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Notes on the Algae of Iowa

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NOTES ON THE ALGAE OF IOWA.

BY ROBERT EARLE BUCHANAN.

HISTORICAL. The first definite mention of Iowa Algae which has come to our notice is that published by Dr. C. M. Hobby[1] in the Proceedings of the Iowa Academy of Science. His list comprises some twenty-seven genera and seventy-four species and varieties. The list is prefaced as follows: "The species given below were mainly collected in the immediate vicinity of Iowa City. I am greatly indebted to Rev. Francis Wolle, of Bethlehem, Pennsylvania, for assistance in the study and identification of these plants. The classification used is that of Kirchner in "Algen von Schlesien, Breslau, 1878." The list comprises an unusually long list of spirogyras, some eighteen species and one variety.

Two years later, in 1882, J. C. Arthur[2] published his "History of Floyd County" in which he listed a number of species of the algae and the fungi, as well as the higher plants.

In the same year, Prof. C. E. Bessey,[3] then at the Agricultural college, published the following note regarding the abundance and distribution of algae: "The excessively wet autumn in central Iowa caused an unusual growth of the fresh water algae. Every pond and ditch was filled with Spirogyra, Zygnema, Vaucheria, etc., until the first of November. Usually our waters are quite barren of these growths so late in the season, but this season the continued wet weather, instead of the usual drouth, favored their development."

Dr. Bessey[4] in 1884 published a "Preliminary list of Cryptogams of Ames and Vicinity." Under Cyanophyceae eleven determined species are listed, under Palmellaceae 2, Protococcaceae 2, Zoosporae 6, Desmidiaceae 2, Diatomaceae 7 genera, Zygnemaceae 6, Oophytes 7. Total 36 specific determinations.

In 1897 Prof. B. Shimek[5] published a paper entitled "Notes on Aquatic plants from Northern Iowa." There is included in this list a number (eight) of species of algae, two Chaetophoras, four Cladophoras, and one Hydrodictyon.

P. C. Meyers[6] in a paper published in 1899 has given preliminary notes on the distribution of the Diatoms of the state, material having been obtained from a variety of sources.

Pammel and Buchanan published in 1905[9] a short list of algae collected in the northeastern part of Iowa.

Dr. Bruce Fink in 1905[8] published an account of the algae which he has studied in Iowa during a period of years. This is one of the most extended of the lists, twenty-eight species being noted for the first time. Most of the collections described were made in the vicinity of Fayette and of Grinnell.

OBJECT OF STUDY. Iowa is pre-eminently a prairie state, streams and lakes form but a very small proportion of her area. For this reason, perhaps, the algal flora of the state has been neglected, short lists and brief notes only of some of the species have been published at various times. It was deemed of interest, therefore, to undertake a study of the distribution of these forms in the state, as extended as time and facilities would permit. It was considered especially necessary that as extended a list of additions as possible might be made to this flora, as a contribution toward a complete list of these forms to be found within the borders of the state. Class material for demonstration in high school and college is often difficult to procure, hence a study of the habitat of some of the various forms may have a practical significance to many instructors and teachers.

From an economic standpoint, furthermore, some of our species are of importance inasmuch as they are frequently found polluting water supplies, especially those drawn from natural reservoirs. The so-called working of our lakes, and consequent production of foul odors and tastes have at various times caused not a little trouble and some destruction of property.

The study was undertaken at the instigation of Dr. Pammel, and the writer's thanks are due him for his many kindnesses.

The list of algae that is appended here makes no pretence of being at all complete; as a matter of fact, not more than one-quarter of the material collected has been worked over. A little more time would certainly result in the addition of much larger number of species to the flora of the state.

SOURCE OF MATERIAL STUDIED. During the years 1904-5 various collections of algae were made in different parts of the state, aggregating perhaps one hundred fifty. The general localities are as follows: Spirit Lake, East and West Okoboji Lakes, Upper and Lower Gar Lakes, Lake Minnewashta, ponds and marshes in Wright, Story, Polk, Linn, Webster, Hamilton, Humboldt counties, about Cedar Falls in the Cedar and tributaries, at the Ledges near

Boone, Davenport, and contributions have been received from Allamakee and Fayette counties. As before noted only a small part of these collections have as yet been thoroughly worked over, and the remainder awaits our leisure for further study.

Most collections were made in small vials, and preserved in 2% formalin solution. This seems particularly adapted to the preservation of the algae, they remain almost of the normal color and retain their shape well for several years at least.

METHODS OF STUDY. Most of the material studied was mounted in a weak solution of formalin to which had been added a small amount of eosin, the mount then ringed. If the ringing is successful the slides may be preserved for several years at least without change. The eosin is very satisfactory as an aid in the determination of the details of structure.

AUTHORITIES ON IDENTIFICATION. As a guide to the identification of the genera of the forms studied, and to the recognition of the great groups of algae, West's "British Freshwater Algae" has been of the most material assistance. The order in which the various genera are given in the list has been adapted from this work, and the same work has furnished a basis for the majority of the keys that are given therein. The section of Engler and Prantl's Pflanzenfamilien devoted to algae has also been of material assistance in the construction of keys, etc. For description of species in general De Toni's "Sylloge Algarum" has been used, together with Rabenhorst's "Kryptogamen Flora," and Kirchner's "Algen von Schlesien" and more particularly Wolle's "Freshwater Algae of the United States" and "Desmids of the United States" in some groups and genera. The same may be said of "Cooke's British Freshwater Algae." "The Ulothricaceae and Chaetophoraceae of the United States" by Tracy Elliott Hazen was used in part in the determination of the species of these groups. "Protophyta and Phycophyta" of the flora of Nebraska published by the Botanical Seminar of the University and written by DeAlton Saunders has proven of considerable comparative interest also. Bornet and Flahault's "Revision des Nostocacees Heterocystees" was also consulted for determination of species described therein. The lists of the Algae of Minnesota published by Miss Tilden have also been consulted with considerable interest, inasmuch as much of the northern part of the state should have about the same algal flora as a large section of Minnesota.

CLASSIFICATION OF ALGAE. The Classification which has been followed in the main in the arrangement of the various groups of the Algae has been that given by West in his "British Freshwater Algae." He has, however, commenced with the higher or more complex types and proceeds to the simpler and probably the more primitive types. We have altered this order, but otherwise the classification is much as is given.

In the list of Algae keys to different groups have been included and also to the species of each genus of algae as far as they have been found in the state. These keys were prepared for the convenience of the writer in making determinations and are here included because they may prove of assistance to others. In many cases these keys are taken directly from West, in others adapted from West or from Engler and Prantl, and many are original. While considerable care has been used in their preparation, nevertheless, a key is but a clumsy device after all for purposes of identification and these are submitted simply for what they are worth; it is to be understood that no attempt is made to differentiate the species found in the state from other species. Under each species in addition to the name and in a few instances some synonym, there have been given a few notes as to general distribution of the species, its Iowa localities as far as known reported to the writer or others.

Included in some of the keys are genera and groups that have not been recorded for Iowa, but that undoubtedly occur.

CONSIDERATION OF SPECIES OF ALGAE FOUND AND REPORTED.

KEY TO THE CLASSES OF ALGAE.

I. Containing a blue coloring matter known as phycocyanin. The stored product of assimilation probably glycogen for the most part. Mostly fresh water Blue green Algae.....Myxophyceae

II. Containing a brown coloring matter, diatomin (much resembling the phycophaein of the brown algae). Each cell with a siliceous covering. Universal in both fresh and salt water.....Bacillarieae

III. Containing a large proportion of yellow pigment known as xanthophyll. The stored product of assimilation is a fatty substance. Fresh water. Yellow green Algae.....Heterokontae

IV. Containing only the green coloring matter known as chlorophyll. Stored product of assimilation usually starch. Usually fresh water. Green Algae .....Chlorophyceae

V. Containing a brown coloring matter called phycophaein. Mostly marine. Brown Algae .....Phaeophyceae

VI. Containing a reddish coloring matter known as phycoerythrin. Mostly marine .....Rhodophyceae

Of the above classes of Algae the Phaeophyceae and the Rhodophyceae have no recorded representative in our flora and are not included in a discussion of the various classes.

CLASS I.

MYXOPHYCEAE (CYANOPHYCEAE). BLUE GREEN ALGAE.

The members of this class, usually easily distinguished by their characteristic blue green color, are almost ubiquitous in distribution in our flora. Wherever there is moisture, on the trunks of trees, on rocks, on damp soil, either alone or as one of the symbionts of the lichen body, as well as in water both in stagnant and running. Even in the soil they are present, at least in the form of spores or resistant cells of some character.

KEY TO THE SUBCLASSES OF MYXOPHYCEAE.

I. Cells with a low type of chromatophore, often scarcely differentiated and with a primitive type of nucleus.....Archiplastideae
II. Cells with a distinct and highly differentiated type of chromatophore and with true cell nucleus.....Glaucocystideae

Subclass I.

Archiplastideae.

This subgroup includes all the blue green algae that have been reported from the state.

KEY TO THE ORDERS OF THE ARCHIPLASTIDEAE.

I. Plants unicellular or colonial, commonly imbedded in gelatinous matrix, more rarely free floating.....Coccogoneae
II. Plants filamentous, filaments simple or branched, generally consisting of one or more rows of cells within a sheath attached to a substratum or free floating .....Hormogoneae

Order I.

Coccogoneae.

KEY TO THE FAMILIES OF COCCOGONEAE.

I. Cells epiphytic, with a distinct base and apex; reproduction by the formation of gonidia only.....Chamaesiphonaceae
II. Cells or colonies free floating or forming a gelatinous stratum very rarely epiphytic, not differentiated into base and apex, multiplication by simple cell division, very rarely by means of gonidia.....Chroococcaceae

Family I.

Chamaesiphonaceae.

I. Chamaesiphon.

1. *C. incrustans.* Grun. Small round celled epiphyte. Cells 4 u. This form has been collected but once, then growing on the surface of some alga, probably an Oedogonium.

Eagle Grove. Hewitt's Pond. 1904. R. E. Buchanan.

Family II.

Chroococcaceae.

KEY TO THE SUBFAMILIES OF CHROOCOCCACEAE.

I. Ephiphytes, with well defined dorsiventrality.....Chroocysteae
II. Free floating or in a gelatinous stratum, no dorsiventrality..Chroococceae

SUBFAMILY I.

CHROOCYSTEAE.

None of the species belonging to this subfamily have been reported from Iowa, but it is probable that some of them, particularly the Gloeochaete, may be found attached to submerged mosses or algae.

SUBFAMILY II.

CHROOCOCCEAE.

This group includes many of the very lowest forms of the algae, some of them bearing evidence of their relationship to the bacteria. There is a considerable number of genera that are native to the state.

KEY TO THE GENERA OF THE CHROOCOCCEAE.

A. Cell division in two directions only, forming plane.....*I. Merismopedia*
B. Cell division in all directions of space, cells enveloped in mucus.
*Cells forming large colonies.
+Cells arranged at or toward the periphery of large colonies. Spherical.
=Cells closely and regularly arranged.....2. *Coelosphaerium*
==Cells geminate and sparsely scattered, markedly pyriform in shape .....3. *Gomphosphaeria*
++Cells densely aggregated in globose, elongated, or clathrate colonies .....4. *Microcystis*
+++Cells aggregated to form irregular gelatinous colonies.
=Individual mucous coats clearly evident around each cell..... .....5. *Gloeocapsa*
==Cells involved in a common mucous covering.....(6. *Aphanocapsa*)
===Cells arranged in a compact gelatinous stratum...7. *Porphyridium*
**Cells more or less solitary, or forming very small colonies..8. *Chroococcus*

1. *Merismopedia.*

KEY TO THE SPECIES.

Diameter of cells 3.3u-3.8u.....*M. glauca*
Diameter of cells 6.5-9.5u.....*M. elegans*

2. M. glauca. (Ehrenb.) Naeg.

This alga is common floating in the quiet waters of ponds.

Ames, 1884? C. E. Bessey. (As *M. nova*).
Grinnell and Fayette. Bruce Fink.
Eagle Grove, Hewitt's Pond. '04. R. E. Buchanan.

3. M. elegans A. Br.

A form agreeing with this species in all essential characteristics has been once collected. Cells 7u in diameter.

Eagle Grove. Slough bottom. 1904. R. E. Buchanan.

2. *Coelosphaerium.*

4. C. kuetzingianum Naeg.

A frequent alga in many permanent ponds, often floating in considerable quantities in the lakes.

South Gar Lake. Dickinson Co. 1904. R. E. Buchanan.
Eagle Grove. Hewitt's Pond. 1904. R. E. Buchanan.
Eagle Grove. Margin of Slough. 1904. R. E. Buchanan.
Collections have been made several times since in similar localities around Eagle Grove.

3. *Gomphosphaeria.*

5. G. aponina Kutz.

Found once only. Should be common in stagnant water.

Eagle Grove. Stagnant Pool. 1904. R. E. Buchanan.

4. *Microcystis.*

6. M. aeruginosa.

Very abundant in the first locality.

East Okoboji Lake. Oct. 1904. R. E. Buchanan.
Ames. 1884. C. E. Bessey.

5. *Gloeocapsa.*

KEY TO THE SPECIES.

Integuments colorless. Cells 2-4u in diameter.....*G. arenaria*
Integuments yellow to brown.....*G. magma*

7. G. arenaria.

Forms thin aeruginous coating on damp stone, etc.

Grinnell. 1905. Dr. Bruce Fink.
Ames. Abundant on flower pots in greenhouse. 1904. R. E. Buchanan.

8. G. magma.

Fayette. On granitic boulders. Bruce Fink.

6. *Aphanocapsa.*

9. Grevillei? (Hass.) Rabenh.

A form referred to this species has been found once in stagnant water.

Ames. Pond, near R. R. 1905. R. E. Buchanan.

7. *Porphyridium.*

10. P. cruentum. (Ag.) Naeg.

This alga has been collected several times on the lower part of the stone wall on the arch in the college park.

Ames. On stone wall. 1904. R. E. Buchanan.

8. *Chroococcus.*

11. C. refractus.

Ames. 1884. C. E. Bessey.

Order II.

Hormogoneae.

KEY TO THE SUBORDERS OF THE HORMOGONEAE.

I. Trichomes cylindrical, sometimes narrowed at the extremities..... ..... Psilonemateae

II. Trichomes conspicuously attenuated toward one or both extremeties, which are generally piliferous.....Trichophoreae

Suborder I.

Psilonemateae.

KEY TO THE FAMILIES OF THE PSILONEMATEAE.

I. Filaments with a false branch system; sheaths firm and tubular of more or less equal thickness; trichomes consisting of a single row of cells, with heterocysts, but not of uniform thickness.....Scytonemaceae

II. Trichomes commonly tortuous and intricate, enveloped within a large gelatinous mass, consisting of a single row of uniform cells, generally torulose, with heterocysts; sheaths very delicate, mostly confluent..... ..... Nostocaceae

III. Trichomes consisting of a simple row of cells, uniform along their entire length except for the apical cells, which are sometime attenuated; heterocysts absent; sheaths variable, more or less gelatinous, and sometimes enclosing more than one trichome.....Oscillatoriaceae

Family I.

Scytonemaceae.

1. *Scytonema.*

KEY TO THE SPECIES.

Superficially corrugated or hirsute, as if erose.....*S. tomentosum*

Superficially smooth, sometimes the external layers dissolved into hairs .....*S. myochrous*

12. S. tomentosum.

Iowa City. 1880. Hobby.
1905 Fink.

13. S. myochrous.

Fayette. 1905. Fink.

Family II.

Nostocaceae.

KEY TO THE GENERA OF NOSTOCACEAE.

A. Trichomes flexuose and contorted within a definite gelatinous investment .....1. Nostoc
B. Trichomes more or less straight, free or forming a thin mucus stratum
  a. Heterocysts and spores intercalary.....2. Anabaena
  b. Heterocysts terminal and spores always contiguous to them.....
  .....3. Cylindrospermum

1. *Nostoc.*

KEY TO THE SPECIES.

Thalli confluent, on soil or more frequently mosses.....*N. muscorum*
Thalli discrete, periderm firm.
  Terrestrial.
    Thallus becoming irregular, tongue-shaped, etc.....*N. commune*
    Thallus remaining usually spherical or subglobose...*N. sphaericum*
  Aquatic.
    Trichomes densely intricate.....*N. coeruleum*
    Trichomes loosely implicate, radiating from the center.*N. pruniform*

14. N. muscorum. Agardh.
On the stem of mosses.
Fayette. 1905. Fink.

15. N. commune. Vaucher.
A very common alga in the damp margins of marshy places, etc.
Iowa City. 1880. Hobby.
Ames. 1884. Bessey.
Grinnell. Fink.
Ames. 1904. Buchanan.
Eagle Grove. 1904. Buchanan.

16. N. sphaericum Vaucher.
Iowa City. Hobby.
Ames. Bessey.

17. N. coeruleum Lyngbye.
Ames. 1884. Bessey.

18. N. pruniforme. Agardh.
Fayette. Fink. Nodules often reaching the size of plum.
Ames. Buchanan. In pool near Ontario. Very small.

2. *Anabaena.*

KEY TO THE SPECIES.

Growing in roots of the Cycas.....*A. cycadacearum*
Not in roots.
Filaments straight, at least not spiral. Spores 7-13u broad.....
.....*A. flos-aquae*

19. A. cycadacearum. Reinke.

Filaments curved, spores 16-18u.....*A. circinalis*

Occurring as the cause of the nodular thickenings on the roots of the Cycas revoluta wherever grown.

Ames. Greenhouse. Buchanan.

20. A. flos-aquae. Breb.

One of the most common (together with the next) of the constitutents of the plankton of many of our lakes at some seasons of the year. Occurs frequently in the sloughs in the northern part of the state also.

Eagle Grove, Jenning's Pond. 1904. Buchanan.

Eagle Grove, Pond near Boone River. Buchanan.

Eagle Grove, Slough. 1904. Buchanan.

Collected some eight or ten times under similar conditions to the above.

21. A. circinalis. Rabenh.

Very common in the lakes.

East Okoboji Lake. October. 1904. Buchanan.

Upper Gar Lake. October. 1904. Buchanan.

3. *Cylindrospermum.*

KEY TO THE SPECIES.

(It is impossible to give a key to the species that occur in Iowa, inasmuch as only one has come to the notice of the writer, and the names that have been used by other writers may mean any one of several species, at least as recognized by Bornet and Flahault).

22. C. limnicola Kg.

Iowa City. Hobby.

Ames. Soil on pots in greenhouse. Buchanan.

23. C. comatum Wood.

Grinnell. Frequent on wet soil along brooks. Fink.

24. C. macrospermum Kg.

Iowa City. Hobby.

Family III.

Oscillatoriaceae.

KEY TO THE SUBFAMILIES.

I. Several trichomes included in a single sheath.....Vaginarieae

II. Single trichome in a sheath.....Lyngbyeae

Subfamily I.

Vaginarieae.

1. *Microcoleus.*

25. M. vaginatus (Vauch) Comont. (*M. terrestris* Kg.)

Grinnell. Damp Ground. Fink.

Ames. On flower pots in greenhouse. Buchanan.

Subfamily II.

Lyngbyeae.

KEY TO THE GENERA.

Trichomes consisting of many cells.
Filaments simple; sheaths firm, apices of trichomes straight.....
.....1. Lyngbya
Filaments simple; sheaths thin, always hyaline, mucous and more or less diffluent, in some species absent, apices of the trichomes commonly curved.
Trichomes more or less agglutinated by their mucous sheaths; cells of the trichome often separated by a thin mucous layer....2. Phormidium
Trichomes destitute of sheaths, free, straight or with curved extremities .....3. Oscillatoria
Trichomes consisting of one cell, twisted into a regular spiral.....
.....4. Spirulina

1. *Lyngbya.*

26. L. vulgaris (Kuetz) Kirch.
Iowa City. Hobby.
Grinnell. Damp Soil. Fink.

27. L. ochracea (Kuetz) Thur.
Iowa City. Hobby.
Eagle Grove. In the trough of a flowing well. It is found very commonly in the waters in this locality that are laden with iron, the sheath becoming impregnated with this substance. Buchanan.

28. L. obscyra. Kuetz.
Eagle Grove. A pond amid bladderwort. Buchanan.

29. L. subtorulosa (Breb.) Wolle. (*Phormidium lacustre* Naeg.)
Iowa City. Hobby.

30. L. cataracta (Rabenh.) Wolle. (*Phormidium cataractum* Rab.)
Iowa City. Hobby.

31. L. glutinosa Ag. (*Phormidium glutinosum* A Br.)

2. *Phormidium.*

32. P. tenue (Menegh) Gomont.
Fayette. Frequent. Fink.
Ames. On pots in greenhouse. Buchanan.
Ames. Pond. Buchanan.
Eagle Grove. In pond among decaying rushes. Buchanan.
Eagle Grove. Bottom of the margin of the slough. Buchanan.

3. *Oscillatoria.*

KEY TO THE SPECIES.

Filaments very narrow, division's often not evident.
Filaments .6 u in diameter.....*O. angustissima*
Filaments 1.8-2.5 u in diameter.....*O. tenerrima*
Filaments broader, articulations usually distinct.
Articulations about half as long as wide.

Filaments 5.5-6.5 u in diameter.....*O. tenuis*
Filaments 6.5-8.5 u in diameter.....*O. limosa*
Filaments 9-10 u in diameter.....*O. nigra*
Articulations less than half as long as broad.
Filaments 12-18 u in diameter.
Forming greenish stratum.....*O. froelichii*
Forming dark olive brown stratum.....*O. froelichii fusca*
Filaments broader than 18 u.
Filaments 30-45 u in diameter, 4-5 articulations to the width.....
.....*O. princeps*
Filaments 38-56 u in diameter, 9 articulations to a diameter.....
.....*O. imperator*

33. O. angustissima W&G. S. West.

Ontario, Ia. In pond with other algae. Buchanan.

34. O. tenerrima Kuetz.

A common species in stagnant water, and on soil.

Fayette. Fink.

Ames. Effluent of the filter beds of the College Sewage disposal plant. Buchanan.

Ames. On the soil in greenhouse. Buchanan.

Eagle Grove. Pond. Buchanan.

35. O. tenuis. Ag.

This is the most common of the Oscillarias, being almost universally present in stagnant water, and in slow running streams, where water drops upon the soil, on boards, etc.

Iowa City. Hobby.

Grinnell. Fink.

Allamakee Co. Spring. Pammel.

Eagle Grove. Hewitt's Pond. Amid Utricularia. Buchanan.

Eagle Grove. From a watering trough. Buchanan.

Eagle Grove. Stone under a water drop, very dense mat. Buchanan.

Ames. Board from a spring. Buchanan.

Ames. Effluent of the filter beds. Buchanan.

And many similar localities.

36. O. limosa. Vauch.

Next to the tenuis this is probably the commonest species in the state.

Iowa City. Hobby.

Ames. Bessey.

Fayette. Fink.

Ames. On damp earth, forming a thin coating. Buchanan.

Eagle Grove. Moist earth. Buchanan.

37. O. nigra Vauch.

Usually floating free in stagnant water.

Iowa City. Hobby.

Ames. Bessey.

Ames, stagnant ditch. Buchanan.

38. O. froelichii Kuetz.

Floating among other algae in ponds.

Iowa City. Hobby.

Eagle Grove. Floating in Hewitt's Pond. Buchanan.

39. O. froelichii var. *fusca* Kirch.

Ames, Ia. On moist soil in the greenhouse. Buchanan.

40. O. princeps Vauch.

Fayette. Fink.

Eagle Grove. Pond, amid dense growth of Lemna. Buchanan.

41. O. imperator Wood.

The largest species of oscillaria that is to be found in the state.

Ames. Bessey.

4. *Spirulina.*

42. S. major Kutz.

Ontario. Slough, amid Lemna trisulca. Buchanan.

Suborder II.

Trichophoreae.

KEY TO FAMILIES.

I. Trichomes attenuated from the base to the apex, which is piliferous; heterocysts basal, rarely absent.....Rivulariaceae

II. Trichomes attenuated from the middle toward each extremity. Heterocysts absent .....Camptotrichaceae

Family I.

Rivulariaceae.

KEY TO THE GENERA.

Filaments free, simple or falsely branched, branches distinct and free.....
.....1. Calothrix

Filaments forming a hemispherical or globular thallus, closely united by mucus.

Filaments radiately disposed in a tough globose or hemispherical attached thallus. Spores unknown.....2. Rivularia

Filaments radiately disposed in a soft globose free floating thallus. Spores regularly produced.....3. Gloeotrichia

1. *Calothrix* (Mastigonema).

43. C. elongatum (Wood).

Ames. Bessey.

44. C. parietina (Naeg.) Thur.

Ontario. On stem of Phragmites. Buchanan.

2. *Rivularia.*

No species of Rivularia as at present recognized has been found in the state, the species reported by Bessey as *R. cartilaginea* is probably *Gloeotricha pisum.*

3. *Gloeotricha.*

45. G. Pisum Thur.

One of the most abundant of the algae in some of the lakes at certain seasons of the year.

Iowa City. 1880. Hobby.

Ames. 1884. Bessey.

South Gar Lake. 1904. Buchanan.
North Gar Lake, on weeds in shallow water, 1904. Buchanan.
Allamakee County. 1905. L. H. Pammel.

Family II.

Camptotrichaceae.

No species or genera belonging to this family have as yet been described from the state.

Subclass.

Glaucocystideae.

None of the representatives of this more highly differentiated group of the Myxophyceae have been reported from Iowa. Perhaps Glaucocystis may be found in the northern part of the state.

CLASS II.

BACILLARIEAE (DIATOMS).

Although a large number of Diatoms have been collected when collecting other forms of algae, no attempt has been made to classify them with the exception of one or two cases. The diatoms have an almost universal distribution over the state. Some work on their distribution in this state has been done by other authors, but a most interesting field is here for anyone who has the time and ability to take it up. Species belonging to the following genera have been noted, with only occasional specific identification:

Centricae.
Discoideae.
Melosiraceae.
46. Melosira. M. granulata. Lake Okoboji and Gar Lake.
Coscinodiscaceae.
47. Stephanodiscus. S. niagarae Ehr. Gar Lake, surface.
Pennatae.
Fragilarioideae.
Tabellariaceae.
48. Tabellaria. T. fenestrata. (Lyngb) Kutz. Gar Lake.
Meridionaceae.
Meridion.
Diatomaceae.
49. Diatoma. D. vulgare Bory. Pond, Eagle Grove Buchanan.
Fragilariaceae.
Fragilaria.
Synedra.
Eunotiaceae.
Eunotia.

Achnanthoideae.
Cocconeidaceae.
Cocconeis. C. placentula Ehrenb. Abundant on old bladderwort in pond, Ontario. Buchanan.
50. Naviculoideae.
Naviculaceae.
Navicula. Numerous species.
Stauroneis.
Amphipleura.
Gyrosigma (Pleurosigma)
Gonphonemaceae
Gonphonema
Cocconemaceae
Cocconema.
Amphora. A. ovalis. Kutz. Pond, Eagle Grove. Buchanan.
Epithemia.
Nitzschioideae.
Nitzschiaceae.
Nitzschia. Very common.
Surirelloideae.
Surirellaceae.
Surirella.

CLASS III.

HETEROKONTAE.

This class is one that has been segregated from the Chlorophyceae to receive certain anomalous forms that seemed to have uncertain affinities. Of the three families created, two are found in the state.

Order I.

Confervales.

KEY TO THE FAMILIES.

Unicellular or filamentous; cells often elongate, uninucleate or subcoenocytic, with several or many chromatophores; cell walls firm and thick ..... Tribonemaceae
Plant body large and coenocytic, fixed, with well developed organs of attachment; chromatophores numerous..... Botrydiaceae

Family I.

Tribonemaceae.

This family as far as known is represented in this state by one genus only, Tribonema.
1. *Tribonema.*

KEY TO THE SPECIES.

Chromatophores usually numerous, cell wall thin.
Diameter of filaments 6-11 u.....*T. bombycinum*
Diameter of filaments 3-6 u.....*T. bombycinum tenue*
Chromatophores numerous, large, cell wall thicker, diameter of cell 11-16.5 u
.....*T. utriculosum*

51. T. bombycinum (Agardh) Derb. & Sol.

Very common in stagnant water, and even slow flowing water and springs.
Eagle Grove. Slough, margin of. Buchanan.
Ames. Floating in spring. Buchanan.

52. T. bombycinum tenue Hazen.

Eagle Grove. Slough. Buchanan.
Eagle Grove. In pond amid Lemna. Buchanan.

53. T. utriculosum (Kutz) Hazen.

Eagle Grove. In rain barrel by the side of railroad.
Eagle Grove. Pond by the side of the railroad.
Ames. In pond near Ontario. Buchanan.

Family II.

Botrydiaceae.

1. *Botrydium.*

54. B. granulatum (L.) Crev.

Occurs abundantly on mud just drying up, such as that found on the banks of a stream that has overflowed.

Ames. 1884. On damp earth in autumn, forming a green coating. Bessey.
Universally distributed in the state. Fink.
Ames. Common in muddy places. Buchanan.

CLASS IV.

CHLOROPHYCEAE.

This is the group to which by far the larger part of the algae found in the state belong. It has normally no other color than the chlorophyll pigment, and may generally on that account be easily recognized.

KEY TO THE ORDERS OF THE CHLOROPHYCEAE.

1. Thallus filamentous or unicellular.
   A. Thallus coenocytic, unseptate. Chloroplasts numerous, without pyrenoids. Sexual reproduction heterogamous.....VII. Siphoneae
   B. Thallus not coenocytic.
      a. Small unicellular, multicellular or colonial algae. Cells uninucleate or coenocytic. Chloroplasts very variable in form, size and disposition, with or without pyrenoids. Sexual reproduction isogamous or heterogamous. Mostly fresh water.....IX. Protococcales
      b. Not characterized as a.

1. Sexual reproduction by isogamous aplanogametes. Thallus unicellular or filamentous. Cells uninucleate chloroplasts single or several, usually large and of some definite shape, with pyrenoids .....VIII. Conjugatae
2. Sexual reproduction not by isogamous aplanogametes.
*Chloroplast single.
+Without pyrenoids. Cells uninucleate, with a large parietal, reticulated or band like chloroplast. Thallus filamentous unbranched.....V. Microsporales
++With one pyrenoid. Chloroplast single, central and substellate. Mostly subaerial. Thallus filamentous, sometimes parenchymatous or expanded by the fusion of the filaments in one plane.... .....IV. Schizogoniales
+++Pyrenoid one or more. Cells uninucleate, with a large parietal anastomosing chloroplast containing one or several pyrenoids. Thallus filamentous, simple or branched. Cell division characterized by the intercalation of a new piece of cell wall between the mother cell and the distal end of the daughter cell. Sexual reproduction by means of heterogamous gametes. Zoogonidia with an anterior circle of cilia. Exclusively fresh water forms..... .....I. Oedogoniales
**Chloroplasts generally one or more, parietal, with pyrenoids. Cells uninucleate. Sexual reproduction either isogamous or heterogamous, sometimes simple, but more often branched..II. Chaetophorales
***Chloroplasts numerous, parietal, each with a pyrenoid. Thallus filamentous, simple or branched, incompletely septate. Sexual reproduction isogamous or heterogamous. Marine or fresh water.... .....IV. Cladophorales

II. Thallus expanded, membranous, parenchymatous, attached at least when young. Cells uni-nucleate; chloroplasts single, parietal and with one pyrenoid. Sexual reproduction isogamous. Mostly marine forms..... .....III. Ulvales

Order I.

Oedogoniales.

Only one family.

Family I.

Oedogoniaceae.

One genus only has been reported from the state.....*Oedogonium*

1. *Oedogonium.*

KEY TO THE SPECIES OF OEDOGONIUM.

A. Monoecious species. (Oogonia and antheridia born in same filament).
1. Oogonia always destitute of median processes.
a. Diameter vegetative cells 7-9 u.....*O. cryptoporum*
b. Diameter vegetative cells 12-19 u.
*Terminal cell of filament with an apical bristle, short....*O. autumnale*
**Terminal cell without apical bristle.....*O. fragile*

B. Dioecious species.
1. Nannandrous (with dwarf males).
a. Dwarf males unicellular.....*O. cataractum*
2. Macrandrous.
a. Oogonia little or not at all swollen.....*O. capillare*
b. Oogonia manifestly swollen.
*Diameter female cells 9-12 u.....*O. franklinianum*
**Diameter female vegetative cell 12-30 u.
+Diameter oospore 28-35 u.....*O. pringsheimii*
++Diameter oospore greater.
=Diameter male vegetative cells 15-25 u.....*O. cardiacum*
==Diameter male vegetative filaments 14-16 u.....*O. carbonicum*

C. Organs of fructification imperfectly known.
1. Oospores globose or sub-globose.....*O. fonticolum*
2. Oospores ellipsoid or oval.
a. Diameter vegetative cells 30-42 u.....*O. giganteum*
b. Diameter vegetative cells 5-6 u.....*O. longatum*

55. O. cryptoporum Wittr.
Iowa City. Hobby.

56. O. autumnale Wittr.
Iowa City. Hobby.

57. O. fragile Wittr.
Iowa City. Hobby.

58. O. cataractum Wolle.
A species that has been referred to this species provisionally has been found several times in stagnant water. Answers description very well, but for the habitat, which Wolle gives as rapids.
Ames. 1905. Buchanan.

59. O. capillare (L.) Kuetz.
One of the commoner forms. Specimens were often found which were referred here, but were not fruiting.
Iowa City. Hobby.
Ames. Pond. 1905. Buchanan.

60. O. franklinianum Wittr.
Gar Lake, attached to weeds, very abundant. Buchanan.

61. O. pringsheimii Gram.
Iowa City. Hobby.

62. O. cardiacum (Hass.) Kuetz. (*O. inequale*).
Ames. Bessey.

63. O. carbonicum Wittr.
Wolle in Fresh Water Algae says: "The only specimens of this species identified were from Iowa."
Iowa City. Hobby.

64. O. fonticolum A. Br.
Iowa City. Hobby.

65. O. giganteum Kuetz.
Iowa City. Hobby.

66. O. longatum Kuetz.
Ames. Bessey.

Order II.

Chaetophorales.

KEY TO THE FAMILIES.

A. Filaments simple.
  1. Chloroplast single, parietal with one or more pyrenoids. Sexual reproduction isogamous .....III. Ulotrichaceae
  2. Cells with thick lamellose coats, usually arranged in a single series within a lamellose gelatinous sheath. Sexual reproduction heterogamous; plants monoecious; oogonia with one non-motile oosphere; fertilization within the oogonium.....IV. Cylindrocapsaceae

B. Filaments branched.
  1. With trichomes, or hairs on some part.
    a. Trichomes not terminal.
      *Filaments creeping, trichomes on most of the cells, often swollen at the base, epiphytic on submerged plants. Sexual reproduction heterogamous, plants monoecious, oospheres motile, fertilization taking place outside the oogonium.....II. Herposteiraceae
      **Filaments forming flat expansions or pulvinate branched masses, epiphytic on the stems and leaves of submerged plants. Sexual reproduction heterogamous; plants monoecious or dioecious; oogonia with a trichogyne and one non-motile oosphere; fertilization within the oogonium and resulting in the formations of a cortical layer on the outer surface of the oogonium. Some of the cells of the thallus are furnished with fine bristles with basal sheaths. I. Coleochaetaceae
    b. Trichomes terminal, branches attenuated into multicellular hair-like prolongations. Chloroplast single, parietal, with one or many pyrenoids. All the cells except those of the rhizoids and hairs are capable of producing zoogonidia or gametes. Sexual reproduction isogamous.....V. Chaetophoraceae
  2. Without trichomes.
    a. Chloroplast single, parietal, with or without a single pyrenoid. Branches scarcely attenuated. Zoogonidia and gametes produced in special cells. Sexual reproduction isogamous.....VI. Microthamniaceae
    b. Chloroplasts several, parietal, without pyrenoids. Zoogonidia and gametes produced in special gonidangia. Sexual reproduction isogamous. Thallus branched, terrestrial or arboreal.....VII. Trentepholiaceae

Family I.

Coleochaetaceae.

1. *Coleochaete.*

KEY TO THE SPECIES.

Filaments not closely united into a membrane.....*C. soluta*
Filaments closely united into a membrane.
  Thallus not circular.....*C. scutata*
  Thallus circular .....*C. orbicularis*

67. C. soluta. Pringsh.

Fayette. Fink.

68. C. scutata Breb.

Fayette. Fink.

69. C. orbicularis. Pringsh.

Ames. In aquarium. Buchanan.

Family II.

Herposteiraceae.

No species of this family have been reported from the state, although Herposteiron will probably be found.

Family III.

Ulotrichaceae.

KEY TO THE GENERA.

Filaments threadlike, cells cylindrical with truncate apices.
Component cells longer than broad.....I. Ulothrix
Component cells in part broader than long.....2. Schizomeris
Filaments fragile, cells with rounded apices, cells cylindric, resembling a fragmented Ulothrix .....3. Stichococcus

1. *Ulothrix.*

70. U. tenerrima Kutz.

Abundant in many places, slow running water or stagnant pools.
Iowa City. Hobby.
Ames. Buchanan.
Eagle Grove. Buchanan.

2. *Schizomeris.*

71. S. leillinii Kutz.

Iowa City. Hobby.

3. *Stichococcus.*

72. S. bacillaris Nag.

Ames, Iowa. Spring on College farm. Buchanan.

Family IV.

Cylindrocapsaceae.

1. *Cylindrocapsa.*

73. C. conferta West.

A species has been found at Ames which agrees exactly with West's figures.
Ames. Pond, amid Gloeotricha. Buchanan.

Family V.

Chaetophoraceae.

KEY TO THE GENERA.

Filaments fine, showing little difference in character of the stem and branches .....1. Myxonema

Filaments fine, involved in tufts in dense gelatinous substance..... .....2. Chaetophora
Filaments and main branches larger, bearing dense fascicles of small branchlets .....3. Draparnaldia

1. *Myxonema (Stigeoclonium)*

KEY TO THE SPECIES.

Opposite branching predominating.
Filaments 11-30 u in diameter.....*M. flagelliferum*
Filaments 7-10 u in diameter.....*M. tenue*
Alternate branching predominating, diameter 6-8 u.....*M. nanum*

74. M. flagelligerum (Kutz) Rabenh.
Iowa City. Hobby.

75. M. tenue (Ag.) Rabenh.
Iowa City. Hobby.
Ames. Main effluent filter beds. Buchanan.

76. M. nanum (Dillw.) Hazen.
Fayette. Fink.
Grinnell. Fink.
Ames. College Spring. Buchanan.

2. *Chaetophora.*

KEY TO THE SPECIES.

Colonies of filaments subglobose or tuberculose. Branching erect, fasciculate at the summit.....*C. pisiformis*
Colonies of filaments extended, irregularly lobed or laciniate..... .....*C. incrassata*

77. C. pisiformis (Roth) Agardh.
Iowa City. Hobby.
West Okoboji. Common. Shimek.
Fayette. Fink.
Eagle Grove, Jenning's Pond. Buchanan.
Ontario Pond. Buchanan.
Ames. Pond near R. R. Buchanan.

78. C. incrassata (Hudson) Hazen. (*cornu-damae*).
Fayette. Fink.
Allamakee Co. Pammel.

79. C. monilifera Kutz.
Clear Lake. On Cladophora. Shimek.

3. *Draparnaldia.*

KEY TO THE SPECIES.

Rachis clearly traceable to or beyond the summits of the fascicles of branches .....*D. plumosa*
Rachis soon lost in the ramifications of the orbicular spreading fascicles .....*D. glomerata*

80. D. plumosa (Vauch.) Agardh.
Ames. Bessey.
Fayette. Fink.

81. D. glomerata (Vauch.) Agardh.
Iowa City. Hobby.

Family VI.

Microthamniaceae.

No species of this family have as yet been reported from the state, though some probably occur.

Family VII.

Trentepohliaceae.

1. *Trentepohlia (Chroolepus)*

82. T. odorata Wittr. *(umbrina).*

Fayette. Fink.
Grinnell. Fink.

Order III.

Ulvales.

No species of this order have been reported from the state.

Order IV.

Schizogoniales.

No species of this order have as yet been reported from the state.

Order V.

Microsporales.

Family I.

Microsporaceae.

1. *Microspora.*

KEY TO THE SPECIES.

Filaments large, cell wall 1.5-3 u thick.....*M. amoena*
Filaments smaller, cell walls thin.
Cell diameter 14-17 u.....*M. floccosa*
Cell diameter 7.5-9.5 u.....*M. stagnorum*

83. M. amoena Rabenh.

Fayette. Fink.
Grinnell. Fink.

84. M. floccosa Thur.

Ames. College Spring. Floating. Buchanan and Holden.

85. M. stagnorum Lagerh.

Eagle Grove. Slough, amid bladderwort. Buchanan.

Order VI.

Cladophorales.

KEY TO THE FAMILIES.

Thallus branched.
Without large barrel shaped resting spores.....I. Cladophoraceae
With large barrel shaped asexual spores.....II. Pithophoraceae
Thallus unbranched .....III. Sphaeropleaceae

Family I.

Cladophoraceae.

1. *Cladophora.*

KEY TO THE SPECIES.

At first attached as tufts, afterwards floating as mats.
Cell membrane smooth, articulations more or less swollen.....*C. fracta*
Filaments thin, long, sparingly branched, green.....*C. fracta gossypina*
Filaments shorter, much branched, in brownish or nearly black masses .....*C. fracta rigidua*
Cell membrane delicately plicate striate.....*C. crispata*
Tufts permanently attached, branches not connate at the base..*C. glomerata*
2-4 inches long, branches somewhat scattered, ultimate cells penicillate fascicles.....*C. glomerata rivularis*
Barely one inch long, corymbosely fasciculate, erect..*C. glomerata pumila*

86. C. fracta Kuetz.
Iowa City. Hobby.
Ames. Bessey.
West Okoboji. Common. Shimek.
Arbor Lake. Grinnell. Fink.
Eagle Grove. Jenning's Pond. Buchanan.
Eagle Grove. Railroad Pond. Buchanan.
Ames, near Ontario. Buchanan.

87. C. fracta var. *gossypina* Rabenh.
West Okoboji. Shimek.

88. C. fracta var. *rigidula* Rabenh.
Grinnell. Arbor Lake. Fink.

89. C. crispata Kuetz.
Iowa City. Hobby.
Fayette. Quiet water of Volga. Fink.
Grinnell. Fink.

90. C. glomerata Kuetz.
Iowa City. Hobby.
Ames. Common in streams. Bessey.
West Okoboji. Common. Shimek.
North Gar Lake. On weeds. Buchanan.
Fayette. Common in Volga. Fink.

91. C. glomerata var. *rivularis* Rabenh.
Fayette. Volga, quiet waters. Fink.

92. C. glomerata var. *pumila* Bail.
Fayette. Volga, quiet waters. Fink.

Family II.

Pithophoraceae.

No species of this family have been reported from the state.

Family III.

No species of this family have been reported as yet.

Order VII.

Siphoneae.

Family I.

Vaucheriaceae.

KEY TO THE SPECIES.

1. Vaucheria.

Antheridia little or not at all bent, oblong cylindric or lanceolate.

Filaments thick +100 u., oogonia erect.....*V. aversa*

Filaments thinner, 50-75 u. oogonia lateral.....*V. sericea*

Antheridia bent in the form of a horn or hook.

Oogonia sesile or nearly so, beside the antheridia on the thallus.

Oogonia usually single, sometimes two together, globose or ellipsoid.. .....*V. Dillwynii*

Oogonia usually in clusters of two or more, ovate or oblong oval..... .....*V. sessilis*

Oogonia on a fruit branch with the antheridia above.

Antheridia and oogonia bending in opposite planes, forming an angle with each other, usually two oogonia.....*V. geminata*

Oogonia 3-10.....*V. geminata racemosa*

Antheridia and oogonia bending in parallel planes.....*V. terrestris*

93. V. aversa Hass.

Fayette. Fink.

94. V. sericea Lyngb.

Iowa City. Hobby.

95. V. dillwynii Ag.

Iowa City. Hobby.

96. V. sessilis DC.

Iowa City. Hobby.
Ames. Bessey.
Fayette. Fink.
Grinnell. Fink.
Ames. Pots in Greenhouse. Buchanan.
Eagle Grove. Hewett's Pond. Buchanan.
Fayette Co. Pammel.

97. V. geminata DC.

Iowa City. Hobby.
Ames. Bessey.
Fayette. Fink.
Grinnell. Fink.
Ames. Spring on hillside. Buchanan.

98. V. germinata var. *racemosa* Walz.
Iowa City. Hobby.
Grinnell. Fink.
Ames. Buchanan.
Ames. Roadside puddle. Fawcett.
99. V. terrestris Lyngb.
Ames. Bessey.
Fayette. Fink.

Order VIII.

Conjugatae.

KEY TO THE FAMILIES.

Thallus multicellular .....I. Zygnemaceae
Thallus uni-cellular.....II. Desmidiaceae

Family I.

Zygnemaceae.

KEY TO THE SUBFAMILIES.

Conjugation forming a zygospore which immediately develops a sporocarp of several cells, one of which is the spore (carpospore). The gametophyte is developed from this after a period of rest.....
.....I. Mesocarpeae
Conjugation producing a zygospore which after a period of rest develops directly into a new gametophyte.....II. Zygnemeae

Subfamily I.

Mesocarpeae.

1. *Mougeotia.*
100. M. genuflexa Ag.
Fayette. Fink.
101. M. scalaris Hass.
Iowa City. Hobby.
Ames. Bessey.

Subfamily II.

Zygnemeae.

KEY TO THE GENERA.

Chlorophyll in stellate masses.....1. Zygnema
Chlorophyll in spiral bands.....2. Spirogyra

1. *Zygnema.*

KEY TO THE SPECIES.

Zygospore in one of the conjugating cells.
Intermediate membrane of spores smooth, 26-30 u broad....*Z. insigne*

Sporoderm punctate or granulate.
Cells 10-36 u in diameter.....*Z. stellium*
Cells 35-50 u in diameter.....*Z. cruciatum*
Zygospore between the conjugating cells.....*Z. pectinatum*

102. Z. insigne Kuetz.
Iowa City. Hobby.
Ames. Bessey.

103. Z stellinum Ag.
Eagle Grove. Floating in Hewitt's Pond. Buchanan.

104. Z. cruciatum Ag.
Iowa City. Hobby.
Eagle Grove. Hewitt's Pond. Buchanan.

105. Z pectinatum Ag.
Iowa City. Hobby.

2. *Spirogyra.*

KEY TO THE SPECIES OF SPIROGYRA.

Septa between cells smooth, not folded back or replicate.
Fruiting cells little or not at all swollen.
One spiral in each cell.
Zygospores spherical.
Vegetative cells 30-48 u wide.....*S. porticalis*
Vegetative cells 30-32 u wide.....*S. porticalis alpina*
Zygospore oval to elliptical.
Broad oval, 1½-2½ times as long as wide.
18-28 u in diameter.....*S. longata*
33-38 u in diameter.....*S. varians*
Elliptical, 2-3 times as long as wide, 19-23 u in diameter.....
.....*S. communis*
Two or more spirals in each cell.
Zygospore ovoid or ellipsoid.
Vegetative filaments 33-40 u in diameter.
Cells 2-4 times as long as wide.....*S. decimina*
Cells 4-10 times as long as wide.....*S. rivularis*
Vegetative cells more than 50 u in width.
Cells 54-78 u in diameter.....*S. nitida*
Cells 86-110 u in diameter.
Cells 1½-2 times as long as wide.....*S. jugalis*
Cells ½-1 times as long as wide.....*S. setiformis*
Zygospore lens shaped or flattened .
Vegetative filaments 54-62 u in diameter.....*S. majuscula*
Vegetative filaments 70-160 u in diameter.
Zygospores 102-115 u in diameter.....*S. maxima*
Zygospores 144-15 u in diameter.....*S. crassa*
Fruiting cells distinctly swollen.
One spiral in each cell.....*S. intermedia*
More than one spiral in each cell.
Two spirals.
Dense, close 3-4 turns.....*S. adnata*
Looser, 2-3 turns.....*S. dubia*
Four spirals. Cells 35-40 u wide.....*S. fluviatilis*

Septa between the cells folded back, replicate.
Membrane of Zygospore smooth.
One (rarely two) spirals in a cell.
Vegetative cells 8-12 u in diameter.....*S. tenuissima*
Vegetative cells 13-18 u in diameter.....*S. inflata*
Vegetative cells 11 u or more in diameter.
Diameter *Zygospores* 26-30 u.....*S. weberi*
Diameter *Zygospores* 30-33 u.....*S. laxa*
Diameter *Zygospores* 20-33 u.....*S. grevilleana*
Diameter *Zygospores* 40-48 u.....*S. quadrata*
Three spirals in a cell.....*S. insignis*
Membrane of the Zygospore areolate or punctate.....*S. calospora*

106. *S. porticalis* Cleve. *(S. quinina).*
Iowa City. Hobby.
Ames. Bessey.
Eagle Grove. Hewitt's Pond. Buchanan.

107. *S. porticalis* var. *alpina* Kuetz.
Iowa City. Hobby.

108. *S. longata* Kuetz.
Iowa City. Hobby.
Ames. Bessey.
Eagle Grove. Pond. Buchanan.

109. *S. varians* Kuetz.
Iowa City. Hobby.

110. *S. communis* Kuetz.
Iowa City. Hobby.

111. *S. decimina* Kuetz.
Iowa City. Hobby.
Eagle Grove. Pond. Buchanan.

112. *S. rivularis* Rabenh.
Iowa City. Hobby.

113. *S. nitida* Link.
Iowa City. Hobby.
Eagle Grove. In pond among lily pads. Buchanan.

114. *S. jugalis* Kuetz.
Eagle Grove. Floating in Hewitt's Pond. Buchanan.

115. *S. setiformis* Kuetz.
Eagle Grove. Jenning's Pond. Buchanan.

116. *S. majuscula* Kuetz.
Iowa City. Hobby.
Ames. Bessey.
Eagle Grove. Hewitt's Pond. Buchanan.

117. *S. maxima* Wittr.
Eagle Grove. Jenning's Pond. Buchanan.

118. *S. crassa* Kuetz.
Iowa City. Hobby.

119. *S. intermedia* Rabenh.
Iowa City. Hobby.

120. *S. adnata* Kuetz.
Iowa City. Hobby.

121. S. dubia Kuetz.
Iowa City. Hobby.

122. S. fluviatilis. Hilse.
Iowa City. Hobby.

123. S. tenuissima Kuetz.
Eagle Grove. Slough, amid Utricularia. Buchanan.

124. S. inflata Rabenh.
Iowa City. Hobby.

125. S. weberi Kuetz.
Iowa City. Hobby.

126. S. laxa Kuetz.
Iowa City. Hobby.

127. S. grevilleana Kuetz.
Iowa City. Hobby.
Eagle Grove. Floating in Hewitt's Pond. Buchanan.

128. S. quadrata Petit.
Ames. Buchanan.
Eagle Grove. Buchanan.

129. S. insignis Kuetz.
Iowa City. Hobby.

130. S. calospora Cleve. *(S. protecta).*
Ames. Bessey.
Eagle Grove. Jenning's Pond. Buchanan.

Family II.

Desmidiaceae.

KEY TO THE SUBFAMILIES.

Cell wall unsegmented. Point of division of cells indefinite, and unknown previous to the actual division.....I. Sacodermae
Cell wall segmented. Cell division of a fixed type, with interpolation of the younger halves between the old ones.....II. Placodermae

Subfamily I.

Saccodermae.

1. *Spirotaenia.*

131. S. condensata Breb.
Eagle Grove. Slough. Buchanan.

Subfamily II.

Placodermae.

KEY TO THE TRIBES.

Cells of moderate length, straight, cylindrical, sometimes with a slight median constriction. Cell wall with or without pores. Point of division of cells often variable. The cell often arrives at maturity by periodical growth .....I. Penieae

Cells elongate, generally curved; symmetrical in one longitudinal plane only. Cell wall commonly with pores. Points of division regularly placed in the middle region of the cell.....II. Closterieae
Cells exhibit a great variety of form, and the cell wall consists of two thin, firm layers with pores. There is no periodical growth, the cell becoming adult immediately after division by the mature growth of the semi-cell .....III. Cosmarieae

Tribe I.

Penieae.

1. *Penium.*

132. *P. closterioides* Ralfs.
East Okoboji, in stagnant pool by water's edge. Buchanan.
Ames. Roadside pool. Buchanan.

Tribe II.

Closterieae.

1. *Closterium.*

KEY TO THE SPECIES.

Cells more or less cylindrical, slightly bent, ends scarcely or not at all tapering. Diameter, 50-55 u.....*C. lanceolatum*
Cells slightly bent, back or dorsum slightly convex, opposite almost straight, distinctly tapering.
Diameter cells 35-62 u.....*C. acerosum*
Diameter cells 80-110 u.....*C. lunula*
Cells more or less curved, dorsal and ventral margins both convex, arched in the same direction, ends sensibly tapering, lunate.
Diameter cell 14 u.....*C. jenneri*
Diameter cell 18-25 u.....*C. dianae*
Diameter cell 25-28 u.....*C. acuminatum*
Cells falcate incurved, ventral margin swollen, ends sensibly tapering, 36-55 u in diameter.....*C. moniliferum*

133. *C. lanceolatum* Kuetz.
Iowa City. Hobby.

134. *C. acerosum* Ehrenb.
Eagle Grove. Jenning's Pond. Buchanan.
Eagle Grove. Hewitt's Pond. Buchanan.

135. *C. lunula* Nitzsch.
Iowa City. Hobby.

136. *C. jenneri* Ralfs.
Eagle Grove. Jenning's Pond. Buchanan.
Eagle Grove. Slough. Buchanan.

137. *C. dianae* Ehrenb.
Eagle Grove. Slough, amid Utricularia. Buchanan.

138. *C. acuminatum* Kuetz.
Eagle Grove. Slough, amid decaying rushes. Buchanan.

139. C. moniliferum Reinsch.

Ames. Bessey.
Ames. Stagnant pool, by railroad. Buchanan.
Eagle Grove. Stagnant pool by railroad. Buchanan.
Eagle Grove. In barrel for fire protection. Buchanan.
Eagle Grove. Slough. Buchanan.
Eagle Grove. Jenning's Pond. Buchanan.

Tribe III.

Cosmariae.

KEY TO THE GENERA.

Cells elongated and cylindrical; constriction slight.
Base of semi-cells plicate.....1. Docidium
Base of semi-cells plane.....2. Pleurotaenium
Cells relatively short, commonly depressed or radiating, constriction usually deep.
Cells compressed (at right angles) to the plane of the front protuberance moderately lobed .....3. Euastrum
Cells very compressed and deeply lobed or incised.....4. Micrasterias
Cells with a more or less entire margin, often furnished with warts or spines.
Cell wall smooth, granulate, verrucose, etc. Central protuberance present or absent .....5. Cosmarium
Cell wall with regularly arranged spines, commonly in pairs. Central protuberance always present.....6. Xanthidium
Cell wall without central protuberance with spines....7. Arthrodesmus
Cells from the vertical view commonly radiating triangular, quadrangular up to 11 radiate.....8. Staurastrum

1. *Docidium.*

140. D. Baculum Breb.

Ames. Pond. Buchanan.

2. *Pleurotaenium.*

141. P. trabeculae (Ehrenb.) Naeg.

Eagle Grove. Slough amid Utricularia. Buchanan.
Eagle Grove. Slough amid decaying rushes. Buchanan.

3. *Euastrum.*

142. E. binale (Turp.) Ralfs.

Eagle Grove. Slough. Buchanan.

4. *Micrastorias.*

143. M. truncata (Corda) Breb.

Eagle Grove. Slough. Buchanan.

5. *Cosmarium.*

KEY TO THE SPECIES.

Single chloroplast (with one pyrenoid) in semi-cell.
Semi-cell semi-orbicular.....*C. leve*
Semi-cell subquadrate, six angled.....*C. meneghinii concinnum*

Two chloroplasts (with two pyrenoids) in each semi-cell.
Membrane smooth or lightly punctate.
Nine crenae to semi-cell.....*C. undulatum*
Ten-fourteen crenae to semi-cell.....*C. undulatum crenulatum*
Membrane verrucose, rarely heavy punctate.
End of semi-cells broadly rounded.....*C. margaritiferum*
End of semi-cells truncate.
Diameter 35-62 u.....C. botrytis
Diameter 25-30 u.....*C. notabile*

144. C. leve Rabenh.
Fayette. Fink.

145. C. meneghinii var. *concinnum* Rabenh.
Eagle Grove. Slough. Buchanan.

146. C. undulatum Corda.
North Gar Lake. Buchanan.

147. C. undulatum var. *crenulatum.*
Eagle Grove. Slough. Buchanan.

148. C. margaritiferum Menegh.
Ames. Bessey.

149. C. botrytis Menegh.
Iowa City. Hobby.

150. C. notabile Hansg.
Eagle Grove. Slough, amid Utricularia. Buchanan.
Eagle Grove. Slough, decaying rushes. Buchanan.

6. *Xanthidium.*

151. X. antilopaeum Kuetz.
Eagle Grove. Slough. Buchanan.

7. *Arthrodesmus.*

152. A. Incus (Breb.) Hass.
Eagle Grove. Slough. Buchanan.

8. *Staurastrum.*

KEY TO SPECIES.

Very small, diameter 16-25 u.....*S. pygmaeum*
Larger.
End view circular.....*S. margaritaceum*
End view triangular.....*S. polymorphum*
End view 4-6 angled.....*S. crenulatum*

153. S. pygmaeum Breb.
Eagle Grove. Slough amid Urticularia. Buchanan.

154. S. margaritaceum Menegh.
Eagle Grove. Slough. Buchanan.

155. S. polymorphum Breb.
Eagle Grove. Slough amid Utricularia. Buchanan.
Eagle Grove. Slough amid decaying rushes. Buchanan.

156. S. crenulatum (Delp) Naeg.
Eagle Grove. Slough amid Urticularia. Buchanan.

Order IX.

Protococcoideae.

KEY TO FAMILIES.

Unicellular or multicellular, sometimes pseudoparenchymatous. Some or all of the cells furnished with hairs or bristles, either simple or sheathed and often mucous. Multiplication by division of cells in two directions. Reproduction by two or four ciliated gametes.....I. Chaetopeltidae
Unicellular or consisting of a definite coenobium of cells, which are either united by protoplasmic processes or enclosed within the swollen mucous mother cell wall. All the cells are ciliated and motile in their vegetative stage .....II. Volvocaceae
Unicellular, cells solitary, differentiated into base and apex, epiphytic on other algae; chloroplast parietal with one pyrenoid. No vegetative division. Reproduction solely by zoogonidia formed by successive divisions of the contents of a mother cell.....III. Characieae
Unicellular and globular, or of short ramified few celled filaments, never attenuated into hairs; often, pseudoparenchymatous. Chloroplasts one or several, parietal, with or without pyrenoids. Multiplication by division in two or three directions, and more rarely by zoogonidia. Cell wall very firm .....IV. Pleurococcaceae

Family I.

Chaetopeltideae.

1. *Chaetosphaeridium.*
157. *C. globosum* (Nordst) Klebahn.
Eagle Grove. Pond. Buchanan.

Family II.

Volvocaceae.

KEY TO SUBFAMILIES.

Unicellular, not united into coenobia.....I. Chlamydomonadeae
Cells united into coenobia.....II. Volvoceae

Subfamily I.

Chlamydomonadeae.

1. *Chlamydomonas.*
158. C. DeBaryana Gorosch.
Ames. In a puddle after rain. Buchanan.

Subfamily II.

Volvoceae.

KEY TO THE GENERA.

Coenobium flat, 16 cells.....1. Gonium

Coenobium spherical.
Of eight to thirty-two cells.
Isogamous .....2. Pandorina
Heterogamous .....3. Eudorina
Of several thousand cells.....4. Volvox

1. *Gonium.*
159. G. pectorale Muell.
Ames. Bessey.
Ames. Aquarium. Buchanan.
Ames. Rain water pond. Buchanan.

2. *Pandorina.*
160. P. morum (Muell) Bory.
Ames. Bessey.
Ames. Aquarium. Buchanan.
Ames. Near Ontario in pond. Buchanan.

3. *Eudorina.*
161. E. elegans Ehrenb.
Fayette. Fink.

4. *Volvox.*
162. V. globator (L.) Ehrenb.
Iowa City. Hobby.
Ames. Bessey.
Ames. Spring. Buchanan.
Fayette. Fink.
Eagle Grove. Jenning's Pond. Buchanan.
Lower Gar Lake. Buchanan.

Family III.

Characieae.

1. *Characium.*
163. C. naegelii A. Br.
Eagle Grove. Pond near R. R. Buchanan.

Family IV.

Pleurococcaceae.

1. *Pleurococcus.*
164. P. vulgaris Menegh.
Ames. Bessey.
Fayette. Fink.
Grinnell. Fink.
Ames. Buchanan.
Eagle Grove. Buchanan.

Family V.

Hydrodictyaceae.

KEY TO THE SUBFAMILIES.

Coenocytes arranged in form of a net.....I. Hydrodictyeae
Coenocyte arranged in a flat plate.....II. Pediastreae

Subfamily I.

Hydrodictyeae.

Hydrodictyon.

165. H. reticulatum (L.) Lagerh.

Iowa City. Hobby.
Forest City. Common Lime Creek. Shimek.
Sioux City. A. E. Paddock.
Cedar Falls. Buchanan.
Fayette. Fink.

Subfamily II.

Pediastreae.

1. *Pediastrum.*

KEY TO SPECIES.

Peripheral cells with two points.....*P. boryanum*
Peripheral cells with four points.....*P. ehrenbergii*

166. P. boryanum (Turp.) Menegh.

Ames. Bessey.
Eagle Grove. Slough, amid Utricularia. Buchanan.

167. P. ehrenbergii A. Br.

Eagle Grove. Slough, several collections. Buchanan.

Family VI.

Protococcaceae.

KEY TO THE SUBFAMILIES.

Cells elongated, often greatly attenuated and frequently curved. Solitary or loosely associated in colonies. One chloroplast per cell.....I. Selenastreae
Cells globose, ellipsoid or reniform or sublunate. Daughter cells retained in mother cell wall, Several chloroplasts to the cell.....II. Oocystideae
Cells solitary, flattened and angular, with a definite number of angles, or polyhedral. Angles generally furnished with simple or furcate spines.....III. Tetraedrieae

Subfamily I.

Selenastreae.

KEY TO THE GENERA.

Cells ellipsoid or much attenuated, forming more or less definite colonies consisting of a row of cells in one plane.....1. Scenedesmus

Cells elongate and acutely attenuated, often lunate, solitary or loosely grouped in irregular bundles. Cells of moderate length, usually with not more than one pyrenoid .....2. Ankistrodesmus

1. *Scenedesmus.*

KEY TO THE SPECIES.

Cells obtuse rounded at each pole.
No cells with hairs or spines.....*S. bijugatus*
Terminal cell with a hair on each pole.....*S. quadricauda*
Cells usually acute at both ends.....*S. obliquus*—*S. obliquus dimorphus*

168. S. bijugatus (Turp.) Kuetz.
Eagle Grove. Slough, amid Utricularia. Buchanan.

169. S. quadricauda (Turp.) Breb.
Fayette. Fink.
Grinnell. Fink.
Ames. Bessey.

170. S. quadricauda var. *abundans.*
Fayette. Fink.
Grinnell. Fink.

171. S. obliquus Kuetz.
Fayette. Fink.
Grinnell. Fink.
Ames. Aquarium. Buchanan.

172. S. obliquus var. *dimorphus* Rabenh.
Fayette. Fink.
Grinnell. Fink.
Aquarium, Ames. With peat from northern Iowa. Buchanan.

2. *Ankistrodesmus (Rhaphidium).*

KEY TO THE SPECIES.

Cells 16-24 times as long as broad.
Chloroplast without pyrenoid.....*A. falcatus*
Chloroplast with pyrenoid.....*A. falcatus aciculare*
Cells 3-6 times as long as broad.....*A. convolutus*

173. A. falcatus (Corda) Ralfs *(R. polymorphum).*
Fayette. Fink.
Grinnell. Fink.

174. A falcatus var. *acicularis* (A. Br.) West.
Fayette. Fink.
Boone. Horse trough. Buchanan.
Eagle Grove. Slough. Buchanan.

175. A. convolutus (Rabenh.) West.
Fayette. Fink.

Subfamily II.

Oocystideae.

1. *Palmellococcus.*

176. P. miniatus (Kuetz.) Chodat.
Ames. Under limestone arch, College. Buchanan.

Subfamily III.

Tetraedrieae.

1. *Tetraedron.*

177. Tetraedron longispinum (Perty) Hausg.
Ames. Bed of Creek below filter beds. Buchanan.

Family VII.

Palmellaceae.

KEY TO THE SUBFAMILIES.

Cells irregularly grouped in a structureless mass of mucus....I. Palmelleae
Cells grouped in four or sometimes irregularly disposed at the periphery of a structureless mass of mucus. Each cell with two pseudocilia.....
.....II. Tetrasporeae
Cells grouped in twos or fours within a lamellose mucous investment.....
.....III. Gloeocystideae

Subfamily I.

Palmelleae.

1. *Palmella.*

178. P. mucosa Kuetz.
Boone. Ledges. In slow stream. Buchanan.

Subfamily II.

Tetrasporeae.

1. *Tetraspora.*

179. T. lubrica Ag.
Iowa City. Hobby.
Ames. Bessey.
Boone. Ledges. Buchanan.
Ames. College spring. Buchanan.

180. T. gelatinosa (Vauch) Desv.
Iowa City. Hobby.

Subfamily III.

Gloeocystideae.

1. *Gloeocystis.*

181. G. gigas (Kuetz) Lagorh.
Ames. Buchanan.

DISTRIBUTION OF THE ALGAE IN GENERAL. Although conditions in Iowa are not generally suitable for the development of a large number of species of algae, yet there have been to date one hundred eighty species described as found within the state. Some of these forms are very local in their distribution, others are found everywhere.

One of the groups of algae having the widest and most general distribution is undoubtedly the Diatomaceae. When these are finally worked up for the state there will undoubtedly be found several hundred of species at least. They are found everywhere, on moist soil in stagnant and running water, wherever there is a fair and constant supply of moisture.

Next in abundance to these forms come the blue green algae or Myxophyceae. These are found likewise ubiquitously. Although their total number of species is not as great as some of the other groups, undoubtedly they surpass the remainder many times over in actual number of individuals.

The genus Spirogyra with twenty-five reported species is the largest with respect to number of species, although it is believed that some of the genera of Desmids will become a close second on a further study of the flora of some sections of the state. It has frequently been stated that the Desmids are not found in numbers in the state. This certainly is not true of the marshy districts in the northern part of the state where in one collection some thirteen species of desmids were secured. These, however, are very local in their distribution. Undoubtedly these sloughs in the northern counties of the state contain a very rich desmid flora, especially those that consist largely of peat.

Some of these algae are of some little importance in that they grow upon the mud along streams, sometimes in dense mats shading the ground, and retaining the moisture and making possible the existence of phanerogamic flora which could not exist otherwise.

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