PHYTOPLANKTON FLORA OF NEWFOUND AND WINNISQUAM LAKES, NEW HAMPSHIRE

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Few comprehensive seasonal studies have been made of New England phytoplankton species (particularly in large lakes), and most of these investigations have been restricted to Massachusetts (Auyang, 1962; Croasdale, 1935; Spencer, 1950; Stone, 1900; Wright, 1964) and Connecticut (Hutchinson, 1944; Hylander, 1928; Patrick, 1943; Riley, 1940). Investigations of the freshwater algal flora of New Hampshire have dealt primarily with its rich desmid populations (Cushman, 1930b, c, 1905a, b, c, 1906, 1907a, b, 1908a, b; Hastings, 1892; Whelden, 1942; Wood, 1869). The New Hampshire Fish and Game Department has conducted limited investigations of phytoplankton in conjunction with its biological surveys, but only generic designations were given (Edmundson, 1938; Edmundson and Fuller, 1937; Cole, 1939). As far as we are aware, only two other published accounts describe phytoplankton species from New Hampshire (Collins, 1909, 1912, 1918b; Gustafson, 1942).

The present systematic account of phytoplankton is a portion of a detailed investigation of the composition, periodicity, and abundance of phytoplankton species in relation to the trophic status of Newfound and Winnisquam Lakes, New Hampshire (Gruendling and Mathieson, in press). Newfound Lake is located in Grafton County (Figure 1), while Winnisquam Lake is in Belknap County (Figure 2). Both lakes are preglacial land forms which were slightly modified (mainly deepened) by Pleistocene glaciation (Billings, 1956). The lakes are similar in size, maximum depth, altitude, underlying geology, and certain chemical and physical characteristics. The chief difference between the two lakes is that Newfound Lake is oligotrophic, while Winnisquam Lake is receiving treated sewage

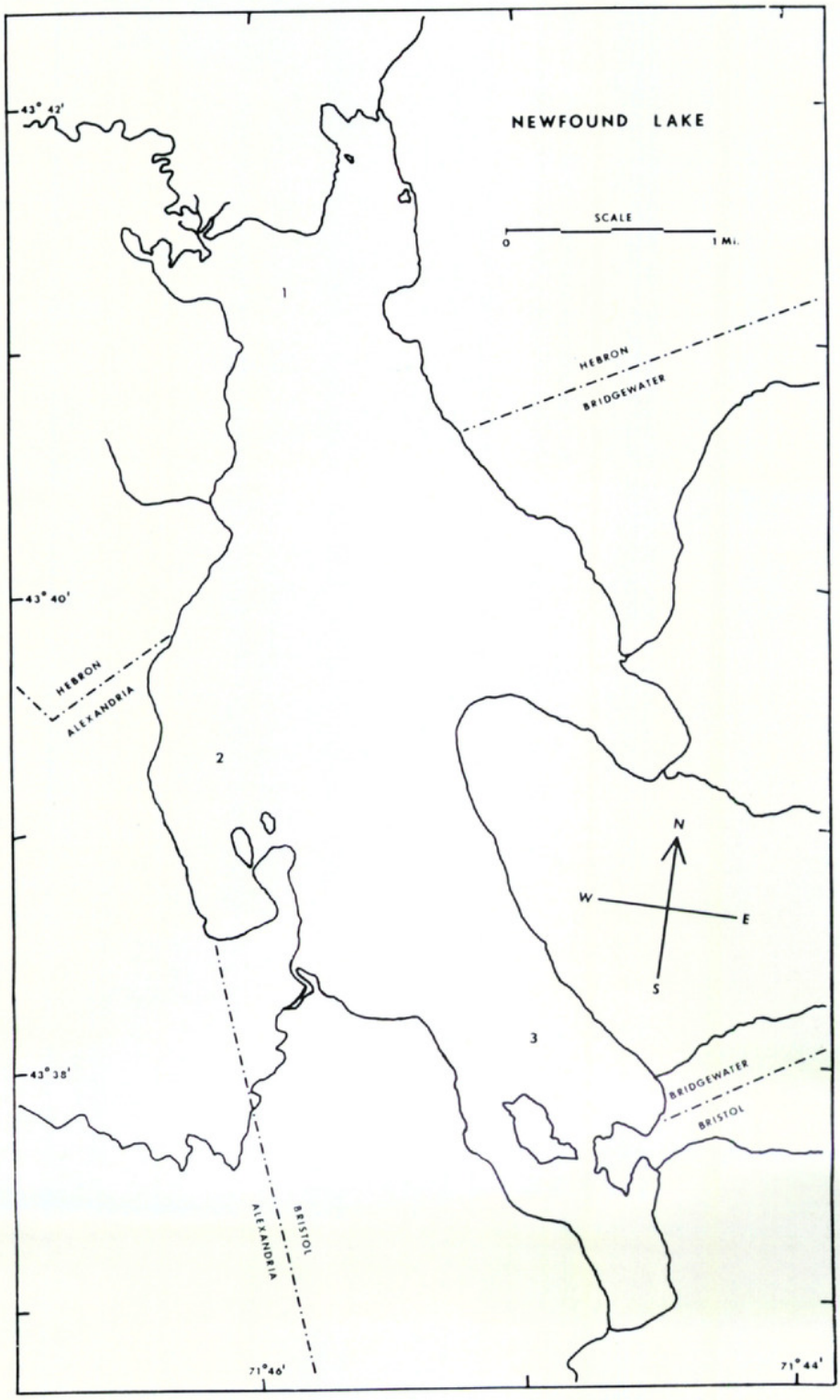

Fig. 1. Map of Newfound Lake.

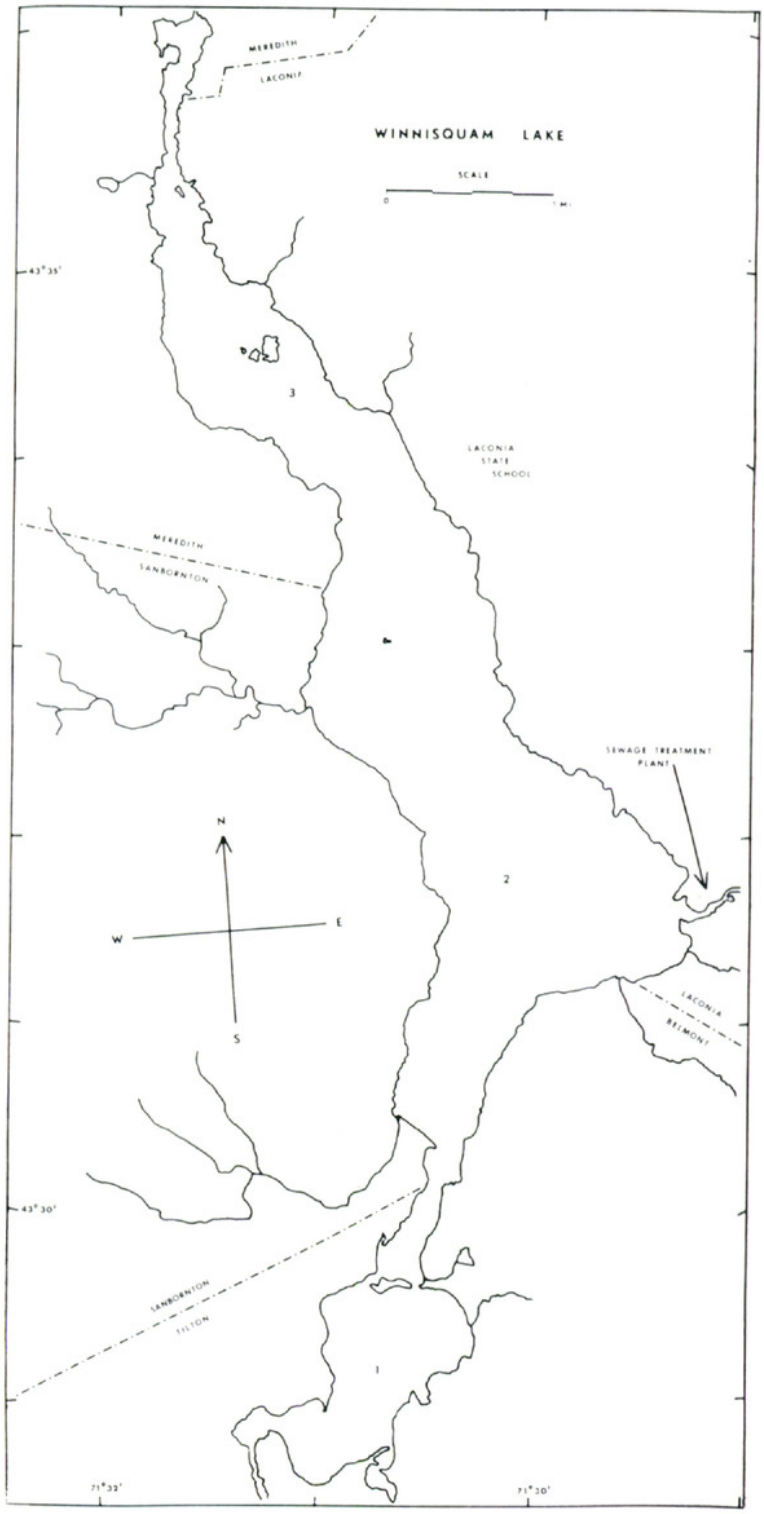

Fig. 2. Map of Winnisquam Lake.

effluent and is in the early stages of eutrophication. The following paper describes the floristic differences between the two lakes and gives specific information regarding the seasonal and vertical distribution of many phytoplankton species. New records for the state of New Hampshire and New England are also designated

Regular collections (approximately fortnightly) were made at Newfound and Winnisquam Lakes from June 25, 1966 to November 10, 1967. Three stations were occupied at each lake and samples were taken from various depths (1, 3, 5, 10, 15, and 20 meters) with a 4-liter Van Dorn water sampler as well as from vertical hauls (20 meters) with a #25 plankton net. Living samples, which were concentrated through a .45 μ millipore filter or a plankton net, were used whenever possible for the identification of organisms. Fixed samples (1% Acid Lugol's Solution) were only used occasionally for identification of species. The generic designations listed by Smith (1950) were used whenever possible. Specific identifications were determined from a variety of sources: Ahlstrom (1937) ; Eddy (1930) ; Huber-Pestalozzi (1938-1961) ; Patrick and Reimer (1966) ; Prescott (1962) ; Smith (1920, 1924) ; Teiling (1967) ; West and West (1904-1912) ; West, West and Carter (1923). Voucher specimens have been deposited in the University of New Hampshire Herbarium.

Synopsis of Species[1]

Cyanophyceae

*__Anabaena circinalis__ Rabenhorst (Figure 7). Common at Winnisquam Lake during the summer; mixed with *Anabaena flos-aquae*, but not as abundant. Akinetes were present throughout the growing season (June to October).

*__Anabaena flos-aquae__ (Lyngbye) De Brébisson (Figure 10). A major constituent of water blooms at Winnisquam Lake in July and August, often occurring in large tufts.

[1] *presumed to be a newly published record for New Hampshire.
**presumed to be a newly published record for New England.

Rarely found at Newfound Lake. Akinetes were present throughout the growing season (June to November).

****Anabaena scheremetievi** Elenkin (Figure 6). Found in small quantities at Winnisquam Lake from August to November. Akinetes were present in all collections.

Aphanizomenon flos-aquae (L.) Ralfs (Figure 11). Present throughout the year at Winnisquam Lake. The largest quantities were found during the summer and fall. Akinetes were only observed from September to November, 1967. During the winter and spring the trichomes were "rafted" while throughout the rest of the year they occurred as single trichomes. Cells were slightly smaller (3.9-5.0 μ in diameter) than those listed by Prescott (1962).

***Aphanothece clathrata** G. S. West. Abundant in the surface waters at Newfound Lake from June to November.

***Chroococcus limneticus** Lemmermann. Common at Newfound Lake from June to November.

***Chroococcus minimum** (Keissl.) Lemmermann. Rare; found at Newfound Lake from June to November.

***Gloeothece linearis** Naegeli. Common throughout the water column at Newfound Lake from June to November.

***Gloeotrichia echinulata** (J. E. Smith) Richter (Figure 5). Present near the surface of Winnisquam Lake from July to September. Akinetes were present throughout the

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Fig. 3. *Dinobryon cylindricum* Imhof with statospores, ×500.

Fig. 4. *Dinobryon bavaricum* Imhof with statospores, ×500.

Fig. 5. *Gloeotrichia echinulata* (J. E. Smith) P. Richter with akinetes, ×500.

Fig. 6. *Anabaena scheremetievi* Elenkin with akinete, ×500.

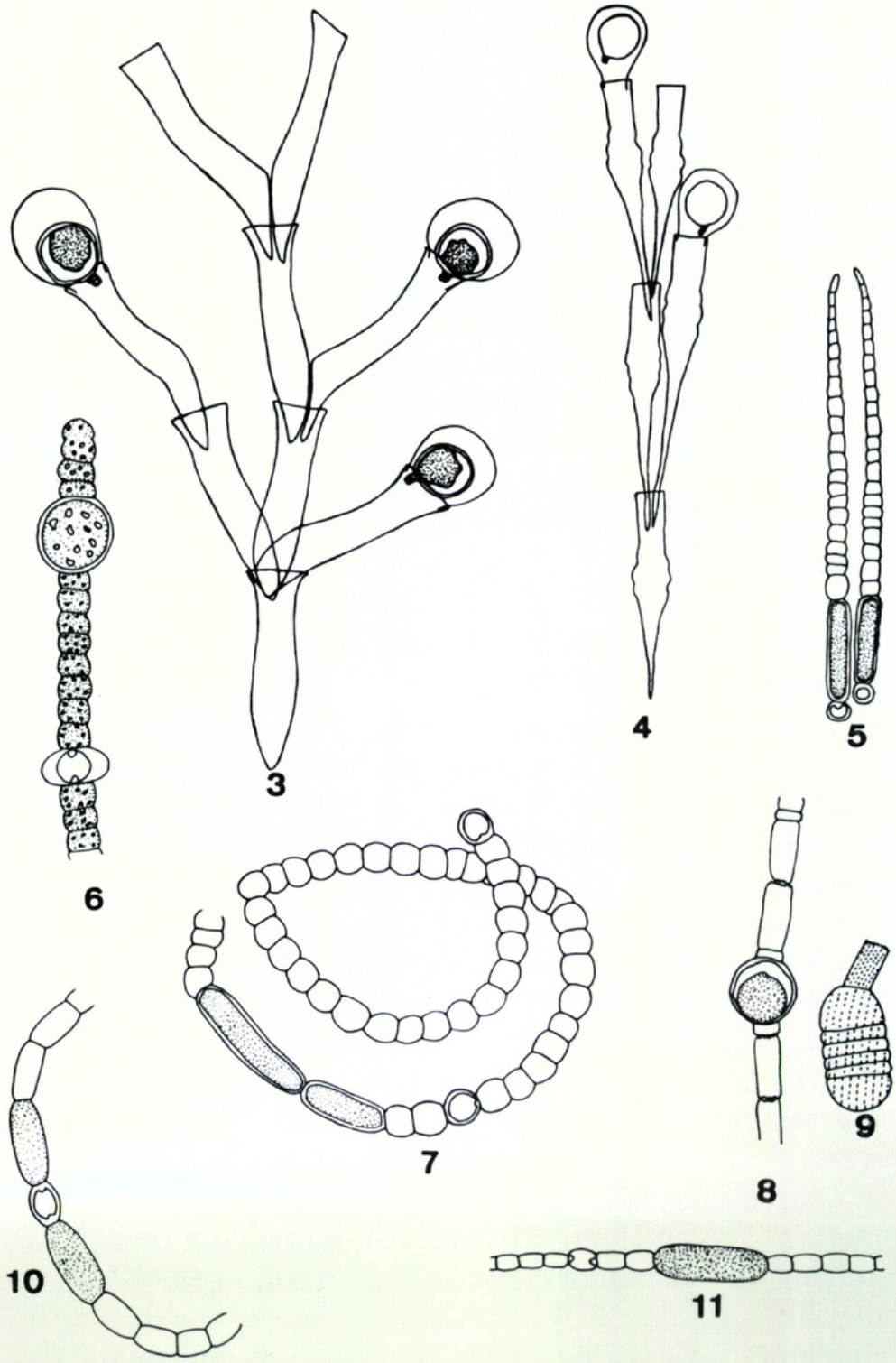
Fig. 7. *Anabaena circinalis* Rabenhorst with akinetes, ×500.

Fig. 8. *Melosira italica* var. *tenuissima* (Grun.) Mull. with auxospore, ×500.

Fig. 9. Germinating auxospore of *Melosira italica* var. *tenuissima*, ×500.

Fig. 10. *Anabaena flos-aquae* (Lyngbye) De Brébisson with akinetes, ×500.

Fig. 11. *Aphanizomenon flos-aquae* (L.) Ralfs with akinete, ×500.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growing season. Although it never formed water blooms, on occasion it was dense enough to be seen with the unaided eye.

****Gomphosphaeria aponina** var. **delicatula** Virieux. Present throughout the year at both lakes, but never in great abundance. **G. aponina** has been recorded from Massachusetts (Croasdale, 1935) and from Connecticut (Hylander, 1928), but the var. *delicatula* has not previously been recorded from New England.

Gomphosphaeria lacustris Chodat. A dominant organism throughout the year at Newfound Lake. Its maximum abundance was recorded during July and August.

****Gomphosphaeria lacustris** var. **compacta** Lemmermann. Found in small quantities throughout the year at Newfound Lake; only evident from August to November at Winnisquam Lake.

***Merismopedia punctata** Meyen. Common at Newfound Lake from June to November.

***Merismopedia tenuissima** Lemmermann. Abundant at Newfound Lake from June to November; a maximum peak was recorded in July.

***Oscillatoria granulata** Gardner. Most common in shallow areas of Winnisquam Lake after heavy rainfalls. Probably not a true planktonic species.

***Oscillatoria limnetica** Lemmermann. Found throughout the year at Winnisquam Lake; the dominant organism in April, May, and November and December. Its populations showed a marked seasonal difference vertically within the water column. During the winter, large quantities were present in the upper three meters but by the end of March the bulk of the population had settled to 10-15 meters — even though it was still increasing in numbers. During the remainder of the year it again sank to lower depths.

****Spirulina laxa** G. M. Smith. Found at Winnisquam Lake from July to September. Only evident at one location (10 to 15 meters); rare.

***Tolypothrix lanata** Wartmann. Found in small quantities

from July to November at Winnisquam Lake. Only collected in shallow portions of the lake, and probably not a true planktonic species. Akinetes were never observed.

CHLOROPHYCEAE

*__Ankistrodesmus falcatus__ (Corda) Ralfs. Relatively common at Winnisquam Lake from June to October but never reaching large numbers.

*__Ankistrodesmus falcatus__ var. __acicularis__ (A. Braun) G. S. West. Present at both lakes from June to October, but not as common as the typical plant.

*__Ankistrodesmus falcatus__ var. __mirabilis__ (W. and G. S. West) G. S. West. Very common throughout the year at Winnisquam Lake. One of the dominant organisms during the spring overturn (April and May).

*__Botryococcus braunii__ Kuetzing. Common throughout the year at both lakes; particularly during the winter at Newfound Lake. The color of the mucilage sheath varied from dark green to dark orange-brown.

**__Botryococcus protuberans__ var. __minor__ G. M. Smith (Figure 20). Present throughout the year at Newfound Lake, but not as abundant as *B. braunii*. Only found at Winnisquam Lake from February to early June.

*__Characium curvatum__ G. M. Smith. Found during the summer at Winnisquam Lake; growing epiphytically on fragments of *Oedogonium*.

*__Characium gracilipes__ Lambert. Found as an epiphyte on *Oedogonium* during August and September at Winnisquam Lake.

**__Characium limneticum__ Lemmermann (Figure 15). Found at Winnisquam Lake from July to September; rare.

**__Chlamydomonas dinobryonis__ G. M. Smith (Figure 12). Cells growing within the lorica of *Dinobryon cylindricum*. Observed a few times during June and July at Newfound Lake.

**__Chlorangium stentorinum__ (Ehrenberg) Stein. Found occasionally during July and August at Winnisquam Lake; growing attached to copepods.

****Closteriopsis longissima** Lemmermann (Figure 19). Found throughout the year at Winnisquam Lake but never in great abundance. It was always confined to deep water samples (15 meters and below) where light was barely detectable.

Closterium acerosum (Shrank) Ehrenberg. A few specimens were observed in September and November, 1966 at Winnisquam Lake; rare.

Closterium dianae Ehrenberg. Seen once in June at Winnisquam Lake.

Closterium kuetzingii De Brébisson. The most common species of *Closterium* found at both lakes; present throughout the year but never in any great quantity.

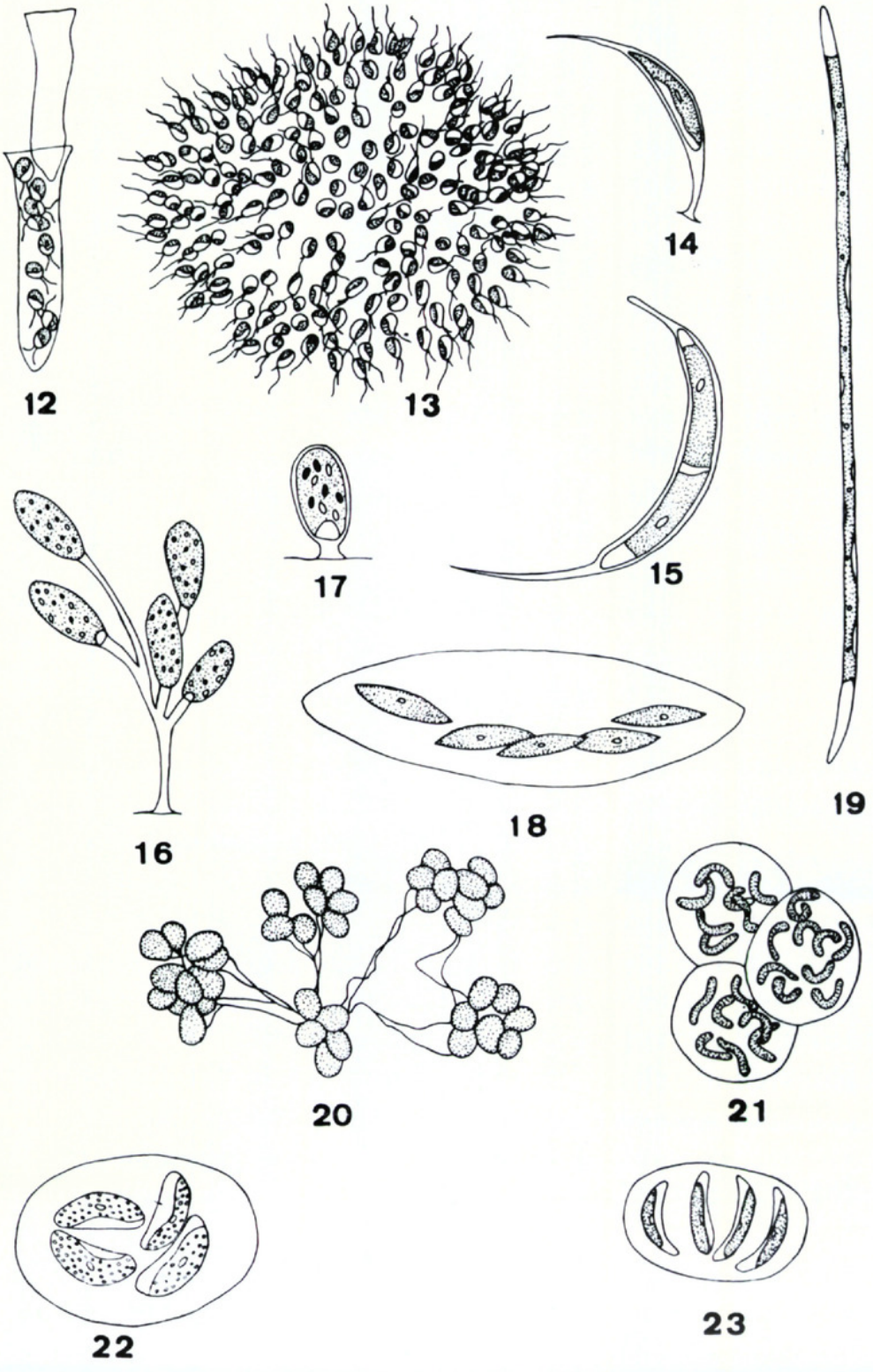
Closterium moniliferum (Bory) Ehrenberg. Seen once in November at Winnisquam Lake.

***Coelastrum microporum** Naegeli. Common from June to November at Winnisquam Lake. Only sporadically present throughout the summer at Newfound Lake.

***Cosmarium bioculatum** De Brébisson. Common throughout the year at Newfound Lake. It was usually found at depths below 10 meters.

Cosmarium contractum var. **papillatum** W. and G. S. West. The most abundant species of **Cosmarium** found at both lakes. It was most common at Newfound Lake, where it occurred throughout the year. At Winnisquam Lake it was only recorded from June to November.

Fig. 12. *Chlamydomonas dinobryonis* G. M. Smith, ×500.
Fig. 13. *Uroglenopsis americana* (Calkins) Lemmermann, ×500.
Fig. 14. *Schroederia judayii* G. M. Smith, ×750.
Fig. 15. *Characium limneticum* Lemmermann, ×500.
Fig. 16. *Colacium arbuscula* Stein, ×500.
Fig. 17. *Colacium vesiculosum* Ehrenberg, ×500.
Fig. 18. *Elakatothrix viridis* (Snow) Printz, ×500.
Fig. 19. *Closteriopsis longissima* Lemmermann, ×500.
Fig. 20. *Botryococcus protuberans* var. *minor* G. M. Smith, ×500.
Fig. 21. *Kirchneriella contorta* (Schmidle) Bohlin, ×750.
Fig. 22. *Nephrocytium limneticum* (G. M. Smith) G. M. Smith ×500.
Fig. 23. *Nephrocytium lunatum* W. West, ×500.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*Cosmarium punctulatum De Brébisson. Common from July to November at both lakes.

*Crucigenia rectangularis (A. Braun) Gay. One of the dominant Chlorophyceae found at Newfound Lake; evident in all collections except in April and May. Its population size was relatively stable throughout the growing season. The alga was only observed a few times from July to November at Winnisquam Lake.

Desmidium baileyi (Ralfs) Nordstedt. Found from July to October at Winnisquam Lake. Present as very long chains; uncommon.

Desmidium swartzii C. A. Agardh. Sporadically present throughout the summer and early fall at both lakes.

*Dictyosphaerium ehrenbergianum Naegeli. Occurring in small quantities from September to November at Winnisquam Lake; uncommon.

*Dictyosphaerium pulchellum Wood. Very abundant throughout the year at Winnisquam Lake. It was the dominant Chlorophyceae during the summer and early fall. Less common at Newfound Lake, but still occurring throughout the year.

*Dimorphococcus lunatus A. Braun. Common from September to November at Winnisquam Lake.

*Elaktothrix gelatinosa Wille. Common from June to November at Winnisquam Lake.

**Elaktothrix viridis (Snow) Printz (Figure 18). Present in very small quantities throughout most of the year (except April and May) at both lakes.

Euastrum didelta (Turpin) Ralfs. Only a few specimens of this species were found during October and November, 1967 at Newfound Lake.

*Euastrum pulchellum De Brébisson. Common from June to November at Newfound Lake.

*Eudorina elegans Ehrenberg. Very abundant throughout the year at Winnisquam Lake; reaching peak numbers during July and August.

*Gloeocystis ampla (Kuetzing) Lagerheim. Found occasionally from July to October at Winnisquam Lake.

*Gloeocystis gigas (Kuetzing) Lagerheim. Common at both lakes from June to November. However, it was most abundant at Newfound Lake where it was a dominant member of the Chlorophyceae population during the summer and fall.

Gloeocystis vesiculosa Naegeli. One of the dominant green algae present at Winnisquam Lake from June to November. Its maximum development occurred during July and August.

Gonatozygon aculeatum Hastings. Abundant on two occasions (August and September, 1966) in the shallow portions of Winnisquam Lake.

Gonatozygon monotaenium De Bary. Found once at Newfound Lake during August and September; rare.

*Gonatozygon pilosum Wolle. Abundant during August and September, 1966 at Newfound Lake; never seen again after September, 1966.

Gymnozyga moniliformis Ehrenberg. Observed once in September, 1967 at Newfound Lake.

Hyalotheca dissiliens (J. E. Smith) De Brébisson. Found sporadically throughout the summer and fall at both lakes.

**Kirchneriella contorta (Schmidle) Bohlin (Figure 21). A few specimens were found in two collections made in November, 1967 at Winnisquam Lake; rare.

*Kirchneriella lunaris (Kirchner) Moebius. The commonest species of **Kirchneriella** found at Winnisquam Lake; recorded from July to November.

*Kirchneriella lunaris var. dianae Bohlin. Found several times during August at Winnisquam Lake; mixed with the typical plant.

**Kirchneriella obesa var. aperta (Teil.) Brunnthaler. Uncommon, but found in most collections throughout the year at Winnisquam Lake. Only the typical plant has been recorded in New England — i.e. from Connecticut (Conn and Webster, 1908; Hylander, 1928) and Massachusetts (Croasdale, 1935).

Micrasterias radiata Hassall. One specimen was seen in September, 1966 at Winnisquam Lake.

Micrasterias radiosa (Lyngbye) Agardh. Observed once at Winnisquam Lake in August, 1967.

Mougeotia sp. Vegetative material was found in the plankton during the spring and summer at Winnisquam Lake.

****Nephrocytium ecdysiscepanum** W. West. A few specimens were observed during July and August at Winnisquam Lake.

****Nephrocytium limneticum** (G. M. Smith) G. M. Smith (Figure 22). Very common at Winnisquam Lake from June to November. Only a few specimens were found at Newfound Lake during August to October.

****Nephrocytium lunatum** W. West (Figure 23). Common from July to October at Winnisquam Lake.

Oedogonium spp. A number of different vegetative filaments were observed in the plankton from May to October at Winnisquam Lake. It was often heavily epiphytized.

***Oocystis borgei** Snow. The most common species of *Oocytis* found at both lakes. It was evident throughout the year, but it was never in any great abundance.

***Oocystis elliptica** W. West. Only a few specimens were found during August and September, 1966 at Winnisquam Lake; rare.

***Oocystis lacustris** Chodat. A few specimens were found during October and November, 1966 at Winnisquam Lake; rare.

***Oocystis parva** W. and G. S. West. A common species of *Oocystis* at Winnisquam Lake from July to September.

***Pediastrum araneosum** (Raciborski) G. M. Smith. Found only twice in September at Winnisquam Lake; rare.

***Pediastrum boryanum** var. **longicorne** Raciborski. Found once at Newfound Lake during October, 1966. The var. *longicorne* is differentiated from the typical species because of its swollen apical lobes.

***Pediastrum duplex** Meyen. The most common species of *Pediastrum* found at Winnisquam Lake. Evident

throughout the year, but never in very large numbers.

*__Pediastrum duplex__ var. __clathratum__ (A. Braun) Lagerheim. Common throughout the year at Winnisquam Lake.

*__Pediastrum duplex__ f. __gracilimum__ W. and G. S. West. Common at Winnisquam Lake from July to November. According to Prescott (1962) it is a growth form of the typical plant.

*__Pediastrum simplex__ var. __duodenarium__ (Bailey) Rabenhorst. Found once in June, 1967 at Newfound Lake.

*__Pediastrum tetras__ (Ehrenberg) Ralfs. A few specimens were found in July and August at Winnisquam Lake; uncommon.

*__Pediastrum tetras__ var. __tetraedon__ (Corda) Rabenhorst. More abundant at Winnisquam Lake than the typical plant; present from July to November.

__Pleurotaenium trabecula__ (Ehrenberg) Naegeli. Present sporadically throughout the summer and fall at Winnisquam Lake.

*__Quadrigula closterioides__ (Bohlin) Printz. Common throughout the year at Newfound Lake. Less common at Winnisquam Lake, and only occurring from June to November.

*__Quadrigula lacustris__ (Chodat) G. M. Smith. Common at Winnisquam Lake from July to October.

*__Scenedesmus abundans__ (Kirchner) Chodat. Only found a few times during July and August at Winnisquam Lake; rare.

*__Scenedesmus acutiformis__ Schroeder. Observed at Winnisquam Lake from June to November.

*__Scenedesmus arcuatus__ var. __platydisca__ G. M. Smith. Common from June to November at Winnisquam Lake.

*__Scenedesmus bijuga__ (Turp.) Lagerheim. Found occasionally during July and August at Winnisquam Lake.

*__Scenedesmus brasiliensis__ Bohlin. Common at Winnisquam Lake from June to November.

*__Scenedesmus dimorphus__ (Turp.) Kuetzing. Common at Winninsquam Lake from June to November.

*__Scenedesmus opoliensis__ P. Richter. Observed once in

October and once in November, 1967 at Winnisquam Lake.

Scenedesmus quadricauda (Turp.) De Brébisson. The dominant species of *Scenedesmus* in Winnisquam Lake; present throughout the year.

*__Scenedesmus quadricauda__ var. **parvus** G. M. Smith. Only found a few times during August and September at Winnisquam Lake.

*__Scenedesmus quadricauda__ var. **westii** G. M. Smith. Found a few times from August to October at Winnisquam Lake.

*__Scenedesmus serratus__ (Corda) Bohlin. The only species of *Scenedesmus* found at Newfound Lake. It was found from June to November, but never in any great abundance.

**__Schroederia judayi__ G. M. Smith (Figure 14). Very abundant from April to November at Winnisquam Lake. Maximum populations were evident in the spring and early fall, and generally in the upper five meters of the water column. The cells were either straight or arcuate.

*__Schroederia setigera__ (Schroeder) Lemmermann. Present throughout the year at Winnisquam Lake, but not as abundant as *S. judayi.*

*__Sorastrum spinulosum__ Naegeli. Only found a few times from August to October at Winnisquam Lake; rare.

*__Sphaerocystis schroeteri__ Chodat. Very common from April to October at Winnisquam Lake. Sparse at Newfound Lake, and only occurring in July and August. The

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Fig. 24. *Staurastrum pentacerum* (Wolle) G. M. Smith (top view) ×500.

Fig. 25. *Staurastrum pentacerum* (end view), ×500.

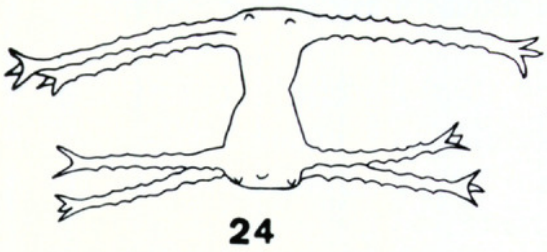
Fig. 26. *Staurastrum limneticum* var. *cornutum* G. M. Smith (top view), ×500.

Fig. 27. *Staurastrum limneticum* var. *cornutum* (end view), ×500.

Fig. 28. *Staurastrum pseudopelagicum* W. & G. S. West (top view), ×500.

Fig. 29. *Staurastrum manfeldtii* Delp. (Top view), ×500.

Fig. 30. *Staurastrum pingue* Teiling (top view), ×500.



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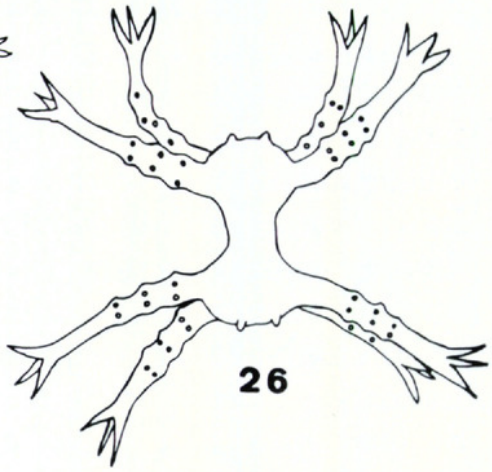

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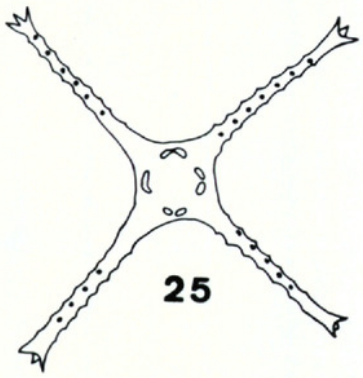

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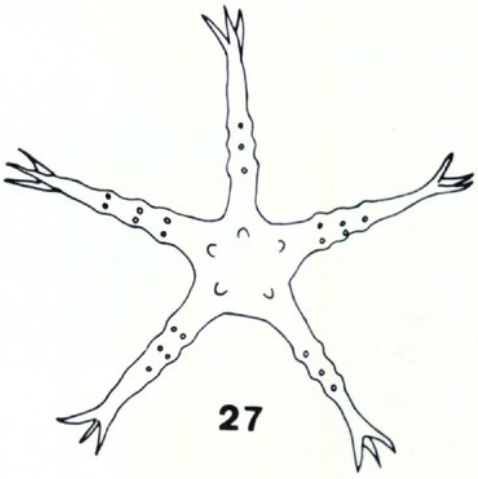

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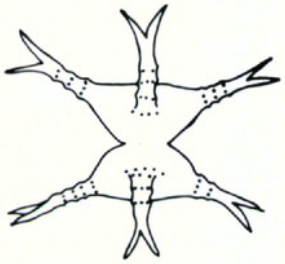

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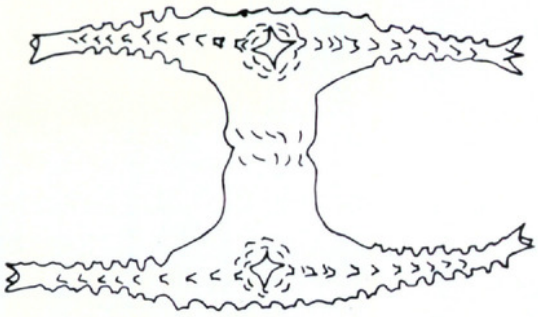

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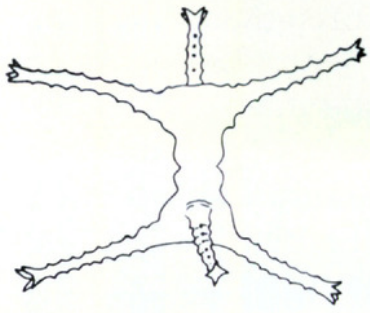

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plant was typically found as a many celled colony, but occasionally as a single cell.

Spirogyra spp. A number of different vegetative filaments (i.e., some with single and others with double chloroplasts) were found in the plankton at Winnisquam Lake from April to November.

*__Spondylosium planum__ (Wolle) W. and G. S. West. A common desmid from June to November at Winnisquam Lake. Only found occasionally in the fall at Newfound Lake.

Staurastrum anatinum var. **longibrachiatum** W. and G. S. West. A few specimens were found in each collection made throughout the year at Winnisquam Lake. The typical plant was previously recorded from Massachusetts (Cushman, 1930a; Stone, 1900), Maine (West, 1888), and New Hampshire (Collins, in PHYC. BOR-AM. XL, #1984).

*__Staurastrum ankyroides__ Wolle. Found once in Newfound Lake in September, 1966.

Staurastrum arctiscon (Ehrenberg) Lund. Found once from each lake; rare.

**__Staurastrum cingulum__ (W. and G. S. West) G. M. Smith. Present sporadically throughout the year at Winnisquam Lake.

Staurastrum johnsonii W. and G. S. West. Common throughout the year, except April and May, at Winnisquam Lake. Typically the plant is biradiate, but one specimen was found in which one semicell was triradiate and the other biradiate.

__Staurastrum limneticum__ var. **cornutum G. M. Smith (Figures 26 & 27). Common at both lakes from August to November. Found with 4, 5, and 6 processes.

**__Staurastrum manfeldtii__ Delp. (Figure 29). Abundant from August to November, 1966 at Winnisquam Lake. Not seen during 1967.

**__Staurastrum pentacerum__ (Wolle) G. M. Smith (Figures 24 and 25). The most common species of *Staurastrum* found at Newfound Lake. Abundant throughout the year.

The number of processes ranged from 3-5; the "janus" forms with 3+4 or 3+5 were the most common.

*__Staurastrum pilosum__ Archer. Present at Winnisquam Lake in small numbers during October and November, 1966, but abundant from June to October, 1967.

**__Staurastrum pingue__ Teiling (Figure 30). The dominant desmid at Winnisquam Lake; maximum populations occurred during October and November. It was generally most abundant at approximately 10 meters.

*__Staurastrum pseudopelagicum__ W. and G. S. West (Figure 28). Common at Winnisquam Lake from June to November.

*__Staurastrum vestitum__ Ralfs. Found a few times in August and September at Winnisquam Lake; rare.

**__Staurodesmus bulnheimii__ (Raciborski) Brook (Equals *Arthrodesmus bulnheimii* in Smith, 1924). Found once in September, 1967 at Newfound Lake.

__Staurodesmus cuspidatus__ (De Brébisson) Teiling. (Equals *Staurastrum cuspidatum* in Smith, 1924). The most abundant species of Staurodesmus found at Newfound Lake; present throughout the year.

*__Staurodesmus dickiei__ (Ralfs) Lillieroth. (Equals *Staurastrum dickiei* in Iréné-Marie, 1939). Only found a few times during May and June at Winnisquam Lake.

*__Staurodesmus extensus__ var. __joshuae__ (Gutwinski) Teiling. (Equals *Arthrodesmus incus* var. *extensus* in Smith, 1924). Present sporadically throughout the year at both lakes. However, it was more abundant at Newfound Lake.

*__Staurodesmus incus__ var. __ralfsii__ (W. West) Teiling. (Equals *Arthrodesmus ralfsii* in Smith, 1924). Common from February to July at both lakes, but most abundant when the water temperatures are low.

*__Staurodesmus mamillatus__ var. __maximum__ (W. West) Teiling. (Equals *Staurastrum cuspidatum* var. *canadense* in Smith, 1924). Very common throughout the year at Newfound Lake; less abundant at Winnisquam Lake and only occurring from July to November.

Staurodesmus megacanthus (Lund) Thunmark. (Equals *Staurastrum megacanthum* in Smith, 1924). Very common throughout the year at Newfound Lake; less abundant at Winnisquam Lake and only occurring from April to November.

***Staurodesmus subtriangularis** (Borge) Teiling. (Equals *Arthrodesmus triangularis* var. *subtriangularis* in Smith 1924). Present sporadically throughout the year at both lakes.

***Stylosphaeridium stipitatum** (Bachmann) Geitler and Gimesi. Found commonly as an epiphyte on *Gomphosphaeria* at Newfound Lake; collected from July to October.

***Tetraedron limneticum** Borge. Observed once in August, 1967 at Newfound Lake.

***Ulothrix subconstricta** G. S. West. Very common from June to November at Winnisquam Lake.

***Ulothrix tenerrima** Kuetzing. Common from April to May at Winnisquam Lake.

***Ulothrix variabilis** Kuetzing. Found occasionally from June to August at Winnisquam Lake.

Xanthidium antilopaeum (De Brébisson) Kuetzing. Found a number of times during September to November at Winnisquam Lake.

Xanthidium antilopaeum var. **polymazum** Nordstedt. Found once in October, 1966 at Newfound Lake.

EUGLENOPHYCEAE

****Colacium arbuscula** Stein (Figure 16). Found attached to various zooplankton. Most common at Newfound Lake, where it was seen every month except February and March. It was seen from June to August at Winnisquam Lake.

****Colacium vesiculosum** Ehrenberg (Figure 17). Found throughout the year at both lakes. Epizooic on various Cladocera; more common than *C. arbuscula*.

***Euglena spirogyra** Ehrenberg. Found once (April) in

shallow water at Winnisquam Lake — after a rainfall. Probably not a true planktonic species.

XANTHOPHYCEAE

****Gloeobotrys limneticus** (G. M. Smith) Pascher (Figure 42). Common at Newfound Lake from August to November. Usually evident below ten meters. Less abundant at Winnisquam Lake where it was found from July to October.

***Ophiocytium capitatum** Wolle. Found only rarely at Newfound Lake from September to November.

***Stipitococcus capense** Prescott. Found at a shallow station at Winnisquam Lake. Epiphytic on various filamentous algae, especially *Oedogonium,* and once on the lorica of *Dinobryon divergens.* Found from July to September; rare.

CHRYSOPHYCEAE

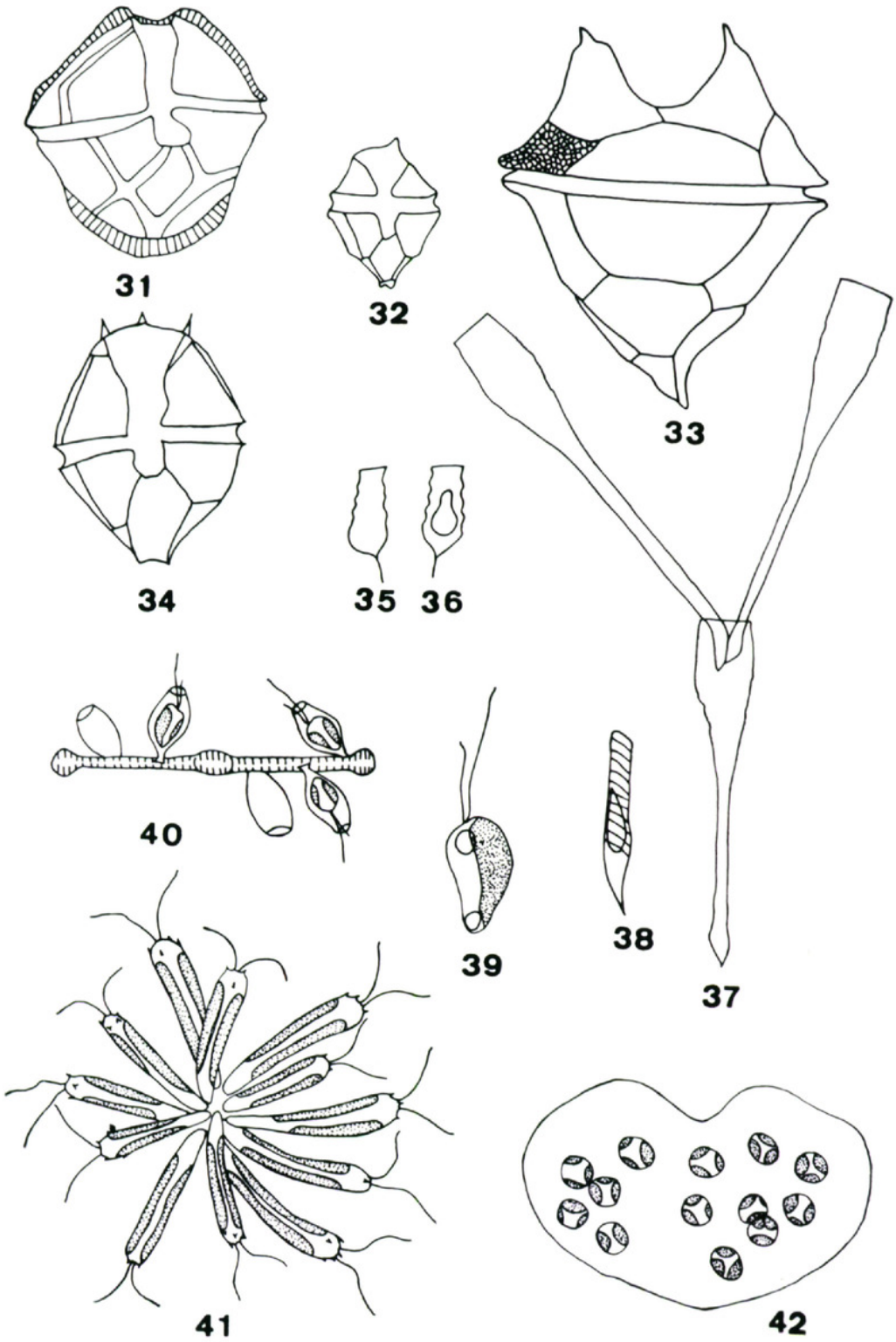
***Chrysosphaerella longispina** Lauterborn. Common at Newfound Lake from July to November; reaching maximum numbers in July and August. Generally evident below 10 meters. Rarely found at Winnisquam Lake (September to November).

****Diceras phaseolus** Fott. Found sporadically throughout the summer at Newfound Lake; rare.

***Dinobryon bavaricum** Imhof (Figure 4). Very common throughout the year at both lakes. Maximum populations were evident in June and July at Newfound Lake. Statospores were also evident at the same time. The maximum quantities were usually found at 10 meters. The size of the lorica in the upper portion of the colony was usually longer (90-100μ) than that in the lower portion (65-75μ).

****Dinobryon crenulatum** W. and G. S. West (Figures 35 & 36). Found sporadically throughout the year at Newfound Lake; rare.

***Dinobryon cylindricum** Imhof (Figure 3). Common throughout the year at both lakes. At Newfound Lake the maximum numbers were found during June, July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and November, while at Winnisquam Lake they were most abundant from April-June. The production of statospores coincided with the population peaks.

*__Dinobryon divergens__ Imhof. Less common than *D. bavaricum* or *D. cylindrum*. Present throughout the year at Newfound Lake, but not seen from February to May at Winnisquam Lake. The lorica of *D. divergens* was often difficult to distinguish from that of *D. cylindricum*.

__Dinobryon sertularia Ehrenberg.__ Common throughout the year at both lakes; forming peak numbers in the fall.

**__Dinobryon suecicum__ Lemmermann (Figure 38). Found throughout the year at Newfound Lake. Often difficult to detect because of its very small size; rare.

**__Dinobryon vanhoeffenii__ (Krieger) Bachmann (Figure 37). Found from June to November at Newfound Lake. Its populations showed very rapid pulsations; maximum numbers were recorded in July and August.

**__Epipyxis tabellariae__ (Lemmermann) Smith (Figure 40). Found as an epiphyte on *Tabellaria* and *Asterionella* during the fall diatom pulse at Newfound Lake (October and November) and during the spring diatom bloom at Winnisquam Lake; uncommon.

**__Epipyxis utriculus__ Ehrenberg. A common epiphyte on *Tabellaria* at Newfound Lake from August to November.

__Mallomonas acaroides__ Perty. Only found during October and November at Newfound Lake; rare.

**__Mallomonas elegans__ Lemmermann. Abundant during the spring phytoplankton pulse (March to May) at Winni-

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Fig. 31. *Peridinium willei* Huitfeld-Kaas, ×500.
Fig. 32. *Peridinium inconspicuum* Lemmermann, ×750.
Fig. 33. *Peridinium limbatum* (Stokes) Lemmermann, ×500.
Fig. 34. *Glenodinium aciculiferum* (Lemmermann) Lindem, ×500.
Fig. 35 & 36. *Dinobryon crenulatum* W. & G. S. West, ×500.
Fig. 37. *Dinobryon vanhoeffenii* (Krieger) Bachmann, ×500.
Fig. 38. *Dinobryon suecicum* Lemmermann, ×1500.
Fig. 39. *Rhodomanas lacustris* Pascher & Ruttner, ×1000.
Fig. 40. *Epipixis tabellariae* (Lemmermann) Smith, ×500.
Fig. 41. *Synura adamsii* G. M. Smith, ×500.
Fig. 42. *Gloeobotrys limneticus* (G. M. Smith) Pascher, ×500.

squam Lake, disappearing quickly after water temperatures increased.

****Mallomonas fastigata** Zacharias. The most common species of *Mallomanas* found at both lakes. Evident from June to November.

****Mallomonas producta** (Zacharias) Iwanoff. Relatively common at both lakes from June to November; found occasionally during the winter at Winnisquam Lake.

****Mallomanas pseudocoronata** Prescott. Common throughout the year at Newfound Lake.

****Mallomonas tonsurata** Teiling var. **alpina** (Pascher and Ruttner) Kuetzing. Common throughout the year at Newfound Lake. During the fall and the period of ice cover it occurred in maximum numbers near the surface, while during the summer it was most abundant at 10 and 15 meters.

****Synura adamsii** G. M. Smith (Figure 41). Found at Winnisquam Lake from May to November; rare.

Synura uvella Ehrenberg. Very common throughout the year at both lakes. However, it was more abundant at Winnisquam Lake where it formed maximum numbers during the summer and fall. It was generally found below 5 meters.

****Uroglenopsis americana** (Calkins) Lemmermann (Figure 13). Common from June to November at Newfound Lake. Large pulses of populations developed suddenly in August, 1966 and July, 1967 and disappeared just as quickly. It was much less common at Winnisquam Lake and was only found in small quantities from May to August, 1967.

BACILLARIOPHYCEAE

Asterionella formosa Hass. Very common at both lakes. Large populations were evident in the spring (April) and fall (November) at Winnisquam Lake. Such a periodic cycle was less evident at Newfound Lake because the diatom was not as abundant. Large populations were recorded under ice cover.

***Asterionella formosa** var. **gracillima** (Hantz) Grun. Much

less common than the typical species; only evident from February to early May. The cells were often in chain-like colonies, as illustrated by Huber-Pestalozzi (1942).

*__Cyclotella bodanica__ Eulenst. The most common species of *Cyclotella* found at Newfound Lake. Evident throughout the year and reaching maximum numbers during the summer. The maximum quantities were found at 10 meters and below.

*__Cyclotella compa__ (Ehrenberg) Kuetzing. Common throughout the year at both lakes; maximum numbers were evident during the spring and late fall between 5 and 10 meters.

*__Cyclotella glomerata__ Bachmann. Found at Newfound Lake when the water temperatures were quite low. Most abundant from February to early May, but even then it was uncommon.

*__Cyclotella stelligera__ Cleve and Grein. Found at Winnisquam Lake from September to November; rare.

__Cymbella ventricosa__ Kuetzing. Found at Winnisquam Lake during the period of the spring overturn (April and May). It is probably not a true planktonic species.

*__Fragilaria capucina__ Desm. Found sporadically at both lakes; uncommon.

*__Fragilaria crotonensis__ Kitton. Very common throughout the year at both lakes. However, it was more abundant at Winnisquam Lake where it formed maximum numbers during November, 1966 and July to August, 1967. The largest concentration of populations occurred between 3 and 5 meters.

*__Melosira ambigua__ (Grun.) Mueller. Abundant throughout the year at both lakes. The maximum populations were evident during the spring and fall at Newfound Lake, while during the fall at Winnisquam Lake.

*__Melosira distans__ (Ehrenberg) Kuetzing. Found throughout the year at Newfound Lake; always in very small quantities.

*__Melosira italica__ (Ehrenberg) Kuetzing. Very abundant throughout the year at Winnisquam Lake. Maximum

numbers were found from February to May with the largest peak occurring at the time of the spring overturn. Lesser peaks occurred during the fall overturn (October and November). During the spring and fall overturn populations were evenly distributed throughout the water column, while throughout the rest of the year they steadily settled out of the photic zone. Such observations are similar to those made by Lund (1954, 1955) upon *Melosira italica* (Ehrenberg) Kuetzing subsp. *subartica* O. F. Müller.

*__Melosira italica__ var. __tenuissima__ (Grun.) Mueller (Figures 8 & 9). Very common at Winnisquam Lake throughout the year. The development of this variety was similar to the typical plant, with maximum development occurring in the spring. Auxospores were observed during April, and they were present until early June, when many appeared to be germinating.

*__Meridion circulare__ var. __constrictum__ (Ralfs) V. H. Present in small numbers during the spring overturn at Winnisquam Lake. Probably not a true planktonic species.

*__Rhizosolenia eriensis__ H. L. Smith. Very common at Newfound Lake during July and August. Its maximum abundance was evident below 10 meters. It was sporadically present at Winnisquam Lake; being most conspicuous during the winter and spring. The morphological variation of the plant is extremely great.

*__Synedra ulna__ (Nitz.) Ehrenberg. Common throughout the year at both lakes. However, it was more abundant at Winnisquam Lake, where it reached its maximum peaks during May and June.

*__Tabellaria fenestrata__ (Lyngbye) Kuetzing. Common throughout the year at both lakes; but most common at Winnisquam Lake. Tending to reach maximum peaks after all other diatoms in the spring, and before all others in the fall.

*__Tabellaria flocculosa__ (Koth) Kuetzing. Common through-

out the year at Newfound Lake. Only occasionally observed at Winnisquam Lake from April to June.

DINOPHYCEAE

Ceratium hirundinella (O. F. Mueller) Dujardin. Common at both lakes from April to November. All specimens were of the form *robustum* as described by Huber-Pestalozzi (1950).

****Glendodinium aciculiferum** (Lemmermann) Linden. (Figure 34). A few specimens were observed in each collection made at Winnisquam Lake from March to early June; rare. The alga has the characteristic three spines on the hypovalve.

***Gonyaulax palustris** Lemmermann. Common at Newfound Lake from February to early June.

***Gymnodinium fuscum** (Ehrenberg) Stein. Present sporadically throughout the year at Newfound Lake.

***Gymnodinium palustre** Schilling. Found at Newfound Lake in February, March and April; rare.

***Peridinium cinctum** (O. F. Mueller) Ehrenberg. Found sporadically throughout the year at both lakes; never in any great abundance.

****Peridinium inconspicuum** Lemmermann (Figure 32). Common at Newfound Lake from June to October; maximum numbers were evident during August. Most of the populations were restricted to the 10 meter collections.

****Peridinium limbatum** (Stokes) Lemmermann (Figure 33). The dominant dinoflagellate at Newfound Lake. Found throughout the year, but reaching maximum numbers in the fall. It was found in very small quantities throughout the year at Winnisquam Lake, and was evenly distributed throughout the water column.

****Peridinium willei** Huitfeld-Kaas (Figure 31). Common throughout the year at Newfound Lake. Maximum numbers were recorded during the winter.

***Peridinium wisconsinense** Eddy. Common from July to October at Newfound Lake. Maximum numbers were evident during September and October.

CRYPTOPHYCEAE

*Cryptomonas erosa Ehrenberg. Common throughout the year at Newfound Lake.

*Cryptomonas erosa var. reflexa Marsson. A few specimens of this variety were found from February to early June at Newfound Lake.

*Cryptomonas marssonii Skuja. Found sporadically from July to November at both lakes.

Cryptomonas ovata Ehrenberg. Very common throughout the year at both lakes, but more abundant at Winnisquam Lake. The maximum populations were reached in the spring and fall.

**Rhodomonas lacustris Pascher and Ruttner (Figure 39). Abundant throughout the year at both lakes; with peaks in the spring and fall. Very large numbers were found at Winnisquam Lake in April and May.

SUMMARY

A total of 185 taxa of fresh algae (primarily phytoplankton) were identified at Winnisquam and Newfound Lakes, New Hampshire. Of these, 149 are presumed to be newly published records for New Hampshire and 45 are presumed to be new records for New England.

Of the 142 taxa recorded at Winnisquam Lake, 85 were found exclusively at this location. The green algae contributed the greatest number of species, but the bulk of the standing crop was composed of blue-green algae. During the summer the phytoplankton flora was primarily composed of members of the Chlorophyceae and Cyanophyceae. Members of the Bacillariophyceae, Chrysophyceae and Chlorophyceae (mainly desmids) contributed the largest number of species during the spring and fall. Diatoms were the major component of the winter flora.

A total of 100 taxa were recorded at Newfound Lake, and 43 of these were found exclusively at Newfound Lake. The largest number of species were green algae. During the summer and fall the phytoplankton was primarily composed of members of the Cyanophyceae, Chlorophyceae

(especially desmids) and Chrysophyceae. The diatoms and the golden-brown algae contributed the largest number of species during the winter and spring.

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REFERENCES TO NEW ENGLAND FRESHWATER ALGAE

AHLSTROM, E. H. 1937. Studies on variability in the genus *Dinobryon* (Mastigophora). Trans. Amer. Microsc. Soc. **56**: 139-159.

AUYANG, T. S. 1962. A survey of the algae of Lake Quinsigamond. Rhodora 64: 49-59.

BAILEY, J. W. 1847-1848. Notes on the algae of the United States. Amer. Jour. Sci. and Arts. Ser. 2. **3**: 80-85, 399-403; **6**: 37-42.

BENNETT, J. L. 1888. Plants of Rhode Island. Proc. Providence Franklin Soc. Providence Press Co., Providence, R. I. 128 pp.

BENOIT, R. J. and J. J. CURRY. 1961. Algae blooms in Lake Zoar,

Connecticut. Algae and Metropolitan Wastes, U. S. Public Health Service, SEC TR W61-3: 18-22.

BILLINGS, M. P. 1956. The geology of New Hampshire Part II — Bedrock Geology. New Hampshire State Planning and Development Comm., Concord, N. H. 203 pp.

CALKINS, G. N. 1892. On *Uroglena*, a genus of colony-building infusoria observed in certain water supplies in Massachusetts. Ann. Rept. Massachusetts State Bd. of Health **23**: 647-657.

———— 1901. Seasonal distribution of microscopic organisms in surface water. Ann. Rept. Massachusetts State Bd. of Health.

CHASE, E. S. 1947. Experience with *Anabaena* in Kenoza Lake, Haverhill, Massachusetts. Jour. New Engl. Water Wks Assn. **61**: 128-134

COLE, R. M. 1939. Studies on the plankton of the Connecticut watershed. *In:* Biological Survey of the Conn. Watershed. N. H. Fish and Game Biol. Surv. Rep. **4**: 190-194.

COLLINS, F. S. 1904. Algae of the Flume. Rhodora **6**: 229-231.

———— 1905. Phycological notes of the late Isaac Holden. Rhodora **7**: 168-172.

———— 1909. The green algae of North America. Tufts College Studies, Sci. Ser. **2**: 79-480 (Reprinted and repaged by G. E. Stechert, New York, 1928).

———— 1912. The green Algae of North America. Supplementary Paper. Ibid. **3**: 69-109 (Reprinted and repaged by G. E. Stechert, New York, 1928).

———— 1916. Notes from the Woods Hole Laboratory. 1915. Rhodora **18**: 90-92.

———— 1918a. Notes from the Woods Hole Laboratory. 1917. Rhodora **20**: 141-145.

———— 1918b. The green algae of North America. 2nd Supplementary Paper. Tufts College Studies, Sci. Ser. **4**: 1-106 (Reprinted and repaged by G. E. Stechert, New York, 1928.)

CONN, H. W. 1905. A preliminary report of the protoza of the fresh water of Connecticut. Conn. Geol. and Nat. Hist. Surv. Bull. No. 2, 69 pp.

———— and L. W. WEBSTER. 1908. A preliminary report of the algae of the freshwaters of Connecticut. Conn. Geol. and Nat. Hist. Surv. Bull., No. 10, 78 pp.

COOPER, G. P. 1939. A biological survey of thirty-one lakes and ponds of the Upper Saco River and Sebago Lake drainage systems in Maine. Maine Dept. of Inland Fisheries and Game. Fish Surv. Report, No. 2.

———— and J. L. Fuller. 1945. A biological survey of

Moosehead Lake and Haymock Lake, Maine. Maine Dept. of Inland Fisheries and Game. Fish Surv. Rept. No. 6, 160 pp.

COWLES, R. P. and C. E. BRAMBEL. 1936. A study of the environmental conditions in a bog pond with special reference to the diurnal vertical distribution of *Gonyostomum semen*. Biol. Bull. **71**: 286-298.

CROASDALE, H. T. 1935. The freshwater algae of Woods Hole, Massachusetts. Philadelphia. 134 pp.

———— 1948. The flora of Penikese, seventy-four years after. II. Fresh and brackish water algae of Penikese Island, Rhodora **50**: 269-279.

CUSHMAN, J. A. 1903a. List of desmids found in Carver's Pond, Bridgewater, Massachusetts. Rhodora **5**: 79-81.

———— 1903b. Notes on New England desmids I. Rhodora **5**: 221-225.

———— 1903c. Notes on New England desmids II. Rhodora **5**: 252-255.

———— 1904a. Notes on *Micrasterias* from southeastern Massachusetts. Bull. Torrey Bot. Club **31**: 393-397.

———— 1904b. Division in desmids under pathological conditions. Rhodora **6**: 234.

———— 1905a. A contribution to the desmid flora of New Hampshire. Rhodora **7**: 111-119.

———— 1905b. A contribution to the desmid flora of New Hampshire. Rhodora **7**: 251-266.

———— 1905c. Notes on the zygospores of certain New England desmids with description of a few new forms. Bull. Torrey Bot. Club. **32**: 223-229.

———— 1905d. The desmid flora of Nantucket. Bull. Torrey Bot. Club **32**: 549-563.

———— 1906. New England desmids of the subfamily Saccodermae. Bull. Torrey Bot. Club. **33**: 343-351.

———— 1907a. A synopsis of the New England species of *Pleurotaenium*. Rhodora **9**: 101-106.

———— 1907b. A synopsis of the New England species of *Tetmemorus*. Bull. Torrey Bot. Club. **34**: 599-601.

———— 1908a. New England species of *Closterium*. Bull. Torrey Bot. Club **35**: 109-133.

———— 1908b. A synopsis of the New England species of *Micrasterias*. Rhodora **10**: 97-111.

DROUET, F. 1937. Three American Oscillatoriaceae. Rhodora **39**: 277-280.

———— 1938. Some Myxophyceae from Nantucket Island, Massachusetts. Rhodora **40**: 74-76.

———— 1938. The Oscillatoriaceae of southern Massachusetts. Rhodora **40**: 221-241; 255-273.

———— and A. COHEN. 1935. The morphology of *Gonyostomum semen* from Woods Hole, Massachusetts. Biol. Bull. **68**: 422-439.

EDDY, S. 1930. The fresh-water armored or thecate dinoflagellates. Trans. Amer. Microsc. Soc. **49**: 277-321.

EDMUNDSON, W. T. 1938. Notes on the plankton of some lakes in the Merrimack watershed. *In:* Biological survey of the Merrimack watershed. N.H. Fish and Game Biol. Surv. Rept. **3**: 207-210.

———— and J. L. FULLER. 1937. Food conditions in some New Hampshire lakes. *In:* Biological Survey of the Androscoggin, Saco, and Coastal watersheds. N. H. Fish and Game Biol. Surv. Rept. **2**: 95-99.

FARLOW, W. G. 1877. Remarks on some algae found in the water supplies of the city of Boston. Bull. Bussey Institution **2**: 75-80.

FLINT, L. H. 1917. The algae of Vermont. Vermont Bot. and Bird Club, Joint Bull. **3**: 12-18.

FORBES, F. F. 1890. Study of algae growth in reservoirs and ponds. Jour. New Eng. Water Wks. Assoc. **4**: 196-210.

GOODWIN, H. A. 1943. Plankton of the lakes and ponds. *In:* A biological survey of lakes and ponds of the central coastal area of Maine. Maine Dept. of Inland Fisheries and Game. Fish Surv. Rept. **5**: 56-66.

GRUENDLING, G. K. and A. C. MATHIESON. Phytoplankton populations in relation to trophic levels of lakes in New Hampshire, U.S.A. Nova Hedwigia (in press).

GUSTAFSON, A. H. 1942. Notes on some freshwater algae from New England. Rhodora **44**: 64-69.

———— 1952. The role of algae in some Massachusetts lakes. Fisheries Report for lakes of northeastern Massachusetts — 1949. Div. Fish and Game. Bur. Wildlife Res. and Management, Commonwealth of Massachusetts. 3-13.

HARVEY, F. L. 1888. The freshwater algae of Maine I. Bull. Torrey Bot. Club. **15**: 155-161.

———— 1889. The freshwater algae of Maine II. Bull. Torrey Bot. Club. **16**: 181-188.

———— 1892. The freshwater algae of Maine III. Bull. Torrey Bot. Club. **19**: 118-125.

HASTINGS, W. N. 1892. New desmids from New Hampshire. Amer. Monthly Microsc. Jour. **13**: 153-155.

HOLLIS, F. S. 1901. On the distribution of growths in surface water supplies and on the method of collecting samples for examinations. Trans. Amer. Microsc. Soc. **22**: 49-62.

HUBER-PESTALOZZI, G. 1938-1961. Das Phytoplankton des Süsswassers. Vol. 16 Pt. 1-5. *In:* Thienemann, A. (ed.) Die Binnengewasser. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.

HUTCHINSON, G. E. 1944. Limnological studies in Connecticut VII. A crictical examination of the supposed relationship between phytoplankton periodicity and chemical changes in lake water. Ecology **25**: 3-26.

HYLANDER, C. J. 1922. Preliminary report of the desmids of Connecticut. Rhodora **24**: 213-224.

———— 1924. Supplementary report on the desmids of Connecticut. Rhodora **26**: 203-210.

———— 1928. The algae of Connecticut. Conn. Geol. and Nat. Hist. Surv. Bull. **42**. Hartford. 245 pp.

IRÉNÉ-MARIE. 1938. Flore Desmidiale de la region de Montreal. Laprairie, Canada. 547 pp.

JAO, C. 1934. *Oedogonium* in the vicinity of Woods Hole, Massachusetts. Rhodora **36**: 197-214.

———— 1936. Notes on *Oedogonium* and *Bulbochaete* in the vicinity of Woods Hole, Massachusetts. Rhodora **38**: 67-73.

KENNEDY, A. S. 1948. The algal environment in relation to fish. Jour. New Eng. Water Wks. Assn. **62**: 196-201.

LAMBERT, F. D. 1909. Two new species of Characium. Rhodora **11**: 65-74.

LEWIS, I. F. 1924. The flora of Penikese, fifty years after. Rhodora **26**: 181-195; 211-220.

———— and W. R. TAYLOR. 1921. Notes from the Woods Hole Laboratory, 1921. Rhodora **23**: 249-256.

———— 1929. Notes from the Woods Hole Laboratory, 1928. Rhodora **30**: 193-198.

LUND, J. W. G. 1954. The seasonal cycle of the plankton diatom *Melosira italica* (Ehr.) Kutz., subsp. *subarctica* O. Mull. Jour. Ecol. **42**: 151-179.

———— 1955. Further observations on the seasonal cycle of *Melosira italica* (Ehr.) Kutz., subsp. *subarctica* O. Mull. Jour. Ecol. **43**: 91-102.

MOORE, G. T. 1899. The pollution of water supplies by algae. Rhodora **1**: 100-102.

PALMER, C. M. 1942. Additional records for algae, including some of the less common forms. Butler Univ. Bot. Stud. **5**: 224-234.

———— 1958. Algae and other interference organisms in New England Water Supplies. Jour. New Eng. Water Wks. Assn. **72**: 27-46.

PARKER, H. N. 1911. Note on a growth of *Synura* in Lake Cochituate, Mass. Trans. Amer. Microsc. Soc. **30**: 141-144.

PATRICK, R. 1943. The diatoms of Linsley Pond, Connecticut. Proc. Acad. Nat. Sci. Phila. **95**: 53-110.

———— and C. W. REIMER. 1966. The diatoms of the United States exclusive of Alaska and Hawaii. Vol. 1. Monograph No. 13, Acad. Nat. Sci. Phila., Philadephia. 688 pp.

POULTON, E. M. 1930. Further studies on the Heterokontae: Some Heteronkontae of New England, U.S.A. New Phytologist **29**: 1-26.

PRESCOTT, G. W. 1935. Notes on the desmid flora of New England I. The genus *Euastrum* in Massachusetts. Rhodora **37**: 22-29.

———— 1935. Notes on the desmid flora of New England II. Desmids from Cape Cod and the Elizabeth Islands. Rhodora **37**: 113-121.

———— 1962. Algae of the western great lakes areas. Rev. Ed. Wm. C. Brown., Publishers, Dubuque. 977 pp.

———— and H. T. CROASDALE. 1937. New or noteworthy freshwater algae of Massachusetts. Trans. Amer. Microsc. Soc. **56**: 269-282.

———— 1942. The algae of New England II. Additions to the freshwater algal flora of Massachusetts. Amer. Midl. Nat. **27**: 662-676.

RILEY, G. A. 1940. Limnological studies in Connecticut III. The plankton of Linsley Pond. Ecol. Monogr. **10**: 279-305.

SETCHELL, W. A. 1895. Notes on some Cyanophyceae of New England. Bull. Torrey Bot. Club **22**: 424-431.

SMITH, G. M. 1920. Phytoplankton of the inland lakes of Wisconsin. Part I. Wisconsin Geol. Nat. Hist. Surv. Bull. No. 57. Madison. 243 pp.

———— 1924. Phytoplankton of the inland lakes of Wisconsin. Part II. Wisconsin Geol. Nat. Hist. Surv. Bull. No. 57. Madison. 227 pp.

———— 1950. The fresh-water algae of the United States. 2nd ed. McGraw-Hill Book Co., Inc., New York. 719 pp.

SPENCER, J. L. 1950. The net phytoplankton of Quabbin Reservoir, Massachusetts, in relation to certain environmental factors. Ecology **31**: 405-425.

STONE, G. E. 1900. Flora of Lake Quinsigamond. F. S. Blanchard and Co., Printers, Worcester, Mass. 12 pp.

TAYLOR, W. R. 1921. Additions to the flora of Mt. Desert, Maine. Rhodora **23**: 65-68.

TEILING, E. 1967. The desmid genus *Staurodesmus:* A taxonomic study. Arkiv för Botanik **6**: 467-629.

TERRY, W. A. 1907. A partial list of Connecticut diatoms with some account of their distribution in certain parts of the state. Rhodora **9**: 125-140.

UNGER, W. B. 1941. A preliminary survey of the protozoa of Beaver Lake near Salsbury Cove, Maine. Bull. Mt. Desert Island Biol. Lab. 17-18.

WEBBER, E. E. 1961. A list of algae from selected areas in Massachusetts. Rhodora **63**: 275-281.

———— 1964. A rare blue-green alga from Massachusetts. Rhodora **66**: 163-164.

WEST, G. S. and W. WEST. 1904-1912. A monograph of the British Desmidiaceae. Vol. 1-4. The Ray Soc., London.

WEST, G. S., W. WEST, and N. CARTER. 1923. A monograph of the British Desmidiaceae. Vol. 5. The Ray Soc., London.

WEST, W. 1888. The desmids of Maine. Jour. Bot. **26**: 339-340.

———— 1889. List of desmids from Massachusetts. Jour. Roy. Microsc. Soc. **9**: 16-22.

———— 1889. The freshwater algae of Maine. I. Jour. Bot. **27**: 205-307.

———— 1891. The freshwater algae of Maine II. Jour. Bot. **29**: 353-357.

———— and G. S. WEST. 1895. New American algae. Jour. Bot. **33**: 52.

WHELDEN, R. M. 1939. Notes on New England Algae I. *Cyclonexis* and *Actidesmium*. Rhodora **41**: 133-137.

———— 1942. Notes on New England Algae II. Some interesting New Hampshire algae. Rhodora **44**: 175-187.

———— 1943. Notes on New England Algae III. Some interesting algae from Maine. Farlowia **1**: 9-23.

WHIPPLE, G. C. 1894. *Synura*. Amer. Monthly Microsc. Jour. **15**: 257-262.

———— 1897. Biological studies in Massachusetts. No. 2. Amer. Nat. **31**: 576-581.

———— and H. N. PARKER. 1899. Note on the vertical distribution of *Mallomonas*. Amer. Nat. **33**: 485-491.

WILLE, N. 1899. New forms of green algae. Rhodora **1**: 149-150.

WOLLE, F. 1877. Freshwater Algae II. Bull. Torrey Bot. Club **6**: 137-141.

———— 1877. Freshwater Algae III. Bull. Torrey Bot. Club **6**: 181-189.

———— 1880. Freshwater Algae IV. Bull. Torrey Bot. Club **7**: 43-48.

WOOD, H. C. 1869. Desmids from the White Mountains. Proc. Acad. Nat. Sci. Phila. 1869: 15-19.

———— 1872. A contribution to the history of the freshwater algae of North America. Smithsonian Institute Contribution to Knowledge **19**: 1-262.

WRIGHT, R. T. 1964. Dynamics of a phytoplankton community in an ice-covered lake. Limnol. Oceangr. **9**: 163-178.