BULLETIN

of the

OHIO BIOLOGICAL SURVEY

NEW SERIES

VOLUME 4 NUMBER 1

THE ALGAE OF WESTERN LAKE ERIE

CLARENCE E. TAFT AND CELESTE W. TAFT

PUBLISHED BY
COLLEGE OF BIOLOGICAL SCIENCES
THE OHIO STATE UNIVERSITY
IN COOPERATION WITH
OHIO SEA GRANT COLLEGE PROGRAM

COLUMBUS, OHIO 1971 REPRINT 1990

OHIO BIOLOGICAL SURVEY Bull. IV(1) NS • ALGAE OF WESTERN LAKE ERIE • TAFT & TAFT, 1971 • Reprint, 1990

OHIO BIOLOGICAL SURVEY

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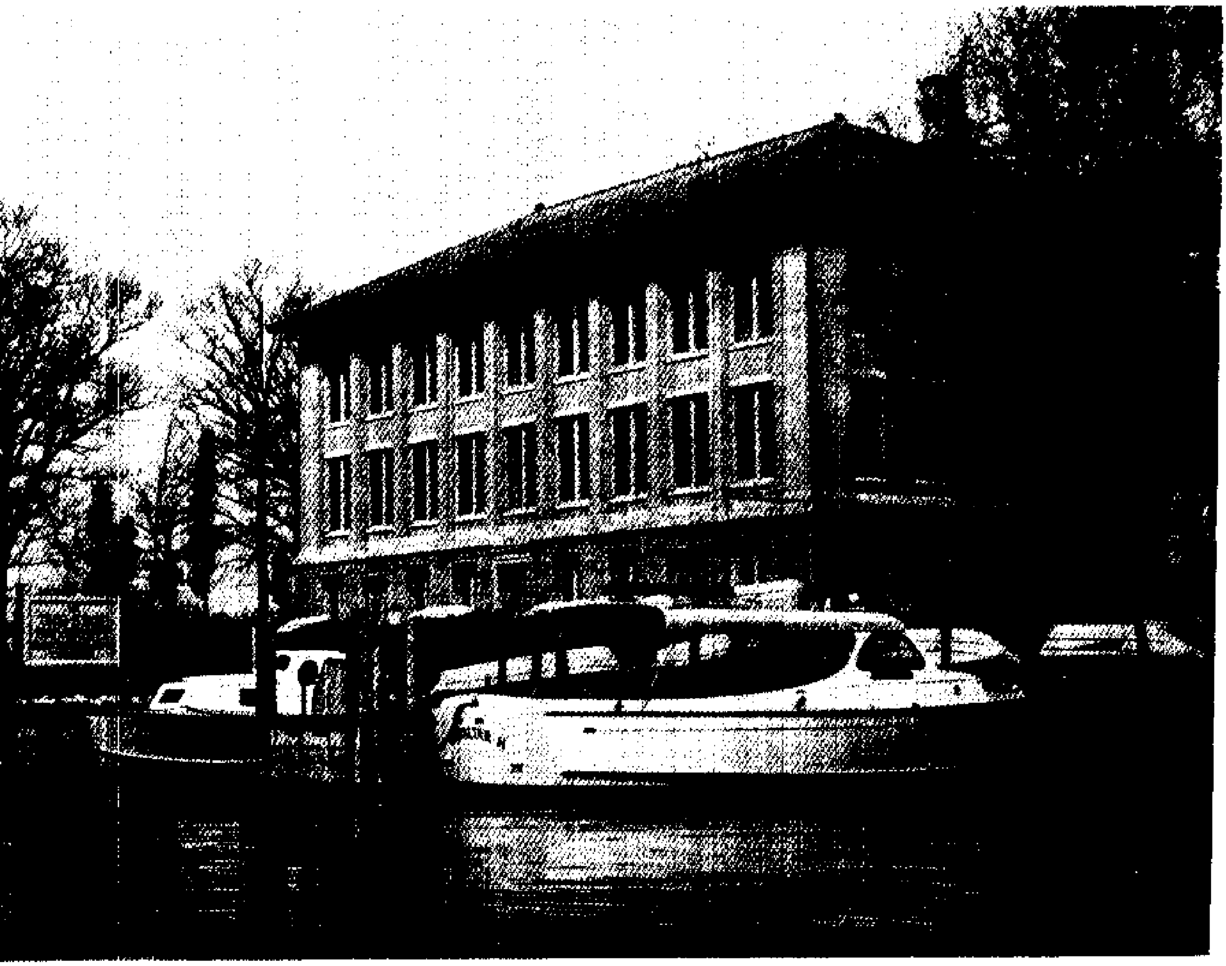
THE ALGAE OF WESTERN LAKE ERIE



George Maxwell II

The Franz Theodore Stone Laboratory of The Ohio State University at Put-in-Bay, Ohio

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ISSN 0078-3994
BULLETIN NEW SERIES VOLUME 4 NUMBER 1:
ISBN 0-86727-060-8

THE OHIO STATE UNIVERSITY

Columbus, Ohio 43210

1971

EDITOR'S NOTE

This monograph, dedicated to the memory of Clarence Egbert Taft, is a reprint of a 1971 edition, but it is not an exact facsimile. The 1990 edition includes a professional biography of Dr. Taft, written by Dr. Ronald L. Stuckey, Professor of Botany, College of Biological Sciences, The Ohio State University. Three lists of references, providing the writings of Dr. Taft, theses and dissertations supervised by Dr. Taft, and references to his life and work, are included also. All three were compiled by Dr. Stuckey. Some original material has been moved a little forward or back in order to accommodate these additions.

Publication of this reprint was made possible by the generous financial contributions of Celeste W. Taft, co-author of the Bulletin and wife of Clarence E. Taft. Additional funds and assistance with manuscript development and preparation were provided by the Ohio Sea Grant College Program (project A/P-3-PD, grant NA89AA-D-SG132) of The National Sea Grant College Program, National Oceanic and Atmospheric Administration.

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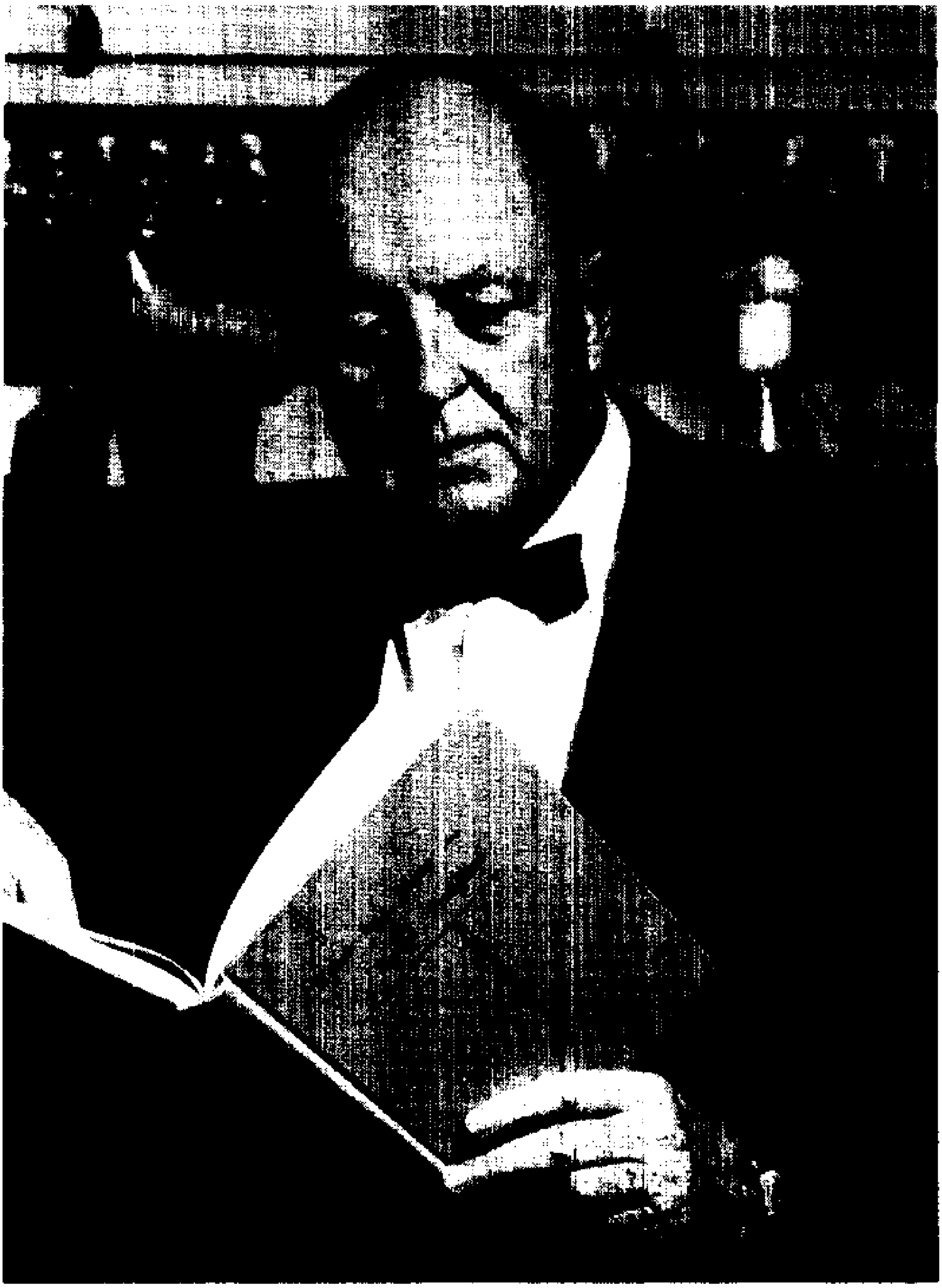


CLARENCE EGBERT TAFT
(13 November 1906 - 31 March 1986)

DEDICATION

AN INSPIRATION TO MANY

"He was the best teacher I ever had!" so have said several of his former students. A kindly and respected gentleman, Dr. Taft had a distinguished career spanning four-and-a-half decades in botany at The Ohio State University. An inspiring, thoroughly dedicated teacher in general botany and the algae, he was highly revered by his students and honored several times for his excellence in the classroom. As a research scientist, Taft was a recognized world authority on algal floristics, especially the taxonomy of the desmids, and water pollution problems related to algae. His research was presented in over 50 published scientific papers and books, as listed in his bibliography, p. 169. As a servant to the general public, he generously shared his scientific knowledge, thereby helping many communities improve their techniques of monitoring water quality and maintaining healthful standards of living. Professor Taft exemplified the full mission of the land-grant university and in so doing, brought honor and respect to his botanical profession and to The Ohio State University.

Clarence's initial choice of botany was not based upon an overwhelming love of the subject, but rather upon the fact that his cousin had arranged a blind date for him on the evening of collegiate registration. To make certain he would complete registration in time for the date, Clarence chose botany, as it had the shortest line. This event occurred at Michigan State Normal College (now Eastern Michigan University), Ypsilanti, where he held an undergraduate assistantship in botany, and obtained a "Teachers Life Certificate" in 1927 and an A.B. degree in the natural sciences in 1929.

In the summer of 1928, he had his first introduction to algae in a course taught by George Nichols at The University of Michigan Biological Station on Douglas Lake near Pellston, Michigan. That summer he met Aaron J. Sharp, who was an assistant in botany at the University of Oklahoma. Following this meeting, Dr. Paul B. Sears, Chairman, offered an assistantship at that University, and Taft earned his M.S. degree in botany there in 1931. His thesis was on the desmids of Oklahoma, which was published that same year in the *Oklahoma Biological Survey Bulletin.*

In 1934, at The Ohio State University, Clarence Taft received the Ph.D. degree in botany, completing a dissertation on the Chlorphyceae and Heterophyceae of Oklahoma, under the guidance of Professor Lewis Hanford Tiffany. Taft's professional career included the following positions and titles in botany at The Ohio State University: Graduate Assistant (1931), Chief Assistant (1933), Instructor (1935), Assistant Professor (1940), Associate Professor (1945), Professor (1951), and Professor Emeritus (1977). Other positions included: Investigator for the Balyeat Hay Fever Clinic, Oklahoma City, Oklahoma (1931); University Scholar in Botany, The Ohio State University (1931-1932); Exchange Instructor in Botany, Cornell University (1937); Assistant Director and Professor, The International School of America (1958-1960), during which time he conducted an educational round-the-world trip for high school seniors; Acting Director, the Franz Theodore Stone Laboratory, The Ohio State University, Put-in-Bay, Ohio (summer 1964); a one-week short course for B-Grade Water Supply Operators, New York University College at Buffalo (summer 1969); a two-week short course for water supply administrators, New York University College at Buffalo (summer 1971).

At The Ohio State University, Professor Taft's major responsibility throughout his career was the teaching of general botany to freshman-sophomore level students. He became a champion of educating by using the "Ohio State Method," the socratic recitation-demonstration method, developed here by his senior professors, Homer C. Sampson, Edgar N. Transeau, and Lewis H. Tiffany. Upon Sampson's retirement in 1955, Taft was chosen from among the faculty as the new leader and director of the general botany program, a post he executed faithfully until 1965. The workbook used in the course, subtitled "A Problem Approach to Plant Science through Observation and Discussion," was completed in 1966 (its third edition) with Taft as the senior editor. His course in "Basic Concepts of Botany," first offered in 1959 for a high school teacher's institute, was soon integrated into the regular botany curriculum. It proved to be a very popular service course for students in various programs.

At the advanced teaching level, Taft's discipline was phycology, the study of algae. It was firmly established in the Department in the 1930's with faculty members, graduate students, and two formal courses. Taft assumed the teaching and research duties in this area upon the resignation of Professor Lewis H. Tiffany in 1937. The algae course was taught in Columbus during spring quarters, and nearly every other summer at the F.T. Stone Laboratory, Put-in-Bay. In 1968, Taft added a course in plankton to serve the increasing demand for trained aquatic biologists and limnologists.

Professor Taft's course in the algae was very popular both on the Columbus campus and at Stone Laboratory where he taught the course during 18 summers, beginning in 1938 through 1974. His association with the Laboratory began in 1933 when he was a student and took the algae course with Professor Lewis H. Tiffany.

Teaching and research became more specialized as the study of polluted waters required more detailed information about specific taxa of algae and their impact upon the aquatic environment. Taft was continually at the forefront in studying algae, both in the classroom and in the research laboratory. He accomplished these new elements through innovative teaching in his algae course, and the establishment of a plankton course. His research publications related to numerous aspects of the algae, especially to the importance of identification, their life histories, and relationships to water quality. Many of his ideas were put forth in his book, *Water and Algae: World Problems*, published in 1965. As explained in the author's preface, his interest was first in the algae and then spread to their role in water and water management.

Taft's legacy is also retained from classroom memories, student notebooks, and unpublished records. During his career, Taft guided 25 masters students and 15 doctoral students, who completed their graduate degrees, in addition to countless number of other students who took his many classes. He was a great inspiration to his graduate students and many others who he loved to have at his side.

Two of his faithful students, Drs. Lois Pfiester and Terry Hufford, wrote of the informality that occurred in his office and algal research laboratory:

> Clarence Taft enjoyed life and the people around him. He was concerned for his students. He spent many hours advising freshmen and explaining the wonders of plant life to them. He was equally concerned for his graduate students. He enjoyed cooking and would bring all sorts of "goodies" to the laboratory. Clarence would

> at times laughingly point out when they contained squid or other unusual delicacies, after, of course, the students had already sampled them and remarked on the unusual taste or flavor. He was never happier than when telling tall tales to his graduate students over fermented hops and barley. He wanted his graduate students to enjoy life as he did and discouraged them from spending every waking moment at the microscope. He believed that a good teacher and researcher was a happy one.

Beginning in 1938, Taft advised the City of Columbus when to treat drinking water to kill the algae and avoid undesirable odors and tastes. This strong dedication and regular, reliable service continued until 30 November 1985, the date of his last report, just four months before his death. Taft's long algal water quality monitoring program is among the few such continuous records of water supply reservoirs in the United States. The algal monitoring program for the drinking water of the City of Columbus continues today in the capable hands of his former student, N. Roderick McGill.

Taft also served as a consultant on algal problems for the Ohio Environmental Protection Agency, Battelle Memorial Institute (Columbus), engineering firms in Ohio, soft drink bottling companies, real estate construction companies, statewide water departments, greenhouse companies, and recreation parks.

Professor Taft was a member of The Ohio Academy of Science, joining in 1939, elected a Fellow in 1940, became Vice President of the Plant Sciences Section in 1941, and served as the Academy Treasurer from 1941 to 1945. He was Vice President of the Limnological Society of America in 1947. Taft was a member of the Committee of Society Presidents to organize the National Science Foundation; the education committee of the Botanical Society of America; the President's advisory committee of Urbana College; the executive committee, President (1949), and life member of the American Microscopical Society; and member of a panel for the Council on Undergraduate Education in the Biological Sciences. He also served as a Science-Mathematics advisor to Urbana College from 1971 to 1978.

Professor Taft was recognized by the College of Education, The Ohio State University, as a "model" teacher. He was awarded several honors during his illustrious career: The Distinguished Teaching Award of the Student Council of the College of Biological Sciences, The Ohio State University, 1971; one of the outstanding educators of America, 1973; the Distinguished Teaching Award of The Ohio State University, 1974; The Distinguished Service Award of The Ohio State University, 1981. He was elected to membership in the honorary societies of Sigma Xi, Gamma Sigma Delta, Phi Sigma, and Gamma Alpha.

Clarence is deeply missed by his many students and friends. This memorial tribute serves as a reminder of all the help and advice he gave us in shaping our personal and professional lives.

Ronald L. Stuckey
Department of Botany
The Ohio State University
Columbus, Ohio 43210
1 December 1989

MAPS

TABLES

INTRODUCTION

In 1934 Professor L. H. Tiffany published the first of his two compilations of the algae of the west end of Lake Erie. This volume included the plankton algae of the region, while the second, published in 1937, dealt with the filamentous genera. These two publications were the culmination of studies he began in 1920 and continued later while a member of the staff of the Franz Theodore Stone Laboratory of The Ohio State University, located on Gibraltar Island, Put-in-Bay, Ohio. In compiling his lists of algae of the region he drew upon studies by Pieters (1902), Snow (1903), Stehle (1923), Tiffany and Ahlstrom (1931), and Ahlstrom and Tiffany (1934), as well as his own personal collections, those of his students, and those of state and federal bureaus which were operating in the western end of Lake Erie.

For many years both publications were standard references for students at the Stone Laboratory and for those doing algae research in western Lake Erie. When copies were no longer available, it was necessary to substitute works of more extensive scope. This ultimately increased the time needed for a student to check his algae collections.

The intervening years since 1937 have seen a number of additions to the recorded algae of the region. Publications by Chandler (1940), Curl (1951), Daily (1942, 1945), McMillan (1951), Normandin and Taft (1959), Taft (1940, 1942, 1945a, 1945b, 1964), Taft and Kishler (1968), Verduin (1952), and Wood (1947) list algae which were previously unrecorded. Papers by Jennings (1900) and Snow (1903) which Tiffany did not include in his bibliography are included now, though the latter, as Tiffany discovered, is of little importance because of the lack of locality records. The present publication combines all the previous records into a comprehensive report of the algae of the Island Region of western Lake Erie.

Acknowledgement is made to the members of the senior author's classes in freshwater algae and to his colleagues on the staff at Stone Laboratory for their interest in calling his attention to particular algae. He is indebted especially to the late Professor Tiffany for instilling a lasting interest in the algal flora of western Lake Erie.

Figures that represent taxa have been redrawn by Celeste W. Taft from those originally published in previous studies. Where no figure of Lake Erie material exists, a suitable figure has been used and proper credit given.

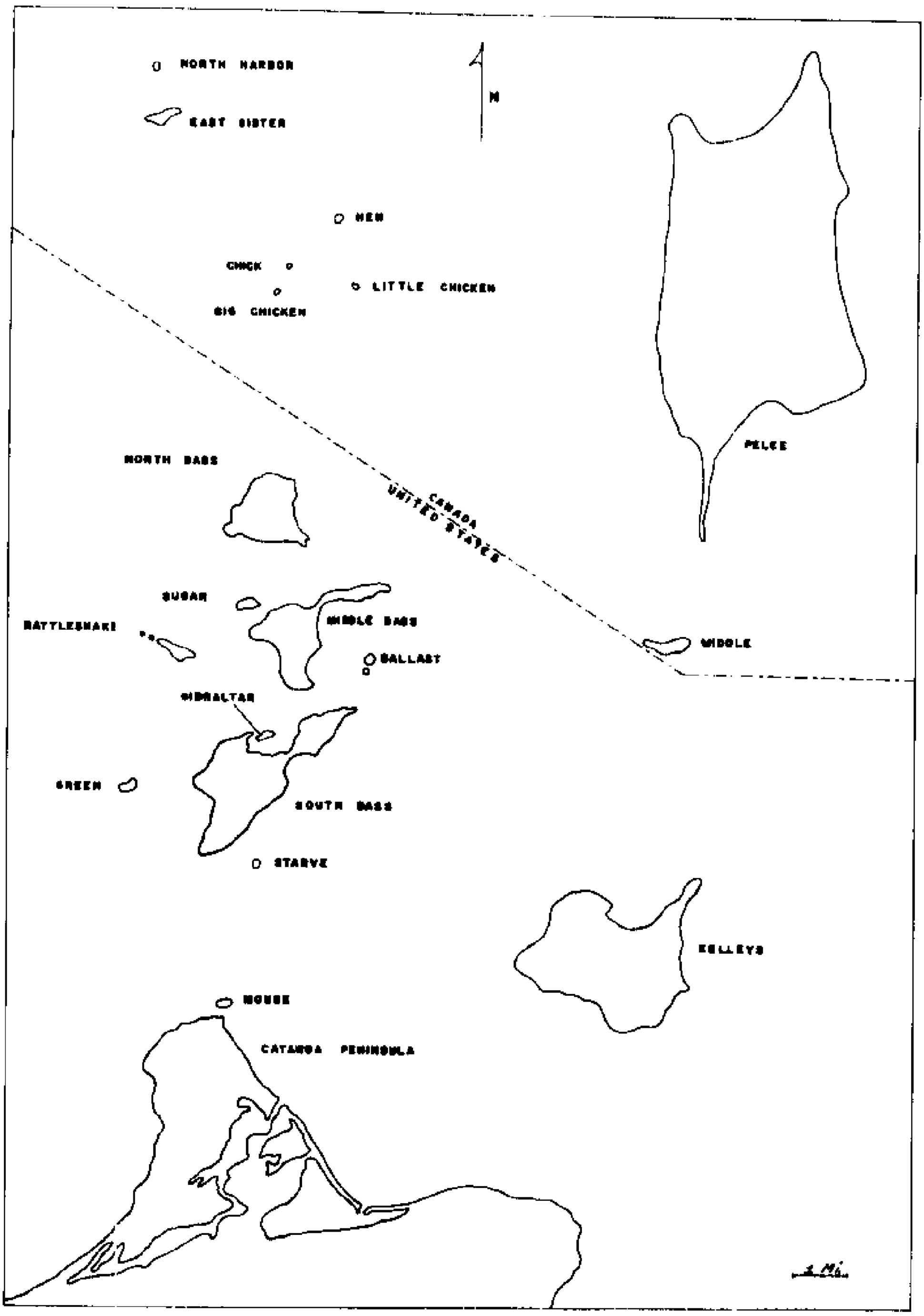
ALGAL HABITATS

The Island Region of western Lake Erie in which algae have been studied most intensively is shown by Map I. Algal habitats on the islands include drainage ditches or canals, marshes, ponds, quarries, and beach pools. Those on the Catawba Peninsula of the mainland are mostly inlets and embayments with occasional ponds. A number of collecting areas have succumbed to the "march of progress" since the early days of the survey. Their names, indicated by an asterisk, are given along with those of existing habitats on the maps of individual islands in order that early locality records of certain taxa may be located.

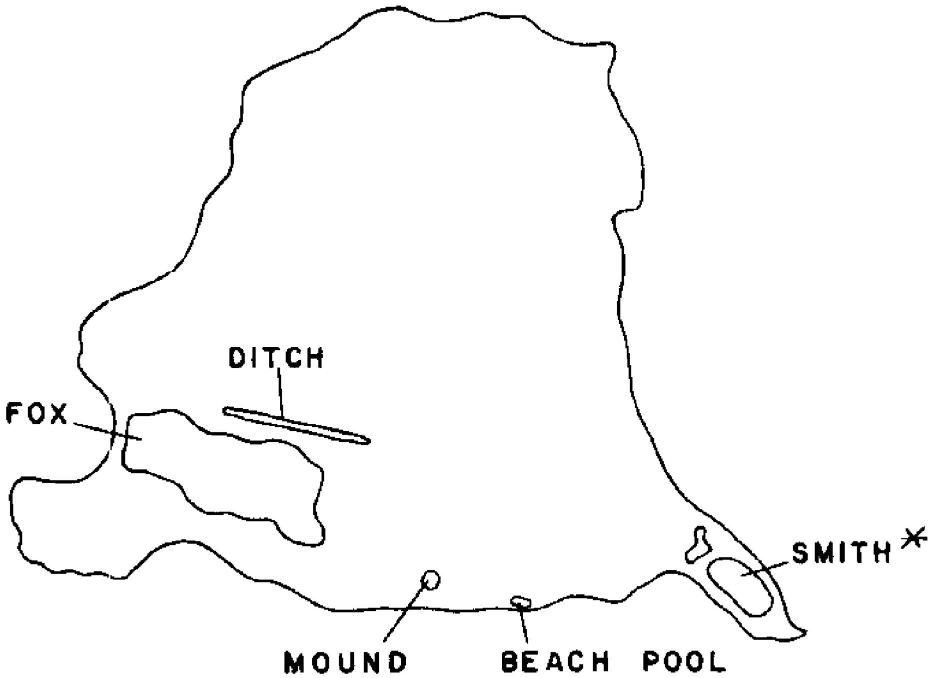
Throughout the years, the three Bass Islands — South, Middle, and North — that lie almost due north from the Ohio shore at Catawba Point, consistently have furnished the greater number of algae collections. Not only are they readily accessible to Stone Laboratory by boat, but they have had in the past numerous habitats that were conducive to good algae collecting.

North Bass (Map II) with an area of 696 acres is the smallest of the three islands. It originally had two extensive marshes or weedy ponds, depending upon the water level of Lake Erie. Fox Marsh, or Fox Pond, on the southwest side of the island still exists except during years of extremely low water. It then becomes a mud flat, or is dry. Smith Marsh, or Smith Pond — a pond formerly choked with submerged and emergent macrophytes — has mostly lost its marsh or pond character since a cut through the beach opened it to the water of the open lake. Mound Pond, a small depression or "sink" on the south side of the island, has water only during years when the lake level is high. Pollution from nearby habitation helped to maintain this pond as an excellent habitat. A drainage ditch north of Fox Pond, a few high water ponds along the southeast shore, and a number of beach pools behind rubble barriers complete the types of habitats on North Bass.

Middle Bass (Map III) with an area of 742 acres is second in size and formerly had three large ponds or marshes — their character also dependent upon the lake level outside the rubble beach. Fisher and Haunck Ponds on the northwest side of the island were excellent collecting areas, but Fisher no longer exists and Haunck is becoming choked with emergent aquatics. The character of Haunck Pond has changed drastically during the past years because of pollution due to trash and garbage. Wehrle Pond, another area with submerged and emergent macrophytes, no longer exists since dredging and a cut through to the lake has converted it into a boat anchorage. Several small ponds, such as Lemna Pond near the southeast end of Haunck Pond, a wooded slough just south of Haunck Pond, and a few water-filled depressions exist during periods of high water.

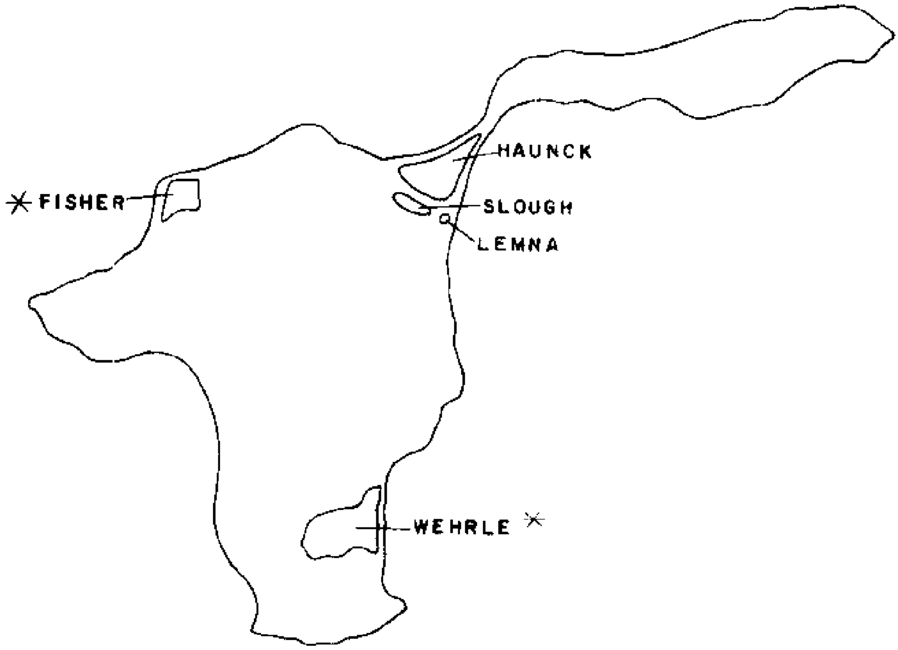


Map I. Map of the Islands of Western Lake Erie. (adapted from the Put-in-Bay and Kelleys Island Quadrangles of the United States Geological Survey and from Canada sheets 40 G/15 East, 40 G/10 East, and 40 G/15 West of the Canadian National Topographic System)



Map II. Map of North Bass Island with the name and location of major algae collecting sites.

South Bass (Map IV) with an area of 1,224 acres, is the largest of the three Bass Islands. Although this island has never been considered an important source of algae collections, there have been and still are some excellent locations on the island as well as quiet bays and inlets along the shore line. Put-in-Bay Harbor, with its extensions Squaw Harbor and Hatchery Bay, now commonly known as Fishery Bay, are all good locations for plankton and filamentous algae that grow on and among submerged macrophytes. Terwilliger Pond, an inlet off Hatchery Bay, has been one of the most collected areas on the island. The only true pond on the island, designated on Map IV as Monument Pond, was located where the Perry Memorial now stands. One location which has some pond characteristics, mostly of a temporary nature, is Armbruster Pond. This is an artificial depression or borrow pit that lies toward the northeast end of the island. It usually is dry after the month of June. Buckeye Pond is a small, high-water pond located on Buckeye Island. This so-called island is the most northeasterly extension of South Bass Island and varies with the elevation of the water in Lake Erie from an island to a peninsula. The pond is small, shaded, and has relatively cool water with some vegetation. Buckeye Island also has good beach pools between Buckeye Pond and the lake shore. In addition to the ponds, bays, and inlets, there are numerous beach pools along the east and west shores of South Bass Island. The beach pools are mostly small, irregular depressions in the limestone and vary in diameter from a few inches to a few



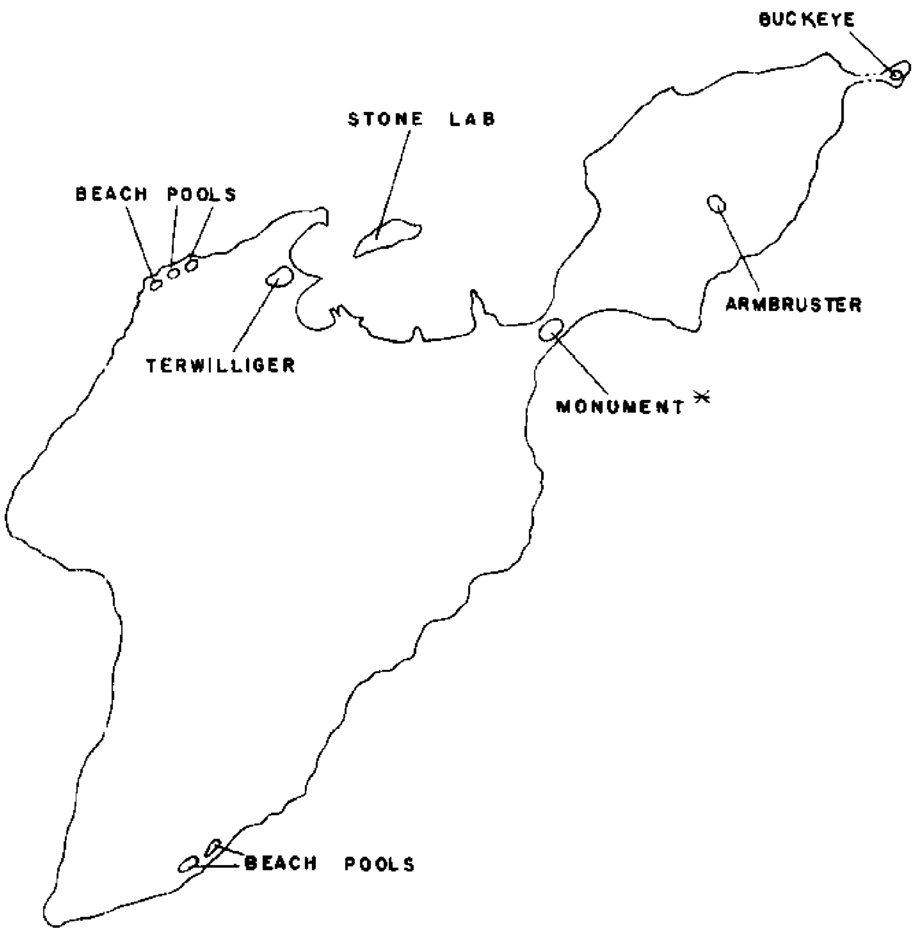
Map III. Map of Middle Bass Island with the name and location of major algae collecting sites.

feet. Their depth is seldom more than a few inches and mostly less than one foot. They are filled with water during storms and are definitely temporary in nature.

The smaller islands in the immediate vicinity of the three Bass Islands (Map I) have less to offer in the way of algae. Sugar, Ballast, Lost Ballast, Rattlesnake, Green, Starve, and Gibraltar Islands are small rocky islands without ponds. Green Island has well formed beach pools along the north and west shores which are deep enough to allow time for the development of filamentous algae before the water disappears. This is also true of Starve Island which lies off the southeast shore of South Bass Island. The contour of this island is low and the water in the rock pools is replenished during storms of even moderate intensity. The island is unique because it is a nesting site for gulls, and formerly for terns. Their droppings maintain a high organic content in the pools. All the islands have a variety of beaches that provide good collecting. Some are precipitous limestone rocks, while others are gravel or larger rubble.

Kelleys Island (Map V) lies southeast of the Bass Islands group and about 3¼ miles north of the Ohio mainland at Marblehead. It is a large island of 2,800 acres and has had numerous and varied algal habitats, though presently they are limited mostly to quarry pools. Kelleys Pond, an extensive pond and marsh area along the southwest shore of the island, no longer exists in its entirety since it was converted into a marina.

Across the island to the north and lying back of the sandy beach is Carp Pond. This is a large marsh-like area in which the depth of the water depends upon the lake level outside the sand barrier. The other habitats are quarry pools. Mostly they are shallow depressions in the bottoms of abandoned quarries and are more or less temporary in nature. During wet years some may contain water throughout the summer, but generally they are dry after June or July. One large quarry pool, designated as the "deep quarry" and located in the west central part of the island, is reported to be 40 or more feet deep. A submerged shelf around two sides of the deeper part of the pool provides excellent collecting during all but the driest years, when it also may be exposed. The deep water in the quarry provides interesting plankton collections with some taxa seemingly limited to this habitat. In the past, an abandoned quarry on the northwest side of the island has provided good collecting throughout the summer months. It is the only quarry that has seepage from the vertical walls,

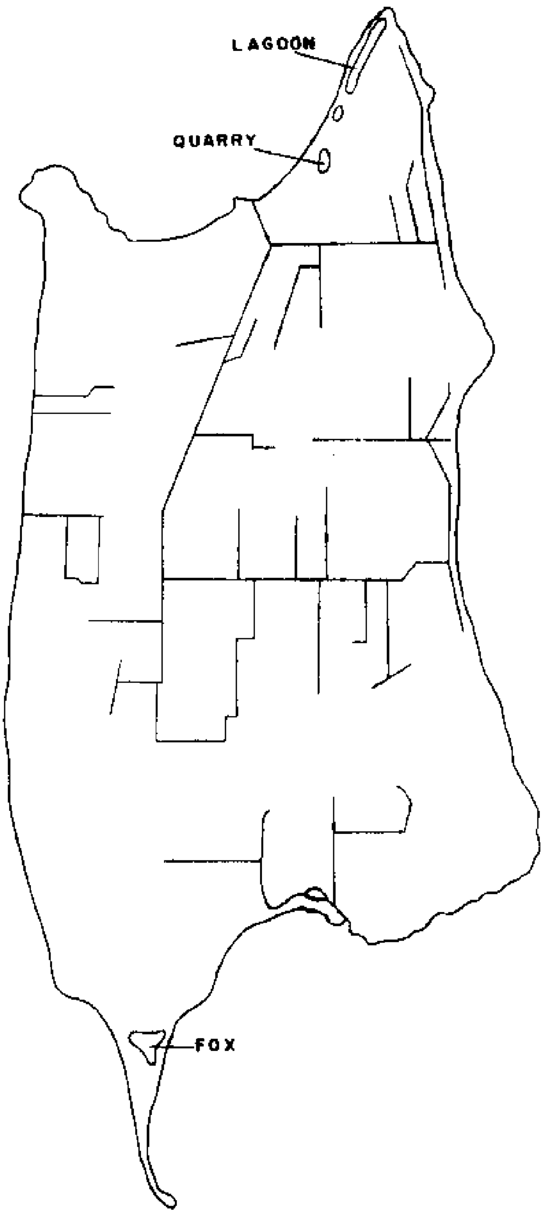


Map IV. Map of South Bass Island with the name and location of major algae collecting sites.

Map V. Map of Kelleys Island with the name and location of major algae collecting sites.

a habitat that is difficult to find in the Island Region. A few scattered depressions with water up to six feet in depth; an old shallow quarry at the north edge of the town of Kelleys Island known as Town Pond or Church Pond, which has pond characteristics during wet years; and Chara Pond, a depression in the large quarry, complete the types of algal habitats on the island. The exact location of Kennedy Pond as a locality for some records is not known.

One major and several smaller islands within the boundaries of the survey lie in Canadian water (Map I). Pelee Island (Map VI), approximately 15 miles northeast of the Bass Islands, is a large island of 10,000 acres. Fox's Marsh, or Pond, is an extensive area lying near the south west shore. A number of drainage ditches, a quarry along the west shore, and a canal to the northeast are all good algae collecting sites. However, during low lake levels Fox's Marsh suffers the same fate as many of the ponds and marshes on the Bass Islands. Middle Island, a small island south of Pelee and just north of the International Boundary, has small depressions which have provided some interesting collections in the past. Hen, Chick, Big Chicken, Little Chicken, East Sister, and North Harbor Islands comprise a group of small islands which lie north-northwest from



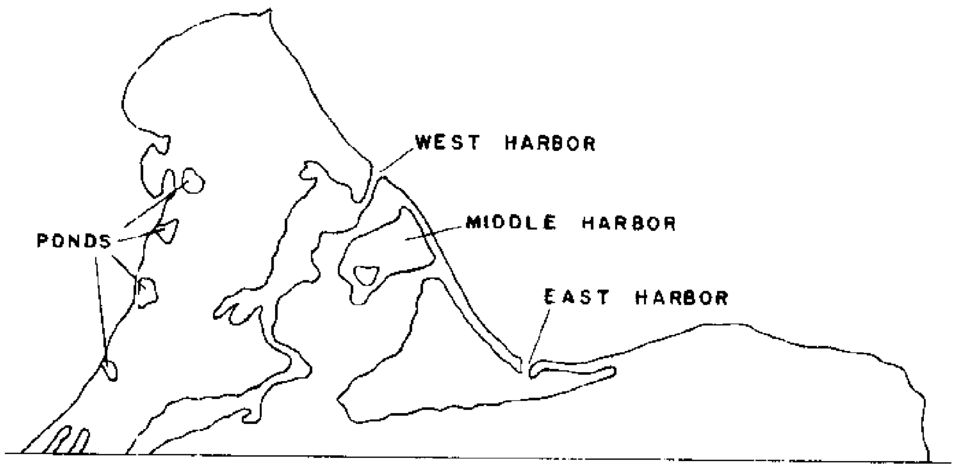
Map VI. Map of Pelee Island with the system of interconnecting canals and drainage ditches shown. Other major algae collecting sites are named and located.

North Bass Island and about due west from Pelee Island. Although these are in the Island Region of western Lake Erie, their algal floras never have been studied to any extent.

The boundaries of the survey, as outlined on Map I, have included more than just the islands. East Harbor and West Harbor are inlets from Lake Erie, each having lake characteristics. They lie on the Catawba Peninsula (Map VII) a short distance south and east of its northern extremity. The "harbors" are fringed with emergent and floating aquatic macrophytes. Submerged and floating macrophytes often choke the open water and have necessitated cutting and dredging to maintain channels and suitable recreation areas. The character of these "harbors" changes with Lake Erie water levels and with the degree of disturbance brought about by man in his pursuit of recreation. However, they have been excellent habitats where the quiet, warm water is favorable for the growth of filamentous, unicellular, and colonial algae alike. A number of ponds, inlets, and bays on Catawba Peninsula are good algae habitats. They have been visited less often during recent years because of their declining accessibility due to increased population of the area.

Less specific habitats on all the islands include shore lines that vary in nature from cliffs, boulders, rubble, and pebbles, to sand. Inland from the shore lines habitats are associated with urban, agricultural, and wooded terrains. Many algae occur in abandoned fields or in cultivated vineyards. The forested areas with their rotting logs contribute algae peculiar to such terrestrial habitats. Ruts left in fields and along roads by farm equipment and automobiles provide good habitats within a few days after rain.

The most extensive habitat, and one in which algae have been studied for many years, is the open lake surrounding the islands. This water mass, mostly less than 40 feet in depth and rich in nutrients, is an



Map VII. Map of Catawba Peninsula with the name and location of major algae collecting sites.

exceptionally fine culture medium for algae. As in all lakes of this category, the number of taxa is not great, but the lake is rich in numbers of individuals of the taxa present. Certain algae occur only as phytoplankton in the lake proper, while many more occur both in the lake and in the various ponds on the islands. Others are limited in occurrence to the island habitats. Because of this, a study of the algae in the habitats within the confines of the islands will yield a much greater percent of the algae known from the region than will the lake itself.

The habitats, and consequently the algal flora, all vary from season to season and from year to year. Much of this variability, especially on the islands, is a result of the changes in elevation of Lake Erie, while some is caused by varying amounts of local precipitation and disturbance by man. In general, suitable habitats conducive to algae collecting in the region are diminishing in numbers. Limited access rights, recreational installations, the increased need for trash and garage disposal, and general eutrophication of many of the ponds have all exacted a noticeable toll. Even the soil of the cultivated areas, and in particular the vineyards, has become less productive during recent years. Possibly the latter may be attributed to the gradual accumulation of algae-toxic pesticides.

RELATIVE ABUNDANCE OF ALGAE

Algae, in terms of taxa, are relatively abundant in the Island Region of western Lake Erie. In all probability, this statement will be accepted as creditable by persons who have seen the extensive and yearly blooms of Myxophyceae, *Ceratium*, and diatoms. In fact, the occurrence of these floating algae has been a source of speculation by investigators throughout the present century. The blooms are deceiving in numbers of taxa because they result from enormous numbers of individuals of a very few genera and species.

The total number of taxa that occur in the region is striking when one considers that the geographical area included in the survey is less than 200 square miles, and that a large percentage of this total is open lake with a relatively uniform environment. Furthermore, the islands exhibit a similar uniformity of algal habitats which in turn lack the diverseness that contributes to good algae collecting.

Algal studies were initiated in the Cleveland Harbor area of Lake Erie by Vorce (1880). Jennings (1900) was the first to report algae with sufficient collecting data to establish locality records in the Island Region of western Lake Erie. Pieters (1902) definitely studied algae in the area, but failed to record specific localities for many of his taxa. Those without locality records have been excluded from the present study. Snow (1903) listed 177 taxa of plankton algae of Lake Erie, but gave specific localities for only four. Though the area included in her study was, in general, the Island Region, her records of the 173 taxa are not included. Of the four, one has been included, two have since been reported by other workers, and one whose identity is questionable has been omitted. The exclusion of Snow's records is not as serious as it may appear because most of the algae reported by her have been reported within the area by others. (*See* Tiffany [1934] for an analysis of Snow's records.)

After many years of investigating the algae of the Island Region of Lake Erie, Tiffany (1937a) reported a total of 128 genera and 435 species, varieties, and forms, of which 145 were filamentous. Table 1, concerning the distribution of these 435 taxa by Classes, is reproduced for comparison with similar data in Table 2 for the algae now known.

Tiffany (1934) stated that the Desmidiaceae in the Chlorophyceae, the Diatomophyceae, and the Dinophyceae were not studied sufficiently to be included in his paper on the plankton algae and that he intended to report on these later. Actually he did report the occurrence of three genera and three species in the Dinophyceae, but did not include them in his totals, as is evident from Table 1. The Desmidiaceae were reported by Taft (1945a). The Diatomophyceae were studied intensively as a separate project and were reported by Hohn (1969).

TABLE 1. Distribution of algae by Classes (From Tiffany (1937).

Class	Species	Genera	Varieties
Myxophyceae	69	25	9
Chrysophyceae	12	7	0
Heterophyceae*	15	8	3
Chlorophyceae	260	84	51
Euglenophyceae	16	4	0
Total	372	128	63

* See Xanthophyceae, Table 2.

The two reports on the algae of western Lake Erie by Tiffany (1934, 1937), as well as the necessity for knowing the algae encountered in aquatic research, has resulted in the discovery of many unreported taxa. During the intervening thirty years the number of algae known for western Lake Erie has increased by 56 genera and 238 species, varieties, and forms. The total of all algae reported for the Island Region of western Lake Erie is now 673 species, varieties, and forms distributed in 184 genera.

Table 2 presents data for the distribution of all known algae by Divisions, Classes, and Orders. It is evident from the table that the Chlorophyta are the most abundant algae in the region, the Cyanophyta second in numbers, and the Chrysophyta and the Euglenophyta run a poor third and fourth in position. As expected, the Rhodophyta are rare. The Pyrrhophyta and Charophyta are only moderately abundant.

The data in Table 2 should not be interpreted as indicating the abundance or widespread distribution of any particular taxon. This can be ascertained only by referring to the number of collection sites that accompany the description of an alga. For example, *Dichotomosiphon tuberosis* (A. Braun) Ernst, the only member of the Order Siphonales collected, is known only from Pelee Island and East Harbor. It is quite common on the mainland in the Rest Haven area near Castalia, Ohio, and was reported from East Harbor by Pieters (1902). Similarly, the genus *Vaucheria* in the Xanthophyceae, which is a common alga on the mainland, occurs only in one restricted locality on Pelee Island, one on Middle Bass, and one on Kelleys Island. Others, such as *Coronastrum aestivale* Thompson and *Cyclonexis annularis* Stokes, have been collected only one time, while some are collected quite regularly but from only one location. In contrast to this, *Platydorina caudata* Kofoid is collected only occasionally from widely divergent localities. However, many algae occur widely throughout the region and appear in collections yearly. The fact that an alga is not recorded from a particular locality does not mean necessarily that it does not occur now, or will not be found there later. Some localities are more accessible than others and therefore have been sampled more extensively. Some algae probably never will be found because they are restricted to habitats that do not exist in western Lake Erie.

Tiffany (1934) included in his table a summary detail of the relative abundance of species and varieties of algae in the various locations from which collections had been made. He recognized that the table was indicative rather than truly characteristic of the phytoplankton richness of the habitats, a premise which he mostly attributed to the accessibility

TABLE 2. Distribution of known algae by Divisions, Classes, and Orders as of 1968.

Taxonomic Unit	Genera	Species	Varieties	Forms
Chlorophyta				
Chlorophyceae				
Volvocales	12	21	....	....
Tetrasporales	9	13	....	....
Ulotrichales	7	11	....	....
Ulvales	1	1	....	....
Microsporales	1	3	....	....
Cylindrocapsales	1	1	1	....
Chaetophorales	9	18	1	....
Cladophorales	4	9	....	....
Siphonales	1	1	....	....
Oedogoniales	2	33	4	....
Chlorococcales	46	147	49	....
Zygnematales	17	114	49	7
Total	110	372	104	7
Charophyta				
Charophyceae				
Charales	3	3	7	7
Total	3	3	7	7
Chrysophyta				
Xanthophyceae				
Rhizochloridales	1	2	....	....
Heterococcales	5	8	1	....
Heterotrichales	2	4	1	....
Heterosiphonales	2	5	....	....
Chrysophyceae				
Chrysomonadales	7	11	....	....
Rhizochrysidales	2	3	....	....
Total	19	33	2	....
Euglenophyta				
Euglenophyceae				
Euglenales	5	34	1	....
Total	5	34	1	....
Pyrrhophyta				
Dinophyceae				
Gymnodinales	1	1	....	....
Peridiniales	5	6	....	....
Dinocapsales	1	1	....	....
Dinococcales	4	5	....	....
Cryptophyceae				
Cryptomonadales	1	1	....	....
Total	12	14	....	....
Cyanophyta				
Myxophyceae				
Chroococcales	14	33	6	....
Hormogoniales	19	46	2	....
Total	33	79	8	....
Rhodophyta				
Rhodophyceae				
Bangiales	1	1	....	....
Nemalionales	1	1	....	....
Total	2	2	....	....
Grand Total	184	537	122	14

of the localities. The comparisons of the locations by number of taxa which he presented, generally, have been substantiated by collections during the intervening thirty years (*see* Table 3). His premise of accessibility is becoming less meaningful as habitats adjacent to Stone Laboratory become less productive and more collecting is done at the more distant localities. Some discrepancies occur because he included only phytoplankton in his Table 1 (1934), whereas Table 3 includes his records of filamentous algae (1937a) as well as those recorded since 1937.

One must remember that the total of 184 genera and the 673 taxa within these genera represent collections that extend over a period of more than sixty years. Though most collecting was done between late spring and early autumn, all seasons are represented by collections. It is remarkable under these circumstances that 80 to 100 or more genera, and a corresponding large number of species, can be collected during a five-week period from late July to 1 September. This number represents the yearly average collected by algae classes at the Stone Biological Laboratory, Put-in-Bay, Ohio, during the second five-week academic session. It is more remarkable when one considers that many algae are autumn, winter, or spring annuals and, therefore, are seldom obtainable during the summer.

Periodicity of most taxa is unknown though continued observations have established definite periodic relationships for some forms. Probably, *Aphanizomenon*, *Anabaena*, *Anacystis (Microcystis)*, and *Cladophora* are known better in this respect because of their obvious annual maxima. Others, such as *Ceratium* and certain of the Volvocales, are periodic in appearance but their blooms, which appear and disappear with more or less regularity, are less noticeable while the intervals between their maxima may be measured in weeks, months, or even years. Changes in lake elevation, total precipitation over the area, turbidity, light, air and water temperatures, and dissolved minerals and gases—combined or in part—certainly all contribute to periodicity, although the exact cause or causes remain mostly unknown.

One possible cause of periodicity that has not received the attention it deserves is parasitism by aquatic fungi. *Asterionella*, *Stephanodiscus*, and *Coscinodiscus* are regularly attacked by fungi with infestations varying in severity from year to year. A striking example of parasitism occurred during the last week of August, 1938. *Platydorina caudata*, which had been present in Put-In-Bay Harbor during July and early August of that year, reached a maximum in numbers on 22 August. On that date it was being severely parasitized by the Chytrid, *Dangeardia sp.* The infestation spread rapidly and after several days it was nearly impossible to find colonies in which the cells were not parasitized or already completely destroyed. The result was the complete, or at least the nearly complete, elimination of the population. The former is suspected because *Platydorina* has not been collected by the writer in the harbor or its adjacent areas since. *Pandorina* and *Eudorina*, also in the Volvocales, and parasitized to a lesser extent, survived. This would seem to indicate that certain algae are extremely susceptible to parasitism by specific fungi and that in these cases populations are eliminated or at least decimated beyond recovery. If so, this may explain some of the erratic periodic appearances of certain taxa.

TABLE 3. The relative abundance of species, varieties, and forms of algae by locality.

Locality	Chloro-phyceae	Charo-phyceae	Xantho-phyceae	Chryso-phyceae	Eugleno-phyceae	Dino-phyceae	Crypto-phyceae	Myxo-phyceae	Rhodo-phyceae	Total
South Bass Isl.	238	8	6	11	19	3	1	56	1	342
Middle Bass Isl.	194	4	7	6	15	5	—	36	—	267
North Bass Isl.	101	—	7	4	10	2	—	20	1	145
Kelleys Isl.	80	—	3	4	4	—	—	15	1	117
Pelee Isl.	46	—	7	1	—	1	—	6	—	61
East, West Harbors	86	9	1	—	2	1	—	22	—	121
Other Localities	80	—	1	6	3	1	—	18	—	109

SYSTEMATIC SECTION

In general, the systematic presentation follows the arrangement used by Dr. G. W. Prescott in his *Algae of the Western Great Lakes Area* (1962).

A key to the Classes of algae is included to provide the reader the means to rapidly assign an unknown alga to its proper Class. Keys to Orders and Genera within the various Classes should simplify the procedures in arriving at these taxonomic units. Species identification will depend largely upon the comparison of the specimen with figures and species descriptions. Species names within a genus are arranged in alphabetical order for the convenience of the reader.

KEY TO CLASSES OF ALGAE

1. Plants tree-like, with distinct nodes and elongated internodes, often calcareous .... Charophyceae
1. Plants not tree-like, without nodes and elongated internodes, or if so, embedded in a gelatinous matrix 2
   2. Cells without differentiated chromatophores .... Myxophyceae
   2. Cells with differentiated chromatophores 3
3. Vegetative cells flagellate 4
3. Vegetative cells not flagellate 8
   4. Mostly with 1 flagellum .... Euglenophyceae
   4. With 2 or 4 flagellae 5
5. Cells with longitudinal or transverse grooves, or both 6
5. Cells without grooves 7
   6. Cells with a longitudinal groove, 2 laminate chromatophores and 2 flagellae .... Cryptophyceae
   6. Vegetative and/or reproductive cells with transverse and longitudinal grooves, 2 flagellae .... Dinophyceae
7. Cells solitary or colonial, 1 or 2 parietal laminate chromatophores, yellow to brown, no pyrenoids .... Chrysophyceae
7. Cells solitary or colonial, chromatophores mostly cup-shaped, green, with pyrenoids .... Chlorophyceae
   8. Cell walls composed of overlapping halves, or with H-pieces, no pyrenoids 9
   8. Cell walls not of overlapping halves, without H-pieces 11
9. Cell walls composed of overlapping halves, valves ornamented with radially or bilaterally arranged striae .... Bacillariophyceae (This class is not included in the present study)
9. Cell walls composed of H-pieces, or walls at least in two parts, not ornamented with striae 10
   10. Chromatophores few, discoid, parietal, yellow-green .... Xanthophyceae
   10. Chromatophores reticulate, parietal, bright green .... Chlorophyceae
11. Cells pyramidate, tetrahedral, attached; free-floating if arcuate or globose; chromatophores yellow-brown .... Dinophyceae
11. Cells not pyramidate or tetrahedral (if so then not attached), chromatophores not yellow-brown 12
   12. Cells in filaments; main axis with cortications, gelatinous; or main axis a filament of loosely arranged ovoid cells with occasional false branches .... Rhodophyceae
   12. Cells solitary, colonial, or in filaments; no cortications or false branches .... Chlorophyceae

Division CHLOROPHYTA

Plants in this Division are commonly known as the grass-green algae because of the preponderance of chlorophylls *a* and *b*, though at times these may be masked by red or yellow pigments. The pigments are located in one to many chromatophores that vary in shape and size. Most forms have pyrenoids in the chromatophores and starch as a reserve food, though starch is characteristic even of those without pyrenoids. The cell walls are composed of pectic compounds and cellulose and are generally firm. Flagellae, when present, are usually two or four in number and of equal length. Asexual reproduction by akinetes, zoospores, aplanospores, autospores, and autocolonies is common. Sexual reproduction is widespread throughout the Division, but is less common than is asexual.

Class CHLOROPHYCEAE

The green algae include motile and nonmotile unicells, nonmotile simple colonies, motile or nonmotile organized colonies, simple or branched filaments, parenchyma-like strata, and coenocytes or partitioned ceonocytes. Asexual and sexual reproduction vary throughout the orders with sexual reproduction being isogamous or heterogamous. Heterogamy may be anisogamous or oogamous.

KEY TO ORDERS OF CLASS CHLOROPHYCEAE

1. Cells motile in vegetative state; unicellular or in colonies with definitely arranged cells; each cell with 2 or 4 equal-length flagellae .... Volvocales
1. Cells nonmotile in vegetative state 2
    2. Siphonaceous and filament-like, branched, with numerous constrictions .... Siphonales
    2. Not siphonaceous; filamentous, organized colonies, unicellular, or with numerous cells variously arranged in mucilaginous envelopes of various shapes 3
3. Unicellular, or cells in organized colonies of more or less regular shape and cell arrangement .... Chlorococcales
3. Filamentous, or with numerous cells variously arranged in mucilaginous envelopes of various shapes 4
    4. With numerous cells in mucilaginous envelopes; cells of some forms with pseudocilia .... Tetrasporales
    4. Filamentous 5
5. Filaments at first uniseriate, then becoming multiseriate thalli or cylinders by repeated cell divisions in all planes .... Ulvales
5. Filaments not multiseriate cylinders or broad thalli 6
    6. Cells arranged in a tough, tubular stratified envelope .... Cylindrocapsales
    6. Filaments uniseriate, cells not in a tough envelope 7
7. Filaments unbranched, or if so, then branches terminated by bulbous-base setae 8
7. Filaments with a few rhizoidal, or numerous well developed branches, without bulbous-base setae 11
    8. Cells cylindrical, composed of 2 H-pieces; chloroplast parietal and reticulate .... Microsporales
    8. Cell walls not composed of H-pieces 9
9. Cells narrower at the base of the cell than at the apex, with apical caps; branches (if present) terminated by bulbous-base setae .... Oedogoniales
9. Cells in filament cylindrical 10
    10. Chloroplasts laminate, parietal, encircling less than ½ to nearly the entire circumference of the cell .... Ulotrichales
    10. Chloroplasts spiral parietal bands, axial bands, or axial stellate .... Zygnematales

11. Plants parenchymatous, pseudoparenchymatous, or with prostrate and upright branching systems; apices of branches narrowly rounded or terminating in long, multicellular hairs .... Chaetophorales
11. Plants not parenchymatous or pseudoparenchymatous, mostly with prostrate and upright branching systems, apices of branches usually broadly rounded, without multicellular hairs or setae .... Cladophorales

KEY TO GENERA OF CLASS CHLOROPHYCEAE

1. Cells adhering in clumps without definite form following cell division; mostly on tree bark .... **Protococcus**
1. Cells solitary, or in colonies of definite form, or in filaments, not in formless clumps 2
   2. Cells solitary 3
   2. Cells not solitary, arranged in colonies or filaments 43
3. Cells motile in vegetative condition 4
3. Cells not motile in vegetative condition 8
   4. Cell wall bivalved 5
   4. Cell wall not bivalved 6
5. Valves nearly circular, compressed, sculptured .... **Phacotus**
5. Valves subrectangular, angles produced, smooth .... **Pteromonas**
   6. Cells ellipsoid to ovoid, with cytoplasmic processes extending from protoplast to cell wall .... **Haematococcus**
   6. Cell shape various, without cytoplasmic processes between photoplast and wall 7
7. Cells circular in vertical view; 2 flagellae .... **Chlamydomonas**
7. Cells ovoid or circular in vertical view; 4 flagellae .... **Carteria**
   8. Cells arcuate, with 2 axial chloroplasts .... **Closterium**
   8. Cells not arcuate 9
9. Cells with a median constriction 10
9. Cells without a median constriction 18
   10. Cells triangular in vertical view .... **Staurastrum**
   10. Cells circular or compressed in vertical view 11
11. Cells circular in vertical view 12
11. Cells compressed in vertical view 14
   12. Cells 1-2 times longer than broad .... **Cosmarium**
   12. Cells greatly elongated, cylindric or truncate-fusiform 13
13. Semicell with basal inflation, apices granulate .... **Pleurotaenium**
13. Semicell not noticably inflated at base .... **Penium**
   14. Semicells with radiating, apiculate or spined processes at the upper angles .... **Staurastrum**
   14. Semicells without radiating processes 15
15. Semicells with marginal lobes 16
15. Semicells without marginal lobes 17
   16. Lobes short, rounded, no spines or apiculations; sinuses shallow, broad .... **Euastrum**
   16. Lobes long, with spines or apiculations; sinuses mostly deep, narrow .... **Micrasterias**
17. Semicells transversely ovate, elliptic, no spines or processes .... **Cosmarium**
17. Semicells elongate ovoid, with nearly parallel sides .... **Cylindrocystis**
   18. Cells cylindrical, length 10-20 times the diameter, apices slightly dilated, chromatophore ribbon-like .... **Gonatozygon** (cells sometimes in disassociating filaments)
18. Cells shorter, apices not dilated, never in filaments 19
   19. Cells with spines 20
   19. Cells without spines 27
20. Cells globose 21
20. Cells not globose 23
   21. Spines long, stout, tapering from broad bases, hyaline .... **Echinosphaerella**
   21. Spines long, delicate 22
22. Spines thickened at base .... **Acanthosphaera**

22. Spines not thickened at base .... **Golenkinia**
23. Cells ellipsoid, subcylindrical or subspherical 24
23. Cells not ellipsoid, subcylindrical or subspherical 25
24. Cells ellipsoidal, densely covered with delicate spines .... **Franceia**
24. Cells ellipsoidal, subcylindrical, or subspherical, spines long, subpolar or equatorial .... **Chodatella** (see *Lagerheimia*)
25. Cells acicular to fusiform, straight or curved, polar spines straight or recurved, sometimes bifurcate .... **Schroederia**
25. Cells not acicular to fusiform 26
26. Cells pyramidate with a single stout spine at the angles .... **Treubaria**
26. Cells tetragonal-compressed or pyramidate, angles with tufts of 4-6 delicate spines .... **Polyedriopsis**
27. Cells endophytic or endozooic 28
27. Cells not endophytic or endozooic 29
28. Endophytic in aquatic angiosperms, cell walls thick and stratified .... **Chlorochytrium**
28. Endozooic in *Hydra*, Planaria, and Ciliates; cells minute .... **Zoochlorella** (see *Chlorella*)
29. Cells epiphytic or epizooic 30
29. Cells not epiphytic or epizooic 31
30. Cells epiphytic on *Anabaena* or *Coelosphaerium*, globose or ovoid, stipe long, delicate; 1 massive chromatophore at outer end of cell .... **Stylosphaeridium**
30. Cells epiphytic or epizooic, subglobose to fusiform, stipe short, stout; 1 or more parietal plate-like chromatophores .... **Characium**
31. Cells acicular 32
31. Cells not acicular 33
32. One laminate chromatophore, with or without a pyrenoid .... **Ankistrodesmus**
32. One laminate chromatophore with a row of numerous pyrenoids .... **Closteriopsis**
33. Cells with 4 stout, quadrately arranged, blunt or bifurcate appendages .... **Pachycladon**
33. Cells without quadrately arranged appendages 34
34. Cells triangular to polygonal, angles with simple or bifurcate processes .... Tetraedron
34. Cells globose, ovoid, or ovoid-elongate 35
35. Cells globose 36
35. Cells ovoid to ovoid-elongate 42
36. Cells surrounded by a broad fusiform envelope .... **Desmatractum**
36. Cells without a fusiform envelope 37
37. Cell walls variously and distinctly sculptured .... **Trochiscia**
37. Cell walls smooth, or at least not distinctly sculptured 38
38. Cell walls with 1 or more local, button-like thickenings .... **Chlorococcum**
38. Cell walls without localized thickenings 39
39. Cells inclosed in a broad gelatinous envelope 40
39. Cells not inclosed in a broad gelatinous envelope 41
40. Envelope homogenous; chromatophore polygonal .... **Planktosphaeria**
40. Envelope lamellate or not, individual cell envelopes not confluent, chromatophores cup-like .... **Gloeocystis**
41. Cells large, chromatophores numerous, discoid, each with 1 pyrenoid .... **Eremosphaera**
41. Cells very small, chromatophore single, parietal, plate-like or cup-like .... **Chlorella**
42. Cell walls thick, with a pronounced, irregular thickening, chromatophore axial .... **Kentrosphaera**
42. Cells very small, wall thin, without irregular thickenings, chromatophore parietal, plate-like or cup-like .... **Chlorella**
43. Cells not arranged in filaments .... 44 (see *Palmodictyon*)
43. Cells arranged in filaments 86
44. Cells in motile colonies 45
44. Cells not in motile colonies 51

45. Colony a flat, quadrangular plate, 4-32 cells .... **Gonium**

45. Colony not a quadrangular plate 46

46. Colony a morula-like cluster of cells in tiers of 4 cells each, cells biflagellate .... **Pyrobotrys**

46. Colony not a morula-like cluster, colonial envelope obvious 47

47. Colony flattened, slightly twisted, horse-shoe shape, 16-32 marginal and interior cells .... **Platydorina**

47. Colony globose or ovoid 48

48. Colony ovoid, cells pyriform, compactly arranged .... **Pandorina**

48. Colony globose or ovoid, cells not pyriform 49

49. Colony globose, hollow, with several hundred to several thousand cells .... **Volvox**

49. Colony globose or ovoid, not over 256 cells 50

50. Colony of 64-256 cells, cells of 2 sizes .... **Pleodorina**

50. Colony with less than 64 cells, cells (32) all similar in size, often in transverse rows .... **Eudorina**

51. Colony tubular, gelatinous, simple or branched; cells multiserrate .... **Palmodictyon**

51. Colony not tubular 52

52. Colony net-like, cells cylindrical or ovoid-elongate .... **Hydrodictyon**

52. Colony not net-like, cells various in shape 53

53. Cells with pseudocilia 54

53. Cells without pseudocilia 55

54. Colonies pyriform, attached by stipe-like base .... **Apiocystis**

54. Colonies saccate, globose, irregularly expanded, attached or free-floating; cells often in 2's or 4's .... **Tetraspora**

55. Cells with delicate or stout spines 56

55. Cells without spines 61

56. Colony pyramidate, each cell with 1 long, stout spine .... **Errerella**

56. Colony not pyramidate 57

57. Cells quadrately arranged 58

57. Cells not quadrately arranged 59

58. Coenobia 4-celled; cells triangular, 1 (or more) spines per cell .... **Tetrastrum**

58. Coenobia 4-celled, quadrate, united into multiple coenobia; cells globose or ovate, each with 1-7 delicate spines .... **Micractinium**

59. Colony spherical; cells cuneate or pyriform, outer surface of cells with 1-4 stout spines .... **Sorastrum**

59. Colony not spherical 60

60. Colony a plate or strip of cells; cells elliptic to fusiform, with long axes parallel, walls with spines, teeth, or granules .... **Scenedesmus**

60. Colony of 2-4 cells, cells elliptic with broadly rounded poles, densely covered with delicate spines .... **Franceia**

61. Colony 8-celled, cubical, perforate; cells connected by gelatinous strands .... **Pectodictyon**

61. Colony not cubical 62

62. Cells quadrately arranged in colony 63

62. Cells not quadrately arranged in colony 64

63. Cells trapezoid or rhomboid, adjacent in 4's or multiples of 4 in plate-like colonies .... **Crucigenia**

63. Cells globose or subglobose, in 4's separated by strands, or in multiples of 4 connected by strands .... **Coronastrum**

64. Colony a stellate plate; cells polygonal, peripheral cells with processes .... **Pediastrum**

64. Colony not a stellate plate 65

65. Colony a flat plate or strip of cells; cells elliptic or fusiform, long axes parallel .... **Scenedesmus**

65. Colony not a strip of cells 66

66. Cells acicular, sharply pointed, 1 laminate chromatophore with or without a pyrenoid, cellls loosely aggregated, or tightly twisted into colonies .... **Ankistrodesmus**

66. Cells not acicular 67

67. Cells lunate, arcuate, or broadly curved cylinders 68
67. Cells not lunate or arcuate 69
68. Cells lunate or arcuate, apices sharply pointed, cells lie with convex surfaces apposed; no obvious gelatinous matrix .... **Selenastrum**
68. Cell apices almost touching, apices rounded; with gelatinous envelope .... **Kirchneriella**
69. Cells fusiform, cylindric-fusiform, or broadly fusiform 70
69. Cells not fusiform 72
70. Cells cylindric-fusiform, (4)-8-(16) in number, radiating from a common center .... **Actinastrum**
70. Cells fusiform or broadly fusiform, not radiating from a common center 71
71. Cells in parallel groups of 4 or 8, long axes paralleling the colony axis, embedded in a wide gelatinous envelope .... **Quadrigula**
71. Cells 2 to many, enclosed in a broad gelatinous, fusiform envelope, cell axes paralleling colony axis .... **Elakatothrix**
72. Cells pyriform, bases apposed in groups of 2-4, peripheral in a wide, homogenous, gelatinous envelope .... **Gloeoactinium**
72. Cells not pyriform 73
73. Cells reniform or oblong-elliptic, often spirally arranged, surrounded by the old parent cell wall .... **Nephrocytium**
73. Cells not reniform, if oblong-elliptic then not spirally arranged 74
74. Cells oblong-elliptic, each in a lamellated sheath, colonies of 2-4 cells arranged end to end in a sheath of the parent cell wall .... **Dactylothece**
74. Cells globose, subglobose, ovoid to elliptic 75
75. Colony crossed by dark bands; cells globose to elliptic, 2-4 in a colony .... **Gloeotaenium**
75. Colony not crossed by dark bands 76
76. Colony with internal branching threads or remains of old cell walls 77
76. Colony without internal thread system or remains of old cell walls 80
77. Cells located individually in periphery of colonial matrix; dichotomously branched internal thread system .... **Dictyosphaerium**
77. Cells in groups of 4 within colony 78
78. Cells of each group of 4 of the same shape 79
78. Two cells of each group of 4 different in shape from other 2, cells of each group cruciately arranged, each cell at end of branching remains of old parent walls .... **Dimorphococcus**
79. Cells of each group of 4 in the same plane; remains of old cell walls in colony .... **Westella**
79. Cells pyramidately arranged in each group of 4; colonial matrix radially fibrillar .... **Radiococcus**
80. Colony of 2-16 cells, surrounded by the old parent cell wall; cells sometimes with pointed or tuberculate poles .... **Oocystis**
80. Colony not surrounded by old parent cell wall 81
81. Colony globose; cells peripheral, or nearly so, attached to one another by short, peg-like processes .... **Coelastrum**
81. Colony in a gelatinous or mucilaginous envelope, cells not joined by peg-like processes 82
82. Colony irregularly globose, surrounded by a thin mucilage; cells ovoid or globose, densely aggregated and peripheral in the mucilage .... **Botryococcus**
82. Colony surrounded by a wide gelatinous envelope 83
83. Colonial envelope homogenous, individual cell envelopes confluent 84
83. Colonial envelope not homogenous, individual cell envelopes not confluent, lamellated or not .... **Gloeocystis**
84. Cells globose, with 1 stellate, axial chromatophore, 1 central pyrenoid .... **Asterococcus**
84. Cells globose with parietal chromatophores 85

85. Chromatophore, 1, cup-shaped,
1 pyrenoid ..... **Sphaerocystis**

85. Chromatophores more than 1, disc-like
or polygonal, each with 1 pyrenoid ..... **Planktosphaeria**

86. Filaments unbranched 87

86. Filaments branched 106

87. Cells with a median constriction 88

87. Cells without a median constriction 91

88. Median constriction very slight, cells without processes,
circular or nearly so in end view ..... **Hyalotheca**

88. Median constriction slight to deep, sinus open or closed 89

89. Cells triangular in end view, sinus slight,
filaments spirally twisted ..... **Desmidium**

89. Cells compressed in end view, sinus deep 90

90. Cells with apical granules or processes, processes not over-
lapping adjoining cells ..... **Sphaerozosma**

90. Cells without apical granules or processes ..... **Spondylosium**

91. Cells with apical caps ..... **Oedogonium**

91. Cells without apical caps 92

92. Cell walls composed of H-pieces;
chromatophore parietal, reticulate ..... **Microspora**

92. Cell walls without H-pieces; chromatophores various 93

93. Chromatophores distinctly axial 94

93. Chromatophores parietal or usually indeterminate 95

94. Cells with 2 stellate chromatophores, each with 1 massive pyrenoid ..... **Zygnema**

94. Cells with 1 plate-like chromatophore, pyrenoids
numerous, in a row or scattered ..... **Mougeotia**

95. Chromatophore usaully indeterminate; cells oblong, in a
tough gelatinous envelope with lamellations around indi-
vidual cells ..... **Cylindrocapsa**

95. Chromatophores parietal 96

96. Chromatophores 1 or more ribbons, nearly
straight or closely spiralled 97

96. Chromatophores not ribbon-like, not spiralled 98

97. Chromatophores usually making more than ½ turn; con-
jugation by distinct tubes between gametangia ..... **Spirogyra**

97. Chromatophores making less than ½ turn; no distinct con-
jugation tubes, conjugation between genuflexed gametangia ..... **Sirogonium**

98. Chromatophores reticulate, cells cylindrical or irregular cylin-
drical, cell walls thin to distinctly lamellated ..... **Rhizoclonium**

98. Chromatophores plate-like, not reticulate 99

99. Cells transverse-elliptic, in a broad
gelatinous sheath ..... **Radiofilum**

99. Cells not transverse-elliptic 100

100. Cells separated from one another, or appearing separated be-
cause protoplast is distant from end walls 101

100. Cells adjacent to one another, or protoplast
adjacent to end walls, not in pairs 102

101. Cells in pairs, protoplast distant from end walls with
lamellated gelatinous material between, no pyrenoids ..... **Binuclearia**

101. Cells in a wide gelatinous sheath, separated from
one another, or paired, with pyrenoids ..... **Geminella**

102. Cell division in 3 planes, cells
quadrangular; filaments multiserrate ..... **Schizomeris**

102. Cell division in only 1 plane; filaments uniserrate 103

103. Chromatophore a laminate band encircling about 2/3
of the protoplast; filaments of indefinite length ..... **Ulothrix**

103. Chromatophore a laminate band
encircling ½ or less of the protoplast 104

104. Filaments attached, apical cell asymmetrically acuminate ..... **Uronema**

104. Filaments may or may not be attached; apical cell not acuminate 105

105. Filaments of indefinite length; chromatophore much less than the length of the cell ..... **Hormidium**

105. Filaments readily disassociating into single cells or a series of a few cells; chromatophore less than cell length ..... **Stichococcus**

106. Without regularly occurring crosswalls, siphonaceous 107

106. With regularly occurring crosswalls 108

107. Dichotomously branched, with a constriction at base of branches ..... **Dichotomosiphon**

107. Not dichotomously branched, without constrictions ..... **Vaucheria**
(This genus is now considered to be in the Xanthophyceae)

108. Cells of main axis much broader than cells of branches ..... **Draparnaldia**

108. Cells of main axis and of branches nearly the same diameter 109

109. Some cells of filament with setae 110

109. Cells of filament without setae 113

110. Setae with bulbous bases ..... **Bulbochaete**

110. Setae without bulbous bases 111

111. Setae enlarged at the base (not bulbous); filaments prostrate epiphytes on various algae ..... **Aphanochaete**

111. Setae emerging from sheathing bases 112

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112. Thallus of gregarious, globose, or flask-like cells connected by tubular elongations of the enveloping sheath ..... **Chaetosphaeridium**

113. At least some branches terminating in long, tapering, multicellular hairs 114

113. Branches not terminating in multicellular hairs 115

114. Filaments densely aggregated into a main axis with densely aggregated lateral branches, or in a hemispherical mass inclosed in a copious, tough gelatinous matrix ..... **Chaetophora**

114. Filaments not aggregated, branches loosely arranged, in a watery, mucilaginous envelope ..... **Stigeoclonium**

115. Branches (when present) rhizoidal, of 1-3 nearly colorless cells; cells of filament cylindrical or irregularly cylindrical; chromatophores reticulate ..... **Rhizoclonium**

115. Branches not rhizoidal 116

116. Branches basal or nearly so; cells progressively of greater diameter from base to apex of filament; epizooic on turtles or snails ..... **Basicladia**

116. Branches not basal, filaments not club-shaped 117

117. Branches and main axes with cylindrical or enlarged dark akinetes ..... **Pithophora**

117. Branches and main axes without cylindrical or enlarged dark akinetes 118

118. Thallus a pseudoparenchymatous layer or pad with compactly arranged, short, erect filaments, terminal cells of erect filaments often enlarged ..... **Gongrosira**

118. Thallus not a pad of compactly arranged, short, erect filaments 119

119. Terminal cells of branches acutely rounded 120

119. Terminal cells of branches obtusely to broadly rounded 121

120. Filaments densely aggregated in a main axis having densely aggregated lateral branches, or densely aggregated in a hemispherical mass, inclosed in a copious, tough, gelatinous envelope ..... **Chaetophora**

120. Filaments not densely aggregated, branches loosely arranged, inclosed in a watery, mucilaginous envelope ..... **Stigeoclonium**

121. Filaments repeatedly branched, forming tufts if attached, or an entangled mass if free-floating, branches arising at anterior end of cells; cell walls usually thick and lamellated ..... **Cladophora**

121. Filaments sparsely branched, some branches arising midway between the ends of cells; terminal cells often with irregular pectose caps ..... **Trentepohlia**

Order Volvocales

Members of this order are motile unicells or colonies with usually 2 or 4-(8) flagellae per cell, though nonmotile palmella stages are frequent. The cells usually have a pigment body, a cup-shaped chloroplast with one or more pyrenoids. Reproduction is by cell division, zoospores, or by isogamous or heterogamous motile gametes.

Family Chlamydomonadaceae

Carteria Diesing 1866

Unicellular, motile, spherical, ellipsoid or cordiform, oval or round in cross section, four long flagellae at anterior end; chloroplast cup-shaped, parietal, with or without a pyrenoid, anterior pigment spot usually present.

Carteria dissecta Tiffany — Fig. 1

Cells compressed-globose, with an apical depression; chloroplast anteriorly dissected into numerous parallel, elongate lobes (or rarely massive and occupying nearly the whole cell), with a single large pyrenoid centrally to posteriorly located; cells with two contractile vacuoles, a pigment spot lacking; cells 13 to 20μ in diameter and 12 to 14μ thick.

Terwilliger.

Carteria klebsii (Dang.) Dill — Fig. 2

Cells ellipsoid to nearly cylindrical, anterior end with a prominent beak; chloroplast massive, cup-shaped with one basal pyrenoid; cells with two contractile vacuoles, pigment spot lacking; cells 5 to 10μ x 8 to 16μ.

Smith.

Chlamydomonas Ehrenberg 1833

Cells unicellular, motile, ovoid, spherical, fusiform, or ellipsoid, anterior end with one or two apical papillae and two equal-length flagellae, often with a mucilaginous envelope; chloroplast occupying entire cell, or a cup-like structure, pyrenoids one to several, with a lateral, anterior pigment spot; cells with two to four anterior contractile vacuoles.

Chlamydomonas globosa Snow — Fig. 3

Cells ovoid to globose, no anterior papilla; chloroplast parietal, cup-shaped, with one basal pyrenoid; pigment spot lateral and supramedian; one contractile vacuole at base of flagellae; cells 5 to 10μ x 10 to 19μ.

Starve.

Chlamydomonas gracilis Snow — Fig. 4

Cells cylindrical, rarely oval or spherical, color a dull blueish-green; two cilia, about one and a half times as long as the cell; pigment spot a dull red disk, often equally distant from the two ends; pyrenoid at extreme posterior end; gametes(?) oval in shape and somewhat smaller than vegetative individual.

Open lake N. of Kelleys.

Description from Snow (1903).

Chlamydomonas snowii Printz — Fig. 5

Cells ovoid to ellipsoid, anterior beak inconspicuous; chloroplast cup-shaped with one centrally located pyrenoid; pigment spot not readily visible; cells 6.5 to 8μ x 10 to 15μ.

Terwilliger.

Family Phacotaceae

Phacotus Perty 1852

Cells unicellular, biflagellate, round or oval in front view, flattened and biconvex in edge view; envelope of two valves, thick, rough, calcified, with thickened rims; protoplast ovoid with two contractile vacuoles and an anterior or posterior pigment spot; chloroplast massive, cup-shaped, with one to several pyrenoids.

Phacotus lenticularis (Ehr.) Stein — Fig. 6

Characters as for the genus; cells lenticular, 13 to 20μ x 13 to 20μ.

Terwilliger, Squaw, Smith, N. Bass dock, Kelleys, E. Harbor, Put-in-Bay Harbor; probably general.

Pteromonas Seligo 1887

Cells unicellular, motile, biflagellate, variously shaped, flattened, broadly winged in vertical view, roughly circular or ovoid or rectangular in front view; envelope composed of two halves with thickened rims; protoplast pyriform with two contractile vacuoles; chloroplast cup-shaped, with one to six pyrenoids.

Pteromonas angulosa (Carter) Lemmermann — Fig. 7

Envelope subcircular to truncate-ovoid in front view; chloroplast with one large pyrenoid; cells 9 to 20μ x 13 to 17μ.

Fisher, E. Harbor.

Family Volvocaceae

Eudorina Ehrenberg 1832

Colony motile, spherical, obovoid or ellipsoid, with (16)-32-(64) cells peripheral in a hyaline gelatinous envelope, cells often in rows that encircle the colony; envelope symmetric or with posterior, rounded projections; cells spherical, biflagellate, with one or two anterior contractile vacuoles and one pigment spot; chloroplast single, cup-shaped, one or more pyrenoids; asexual reproduction by autocolonies common.

Eudorina elegans Ehrenberg — Fig. 8

Colony usually 32-celled, ovate; cells 12 to 24μ in diameter, colonies 50 to 200μ in diameter.

Distribution general.

Eudorina unicocca G. M. Smith — Fig. 9

Colony ellipsoid or ovoid-ellipsoid, mammillate at the posterior pole; cells 6 to 18μ in diameter, colonies 50 to 100μ x 60 to 100μ.

Terwilliger.

There is a question as to the authenticity of this species. Some authors feel that it is a "preserved form" of *E. elegans;* yet specimens in living condition and having the mammillate posterior pole are occasionally found.

Gonium Mueller 1773

Colony motile, plate-like, quadrangular, with 4 to 32 ovoid, pyriform, or bilobed cells in a gelatinous matrix or connected by gelatinous strands; cells with two equal flagellae and interconnected by fine protoplasmic processes; each cell with contractile vacuoles and a pigment spot; chloroplast a single parietal cup with one or two pyrenoids; asexual reproduction commonly by autocolonies.

Gonium formosum Pascher — Fig. 10

Colony 4, 8, or usually 16 cells inclosed in a wide colonial envelope having a circular open space at the center of the plate; cells ovoid-pyriform; chloroplast parietal, cup-like, with one pyrenoid; one anterior, lateral pigment spot; cells 7 to 11μ x 10 to 25μ.

Gibraltar, Terwilliger, Squaw, Haunck, Fisher, Pelee quarry.

Gonium pectorale Mueller — Fig. 11

Colony 4, 8, or usually 16 cells arranged in a flat, quadrangular plate, 4 inner cells surrounded by 12 marginal cells with the anterior ends outward; cells ovoid or sub-spherical; cells 5 to 14μ x 5 to 16μ, colonies 70 to 100μ in diameter.

Terwilliger, Mound, N. Bass beach pool, Chick.

Pandorina Bory 1824

Colony motile, spherical, subspherical or obovoid, with (4)-8 to 16-(32) cells mutually compressed in the periphery of a copious, hyaline envelope, envelope with or without protuberances; cells pyriform or angular, biflagellate; chloroplast single, cup-shaped, with one pyrenoid; one pigment spot and two contractile vacuoles; asexual reproduction by autocolonies common.

Pandorina morum (Muell.) Bory — Fig. 12

Colony ovate, usually with 16 cells; cells pyriform; cells 8 to 16μ x 12 to 17μ; colonies 20 to 45μ x 20 to 50μ.

Distribution general.

Pandorina protuberans Tiffany — Fig. 13

Characters as in the genus; colony with regular, mound-like protuberances over the surface; cells 10 to 16μ in diameter, colonies 30 to 50μ x 30 to 55μ.

Terwilliger, Squaw, Smith.

Platydorina Kofoid 1899

Colony motile, flat, twisted, with 16 to 32 cells in one layer, those at the center of the colony alternately pointing to opposite sides of the colony, marginal cells pointing outwards; cells enclosed in a horseshoe-shaped sheath with three to five posterior, gelatinous prolongations; cells oblately spheroid, seldom compressed, biflagellate, with pigment spot; chloroplast parietal, cup-shaped; asexual reproduction by autocolonies common.

Platydorina caudata Kofoid Fig. 14

Characters as for the genus; cells 10 to 20μ x 10 to 20μ, 16-celled colonies 43 x 70μ, 32-celled colonies 145 x 165μ.

Terwilliger, Squaw, Hatchery, Put-in-Bay Harbor, N. Bass dock.

Pleodorina Shaw 1894

Colony motile, globose to subglobose, with (32)-128-(256) spherical or ovoid cells spaced at some distance from one another near the periphery of a hyaline, gelatinous envelope; cells of two sizes, the smaller vegetative cells toward the posterior part of the colony and reproductive cells toward the anterior part of the colony; cells biflagellate with a cup-shaped chloroplast and one or more basal pyrenoids, one anterior pigment spot, and two contractile vacuoles; asexual reproduction by autocolonies common.

Pleodorina californica Shaw Fig. 15

Colony motile, nearly spherical, with 128 cells, about half vegetative and half reproductive; vegetative cells 6 to 14μ in diameter, reproductive cells 6 to 34μ in diameter, colonies 40 to 400μ in diameter, zygotes spherical, 22 to 33μ in diameter, reddish-brown, wall smooth, finely granulate or sometimes irregularly thickened.

Fisher, Wehrle.

Pleodorina illinoisensis Kofoid Fig. 16

Colony motile, globose, with 16 to 32 cells, four small vegetative cells located near the posterior end of the colony; vegetative cells 9 to 16μ in diameter, reproductive cells 16 to 25μ in diameter, colonies 130 to 175μ x 150 to 200μ.

Terwilliger, Haunck, Smith, Mound.

Volvox Linnaeus 1758

Colony large, motile, spherical to ovoid, composed of 200 to several thousand cells peripherally arranged in a hyaline, colonial envelope; cells biflagellate, spheroid, ovoid, of disciform and directed outwards at the margin of the colony, differentiated into vegetative and reproductive cells; vegetative cells may or may not be interconnected by protoplasmic strands; chloroplast single, cup-shaped, with one pyrenoid; one pigment spot and two to six contractile vacuoles.

Volvox aureaus Ehrenberg Fig. 17

Colony motile, composed of 200 to 4000 cells; cells connected by fine protoplasmic strands, each with a disc-like chloroplast; vegetative cells 4 to 9μ in diameter, zygote smooth walled, 48 to 75μ in diameter, colonies 200 to 700μ in diameter.

Squaw, Terwilliger, Hatchery, Haunck, Wehrle.

Volvox globator Linnaeus Fig. 18

Colony motile, composed of 1000 to 20,000 cells; cells in well-defined, angular cell sheaths and interconnected by stout protoplasmic strands, each with a single flattened chloroplast; vegetative cells 2 to 7μ in diameter, zygote with a verrucose wall, 44 to 56μ in diameter, colonies 400 to 800μ in diameter.

Gibraltar, Squaw, Terwilliger, Hatchery, Smith, N. Bass ditch, Catawba.

Volvox tertius A. Meyer Fig. 19

Colony motile, small, composed of 400 to 2500 cells, cells not connected by protoplasmic strands; cells ovoid or ellipsoid; chloroplast parietal, cup-shaped, one pigment spot and at least two contractile vacuoles; vegetative cells 5 to 8μ in diameter, zygotes with a smooth, thick wall, 58 to 66μ in diameter, colonies 280 to 550μ x 300 to 590μ.

Haunck, Fisher.

This species was reported as *V. mononae* G. M. Smith by Tiffany (1934).

Family Spondylomoraceae

Pyrobotrys Arnoldi 1914

Colony up to 16 cells, motile; cells pyriform, in tiers of four, usually alternately arranged; each cell with two flagellae that arise at the broad end of the cell; chloroplast cup-shaped and covering most of the cell wall, pyrenoids lacking; asexual reproduction into daughter colonies simultaneous in most of the cells; sexual reproduction isogamous.

Pyrobotrys gracilis Korshikov — Fig. 20

Characters as for the genus; cells about 18μ in diameter.

Haunck.

Family Haematococcaceae

Haematococcus C. A. Agardh 1828

Cells solitary, motile, ovoid to ellipsoid, biflagellate, flagellae divergent, protoplast separated from the peripheral wall by a wide band of mucilage traversed by strands of the protoplast; chloroplast cup-shaped, usually masked by haematochrome, with one pigment spot and several pyrenoids.

Haematococcus lacustris (Girod.) Wittrock — Fig. 21

Characters as for the genus; cells 8 to 30μ in diameter, 10 to 50μ in the encysted condition.

Common in rock pools on S. Bass, Green, Starve, Buckeye; probably in similar habitats in the entire survey area.

Order Tetrasporales

Cells of this order are similar to those in the Volvocales. They differ by being nonmotile in vegetative condition, from which they may readily return to the motile condition. Some taxa have pseudocilia. Most forms are colonial though some are unicellular. They may be free-floating or sedentary with cells embedded in mucilaginous envelopes. Reproduction by cell division and zoospores is common. Sexual reproduction, where known, is isogamous.

Family Palmellaceae

Asterococcus Scherffel 1908

Colony with a homogeneous mucilaginous envelope; cells globose or nearly so, solitary or in colonies of 4 to 16 cells; chloroplast a single, stellate, central mass with radiating lobes ending in discs at the cell wall, one pyrenoid.

Asterococcus limneticus G. M. Smith — Fig. 22

Colony spherical, with 4 to 16 cells widely separated in a hyaline, homogeneous envelope; chloroplast with 4 to 16 radiations; cells 7.5 to 35μ in diameter, colonies up to 125μ in diameter.

Terwilliger, Haunck.

Gloeocystis Naegeli 1849

Colony spherical, lobed, or somewhat amorphous; cells globose or ellipsoid, solitary or embedded in colonies of four or more individuals in lamellated, gelatinous envelopes formed from the membranes of successive mother cells; chloroplast parietal, cup-shaped, with one pyrenoid, often obscured by starch and oil.

Gloeocystis ampla (Kuetz.) Lagerheim — Fig. 23

Cells ovoid or oblong, embedded in unlamellated gelatinous envelopes, sheaths of cells in a colony not confluent, but distinct and angular by compression; cells 5.5 to 9μ x 7 to 11μ.

Fox.

Gloeocystis gigas (Kuetz.) Lagerheim — Fig. 24

Cells spherical or broadly ellipsoid, solitary or in groups of two to eight, inclosed by distinctly lamellated sheaths; cells 9 to 17μ in diameter, colonies 45 to 100μ or more in diameter.

Squaw, Starve, Pelee canal, Kelleys.

Gloeocystis planctonica (W. & G. S. West) Lemmermann — Fig. 25

Cells spherical or ovoid, embedded in angular or pyramidal, free-floating colonies, sheaths of each cell or group of cells lamellate; cells 7.5 to 12μ in diameter, colonies 120 to 135μ in diameter.

Pelee ponds.

Palmodictyon Kuetzing 1845

Thallus a tubular, gelatinous strand, which may be branched or anastomosing; cells spherical, regular or irregular linear arrangement, with or without distinct gelatinous sheaths; chloroplast a parietal plate, one pyrenoid.

Palmodictyon varium (Naeg.) Lemmermann — Fig. 26

Thallus a tubular, gelatinous strand; cells spherical, linearly arranged, without evident individual sheaths; chloroplast a parietal plate, one pyrenoid; cells 5 to 7μ in diameter.

Gibraltar.

Sphaerocystis Chodat 1897

Colony free-floating, spherical, with groups of 4 to 32 cells arranged toward the periphery of a hyaline, homogeneous envelope; cells spherical, sometimes with individual sheaths; chloroplast cup-shaped, or covering almost the entire wall, with one pyrenoid.

Sphaerocystis schroeteri Chodat — Fig. 27

Characters as for the genus; cells 6 to 22μ in diameter, colonies 50 to 500μ in diameter.

Distribution general.

This algae is extremely variable in appearance as cells at all stages of reproduction and maturity may be present in the colony.

Family Tetrasporaceae

Apiocystis Naegeli 1849

Colony microscopic, pyriform, epiphytic on algae and submerged macrophytes, envelope usually with a distinct peripheral zone; cells spherical, each with two very long pseudocilia; chloroplast parietal, with one pyrenoid.

Apiocystis brauniana Naegeli — Fig. 28

Characters as for the genus; cells 6 to 8μ in diameter, colonies up to 1000μ or more in diameter.

E. Harbor.

Tetraspora Link 1809

Colony macroscopic or microscopic, attached or free-floating, spherical, elongate-tubular, or membranous, with copious, homogeneous envelopes; cells spherical or subspherical, in groups of two or four, sometimes irregular, each cell with long pseudocilia; chloroplast parietal, cup-shaped, usually with one pyrenoid.

Tetraspora gelatinosa (Vaucher) Desvaux — Fig. 29

Colony an attached cylindrical sac becoming globular and lobed with age; cells irregularly placed in old colonies; cells 3 to 13μ in diameter.

Squaw, Gibraltar, Buckeye.

Tetraspora lacustris Lemmermann — Fig. 30

Colony free-floating, spherical, elongate or irregular; cells few, spherical, in groups of two or four cells; 7 to 10μ in diameter, pseudocilia distinct, 45 to 75μ long, colonies up to 300μ in diameter.

Squaw, Haunck.

Tetraspora lubrica (Roth) C. A. Agardh — Fig. 31

Colony a long tubular envelope up to 12 inches; cells usually grouped in fours or scattered when old; cells 7 to 11μ in diameter.

Pelee.

Stylosphaeridium Geitler & Gimesi 1925

Cells solitary or gregarious, spherical to pyriform, stipitate, epiphytic; chloroplast single, massive, posterior, with one pyrenoid.

Stylosphaeridium stipitatum (Bachm.) Geitler & Gimesi — Fig. 32

Cells spherical to pyriform, with a delicate stipe; cells 5 to 8μ broad, stipe 10 to 16μ long. Epiphytic on cells within the gelatinous envelope of *Coelosphaerium*.

Squaw.

Family Coccomyxaceae

Dactylothece Lagerheim 1883

Cells solitary, or arranged end to end in colonies of two to four cells; cells cylindrical, ovoid, or oblong-ellipsoidal, each inclosed by a broad lamellated sheath, a similar sheath surrounding the colony; chloroplast laminate, parietal, with or without a pyrenoid.

Dactylothece confluens (Kuetz.) Lagerheim — Fig. 33

Colony small, four cells; cells cylindrical to broadly ovoid, ends slightly rounded, inclosed by lamellated sheaths; chloroplast parietal, laminate, no pyrenoid; cells 3 to 3.5μ x 5 to 6μ, colonies 7 to 8μ x 15 to 17μ.

Kelleys.

Elakatothrix Wille 1898

Colony fusiform, free-floating when mature; cells fusiform, both poles acutely pointed, longitudinally arranged in rows within a homogeneous envelope; chloroplast single, parietal, covering most of the cell wall, with one or two pyrenoids; cell division transverse, daughter cells at first lying in pairs, then later separating slightly.

Elakatothrix viridis (Snow) Printz — Fig. 34

Characters as for the genus; cells 6 to 20μ x 12 to 35μ.

Fox pond on Pelee, open lake N. of Kelleys.

Order Ulotrichales

Plants in this order are unbranched, simple filaments with cells uniseriate except in one suborder where they are multiseriate. The filaments may exhibit differentiated basal holdfast cells and terminal cells. The cells are cylindrical with a single, parietal, laminate chloroplast having one or more pyrenoids. Reproduction is by zoospores and isogametes that form in undifferentiated vegetative cells.

Suborder Ulotrichineae

Cells mostly uniseriately arranged, adjoined or spaced from one another.

Family Ulotrichaceae

Binuclearia Wittrock 1886

Filaments unbranched, without a gelatinous sheath; cells cylindrical with flattened poles daughter cells often in pairs, older cells becoming equidistant; space between end of cell and chloroplast gelatinous and lamellose; chloroplast single, parietal, laminate, rounded ends, usually occupying central portion of cell, without pyrenoids, but often with a prominent granule at each end.

Binuclearia eriensis Tiffany — Fig. 35

Characters as for genus; cells 2 to 3μ x 8 to 20μ.

Squaw, Terwilliger, Put-in-Bay Harbor, Haunck.

Binuclearia tatrana Wittrock — Fig. 36

Characters as for the genus; cells 6 to 10μ x 10 to 70μ.

Terwilliger. Wehrle.

Geminella Turpin 1828

Filaments free-floating or sessile, enclosed in a tubular gelatinous envelope; vegetative cells usually cylindrical, longitudinally adjacent, or remote and in pairs, or equidistant chloroplast laminate, zonal, usually with one pyrenoid.

Geminella interrupta (Turpin) Lagerheim — Fig. 37

Vegetative cells in pairs within a tubular, gelatinous envelope; cells 5 to 8μ x 6 to 15μ, envelope 16 to 20μ in diameter.

Kelleys.

Geminella minor (Naeg.) Heering — Fig. 38

Vegetative cells lying pole to pole in a tubular, gelatinous envelope: cells 2 to 10μ x 3 to 14μ, envelope 8 to 18μ in diameter.

Haunck, Terwilliger.

Hormidium Kuetzing 1843

Filaments long, but may fragment into short segments, without basal holdfast cells and no gelatinous sheaths; cells are cylindrical, each with a parietal, laminate chloroplast that encircles one-half or less of the cell and with one pyrenoid; asexual reproduction is by an aplanospore or a single biflagellate zoospore in each cell.

Hormidium subtile (Kuetz.) Heering — Fig. 39

Characters as for the genus with filaments pale to yellow-green, of indefinite length, often terrestrial on damp soil or decaying logs; cells about twice as long as broad, 6 to 8μ in diameter.

Fisher on log, Green Isl. on log, Buckeye Isl. on soil.

Radiofilum Schmidle 1894

Filaments branched or unbranched, sometimes anastomosing, enclosed in a gelatinous sheath; cells lenticular, spherical, ellipsoidal to subquadrate, cells of some species with a median, transverse rim; chloroplast a parietal plate along the transverse wall, one pyrenoid.

Radiofilum flavescens G. S. West — Fig. 40

Filaments long, enclosed in a gelatinous sheath; cells ellipsoidal to mostly subquadrate; chloroplast a parietal plate along the transverse wall, one pyrenoid; cells 7 to 8μ in diameter, 4 to 5μ long.

Kelleys deep quarry.

Stichococcus Naegeli 1849

Filaments unbranched, consisting of one to a few, uninucleate, cylindrical vegetative cells; chloroplast parietal, laminate, encircling one-half or less of the cell circumference, one pyrenoid.

Stichococcus subtilis (Kuetz.) Klercher — Fig. 41

Filaments not constricted at cross walls; cells 5 to 8μ x 6 to 23μ.

Terwilliger, Fisher.

Ulothrix Kuetzing 1833

Filaments unbranched, not apically attenuated, frequently attached by a basal holdfast, with or without an evident sheath; vegetative cells cylindrical; chloroplast a parietal band, encircling more than half the cell, one or more pyrenoids.

Ulothrix subconstricta G. S. West — Fig. 42

Cells only slightly constricted at crosswalls, without an evident sheath; chloroplast an irregular parietal plate, from two-thirds to nearly the length of the cell, none to three pyrenoids; cells 5.5 to 7.5μ x 16 to 30μ.

N. Bass dock.

Ulothrix tenerrima Kuetzing — Fig 43

Vegetative cells cylindrical, walls thin; chloroplast zonate, or on one side, one pyrenoid.

Haunck.

Ulothrix zonata (Weber & Mohr) Kuetzing — Fig. 44

Vegetative cells cylindrical or swollen, cell wall thick; chloroplast a median band, several large pyrenoids; cells 10 to 45μ x 10 to 100μ.

Gibraltar, Catawba, M. Bass.

Uronema Lagerheim 1887

Filaments sessile, relatively short, mostly rigid; cells cylindrical, terminal cell asymmetrically acuminate, sometimes slightly recurved; chloroplast laminate, parietal, covering more than half the circumference of the cell and half to two-thirds the cell length.

Uronema elongatum Hodgetts — Fig. 45

Characters as for the genus; cells 6 to 9μ in diameter.

Fox pond cut-off.

Order Ulvales

Plants in this order are thalloid due to cell division in two planes. The thalli may be expanded sheets, solid cylinders, or tubular. Tubes may split into sheets one cell in thickness. In some forms the young plant is first filamentous with uniseriate cells, then later multiseriate and thalloid. Thalli which are attached when young may be free-floating when older. The cells are mostly angular by mutual compression and are separated by walls of medium thickness. Each cell has one chloroplast, that is cup-shaped or laminate and one pyrenoid. Reproduction may be vegetative by fragmentation, or asexual by quadriflagellate zoospores. Sexual reproduction is isogamous or anisogamous.

Family Ulvaceae

Schizomeris Kuetzing 1843

Filamentous, uniseriate with apical cell somewhat acuminate and with hold-fast cell when young; older filaments solid cylinders of brick-like cells; filaments cylindrical or constricted at intervals; cells with ring-like transverse walls, sometimes not extending to the surface; chloroplast band-like or massive with several pyrenoids or several chloroplasts each with a pyrenoid; reproduction by fragmentation, quadriflagellate zoospores, aplanospores, gametes.

Schizomeris leibleinii Kuetzing — Fig. 46

Filaments macroscopic, stout; older filaments up to 150μ in diameter and 10 to 20 cm long; vegetative cells 10 to 30μ x 10 to 50μ, rounded, or angular.

Gibraltar dock, Kelleys, E. Harbor.

Order Microsporales

The plants in this order are unbranched, free-floating filaments which are attached when young. The cells are cylindrical and are composed of two H-pieces, a character of *Tribonema* in the Chrysophyta. The chloroplast is either a thin, or a heavy parietal reticulum without pyrenoids. However, the cells have starch which *Tribonema* does not have. Asexual reproduction is commonly by aplanospores or biflagellate zoospores.

Family Microsporaceae

Microspora Thuret 1850

Filaments unbranched, composed of articulated H-pieces, vegetative cells cylindrical or swollen, uninucleate, walls thick or thin; chloroplast perforate or reticulate, covering entire inner cell wall surface, no pyrenoids.

Microspora floccosa (Vaucher) Thuret — Fig. 47

Characters as for the genus; filaments cylindrical or nearly so, cell walls thin; akinetes variously shaped; cells 14 to 18μ x 14 to 40μ, akinetes 18 to 22μ in diameter.

E. Harbor.

Microspora stagnorum (Kuetz.) Lagerheim — Fig. 48

Characters as for the genus; cell walls thin; aplanospores ellipsoid or spheroid; cells (5-)7 to 10μ x 8 to 30μ.

Squaw.

Microspora willeana Lagerheim — Fig. 49

Characters as for the genus; filaments cylindrical, cell walls thin; akinetes spherical or nearly so; cells 11 to 16μ x 6 to 25μ, akinetes 14 to 18μ in diameter.

Haunck.

Order Cylindrocapsales

Plants are usually filamentous, free-floating when old. The cells are uniseriate, or becoming biseriate to palmelloid, and may be evenly spaced or in pairs enclosed by the gelatinous, lamellate sheath. Individual cells are surrounded by concentric cellulose layers. Chromatophores are massive and dense, obscured by starch, and having one pyrenoid. Asexual reproduction is by biflagellate zoospores; sexual reproduction is oogamous.

Family Cylindrocapsaceae

Cylindrocapsa Reinsch 1867

Filaments unbranched, usually uniseriate within a wide, tough, tubular sheath; cells ellipsoid, ovoid, subrectangular, or spheroid, each with a lamellated gelatinous envelope; chloroplast one, massive, dense, with one central pyrenoid.

Cylindrocapsa geminella Wolle Fig. 50

Vegetative cells globose or nearly so, with thick lamellate walls; oospore globose; vegetative cells 14 to 24μ in diameter, oospore 40 to 50μ in diameter, lamellate wall 10 to 15μ thick.

Squaw, Haunck.

Cylindrocapsa geminella var. minor Hansgirg Fig. 51

Vegetative cells ellipsoid to cylindric; oospore globose, not filling the oogonium; vegetative cells 12 to 25μ x 15 to 50μ, oospore 18 to 25μ in diameter.

Pelee.

Order Chaetophorales

Plants in this order are branched filaments except for the two genera *Protococcus* and *Chaetosphaeridium* which are unicellular or unorganized colonies. The plants may be prostrate, or they may be prostrate with erect filaments arising from the prostrate stratum. The cells are usually cylindrical, though in some they are globose. In some forms the cells bear a seta or an attenuated cell outgrowth. Branch and main axis cells may be distinctly different in diameter. The chloroplast are parietal bands or plates that may completely encircle the cell wall and that have one or more pyrenoids. Asexual reproduction is by zoospores; sexual reproduction which is generally isogamous may be oogamous.

Family Chaetophoraceae

Aphanochaete A. Braun 1851

Filaments simple or slightly and irregularly branched, prostrate (epiphytic) on other algae; vegetative cells cylindrical, barrel-shaped, cylindric-globose, or globose, bearing one or more long hyaline setae from their dorsal surfaces; chloroplast laminate, parietal, usually with several pyrenoids.

Aphanochaete repens A. Braun Fig. 52

Vegetative cells subglobose to cylindrical; vegetative cells 5 to 10μ x 5 to 24μ, setae 3 to 4μ broad at the base and up to 200μ long when present. This algae may be looked for on filaments of *Oedogonium* and *Tribonema.*

Squaw, Put-in-Bay Harbor.

Chaetophora Schrank 1783

Filaments much branched, arising from a prostrate palmelloid or parenchyma-like mass of cells, and inclosed in a tough mucilage envelope, envelope may be spherical, hemispherical, elongate, or irregularly tuberculate; branches fasiculate at apices, ultimate branches tapering to blunt points or to long multicellular hairs; vegetative cells cylindrical or slightly swollen; chloroplast a parietal band covering the entire wall of young cells, becoming zonate in older cells, one pyrenoid in young cells, older cells with more than one pyrenoid.

Chaetophora elegans (Roth) Agardh Fig. 53

Colony gelatinous, globose or subglobose; filaments laxly branched, radiating from center of colony; vegetative cells of main filaments 6 to 11μ x 20 to 100μ.

Gibraltar, Haunck, Fisher, Kelleys quarries.

Chaetophora incrassata (Hudson) Hazen Fig. 54

Colony gelatinous, elongate, irregularly lobed and laciniate; main filaments elongate, with densely fascicled and usually setiferous branchlets; vegetative cells of main filaments cylindrical or swollen, 8 to 16μ x 8 to 90μ.

Kelleys quarries, Pelee, E. Harbor, W. Harbor.

Chaetophora pisiformis (Roth) Agardh Fig. 55

Colony gelatinous, globose to tuberculate; filaments radiating from center of colony, branches with fasciculate and sometimes setiferous apices; vegetative cells of main filaments cylindrical, 5 to 8μ x 15 to 40μ.

Gibraltar, Fisher.

Draparnaldia Bory 1808

Erect filaments branched, attached by an inconspicuous rhizoidal prostrate system, erect filaments differentiated into large primary branches and smaller fasciculate branches which terminate in long hyaline setae; cells of main axis and of primary branches cylindrical or swollen, cells of branches usually cylindrical; chloroplasts of axial cells entire or reticulate, with several pyrenoids; those of primary branches transversely zonate; those of ultimate branches covering the entire wall, mostly with one pyrenoid.

Draparnaldia glomerata (Vauch.) C. A. Agardh Fig. 56

Filaments repeatedly branched, branchlets without a distinct main axis; vegetative cells of main axis inflated; chloroplasts of cells of main axis narrowly zonate; vegetative cells 50 to 125μ x 30 to 200μ.

W. Harbor.

Stigeoclonium Kuetzing 1843

Plants differentiated into an irregularly branched or pseudoparenchymatous prostrate system and a loosely branched erect portion, enveloped in a thin mucilaginous film; main axis often obscure, lateral branches either alternate or opposite and the cells of the branches scarcely smaller than those of the main axis; branches ending in bluntly pointed or setiferous cells; vegetative cells mostly cylindric; chloroplast plate-like, covering most of the cell wall in younger cells, pyrenoids one to several.

Stigeoclonium gracile (W. & G. S. West) Tiffany Fig. 57

Erect branches tapering, sharp pointed or not; vegetative cells of prostrate thallus 5 to 8μ x 5 to 12μ, of erect portion 1.5 to 3μ x 20 to 400μ.

Hatchery Bay, Squaw, on *Vallisneria* leaves.

Islam (1963) states that this is an invalid name as it had been used by Kuetzing. As described, the plant is the same as *S. farctum* var. *simplex* Fritsch. It is doubtful whether this is a species of *Stigeoclonium* or of *Pseudochaete* W. & G. S. West to which it was originally assigned.

Stigeoclonium lubricum (Dillw.) Kuetzing Fig. 58

Branching opposite or various; vegetative cells somewhat swollen, 14 to 17μ x 10 to 30μ.

Gibraltar, Squaw.

Stigeoclonium lubricum var. **varians** (Hazen) Collins Fig. 59

Plants with shorter tufts of branches and with more setiferous cells; vegetative cells 10 to 12μ x 20 to 60μ.

Gibraltar.

According to Islam (1963) the var. *varians* is not considered to be a good variety.

Stigeoclonium stagnatile (Hazen) Collins Fig. 60

Plants in floccose masses, filaments sparsely branched, solitary or opposite; vegetative cells 7 to 11μ x 8 to 32μ.

Gibraltar.

According to Islam (1963) this is a doubtful species which may be a stage in the life history of *S. protensum* (Dillw.) Kuetz.

Stigeoclonium subsecundum Kuetzing Fig. 61

Plants loose, pale green to yellowish, branching sparse and solitary; vegetative cells 12 to 18μ x 13 to 150μ.

Gibraltar, W. Harbor.

Stigeoclonium tenue (Agardh) Kuetzing Fig. 62

Branches mostly opposite, some solitary; vegetative cells 5 to 10μ x 7 to 30μ.

Squaw, Smith, Kelleys, Gibraltar, Starve, Catawba; probably generally distributed along Lake Erie shores in spring.

Family Protococcaceae

Protococcus C. A. Agardh 1824

Cells solitary, in clumps of a few cells, or in much reduced, branching filaments; cells rounded, ellipsoid, or angularly compressed, wall thick; chloroplast a parietal, lobed plate, usually without pyrenoids; aerial on tree bark, stones, and weathered wood; multiplication by cell division only.

Protococcus viridis Agardh Fig. 63

Characters as for the genus; vegetative cells 4 to 10μ x 4 to 12μ.

General on all islands.

Family Coleochaetaceae

Chaetosphaeridium Klebahn 1892

Thallus unicellular, in clumps of cells or roughly filamentous, with or without an evident gelatinous envelope; epiphytic on other algae; vegetative cells ovoid or globose, each bearing distally a long, basally ensheathed seta; chloroplasts one to two, laminate, parietal, massive.

Chaetosphaeridium pringsheimii Klebahn Fig. 64

Cells united by persistent utricles, 9 to 12μ x 9 to 14μ, sheaths 2μ x 13 to 18μ, setae up to 300μ long.

Squaw, Terwilliger.

Coleochaete de Brébisson 1844

Filamentous, irregularly branched, either erect from a prostrate system, or entirely prostrate and radiating as a parenchymatous or pseudoparenchymatous monostromatic layer, usually epiphytic; some cells with single, long, unbranched, basally ensheathed setae; chloroplast single, laminate, covering most of the cell wall, usually with one pyrenoid.

Coleochaete irregularis Pringsheim Fig. 65

Filaments irregularly branched, free or somewhat united, prostrate to nearly erect; vegetative cells quadrangular or polygonal, 18 to 25μ x 18 to 40μ; oogonia ovoid, naked or corticate, 60 to 100μ x 60 to 120μ.

Squaw.

Coleochaete orbicularis Pringsheim Fig. 66

Filaments laterally united into a parenchymatous monostromatic layer; vegetative cells oblong to polygonal, 8 to 16μ x 16 to 30μ; oogonia ovoid, 50 to 66μ x 60 to 86μ.

E. Harbor.

Coleochaete scutata de Brébisson Fig. 67

Filaments united into a parenchymatous disc and radiating from the center; vegetative cells quadrangular, 25 to 45μ x 25 to 125μ; oogonia subglobose, corticate, 120 to 140μ x 140 to 160μ.

Squaw, E. Harbor.

Coleochaete soluta (de Bréb.) Pringsheim Fig. 68

Filaments prostrate, radiating from a common center, not laterally united; vegetative cells 12 to 25μ x 25 to 100μ; oogonia usually globose, corticate, up to 200μ in diameter.

E. Harbor.

Family Trentepohliaceae

Gongrosira Kuetzing 1843

Filaments branched, pseudoparenchymatous, prostrate, with short erect branches, terminal cells enlarged and often sporangia; on wood, shells, and old *Cladophora* bases; often penetrating the substrate; cells cylindrical and elongate, or broadly ovoid to angular, walls thick and often lamellate; chloroplast single, parietal, with one or more pyrenoids.

Gongrosira stagnalis (G. S. West) Schmidle Fig. 69

Characters as for the genus; vegetative cells 12 to 23μ in diameter, length 20 to 60μ, basal cells 17 to 24μ in diameter; sporangia 17 to 29μ in diameter.

West shore of S. Bass, on old *Cladophora* filaments.

Trentepohlia Martius 1817

Algal mass felt-like, on rocks, orange-brown, or green-olive when wet; filaments branched, branch cells cylindrical, older cells sometimes slightly swollen; cell wall thick, smooth; terminal cells bluntly rounded, or with a cap or peg of pectose; sporangia globose or ovate, lateral or terminal.

Trentepohlia aurea (L.) Martius Fig. 70

Characters as for the genus; cells 10 to 25μ in diameter.

S. Bass, Gibraltar.

Order Cladophorales

The plants are mostly macroscopic and filamentous with regularly or irregularly arranged branches which in some may be reduced to rhizoids of one or a few cells, or branches may be lacking. In some forms there is a basal stratum of cells with a differentiation of the upright filaments toward the bluntly rounded apices. Filaments may remain attached or they may become free-floating mats. The multinucleate cells have a parietal reticulate, or numerous discoid chloroplasts and many pyrenoids. Abundant starch may mask the chloroplasts. The cell walls, which lack mucilaginous envelopes, are usually thick and lamellate. Vegetative reproduction is by fragmentation and akinetes. Asexual reproduction is by zoospores and sexual reproduction is by isogametes.

Family Cladophoraceae

Basicladia Hoffman & Tilden 1930

Filaments coarse, erect from a prostrate, rhizoidal system, branches basal, sparse; filaments often club-shaped with the basal cells long and cylindrical, upper cells broader and often rounded; cell walls thick and lamellate; chloroplast parietal, reticulate, often dense and indistinct.

Basicladia chelonum (Collins) Hoffman & Tilden Fig. 71

Branches common, usually in vicinity of holdfast cells; vegetative cells 12 to 50μ x 25 to 500μ, basal coenocyte up to 1000μ long, sporangia 30 to 50μ x 30 to 200μ.

Haunck, Smith, on shells of living *Chrysemys marginata* Agassiz.

Basicladia crassa Hoffman & Tilden Fig. 72

Branches common, short or long, those of the basal coenocyte sometimes dichotomous; vegetative cells (40-) 50 to 125μ x 40 to 700μ, basal coenocyte 40 to 120μ x 1000 to 3175μ, sporangia 64 to 127μ x 87 to 180μ.

Smith, on shell of living *Graptemys geographica* (Le Sueur).

Basicladia vivipara Normandin & Taft Fig. 73

Upright filaments unbranched, quite rigid, club-shaped, clumped; individual coenocytes becoming shorter and broader from base to apex of filaments; chloroplasts of basal coenocytes reticulate, of apical coenocytes coarse and granulated; apical cells become sporangia; primary basal coenocytes confluent with coenocytic substrate mat; mat showing rhizoidal tendencies, rhizoidal cells irregular to polygonal; filament length 0.3 to 0.35 mm, coenocytes diameter 5 to 28μ, basal coenocytes 5 to 10μ, rhizoidal cells 1.2 to 12.2μ in diameter.

Terwilliger, on shells of *Viviparus malleatus* Reeve.

Cladophora Kuetzing 1843

Filaments repeatedly and often profusely branched, attached, at least when young, and forming feathery tufts when in turbulent water; branches alternate, opposite, or at times dichotomous, smaller than the main axis and usually tapering toward their apices; vegetative cells cylindrical or swollen, usually much longer than broad; walls thin and firm, or often thick and stratified; chloroplast reticulate, parietal, or fragmented and discoid, pyrenoids numerous.

Cladophora crispata (Roth) Kuetzing Fig. 74

Filaments floating except when young, delicate, successively branched; vegetative cells long, cylindrical, gradually attenuated in the branches to slightly narrowed, rounded apices; walls thin; main axis cells 40 to 75μ in diameter, branch cells 20 to 35μ in diameter, length up to 20 times the diameter.

Locality unknown.

Tiffany (1937) did not include *C. crispata* as a described species but referred to it as probably having been collected, as he also did for *C. fracta*. Descriptions of both species have been adapted from Prescott (1962).

Cladophora fracta (Dillw.) Kuetzing Fig. 75

Filaments floating, irregularly branched, branches often curving; vegetative cells irregularly swollen, sometimes cylindrical; main axis cells 60 to 120μ in diameter, length one to three times the diameter; ultimate branch cells 20 to 40μ in diameter, length three to six times the diameter.

Locality unknown.

Cladophora glomerata (L.) Kuetzing Fig. 76

Filaments densely branched, branches usually crowded at the upper end of the filaments, forming dark green tufts in turbulent water; vegetative cells slightly attenuate to the bluntly rounded apices of the branches; vegetative cells 35 to 100μ x 120 to 700μ.

General distribution in the island region.

Pithophora Wittrock 1877

Filaments free-floating, branched, branches rising at right angles to main axis; cells long, cylindrical, sometimes somewhat irregular; akinetes ovoid or cylindrical, terminal or intercalary, solitary or in series; chloroplast parietal, reticulate, many pyrenoids.

Pithophora varia Wille Fig. 77

Vegetative cells 50 to 100μ x 100 to 500μ; akinetes ovoid, cylindrical, or irregular, 60 to 112μ x 70 to 250μ.

Fisher, Haunck, Wehrle, Kelleys Church Pond and quarries, Buckeye.

Rhizoclonium Kuetzing 1843

Filaments coarse, with short rhizoidal branches of one to a few cells, sometimes unbranched, or with long multicellular branches, attached or floating; vegetative cells stout, cylindric, sometimes inflated at the apices; cell walls mostly thick and lamellate; chloroplast parietal, reticulate, sometimes dense, numerous pyrenoids.

Rhizoclonium hieroglyphicum (Agardh) Kuetzing Fig. 78

Characters as for the genus; branches one-celled or lacking; vegetative cells 10 to 25μ x 20 to 125μ.

Terwilliger, Haunck, Fisher, Pelee, Wehrle, E. Harbor.

Rhizoclonium hookeri Kuetzing Fig. 79

Characters as for the genus; branches numerous, with numerous cells; vegetative cells 50 to 90μ x 100 to 350μ.

Terwilliger, Fisher.

Order Oedogoniales

Plants in this order are simple or branched filaments which are always attached when young, but which may later form free-floating mats. The filaments terminate at the base in specialized holdfast cells, while the terminal cells may be rounded, extended into elongate, hair-like tips, or bear bulbous-base setae. The vegetative cells are slightly to noticeably broader at their anterior ends which exhibit one or more apical caps. The chloroplasts are parietal reticulate with several pyrenoids. Asexual reproduction by multiflagellate zoospores is common. Sexual reproduction is oogamous and the filaments are either homothallic or heterothallic.

Family Oedogoniaceae

Bulbochaete C. A. Agardh 1817

Filamentous, unilaterally branched main axis from a basal cell with a disc-like or rhizoidal holdfast structure; main axis formed by successive divisions of the basal cell with subsequent cells intercalated between basal cell and the one above; vegetative cells cylindrical, ovoid, or rarely repand, usually widening upwards where branch cells rise at the broader, anterior end; many or all cells with a long, hyaline, bulbous-base seta from the anterior end; chloroplast parietal, reticulate; sexual reproduction monecious macrandrous, nannandrous idioandrosporous, or nannandrous gynandrosporous.

Bulbochaete crenulata Pringsheim Fig. 80

Diecious, nannandrous, gynandrosporous; oogonia subdepressed-globose, patent, below terminal setae or androsporangia, or rarely vegetative cells; division of suffultory cells median or slightly below; outer wall of oospore scrobiculate to crenulate; androsporangia one to five, epigynous or scattered; dwarf males on or near oogonia, antheridia interior, stipe slightly curved, shorter than antheridium; vegetative cells 16 to 20μ x 32 to 70μ; oogonia 43 to 48μ x 35 to 43μ; oospores 40 to 46μ x 33 to 40μ; antheridia 10 to 15μ x 7 to 10μ; dwarf males 9 to 10μ x 24 to 26μ.

E. Harbor.

Bulbochaete intermedia De Bary Fig. 81

Diecious, nannandrous, gynandrosporous; oogonia subdepressed-globose, patent, below androsporangia; division of suffultory cells nearly median; outer wall of oospore scrobiculate, rarely apparently smooth; androsporangia one to two, epigynous or rarely scattered; dwarf males on oogonia; antheridia interior, stipe slightly curved, shorter than antheridium; vegetative cells 17 to 20μ x 35 to 70μ; oogonia 40 to 48μ x 31 to 40μ; oospores 38 to 46μ x 30 to 38μ; androsporangia 11 to 13μ x 7 to 12μ; dwarf males 9 to 10μ x 24 to 26μ.

E. Harbor

Bulbochaete nana Wittrock Fig. 82

Monecious; oogonia ellipsoid, patent, below terminal setae or vegetative cells; outer wall of oospore longitudinally ribbed; antheridia one to two erect or rarely patent, subepigynous or scattered; vegetative cells 10 to 17μ x 10 to 27μ; oogonia 20 to 25μ x 33 to 40μ; oospores 18 to 23μ x 30 to 38μ; antheridia 7 to 9μ x 5 to 9μ.

Gibraltar.

Bulbochaete rectangularis Wittrock Fig. 83

Diecious, nannandrous, gynandrosporous; oogonia ellipsoid, patent or more rarely erect, below terminal setae or androsporangia, or more rarely below vegetative cells; outer wall of oospore longitudinally ribbed; androsporangia one to ?, scattered or epigynous; dwarf males near or occasionally on oogonia; antheridia one to four, exterior; vegetative cells subrectangular in cross section, 16 to 23μ x 20 to 46μ; oogonia 32 to 39μ x 45 to 63μ; oospores 29 to 37μ x 43 to 61μ; androsporangia 13 to 16μ x 10 to 27μ; dwarf male stipes 14 to 18μ x 22 to 27μ; antheridia 8 to 10μ x 5 to 7μ.

Squaw, Hatchery.

Bulbochaete robusta (Hirn) Tiffany Fig. 84

Monecious; vegetative cells often nearly globose; oogonia broadly ellipsoid, usually patent, below terminal setae or vegetative cells; outer wall of oospore longitudinally costate; antheridia one to two, erect or patent, subepigynous or scattered; vegetative cells 14 to 23μ x 14 to 27μ; oogonia 28 to 34μ x 39 to 45μ; oospores 26 to 32μ x 37 to 42μ; antheridia 8 to 10μ x 5 to 8μ.

Kennedy Pond on Kelleys. (The exact location of a pond by this name is unknown.)

Bulbochaete varians Wittrock Fig. 85

Diecious, nannandrous, gynandrosporous; oogonia ovoid, patent or erect, below terminal setae or below androsporangia; outer wall of oospore longitudinally ribbed, ribs serrate; androsporangia one to two, scattered, epigynous or hypogynous; dwarf males on or near oogonia, antheridia one to three, exterior; vegetative cells 17 to 22μ x 22 to 33μ; oogonia 30 to 36μ x 44 to 54μ; oospores 28 to 34μ x 42 to 52μ; androsporangia 14 to 17μ x 14 to 18μ; dwarf male stipes 14 to 16μ x 24 to 27μ; antheridia 8 to 10μ x 6 to 7μ.

Squaw, Hatchery.

Bulbochaete varians var. subsimplex (Wittr.) Hirn Fig. 86

Characters as for the species; smaller in nearly all parts; ribs of oospore serrulate or smooth; vegetative cells 13 to 18μ x 16 to 34μ; oogonia 26 to 30μ x 39 to 46μ; oospores 24 to 28μ x 37 to 44μ; androsporangia 10 to 14μ x 7 to 16μ; dwarf male stipes 11 to 14μ x 15 to 24μ; antheridia 7 to 8μ x 5 to 7μ.

Squaw.

Oedogonium Link 1820

Filaments single, unbranched; vegetative cells cylindrical or sometimes capitellate, nodulose, or undulate; basal cell with a holdfast; apical cell obtuse, apiculate, or hyaline; chloroplast parietal and usually reticulate, with one or more pyrenoids; sexual reproduction monecious or diecious, or nannandrous gynandrosporous or idioandrosporous.

Oedogonium capillare (L.) Kuetzing Fig. 87

Diecious, macrandrous; oogonium one, not or scarcely exceeding the vegetative cells in diameter, cylindrical to subcylindrical, pore superior; oospore globose to cylindric-globose to ovoid, not filling the oogonium, spore wall smooth; antheridia one to four, often alternating with vegetative cells; sperms two, division horizontal; basal cell elongate; terminal cell broadly apiculate to obtuse; female vegetative cells 35 to 56μ x 36 to 120μ, males 35 to 50μ x 35 to 90μ; oogonia 40 to 60μ x 45 to 75μ; oospores 30 to 52μ x 35 to 65μ; antheridia 30 to 48μ x 5 to 10μ.

Distribution general.

Oedogonium capillare forma **stagnale** (Kuetz.) Hirn Fig. 88

Oospore subcylindrical or cylindrical-globose, sometimes constricted at the middle, not filling the oogonium; female vegetative cells 38 to 50μ x 40 to 100μ, males 35 to 45μ x 36 to 90μ; oogonia 40 to 60μ x 55 to 75μ; oospores 36 to 57μ x 40 to 60μ; antheridia 33 to 42μ x 5 to 9μ.

Gibraltar.

Oedogonium capitellatum Wittrock Fig. 89

Monecious; oogonium one, subdepressed-, or depressed-globose, operculate, division median; oospore depressed-globose, completing oogonium, or nearly so, walls smooth; antheridia one to three, subepigynous or hypogynous or rarely scattered; sperm one; basal cell subhemispherical or broadly ellipsoid; terminal cell piliform; vegetative cells capitellate, 6 to 9μ x 20 to 60μ; oogonia 20 to 26μ x 17 to 23μ; oospores 18 to 23μ x 15 to 19μ; antheridia 6 to 7μ x 5 to 9μ; basal cells 16 to 18μ x 6 to 10μ.

Squaw, Hatchery.

Oedogonium crenulatocostatum Wittrock Fig. 90

Diecious, macrandrous; oogonia one to six, obovoid to subellipsoid, often terminal, pore superior; oospore the same form as the oogonium, which it nearly fills, outer spore wall smooth, median wall with 14 to 20 longitudinal ribs, crenulate and sometimes anastomosing, inner wall smooth; antheridia two to six, often alternating with vegetative cells; sperms two, division horizontal; terminal cell obtuse to broadly apiculate; female vegetative cells 10 to 18μ x 25 to 125μ, males 9 to 13μ x 32 to 80μ; oogonia 30 to 36μ x 40 to 65μ; oospores 28 to 34μ x 37 to 55μ; antheridia 9 to 12μ x 9 to 14μ.

Gibraltar, E. Harbor.

Oedogonium crenulatocostatum var. **cylindricum** (Hirn) Tiffany Fig. 91

Characters as for the species; oogonium and oospore cylindric-oblong or more rarely ellipsoid or obovoid-ellipsoid; ribs of oospore scarcely crenulate; vegetative cells 11 to 16μ x 44 to 150μ; oogonia 30 to 36μ x 42 to 81μ; oospores 27 to 34μ x 40 to 65μ.

Haunck, E. Harbor.

Oedogonium crispum (Hassall) Wittrock Fig. 92

Monecious; oogonium, usually one, obovoid-globose, operculate, division superior; oospore, globose or subglobose, filling the oogonium, spore wall smooth; antheridia one to five, subepigynous or hypogynous; sperms two, division horizontal; basal cell elongate; terminal cell apically obtuse; vegetative cells (10-) 12 to 16μ x 35 to 80μ; oogonia 37 to 45μ x 41 to 53μ; oospores 35 to 43μ x 37 to 43μ; antheridia 8 to 14μ x 7 to 12μ.

Haunck.

Oedogonium cyathigerum Wittrock Fig. 93

Nannandrous, idioandrosporous; oogonia one to two, subovoid, pore superior; oospore same shape as oogonium, filling it, median spore wall with about 16 longitudinal ridges; dwarf male goblet-shaped, curved; vegetative cells 25 to 30μ x 76 to 105μ; suffultory cells 35 to 46μ x 69 to 92μ; oogonia 55 to 71μ x 64 to 80μ; oospores 54 to 69μ x 62 to 74μ; dwarf males 13 to 16μ x 57μ.

M. Bass, Wehrle.

Oedogonium echinospermum A. Braun Fig. 94

Diecious, nannandrous, gynandrosporous or idioandrosporous; oogonium one, ellipsoid-globose or subglobose, pore median; oospore globose, filling oogonium, outer layer of spore wall echinate, androsporangia one to five, dwarf male curved or not, on suffultory cell, antheridia one to two exterior; vegetative cells 18 to 30μ x 45 to 130μ; oogonia 39 to 50μ x 41 to 57μ; oospores (with spines) 38 to 47μ x 38 to 49μ; androsporangia 21 to 25μ x 9 to 15μ; dwarf male stipes 10 to 15μ x 26 to 35μ; antheridia 6 to 12μ x 6 to 15μ.

E. Harbor.

Oedogonium eriense Tiffany Fig. 95

Monecious; oogonium ellipsoid to broadly ellipsoid, with superior operculum; oospore broadly ellipsoid to ovoid, not filling oogonium longitudinally, with outer and inner walls smooth and median wall longitudinally ribbed, ribs 18 to 26 in number; antheridia one to ?, subepigynous; sperm (?) single; vegetative cells 16 to 24μ x 52 to 104μ; oogonia 38 to 48μ x 64 to 85μ; oospores 36 to 46μ x 48 to 70μ; antheridia 16 to 19μ x 15 to 16μ.

Haunck.

Oedogonium exocostatum Tiffany Fig. 96

Diecious, macrandrous; oogonia one to two, ellipsoid to ellipsoid-globose, occasionally terminal, pore superior; oospore the same form as oogonium and nearly filling it, spore wall of two layers, outer with 13 to 15 longitudinal ribs, inner smooth; suffultory cell swollen; male filament more slender than female; antheridia three to seven; sperms two, division horizontal; basal cell elongate; female vegetative cells (13-) 18 to 25μ x 72 to 140μ, males (13-) 16 to 20μ x 48 to 100μ; suffultory cells 22 to 30μ x 60 to 90μ; oogonia 40 to 52μ x 60 to 96μ; oospores 38 to 41μ x 56 to 68μ; antheridia 12 to 16μ x 7 to 12μ.

Gibraltar, Haunck.

Oedogonium geniculatum Hirn Fig. 97

Monecious; oogonium one, obovoid or obovoid-globose, pore superior; oospore globose or subdepressed-globose, not filling oogonium, spore wall smooth and thick; antheridia one to five, subepigynous or subhypogynous or scattered, sometimes alternating with vegetative cells; sperms (?) two, division (?) horizontal; vegetative cells 37 to 48μ x 60 to 135μ; oogonia 56 to 63μ x 56 to 58μ; oospores 48 to 59μ x 48 to 59μ; antheridia 37 to 44μ x 5 to 9μ.

Exact locality in survey area unknown.

Oedogonium gracilius (Wittr.) Tiffany Fig. 98

Diecious, macrandrous; oogonium one, obovoid-globose, pore superior; oospore globose to subglobose, usually filling oogonium, wall smooth; antheridia one to eight, often alternating with vegetative cells; basal cell elongate; vegetative cells 20 to 25μ x 40 to 100μ; oogonia 36 to 42μ x 46 to 57μ; oospores 34 to 39μ x 36 to 44μ; antheridia 19 to 22μ x 7 to 10μ.

Terwilliger, Sugar.

Oedogonium gracillimum Wittrock & Lundell Fig. 99

Monecious; oogonium one, oblong, operculate, division superior; oospore oblong-ellipsoid, not filling oogonium, spore wall smooth; antheridium one; sperms two, division horizontal; basal cell elongate; vegetative cells 4 to 7μ x 16 to 42μ; oogonia 14 to 19μ x 34 to 40μ; oospores 13 to 17μ x 24 to 32μ; antheridia 3 to 5μ x 4 to 7μ.

Wehrle, Hatchery, E. Harbor.

Oedogonium grande Kuetzing Fig. 100

Diecious, macrandrous; oogonia one to five, subovoid, pore superior; oospore same form as oogonium, which it completely fills or not, spore wall smooth; antheridia one to ten; sperms two, division vertical; basal cell elongate; female vegetative cells 28 to 37μ x 70 to 110μ, males 28 to 33μ x 70 to 175μ; oogonia 49 to 60μ x 86 to 110μ; oospores 47 to 58μ x 60 to 94μ; antheridia 25 to 33μ x 11 to 18μ.

Squaw, Gibraltar, Haunck, Fisher, Wehrle.

Oedogonium howardii G. S. West Fig. 101

Diecious, macrandrous; oogonium single or in groups of two, globose or subglobose, operculate, division median and wide; oospore globose, filling oogonium, wall smooth; antheridia up to 16-celled; sperm single; vegetative cells capitellate; basal cells hemispherical or nearly spherical; vegetative cells 7 to 12μ x 18 to 42μ; oogonia 26 to 33μ x (23-) 26 to 33μ; oospores 21 to 30μ x 24 to 30μ; antheridia 7 to 9μ x 5 to 14μ; basal cells 12 to 20μ x 10 to 13μ.

Fisher, Haunck, E. Harbor.

Oedogonium howei Tiffany Fig. 102

Diecious, macrandrous; oogonium one, depressed-globose (rarely subglobose), with basal operculum; oospore similar in form to oogonium and filling it, walls smooth; antheridia 1 to 20, alternating with vegetative cells if single: sperm (?) one; vegetative cells capitellate; basal cells hemispherical or depressed-globose; vegetative cells 8 to 17μ x 21 to 78μ; oogonia 27 to 37μ x 22 to 30μ; oospores 25 to 35μ x 20 to 27μ; antheridia 9 to 11μ x 8 to 14μ; basal cells 16 to 23μ x 13 to 16μ.

Hatchery.

Oedogonium idioandrosporum (Nordst. & Wittr.) Tiffany Fig. 103

Diecious, nannandrous, idioandrosporous; oogonia one to three, globose-obovoid to globose, pore superior; oospores ellipsoid-globose, ovoid, or angular-globose (rarely globose), nearly filling the oogonium, wall smooth and thick; androsporangia one to four; dwarf male straight or slightly curved, on or near suffultory cell; antheridia one or two, exterior; vegetative cells 25 to 36μ x 65 to 200μ; oogonia 48 to 59μ x 57 to 90μ; oospores 42 to 57μ x 50 to 66μ; androsporangia 30 to 34μ x 12 to 21μ; dwarf male stipes 14 to 16μ x 60 to 70μ; antheridia 8 to 10μ x 10 to 18μ.

Haunck.

Oedogonium inconspicuum Hirn Fig. 104

(?) Diecious, (?) macrandrous; oogonia one to four, depressed-, or subpyriform-globose, operculate, division narrow, median; oospores depressed-globose or ovoid, filling the inflated part of the oogonium, wall smooth; vegetative cells 3 to 5μ x 20 to 34μ; oogonia 13 to 18μ x (13-) 17 to 23μ; oospores 12 to 17μ x 8 to 13μ; basal cells 16 to 18μ x 7 to 8μ.

Hatchery, Pelee.

Oedogonium infimum Tiffany Fig. 105

Diecious, macrandrous; oogonium one, globose or subglobose, with basal operculum; oospore globose or subglobose, walls smooth; antheridia one to ten; sperms two; vegetative cells distinctly capitellate; basal cells subhemispherical; vegetative cells 12 to 20μ x 60 to 140μ; oogonia 40 to 48μ x 41 to 50μ; oospores 40 to 44μ x 38 to 42μ; antheridia 14 to 20μ x 8 to 12μ; basal cells 30 to 42μ x 16 to 24μ.

Hatchery.

Oedogonium landsboroughi (Hass.) Wittrock Fig. 106

Diecious, macrandrous; oogonia one to two, (rarely three), obovoid to ovoid, pore superior; oospores ovoid to ellipsoid, filling or not filling the oogonium, walls smooth; antheridia up to 30-seriate; sperms two, division vertical; basal cells elongate; terminal cells obtuse; female vegetative cells 31 to 40μ x 90 to 240μ, males 30 to 37μ x 120 to 225μ; oogonia 63 to 78μ x 85 to 115μ; oospores (55-) 59 to 70μ x 73 to 102μ; antheridia 27 to 35μ x 9 to 20μ.

Haunck.

Oedogonium longum Transeau Fig. 107

Diecious, macrandrous; oogonium one, ellipsoid, pore superior; oospore ellipsoid to elongate-ellipsoid, not filling oogonium longitudinally, walls smooth; antheridia one to five; sperms two, division vertical; female vegetative cells 40 to 52μ x 100 to 240μ, males 36 to 44μ x 100 to 180μ; oogonia 68 to 84μ x 120 to 180μ; oospores 66 to 80μ x 100 to 125μ; antheridia 34 to 40μ x 8 to 14μ.

Haunck.

Oedogonium moniliforme Wittrock Fig. 108

Diecious, macrandrous; oogonia one to five, pyriform to globose-ovoid, pore supramedian (sometimes nearly superior); oospore globose or subdepressed-globose, not filling oogonium, at least longitudinally, middle layer of oospore wall scrobiculate; terminal cells apically obtuse; antheridia one to five; vegetative cells 9 to 13μ x 30 to 72μ; oogonia 23 to 33μ x 28 to 42μ; oospores 22 to 32μ x 22 to 32μ; antheridia 10 to 12μ x 8 to 13μ.

E. Harbor.

Oedogonium plagiostomum Wittrock Fig. 109

Diecious, macrandrous; oogonium one, obovoid-globose, pore superior; oospore globose to subglobose, usually filling the oogonium, wall smooth and thickened; antheridia one to six, often alternating with vegetative cells; basal cells elongate; vegetative cells 22 to 27μ x 65 to 120μ; oogonia 42 to 49μ x 50 to 60μ; oospores 41 to 47μ x 42 to 49μ; antheridia 20 to 24μ x 8 to 10μ.

Terwilliger.

Oedogonium princeps (Hass.) Wittrock Fig. 110

Diecious, macrandrous; oogonium one, slightly tumid, subobovoid, pore superior; oospore globose to subglobose, not filling oogonium, wall smooth; terminal cells apiculate; antheridia one to seven; vegetative cells 33 to 43μ x 40 to 155μ; oogonia 51 to 63μ x 54 to 80μ; oospores 48 to 58μ x 47 to 65μ; antheridia 32 to 38μ x 5 to 20μ.

Pelee.

Oedogonium pringsheimii Cramer Fig. 111

Diecious, macrandrous; oogonium one to six, subovoid-globose, operculate, division superior; oospore globose, nearly filling ogonium, wall smooth, often thickened; antheridia to 10-seriate, often alternating with vegetative cells; sperms two, division horizontal; basal cells elongate; terminal cells broadly apiculate or obtuse; female vegetative cells 14 to 20μ x 28 to 100μ, males 12 to 16μ x 24 to 64μ; oogonia 35 to 43μ x 36 to 46μ; oospores 30 to 37μ x 30 to 37μ; antheridia 10 to 15μ x 6 to 9μ.

Haunck, Gibraltar.

Oedogonium pringsheimii var. nordstedtii Wittrock Fig. 112

Characters as for the species; smaller than the type, oogonia one to two; oospore not filling oogonium; female vegetative cells 10 to 16μ x 20 to 76μ, males 9 to 15μ x 18 to 68μ; oogonia 28 to 39μ x 36 to 45μ; oospores 26 to 34μ x 27 to 34μ; antheridia 9 to 12μ x 8 to 9μ.

Gibraltar.

Oedogonium punctatum Wittrock Fig. 113

Diecious, macrandrous; oogonia one to four, obovoid (rarely globose-obovoid), pore superior; oospore obovoid, nearly filling oogonium (rarely subglobose and not filling oogonium), outer spore wall scrobiculate; antheridia one to five, often alternating with vegetative cells; sperms two, division horizontal; basal cells elongate; terminal cells (often an oogonium) apically obtuse; vegetative cells 15 to 22μ x 42 to 128μ; oogonia 38 to 45μ x 52 to 65μ; oospores 37 to 43μ x 43 to 55μ; antheridia 15 to 17μ x 6 to 10μ.

Haunck.

Oedogonium pusillum Kirchner Fig. 114

Monecious; oogonium one (rarely two), subbiconic-ellipsoid or subbiconic-globose, seen from above circular, margin even, operculate, division wide (usually up to 2.5μ); oospore ellipsoid or globose, generally constricted at the middle, not quite filling oogonium, wall smooth; antheridia one or two, subepigynous; sperm (?) one; basal cells subhemispherical; terminal cells obtuse or obtusely conical; vegetative cells 3 to 6μ x 10 to 60μ; oogonia 14 to 16μ x 15 to 25μ; oospores 11 to 13μ x 13 to 15μ; antheridia 3 to 4μ x 5 to 6μ; basal cells 7 to 8μ x 7 to 8μ.

Pelee.

Oedogonium varians Wittrock & Lundell Fig. 115

Monecious (sometimes diecious); oogonium one, rarely more, depressed-, or subdepressed-pyriform-globose, pore nearly superior; oospore globose, not filling oogonium, wall smooth; antheridia to 9-seriate, scattered; sperms two, division horizontal; basal cells elongate; terminal cells apically obtuse; vegetative cells 12 to 16μ x 35 to 144μ; oogonia 34 to 50μ x 34 to 55μ; oospores 31 to 41μ x 30 to 41μ; antheridia 11 to 15μ x 5 to 7μ.

Squaw, Haunck, Gibraltar.

Oedogonium wyliei Tiffany Fig. 116

Diecious, macrandrous; oogonia one to four, globose to ovoid, pore superior; oospore globose to ovoid, filling or not filling oogonium, outer spore wall irregularly scrobiculate; antheridia one to four; sperms two, division horizontal; basal cells elongate; terminal cell, often an oogonium, apically obtuse or broadly apiculate; vegetative cells 16 to 24μ x 80 to 170μ; oogonia 52 to 64μ x 68 to 112μ; oospores 48 to 60μ x 52 to 64μ; antheridia 16 to 19μ x 8 to 18μ.

Gibraltar, Haunck, E. Harbor.

Order Chlorococcales

The order includes a large number of divergent unicellular and colonial forms. Although the cell shapes of the unicellular forms vary from globose to ovoid, to fusiform, or even polyhedral, the shape of any particular taxon is remarkably constant. The colonial forms are organized colonies of definite shape, size, and usually of cell numbers. There is no vegetative cell division. New cells or colonies arise as autospores or autocolonies within the old parent cells. The cells are mostly uninucleate, though some are coenocytic. The chromatophores are various in number and kinds. Pyrenoids may be lacking, although there are usually one or more present. Asexual reproduction, other than by autospores and autocolonies, may be by zoospores. Sexual reproduction, where known, is isogamous.

Family Chlorococcaceae

Acanthosphaera Lemmermann 1899

Cells solitary, spherical, free-floating; cell wall with many long hyaline setae (usually 24) thickened basally for about one-third of their length, then abruptly becoming hair-like spines; chloroplast cup-shaped, covering most of the cell wall, with one pyrenoid.

Acanthosphaera zachariasi Lemmermann — Fig. 117

Characters as for the genus; cells 9 to 15μ in diameter; setae 30 to 35μ long.

Terwilliger.

Chlorococcum Fries 1825

Cells spherical, solitary or angular in amorphous gelatinous masses, terrestrial or aquatic; chloroplast parietal or plate-like, with one pyrenoid when young, diffuse with several pyrenoids when older; cells becoming multinucleate.

Chlorococcum infusionum (Schrank) Meneghini — Fig. 118

Characters as for the genus; cells 10 to 20μ in diameter.

Gibraltar, Haunck.

Tiffany (1934) reported *C. humicola* (Naeg.) Rabenhorst from Middle Sister Island. This island lies beyond the present survey boundaries.

Desmatractum (W. & G. S. West) Pascher 1930

Cells solitary, free-floating, spherical to broadly ellipsoid, surrounded by a spindle-shaped envelope of two halves united at the midregion of the spindle; envelope transparent or brownish with longitudinal striations; chloroplast single, cup-shaped with one or two pyrenoids.

Desmatractum indutum (Geitler) Pascher — Fig. 119

Characters as for the genus; cells 3 to 5μ x 5 to 10μ; envelope 36 to 45μ, and 8 to 18 striations.

Haunck.

Golenkinia Chodat 1894

Cells spherical, solitary, free-floating; cell wall furnished with long, slender, hyaline, tapering setae; chloroplast single, parietal, cup-shaped or entirely filling the cell, with one pyrenoid.

Golenkinia maxima Tiffany & Ahlstrom — Fig. 120

Cells spherical, with delicate, tapering setae which are often bent; chloroplast apparently filling the cell, one large pyrenoid; cells (13-) 17 to 22μ in diameter; setae 35 to 45μ long.

Terwilliger, Squaw, Smith.

Golenkinia paucispina W. & G. S. West — Fig. 121

Cells spherical with a few short setae; chloroplast single, completely filling the cell, with one pyrenoid; cells 15 to 18μ in diameter; setae 12 to 18μ long.

Terwilliger, Squaw.

Golenkinia radiata (Chod.) Wille — Fig. 122

Cells spherical with very long, slender setae; chloroplast single, parietal, cup-shaped, with one pyrenoid; cells 7 to 15μ in diameter; setae 25 to 45μ long.

Squaw, Terwilliger, Wehrle, Haunck, Smith.

Golenkinia radiata (Chod.) Wille var. **brevispina** Tiffany & Ahlstrom — Fig. 123

Characters as for the type; cells 8 to 19μ in diameter; setae 8 to 15μ long.

Haunck.

Family Endosphaeraceae

Chlorochytrium Cohn 1875

Unicellular; cells oblong, ovoid, or broadly ellipsoid; cell walls thick and lamellate, with localized thickenings; chloroplast parietal, becoming radial and indistinct.

Chlorochytrium biennis (Klebs) G. S. West — Fig. 124

Cells ovoid; cell walls strongly stratified, with localized thickenings, endophytic in grass sheaths; young cells green, old cells yellowish to brown; cells 40 x 70μ.

Kelleys.

Kentrosphaera Borzi 1883

Unicellular; intermingled with other algae, often with Myxophyceae; cells ellipsoid, cylindric-elliptic, or ovoid; cell walls lamellate, with irregular thickenings; chloroplast axial, with extensions flattened against the cell wall.

Kentrosphaera bristolae G. M. Smith — Fig. 125

Cells solitary, free-living, cylindric-elliptic; cell walls thick, lamellated, with one or more localized thickenings; chloroplast axial with numerous lobes; cells 23 x 83μ; wall 3 to 5.5μ thick.

Kelleys, on soil with Myxophyceae.

Family Characiaceae

Characium A. Braun 1849

Cells solitary or gregarious, epiphytic or epizooic, stipitate to nearly sessile, pyriform, ovoid, subspherical, cylindrical or fusiform; chloroplasts one or several, parietal, laminate to cup-shaped, with one or more pyrenoids, mostly uninucleate.

Characium ambiguum Hermann — Fig. 126

Cells straight, asymmetric, oblique or somewhat lanceolate, with pointed bent apex; stipe short, narrow, without basal thickening; epiphytic on other algae; cells 4 to 8μ x 24 to 32μ.

Haunck.

Characium curvatum G. M. Smith — Fig. 127

Cells lunate or recurved, with acute apex; stipe hyaline, thick, tubular or conical, without a basal disc; chloroplast with or without a pyrenoid; epiphytic on various algae; cells 3 to 6μ x 8 to 18μ, with the stipe 13 to 22μ long.

Terwilliger, Squaw.

Characium falcatum Schroeder — Fig. 128

Cells lanceolate, curved, ending in a long sharp point; stipe long and slender; epiphytic on *Spirogyra;* cells 23 to 24μ x 90 to 115μ.

Squaw.

Characium gracilipes Lambert — Fig. 129

Cells elongate cylindric-fusiform, straight or curved, apex abruptly tapering into a long hyaline hair, base with a long hair-like stipe having two or three fine branches; chloroplasts one to numerous, each with a pyrenoid; epizooic on *Branchipus;* cells 5 to 14μ x 70 to 480μ.

Squaw.

Characium naegelii A. Braun — Fig. 130

Cells ellipsoid, lanceolate, pyriform or ovoid, with a rounded apex; stipe short, without a basal thickening; chloroplast single, with one pyrenoid; cells 7 to 18μ x 20 to 42μ.

Haunck.

Characium ornithocephalum A. Braun — Fig. 131

Cells broadly ellipsoid, curved, convex on one side, other straight, terminating abruptly in a sharp apex; stipe long, with a basal disc; chloroplast parietal, laminate, with one pyrenoid; cells 12 to 16μ x 25 to 33μ; stipe 10 to 15μ long.

Terwilliger, Squaw.

Characium sieboldii A. Braun — Fig. 132

Cells straight, pyriform to obovoid, apex bluntly rounded; stipe short and thick; chloroplast single with one pyrenoid; epiphytic on algae and aquatic macrophytes; cells 20 to 33μ x 40 to 70μ.

E. Harbor.

Family Hydrodictyaceae

Hydrodictyon Roth 1800

Macroscopic; cells cylindrical, united at their ends into a cylindrical-saccate net with five- or six sided meshes; cells coenocytic with parietal reticulate chloroplasts which later become diffuse; pyrenoids single at first, then becoming numerous.

Hydrodictyon reticulatum (L.) Lagerheim — Fig. 133

Characters as for the genus; cells 5 to 250μ in diameter, up to 1.5 cm long.

Wehrle, Haunck, Fisher.

Pediastrum Meyen 1829

Colony free-floating, flat, circular, compact or perforate, composed of 4 to 256 cells; cells coenocytic, marginal cells usually of different shape than the interior cells, with variable shaped processes; cell wall smooth or rough; choroplast parietal, disc-like, becoming diffuse, one or more pyrenoids.

Tiffany (1934) made the following comments concerning the genus *Pediastrum*. "The genus *Pediastrum* is readily recognized, but there exists much variation and intergrading among the species and varieties making up the genus. Our Lake Erie material shows too many intergradations between *P. simplex* and *P. ovatum*, for example, to do more than recognize the latter as a variety of the former. The varieties of *P. duplex* described above represent merely some of the more prominent variations in the species. Even such apparently distinct species as *P. integrum*, *P. kawraiskyi*, and *P. boryanum* are closely related."

Pediastrum angulosum (Ehr.) Meneghini — Fig. 134

Colony large, circular, perforate; cell walls undulate, surface of cells with a coarse, undulate reticulum; colony 230μ; cells 18 to 25μ.

E. Harbor.

Pediastrum biradiatum Meyen — Fig. 135

Colony perforate, up to 64 cells; marginal cells deeply bilobed, lobes incised; inner cells bilobed; cell walls concave, smooth; cells 10 to 22μ x 15 to 30μ.

Terwilliger, E. Harbor.

Pediastrum boryanum (Turp.) Meneghini — Fig. 136

Colony compact, up to 256 cells; marginal cells with two blunt processes; inner cells angular; cell walls granular; cells 7 to 30μ in diameter.

Distribution general.

Pediastrum boryanum (Turp.) Meneghini var. **longicorne** Raciborski — Fig. 137

Characters as for the type except the marginal processes are long with slightly swollen tips; cells up to 40μ in diameter.

Terwilliger, E. Harbor.

Pediastrum duplex Meyen — Fig. 138

Colony perforate, 8 to 128 cells; marginal cells quadrate, the outer half of each cell with two short, tapering, blunt-tipped processes; inner cells quadrate with lens-shaped openings between cells; cell walls smooth; cells 11 to 21μ in diameter.

Distribution general.

Pediastrum duplex Meyen var. **cohaerens** Bohlin — Fig. 139

Colony with irregularly-sized perforations; cell walls with short, linear, concentrically arranged granules; cells 12 to 22μ x 13 to 24μ.

Terwilliger, Squaw.

Pediastrum duplex Meyen var. **gracillimum** W. & G. S. West — Fig. 140

Colony with large perforations; marginal cells with two long, slightly converging processes; cells 10 to 22μ x 12 to 32μ.

Terwilliger, Smith.

Pediastrum duplex Meyen var. **reticulatum** Lagerheim — Fig. 141

Marginal cells with processes having subparallel sides; inner cells markedly H-shaped; cells 10 to 20μ x 15 to 40μ.

Squaw, Kelleys N. dock.

Pediastrum duplex Meyen var. **rotundatum** Lucks — Fig. 142

Characters as for the type except marginal cells have stout lobes with convex sides and capitate apices.

Squaw.

Pediastrum integrum Naegeli — Fig. 143

Colony compact, nearly circular, up to 64 cells; marginal cells smooth, or with two short, reduced processes, slightly emarginate between the processes; cell walls smooth or granular; cells 15 to 30μ in diameter.

Kelleys.

Pediastrum kawraiskyi Schmidle — Fig. 144

Colony compact, 16 to 64 cells; marginal cells with two projections which are not in the same plane, one being above the other; inner cells with five or six sides; cell walls smooth; cells 9 to 22μ in diameter.

Squaw, Kelleys.

Pediastrum simplex (Meyen) Lemmermann Fig. 145

Colony compact, 8 to 64 cells; marginal cells with outer wall extended into a single tapering process having concave margins, inner cells with five or six sides; cell walls smooth or punctate (?); cells 7 to 20μ x 15 to 30μ.

Terwilliger, E. Harbor, Hatchery, Gibraltar, Buckeye, N. Bass dock; probably generally distributed.

Pediastrum simplex (Meyen) Lemmermann var. **duodenarium** (Bailey) Rabenhorst Fig. 146

Colony perforate; marginal cells with inner margins concave, perforations large; outer wall of inner cells extended into a long process; cells 10 to 24μ x 20 to 45μ.

Terwilliger, Squaw, Wehrle, Haunck, Kelleys, N. dock; probably general in the open lake.

Pediastrum simplex (Meyen) Lemmermann var. **ovatum** (Ehr.) Tiffany Fig. 147

Marginal cells usually outwardly convex, more plump than in the type; cell walls smooth or punctate; cells 8 to 19μ x 25 to 37μ.

Terwilliger, Wehrle.

Pediastrum tetras (Ehr.) Ralfs Fig. 148

Colony without perforations, 4 to 32 cells, rectangular, oval or circular; marginal cells with a deep incision; inner cells with one margin deeply incised; cell wall smooth; cells 8 to 15μ in diameter.

Distribution general, though not common.

Pediastrum tetras (Ehr.) Ralfs var. **tetraodon** (Corda) Rabenhorst Fig. 149

Marginal cells with deep incisions, the lobes extending into sharp, horn-like processes; cells 8 to 15μ x 12 to 18μ.

Squaw, Terwilliger, Haunck, Wehrle, Smith, Buckeye, E. Harbor.

Sorastrum Kuetzing 1845

Colony more or less globose, composed of 8 to 128 loosely or compactly arranged, sublunate, reniform, pyriform or pyramidate cells, with one to four spines on the distal ends and radiating from a common central core of mucilage; chloroplast parietal or diffuse, with one pyrenoid.

Sorastrum americanum (Bohlin) Schmidle Fig. 150

Colony spherical, free-floating, 16 to 128 cells; cells heart-shaped to pyramidate, outer margin concave, each of the four angles with a long, stout spine, cells narrower toward the base, ending in a cylindrical, gelatinous stalk with a five- or six-faceted base, facets joined and forming a central, hollow sphere; cells 7 to 20μ x 5 to 20μ, 4 to 8μ thick; stalk up to 20μ long; spines 10 to 15μ long.

Haunck, E. Harbor.

Sorastrum americanum (Bohlin) Schmidle var. **undulatum** G. M. Smith Fig. 151

Characters as for the species except that the facets at the base of each stipe are undulate.

Wehrle.

Sorastrum spinulosum Naegeli Fig. 152

Colony spherical, free-floating; cells broadly reniform to cuneate, outer end truncate, each angle with two short spines; stipe short; cells 8 to 20μ x 6 to 18μ, 5 to 8μ thick.

Distribution general.

Family Coelastraceae

Coelastrum Naegeli 1849

Colony a hollow, spherical coenobium with as many as 128 globose, ovoid, or pyramidal cells; cells compactly arranged or interconnected by narrow processes of variable length; daughter coenobia formed within the parent cells, often remaining joined in a multiple colony.

Coelastrum bohlini Schmidle & Senn Fig. 153

Colony irregular; cells with four ridges or flanges across the surface; cells 9 to 12μ in diameter, colonies about 27μ in diameter.

Kelleys, Smith.

Coelastrum cambricum Archer Fig. 154

Colony spherical, composed of (8)-32-(128) cells joined to adjacent cells by six short, broad projections, outer walls of cells with a short, truncate projection; cells spherical, 5 to 18μ in diameter, with sheath 6 to 20μ; coenobia 20 to 100μ in diameter.

Kelleys, Kelleys N. dock, Haunck.

Coelastrum microporum Naegeli Fig. 155

Colony spherical or ovoid, composed of 8 to 64 cells interconnected by very short, indistinct processes; cells spherical, or ovoid with the narrow end outward; cells 3 to 20μ in diameter, with sheath 4 to 23μ; coenobia 20 to 90μ in diameter.

Distribution general.

Coelastrum proboscideum Bohlin Fig. 156

Colony pyramidal, cubical, or sometimes polygonal, composed of 4 to 32 cells; cells truncate cone-shaped, at least some of the sides concave, base of cone towards the center of the coenobium; large polygonal interstices between cells; cells 7 to 17μ in diameter.

Kelleys.

Coelastrum reticulatum (Dang.) Senn Fig. 157

Colony spherical, composed of 8 to 32 cells interconnected by six long, slender, firm, gelatinous processes leaving large intercellular spaces; cells spherical, with a gelatinous sheath, outer margin of cells without processes; cells 6 to 24μ in diameter; processes 6 to 9μ long; coenobia up to 65μ in diameter.

Squaw, Terwilliger, Haunck, Smith, Put-in-Bay Harbor.

Coelastrum sphaericum Naegeli Fig. 158

Colony ovoid, composed of 4 to 16 cells adjoined without evident processes; cells ovoid or conical, the narrow end outwards; cells 3.5 to 7.5μ (at base) x 6 to 12μ; coenobia up to 32μ in diameter.

Terwilliger, Squaw, Smith, E. Harbor.

The identification of *Coelastrum* as a genus may be difficult for the uninitiated. Compound colonies in which each individual cell is replaced by a daughter colony may not have the distinctive characters readily evident. The presence of the lateral processes by which the cells are interconnected will be the determining factor.

Family Botryococcaceae

Botryococcus Kuetzing 1849

Colony free-floating, nearly globose to indefinite in shape; cells closely appressed and enclosed in a tough, gelatinous membrane; cells usually in several aggregates connected by broad or delicate strands of the colonial membrane; cells spherical, ovoid, or cuneate with the broader ends outwards; chloroplast single, parietal, laminate to disciform, yellow-green to green, no pyrenoid.

Botryococcus braunii Kuetzing Fig. 159

Cells ovoid or ellipsoid, forming a single layer around a central cavity, held together by an irregular, tough membrane; cells and cell structure indistinct because of the surrounding membrane, sometimes brick-red in color; cells 3.5 to 5.5μ x 6 to 11μ.

Squaw, Terwilliger, Smith, Haunck, Kelleys; probably general in plankton.

Botryococcus protuberans W. & G. S. West var. **minor** G. M. Smith Fig. 160

Cells ovoid to cuneate-ovoid, with bases embedded in a tough, gelatinous membrane, arranged in a single layer around a common center; clusters of cells interconnected by tough, gelatinous strands into compound colonies; chloroplast single, laminate, yellow-green, medially located; cells 5 to 6.5μ x 8 to 9.5μ.

Kelleys.

Botryococcus sudeticus Lemmermann Fig. 161

Cells spherical or subspherical, 16 to 32 cells (or more) in a group and arranged around a common center within a hyaline, mucilaginous matrix; groups of cells may be joined by mucilaginous strands into compound colonies; cells 6 to 13μ in diameter.

Squaw, Hatchery.

Family Oocystaceae

Ankistrodesmus Corda 1838

Cells acicular to fusiform, solitary or in fasicles, straight, curved or sigmoid, sometimes twisted about one another; chloroplasts, one or more parietal plates, with or without pyrenoids.

Ankistrodesmus convolutus Corda — Fig. 162

Cells solitary or in groups of two to four, fusiform, variously twisted to sigmoid; apices sharply pointed; cells 3 to 6μ x 10 to 40μ.

Gibraltar, Terwilliger, Squaw, Haunck, Smith, Fisher.

Ankistrodesmus falcatus (Corda) Ralfs — Fig. 163

Cells solitary or in loose fasciculate bundles, needle-like, curved; apices sharply pointed; cells 1.5 to 4μ x 20 to 80μ.

Squaw, Terwilliger, Wehrle, Haunck, Fisher, Smith, Kelleys, E. Harbor, Catawba; probably generally distributed.

Ankistrodesmus falcatus (Corda) Ralfs var. **mirabilis** (W. & G. S. West) G. S. West — Fig. 164

Cells longer than the type, solitary, variously curved, often sigmoid; apices tapering to fine points; cells 2 to 4μ x (up to) 150μ.

Terwilliger, Wehrle, Fisher.

Ankistrodesmus falcatus (Corda) Ralfs var. **spirilliformis** G. S. West — Fig. 165

Cells solitary, spirally twisted, making one to one and a half turns; apices very acute; cells 1 to 2μ x 20 to 30μ.

Distribution general.

Ankistrodesmus falcatus (Corda) Ralfs var. **tumidus** (W. & G. S. West) G. S. West — Fig. 166

Cells fusiform, tumid, sometimes slightly sigmoid; cells 4 to 6μ x 47 to 54μ.

Fisher.

Ankistrodesmus spiralis (Turner) Lemmermann — Fig. 167

Cells in colonies of four to eight, acicular and attenuated into acute apices, spirally twisted around each other at the middle of the cells, with apices free; cells 1 to 2.5μ x 20 to 40μ.

Kelleys.

Chlorella Beyerinck 1890

Cells small, globose or ellipsoid, solitary or aggregated into a thin mucous layer; chloroplast one or more, parietal, laminate or often cup-shaped, with or without a pyrenoid.

Chlorella variegatus Beyerinck — Fig. 168

Cells spherical; chloroplast very delicate, cup-shaped; cells 2 to 10μ in diameter.

Kelleys.

Chlorella vulgaris Beyerinck — Fig. 169

Cells spherical, forming two to eight autospores; cells 5 to 10μ in diameter.

Terwilliger, Gibraltar.

Zoochlorella Brandt 1882

Ovoid or globose unicells; chloroplast usually single, a parietal plate, with or without a pyrenoid; reproduction by autospores.

Cells of this genus which are considered by some to belong to the genus *Chlorella* commonly inhabit certain invertebrates.

Zoochlorella parasitica Brandt — Fig. 170

Characters as for the genus; cells very small, up to 4μ in diameter.

Closteriopsis Lemmermann 1899

Cells solitary, elongate, acicular or narrowly fusiform, apices acute or setiferous; chloroplast an elongate plate with 12 or more pyrenoids.

Closteriopsis longissima Lemmermann — Fig. 171

Cells solitary, acicular, ends produced into setiferous apices; chloroplast single, often fragmenting, with 12 or more pyrenoids; cells 4 to 9μ x 225 to 650μ.

Hatchery, Haunck, open lake.

Closteriopsis longissima Lemmermann var. **tropica** W. & G. S. West Fig. 172

Characters as in the species; apices acute rather than setiferous; cells 6 to 7.5μ x 225 to 370μ.

Smith.

Dictyosphaerium Naegeli 1849

Colony spherical, ovoid, or irregular; cells spherical, ovoid, ellipsoid, or reniform, connected by branching threads to the center of the hyaline, homogeneous colonial matrix; chloroplasts one to two, parietal, cup-shaped, with one pyrenoid.

Dictyosphaerium ehrenbergianum Naegeli Fig. 173

Colony spherical to ellipsoid; cells ovoid to ellipsoid; chloroplasts one or two; cells 4 to 7μ x 6 to 10μ.

Terwilliger, Squaw, Wehrle, Smith, Fisher.

Dictyosphaerium planctonicum Tiffany & Ahlstrom Fig. 174

Colony ovoid with less than 40 cells, gelatinous envelope frequently surrounding two (or four) cells, colonial sheath very delicate; cells ovoid or ellipsoid, bluntly rounded; chloroplasts one or two; cells 8 to 9μ x 12 to 16μ.

Terwilliger, Squaw, Smith.

Dictyosphaerium pulchellum Wood Fig. 175

Colony spherical to ovoid, four to many celled; cells spherical to ovoid; chloroplast one; cells 3 to 10μ in diameter.

Distribution general.

Dimorphococcus A. Braun 1855

Colony free-floating, irregular, enveloping mucus inconspicuous; cells in groups of four, attached to the branching fragments of the previous cell, two cells in each group ellipsoid to oblong and the other two cells reniform or heart-shaped; chloroplast single, parietal, with one pyrenoid.

Dimorphococcus lunatus A. Braun Fig. 176

Characters as for the genus; cells 4 to 15μ x 9 to 25μ; colonies 50 to 150μ in diameter.

Squaw, Terwilliger, Fisher.

Echinosphaerella G. M. Smith 1920

Cells solitary, spherical, free-floating; wall thin, covered by stout, hyaline, tapering spines; chloroplast single, parietal, cup-shaped, with one pyrenoid.

Echinosphaerella limnetica G. M. Smith Fig. 177

Characters as for the genus; cells without spines 9 to 14μ in diameter; spines 2.5 to 3μ at base and 16 to 25μ long.

Terwilliger, Squaw, Wehrle.

Eremosphaera De Bary 1858

Cells usually solitary, spherical, free-floating or intermingled with other algae; wall thin; chloroplasts many, small, ovate or irregularly discoid, parietal, with conical projections directed toward the center of the cell, one to four pyrenoids.

Eremosphaera viridis De Bary Fig. 178

Characters as for the genus; cells 55 to 200μ in diameter.

E. Harbor, W. Harbor.

Franceia Lemmermann 1898

Cells free-floating, solitary or in colonies of two to eight, ovoid to ellipsoid; walls covered by long, hyaline, bristle-like setae which may have a basal swelling; chloroplasts two to four, parietal, laminate, with one pyrenoid.

Franceia droescheri (Lemm.) G. M. Smith Fig. 179

Cells ovoid to ellipsoid; walls covered with setae; chloroplasts two to four, each with a pyrenoid; cells without setae, 5 to 12μ x 9 to 16μ; setae 15 to 22μ long.

Gibraltar, Squaw, Terwilliger, Haunck, Smith, N. Bass dock.

Franceia ovalis (Francé) Lemmermann Fig. 180

Cells ovate; cells without setae 7 to 10μ x 13 to 17μ; setae 15 to 23μ long.

Terwilliger, Smith.

Franceia tuberculata G. M. Smith Fig. 181

Cells ovate, in groups of (2)-4-(8); setae with basal tubercles up to 3μ on free walls; cells without setae 5 to 12μ x 8 to 22μ; setae 7 to 32μ long.

Wehrle, Haunck, Smith.

Franceia tuberculata G. M. Smith var. **irregularis** Tiffany & Ahlstrom Fig. 182

Characters as for the type except that half the cells of a colony are usually arranged at right angles to the other cells.

Haunck, Smith.

Gloeoactinium G. M. Smith 1926

Cells narrowly ovate-cuneate, apposed at their bases in radiating groups of two or four; several such groups peripherally located in a wide, homogeneous, gelatinous envelope; cells with long axes radiating from a common center, the narrow and acute ends directed outward; chloroplast laminate and parietal, or completely filling the cell, without a pyrenoid.

Gloeoactinium limneticum G. M. Smith Fig. 183

Characters as for the genus; cells 1.5 to 2.5μ x 3.5 to 7.5μ; colonies 25 to 45μ in diameter.

Terwilliger, N. Bass dock.

Gloeotaenium Hansgirg 1890

Colony spherical, ellipsoid, or quadrangular-ovate, composed of two, four, or eight spherical, ellipsoid or flattened cells, cruciately arranged (if four) within the old mother cell wall; cells separated in the colony by dark-colored (black) masses impregnated with calcium carbonate; cell walls thick; chloroplast massive, shape indistinct, with or without a pyrenoid.

Gloeotaenium loitlesbergerianum Hansgirg Fig. 184

Characters as for the genus; cells 20 to 30μ in diameter; two-celled colonies 22 to 40μ x 40 to 70μ, four-celled colonies 40 to 70μ x 40 to 80μ.

Fox on Pelee, Haunck, Fisher, E. Harbor.

Tiffany (1934) stated that this alga had not been seen until 1933 when it was in many collections. During the past twenty years it has rarely been found.

Kirchneriella Schmidle 1893

Cells free-floating, arcuate, lunate, attenuate or subcylindrical, often twisted, apices often nearly touching, loosely arranged in a wide gelatinous envelope; chloroplast single, parietal along the convex wall of the cell, with one pyrenoid, sometimes with none.

Kirchneriella contorta (Schmidle) Bohlin Fig. 185

Colony rarely more than 16 cells; cells cylindrical, arcuate or spiral, with acute or rounded ends; chloroplast covering entire cell wall, without a pyrenoid; cells 0.7 to 2μ x 8 to 14μ; colonies up to 60μ.

Squaw, Terwilliger, Haunck, Fisher, Smith, E. Harbor.

Kirchneriella elongata G. M. Smith Fig. 186

Colony with a homogeneous, gelatinous sheath, cells eight to ten; cells elongate, ends rounded, irregularly twisted and entwined; chloroplast single, parietal, no pyrenoids; cells 3μ x 14 to 20μ.

E. Harbor.

Kirchneriella lunaris (Kirch.) Moebius Fig. 187

Colony composed of numerous cells; cells crescent-shaped, bluntly pointed, irregularly in groups of four to eight; chloroplast nearly entire, one pyrenoid; cells 3 to 8μ x 6 to 15μ; colonies up to 250μ in diameter.

Squaw, Terwilliger, Wehrle, Haunck, Smith, Middle Isl., Kelleys N. dock.

Kirchneriella lunaris (Kirch.) Moebius var. **dianae** Bohlin Fig. 188

Cell apices curved, pointed, and almost touching; cells 3 to 5μ x 10 to 21μ.

Squaw, Haunck.

Kirchneriella lunaris (Kirch.) Moebius var. **irregularis** G. M. Smith Fig. 189

Apices of cells twisted; cells 4 to 6μ x 6 to 13μ.

Terwilliger, Squaw, Wehrle.

Kirchneriella obesa (W. West) Schmidle Fig. 190

Cells flattened, outer side strongly convex to nearly circular, inner sides parallel, apices rounded; chloroplast nearly filling the cell, one pyrenoid; cells 3 to 8μ x 6 to 16μ.

Distribution general.

Kirchneriella obesa (W. West) Schmidle var. **aperta** (Teiling) Brunnthaler Fig. 191

Characters as for the species except the apices of the cell are bluntly rounded, and the inner sides V-shaped; cells 6 to 12μ in diameter.

Terwilliger, Haunck, Wehrle, Smith.

Kirchneriella obesa (W. West) Schmidle var. **major** (Bernard) G. M. Smith Fig. 192

Characters as for the species except that the inner sides are curved; cells 3 to 5μ x 8 to 24μ.

Terwilliger, Haunck, Smith, Middle Isl.

Kirchneriella subsolitaria G. S. West Fig. 193

Colony with usually four crescent-shaped cells within the old mother cell wall; cell apices bluntly rounded, not tapering; cells 2.5 to 3.5μ x 5 to 6.5μ.

Terwilliger, Haunck.

Lagerheimia Chodat 1895

Cells solitary, free-floating, ovoid, ellipsoid, or citriform, with a firm wall bearing long, tapering, needle-like setae located at the polar or at the equatorial region; chloroplasts one to four, parietal, laminate, with or without pyrenoids.

Lagerheimia ciliata (Lager.) Chodat Fig. 194

Cells oblong-ovoid, with three to eight setae at each pole; cells without setae 6 to 18μ x 10 to 21μ.

Terwilliger, Squaw, Haunck.

Lagerheimia citriformis (Snow) G. M. Smith Fig. 195

Cells lemon-shaped, with four to eight setae at each pole; chloroplast single, one pyrenoid; cells without setae 8 to 20μ x 13 to 26μ; cetae 25 to 60μ.

Squaw, Wehrle, Haunck, open lake.

Lagerheimia citriformis (Snow) G. M. Smith var. **paucispina** Tiffany & Ahlstrom Fig. 196

Characters as for the type except with two to four setae at each pole; cells without setae 8 to 9μ x 10 to 14μ.

Gibraltar, open lake.

Lagerheimia genevensis Chodat var. **subglobosa** (Lemm.) Chodat Fig. 197

Cells broadly ellipsoid to subglobose with four setae, one on each side of each apex; cells without setae 4 to 5.5μ x 5 to 9μ; setae 10 to 13μ long.

Terwilliger.

Lagerheimia longiseta (Lemm.) Printz Fig. 198

Cells ellipsoid with four to ten setae near each pole; cells without setae 5 to 8μ x 9 to 13μ, setae 40 to 55μ long.

Gibraltar, Terwilliger, Wehrle, Haunck.

Lagerheimia longiseta (Lemm.) Printz var. **major** G. M. Smith Fig. 199

Characters as for the type except cells large; cells without setae 12 to 25μ x 15 to 37μ; setae 40 to 60μ long.

Terwilliger, Squaw, Wehrle, Haunck, Smith.

Lagerheimia quadriseta (Lemm.) G. M. Smith Fig. 200

Cells ovate with two long, diverging setae inserted just below the poles; chloroplast single, one pyrenoid; cells without setae 4 to 6.5μ x 7.5 to 12μ; setae 17.5 to 23μ.

Open lake.

Lagerheimia subsalsa Lemmermann Fig. 201

Cells ovoid with two to four setae at each pole; chloroplast single, one pyrenoid; cells without setae 2.5 to 8μ x 5 to 12μ; setae 7.5 to 26μ long.

Squaw, Starve.

Lagerheimia wratislawiensis Schroeder Fig. 202

Cells ovoid to nearly ellipsoid with four tuberculate-base setae, one seta at each pole and one on each side at the equator; chloroplast single, with or without a pyrenoid; cells without setae 3 to 7μ x 10 to 14μ; setae 14 to 26μ long.

Haunck, Fisher, Wehrle.

Nephrocytium Naegeli 1849

Colonial; colony of 2 to 16 cells enclosed in a persistent, well-defined mother cell wall, sometimes with daughter colonies adhering into compound colonies; cells ovoid, reniform, oblong, or oblong-ellipsoid; chloroplast at first a curved plate, later diffuse, one pyrenoid.

Nephrocytium agardhianum Naegeli — Fig. 203

Cells reniform or nearly so with rounded ends, arranged spirally within the mother cell wall; cells 2 to 13μ x 6 to 28μ.

Terwilliger, Fisher, Kelleys, Catawba.

Nephrocytium limneticum (G. M. Smith) G. M. Smith — Fig. 204

Cells elongate-cylindrical to nearly reniform, apices broadly rounded; mother cell wall gelatinized and not persistent as a distinct membrane; cells 4 to 6μ x 10 to 15μ.

Squaw, Terwilliger, Wehrle.

Nephrocytium lunatum W. West — Fig. 205

Cells crescent-shaped, apices bluntly pointed, concave side directed inward; cells 4 to 7μ x 14 to 18μ.

Kelleys.

Nephrocytium obesum W. & G. S. West — Fig. 206

Colony broadly ovate, surface shallowly scrobiculate with two to four cells; cells broadly ovate to hemispherical, poles broadly rounded, one margin strongly convex, the other concave or straight; chloroplast massive, reticulate (?); cells 12 to 19μ x 32 to 34μ.

Kelleys deep quarry.

Oocystis Naegeli 1855

Unicellular or colonial; colony of 2 to 16 cells enclosed by a swollen and partially gelatinized old mother cell wall, sometimes with several successive generations within the old membrane; cells ovoid, ellipsoid, or subcylindrical, poles rounded or with a nodular thickening; chloroplasts one to many, parietal, discoid, stellate or reticulate, with one pyrenoid in each chloroplast, or sometimes lacking.

Oocystis borgei Snow — Fig. 207

Cells solitary or in a colony of two to eight cells; cells broadly ellipsoid, poles rounded, without polar nodules; chloroplasts one to four, parietal, laminate, each with one pyrenoid; cells 9 to 13μ x 9 to 17μ.

Distribution general.

Oocystis crassa Wittrock — Fig. 208

Cells solitary or in a colony of two to eight cells; cells ovoid, poles rounded with polar nodules; chloroplasts four to ten, parietal, discoid, or angular, each usually with a pyrenoid; cells 10 to 20μ x 14 to 26μ.

Terwilliger, Squaw, Wehrle, Smith.

Oocystis elliptica W. West — Fig. 209

Colony of four to eight cells, rarely solitary; cells oblong-ellipsoid, without polar nodules; chloroplasts 10 to 20, parietal, discoid; cells 11 to 12.5μ x 20 to 25μ.

Squaw, Terwilliger, Wehrle, open lake.

Oocystis eremosphaeria G. M. Smith — Fig. 210

Solitary or in a colony of two to four cells; cells ovoid, with conspicuous polar nodules; chloroplasts 40 to 60, parietal, lenticular, each with one pyrenoid; cells 17 to 31μ x 21 to 45μ.

Terwilliger, Squaw.

Oocystis lacustris Chodat — Fig. 211

Colony of two to eight cells, rarely solitary; cells ellipsoid to nearly fusiform, ends pointed, without nodules; chloroplasts one to three, parietal, laminate, or discoid, with or without one pyrenoid; cells 8 to 22μ x 14 to 32μ.

Squaw, Terwilliger, Haunck, Wehrle, Smith, Fisher, open lake.

Oocystis parva W. & G. S. West — Fig. 212

Solitary or in a colony of two to eight cells; cells broadly fusiform to elliptic, with pointed ends, without nodules; chloroplasts one to three, parietal, laminate to discoid, sometimes with pyrenoids; cells 4 to 7μ x 6 to 12μ.

Squaw, Terwilliger, Haunck, Wehrle, Smith.

Oocystis pusilla Hansgirg Fig. 213

Solitary or in a colony of two to eight cells; cells cylindric-elliptical, poles broadly rounded, without polar nodules; chloroplasts two to three, parietal, laminate, usually without pyrenoids; cells 4.5 to 6.5μ x 8 to 12μ.

Terwilliger, Squaw, Haunck, Smith.

Oocystis solitaria Wittrock Fig. 214

Usually solitary, sometimes in a colony of two to eight cells; cells ovoid to ellipsoid, with conspicuous polar nodules; chloroplasts 12 to 25, parietal, discoid, or polygonal, usually with a pyrenoid; cells 7 to 10μ x 14 to 35μ.

Gibraltar, Terwilliger, Squaw.

Oocystis submarina Lagerheim Fig. 215

Solitary, or more often in a colony of 2 to 16 cells; cells oblong-cylindrical, narrowed at the poles, each with a polar nodule; chloroplasts one to two, laminate, parietal, with one pyrenoid; cells 3 to 9μ x 7 to 20μ.

Terwilliger, Squaw, Hatchery, Gibraltar, open lake.

Pachycladon G. M. Smith 1924

Cells solitary, spherical, with a delicate cell wall devoid of gelatinous envelope; cell wall with four quadrately or rarely pyramidately arranged spines which are stout, blunt, and often apically bifurcate; chloroplast single, cup-shaped, parietal, nearly filling the cell, one pyrenoid.

Pachycladon umbrinus G. M. Smith Fig. 216

Characters as for the genus; cells 8.5 to 12.5μ in diameter; spines 2.5 to 3.75μ at base, 1.2μ at apex, and 35 to 50μ long.

Haunck, Smith.

Planktosphaeria G. M. Smith 1918

Cells spherical, at first solitary, later irregularly distributed within a copious, homogeneous, hyaline, gelatinous envelope; mature cells with several parietal, angular discs, each with one pyrenoid.

Planktosphaeria gelatinosa G. M. Smith Fig. 217

Characters as for the genus; cells 4.5 to 25μ in diameter; colonies up to 150μ in diameter.

Terwilliger.

Polyedriopsis Schmidle 1900

Cells solitary, tetragonal, pyramidate, or somewhat cruciate, angles truncate, with three to ten long, hyaline, tapering setae; chloroplast parietal, plate-like, covering most of the cell wall, with one pyrenoid.

Polyedriopsis quadrispina G. M. Smith Fig. 218

Cells rectangular in front view, compressed, with slightly rounded corners, each corner with a single stout spine; chloroplast cup-shaped, with a single, conspicuous pyrenoid; cells without spines 5 to 7.5μ in diameter, with spines 32 to 44μ in diameter.

Smith.

Polyedriopsis spinulosa Schmidle Fig. 219

Characters as for the genus; cells without spines 12 to 25μ in diameter; spines 17 to 40μ long.

Terwilliger, Haunck, Wehrle, Smith.

Polyedriopsis spinulosa Schmidle var. **excavata** (Playf.) G. M. Smith Fig. 220

Angles of cells more rounded, sides deeply concave; cells without spines 15 to 22μ in diameter; spines 17 to 40μ long.

Wehrle, Haunck, Smith.

Quadrigula Printz 1915

Colonial, free-floating; colony composed of 2-8(-16) cells, gelatinous matrix, ellipsoid, hyaline, homogeneous; cells fusiform, elongate-cylindrical, straight or slightly curved, apices acute, lying in parallel groups with long axes parallel to that of the colony; chloroplast single, covering most of the cell wall, with or without pyrenoids.

Quadrigula chodati (Tann.-Full.) G. M. Smith Fig. 221

Cells long, fusiform, acute or lunate; chloroplast parietal, plate-like, with a median notch, with two pyrenoids; cells 3.5 to 7μ x 30 to 80μ.

Terwilliger.

Quadrigula closterioides (Bohlin) Printz Fig. 222

Cells cylindrical, straight, with one margin slightly curved, ends tapering to sharply rounded apices; chloroplast parietal, covering most of the cell wall, with a median notch and one pyrenoid; cells 3 to 6μ x 22 to 45μ.

Squaw, Haunck, Smith, open lake.

Quadrigula lacustris (Chodat) G. M. Smith Fig. 223

Colony fusiform; cells fusiform, straight, tapering to blunt points; chloroplast parietal, plate-like, without a median notch, with one pyrenoid; cells 3 to 5μ x 20 to 25μ.

Kelleys.

Radiococcus Schmidle 1902

Colonial, free-floating; envelope an ovate or rounded gelatinous matrix with radially arranged fibrillar, ungelatinized remains of the old mother cell walls; cells globose, arranged tetrahedrally in the colonial matrix; chloroplast cup-shaped, parietal, with one pyrenoid.

Radiococcus nimbatus (de Wildm.) Schmidle Fig. 224

Characters as for the genus; cells 10 to 13μ in diameter.

Kelleys deep quarry.

Schroederia Lemmermann 1898

Unicellular, acicular, fusiform, one apex produced into a long, fine, tapering seta and the other apex tapering into a slightly broader seta which may be bifurcate or ending in a disc.

Schroederia setigera (Schroed.) Lemmerman Fig. 225

Characters as for the genus; cells without spines 2.5 to 10μ x 22.5 to 52.5μ; spines 13 to 45μ long.

Terwilliger, Wehrle, Smith, N. Bass dock, open lake.

Selenastrum Reinsch 1867

Cells arcuate to lunate, attenuate, the convex surfaces apposed into aggregates of 4 to 16 cells or more, without a gelatinous envelope; chloroplast single, parietal, against the convex wall, usually with one pyrenoid.

Selenastrum bibraianum Reinsch Fig. 226

Colony spherical to ovoid, 4 to 16 or more cells; cells crescent- to sickle-shaped, convex surfaces mostly toward center of colony; cells 5 to 8μ x 20 to 38μ, 5 to 25μ between apices.

Terwilliger, Squaw, Haunck, Wehrle, Kelleys, open lake.

Selenastrum bibraianum Reinsch var. **gracile** (Reinsch) Tiffany & Ahlstrom Fig. 227

Characters as for the type; cells 3 to 5μ x 15 to 30μ.

Terwilliger, Squaw, Haunck, Wehrle, Smith.

Selenastrum minutum (Naeg.) Collins Fig. 228

Colony in plankton; cells irregularly arranged in a soft, mucilaginous matrix, crescent-shape, poles bluntly pointed; cells 3 to 3.5μ in diameter, 6 to 8μ between apices.

Put-in-Bay Harbor.

Selenastrum westii G. M. Smith Fig. 229

Colony small, composed of 2 to 8 (-16) cells, cells arranged irregularly with convex sides apposed; cells lunate to arcuate, not sickle-shaped; cells 1.5 to 2.5μ x 15 to 18μ between apices.

Terwilliger, Hatchery, Haunck.

Tetraedron Kuetzing 1845

Cells solitary, flat and triangular, quadrangular, or polygonal, or polyhedral, with angles simple or produced into simple or furcate spines; wall smooth or not; chloroplasts one to many, parietal discs or plates, pyrenoids usually present.

Tetraedron arthrodesmiforme (G. S. West) Woloszynska Fig. 230

Cells quadrate, two sides subparallel and other two sides deeply constricted, a spine on each of the four angles; cells without processes 16 to 22μ in diameter, length with spines up to 56μ.

Smith.

Tetraedron arthrodesmiforme (G. S. West) Woloszynska var. **contorta** Woloszynska Fig. 231

Cells with the four arms variously twisted; cells with processes 20 to 50µ x 32 to 60µ, each spine at base 5 to 8µ.

Smith.

Tetraedron caudatum (Corda) Hansgirg Fig. 232

Cells flat, five-sided, one side deeply incised and four concave, spines parallel to the flat sides of the cell; cells 6 to 22µ in diameter; spines 1 to 3.5µ long.

Squaw, Terwilliger, Wehrle, Smith, Buckeye.

Tetraedron caudatum (Corda) Hansgirg var. **longispinum** Lemmermann Fig. 233

Spines longer than in type, not parallel with flat side of cell; cells without spines 8 to 18µ in diameter; spines 3 to 8µ long.

Wehrle, Smith.

Tetraedron enorme (Ralfs) Hansgirg Fig. 234

Cells irregularly tetrahedric, angles produced into usually bilobed and short-spined processes; cells 25 to 45µ in diameter.

Terwilliger, Squaw, Fisher.

Tetraedron gracile (Reinsch) Hansgirg Fig. 235

Cells flat, rectangular, with narrow branched processes at the angles; cells without processes 15 to 30µ in diameter, with processes 35 to 80µ.

Wehrle, Smith.

Tetraedron hastatum (Reinsch) Hansgirg Fig. 236

Cells pyramidate, angles produced into long, tapering, unbranched, somewhat concave processes with two or three short spines at each tip; cells with processes 28 to 36µ in diameter.

Haunck, Wehrle, Smith.

Tetraedron hastatum (Reinsch) Hansgirg var. **palatinum** (Schmidle) Lemmermann Fig. 237

Cells with angles produced into non-tapering, unbranched processes with three short spines at each apex; cells without processes 4 to 14µ in diameter.

Terwilliger, Haunck, Smith.

Tetraedron incus (Teiling) G. M. Smith Fig. 238

Cells tetragonal, flat or pyramidate, sides slightly concave, each angle produced into a short spine; cells without spines 13 to 18µ in diameter, spines 7 to 8µ long.

Terwilliger, Wehrle, Haunck, Smith.

Tetraedron incus (Teiling) G. M. Smith var. **irregulare** G. M. Smith Fig. 239

Cells cruciately twisted, spines straight to twisted; cells without spines 10 to 17µ in diameter, spines 10 to 20µ long.

Squaw, Haunck.

Tetraedron limneticum Borge Fig. 240

Cells tetragonal, pyramidal, the angles dichotomously branched and terminating in two or three short spines; cells with processes 45 to 85µ in diameter, processes 8 to 12µ in diameter at the base.

Wehrle, Terwilliger.

Tetraedron lobulatum (Naeg.) Hansgirg Fig. 241

Cells tetragonal, flat or pyramidate, with concave sides, and one to two short, dichotomous, usually spineless processes at the angles; cells without processes 30 to 40µ in diameter.

Terwilliger, Wehrle.

Tetraedron lobulatum (Naeg.) Hansgirg var. **polyfurcatum** G. M. Smith Fig. 242

Cell with tapering and three to five times dichotomously branching processes, the extreme tips ending in two or three very small spines; cells without processes 15 to 25µ, with processes 35 to 70µ in diameter.

Terwilliger, Smith.

Tetraedron minimum (A. Br.) Hansgirg Fig. 243

Cells quadrate or oblong-quadrate, with concave sides and slightly rounded angles; side view fusiform-elliptic; wall smooth or granulate; cells 5 to 8µ thick, 6 to 20µ long.

Distribution general.

Tetraedron muticum (A. Br.) Hansgirg Fig. 244

Cells triangular, with concave sides, angles truncate and rounded; cells 5 to 8μ thick, 8.5 to 15μ long.

Squaw, Wehrle, Smith.

Tetraedron pentraedricum W. & G. S. West Fig. 245

Cells five-angled, four angles in one plane, the angles subacute, each with a short curved spine; cells without spines 5.5 to 14μ, with spines 9 to 20μ.

Squaw.

Tetraedron regulare Kuetzing Fig. 246

Cells tetragonal, pyramidal, sides convex, straight, or concave, each angle with a short, blunt spine; cells with spines 14 to 45μ in diameter.

Terwilliger, Haunck, Wehrle, Smith, E. Harbor.

Tetraedron regulare Kuetzing var. **torsum** Turner Fig. 247

The two cell halves are cruciately arranged; cells 25 to 40μ in diameter.

Wehrle, Smith.

Tetraedron smithii (G. M. Smith) Tiffany Fig. 248

Cells strongly angled, sides convex, angles usually in two planes of three each, each with a stout spine at the apex; cells without processes 10 to 12μ, with processes 20 to 25μ.

Wehrle.

Tetraedron trigonum (Naeg.) Hansgirg Fig. 249

Cells triangular, flat, sides concave or rarely straight, angles with a single, stout spine; cells without spines 20 to 30μ in diameter, spines 8 to 10μ long.

Terwilliger, Squaw, Wehrle, Haunck, Smith, Fisher.

Tetraedron trigonum (Naeg.) Hansgirg var. **gracile** (Reinsch) De Toni Fig. 250

Cells flat, triangular, sides very concave; cells 6 to 10μ thick, 23 to 50μ broad.

Terwilliger, Wehrle, Haunck, Smith.

Tetraedron trigonum (Naeg.) Hansgirg var. **papilliferum** (Schroed.) Lemmermann Fig. 251

Cells with a small wart at each corner; wall smooth or granulate; cells 5 to 9μ thick, 10 to 15μ broad.

Squaw, Fisher.

Tetraedron tumidulum (Reinsch) Hansgirg Fig. 252

Cells tetragonal, with concave sides and broadly rounded angles; cells 20 to 60μ in diameter.

Terwilliger, Wehrle, Haunck, Smith.

Treubaria Bernard 1908

Cells solitary, free-floating, three- to eight-angled, pyramidate to quadrate, sides concave or straight, angles broadly rounded, each with a single, stout, hyaline spine that gradually tapers or has subparallel sides and terminates abruptly into a sharp point; chloroplasts one to four, parietal, cup-shaped or massive and completely filling the cell, with one to four pyrenoids.

Treubaria crassispina G. M. Smith Fig. 253

Spines stout, with subparallel margins; cells without spines 12 to 15μ, with spines 100 to 115μ in diameter; spines 45 to 60μ long, 4 to 6μ broad at the base.

Terwilliger.

Treubaria varia Tiffany & Ahlstrom Fig. 254

Spines broad at the base and tapering toward the apex; cells without spines 8 to 19μ, with spines 48 to 89μ in diameter; spines (20-) 25 to 38μ long, 3 to 6μ broad at base.

Terwilliger, Squaw, Haunck, Wehrle, Smith.

Trochiscia Kuetzing 1833

Cells free-floating or subaerial, spherical or nearly so, solitary or aggregated; walls thick, variously ornamented with reticulations, warts, or spines, or smooth; chloroplasts one to several, parietal, each with a pyrenoid.

Trochiscia aspera (Reinsch) Hansgirg Fig. 255

Cells solitary, spherical, free-floating; wall with evenly distributed verrucose warts; chloroplasts several, discoid; cells 13.5 to 29μ in diameter.

E. Harbor.

Trochiscia reticularis (Reinsch) Hansgirg Fig. 256

Cells solitary, spherical, free-floating; wall reticulate; cells 24 to 32μ in diameter.

Terwilliger.

Westella de Wildemann 1897

Colony globose, free-floating, composed of numerous cells grouped into fours or eights; each group loosely connected by the non-gelatinizing remnants of the old mother cell wall; chloroplast cup-shaped and parietal, or filling the cell, with or without a pyrenoid.

Westella botryoides (W. West) de Wildemann Fig. 257

Cells spherical, pyramidately or quadrately grouped in fours, remains of old mother cell walls evident; chloroplast cup-shaped, pyrenoid may be present; cells 3 to 9μ in diameter.

Distribution general.

Westella botryoides (W. West) de Wildemann var. **major** G. M. Smith Fig. 258

Cells larger than in type; cells 8 to 13μ in diameter.

Terwilliger.

Westella linearis G. M. Smith Fig. 259

Cells in groups of four, arranged in a linear series, remnants of old mother cell wall inconspicuous; cells 3 to 6μ in diameter.

Squaw, Terwilliger, Haunck, Wehrle, Pelee, E. Harbor, open lake.

Family Scenedesmaceae

Actinastrum Lagerheim 1882

Colonial, free-floating, composed of 4 to 16 cells that radiate from a common center, without colonial envelope; cells truncate-fusiform, oblong, or narrowly ovoid; chloroplast parietal, laminate, nearly as long as the cell, usually with one pyrenoid.

Actinastrum gracillimum G. M. Smith Fig. 260

Cells elongate-cylindric, tapering slightly to truncate apices, seven to ten times longer than broad; cells 1.75 to 3μ x 14 to 21μ.

Squaw, Terwilliger, Hatchery, Haunck, N. Bass dock, open lake.

Actinastrum hantzschii Lagerheim Fig. 261

Cells ovoid or fusiform-cylindric with truncate apices, three to six times longer than broad; chloroplast single, one pyrenoid; cells 3 to 6μ x 10 to 26μ.

Distribution general.

Actinastrum hantzschii Lagerheim var. **fluviatile** Schroeder Fig. 262

Characters as for the species except that the apices are sharply pointed; cells 1.5 to 5μ x 16 to 32μ.

Terwilliger, Squaw, Haunck, Kelleys N. dock.

Coronastrum Thompson 1938

"Cells pyriform or globose, 3.3 to 3.6μ in diameter, each containing one parietal chloroplast and one pyrenoid; coenobia composed of 4 cells arranged in a flat plate at the angles of a square, remote from one another but connected by strands of cell-wall substance; each cell bearing a scale-like fragment of mother-cell wall. Four to 16 coenobia may be united by strands of cell-wall substance, each coenobium attached to corners of a square, but with the plane of each coenobium at right angles to the plane of the colony as a whole [Thompson, 1938]."

Coronastrum aestivale Thompson Fig. 263

Characters as for the genus.

Haunck.

Crucigenia Morren 1830

Colonies of four cells or multiples of four in a more or less conspicuous gelatinous envelope, forming a flat or slightly curved plate; cells flat, appearing ovoid, angular or semicircular in front view; quadrately arranged with a quadrate or rhomboid space in the center; cell wall smooth; chloroplasts one to four, parietal, cup-shaped or plate-like, with or without a pyrenoid.

Crucigenia alternans G. M. Smith Fig. 264

Cells ovoid with broadly rounded apices, alternately arranged and in contact at the center, without a single central open space, embedded in a gelatinous envelope; chloroplast parietal, laminate, longitudinally adjacent to the outer faces of the cells, with or without a pyrenoid; cells 5 to 7μ x 6.5 to 11.5μ.

Terwilliger, Haunck.

Crucigenia apiculata (Lemm.) Schmidle Fig. 265

Colony of four cells, or often in multiples and somewhat irregular; cells ovoid to triangular, with a short conical projection at the free apex and one at the base away from the center of the coenobium; chloroplasts one to four, each with a pyrenoid; cells 3 to 7μ x 5 to 10μ.

Terwilliger, Squaw, Wehrle, Smith.

Crucigenia apiculata (Lemm.) Schmidle var. **eriensis** Tiffany & Ahlstrom Fig. 266

Cells elongate, somewhat lunate, free ends truncate, base and median part of inner sides in contact; apices free; cells 3 to 5μ x 6 to 10μ.

Terwilliger, Squaw, Wehrle.

Crucigenia apiculata (Lemm.) Schmidle var. **truncata** (G. M. Smith) Ahlstrom & Tiffany Fig. 267

Cells elongate to ovoid, free ends truncate, bases and median parts of cells in mutual contact; apices and outer cell faces free; chloroplasts one to four, without pyrenoids; cells 4 to 6μ x 6 to 10μ.

Terwilliger.

Crucigenia fenestrata Schmidle Fig. 268

Cells four, trapezoidal, arranged about a quadrate opening; outer free walls long and convex, free angles sharply rounded; inner free walls straight or slightly convex; cells 3 to 5μ x 5 to 12μ.

Gibraltar.

Crucigenia irregularis Wille Fig. 269

Cells four or in multiples of four, ovoid, with cells in contact at sides and poles, not in quadrangular formation, central space not quadrate; chloroplasts one to four, parietal, with or without a pyrenoid; cells 4 to 9μ x 6 to 14μ.

Squaw, Terwilliger, Haunck, open lake.

Crucigenia lauterbornei Schmidle Fig. 270

Cells four or multiples of four, flat, subhemispherical, the inner free wall straight, the outer strongly convex, in contact at the apices only; central opening quadrate; chloroplast single, with one pyrenoid; cells 4.5 to 9μ x 8 to 15μ.

Squaw, Terwilliger, Hatchery, Smith.

Crucigenia quadrata Morren Fig. 271

Cells four or multiples of four, nearly triangular, cruciately arranged, central space very small or lacking, lateral walls straight; cell wall smooth or with one to six small, knob-like projections; cells 2.5 to 6μ x 3 to 7μ.

Squaw, Terwilliger, Hatchery, Smith, open lake.

Crucigenia rectangularis (A. Br.) Gay Fig. 272

Cells four, commonly in multiples of four, ovoid to elongate-ovoid, regularly arranged about a small central rectangular opening; chloroplasts one to four, each with one pyrenoid; cells 4 to 7μ x 5 to 10μ.

Squaw, Terwilliger, open lake.

Crucigenia tetrapedia (Kirch.) W. & G. S. West Fig. 273

Cells four, commonly in multiples of four, triangular and cruciately arranged about a small central opening, angles acutely rounded; chloroplast single, with one pyrenoid; cells 5 to 10μ in diameter.

Smith, E. Harbor.

Errerella Conrad 1913

Colonial, with 4 to 256 cells arranged in pyramidal units of four cells each, forming a pyramidate colony; cells spherical, each with one long spine, interior cells of colony frequently spineless.

Errerella bornhemiensis Conrad Fig. 274

Characters as for the genus; cells 3 to 6μ in diameter, spines 22 to 100μ long.

Terwilliger, Squaw, Smith, Put-in-Bay Harbor.

Micractinium Fresenius 1858

Colonial, free-floating, 4 to 32 cells quadrately or tetrahedrically arranged; cells spherical to broadly ellipsoid; cell wall with one or more setae on the free surface, setae not basily thickened; chloroplast single, parietal, cup-shaped, with one pyrenoid.

Micractinium eriense Tiffany & Ahlstrom Fig. 275

Cells spherical, with 8 to 13 setae; cells 7 to 10μ in diameter, setae 20 to 35μ long.

Terwilliger, Squaw, Haunck, Wehrle, Smith.

Micractinium pusillum Fresenius Fig. 276

Cells spherical, quadrately or pyramidately arranged, with one to five setae; cells 3 to 7μ in diameter, setae 20 to 35μ long.

Terwilliger, Squaw, Haunck, Wehrle, Smith, Kelleys N. dock.

Micractinium pusillum Fresenius var. **elegans** G. M. Smith Fig. 277

Characters as for the species except cells with five to seven setae.

Terwilliger, Squaw, Haunck, Wehrle, Smith.

Micractinium pusillum Fresenius var. **longisetum** Tiffany & Ahlstrom Fig. 278

Characters as for the species except cells are larger with five to eight longer setae; cells 6 to 8μ in diameter, setae up to 65μ long.

Mouth of the Maumee River.

This form is not from the survey area but was reported by Tiffany (1934).

Micractinium quadrisetum (Lemm.) G. M. Smith Fig. 279

Cells ovoid with one to four setae; cells 4 to 7μ x 8 to 10μ, setae 23 to 40μ long.

Squaw, Terwilliger, Haunck.

Pectodictyon Taft 1945

Colony is a cubical, gelatinous mesh with a single cell at each angle of the cube, each cell capable of giving rise to a new cubical colony which may remain attached at the angle of the parent mesh; cells globose; chloroplast single, parietal, cup-shaped with one pyrenoid.

Pectodictyon cubicum Taft Fig. 280

Characters as for the genus; mature cells 6 to 8μ in diameter; eight-celled cubes up to 40μ in diameter.

Kelleys deep quarry.

Scenedesmus Meyen 1829

Coenobia generally plates of 2 to 32 cells in multiples of two, either side by side in a single series, or in a double row with the cells alternating; cells ellipsoid, fusiform, oblong, ovoid or crescent-shaped; cell walls smooth, or ornamented with spines, teeth or ridges; chloroplast a single, parietal plate, often covering most of the cell wall and sometimes with a median lateral notch, one pyrenoid.

Scenedesmus abundans (Kirch.) Chodat Fig. 281

Cells ovoid to oblong-ellipsoid, in series of four; terminal cells with polar spines and one or two spines on the lateral wall; inner cells with or without spines at each pole; cells 4 to 7μ x 7 to 12μ.

Squaw, Terwilliger, Wehrle, Starve, Catawba, E. Harbor.

Scenedesmus acuminatus (Lagerh.) Chodat Fig. 282

Coenobia curved; cells usually four, fusiform, arcuate or lunate, with pointed ends; cell wall smooth, without spines; cells 3 to 7μ x 30 to 40μ.

Squaw, Terwilliger, Haunck, Wehrle, Smith, E. Harbor, open lake.

Scenedesmus acutiformis Schroeder Fig. 283

Cells in a single series of (2-) 4 (-8), fusiform-elliptic; apices sharply pointed, without spines or teeth; inner cells with one longitudinal ridge; terminal cells with two to four longitudinal ridges; cells 5 to 8μ x 16 to 22μ.

Squaw, Terwilliger, Haunck, Fisher, Wehrle, Catawba.

Scenedesmus anomalus (G. M. Smith) Ahlstrom & Tiffany Fig. 284

Cells in pairs, cylindrical, arcuate, convex faces in contact, with polar spines on most or all cells; chloroplast single with one pyrenoid.

Terwilliger.

Scenedesmus arcuatus Lemmermann Fig. 285

Cells oblong-ovate or somewhat angular in a double row, forming a curved coenobium; cell wall smooth, without teeth or spines; cells 3 to 9μ x 9 to 17μ.

Squaw, open lake.

Scenedesmus arcuatus Lemmermann var. **platydisca** G. M. Smith Fig. 286

Cells in a flat rather than curved plate; cells 4.5 to 7.5μ x 8 to 17μ.

Terwilliger, Squaw, Haunck, Wehrle, Smith, Fisher, Kelleys N. dock, Catawba.

Scenedesmus armatus (Chod.) G. M. Smith Fig. 287

Cells ovoid to oblong-ellipsoid; apices rounded, in a linear or subalternating series; each side of cell with a longitudinal ridge; terminal cells with a long, usually curved spine at each pole; cells 4 to 7μ x 7 to 16μ.

Squaw, Terwilliger, Wehrle, Smith, Catawba, E. Harbor.

Scenedesmus bernardii G. M. Smith Fig. 288

Cells fusiform, lunate or sigmoid, alternately arranged in a loosely connected coenobium; apices acute; cell wall smooth, without spines or teeth; cells 3 to 6μ x 8 to 17μ.

Smith, E. Harbor.

Scenedesmus bijuga (Turp.) Lagerheim Fig. 289

Cells two to eight in a single series, oblong-ellipsoid to ovoid, with broadly rounded ends; cell wall smooth, without teeth or spines; cells 4 to 7μ x 7 to 18μ.

Distribution general.

Scenedesmus bijuga (Turp.) Lagerheim var. **alternans** (Reinsch) Hansgirg Fig. 290

Characters as for the species except cells alternately arranged; cells 4 to 8μ x 6 to 15μ.

Squaw, Haunck, Wehrle, Fisher, Pelee, Catawba.

Scenedesmus bijuga (Turp.) Lagerheim var. **flexuosos** (Lemm.) Collins Fig. 291

Cells up to 32 in a single, sometimes twisted, series; cells 5 to 8μ x 10 to 20μ.

Squaw, Terwilliger, open lake.

Scenedesmus bijuga (Turp.) Lagerheim var. **major** Tiffany & Ahlstrom Fig. 292

Cells ovoid, irregularly and alternately arranged in a single row; cells 10 to 13μ x 15 to 21μ.

Terwilliger, Squaw, Wehrle, Haunck.

Scenedesmus brasiliensis Bohlin Fig. 293

Cells cylindric to ovoid-ellipsoid, in a single series; apices with one to four short teeth and with a median longitudinal ridge between the apices; cells 3 to 6μ x 11 to 24μ.

Squaw, Terwilliger.

Scenedesmus carinatus (Lemm.) Chodat Fig. 294

Cells in a single series of four, fusiform, with a longitudinal ridge on each side of the cell; each apice with two to three teeth; cells 6 to 9μ x 15 to 17μ.

Terwilliger, Squaw, Wehrle.

Scenedesmus denticulatus Lagerheim Fig. 295

Cells in a single series of four or eight, ovoid or ovoid-ellipsoid; apices with one to four short teeth, walls otherwise smooth; cells 5 to 11μ x 7 to 15μ.

Squaw, Terwilliger, Haunck, Smith, Kelleys N. dock.

Scenedesmus dimorphus (Turp.) Kuetzing Fig. 296

Cells in a linear or alternating series of four or eight, fusiform; inner cells straight, with sharp apices; terminal cells lunate, with acute apices; cell wall smooth, without teeth or spines; cells 2 to 5μ x 18 to 23μ.

Distribution general.

Scenedesmus hystrix Lagerheim Fig. 297

Cells two to eight in a single series, oblong-cylindrical; apices blunt and conical; cell wall covered with minute spines; cells 3 to 5μ x 8 to 18μ.

Squaw, Wehrle.

Scenedesmus incrassatulus Bohlin var. **mononae** G. M. Smith Fig. 298

Cells small, slender, fusiform, subacute, in one or two series of four or eight; median cells slightly curved; outer cells curved with free walls strongly convex; cells 3 to 4.5μ x 11 to 12μ.

Mouth of Maumee River.

This form does not rightfully belong in the survey area, though it was reported by Tiffany (1934).

Scenedesmus longus Meyen Fig. 299

Cells two to eight in a single series, oblong-cylindric; apices broadly rounded, with one or two sharp spines, those on the terminal cells longer; cells 4 to 5μ x 8 to 11μ.

Terwilliger.

Scenedesmus obliquus (Turp.) Kuetzing Fig. 300

Cells usually four or eight in a single series, fusiform; apices acute-apiculate; cell sides in contact straight, free sides of terminal cells various; cell wall smooth, without teeth or spines; cells 3 to 9μ x 10 to 21μ.

Distr bution general.

Scenedesmus opliensis P. Richter Fig. 301

Cells two to eight in a single series; inner cells naviculoid; free walls of terminal cells convex, cells joined together in median portion only; inner cells with a spine at one apex only, or without spines; terminal cells with a long spine at each apex; cells 5 to 8μ x 12 to 28μ.

Distribution general.

Scenedesmus protuberans Fritsch & Rich Fig. 302

Cells in a single series of four, or rarely eight; internal cells cylindric, shorter than the external cells; external cells fusiform with their free walls slightly tumid; each apex with a long curved spine; cells with a longitudinal ridge on each side; cells 6 to 7μ x 25 to 34μ, spines 25 to 35μ long.

Terwilliger, Squaw, Wehrle.

Scenedesmus quadricauda (Turp.) de Brébisson Fig. 303

Cells in a single series of two to eight, cylindric-ovoid, ends rounded; apices of outer cells with a long curved spine; inner cells without spines, or with a small papilla; cells 3.5 to 6μ x 11 to 16μ, spines 10 to 12μ long.

Distribution general.

Scenedesmus quadricauda (Turp.) de Brébisson var. **alternans** G. M. Smith Fig. 304

Cells broadly ellipsoid, alternately arranged in a linear series, spines sometimes lacking on certain cells; cells 2.5 to 5μ x 5 to 7.5μ, spines 4 to 10μ.

Terwilliger, Wehrle, Smith.

Scenedesmus quadricauda (Turp.) de Brébisson var. **longispina** (Chodat) G. M. Smith Fig. 305

Cells ovoid-cylindric; cells 3.5 to 5μ x 8 to 11μ, spines 7.5 to 10μ long.

Squaw.

Scenedesmus quadricauda (Turp.) de Brébisson var. **maximus** W. & G. S. West Fig. 306

Cells large, spines long; cells 9 to 11.5μ x 27 to 36μ, spines 20 to 30μ long.

Squaw, Terwilliger.

Scenedesmus quadricauda (Turp.) de Brébisson var. **quadrispina** (Chodat) G. M. Smith Fig. 307

Cells broadly ovoid with short spines, usually recurved; cells 3.5 to 8μ x 8.5 to 15μ, spines 2.5 to 5.5μ long.

Squaw, Terwilliger, Haunck.

Scenedesmus quadricauda (Turp.) de Brébisson var. **westii** G. M. Smith Fig. 308

Cells broadly ovoid with medium length spines, strongly recurved; cells 4.5 to 8μ x 16 to 22μ, spines 12 to 16μ long.

Squaw, Catawba.

Scenedesmus wisconsinensis (G. M. Smith) Chodat Fig. 309

Cells ellipsoid-fusiform, ranged parallel to one another in two planes, often in groups of four; free margins concave, apposed margins convex; cells 4 to 6μ x 12 to 15μ.

Haunck.

Tetrastrum Chodat 1895

Colonies of four cruciately arranged cells; cells triangular, inner faces straight or convex, outer faces straight, convex, or concave; outer margins of cells usually with one or more spines or setae; chloroplasts one to four per cell, parietal, with or without a pyrenoid.

This genus differs from *Crucigenia* by having marginal spines and by the absence of multiple colonies.

Tetrastrum glabrum (Roll) Ahlstrom & Tiffany Fig. 310

Colony four-celled, with or without an open central space, surrounded by a delicate gelatinous envelope; cells angularly rounded or ovoid to broadly triangular, inner faces straight, outer free faces rounded or convex, without spines; chloroplast single, laminate, parietal, with or without a pyrenoid; cells 3 to 7μ broad; coenobia 7 to 15μ broad.

Haunck, Smith.

Tetrastrum heteracanthum (Nordst.) Chodat Fig. 311

Colony four-celled, with or without a minute central opening; cells broadly triangular to angularly rounded, with two (rarely one) setae, if two, then one is shorter and more delicate than the other; chloroplast single, laminate, parietal, with or without a pyrenoid; cells without setae 3 to 11.5μ in diameter, longer spine 8 to 24μ, shorter spine 1 to 9μ.

Squaw, Haunck, Smith.

Tetrastrum staurogeniaeforme (Schroeder) Lemmermann Fig. 312

Colony four-celled, without a distinct central opening; cells angularly rounded or ovoid to broadly triangular, inner faces straight, outer faces rounded or convex with one to six delicate setae on each free face; chloroplast single, laminate, parietal, with or without a pyrenoid; cells 3 to 6μ in diameter, setae less than the diameter of the cell.

Terwilliger, Squaw, Haunck.

Order Siphonales

The plants are macroscopic, branched siphonaceous tubes which may or may not be transversely constricted at or between the branches. Fresh-water members grow as submerged aquatic mats, or they may be terrestrial or nearly so. The nuclei of the coenocyte lie in a thin cytoplasmic layer that surrounds the elongate central vacuole. The chloroplasts are discoid, numerous, and without pyrenoids. Reproduction is by akinetes, aplanospores, and oogamous sexual reproduction.

Family Dichotomosiphonaceae

Dichotomosiphon Ernst 1902

Thallus a coarse, loosely entwined, felt-like or bushy mass on the bottom of aquatic habitats, or barely submerged along shorelines; filaments coenocytic, dichotomously branched, transversely constricted at each dichotomy and less commonly between branches; chloroplasts numerous, discoid, parietal, without pyrenoids; sexual reproduction oogamous, akinetes common.

Dichotomosiphon tuberosus (A. Braun) Ernst Fig. 313

Filaments 40 to 110μ in diameter, up to 10 cm long; akinetes elongate and straight or curved and clavate, 200 to 400μ x 500 to 5000μ; antheridia and oogonia at the ends of ultimate branches; antheridia 35 to 50μ x 130 to 170μ; oogonia globose, 290 to 320μ in diameter; oospores of same shape, dark green, 250 to 280μ in diameter.

Pelee, E. Harbor.

Order Zygnematales

Plants in this order are either solitary, or unbranched filaments without basal or apical differentiation. Either type of plant body may be sedentary or free-floating. The filamentous forms often occur as floating mats. The cell walls are composed of an inner cellulose layer, an outer pectic layer, and a surrounding mucilaginous sheath. The cells are uninucleate and have axial stellate chloroplasts. There are one or more pyrenoids in each chloroplast. There are no flagellate cells. Those that occur as unicells often have bizarre shapes and sculptured walls. The unicellular forms multiply by cell division, while the filamentous forms may fragment. Asexual reproduction involves akinetes and aplanospores. Sexual reproduction (conjugation) is isogamous by amoeboid gametes that pass through conjugation tubes between cells.

Family Zygnemataceae

Mougeotia C. A. Agardh 1824

Filaments simple, or rarely with one or two-celled branches, rhizoids common; cells cylindric, length usually much greater than the diameter; chloroplasts one or two axial plates, pyrenoids several, in a single row or scattered; zygotes usually in the conjugating tubes, cytoplasmic residues remaining in the gametangia.

Mougeotia cyanea Transeau — Fig. 314

Vegetative cells (14-) 16 to 18 (-20)μ x 160 to 200μ; chloroplast occupying less than one-half of the cell and with four to ten pyrenoids; zygote with long axis parallel to filament, compressed-spheroidal, 30 to 40μ x 38 to 48μ; aplanospore spheroidal, 30 to 32μ in diameter, both zygotes and aplanospores blue, walls finely punctate, with a peripheral pectic layer 4 to 8μ thick.

Kelleys.

Mougeotia elegantula Wittrock — Fig. 315

Vegetative cells 3.5 to 4.5μ x 50 to 135μ; chloroplast with four to eight pyrenoids; conjugating cells geniculate, sporangium adjoined by four cells; zygote cruciate-quadrate, 18 to 24μ in diameter, corners rounded, walls smooth.

Kelleys.

Mougeotia genuflexa (Dillw.) Agardh — Fig. 316

Vegetative cells 25 to 38μ x 50 to 225μ, often geniculate and not forming zygotes; conjugation lateral or scalariform; sporangium adjoined by two cells; zygote quadrate-ovoid to globose, 30 to 40μ in diameter, walls brown, smooth.

Fisher, Haunck, E. Harbor, W. Harbor.

Mougeotia nummuloides (Hass.) De Toni — Fig. 317

Vegetative cells 8 to 16μ x 32 to 160μ, sporangium adjoined by two cells; chloroplast with four pyrenoids; zygote globose to ovoid, 17 to 37μ (usually 22 to 32μ) in diameter, median wall brown, scrobiculate; aplanospore similar.

Kelleys.

Mougeotia sphaerocarpa Wolle — Fig. 318

Vegetative cells 19 to 24μ x 60 to 240μ, usually with four to six pyrenoids; zygote in greatly enlarged conjugating tube or extending into one of the gametangia, ovoid to subglobose, 36 to 40μ x 40 to 55μ, walls smooth, brown; aplanospore ovoid to obliquely ovoid, 24 to 30μ x 35 to 50μ.

Haunck.

Mougeotia transeaui Collins — Fig. 319

Vegetative cells 10 to 18μ x 50 to 250μ, sporangium usually adjoined by three cells; zygote subglobose to nearly ovoid, 24 to 28μ x 26 to 36μ; aplanospore obliquely ovoid to trapezoid, 16 to 20μ x 25 to 30μ; spore walls smooth.

Gibraltar.

Tiffany (1937) reported this species as *Mougeotia notabilis* Hassall. See Transeau (1950) for synonymy.

Sirogonium Kuetzing 1843

Filaments simple, unbranched; cells cylindric, short to very long, with plane end walls; chloroplasts two to nine, straight to slightly spiral, pyrenoids numerous; conjugation mostly direct, without formation of conjugating tubes, between short genuflexed cells, with a ring of pectose outside the walls and at the edges of the contact disc; zygotes in one of the gametangia.

Sirogonium sticticum (Engl. Bot.) Kuetzing — Fig. 320

Vegetative cells 38 to 56μ x 80 to 300μ, with plane end walls; chloroplasts three to six, nearly straight, or making 0.5 turn; conjugation direct between usually shortened and more or less reflexed gametangia; receptive gametangia inflated to 72μ; zygote ellipsoid, sometimes more or less ovoid, 41 to 67μ x 68 to 127μ, median wall smooth, yellow.

Haunck, E. Harbor, Kelleys.

Spirogyra Link 1820

Filaments simple, unbranched, sometimes with rhizoids at the point of contact with the substrate; cells cylindrical, short to very long, with plane, replicate, or colligate end walls, surrounded by more or less evident gelatinous sheaths; chloroplasts 1 to 16 per cell, spirally arranged or sometimes very slightly so, numerous pyrenoids; conjugation scalariform or lateral, through conjugation tubes; zygotes in one of the gametangia; aplanospores, parthenospores, and akinetes known.

Spirogyra crassa Kuetzing Fig. 321

Vegetative cells 140 to 165μ x 126 to 330μ, with plane end walls; chloroplasts 6 to 12, making 0.5 to 1 turn; fertile cells cylindric or rarely enlarged; zygote compressed-ovoid, 120 to 150μ x 140 to 160μ x 80 to 100μ, median wall smooth, brown.

Fisher, Pelee.

Spirogyra crassoidea Transeau Fig. 322

Vegetative cells 140 to 150μ x 140 to 500μ, with plane end walls; chloroplasts three to eight, making 0.5 to 4 turns; zygote compressed-ellipsoid, usually with rounded ends, 120 to 140μ x 145 to 220μ, median wall smooth and yellow-brown.

Fisher, E. Harbor, Catawba.

Spirogyra ellipsospora Transeau Fig. 323

Vegetative cells 125 to 150μ x 125 to 500μ, with plane end walls; chloroplasts three to eight, making 0.4 to 5 turns; fertile cells cylindrical; zygote ellipsoid, more or less pointed 100 to 140μ x 160 to 255μ, median wall smooth and yellow-brown.

Fisher, E. Harbor.

Spirogyra fluviatilis Hilse Fig. 324

Vegetative cells 35 to 45μ x 70 to 240μ, with plane end walls; chloroplasts three to four, making 1.5 to 3.5 turns; fertile cells shortened and inflated; zygote ovoid, 57 to 65μ x 68 to 110μ, with median wall scrobiculate, brown.

Squaw, Hatchery, Terwilliger.

Spirogyra juergensii Kuetzing Fig. 325

Vegetative cells 24 to 30μ x 60 to 125μ, with plane end walls; chloroplast single, making two to four turns; zygote and aplanospore ellipsoid, 29 to 33μ x 50 to 75μ, median wall smooth, yellow.

W. Harbor.

Spirogyra longata (Vauch.) Kuetzing Fig. 326

Vegetative cells 26 to 38μ x 45 to 280μ, with plane end walls; chloroplast single, making two to five turns; fertile cells cylindric or enlarged by the spores; zygote ovoid or sometimes ellipsoid with round ends, 28 to 38μ x 50 to 83μ, median wall smooth, yellow.

E. Harbor.

Spirogyra majuscula Kuetzing Fig. 327

Vegetative cells 50 to 80μ x 80 to 500μ, with plane end walls; chloroplasts three to eight, straight or making about 0.3 turn; fertile cells shortened, cylindric or inflated; zygote lenticular, 57 to 72μ in diameter, 45 to 60μ in thickness, median wall smooth, brown.

Fisher, Smith, Kelleys, Pelee, E. Harbor.

Spirogyra neglecta (Hass.) Kuetzing Fig. 328

Vegetative cells 55 to 67μ x 100 to 300μ, with plane end walls; chloroplasts three, making 1 to 2.5 turns; fertile cells enlarged or inflated; zygote and aplanospore ovoid, 54 to 64μ x 75 to 100μ, median wall smooth, yellow.

Terwilliger.

Spirogyra protecta Wood Fig. 329

Vegetative cells 28 to 34μ x 120 to 425μ, with replicate end walls; chloroplast single rarely two, making two to six turns; fertile cells cylindric or slightly enlarged; zygote ovoid to cylindric-ovoid, 30 to 38μ x 66 to 90μ, outer wall of two layers, the inner scrobiculate and the outer smooth, median wall smooth, yellow.

E. Harbor.

Spirogyra quadrata (Hass.) Petit Fig. 330

Vegetative cells 24 to 30μ x 70 to 300μ, with replicate end walls; chloroplast single, making 1 to 5.6 turns; fertile cells cylindrically inflated up to 60μ; zygote and aplanospore ellipsoid to cylindric-ellipsoid, 33 to 44μ x 50 to 78μ, median wall smooth, brown.

Fox.

Spirogyra setiformis (Roth) Kuetzing Fig. 331

Vegetative cells 86 to 115μ x 100 to 225μ, with plane end walls; chloroplasts four, making 0.5 to 1 turn; fertile cells cylindric; zygote ellipsoid, 85 to 100μ x 115 to 160μ, median wall smooth, brown.

Fisher.

Spirogyra tennuissima (Hass.) Kuetzing Fig. 332

Vegetative cells 8 to 12μ x 40 to 250μ, with replicate end walls; chloroplast single, making three to six turns; fertile cells enlarged or inflated; zygote and aplanospore ellipsoid, 25 to 32μ 40 x 70μ, median wall smooth, yellow.

Squaw, Terwilliger.

Spirogyra varians (Hass.) Kuetzing Fig. 333

Vegetative cells 30 to 40μ x 30 to 120μ, with plane end walls; chloroplast single, making one to five turns; fertile cells inflated, usually on the conjugating side only; sterile cells often greatly inflated; zygote (ellipsoid, rarely ovoid or globose), 32 to 40μ x 50 to 100μ, median wall smooth, yellow.

Haunck, Terwilliger.

Spirogyra weberi Kuetzing Fig. 334

Vegetative cells 19 to 30μ x 80 to 480μ, with replicate end walls; chloroplast single, making 3 to 6.5 turns; fertile cells slightly enlarged; zygote ovoid to cylindric-ovoid, 21 to 29μ x 30 to 96μ, median wall smooth, yellow.

Haunck, Terwilliger, Hatchery.

Zygnema Agardh 1824

Filaments unbranched, sometimes with rhizoidal branches at the point of contact with the substrate; cells cylindric, of varying length, with or without conspicuous gelatinous sheaths; chloroplasts two (rarely four), stellate, axial, each with a large central pyrenoid; conjugation usually scalariform, sometimes lateral; zygotes formed in one of the gametangia or in the conjugation tube; aplanospores and akinetes present in some.

Zygnema cruciatum (Vauch.) Agardh Fig. 335

Vegetative cells 30 to 35μ x 30 to 60μ; zygote in one of the gametangia, globose to ovoid, 30 to 38μ x 32 to 40μ, median wall brown, scrobiculate, pits 1.5 to 2μ in diameter.

Wehrle.

Zygnema insigne (Hass.) Kuetzing Fig. 336

Vegetative cells 26 to 32μ x 26 to 60μ; zygote in one of the gametangia, globose or subglobose, 27 to 33μ x 27 to 35μ, median wall brown, smooth.

E. Harbor.

Zygnema stellinum (Vauch.) Agardh Fig. 337

Vegetative cells 28 to 38μ x 27 to 100μ; zygote in one of the gametangia, ovoid, 30 to 42μ x 35 to 48μ, median wall yellow-brown, scrobiculate, pits 3 to 4μ in diameter and spaced 3 to 4μ apart.

Terwilliger, Squaw.

Zygnema vaucherii Agardh Fig. 338

Vegetative cells 24 to 28μ x 50 to 180μ; zygote in one of the gametangia, ovoid, 24 to 36μ x 24 to 45μ, median wall brown, scrobiculate, pits 3μ in diameter.

E. Harbor.

Family Desmidiaceae

Closterium Nitzsch 1817

Cells elongate, more or less attenuated toward the apices, slightly curved to strongly lunate, unconstricted, ends of cells rounded, truncate, or sharply pointed; cell wall smooth or striate, colorless to brown; one axial chloroplast per semicell, each with longitudinal ridges; pyrenoids few to many, axial or scattered; a terminal vacuole at each end of the cell with one or more granules of calcium sulphate.

Closterium acerosum (Schrank) Ehrenberg Fig. 339

Cells large, almost straight, fusiform, outer margin curved more than the straight or slightly convex inner margin; apices rounded-truncate; cell wall smooth, colorless, often yellow when old; chloroplast with 14 to 16 ridges and an axial series of about ten pyrenoids; length 340 to 475μ, width 40 to 60μ.

Squaw, Hatchery, E. Harbor.

Closterium brébissonii Delpont Fig. 340

Cells long, narrow, slightly curved, inner margins nearly straight, tapering gradually to truncate apices; wall smooth, with 15 to 20 pyrenoids in each semicell; cell diameter 23μ, length 28 to 29 times the diameter, apices 6μ broad.

Starve.

Discription and figure redrawn from Borge (1925).

Closterium calosporum Wittrock Fig. 341

Cells small, strongly curved, inner margin not tumid; apices subacute or acutely rounded; cell wall smooth, colorless; chloroplast with an axial series of about four pyrenoids; zygospore with conical projections; length of cells 160μ, width 13μ, zygospore about 32μ in diameter.

Closterium dianae Ehrenberg Fig. 342

Cells of medium size, strongly curved, inner margin very slightly tumid, gradually attenuated to the apices; apices obtusely-rounded, dorsal margin of each apex obliquely truncate; cell wall smooth, very pale yellow, sometimes dark yellowish-red; chloroplast with four ridges and three to four pyrenoids; length 147 to 160μ, width 13 to 14μ.

Kelleys.

Closterium eboracense (Ehr.) Turner Fig. 343

Cells large, stout, with medium curvature, inner margin straight or very slightly tumid; apices obtusely rounded; cell wall smooth, colorless; chloroplast with about eight ridges and four pyrenoids; length 220μ, width 47μ.

Squaw.

Closterium ehrenbergii Meneghini Fig. 344

Cells large, stout, moderately curved, inner margin concave, inflated in median portion; apices obtusely rounded; cell wall smooth, colorless; chloroplast with 10 to 12 ridges, numerous scattered pyrenoids; length 420 to 590μ, width 80 to 101μ.

Wehrle, Fisher, Haunck, Terwilliger, Fox, E. Harbor.

Closterium eriense Taft Fig. 345

Cells of medium size, strongly curved, nearly 180 degrees of arc, inner margin concave, not tumid, gradually attenuated to broadly rounded apices; cell wall smooth, very pale yellow; chloroplast?; length 215μ, width 30μ, width of apices 10μ.

Squaw.

Closterium gracile de Brébisson Fig. 346

Cells small, slender, linear, median portion straight, margins parallel, slightly curved towards the obtuse apices; cell wall smooth, colorless; chloroplast with about six pyrenoids; length 211μ, width 7μ.

E. Harbor.

Closterium idiosporum W. & G. S. West Fig. 347

Cells small, very slightly curved, inner margin very slightly tumid, median portion of cell with subparallel margins; apices narrow and truncately rounded; cell wall smooth, colorless; chloroplast faintly four-ridged, with about five pyrenoids; length 197 to 232μ, width 9 to 10μ.

Wehrle.

Closterium kützingii de Brébisson Fig. 348

Cells of medium size, nearly straight, median portion of cell fusiform-lanceolate, both margins about equally convex; apices slightly incurved, rounded and often slightly swollen; cell wall finely striate, with about 12 striae per 10μ, becoming dark yellow when old; chloroplast about four-ridged, with six pyrenoids; length 273 to 380μ, width 20μ.

Pelee.

Closterium leibleinii Kuetzing Fig. 349

Cells of medium size, strongly curved, inner margin strongly concave, slightly tumid in median portion; apices acutely rounded; cell wall smooth, colorless, sometimes very pale yellow; chloroplast about six-ridged, with three pyrenoids; length 115 to 121μ, width 18 to 21μ.

Haunck, Hatchery, E. Harbor.

Closterium lunula var. **coloratum** forma? Taft Fig. 350

Cells quite large, inner wall straight, outer wall broadly convex; apices broadly rounded; cell wall finely striate, 10 striae per 10μ, yellow-brown; chloroplast with 10 to 12 ridges, numerous scattered pyrenoids; length 330 to 375μ, width 37 to 44μ.

Squaw.

Closterium macilentum de Brébisson Fig. 351

Cells of medium size, very long and narrow, slightly curved towards the ends, median portion of cell straight, inner margin not tumid; apices obtusely rounded; cell wall smooth, colorless, very faintly yellow when old; chloroplast with eight to ten pyrenoids; lengths 270μ, width 7μ.

Smith.

Closterium moniliferum (Bory) Ehrenberg Fig. 352

Cells of medium size, moderately curved, inner margin with a distinct median inflation; apices obtusely rounded; cell wall smooth, colorless; chloroplast with about six ridges and five to six axial pyrenoids; length 204 to 310μ, width 27 to 53μ.

Fisher, Smith, Squaw, Hatchery, E. Harbor.

Closterium parvulum Naegeli Fig. 353

Cells small, quite strongly curved, inner margin not tumid; apices acutely rounded; cell wall smooth, colorless; chloroplast with about six ridges, five to six axial pyrenoids; length 110 to 119μ, width 13 to 18μ.

Wehrle, Smith, Fox, Squaw.

Closterium parvulum var. **angustum** W. & G. S. West Fig. 354

Characters as for the species with cells narrower, usually shorter, curvature greater; length 96 to 112μ, width 5 to 7μ.

Hatchery, Kelleys, E. Harbor.

Closterium praelongum de Brébisson Fig. 355

Cells of medium to large size, elongate, slightly curved, inner margin not tumid, ends of cells slightly recurved; apices rounded; cell wall appearing smooth, very finely striate under high magnification, colorless to yellow; chloroplast with five ridges and ten pyrenoids; length 860μ, width 24μ.

Pelee.

Closterium praelongum var. **brevius** Nordstedt Fig. 356

Characters as in the species but with smaller dimensions; length 365 to 410μ, width 18μ.

Fisher.

Closterium pritchardianum Archer Fig. 357

Cells large, slightly curved, inner margin straight or slightly concave, not tumid; apices slightly recurved, narrow, truncate; cell wall finely striate with 9 to 10 striae per 10μ, striae composed of fine punctae, color yellow to red-brown; chloroplast with six to eight ridges, eight axial pyrenoids; length 334 to 530μ, width 21 to 37μ.

Haunck, Fisher, Mound, Squaw, Hatchery.

Closterium subulatum (Kuetz.) de Brébisson Fig. 358

Cells small, moderately curved, inner margin slightly tumid; apices acutely rounded; cell wall smooth, colorless, rarely yellowish when old; chloroplast with three to four pyrenoids; length 39 to 56μ, width 7 to 12μ.

Haunck, Smith, Squaw, E. Harbor.

Closterium venus Kuetzing Fig. 359

Cells small, strongly curved, inner margin not tumid; apices acute to acutely rounded; cell wall smooth, colorless; chloroplast ridged, with (1-) -2 (-3) pyrenoids; length 76 to 85μ, width 9 to 14μ.

Haunck.

Closterium venus var. **incurvum** (de Bréb.) Krieger Fig. 360

Cells very small, strongly curved; cell wall smooth, colorless, rarely yellowish when old; chloroplast with three to four pyrenoids; length 39 to 66μ, width 7 to 12μ.

Haunck, Smith, Squaw, E. Harbor.

Cosmarium Corda 1834

Cells extremely variable in size, usually somewhat longer than broad, more or less compressed, usually with a fairly deep median constriction; cells variable in outline, without radiating processes or spines; vertical view usually oblong or elliptic, with or without a central protuberance; chloroplast usually axial, with one or more pyrenoids; cell wall varying from smooth to papillate, markings usually forming a definite pattern.

Cosmarium abbreviatum Raciborski Fig. 361

Cells very small, sinus linear, closed; semicells elliptic-hexagonal; vertical view without a central protuberance, elliptic; chloroplast with one pyrenoid; cell wall smooth; length 10 to 11μ, width 9 to 10μ, isthmus 2 to 3μ.

Squaw.

Cosmarium angulare Johnson Fig. 362

Cells small, circular-octagonal, deeply constricted, sinus linear, closed; semicells broadly pyramidate, basal angles and the one immediately above with a broad, conical tooth; apex truncate; vertical view with two slight protuberances on each side; cell wall indistinctly punctulate; chloroplast with one pyrenoid; length 28 to 30μ, width 25 to 27μ, isthmus 6 to 8μ.

Fisher, Kelleys.

Cosmarium angulare var. canadense Irénée-Marie Fig. 363

Varies from the species by not having teeth at the angles; vertical view of the semicells with only one slight protuberance on each side; length 28 to 29μ, width 26 to 27μ, isthmus 7 to 8μ.

Fisher, Wehrle, Pelee.

Cosmarium angulosum de Brébisson Fig. 364

Cells small, deeply constricted, sinus linear, closed; semicells subhexagonal; apex truncate; vertical view elliptic-ovoid, not tumid; chloroplast with one pyrenoid; cell wall smooth; length 16μ, width 14μ, isthmus 3 to 4μ.

Squaw.

Cosmarium aphanichondrum Nordstedt Fig. 365

Cells of medium size, deeply constricted, sinus linear, closed; semi-cells semielliptic, basal angles acutely rounded; apex flattened, margins with 12 undulations, and two series of undulations within the margins; vertical view elliptic, tumid; chloroplast with one pyrenoid; cell wall smooth; length 39 to 40μ, width 32μ, isthmus 9μ.

Squaw, M. Bass beach pools.

Cosmarium bipunctatum Boergesen Fig. 366

Cells of medium size, hexagonal, deeply constricted, sinus linear, closed; semicells depressed-pyramidate, basal angles mostly acutely rounded; apex truncate, margins crenate with about four rows of crenations within the margin, two large granules at center of each semicell; vertical view broadly elliptic, two granules on each side; chloroplast with one pyrenoid; cell wall smooth; length 27 to 31μ, width 25 to 30μ, isthmus 8μ.

Squaw.

Cosmarium bireme Nordstedt Fig. 367

Cells small, sinus linear, closed; semicells elliptic-hexagonal; vertical view with an acutely pointed protuberance on each side; chloroplast with one pyrenoid; cell wall smooth; length 16 to 17μ, width 14 to 15μ, isthmus 3 to 4μ.

Squaw, E. Harbor.

Cosmarium biretum de Brébisson Fig. 368

Cells large, nearly quadrate, sinus linear, open; semicells rectangular, or slightly reniform, basal and apical angles broadly rounded; apex nearly flat; vertical view broadly elliptic, tumid; chloroplast with two pyrenoids; cell wall granulate, granules in vertical and horizontal rows, median portion of apex smooth; length 64 to 65μ, width 60 to 64μ, isthmus 21 to 23μ.

Smith, N. Bass dock.

Cosmarium biretum var. minus Hansgirg Fig. 369

Cells smaller, sinus linear, closed; semicells more reniform than in the species; apex in vertical view granulate; length 39 to 41μ, width 36 to 38μ, isthmus 11 to 12μ.

Middle.

Further studies may show that this *Cosmarium* should not be assigned as a variety of *Cos. biretum.*

Cosmarium biretum var. trigibberum Nordstedt Fig. 370

Cells of medium size, sinus linear, closed; semicells more reniform than the species; apex slightly convex; vertical view flattened-ellipsoid; length 43μ, width 43μ, isthmus 14μ.

Haunck, Squaw, M. Bass.

Cosmarium botrytis Meneghini Fig. 371

Cells large, deeply constricted, sinus linear, closed; semicells pyramidate-semicircular, basal angles almost acutely rounded; apex very slightly flattened; vertical view elliptic, not tumid; chloroplast with two pyrenoids; cell wall granulate, granules in rows; length 60 to 66μ, width 50 to 53μ, isthmus 16 to 18μ.

Pelee, Put-in-Bay Harbor.

Cosmarium crenulatum var. **timidulum** Insam & Krieger Fig. 372

Cells very small, deeply constricted, sinus linear, closed; semicells roughly semicircular, basal angles acutely rounded, one prominent undulation above each basal angle and one smaller undulation between that and the apex; apex retuse; vertical view with an acutely rounded protuberance on each side; chloroplast with one pyrenoid; cell wall smooth; length 15μ, width 13μ, isthmus 3 to 4μ.

Fisher?

Cosmarium dentatum Wolle Fig. 373

Cells large, deeply constricted, sinus linear, open; semicells truncate-ovate, base broad, basal and apical angles broadly rounded; vertical view broadly ovoid; chloroplast parietal, numerous, with numerous pyrenoids; cell wall with scattered, conical granules; length 115 to 142μ, width 74 to 87μ, isthmus 25 to 28μ.

E. Harbor.

Cosmarium depressum (Naeg.) Lundell Fig. 374

Cells small, deeply constricted, sinus linear, narrow, opening outwards; semicells transversely subelliptic, basal angles broadly rounded; apex convex; vertical view elliptic; chloroplast with one pyrenoid; cell wall finely punctulate; length 37 to 43μ, width 40 to 50μ, isthmus 12 to 14μ.

Put-in-Bay Harbor.

The dimensions are those in the British Desmideae by W. & G. S. West as Pieters (1902) did not give sizes.

Cosmarium depressum var. achondrum (Boldt) W. & G. S. West Fig. 375

Characters as for the species except the semicells are subhexagonal-elliptic, while the apex is broader and more truncate; length 33 to 43μ, width 43 to 46μ, isthmus 10 to 11μ.

Wehrle.

Cosmarium difficile Lütkem. var. **sublaeve** Lütkemuller. Fig. 376

Cells small, deeply constricted, sinus linear, closed; semicells hexagonal, basal angles acutely rounded, other angles obtuse; apex slightly retuse; vertical view elliptic; chloroplast with one pyrenoid; cell wall with one row of granules just above the isthmus and two rows below the apical angles; length 21 to 26μ, width 12 to 14μ, isthmus 2 to 3μ.

Kelleys.

Cosmarium eriense Taft Fig. 377

Cells of medium size, deeply constricted, sinus linear, closed; semicells somewhat rectangular, each with a broad truncate lobe just below the apical angles, each lobe with a conical granule within the margin of the upper angle; apex truncate, upper lateral margins retuse, basal angles broadly rounded, each with a single granule; vertical view ellipsoid with broadly rounded ends, each side with three undulations, four granules visible, one on either side near the ends; chloroplast with one pyrenoid; cell wall indistinctly punctate; length 35 to 37μ, width 30 to 33μ, isthmus 11μ.

Pelee.

Cosmarium exiguum? Archer Fig. 378

Cells small, not deeply constricted, sinus open; semicells subquadrate, angles rounded, sides slightly convex; apex truncate or slightly convex; vertical view elliptic; chloroplast with one pyrenoid; cell wall smooth; length 14 to 15μ, width 7 to 8μ, isthmus 6 to 7μ.

Kelleys.

Cosmarium favum W. & G. S. West Fig. 379

Cells large, deeply constricted, sinus open towards the isthmus, closed by the basal lobes of the semicells; semicells rectangular to reniform, all angles broadly rounded, sides and apex convex; vertical view broadly elliptic; chloroplast with one pyrenoid; cell wall granulate, each granule within a hexagonal area delimited by extremely delicate lines; length 62μ, width 51μ, isthmus 15μ.

Kelleys.

Cosmarium fontigenum Nordstedt Fig. 380

Cells small, deeply constricted, sinus slightly open towards the isthmus; semicells broadly subpyramidate; apex convex, basal angles broadly rounded, margins slightly convex, each with one undulation below the apex; vertical view narrowly elliptic, tumid; chloroplast with one pyrenoid; cell wall finely punctulate; length 22μ, width 20 to 21μ, isthmus 5 to 6μ.

E. Harbor.

Cosmarium formulosum Hoffman Fig. 381

Cells of medium size, deeply constricted, sinus linear, closed; semicells pyramidate-hemispherical, sides strongly convex; apex truncate, basal angles broadly rounded; vertical view elliptic, slightly tumid; chloroplast with two pyrenoids; cell wall granulate, with five to six rows showing within the margins, central portion of semicell smooth, with five vertical rows of large granules; length 35 to 50μ, width 32 to 42μ, isthmus 9 to 13μ.

Squaw, Wehrle.

Cosmarium formulosum Hoffman forma? Taft Fig. 382

Characters as for the species except for size; length 48 to 55μ, width 44 to 48μ, isthmus 11 to 13μ.

Middle.

Cosmarium franzstonii Taft Fig. 383

Cells large, deeply constricted, sinus linear, closed; semicells ovate-pyramidate; apex slightly flattened, apical angles rounded, basal angles broadly rounded; vertical view broadly elliptic with two large protuberances on each side; chloroplasts two, massive, each with one pyrenoid; cell wall granulate with punctulations between the granules, granules near the apex large, smaller and more numerous below; length 60 to 65μ, width 50 to 55μ, isthmus 16 to 20μ, cells 32μ thick.

Gibraltar, Squaw, Haunck, Kelleys.

Cosmarium geometricum W. & G. S. West var. **suecicum** Borge Fig. 384

Cells small, constriction deep, sinus linear, closed; semicells depressed truncate-pyramidate, basal angles rounded, sides slightly concave; apex truncate; vertical view elliptic, with an acutely rounded protuberance on each side; chloroplast with one pyrenoid; cell wall smooth; length 12μ, width 11μ, isthmus 3μ.

Kelleys.

Cosmarium globosum Bulnh. var. **subaltum** Messikommer Fig. 385

Cells small, constriction shallow, open; semicells subglobose; vertical view circular; chloroplast with one pyrenoid; cell wall granulate, granules interspersed with punctulations; length 35μ, width 20μ, isthmus 16μ.

Kelleys.

Cosmarium granatum de Brébisson Fig. 386

Cells small, constriction deep, sinus linear, closed; semicells truncate-pyramidate, basal angles mostly acutely rounded, base of semicells sometimes nearly subparallel, margins straight to slightly concave; apex rounded or often slightly truncate; vertical view narrowly elliptic; chloroplast with one pyrenoid; cell wall finely granulate; length 23 to 27μ, width 18 to 19μ, isthmus 4 to 5μ.

Haunck, Fisher, Smith, Squaw, Kelleys, Pelee.

A highly variable species.

Cosmarium granatum de Brébisson var. **subgranatum** Nordstedt Fig. 387

Semicells truncate-subpyramidate, basal angles acute, base of semicells parallel, lateral margins two-undulate; apex narrowly truncate; vertical view elliptic, tumid; chloroplast with one pyrenoid; cell wall finely granulate; length 25 to 29μ, width 18 to 21μ, isthmus 4 to 5μ.

Haunck, Fisher, Wehrle, Pelee.

Cosmarium hammeri Reinsch var. **protuberans** W. & G. S. West Fig. 388

Cells of medium size, constriction deep, sinus linear, closed; semicells truncate-pyramidate, basal angles rounded, upper margins retuse; apex broad, truncate, slightly retuse; vertical view elliptic and tumid; chloroplast with one pyrenoid; cell wall finely punctate; length 32 to 35μ, width 25 to 29μ, isthmus 8 to 10μ.

Pelee.

Cosmarium holmiense Lundell — Page 389

Cells of medium size, constriction moderately deep, sinus linear, closed; semicells broad-pyramidate, basal angles rounded, margins straight with two crenulations below the apical angles, apical angles rounded; apex truncate with a slight retuse central portion; vertical view broadly elliptic; chloroplast with one pyrenoid; cell wall smooth; length 50μ, width 30μ, isthmus 16μ.

Kelleys.

Cosmarium holmiense Lundell forma? Taft — Fig. 390

Cells of medium size, constriction moderately deep, sinus linear, closed; semicells broad-pyramidate, basal angles somewhat acutely rounded, margins convex with two undulations below the apical angles, apical angles broadly rounded; apex convex, not retuse; vertical view broadly elliptic; chloroplast with one pyrenoid; cell wall smooth; length 48 to 50μ, width 28 to 30μ, isthmus 16μ.

Kelleys.

Dimensions and cell outline are those of *Cos. holmiense* var. *trigonum* Nordstedt. The vertical view is elliptic, not triangular.

Cosmarium humile (Gay) Nordstedt var. **striatum** (Boldt) Schmidle — Fig. 391

Cells small, nearly quadrate, deeply constricted, sinus linear, closed; semicells rectangular, basal angles acute, margins nearly parallel to the broad truncate apex, one distinct undulation between each basal angle and the apical angle, apical angles rounded; apex with four distinct crenations between apical angles; vertical view elliptic, ends acutely rounded; chloroplast with one pyrenoid; cell wall smooth; length 16 to 19μ, isthmus 4μ.

Wehrle, Haunck, Fisher, Smith, Squaw.

Cosmarium impressulum Elfving var. **suborthogona** (W. & G. S. West) Taft — Fig. 392

Cells small, deeply constricted, sinus linear, closed; semicells subsemicircular, margins regularly eight-undulate, including basal angles; vertical view elliptic, with a slight protuberance on each side; chloroplast with one pyrenoid; cell wall very finely punctulate; length 25 to 27μ, width 19 to 21μ, isthmus 4 to 6μ.

Haunck.

Cosmarium kjellmani Wille var. **grande** Wille — Fig. 393

Cells of medium size, deeply constricted, sinus linear, closed; semicells pyramidate-hemispherical, basal angles rounded, margins convex and crenulate; apex truncate; vertical view broadly elliptic and tumid; chloroplast with two pyrenoids; cell wall with a granule at each marginal crenation and several rows of granules within the margin, apical crenations with two granules and two rows of granules below, central area of semicell with five vertical rows of large granules; length 46 to 50μ, width 37 to 39μ, isthmus 11 to 13μ.

Squaw, N. Bass dock.

Cosmarium laeve Rabenhorst — Fig. 394

Cells very small, deeply constricted, sinus linear, closed; semicells semielliptic, basal angles slighty rounded; apex truncate, retuse; vertical view elliptic; chloroplast with one pyrenoid; cell wall usually sparsely punctate, appearing smooth; length 13 to 14μ, width 11 to 12μ, isthmus 2 to 3μ.

Squaw, E. Harbor.

Cosmarium laeve var. **distentum** G. S. West forma? Taft — Fig. 395

Characters as for the species with cells small, deeply constricted, sinus closed, opening outwards; semicells ovoid-elliptic; vertical view elliptic and tumid; length 14 to 18μ, width 11 to 15μ, isthmus 3 to 4μ.

Kelleys, M. Bass beach pools.

Cosmarium laeve var. **octangularis** (Wille) W. & G. S. West — Fig. 396

Characters as in the type except semicells angular, eight-sided including the base; length 26μ, width 18μ, isthmus 7μ.

Pelee.

Cosmarium lundellii Delp. var. **ellipticum** W. West — Fig. 397

Cells large, deeply constricted, sinus linear, closed; semicells subsemicircular to semicircular-pyramidate, basal angles broadly rounded; apex rounded or very slightly truncate; vertical view broadly elliptic; chloroplast axial, ridged, with two pyrenoids; cell wall with small, sparse granules; length 69 to 87μ, width 50 to 57μ, isthmus 14 to 16μ.

Fisher.

Cosmarium margaritatum (Lund.) Roy & Bissett Fig. 398

Cells large, deeply constricted, sinus nearly closed, opening towards the isthmus; semicells quadrate to quadrate-reniform, basal angles broadly rounded; apex rounded; vertical view broadly elliptic; chloroplast with two pyrenoids; cells wall granulate, granules in vertical and oblique rows, interspersed with punctae; length 57 to 60μ, width 46 to 48μ, isthmus 18μ.

Wehrle.

Cosmarium meneghinii de Brébisson Fig. 399

Cells small, deeply constricted, sinus linear, closed; semicells transversely rectangular in basal part, and pyramidate-truncate above, basal angles acutely rounded, lower part of margins parallel and retuse, upper parts convergent and retuse; apex truncate and retuse; vertical view elliptic; chloroplast with one pyrenoid; cell wall smooth; length 17 to 18μ, width 11 to 14μ, isthmus 3.5μ.

Squaw, M. Bass beach pools.

Cosmarium moniliforme (Turp.) Ralfs var. **punctata** Lagerheim Fig. 400

Cells of medium size, deeply constricted, sinus opening outwards; semicells subcircular; vertical view circular; chloroplast axial, with six to seven radiating plates, one pyrenoid; cell wall finely punctulate; length 37 to 41μ, width 23μ, isthmus 7μ.

E. Harbor.

Cosmarium moniliforme (Turp.) Ralfs var. **subpyriforme** W. & G. S. West Fig. 401

Cells of medium size, deeply constricted, sinus opening outwards; semicells subpyriform; vertical view circular; chloroplast axial with 10 to 11 flanges, one pyrenoid; cell wall finely punctulate; length 44 to 48μ, width 25 to 28μ, isthmus 11 to 12μ.

Pelee.

Cosmarium nitidulum De Not. var. **pseudovalidum** Taft Fig. 402

Cells of medium size, deeply constricted, sinus linear, closed; semicells subrectangular, basal angles nearly rectangular, more or less produced, upper angles broadly rounded; apex truncate-convex; vertical view elliptic; chloroplast with one pyrenoid; cell wall punctate; length 33 to 35μ, width 28 to 30μ, isthmus 6 to 7μ.

Kelleys.

Cosmarium nobile (Turner) Krieger Fig. 403

Cells small, nearly quadrate, deeply constricted, sinus linear; semicells rectangular, basal angles acute with a conical tooth, margins parallel with one undulation and two conical granules, apical lobes produced, with four granules; apex truncate, crenulate, each crenulation with two granules, middle of semicell with one large conical granule; vertical view elliptic, tumid, with a conical granule centrally located; chloroplast with two pyrenoids; cell wall smooth; length 17 to 18μ, width 17 to 18μ, isthmus 4μ.

Haunck.

Cosmarium ochtodes Nordstedt Fig. 404

Cells large, deeply constricted, sinus linear; semicells ellipsoid-pyramidate, basal angles rounded, margins convex with seven to nine marginal crenations, about three rows of crenations within the margin; apex truncate and undulate; chloroplast with two pyrenoids; cell wall smooth in central portion of semicell, finely punctate within the crenations; length 67 to 74μ, width 50 to 55μ, isthmus 14 to 16μ.

Kelleys, Pelee.

Cosmarium pachydermum Lund. var. **aethiopicum** W. & G. S. West Fig. 405

Cells large, deeply constricted, sinus closed, open toward the isthmus; semicells broadly semielliptic, basal angles broadly rounded; apices broadly convex; vertical view broadly elliptic; chloroplast with two pyrenoids; cell wall punctate, punctae interspersed with very fine punctulations; length 78 to 83μ, width 62μ, isthmus 27 to 30μ.

Pelee.

Cosmarium phaseolus de Brébisson var. **elevatum** Nordstedt Fig. 406

Cells small, deeply constricted, sinus linear, closed; semicells hexagonal-elliptic, basal angles mostly rounded, margins straight to slightly convex; apex truncate to slightly convex; vertical view with a protuberance on each side; chloroplast with one pyrenoid; cell wall finely punctate; length 23 to 25μ, width 21 to 23μ, isthmus 4 to 5μ.

Squaw, Haunck, Wehrle, E. Harbor.

Cosmarium phaseolus de Bréb. forma **minor** Boldt Fig. 407

Cells small, deeply constricted, sinus linear, closed; semicells rounded, or reniform-pyramidate, basal angles rounded, margins convex; apex rounded or sometimes somewhat truncate; vertical view with a protuberance on each side; chloroplast with one pyrenoid; cell wall smooth; length 17 to 20μ, width 16μ, isthmus 4μ.

Fisher, Pelee.

Cosmarium pokornyanum (Grun.) W. & G. S. West Fig. 408

Cells small, medium deep constriction, sinus usually linear; semicells truncate-pyramidate with lower margins parallel, basal angles acutely rounded or rectangular, upper margins concave; apex truncate and retuse; vertical view ovate-tumid; chloroplast with one pyrenoid; cell wall sparsely punctate; length 33 to 35μ, width 18 to 19μ, isthmus 10 to 11μ.

Kelleys.

Cosmarium porrectum Nordstedt Fig. 409

Cells large, deeply constricted, sinus linear, closed; semicells rectangular, basal angles abruptly rounded, lateral margins slightly concave and diverging to the rounded and produced apical angles; apex broad and concave; vertical view tumid; chloroplast with one pyrenoid; cell wall granulate, granules in oblique series, wall with minute pores between the granules.

E. Harbor.

Cosmarium portianum Archer Fig. 410

Cells of medium size, deeply constricted, sinus open; semicells ovoid-elliptic, basal angles broadly rounded; apex rounded; vertical view elliptic; chloroplast with one pyrenoid; cell wall granulate, granules in vertical and horizontal series; length 33 to 37μ, width 24 to 27μ, isthmus 9 to 10μ.

E. Harbor.

Cosmarium protractum (Naeg.) De Bary Fig. 411

Cells of medium size, deeply constricted, sinus linear, closed; semicells depressed-pyramidate, basal angles broadly rounded, upper lateral margins distinctly concave to retuse, apical angles rounded; apex retuse; vertical view elliptic, tumid; chloroplast with two pyrenoids; cell wall granulate, a circle of large granules with scattered granules at the median portion; length 33 to 46μ, width 30 to 37μ, isthmus 9 to 10μ.

Haunck, E. Harbor.

Cosmarium pseudarctoum Nordstedt Fig. 412

Cells small, sinus shallow, open; semicells subsemicircular; vertical view circular; chloroplast axial with four to five radiating plates, one pyrenoid; cell wall smooth; length 19 to 20μ, width 14μ, isthmus 10 to 11μ.

Kelleys.

Cosmarium pseudoprotuberans Kirchner Fig. 413

Cells small, deeply constricted, sinus nearly linear, open; semicells hexagonal-elliptic, lateral angels rounded; apex truncate to slightly convex; vertical view elliptic, tumid; chloroplast with one pyrenoid; cell wall appearing smooth but with very fine punctulations; length 25 to 27μ, width 23 to 24μ, isthmus 5 to 6μ.

E. Harbor.

Cosmarium punctulatum de Brébisson var. **subpunctulatum** (Nordst.) Borge Fig. 414

Cells of medium size, deeply constricted, sinus linear, closed; semicells subsemicircular, basal angles acutely rounded, each with a conical granule; apex truncate; vertical view elliptic, tumid; chloroplast with one pyrenoid; cell wall granulate, median portion of semicell with a circle of large granules; length 32μ, width 30μ, isthmus 7μ.

Kelleys.

Cosmarium quadrum Lundell var. **minus** Nordstedt Fig. 415

Cells medium large, deeply constricted, sinus closed, open toward the isthmus; semicells subrectangular, basal angles rounded, apical angles broadly rounded, sides convex; apex straight; vertical view oblong-elliptic; chloroplast with two pyrenoids; cell wall granulate; length 44μ, width 35μ, isthmus 14μ.

Haunck.

Cosmarium rectangulare Grunow Fig. 416

Cells of medium size, deeply constricted, sinus linear, closed; semicells subhexagonal, basal angles acutely rounded, lower sides parallel, upper sides obliquely truncate; apex truncate; vertical view subelliptic; chloroplast with one pyrenoid; cell wall punctate; length 42 to 44μ, width 34 to 35μ, isthmus 11 to 12μ.

Pelee.

Cosmarium regnellii Wille Fig. 417

Cells small, deeply constricted, sinus linear, closed; semicells trapezoid-hexagonal, lower and upper lateral margins retuse, separated by a protruding lateral angle; apex broad and truncate; vertical view elliptic with a protuberance on each side; chloroplast with one pyrenoid; cell wall smooth; length 17 to 18μ, width 14 to 17μ, isthmus 4 to 5μ.

Smith, Wehrle, Fisher.

Cosmarium regnellii Wille var. **minimum** Eichler & Gutwinski Fig. 418

Characters as for the species; length 11 to 14μ, width 11 to 12μ, isthmus 3 to 4μ.

Wehrle.

Cosmarium reniforme (Ralfs) Archer Fig. 419

Cells medium large, deeply constricted, sinus mostly closed, open toward the isthmus; semicells reniform, basal angles broadly rounded; vertical view broadly elliptic; chloroplast with two pyrenoids; cell wall granulate, granules in oblique rows; length 48μ, width 44μ, isthmus 14μ.

Hauck.

Cosmarium reniforme (Ralfs) Archer var. **compressum** Nordstedt Fig. 420

Cells of medium size, deeply constricted, sinus closed; semicells depressed; apex slightly truncate; vertical view oblong-elliptic; cells 47 to 56μ x 46 to 64μ, isthmus 13 to 18μ wide.

Exact location not known.

Description adapted from W. & G. S. West.

Cosmarium reniforme (Ralfs) Archer var. **seminudum** Taft Fig. 421

Cells medium large, deeply constricted, sinus closed, open toward the isthmus; semicells reniform, basal angles rounded; vertical view oblong-elliptic with concave sides and one large granule on each side; chloroplast with one pyrenoid; cell wall granulate, granules in oblique series from basal angles to middle of apex, then downward to middle of semicell where there is one large granule, ends of semicells in vertical view with six or seven rows of granules, these areas connected by two double rows of granules, median portion not granulate; length 46 to 48μ, width 41μ, isthmus 14μ.

Squaw.

Cosmarium seelyanum Wolle Fig. 422

Cells small, deeply constricted, sinus linear, closed; semicells rectangular, apices slightly produced, basal angles rounded, each with three marginal granules, one undulation with three granules between basal angle and apex; apex truncate with four undulations; vertical view tumid; chloroplast with one pyrenoid; cell wall with granules within the lateral lobes, a row of granules just below the apex and a median ring of large granules with four granules within; length 23μ, width 23μ, isthmus 6 to 7μ.

E. Harbor.

Cosmarium subcostatum? Nordstedt Fig. 423

Cells medium size, deeply constricted, sinus linear, closed; semicells subsemicircular, basal angles rounded; apex flattened to truncate; vertical view tumid; chloroplast with one pyrenoid; cell wall margin crenate, each with two denticulations, apical crenations smooth, three to four rows of crenations within the lateral margins, a ring of large granules with four granules within at the middle of the semicell; length 32μ, width 27μ, isthmus 7μ.

Middle.

Cosmarium subcrenatum Hantzsch Fig. 424

Cells small, deeply constricted, sinus linear, closed; semicells broadly truncate-pyramidate, basal angles rounded, margins moderately convex, undulate; apex broad, truncate; vertical view elliptic and tumid; chloroplast with one pyrenoid; cell wall with two rows of undulations within the undulate margins, three to four undulations across the apex, three vertical rows of granules at the middle of the semicell, these surrounded by a hemispherical row of granules lying within the marginal series of undulations; length 23μ, width 19μ, isthmus 7μ.

Kelleys.

Cosmarium subcrenatum Hantzsch forma? Taft — Fig. 425

Characters as for the species except that the semicells are more depressed and the margins are more strongly convex; length 21 to 25μ, width 19 to 23μ, isthmus 5 to 6μ.

Squaw.

Cosmarium subcucumis Schmidle — Fig. 426

Cells large, deeply constricted, sinus linear, closed, but open toward the isthmus; semicells longitudinally semielliptic, basal angles rounded; apex convex; vertical view elliptic; chloroplast with two pyrenoids; cell wall smooth; length 55 to 60μ, width 35 to 37μ, isthmus 14 to 19μ.

Kelleys, Pelee.

Cosmarium subnudiceps W. & G. S. West var. **granulatum** Taft — Fig. 427

Cells large, deeply constricted, sinus linear, closed; semicells quadrate-reniform, basal angles broadly rounded; apex convex; vertical view broadly ellipsoid; chloroplast with one pyrenoid; cell wall densely granulate except in the upper median portion of the semicell where the granules are sparse and arranged at the angles of overlapping hexagonal areas, these granules interconnected by thickened ridges of the wall; length 50 to 54μ, width 41 to 43μ, isthmus 10 to 11μ.

Kelleys, Pelee, E. Harbor.

Cosmarium subochthodes Schmidle — Fig. 428

Cells large, deeply constricted, sinus closed and the basal angles of the two semicells overlapping; semicells pyramidate-subsemicircular, basal angles rounded, margins convex, eight to nine crenate; apex smooth and very slightly produced; vertical view elliptic; chloroplasts two, axial, each with one pyrenoid; cell wall with two or three rows of crenations within the margins and sparsely granulate; length 64μ, width 50μ, isthmus 16μ.

Haunck.

Cosmarium subraciborskii Taft — Fig. 429

Cells small, deeply constricted, sinus opening outwards; semicells subelliptic, ventral margin slightly more convex than dorsal margin, lateral angles sharply rounded; vertical view narrowly elliptic, slighty tumid; chloroplast with one pyrenoid; cell wall minutely granulate, granules in 18 to 20 vertical series across semicell; length 23 to 27μ, width 25 to 30μ, isthmus 5 to 7μ.

Squaw, Kelleys, Buckeye Isl. beach pools, E. Harbor.

Cosmarium subtumidum Nordstedt var. **klebsii** (Gutw.) W. & G. S. West — Fig. 431

Cells small, deeply constricted, sinus linear, closed; semicells pyramidate-semicircular with upper margins nearly straight, basal angles broadly rounded; vertical view broadly elliptic; chloroplast with one pyrenoid; cell wall smooth to finely punctulate; length 32μ, width 25 to 28μ, isthmus 7 to 9μ.

Squaw.

Cosmarium sulcatum Nordstedt var. **sumatranum** Schmidle — Fig. 430

Cells of medium size, deeply constricted, sinus linear, closed; semicells depressed elliptic-pyramidate, basal angles broadly rounded; apex truncate to slightly convex; vertical view broadly elliptic with three undulations on each side; chloroplast with one pyrenoid; cell wall smooth; length 39μ, width 29 to 32μ, isthmus 9μ.

Kelleys.

Cosmarium triplicatum Wolle — Fig. 432

Cells of medium size, deeply constricted, sinus linear, closed; semicells rectangular, basal angles rounded, upper angles broadly rounded, lateral margins parallel; apex truncate; vertical view broadly elliptic, ends rounded; chloroplast with two pyrenoids; cell wall partially granulate, two marginal and two within the basal angles, three marginal and three within the apical angles, upper face of semicell with one central, one above and four laterally displaced large granules interspersed with smaller granules; length 44 to 46μ, width 36 to 37μ, isthmus 11 to 12μ.

Kelleys, E. Harbor.

Cosmarium turpinii de Brébisson var. **podolicum** Gutwinski — Fig. 433

Cells large, deeply constricted, sinus linear, opening outwards; semicells truncate-pyramidate, basal angles broadly rounded, apical angles rounded; apex truncate and retuse, upper margins straight to slightly concave, undulate, face of semicell with two median protuberances; vertical view elliptic with 2 protuberances on each side; chloroplast with two pyrenoids; cell wall granulate, granules on basal angles larger than others; length 57 to 64μ, width 50 to 53μ, isthmus 12 to 14μ.

Wehrle, Fox, Fisher, Pelee.

Cosmarium variolatum Lundell var. **cataractarum** Raciborski — Fig. 434

Cells medium small, deeply constricted, sinus linear, closed; semicells pyramidate, basal angles rounded, upper margins straight or convex, sometimes retuse; apex rounded; vertical view elliptic and tumid with a thickened area in the wall of each protuberance; chloroplast with one pyrenoid; cell wall granulate with a median, circular, thickened spot; length 37 to 43μ, width 25 to 30μ, isthmus 6 to 7μ.

Fisher, Wehrle, Squaw, Gibraltar, Kelleys.

Cosmarium viride (Corda) Joshua var. **compressum** Taft — Fig. 435

Cells small, slightly constricted, sinus obtuse; semicells obovate-circular with slightly depressed apices; vertical view compressed, circular; chloroplast with one pyrenoid; cell wall finely but distinctly granulate, granules arranged in concentric rows within the margins of the semicells; length 30 to 33μ, width 18 to 22μ, isthmus 12 to 14μ.

Kelleys.

Desmidium Agardh 1824

Cells united into twisted filaments, usually inclosed in a broad, gelatinous sheath; cells depressed, broader than long, with a distinct, moderately deep constriction; vertical view elliptic, citriform, or three to four angled; chloroplast axial, massive, lobed with one pyrenoid in each lobe.

Desmidium swartzii Agardh — Fig. 436

Characters as for the genus; filaments triangular, twisted; cell length 18μ, width 44 to 46μ, isthmus 37 to 41μ.

Kelleys, E. Harbor, Put-in-Bay Harbor.

Euastrum Ehrenberg 1832

Cells of variable size, longer than broad, or about as broad as long, strongly compressed, deeply constricted, sinus linear; semicells usually pyramidate, apices mostly truncate, lateral margins variously lobed, center of semicell with one or more protuberances; apex usually with an incision of variable depth, or retuse; vertical view elliptic with variously arranged protuberances; chloroplast one, irregularly lobed and ridged with one or more pyrenoids in each semicell.

Euastrum abruptum Nordstedt — Fig. 437

Semicells truncate-pyramidate, apical incision deep, narrow, lateral lobes with conical denticulations, one large conical granule at each apical angle, median protuberance with about four ovate granules; length 38 to 41μ, width 27 to 28μ, polar lobe 18μ wide, isthmus 6 to 7μ.

E. Harbor.

Euastrum abruptum Nordstedt var. **lagöense** (Nordst.) **Krieger** — Fig. 438

Cells smaller than species with a single small, conical tooth on the lateral lobe; length 23 to 27μ, width 18 to 21μ, polar lobe 12 to 14μ wide, isthmus 4 to 5μ.

E. Harbor.

Eustrum abruptum Nordstedt var. **lagöense** (Nordst.) Krieger forma? Taft — Fig. 439

A variation of the var. *lagöense* in which the lateral lobes have three small granules on the margins and four pronounced granules within the apex on each side of the apical incision.

E. Harbor.

Euastrum bidentatum Naegeli — Fig. 440

Cells small; semicells subpyramidate, margins bilobate, each lobe with a sharp granule or with one to three granules just within the margin, central protuberance with three to four granules, one large granule on each side and below the apical incision; length 32 to 41μ, width 24 to 26μ, isthmus 4 to 7μ.

Pelee, E. Harbor.

Euastrum binale (Turp.) Ehrenberg var. **hians** (W. West) Krieger — Fig. 441

Cells very small; semicells subpyramidate, basal angles subacute, obliquely truncate toward the sinus, upper part of lateral margins concave; apex retuse; vertical view elliptic, each side with a small protuberance; cell wall smooth; length 14 to 17μ, width 11 to 13μ, isthmus 3 to 4μ.

Kelleys.

Euastrum dubium Naegeli forma? Taft — Fig. 442

Cells very small, nearly quadrate; semicell margins bilobed, upper lobes with a single granule, apical angles with a conical tooth, apical incision open, not as deep as in the species; length 19 to 23μ, width 16 to 19μ, polar lobe 12 to 13μ wide, isthmus 3 to 5μ.

Haunck, E. Harbor.

This form is doubtfully included with *E. dubium*.

Euastrum insulare (Wittr.) Roy var. **silesiacum**? Gronblad — Fig. 443

Cells small; semicells subpyramidate, basal angles nearly rounded, obliquely truncate toward the sinus, upper part of lateral margins concave, apical angles rounded; apex slightly retuse; vertical view elliptic, each side with a small protuberance; cell wall smooth; length 19 to 20μ, width 14μ, isthmus 3 to 4μ.

Pelee.

Euastrum lutkemulleri Duc. — Fig. 444

Cells small; semicells subpyramidate, basal angles acutely rounded, lateral margins with one undulation above the basal angle; apex flattened and apical angles broadly rounded, very slightly retuse; vertical view elliptic, each cell with a small, granulated protuberance; cell wall smooth; length 28μ, width 21μ, isthmus 7μ.

Kelleys.

Euastrum ohioense Taft — Fig. 445

Cells of medium size, as broad as long, deeply constricted, sinus closed, then opening outwards; semicells broadly pyramidate; polar lobe with a broad cuneate depression, each angle with small conical teeth, lateral margins slightly concave, each with a slight protuberance below the polar lobe, each protuberance with three conical teeth along the margin; basal lobes sharply rounded, with five vertical rows of conical granules; center of semicell with four conical granules inside a ring of flattened granules and one granule above the isthmus; vertical view with median tumid area with three conical granules and a portion of a ring of granules, ends with five rows of granules; length 60μ, width 60μ, polar lobe 23μ wide, isthmus 16μ.

E. Harbor.

Euastrum quebecense Irénée-Marie — Fig. 446

Cells of medium size, deeply constricted, sinus closed; semicells subquadrate-pyramidate, basal angles with a conical tooth in the plane of the isthmus, lateral margins with two slight undulations above the basal angle, strongly concave in upper part; apex broad, slanting obliquely upward to the deep, open apical incision, each apical angle with a long, conical tooth, and a smaller tooth just below and within the margin, one tubercle on each side of the base of the apical incision; vertical view with a protuberance with four nearly rectangular granules; length 55μ, width 37μ, polar lobe 23μ wide, isthmus 6μ.

Pelee.

Euastrum verrucosum Ehrenberg var. **alatum** Wolle — Fig. 447

Cells large, subhexagonal, deeply constricted, outer half of sinus open, basal angles closing, resulting in a hooked appearance; semicells three-lobed, polar lobe broadly retuse, all lobes granulate, semicells with three large protuberances across the basal portion, each with granules in concentric circles; cell wall granulate; length 76 to 80μ, width 62 to 67μ, polar lobe 30 to 35μ wide, isthmus 16 to 18μ.

Kelleys, Pelee.

Hyalotheca Ehrenberg 1840

Filaments with broad gelatinous sheaths; cells broader than long, nearly cylindrical, median constriction slight, apices flattened; cell wall smooth or with delicate transverse ridges that encircle the cell below the apices; chloroplasts two, axial with radiating lobes and one central pyrenoid.

Hyalotheca dissiliens (Smith) de Brébisson — Fig. 448

Characters as for the genus; cell wall smooth; length 12 to 15μ, width 23 to 25μ.

Kelleys deep quarry.

Hyalotheca mucosa (Mert.) Ehrenberg Fig. 449

Characters as for the genus; cell wall with two parallel rows of granules just within the apices; length 16 to 21μ, width 18 to 20μ, isthmus 16 to 18μ.

E. Harbor.

Micrasterias Agardh 1827

Cells variable in size, greatly compressed, with a very deep, nearly linear median incision; semicells three to five-lobed, apical lobe widely cuneate, lateral lobes bilobulate, face of semicell generally without granulate protuberances; chloroplast single, lobed, with many pyrenoids.

The genus *Micrasterias* is rare in the Island Region. The only recorded species are from E. Harbor.

Micrasterias radiata Hassall Fig. 450

Cells deeply constricted, sinus wide open; semicells five-lobed, incisions wide and deep, each angle of polar lobe produced into long diverging processes with deeply furcate apices, lateral lobes divided into two bifurcate processes; apex acute; cell wall smooth; length 140μ, width 106μ, polar lobe 89μ wide, isthmus 18μ.

E. Harbor.

Micrasterias truncata (Corda) de Brébisson var. **semiradiata** Cleve Fig. 451

Cells elliptical, poles broadly truncate, deeply constricted, sinus linear, opening outwards; semicells five-lobed, upper incision deep and open, lateral lobes bilobulate, each lobule emarginate, apical lobe slightly convex and retuse in middle; cell wall punctate; length 80 to 88μ, width including teeth 92 to 96μ, without teeth 83μ, isthmus 11 to 13μ.

E. Harbor.

Penium de Brébisson 1844

Cells straight, cylindrical to fusiform, with or without a slight median constriction, apices rounded or subtruncate; chloroplasts one or two per semicell, each a central mass with radiating longitudinal plates, plates entire along the margins; pyrenoids axial, one or more; cell wall with pores.

Penium margaritaceum (Ehr.) de Brébisson Fig. 452

Cells large, cylindrical or subfusiform, with a median constriction, apices truncately rounded; cell wall brownish, with longitudinal rows of granules; length 115 to 184μ; width 21 to 23μ.

Fox, Kelleys, E. Harbor.

Pleurotaenium Naegeli 1849

Cells straight, elongated, cylindrical, constricted; semicells with a nonplicate, inflated base; apex with or without tubercles, truncate or truncately rounded; chloroplasts numerous, parietal, longitudinal bands, pyrenoids numerous.

Pleurotaenium ehrenbergii (de Bréb.) De Bary Fig. 453

Cells large, nearly cylindrical or with sides of semicells somewhat convex; base of semicell inflated with one undulation above it; apex surrounded by tubercles; length 270 to 520μ, width at base 27 to 30μ, width at middle of semicell 25 to 35μ, width at apex 16 to 18μ, isthmus 21 to 23μ.

Pelee.

Pleurotaenium trabecula (Ehr.) Naegeli Fig. 454

Cells large, nearly cylindrical; semicells with one basal inflation, apices rounded-truncate, no tubercles; cell wall punctate; length 360 to 580μ, width at base 26 to 35μ, width at apex 20 to 23μ.

Squaw, Fisher, Wehrle.

Sphaerozosma Corda 1835

Cells small, flattened, deeply constricted, sinus narrow and linear, or open, united in long, twisted filaments by short apical appendages; chloroplast one axial with one pyrenoid in each semicell.

Sphaerozosma granulatum Roy & Bissett Fig. 455

Characters as for the genus; lateral walls of semicells with about five minute granules; length 9 to 10μ, width 9 to 11μ, isthmus 4 to 5μ.

Smith, Kelleys church quarry.

Spondylosium de Brébisson 1844

Cells small, flattened, often deeply constricted, sinus open; semicells variable in shape, apices truncate, concave, or convex; vertical view elliptic, tumid-elliptic, or triangular; cells united by apposition of the apices into filaments.

Spondylosium luetkemuelleri? Gronblad — Fig. 456

Cells deeply constricted, sinus open; semicells subelliptic, ventral margin nearly straight, dorsal margin convex and elvated at the central portion; vertical view elliptic and tumid; cell walls smooth; length about 27μ, width about 30μ, isthmus about 8μ.

Exact location not known.

Staurastrum Meyen 1829

Cells variable in size, usually as broad as long, or broader, usually radially symmetrical, median constriction more or less deep; semicells variable in outline, with the angles frequently produced into elongate, hollow processes, 2 to 12 radiate in vertical view; cell wall smooth to granulate, or with variously arranged spines or verrucae; chloroplast one per semicell, axial, with radiating lobes, and with one pyrenoid.

Staurastrum avicula de Brébisson var. subarcuatum (Wolle) W. West — Fig. 457

Cells of medium size, deeply constricted, sinus open; semicells oblong-elliptic, ventral margin more angular and more convex than dorsal margin, lateral angles rounded and with two sharply pointed, divergent teeth; vertical view triangular with retuse margins; cell wall finely granulate, granules in vertical series; length 36 to 37μ, width 38 to 40μ, isthmus 9 to 10μ.

Wehrle.

Staurastrum biarcuus Taft — Fig. 458

Cells small, sinus deep, opening outwards; semicells truncate-pyramidate, sides straight, base convex; apex retuse; vertical view triangular, each angle with a tooth-like granule, sides straight or slightly convex, sharply retuse at the center; within the vertical view formed by the basal angles, and in miniature, is the smaller vertical view of the apical angles; cell wall granulate, granules arranged in concentric series about the angles, each basal angle furnished with two vertically arranged teeth, the lower smaller than the one above; each apical angle with a single, broad, conical granule; length 35 to 36μ, width 32 to 34μ, isthmus 14μ.

Kelleys.

Staurastrum bicoronatum Johnson var. **tridentatum** Taft — Fig. 459

Cells small, deeply constricted, sinus open from an apiculate apex; semicells narrowly elliptic; apex distinctly elevated, lateral angles extended into processes terminating in three short spines; vertical view triangular, sides strongly concave, base of each process with two short laterally placed processes and a circle of verrucae; length 23μ, width 38 to 43μ, isthmus 4 to 6μ.

E. Harbor.

Staurastrum bieneanum Rabenhorst — Fig. 460

Cells small, deeply constricted, sinus first linear, then opening outwards; semicells oblong-elliptic, both surfaces strongly convex, lateral angles acutely rounded, with two minute apiculations; vertical view triangular, sides concave; cell wall finely granulate length 31 to 32μ, width 30 to 34μ, isthmus 7 to 8μ.

Kelleys.

Staurastrum brevispinum de Brébisson var. **canadense** Taft — Fig. 461

Cells of medium size, deeply constricted, sinus first narrow, then opening widely; semicells depressed hexagonal, lateral angles acute, with one conical tooth; apex flattened or very slightly convex; vertical view triangular and sides retuse; cell wall obscurely granulate; length 46 to 48μ, width 44μ, isthmus 9 to 10μ.

Pelee.

Staurastrum chaetocerus (Schroeder) G. M. Smith — Fig. 462

Cells small, constriction slight, opening outwards; semicells pyramidate, upper angles extended into long processes with three teeth, margins of processes with apiculations; vertical view biradiate; length with processes 40 to 75μ, without processes 18 to 25μ, width with processes 60 to 73μ, without processes 14 to 16μ, isthmus 4 to 7μ.

Hatchery.

Staurastrum crenulatum Delpont forma? Taft — Fig. 463

Cells small, deeply constricted, sinus open; semicells pyramidate, margins undulate, apical angles extended into short processes, each with four teeth; vertical view triangular, sides retuse, each process with rings of punctations, each side with two verrucae inside the margin; length 21μ, width 23μ, isthmus 5μ.

Wehrle.

Staurastrum cuspidatum de Brébisson — Fig. 464

Cells small, deeply constricted, sinus wide, opening outwards; semicells elliptic, lateral angles rounded, each with a long down-curving spine; vertical view triangular, sides concave, angles with one long spine; length 18 to 20μ, width without spines 16 to 18μ, isthmus 4 to 5μ.

Smith.

Staurastrum dejectum de Brébisson — Fig. 465

Cells small, deeply constricted, sinus wide, opening outwards; semicells triangular, dorsal and lateral margins straight or slightly convex, lateral angles with a long, divergent spine; vertical view triangular, margins slighty concave, angles with a long spine; length 18 to 27μ, width without spines 17 to 27μ, isthmus 5 to 8μ.

Put-in-Bay Harbor.

Staurastrum floriferum? W. & G. S. West — Fig. 466

Cells of medium size, medium deep constriction, open; semicells nearly quadrate, upper angles extending into long processes, each with three teeth; vertical view triangular, sides slightly concave, processes with rows of teeth, center of apex with a circle of six verrucae; length 34 to 46μ, width with processes 48 to 50μ, isthmus 7 to 9μ.

Wehrle, Smith, Haunck.

Straurastrum furcigerum de Brébisson — Fig. 467

Cells large, deeply constricted, sinus narrow, then opening outwards; semicells elliptic, dorsal and ventral margins equally convex, lateral angles produced into short processes tipped with three stout spines; apex of semicell having a similar series of processes with concentric rows of teeth; vertical view triangular, margins concave, each angle with an apical process; length without processes 41μ, width with processes 55 to 57μ, isthmus 13μ.

Pelee.

Staurastrum granulosum (Ehren.) **Ralfs** — Fig. 468

Cells small, deeply constricted, sinus open; semicells oblong-elliptic, dorsal margin less convex than ventral margin, lateral angles acutely rounded, each with two vertically arranged teeth; vertical view triangular, margins concave, each angle with one tooth showing; cell wall densely granulate; length 27 to 32μ, width 25 to 32μ, isthmus 10 to 14μ.

Kelleys.

Staurastrum orbiculare Ralfs var? Taft — Fig. 469

Cells medium large, deeply constricted, sinus linear, closed; semicells pyramidate-semicircular, basal angles rounded, upper margins convex to nearly straight; apex rounded; vertical view triangular, margins concave, angles more or less pointed; cell wall punctulate; length 42μ, width 40μ, isthmus 11μ.

Pelee.

Staurastrum ornatum Turner var. **asperum** (Perty) Schmidle — Fig. 470

Cells small, constriction shallow; semicells pyramidate, upper angles extending into short depressed processes; apex rounded; vertical view six-radiate, each process with a short process on either side at the base, apex with a ring of granules, two granules at the base of each process; length 26 to 28μ, width 37μ, isthmus 8 to 10μ.

Pelee, E. Harbor.

Staurastrum paradoxum Meyen — Fig. 471

Cells of medium size, constriction slight, sinus acute; semicells cup-shaped, widening toward the apex which is slightly convex, upper angles extending into long, stout processes tipped with four spines; vertical view three-radiate, sides mostly straight, processes with concentric rings of minute teeth; length 28 to 29μ, width without processes 12 to 15μ, with processes 53μ, isthmus 7μ.

Hatchery, open lake in Isl. Region.

Staurastrum peleii Taft Fig. 472

Cells deeply constricted, sinus closed; semicells rectangular with three apical processes continued into two short, truncate, vertically arranged processes, basal angles rounded, with three concentric rows of granules; vertical view triangular, each angle broadly rounded, superimposed and projecting beyond this angle is the lower of the two vertically arranged processes with three marginal teeth and three small granules within the margin, within this process is a bidentate protuberance, sides sharply retuse at center; length 37 to 39μ, width 37 to 39μ, isthmus 16μ.

Pelee.

Staurastrum polymorphum de Brébisson Fig. 473

Cells small, sinus open; semicells narrowly elliptic, both dorsal and ventral surfaces equally convex, upper angles produced into short processes, each with four teeth; apex and processes undulate; vertical view triangular, sides concave, processes with concentric double rows of minute granules; length 28 to 30μ, width 35 to 46μ isthmus 7 to 9μ.

Haunck, Squaw, E. Harbor.

Staurastrum polytrichum Perty var. **ornatum** Taft Fig. 474

Cells large, deeply constricted, sinus open; semicells hexagonal-elliptic, apices truncate; vertical view triangular, sides concave, angles rounded; cell wall with long, acutely pointed and mostly curved spines, spines arising from truncate, conical protuberances of the wall; length without spines 58μ, width without spines 55 to 57μ, with spines 66 to 67μ, spines 4.5 to 5.5μ, isthmus 21μ.

Pelee.

Staurastrum punctulatum de Brébisson Fig. 475

Cells small, deeply constricted, sinus open and acute angled, often twisted at the isthmus; semicells subrhomboid-elliptic, dorsal and ventral margins equally convex, angles acutely rounded; vertical view triangular, sides slighty retuse, angles of one semicell often alternate with the other; cell wall granulate, granules in series around the angles; length 26 to 40μ, width 23 to 36μ, isthmus 8 to 16μ.

Put-in-Bay Harbor.

Description and figure from West & West (1904-1923)

Staurastrum punctulatum de Brébisson var. **kjellmanii** Wille Fig. 476

Characters as for the species except sinus more open, angles of semicells more rounded, and sides of vertical view straight or slightly convex; length 39μ, width 30μ, isthmus 13μ.

Kelleys.

Staurastrum sebaldi Reinsch var. **ornatum** Nordstedt Fig. 477

Cells large, moderately constricted, sinus opening widely; semicells cup-shaped, angles produced into stout processes with three spines, processes with large denticulations and verrucae; vertical view triangular, sides straight, processes with a series of spines within the margins, sides of semicell with verrucae within the margins; length 53μ, width with processes 96μ, without processes 21μ, isthmus 14μ.

E. Harbor.

Staurastrum setigerum Cleve Fig. 478

Cells of medium size, deeply constricted, sinus opening outwards; semicells ovate-elliptic; vertical view triangular, sides concave, angles acutely rounded; cell wall with long, sharp spines irregularly arranged around the angles; length 35 to 39μ, width 39 to 46μ; isthmus 11μ.

Squaw, Wehrle, Haunck.

Staurastrum striolatum (Naeg.) Archer Fig. 479

Cells small, deeply constricted, sinus wide; semicells oblong-elliptic, ventral margin strongly convex, dorsal margin straight or sightly retuse, angles rounded; vertical view triangular or four-radiate, sides concave; cell wall finely granulate, granules in rows around the angles; length 19 to 21μ, width 18 to 23μ, isthmus 8μ.

Wehrle, Haunck, Smith, Kelleys.

Staurastrum tetracerum Ralfs Fig. 480

Cells small, constriction medium deep, sinus open; semicells rectangular, upper angles produced into long diverging processes with four minute teeth, processes with rows of minute apiculations; apex slightly concave; vertical view fusiform; length with processes 25 to 27μ, without processes 10 to 11μ, width with processes 28 to 30μ, without processes 7 to 9μ, isthmus 5μ.

E. Harbor.

Family Mesotaeniaceae

Cylindrocystis Meneghini 1838

Cells cylindrical, sometimes slightly curved, length varying to three and one-half times the diameter, unconstricted, or with a very slight identation; apices rounded, embedded in mucilage; choroplast one per semicell, axial, stellate, one large pyrenoid per chloroplast.

Cylindrocystis brébissonii var. **minor** W. & G. S. West — Fig. 481

Characters as for the genus; length up to 42μ, width 12 to 13μ.

Gibraltar, Kelleys N. quarry seepage.

Gonatozygon De Bary 1856

Cells cylindrical, length 10 to 20 times the diameter, not constricted; apices truncate and slightly inflated, in filaments which readily disassociate; chloroplasts two, axial, narrow and undulate, pyrenoids numerous.

Gonatozygon kinahani (Arch.) Rabenhorst — Fig. 482

Characters as for the genus; cell wall smooth; length 135 to 195μ, width 11 to 12μ.

Squaw.

Gonatozygon monotaenium De Bary — Fig. 483

Cell wall minutely and densely granulate, granules variable in shape and size; length 101 to 190μ, width 9 to 10μ.

Mound, Kelleys.

Division Charophyta

Plants included in this division are unique and occupy an isolated taxonomic position. They are alga-like in some respects, but this does not necessarily imply that they should be included in one of the several algae divisions, especially since the great differences among algae have been recognized by the establishment of a number of separate plant divisions to accommodate these differences. They have no known ancestors, and no evolutionary line directly attributable to them can be traced. They resemble the Chlorophyta in their pigmentation and to some respect in their reproduction. The sex organs are one-celled, but the sterile sheaths around these organs are distinctive. Also distinctive is the germination of the zygote with its protonema-like stage.

The diversity of opinion concerning their taxonomic position is evident in the literature where they are assigned to an order of the Chlorophyceae, to a class coordinate with the Chlorophyceae, or to a separate division of the plant kingdom. The latter seems to the writer, to be the best choice.

Class Charophyceae

These plants are macroscopic, up to 60 cm in length, usually erect, and often calcareous. Their axes regularly are differentiated into nodes and internodes by the repeated division of an apical meristematic cell. The internodes are either corticated or ecorticated; the nodes have whorls of leaf-like branches from which branches of unlimited growth arise in the axils. Asexual multiplication is either by stolons or by bulbils on the basal rhizoidal branches; sexual reproduction is oogamous with oogonia and antheridia at the nodes. The oogonia are large, ovoid, or sub-globose, enclosed by spiral cortications that terminate anteriorly in a coronula. Smaller than the oogonia, the antheridia are globose and red or orange-red in color. With a wall of interlocking plate-cells, they are located above, below, or beside the oogonia. Each oogonium has one egg; each antheridium contains numerous motile sperms.

KEY TO GENERA OF CLASS CHAROPHYCEAE

1. Main axis corticated .... **Chara**
1. Main axis not corticated 2
    2. Each leaf subtended by 1 or 2 spine-like cells; corona of 1 tier of 5 cells .... **Chara**
    2. No whorl of spine-like cells at nodes 3
3. All leaves branched, corona of 2 tiers of 5 cells each .... **Nitella**
3. Leaves both branched and unbranched; corona of 2 tiers of 5 cells each .... **Tolypella**

Order Charales

All Charaophyceae are in the one order, Charales. The characters that distinguish the order are the same as those for the Charophyceae.

Family Characeae

Those who find it necessary to study the Characeae are referred to the monumental works by Richard D. Wood and Kozo Imahori (1964, 1965). This monograph and iconograph provide detailed descriptions, synonymy, and figures necessary for a critical study of the taxa.

The treatment of the Characeae in western Lake Erie will include only names of the taxa, their locality records, and such synonymy as is necessary to assign the earlier records to their proper taxonomic position.

Chara L., em. Ag., em. A. Braun 1849

Plants usually coarse and upright, often branched, calcareous; axes composed of nodes and internodes, internodal cells corticated, some ecorticated; each node with a whorl of leaves, each leaf subtended by one or two spine-like cells; usually with one branch at a node, branches in axils of leaves; homothallic or heterothallic; antheridium below oogonium if homothallic; coronula of oogonium with a single tier of five cells.

Chara braunii Gmelin See Wood and Imahori (1965), p. 257.

Reported by Pieters (1902), Put-in-Bay, Squaw as *C. coronata, microptila, incrustata*, East Harbor and Carp Pond as *C. coronata;* by Wood (1947), Alligator Bar, Gibraltar.

Chara braunii forma **schweinitzii** (A. Br.) R. D. W. See Wood and Imahori (1965), p. 263.

Reported by Pieters (1902), Squaw as *C. coronata* f. *incrustata*, E. Harbor as *C. coronata, meiocarpa, meioptila;* by Wood (1947), Fisher, Put-in-Bay as *C. schweinitzii*, Squaw as *C. coronata* and *schweinitzii.*

Chara fibrosa var. **fibrosa** forma **keukensis** (T.F.A.) R. D. W. See Wood and Imahori (1965), p. 292.

Reported by Pieters (1902), Squaw as *C. hydropitys* f. *compacta;* by Wood (1947), Squaw as *C. keukensis* (Allen) Robinson.

Chara fibrosa var. **hydropitys** (Reich.) R. D. W., em. See Wood and Imahori (1965), p. 302.

Reported by Pieters (1902), Squaw as *C. hydropitys* f. Reich.

Chara globularis var. **aspera** (Deth. ex. Willd.) R. D. W., em. See Wood and Imahori (1965), p. 199.

Reported by Pieters (1902), Squaw as *C. aspera* (Deth.) Willd.

Chara globularis var. **globularis** (Desvaux) R. D. W. See Wood and Imahori (1965), p. 169.

Reported by Pieters (1902), E. Harbor as *C. fragilis* f. *brevifolia*, Put-in-Bay as *C. fragilis* f. *subinermis;* by Wood (1947), Haunck, L. Erie shore at Fisher as *C. contraria.*

Chara globularis var. **virgata** forma **macounii** (T. F. A.) R. D. W. See Wood and Imahori (1965), p. 186.

Reported by Pieters (1902), Squaw as *C. aspera* Willd.; by Wood (1947), Squaw as *C. macounii* (Allen) Robinson.

Chara hispida var. **major** forma **intermedia** (A. Br.) R. D. W. See Wood and Imahori (1965), p. 145.

Reported by Pieters (1902), Put-in-Bay as *C. intermedia* A. Br.

Chara vulgaris var. **vulgaris** (A. Br. ex. Kuetz.) R. D. W. See Wood and Imahori (1965), p. 78.

Reported by Pieters (1902), Put-in-Bay as *C. intermedia;* by Wood (1947), Haunck, L. Erie shore at Fisher, near Monument at Put-in-Bay, Gibraltar dock as *C. contraria.*

Chara zeylanica var. **sejuncta** (A. Br.) R. D. W., em. See Wood and Imahori (1965), p. 238.

Reported by Pieters (1902), E. Harbor as *C. sejuncta* A. Br.; by Wood (1947), Haunck as *C. compacta.*

Chara zeylanica var. **zeylanica** forma **michauxii** (A. Br.) H. and J. Gr. See Wood and Imahori (1965), p. 231.

Reported by Pieters (1902), E. Harbor as *C. sejuncta;* by Wood (1947), E. Harbor as *C. haitensis* Turpin.

Nitella Ag., em. A. Br., Leonhardi 1863

Plants more or less upright, often branched, only occasionally calcareous; axes composed of nodes and internodes, internodal cells ecorticate; nodes without whorls of spine-like cells; usually with two or more branches in the axils of the leaves at a node, branchlets repeatedly furcate, not in dense terminal clusters; homothallic or heterothallic; coronula of oogonium with two tiers of five cells each; oogonia and oospores compressed in cross section.

Nitella acuminata var. **acuminata** forma **subglomerata** (A. Br.) R. D. W. See Wood and Imahori (1965), p. 404.

Reported by Pieters (1902), E. Harbor as *N. subglomerata* A. Braun; also by Wood (1947), same.

Nitella furcata sub. sp. **furcata** (A. Br.) R. D. W. See Wood and Imahori (1965), p. 475.

Reported by Pieters (1902), E. Harbor as *N. polyglochin* A. Br.

Nitella gracilis sub. sp. **gracilis** var. **confervacea** Bréb. em. See Wood and Imahori (1965), p. 616.

Reported by Pieters (1902), E. Harbor as *N. batrachospermae* (Reich.) A. Br.; by Wood (1947), as *N. gracilis* (Smith) Agardh.

Nitella megacarpa (T. F. A.) R. D. W., comb. nov., em. See Wood and Imahori (1965), p. 522.

Reported by Pieters (1902), E. Harbor as *N. polyglochin;* by Wood (1947), E. Harbor as *N. megacarpa* Allen.

Nitella tenuissima (Desv.) Kuetzing. See Wood and Imahori (1965), p. 544.

Reported by Pieters (1902), E. Harbor as *N. tenuissima;* by Wood (1947), E. Harbor as *N. tenuissima.*

Tolypella (A. Br.) A. Braun 1857

Plants more or less upright, branched, almost dendroid, sometimes encrusted; axes composed of nodes and internodes, internodal cells corticate, nodes without whorls of spine-like cells; irregularly branched, two or three in the leaf axils; branchlets monopodial, terminating in coarse, dense, fertile clusters; homothallic or heterothallic; coronula of oogonium with two tiers of five cells each; oogonia and oospores circular in cross section.

Tolypella intricata var. **intricata** forma **intricata** (T. F. A.) R. D. W. See Wood and Imahori (1965), p. 739.

Reported by Pieters (1902), Hatchery as *T. intertexta* Allen; also by Wood (1947) as *T. intertexta Allen.*

Division Chrysophyta

This is a large and varied group which includes amoeboid and flagellate cells that are sessile or free-floating, solitary or colonial, both organized and unorganized. They are simple, branched, or nearly pseudoparenchymous filaments. Their common characteristics include a preponderance of carotinoids in the chromatophores, the reserve food being oils and leucosin rather than starch, and cell walls often composed of two parts and frequently containing silica. Reproduction includes cell division, fragmentation aplanospores, zoospores, and isogamous sexual reproduction.

Class Xanthophyceae

The plants may be unicellular, multicellular and filamentous, or siphonaceous. The formation of H-pieces in the cell wall structure is especially prominent in this class. Motile cells have two flagellae of unequal length and structure. Other characteristics are the same as for the division.

KEY TO ORDERS OF CLASS XANTHOPHYCEAE

1. Filamentous, siphonaceous, or coenocytic 3
1. Not filamentous, siphonaceous, or coenocytic 2
   2. Cells plasmodial, protoplast naked or enclosed in a lorica; cells often stipitate, attached .... Rhizochloridales
   2. Cells unicellular or in loose colonies, protoplast enclosed by a cell wall, not motile .... Heterococcales
3. Filamentous, mostly unbranched, usually free-floating .... Heterotrichales
3. Branched siphonaceous or globular coenocytic; often terrestrial, or in attached, submerged mats .... Heterosiphonales

KEY TO GENERA OF CLASS XANTHOPHYCEAE

1. Filamentous 2
1. Not filamentous 3
   2. Branched, parietal, discoid chromatophores .... **Monocilia**
   2. Unbranched, stout H-pieces, parietal, discoid chromatophores .... **Tribonema**
3. Terrestrial, macroscopic, globose above, coenocytic .... **Botrydium**
3. Aquatic, submerged 4
   4. Colonial 5
   4. Cells solitary, attached, or free-floating 6
5. Cells globose or ovoid, 2-8 in a wide gelatinous envelope .... **Gloeobotrys**
5. Cells cylindrical, in corymb-like colonies .... **Ophiocytium**
   6. Cells free-floating 7
   6. Cells stipitate, attached 8
7. Cells cylindrical, 1 end capitate .... **Ophiocytium**
7. Cells ellipsoid or subcylindrical, with a spine at each end .... **Centritractus**
   8. Cell-shape various, inclosed in a lorica-like envelope, stipe thread-like .... **Stipitococcus**
   8. Cells ovoid, subglobose, pyriform, or sickle shaped, not inclosed in a lorica 9
9. Stipe thin, longer than cell, without disc at point of attachment .... **Perionella**
9. Stipe usually shorter than cell, with disc at point of attachment .... **Characiopsis**

Order Rhizochloridales

The cells are plasmodial with the protoplast naked or inclosed in a lorica of definite shape. The chromatophore is a laminate disc. Reproduction is by cell division or zoospores.

Family Stipitococcaceae

Stipitococcus W. & G. S. West 1898

Cells epiphytic, inclosed in an envelope basally attached to other algae by an elongate, thread-like stipe; lorica with a rounded base and expanded apex; chromatophores one to three, parietal, cup-shaped or irregular, pale yellow-green.

Stipitococcus urceolatus W. & G. S. West — Fig. 484

Lorica ovoid, extending into an irregularly flaring apex; stipe thread-like, without a basal disc; chromatophores one or two parietal discs; cells 3 to 4μ x 6 to 11μ.

Squaw; on *Mougeotia*.

Stipitococcus vasiformis Tiffany — Fig. 485

Lorica vase-like, basal portion subglobose, upper portion elongate with nearly parallel sides, opening only slightly enlarged; stipe short; chromatophore one, plate-like; cells 4.5 to 7μ x 8 to 13μ.

Pelee canal.

Order Heterococcales

The plants are nonfilamentous and mostly unicellular or loosely bound colonies. Some are free-floating while others are epiphytic or in some manner sedentary. The cells are nonmotile and do not return directly to the motile condition. They rarely divide vegetatively but form zoospores and autospores. There are one or more parietal, oval or plate-like chromatophores.

Family Gloeobotrydaceae

Gloeobotrys Pascher 1930

Colony free-floating or sedentary, a gelatinous mass of regular or irregular shape, matrix homogeneous or weakly lamellate; cells numerous, spherical or slightly ovate; chromatophores two to four, parietal discoid.

Gloeobotrys limneticus (G. M. Smith) Pascher — Fig. 486

Colony ovate, with 4 to 30 cells; chromatophores three to four, pale yellowish-green, parietal, disciform, without pyrenoids; cells 5 to 6μ x 6 to 9μ.

Kelleys.

This alga was reported by Tiffany (1934) as *Chlorobotrys limneticus* G. M. Smith. It is presently assigned to Pascher's genus, *Gloeobotrys*.

Family Characiopsidaceae

Characiopsis Borzi 1895

Cells sessile, solitary or gregarious, ovoid, pyriform, subcylindrical or arcuate, with a long or short basal stalk having a basal disc at point of attachment; cell wall of overlapping halves; chromatophores usually two to five, plate-like, yellow-green, without pyrenoids.

Characiopsis cylindrica (Lambert) **Lemmermann** — Fig. 487

Cells cylindrical, with rounded apex and slightly tapering base, nearly sessile, no basal disc; chromatophores two; cells 8 to 20μ x 20 to 430μ.

Terwilliger, Squaw, Hatchery, Haunck, Smith; on *Polyarthra trigla* Ehrenberg.

Peroniella Gobi 1887

Cells epiphytic on other algae, solitary or gregarious; cells globose to ovoid, sometimes pyriform when young, with a delicate, hyaline basal stipe with or without a basal disc; chromatophores one or two, parietal, pale yellow-green, without pyrenoids.

Peroniella planctonica G. M. Smith — Fig. 488

Characters as for the genus; cells without stipe 6 to 10μ long; stipe 1.2μ x 8 to 10μ.

Kelleys; on *Oedogonium*.

Family Centritractaceae

Centritractus Lemmermann 1900

Cells solitary, cylindric-ellipsoid to elliptic, with a long spine at each pole; cell wall thick, composed of two overlapping pieces; chromatophores two or more, parietal, plate-like, yellow-brown.

Centritractus belanophorus Lemmermann — Fig. 489

Cells elongate; wall of two nearly equal parts, junctures conspicuous; cells 5 to 9μ x 8 to 16μ, spines 20 to 50μ long.

Smith.

Family Chlorotheciaceae

Ophiocytium Naegeli 1849

Cells epiphytic or free-floating, solitary or colonial, straight, curved, or spiral cylinders with round or capitate ends that may or may not be apiculate or attenuate; some cells with a homogenous cap at one end and the rest of the wall laminate; chromatophores 4 to 16, pale yellow-green, without pyrenoids.

Ophiocytium arbuscula (A. Braun) Rabenhorst — Fig. 490

Cells attached, cylindrical, straight or curved, in umbellate colonies; diameter 3 to 7μ, length of longest cell without stipe up to 150μ.

Haunck; on filamentous algae.

Ophiocytium capitatum Wolle Fig. 491

Cells free-floating, cylindrical, curved, solitary, with a short spine at each pole; cells 5 to 10μ x up to 85μ, spines 5 to 7μ long.

Smith.

Ophiocytium capitatum Wolle var. **longispinum** (Moebius) Lemmermann Fig. 492

Cells free-floating, straight to spiral, each pole with a spine; cells 4.5 to 6μ in diameter, spines 16 to 50μ long.

Smith, Haunck.

Ophiocytium cochleare (Eichw.) A. Braun Fig. 493

Cells free-floating, cylindrical, arcuate to spiral, spine at one end only; cells 5 to 8μ broad.

Smith.

Ophiocytium parvulum (Perty) A. Braun Fig. 494

Cells free-floating, cylindrical, S-curved or spiral, ends truncate and without spines; cells 3 to 9μ broad.

Open lake.

Order Heterotrichales

The plants are all filamentous and mostly unbranched, although some have simple branches. Some authors regard the branched forms as being in the suborder Heterocloniales. They are mostly free-floating except possibly when young. The cells are cylindrical or barrel-shaped and may exhibit stout H-pieces. The parietal, discoid or plate-like chromatophores vary in number from few to many. Fragmentation of the filament is common, as is zoospore and aplanospore formation. Sexual reproduction is isogamous.

Family Tribonemataceae

Tribonema Derbes and Solier 1856

Unbranched filaments of cylindrical to barrel-shaped cells; cell walls of two overlapping sections which break into H-pieces upon the fragmentation of the filament; chromatophores two to several, discoid, parietal, yellow-green, without pyrenoids.

Tribonema bombycinum (C. A. Agardh) Derbes & Solier Fig. 495

Cells cylindrical or somewhat inflated, walls thin; chromatophores four to eight, small, parietal; cells 6 to 11μ x 15 to 38μ.

Terwilliger, Haunck, Smith, Pelee canal, Buckeye Pond.

Tribonema bombycinum (C. A. Agardh) Derbes & Solier var. **tenue** (Hazen) Tiffany Fig. 496

Characters as for the type except cells 3 to 6μ in diameter.

Terwilliger, Haunck, Smith.

Tribonema minus (Wille) Hazen Fig. 497

Cells slender, cylindrical or slightly inflated; chromatophores two to four, large, discoid; cells 5 to 6μ in diameter.

Terwilliger.

Tribonema utriculosum (Kuetz.) Hazen Fig. 498

Cells usually barrel-shaped, sometimes cylindrical, stout, walls usually thick, showing H-pieces; chromatophores numerous, large, discoid; cells 11 to 17μ x 15 to 54μ.

Haunck, Wehrle, Pelee canal.

Family Monociliaceae

Monocilia Gerneck 1907

Filamentous, freely branched, microscopic; cells uninucleate; chromatophores numerous, discoid, parietal; food reserves mostly oil, never starch.

Monocilia viridis Gerneck Fig. 499

Filamentous, branched, filaments sometimes short and becoming palmelloid; chromatophores several, discoid, parietal; cells 10 to 12μ in diameter, varying to 15μ in length.

S. Bass.

Order Heterosiphonales

Plants in this order are multinucleate and siphonaceous. They are terrestrial or aquatic, and are either globular with subterranean rhizoids, or elongate, branched coenocytes that form cobweb-like or felt-like mats on damp soil or partially or wholly submerged. The chromatophores are discoid and mostly lacking pyrenoids. The reserve food is oil, although starch has been reported. Asexual reproduction is by zoospores, aplanospores, or hypnospores, and sexual reproduction is oogamous, isogamous, or anisogamous.

Family Botrydiaceae

Botrydium Wallroth 1815

Coenocytic, macroscopic, on soil, globular above with rhizoidal, subterranean branches; chromatophores numerous, discoid, yellow-green.

Botrydium granulatum (L.) Greville — Fig. 500

A terrestrial alga with a globular structure at the surface of the soil and a branched, colorless rhizoidal system below; diameter of aerial portion up to 2 mm.

N. Bass vineyard, Pelee.

Family Vaucheriaceae

Vaucheria DeCandolle 1803

Thallus terrestrial or aquatic, sometimes forming densely tufted or felt-like masses or a web-like stratum on damp soil; filaments coenocytic, except for occasional cross walls where reproductive structures arise, sparsely or much branched, with rhizoids when attached; chloroplasts numerous, small, discoid, peripherally located, without pyrenoids; sexual reproduction oogamous.

Vaucheria geminata (Vauch.) DeCandolle — Fig. 501

Oogonia one to six, ellipsoid-hemispherical to concave-convex, shortly stipitate near the end of a short branch; antheridium cylindrical, hooked or circinate, usually on a stipe longer than those of the oogonia; mature oospore brown-spotted with triple membrane, filling oogonium; aplanospores in ovoid sporangia, usually terminating short lateral branches; thick-walled akinetes may be present; filaments 29 to 130μ in diameter, oogonia 52 to 225μ x 64 to 190μ, aplanospores 120 to 200μ x 120 to 190μ.

Haunck.

Vaucheria hamata (Vauch.) DeCandolle — Fig. 502

Oogonia one or two, ovoid to convex-concave, borne on the shorter division of the apparently forking branch; the longer division recurved, bearing the hooked or circinate antheridium, if two oogonia, the antheridium between; oospore with four membranes, filling the oogonium, with a dark brown or black spot; filaments 38 to 80μ in diameter, oogonia 75 to 90μ x 60 to 75μ.

Pelee.

Vaucheria sessilis (Vauch.) DeCandolle — Fig. 503

Oogonia usually two, sometimes single, sessile or on very short stalks, ovoid or oblong-ovoid, more or less oblique, beak short; antheridium between the two oogonia, or adjacent to the single oogonium, on a short pedicel, straight, hooked, or circinate: mature oospore dark-spotted, with triple membrane, filling oogonium; zoosporangium ovoid-clavate, terminal; one zoospore; filaments 50 to 130μ in diameter, oogonia 75 to 85μ x 75 to 100μ, zoospore 77 to 154μ x 82 to 176μ.

Fox on Pelee.

Vaucheria terrestris (Vauch.) DeCandolle — Fig. 504

Ooogonium usually solitary, lateral on a short branch bearing at its summit a curved or circinate antheridium; oospore globose to plano-convex, with four membranes and numerous brown spots; filaments 43 to 100μ in diameter, oogonium 85 to 125μ x 60 to 100μ, antheridium 18 to 24μ in diameter.

E. Harbor, Pelee.

Vaucheria sp.

A species of *Vaucheria* has been repeatedly collected in Church Pond on Kelleys Island, but never with the reproductive stages. The locality is recorded in the hopes that mature material may be collected in the future.

Class Chrysophyceae

The members of this class are yellow to golden-brown unicells or colonies of distinctive shape and organization which are almost all motile. The flagellae may be one or two in number of either equal or unequal length if two. The one or two large, laminate chromatophores contain abundant phycochrysin. Reserve food is leucosin and oils. Reproduction is by cell division and zoospores, and by fragmentation of colonies. Statospores are common.

KEY TO ORDERS OF CLASS CHRYSOPHYCEAE

Only two orders are represented in the algae records from western Lake Erie.

1. Flagellate motile unicells or colonies; cells often enclosed by a lorica of definite shape .... Chrysomonadales
1. Cells mostly solitary, more or less amoeboid .... Rhizochrysidales

KEY TO GENERA OF CLASS CHRYSOPHYCEAE

1. Unicellular 2
1. Colonial 7
    2. Cells inclosed in conical or cylindrical loricas 3
    2. Cells not inclosed in conical or cylindrical loricas 4
3. Loricas smooth; cells free-swimming .... **Dinobryon**
3. Loricas not smooth; cells attached .... **Hyalobryon**
    4. Cells smooth, ovoid, with an anterior emargination, 2 unequal-length flagellae, 2 parietal laminate chromatophores .... **Ochromonas**
    4. Cells not smooth, with long needle-like spines or pseudopodia 5
5. Cells rigid, ovoid to ellipsoid, periplast with silicified scales and spines, 1 flagellum .... **Mallomonas**
5. Cells amoeboid, irregularly spherical 6
    6. Cells with many delicate, needle-like pseudopodial processes .... **Rhyzochrysis**
    6. Cells with few tapering pseudopodial processes .... **Chrysamoeba**
7. Colonies arborescent; cells in conical or cylindrical loricas .... **Dinobryon**
7. Colonies not arborescent 8
    8. Colonies ring-like .... **Cyclonexis**
    8. Colonies globose, or nearly so 9
9. Cells pyriform, radiating from a common center, membrane apiculate, 2 equal-length flagellae .... **Synura**
9. Cells spherical or ellipsoidal, arranged at the periphery of a colonial envelope, 2 unequal-length flagellae 10
    10. Colony with internal branched threads that terminate at the cells* .... **Uroglena**
    10. Colony without internal branched threads; colony *Volvox*-like in appearance .... **Uroglenopsis**

* *Uroglena* and *Uroglenopsis* may be indistinguishable at times because of the inability to see the internal branching threads.

Order Chrysomonadales

These plants are motile unicells or colonies with each cell having one or two flagellae. The cells may lack a cell wall but may be enclosed in a lorica of definite shape and ornamentation.

Suborder Chromulineae

Family Mallomonadaceae

Mallomonas Perty 1852

Cells solitary, motile with one flagellum, ovoid to ellipsoid; periplast with small circular or angular silicified imbricating scales; scales regularly or irregularly arranged, each with a siliceous spine which may be toothed; chromatophores two, parietal, golden-brown; nucleus often large and distinct.

Mallomonas alpina Pascher & Ruttner Fig. 505

Cells ellipsoid; spines confined to anterior end of cell; cells 8 to 12μ x 25 to 45μ.

Squaw, Terwilliger, open lake.

Mallomonas caudata Iwanoff Fig. 506

Cells obovoid; entire surface covered with smooth or distally toothed spines; cells 15 to 30μ x 50 to 80μ.

Terwilliger, Pelee, open lake.

Suborder Isochrysidineae

Family Synuraceae

Synura Ehrenberg 1838

Colonies more or less globose and compact; cells broadly pyriform, two flagellae; periplast with siliceous scales and short, small spines or reticulations; chromatophores two, parietal, laminate; no pigment spot.

Synura uvella Ehrenberg Fig. 507

Characters as for the genus; cells with fine spines or apiculations; cells 8 to 17μ x 20 to 35μ.

Squaw, Haunck, Fisher, Smith, Monument, Buckeye.

Suborder Ochromonadineae

Family Ochromonadaceae

Cyclonexis Stokes 1886

Cells laterally united into flat, discoid colonies with an open space at the center; cells obovoid, broadly rounded anterior ends, two flagellae of unequal length; chromatophores two, laterally placed, two contractile vacuoles; 10 to 20 cells in a colony.

Cyclonexis annularis Stokes Fig. 508

Characters as for the genus; cell length 10 to 15μ; colony 25 to 35μ in diameter.

Hatchery.

Dinobryon Ehrenberg 1835

Cells free-floating, usually in arborescent colonies; loricas conical, campanulate, or cylindrical, open at the top, pointed bases, each lorica inclosing an ovoid or spindle-shaped protoplast that is attached to its base, each protoplast with two unequal-length flagellae; chromatophores one or two in each cell, elongate, parietal, golden-brown; cells with two contractile vacuoles and one pigment spot.

Dinobryon bavaricum Imhof Fig. 509

Colony compact; loricas elongate-conical, base long and sides almost parallel, upper part with undulate sides; cells 6.5 to 8μ x 45 to 100μ.

Haunck.

Dinobryon divergens Imhof Fig. 510

Colony with divergent branching; loricas with conical bases, flaring mouth, sides sometimes undulate; cells 7 to 8μ x 35 to 50μ.

Squaw, Kelleys, open lake.

Dinobryon sertularia Ehrenberg Fig. 511

Colony densely branched; loricas cylindric-campanulate, bases convex, tapering to sharp points; cells 10 to 14μ x 30 to 44μ.

Squaw, Haunck, open lake.

Dinobryon stipitatum Stein Fig. 512

Colony narrow, dense; loricas elongate-conical, stipes with nearly parallel sides; cells 6 to 8μ x 56 to 96μ.

Smith, open lake.

Hyalobryon Lauterborn 1896

Cells solitary, epiphytic on *Fragillaria* sp., receptacle delicate, upper portion nearly cylindrical with a flaring opening, lower portion conical, produced into a short stipe, growth rings appearing as minute denticulations; protoplast ovoid, at base of receptacle, two unequal-length flagellae; chromatophores two, golden-brown.

Hyalobryon mucicola (Lemm.) Pascher — Fig. 513

Characters as for the genus; receptacle 4.6μ x 23 to 28μ.

Hatchery.

Ochromonas Wyssotzki 1887

Cells solitary or in temporary colonies, metabolic, spherical, ellipsoid, ovoid, or heart-shaped, free-swimming, with two unequal-length flagellae at the anterior end of cell, sometimes sessile; chromatophores one or two, golden-yellow to yellow-brown; with contractile vacuoles, pigment spot present or not.

Ochromonas mutabilis Klebs — Fig. 514

Cells spherical to ellipsoid, strongly metabolic; two trough-shaped chromatophores at the sides of the cell; two contractile vacuoles, one small pigment spot; cells 8 to 22μ x 15 to 30μ.

Kelleys.

Uroglenopsis Lemmermann 1899

Colonies free-swimming, several hundred cells distributed at the periphery of a hyaline, homogeneous, gelatinous, spherical or ovoid envelope; cells ovoid, narrowly elliptic, or spherical, two unequal-length flagellae, two contractile vacuoles; chromatophores one or two, parietal, laminate or disciform, golden-brown, with or without a pigment spot.

Uroglenopsis americana (Calkins) Lemmermann — Fig. 515

Cells ellipsoid; chromatophore one, one pigment spot; cells 3 to 7μ x 5 to 10μ.

Squaw, Gibraltar.

Order Rhizochrysidales

These forms are rhizopodal, although there may be temporary flagellate stages. Some exist as loosely organized colonies, but they are mostly solitary unicells. The cells have one or two golden-brown chromatophores and leucosin as the food reserve. Some obtain food by amoeboid action. Multiplication is by vegetative division.

Family Rhizochrysidaceae

Chrysamoeba Klebs 1893

Cells solitary, free-swimming or floating, radiating pseudopodia in the amoeboid state; chromatophores plate-like, greenish-yellow to golden-brown.

Chrysamoeba radians Klebs — Fig. 516

Cells solitary, free-floating, with radiating pseudopodia, chromatophores two; cells about 10μ in diameter; pseudopodia about 25μ long.

Kelleys deep quarry.

Rhizochrysis Pascher 1913

Cells free-floating, solitary or in colonies; cells naked, amoeboid, with needle-like or stout pseudopodial processes; chromatophores one or two, golden-brown, one to numerous contractile vacuoles, or none; reserve food is leucosin and oil.

Rhizochrysis limnetica G. M. Smith — Fig. 517

Cells irregularly spherical, with needle-like processes; chromatophore one; cells without processes 35 to 45μ in diameter.

Terwilliger, Squaw, Haunck.

Rhizochrysis scherffelii Pascher — Fig. 518

Cells irregular in shape, solitary or in small colonies; chromatophores one to two; cells without processes 10 to 15μ in diameter.

Terwilliger, Squaw, Fisher.

Class Bacillariophyceae

Not included in this survey.

Division Euglenophyta

The members assigned to this division constitute a controversial group of organisms for those who retain the traditional "plant" versus "animal" concept. They are mostly chlorophyll-bearing, protozoa-like organisms of the Protista and will be retained as algae in this survey because they are chlorophytes.

Class Euglenophyceae

The organisms usually are considered as members of a single class, the Euglenophyceae. They are mostly freshwater forms, unicellular, and free-swimming, although some may exist as palmelloid or dendroid colonies. There are one or two flagellae that emerge through a canal from a reservoir. Most have an indistinct gullet except for the colorless forms where it is quite distinct.

Order Euglenales

The cells of the Euglenales may be rigid or metabolic to a varying degree. The shape may be cylindrical, pyriform, fusiform, or ovoid. The cell membrane is smooth or ornamented with punctae, granules, or striations. The protoplast in the genus *Trachelomonas* is inclosed in a lorica with an apical pore through which the flagellum projects. The lorica may be smooth or variously sculptured with punctae, granules, or spines. The chloroplasts are ribbon-, disc-, or plate-like and may be scattered or they may radiate from the center of the cell. Haematochrome is often present along with the chlorophyll and may give a blood-red coloration to the cell. Pyrenoids are sometimes present, but the food reserve is paramylum, a polysaccharide that occurs as bodies having distinctive shapes.

Family of Euglenaceae

KEY TO GENERA OF CLASS EUGLENOPHYCEAE*

1. Epizooic (on Ostracoda in Lake Erie collections), attached singly or in colonies by simple or branched gelatinous stalks ..... **Colacium**
1. Free-swimming, solitary 2
    2. Cells inclosed in a lorica varying in color from pale yellow to brown-red, lorica with an anterior pore ..... **Trachelomonas**
    2. Cells not inclosed in a lorica 3
3. Cells metabolic ..... **Euglena**
3. Cells rigid 4
    4. Cells flattened dorsi-ventrally, some spirally twisted ..... **Phacus**
    4. Cells not distinctly flattened dorsi-ventrally 5
5. Cells broadly ovoid or pyriform, posterior usually with a short caudus ..... **Lepocinclis**
5. Cells cylindric or fusiform, some spirally twisted ..... **Euglena**

**Anisonema*, *Entosiphon*, and *Peranema* have been recorded from the area but are not included because of absence of chlorophyll.

Colacium Ehrenberg 1832

Euglena-like cells attached by stalks to various invertebrates; cells elongate-ovate or pyriform, solitary, gregarious or in branched colonies; chloroplasts numerous ovoid discs, with or without a pyrenoid.

Colacium steinii Kent — Fig. 519

Cells elongate-ovate, sedentary, about two and one-half times longer than broad when extended; globose or pyriform with an inflated central portion and a conically projecting anterior and posterior elongation when contracted; stalk branching irregularly or subdichotomously, bearing cells at different heights; motile cells Euglena-like, variable in form; chloroplasts numerous, ovate, evenly distributed; length of cells 25 to 30μ.

Reported on *Diaptomus* sp. near S. Bass by Jennings (1900). *C. steinii* differs from *C. arbusculum* by its irregular dichotomous branching and by having the cells at diverse heights.

Description and figures from Kent 1880-1881.

Colacium vesiculosum Ehrenberg Fig. 520

Cells solitary or in groups of a few cells, elongate-ovate or slightly pyriform, attached; stalks short; chloroplasts numerous, discoid; cells about 25μ long.

On *Cyclops* north of Kelleys, on *Polyarthra platyptera* in Monument Pond, also in Hatchery.

Euglena Ehrenberg 1838

Cells cylindric to narrowly fusiform, circular in cross section, rarely flattened, posterior end rounded or produced into a stout or narrow caudus; periplast rigid or pliable, one anterior flagellum of variable length protruding from a gullet; chloroplasts numerous, variable, discoid to band-shaped, hematochrome sometimes present; paramylon bodies as rings, plates, rods, or discs.

Euglena acus Ehrenberg Fig. 521

Cells elongate, fusiform, with an attenuate tip; periplast slightly spirally striated; paramylon bodies 7 to 12, rod-like, scattered; cells 7 to 12μ x 70 to 200μ.

Terwilliger, Haunck, Smith.

Euglena deses Ehrenberg Fig. 522

Cells elongate with a short tip, markedly metabolic; flagellum short and usually stout; paramylon bodies ovoid to rod-shaped; cells 17 to 24μ x 70 to 200μ.

Terwilliger, Kelleys.

Euglena ehrenbergii Klebs Fig. 523

Cells metabolic, but usually straight, slight if any tapering at the poles which are truncately rounded, membrane twisted-striate, body flattened-elliptic, sometimes twisted; chloroplasts ovoid discs; paramylon bodies elongate; cells 24μ x 190 to 200μ.

Fisher.

Euglena fusca (Klebs) Lemmermann Fig. 524

Cells elongate; periplast longitudinally punctate; paramylon bodies two, large.

Terwilliger.

Euglena minuta Prescott Fig. 525

Cells strongly metabolic, shape various, though usually curved fusiform, posterior end a short, rounded tip; flagellum less than the length of the cell; cells 4.5 to 7μ x 10 to 14μ.

Haunck.

Euglena oxyuris Schmarda Fig. 526

Cells elongate-cylindric; periplast markedly spirally striate; paramylon grains two large annular elongate rings; cells 30 to 45μ x 375 to 490μ.

Wehrle, Monument.

Euglena polymorpha Dangeard Fig. 527

Cells ovoid to cylindric; periplast striated spirally; paramylon bodies oval or often absent; cells 20 to 25μ x 80 to 90μ.

Terwilliger.

Euglena sanguinea Ehrenberg Fig. 528

Cells elongate-ovoid, with a short tip, red in color; paramylon bodies round or ovoid; cells 28 to 33μ x 55 to 120μ.

Haunck, Smith, Carp.

Euglena spirogyra Ehrenberg Fig. 529

Cells cylindric-elongate, sometimes bent; periplast with prominent spiral punctations; paramylon bodies two; cells 6 to 20μ x 80 to 150μ.

Terwilliger, Hatchery, Haunck, Smith, open lake.

Euglena tripteris (Duj.) Klebs Fig. 530

Cells elongate, band-like, spirally twisted, anterior end rounded, posterior end with a long colorless spine; periplast longitudinally striate, not metabolic; cells 14μ x 103μ.

Terwilliger, Fisher.

Euglena viridis Ehrenberg Fig. 531

Cells fusiform to obovate, wider below the median region, posterior end extended into a short colorless tip, metabolic; periplast spirally striate; chloroplasts six or more, fusiform; paramylon bodies annular, discoid, two attached to each chloroplast; cells 14 to 20μ x 40 to 65μ.

Terwilliger, Monument?, E. Harbor, open lake near S. Bass.

Euglena viridis was reported by Stehle (1923) without description or size range. In order to make this compilation as complete as possible, it has been included with a description abstracted from Tiffany & Britton (1952).

Lepocinclis Perty 1849

Cells broadly ovoid to fusiform, posterior abruptly pointed; periplast rigid, usually spirally striate, circular in cross section, one anterior flagellum; chloroplasts numerous, discoid, parietal; two, large, lateral, ring-shaped paramylon bodies.

Lepocinclis fusiformis (Carter) Lemmermann — Fig. 532

Cells broadly fusiform, posterior slightly pointed; periplast firm, spirally striate; paramylon bodies several, plate-like; cells 30 to 35μ x 35 to 51μ.

Mound.

Lepocinclis ovum (Ehr.) Lemmermann — Fig. 533

Cells broadly ovoid, with a distinct posterior spine; periplast decidedly spirally striate; cells 15 to 18μ x 30 to 38μ, spine 6 to 7μ long.

Terwilliger.

The posterior spine as described and figured by Tiffany (1934) is longer and more pointed than is common for *L. ovum*. However, his description and figure have been retained in the absence of material seen by the writer.

Phacus Dujardin 1841

Cells rigid, ovate to fusiform, flattened, slightly to markedly twisted, posterior extended into a caudus; periplast longitudinally or spirally striate, or with rows of granules or punctae; chloroplasts numerous, ovoid, disc-like; paramylon bodies plates, rings, or rods.

Phacus hispidula (Eichw.) Lemmermann — Fig. 534

Cells broadly ovoid with a straight, stout posterior caudus; periplast longitudinally striate, striae covered with minute spines; paramylon bodies discoid or rod-like; cells 18 to 33μ x 30 to 55μ.

Haunck.

Phacus longicauda (Ehr.) Dujardin — Fig. 535

Cells ovoid to subcircular with a long, straight, gradually tapering, sharply pointed caudus; periplast longitudinally striated; paramylon body a circular plate; cells 46 to 70μ x 85 to 115μ.

Terwilliger, Squaw, Haunck, Kelleys church quarry, E. Harbor, open lake.

Phacus morii var. insecta (Koczwara) Skvortzow — Fig. 536

Cells oval, with usually two lateral indentations; cell wall finely striate; chloroplasts small, round; one large ring-shaped paramylon body; cells 32 to 34μ x 69 to 71μ.

Haunck.

Phacus pleuronectes (O. F. Muell.) Dujardin — Fig. 537

Cells broadly ovoid to subcircular with a median fold, slightly twisted with a short, stout, uncinate caudus; periplast longitudinally striated; paramylon bodies one or two ring-like discs; cells 33 to 35μ x 45 to 49μ.

Terwilliger, Fisher, Put-in-Bay Harbor.

Phacus pyrum (Ehr.) Stein — Fig. 538

Cells ovoid, gradually narrowed to a long, straight, sharply pointed caudus; periplast spirally striate; paramylon bodies two, ring-like, or (according to Tiffany, 1934) several, small and discoid; cells 13 to 15μ x 30 to 55μ.

Terwilliger.

Phacus tortus (Lemm.) Skvortzow — Fig. 539

Cells ovoid, with an elongate, spirally twisted, straight caudus; periplast longitudinally and spirally striate; paramylon bodies one or two large central plates; cells 37 to 44μ x 74 to 87μ.

Terwilliger, Fisher, Haunck, Smith, Kelleys.

Phacus triqueter (Ehr.) Dujardin — Fig. 540

Cells broadly ovoid, narrowed posteriorly into a prominent, deflected, sharply pointed caudus; dorsal surface with a pronounced longitudinal flange; periplast longitudinally striated; paramylon bodies one to several large rings; cells 33 to 35μ x 49 to 55μ.

Monument?, E. Harbor.

Reported by Jennings (1900) without description. Description and size range abstracted from Tiffany & Britton (1952) in absence of material.

Trachelomonas Ehrenberg 1835

Eugleroid cells free-swimming, surrounded by a lorica; lorica of various shapes and decoration, nearly colorless to red-brown, with an anterior pore through which projects a single, long flagellum; chloroplasts numerous, discoid, parietal, with or without pyrenoids.

Trachelomonas acuminata (Schmarda) Stein — Fig. 541

Lorica trapezoidal, anterior end narrowed, posterior end narrowed into a straight or slightly curved spike; collar obliquely truncate; cells 50 to 59μ long.

Terwilliger, Hatchery.

Reported by Stehle (1923) without description or figure. Description abstracted from Tiffany & Britton (1952).

Trachelomonas armata (Ehr.) Stein var.? Taft — Fig. 542

Lorica ovoid, poles rounded, pore surrounded by a very short collar and a circle of erect spines; wall with spines of variable length at the anterior and posterior ends, median portion of wall smooth; lorica 35 to 37μ x 46μ.

Fisher, Haunck, Terwilliger, Monument?, E. Harbor.

Trachelomonas bulla (Stein) Deflandre — Fig. 543

Lorica ovoid, irregularly and finely granulate, pore small; collar large, margin of collar finely denticulate; lorica including collar 29 to 32μ, length without collar 25 to 26μ, diameter 18 to 23μ.

S. Bass. (Exact locality on S. Bass unknown)

Trachelomonas caudata (Ehr.) Stein — Fig. 544

Lorica ellipsoid-ovoid, with slightly concave lateral margins, narrowed abruptly into a short caudus; anterior end narrowed abruptly into a long neck having numerous minute teeth along the margin; wall slightly yellowish, indistinctly punctate; lorica 26 to 30μ x 57 to 64μ.

Terwilliger, Haunck.

Trachelomonas gibberosa Playfair — Fig. 545

Lorica rhomboidal, inflated in median portion, tapering posteriorally into a long sharp spine; collar truncate; lorica 29 to 43μ x 50 to 66μ.

Smith.

Trachelomonas girardiana (Playf.) Deflandre — Fig. 546

Lorica subhexagonal, sides retuse, end view circular, collar elongate and variable in length; posterior narrowed into a long, stout caudus; wall granulate; lorica 23 to 27μ x 42 to 57μ.

S. Bass, Squaw, Smith, Fisher.

Trachelomonas hispida (Perty) Stein — Fig. 547

Lorica broadly ovate; collar short, uniformly covered with short, sharp-pointed spines; lorica 15 to 26μ x 20 to 42μ.

Hatchery, Monument, open lake.

Trachelomonas horrida Palmer — Fig. 548

Lorica broadly ovoid; collar elongate; mouth wide, uniformly covered with abruptly pointed spines which have nearly parallel margins, sometimes with wart-like granules among the bases of the spines; lorica 30 to 36μ x 40 to 45μ.

Fisher.

Trachelomonas lacustris Drezepolski — Fig. 549

Lorica cylindrical, sides parallel, ends rounded; pore with a very short collar; wall densely punctate; lorica 11μ x 21μ.

Smith.

Trachelomonas piscatoris (Fisher) Stokes — Fig. 550

Lorica narrowly ovoid to ovoid-cylindrical, anterior end abruptly extended to the pore; wall covered with short, stout spines; lorica 15 to 25μ x 25 to 40μ.

Squaw, Smith.

Trachelomonas schauinslandii Lemmermann Fig. 551

Lorica ovoid to depressed-ovoid, posterior abruptly continued into a sharp spine, anterior abruptly extended into a long cylindrical neck; wall granulate; lorica 14μ x 27 to 28μ.

Terwilliger.

Trachelomonas volvocina Ehrenberg Fig. 552

Lorica spherical, smooth, light yellow; pore without a collar; lorica 15 to 18μ x 15 to 18μ.

Mound, Fisher, Monument, Terwilliger, E. Harbor; probably generally distributed.

Division Pyrrhophyta

The basic similarities of the organisms in this division concern the preponderance of brownish pigments, starch and sometimes oils as the reserve food, and cellulose in the walls of those that have definite walls around the protoplast. They are diverse and often bizarre in shape and structure. They range from motile unicells through nonmotile, free-floating, sedentary or attached unicells, to palmelloid colonies and simple filaments. Motile cells are biflagellate and may or may not have a distinct transverse furrow. They are important components of the marine and freshwater plankton.

Class Desmokontae

Members of this class are mostly marine and no representatives have been recorded for western Lake Erie.

Class Dinophyceae

The structure of the motile vegetative cells and of the zoospores of nonmotile types in which the cell is more or less completely encircled by a transverse furrow is a characteristic feature of the class. Motile cells have two flagellae inserted in the furrow, one of which encircles the cell and the other trails posteriorly. The protoplast may be naked, or it may be surrounded by a wall of thin indistinct plates or by thick articulated plates which may be sculptured to a varying degree. The number and arrangement of the plates are important taxonomic characters. The chromatophores are discoid or fusiform and pyrenoids may be present in some taxa. The characteristic brown or gold-brown color is due to the predominance of the pigment peridinin. A conspicuous pigment spot is often present. Reproduction in the motile forms is usually vegetative cell division or by aplanospores. That in the nonmotile forms is by zoospores or aplanospores. Sexual reproduction is rarely encountered.

KEY TO ORDERS OF CLASS DINOPHYCEAE

1. Vegetative cells with a transverse furrow, with flagellate motility 3
1. Vegetative cells without a transverse furrow, attached, free-floating, or sedentary 2
   2. Cells solitary, globose, angular or lunate, with horns or spines, attached or free-floating .... Dinococcales
   2. Cells in few-celled colonies, free-floating or sedentary .... Dinocapsales
3. Periplast of vegetative cells very thin, without distinct plates .... Gymnodiniales
3. Cell wall usually thick, plates mostly distinct .... Peridiniales

KEY TO GENERA OF CLASS DINOPHYCEAE

1. Cells solitary, stalked, epiphytic 2
1. Cells solitary or colonial, not epiphytic 3
   2. Cells pyramidate or tetrahedral, angles with 1 or 2 short, stout spines, stalk short .... **Tetradinium**
   2. Cells globose or ovoid, stalk longer .... **Stylodinium**

3. Cells colonial, subspherical, nonflagellate . . . . . **Gloeodinium**
3. Cells solitary, flagellate or nonflagellate 4
4. Cells nonflagellate, free-floating 5
4. Cells flagellate, motile 6
5. Cells globose, furrow in protoplast within the outer cellulose wall . . . . **Hypnodinium**
5. Cells lunate or arcuate, poles with or without sharp spines, spines usually recurved . . . . . **Cystodinium**
6. Cells naked, without walls, protoplast membrane smooth . . **Gymnodinum**
6. Cells with walls composed of plates 7
7. Cell walls thin, delicate, plates obscure 8
7. Cell walls thick, plates distinct 9
8. Cells globose or slightly flattened dorsiventrally, transverse furrow completely surrounding the cell . . . . . **Glenodinium**
8. Cells narrowly ovoid or elliptical, strongly flattened dorsiventrally, transverse furrow only partially surrounding the cell . . . . . **Hemidinium**
9. Cells with one long anterior horn and 2-3 shorter posterior horns . . . . **Ceratium**
9. Cells without long anterior and posterior horns 10
10. Cells globose, ovoid, or fusiform, usually dorsiventrally flattened, poles broadly rounded, or apiculate . . . . . **Peridinium**
10. Cells flattened longitudinally, nearly circular in end view, longitudinal furrow not entering epicone . . . . . **Diplosalis**

Order Gymnodiniales

The cells are naked protoplasts with very thin periplasts which reportedly have delicate plates. All have a transverse furrow that spirals to the left and connects with a longitudinal furrow that may or may not extend into the epicone. The cells vary in shape although mostly they are ovoid to somewhat rhomboid. The shape and pigmentation of the chromatophores vary.

Family Gymnodiniaceae

Gymnodinium (Stein) Kofoid & Swezy 1921

Cells ellipsoid, ovoid, to subpyriform; transverse furrow complete, spiralling to the left; cells in two nearly equal parts, longitudinal furrow extending farther into the hypocone than into the epicone, without a definite cell wall or with a very delicate periplast and plates; chromatophores golden-brown (blue to blue-green in the L. Erie specimens), ovoid, parietal.

Gymnodinium aeruginosum Stein — Fig. 553, 553a

Cells slightly longer than broad, flattened slightly dorsiventrally; epicone larger and more pointed than the broadly rounded hypocone; chromatophores small, parietal, ovoid, bright blue-green to bright blue; cells 24 to 25μ x 30 to 31μ.

Fisher.

Order Peridiniales

The vegetative cells are solitary and motile with thick walls of heavy, variously sculptured, articulated plates except in the genus *Glenodinium* where the plates are thin and closely adjoined. A broad transverse furrow separates the cell into a definite epicone and hypocone.

Family Glenodiniaceae

Glenodinium (Ehr.) Stein 1883

Cells flattened slightly dorsiventrally, wall thin, faintly demarcated; complete transverse furrow lying in one plane, or slightly spiral, plates variable in number; chromatophores numerous, brown, oval or circular.

Glenodinium aciculiferum Lemmermann — Fig. 554

Cells pyriform, slightly compressed dorsiventrally, epicone nearly triangular, apex bluntly rounded, hypocone broadly rounded; epicone with seven precingular, one rhomboidal, two ventral apicals, one median apical, and three dorsal apical plates;

hypocone with five postcingular and two antapical plates; plates smooth, intercalary bands narrow, ventral edge of each antapical plate with a stout spine; girdle slightly spiral, longitudinal furrow extends slightly into the epicone; chromatophores small, discoid, brown; cells 29 to 42µ x 35 to 51µ.

Open lake.

Glenodinium pulvisculus (Ehr.) Stein — Fig. 555

Cells ovate to nearly globose; epicone and hypocone broadly rounded; longitudinal furrow extends slightly into the epicone and far into the hypocone; cell wall plates not readily visible; chromatophores numerous, golden-brown; cells 22 to 27µ x 25 to 31µ.

Fisher.

Hemidinium Stein 1883

Cells asymmetric-ellipsoid, compressed, poles broadly rounded; transverse furrow incomplete and spirally descending to the left; wall thin, delicate, plates indistinct; epitheca with six apical, six precingular plates, and the hypotheca with five post-cingular, one intercalary, and one antapical plate; chromatophores fusiform, radially arranged, golden-brown.

Hemidinium nasutum Stein — Fig. 556

Cells ellipsoidal, strongly flattened; transverse furrow incomplete; longitudinal furrow extends from the transverse furrow to the broadly rounded posterior pole; chromatophores as in the genus; cells 20µ x 28 to 29µ.

Kelleys.

Family Peridiniaceae

Diplosalis Bergh 1904

Cells flattened longitudinally, nearly circular in end view, epicone longer than hypocone; transverse furrow distinct; longitudinal furrow not extending into the epivalve, with a pronounced ridge or flange on the left; plate arrangement similar to that of *Peridinium.*

Diplosalis acuta (Apstein) Entz. fil. — Fig. 557

Characters as for the genus; epivalve has seven precingular, one rhomboidal, two ventral apical, one median apical, and two dorsal apical plates; chromatophores (?), grey-brown to dark chestnut-brown; cells 44 to 49µ long, 42 to 49µ broad.

Put-in-Bay Harbor, N. Bass dock, in deep water.

Peridinium Ehrenberg 1832

Cells motile, spherical, ovoid, broadly fusiform, or angular, usually dorsiventrally compressed; apices either rounded or with short horns; transverse furrow inframedian and slightly spiral; longitudinal furrow broad, sometimes extending to the posterior pole and only slightly into the epicone; plates variable, epitheca with four apical, two to three intercalary, and six to seven precingular plates; hypotheca with five postcingular and two antapical plates, all plates variously sculptured.

Peridinium quadridens Stein — Fig. 558

Cells obovoid to slightly pyriform; epitheca bell-shaped, with seven precingular, one rhomboidal, two ventral apicals, two lateral apicals and one dorsal apical plate; hypotheca with five postcingular and two antapical plates, each antapical with a prominent spine, sometimes with a spine on each of the lateral postcingular plates; cells 20 to 33µ x 30 to 39µ.

Terwilliger.

Family Ceratiaceae

Ceratium Schrank 1793

Cells angular, unsymmetrical, flattened dorsiventrally; one long (or short) apical horn and two to three shorter antapical horns, plates heavy and areolate; transverse furrow distinct; epitheca with about four apical and five precingular plates; hypotheca with five postcingular and two antapical plates.

Ceratium hirundinella (O. F. Muell.) Dujardin — Fig. 559

Cells slender, variable in size and robustness; apical horn long, slender, straight; apex truncate and closed; antapical horns two to three, stouter; cells 95 to 400µ long.

Distribution general.

A form that is much more slender and with longer horns occurs in the deep quarry on Kelleys Island. The form that is common in L. Erie is not ordinarily found in this quarry.

Order Dinocapsales

This order includes the palmelloid colonial Dinophyceae. Vegetative cell division, followed by retention of the daughter cells within the old parent envelope, results in small colonies until the individual cells are liberated by gelatinization of the parent envelope. Temporary motile stages result from the formation of naked gymnodinoid zoospores.

Family Gloeodiniaceae

Gloeodinium Klebs 1912

Cells nonmotile, in colonies of two to four cells, envelope homogeneous or stratified; chromatophores numerous, brownish, radially arranged.

Gloeodinium montanum Klebs — Fig. 560

Cells large, spherical, or nearly so, united in four-celled colonies by a common, stratified envelope, each cell also with a stratified envelope: chromatophores numerous, golden-brown, radially arranged, often obscured by starch and oil; cells 25 to 28μ in diameter colonies 69 to 74μ in diameter.

Fox Pond on Pelee.

Order Dinococcales

These dinophyceans are nonmotile in vegetative condition and have no vegetative cell division. They may be free-floating, sedentary, or attached by stalks or setae of varied lengths. The cell shape may be globose, pyramidal, lunate, or quadrangular and the angles may be produced into stout horns or spines. The cell walls are mostly thick and sometimes lamellate at the angles. There are no transverse furrows that encircle the cells. Reproduction is by autospores and by zoospores which have a transverse furrow.

Family Dinococcaceae

Cystodinium Klebs 1912

Cells free-floating, lunate, poles broadly rounded, or produced into blunt teeth or curved spines; no transverse or longitudinal furrows; chromatophores numerous, irregularly discoid, parietal.

Cystodinium bataviense Klebs — Fig. 561

Cells broadly lunate, one margin more convex than the other, poles broadly rounded, or produced into short, blunt teeth; chromatophores golden-brown, numerous, parietal, discoid to narrowly ovoid; some cells with a red pigment spot; cells 50 to 58μ x 69 to 104μ.

Haunck.

Cystodinium iners Geitler — Fig. 562

Cells solitary, with strongly convex outer margins and straight to slightly curved inner margins, ends produced into stout, curved spines; cells 25 to 28μ x 55 to 65μ.

Haunck.

Hypnodinium Klebs 1912

Cells solitary, spherical, free-floating, nonmotile, wall homogeneous, smooth; chromatophores elongate-ellipsoid, aggregated into parietal rosettes which form a reticulum; protoplast with a gymnodinoid organization and a red pigment spot.

Hypnodinium sphaericum Klebs — Fig. 563

Characters as for the genus; cells 64 to 66μ in diameter.

Mound, Smith.

Stylodinium Klebs 1912

Cells globose, stipitate, sessile; stipe enlarged slightly at juncture with cell ending in a disc-like holdfast; stipe and holdfast colorless to jet-black; chromatophores parietal, ovoid, golden-brown; nucleus evident; some cells with a red pigment spot.

Stylodinium globosum Klebs — Fig. 564

Characters as for genus; cells 29 to 33μ in diameter, stipe 7 to 8.5μ long.

Fisher on *Hydrodictyon* and *Oedogonium*.

Tetradinium Klebs 1912

Cells solitary, often gregarious, tetrahedrally lobed, two horn-like processes at each lobe; stipe enlarged at point of attachment to cell, terminating in a disc-like holdfast; chromatophores parietal, ovoid, golden-brown; nucleus evident, usually epicentric, some cells with a red pigment spot.

Tetradinium javanicum Klebs — Fig. 565

Characters as for genus; cells including horns 26 to 43μ in diameter.

Haunck on *Oedogonium* and insect exuvia.

Class Cryptophyceae

This grouping has mostly golden-brown motile cells, but some nonmotile coccoid forms are included. The cells are ovoid to slipper-shaped, dorsiventrally flattened, and have a longitudinal furrow. There are two lateral or apical flagellae and two laminate chromatophores which may have pyrenoids. The reserve food is starch and oils.

Order Cryptomonadales

The organisms here are motile and have two anterior flagellae.

Family Cryptomonadaceae

Cryptomonas Ehrenberg 1838

Cells ovoid or slipper-shaped, flattened; a long longitudinal furrow; two anterior flagellae and two laminate chromatophores.

Cryptomonas ovata Ehrenberg — Fig. 566

Characters as for the class and the genus; cells about 10μ by 25μ.

Terwilliger, Put-in-Bay.

Division Cyanophyta

The blue-green algae as a group is widely distributed and sharply delimited from the other algae. They exist as unicells, unorganized and organized colonies, trichomes with or without sheaths, and true or falsely branched filaments. There are no flagellate motile cells and they are the only algae without definite chromatophores, the pigments being localized in the peripheral part of the protoplast. The pigments, from which chlorophyll-b is lacking, include phycocyanin and myxophycean phycoerythrin. The predominance of one pigment, or of several in combination, results in the extensive array of colors in the group. The nuclear material occupies the central portion of the cell, but there is no definite nuclear membrane. The cell membrane is thin and appears to be an integral part of the underlying protoplast. The cells are surrounded by a mucilaginous matrix which is often thin and watery or firm enough to form a tough, sometimes lamellated sheath. The protoplast may contain numerous pseudovacuoles whose exact structure is incompletely known. Reserve foods are glycogen and glycoproteins. There is no starch. Reproduction is by fission, fragmentation, heterocysts, akinetes, and endospores in one order. Sexual reproduction has not been verified.

Class Myxophyceae

The Myxophyceae constitute the only class in the division. The characters are the same as those given for the division.

KEY TO ORDERS OF CLASS MYXOPHYCEAE

1. Cells solitary or gregarious; reproduction by endospores .... Chamaesiphonales*
1. Cells solitary, colonial, or in trichomes; reproduction not by endospores 2
   2. Cells solitary or in unorganized or organized colonies .... Chroococcales
   2. Cells in trichomes, or filamentous in organization .... Hormogonales

* Not reported from western Lake Erie.

KEY TO GENERA OF CLASS MYXOPHYCEAE

1. Cells in trichomes 15
1. Cells not in trichomes 2
   2. Cells appearing as blue-green structures within colorless host cells 3
   2. Cells not within colorless host cells 4
3. Host cells (2)-4-(8), spherical or ovoid; epiphytic in a mucilaginous envelope, with long mucilaginous setae .... **Gloeochaete**
3. Host cells solitary, free-floating, without setae or envelope .... **Glaucocystis**
   4. Cells pyriform, radially arranged .... **Marssoniella**
   4. Cells not pyriform, not radially arranged 5
5. Cells arranged in plate-like colonies 6
5. Cells not arranged in plate-like colonies 7
   6. Cells regularly arranged in rectilinear series .... **Merismopedia**
   6. Cells not arranged in rectilinear series .... **Holopedium**
7. Cells spherical, arranged in a cubical colony, sheaths lamellate .... **Chroococcus**
7. Cells not arranged in a cubical colony 8
   8. Cells spherical, hemispherical, oblong, or short-cylindric 10
   8. Cells fusiform, reniform, or vermiform 9
9. Cells reniform or vermiform, apices rounded .... **Rhabdoderma**
9. Cells fusiform, apices pointed .... **Dactylococcopsis**
   10. Cells in small clusters, with or without conspicuous mucilaginous sheaths, commonly hemispherical (some spherical) .... **Chroococcus**
   10. Cells in spherical or irregular colonies 11
11. Cells peripheral in a hollow colony 12
11. Cells distributed throughout the colony 13
   12. Colony with internal branching gelatinous strands that radiate from the center .... **Gomphosphaeria**
   12. Colony without an internal branching system .... **Coelosphaerium**
13. Cells spherical 14
13. Cells oblong, densely aggregated, individual sheaths evident or not .... **Anacystis** (see *Apanothece* and *Gloeothece*)
   14. Cells densely aggregated, unevenly distributed throughout the colony .... **Anacystis** (see *Microcystis*)
   14. Cells not densely aggregated, evenly distributed throughout the colony .... **Aphanocapsa**
15. Trichomes without heterocysts 16
15. Trichomes with heterocysts 23
   16. Trichomes 1-celled, regularly spiraled .... **Spirulina**
   16. Trichomes with crosswalls, multicellular 17
17. Trichomes without evident sheaths 18
17. Trichomes with evident sheaths (sometimes very delicate) 20
   18. Trichomes of 3-5 cells, terminal cells hemispherical .... **Borzia**
   18. Trichomes regularly with more than 5 cells 19
19. Trichomes usually with less than 20 cells, 1 or both ends of trichome tapering to a sharp point .... **Raphidiopsis**
19. Trichomes usually with many cells, terminal cells of trichome rounded or acutely pointed .... **Oscillatoria**
   20. Trichomes multiserrate, spirally interwoven, sheaths homogeneous .... **Microcoleus**
   20. Trichomes uniserrate 21

21. With infrequent false branches ..... Plectonema
21. Without branches 22

22. Sheaths firm, often colored, not confluent ..... Lyngbya
22. Sheaths thin, hyaline, confluent, trichomes forming mucilaginous membranaceous sheets ..... Phormidium

23. Heterocysts terminal on trichomes 24
23. Heterocysts intercalary and scattered 28

24. Trichomes attenuate 25
24. Trichomes not attenuate 27

25. Trichomes with dichotomous false branching, heterocysts basal ..... Dichothrix
25. Trichomes not dichotomously branched 26

26. Trichomes usually short, blunt or only slightly attenuate ..... Calothrix
26. Trichomes long, attenuated to a long narrow apex, akinete adjacent to the basal heterocyst ..... Gloeotrichia

27. Heterocyst at 1 end of trichome only, akinetes adjacent to heterocyst ..... Cylindrospermum
27. Heterocysts at both ends of trichome, akinetes not adjacent to heterocyst ..... Anabaenopsis

28. Trichomes contorted, densely aggregated within a definite gelatinous envelope having an outer tegument ..... Nostoc
28. Trichomes not densely aggregated within a definite gelatinous envelope, no outer tegument 29

29. Cells and heterocysts strongly compressed, their diameter greater than their length ..... Nodularia
29. Cells and heterocysts not compressed, heterocysts spherical, quadrate, or elongate 30

30. Without false branches 31
30. With false branches 32

31. Trichomes free or loosely floccose, heterocysts spherical, or nearly so ..... Anabaena
31. Trichomes in laterally arranged bundles, heterocysts cylindrical, akinetes enlarged cylindric ..... Aphanizomenon

32. False branches arising singly adjacent to heterocysts ..... Tolypothrix
32. False branches arising in pairs midway between heterocysts ..... Scytonema

Order Chroococcales

The members of this order may be unicellular or colonial, either organized or unorganized. There is no differentiation of cells which are mostly embedded in a copious gelatinous matrix.

Studies by Drouet and Dailey (1939, 1956) and by Dailey (1942) culminated in these authors combining species of certain genera with other genera, or in assigning species of some genera to generic names that in their opinion deserved priority. However the proper generic disposition of some members of the order and of certain species is still questionable. Because the reported names have been widely used in the literature that pertains to western Lake Erie, this author prefers to retain the names of the taxa by which they were originally reported. The system that will be followed is essentially that proposed by Prescott (1962). This will lessen the danger of assigning taxa previously reported but not seen by this writer to improper generic names. Correct assignments can be made at a later date if and when critical studies of Lake Erie material make this necessary.

Family Chroococcaceae

The synonymy of the Chroococcaceae will be found in Drouet and Dailey (1956).

Aphanocapsa Naegeli 1849

Colony spherical, ovoid, or irregular, microscopic or macroscopic, hyaline, yellow, brown or blue-green; cells solitary or in pairs, equally distributed, and spaced from one another, sheaths confluent with the colonial envelope; cell contents homogeneous, bright to pale blue-green, or gray.

Aphanocapsa delicatissima W. & G. S. West Fig. 567

Colony spherical, ovoid or irregular, free-floating, envelope homogeneous, hyaline or yellow; cells spherical, contents homogeneous, gray to pale blue-green; cells 0.5 to 0.75μ in diameter.

Terwilliger, Squaw.

Aphanocapsa elachista var. conferta W. & G. S. West Fig. 568

Colony spherical, ovoid, or irregular, envelope homogeneous, hyaline or yellow; cells spherical, contents homogeneous, gray to pale blue-green; cells 1.5 to 2.0μ in diameter.

Terwilliger, Squaw.

Aphanocapsa grevillei (Hass.) Rabenhorst Fig. 569

Colony spherical or ellipsoid, free-floating or sedentary colonies; cells spherical, solitary or in pairs, often close together; olive green; cell contents homogeneous or finely granulose.

Terwilliger, Squaw.

Aphanocapsa pulchra (Kuetz.) Rabenhorst Fig. 570

Colony free-floating, spherical to ovoid, envelope firm, hyaline, homogeneous; cells spherical or ovoid, evenly spaced at some distance apart in the colonial envelope; cell contents homogeneous, gray to pale blue-green; cells 3.5 to 4.5μ in diameter.

Squaw, Pelee quarry.

Aphanothece Naegeli 1849

Colony free-floating or sedentary, irregular; cells numerous, oblong to subcylindrical, evenly distributed in a thick colonial envelope, cell sheaths confluent with the colonial matrix; cell contents homogeneous or finely granulose, without pseudovacuoles.

Kelleys.

Aphanothece and *Gloeothece*, the latter a genus with cells having definite individual sheaths, have been assigned to the genus *Anacystis* Meneghini 1837.

Aphanothece clathrata W. & G. S. West Fig. 571

Colony microscopic, free-floating, elongate and irregular, usually perforate, envelope hyaline, homogeneous; cells rod-shaped, straight or curved, contents homogeneous, gray to light blue-green; cells 0.6 to 1.0μ x 3.5 to 4.5μ.

Terwilliger, Squaw, Haunck, Wehrle.

Aphanothece nidulans P. Richter Fig. 572

Colony spherical or ovoid, envelope homogeneous, hyaline; cells broadly cylindrical, straight or curved, contents homogeneous, gray to light blue-green; cells 1 to 1.5μ x 2 to 3.5μ.

Terwilliger, Squaw, Wehrle, Kelleys.

Aphanothece prasina A. Braun Fig. 573

(*Anacystis rupestris* var. *prasina* (A. Br.) Drouet & Dailey.)

Colony spherical to cylindrical; cells broadly cylindrical, evenly distributed throughout the colony, contents homogeneous, bright blue-green; colonies up to 4 cm in diameter; cells 5 to 6.5μ x 8 to 11μ.

Terwilliger, Smith.

Chroococcus Naegeli 1849

Colony, and sometimes individual cells, enclosed by a hyaline or colored, homogeneous or lamellated sheath; cells solitary, or 2 to 16 or more, spherical or hemispherical for some time after division, free-floating or epiphytic; cell division in three planes, cell contents granular or homogeneous, brilliant blue-green, light blue-green, olive-green, brown, gray, violet, or grayish-purple.

Chroococcus dispersus (V. Keissler) Lemmermann Fig. 574

Cells spherical, 4 to 16 or more, in spherical, ovoid, or irregular colonies; cells 3 to 4μ in diameter, with sheath, 5 to 6μ; cells or groups of cells 15 to 20μ distant.

Terwilliger, Squaw, Kelleys quarries.

Chroococcus giganteus W. West Fig. 575

Cells hemispherical, rarely spherical or ovoid, solitary or two to four in colonies, surrounded by a thick hyaline, lamellated sheath; cell contents granulose, bright blue-green; cells 54 to 58μ in diameter, with sheath 67 to 70μ.

Terwilliger.

Chroococcus limneticus Lemmermann Fig. 576

Cells spherical to subspherical, 4 to 32 in spherical to ovoid colonies; cell division often in one plane, giving the colonies a tabular appearance; cell contents homogeneous, light blue-green, pale blue-green, olive-green, gray, grayish-purple, brown; cells 5 to 12μ in diameter, with sheath 7 to 14μ.

Terwilliger, Squaw, Wehrle, Smith.

Chroococcus limneticus var. purpureus (Snow) Tiffany & Ahlstrom Fig. 577

Colony circular to semicircular in front view, somewhat flattened in side view, cells enclosed by a spherical or oval, hyaline, homogeneous envelope; individual sheaths of cells conspicuous or not; cell contents homogeneous, blue-green to grayish-purple, sometimes brown; cells 13 to 26μ in diameter, usually 16 to 19μ, with sheath 15 to 30μ.

Terwilliger, Squaw, E. Harbor.

Chroococcus limneticus var. **subsalsus** Lemmermann Fig. 578

Cells 3.5 to 4.5μ in diameter, with sheath 4 to 6μ.

Terwilliger, Squaw.

Chroococcus minutus (Kuetz.) Naegeli Fig. 579

Cells spherical, or often hemispherical, solitary or two to four in a spherical, homogeneous sheath; cell contents pale blue-green to gray, homogeneous or granulose; cells 5 to 8μ in diameter, with sheath 6 to 12μ.

Terwilliger, Haunck, Wehrle, Smith, W. Harbor.

Chroococcus prescottii Drouet & Dailey Fig. 580

Colony free-floating, (8)-16-(32) cells with a cubical arrangement; colonial envelope hyaline, lamellate; cells spherical, bright blue-green, granular, with individual sheaths; cells 6 to 8μ in diameter; colony of 16 cells 27 to 29μ x 25 to 33μ.

Kelleys quarry.

This is undoubtedly the same alga reported by Tiffany (1934) as *Eucapsis alpina* Clements & Shantz.

Chroococcus turgidus (Kuetz.) Naegeli Fig. 581

Cells hemispherical, spherical, or ovoid, often flattened, solitary or two to eight inclosed by a hyaline, lamellate sheath; cell contents homogeneous, or finely granulose, pale to bright blue-green to brownish; cells 8 to 32μ in diameter, with sheath 13 to 40μ.

Terwilliger, Squaw, Wehrle, Fisher, Kelleys, E. Harbor.

Coelosphaerium Naegeli 1849

Colony globose, ellipsoid, reniform, or sometimes irregular; colonial envelope homogeneous or with gelatinous radial striae; cells globose to ovoid or pyriform, closely grouped in a single peripheral layer in the gelatinous colonial envelope; cell contents homogeneous or granular, or with pseudovacuoles.

Coelosphaerium dubium Grunow Fig. 582

Colony spherical to irregular, or as compound aggregates of smaller colonies enclosed in a common gelatinous envelope, free-floating colonial envelope firm, hyaline, homogeneous; cells spherical, densely arranged in the peripheral layer of the colonial envelope, forming a hollow colony, cell contents blue-green, homogeneous, or with pseudovacuoles; cells 5 to 7μ in diameter; colonies up to 150μ in diameter.

Squaw, open lake in Island Region.

Coelosphaerium kuetzingianum Naegeli Fig. 583

Colony free-floating, spherical or subspherical; colonial envelope hyaline, homogeneous; cells spherical or subspherical, usually somewhat spaced from one another at the periphery of the colonial envelope; cell contents homogeneous, usually without pseudovacuoles, gray, or pale to bright blue-green; cells 2 to 4μ in diameter; colonies 20 to 90μ in diameter.

Terwilliger, Squaw, Haunck, E. Harbor.

Coelosphaerium naegelianum Unger Fig. 584

Colony free-floating, spherical, ovoid, reniform, or irregular; colonial envelope wide, hyaline often radially striated; cells ovoid to ellipsoid, arranged in a dense peripheral layer some distance beneath the colonial periphery; cell contents sometimes homogeneous, but usually with numerous pseudovacuoles which cause the cell to have a reddish or black appearance; cells 2 to 5μ x 3.5 to 7μ.

Hatchery. Put-in-Bay, Catawba, open lake.

Dactylococcopsis (Reinsch) Hansgirg 1888

Colony microscopic, free-floating; colonial envelope hyaline, homogeneous, acicular, or fusiform; cells elongate, acicular, or sigmoid, ends pointed, sometimes spirally twisted; cell contents homogeneous, gray-green to pale blue-green.

Dactylococcopsis smithii R. & F. Chodat — Fig. 585

Colony with 2 to 16 cells; envelope broad, hyaline, homogeneous; cells fusiform, straight or sigmoid, frequently in pairs; cell contents pale blue-green; cells 1 to 3μ x 5 to 25μ.

Fox Pond on Pelee.

Glaucocystis Itzigsohn 1866

Colony of 4 to 16 cells in an old mother-cell wall; cells spherical, ovoid, or elliptical, with numerous, curved, rod-like or irregular chromatophore-like bodies which may be parietal or axial and radiating.

Glaucocystis nostochinearum (Itz.) Rabenhorst — Fig. 586

Cells solitary or in two- to four- to eight-celled colonies enclosed by the old mother cell wall; cells ovoid or elliptical, containing numerous, curved, rod-shaped bodies that are considered to be members of the Chroococcaceae; cells 11 to 12μ x 18 to 21μ, colonies 28μ x 37μ.

Haunck, Smith, E. Harbor, Pelee.

Gloeochaete Lagerheim 1883

Cells four, spherical, colorless, embedded in a broad hyaline envelope with each cell bearing a long gelatinous bristle; endophyte in each cell is parietal, cup-shaped, and bright blue-green.

Gloeochaete wittrockiana Lagerheim — Fig. 587

Characters as for the genus; host cells 13 to 16μ in diameter, colonies 45 to 50μ in diameter.

Haunck, on *Rivularia* colonies; Kelleys, on *Oedogonium*.

Gloeothece Naegeli 1849

Cells ovate to cylindric, ends rounded, irregularly distributed or parallel in a free-floating or sessile, hyaline or colored, homogeneous or lamellated mucilage envelope; single cells or groups of two to eight cells within lamellated sheaths; cell contents homogeneous or finely granulose, various shades of blue-green.

Gloeothece rupestris (Lyng.) Bornet — Fig. 588

Cells cylindric to nearly ellipsoid, blue-green, in colorless or yellowish sheaths; cells 4.5 to 5μ x 6 to 15μ.

Wehrle, Middle Isl., Kelleys.

Gomphosphaeria Kuetzing 1836

Colony microscopic, free-floating or sedentary, spherical to ovate; colonial envelope copious, hyaline, solid; cells pyriform, obovoid or sometimes heart-shaped, solitary or peripherally arranged in pairs or fours at the ends of short, dichotomous, gelatinous strands which radiate from the center of the colonial envelope; individual cell sheaths usually confluent.

Gomphosphaeria aponina Kuetzing — Fig. 589

Colony spherical or subspherical with a wide hyaline envelope; cells pyriform, or cuneate just prior to division, peripherally arranged at the ends of stout, radiating strands, contents bright blue-green; cells 3 to 5μ x 8 to 15μ.

Kelleys, E. Harbor.

Gomphosphaeria aponina var. **cordiformis** Wolle — Fig. 590

Cells distinctly cordate, not pyriform, compactly arranged; cell sheaths distinct; cells 6 to 13μ x 9 to 20μ.

Kelleys, Catawba.

Gomphosphaeria lacustris Chodat — Fig. 591

Colony spherical or subspherical, gelatinous envelope copious and hyaline; cells spherical to broadly ellipsoid, arranged in spaced clusters of four to eight cells at the ends of fine gelatinous strands; cells 1.5 to 3μ x 2 to 4μ, colonies 25 to 76μ in diameter.

Terwilliger, Squaw, Gibraltar, Haunck, Fisher, Buckeye beach pools, Kelleys, E. Harbor, open lake.

Holopedium Lagerheim 1883

Cells subcylindric, broadly ellipsoid, or subspherical, mostly irregularly disposed in flat, curved, quadrate to subquadrate plates.

Holopedium obvolutum Tiffany Fig. 592

Colony irregular, flat, folded, usually with 200 to 400 cells; cells cylindric to ellipsoid with rounded ends, often polygonal in end view; cells 3 to 5μ x 6 to 7μ.

Terwilliger, Squaw, Hatchery.

Marssoniella Lemmermann 1900

Colonial, colony of 4 to 12 cells or in compound colonies with up to 100 cells; cells pyriform with the broad ends inward and radially arranged about a common center, inclosed in a delicate, hyaline, mucilaginous envelope.

Marssoniella elegans Lemmermann Fig. 593

Characters as for the genus; cells 1 to 3μ x 5 to 6μ.

Terwilliger, Squaw, Smith, Kelleys.

Merismopedia Meyen 1839

Colony of four to many cells in rectilinear series, usually in groups of four or multiples of four arranged in flat, curved, rolled, or convolute plates; envelope hyaline, mucilaginous and homogeneous; cells spherical, ovate, or ellipsoid, hemispherical for some time after division; cell contents homogeneous.

Merismopedia convoluta de Brébisson Fig. 594

Colony flat or rolled, with 64 to 1000 cells; cells broadly ellipsoid or ovoid; cell contents homogeneous, pale blue-green; cells 3.5 to 4.5μ in diameter.

Terwilliger, Squaw, Wehrle.

Merismopedia convoluta de Brébisson var. **minor** (Wille) Tiffany & Ahlstrom Fig. 595

Colony with a larger number of cells which are smaller than in the species; cells 2.75μ to 3.5μ in diameter.

Terwilliger, Squaw.

Merismopedia elegans A. Braun Fig. 596

Colony of 16 to 4000 cells; cells spherical to broadly ovoid, homogeneous, bright blue-green; cells 5 to 7μ x 5 to 9μ.

Terwilliger, Squaw, Smith, E. Harbor, open lake.

Merismopedia glauca (Ehr.) Naegeli Fig. 597

Colony up to 64 cells, compact, regular; cells spherical to ovate, homogeneous, pale blue-green; cells 3 to 5μ in diameter.

Gibraltar, Terwilliger, Squaw, Wehrle, Smith, E. Harbor, open lake.

Merismopedia major (G. M. Smith) Geitler Fig. 598

Colony small; cells spherical to broadly ovoid, homogeneous, bright blue-green; cells 10 to 17μ x 12 to 20μ.

Terwilliger.

Prescott (1962) retains this form as *M. elegans* A. Braun var. *major* G. M. Smith.

Merismopedia punctata Meyen Fig. 599

Colony rather small, up to 128 cells, cells spaced some distance apart; cells spherical to broadly ovoid, or hemispherical, cell contents homogeneous, gray to pale blue-green; cells 2.5 to 3.5μ in diameter.

Terwilliger, Smith, E. Harbor, Catawba.

Merismopedia tenuissima Lemmermann Fig. 600

Colony small with 16 (-100) cells; cells minute, spherical to ovoid, sometimes with individual sheaths distinct; cell contents homogeneous, gray to pale blue-green; cells 1.5 to 2.0μ in diameter.

Terwilliger, Squaw, Fisher, Wehrle, Smith, E. Harbor, open lake.

Microcystis Kuetzing 1833

Colony free-floating or sedentary, spherical, ellipsoid, oblong, elongate, clathrate, or irregular; cells small, spherical, densely aggregated and irregularly arranged in the copious, mucilaginous, colonial envelope; cell sheaths confluent with the colonial matrix; cell contents pale or bright blue-green, or in older cells appearing black or reddish because of numerous pseudovacuoles.

The writer prefers to use *Microcystis* rather than *Anacystis* because of the widespread and generally understood use of the former in the literature that pertains to Lake Erie. The reader may refer to Drouet and Dailey (1956) for synonymy. Prescott (1962) should also be consulted.

Microcystis aeruginosa Kuetzing — Fig. 601

Colony spherical when small, but soon becomes saccate, reticulate and clathrate; cells spherical to subspherical; cell contents occasionally homogeneous and gray to pale or bright blue-green, then later with pseudovacuoles reddish to black; cells 3 to 4μ in diameter.

Terwilliger, Squaw, Hatchery, Haunck, Smith, Wehrle, Pelee canals; generally distributed in the Island Region.

Microcystis aeruginosa var. **major** (Wittr.) G. M. Smith — Fig. 602

Characters as for the type; colonial envelope very firm; cells larger; cells 5.5 to 6.5μ in diameter.

Terwilliger, Squaw, Wehrle, Haunck, Smith.

Microcystis flos-aquae (Wittr.) Kirchner — Fig. 603

Colony spherical to ovoid, rarely elongate, not perforate, margin of colony not sharply defined; cells spherical, cell contents usually reddish with pseudovacuoles, rarely homogeneous and gray to pale blue-green; cells 3.5 to 6.5μ in diameter.

Terwilliger, Squaw, Smith, open lake.

The original concept of the name *M. aeruginosa* Kuetzing for a lobed and perforate or clathrate colony, and of *M. flos-aquae* (Wittr.) Kirchner with globose and non-perforate or non-clathrate colonies has been retained by the writer. Some students of the group consider the perforate condition as an ageing phenomenon and related to environmental conditions. They consider the two species as one entity and have reduced the latter to synonymy with *M. aeruginosa* Kuetzing.

Lake Erie material does not bear out this contention. Perforate colonies of *M. aeruginosa* and globose and non-perforate colonies of *M. flos-aquae* exist side by side in the plankton without distinct intergrading forms. The globose colonies of *M. flos-aquae* enlarge and finally disintegrate without becoming perforated. Colonies sometimes have spaces devoid of cells, or are with "holes", but this is not comparable to the perforate or clathrate condition with sharply defined colony margins.

The reader should refer to Elenkin (1924), Drouet and Dailey (1939), Teiling (1941), and Prescott (1962) for further details of synonymy.

Microcystis incerta Lemmermann — Fig. 604

(*M. pulvera* (Wood) Migula and *M. pulvera* var. *incerta* Lemmermann as reported by Tiffany (1934).

Colony spherical or elongate; cells spherical, densely crowded in a thin mucilaginous envelope; cell contents gray to light blue-green, homogeneous, or with minute pseudovacuoles if present; cells 2 to 3μ in diameter.

Terwilliger, Squaw, Haunck, Wehrle, Smith.

Rhabdoderma Schmidle & Lauterborn 1900

Colony small, of few cells, envelope hyaline, homogeneous; cells cylindric, straight or arcuate, ends rounded, the long axes of the cells about parallel in the colony; cell contents homogeneous, gray to bright blue-green.

Rhabdoderma lineare Schmidle & Lauterborn — Fig. 605

Characters as for the genus; cells 2 to 3μ x 6 to 12μ.

Terwilliger.

Order Hormogonales

The order includes all blue-green algae in which the cells are arranged in trichomes or are of a filamentous organization. The trichomes may be naked, or they may be inclosed in firm or mucous, lamellate or homogeneous sheaths. They may be uniseriate or multiseriate, unbranched or true or falsely branched, of the same diameter throughout or attenuate. They may be straight and rigid, spiralled, or irregularly twisted. They may be composed only of vegetative cells, or they may contain akinetes and heterocysts at various locations along the trichome.

Suborder Homocystineae

These plants are simple trichomes without differentiated cells. Trichomes reproduce by fragmentation, the cells by fission. They may or may not have distinct sheaths.

Family Oscillatoriaceae

Borzia Cohn 1883

Trichomes of three to six cells, no sheath; terminal cells hemispherical, other cells barrel-shaped.

Borzia trilocularis Cohn — Fig. 606

Characters as for the genus; trichome 10 to 25μ long, 6 to 7μ broad.

Gibraltar, Kelleys.

Lyngbya C. Agardh 1824

Filaments solitary or intertwined into floccose or tough membranaceous sheets, unbranched, cylindrical, straight, curved, or spiralled; sheaths firm, mostly thick, hyaline or not, usually extending beyond the trichome; trichome sometimes tapering slightly toward the apex, constricted at crosswalls, or not; apical cell generally not capitate; cell contents may be homogeneous, granulose, or with pseudovacuoles.

Lyngbya aestuarii (Mert.) **Leibmann** — Fig. 607

Filaments solitary, or intertwined into a dull blue-green floccose mass; sheath at first thin and colorless, later irregular, lamellose, and colored; trichomes not constricted at crosswalls, slightly tapering and apex capitate, truncate, or acute-conic; cells finely granulose, blue-green to olive; cells 8 to 24μ x 2.7 to 5.6μ.

Wehrle.

Lyngbya birgei G. M. Smith — Fig. 608

Filaments free-floating, solitary, straight, or curved; sheath hyaline, homogeneous, or rarely lamellate; trichomes not constricted at crosswalls, not attenuate; cells usually with pseudovacuoles, gray to olive-green; cells 18 to 23μ x 2 to 5.5μ, sheath 0.5 to 4μ thick.

Squaw, Wehrle, E. Harbor.

Lyngbya contorta Lemmermann — Fig. 609

Filaments solitary, free-floating, usually in regular loose or compact spirals; sheaths firm, thin; trichomes not constricted at crosswalls; apical cell rounded; cells homogeneous, gray to pale blue-green; cells 1.5 to 2μ x 3 to 6μ, spirals 15 to 20μ broad and 6 to 14μ between turns.

Gibraltar, Pelee canal.

Lyngbya major Meneghini — Fig. 610

Filaments solitary or gregarious, not in floccose masses, straight; sheaths thick, lamellate, colorless; trichomes not constricted at crosswalls, tapering slightly toward the apex which is somewhat capitate; cells granulose along the crosswalls, dark blue-green; cells 11 to 16μ x 2 to 4μ.

Haunck, Catawba.

Lyngbya majuscula (Dillw.) Harvey — Fig. 611

Filaments solitary or more often in dark blue-green to blue masses, long, curled or occasionally straight; sheath colorless and becoming rough; trichomes not constricted at crosswalls, not tapering; apical cell rounded; cells finely granulose, variously colored; cells 16 to 20μ x 2 to 4μ, sheath up to 11μ thick.

Fox.

Microcoleus Desmazieres 1823

Plants on wet soil or submerged slightly; a wide, gelatinous, unbranched, homogeneous sheath surrounds a central axis of many spirally entwined trichomes, some of which may extend beyond the sheath; trichomes tapering to acute or rounded apices; apical cells conical or capitate; cells cylindric, without pseudovacuoles.

Microcoleus lacustris (Raben.) Farlow — Fig. 612

Characters as for the genus; sheaths of trichomes colorless and confluent; apical cells not capitate, cell contents pale blue-green; cells 4 to 5μ in diameter, 8 to 12μ long.

Kelleys, in roadside puddles and intermingled with *Scytonema myochrous* (Dillw.) C. A. Agardh

Oscillatoria Vaucher 1803

Trichomes unbranched, cylindrical, without an evident sheath, solitary and free-floating, or forming a membranaceous and slimy layer on wet soil or over submerged rock; trichomes straight or twisted, ends often narrowed, apical cell rounded or capitate; trichomes exhibiting an oscillating and often a gliding movement.

Oscillatoria agardhii Gomont — Fig. 613

Trichomes free-floating or in expanded masses, straight, not constricted at the crosswalls, slightly tapering toward the apex, calyptrate or cylindrical; apical cell rounded, capitate, or truncate; cells coarsely granular, pale blue-green, with granules along the crosswalls; cells 4 to 6μ x 2.5 to 4μ.

Wehrle.

Oscillatoria chalybea Mertens — Fig. 614

Trichomes rarely solitary, much entangled, straight or sometimes twisted, gradually tapering to the curved apex, slightly constricted at the crosswalls; apical cell conical; cells finely granular, dark blue-green, sometimes with granules along the crosswalls; cells 8 to 13μ x 3.5 to 8μ.

Terwilliger, Catawba.

Oscillatoria lacustris (Kleb.) Geitler — Fig. 615

Trichomes rarely solitary, usually joined laterally into plate-like, free-floating aggregates, cylindric, straight or twisted, with delicate sheaths; apical cell rounded; cells compressed globose, barrel-shaped, or subquadrate; cells 5 to 7μ x 5 to 7μ.

Terwilliger, Squaw, Fisher.

Oscillatoria limosa (Roth) C. A. Agardh — Fig. 616

Trichomes rarely solitary, forming masses on submerged substrates, straight, not tapering, not constricted at crosswalls; apical cell convex, outer membrane thickened; cells dark blue-green, brown, or olive, with granules at crosswalls; cells 11 to 20μ x 2 to 5μ.

Terwilliger, Squaw, Hatchery, Fisher, Wehrle, Haunck, Catawba.

Oscillatoria princeps Vaucher — Fig. 617

Trichomes solitary, or in dark green to black masses, individual trichomes macroscopic, straight, not constricted, apically curved, truncate, or capitate; apical cell convex; cells granular; cells 16 to 60μ x 3.5 to 7μ.

Haunck, Fisher, Fox, Pelee canal, E. Harbor, W. Harbor.

Oscillatoria prolifica (Grev.) Gomont — Fig. 618

Trichomes rarely solitary, forming free-floating, red to purple floccose mats, straight, not constricted at crosswalls, tapering slightly toward the apex; apical cell obtuse-capitate; cells with reddish pseudovacuoles and rows of granules along the crosswalls; cells 2 to 2.5μ x 4 to 6μ.

Squaw, Terwilliger, Hatchery, E. Harbor.

Oscillatoria splendida Greville — Fig. 619

Trichomes solitary, scattered, or in a thin mass, straight or twisted, not constricted at crosswalls, gradually tapering toward the apex; apical cell conical and capitate; cells homogeneous, with granules along the crosswalls; cells 2 to 3μ x 3 to 9μ.

E. Harbor.

Oscillatoria tenuis C. A. Agardh — Fig. 620

Trichomes solitary, or in pale blue-green floccose masses, cylindrical, straight or curved, slightly constricted at crosswalls; apical cell convex, not capitate; cells homogeneous with a row of granules along the crosswalls; cells 4 to 10μ x 2.6 to 5μ.

Distribution general.

Phormidium Kuetzing 1843

Filaments unbranched, densely interwoven and aggregated into tough membranaceous sheets, rarely solitary and floating; sheaths very thin, transparent, diffluent; trichomes cylindrical, apex often tapering, straight, or curved, capitate or not; apical cell conical, blunt pointed, or sometimes capitate or calyptrate.

Phormidium retzii (C. A. Agardh) Gomont — Fig. 621

Filaments entangled into tufts, often separated and floating; trichomes constricted at crosswalls or not, apex straight, not capitate; apical cell slightly tapering, truncate; sheaths thin, fragile, diffluent; cells 4 to 12μ x 4 to 9μ.

Squaw.

Phormidium subfuscum Kuetzing Fig. 622

Filaments straight, short, subparallel, agglutinated, rarely floating, sheaths diffluent into a lamellated mucus; trichomes not constricted at crosswalls, apex straight, capitate and calyptrate; cells densely granular with two rows of granules at crosswalls, dull blue-green; cells 5.5 to 11μ x 2 to 4μ.

Wehrle.

Spirulina Turpin 1827

Trichome unicellular, elongate, cylindrical, ends rounded, no sheath, twisted into a loose or compact spiral; cell contents homogeneous or granulose, pale to dark blue-green.

Spirulina laxissima G. S. West Fig. 623

Spirals regular, loose; cells bright blue-green; cells 0.7 to 0.8μ in diameter; spirals 4.5 to 5.5μ broad and 17 to 22μ between turns.

Hatchery.

Spirulina major Kuetzing Fig. 624

Spirals more or less loose, straight or bent; cells bright blue-green; cells 1.2 to 1.7μ in diameter, spirals 2.5 to 4μ broad and 2.7 to 5μ between turns.

Gibraltar, Middle Isl., Catawba.

Spirulina princeps (W. & G. S. West) G. S. West Fig. 625

Spirals loose, straight or curved; cells homogeneous or slightly granulose, bright blue-green; cells 3 to 5μ in diameter, spirals 8 to 16μ broad, 9 to 12μ between turns.

Squaw, Haunck, E. Harbor.

Spirulina should be compared with *Arthrospira* in which the trichomes are multicellular. Some workers do not separate the two genera, but for this compilation they are considered separately.

Suborder Heterocystineae

The characteristic of this group is the heterocyst though it may be lacking in some. If so, other morphological features will relate them to the characteristic forms.

Family Nostocaceae

Anabaena Bory 1822

Trichomes free-floating, solitary or aggregated in tangled masses of a few trichomes; trichomes straight, circinate, spiral or twisted, without a basal differentation of cells, without an evident sheath; cells spherical to barrel-shaped, often with pseudovacuoles in older cells; heterocysts spherical, intercalary; akinetes variously shaped, solitary or in series, may or may not be adjacent to the heterocyst.

Anabaena affinis Lemmermann Fig. 626

Trichomes solitary, free-floating, straight or slightly curved; cells usually spherical; heterocysts spherical; akinetes about spherical, generally not next to heterocysts; cells 5 to 6μ in diameter, heterocysts 7.5 to 10μ in diameter, akinetes 9.5 to 12μ x 17 to 26μ.

Haunck.

Anabaena catenula (Kuetz.) Bornet & Flahault Fig. 627

Trichomes bent; cells barrel-shaped, homogeneous to granulose, without pseudovacuoles; heterocysts spherical to elliptic; akinetes cylindric, in series, next to or remote from heterocysts; cells 5 to 8μ in diameter, heterocysts 6 to 9μ x 9 to 13μ, akinetes 7 to 10μ x 16 to 30μ.

E. Harbor.

Anabaena circinalis Rabenhorst Fig. 628

Trichomes free-floating, rarely solitary, curved or sigmoid, usually in twisted floccose aggregates; cells spherical or nearly so; heterocysts spherical; akinetes cylindric, often curved, solitary or in series, usually next to heterocysts; cells 4 to 8μ in diameter, heterocysts 6 to 9μ, akinetes 7 to 13μ x 20 to 50μ.

Squaw, Smith.

Anabaena flos-aquae (Lyng.) de Brébisson Fig. 629

Trichomes are free-floating, coiled or twisted into floccose aggregates; cells spherical or nearly so; heterocysts spherical; akinetes cylindric, often curved, solitary or in series, usually next to heterocysts; cells 4 to 8μ in diameter, heterocysts 6 to 9μ, akinetes 7 to 13μ x 20 to 50μ.

Squaw.

Anabaena lemmermanni P. Richter Fig. 630

Trichomes free-floating, irregularly twisted into masses; cells spherical or slightly elongate; heterocysts spherical; akinetes cylindric, one side convex, the other mostly straight, usually in series on both sides of the heterocysts, forming a dense mass at the center of the aggregation; cells 5.5 to 7μ x 5 to 8μ, heterocysts 6 to 7.5μ, akinetes 8 to 11μ x 19 to 33μ.

Terwilliger, Squaw, Hatchery, Put-in-Bay Harbor.

Anabaena macrospora Klebahn var. **robusta** Lemmermann Fig. 631

Trichomes solitary, free-floating, straight or bent; cells spherical or subspherical with truncate ends; heterocysts spherical; akinetes cylindric, with conic apices, walls thick, solitary or in pairs; cells 12 to 16μ x 9 to 12μ, heterocysts 10 to 16μ in diameter, akinetes 17 to 20μ x 30 to 34μ.

Haunck.

Anabaena planctonica Brunnthaler Fig. 632

Trichomes free-floating, solitary, usually straight; cells spherical, hemispherical, or broadly ellipsoid; heterocysts spherical; akinetes spherical or elongate, solitary, adjacent or remote from heterocysts; cells 9 to 15μ in diameter, heterocysts 12 to 14μ, akinetes 12 to 20μ x 12 to 30μ.

Terwilliger, Wehrle, Pelee canal, Catawba.

Anabaena spiroides Klebahn var. **crassa** Lemmermann Fig. 633

Trichomes free-floating, solitary, forming regular spirals; cells spherical or oblate; heterocysts spherical, pale yellow or hyaline; akinetes broadly ovoid, solitary, remote from heterocysts; cells 11 to 15μ in diameter, heterocysts 10 to 17μ, akinetes 20 to 25μ x 27 to 42μ, spirals 50 to 60μ broad and 45 to 55μ between turns.

Squaw, Smith.

Anabaenopsis (Wolosz.) Miller 1923

Trichomes free-floating, usually solitary, cylindrical, circinate or twisted, sheath not apparent; vegetative cells spherical or elongate-spherical; heterocysts spherical, terminal on one or both ends of trichome.

Anabaenopsis arnoldii Aptekarj Fig. 634

Trichomes short, almost a complete circle or spiral; cells compressed-spherical to short barrel-shaped; heterocysts spherical; vegetative cells 6 to 8.5μ x 5 to 8μ, heterocysts 6.5 to 10μ x 8.5 to 10.5μ, akinetes 10.5 x 12μ.

Wehrle.

Anabaenopsis circularis (W. & G. S. West) V. Miller Fig. 635

Trichomes short, almost a complete circle, or in a spiral of one and one-half to five turns; heterocysts nearly spherical; akinetes nearly spherical to broadly ellipsoid; cells 5 to 8μ x 7 to 10.5μ, heterocysts 6 to 9μ x 6 to 10μ, akinetes 10 to 12μ x 12 to 15μ.

Wehrle.

Aphanizomenon Morren 1838

Trichomes straight, rigid, arranged laterally into fusiform-shaped bundles, free-floating; vegetative cells cylindric; heterocysts cylindric, intercalary, often lacking in young colonies; akinetes elongate, cylindric, solitary.

Aphanizomenon holsaticum Richter Fig. 636

Characters as for the genus; vegetative cells 4 to 6μ x 5 to 15μ, heterocysts 5 to 7μ x 7 to 20μ, akinetes 6 to 8μ x 35 to 80μ.

Squaw, Terwilliger, Hatchery, Put-in-Bay Harbor, E. Harbor; this alga occurs commonly in the plankton throughout the open lake in the Island Region.

Cylindrospermum Kuetzing 1843

Filaments straight or loosely entangled into an indefinite mass on soil or on submerged substrates; vegetative cells cylindric; heterocysts cylindric to elongate, terminal; akinetes next to the heterocysts, solitary and sometimes papillate.

Cylindrospermum stagnale (Kuetz.) Bornet & Flahault Fig. 637

Trichomes entangled or parallel, in an attached or floating mucous; vegetative cells quadrate to cylindric, constricted at the crosswalls; heterocysts terminal, spherical or elongate; akinetes usually single, broadly cylindric and next to the heterocysts; vegetative cells 3.8 to 4.5μ in diameter, heterocysts 6 to 7μ x 7 to 16μ, akinetes 10 to 16μ x 32 to 40μ.

Wehrle, Fisher.

Nodularia Mertens 1822

Filaments solitary, free-floating, or forming a thin stratum on soil; trichomes usually straight with short, vertically compressed cells; sheaths hyaline; heterocysts compressed as the vegetative cells; akinetes spherical or compressed, in intercalary series.

Nodularia harveyana (Thw.) Thuret Fig. 638

Trichomes tapering at the ends; apical cell obtusely conical; sheath thin, colorless; heterocysts spherical or compressed, akinetes almost spherical, yellow-brown; vegetative cells 4 to 6μ x 4 to 7μ, heterocysts 5 to 7μ x 4 to 7μ, akinetes 6 to 8μ in diameter.

Haunck.

Nodularia sphaerocarpa Bornet & Flahault Fig. 639

Sheath thin; vegetative cells depressed-spherical; heterocysts only slightly larger than vegetative cells; akinetes depressed spherical, 2 to 12 in a series, brown; vegetative cells 6 to 7μ x 4μ, akinetes 7 to 10μ in diameter.

Haunck, E. Harbor.

Nodularia spumigena Mertens Fig. 640

Filaments solitary, free-floating or straight or curled, in a mucous mass; vegetative cells disciform; heterocysts about the same size as the vegetative cells; akinetes spherical, solitary, or up to many in series; vegetative cells 8 to 12μ x 3 to 4μ, akinetes 12 to 15μ x 6 to 10μ, filaments 8 to 18μ in diameter.

Squaw, Terwilliger, Fox, Pelee canal.

Nostoc Vaucher 1803

Trichomes contorted and entangled in a more or less gelatinous envelope which is firm and usually with a definite shape; colony microscopic or macroscopic, free-floating or sessile in subaquatic habitat; cells globose, ovoid or cylindric, no basal differentation in trichome; heterocysts and akinetes present.

Nostoc coeruleum Lyngbya Fig. 641

Trichomes densely interwoven and contorted; colony spherical, solid; cells barrel-shaped; heterocysts spherical; vegetative cells 5 to 7μ in diameter, heterocysts 8 to 10μ in diameter; colonies five to six mm in diameter.

Squaw.

Nostoc pruniforme C. A. Agardh Fig. 642

Trichomes loosely entangled; colony spherical, integument tough; cells compressed-spherical or elongate; vegetative cells 4 to 6μ in diameter, heterocysts 6 to 7μ in diameter; colonies to one inch in diameter.

Squaw, Fisher, Armbruster.

Family Scytonemataceae

Plectonema Thuret 1875

Trichomes in sheaths of various thickness, falsely branched, occurring free or in mats, slight or no tapering; cells short, disc-like or barrel-shaped, usually constricted at crosswalls; no heterocysts.

Plectonema wollei Farlow Fig. 643

Filaments long, not contorted, false branches few, sheath thick and slightly yellow when old, lamellated; cells discoidal, not constricted at crosswalls, dark blue-green, end cells rounded; filaments 42 to 60μ, sheath 5 to 10μ, cells 37 to 45μ x 5 to 7μ.

Middle Isl., Hatchery, N. Bass; probably general in deep water throughout the Island Region.

Scytonema C. A. Agardh 1824

Plant mass usually leather-like or felt-like, on moist soil, or at least mostly subaerial; filaments falsely branched, usually arising in pairs between two heterocysts; sheaths firm, usually lamellate, hyaline or yellowish to brown; trichomes uniseriate, approximately the same diameter throughout; cells quadrate to short cylindric; heterocysts one to three, intercalary, subglobose to quadrangular, about the same diameter as the vegetative cells.

Scytonema alatum (Carm.) Borzi — Fig. 644

Characters as for the genus; sheaths wide, lamellated, with diverging layers, yellow to brown; heterocysts subglobose; filaments 12 to 20μ in diameter, cells 7 to 10μ x 7 to 12μ, heterocysts about the same dimensions as the vegetative cells.

Kelleys quarry.

Scytonema myochrous (Dillw.) C. A. Agardh — Fig. 645

Characters as for the genus; sheaths wide, lamellated, dark gray-brown; cells quadrate or slightly cylindric; heterocysts cylindric or nearly quadrate; filaments 12 to 24μ in diameter, cells 6 to 11μ x 6 to 12μ, heterocysts 6 to 11μ x 12 to 24μ.

Kelleys, roadside puddles in quarry.

Tolypothrix Kuetzing 1843

Trichomes in sheaths, falsely branched, branches single, long, arising just below a heterocyst, sessile or forming a floccose, floating mass; vegetative cells quadrate, cylindric, or ovoid-cylindric; heterocysts quadrate to subglobose, single or three to five seriate; akinetes spherical, ovoid or ellipsoid, single or in series.

Tolypothrix distorta Kuetzing — Fig. 646

Vegetative cells quadrate or shorter than long, blue-green to brown, constricted at the crosswalls; sheath at first colorless, then brown; heterocysts spherical to cylindrical, single or in series of two or three; vegetative cells 9 to 12μ in diameter, heterocysts 12 to 14μ in diameter, filaments 10 to 15μ in diameter.

Haunck.

Tolypothrix tenuis Kuetzing — Fig. 647

Filaments forming a floccose layer, sessile then free-floating; sheaths colorless to yellowish; vegetative cells blue-green to olive-green; heterocysts quadrate, in a series of one to five; cells 5 to 8μ in diameter, heterocysts 7 to 10μ x 7 to 11μ; filaments 8 to 10μ in diameter.

E. Harbor.

Family Rivulariaceae

Calothrix C. A. Agardh 1824

Trichomes tapering from a basal heterocyst to either a blunt or fine point; sheaths firm, close, hyaline or colored, homogeneous or lamellate, solitary or clustered, epiphytic on other algae, or on rock; cells short and broad in the basal portion of the trichome, elongate near the apex; heterocysts hemispherical or subglobose; akinetes adjacent to the heterocysts.

Calothrix fusca (Kuetz.) Bornet & Flahault — Fig. 648

Characters as for the genus; basal cells 9 to 11μ in diameter, heterocysts 9 to 11μ in diameter.

S. Bass shore line.

Dichothrix Zanardini 1858

Plant mass tufted, slippery; trichomes tapering, in flexuous, thick, indistinctly lamellated, tapering sheaths, branches common, remaining for most of their length within the common sheath.

Dichothrix orsiniana (Kuetz.) Bornet & Flahault — Fig. 649

Characters as for the genus; heterocysts subglobose to hemispherical; trichomes 7 to 13μ wide at base, vegetative cells 3 to 4μ long, heterocepts 7 to 11μ wide.

Kelleys.

Gloeotrichia J. A. Agardh 1842

Colonial free-floating or sessile, spherical or irregular masses when old, matrix gelatinous and tough; trichomes attenuated from base to apex, falsely branched;

sheaths evident only near the base, radiating from a center; heterocysts basal on trichome, spherical to hemispherical, solitary; akinetes solitary, cylindrical, adjacent to heterocysts.

Gloeotrichia echinulata (J. E. Smith) P. Richter — Fig. 650

Colony spherical, free-floating; vegetative cells mostly with pseudovacuoles, increasing in length from base of trichome to apex; heterocysts spherical; basal cells 8 to 10μ in diameter, apical cells 1 to 2μ in diameter, heterocysts 7 to 10μ in diameter, akinetes 8 to 10μ x 40 to 54μ.

Squaw, Fisher.

Gloeotrichia natans (Hedwig) Rabenhorst — Fig. 651

Colony spherical or nearly so, first sessile then free-floating, hard, hollow, composed of loosely associated trichomes; sheaths folded and wrinkled, colorless to brown; vegetative cells longer toward the apex of the trichome; heterocysts spherical; basal cells 7 to 9μ in diameter, heterocysts 6 to 12μ in diameter, akinetes 10 to 18μ x 40 to 250μ.

Squaw, Fisher.

Gloeotrichia pisum (C. A. Ag.) Thuret — Fig. 652

Colony free-floating or sessile, spherical, hard, blackish-green; heterocysts spherical; akinetes cylindrical; basal cells 4 to 7μ in diameter, heterocysts 11 to 15μ in diameter, akinetes 9 to 15μ x 60 to 400μ.

Haunck.

Raphidiopsis Fritsch & Rich 1930

Trichomes usually solitary, free-floating, short, usually curved or sigmoid, without a sheath; apices acuminate, or one end rounded and the other acuminate, tapering occurs only near the end, the apex may be contained in a solid bristle; cells usually with numerous pseudovacuoles, septa indistinct; spores formed singly or in pairs at the middle of the trichome.

Raphidiopsis curvata Fritsch & Rich — Fig. 653

Characters as for the genus; cells 4 to 5μ in diameter, spores 5μ x 10 to 13.5μ.

E. Harbor.

The description is from Fritsch and Rich (1930). The figure is redrawn from the same source.

Division Rhodophyta

The plants in this division are multicellular and either microscopic or macroscopic. Most forms are aquatic and occur only in warm quiet water, or in well aerated cold water. The cells contain various pigments, among which is phycocyanin and phycoerythrin. The latter gives the characteristic red color to some forms. Most of the freshwater forms are varying shades of blue-green, violet or purple. The chromatophores are usually axial with a central pyrenoid and starch as the reserve food. There are no flagellated cells. The distinguishing characteristic of the Rhodophyta is the *cystocarp*, a spore-forming structure that follows fertilization and the meiotic division of the zygote.

Class Rhodophyceae

KEY TO GENERA OF CLASS RHODOPHYCEAE

1. Thallus a simple or falsely branched filament; ovoid cells with an axial stellate chromatophore and one pyrenoid, arranged in a tubular gelatinous sheath .... **Asterocytis**
1. Thallus a corticated axis of cells with whorls of tufted lateral branches .... **Batrachospermum**

Subclass Bangioideae

Order Bangiales

The thallus of the freshwater forms is a branched or unbranched filament. The cell walls are thick, gelatinous, and often lamellate. The chromatophore is axial, stellate, and has one pyrenoid. Asexual reproduction is by nonmotile spores. Sexual reproduction is between spermatia and vegetative cells.

Family Goniotrichaceae

Asterocytis (Thwait) Gobi 1879

Filaments simple or branched; cells mostly oblong, enclosed in distinct gelatinous sheaths, spaced, or closely arranged, regularly or irregularly uniseriate; chromatophores axial, stellate, with one central, conspicuous pyrenoid.

Asterocytis smaragdina (Reinsch) Forti Fig. 654

Characters as for the genus; cells 7 to 9μ x 10 to 14μ.

Gibraltar, Buckeye beach pool, State Dock; intermingled with dead or dying *Cladophora* along shore lines.

Subclass Florideae

Order Nemalionales

Thalli are monoaxial or multiaxial and of a definite form. Axes often have nodal and internodal regions with clusters of branches at the nodes. Sexual reproduction involves carpogonia and antheridia.

Family Batrachospermaceae

Batrachospermum Roth 1797

An attached, repeatedly branched thallus with nodal and internodal regions; axis a row of elongated cells invested by cortical filaments that arise at the nodes; whorls of branches arising at the nodes provide a beaded appearance to the axis; cells of the branches ovoid, ellipsoid, or fusiform, terminal cells often bearing colorless hairs; chromatophores in branch cells two to five, irregular or disc-like, each with one pyrenoid; thallus enclosed in a hyaline mucilage.

Batrachospermum sp.

Only a few vegetative plants have been collected and the species has not been determined.

N. Bass; Fox, attached to snail shells; Kelleys, N. dock on snail shells and in quarry pool.

The genus is recorded so that future collectors will be alert to its presence and possibly be able to identify the species.

PLATES

Most of the figures have been redrawn from those by authors who studied the algae of western Lake Erie. Illustrations of taxa that were reported without accompanying figures are from various sources. All figures have been accredited to the respective authors in the following listing.

Tiffany: Figures 1-3, 5-19, 21-22, 24-25, 27-28, 30, 32, 34-38, 41, 43-44, 46-68, 71-72, 76-92, 94-123, 126-133, 135-152, 154-165, 167-169, 171-185, 187-205, 207-223, 225-227, 229-257, 259-262, 264-279, 281-338, 484-498, 501-512, 514-515, 517-518, 521-522, 524, 526-529, 533-535, 537-538, 545, 547-548, 550-551, 554, 558-559, 567-579, 581-585, 588-605, 607-611, 613-641, 646-647, 650-652.
Taft: Figures 20, 23, 26, 29, 31, 33, 39-40, 42, 70, 74-75, 93, 124-125, 134, 153, 166, 170, 186, 228, 258, 263, 280, 339, 341-373, 375-419, 421-464, 466-474, 476-483, 499-500, 513, 516, 523, 525, 530, 532, 536, 539, 542-544, 546, 549, 552-553, 555-557, 560-566, 580, 586-587, 606, 642-643, 649, 654*
Borge: Figure 340
Fritsch and Rich: Figure 653
Normandin and Taft: Figure 73
Pascher: Figures 519-520
Snow: Figure 4
Taft and Kishler: Figures 45, 69, 206, 224, 580, 612, 644-645, 648
Tiffany and Britton: Figures 531, 540-541
West and West: Figures 374, 420, 465, 475

*Figures 20, 29, 31, 39, 75, 170, 258 have not been published previously.

PLATE I

Figure 1. *Carteria dissecta* Tiffany
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Figure 21. *Haematococcus lacustris* (Girod.) Wittrock
Figure 22. *Asterococcus limneticus* G. M. Smith; a. a recently divided cell.
Figure 23. *Gloeocystis ampla* (Kuetz.) Lagerheim

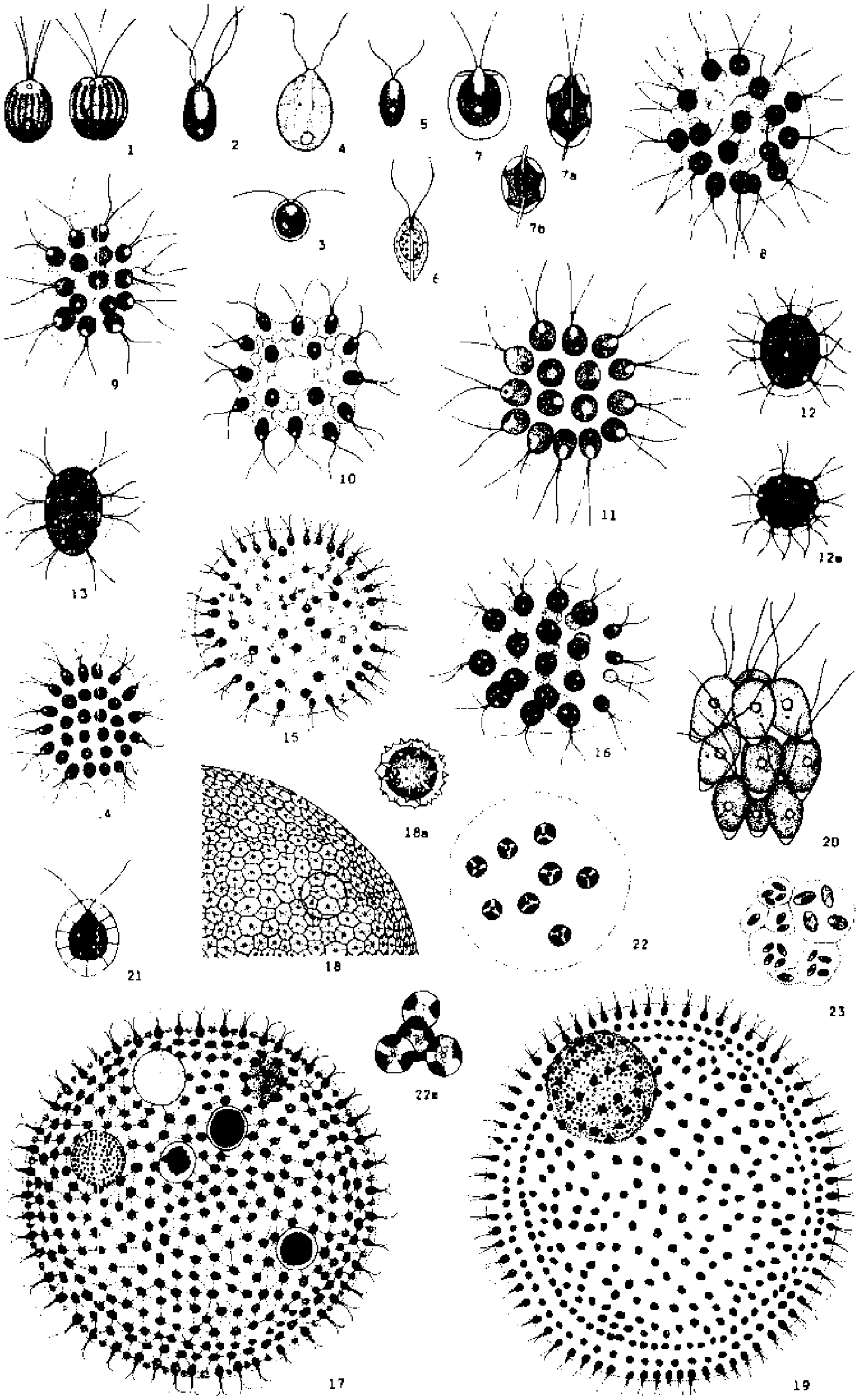
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PLATE II

Figure 24. *Gloeocystis gigas* (Kuetz.) Lagerheim
Figure 25. *Gloeocystis planctonica* (W. & G. S. West) Lemmermann
Figure 26. *Palmodictyon varium* (Naeg.) Lemmermann
Figure 27. *Sphaerocystis schroeteri* Chodat
Figure 28. *Apiocystis brauniana* Naegeli; a. inactive stage.
Figure 29. *Tetraspora gelatinosa* (Vaucher) Desvaux, habit sketch; a. cell arrangement.
Figure 30. *Tetraspora lacustris* Lemmermann
Figure 31. *Tetraspora lubrica* (Roth) C. A. Agardh, habit sketch; a. cell arrangement.
Figure 32. *Stylosphaeridium stipitatum* (Bachm.) Geitler & Gimesi
Figure 33. *Dactylothece confluens* (Kuetz.) Lagerheim
Figure 34. *Elakatothrix viridis* (Snow) Printz
Figure 35. *Binuclearia eriensis* Tiffany
Figure 36. *Binuclearia tatrana* Wittrock
Figure 37. *Geminella interrupta* (Turpin) Lagerheim
Figure 39. *Geminella minor* (Naeg.) Heering
Figure 39. *Hormidium subtile* (Kuetz.) Heering
Figure 40. *Radiofilum flavescens* G. S. West
Figure 41. *Stichococcus subtilis* (Kuetz.) Klercher
Figure 42. *Ulothrix subconstricta* G. S. West
Figure 43. *Ulothrix tenerrima* Kuetzing
Figure 44. *Ulothrix zonata* (Weber & Mohr) Kuetzing
Figure 45. *Uronema elongatum* Hodgetts
Figure 46. *Schizomeris leibleinii* Kuetzing; a. older filament.
Figure 47. *Microspora floccosa* (Vaucher) Thuret; a. aplanospore.
Figure 48. *Microspora stagnorum* (Kuetz.) Lagerheim
Figure 49. *Microspora willeana* Lagerheim; a. aplanospores.
Figure 50. *Cylindrocapsa geminella* Wolle
Figure 51. *Cylindrocapsa geminella* var. *minor* Hansgirg
Figure 52. *Aphanochaete repens* A. Braun
Figure 53. *Chaetophora elegans* (Roth) Agardh, basal portion; a. terminal filaments.

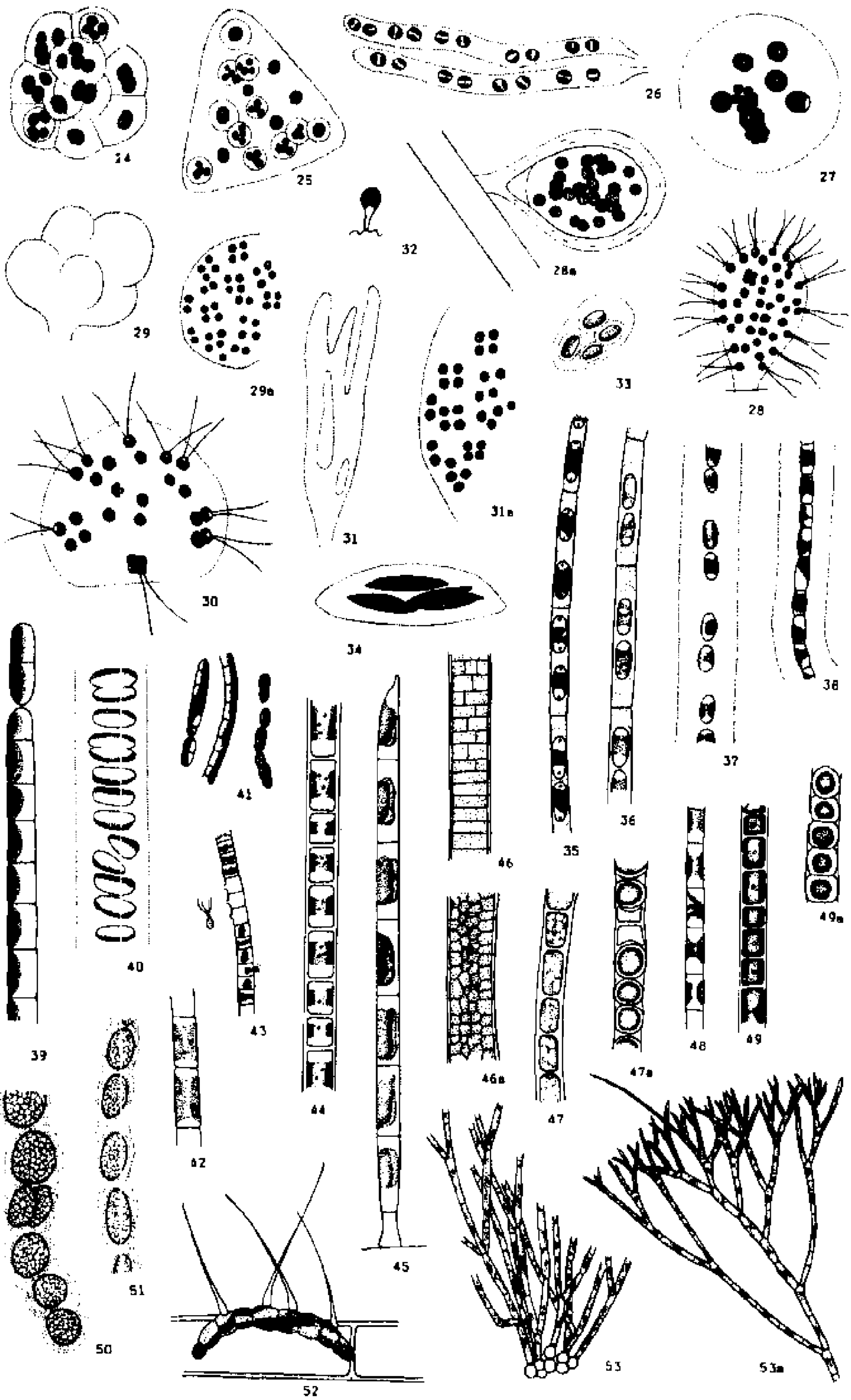
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PLATE III

Figure 54. *Chaetophora incrassata* (Hudson) Hazen
Figure 55. *Chaetophora pisiformis* (Roth) Agardh
Figure 56. *Draparnaldia glomerata* (Vauch.) C. A. Agardh
Figure 57. *Stigeoclonium gracile* (W. & G. S. West) Tiffany
Figure 58. *Stigeoclonium lubricum* (Dillw.) Kuetzing; a. terminal branches.
Figure 59. *Stigeoclonium lubricum* var. *varians* (Hazen) Collins
Figure 60. *Stigeoclonium stagnatile* (Hazen) Collins
Figure 61. *Stigeoclonium subsecundum* Kuetzing
Figure 62. *Stigeoclonium tenue* (Agardh) Kuetzing
Figure 63. *Protococcus viridis* Agardh
Figure 64. *Chaetosphaeridium pringsheimii* Klebahn
Figure 65. *Coleochaete irregularis* Pringsheim
Figure 66. *Coleochaete orbicularis* Pringsheim
Figure 67. *Coleochaete scutata* de Brébisson
Figure 68. *Coleochaete soluta* (de Bréb.) Pringsheim
Figure 69. *Gongrosira stagnalis* (G. S. West) Schmidle

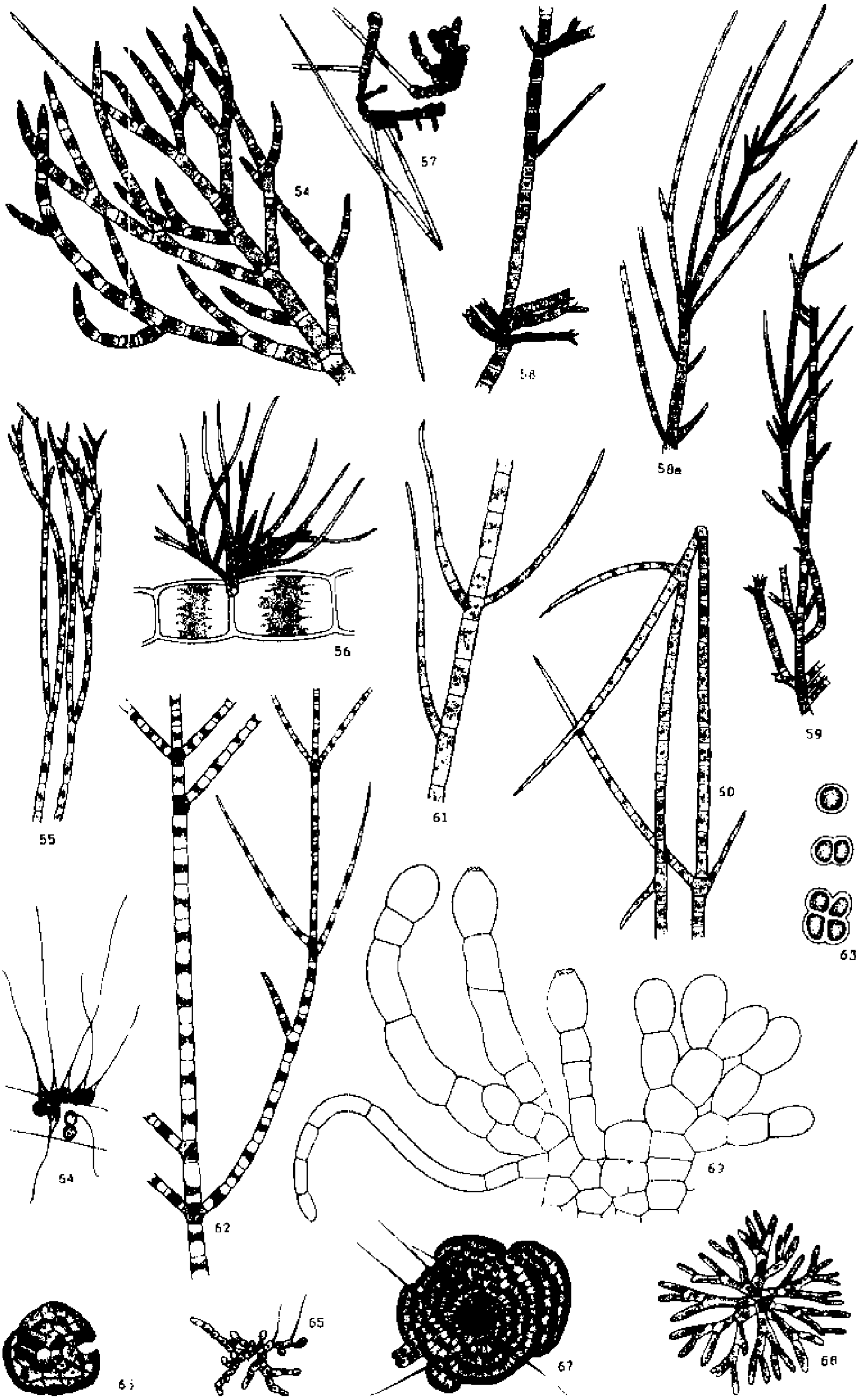
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PLATE IV

Figure 70. *Trentepohlia aurea* (L.) Martius; a. terminal cell with pectose peg, b. lateral sporangium.
Figure 71. *Basicladia chelonum* (Collins) Hoffman & Tilden, holdfast and basal branch; a. mid-filament, b. terminal filament, c. sporangia.
Figure 72. *Basicladia crassa* Hoffman & Tilden; a. basal cell and holdfast, b. sporangium, c. new filament forming within old filament.
Figure 73. *Basicladia vivipara* Normandin & Taft, filaments with sporangia; a. basal portion.
Figure 74. *Cladophora crispata* (Roth) Kuetzing
Figure 75. *Cladophora fracta* (Dillw.) Kuetzing
Figure 76. *Cladophora glomerata* (L.) Kuetzing
Figure 77. *Pithophora varia* Wille, intercalary akinetes and branch; a. terminal akinete.
Figure 78. *Rhizoclonium hieroglyphicum* (Agardh) Kuetzing
Figure 79. *Rhizoclonium hookeri* Kuetzing

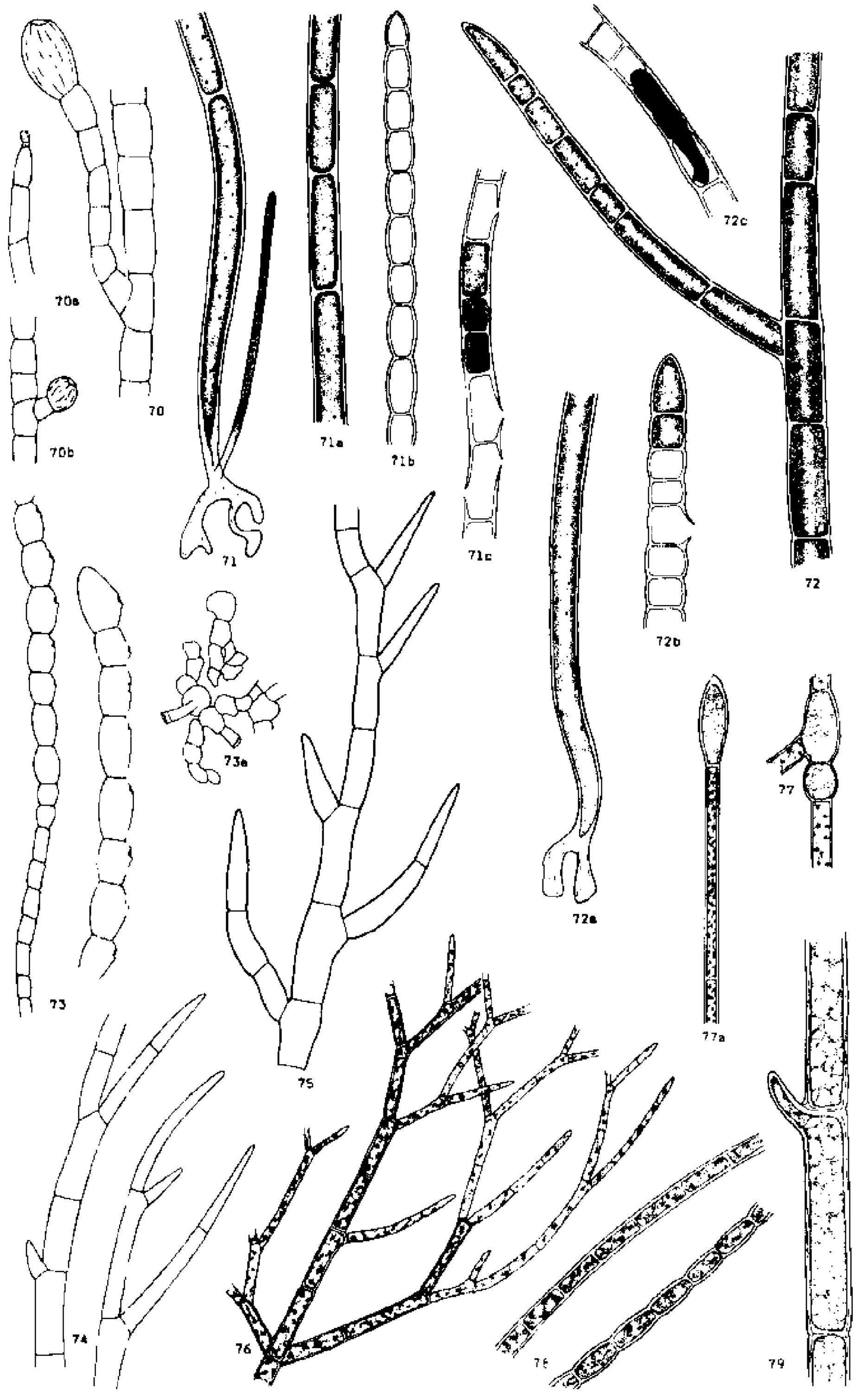
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PLATE V

Figure 80. *Bulbochaete crenulata* Pringsheim
Figure 81. *Bulbochaete intermedia* De Bary
Figure 82. *Bulbochaete nana* Wittrock
Figure 83. *Bulbochaete rectangularis* Wittrock
Figure 84. *Bulbochaete robusta* (Hirn) Tiffany
Figure 85. *Bulbochaete varians* Wittrock
Figure 86. *Bulbochaete varians* var. *subsimplex* (Wittr.) Hirn
Figure 87. *Oedogonium capillare* (L.) Kuetzing; a. antheridia.
Figure 88. *Oedogonium capillare* forma *stagnale* (Kuetz.) Hirn
Figure 89. *Oedogonium capitellatum* Wittrock; a. terminal cell, b. antheridia.
Figure 90. *Oedogonium crenulatocostatum* Wittrock; a. terminal oogonium, b. antheridia.
Figure 91. *Oedogonium crenulatocostatum* var. *cylindricum* (Hirn) Tiffany
Figure 92. *Oedogonium crispum* (Hassall) Wittrock
Figure 93. *Oedogonium cyathigerum* Wittrock
Figure 94. *Oedogonium echinospermum* A. Braun; a. antheridia.
Figure 95. *Oedogonium eriense* Tiffany; a. mature oogonium.
Figure 96. *Oedogonium exocostatum* Tiffany; a. terminal oogonium, b. antheridia, c. holdfast.

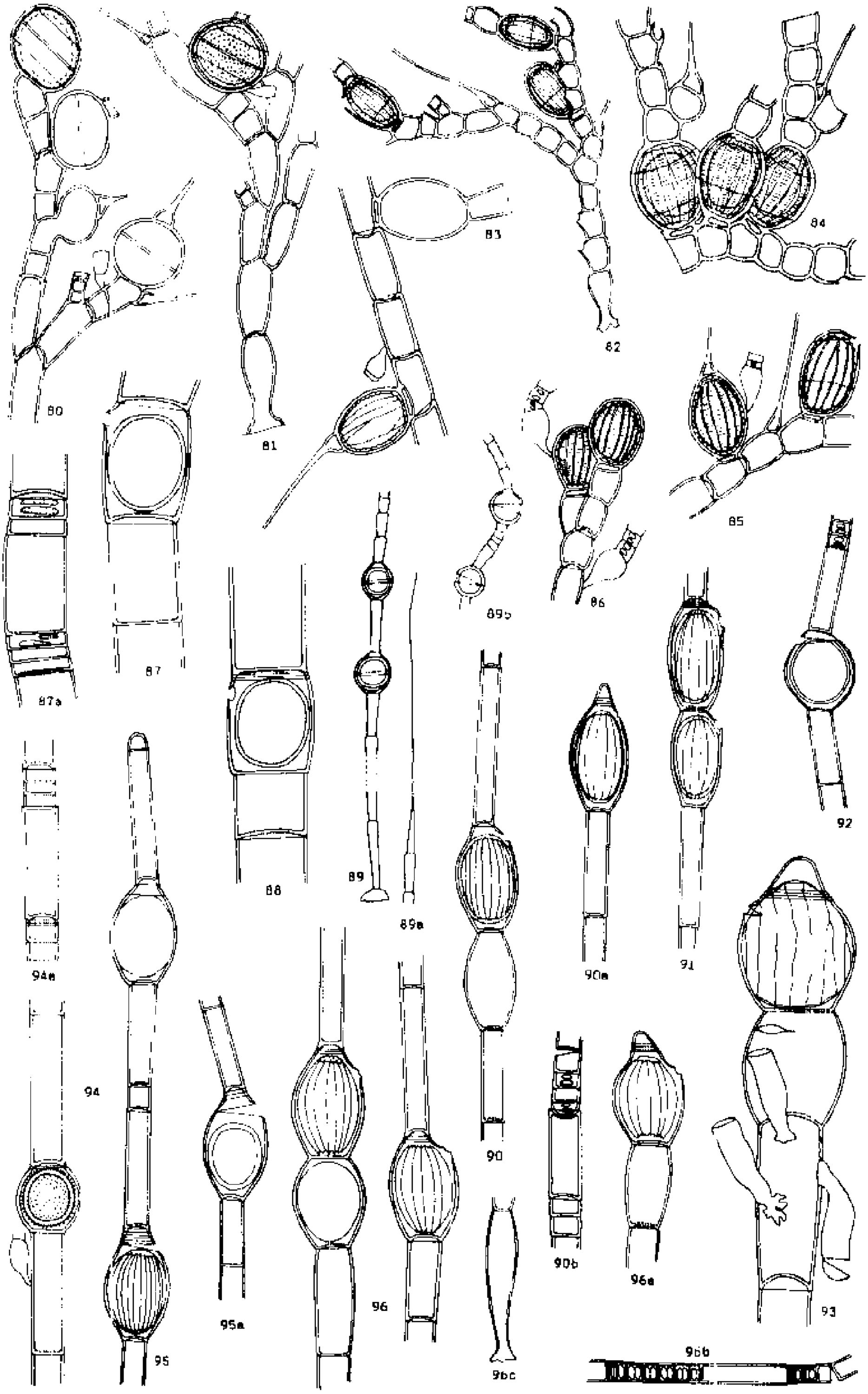
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PLATE VI

Figure 97. *Oedogonium geniculatum* Hirn
Figure 98. *Oedogonium gracilius* (Wittr.) Tiffany; a. antheridia.
Figure 99. *Oedogonium gracillimum* Wittrock & Lundell
Figure 100. *Oedogonium grande* Kuetzing; a. antheridia.
Figure 101. *Oedogonium howardii* G. S. West, four figures including holdfast cells; a. antheridia.
Figure 102. *Oedogonium howei* Tiffany; a. basal cell, b. antheridia.
Figure 103. *Oedogonium idioandrosporum* (Nordst. & Wittr.) Tiffany; a. antheridia.
Figure 104. *Oedogonium inconspicuum* Hirn; a. basal cell, b. apical cell.
Figure 105. *Oedogonium infimum* Tiffany; a. basal cell, b. antheridia.
Figure 106. *Oedogonium landsboroughi* (Hass.) Wittrock
Figure 107. *Oedogonium longum* Transeau; a. antheridia.
Figure 108. *Oedogonium moniliforme* Wittrock; a. antheridia.
Figure 109. *Oedogonium plagiostomum* Wittrock; a. basal cell.

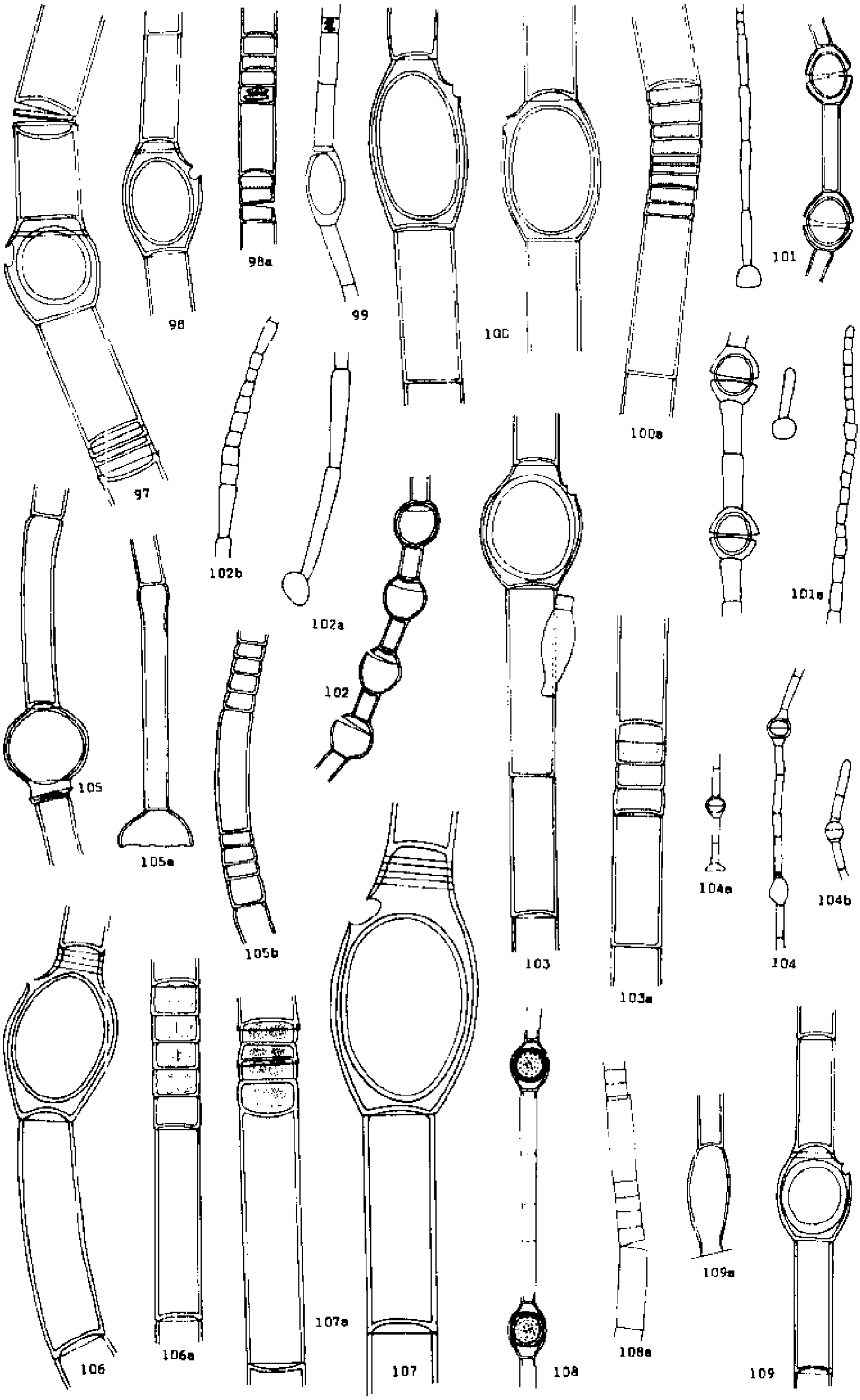
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PLATE VII

Figure 110. *Oedogonium princeps* (Hass.) Wittrock; a. basal and apical cells, b. antheridia.
Figure 111. *Oedogonium pringsheimii* Cramer; a. antheridia.
Figure 112. *Oedogonium pringsheimii* var. *nordstedtii* Wittrock; a. antheridia.
Figure 113. *Oedogonium punctatum* Wittrock; a. antheridia.
Figure 114. *Oedogonium pusillum* Kirchner
Figure 115. *Oedogonium varians* Wittrock & Lundell
Figure 116. *Oedogonium wyliei* Tiffany; a. single oogonium, b. basal and apical cells, c. antheridia.
Figure 117. *Acanthosphaera zachariasi* Lemmermann
Figure 118. *Chlorococcum infusionum* (Schrank) Meneghini
Figure 119. *Desmatractum indutum* (Geitler) Pascher
Figure 120. *Golenkinia maxima* Tiffany & Ahlstrom
Figure 121. *Golenkinia paucispina* W. & G. S. West
Figure 122. *Golenkinia radiata* (Chod.) Wille
Figure 123. *Golenkinia radiata* var. *brevispina* Tiffany & Ahlstrom
Figure 124. *Chlorochytrium biennis* (Klebs) G. S. West
Figure 125. *Kentrosphaera bristolae* G. M. Smith
Figure 126. *Characium ambiguum* Hermann
Figure 127. *Characium curvatum* G. M. Smith
Figure 128. *Characium falcatum* Schroeder
Figure 129. *Characium gracilipes* Lambert
Figure 130. *Characium naegelii* A. Braun
Figure 131. *Characium ornithocephalum* A. Braun
Figure 132. *Characium sieboldii* A. Braun
Figure 133. *Hydrodictyon reticulatum* (L.) Lagerheim

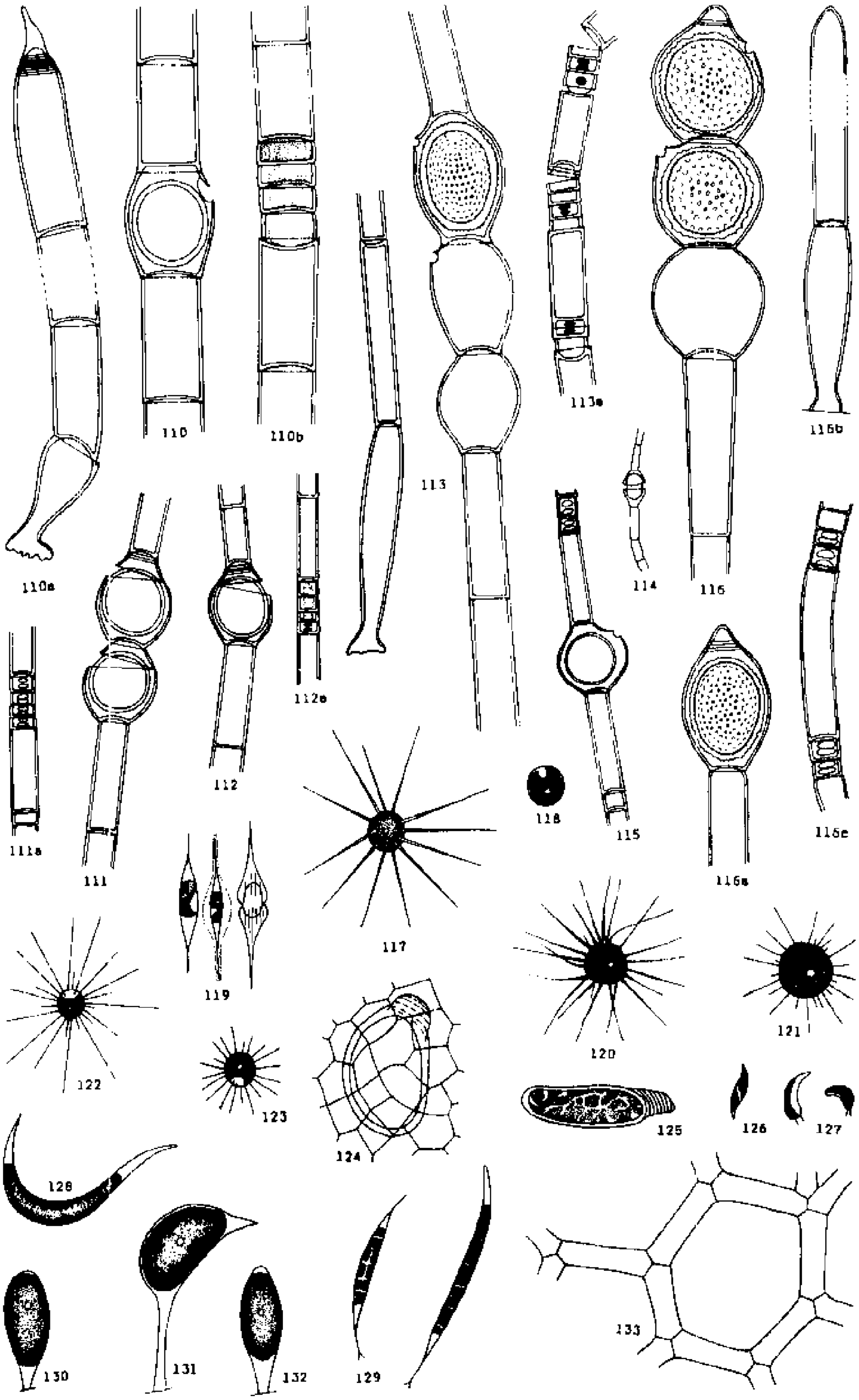
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PLATE VIII

Figure 134. *Pediastrum angulosum* (Ehr.) Meneghini
Figure 135. *Pediastrum biradiatum* Meyen
Figure 136. *Pediastrum boryanum* (Turp.) Meneghini; a variation in colony size and shape.
Figure 137. *Pediastrum boryanum* (Turp.) Meneghini var. *longicorne* Raciborski
Figure 138. *Pediastrum duplex* Meyen
Figure 139. *Pediastrum duplex* Meyen var. *cohaerens* Bohlin
Figure 140. *Pediastrum duplex* Meyen var. *gracillimum* W. & G. S. West
Figure 141. *Pediastrum duplex* Meyen var. *reticulatum* Lagerheim
Figure 142. *Pediastrum duplex* Meyen var. *rotundatum* Lucks
Figure 143. *Pediastrum integrum* Naegeli
Figure 144. *Pediastrum kawraiskyi* Schmidle
Figure 145. *Pediastrum simplex* (Meyen) Lemmermann; a. non-perforate colony.
Figure 146. *Pediastrum simplex* (Meyen) Lemmermann var. *duodenarium* (Bailey) Rabenhorst
Figure 147. *Pediastrum simplex* (Meyen) Lemmermann var. *ovatum* (Ehr.) Tiffany, two figures.
Figure 148. *Pediastrum tetras* (Ehr.) Ralfs
Figure 149. *Pediastrum tetras* (Ehr.) Ralfs var. *tetraodon* (Corda) Rabenhorst
Figure 150. *Sorastrum americanum* (Bohlin) Schmidle
Figure 151. *Sorastrum americanum* (Bohlin) Schmidle var. *undulatum* G. M. Smith
Figure 152. *Sorastrum spinulosum* Naegeli
Figure 153. *Coelastrum bohlini* Schmidle & Senn
Figure 154. *Coelastrum cambricum* Archer
Figure 155. *Coelastrum microporum* Naegeli
Figure 156. *Coelastrum proboscideum* Bohlin
Figure 157. *Coelastrum reticulatum* (Dang.) Senn
Figure 158. *Coelastrum sphaericum* Naegeli
Figure 159. *Botryococcus braunii* Kuetzing
Figure 160. *Botryococcus protuberans* W. & G. S. West var. *minor* G. M. Smith
Figure 161. *Botryococcus sudeticus* Lemmermann
Figure 162. *Ankistrodesmus convolutus* Corda
Figure 163. *Ankistrodesmus falcatus* (Corda) Ralfs; a. colony variation.
Figure 164. *Ankistrodesmus falcatus* (Corda) Ralfs var. *mirabilis* (W. & G. S. West) G. S. West
Figure 165. *Ankistrodesmus falcatus* (Corda) Ralfs var. *spirilliformis* G. S. West
Figure 166. *Ankistrodesmus falcatus* (Corda) Ralf var. *tumidus* (W. & G. S. West) G. S. West
Figure 167. *Ankistrodesmus spiralis* (Turner) Lemmermann
Figure 168. *Chlorella variegatus* Beyerinck
Figure 169. *Chlorella vulgaris* Beyerinck
Figure 170. *Zoochlorella parasitica* Brandt
Figure 171. *Closteriopsis longissima* Lemmerman
Figure 172. *Closteriopsis longissima* Lemmermann var. *tropica* W. & G. S. West
Figure 173. *Dictyosphaerium ehrenbergianum* Naegeli
Figure 174. *Dictyosphaerium planctonicum* Tiffany & Ahlstrom
Figure 175. *Dictyosphaerium pulchellum* Wood
Figure 176. *Dimorphococcus lunatus* A. Braun
Figure 177. *Echinosphaerella limnetica* G. M. Smith

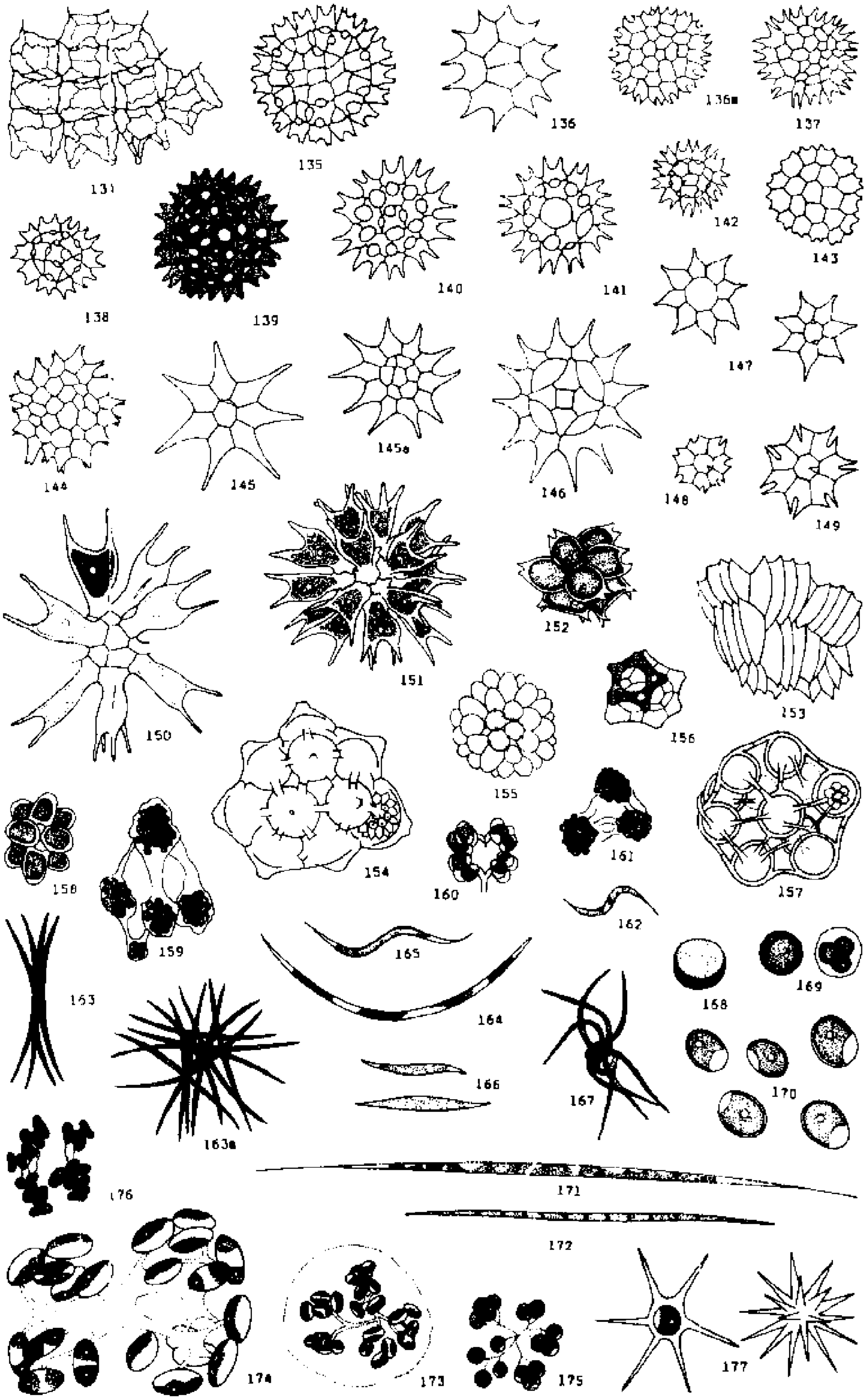
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PLATE IX

Figure 178. *Eremosphaera viridis* De Bary
Figure 179. *Franceia droescheri* (Lemm.) G. M. Smith
Figure 180. *Franceia ovalis* (Francé) Lemmermann
Figure 181. *Franceia tuberculata* G. M. Smith
Figure 182. *Franceia tuberculata* G. M. Smith var. *irregularis* Tiffany & Ahlstrom
Figure 183. *Gloeoactinium limneticum* G. M. Smith
Figure 184. *Gloeotaenium loitlesbergerianum* Hansgirg
Figure 185. *Kirchneriella contorta* (Schmidle) Bohlin
Figure 186. *Kirchneriella elongata* G. M. Smith
Figure 187. *Kirchneriella lunaris* (Kirch.) Moebius
Figure 188. *Kirchneriella lunaris* (Kirch.)) Moebius var. *dianae* Bohlin
Figure 189. *Kirchneriella lunaris* (Kirch.) Moebius var. *irregularis* G. M. Smith
Figure 190. *Kirchneriella obesa* (W. West) Schmidle
Figure 191. *Kirchneriella obesa* (W. West) Schmidle var. *aperta* (Teiling) Brunnthaler
Figure 192. *Kirchneriella obesa* (W. West) Schmidle var. *major* (Bernard) G. M. Smith
Figure 193. *Kirchneriella subsolitaria* G. S. West
Figure 194. *Lagerheimia ciliata* (Lager.) Chodat
Figure 195. *Lagerheimia citriformis* (Snow) G. M. Smith
Figure 196. *Lagerheimia citriformis* (Snow) G. M. Smith var. *paucispina* Tiffany & Ahlstrom; a. and b. variation in number of setae.
Figure 197. *Lagerheimia genevensis* Chodat var. *subglobosa* (Lemm.) Chodat
Figure 198. *Lagerheimia longiseta* (Lemm.) Printz
Figure 199. *Lagerheimia longiseta* (Lemm.) Printz var. *major* G. M. Smith
Figure 200. *Lagerheimia quadriseta* (Lemm.) G. M. Smith
Figure 201. *Lagerheimia subsalsa* Lemmermann
Figure 202. *Lagerheimia wratislawiensis* Schroeder
Figure 203. *Nephrocytium agardhianum* Naegeli
Figure 204. *Nephrocytium limneticum* (G. M. Smith) G. M. Smith
Figure 205. *Nephrocytium lunatum* W. West
Figure 206. *Nephrocytium obesum* W. & G. S. West
Figure 207. *Oocystis borgei* Snow
Figure 208. *Oocystis crassa* Wittrock
Figure 209. *Oocystis elliptica* W. West
Figure 210. *Oocystis eremosphaeria* G. M. Smith
Figure 211. *Oocystis lacustris* Chodat
Figure 212. *Oocystis parva* W. & G. S. West
Figure 213. *Oocystis pusilla* Hansgirg
Figure 214. *Oocystis solitaria* Wittrock
Figure 215. *Oocystis submarina* Lagerheim
Figure 216. *Pachycladon umbrinus* G. M. Smith
Figure 217. *Planktosphaeria gelatinosa* G. M. Smith

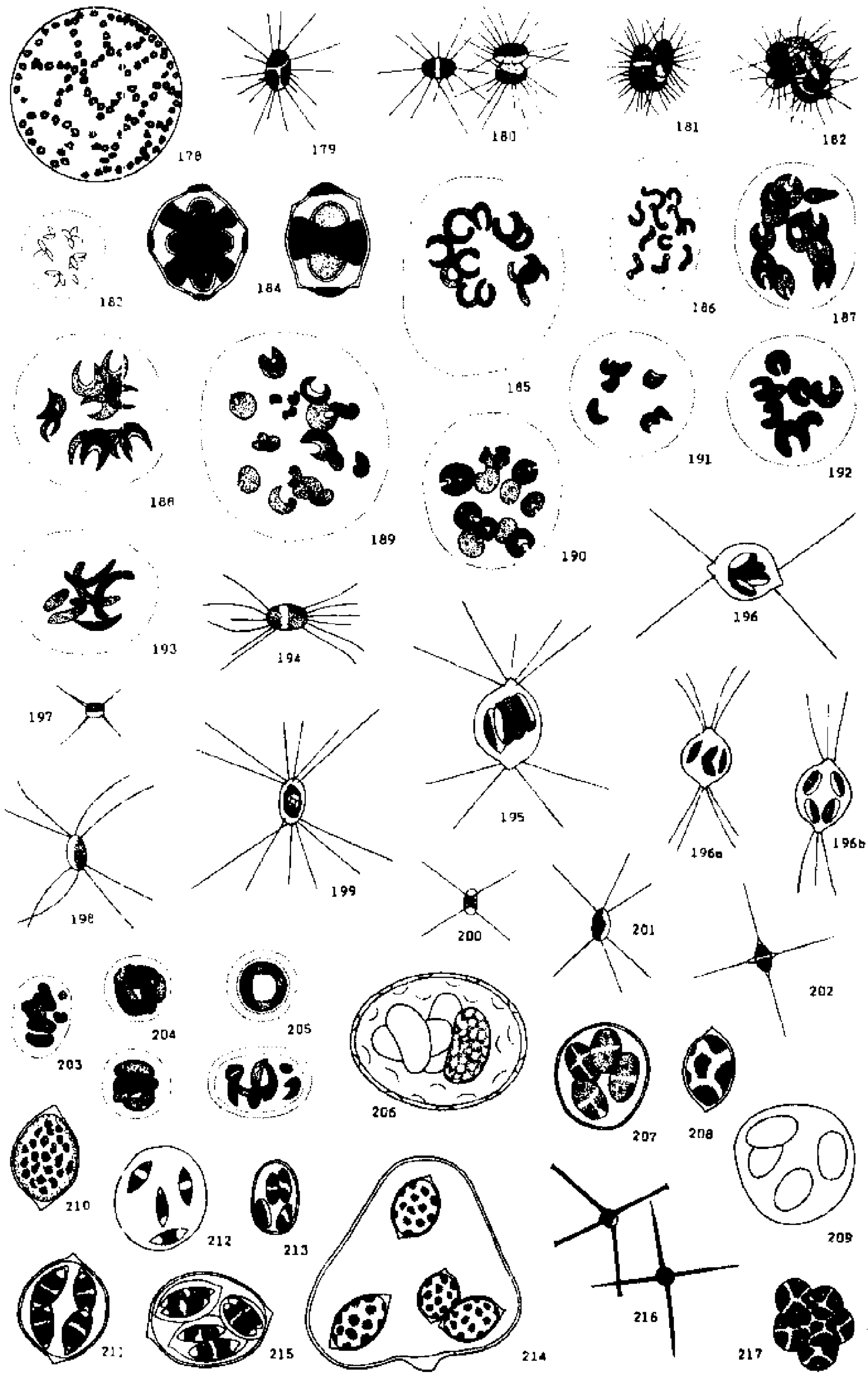
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PLATE X

Figure 218. *Polyedriopsis quadrispina* G. M. Smith
Figure 219. *Polyedriopsis spinulosa* Schmidle
Figure 220. *Polyedriopsis spinulosa* Schmidle var. *excavata* (Playf.) G. M. Smith
Figure 221. *Quadrigula chodati* (Tann.-Full.) G. M. Smith
Figure 222. *Quadrigula closterioides* (Bohlin) Printz
Figure 223. *Quadrigula lacustris* (Chodat) G. M. Smith
Figure 224. *Radiococcus nimbatus* (de Wildm.) Schmidle
Figure 225. *Schroederia setigera* (Schroeder) Lemmermann
Figure 226. *Selenastrum bibraianum* Reinsch
Figure 227. *Selenastrum bibraianum* Reinsch var. *gracile* (Reinsch) Tiffany & Ahlstrom
Figure 228. *Selenastrum minutum* (Naeg.) Collins
Figure 229. *Selenastrum westii* G. M. Smith
Figure 230. *Tetraedron arthrodesmiforme* (G. S. West) Woloszynska
Figure 231. *Tetraedron arthrodesmiforme* (G. S. West) Woloszynska var. *contorta* Woloszynska, four different cells.
Figure 232. *Tetraedron caudatum* (Corda) Hansgirg
Figure 233. *Tetraedron caudatum* (Corda) Hansgirg var. *longispinum* Lemmermann
Figure 234. *Tetraedron enorme* (Ralfs) Hansgirg
Figure 235. *Tetraedron gracile* (Reinsch) Hansgirg
Figure 236. *Tetraedron hastatum* (Reinsch) Hansgirg
Figure 237. *Tetraedron hastatum* (Reinsch) Hansgirg var. *palatinum* (Schmidle) Lemmermann
Figure 238. *Tetraedron incus* (Teiling) G. M. Smith
Figure 239. *Tetraedron incus* (Teiling) G. M. Smith var. *irregulare* G. M. Smith
Figure 240. *Tetraedron limneticum* Borge, two figures.
Figure 241. *Tetraedron lobulatum* (Naeg.) Hansgirg
Figure 242. *Tetraedron lobulatum* (Naeg.) Hansgirg var. *polyfurcatum* G. M. Smith
Figure 243. *Tetraedron minimum* (A. Br.) Hansgirg
Figure 244. *Tetraedron muticum* (A. Br.) Hansgirg, two figures.
Figure 245. *Tetraedron pentraedricum* W. & G. S. West
Figure 246. *Tetraedron regulare* Kuetzing
Figure 247. *Tetraedron regulare* Kuetzing var. *torsum* Turner
Figure 248. *Tetraedron smithii* (G. M. Smith) Tiffany
Figure 249. *Tetraedron trigonum* (Naeg.) Hansgirg
Figure 250. *Tetraedron trigonum* (Naeg.) Hansgirg var. *gracile* (Reinsch) de Toni
Figure 251. *Tetraedron trigonum* (Naeg.) Hansgirg var. *papilliferum* (Schroed.) Lemmermann; a. autospore formation.
Figure 252. *Tetraedron tumidulum* (Reinsch) Hansgirg
Figure 253. *Treubaria crassispina* G. M. Smith
Figure 254. *Treubaria varia* Tiffany & Ahlstrom, three figures.
Figure 255. *Trochiscia aspera* (Reinsch) Hansgirg
Figure 256. *Trochiscia reticularis* (Reinsch) Hansgirg
Figure 257. *Westella botryoides* (W. West) de Wildemann

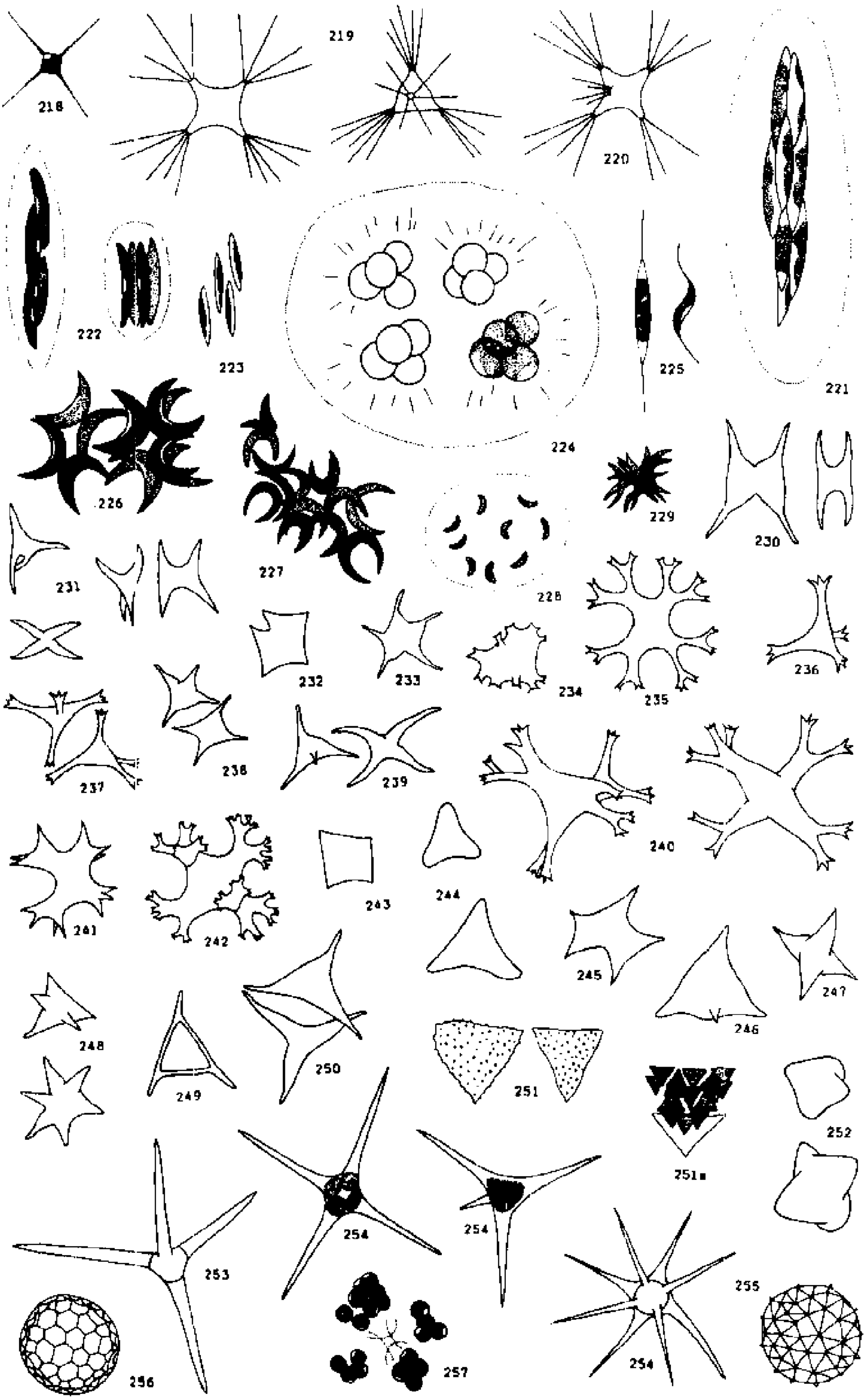
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PLATE XI

Figure 258 *Westella botryoides* (W. West) de Wildemann var. *major* G. M. Smith
Figure 259 *Westella linearis* G. M. Smith
Figure 260 *Actinastrum gracillimum* G. M. Smith
Figure 261 *Actinastrum hantzschii* Lagerheim
Figure 262 *Actinastrum hantzschii* Lagerheim var. *fluviatile* Schroeder
Figure 263 *Coronastrum aestivale* Thompson
Figure 264 *Crucigenia alternans* G. M. Smith
Figure 265 *Crucigenia apiculata* (Lemm.) Schmidle
Figure 266 *Crucigenia apiculata* (Lemm.) Schmidle var. *eriensis* Tiffany & Ahlstrom
Figure 267 *Crucigenia apiculata* (Lemm.) Schmidle var. *truncata* (G. M. Smith) Ahlstrom & Tiffany
Figure 268 *Crucigenia fenestrata* Schmidle
Figure 269 *Crucigenia irregularis* Wille
Figure 270 *Crucigenia lauterbornei* Schmidle
Figure 271 *Crucigenia quadrata* Morren
Figure 272 *Crucigenia rectangularis* (A. Br.) Gay
Figure 273 *Crucigenia tetrapedia* (Kirch.) W. & G. S. West, two figures.
Figure 274 *Errerella bornhemiensis* Conrad
Figure 275 *Micractinium eriense* Tiffany & Ahlstrom, two figures.
Figure 276 *Micractinium pusillum* Fresenius
Figure 277 *Micractinium pusillum* Fresenius var. *elegans* G. M. Smith
Figure 278 *Micractinium pusillum* Fresenius var. *longisetum* Tiffany & Ahlstrom
Figure 279 *Micractinium quadrisetum* (Lemm.) G. M. Smith
Figure 280 *Pectodictyon cubicum* Taft
Figure 281 *Scenedesmus abundans* (Kirch.) Chodat
Figure 282 *Scenedesmus acuminatus* (Lagerh.) Chodat
Figure 283 *Scenedesmus acutiformis* Schroeder
Figure 284 *Scenedesmus anomalus* (G. M. Smith) Ahlstrom & Tiffany
Figure 285 *Scenedesmus arcuatus* Lemmermann
Figure 286 *Scenedesmus arcuatus* Lemmermann var. *platydisca* G. M. Smith
Figure 287 *Scenedesmus armatus* (Chod.) G. M. Smith
Figure 288 *Scenedesmus bernardii* G. M. Smith
Figure 289 *Scenedesmus bijuga* (Turp.) Lagerheim
Figure 290 *Scenedesmus bijuga* (Turp.) Lagerheim var. *alternans* (Reinsch) Hansgirg
Figure 291 *Scenedesmus bijuga* (Turp.) Lagerheim var. *flexuosus* (Lemm.) Collins
Figure 292 *Scenedesmus bijuga* (Turp.) Lagerheim var. *major* Tiffany & Ahlstrom
Figure 293 *Scenedesmus brasiliensis* Bohlin
Figure 294 *Scenedesmus carinatus* (Lemm.) Chodat
Figure 295 *Scenedesmus denticulatus* Lagerheim, two figures.
Figure 296 *Scenedesmus dimorphus* (Turp.) Kuetzing
Figure 297 *Scenedesmus hystrix* Lagerheim
Figure 298 *Scenedesmus incrassatulus* Bohlin var. *mononae* G. M. Smith
Figure 299 *Scenedesmus longus* Meyen
Figure 300 *Scenedesmus obliquus* (Turp.) Kuetzing

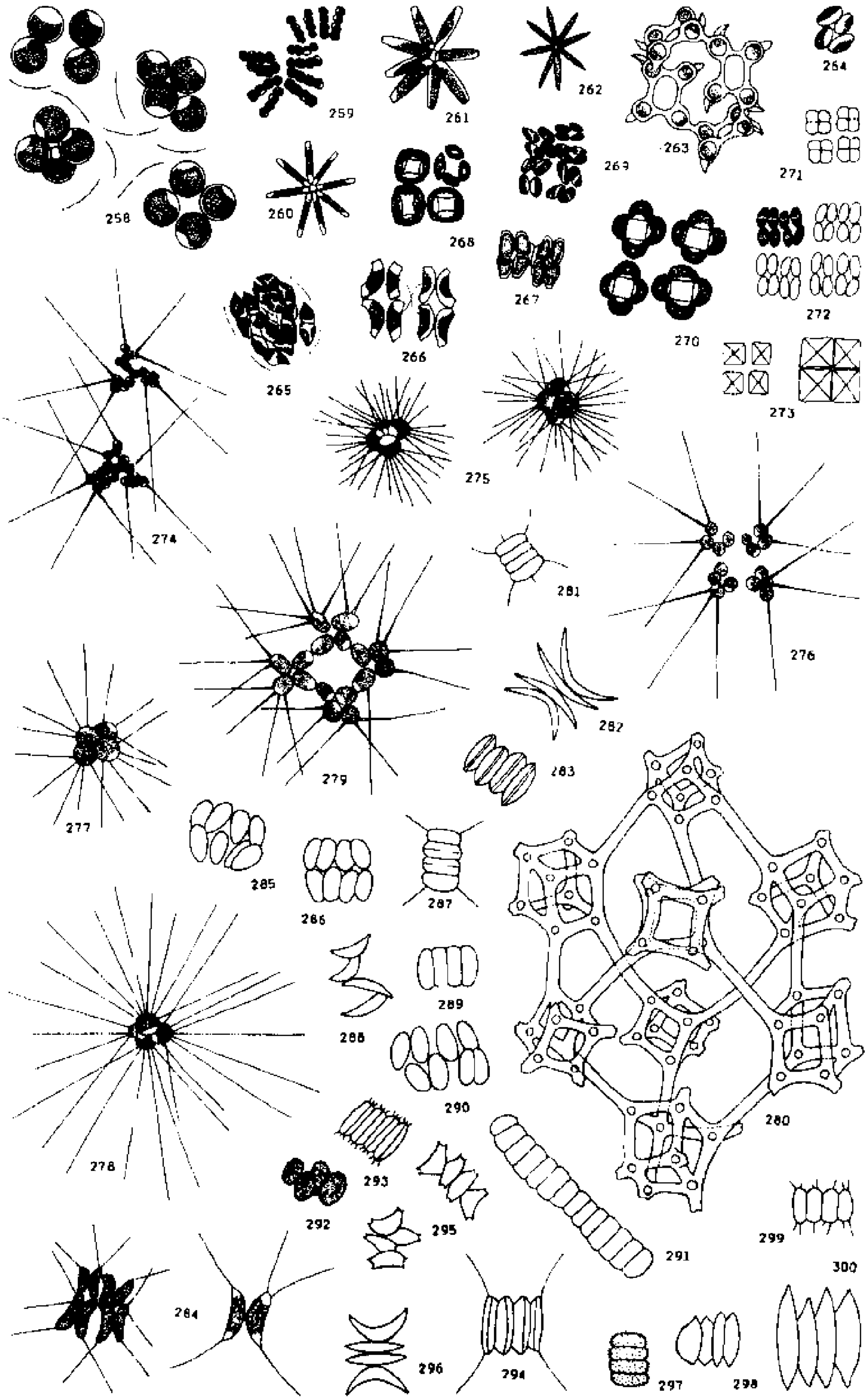
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PLATE XII

Figure 301. *Scenedesmus opliensis* P. Richter
Figure 302. *Scenedesmus protuberans* Fritsch & Rich
Figure 303. *Scenedesmus quadricauda* (Turp.) de Brébisson
Figure 304. *Scenedesmus quadricauda* (Turp.) de Brébisson var. *alternans* G. M. Smith
Figure 305. *Scenedesmus quadricauda* (Turp.) de Brébisson var. *longispina* (Chodat) G. M. Smith
Figure 306. *Scenedesmus quadricauda* (Turp.) de Brébisson var. *maximus* W. & G. S. West
Figure 307. *Scenedesmus quadricauda* (Turp.) de Brébisson var. *quadrispina* (Chodat) G. M. Smith
Figure 308. *Scenedesmus quadricauda* (Turp.) de Brébisson var. *westii* G. M. Smith
Figure 309. *Scenedesmus wisconsinensis* (G. M. Smith) Chodat
Figure 310. *Tetrastrum glabrum* (Roll) Ahlstrom & Tiffany, two figures.
Figure 311. *Tetrastrum heteracanthum* (Nordst.) Chodat, five figures.
Figure 312. *Tetrastrum staurogeniaeforme* (Schroeder) Lemmermann
Figure 313. *Dichotomosiphon tuberosus* (A. Br.) Ernst
Figure 314. *Mougeotia cyanea* Transeau
Figure 315. *Mougeotia elegantula* Wittrock
Figure 316. *Mougeotia genuflexa* (Dillw.) Agardh
Figure 317. *Mougeotia nummuloides* (Hass.) De Toni
Figure 318. *Mougeotia sphaerocarpa* Wolle
Figure 319. *Mougeotia transeaui* Collins
Figure 320. *Sirogonium sticticum* (Engl. Bot.) Kuetzing
Figure 321. *Spirogyra crassa* Kuetzing
Figure 322. *Spirogyra crassoidea* Transeau
Figure 323. *Spirogyra ellipsospora* Transeau
Figure 324. *Spirogyra fluviatilis* Hilse
Figure 325. *Spirogyra juergensii* Kuetzing
Figure 326. *Spirogyra longata* (Vauch.) Kuetzing
Figure 327. *Spirogyra majuscula* Kuetzing
Figure 328. *Spirogyra neglecta* (Hass.) Kuetzing

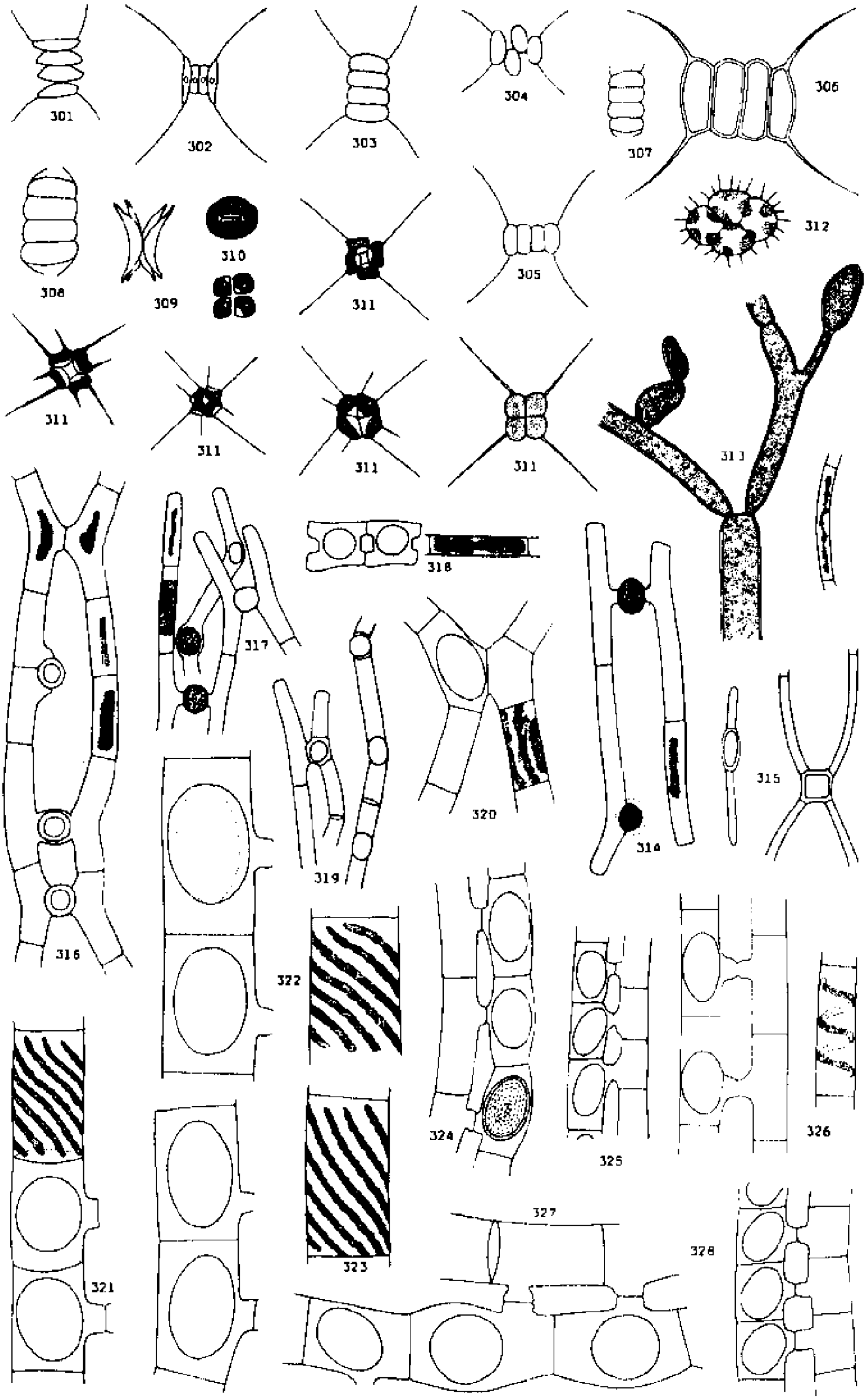
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PLATE XIII

Figure 329. *Spirogyra protecta* Wood
Figure 330. *Spirogyra quadrata* (Hass.) Petit
Figure 331. *Spirogyra setiformis* (Roth) Kuetzing
Figure 332. *Spirogyra tennuissima* (Hass.) Kuetzing, two figures.
Figure 333. *Spirogyra varians* (Hass.) Kuetzing
Figure 334. *Spirogyra weberi* Kuetzing
Figure 335. *Zygnema cruciatum* (Vauch.) Agardh
Figure 336. *Zygnema insigne* (Hass.) Kuetzing
Figure 337. *Zygnema stellinum* (Vauch.) Agardh
Figure 338 *Zygnema vaucherii* Agardh
Figure 339 *Closterium acerosum* (Schrank) Ehrenberg; a. apex of cell.
Figure 340. *Closterium brébissonii* Delpont; a. apex of cell.
Figure 341 *Closterium calosporum* Wittrock; a. apex of cell, b. zygote.
Figure 342 *Closterium dianae* Ehrenberg; a. apex of cell.
Figure 343 *Closterium eboracense* (Ehr.) Turner; a. apex of cell.
Figure 344 *Closterium ehrenbergii* Meneghini
Figure 345 *Closterium eriense* Taft
Figure 346 *Closterium gracile* de Brébisson
Figure 347 *Closterium idiosporum* W. & G. S. West
Figure 348 *Closterium kützingii* de Brébisson
Figure 349 *Closterium liebleinii* Kuetzing
Figure 350 *Closterium lunula* var. *coloratum* forma? Taft

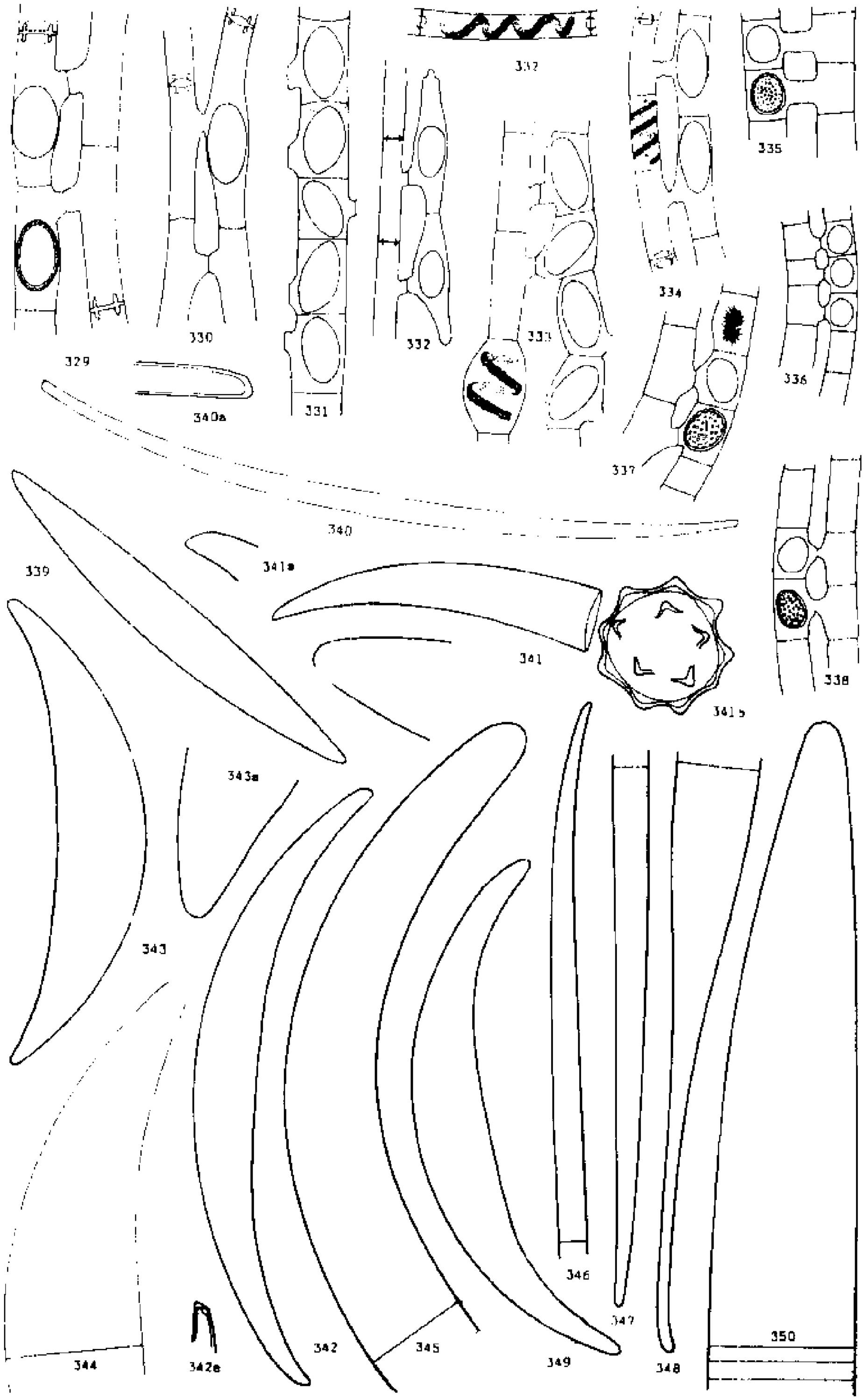
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PLATE XIV

Figure 351. *Closterium macilentum* de Brébisson
Figure 352. *Closterium moniliferum* (Bory) Ehrenberg
Figure 353. *Closterium parvulum* Naegeli
Figure 354. *Closterium parvulum* var. *angustum* W. & G. S. West
Figure 355. *Closterium praelongum* de Brébisson
Figure 356. *Closterium praelongum* var. *brevius* Nordstedt
Figure 357. *Closterium pritchardianum* Archer
Figure 358. *Closterium subulatum* (Kuetz.) de Brébisson
Figure 359 *Closterium venus* Kuetzing
Figure 360 *Closterium venus* var. *incurvum* (de Bréb.) Krieger
Figure 361 *Cosmarium abbreviatum* Raciborski
Figure 362 *Cosmarium angulare* Johnson
Figure 363 *Cosmarium angulare* var. *canadense* Irénée-Marie
Figure 364 *Cosmarium angulosum* de Brébisson
Figure 365 *Cosmarium aphanichondrum* Nordstedt
Figure 366 *Cosmarium bipunctatum* Boergesen
Figure 367 *Cosmarium bireme* Nordstedt
Figure 368 *Cosmarium biretum* de Brébisson
Figure 369 *Cosmarium biretum* var. *minus* Hansgirg
Figure 370 *Cosmarium biretum* var. *trigibberum* Nordstedt
Figure 371 *Cosmarium botrytis* Meneghini

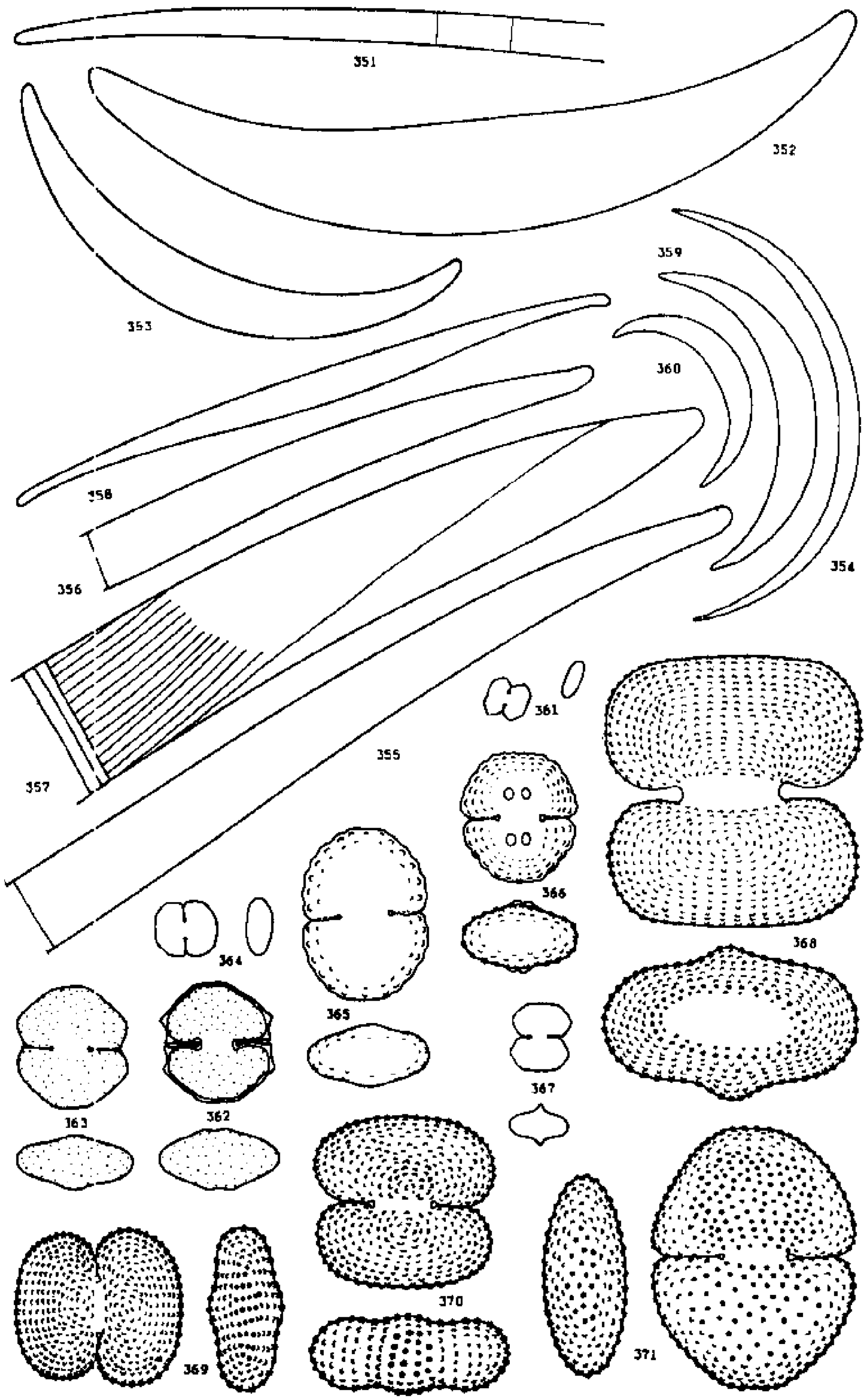
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PLATE XV

Figure 372. *Cosmarium crenulatum* var. *tumidulum* Insam & Krieger
Figure 373. *Cosmarium dentatum* Wolle
Figure 374. *Cosmarium depressum* (Naeg.) Lundell
Figure 375. *Cosmarium depressum* var. *achondrum* (Boldt) W. & G. S. West
Figure 376. *Cosmarium difficile* Lütkem. var. *sublaeve* Lütkemuller
Figure 377. *Cosmarium eriense* Taft
Figure 378. *Cosmarium exiguum?* Archer
Figure 379. *Cosmarium favum* W. & G. S. West
Figure 380. *Cosmarium fontigenum* Nordstedt
Figure 381. *Cosmarium formulosum* Hoffman
Figure 382. *Cosmarium formulosum* Hoffman forma ? Taft
Figure 383. *Cosmarium franzstonii* Taft
Figure 384. *Cosmarium geometricum* W. & G. S. West var. *suecicum* Borge
Figure 385. *Cosmarium globosum* Bulnh. var. *subaltum* Messikommer
Figure 386. *Cosmarium granatum* de Brébisson
Figure 387. *Cosmarium granatum* de Brébisson var. *subgranatum* Nordstedt
Figure 388. *Cosmarium hammeri* Reinsch var. *protuberans* W. & G. S. West
Figure 389. *Cosmarium holmiense* Lundell
Figure 390. *Cosmarium holmiense Lundell* forma ? Taft
Figure 391. *Cosmarium humile* (Gay) Nordstedt var. *striatum* (Boldt) Schmidle
Figure 392. *Cosmarium impressulum* Elfving var. *suborthogona* (W. & G. S. West) Taft
Figure 393. *Cosmarium kjellmani* Wille var. *grande* Wille
Figure 394. *Cosmarium laeve* Rabenhorst
Figure 395. *Cosmarium laeve* var. *distentum* G. S. West forma? Taft
Figure 396. *Cosmarium laeve* var. *octangularis* (Wille) W. & G. S. West
Figure 397. *Cosmarium lundellii* Delp. var. *ellipticum* W. West
Figure 398. *Cosmarium margaritatum* (Lund.) Roy & Bissett

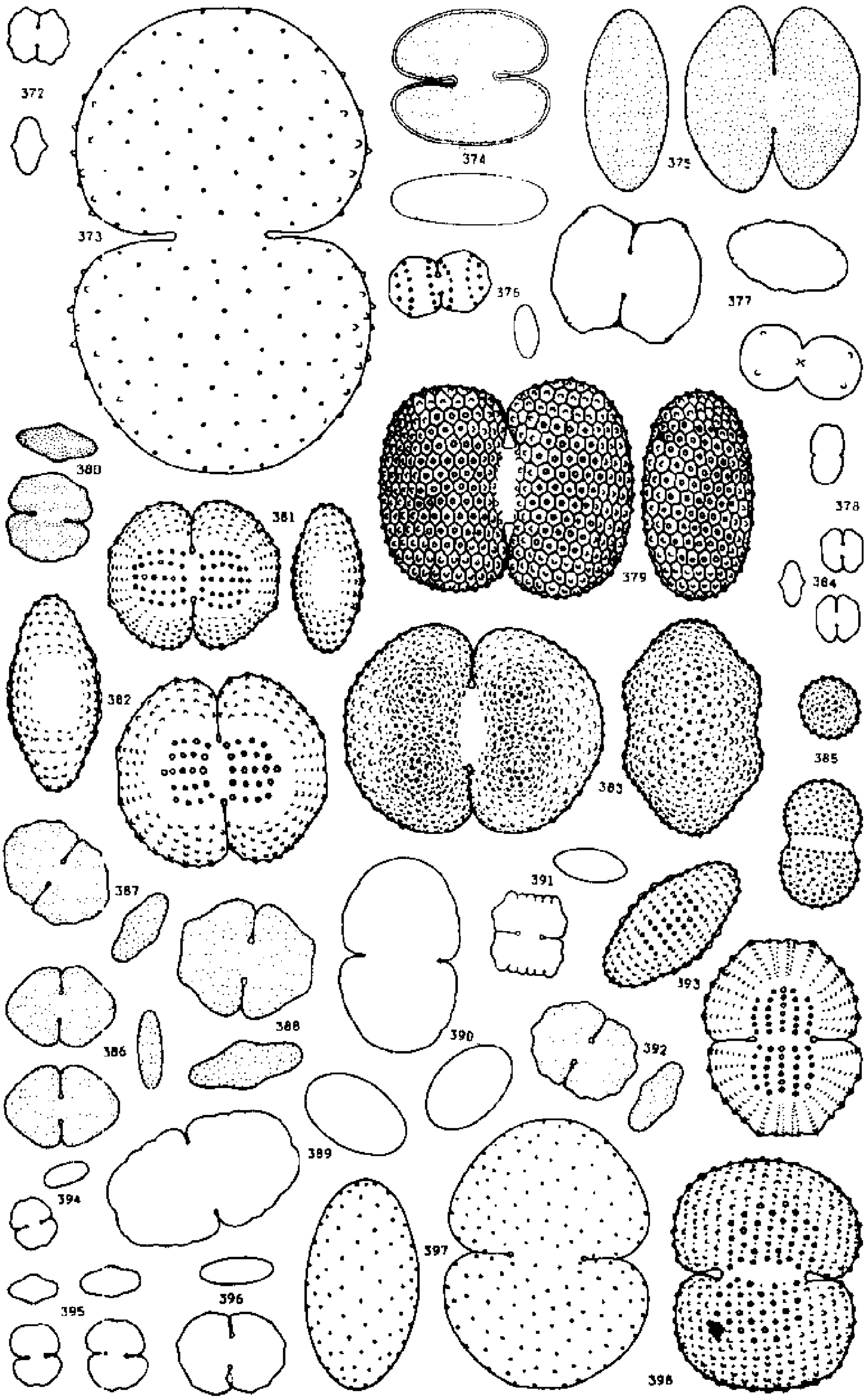
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PLATE XVI

Figure 399. *Cosmarium meneghinii* de Brébisson
Figure 400. *Cosmarium moniliforme* (Turp.) Ralfs var. *punctata* Lagerheim
Figure 401. *Cosmarium moniliforme* (Turp.) Ralfs var. *subpyriforme* W. & G. S. West
Figure 402. *Cosmarium nitidulum* De Not var. *pseudovalidum* Taft
Figure 403. *Cosmarium nobile* (Turner) Krieger
Figure 404. *Cosmarium ochtodes* Nordstedt
Figure 405. *Cosmarium pachydermum* Lund. var. *aethiopicum* W. & G. S. West
Figure 406. *Cosmarium phaseolus* de Brébisson var. *elevatum* Nordstedt
Figure 407. *Cosmarium phaseolus* de Bréb. forma *minor* Boldt
Figure 408. *Cosmarium pokornyanum* (Grun.) W. & G. S. West
Figure 409. *Cosmarium porrectum* Nordstedt
Figure 410. *Cosmarium portianum* Archer
Figure 411. *Cosmarium protractum* (Naeg.) De Bary
Figure 412. *Cosmarium pseudarctoum* Nordstedt
Figure 413. *Cosmarium pseudoprotuberans* Kirchner
Figure 414. *Cosmarium punctulatum* de Brébisson var. *subpunctulatum* (Nordst.) Borge
Figure 415. *Cosmarium quadrum* Lundell var. *minus* Nordstedt
Figure 416. *Cosmarium rectangulare* Grunow
Figure 417. *Cosmarium regnellii* Wille, two figures.
Figure 418. *Cosmarium regnellii* Wille var. *minimum* Eichler & Gutwinski
Figure 419. *Cosmarium reniforme* (Ralfs) Archer
Figure 420. *Cosmarium reniforme* (Ralfs) Archer var. *compressum* Nordstedt
Figure 421. *Cosmarium reniforme* (Ralfs) Archer var. *seminudum* Taft
Figure 422. *Cosmarium seelyanum* Wolle
Figure 423. *Cosmarium subcostatum* ? Nordstedt
Figure 424. *Cosmarium subcrenatum* Hantzsch
Figure 425. *Cosmarium subcrenatum* Hantzsch forma? Taft
Figure 426. *Cosmarium subcucumis* Schmidle
Figure 427. *Cosmarium subnudiceps* W. & G. S. West var. *granulatum* Taft
Figure 428. *Cosmarium subochthodes* Schmidle

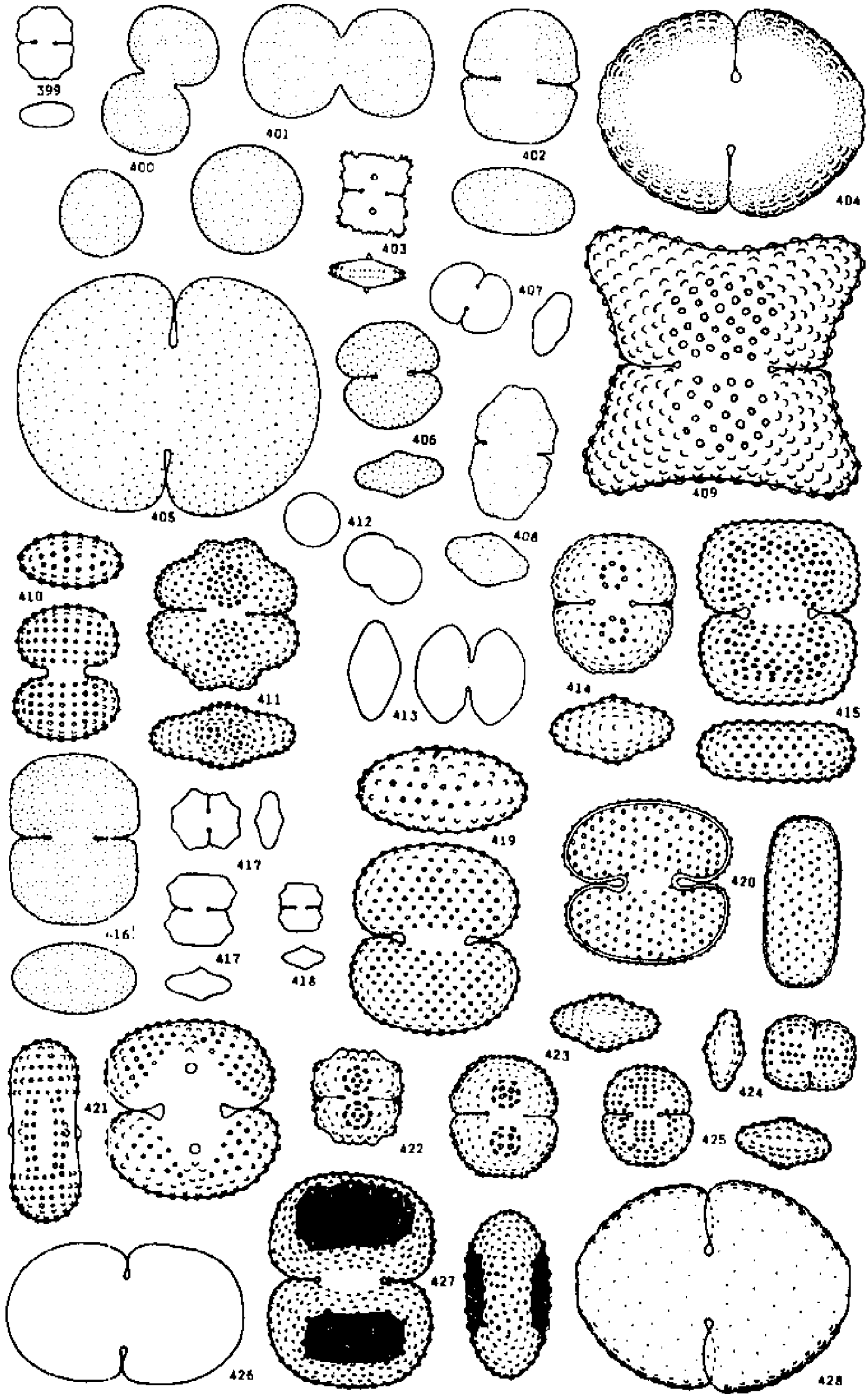
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PLATE XVII

Figure 429. *Cosmarium subraciborskii* Taft
Figure 430. *Cosmarium sulcatum* Nordstedt var. *sumatranum* Schmidle
Figure 431. *Cosmarium subtumidum* Nordstedt var. *klebsii* (Gutw.) W. & G. S. West
Figure 432. *Cosmarium triplicatum* Wolle
Figure 433. *Cosmarium turpinii* de Brébisson var. *podolicum* Gutwinski
Figure 434. *Cosmarium variolatum* Lundell var. *cataractarum* Raciborski
Figure 435. *Cosmarium viride* (Corda) Joshua var. *compressum* Taft, two figures.
Figure 436. *Desmidium swartzii* Agardh
Figure 437. *Euastrum abruptum* Nordstedt
Figure 438. *Euastrum abruptum* Nordstedt var. *lagöense* (Nordst.) Krieger
Figure 439. *Euastrum abruptum* Nordstedt var. *lagöense* (Nordst.) Krieger forma? Taft
Figure 440. *Euastrum bidentatum* Naegeli, two figures.
Figure 441. *Euastrum binale* (Turp.) Ehrenberg var. *hians* (W. West) Krieger
Figure 442. *Euastrum dubium* Naegeli forma? Taft
Figure 443. *Euastrum insulare* (Wittr.) Roy var. *silesiacum?* Gronblad
Figure 444. *Euastrum lutkemulleri* Duc.
Figure 445. *Euastrum ohioense* Taft
Figure 446. *Euastrum quebecense* Irénée-Marie
Figure 447. *Euastrum verrucosum* Ehrenberg var. *alatum* Wolle
Figure 448. *Hyalotheca dissiliens* (Smith) de Brébisson
Figure 449. *Hyalotheca mucosa* (Mert.) Ehrenberg
Figure 450. *Micrasterias radiata* Hassall
Figure 451. *Micrasterias truncata* (Corda) de Brébisson var. *semiradiata* Cleve

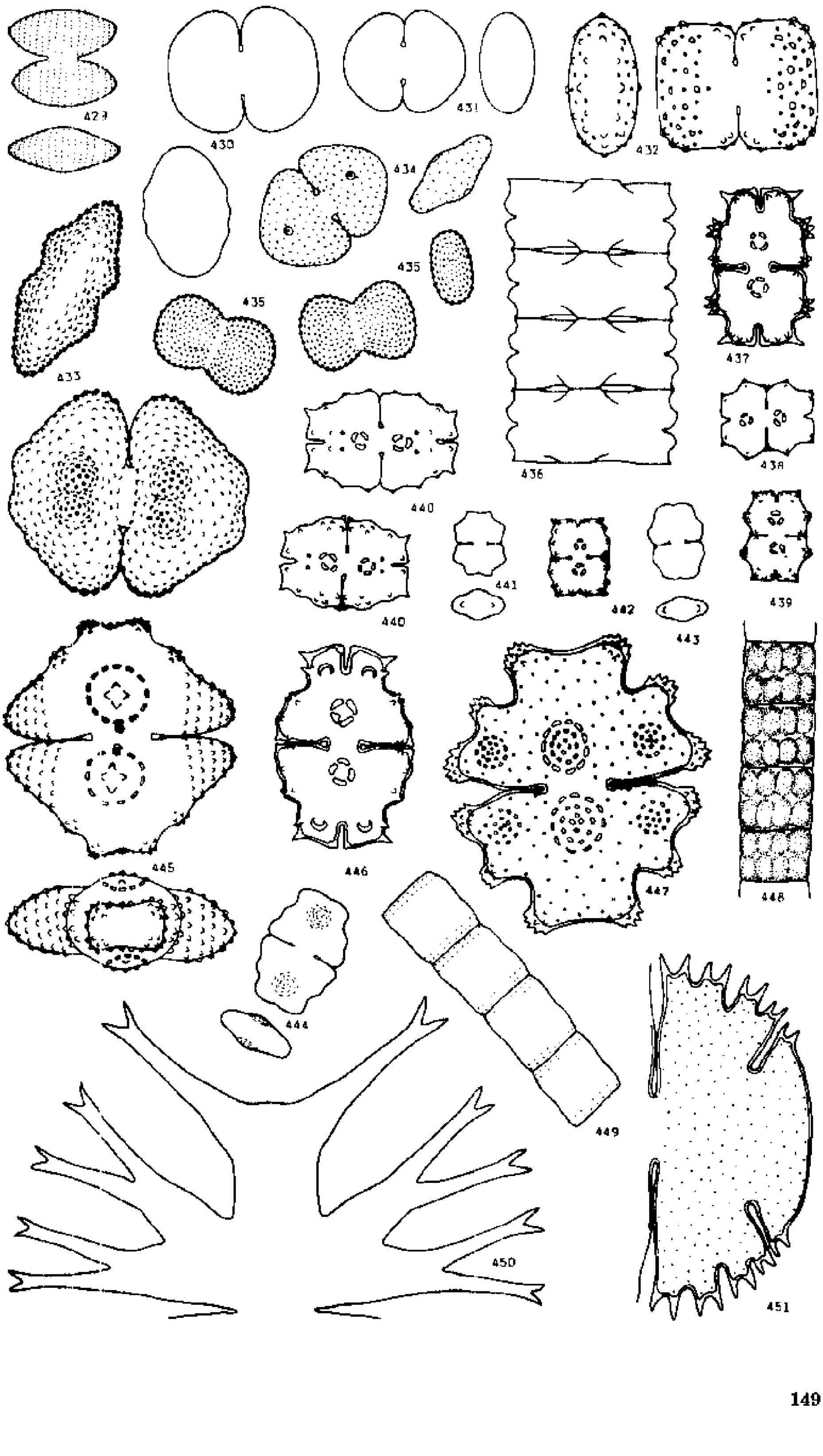
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PLATE XVIII

Figure 452. *Penium margaritaceum* (Ehr.) de Brébisson
Figure 453. *Pleurotaenium ehrenbergii* (de Bréb.) De Bary, two figures.
Figure 454. *Pleurotaenium trabecula* (Ehr.) Naegeli
Figure 455. *Sphaerozosma granulatum* Roy & Bissett
Figure 456. *Spondylosium luetkemuelleri* ? Gronblad
Figure 457. *Staurastrum avicula* de Brébisson var. *subarcuatum* (Wolle) W. West
Figure 458. *Staurastrum biarcuus* Taft
Figure 459. *Staurastrum bicoronatum* Johnson var. *tridentatum* Taft
Figure 460. *Staurastrum bieneanum* Rabenhorst
Figure 461. *Staurastrum brevispinum* de Brébisson var. *canadense* Taft
Figure 462. *Staurastrum chaetocerus* (Schroeder) G. M. Smith.
Figure 463. *Staurastrum crenulatum* Delpont forma? Taft
Figure 464. *Staurastrum cuspidatum* de Brébisson
Figure 465. *Staurastrum dejectum* de Brébisson
Figure 466. *Staurastrum floriferum* ? W. & G. S. West
Figure 467. *Staurastrum furcigerum* de Brébisson
Figure 468. *Staurastrum granulosum* (Ehren.) Ralfs
Figure 469. *Staurastrum orbiculare* Ralfs var. ? Taft

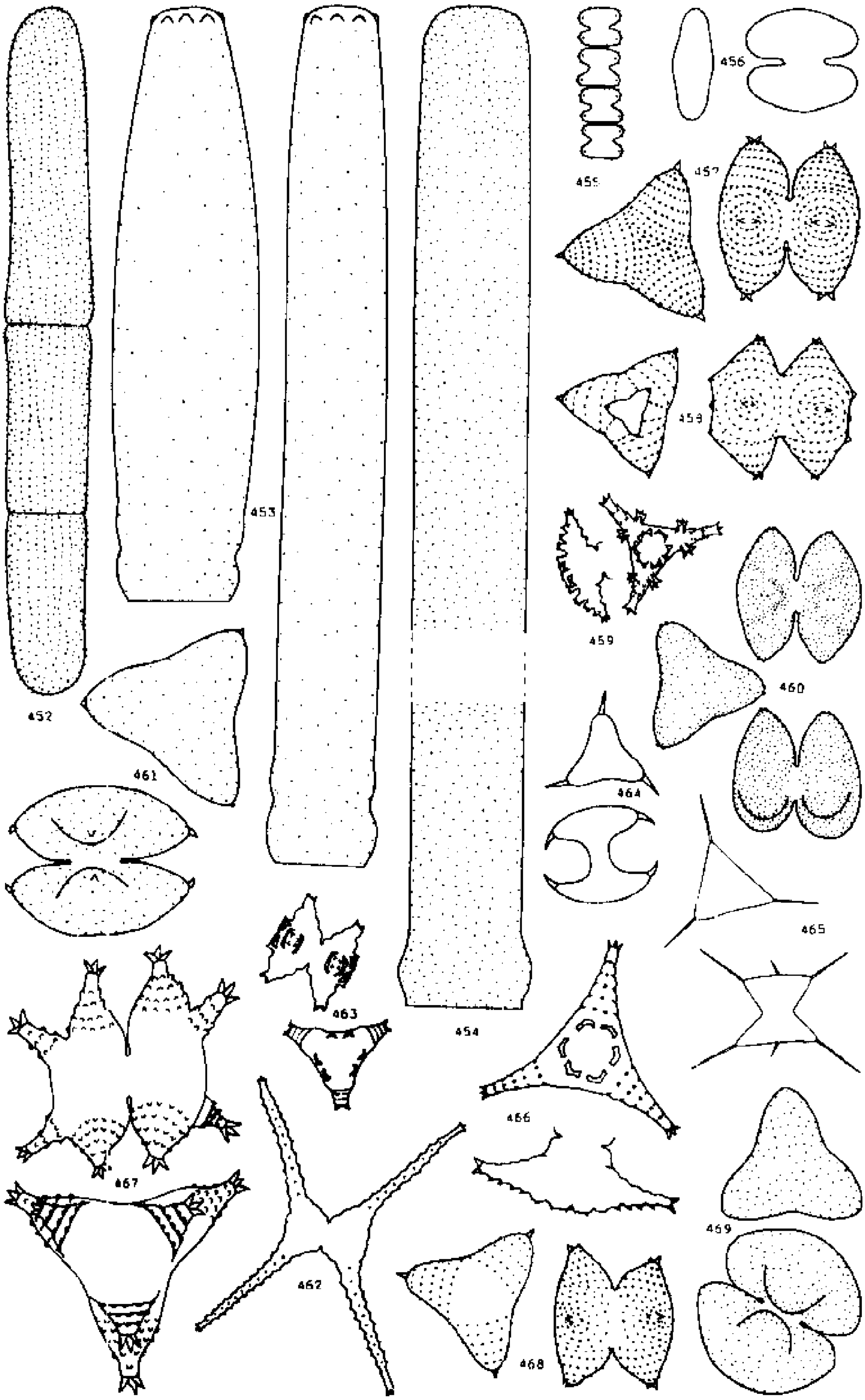
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PLATE XIX

Figure 470. *Staurastrum ornatum* Turner var. *asperum* (Perty) Schmidle
Figure 471. *Staurastrum paradoxum* Meyen
Figure 472. *Staurastrum peleii* Taft
Figure 473. *Staurastrum polymorphum* de Brébisson
Figure 474. *Staurastrum polytrichum* Perty var. *ornatum* Taft; a. detail of spine.
Figure 475. *Staurastrum punctulatum* de Brébisson
Figure 476. *Staurastrum punctulatum* de Brébisson var. *kjellmanii* Wille
Figure 477. *Staurastrum sebaldi* Reinsch var. *ornatum* Nordstedt
Figure 578. *Chroococcus limneticus* var. *subsalsus* Lemmermann
Figure 479. *Staurastrum striolatum* (Naeg.) Archer
Figure 480. *Staurastrum tetracerum* Ralfs
Figure 481. *Cylindrocystis brébissonii* var. *minor* W. & G. S. West, two figures.
Figure 482. *Gonatozygon kinahani* (Arch.) Rabenhorst
Figure 483. *Gonatozygon monotaenium* De Bary
Figure 484. *Stipitococcus urceolatus* W. & G. S. West
Figure 485. *Stipitococcus vasiformis* Tiffany
Figure 486. *Gloeobotrys limneticus* (G. M. Smith) Pascher
Figure 487. *Characiopsis cylindrica* (Lambert) Lemmermann
Figure 488. *Peroniella planctonica* G. M. Smith
Figure 489. *Centritractus belanophorus* Lemmermann
Figure 490. *Ophiocytium arbuscula* (A. Braun) Rabenhorst
Figure 491. *Ophiocytium capitatum* Wolle
Figure 492. *Ophiocytium capitatum* Wolle var. *longispinum* (Moebius) Lemmermann
Figure 493. *Ophiocytium cochleare* (Eichw.) A. Braun
Figure 494. *Ophiocytium parvulum* (Perty) A. Braun
Figure 495. *Tribonema bombycinum* (C. A. Agardh) Derbes & Solier

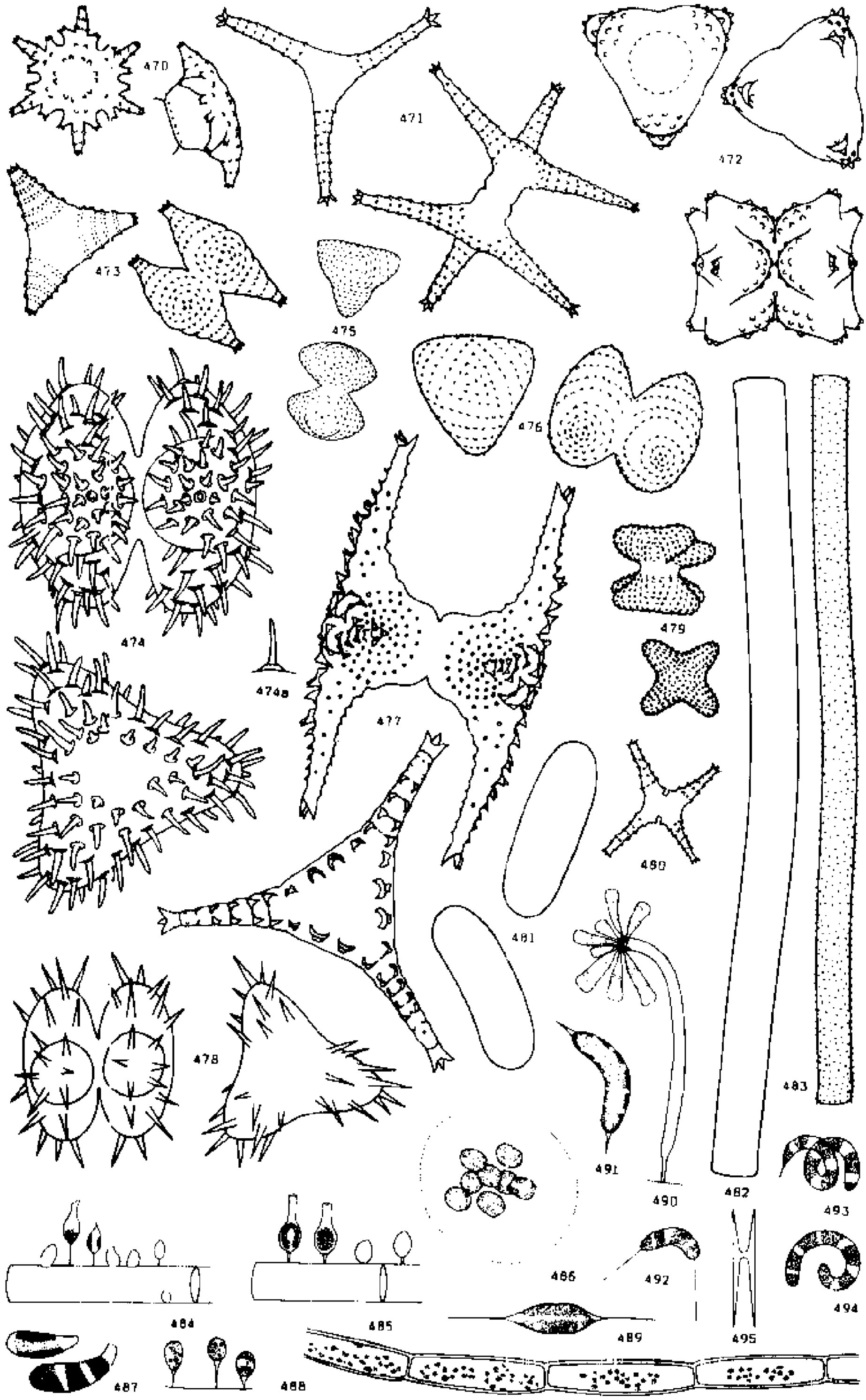
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PLATE XX

Figure 496. *Tribonema bombycinum* (C. A. Agardh) Derbes & Solier var. *tenue* (Hazen) Tiffany
Figure 497 *Tribonema minus* (Wille) Hazen
Figure 498 *Tribonema utriculosum* (Kuetz.) Hazen
Figure 499 *Monocilia viridis* Gerneck
Figure 500 *Botrydium granulatum* (L.) Greville
Figure 501 *Vaucheria geminata* (Vauch.) DeCandolle
Figure 502 *Vaucheria hamata* (Vauch.) DeCandolle
Figure 503 *Vaucheria sessilis* (Vauch.) DeCandolle
Figure 504 *Vaucheria terrestris* (Vauch.) DeCandolle
Figure 505. *Mallomonas alpina* Pascher & Ruttner
Figure 506. *Mallomonas caudata* Iwanoff
Figure 507 *Synura uvella* Ehrenberg
Figure 508. *Cyclonexis annularis* Stokes
Figure 509. *Dinobryon bavaricum* Imhof
Figure 510. *Dinobryon divergens* Imhof
Figure 511. *Dinobryon sertularia* Ehrenberg; a. cyst.
Figure 512. *Dinobryon stipitatum* Stein
Figure 513. *Hyalobryon mucicola* (Lemm.) Pascher
Figure 514. *Ochromonas mutabilis* Klebs
Figure 515. *Uroglenopsis americana* (Calkins) Lemmermann
Figure 516. *Chrysamoeba radians* Klebs
Figure 517. *Rhizochrysis limnetica* G. M. Smith
Figure 518. *Rhizochrysis scherffelii* Pascher
Figure 519. *Colacium steinii* Kent
Figure 520. *Colacium vesiculosum* Ehrenberg
Figure 521. *Euglena acus* Ehrenberg
Figure 522. *Euglena deses* Ehrenberg
Figure 523. *Euglena ehrenbergii* Klebs
Figure 524. *Euglena fusca* (Klebs) Lemmermann
Figure 525. *Euglena minuta* Prescott
Figure 526. *Euglena oxyuris* Schmarda
Figure 527. *Euglena polymorpha* Dangeard
Figure 528. *Euglena sanguinea* Ehrenberg
Figure 529. *Euglena spirogyra* Ehrenberg
Figure 530. *Euglena tripteris* (Duj.) Klebs
Figure 531. *Euglena viridis* Ehrenberg, two figures.
Figure 532. *Lepocinclis fusiformis* (Carter) Lemmermann
Figure 533. *Lepocinclis ovum* (Ehr.) Lemmermann
Figure 534. *Phacus hispidula* (Eichw.) Lemmermann

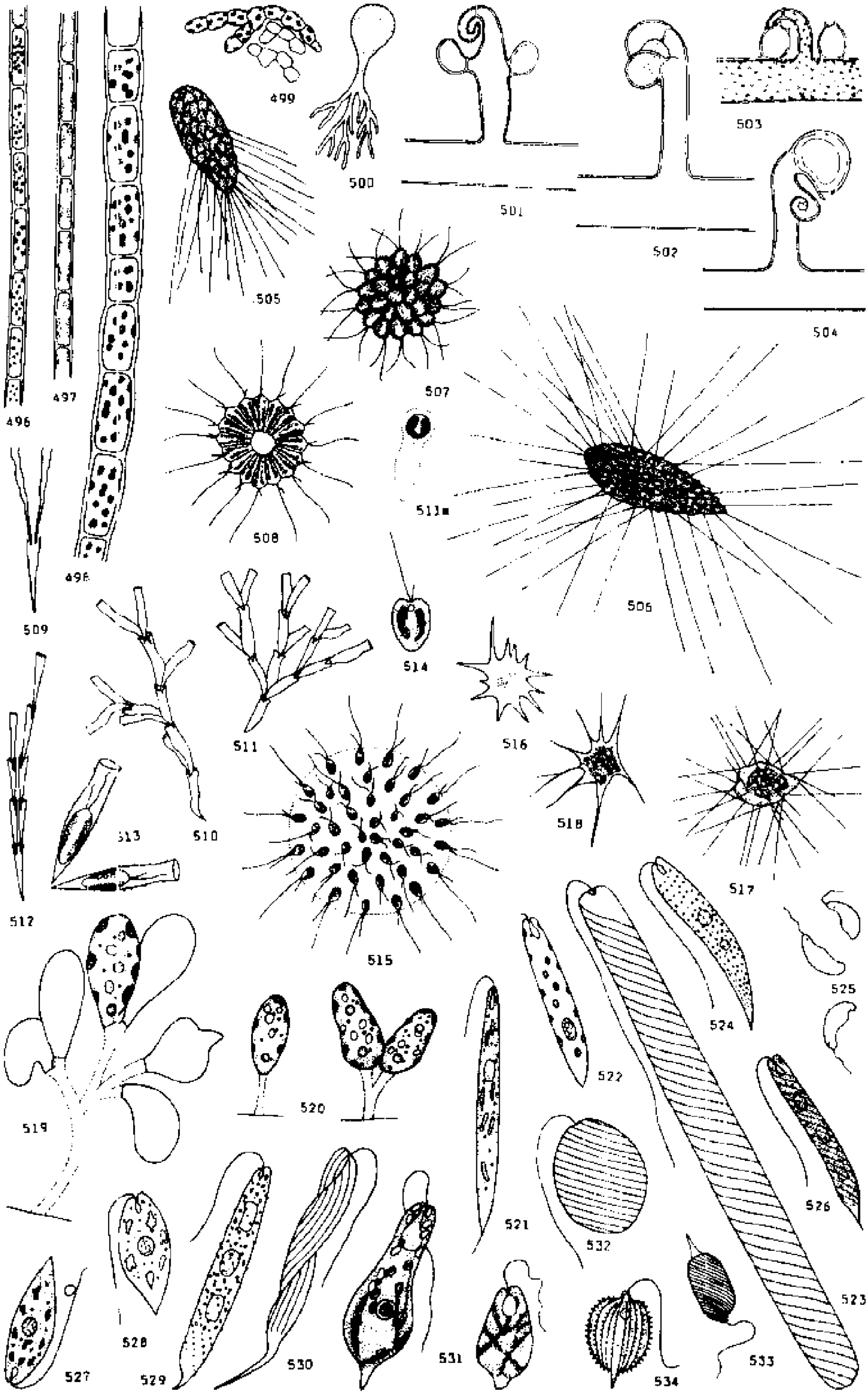
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PLATE XXI

Figure 535 *Phacus longicauda* (Ehr.) Dujardin
Figure 536. *Phacus morii* var. *insecta* (Koczwara) Skvortzow
Figure 537. *Phacus pleuronectes* (O. F. Muell.) Dujardin
Figure 538. *Phacus pyrum* (Ehr.) Stein
Figure 539. *Phacus tortus* (Lemm.) Skvortzow
Figure 540 *Phacus triqueter* (Ehr.) Dujardin
Figure 541. *Trachelomonas acuminata* (Schmarda) Stein
Figure 542. *Trachelomonas armata* (Ehr.) Stein var. ? Taft
Figure 543. *Trachelomonas bulla* (Stein) Deflandre
Figure 544. *Trachelomonas caudata* (Ehr.) Stein, two figures.
Figure 545. *Trachelomonas gibberosa* Playfair
Figure 546. *Trachelomonas girardiana* (Playf.) Deflandre
Figure 547. *Trachelomonas hispida* (Perty) Stein
Figure 548. *Trachelomonas horrida* Palmer
Figure 549. *Trachelomonas lacustris* Drezepolski
Figure 550. *Trachelomonas piscatoris* (Fisher) Stokes
Figure 551. *Trachelomonas schauinslandii* Lemmermann
Figure 552. *Trachelomonas volvocina* Ehrenberg
Figure 553. *Gymnodinium aeruginosum* Stein
Figure 553a. *Gymnodinium aeruginosum* Stein, cell division, two figures.
Figure 554. *Glenodinium aciculiferum* Lemmermann
Figure 555. *Glenodinium pulvisculus* (Ehr.) Stein
Figure 556. *Hemidinium nasutum* Stein
Figure 557. *Diplosalis acuta* (Apstein) Entz. fil., two figures.
Figure 558. *Peridinium quadridens* Stein, two figures.
Figure 559. *Ceratium hirundinella* (O. F. Muell.) Dujardin
Figure 560. *Gloeodinium montanum* Klebs
Figure 561. *Cystodinium bataviense* Klebs, two figures.
Figure 562. *Cystodinium iners* Geitler
Figure 563. *Hypnodinium sphaericum* Klebs
Figure 564. *Stylodinium globosum* Klebs, two figures.
Figure 565. *Tetradinium javanicum* Klebs, two figures.
Figure 566. *Cryptomonas ovata* Ehrenberg
Figure 567. *Aphanocapsa delicatissima* W. & G. S. West
Figure 568. *Aphanocapsa elachista* var. *conferta* W. & G. S. West
Figure 569. *Aphanocapsa grevillei* (Hass.) Rabenhorst
Figure 570. *Aphanocapsa pulchra* (Kuetz.) Rabenhorst
Figure 571. *Aphanothece clathrata* W. & G. S. West
Figure 572. *Aphanothece nidulans* P. Richter
Figure 573. *Aphanothece prasina* A. Braun
Figure 574. *Chroococcus dispersus* (V. Keissler) Lemmermann
Figure 575. *Chroococcus giganteus* W. West
Figure 576. *Chroococcus limneticus* Lemmermann, four figures.

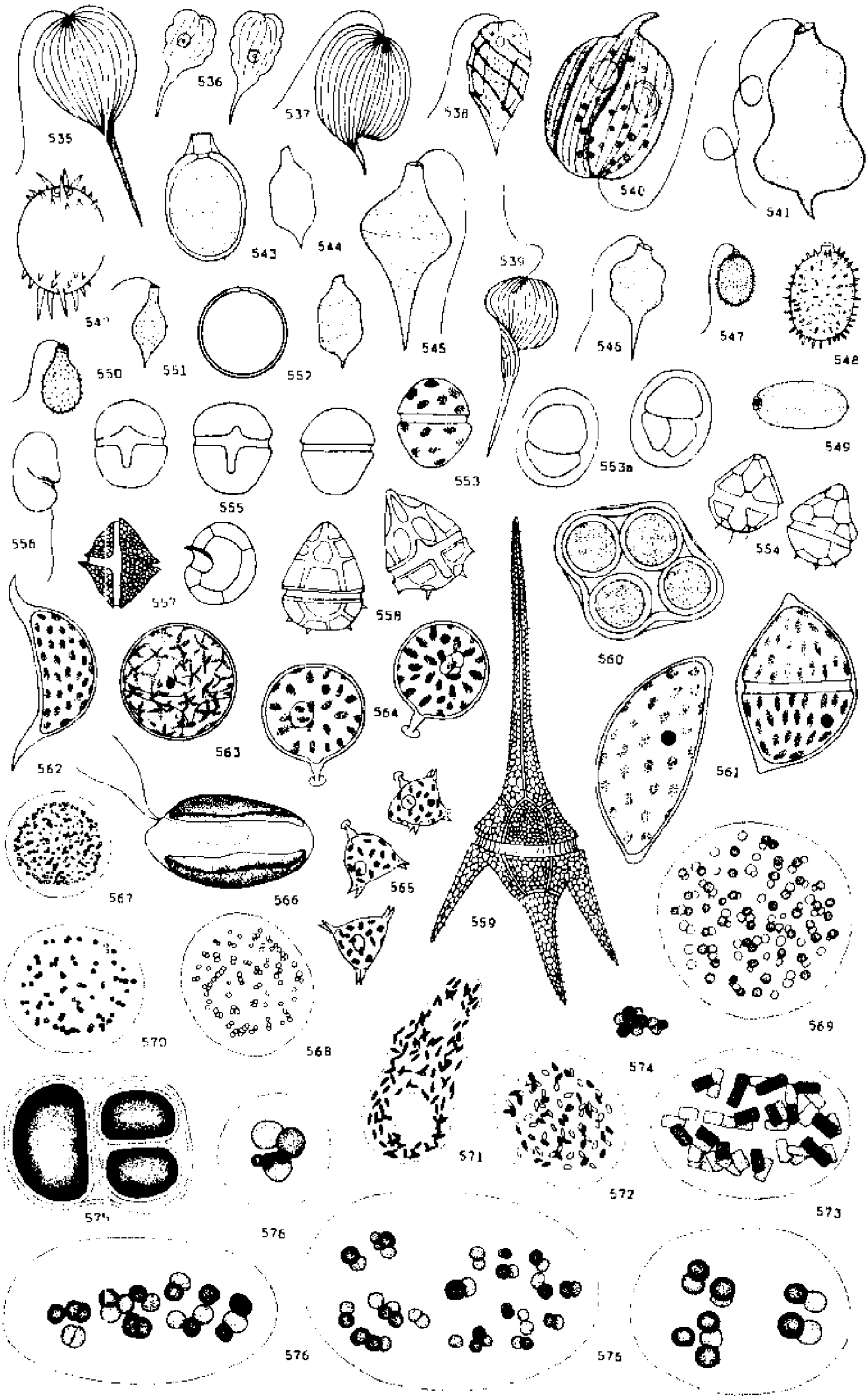
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PLATE XXII

Figure 577. *Chroococcus limneticus* var. *purpureus* (Snow) Tiffany & Ahlstrom, two figures.
Figure 578. *Chroococcus limneticus* var. *subsalsus* Lemmermann
Figure 579. *Chroococcus minutus* (Kuetz.) Naegeli
Figure 580. *Chroococcus prescottii* Drouet & Dailey
Figure 581. *Chroococcus turgidus* (Kuetz.) Naegeli
Figure 582. *Coelosphaerium dubium* Grunow
Figure 583. *Coelosphaerium kuetzingianum* Naegeli
Figure 584. *Coelosphaerium naegelianum* Unger
Figure 585. *Dactylococcopsis smithii* R. & F. Chodat
Figure 586. *Glaucocystis nostochinearum* (Itz.) Rabenhorst
Figure 587. *Gloeochaete wittrockiana* Lagerheim
Figure 588. *Gloeothece rupestris* (Lyng.) Bornet
Figure 589. *Gomphosphaeria aponina* Kuetzing
Figure 590. *Gomphosphaeria aponina* var. *cordiformis* Wolle
Figure 591. *Gomphosphaeria lacustris* Chodat
Figure 592. *Holopedium obvolutum* Tiffany
Figure 593. *Marssoniella elegans* Lemmermann
Figure 594. *Merismopedia convoluta* de Brébisson
Figure 595. *Merismopedia convoluta* de Brébisson var. *minor* (Wille) Tiffany & Ahlstrom
Figure 596. *Merismopedia elegans* A. Braun
Figure 597. *Merismopedia glauca* (Ehr.) Naegeli
Figure 598. *Merismopedia major* (G. M. Smith) Geitler
Figure 599. *Merismopedia punctata* Meyen
Figure 600. *Merismopedia tenuissima* Lemmermann
Figure 601. *Microcystis aeruginosa* Kuetzing; a. detail of cells.
Figure 602. *Microcystis aeruginosa* var. *major* (Wittr.) G. M. Smith
Figure 603. *Microcystis flos-aquae* (Wittr.) Kirchner
Figure 604. *Microcystis incerta* Lemmermann, two figures.
Figure 605. *Rhabdoderma lineare* Schmidle & Lauterborn
Figure 606. *Borzia trilocularis* Cohn
Figure 607. *Lyngbya aestuarii* (Mert.) Leibmann
Figure 608. *Lyngbya birgei* G. M. Smith
Figure 609. *Lyngbya contorta* Lemmermann
Figure 610. *Lyngbya major* Meneghini
Figure 611. *Lyngbya majuscula* (Dillw.) Harvey
Figure 612. *Microcoleus lacustris* (Raben.) Farlow
Figure 613. *Oscillatoria agardhii* Gomont

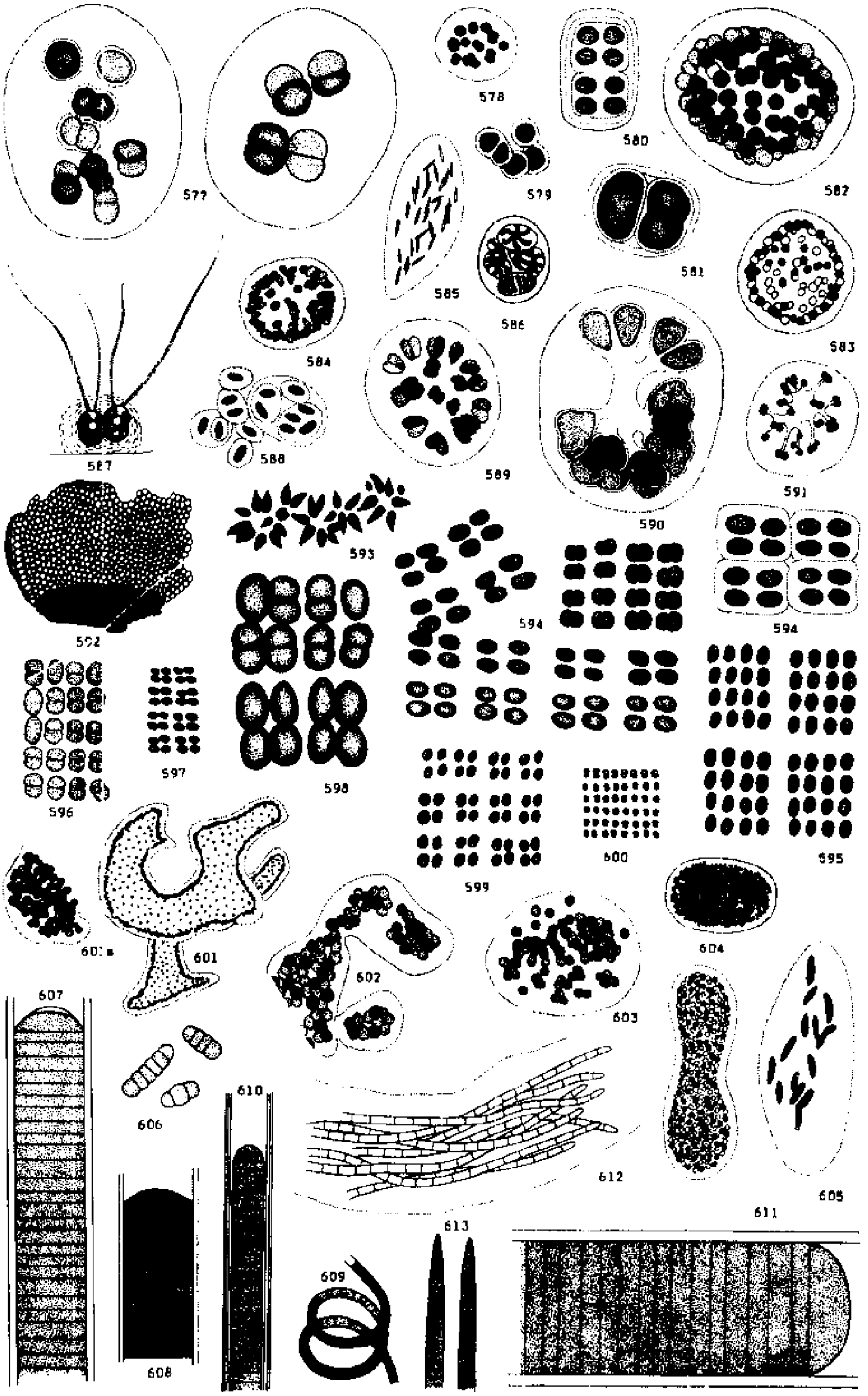
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PLATE XXIII

Figure 614. *Oscillatoria chalybea* Mertens
Figure 615. *Oscillatoria lacustris* (Kleb.) Geitler
Figure 616. *Oscillatoria limosa* (Roth) C. A. Agardh
Figure 617. *Oscillatoria princeps* Vaucher
Figure 618. *Oscillatoria prolifica* (Grev.) Gomont
Figure 619. *Oscillatoria splendida* Greville
Figure 620. *Oscillatoria tenuis* C. A. Agardh
Figure 621. *Phormidium retzii* (C. A. Agardh) Gomont
Figure 622. *Phormidium subfuscum* Kuetzing
Figure 623. *Spirulina laxissima* G. S. West
Figure 624. *Spirulina major* Kuetzing
Figure 625. *Spirulina princeps* (W. & G. S. West) G. S. West
Figure 626. *Anabaena affinis* Lemmermann
Figure 627. *Anabaena catenula* (Kuetz.) Bornet & Flahault
Figure 628. *Anabaena circinalis* Rabenhorst
Figure 629. *Anabaena flos-aquae* (Lyng.) de Brébisson
Figure 630. *Anabaena lemmermannii* P. Richter
Figure 631. *Anabaena macrospora* Klebahn var. *robusta* Lemmermann
Figure 632. *Anabaena planctonica* Brunnthaler
Figure 633. *Anabaena spiroides* Klebahn var. *crassa* Lemmermann; a. detail of cells
Figure 634. *Anabaenopsis arnoldii* Aptekarj
Figure 635. *Anabaenopsis circularis* (W. & G. S. West) V. Miller
Figure 636. *Aphanizomenon holsaticum* Richter
Figure 637. *Cylindrospermum stagnale* (Kuetz.) Bornet & Flahault
Figure 638. *Nodularia harveyana* (Thw.) Thuret
Figure 639. *Nodularia sphaerocarpa* Bornet & Flahault
Figure 640. *Nodularia spumigena* Mertens
Figure 641. *Nostoc coeruleum* Lyngbya
Figure 642. *Nostoc pruniforme* C. A. Agardh
Figure 643. *Plectonema wollei* Farlow
Figure 644. *Scytonema alatum* (Carm.) Borzi
Figure 645. *Scytonema myochrous* (Dillw.) C. A. Agardh
Figure 646. *Tolypothrix distorta* Kuetzing
Figure 647. *Tolypothrix tenuis* Kuetzing
Figure 648. *Calothrix fusca* (Kuetz.) Bornet & Flahault
Figure 649. *Dichothrix orsiniana* (Kuetz.) Bornet & Flahault
Figure 650. *Gloeotrichia echinulata* (J. E. Smith) P. Richter

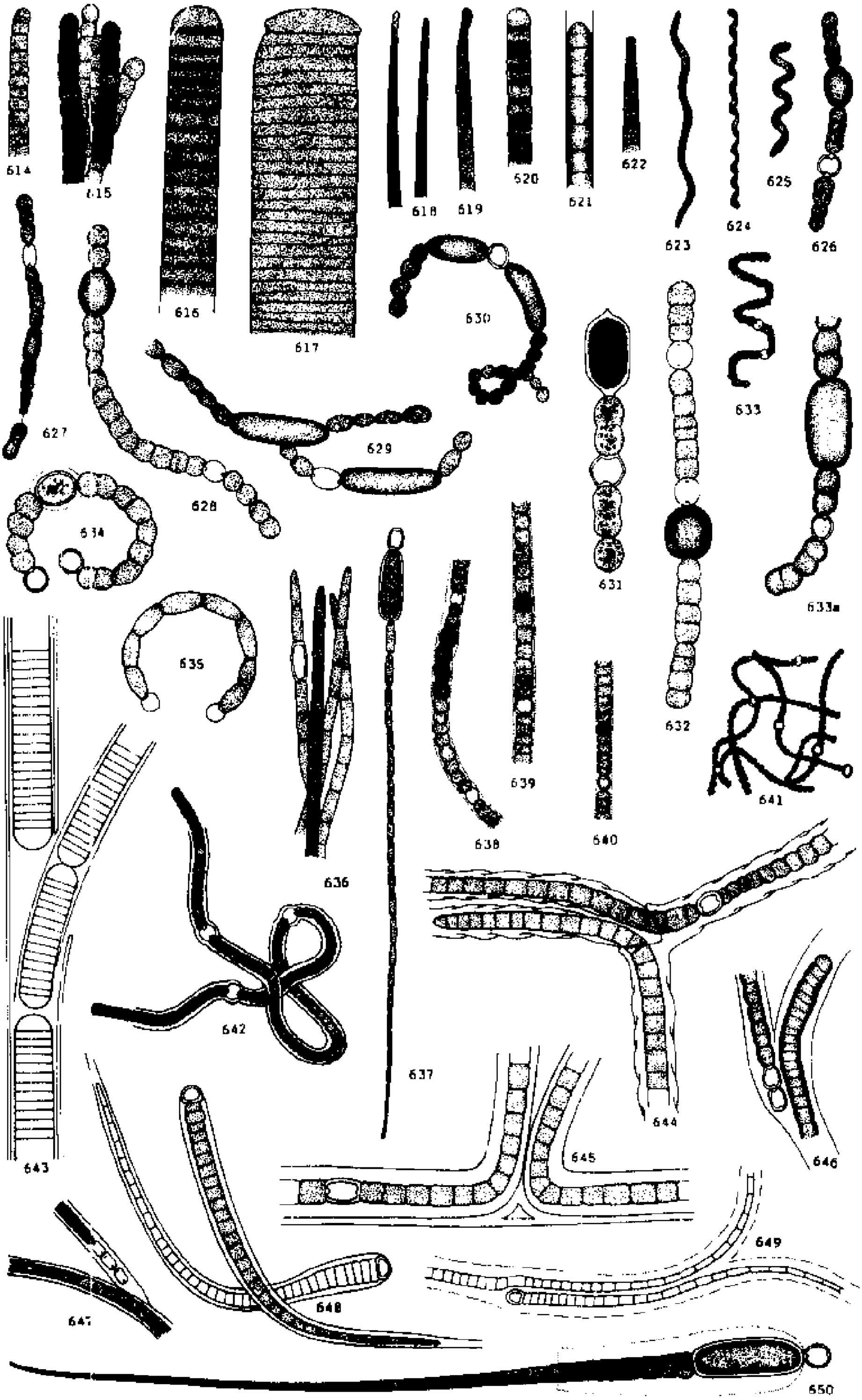
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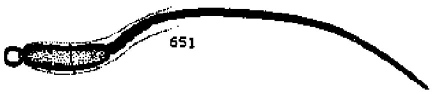
PLATE XXIV

Figure 651. *Gloeotrichia natans* (Hedwig) Rabenhorst
Figure 652. *Gloeotrichia pisum* (C. A. Ag.) Thuret
Figure 653. *Raphidiopsis curvata* Fritsch & Rich, three figures.
Figure 654. *Asterocytis smaragdina* (Reinsch) Forti



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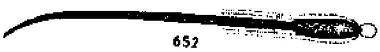

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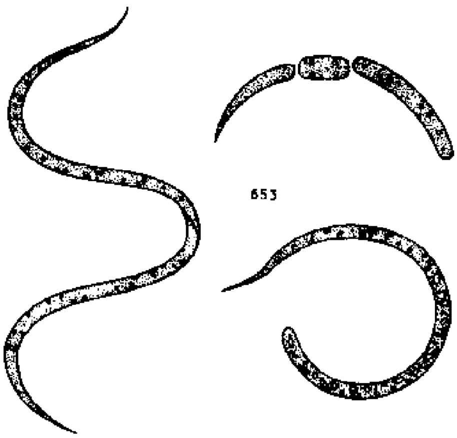

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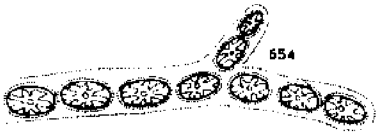

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APPENDIX

The following key is designed to aid in the recognition of algae in their natural habitats. The decisions to be made will depend upon the features of the habitats and upon the gross structure of the algae. A hand lens may be helpful but it is not essential.

The key includes only those algae which are macroscopic and with a definite organization, or those which have distinguishing features because of numbers present. The users judgement precludes the necessity for minutely describing each habitat.

FIELD KEY TO SOME GENERA OF ALGAE

1. Living in or upon animals 2
1. Not living in such association with animals 6
    2. On shells of snapping turtles (also on *Viviparus malleatus* Reeve in L. Erie); filamentous, tufted, coarse .... **Basicladia**
    2. Not on turtle shells 3
3. Forming a hard green coating on snail shells .... **Gongrosira**
3. Not on snail shells 4
    4. Green masses attached to anterior and posterior appendanges of fairy shrimp or to copepods .... **Characium**
    4. Not attached to fairy shrimp or copepods 5
5. In old egg masses of the salamander *Ambystoma;* dark green .... **Oophilia**
5. Living within green *Hydra* or green planaria .... **Chlorella (Zoochlorella)**
    6. Aquatic, submerged or nearly so 15
    6. Not aquatic; on soil, rock, concrete, wood, or bark 7
7. On soil, rock, or concrete 9
7. On wood or bark 8
    8. On shaded side of tree trunks, or on weathered siding of old buildings .... **Protococcus**
    8. On rotting logs or pilings, pale green .... **Hormidium Stichococcus**
9. On rock or concrete 10
9. On soil 11
    10. Algal mass orange or reddish; on "dry" cliff or quarry faces .... **Trentepohlia**
    10. Algal mass dark olive to black; slimy (peeling if dry) .... **Oscillatoria**
11. Algal mass filamentous; often in greenhouses 12
11. Algal mass not filamentous or felt-like; locations various 14
    12. Dark green; felt-like, coarsely branched .... **Vaucheria**
    12. Yellow green, tawny or olive-brown 13
13. Yellow green; filmy .... **Hormidium**
13. Tawny or olive brown; velvet or felt-like .... **Scytonema**
    14. Algal mass jelly-like, spherical or in expanded sheets .... **Nostoc**
    14. Algal mass globular, 1-2mm in diameter; shining, with white flakes .... **Botrydium**
15. Running water, lake shores, or in spray; attached 16
15. Standing or very slow moving water; attached or not 34
    16. Water cold; late winter, early spring, or spring fed 17
    16. Water cool to warm; late spring, summer, autumn 27
17. Algal mass filamentous 18
17. Algal mass not filamentous 24
    18. Algal mass a felt-like mat .... **Vaucheria**
    18. Algal mass not a felt-like mat 19

19. Plants not branched 20
19. Plants profusely branched (bushy) 21
 20. Plants short; slippery; bright green ..... **Ulothrix**
 20. Plants nodulose; cartilagenous; olive ..... **Lemanea**
21. Plants embedded in a jelly-like mass 22
21. Plants not gelatinous, "dry," coarse; often in very swift water ..... **Cladophora**
 22. Olive-green to red-purple ..... **Batrachospermum**
 22. Brilliant green 23
23. Gelatinous mass soft, indefinite, lateral branches long ..... **Stigeoclonium**
23. Gelatinous mass firm, definite, lateral branches short and mostly at right angles to main axis ..... **Draparnaldia**
 24. Colony brown, gelatinous, amorphous, spreading over rocks ..... **Diatoms**
 24. Colony green, gelatinous, not amorphous 25
25. Colony tubular, convolute, "like green intestines" ..... **Enteromorpha**
25. Colony saccate, membranaceous, or if tubular, not convolute 26
 26. Colony firm, easily handled intact ..... **Monostroma**
 26. Colony delicate, readily disintegrating when handled ..... **Tetraspora**
27. Filamentous, branched or not branched 28
27. Algal mass not filamentous 32
 28. Filaments branched 29
 28. Filaments not branched 31
29. Algal mass a felt-like mat ..... **Vaucheria**
29. Algal mass not felt-like; in turbulent water 30
 30. Algal mass bushy, coarse, dark green ..... **Cladophora**
 30. Algal mass slimy, bright green ..... **Stigeoclonium**
31. Filaments short (to 1 inch), nodulose, dark olive; in turbulent water ..... **Lemanea**
31. Filaments long (to 2 feet), silky, green; mass tough ..... **Rhizoclonium**
 32. Colonies "shot-like," olive to black; on rock ..... **Nostoc**
 32. Colonies not "shot-like," some shade of green 33
33. Green incrustation on rocks and sticks; calcareous ..... **Chlorotylium**
33. Colonies green, gelatinous pads or sacs ..... **Tetraspora**
 34. Cold water; late winter or early spring 35
 34. Cool to warm water; late spring, summer, autumn 40
35. Woodland pools, leaf litter bottom 36
35. Open ponds, lake margins, pools, "cut-offs" 37
 36. Algal mass yellow-green, filamentous, silky ..... **Tribonema**
 36. Green, motile spheres visible in a glass jar of the water ..... **Volvox**
37. Plants tree-like, often calcareous, attached to bottom ..... **Chara**
Nitella
37. Filamentous 38
 38. Attached to dead or living sticks, weeds and grass ..... **Oedogonium**
 38. Free floating 39
39. Brilliant green, slippery; ends of mass curling when held aloft ..... **Spirogyra**
39. Bright to light green, less slippery; ends of mass not distinctly curling ..... **Zygnema**
Mougeotia
 40. Temporary bodies of water 41
 40. Permanent or semipermanent bodies of water 44
41. Bird baths, urns, limestone shoreline depressions; reddish scum on bottom and sides ..... **Sphaerocystis**
(Haematococcus)
41. Puddles, cow tracks, ruts, manure water pools 42
 42. Blue-green, olive, black; slimy, membranaceous, often on mud ..... **Oscillatoria**
 42. Green or red; living in or on the water 43
43. Forming a red or green scum on the surface of the water ..... **Euglena**
43. Water uniformly green throughout ..... **Chlamydomonas**
Pandorina
Eudorina
 44. Aquaria, bottles and culture dishes in laboratory or greenhouse 45
 44. Ponds, lakes, lake margins, "cut-offs" 46
45. As a green film on the glass walls ..... **Chlorella**
45. Water uniformly green throughout ..... **Scenedesmus**
Ankistrodesmus

46. On wet soil at margins 47
46. Aquatic, floating or submerged 48
47. Globular, gelatinous colonies .... **Nostoc**
47. Slimy membranaceous colonies, blue-green, olive, black .... **Oscillatoria**
48. Submerged and attached 49
48. Free floating, or enmeshed in other aquatics 53
49. Plants tree-like; often calcareous; growing on bottom mud, scarcely submerged to 30 feet .... **Chara**
Nitella
49. Plants not tree-like; not calcareous 50
50. Filamentous 51
50. Not filamentous 52
51. Filaments dichotomously branched; growing on bottom mud .... **Dichotomosiphon**
51. Filaments not branched; attached to sticks, weed and grass stems .... **Oedogonium**
52. Small hemispherical or branched gelatinous colonies; green; attached to weeds, sticks, or stones .... **Chaetophora**
52. Flat green discs, often attached to dead cattail or water lily leaves .... **Coleochaete**
53. Algal mass forming a net .... **Hydrodictyon**
53. Algal mass not net-like 54
54. Algal mass a tough, membranaceous, paper-like sheet; green to olive-green .... **Lyngbya**
54. Algal mass not a membranaceous sheet 55
55. Algal mass filamentous; green 59
55. Algal mass not filamentous 56
56. Green motile spheres visible in a glass jar of the water .... **Volvox**
56. Algal mass nonmotile, definitely macroscopic 57
57. Algal mass irregular, gelatinous lumps; yellow to tawny .... **Gloeotrichia**
57. Algal particles blue-green; dispersed throughout the water, or floating as a bluish scum; sticky in mass 58
58. Particles appearing as "chopped grass" in the water .... **Aphanizomenon**
58. Particles of irregular shape and size .... **Anabaena**
Anacystis
(Microcystis)
59. Filaments coarse, branched, not slippery 60
59. Filaments silky, unbranched, slippery 61
60. Filaments with well defined, scattered, dark, swollen areas .... **Pithophora**
60. Filaments without dark, swollen areas .... **Cladophora**
61. Bright green to yellowish, very slippery if green; ends of mass curling if held aloft .... **Spirogyra**
61. Green to yellowish, only slightly slippery; ends of mass not curling .... **Zygnema**
Mougeotia

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This publication was cooperatively produced with Ohio Sea Grant College Program (grant NA89AA-D-SG132, project A/P-3-PD) as book series #009 (OHSU-BS-009).

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ISSN 0078-3994
ISBN 0-86727-060-8