SEASONAL ALGAL FLORA ON THE CAMPUS OF CATHOLIC COLLEGE, GUTHRIE, OKLAHOMA[1]

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INTRODUCTION

Almost nothing was known about the algae of Oklahoma before Taft undertook a survey of the state to determine as far as possible the extent of its algal flora. His early work was limited to specific families and resulted in a series of reports concerning the Desmidiaceae (1931, 1934, 1937a), the Oedogoniaceae (1935a), the Vaucheriaceae (1937b), the Zygnemataceae (Transeau, Tiffany, Taft, and Li 1934 which contains only records of new species described by Transeau and Taft), the Chlorophyceae and Heterophyceae (1935b), and "Additions to the Algae of Oklahoma" (1940). In addition to these publications there is a report by Leake (1939) describing motile cells of *Basicladia crassa*. These apparently comprise the work on Oklahoma algae.

Although Taft's collections roughly included the whole state there were none reported from Logan County. His last paper (1940) brought the total number to 458 species, varieties, and forms, indicating that the algal flora is exceptionally rich and diverse in nature.

The 70-acre campus of Catholic College, situated about three miles west of Guthrie, Logan County, has an elevation of about 1120 feet at the highest point. Topographical maps of this central region have not been made.

The rocks exposed in the county belong to the Enid group of Permian red beds (Bale 1928). The Garber sandstone forms by far the greater part of the exposed rocks in this area. The Garber sandstone has been divided by Aurin, Officer, and Gould (1926) into two members, the Lucien shale, made up chiefly of red shales with several more or less lenticular sands and one rather prominent red sandstone at the base about 250 feet thick, and the Hayward sandstone, which consists chiefly of red massive sandstone, completely cross-bedded and interstratified with shales and sandy shales. The thickness of this sandstone is about 350 feet. In general, the structural geology of the surface formations in Logan County is monoclinal with a dip of about 40 feet per mile to the northwest.

[1] A resume of a thesis submitted to the Graduate Faculty of the University of Oklahoma in partial fulfillment of the requirements for the degree of Master of Science. Typewritten copies of the unabridged dissertation are on file at the University. This contains a table of data on the periodicity in the occurrence of the various types of algae in the several bodies of water investigated, a "Taxonomic Tabulation" of the forms found, maps of Logan County and the Campus of Catholic College, 61 pen-and-ink illustrations of species identified, and an extensive bibliography on algology.

Weather data for Logan County were obtained from the U. S. Yearbook of Agriculture for 1941. Temperature records over a period of 40 years show a wide range (—24° F to 116° F), with a January average of 38.8° F and a July average of 82.4° F. Records for 38 years give April 2 as the average date of the last killing frost in the spring, and October 30 as the average date of the first in the fall. The usual growing season has an extent of 211 days.

Precipitation statistics for 39 years show that January is the driest month, having an average of 1.10 inches. Other low averages occur in February, 1.22 inches, and December, 1.47 inches. The maximum precipitation of 4.80 inches occurs in May, with April, June, September, and October having more than 3 inches of rain each. The annual average precipitation for Logan County is 32.34 inches.

In addition to three aquaria in the biology laboratory, there were eight principal collecting stations, which will be designated as: 1, gold fish pond; 2, stock tank; 3, duck pond; 4, windmill pond; 5, septic tank pond; 6, head of creek; 7, along the creek; 8, below the dam; and, 9 and 10, the aquaria.

The gold fish pond (Station 1), constructed of concrete, is about six feet wide, fifteen feet long, and about four feet deep at the deeper end and one and a half at the shallow end. It is well stocked with gold fish which remain there throughout the year, water lilies, and other large water plants. This pond has been in use for twenty years, the water level being maintained by the addition of water from a deep well. Although there was an abundance of *Spirogyra* growing on the sides of this pool it was never found to contain spores. Occasionally, *Oscillatoria* and other genera of Cyanophyceae were present in the collections but to no very great extent.

Station 2, the stock tank, is about three feet deep and about five feet in diameter and is kept filled with well water. Numerous unicellular and colonial forms have been found here, varying throughout the year.

The duck pond (Station 3), formed by an earthen dam, is 25 to 30 feet in diameter, and when full is about four feet deep on the west side. This station has been the best source of plankton and has shown several interesting changes throughout the year.

Below the barnyard, near the first woods, is a pond partly filled with natural water and partly with the overflow water from the windmill tank nearby (Station 4). Here *Chlamydomonas*, *Trachelomonas*, and other unicellular forms were found. *Stigeoclonium* was the only filamentous form found. During the winter this pond gradually dried up, but after the spring rains, the usual forms were found again.

Perhaps the largest body of water from which collections were made is the large pond formed by water flowing from the septic tank (Station 5). Willow, elm, and persimmon trees grow around three sides of this pond. It has yielded by far the greatest variety of algae, at times showing almost a complete turnover in two weeks time (Table I).

The three remaining stations are on the spring-fed creek in a deep ravine in the second woods. The creek arises here and eventually flows into the Cimarron River 3.5 miles to the north. Here the vegetation is of the oak-juniper type with red buds and a few elms. At the head of the creek is a small pool (Station 6), the most prominent source of diatoms throughout the year. Several filamentous algae were found here also. Diatoms occurred all along the creek bed; usually *Spirogyra* could be found floating in the slowly moving clear water (Station 7). During the years

of extreme drouth this creek was never dry, water always flowing from the many small springs along its course.

Several years ago a brick and concrete dam was built across the creek; some time later an opening was made in it, so that water flows continuously through it now. Below the dam are wide flat sandstone rocks, constantly wet with water trickling down from springs in crevices higher up the sides of the ravine (Station 8). A variety of filamentous forms and many diatoms are found here. In the middle of the creek bed, the rocks dip sharply and increase the speed of the flowing water; many smaller forms of algae are found growing epiphytically upon moss in this water.

COLLECTIONS AND METHODS

Collections were made regularly every two weeks from June 20, 1942, to April 21, 1943. Because the excessive rainfall in May 1943 completely washed away all the available algae no collections were made in that month, but some material was gathered in June and July 1943. Occasionally the septic tank pond and the windmill pond were so muddied by stock wading in them that it was impossible to make suitable collections.

Materials were collected from floating and submerged masses of algae, scraped from wet rocks, and taken from the surfaces and bottoms of the various bodies of water. Most of the collections containing fruiting species were obtained by pipetting material from the bottoms of the ponds and streams. The collections were preserved immediately in small vials containing Transeau's fixative (six parts water, three parts 95 per cent ethyl alcohol, and one part formalin); 675 vials of material were collected.

Permanent mounts were made of vegetative forms of various species and of all species presenting spores and fruiting bodies.

Diatoms were cleared by boiling for 20 to 30 minutes in a 10 per cent nitric acid solution to which had been added a small amount of hydrochloric acid. A small funnel fitted with filter paper was placed in a ring stand and filled with distilled water. When the water had filtered through until its level was a little below the top edge of the filter paper, a small amount of the liquid containing the diatoms was added. As the liquid continued to filter through, more water and more diatom material were added from time to time. After all of the material had been filtered the diatoms were washed into the point of the filter paper by means of a blow bottle. Distilled water was poured into the filter several times and allowed to drain through. After this washing process was completed, the funnel containing the filter paper was placed in a small vial, the point of the filter paper was pierced with a needle, then the cleared diatoms were washed into the vial by means of the blow bottle. After being allowed to settle gradually to the bottom of the vial the specimens were removed with a pipette. Following this process they were mounted permanently in Hyrax.

The vegetative algal maxima in this region correspond with the data given by Taft (1935b), beginning in March and October.

The pH determinations of seven of the stations were made in June 1943. A LaMotte-Kenny Indicator field set was used for making the determinations which were as follows: Station 1, 7.0; Station 2, 6.0; Station 3, 7.4; Station 4, 8.2; Station 5, 8.4; Station 6, 6.8; and Station 8, 7.0. This gives a range in pH of 6.0 to 8.4. Since only one determination of pH was made on the above stations, no attempt was made to study the correlation between the distribution of algal flora and the pH of the habitat.

Representative vials of the collections have been deposited in the herbaria of the University of Oklahoma, the Catholic College at Guthrie, and Monte Cassino Junior College at Tulsa.

DISCUSSION

A total of 135 species and varieties was identified from the collections. Only 12 species of the many Cyanophyceae were determined. One *Chantransia* form of the Rhodophyceae appeared several times but positive identification was impossible. Much of the material was exceedingly rich in diatoms—69 species in 29 genera were noted. Because of time limitations it was impossible to make a complete list.

Nine species of *Spirogyra* were identified from materials collected in August 1942, and March, April, and June 1943. Several other species, found in the vegetative state, were never found producing zygospores.

Oedogonium spores appeared in the collections of April, June, and July 1943. Five species were recognized, although there were several others with immature spores in the material.

Vaucheria geminata (Vauch.) DC. in a fruiting condition was collected in June and August 1942 and in March and April 1943.

Many of the motile forms could not be identified because most of the material had been preserved before it was examined.

Most of the filamentous forms were present during the whole year as were the omnipresent diatoms. Desmids were more abundant during the cooler seasons. Other unicellular forms such as *Trachelomonas*, *Euglena*, and *Chlamydomonas*, as well as colonial forms like *Merismopedia*, *Pediastrum*, and *Pandorina*, had definite maximum periods.

In comparing the species occurring in Oklahoma as listed by Taft (1931, 1934, 1935, 1937) with those discovered in this investigation, several are reported for the first time. Taft did not include the Bacillariophyceae in any of his lists. The writer wishes to add the following species and varieties to the list of Oklahoma algae:

CYANOPHYCEAE

Gleocapsa arenaria (Hass.) Rab.
Spirulina major Kuetz.
Oscillatoria formosa Bory
O. limosa Ag.
Microcoleus vaginatus (Vauch.) Gom.
Schizothrix purpurascens (Kuetz.) Gom.
Anabaena circinalis (Kuetz.) Rab.
Rivularia dura Roth
Gloeotrichia echinulata (J. E. Smith) Richter

CHLOROPHYCEAE

Chlamydomonas epiphytica G. M. Smith
Pandorina morum Bory
Stigeoclonium amoenum Kuetz.
S. nanum (Dillw.) Kuetz.
Chaetopeltis orbicularis Berth.
Rhizoclonium crassipelitum W. & G. S. West
Pithophora Oedogonia (Mont.) Wittr.
Oedogonium hirnii var. *africanum* G. S. West
O. vesicatum (Lyngbye) Wittr.
Spirogyra kaffiritica Transeau
S. tuberculata Lagerheim
S. bicalyptrata Czurda
Golenkinia radiata Chod.
Acanthosphaera Zachariasi Lemm.
Polyedriopsis quadrispina G. M. Smith
Actinastrum gracillimum G. M. Smith
Micratinium pusillum Frensentius
Closterium acerosum var. *elongatum* Breb.
C. macilentum Breb.
C. striolatum Ehr.
Cosmarium meneghinii Breb.
C. nitidulum De Not.
C. ornatum Ralfs
Scenedesmus quadricauda var. *longispina* (Chodat) G. M. Smith

EUGLENOPHYCEAE

Euglena intermedia (Klebs) Schmitz
Phacus acuminatus Stokes
Trachelomonas volvocina Ehr.

BACILLARIOPHYCEAE

Cyclotella Meneghiniana Kuetz.
C. operculata (Ag.) Breb.
Tabellaria fenestrata var. *asterionelloides* Grun.

Fragilaria brevistriata Grun.
F. lapponica Grun.
F. virescens Ralfs
Synedra pulchella (Ralfs) Kuetz.
Asterionella formosa Hass.
Rhiocosphenia curvata (Kuetz.) Grun.
Cocconeis Pediculis Ehr.
C. placentula Ehr.
C. p. var. *euglypta* (Ehr.) Cl.
Navicula affinis (Ehr.)
N. anglica Ralfs
N. cuspidata var. *ambigua* Ralfs
N. dicephala W. Smith
N. fulva (Nitz.) Ehr.
N. gracilis Ehr.
N. parva (Ehr.) Elmore
N. pennata Schmidt
N. radiosa Kuetz.
N. salinarum Grun.
N. viridis Kuetz.
Pinnularia aestuari Cl.
P. mesogongyla (Ehr.) Cl.
P. viridis (Nitz.) Ehr.
Caloneis silicula var. *gibberula* (Kuetz.) Grun.
Neidium affine (Ehr.) Pfitzer
Diploneis elliptica (Kuetz.) Cl.
D. puella (Schum.) Cl.
Stauroneis Smithii Grun.
Amphipleura pellucida Kuetz.
Frustulia interposita (Lewis) DeToni
F. rhomboides var. *saxonica* (Rab.) DeToni
Brebissonia Palmeri Boyer
Gyrosigma Spencerii (Queckett) Cl.
Pleurosigma Spencerii W. Smith
Mastigloia Smithii Thwaites
Gomphonema montanum Schum.
Cymbella amphicephala Naeg.
C. aspera (Ehr.) Cl.
C. prostrata (Berk.) Cl.
C. turgida (Greg.) Cl.
Encyonema ventricosum (Ag.) Grun.
E. prostratum (Berk.) Kuetz.
Amphora ovalis Kuetz.
Cystopleura argus (Ehr.) Kuntze
Nitzschia angustata (W. Smith) Grun.
N. commutata Grun.
N. denticula (Grun.) Cl.
N. dissipata (Kuetz.) Grun.
N. linearis W. Smith
N. thermalis (Ehr.) Grun.
N. vitrea Norman
Hantzschia amphioxys (Ehr.) Grun.
Homoeocladia acularis (Kuetz.) Kuntze
H. intermedia (Hantz.) Kuntze
H. sigmoides (Nitz.) Elmore
Surirella angustata Kuetz.
S. elegans Ehr.
S. fastuosa var. *recens* (A. S.) Cl.
S. f. var. *sentis* (Pant.) Deby.
S. ovalis Breb.
S. ovata var. *crumena* (Breb.) Hust.
S. robusta var. *splendida* Kuetz.
S. spiralis Kuetz.
S. tenera Greg.
Campylodiscus hibernicus Ehr.
Eunotogramma laeva Grun.

This gives a total of 36 species included in the Cyanophyceae, Chlorophyceae, and Euglenophyceae, and 29 genera of the Bacillariophyceae comprising 69 more species.

SUMMARY

Algal collections were made from 10 distinct stations on the campus of Catholic College, Guthrie, Oklahoma, every two weeks from June 20, 1942, through July 11, 1943; 135 species and varieties were recognized. Diatoms were always present along a creek during the whole collecting period, and in other places during the fall and spring. Filamentous forms invariably found were *Spirogyra, Oedogonium, Vaucheria,* and *Rhizoclonium.* Unicellular and colonial forms varied in occurrence and distribution according to station and season. Genera and species identified are listed in a taxonomic outline. Much material was unidentified because no spores were found. Sixty-nine species of diatoms and 36 species representing the Cyanophyceae, Chlorophyceae, and Euglenophyceae have been added to the Oklahoma list by this investigation.

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