AFRICA

Notes on the phytoplankton of Victoria Nyanza, East Africa.

C. H. OSTENFELD.

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No. 10. *Notes on the Phytoplankton of Victoria Nyanza, East Africa.* By C. H. Ostenfeld.

1. General Remarks.

From Dr. Alexander Agassiz I received some few plankton samples from Lake Victoria Nyanza, East Africa, with the request to examine their microflora. As I have, quite recently, published a paper on the same subject I agreed with pleasure to the proposal, and I extend to Dr. Agassiz my sincere thanks for placing this material at my disposal and for giving me permission to illustrate it so richly.

The samples in question were collected on the 21st and 23d of February, 1908, respectively, and their main interest lies in this early date, as the knowledge of the plankton of this large lake hitherto has been based upon collections from April (1905, Dr. Cunnington), October (1892, Dr. Stuhlmann), and November (1904, Dr. Borgert); furthermore the earlier collections were from places in the northern and western parts of the lake [1], while Dr. Agassiz's samples were taken in the harbor of Mwanza and off Shirati, both places on the southern shore of the lake.

I have had five samples at my disposal, but as they are from only the two localities just mentioned, I prefer to take them as corresponding to but two numbers. I do not know with certainty the number of silk gauze used, but I have been informed that it is rather wide-meshed, which perhaps may explain, to some degree, the scarcity of some of the smaller phytoplanktonts.

The above given dates of earlier plankton collections show how little we know the plankton of Victoria Nyanza. The few (7) samples collected by Dr. Stuhlmann in 1892 have been examined — with regard to the phytoplankton of which only I speak here — by Prof. W. Schmidle [2]; three samples from the third British Tanganyika Expedition of 1905

[1] As to the collection made by Dr. Stuhlmann, it was taken "an verschiedenen Stellen des Sees."

[2] Schmidle, W., Botan. Jahrb., 1898, 26, p. 1–59, pl. 1–4; 1902, 33, p. 1–33.

have been published, together with the examination of the phytoplankton from Lake Nyassa and Lake Tanganyika by Mr. G. S. West[1]; and the few (7) samples brought home by Dr. A. Borgert in 1904 have been worked out by me in the paper mentioned above where I[2] have put together all the few data on the phytoplankton of Victoria Nyanza and have compared them with the statements of the phytoplankton of Lake Nyassa[3].

Referring to this paper I quote some of its main results: —

"The phytoplankton of Victoria Nyanza and Lake Nyassa bear a great resemblance to each other, the dominant species being the same in both lakes. Both lakes are characterized by rare tropical species, some of which are common to both lakes, others of which are restricted to one of them.

"In spite of their extensive areas the lakes contain a phytoplankton which must be spoken of as a pond plankton ('lac-étang' plankton, in *Chodat's* sense), not as a true lake plankton, and the tycholimnetic species play a great part in the composition of the plankton.

"The phytoplankton of Victoria Nyanza itself is characterized by Microcystis, Anabaenae, Lyngbyae, Melosirae, Surirellae, Cymatopleurae, Nitzschiae, numerous Protococcales, and many Desmidiaceae (especially Staurastrum species); it is richer in species than that of Lake Nyassa, especially through the occurrence of many Desmids."

As to the seasonal changes in the composition of the plankton our knowledge is too limited to say anything more definite, but in this particular respect the two samples collected in February by Dr. Agassiz are interesting, as compared with the samples later in the year from April, October, and November; they show that *the Diatoms* (especially Melosira) *are dominant in the early spring, while later in the year the Green Algae and Blue-green Algae reach their maximum.* This change corresponds to the normal changes in the composition of the lakes in the lowland of the temperate Europe ("The Baltic Fresh-water Plankton," of C. Wesenberg-Lund).[4] In my paper I have suggested something in

[1] West, G. S., Journ. Linnean Soc. London, Botany, 1907, **38**, p. 81–197, pl. 2–10.

[2] Ostenfeld, C. H., Botan. Jahrb., 1908, **41**, p. 330–350.

[3] See Schmidle, W., Botan. Jahrb., 1899, **27**, p. 229–237; 1901, **30**, p. 240–253, pl. 4–5; 1902, **32**, p. 56–88, pl. 1–3; 1902, **33**, p. 1–33; and Müller, Otto, Botan. Jahrb., 1903, **34**, p. 9–38, pl. 1–2; p. 256–301, pl. 3–4; 1905, **36**, p. 137–205, pl. 1–3.

[4] See C. Wesenberg-Lund, Plankton Investigations of the Danish Lakes. General Part, 1908, Copenhagen, p. 281, etc.

this way in saying of the samples from April collected by Dr. Cunnington (*l. c.*, p. 344): "nur treten die Schizophyceen (Myxophyceen) in diesem Frühjahrs-Plankton zurück." But it is not until we have the still earlier samples collected by Dr. Agassiz that we may be justified in drawing a conclusion concerning the seasonal change and its resemblance to the seasonal changes of the "Baltic fresh-water plankton."

Nevertheless, there are many differences between the plankton of Victoria Nyanza and Lake Nyassa on the one hand and that of temperate Europe on the other; *e. g.*, it seems that the following dominant species of temperate Europe, viz., Asterionella, *Fragilaria crotonensis* and *Ceratium hirundinella*, are wanting or, with regard to the last species, of small importance in the large African lakes, while on the other side those lakes contain a number of beautiful forms of Surirella and the numerous Desmids. The last feature they have in common with the lakes of West Europe (Great Britain), but the species are different.

The consecutive order of the plankton maxima in Victoria Nyanza is, then, if we may be allowed to judge from our present very limited knowledge, the following: —

February (A. Agassiz): *Melosira Agassizii* dominates, other Diatoms of less importance, Green and Blue-green Algae rather scarce.

April (Cunnington): Green Algae, both Desmids and Protoccoideae dominate; Diatoms of less importance; Blue-green Algae rather scarce.

October (Stuhlmann) and *November* (A. Borgert): Myxophyceae dominant, but both Green Algae (especially *Botryococcus Braunii*) and Diatoms (*Melosira nyassensis* and Surirellae) subdominant. Plankton very rich in species and individuals.

From this fragmentary picture it will be evident how necessary and important it would be to get a regular plankton investigation of Victoria Nyanza throughout a year at least, and with short intervals (a week or a fortnight). It is my hope that this gap in our knowledge of the fresh-water plankton of the earth may soon be realized.

2. The Samples from Mwanza and Shirati.

The phytoplanktons present in the two February samples from Mwanza and Shirati are not so abundant with regard to both species and individuals as the organisms recorded from Victoria Nyanza samples taken later in the year.

The accompanying table will show the species found in the samples and, further, their relative frequency given in the ordinary way, viz., cc denotes "dominant," c "common," + "not common nor rare," r "rare,"

and rr "very rare" (only a single or few individuals seen). With regard to the frequency the above mentioned circumstance, that the silk gauze used was relatively wide-meshed, must be remembered.

PHYTOPLANKTON FROM VICTORIA NYANZA,
FEBRUARY, 1908.

Species.	Shirati.	Mwanza.	Species.	Shirati.	Mwanza.
Peridiniales.			*Chlorophyceae.*		
Ceratium hirundinella (O. F. Müll.) Schrank, var. brachyceras (v. Dad.) Ostf.	rr	...	Botryococcus Braunii Kütz.	rr	rr
Bacillariales.			Closteriopsis longissima Lemm.	r	rr
Cymatopleura solea (Brèb.) W. Sm., et varr.	+	r	Coelastrum cambricum Archer, var. Stuhlmanni (Schmidle)	rr	rr
Melosira Agassizii nov. sp.	cc	+	Coelastrum reticulatum (Dang.) Senn.	rr	...
Melosira nyassensis O. Müll. f. Victoriae, O. Müll.	r	r	Dictyosphaeriumpulchellum Wood	...	rr
Stephanodiscus astraea (Ehrenb.) Grun.	rr	rr	Oocystis lacustris Chod., var.	rr	rr
Surirella nyassae O. Müll.	rr	...	Pediastrum boryanum (Turp.) Menegh., var. granulatum (Kütz.) A. Br.	r	...
— var. malombae (O. Müll.)	r	r	— var. rugulosum G. S. West	rr	...
— var. Engleri (O. Müll.)	r	rr	Pediastrum duplex Meyen	rr	rr
Surirella bifrons (Ehrenb.) Kütz.	rr	...	Pediastrum simplex Meyen, var. clathratum (Schröter)	r	rr
Surirella Fülleborni O. Müll., var. elliptica O. Müll.	rr	rr	Scenedesmus bijugatus (Turp.) Kütz.	...	rr
Myxophyceae.			Scenedesmus quadricauda (Turp.) Brèb.	rr	...
Anabaena flosaquae (Lyngb.) Brèb.	rr	rr	Staurastrum gracile Ralfs, var. subornatum Schmidle	rr	...
Chroococcus limneticus Lemm.	rr	rr	Staurastrum leptocladum Nordst., f. africana G. S. West	r	rr
Lyngbya Lagerheimii (Möbius) Gomont	r	+	Staurastrum limneticum Schmidle	r	...
Lyngbya limnetica Lemm.	rr	rr	Staurastrum tohopekaligense Wolle	rr	...
Microcystis aeruginosa Kütz.	r	+			
Microcystis incerta Lemm.	...	rr			

The prominent forms are the Diatoms of which again one species is dominant, viz., *Melosira Agassizii*, sp. nov.; this species which is closely related to *M. granulata* occurs also in the plankton in April (recorded by G. S. West, *l. c.*, p. 147, as *M. granulata*) and in November (recorded by me, *l. c.*, p. 338, as *M. aff. granulata*), but is both in April and November less abundant than *M. nyassensis*, while in February *M. Agassizii* is more

abundant than *M. nyassensis*. *Melosira nyassensis* and the forms of Surirellae are less abundant in February than later in the year, and *Nitzschia nyassensis* is very rare.

In the samples from Shirati I have found a few species of the peculiar form of *Ceratium hirundinella* which inhabits Victoria Nyanza. It has also been recorded from April, October, and November, but at all times very sparsely. It would be quite strange if this organism, which in temperate lakes plays so dominant a part in the composition of the plankton and which always has a great maximum of development, should not behave in the same manner in Victoria Nyanza, but hitherto we have no indications as to this point.

If we pass over to the *Green Algae* we find that several species have been found in the February samples, but that all are very rare, and it must be added that some of the individuals met with were dead, especially among the species of Staurastrum. Also the *Blue-green Algae* are very unimportant in the samples, only *Microcystis aeruginosa* and *Lyngbya Lagerheimii* reaching to +. Of these Microcystis occurs in colonies of a peculiar kind, the mucus-envelope being unusually firm (a resting stage?); *Lyngbya Lagerheimii* is a tycholimnetic species carried out in the water from the shore and bottom by the waves.

The table shows further that there is very little difference between the two samples.

3. Remarks on Some of the Observed Species.

A. Peridiniales.

Ceratium hirundinella (O. F. Müll.) Schrank, var. *brachyceras* (v. Dad.) Ostf., *l. c.*, p. 345; *C. brachyceros* E. v. Daday, Plankton-Tiere aus dem Victoria Nyanza, in Zool. Jahrb. Abt. f. System., 1907, 45, p. 251, fig. A; *C. hirundinella*, G. S. West, *l. c.*, p. 189, pl. 9, fig. 4.

The form of Ceratium which occurs in Victoria Nyanza is, as above mentioned, a very aberrant one. E. v. Daday has described it as a new species closely related to *C. hirundinella* and has given a rather rough drawing of it. At about the same time G. S. West recorded it as *C. hirundinella* and figured it very well. His description contains the main points in which it differs from typical *C. hirundinella*. He says that "the few specimens observed differed very much from any others which have come under my notice." The more important differences from *C. hirundinella* are: (1) the short and clumsy horns, (2) the very much reduced second antapical horn and its place close to the first one,

much nearer than in the typical form, (3) the strong reticulation of the plates. In all these respects the Victoria Nyanza Ceratium comes near to *C. cornutum* (Ehbg.) Clap. & Lachm. In my former paper on Victoria Nyanza plankton, following West, as I had not seen any entire and undamaged specimen, I have considered it as merely a form of *C. hirundinella*, but now, when I have examined better material, I must admit that its diversity from the type is so great that it deserves at least varietal rank.[1]

With regard to the arrangements of the plates which have not been given by either of the two earlier observers, my drawings (pl. 2, figs. 15 and 16) show that the arrangement is quite typical (see C. A. Kofoid, Zool. Anzeiger, 1907, 32). I have also given a drawing of a specimen with its plasma protruding as a spherical body outside longitudinal furrow (pl. 2, fig. 17). All the few specimens observed were found in this condition, which remind us of the observations on copulation in *Ceratium hirundinella* first described by E. Zederbauer (Ber. Deutschen Botan. Ges., 1904, 22, p. 1–8, pl. 1). The specimens observed varied between 150 μ and 165 μ in length.

B. Bacillariales.

The plankton Diatoms present in the samples are *Nitzschia nyassensis* O. Müll., *Stephanodiscus astraea* (Ehbg.) Grun., *Cymatopleura solea* (Bréb.) W. Sm., with several varieties, some forms of Surirella, and two species of Melosira.

Cymatopleura solea occurs in the following varieties which apparently are connected through intermediate forms: 1. *typica*, 2. *subconstricta* O. Müll., 3. *clavata* O. Müll., 4. *laticeps* O. Müll., and 5. *nyanzae* G. S. Westpro sp.

Surirella. The many handsome forms of this genus have attracted the attention of all former observers. In his excellent paper on the Nyassa Diatoms Professor Otto Müller treats them in great detail and describes a number of new species from Lake Nyassa and adjacent lakes. G. S. West also records many species from Lake Nyassa, from Victoria Nyanza, and from Lake Tanganyika; he points out (*l. c.*, p. 165) with regard to some of the species that there occur intermediate stages between them. When I studied the Victoria Nyanza samples collected by Professor A. Borgert, I could not identify the specimens observed with Müller's species as they seemed to form continuous series from one species to another. I therefore asked Professor Müller to examine my slides, and this he did with his usual readiness, and placed at my disposal the results of his examination, permitting me to publish them in my paper. From his notes therein I quote the following sentences, which show that my suggestion on the absence of distinct limits between the species was quite correct: —

"Die im Plankton des Victoria Nyanza enthaltenen Surirellen sind . . . mannigfacher gestaltet und in grösserer Anzahl vorhanden, als diejenigen des Nyassa- und Malombasees. In den letzgenannten Seen sind die drei Arten *S. Nyassæ*, *S. Malombæ* und *S. Engleri* ziemlich scarf begrenzt; im Victoria Nyanza dagegen finden sich vorwiegend Übergangsformen, d. h. die typischen Arten kommen nur selten und meistens in veränderten Grössen vor, an ihrer Stelle aber sind gleitende Übergänge zwischen den drei Arten vorhanden" (*l. c.* p. 340–341).

He then gives a number of measurements of the observed specimens, studying the limits of their variation, and concludes: —"es dürfte daher über den Zusammenhang von *S. Nyassæ* und *S. Malombæ* kaum ein Zweifel bestehen" (*l. c.*, p. 341); and further: — "Alle diese Abweichungen bilden eine Reihe, deren Endglider *S. Nyassæ* und *S. Malombæ* sind. Ebenso deutlich ist der Zusammenhang von *S. Nyassæ* und *S. Engleri*, var. *constricta*" (*l. c.*, p. 342).

In his own paper on Nyassa Diatoms part 1 (1903), O. Müller has illustrated the new species of Surirella with beautiful drawings; we find there the typical forms of his species; but the intermediate stages — such as they occur in Victoria Nyanza — have not been illustrated in my former paper. Therefore I take the opportunity to fill out this lacuna in reproducing a series of microphotographs taken by Mr. A. Hesselbo under my direction. When one wishes to demonstrate a series of transition stages, it is always better to use the camera than to rely upon drawings which can be spoken of as influenced by the author's own opinion.

All the microphotographs have been taken at the same magnification (× 300) and are fully comparable. Fig. 1 represents a typical *S. nyassae* O. Müll., Figs. 9–10, typical *S. malombae* O. Müll., and Fig. 13, typical *S. Engleri* O. Müll, var. *constricta* O. Müll. I trust that the figures from 1 to 10, Plate 1, show at once how continuous the transition from *S. nyassae* to *S. malombae* is; further that in Fig. 2, 3, and 4 we find transitions through Fig. 11 and 12 to Fig. 13, that is from *S. nyassae* to *S.*

[1] Prof. Charles A. Kofoid has kindly drawn my attention to a form described by A. Hempel (Bull. Illinois State Lab. Nat. Hist., 1896, 4, p. 314, pl. 25, fig. 11 and 12, pl. 26, fig. 13) as *Ceratium brevicorne*; it resembles our form in many respects but differs according to the description and the figures in others, *e. g.*, the position and shape of the short second antapical horn; and I hesitate to consider the two forms identical.

Engleri, var. *constricta*, of which Fig. 14 is a gigantic form. The transitions manifest themselves in all distinctive characters, viz., the shape of the valve, its size, and the number of "costae" in a given area (*e. g.*, 10 μ); this last character separates *S. Engleri* from the two others.

If we admit that there are no distinct limits between the forms, I think it is better to unite them as one species, retaining the most diverging forms as varieties, and I propose to name them *S. nyassae* O. Müll. with the var. *Engleri* (O. Müll.) and var. *malombae* (O. Müll.).

Another question is, if we should subordinate them all under the older species *S. bifrons* (Ehbg.) Ktz. and *S. constricta* Ehbg. To answer this question it would be necessary to take up for study a large number of species of which I have no authentic material, but must rely upon the drawings in A. Schmidt's Atlas, in W. Smith's British Diatomaceae, and in H. Van Heurck's Atlas, as well as earlier publications by Ehrenberg, Kützing, etc. The chance for error is, I think, too great, and I will not enter upon the matter, but will confine myself to the reduction already made.

Besides, the large Surirellas of the plankton of the East African lakes are so peculiar that they deserve to be distinguished. perhaps, also, by maintaining the names given to them.

Melosira. With regard to the Melosira forms of the Central African lakes, much the same may be said, as in the case of Surirella. Our knowledge of them is also due to Professor Otto Müller, and in his paper on Nyassa Diatoms (part II, 1904) he has given an exhaustive study of the Melosira forms of this region. Further, he has examined the Melosirae occurring in Victoria Nyanza slides sent him by me and has given his notes on these forms in my paper (*l. c.*, p. 338–339). The most common form in these slides, which have been made from Professor Borgert's material, is a slightly divergent form of *M. nyassensis* O. Müll., named by Müller, var. *Victoriae* O. Müller. This form occurs also in the samples taken by Dr. Agassiz, but is not the dominant one; it seems to attain its maximum later in the year. The dominant Melosira of the February samples — and it is the most common species of the whole phytoplankton — is the same as Müller mentions as a new species in the Borgert samples, where it was not so common. As it stands near *M. granulata* (Ehrbg.) Ralfs, I have recorded it in my paper as "*M. aff. granulatam.*" Now when I have had excellent and rich material at my disposal, I think myself justified in describing it as a new species, which I name in honor of Dr. Alexander Agassiz.

Melosira Agassizii, sp. nov. (pl. 2, fig. 18–22). *Ex affinitate M. granulatae. Theca cylindrica, robusta; disci circulares, arcte connati, margine denticulato; discus valvae terminalis dentibus longis inaequalibus marginalibus praeditus; pseudo-sulcus (sensu de O. Müller) distinctus; pars cylindrica valvae ut visa aspectu cingulato rectangulata cum lateribus duobus incurvatis, granulis (poris) rotundis in seriebus curvatis (in valva terminali rectis), 10–12 in 10 μ praedita; sulcus distinctus in lumine cellulae prominens. Diametrum cellulae* (12–)24–42 μ, *altitudo partis cylindricae valvae* 9–14 μ.

This species is larger and coarser than *M. nyassensis*, and is, when seen in side view, easily recognized by the more or less inwardly curved sides of the cylindrical parts of valves, the inwardly prominent sulcus, the round pores, and the long marginal teeth of the terminal valve. The description given by O. Müller in my paper is as follows: "Die zweite Art gehört offenbar zum Formenkreise von *Melosira granulata*, denn sie besitzt die, diesen Art eigenthümlichen, langen Dornen an den Endhälften des Fadens. Sie stimmt indessen nicht mit *M. granulata* selbst überein. Die Zellwand ist stärker als bei *M. granulata*, die inneren Mantellinien sind nicht gerade, sondern nach dem Zelllumen zu konkav. Die Porenreihen verlaufen in stark gekr mmten Linien, 10–12 auf 10 μ; in den Endhälften des Pervalvarachse parallel, 14–15 auf 10 μ. Poren kreisrund. Sulcus eine Hohlkehle. Der Durchmesser schwankt von 12–30 μ die Höhen der Zellhälften messen 9–15, 5 μ."

It will be seen that this description agrees very well with my drawings and my diagnosis. Only my specimens are somewhat larger; I have found the diameter varying from 24 μ to 42 μ, while Müller in his material found 12 μ to 30 μ. Now my specimens were collected at a time when the species has probably its maximum, and perhaps there has been a formation of auxospores before this maximum. This would explain the differences in diameter; but it is only a supposition, as I have not succeeded in finding any trace of such auxospores.

There is another matter with regard to this species which may have some interest. Undoubtedly it was in full and active development in February when taken; this is evident from the many cell-divisions observed. Although the preservation of the cell-contents has not been entirely satisfactory, some points of interest have been made out, as I hope the accompanying drawings will show. Plate 2, fig. 19 shows two cells of a normal filament, not in cell-division; through the preservation the plasma has withdrawn from the inner side of the cell-wall; but the nucleus is distinct and the aggregated chromatophores are also

visible; the girdle part of the cell-wall is very narrow. When the cells begin to divide, the two valves diverge, and a large girdle part becomes formed, as shown in Plate 2, fig. 20. This girdle part has no structure at all; it is only a very thin, hyaline, silicious tube or cylinder, as can be clearly seen in ignified specimens mounted in styrax balsam, where the transparent girdle is contrasted with the porulate valves. As Plate 2, fig. 21 shows, the plasmatic contents are much altered at this stage; the plasma lies close to the girdle wall; and must be adherent to the inner side of it, as it has not withdrawn in the preservation. The nucleus is large and of an amoeboid shape, and nearly all the chromatophores are aggregated in the parts of the plasma nearest to the disc. A later stage has been given in Plate 2, fig. 22. The cell-division is now accomplished, and the cell-wall is nearly everywhere as thick as usual, the discs only being somewhat thinner, but the plasma has not reached its final condition. It lies close to the newly formed disc-walls, and only few of the chromatophores have changed their place, the main part remaining aggregated in the part of the plasma most remote from the new cell-wall, and here we find also the nuclei. Some time later the initial stage (Plate 2, fig. 19) is again reached. I think that the manner of cell-division here described — and this is, I believe, the normal manner in this group of Melosirae — has the effect that the diminution of size, so characteristic for the Diatoms, is reduced to a minimum in spite of the very thick cell-wall of these species. It would be an interesting matter to follow the process more closely on fresh material and on material fixed for cytological purposes.

C. Myxophyceae and Chlorophyceae.

With regard to the Blue-green and the Green Algae very little is to be said, as they play so small a part in the February samples. It is sufficient to refer to the papers by W. Schmidle (1898), G. S. West (1907), and myself (1908), as they are based upon much better material of these Algae. I have only two small points to add, both due to examination of a sample of phytoplankton from Lago di Muzzano in Tessin (Switzerland) collected by me on July 20, 1908.[1] The phytoplankton of Lago di Muzzano was very rich in Green Algae. Among the many species observed was a form of *Pediastrum boryanum* which agreed exactly with var. *rugulosum* described by West (*l. c.*, p. 136, pl. 5, figs. 8–9) from Victoria Nyanza; this form is then not endemic for Victoria Nyanza,

[1] Water temperature 20° C.

but is probably a warm-water form. An analogous phenomenon is that *Coelastrum Stuhlmanni*, described by W. Schmidle (Botan. Zentralblatt, 1900, 81; Engler, Botan. Jahrb., 1902, 32, pl. 3, fig. 8) from Victoria Nyanza, occurred also in Lago di Muzzano, and through all intermediate stages was connected with *C. cambricum* Archer, of which it is to be considered as merely a variety. The main character in *C. Stuhlmanni* is the prominent ribs radiating from the external tips of one cell to the tips of another; in Lago di Muzzano some coenobia without these radiating ribs were found, others with radiating ribs on some of the cells, and others again which were true *C. Stuhlmanni*. Already in my paper (*l. c.*, p. 337) I had suggested that *C. Stuhlmanni* was nearly related to *C. cambricum*, var. *elegans* C. Schroeter, and this has now proved to be the case; but perhaps we may retain the form as a variety, viz., *C. cambricum*, var. *Stuhlmanni* (Schmidle) Ostf. In this way one more of the endemic forms for Victoria Nyanza has disappeared.

PLATE I.

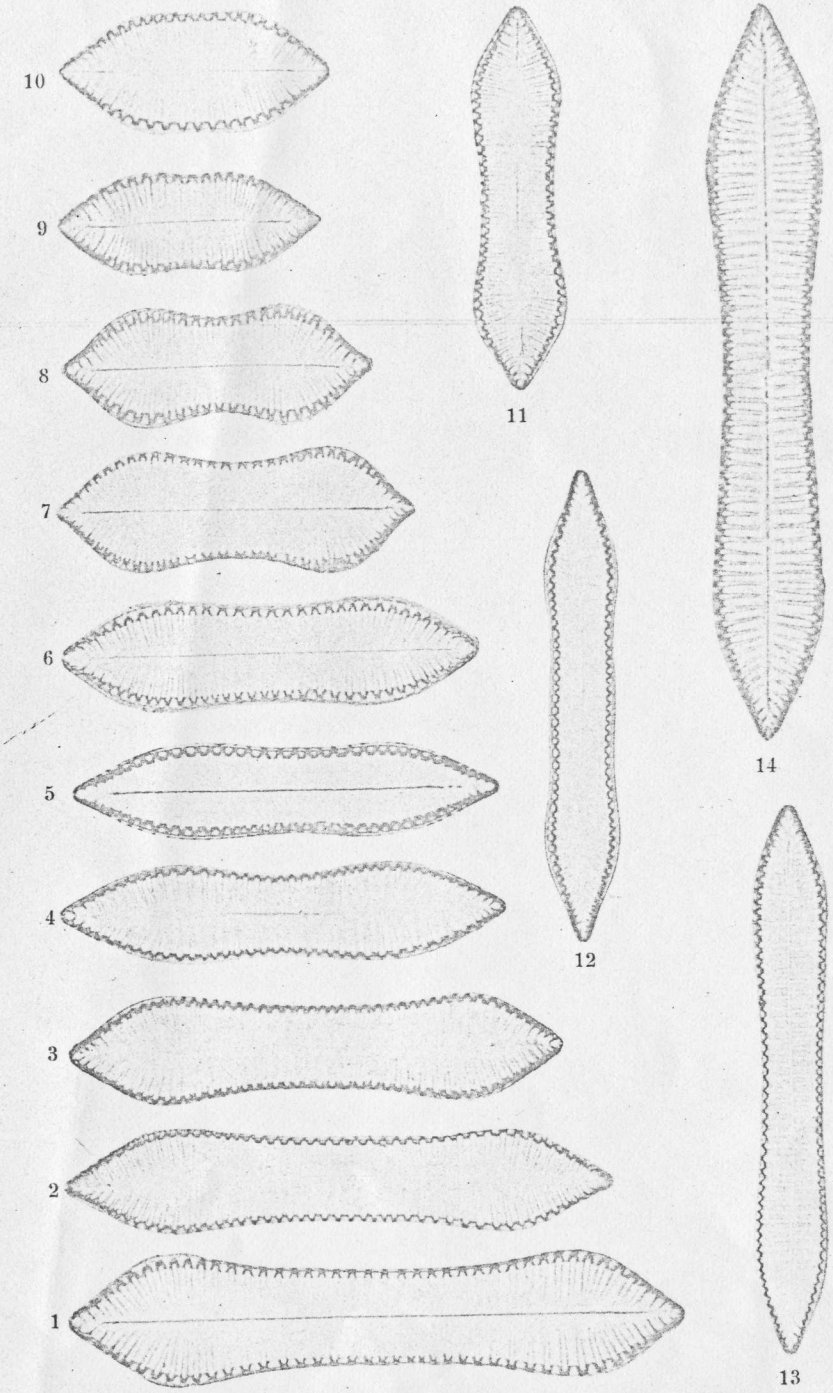
FIGS. 1–10 show the transition from *Surirella nyassae* O. Müll. into *S. malombae* O. Müll.

FIGS. 11 and 12 show the transition from *Surirella nyassae* into *S. Engleri* O. Müll. var. *constricta* O. Müll.

FIG. 13. *S. Engleri*, var. *constricta*.

FIG. 14. *S. Engleri*, var. *constricta*, gigantic form.

All the figures are from microphotographs taken by Mr. A. Hesselbo; ×300.



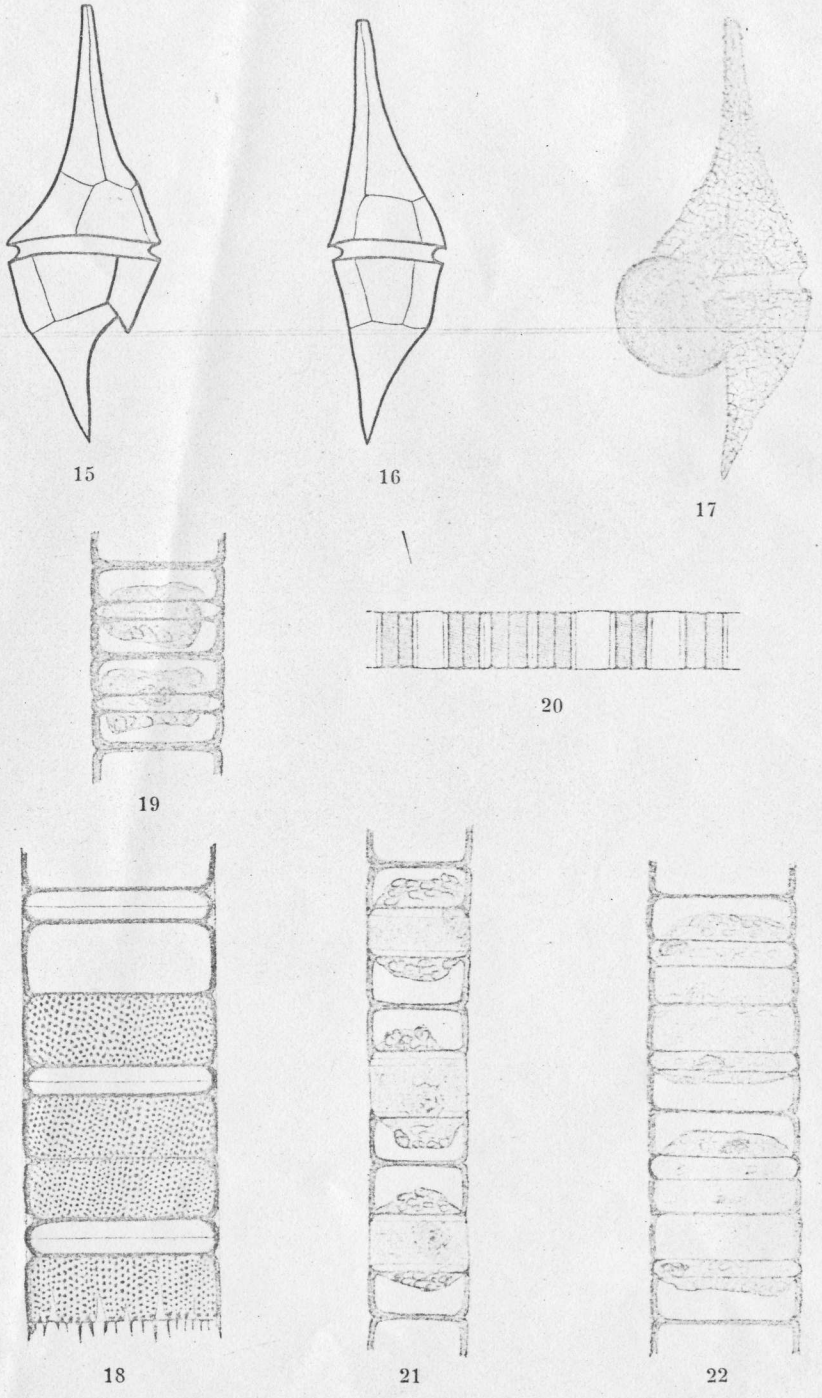
A. Hesselbo phot.

PLATE 2.

FIGS. 15–17. *Ceratium hirundinella* (O. Müll.) Schrank, var. *brachyceras* (v. Dad.) Ostf. Fig. 15, seen in dorsal view and a little from antapex; Fig. 16, seen from the left side and a little from antapex; Fig. 17, cell with contents in ventral view.

FIGS. 18–22. *Melosira Agassizii*, sp. nov. Fig. 18, part of a filament with terminal cell, showing wall structure; Fig. 20, diagrammatic drawing of a filament with large hyaline girdle parts; Fig. 19, two cells with contents; Fig. 21, three cells in divisions; Fig. 22, two cells with recently completed division.

Figs. 15–17. $\frac{\text{oc. } 6}{\text{ob. } 4.0}$, Fig. 18. $\frac{\text{oc. } 8}{\text{ob. } 2.5}$, Fig. 20. $\frac{\text{oc. } 8}{\text{ob. } 8.0}$, Figs. 9, 21, 22, $\frac{\text{oc. } 8}{\text{ob. } 4.0}$; all Zeiss's apochromatic objectives and compensation oculars.



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