A STUDY OF THE ALGAE OF A FRESHWATER STREAM

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The algae of the state of Illinois have received little attention from investigators. The most extensive investigations are undoubtedly those of Transeau on the algae of Charleston and vicinity. Eddy (1925) has studied to some extent the algal succession of a stream in various stages of development near Muncie. No other definite study of any given area has been made. Since algae form an integral part of any flora it seems strange that more attention has not been given them.

The investigation here recorded deals with a small freshwater stream which empties into the Salt Fork river just north of Urbana. The stream consists of a lower cutting portion with a fairly rapid current and an upper portion in which there was little or no movement, formed by log dams. The stream is fed by springs keeping the water fairly fresh at all seasons.

During the dry period of the summer of 1926 the lower part of the stream completely dried up for about a week. Later on during the periods of abundant precipitation the water rose so high as to practically wash out the majority of the algae. However the algae were soon present again in great abundance following periods of this nature. Such periods were always of short duration.

Collection and Identification of Algae.*

Collections of algae were made between April 13, 1926 and April 1, 1927. In all collections were made on twenty different dates, at least one being made every month with the exception of January. In order that the collecting should not be entirely indiscriminate the stream was divided into stations on the basis of varying conditions. Repeated collections were then made from each station on the dates recorded in the table.

*The authors wish to express their appreciation to Dr. Stella M. Hague for aid in determination of some of the forms.

	Running Water																			
	1926																1927			
	Apr. 13	Apr. 20	Apr. 27	May 4	May 11	May 18	May 25	June 8	June 18	June 23	July 7	July 20	Aug. 17	Sept. 20	Oct. 12	Nov. 16	Dec. 16	Feb. 8	Mar. 11	Mar. 31
Myxophyceae																				
Coccogonales																				
Chroococcaceae																				
Synechocystis																				
S. aquatilis	—	—	—	—	—	—	—	—	—	—	—	—	r	—	—	—	—	—	—	—
Merismopedium																				
M. convolutum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	r	—	—	—
M. glaucum	—	—	—	—	—	—	—	—	—	—	—	—	r	—	—	—	—	—	—	—
Hormogoniales																				
Oscillatoriaceae																				
Oscillatoria																				
O. limosa	—	a	—	—	a	s	—	—	r	—	—	—	—	—	—	—	—	r	r	c
O. curviceps	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. ornata	—	[illegible]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. geminata	—	r	—	—	—	—	—	—	—	—	—	—	c	—	—	—	—	—	—	—
O. formosa	—	—	—	—	—	—	—	—	—	—	—	—	r	—	—	—	—	—	—	—
O. princeps	—	—	—	—	r	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. tenuis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. chlorina	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. acuminata	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. chalybea	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. minnesotensis	—	—	—	—	a	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. amphibia	—	—	—	—	—	—	—	—	—	—	—	—	c	—	—	—	—	—	—	—
O. subtelissima	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. sancta	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. subsalsa	—	—	—	—	—	—	—	—	—	—	—	—	r	—	—	—	—	—	—	—
O. amoena	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. agardii	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. animalis	—	—	—	—	—	—	—	—	—	—	—	r	—	—	—	—	—	—	—	—
Spirulina																				
S. major	—	—	—	—	—	—	—	—	—	—	—	s	—	—	—	—	—	—	—	—
S. nordstettii	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Microcoleus																				
M. sp.	—	—	—	—	—	—	—	—	r	s	—	r	—	—	—	—	—	—	—	—

	Stagnant Water																			
	1926																1927			
	Apr. 13	Apr. 20	Apr. 27	May 4	May 11	May 18	May 25	June 8	June 18	June 23	July 7	July 20	Aug. 17	Sept. 20	Oct. 12		Dec. 16	Feb. 8	Mar. 11	Mar. 31
Myxophyceae																				
Coccogonales																				
Chroococcaceae																				
Synechocystis																				
S. aquatilis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Merismopedium																				
M. convolutum	—	—	—	—	—	c	c	c	c	c	c	c	—	c	c	c	—	—	s	s
M. glaucum	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hormogoniales																				
Oscillatoriaceae																				
Oscillatoria																				
O. limosa	c	a	a	c	s	s	r	—	—	—	—	—	—	—	—	r	r	—	s	c
O. curviceps	—	s	s	r	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. ornata	—	—	s	—	—	—	—	c	—	—	—	—	—	—	—	—	—	—	—	—
O. geminata	—	—	—	c	s	—	—	s	—	r	r	r	—	—	r	—	—	—	—	—
O. formosa	—	—	—	s	—	c	—	—	—	—	—	—	—	—	—	—	—	—	—	—
O. princeps	—	—	—	—	a	a	a	a	a	a	a	a	a	a	c	s	r	r	—	r
O. tenuis	—	—	—	—	c	s	c	r	—	r	—	—	—	—	—	—	—	r	r	—
O. chlorina	—	—	—	—	s	—	—	s	—	s	—	—	—	—	—	—	—	—	—	—
O. acuminata	—	—	—	—	a	c	—	—	c	—	—	—	—	—	—	—	—	—	—	—
O. chalybea	—	—	—	—	—	c	c	c	—	s	—	—	—	s	—	—	—	—	—	—
O. minnesotensis	—	—	—	—	—	c	—	—	—	—	—	—	r	—	—	—	—	—	—	—
O. amphibia	—	—	—	—	—	—	c	—	—	—	r	r	—	—	—	—	—	—	—	—
O. subtelissima	—	—	—	—	—	—	—	—	c	—	—	—	—	—	—	—	—	—	—	—
O. sancta	—	—	—	—	—	—	—	—	—	s	—	—	—	—	—	—	—	—	—	—
O. subsalsa	—	—	—	—	—	—	—	—	—	—	r	—	s	s	r	—	—	—	—	—
O. amoena	—	—	—	—	—	—	—	—	—	—	r	—	—	—	—	—	—	—	—	—
O. agardii	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	c	—	—
O. animalis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Spirulina																				
S. major	—	—	s	s	r	a	s	s	r	s	—	—	—	—	—	—	—	—	—	—
S. nordstettii	—	—	—	—	—	r	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Microcoleus																				
M. sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Nostocaceae																																								
Anabaena																																								
A. inaequalis	a	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	a	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
A. variabilis	–	–	–	–	–	–	–	–	–	–	–	a	a	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Scytonemaceae																																								
Plectonema																																								
P. tomasinanum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–
CHLOROPHYCEAE																																								
ISOKONTAE																																								
Protococcales																																								
Palmellaceae																																								
Tetraspora																																								
T. lubrica	–	–	c	c	c	–	–	–	–	–	–	–	–	–	–	–	–	r	c	c	–	c	c	s	–	–	–	–	–	–	–	–	–	–	–	–	–	–	c	c
Autosporaceae																																								
Scenedesmus																																								
S. obliqua	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	c	–	–	–	–	–	–	–	–	–	–
Siphonales																																								
Vaucheriaceae																																								
Vaucheria																																								
V. spp	–	–	–	a	a	c	s	–	c	r	–	a	–	–	–	–	–	a	c	c	c	–	–	c	–	c	–	–	r	s	–	–	–	–	–	s	–	r	s	c
Siphonocladiales																																								
Cladophoraceae																																								
Cladophora																																								
C. glomerata callicoma	–	–	s	s	c	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	c	a	–	c	a	c	c	c	–	c	c	c	c	–	c	c
C. crispata	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	c	–	–	–	–	–	–	–	–	–	–	–	–
C. keutzingeana	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	s	–	–	–	–	–	–	–
Ulotrichales																																								
Ulotrichaceae																																								
Stichococcus																																								
S. subtillis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	s	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S. spp	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	r	–	r	–	s	–	–	–	–	–	r	–	–
Chaetophoraceae																																								
Chaetophora																																								
C. attenuata	–	–	–	–	s	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	r	–	r	–	–	–	–	–	–	–	–	–	–
C. elegans	–	–	–	–	–	c	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	a	r	c	–	s	–	–	–	–	–	–	–	–
Draparnaldia																																								
D. plumosa	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	c	c	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Stigeoclonium																																								
S. stagnatile	–	a	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	a	a	–	–	–	–	–	–	–	–	–	–	–	–	–	–	r	–	–	–	c	a
S. subsecundum	–	–	–	–	a	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Microthamnion																																								
M. keutzingeanum	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	r	–	–	–	–	–	–	r	–	–
Aphanochaetaceae																																								
Aphanochaete																																								
A. repens	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	c	–	–	–	–	–	–	–	–	–	–	–	–
A. sp	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	s	–	–	–	–	–
AKONTAE																																								

	Running Water																				Stagnant Water																			
	1926																	1927			1926																	1927		
	Apr. 13	Apr. 20	Apr. 27	May 4	May 11	May 18	May 25	June 8	June 17	June 23	July 7	July 20	Aug. 17	Sept. 20	Oct. 12	Nov. 16	Dec. 16	Feb. 8	Mar. 11	Mar. 31	Apr. 13	Apr. 20	Apr. 27	May 4	May 11	May 18	May 25	June 8	June 17	June 23	July 7	July 20	Aug. 17	Sept. 20	Oct. 12	Nov. 16	Dec. 16	Feb. 8	Mar. 11	Mar. 31
Conjugales																																								
Zygonemaceae																																								
Mougeotia																																								
M. spp	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	c	c	c	–	–	c	s	s	a	a	c	r	r	–	–	–	–	–	a	s	c	c	a
Spirogyra																																								
S. porticalis	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	c	–	–	–	a	–	–	–	–	–	–	–	–	–	–	–	–	–	a
S. weberi	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	c	–
S. hassallii	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	a	–
S. spp	–	c	–	c	a	c	–	–	–	–	–	s	–	–	–	–	–	a	a	c	a	a	c	a	a	c	c	c	s	c	c	c	s	–	s	c	s	a	a	a
Desmidaceae																																								
Closterium																																								
C. moniliferum	–	s	–	c	s	r	–	–	–	r	–	–	r	–	–	–	–	–	–	–	–	s	–	s	s	s	c	r	r	r	r	–	–	–	–	–	–	–	–	–
C. acerosum	–	–	–	–	s	–	–	–	–	c	–	–	–	–	–	–	–	–	–	–	–	–	–	s	–	–	r	r	r	–	–	–	–	–	–	–	–	–	–	–
C. spp	–	–	–	–	–	s	–	–	–	–	–	–	c	–	–	–	–	–	–	c	–	–	–	–	–	s	–	s	–	r	–	–	–	–	–	c	s	s	c	c
Mesotaenium																																								
M. sp	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	c	c	–	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
STEPHANOKONTAE																																								
Oedogoniales																																								
Oedogoniaceae																																								
Oedogonium																																								
O. spp	–	–	–	–	c	–	–	–	r	–	–	–	–	–	–	–	–	–	–	–	r	c	s	s	s	c	c	a	a	a	a	c	a	a	c	c	s	–	r	r
HETEROKONTAE																																								
Heterococcales																																								
Tribonemaceae																																								
Tribonema																																								
T. bombycina	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	a	c
T. spp	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	c	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	a	a	c

For purposes of determination of species it was necessary to bring the collections to the laboratory since field identification of algae is practically impossible. Only in a very few cases can an algae be placed in the genus to which it belongs without microscopic examination.

All forms found have been placed in their respective genera and a good number of specific determinations have been made. However, the latter was not possible in all cases as all the algae were not at the stage necessary for specific diagnosis. Time did not permit the culture of these forms for identification purposes.

Results.

The results are imbodied in the following table. This table has been divided into two sections, the first listing the algae found in running water, the second, those found in stagnant water. Their frequency throughout the period is designated as follows: (a) abundant, (c) common, (s) scarce, (r) rare, and (—) none found. West's scheme of classification has been followed and the algae are listed according to it.

An examination of the table reveals several interesting things. In the first place the number of species and the total number of algae is greater at all seasons of the year in stagnant water than in running water. This is natural enough and is what one would expect. Also, it is quite probable that several of the species found in the running water are not normally found there but in this case have washed in from the stagnant portion of the stream and were caught in passage through the running portion.

Most of the species present in the running water were also present in the stagnant portion. Usually they were much more abundant in the latter place. A few forms, however, were more abundant in running water as *Tetraspora lubrica, Stigeoclonium* spp., and *Vaucheria* spp. *Drapernaldia plumosa* was found only in running water.

Secondly the table reveals a rather definite seasonal succession. Transeau[1] in treating of the periodicity of algae divides them into six groups: 1. Winter annuals, 2.

[1]E. N. Transeau. The periodicity of freshwater algae. Am. Jour. Bot. 3:121-133. 1915.

Spring annuals, 3. Summer annuals, 4. Autumn annuals, 5. Perennials and 6. Ephemerals. This same grouping is made use of here as far as possible. The significance of each group is made clear by consulting the table when species are referred to it.

In grouping the algae as indicated above a single species may be considered alone or all the species belonging to one genus may be considered collectively. In some cases as in *Spirogyra* and *Oedogonium* only the latter can be done as specific determinations were rarely possible.

Taking the species of *Oscillatoria* collectively the table shows that they are spring and early summer perennials. In other words the genus *Oscillatoria* is represented throughout the year but the greatest number of species and also total number occur between the middle of April and the first part of July. Considering individual species, *Oscillatoria limosa* is a winter annual, *O. tenuis* a spring annual, *O. princeps* a summer annual or perhaps a summer perennial. Several species are ephemerals while others appear to be spring annuals but cannot be definitely classified as such until more evidence is secured.

The fluctuations in abundance of a single species from date to date is largely due to flooding as previously mentioned. Flooding is a very important factor in determining the distribution and local abundance of algae.

A striking difference is shown between the seasonal abundance of *Spirogyra* spp. and *Oedogonium* spp. *Spirogyra* spp. collectively are winter perennials while *Oedogonium* spp. are summer perennials. In the early spring *Spyrogyra* is the predominant form and in the summer *Oedogonium* is largely the predominant form. Following the predominance of *Spirogyra* spp. and overlapping them and *Oedogonium* spp., *Oscillatoria* spp. especially *O. limosa* and *O. princeps* are largely the predominants. *Mougeotia* spp. and *Tribonema* spp. were associated with the *Spirogyra* spp. as sub-predominants in the seasonal succession.

Although all the species found cannot be definitely collected into perodicity groups the table suggests the following grouping:

1. Winter annuals; *Oscillatoria limosa, Tetraspora lubrica, Stigeoclonium stagnatile, Spirogyra porticalis,* S. spp. and *Tribonema* spp.

2. Spring annuals; *Oscillatoria geminata, O. tenuis, O. acuminata, O. chalybea* and *Spirulina major.*

3. Summer annuals; *Oscillatoria princeps* and *Oedogonium* spp.

4. Perennials; *Merismopedium convolutum* and *Cladophora glomerata callicoma.*

5. Ephemerals; The remaining species either fall into this group or else the evidence is such that it is at present impossible to place them in any particular group.

Summary.

1. The distribution and seasonal succession of algae in a freshwater stream consisting of a lower portion with running water and an upper portion with stagnant water near Urbana, Illinois has been studied.

3. The algal flora of the running water differed from that of the stagnant water in that the total number as well as the variety of species was much smaller in the former case. A few species of attached forms were more abundant in running water than in stagnant water.

4. The annual succession of algae was definite and often very striking, the flora being almost completely changed in relatively short periods.

5. Some algae are of long duration, whereas others are very abundant but only for short periods. On the basis of their periodicity, the algae have been grouped as winter annuals, spring annuals, summer annuals, perennials, and ephemerals.

6. Flooding was one of the greatest factors in the distribution of the algae, especially in the lower part of the stream.