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THE HOLOPHYTIC PLANKTON OF LAKES ATITLAN AND AMATITLAN, GUATEMALA.

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In the present paper is given a list of the chlorophyl-bearing plankton-elements of the lakes Atitlan and Amatitlan, Guatemala, collected by Dr. Seth E. Meek, of the Field Museum of Natural History, Chicago, during the winter of 1905–1906. Among the material examined were examples of certain plants, *Salvinia natans* (L.), *Ceratophyllum demersum* L., *Ionardia natans* (Ell.) and fragments of *Chara*, which do not belong to plankton.

The holophytic animals are included in this report, partly because they are regarded by some authors as plants, but primarily because plankton studies are essentially ecological rather than taxonomic, the most important division being that which separates the material according to whether it is self-supporting or whether it depends upon organic matter for subsistence.

So far as they could be found, references have been given to publications containing figures of each species listed, and in cases where the original description or other important references could be found they have also been cited.

The attempt has been, not so much to give a complete list of synonyms, as to include, and enable the student to correlate, the names generally known. In looking up the references I have received much assistance from Mr. P. L. Ricker of the U. S. Department of Agriculture, to whom I take this opportunity of expressing my thanks.

The phytoplankton of lakes Atitlan and Amatitlan, so far as the collections indicate, consists exclusively of algæ. None of the minute Lemnaceæ were found: they are, however, usually

taken only in horizontal hauls in sheltered bays, and may on this account have escaped.

The organisms mentioned under the holophytic zooplankton are by some authorities counted among plants, and by others among animals. In some cases the only reason for their being included in the vegetable kingdom appears to be the presence of chlorophyl. In structure they are closely allied to animals everywhere recognized as such and the presence of chlorophyl appears to be simply a physiological adaptation, much as the absence of chlorophyl among parasitic and saprophytic plants is. The structure of various members of the Volvocaceæ is particularly significant in this connection, as the organisms as a whole represent embryonic stages well-known in the animal kingdom and indeed necessary to complete the animal series, while they have no particular significance in the plant series and placed anywhere in that group have always the aspect of foreigners.

In so far as the question of fish food is concerned, or indeed from any point of view, the presence of a small amount of holozoic plankton is much more satisfactory than a large amount of holophytic plankton. A great excess of phyto-plankton is even a disadvantage; in addition to its frequently accumulating in masses as a scum on the surface or along the shore, and there decaying and becoming an offence both to sight and smell, it may sink to the bottom in masses where its decay induces conditions unfavorable to fish life. On the other hand, the presence of holozoic plankton is evidence of at least enough holophytic material to provide food for fishes, and it rarely or never becomes objectionable by its abundance. Most young fishes live on zooplankton, and the phytoplankton is significant mainly as affording pasturage for the zooplankton, and through it for the fish. Even in the case where fishes with herbivorous young are present, the zooplankton offers a more varied food-supply and is of special importance when it comes to the question of introducing other species of fish.

For example, Amatitlan appears to have much more plankton than Atitlan, but unless the young of the fishes of that lake are herbivorous it does not contain nearly so much fish food, as the plankton is mainly holophytic, relatively few entomostraca being present, while in Atitlan, though there is not nearly so much

algæ, entomostraca are quite abundant. Among the holozoic forms, in addition to entomostraca, a rotifer, resembling *Anuræa cochlearis*, is quite abundant, and another, probably *Notholca longispina*, very common.

One of the most striking features of Lake Amatitlan, and perhaps of tropical lakes in general is the indication of "wasserbluethe*" during February, and therefore probably throughout the year. Although the field notes do not make special mention of "wasserbluethe," the presence of *Clathrocystis* and *Anabæna*, both characteristic wasserbluethe plants, together with the notes "abundant on surface," make it almost certain that wasserbluethe is present. This would indicate, also, that probably the same elements of plankton are present and in pretty uniform quantities the year round, so that plankton-taking for a few weeks would be a fair gauge of what was really in the lake at any time. In more northern lakes, or in cooler regions, with extreme seasons, a short series of hauls during a single season would mean almost nothing.

The following is a list of the algæ represented in the collection:

ORDER COCOGONÆ.

1. **Glœocystis rupestris** (Lyngb.).

Palmella rupestris Lyngb., Hydro. Dan., 207, pl. 69, 1819.
Glœcapsa polydermatica Kuetzing, Tab. Phyc., I, 15, Tab. 20, fig. III, 1845; Wolle, F. W. Alg. U. S., 331, pl. CCX, figs. 29–31, 1887.

Glœocystis is very rare in the collection; only one example was noted, this was in a sample of plankton collected from the surface of Atitlan in front of the hotel, February 18, 9 P. M.

It may be remarked that some authors, Wollè in particular, regard this genus as simply the early condition of some higher alga, and place no value on specific distinctions between the various forms. The example seen agrees very well with Wolle's figures and brief description. Compared with Kuetzing's plates it more closely resembles his *quaternata* than any other but in view of the very little significance attached by

* The term "wasserbluethe" is here used to indicate the minute algæ, mostly blue-greens, which come to the surface and form a scum. In this strict sense there was no "wasserbluethe" present. The expression "abundant on the surface," put on many of the labels by me, should have been, "abundant at or near the surface," for nearly all of the algæ so evident to the naked eye were distributed in the stratum of water from the surface to the depth of a meter or more. Where it was driven in masses, apparently by the wind, it nowhere formed a scum on the surface even when the water had been but little if any agitated by the wind for one or more days. "Wasserbluethe" could not be said to exist in the lower half of the lake. The presence of so much *Anabæna flos-aquæ* near the surface in the upper half of the lake certainly indicated that "wasserbluethe" did exist there at least to a limited extent (Meek).

some writers to the species of this genus, I prefer to let it stand among the forms already listed from the American continent.

2. **Microcystis marginata** (Menegh.).

Anacystis marginata Menegh., Nost., 93, Tab. XIII, fig. 4, 1841; Wolle, F. W. Alg. U. S., 329, 1887.

Microcystis marginata, Kuetzing, Tab. Phyc. I, 6, 1845; Kirchner in Eng. and Pr., Nat. Pfl-fam. I, 1a, 56, 1900.

In many of the samples (formalin material) collected in Lake Amatitlan, the solid matter has separated, the heavier material settling to the bottom and the lighter material coming to the top. The surface material is of a bright blue-green color, and is either coarsely flocculent or exceedingly fine in appearance. In case it is coarsely flocculent it is usually composed mainly of *Clathrocystis* (q. v.) along with a few other elements such as *Microcystis*, *Anabæna*, *Gomphosphæria* and the like. When it is exceedingly fine in appearance it is found to be mainly *Microcystis*.

In many cases it occurs in the vertical hauls, in which case it was presumably taken mainly in the upper part of the haul. A few colonies often occur, however, in the bottom material. If any wasserbluethe occurs on the Central American lakes it is probably mainly due to this *Anabæna* and *Clathrocystis*. It occurs in large colonies (a colony of medium size measures 1080μ long and 400μ wide) composed of innumerable minute bright blue-green cells 3–5μ in diameter. The families appeared to be indistinctly arranged in minute looping strings, reminding one somewhat of *Clathrocystis*, although no perforations in the colonies were evident.

The identification of this form with *M. marginata* is not perfectly satisfactory, inasmuch as the thin colorless tegument is not in evidence, and the colonies are considerably too large. The latter matter, however, is merely a matter of coherence, closely related to such local influences as winds and calms. The thalli quite closely resemble the figure of *Microhela firma* ("*Palmella firma* Breb. & Lenorm") in Kuetzing's Tabulæ Phycologia.

3. **Clathrocystis robusta** Clark sp. nov.

Diagnosis: Thallus in younger stages a dense spherical colony of dark blue-green spherical or oval cells, 6–9μ in diameter, surrounded by a spherical envelope of refractive jelly. Plant-body in later stages of growth perforate, clathrate or broken up into elongate rounded lobes. Jelly tardily deliquescent, finally wholly dissolving, leaving the plant-body a densely cohering mass of cells. Colonies quite large and conspicuous. Agrees in form and life history with *Clathrocystis æruginosa* Kuetzing, from which it differs in the much greater size of the individual cells. Color in formalin bright blue. Type material Sample No. 1, collected at Lake Amatitlan, Guatemala, February 1, 1906, by Dr. Seth E. Meek.

The type material will be deposited in the U. S. Museum.

This alga is abundant in the surface material of the collections from Lake Amatitlan, forming a flocculent bright blue-green scum. It is at

hand in all stages of growth from that of a relatively small globular colony to the last stage of old age, and they agree with the stages given in the life history of *Clathrocystis æruginosa* (Kuetzing).

Associated with this plant and apparently intimately connected with its life history is a minute filamentous alga which I identify with some doubt as *Anabæna stagnalis* Kuetz. to be more fully discussed later on. The colonies in their earlier stages are usually free from the *Anabæna* or nearly so, but by the time they have reached middle size, and while the contour of the surrounding jelly is still unbroken, the greater number of colonies are more or less infected, many of them containing the *Anabæna* filaments in great numbers. After the jelly has disappeared, the *Clathrocystis* cells still continue to cohere. In this stage the filaments of the invading alga are very much in evidence, forming indeed a very conspicuous part of the colony, projecting from the periphery of the cell-mass thickly in all directions, giving it a bristly appearance. The mingled mass of filaments and globular cells remind one strongly of sections of lichens with their gonidia and accompanying hyphal filaments.

It does not appear that the *Anabæna* filaments exercise any injurious influence on the *Clathrocystis* cells; they appear to be merely aulophytes. Some colonies that contain them in great numbers appear pale, but the greater number appear healthy and robust as before infection. The filaments, moreover, are not closely applied to the *Clathrocystis* cells but lie loose in the jelly. It is probable that they have a good deal to do with the breaking down and deliquescence of the jelly, but this has always been described as a normal event in the life history of *Clathrocystis* colonies, and no accompanying organisms have been mentioned.

The specimens of *Clathrocystis* at hand agree almost perfectly both in form and color with the figures of *Clathrocystis æruginosa* given in Griffith and Henfrey's Micrographic Dictionary, pl. 5, fig. 9d, and with the other figures in the same plate except in color. They agree fairly well with Wolle's figures (plate CCX, figs. 17, 18, 19, F. W. Algæ), except that the colonies are usually broken up into lobate masses instead of being clathrate. The cells of *C. æruginosa* are variously given as 2.5 to 3.5 and 3 to 4μ. those of *C. robusta* attain a diameter of from 6 to 9μ. In both species the colonies vary greatly in size; they probably attain much larger size when there is little wave-motion.

Probably whatever is true of *Clathrocystis æruginosa* in general in relation to the other life of the lake is true of this. The behavior of that species is such that one can hardly speak of its abundance in general terms, or make general comparisons between different bodies of water except in cases where it has been under long periods of observation, as it is likely to be very much in evidence some days and rare at other times. Apstein (Das Süsswasser plankton, 135) gives an interesting discussion concerning *C. æruginosa*, noting its great abundance on a certain occasion, and discusses its probable relation to fish life. He remarks in substance that it is a common opinion that *C. æruginosa*, with other algæ that form wasserbluethe, is injurious to fishes, but asserts that while this may be true in small ponds, that it is certainly not true

in larger bodies of water. He is of the opinion that it forms an important food supply of Entomostraca.

Clathrocystis robusta is usually associated with *Microcystis*, *Anabæna*, and a few entomostraca.

4. **Gomphosphæria aponia** Kuetzing.

Gomphosphæria aponia Kuetzing, Alg. ag. dulc. Dec. XVI, No. 151 ——; Tab. Phyc. I, 22, Tab. 31, fig. III, 1845; Wolle, F. W. Alg. U. S., 328, pl. CCX, figs. 20, 21, 22, 1887; Kirchner, in Eng. & Pr. Nat. Pfl-fam. I, 1a, 56, fig. 49p, 1900.

Frequently found mixed in with the *Clathrocystis-Microcystis* scum mentioned above; sometimes present on the surface of the material, usually alone in the form of small brown grains. All forms represented the mature condition, and nearly all were bright yellowish brown in color. Each cell usually exhibited a small dark speck resembling an eyespot.

5. **Merismopœdia glauca** (Ehrenberg).

Gonium? glaucum Ehrenberg, Infus., 58, pl. 3, f. V, 1838.

Merismopœdia glauca Kuetzing, Tab. Phyc., V. 13, Tab. 38. fig. 2, 1855; Wolle, F. W. Alg. U. S., 326, pl. CCX, figs. 12–15, 1887; Kirchner in Eng. & Pr. Nat. Pfl-fam. I, 1a, 57, 1900.

Rare. Only one specimen noted; this was in sample No. 1, "Amatitlan in 85 ft. water, towed in about 75 to 65, February 1, 1906, at middle of upper part of lake." It was associated with numerous other algæ.

Order OSCILLATORIACEÆ.

6. **Spirulina tenuissima** Kuetzing.

Spirulina tenuissima Kuetzing, Phyc. Germ., 156, 1845; Tab. Phyc., I, 26, pl. 37, fig. IV, 1845; Wolle, F. W. Alg. U. S., 323, pl. CCX, fig. 3, 1887.

One vial, marked "Jan. 24, dark colored algæ growing in very warm water; left 36 hours, it turned red in bottle, put formal on it then; from upper end of lake," contained a dark blue-green gelatinous stratum consisting almost entirely of filaments of this species. A single filament was also found in a flat gelatinous stratum composed mainly of *Oscillaria* obtained from the surface, between pools of hot water, Laguna, January 13. Diameter of filament (diagonally, along axis of cells) 5μ, short axis of cells 2μ.

The liquid in which the *Spirulina* was kept was of a beautiful amethyst color.

7. **Oscillaria* cruenta** Grunow.

Oscillaria cruenta, Wolle, F. W. Alg. U. S., 312, pl. CCVII, figs. 1–3 and 4–7, and pl. CCVI, fig. 5, 1887.

Abundant, forming a flat gelatinous striated stratum, brownish in

* The name *Oscillatoria* is older than *Oscillaria* and covers a number of the species included in the same genus. As I am unable to find what disposition has been made of these two species in the various revisions through which the group has passed, I leave them under the familiar name *Oscillaria*.

color, about 4 mm. thick, obtained from the surface between pools of hot water, Laguna, January 31.

These filaments do not agree in every respect with any description that could be found, but fit that of *cruenta* more closely than any other. On account of the deviation from the description of that species the following notes are appended:

Filaments slender, 5–8μ in diameter, very light blue-green, with numerous dark brown dots or granulations. No septæ visible; most of the filaments straight, but a great number gracefully undulate; apex bluntly rounded; no coiled forms were seen.

In the jelly mass from which these filaments projected were numerous filaments (*Anabæna stagnalis?*) similar to those found in the *Clathrocystis* colonies, but much longer, the filaments frequently attaining a length of 130μ. There were also present innumerable small cells, probably bacteria.

8. **Oscillaria chlorina** Kuetzing.

Oscillaria chlorina Kuetzing, Phyc. Germ. No. 10; Tab. Phyc., I, 28, 1845; Wolle, F. W. Alg. U. S., 311, 1887.

I identify as this species examples collected by hand and not forming part of the plankton proper. It formed a dirty green, somewhat firm mass, looking much like a fresh-water sponge. Filaments 3μ in diameter, articulations indistinct, the cells about as long as wide.

Order NOSTOCACEÆ.

9. **Anabæna stagnalis** Kuetzing.

Anabæna stagnalis Kuetzing, Sp. Alg., 1849; Tab. Phyc. I, 50, Tab. 93, fig. IV, 1845; Wolle, F. W. Alg. U. S., 288, 1887.

Associated with *Clathrocystis* colonies, as noted above, is a filamentous form, which, after considerable study, I identify with *Anabæna stagnalis* Kuetzing. It resembles in many respects some of Kuetzing's figures of species of *Phormidium*, but all which resemble it are much too large. I have not observed any large heterocysts, which are said to be present in *A. stagnalis*, but otherwise it fits the brief description of that species in Wolle very well. The following notes were taken.

Filaments short, straight, simple (one filament forked somewhat at the end by ending in two diverging cells), usually about 2–8 cells long. Cells usually somewhat elongate, sometimes spherical, turgid. Diameter of filaments 3μ; length of cells about 5μ; length of long filaments about 20μ, color very pale blue-green. Habitat, jelly of *Clathrocystis* colonies.

In a jelly mass surrounding some *Oscillaria* found in one of the samples, much longer filaments (attaining a length of 110μ) of what appears to be the same thing, are abundant. (See under *Oscillaria cruenta.*) It is probable that the firmness of the *Oscillaria* jelly, as well as its freedom from disturbance, permits a much longer growth of this form than in the *Clathrocystis*.

10. **Anabæna flos=aquæ** Brebisson.

Anabæna flos-aquæ Brebisson, "Algues des environs de Falaise. 1835"; Kuetzing Sp. Alg. 289, 1849; Tab. Phyc. I, 51, Tab. 94, fig. IV, 1845; Apstein Süssw-p. 136, fig. 3, 1896; Wolle, F. W. Alg. U. S. 236 (the specimens at hand resemble most closely his figure of var. *circinalis* pl. CXCVIII, figs. 24–26), 1887.

Very common in all the phyto-plankton from Lake Amatitlan, usually found in the *Clathrocystis–Microcystis* scum.

ORDER RIVULARIACEÆ.

11. **Glœotrichia natans** Thuret.

Glœotrichia natans Thuret (Ref. not found); Wolle, F. W. Alg. U. S., 246, pl. CLXXVIII, figs. 4-20, 1887.

This appears in one sample of hand-gathered material, among sponges. The forms at hand are hollow jelly spheres about the size of a hazel-nut and much resembling some of the familiar forms of *Nostoc*. Many of the old, large filaments are brown; but there are many new filaments, some of which are greatly twisted in a rather elongate irregular spiral. The jelly of this species harbors many diatoms and a number of sponge spicules are also present. The plants agree very well with Wolle's description and figures.

CHLOROPHYCEÆ. THE GREEN ALGÆ.

ORDER HYDRODICTYACEÆ. THE WATER NETS.

12. **Raphidium brauni** Nægeli.

Raphidium brauni Nægeli in Kuetzing, Sp. Alg. 891, 1849; Wolle, F. W. Alg. U. S., 198, pl. CLX, figs. 26, 27, 1887.

Not common; several specimens, however, found in material collected from the surface about one hour before dark, Amatitlan, February 16, (Sample 7).

13. **Tetrædron minimum** A. Braun.

Tetrædron minimum Braun. Alg. Unicell. 94, 1855.
Polyedrium minimum, Wolle, F. W. Alg. U. S., 185, pl. CLIX figs. 28–34, 1887.

Not common in the plankton; a few examples were observed in sample No. 6, collected at Lake Amatitlan, February 16, 3 P. M. Diameter of cells from side to side 10μ; diagonal diameter 12μ.

14. **Pediastrum boryanum** (Turpin).

Hierella boryana Turpin, Mem. Mus. Hist. Nat. Paris, 16; 319, pl. 13, fig. 22, 1828.
Pediastrum boryanum Wolle, Desm. U. S., 153, pl. LIII, figs. 29, 32, 1884.

Rare; only one example found, lodged in a mass of *Oscillaria*. In the shape of its cells it resembled Wolle's figure 32. Horns quite short. Diameter of colony seen 70μ, cells 20μ.

ORDER ZYGNEMACEÆ.

15. **Spirogyra maxima** (Hassall).

Zygnema maxima Hassall, Annals of Nat. Hist. X, 36, 1842.
Zygnema orbiculare Hassall, Brit. F. W. Alg. I, 138, pl. XIX, figs. 1, 2, 1845.
Spirogyra maxima Wolle, F. W. Alg. U. S., 218, pl. CXXXIX, figs. 3, 4, 1887.

A large and exceedingly long *Spirogyra*, represented by one vial of rather poorly preserved material, agrees very well with Wolle's description. Pyrenoids prominent, making the spiral bands appear moniliform. Diameter of the specimens at hand 120μ, length of cells 130μ.

Not a plankton species properly speaking. Only the smaller species of *Spirogyra* are occasionaly found freely floating and are taken in the plankton net. All the Spirogyras are, however, intimately associated with plankton, as they form much of the food of rotifers and various insect larvæ.

16. **Spirogyra fluviatilis** Hilse.

Spirogyra fluviatilis Hilse, in Rabenhorst, Fl. Eur. Alg. 3; 243; 1868; Wolle, F. W. Alg. U. S., 216, pl. CXXVI, fig. 1, 1887.

Occurs in two bottles of rather fine filamentous algæ not belonging to the plankton-haul series. The examples agree fairly well with Wolle's description, the chlorophyl bands are broader, and the pyrenoids prominent, giving the bands a somewhat moniliform appearance. Bands about 4, making about 2 turns. Diameter 36μ, length of cells 75μ.

ORDER DESMIDIACEÆ.

17. **Cosmariun retusum** Perty.

Cosmarium retusum Perty, Klein. Lebensf., 208, pl. 16, f. 12 a–d, 1852; Wolle, Desm. U. S., 80, pl. XVIII, figs. 25, 26, 1884.

Not common; a few specimens occurring sporadically in different samples of plankton from Lake Amatitlan. Our specimens agree well with Wolle's figures. One measured 28μ long and 25μ wide at the suture. Wolle gives "diam. of cells about 22μ."

18. **Cosmarium subcrenatum** Hantzsch.

Cosmarium subcrenatum Hantzsch, in Rabenht., Fl. Eur. Alg. 3; 164, 1868; Wolle, Desm. U. S., 84, pl. XVIII, figs. 6, 7; pl. XIX, fig. 20, 1884.

Not abundant, but generally scattered through the plankton samples, one or two individuals occurring on quite a number of the slides from different gatherings. The number of crenulations on the margin do not agree exactly with those mentioned in descriptions, but the examples bear a very close resemblance to published figures. An average specimen measured 24μ long and 22μ wide at the suture.

19. **Staurastrum gracile** Ralfs.

Staurastrum gracile Ralfs, Ann. Nat. Hist. 15; 155, pl. 11, f. 3, 1845; Wolle, Desm. U. S., 133, pl. XLIII, figs. 16, 17, 1884.

Not common, but single individuals were frequently found scattered through the other plankton-algæ of Lake Amatitlan. A few examples were observed dividing. Our average specimens have a length of 40μ, and length of arm 50μ.

20. **Staurastrum evermanni** Clark sp. nov.

Diagnosis: End view a slender, long-armed triangle with concave sides; main axis of the body slender, enlarged into bulbous swellings at the junction of the semi-cells; chloroplasts bright green, regular, following the general form of the group; periderm prickly; length of individual arms from center of body about 55μ; length of the long arms of the H-shaped figure formed by the desmid in side view 110μ; length of axis 40μ, its average width 10μ; arms each ending in stout diverging spines; asexual reproduction of the species, frequent in the material at hand, and, as usual in the group, by the formation of new semi-cells joining the old. Type material, plankton sample No. 14, collected at a surface towing in front of Hotel Laguna, Lake Amatitlan, Guatemala, February 5, at 9 P. M. by Dr. Seth E. Meek.

The type material will be deposited in the U. S. National Museum.

This species is very common in some of the plankton, nearly all the samples containing a few plants, and the type sample contained it in marked abundance. In end view this desmid almost exactly resembles *S. pseudobaldi* Wille, as figured by Wolle (Desm. U. S., pl. XLVI, fig. 9), and the side view is more like that of *S. macrocerum* Wolle (figured in Desm. U. S., pl. XLIII, fig. 4) than any other species of which I can find figures. It differs from that species, however, in the arms being more nearly straight and more slender, and particularly in the elongate, slender body, the ends of which terminate at the junction of the semi-cells in a well-marked bulb-like expansion. I take great pleasure in naming this attractive species for Dr. Barton Warren Evermann, of the U. S. Bureau of Fisheries.

ORDER DIATOMACEÆ.

21. **Epithemia turgida** (Ehrenberg).

Navicula turgida Ehrenberg. Phys. Abh. Akad. Wiss. Berlin, 1830, 64, 1830.

Epithemia turgida Griff. and Henf. Mic. Dict. 299, pl. 16, fig. 32, 1883, Wolle, Diatom, N. A., pl. XXXV, figs. 10–13, 1890, Van Heurck, Treat. Diatom. (Baxter trans.), 294, fig. 66, and pl. 9, fig. 346, 1896; Stokes, Aquat. Mic. 94, fig. 70, 1896. West, Brit. F. W. Alg., 300, fig. 142, 1904.

Rather rare, only occasional specimens having been seen in the gatherings.

22. **Fragilaria crotonensis** Kitton.

Fragilaria crotonensis Kitton, Science Gossip, 110, fig. 81, 1869; Van Heurck, Treat. Diatom., 324, p. 11, fig. 44, 1896.

Several examples which I identify with some doubt as this species were found in sample No. 5, collected February 16, at the depth of 120 feet of St. Lucas. They agree fairly well with Van Huerck's figures.

23. **Melosira crenulata** (Ehrenberg).

Gallionella crenulata Ehrenberg, Phys. Abh. Akad. Wiss. Berl., 1841; 441, pl. 3, fig. 28, and p. 444, pl. 4, fig. 31, 1843.

Melosira crenulata Wolle, Diatom. U. S. pl. LVII, fig. 16–20, 1890; Van Huerck, Treat. Diatom., 443, pl. 19, fig. 618, 1896.

One of the most striking features of the Amatitlan plankton is the abundance of *Melosira*, which is found abundantly in the bottom of nearly all the hauls and usually makes up the main mass of the filamentous material. Samples of the mud from the bottom of the lake are also full of the frustules of this species. Although not agreeing in every respect with the descriptions found of *M. crenulata* it approaches it more nearly than anything else I can find described, and I provisionally identify it as that species. The frustules are, in some cases at least, broader than long (some measured specimens being 20μ in diameter with cells 15μ long) which is not the proportion for *crenulata*, in which the cells are longer than broad. The specimens occur as long, rigid filaments, exceedingly and surprisingly various in diameter. The chloropasts are in the form of green oval bodies about the middle of the cell, so that the general appearance is strikingly like a confervoid alga, the differences only appearing manifest upon sharp focussing which reveals the characteristic diatom sculpture on the cell walls. The old cell walls project from the end of the filament in the form of long sharp needles, one usually being longer than the other, and there are traces of minute teeth along the ends of the filament. As Hassall (Brit. F. W. Alg., I, 397) aptly remarked, "The genus *Melosira* amongst the Diatomaceæ seems to have been constituted with a view of making apparent the affinity between the Diatomaceæ and the algæ proper" (this was written when the relationship of the diatoms was still a matter of doubt, some contending that they belonged to the animal kingdom).

Concerning another species (*varians*) of *Melosira*, Apstein (Süssw–p., 140) makes the following significant remarks, which are also probably applicable in the case of this species:

"*Melosira* habe ich direkt als Nahrung von *Bosminien*, *Daphnien* und *Diaptomus* schon 1892 (Biol. Centralblatt Bd. 12, No. 16, 17, 1 Sept., 1892) nachweisen konnen bei denen ich die zellen dieszer Algen deutlich und zahlreich im Darm sehen konnte."

ORDER ULOTHRICHACEÆ.

24. **Hormospora** sp.?

Hormospora forms, consisting usually of 4–8 very short dark green cells, arranged in a short filament and surrounded by quite thick cell walls, were

quite common in some of the samples of plankton. Wolle (F. W. Alg. U. S. 189) regards *Hormospora* as a "pseudo-genus" composed of stages of degeneration of filaments of *Ulothrix*, *Conferva*, etc. All the specimens seen were much alike, showing no young stages nor mature forms. Moreover, there was no other alga present that could readily give rise to such forms. This alga was found in samples 4, 5 and 6.

25. **Microspora fontinalis** (Berkeley).

Conferva fontinalis Berkeley, in Sowerby, Eng. Bot. 29, pl. 2054, 1809; Wolle, F. W. Alg. U. S. 141, pl. CCX, figs. 17–20, 1887.

I identify with the species called *Conferva fontinalis* Berk., by Wolle, an alga which occurs somewhat sparsely through the plankton, most abundantly in sample 5, from near St. Lucas, February 16. No form of reproduction was observed, and the chlorophyl is aggregated in the center of the cell, appearing in the form of small elliptical globoids, somewhat suggesting gonidia ready to escape; cell-walls thin; diameter of filament 18μ; length of cells about 190μ.

Precisely the same as the above in structure and appearance, but differing markedly in size (diameter 3.5μ, length of cells 38μ) are forms which would for the present better be regarded as young individuals of the same species. They occur abundantly among the filamentous material of the greater number of samples from Lake Amatitlan.

Wolle gives the characters of "*Conferva fontinalis*" as "diameter of filaments 15–18μ, articulations 6–10 times as long as wide" and reports it from fresh-water ponds and lakes in Florida. In looking up the original description of *Conferva fontinalis*, I find it to be very poorly defined. Wolle's plant does not appear to be the same species, but it is a form with such a complete absence of diagnostic characteristics that I prefer to let it stand as it is.

26. **Conferva gyrans** Clark sp. nov.

Diagnosis: Filaments simple, rather short, consisting of about 3–8 cylindrical cells, the whole plant-form assuming the shape of an open spiral; cells three times as long as wide. Plants exceedingly various in size, the largest being 25μ in diameter with cells 80μ long. Cell walls thin, chloropasts in formalin material bright green, elongate or spherical, arranged irregularly in the center of the cell; ends of filaments truncate, formed by one of the former septæ, the remains of the old cell-walls projecting beyond, and suggesting that the terminal cells may allow their contents to escape as reproductive bodies, and then gradually break down. Type material, plankton sample No. 3. Collected in Lake Atitlan, Guatemala, in front of the hotel, February 18, 1906, 9 P. M., by Dr. S. E. Meek. The type material will be deposited in the U. S. National Museum.

Scattered through the plankton samples from Lake Atitlan, nowhere abundant, but occurring quite commonly in some samples, is an alga which is unlike anything of which I can find any description or figures. The filaments are twisted in the form of a corkscrew, and are very inconspicuous, hardly visible to the naked eye because of their transparency. They

vary greatly in size, some filaments being 25μ in diameter with the cells 80μ long, while others are only 10μ in diameter. The peculiar arrangement of the chlorophyl as described in the diagnosis above may represent the formation of gonidia, but the smaller plants have this arrangement as well as the old. It is probable that the plant is reproducing, and that the gametes or gonidia have recently escaped from the ends of the larger filaments, the peripheral walls of which project considerably beyond the terminal septæ in many instances.

West's notes on the genus *Tribonema*, a generic name which has been proposed for *Conferva* which some authors do not regard as having been sufficiently defined (Brit. F. W. Alg. 256) fit in well with this species and appear to point out pretty clearly where it should belong. The chromatophores are parietal, "Asexual reproduction takes place by globular or ellipsoidal aplanospores and it is related to *Ophiocytium*." In its habit of curling in the fashion of a corkscrew it bears a strong superficial resemblance to *Ophiocytium*, but can be distinguished from the species of that genus at once by the numerous septæ and truncate ends. The peculiar spiral growth, however, is possibly merely physiological, and may be, as Ostenfeld has pointed out in the case of a much curved form of *Melosira granulata* noted in one of the lakes of Iceland (Journ. de Botanique, Bot. Tids. Kjobenhaven, XXVI, fasc. 22, p. 233), "an interesting adaptation to the limnetic condition."

Order ŒDOGONIACEÆ.

27. **Bulbochæte** sp.

A few sterile plants of *Bulbochæte* were found mixed in with the *Glœotrichia*, but on account of their sterile condition, I could not identify them with any degree of certainty. The following notes were made:

Cells rather short and stout, somewhat turgid, the diameter from 15 to 18μ, the length from 25 to 28μ; each living cell contains a bright, large eye-spot, and a number of cells are empty. Filament rather well branched; lateral setæ short with a small bulb; terminal setæ long and slender, occasionally terminating in a clavate expansion.

The following is a list of the holophytic species occurring in the Zooplankton. Besides these, rotifers and entomostracans were present in considerable numbers.

Order FLAGELLATA.

1. **Cœlastrum microporum** Naegeli.

Cœlastrum microporum Nægeli (Ref. not found) Wolle, F. W. Alg. U. S. 171, 1887.

Not uncommon, a few specimens found scattered through samples No. 19 (February 5, Amatitlan, towing made at noon from bottom to top in 110 feet of water) and No. 20 (Lake Amatitlan in front of hotel, Jan-

uary 17). None of these specimens showed the tubercles on the cells shown in many illustrations, but according to descriptions and a few figures, these may be absent. One colony appeared to possess eye-spots, one in each cell. One colony examined measured 60μ diameter, cells 15μ. Full grown colonies are said to attain a diameter of 40–100μ, and individual cells as much as 25μ.

2. **Eudorina stagnale** Wolle.

Eudorina stagnale Wolle, F. W. Alg, U. S., 160, pl. CLII, figs. 11–21, 1887.

This is one of the common elements of the plankton. It occurred in the greater number of samples, never in great abundance, but usually several and often numerous examples could be seen in the field of the microscope at the same time. It was quite frequently found in stages of active division.

There is probably little if any difference between this and the European form *elegans*. Schmidle, in a recent article on Algæ from Brazil (Hedwigia, Vol. 40, 46), identifies the Eudorina found there as *elegans*.

Order DINOFLAGELLATA.

3. **Peridinium tabulatum** (Ehrenberg).

Glenodinium tabulatum Ehrenberg, Inf. 257, Taf. XXII, fig. XXIII, 1838.

Peridinium tabulatum, Kent, Man. Inf., I, 448, III, pl. XXV, figs. 1–5 and 55–57, 1880–1882; Griffith and Henf., Mic. Dict., 1883; Apstein, Süssw-p., 152, fig. 52, 1896.

Common or abundant in most of the plankton. The form at hand is that with the cleft anterior portion; diameter of a specimen measured, 63μ. Griffith and Henfrey give the length as 1–480″ which reduces to 52μ.

All our examples appear to be of nearly uniform size. They are exceedingly abundant in sample 8, collected at the west end of Lake Amatitlan on the surface. This catch consisted mostly of insect exuviæ and it is worthy of remark that the greater number of the Peridiniums were crowded densely in the cast-off skins as if they had worked their way in for food or shelter.

4. **Ceratium hirundinella** (O. F. Müller).

Bursaria hirundinella O. F. Müller, Vermium terrest., I, 63, 1773.

Ceratium longicorne (Perty) Kent. Man. Inf., I, 457, III, pl. XXV, fig. 26, 1880–1881.

"*Ceratium macroceras* Shrank" Ref. not found.

Ceratium hirundinella, Apstein. Süssw-p., 149, figs. 48–50, 1896.

Rather common, scattered through most of the phytoplankton from Lake Amatitlan, and also in the Atitlan material. Our specimens agree

very well with the figures in Kent, and those in the Riverside Natural History. All are robust and quite rough.

This species is almost cosmopolitan, having been reported from England, India (Kent), the Great Lakes (Riverside Nat. Hist.), and from lakes in Iceland. (I have so far found none in material examined from Lake McDonald, Alaska, though there are several other species represented.) Apstein (l. c.), notes slender 3-horned specimens as occurring in the Dorbersdorf Lakes. All the examples seen from Lake Atitlan are 4-horned but many, perhaps the majority, from Lake Amatitlan, are 3-horned. They do not appear to be more slender than the others however. Kent gives the sizes as "length 1–120″ to 1–90″ 208μ–277μ." The examples at hand measure 220μ long and 70μ wide at the broadest portion of the body.

Clark, H. Walton. 1908. "The holophytic plankton of Lakes Atitlan and Amatitlan, Guatemala." *Proceedings of the Biological Society of Washington* 21, 91–105.

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