DET KONGELIGE DANSKE VIDENSKABERNES SELSKAB

BIOLOGISKE SKRIFTER, BIND VII, NR. 1

HYDROBIOLOGICAL STUDIES ON SOME DANISH PONDS AND LAKES

PART II: THE QUOTIENT HYPOTHESIS AND SOME NEW OR LITTLE KNOWN PHYTOPLANKTON ORGANISMS

BY

GUNNAR NYGAARD

KØBENHAVN

I KOMMISSION HOS EJNAR MUNKSGAARD

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CONTENTS

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1. Introduction.

The first part of this treatise was published in the "Archiv für Hydrobiologie" in 1938. It contained a detailed chemical treatment of a number of highly different Danish ponds, especially the annual variation in some of the dissolved substances. Further an elaborate account was given of the fluctuations of the plankton quantities through 1—4 years of sample collectings in each of the ponds. Both oligotrophic lakes and ponds (of the acidotrophic as well as the dystrophic phase) and eutrophic lakes and ponds (also of the mixotrophic phase) were represented in this selection. Finally the saprotrophic type of pond was erroneously set up as a new type (p. 621). As for instance REINHOLD WEIMANN in his instructive paper of 1942 (p. 508) has referred to me as the originator of this type, it should be mentioned here that R. MAUCHA set up the type in 1931 (p. 92), a fact of which I was ignorant at the time.

It is difficult to say who has first set up the "biological lake types," every author building on the results of previous investigators. THIENEMANN (1913—14), for instance, by working on the lakes of Eifel built on BIRGE & JUDAY's important results (1911—12) from lakes in Wisconsin and New York. When NAUMANN in 1917 set up his lake types of poor or rich nutrition, he was able to found on E. TEILING's significant paper of 1916, a paper that was written in Swedish and is perhaps therefore little known, but its argument for the classification of the lakes is similar to that given by NAUMANN (TEILING 1916, p. 509).

In the present paper some new or interesting phytoplankton species of the material from eastern Funen from 1925—30, northeastern Seeland from 1929—31 and Jutland from 1925—46 are dealt with. Several new localities, particularly in North Sleswick (the Sønderborg district) have been visited; a list of them is found on p. 219. A few of the new species, which are supposed to be distributed in this country, have been described and pictured in "Dansk Plante-Plankton" (1945, p. 52). Of course some of these species will also be subjected to a closer study here, which was not possible in an exoteric paper.

I have made a point of characterising the species considered as accurately as possible and so I have not only accounted for their morphology and systematic position, but also for the periodicity, sociology and ecology to the full of the extent permitted by the material.

Under periodicity *i. a.* the limits of temperature and pH are given within which the species was found. In the present paper organisms that have been found only at temperatures between 0 and 7° C. are termed "oligothermic," between 8 and 15° C. "mesothermic" and form 16° C. upwards "polythermic." Furthermore the values of temperature and pH are given which, judging from the material, seem to be particularly favourable to the development of the species in question.

How is it possible, then, to characterise the individual species sociologically? In this paper I have partly given the associations in which the species occurs and partly mentioned the constant associates.

The value of the constant associates depends on our present and future knowledge of their ecology. Species that occur in less than 75 % of the samples containing the species to be characterised are normally not considered worthy of the term "constant associate." In fact the degrees of frequency of the constant associates, considered as associates, are presumably higher than stated in this paper. If a constantly associating species is generally represented by very few individuals in the plankton samples, is it much easier to overlook this species than a constant associate that plays a prominent rôle in the locality considered.

It must be acknowledged that the setting up of the associations is mostly based on an estimate of the relative degree of abundance of the plankton organisms, and always so when nothing else is stated. In order to simplify the long names of associations the Latin-Greek names of the dominants and sub-dominants are, if possible, reduced to the first two letters of the names of genus, species, variety and form. In several cases it has been necessary to use 3, occasionally even 4 or 5 letters in order to avoid confusion:

*Os*cillatoria *li*mnetica	= *Os li*
*Mica*ctinium *pu*sillum	= *Mia pu*
*Mic*r*o*cystis *aer*uginosa	= *Mio aer*
*Chla*mydomonas *bi*cocca	= *Chla bi*
*Chlo*rogonium *ma*ximum	= *Chlo ma*
*Chr*o*m*ulina *fl*avicans	= *Chrm fl*
*Chroc*occus *li*mneticus	= *Chroc li*
*Chro*o*m*onas *ac*uta	= *Chrom ac*
*Chry*sococcus *ru*fescens	= *Chry ru*

A list of these abbreviations is found on p. 225.

In his paper from 1945 (p. 18), where he thoroughly and critically reviews certain sides of the sociology of the plankton, Sv. Thunmark proposes a special method ("Methode der exakten Deckungsgradbestimmung") for the determination of the species that dominates in a net sample of plankton. As regards the total volume of the species the method, which after all is subjective because an estimate of the thickness of the organisms measured is introduced after a measuring of their relative area, is better than W. H. PEARSALL's method, by which a total of 500—2000 plankton organisms are counted, after which it is calculated how many $^0/_0$ of individuals is reached by every single species. However, if we start a great and time-wasting counting, the only really satisfactory result in my opinion is achieved in the following way: by means of the Kolkwitz chamber or in some other way we determine the number of individuals of each individual species per 1 ml or 1 litre. In order to find the volume of the cells of each species from 1 ml or 1 litre we must base our calculations on direct measurings of the spherical, cylindrical, spindle-shaped, ellipsoidical, etc. cells. If the cells have no "mathematical" shape as in the case of for instance *Ceratium hirundinella*, we may find the volume by making, on the basis of some drawings, a wax model of an average cell in for instance a 1000 times linear magnification and a wax cube of 1 μ^3 in the same linear magnification (= 1 mm^3). The ratio between the weights of the model and the cube will then be the volume of the cell. In all these measurings we must of course use the usual statistical formulas. A special problem is the gelatinous envelope of the organisms, which in many cases can be seen only when the plankton is inserted into Chinese ink.

Another way in which to find the volume of for instance *Ceratium hirundinella* is to make a pure culture of the species. After drawings, slides or photomicrographs of the species have been made it is possible by means of the Kolkwitz chamber to determine how many individuals are found in for instance 10 litres of the culture medium. If this known number of individuals is filtered off and weighed in an adequate state of moistness, we shall be able to find the mean weight of a *Ceratium* cell. After experimentally finding the saline solution in which the *Ceratium* cells are just able to remain suspended we may put the specific gravity of the cells equal to that of the saline solution if due regard is paid to the osmotic effect of the fluid. We are then able to determine the volume of an average cell from the weight and the specific gravity. If the dominant of an association is understood to be the species of which the individuals from 1 ml or litre reach the highest total weight of dry matter, the known number of *Ceratium* individuals, which have been filtered off, must be dried to constant weight and the weight of one cell then determined.

It appears from Fig. 2 in THUNMARK's paper of 1945 how difficult it may be to determine the dominant on an estimate. In the explanation of the figure it is told that *Anabaena circinalis* is the dominant and that quantitively it is much superior to *Tabellaria fenestrata* (besides 2 *Fragilaria crotonensis* colonies about 4 *Asterionella* colonies are visible). If we put the diameter of the *Anabaena* cells in the figure at 1 mm, their total area is

$$\text{abt. } 1240 \times 3.1 \times {}^1/_4 \text{ mm}^2 = \text{abt. } 961 \text{ mm}^2.$$

If we put the breadth of the *Tabellaria* cells in the figure at 1 mm and the length at 11 mm, their total area is

$$\text{abt. } 113 \times 11 \text{ mm}^2 = \text{abt. } 1234 \text{ mm}^2!$$

As the thichness of the *Tabellaria* cells is not very different from that of the *Anabaena* cells, it is misleading to write like this in the explanation of the figure and to make Fig. 2 an instance of the easiness with which it is often possible to solve the problem of the dominant by an estimate (1945, p. 22). The discrepancy between the figure and the text may be due to THUNMARK's possible use of this method of area determination on the water-bloom from Lake Ryven, by which he established that *Anabaena* is really the dominant.

It has often proved difficult to find the dominant in the Danish net samples of plankton. In these cases the method applied was the same as that used by PEARSALL (1925, p. 56) with the exception that only 100—200 individuals or colonies were counted and the numerically superior organism was considered dominant. It was normally marked down as c, cc or ccc (c =common, cc = very common, ccc = abundant) according to its numerical strength in proportion to the other species counted, its being a colony form or a single cell, and its relative proportion of size. The frequensies of the other species were marked down as c+, +, r+, r, rr or rrr according to the numbers reached by them in the counting (+ = rather common, r = infrequent, rr = rare, rrr = sporadic).

All these relative frequencies do not tell us very much about the absolute frequency. When *Uroglena americana* in Madum Sø reaches the frequency cc (or ccc) on May 23th, 1929, this covers an absolute frequency of 0.48 colony per 1 ml, but when *Uroglena volvox* in Badstue-Ødam reaches ccc on May 16th, 1930, these ccc cover an absolute frequency of 694 colonies per 1 ml.

There is no doubt that the samples of net plankton only occasionally are absolutely representative of the world of pelagic organisms in the water, both in a qualitative and especially in a quantitative respect. BIRGE & JUDAY's minute and very frequent examinations (1922, Tables 43—44) of the net plankton and the nannoplankton of the eutrophic Lake Mendota show very convincingly that in 1915—17 the quantity of nannoplankton was never less than twice the quantity of net plankton and sometimes even rose to 45 times as much. Even in the summer months the quantities of nannoplankton were often 10 times larger than those of net plankton and would even rise to 34 times as much, as for instance on July 24th—28th, 1916: 116 mg of net plankton per 1 m^3 against 3951 mg of nannoplankton per 1 m^3. Some of the Swedish lakes, examined by THUNMARK (1945), may be quite similar. As far as I know there is unfortunately no corresponding examination of an oligotrophic lake, but there are symptoms that conditions here are perhaps different (cp. NAUMANN 1927, p. 18—19). In order to avoid misunderstandings it should be mentioned that the term "nannoplankton" in my paper of 1938 and in the present paper of course also includes the organisms of the net plankton, which are sedimented (or filtered off through filter paper) together with the nanno-forms. The composition in Store Gribsø will serve as an example of the difference that may exist between samples of netplankton and nannoplankton from a dystrophic lake.

Store Gribsø, 18. VI. 1929:

	nannoplankton	net plankton
Ceratium hirundinella	..	rrr
Closterium Kützingii	..	rrr
Cryptomonas ovata	ccc	rrr
Mallomonas caudata	+	c
Mallomonas tessellata	rrr	..
Peridinium Willei	rr	rr

2. The Phytoplankton Quotients.

a. Definitions.

Thunmark (1945, p. 55) has proposed to use the ratio of Chlorococcales to Desmids for the characterisation of a phytoplankton community. The author further shows that this ratio (in the following termed the "chlorophycean quotient") is eloquently expressive of the trophic degree of the lake in question. Though this ratio within the same locality in the course of one or two months may vary between 5.4 and 14.0 (Lake Trummen), Table 1 in Thunmark's paper shows that in oligotrophic Swedish lakes the quotient ranges between 0.2 and 0.5, in slightly eutrophic Swedish lakes between 1.0 and 3.0 and in highly eutrophic Swedish lakes between 2.6 and 14.0.

Unfortunately Table 1 in Pearsall's paper from 1925, which minutely deals with the sociology of the phytoplankton in the lakes of the English Lake District, does not illustrate the composition of the plankton of the individual samples. Therefore it is not possible to determine Thunmark's chlorophycean quotient for these lakes, of which for instance Wastwater and Ennerdale are presumably poorer in nutritive substances than the Swedish oligotrophic lakes of the Fiolen type. It is true that Pearsall in his significant paper of 1932 gives the composition of the individual samples, but this is only for the more important algae.

W. H. Pearsall (1932, p. 252) has shown that generally speaking the ratio of Desmids to green colonial forms falls when the $\frac{N}{P}$ ratio rises, but on the whole he uses this quotient with great caution. While Pearsall includes *Tetrasporales* in his term "green colonial froms" and uses the numbers of individuals (expressed in percentages of the total number of organisms of the sample) of the Desmids and green colonial forms, Thunmark exclusively employs the numbers of species of *Chlorococcales* and *Desmidieae*.

We will now try to characterise the trophic degree of some chosen Danish lakes and ponds by the following quotients, which are based exclusively on the numbers of species of taxonomic groups:

$$\text{The myxophycean quotient} = \frac{\textit{Myxophyceae}}{\textit{Desmidieae}}$$

$$\text{The chlorophycean quotient} = \frac{\textit{Chlorococcales}}{\textit{Desmidieae}} \text{ (THUNMARK 1945)}$$

$$\text{The diatom quotient} = \frac{\textit{Centrales}}{\textit{Pennales}}$$

$$\text{The euglenine quotient} = \frac{\textit{Euglenineae}}{\textit{Myxophyceae} + \textit{Chlorococcales}}$$

$$\text{The compound quotient} = \frac{\textit{Myxophyceae}+\textit{Chlorococcales}+\textit{Centrales}+\textit{Euglenineae}}{\textit{Desmidieae}}$$

It is well-known that especially *Euglenineae*, but also *Myxophyceae* and the great majority of *Chlorococcales* and *Centrales* are taxonomic groups with an eutrophic tendency, *Desmids*, however, with an oligotrophic tendency. *Pennales* and certain *Chlorococcales* are more or less eurytrophically disposed (cp. for instance PEARSALL 1925, pp. 64—65; BERG & NYGAARD 1929, p. 289; FR. HUSTEDT 1930; THUNMARK 1945, p. 54).

It must be emphasized here that there are exceptions to these rules. Even the highly food-craving group of *Euglenineae* contains eurytrophic species like *Euglena proxima* and *Trachelomonas intermedia*. Among the *Myxophyceae Coelosphaerium Kützingianum* is very adaptive: it may be found in acid heath lakes on fluvioglacial deposits. Within the Diatoms even species like *Cymatopleura elliptica*, *Cymatopleura solea* and *Synedra acus* var. *angustissima*, which all belong to *Pennales*, are undoubtedly just as "eutrophic" as for instance the *Melosira* species, which belong to *Centrales*. On the other hand the alpine lakes of Europe contain *Cyclotella* species (*Centrales*) that are probably more "oligotrophic" than for instance *Tabellaria fenestrata* (*Pennales*). Even among the Desmids we know "eutrophic" forms like for instance *Cosmarium depressum* var. *planctonicum*, *Closterium gracile* and *Staurastrum tetracerum* var. *validum*. Within the *Chlorococcales* TEILING (1916, p. 510) established the oligotrophic (or eurytrophic) tendency of a number of species.

In my opinion, therefore, the quotients proposed by THUNMARK and me should be considered provisional because the aim must be to work up an E:O-quotient where E denotes the number of ecologically well-studied plankton species of an "eutrophic," O the number of ecologically well-known plankton species of an "oligotrophic" tendency. It remains an open question whether the quantitative factor should be introduced into this E:O-quotient.

By far the most extensive development of *Myxophyceae*, *Chlorococcales* and *Desmidieae* takes place within the period May—September whereas *Centrales* and *Pennales* also develop during the cold season. Therefore the importance attached to the myxophycean, chlorophycean, euglenine and compound quotients should be confined to the period May—September or even the months of June—August whereas the diatom quotient may be of indicative value at any season.

The Desmid species in several cases being bigger than the *Chlorococcales* species, which escape more easily through the pores of the tow-net, we would expect beforehand to find a somewhat higher chlorophycean quotient for the nannoplankton than for the net plankton when both are taken under exactly the same conditions. This is indeed the case as will appear from Table III:

Lille Gribsø,	28. VI. 1929:	1.25	for nannoplankton,	0.3	for net plankton
Blankeborg I,	17. VIII. 1927:	1.7	— —	1.25	— — —
Blankeborg I,	18. VIII. 1928:	1.8	— —	0.6	— — —
Frederiksborg Slotssø,	11. VI. 1929:	4.25	— —	2	— — —
Blankeborg II,	28. VIII. 1928:	11	— —	6	— — —
Vandingsdam,	28. VI. 1929:	25	— —	14	— — —

Of course this fact must also—though to a much less degree—influence the compound quotient for both net plankton and nannoplankton.

If we want to characterise a phytoplankton community, this may be done briefly by giving the dominant and its absolute frequency and perhaps the sub-dominant(s) that reach at least half the absolute frequency of the dominant; further the total number of species and the 5 phytoplankton quotients in such a way, be it understood, that the numbers of species of the taxonomic groups can be seen. As examples may be mentioned:

Madum Sø, May 23rd, 1929: *Ura am*-association (0.48 colonies per ml), 6 species; myxophycean quotient $\frac{0}{2}$, chlorophycean quotient $\frac{0}{2}$, diatom quotient $\frac{0}{0}$, euglenine quotient $\frac{0}{0}$, compound quotient $\frac{0}{2}$.

Hampen Sø, September 23rd, 1929: *Ta fe-Ana Ha ma*-association (1.5 colonies and 1.2 trichomes per ml), 33 species; myxophycean quotient $\frac{4}{13}$, chlorophycean quotient $\frac{5}{13}$, diatom quotient $\frac{0}{2}$, euglenine quotient $\frac{0}{9}$, compound quotient $\frac{9}{13}$.

Tissø, August 10th, 1927: *Ly li*-association (195 trichomes per ml) with *Os Ag* as sub-dominant, 55 species; myxophycean quotient $\frac{16}{8}$, chlorophycean quotient $\frac{17}{8}$, diatom quotient $\frac{6}{2}$, euglenine quotient $\frac{1}{33}$, compound quotient $\frac{40}{8}$.

Lynge Vandingsdam, August 6th, 1947: *Eug ob*-association (23300 cells per ml), 33 species; myxophycean quotient $\frac{0}{0}$, chlorophycean quotient $\frac{7}{0}$, diatom quotient $\frac{1}{2}$, euglenine quotient $\frac{21}{7}$, compound quotient $\frac{29}{0}$.

b. Classification of the lakes.

The lakes in question are not classified as dystrophic lakes (Thienemann 1921), oligotrophic lakes (Teiling 1916, Naumann 1921), eutrophic lakes (Naumann 1921, Teiling 1916) and mixotrophic lakes (Järnefelt 1925) as proposed by ÅBERG & ROHDE (1942, p. 232). At normal thermic conditions and exposition to wind the size of the production of plankton should be the primary basis of classification, and a distinction is made only between oligotrophic and eutrophic lakes with their sub-phases.

This is because the notion of oligotrophy is by no means unvarying: DONAT (1926b, p. 51) distinguishes 2 types of oligotrophic waters, the geomorphologically oligotrophic type (= THIENEMANN's "harmonisch oligotropher Seetypus") and the physiologically oligotrophic type. According to IVERSEN (1929, p. 304) the latter type, which is also called the Lobelia-Isoëtes type, in this country occurs in 2 phases: the very acid phase (Madum Sø) and the alternately slightly acid — alkaline phase (Hampen Sø).

In northern Europe clear and intact heath lakes situated on fluvioglacial sand or on deposits of moraine sand and with well-developed Lobelia-Isoëtes vegetations are frequently very acid. When DONAT stresses that *Myriophyllum alterniflorum* is lacking in his typical example of a physiologically oligotrophic lake (Höllenpinnowsee in Pomerania), this would seem to indicate that this typical Lobelia-Isoëtes lake is very acid. According to DONAT this physiologically oligotrophic type of lake regularly contains quite a number of pelagic Desmids; indeed this Desmid plankton is occasionally said to abound in species. As will appear from Table I and from the list of species on p. 256—62 it is true that the Danish lake Madum Sø sometimes contains up to 15 Desmids in one plankton sample, but the quantitatively dominant species are the Flagellates *Dinobryon cylindricum* var. *palustre* and *Uroglena americana*. For such "disharmonic" lakes as for instance Höllenpinnowsee and Madum Sø with pH constantly below 5.5 we ought to retain the characteristic term acidotrophic (NAUMANN 1932), indicating a subtype of the oligotrophic type.

LOHAMMAR (1938, p. 243) says about the acidotrophic water type, "Man kann aber die Frage aufwerfen, ob es in Nordeuropa überhaupt Seen mit so saurem Wasser gibt, dass die Produktion von der Azidität beherrscht wird." However, STEEMANN NIELSEN's investigations (1944 and 1945) on the photosynthesis at different pH values and varying concentrations of free carbon dioxide, bicarbonate ion and carbonate ion show that if pH is below 4 there can be no bicarbonate ions in the water because the high hydrogen ion concentration will then prevent the dissociation of carbonic acid. To certain aquatic plants bicarbonate ions seem to be a much better source of carbon than the free carbon dioxide when the concentrations are low. There are many indications that also the amount of free carbon dioxide is very small in clear, highly acid heath lakes. Although our knowledge of the photo-synthesis and the ecology of the individual limnophytes and phytoplankton species is limited, there is no doubt that indirectly pH is able to influence the production to a considerable degree. Basing on K. MÜNSTER STRÖM's (1931) and RUTTNER's (1931) views W. OHLE (1934, p. 436) is of opinion that the free carbon dioxide can be used for the classification of the lakes. With STEEMANN NIELSEN's results in mind it must be supposed that the amount of free carbon dioxide, bicarbonate ion and carbonate ion is a factor of at least the same value for the classification as the oxygen.

WEIMANN (1942, p. 492) maintains that actually harmonically oligotrophic ponds are found on pure sandy substratum and as an example he mentions Pechofen Teich in Silesia. About its vegetation it is only said that Equisetum is the predominant plant near the margins, and curiously enough WEIMANN does not mention one Desmid for the oligotrophic ponds in the otherwise very instructive survey of plankton in his paper of 1942. In a previous paper (1939, p. 671) the May value of pH for Pechofen Teich is stated to be 6.9.

It is hardly likely that this neutral, clear type of heath lake is identical with the harmonically oligotrophic water type on a pre-Cambrian substratum (cliff lakes in Scandinavia and Great Britain). One would think beforehand that the decomposition of the pre-Cambrian minerals would make possible a more comprehensive representation of salts than the poor sediments of SiO_2 that constitute by far the greater part of sandy deposits.

On account of the character of the substratum (mostly sand) the Danish Lobelia-Isoëtes lakes Hampen Sø and Kalgaard Sø with their pH variation about the neutral point and their clear water bear a close relationship to the oligotrophic type. Their average depth being considerably lower than THIENEMANN's morphometric value of 18.5 m, these lakes are not harmonically oligotrophic in THIENEMANN's sense.

LOHAMMAR (1938, p. 239) is of opinion that LUNDBECK's distinction between the primarily oligotrophic lake, which is situated on a poor substratum and is therefore poor in nutrition, and the secondarily oligotrophic, deep lake on a soil that is rich in nutrition, the nutritive matters of which, however, are distributed in a very large volume of water, is rather irrelevant: examinations of the lakes of Wisconsin have shown that seepage lakes are mostly much poorer in inorganic and organic matter than drainage lakes. LOHAMMAR maintains that the content of nutrition in the lake is determined by the inlets or rather by the quality of the surroundings. Lakes in poor tracts will therefore be poor in nutrition, lakes in fertile tracts rich in nutrition, no matter whether all these lakes be shallow or deep. As shown before (NYGAARD 1944, p. 36) the truth is no doubt that in lakes with inlets and outlets the inlet is a more important factor for the trophic degree than the morphometry of the lake; if the lake has no inlet, however, it is not always certain that the quality of the surroundings is the dominant factor in comparison to the shape and depth of the basin of the lake. On account of the comparatively high temperatures and the consequential intenser decomposition during the summer season the epilimnion of the shallow lake must always contain larger amounts of recently extricated nutritive matters than the colder epilimnion of the deep lake, all other things equal. Two morphologically different lakes without inlets and outlets and situated in surroundings of the same quality must therefore be considered able to show a different production.

c. Lakes.

In Table I the trophic degree is determined partly by an estimate of the higher or lower transparency of the water, partly, in certain lakes, by a statement of the absolute frequency of the dominants. The numbers of individuals were counted in 5 ml (Tissø), 100 ml (Store Gribsø, Madum Sø and Furesø) or 275 ml (Hampen Sø). The few chemical analyses (NYGAARD 1938, p. 684) may also afford some data for the valuation of the trophic degree though it must be admitted that two heterogeneous lakes as for instance Hampen Sø and Furesø in the winter months mentioned are not very different as regards nitrate (and also phosphate and ammonia). The lake Tissø on the other hand was remarkably rich in nitrate in the winter of 1931, and this was also true of its bottom water in the summer of 1929.

As regards the total number of species of the net plankton the oligotrophic lakes of the dystrophic phase are conspicuous by their remarkably low numbers of plankton organisms, which range between 5 and 8! The plankton of the other lakes that are oligotrophic is somewhat richer in species (6—33 species) while the eutrophic lakes may be very rich in species (18—76) likewise as the lakes of the mixotrophic phase (31—57 species). FRITSCH's statement (1931, p. 235) that the plankton of oligotrophic waters is in general richer in species than that of eutrophic waters accordingly does not apply to Danish lakes. The discrepancy is no doubt explained by the fact that we have no harmonically oligotrophic lakes in this country. It must further be mentioned that the number of phytoplankton species in net samples from Danish lakes only occasionally exceeds 50.

A closer contemplation of the quotients given in Table I will show that the myxophycean quotient ranges between 0 and 3.0, the chlorophycean quotient (apart from the value 9 in Hulsø which may just as well be considered a pond as a lake) between 0 and 3.5, the diatom quotient between 0 and 3, the euglenine quotient between 0 and 1 and the compound quotient between 0 and 8.75 (apart from the value 25 in Hulsø).

In the oligotrophic lakes of the dystrophic phase, Løvenholm Langsø, Store Øxsø and Store Gribsø, all quotients are $= 0—\frac{1}{3}$ or an indefinite figure because either the numerators or the denominators or both are 0; the only exception is one of the diatom quotients in Store Øxsø. None of the numerators or denominators of the quotients are above 3.

Both BOISEN BENNIKE (1943, p. 23) and CLEMENS PETERSEN (in a letter to me) seem to be a little sceptical for calling Store Gribsø dystrophic. pH may rise as high as 6.5, and the consumption of $KMnO_4$ per litre sometimes sinks to 33 mg; besides the animal production of the profundal region may be rather considerable (CLEMENS PETERSEN 1943, p. 57). On the other hand it cannot be denied that its colour apparently always lies between 15 and 40 "Ohle units," which shows us that Store Gribsø belongs to W. OHLE's (1934) Farbengruppe III ("eigentliche Braunwasserseen"); moreover repeated measurings gave a pH of 4.3 in this up to 13 m deep and only slightly polluted lake, which is highly sheltered from winds. Both the quotients of Table I and the paucity in species and individuals and the composition of the phytoplankton are indicative of a close relationship to the lakes of the dystrophic phase.

In the oligotrophic Madum Sø of the acidotrophic phase the myxophycean quotient is always 0, the chlorophycean quotient 0—0.1, the diatom quotient and euglenine quotient 0 (or indefinite) while the compound quotient ranges as low as 0—0.1.

In the approximately oligotrophic lakes Hampen Sø, Vedsted Sø and Kalgaard Sø the myxophycean quotient lies at 0—0.4, the chlorophycean quotient at 0—0.7, the diatom quotient at 0 (or indefinite), the euglenine quotient at 0—0.2 while the compound quotient ranges between 0.25 and 1.

In the small heath lake Præstesø the diatom quotient is still 0, the myxophycean quotient 0.5, the chlorophycean quotient 0.65, the euglenine quotient 0.1 and the compound quotient reaches 1.2. *Lobelia Dortmanna*, *Littorella uniflora* and *Potamogeton crispus* were found in the lake.

According to information received from Dr. Johs. Iversen Slaaen Sø has strong submerse springs, which cause a comparatively rapid renewal of the lake water. If, in this case, we used only Thunmark's chlorophycean quotient and the myxophycean quotient, the conclusion would be: oligotrophic. Here the diatom quotient helps us because its value of 0.75 indicates eutrophy; the same does the euglenine quotient, which reaches the uncommonly high lake value of 1! As a matter of fact the September analysis of 1929 tells of rather considerable amounts of N and P in both surface and bottom water, quantities that cannot apparently be utilized without difficulty on account of the rapid renewal of the water (see Nygaard 1938, p. 555). The compound quotient of Slaaen Sø lies at 1.1.

In the eutrophic lakes the myxophycean quotient ranges between 0.8 and 3.0, 5 samples from the slightly eutrophic Nors Sø showing the values 0.8—1 and 4 samples from the more eutrophic lakes Mossø, Tissø and Salten Langsø the values 1.2—3.0. The chlorophycean quotient ranges between 0.7 and 3.5, in the slightly eutrophic lake between 0.7 and 1.1, in the 3 more eutrophic lakes between 2.1 and 3.5. The diatom quotient ranges between 0.2 and 3, the slightly eutrophic lake showing values between 0.2 and 1.5, the 3 more eutrophic lakes values between 1.25 and 3. The euglenine quotient is 0 in all lakes except in Nors Sø where, strange to say, it reaches the values 0—0.2 (mostly 0). The compound quotient varies between 2.0 and 8.75, the 5 samples from the slightly eutrophic Nors Sø showing values between 2.0 and 2.25, the 4 samples from the 3 more eutrophic lakes, however, values between 4.3 and 8.75. In the moderately eutrophic lake Furesø the compound quotient ranges between 3.5 and 4.4.

In the two eutrophic lakes of the mixotrophic phase, Hostrup Sø and Hulsø, the latter of which might just as well be classed as a pond, the myxophycean quotient is found to be 0.9—2.7 (3), the chlorophycean quotient 2.2—2.5 (9), the diatom quotient 0.2—0.5 (1.75), the euglenine quotient always 0 in Hostrup Sø and always 0.3 in Hulsø, and the compound quotient 3.3—5.3 (7—25 in Hulsø).

The low values of the diatom quotients in Hostrup Sø (4 samples from 4 different years give the variation 0.2—0.5) must possibly be ascribed to the comparatively lime-deficient water of the lake. The lime-richer lake Hulsø shows the values 1.5 and 1.75. Also the paucity in pelagic diatoms of the oligotrophic lakes (no more than 4 species were ever found in one sample) is most probably connected with their calcium deficiency.

Survey of the phytoplankton quotients of 15 Danish lakes.

Types	Myxophyceean quotient	Chlorophyceean quotient	Diatom quotient	Euglenine quotient	Compound quotient
3 oligotrophic lakes of the dystrophic phase	0 (or indefinite)	0—0.3 (or indefinite)	0 (0.3?)	0 (or indefinite)	0—0.3 (or indefinite)
1 oligotrophic lake of the acidotrophic phase	0	0—0.1	0 (or indefinite)	0 (or indefinite)	0—0.1
3 approximately oligotrophic lakes	0—0.4	0—0.7	0 (or indefinite)	0—0.2	0.25—1
2 intermediate (mesotrophic) lakes	0.1—0.5	0.2—0.6	0 —0.75	0.1—1	1.1—1.2
1 slightly eutrophic lake	0.8—1	0.7—1.1	0.2 —1.5	0—0.2	2.0—2.25
1 moderately eutrophic lake	1.4—2	1.25—1.4	0.6 —1.7	0	3.5—4.4
3 more eutrophic lakes	1.2—3	2.1—3.5	1.25—3	0	4.3—8.75
1 eutrophic lake of the mixotrophic phase	0.9—2.7	2.2—2.5	0.2 —0.5	0	3.3—5.3

d. Ponds.

The ponds of this paper are much better known than the lakes dealt with above. Basing on Part I of the present investigations (Nygaard 1938, pp. 646—684) Table III gives the annual variations in chosen ponds for pH, calcium, consumption of potassium permanganate, phosphate phosphorus, ammonia-nitrogen, nitrate-nitrogen and the weight of the plankton together with its annual means. There are further some comments on the pollution of the ponds. Although this is but a small part of the total number of factors that influence the plankton organisms, and though the weight of the plankton includes the weight of detritus, Rotifers and the pelagic Crustacea, it is possible to distinguish between oligotrophy and eutrophy in their different phases.

In Table III the qualitative composition of the samples of both net plankton and nannoplankton are given with a view to comparison because the two samples in many cases originate from the same day.

The total number of species in the oligotrophic ponds of the dystrophic phase is 14—15 (nannoplankton 8—19) species, thus being larger than in the corresponding lakes. In the other oligotrophic ponds (of the acidotrophic phase) the number of species amounts to 9—42 per sample. Like the eutrophic lakes the eutrophic ponds may be very rich in species (35—67 per sample). Eutrophic ponds of the mixotrophic phase may be equally rich in species (17—71 species) whereas the pond of the saprotrophic phase is unusually poor in species (5—10 per sample).

Table III shows that in Danish ponds the myxophycean quotient ranges between 0 and 5, the chlorophycean quotient between 0.1 and 31, the diatom quotient between 0 and 6, the euglenine quotient between 0 and 8 and the compound quotient between 0.1 and 43. As might be expected the fluctuations of the ponds are much greater than those of the lakes.

In the 4 oligotrophic ponds of the dystrophic phase, Bøndernes Mose I and II, turf pit at Store Jenshøj and turf pit NE. of Skaansø the myxophycean quotient varies between 0 and 0.25, the chlorophycean quotient between 0.1 and 0.3; the diatom quotient is always 0 (or indefinite) while the euglenine quotient may be surprisingly high, up to 1! The compound quotient ranges between 0.1 and 0.6.

The 5 oligotrophic ponds of the acidotrophic phase are Holmsø, Skaansø, Mørksø, Klitsø at Højsande, and Lille Gribsø. The last-mentioned all the year round showed a "Vegetationstrübung" or "Vegetationsfärbung" caused by minute green algae: on December 16th, 1929 no less than 236000 *Stichococcus bacillaris* and 17500 *Cosmarium asphaerosporum* var. *strigosum* were counted per ml, to mention only the dominant and the sub-dominant. Lille Gribsø, which is pictured in "Dansk Plante-Plankton" (Nygaard 1945, p. 8), is surrounded by a broad zone of quaking bog composed of several *Sphagnum* species. The rest of the ponds were uncommonly poor in plankton when they were visited. The myxophycean quotient ranges between 0.1 and 0.3 (0.5), the chlorophycean quotient between 0.25 and 0.45 (1.25); the diatom quotient is always 0 (or indefinite), the euglenine quotient lies between 0 and 0.1 (0) and the compound quotient between 0.4 and 0.8 (1.75). The figures in brackets are taken from a sample of nannoplankton from Lille Gribsø, June 28th, 1929.

In the slightly eutrophic turf pit Blankeborg I of the mixotrophic phase the myxophycean quotient ranges between 0.1 and 0.7, the chlorophycean quotient between 0.6 and 1.9, the diatom quotient between 0.1 and 0.7, the euglenine quotient between 0.1 and 0.4 and the compound quotient between 1.4 and 3.55, all figures originating from 8 different plankton samples from the years 1925—30. For the 4 samples of net plankton the compound quotients were 1.4—2.2—1.8—2.2, for the 4 samples of nannoplankton 2.2—2.55—2.8—3.55.

The other eutrophic ponds of the mixotrophic phase (Blankeborg II, Sortedam II, Gadevang Mose and Vandingsdam) are more or less polluted, especially Vandingsdam. For the 14 plankton samples from these ponds the myxophycean quotient ranges between 0.25 and 3 (or indefinite), the chlorophycean quotient between 1.6 and 25 (or indefinite), the diatom quotient between 0.4 and 2 (or indefinite), the euglenine quotient between 0 and 0.5 and the compound quotient between 2.8 and 33.

The eutrophic ponds Badstue-Ødam, Frederiksborg Slotssø, Jægerbakke Dam and Flødegaardens Dam are also polluted, particularly the last-mentioned. It must be emphasized, however, that the water of Flødegaardens Dam was amazingly poor in plankton on August 3rd, 1939, at which time the Limnophytes had occupied most of the pond, especially *Batrachium circinnatum*, but also *Potamogeton natans*; *Lemna trisulca* and *L. minor* were common. In the 15 plankton samples from these 4 ponds the myxophycean quotient is generally high, between 0.5 and 5 (or indefinite), the chlorophycean quotient varies between 2 and 31 (or indefinite), the diatom quotient between 0.4 and 6 (or indefinite in the calcium-deficient Jægerbakke Dam where no pelagic diatoms were found), the euglenine quotient between 0 and 0.4 and the compound quotient between 4.3 and 43 (or indefinite).

The 2 eutrophic ponds of the saprotrophic phase are Lynge Vandingsdam and Bistrup Dam; the former represents the transition stage between eutrophy and saprotrophy. In these ponds the myxophycean quotient is 0 (or indefinite), the chlorophycean quotient 12 (or indefinite), the diatom quotient 0.5 (in the lime-rich, but extremely polluted Bistrup Dam indefinite, no pelagic diatoms occurring here). The euglenine quotient, however, shows the high values of 1.5—8 (or indefinite). The compound quotient is 31 (or indefinite).

Survey of the phytoplankton quotients of 20 Danish ponds.

Types	Myxophycean quotient	Chlorophycean quotient	Diatom quotient	Euglenine quotient	Compound quotient
4 oligotrophic ponds of the dystrophic phase	0—0.3	0.1—0.3	0 (or indefinite)	0—1	0.1—0.6
4 oligotrophic ponds of the acidotrophic phase	0.1—0.3	0.25—0.45	0 (or indefinite)	0—0.1	0.4—0.8
1 approximately acidotrophic pond	0.1—0.5	0.3—1.25	0	0	0.55—1.75
1 slightly eutrophic pond of the mixotrophic phase	0.1—0.7	0.6—1.9	0.1—0.7	0.1—0.4	1.4—3.55
4 eutrophic ponds of the mixotrophic phase	0.5—3	1.6—25	0.4—2	0—0.5	2.8—33
4 eutrophic ponds	0.5—5	2—31	0.4—6	0—0.4	4.3—43
1 approximately saprotrophic pond	0 (or indefinite)	12 (or indefinite)	0.5	1.5—3	31 (or indefinite)
1 eutrophic pond of the saprotrophic phase	indefinite	indefinite	indefinite	3—8	indefinite

e. The quotient hypothesis.

It must be emphasized that it is no easy matter to base statistics on so small figures as those contained in certain quotients of Tables I and III. The highest figures are included in the compound quotient, which I therefore consider most suitable for a characterisation of the trophic degree. This makes me advance the following *hypothesis* on temperate lakes and ponds:

If the compound quotient is below 1, the water is probably oligotrophic; the lower the quotient, the poorer the assimilable nutrition. The lowest values (0—0.3) mostly suggest that the lake or pond belongs to the dystrophic phase though also waters of the acidotrophic phase may show equally low values.

If the compound quotient is above 1, the water is probably eutrophic; the higher the quotient, the richer the assimilable nutrition. Values of 1—2.5 indicate a slightly eutrophic ("mesotrophic") water; values of 3—5 indicate moderate eutrophy, and values between 5 and about 20 show that the lake or pond is distinctly or much eutrophicated and somewhat contaminated. Values between about 20 and 43 finally indicate a highly eutrophic water soiled by cattle.

The genuine saprotrophy seems to be revealed only by the euglenine quotient, the rest of the quotients in such extremely contaminated waters being indefinite. The border value between extreme eutrophy and saprotrophy is possibly about 2—3 for the euglenine quotient, but my material is much too small for an exact determination of this critical value.

If this hypothesis proves tenable, it is possible merely by means of a plankton sample to get a rather good notion of the trophic degree of some body of water. This will undoubtedly be of interest to fishery biologists and those who determine the pollution of stagnant water. The phytoplankton is a very sensitive indicator of pollution of the water. A determination of the compound quotient and the other quotients supposes either a detailed knowledge of the species of phytoplankton or a conversance with genera and an acute faculty of observation combined with a pronounced sense of delimitation of species, so that it can be determined how many species of *Staurastrum*, *Trachelomonas*, *Pediastrum*, *Cyclotella*, etc., are contained in the sample. For the calculation of the quotients it is unnecessary to be able to identify to species.

The reasons why certain ponds may exhibit very variable values for the compound quotient in comparison to the lakes is due to the fact that the conditions of life, for instance the weather or the contamination, may vary highly from year to year or even within a much shorter period. According to Tables III and IV Lynge Vandingsdam was highly eutrophic approximating saprotrophy in the summer of 1947. In the following summer, however, the pond was quite filled up with *Chara vulgaris*, which like all Charophyta does not endure pollution, *Batrachium aquatile* and *Batrachium trichophyllum*. On the other hand the water itself was exceedingly poor in plankton species and individuals (very little *Volvox aureus*). Accordingly the pond has not been utilized as watering place for cattle in the spring and summer of 1948.

The compound quotient should never be given merely as a decimal fraction, since it is not indifferent whether the ratio is for instance $\frac{1}{1}$ or $\frac{12}{12}$. At any rate the numerator and the denominator should be given beside the decimal fraction.

The quotients should only be regarded as a help which together with the vertical distribution of carbon dioxide, calcium bicarbonate and oxygen, the qualitative and quantitative composition of the higher vegetation and the bottom fauna, the number of plankton generations per unity of time, the waterbloom phenomenon, the morphometry of the water piece, its bottom sediments and geological substratum, the occurrence of inlets and outlets, the climate, the exposition to winds, the quantity of humic substances, the hydrogen ion concentration, the annual cycle of nitrogen, iron, phosphate, etc., should make it possible to place the water in question in the trophic scale.

It is, however, possible only with difficulty to apply the hypothesis to the extreme parts of this scale, the dystrophic and saprotrophic phase, especially the former, being extremely poor in plankton species; as to the latter the compound quotient should be replaced by the euglenine quotient as mentioned above.

3. Some Remarks on the Ecology of Danish Phytoplankton Organisms.

In "Dansk Plante-Plankton" (Nygaard 1945) I discuss rather extensively the periodicity of the species, but besides this I have tried, on the basis of my Danish plankton material, to set up "indicatory species", which of course to some extent must be a corroboration of the results previously achieved by other investigators. It is well-known that within the Diatoms (loc. cit., pp. 18, 20) all the euplanktic *Melosira* species, *Cyclotella Meneghiniana*, *C. stelligera*, *Stephanodiscus Astraea*, *St. dubius* and particularly *St. Hantzschii*, together with *Rhizosolenia longiseta* and *Attheya Zachariasi* are characteristic of eutrophic lakes, likewise *Synedra acus* var. *angustissima* and especially *Nitzschia acicularis*.

Within the Flagellates (Nygaard 1945, p. 24) the following 3 species seem to be indicators of dystrophic localities: *Dinobryon pediforme*, *Goniostomum semen* and *Synura sphagnicola*[1]. *Uroglena americana* (*Uroglenopsis americana*) is rather characteristic of Danish oligotrophic lakes with clear acid or neutral water on sandy bottom. Species like *Euglena pisciformis*, *Eugl. tripteris*, *Lepocinclis Steinii*, *Phacus caudata* together with *Mallomonas Teilingii*, *Mall. tonsurata*, *Lepocinclis ovum*, *Trache-*

[1] given as *Synura uvella* f. *punctata*.

lomonas armata, Phacus acuminata, Ph. pyrum, Ph. suecica and *Ph. aenigmatica* are all characteristic of eutrophic waters, the 8 last-mentioned also of the mixotrophic phase. Species like *Lepocinclis texta, Lep. fusiformis, Phacus platyaulax*, and *Euglena sanguinea* are characteristic of highly eutrophic or even saprotrophic water.

Among the Dinoflagellates (NYGAARD 1945, p. 29) *Peridinium palustre, Glenodinium pusillum* and *Gymnodinium fuscum* are indicatory forms of oligotrophic water in the dystrophic or acidotrophic phase. Species like *Amphidinium lacustre, Diplopsalis acuta, Glenodinium aciculiferum, Gl. dinobryonis, Gl. gymnodinium, Gymnodinium excavatum, Gymn. hiemale, Gymn. inversum, Gymn. paradoxum, Gymn. tenuissimum*, and *Gymn. aeruginosum* are indicative of neutral-alkaline, lime-rich, more or less eutrophicated water. On the other hand *Peridinium bipes, Per. cinctum*, and *Per. Willei* are eurytrophic and otherwise very adaptive; but in this paper it must be added that among the *Peridinium* species *P. cinctum* is the form that is most commonly met with in eutrophic, whereas *P. Willei* mostly occurs in oligotrophic (acidotrophic and dystrophic) lakes.

Among the large numbers of green algae especially *Staurastrum brachiatum* but also *Bambusina Borreri* (*Gymnozyga moniliformis*) and *Cosmarium tetraophtalmum* seem to be characteristic of the dystrophic phase. *Oocystis solitaria*, however, is not exclusively confined to the dystrophic sub-type: during a re-examination of my plankton samples from the slightly eutrophic Nors Sø I found one individual of this species. In Danish oligotrophic waters *Arthrodesmus triangularis* and *Staurastrum anatinum* seem to be characteristic species, and also the 2 last-mentioned species of the dystophich phase are frequent here. None of these *Chlorophyceae* were found in Danish eutrophic (or mixotrophic) waters. In this country the species *Closterium Kützingii* was mainly observed in eutrophic ponds and lakes of the mixotrophic phase.

A great number of green algae, mainly *Chlorococcales*, may be found in eutrophic lakes and ponds; they are mentioned in "Dansk Plante-Plankton" at the bottom of p. 35 and the top of p. 36. Moreover *Cosmarium depressum* var. *planctonicum, Closterium aciculare* and a few *Staurastrum* species like *Staurastrum tetracerum* and its var. *validum* are typical Desmids of our eutrophic lakes.

Among the particularly adaptive green algae may be mentioned *Botryococcus Braunii, Chlamydomonas acidophila, Quadrigula closterioides, Sphaerocystis Schroeteri* and *Staurastrum gracile*, all of which may occur in both oligotrophic (dystrophic, acidotrophic) and eutrophic (mixotrophic) waters. Other species are conspicuous by a far-going indifference to extreme pH and calcium values; the names of these species are given in "Dansk Plante-Plankton" in the middle of p. 35.

4. Systematic Part.

Chlorophyceae.

Volvocales.

Chlamydomonadaceae.

Carteria agloëformis n. sp.

Fig. nostra 1.

Diagnosis. Cellulae parvae, subsphaericae vel late ellipsoideae. Membrana tenuis, adpressa, sine papilla antica. Flagellis 4, longitudine cellulae $1^1/_2$—2 plo longioribus. Chromatophorus tenuiter sacculiformis, supraaequatorialiter valde incrassatus, pyrenoide solitaria, sphaerica et axillari in parte transversali instructus. Nucleus in posteriore parte cellulae situs. Stigma ovale, supraaequatoriale vel raro aequatoriale. Vacuola contractilia bina. Longitudo cellularum 16—18 μ, latitudo 14—16 μ.

Hab. In stagno parvo prope Stavnsholt, Selandia, Dania, libere natans.

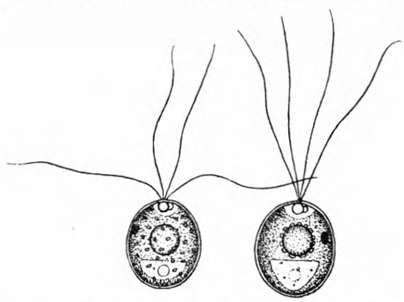

Fig. 1. *Carteria agloëformis* n. sp. from pond in western Stavnsholt, July 22nd, 1929. 800×.

This new species is closely related to *Carteria micronucleata* Korsch. (Pascher 1927, p. 156, Fig. 107), which, however, has a papilla, is more elongate and has an anteriorly situated stigma and shorter flagella than *Carteria agloëformis* mihi. Besides, the pyrenoid of the latter is situated more apically than that of the former.

Carteria agloëformis was observed once (July 22nd, 1929) in the said locality when it occurred in enormous quantities. This small polluted field pond was eutrophic (the dry weight of the plankton on the date mentioned was 160 mg/l); its water was of a pale yellow colour caused by large quantities of *Microcystis flos aquae*; the temperature was 26.5° C. and pH 9.8. The myxophycean quotient was $\frac{4}{5}$, chlorophycean quotient $\frac{13}{5}$, diatom quotient $\frac{0}{0}$, euglenine quotient $\frac{0}{17}$, and compound quotient $\frac{17}{5} = 3.4$.

Carteria fornicata n. sp.

Fig. nostra 2.

Diagnosis. Cellulae mediocres, late vel anguste ellipsoideae, raro subcylindricae apicibus late rotundatis, a vertice visae non compressae, ex 11 mensionibus 1.3—2.3 (saepe 1.5) plo longiores quam latiores. Membrana tenuis, adnata, basaliter interdum a protoplasto discedens, apicaliter in papillam magnam vel ingentem, late rotundatam, 2—5 μ altam et 6—16 μ latam incrassata. Flagella 4 longitudinis cellulae circiter aequilonga. Chromatophorus urnaeformis, fere apicem attingens, cum pyrenoide ampla, ellipsoidea vel sphaerica, raro subangulata, medio vel paulo inferiore. Stigma parvum vel submagnum, late ovale vel rotundum, raro subangu-

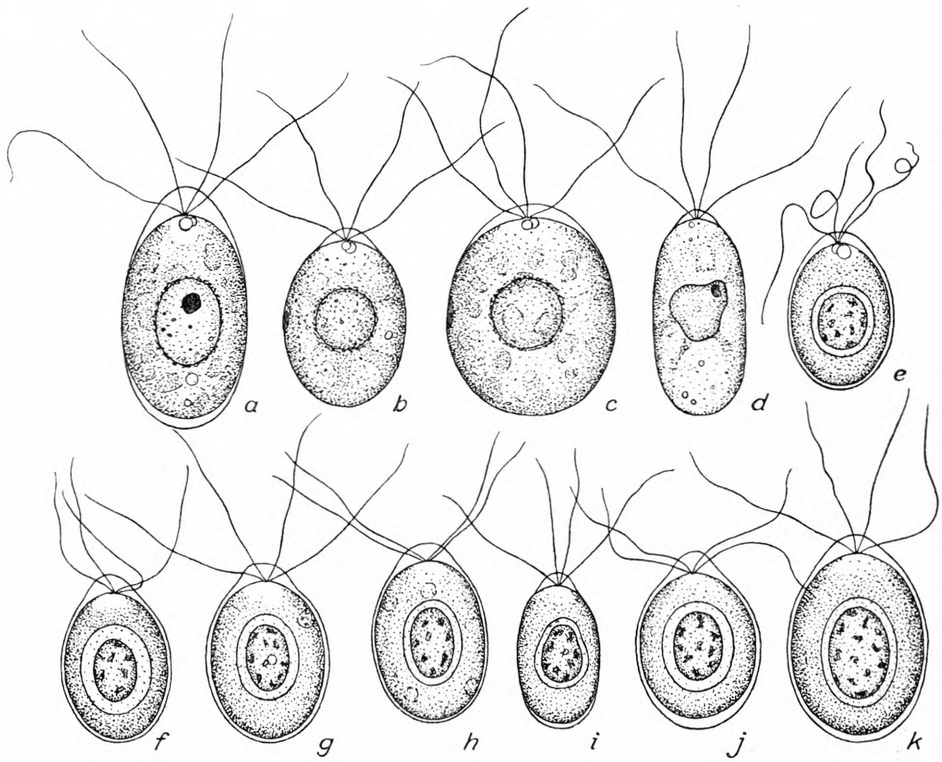

Fig. 2. *Carteria fornicata* n. sp. *a*—*e* from Sandberg Sø, September 4th-10th, 1937; *f*—*k* from Lynge Vandingsdam, June 30th, 1947. *a*—*d* are drawn after living material, *e*—*k* after material fixed in formalin. 800×.

latum, aequatoriale vel medio cellulae paulo superius. Cellulae 26—40 μ longae, 14—28 μ latae.

Hab. In Sandbjerg Sø prope Alssund et Lynge Vandingsdam prope Sorø, Dania, libere natans.

Systematics. In three cells I observed 2 contractile apical vacuoles, but I do not know whether this is a general feature, and so it has been omitted in the diagnosis. The fine granules in the chromatophore in certain individuals showed a very indistinct, asteroid arrangement, but in others they were indistinctly arranged in irregular, roundish groups. This arrangement of granules is perhaps due to the ± infavourable conditions of living under the coverslip: an individual cannot be drawn until it is quiet or nearly quiet. In fixed material the chromatophore was without any indication of radial structure.

Carteria fornicata is presumably comparatively closely related to *Carteria Olivieri* West (Pascher 1927, p. 152, fig. 100); the latter species, however, shows a quite different build of the papilla, which is as broad as the cell, it is true, but in the middle has a firm, conical verruca. Moreover it has cylindrical or narrowly ellipsoidical cells, whereas *Carteria fornicata* normally has rather broadly ellipsoidical cells.

Periodicity and Sociology. The species was observed only between September 4th and 10th, 1937 in Sandbjerg Sø and on June 30th, 1947 in Lynge Vandingsdam. It seems to be a warm water form.

In Sandbjerg Sø it was very rare in an *Os li*-association with *Mia pu* as subdominant, and in Lynge Vandingsdam it was rare in a *Tra vo*-association with *Chla ci* and bacteria as subdominants.

Ecology. Both Sandbjerg Sø and the small Lynge Vandingsdam are highly eutrophic, permanently alkaline, contaminated ponds, the latter to such a degree, that it approaches saprotrophy. The compound quotients of Sandbjerg Sø are found on p. 204, those of Lynge Vandingsdam in Table III; on the two dates mentioned above the compound quotient was $\frac{31}{0}$ and $\frac{31}{1}$, respectively. In other words the ecology of *Carteria fornicata* is characterized by a very strong eutrophy.

Carteria polysticta n. sp.

Fig. nostra 3.

Diagnosis. Cellulae late ellipsoideae. Membrana tenuis, adpressa, sine papilla antica. Flagella 4, longitudine cellulae paulo longiores. Chromatophorus grandis, cellulam totam fere explens, sine incrassitudine basali, incrassitudinibus lateralibus cum pyrenoidibus 7—8. Stigma elongatum, aequatoriale. Vacuola contractilia bina. Longitudo cellularum 27—28 μ, Latitudo 20 μ.

Hab. In Madum Sø, Jutlandia, Dania, libere natans.

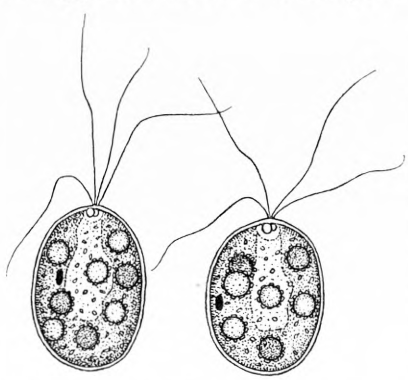

Fig. 3. *Carteria polysticta* n. sp. from Madum Sø, February 5th, 1930. 750×.

Systematics. On account of the many pyrenoids the species will easily be classed within the sub-genus *Carteriopsis*. Within the latter Pascher (1927, p. 161) gives only one species, *Carteria coccifera* Pascher, which, however, differs from the present species by having egg-shaped cells, a papilla, and the stigma in the front third of the cell.

Periodicity. This new species is perhaps oligothermic, but the material on which this opinion bases is very sparse. Only a few individuals were seen on February 5th, 1930 at a temperature of 0° or a little more (the lake being completely covered with ice). The species was never observed in the summer samples from this lake.

Sociology. The amount of plankton in Madum Sø was extremely small on February 5th, 1930. The association was mostly characterised by *Dinobryon pediforme*, to a less degree by *Staurastrum gracile* and *Peridinium bipes*.

Ecology. Madum Sø is oligotrophic of the acidotrophic phase and otherwise conspicuous by its extremely small content of organic matter dissolved in the water. Some ecological data of the species are: pH 5.1, consumption of $KMnO_4$ 6.6 mg/l, contents of CaO 4 mg/l, NO_3-N 0.04 mg/l, NH_3-N 0 mg/l, PO_4-P 0 mg/l; an analysis from March 1931 showed 0.01 mg/l of Fe.

Carteria stellifera n. sp.

Fig. nostra 4.

Diagnosis. Cellulae sphaericae vel subsphaericae. Membrana tenuis, adpressa, in polo antico papilla hemisphaerica praedita. Flagella 4, cellulae ad 2—3 plo longiores. Chromatophorus magnus, plusminusve urnaeformis cum processibus ab pyrenoide magna, axiali, late ovali, subbasali raro centrali radiantibus. Inter processus cavernae vacuoliformes, omnes cum corpusculo vel corpusculis moventibus paucis. Nucleus et vacuola bina contractilia in parte anteriore cellulae situs. Stigma parvius, ovale, aequatoriale vel paulum supra partem mediam dispositum. Longitudo cellularum 16—24 μ, latitudo $15^1/_2$—$23^1/_2$ μ.

Hab. In Vandingsdam et in stagno parvo prope Stavnsholt, Selandia, Dania, libere natans.

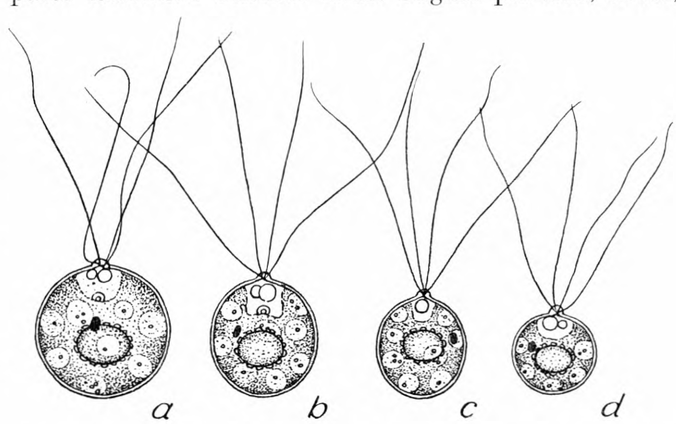

Fig. 4. *Carteria stellifera* n. sp. from Vandingsdam, July 6th, 1929; *a, b, c,* 750×, *d* 570×.

Systematics. The species shows some relationship to *Carteria radiosa* Korsch. (Pascher 1927, p. 155, fig. 105), which, however, has much shorter flagella, a flat and broad papilla and more numerous chloroplast lobes than *Carteria stellifera* mihi; besides it has no moving granules in the cavities between these lobes. During the swimming the motions of *Carteria stellifera* are trembling.

Periodicity. This Volvocale is meso- to polythermic: it was only found in the plankton during the period June-September, at temperatures between 12 and

26.5° C. In Vandingsdam it was comparatively rare on June 16th, 1930 (temp. 23° C.), but large quantities occurred on July 6th, 1929 (temp. 16° C.). In June, August and September 1929 it was extremely sparse; it disappeared before the beginning of October and did not reappear until June 16th, 1930. In the enclosed pond of the western part of Stavnsholt it was observed only on July 22nd, 1929 when it was very rare.

Sociology. In Vandingsdam the species was found in the following associations:

June 28th, 1929: *Dic pu*-association (*Carteria* very rare).
July 6th, — : *Dic pu*-association (*Carteria* common).
— 16th, — : *Sce arv—Ank fa mi du*-association[1] (*Carteria* very rare).
— 26th, — : *Sce fa*-association (*Carteria* very rare).
Aug. 10th, and
— 17th, 1929: *Sce fa*-association with *Mio pu ra* as subdominant (*Carteria* very rare).
— 24th, — : *Teë mi*-association with *Mio pu ra* and *Sce fa* as sub-dominants (*Carteria* very rare).
Sep. 3rd, — : *Teë mi*-association with *Miu pu ra* as sub-dominants (*Carteria* very rare).
— 9th, — : *Teë mi-Tra hi*-association (*Carteria* very rare).
— 13th, — : *Teë mi*-association with *Mio ho* and *Tra hi* as sub-dominants (*Carteria* very rare).
— 21st, — : *Sce arm*-association with *Mio ho*, *Mer te*, *Tra hi*, and *Teë mi* as subdominants (*Carteria* very rare).
— 23rd, — : *Teë mi-Tra hi*-association (*Carteria* very rare).
June 16th, 1930: *Teë mi*-associations with *Ank co mi* as subdominant (*Carteria* rare).

In the enclosed pond of western Stavnsholt the species was very rare in the following association:

Jul. 22nd, 1929: *Mio fl*-association with *Ca ag* as subdominant, see p. 20.

In other words *Carteria stellifera* mainly occurred in associations that were characterised by green algae (*Dictyosphaerium*, *Ankistrodesmus*, *Tetraëdron*, *Scenedesmus*), flagellates (*Trachelomonas*) and blue-green algae (*Microcystis*).

The most constant associates were *Pediastrum duplex*, *Ped. Tetras*, *Scenedesmus armatus*, *Sce. arvernensis*, *Sce. falcatus* and *Tetraëdron minimum*, which occurred in 100 $^0/_0$ of the number of samples (14) that contained *Carteria stellifera*. *Closterium gracile*, *Cyclotella Meneghiniana*, *Dictyosphaerium pulchellum*, *Microcystis holsatica* and *Trachelomonas volvocina* occurred in 93 $^0/_0$, *Ankistrodesmus convolutus* var. *minutus*, *Chlamydomonas Reinhardii*, *Microcystis pulverea* var. *racemiformis* in 86 $^0/_0$, and *Ankistrodesmus falcatus* var. *mirabilis* f. *dulcis* and var. *spirilliformis*,

[1]) and indeterminable green algae.

Chlorogonium acus, *Lampropedia hyalina* and *Merismopedia tenuissima* only in 79 % of the samples.

Ecology. Both Vandingsdam and the enclosed pond in western Stavnsholt are highly productive small ponds without inlets or outlets and contaminated by cattle (maximum production 92.4 and 160 mg/l of dried plankton, respectively). Some ecological data of the species are: pH 7—9.8, consumption of $KMnO_4$ 81—92 mg/l, contents of CaO 19.5—27 mg/l, NO_3-N 0—0.01 mg/l, NH_3-N 0.08—0.2 mg/l, PO_4-P 0—0.03 mg/l, and Fe 0.35 mg/l (analysis of iron from June).

Platymonas incisa n. sp.

Fig. nostra 5.

Diagnosis. Cellulae late ellipsoideae, 1.3—1.5 plo longiores quam latiores, compressae, non contortae. Pars antica excavata et interdum protracta, pars posterior saepe leviter sed perspicue excavata, rarissime sine sinu basali. Flagella 4 cellula aequilonga. Chromatophorus poculiformis, sine pyrenoide, incisionibus verticalibus in quattuor lacinias divisus, quae basaliter continuae sunt. Incisiones partis frontalis alteriores et lateriores quam incisiones partis lateralis. Incisiones partis frontalis saepe cum granulis in serie una. Nucleus in media cellula situs. Stigma rotundum, parvius, semper in parte frontali, aequatoriale vel paulum supra partem mediam dispositum. Longitudo cellularum $13^1/_2$—$17^1/_2\,\mu$, latitudo $10^1/_2$—$13^1/_2\,\mu$, crassitudo 7—9 μ.

Hab. In Spejldam et Hesteskodam prope Hillerød, Dania, libere natans.

Systematics. On account of the appearance of the cells this characteristic species cannot be mistaken for any other *Platymonas* species described, and it may as well be called *Platymonas scherffelioides* mihi or perhaps even *Scherffelia incisa* mihi because the individuals in certain respects are much like *Scherffelia*. But they are not nearly so much flattened as the species of the *Scherffelia* genus (according to A. Pascher, 1927, p. 170, 4—6 times broader than thick), and I have therefore considered it correct to class the species within the genus *Platymonas*. But *Platymonas incisa* is a transition form between *Platymonas* and *Scherffelia*.

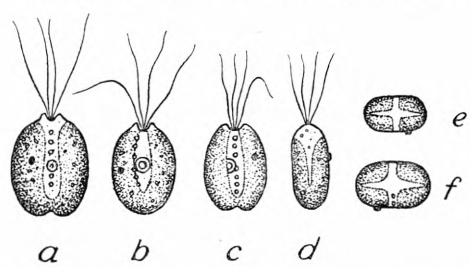

Fig. 5. *Platymonas incisa* n. sp. from Spejldam, November 22nd, 1929 and March 15th, 1930; *a*, *b*, *c* front views, *d* lateral view, *e* and *f* vertical views. 750×.

In fixed material, which shows a marked receding of the protoplast from the cell wall, it looks as if the apical incision in fact goes longitudinally round the whole cell, growing less deep at the basal end of the cell.

Periodicity. In Spejldam a few individuals of the species appeared on November 22nd, 1929 when the temperature had fallen to 4° C. During the following winter months it was very rare in the plankton. At the beginning of March 1930 it grew more common, and in particular many individuals were observed on March 15th—when the ice was about to break—though it could not be said to prevail in the plankton. Already at the beginning of April it had disappeared from the plankton of Spejldam in spite of the fact that a few individuals were seen on April 4th, 1930 (temp. 5° C. and pH 7.4) in Hesteskodam, the outlet of which falls into Spejldam. During the warm half of the year the species was never observed. Thus *Platymonas incisa* is a stenothermic cold water form, being found only at temperatures between 0.5 and 5° C.

Sociology. In Spejldam the species occurred in the following associations:

Nov. 22nd, 1929: *Ma ak-Tra vo*-association (*Platymonas* very rare).
Jan. 15th, 1930: *Tra vo*-association (*Platymonas* very rare).
Feb. 17th, — : *Crym ov-Chla ac*-association (*Platymonas* very rare).
Mar. 1st, — : *Chla ac*-association with *Ma* sp_1 as subdominant (*Platymonas* not infrequent).
— 15th, — : *Ma se*-association with *Ank fa se br* as subdominant (*Platymonas* rather common).

In Hesteskodam the species was very rare in the following association:

Apr. 4th, 1930: *Ank fa se br*-association.

Platymonas incisa thus occurred in flagellate associations of *Mallomonas, Trachelomonas* and *Cryptomonas* and in green algae associations of *Chlamydomonas* and *Ankistrodesmus.*

The most constant associates are *Trachelomonas volvocina*, which occurred in 100 % of the number of samples (6) that contained *Platymonas incisa. Chlamydomonas acidophila, Mallomonas akrokomos* and *M. semiglabra* were found in 83 % of the samples.

Ecology. Both Spejldam and Hesteskodam are eutrophic, the latter approaching sapotrophy; the former is highly overshadowed and therefore cold in summer. Its water is of a light brown colour and mostly poor in plankton. The pond stands between the eutrophic and the mixotrophic types but it should perhaps rather be called eutrophic on account of its characteristic water-bloom of *Aphanizomenon flos aquae* in late summer. Some data of the ecology of the species are: pH 7.3—8.0, consumption of $KMnO_4$ 37 mg/l, contents of CaO 36.4—40.5 mg/l, Fe 0.17 mg/l, NH_3-N 0.08—0.2 mg/l, NO_3-N 0.06—0.175 mg/l, and PO_4-P 0.018—0.03 mg/l.

Chlamydomonas.

In Dansk Plante-Plankton I have described a *Chlamydomonas fusiformis* n. sp. (Nygaard 1945, p. 52, Fig. 24). According to Gerloff (1940, p. 485) a *Chlamydo-*

monas fusiformis Boye Petersen (1932) and an incompletely described species, *Chlamydomonas fusiformis* Schiller (1913) are previously known.

Chlamydomonas fusiformis Boye Petersen has been called *Chlamydomonas subfusiformis* (Boye Petersen) Gerloff, and to *Chlamydomonas fusiformis* Nyg. I hereby give the new name of *Chlamydomonas retroversa* Nygaard.

Originally I believed that the *Chlamydomonas retroversa* individuals were identical with *Chlamydomonas microscopica* G. S. West (1915, p. 77, Fig. 2F—I, sub nomine *Chlamydomonas gracilis* West). In his diagnosis West states that the stigma is lacking; Pascher (1927, p. 274) suggests that West may have overlooked it. On the chromatophore West only says, 'chromatophora singula cum pyrenoide singulo parvo submediano'; Pascher (*loc. cit.*) supposes that the chromatophore is girdle-shaped and parietal. If this supposition is correct, at any rate some of West's drawings are wrong for in all of them the pyrenoid is shown to be situated in the longitudinal axis of the cell. If West's drawing of the flagella is correct, his *Chlamydomonas microscopica* in this respect differs from *Chlamydomonas subfusiformis* and *Chlam. retroversa*, both of which in a resting state bend their flagella backwards along the cell. In his excellent 1940 paper Gerloff strangely enough does not mention *Chlamydomonas microscopica* under *species inquirendae* where it properly belongs.

Boye Petersen found *Chlamydomonas subfusiformis* in an earth sample from the drift-sand area of West Jutland; pH was 4.83 (1932, p. 396, Figs. 1—3). It appears (in part) from Table IV that *Chlamydomonas retroversa* was found only in Jægerbakke Dam, Vandingsdam, Flødegaardens Dam, Hesteskodam, and Frederiksborg Slotssø, all of them alkaline (pH as high as 9.8), highly eutrophic, contaminated ponds; moreover in the two alkaline, eutrophic ponds of the mixotrophic phase, Blankeborg I and II.

Apart from this conclusive difference in an ecological respect the two species also differ morphologically. *Chlamydomonas subfusiformis* has quite a small papilla and its stigma in the posterior half or third of the cell while the lateral pyrenoid is situated above the middle of the cell; moreover the cells are sometimes slightly curved. *Chlamydomonas retroversa* has no papilla, and its stigma is always situated in the anterior half or third of the cell while the lateral pyrenoid is found below, very rarely in the middle of the cell; the build of the cell is symmetrical.

Gerloff refers *Chlamydomonas subfusiformis* to *Bivacuolatae*; Boye Petersen mentions only one vacuole. Also *Chlam. retroversa* has only one vacuole.

Chlamydomonas anulata n. sp.

Fig. nostra 5 bis.

Diagnosis. Cellulae parvae, concinne ellipsoideae vel subglobosae, 0.6—0.95—plo longiores quam latiores. Membrana tenuis, adpressa, papilla antica plane truncata et brevissima instructa. Chromatophorus parietalis, a fronte et postremus exiliter evolutus, in parte aequatoriali valde incrassatus; haec incrassitudo anularis pyrenoidem unam, magnam et lateralem continet. Stigma ovale, aequatoriale, semper prope pyrenoidem. Nucleus in lumine posteriore situs est, saepe subexcentricus. Vacuola contractilia bina in parte anteriori. Flagella bina cellula breviora. Longitudo cellularum 10.5—17.5 μ, latitudo 7.5—16.5 μ.

Hab. In stagno prope Ragebøl, Sundeved, Jutlandia meridionali, Dania, libere natans.

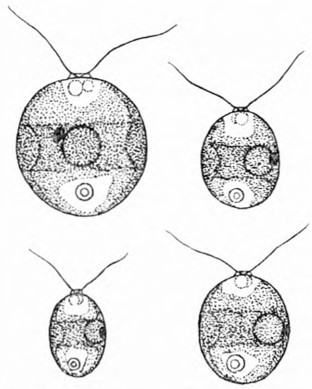

Fig. 5 bis. *Chlamydomonas anulata* n. sp. from a pond at Ragebøl, North Sleswick, April 2nd, 1938, 1070×.

Systematics. This species belongs to *Chlamydella*; within this subgenus it should rather be referred to the subsect. *Monopleura*. On account of the ring-formed and aequatorial thickening of the chromatophore and the aequatorial eye-spot which always lies close to the big, lateral pyrenoid, the species may hardly be mistaken for any other species described. This ring-formed thickening is locally so limited and well developed, that it gives the individuals the appearance of possessing two pyrenoids.

Chlamydomonas anulata was not infrequent in the pond at Ragebøl in North Sleswick on April 2nd, 1938. It occurred in a *Sce arm*-association with *Cym so* as subdominant. The pond is no doubt eutrophic as is evident from the plankton quotients of August 30th, 1937: the association was dominated by an undeterminable *Chrysophycea* with *Ste du* and *Tst st* as subdominants, the myxophycean quotient was $\frac{3}{3}$, the chlorophycean $\frac{27}{3}$, the diatom $\frac{2}{0}$, the euglenine $\frac{4}{30}$ and the compound quotient $\frac{36}{3} = 12$; number of species 43.

Chlamydomonas Bergii n. sp.

Fig. nostra 6.

Diagnosis. Cellulae oblonge oviformes, teretes, asymmetricae, 2—3 plo longiores quam latiores, parte apicali obtusa, parte posteriore in caudam hyalinam obliquam exeunte. Membrana tenuis, sine papilla, plerumque ad finem posteriorem a protoplasto discedit et hic caudam 5—6 μ longam, 1 μ crassam possidet. Chromatophorus parietalis, late taeniaeformis, marginibus non continuis; pars incrassata aequatorialis vel subbasalis pyrenoide grande sphaerica vel late ellipsoidea instructa. Nucleus in parte posteriore cellulae situs. Stigma ellipsoideum, aequatoriale vel paulum supra mediam cellulam. Vacuola contractilia bina, flagella bina $^1/_2$—$^2/_3$ longitudinis cellulae. Longitudo cellularum incl. cauda 17—30 μ, latitudo 7—12 μ.

Hab. In Rønhavegaard Dam, Alsia, et Lynge Kirkedam prope Sorø, Dania, libere natans.

Systematics. This quietly swimming species is closely related to *Chlamydomonas rigensis* Skuja (1927, p. 62, t. 1, fig. 11 a—d). However, the cells of the Latvian species are subacute and provided with a papilla, but especially the caudal spine differs from that of the Danish species in being thick, more or less conical and with a smooth transition into the membrane of the cell. The species is called after Prof. Dr. KAJ BERG, who in so many ways has encouraged and prompted me in my studies on the limnic microflora of this country.

Periodicity. The species occurred in small quantities in Rønhavegaard Dam on March 12th and 19th, 1944 (temp. 4.5 and 6° C.) and in Lynge Kirkedam on November 15th, 1947 (temp. 2°) and is probably a cold water form like *Chlamydomonas rigensis*. In March 1945 it was not found again in Rønhavegaard Dam in spite of repeated samplings, so that a planned cultivation of clones for the purpose of elucidating its sexual conditions could not be carried out.

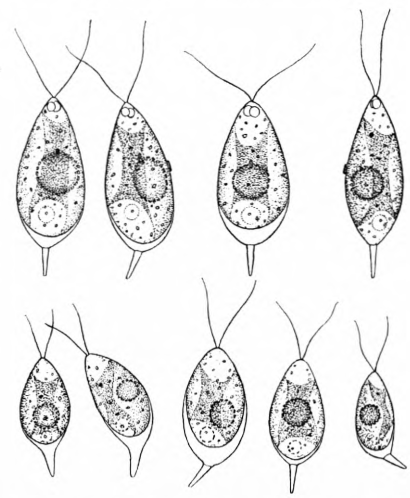

Fig. 6. *Chlamydomonas Bergii* n. sp. from Rønhavegaard Dam, March 12th, 1944. The upper row is drawn from living material, the lower from fixed material. 800×.

Sociology. On March 12th, 1944 the plankton of Rønhavegaard Dam consisted of a *Chrom No mi*-association with *Chla Re* and *Ste Ha* as subdominants, on March 19th of a *Chrom No mi*-association with *Ste Ha* as subdominant. For the rest *Chlamydomonas Berg'i*, here occurred together with several Chlamydomonads: *Chlamydomonas bicocca*, *Chl. multitaeniata*, *Chl. pseudoplatyrhyncha*, *Chl. sacculiformis*, *Chl. Reinhardii* and *Scourfieldia cordiformis*. On November 15th, 1947 the plankton of Lynge Kirkedam consisted of a *Chla Re-Phu py*-association with 6 other Chlamydomonas-species.

Ecology. Rønhavegaard Dam and Lynge Kirkedam are highly eutrophic ponds, polluted by ducks and swans. Already in March 1944 and also in March 1945 the quantity of plankton in Rønhavegaard Dam was enormous; an intense green coloration of the water was observed. pH measured 8.2 and 7.8 at the time when *Chlamydomonas Bergii* occurred. The former pond is undoubtedly rich in calcium because it is situated on a substratum of moraine clay.

Chlamydomonas capitis n. sp.

Fig. nostra 7.

Diagnosis. Cellulae parvae, tenuiter ellipsoideae vel longissime ovatae, 2.8—3 plo longiores quam latiores. Membrana tenuissima, adpressa, in polo antico papilla distincta, circiter 2 μ lata, cylindracea ordinata. Chromatophorus longe urnaeformis, basaliter valde incrassatus (incrassitudo partem dimidiam cellulae saepe explens), pyrenoide basali, axiali instructus. Nucleus centralis vel paulo supra medium situs. Stigma punctiforme, in media cellula vel in parte basali. Flagella bina, 22—35 μ

longa, 2—3 plo longitudinis cellulae. In polo antico vacuola bina contractilia sita sunt. Longitudo cellularum 10.5—17.5 μ sine papilla, latitudo 4—6.5 μ.

Hab. In Jægerbakke Dam prope Hillerød, Dania, libere natans.

Systematics. The species is closely related to *Chlamydomonas capitata* Scherffel et Pascher (Pascher's Süsswasserflora, Heft 4, 1927, p. 246, Fig. 200). The cells of this species, however, are often obovate, and judging from the drawings they are 2.2—2.5 times longer than broad (6—8 μ broad), the flagella only 1.5 times the length of the cell, and the stigma is situated in the front third of the cell. *Chlamydomonas capitis* is also related to *Chlamydomonas solida* Pascher (1930, p. 136, fig. 31), which, however, has fusiform cells without papilla and pyrenoid, and the flagella of which are likewise 1.5 times the length of the cell.

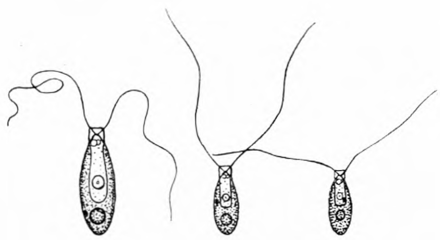

Fig. 7. *Chlamydomonas capitis* n. sp. from Jægerbakke Dam; *a* from December 16th, 1929, *b* and *c* from May 16th, 1930. 750×.

Periodicity. Only a few individuals of the species were observed and only on the dates of December 16th, 1929 and May 16th, 1930 at temperatures of 3° and 20.5° C., respectively. It thus seems to be eurythermic. It was not found in any of the other samples from Jægerbakke Dam although this pond was examined every 10th or 14th day throughout a whole year.

Sociology. The species occurred in the following associations:

Dec. 16th, 1929: *Ank fa se br-Ki mi*-association with *Ank fa spa* and *Mio ho* as subdominants (the species very rare).

May 16th, 1930: *Ank fa spa-Mio ho-Sce arm*-association, see Table IV (the species very rare).

It thus occurs in associations of green algae (*Ankistrodesmus*, *Kirchneriella* and *Scenedesmus*) and blue-green algae (*Microcystis*). On account of the paucity of the material no constant associates are given.

Ecology. Jægerbakke Dam is a highly eutrophic, lime-deficient pond, sheltered from winds and without inlets or outlets. The compound quotient was $\frac{35}{2} = 17.5$ on May 16th, 1930 (see also Table III). The following are data from the ecology of *Chlamydomonas capitis*, including the values of analysis from May 21st, 1930: pH 7.4, CaO 7.3—10.9 mg/l, consumption of $KMnO_4$ 32 mg/l, PO_4-P 0.005—0.008 mg/l, NH_3-N 0.05—0.75 mg/l, NO_3-N 0—0.01 mg/l.

Chlamydomonas clavata n. sp.

Fig. nostra 8.

Diagnosis. Cellulae parvae, clavatae, e 7 mensionibus 3.3—4.25 (saepe circiter 3.5) plo longiores quam latiores (a vertice visae circulares), leviter curvatae, aut altero latere convexo, altero recto aut utroque latere curvato, polo antico obtuse acuto, sine papilla, polo posteriore rotundato. Membrana delicatissima, adnata. Flagellis binis, corpore aequilongis vel paulo longioribus, in statu quiescente secundum latera cellulae valde recurvatis. Chromatophorus unus, lateralis, alveiformis, saepe ad latus convexum cellulae, cum pyrenoide una in dimidio altitudine cellulae vel paulo inferiore; fines cellulae hyalini. Stigma minimum, ovale, in parte anteriore cellulae situm. Nucleus in parte posteriore cellulae. Vacuola contractilia bina. Cellulae 8.5—10.5 μ longae, 2—3 μ latae.

Hab. In Præstesø prope Oxbøl, Jutlandia occidentali, et Blankeborg II, Fionia, Dania, libere natans.

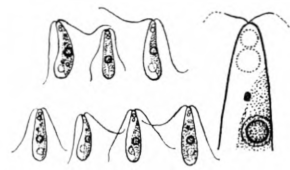

Fig. 8. *Chlamydomonas clavata* n. sp. from Præstesø, June 24th, 1930. 750×.

Systematics. This new species, which is easily distinguished by its clavate, small cells, shows the closest relationship to *Chlamydomonas minima* Korsch. (see PASCHER 1927, p. 280, fig. 241, or, as it is called by GERLOFF: *Chlamydomonas perpusilla*, because SCHILLER has formerly described a *Chlamydomonas minima*, which, however, according to GERLOFF is possibly no *Chlamydomonas* at all). KORSHIKOV's species differs by being thickest in the middle.

Periodicity and Sociology. *Chlamydomonas clavata* was found only on June 24th and 28th, 1930 (temp. 20—21° C.) in Præstesø and on June 10th, 1930 (temp. 21.5° C.) in Blankeborg II, in the following associations:

Præstesø: *Ana fl*-association (the species very rare; see Table II),

Blankeborg II: *Ste Ha*-association (the species extremely rare; see Table IV), i. e. in an *Anabaena* and in a *Stephanodiscus* association.

Ecology. Præstesø is a clear, "mesotrophic" heath lake, the compound quotient of which according to Table I was $\frac{21}{17}$ = 1.2 on the dates mentioned, when pH was 7.0—7.1; see further p. 13. Blankeborg II is a eutrophic turf pit of the mixotrophic phase; in 1928—29 the consumption of $KMnO_4$ was 70—88 mg per litre, and January 6th, 1930 showed the following contents of CaO 153.5 mg/l, PO_4-P 0.6 mg/l, NH_3-N 0.9 mg/l, and NO_3-N 1.3 mg/l. On June 10th, 1930 the compound quotient was $\frac{20}{0}$.

Chlamydomonas excentrica n. sp.

Fig. nostra 8 bis.

Diagnosis. Cellulae concinne oviformes, 1.3—1.5-plo longiores quam latiores. Membrana adpressa, tenuis, sine papilla. Chromatophorus sine pyrenoide, forma ut chlamys aperta, obliqua, irregulariter lobata vel sinuata, fere ad polum anticum attingens, sed nunquam parte basali cellulae implens, et hic cum lumine incolorato et excentrico. Stigma mediocre vel grande, late ovale vel rotundum, rubrum vel saepe brunneorubrum, aequatoriale vel saepe subaequatoriale, raro basale. Nucleus semper basalis, subexcentricus, in lumine posteriore situs. Vacuola contractilia bina in polo antico sunt. Flagella bina, 1—1$^1/_2$-plo cellula longiora. Intus granula saepe in seriebus decussatis ordinata sunt. Longitudo cellularum 8.5—13.5 μ, latitudo 5.5—9 μ.

Hab. In stagno turfaceo prope Søgaard Sø, Dania, libere natans.

Systematics. The species comes nearest to *Chlamydomonas anglica* Pascher (1927, p. 295, fig. 260) within the subgenus *Chloromonas*. The latter species differs from *Chlamydomonas excentrica* in the shape of the cells which are not typically ovate, the lack of eye-spot, the position of the nucleus, which is situated in the former half of the cell, and the flagella inserting relatively long from each other.

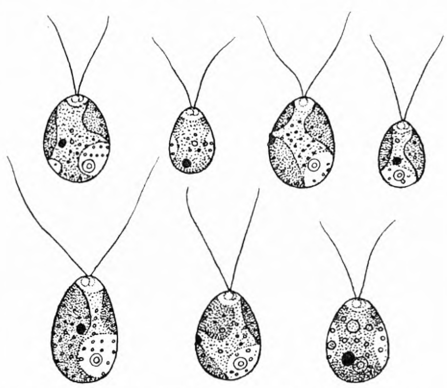

Fig. 8 *bis. Chlamydomonas excentrica* n. sp. from a Sphagnum bog south of Søgaard Sø in North Sleswick, July 16th, 1939. 1070 ×.

The species was found only on July 16th, 1939 (temp. 21.5° C.) in a *Sphagnum* bog ("Cirkelsø") south of Søgaard Sø, North Sleswick. This dystrophic locality has extensive quaking bogs at the margins, and its water is very acid and brownish. The compound quotient on July 23rd, 1926 (pH 4.0) was $\frac{2}{5} = 0.4$, on July 16th, 1939 (pH 4.3) it was $\frac{0}{3}$. *Chlamydomonas excentrica* was rather common on July 16th, 1939 in the plankton which was dominated of *Cryptomonas ovata*. This species and *Mallomonas caudata* were destroyed under the coverglass after a relatively short examination, whereas *Chlamydomonas excentrica* proved much more resistant under these conditions.

Chlamydomonas oleosa n. sp.

Fig. nostra 9.

Diagnosis. Cellulae mediocres, oviformes, interdum ellipsoideae. Membrana distincta, interdum mucosa, in polo antico papilla parva et hemisphaerica praedita. Protoplastus ad finem posteriorem rotundatus a membrana saepe leviter descedit. Chromatophorus parietalis, peripheriam excl. polo antico totam fere occupans, in partes numerosas, irregulares, inter se subaequales divisus. Pyrenoides abest. Protoplastus sphaera oleosa una vel sphaeris oleosis binis, rarissime numerosis instructus. Nucleus centralis vel paulo supra mediam cellulam situs est. Stigma breviter lineare, aequatoriale vel subaequatoriale est. Vacuola contractilia bina, Flagella bina, cellula aequilonga vel paulo longioria sunt.

Propagatio sexualis heterogama; gynogametae sphaericae, circiter 12 μ in diametro, majores quam androgametae oviformes, circiter 11 μ longae et circiter 8 μ latae.

Longitudo cellularum vegetativarum 17—23 μ, latitudo 13—18.5 μ; diameter zygotae immaturae 16.5—18.5 μ.

Hab. In Bistrup Dam, Selandia septentrionali, Dania, libere natans.

Systematics. The species differs from the closely related *Chlamydomonas polychloris* Pascher et Jahoda (1928, p. 277, fig. 29) by its minute and hemispherical papil the subaequatorial eye-spot and by having one or two oil drops, situated each in its cavity near the perifery of the protoplast. As far as I know big oil drops within the green, unicellular *Chlamydomonadaceae* are known only in *Carteria oleifera* Pascher (1927, p. 162, fig. 115).

After 18 years' stay in dilute formalin the material of *Chlamydomonas oleosa* was mounted in chlor-zinc-iodide; here the cell wall and a lot of small granules in

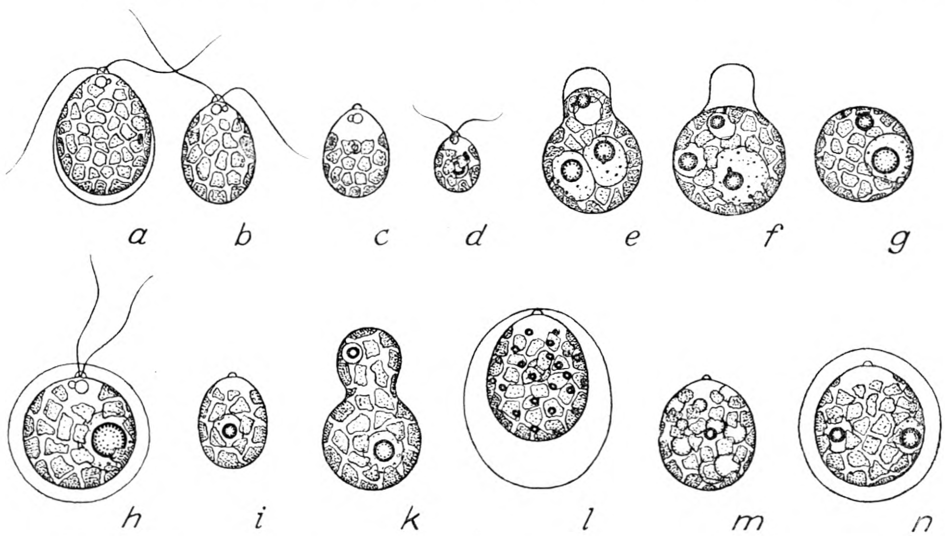

Fig. 9. *Chlamydomonas oleosa* n.sp. from Bistrup Dam, April 12th, 1930. The figures of the upper row are drawn after living material (750×), those of the lower row after material fixed in formalin (1070×). The nucleus is only delineated in *c* and *l*; *d* is a male gamet, *h* is presumably a female gamet; *e*, *f* and *k* are stages of copulation, *g* an immature zygote.

the chromatophore turned blue; the latter also turned blue in iodine potassium iodide, which shows that the product of photosynthesis is starch. The pale, brownish balls in the cells were not affected by this treatment, but in osmic acid they turned dark-brown, which seems to indicate that they consist of fat.

On April 12th, 1930 I repeatedly observed that small, ovate cells (presumably androgametes) united with slightly bigger, spherical cells (presumably gynogametes). The copulation started with a fusion of the front parts of the cells. The wall of the small, ovate cell then remained as an empty sheath on the zygote. Also the gametes contained 1—2 oil drops per cell and in their inner structure were quite like the vegetative cells.

Periodicity and Sociology. The species was found only on November 16th, 1929 (temp. 5° C.) when it was very rare, and on April 12th, 1930 (temp. 9° C.) when it was common and formed gametes.

Both associations were dominated by enormous quantities of bacteria. On the former of the dates mentioned (the composition of the associations appears from Table IV) *Euglena phacoides* was the most frequent, non-bacterial organism (60 cells per ml), but on April 12th *Chlamydomonas oleosa* itself was the dominant form among the non-bacterial organisms. In July, August, September, and October the species was never seen in the plankton of Bistrup Dam, which seems to indicate that *Chlamydomonas oleosa* is a cold water form.

Ecology. Bistrup Dam was distinctly eutrophic of the saprotrophic phase. Accordingly, the species must be characterized as α-mesosaprobic (or polysaprobic). On April 12th, 1930 Bistrup Dam contained 4 mg PO_4-P and 20 mg NH_3-N per litre! (On August 12th, 1929 the content of CaO was 118.7 mg/l).

Phacotaceae.

Pteromonas spinosa n. sp.

Fig. nostra 10.

Diagnosis. Cellulae parvae, a fronte visae hexangulatae, angulis rotundatis; a latere visae cum quattuor sinibus in utroque latere, pars anterior cellulae subconiformis, pars posterior subacuta, cum una spina robusta, decurva in utroque latere; a basi visae fusiformes cum sinu grandi in medio lateris utriusque. Margo cellulae ala hyalina, subhexangulata, satis lata circumdatus, anteriore profunde incisa. Membrana cellulae subcrassa. Chromatophorus cum pyrenoide grandi, basali et axiali. Stigma ovale, aequatoriale; flagellis binis, longitudine cellulae aequilongis. Longitudo cellularum sine ala 15—19.5 μ, latitudo sine ala 11—13 μ, crassitudo 9—11 μ, ala 2—4 μ lata, spinae 2—3 μ longae.

Hab. In Flødegaardens Dam, Fionia, et in stagno prope Hokkerup, Jutlandia meridionali, Dania, libere natans.

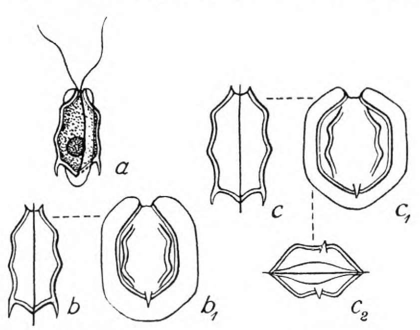

Fig. 10. *Pteromonas spinosa* n. sp. from Flødegaardens Dam. *a*: a living cell in obliquely lateral view from June 10th, 1930. The cell content is not depicted in the other figures (from August 3rd, 1939). *b* and *c* lateral views, b_1 and c_1 front views, c_2 basal view. 800×.

Systematics. By its 2 posteriorly directed, antapical spines the species is easily distinguished from *Pteromonas angulosa*, for which it may be mistaken on a superficial view.

The species is closely related to *Pteromonas varians* Frank Jane (1944, p. 38, Figs. 5—21). In his diagnosis the author says, "surface of cell beset with gently rounded, sometimes angular protuberances, of which two are posterior". Accordingly, *Ptero-*

monas varians does not seem to possess conspicuous and sometimes curved spines as in *Pteromonas spinosa*, neither according to diagnosis nor text-figs. The dimensions of *Pteromonas varians* are a little smaller than those of *Pteromonas spinosa*: longitudo cellae sine ala 14—15 μ, latitudo cellae sine ala 7—12 μ, altitudo 8 μ.

Periodicity. *Pteromonas spinosa* occurs very sporadically: out of 87 samples taken at regular intervals during the period 1926—30 (1939) only 3 samples from July 1st, 1926, June 10th, 1930 (temp. 20° C.) and August 3rd, 1939 contained this species which accordingly occurs in summer samples only. It was always very sparsely represented. Both *Pteromonas aculeata* and *Pteromonas angulosa* are more frequent in Flødegaardens Dam, occurring in 6 and 11 of the 87 samples, respectively.

Sociology. The species was found in the following associations:

Flødegaardens Dam.

July 1st, 1926: *Sce ec*-association with *Dic pu* as subdominant (the species very rare).

June 10th, 1930: association of indeterminable, minute green algae with *Chry mi* as subdominant (the species very rare).

Aug. 3rd, 1939: *Dic pu*-association with *Ste Ha* as subdominant (the species very rare),

Pond situated near the beginning of the Hokkerup road from the Graasten-Søgaard road.

Sep. 14th, 1944: *Ank co mi-Euglena*-association (the species very rare).

The qualitative composition of the plankton on the 3 dates first mentioned appears from Table IV. *Pteromonas spinosa* thus occurs in associations dominated by green algae, *Chlorococcales* (*i. a. Ankistrodesmus*, *Dictyosphaerium* and *Scenedesmus*) and *Euglena*. Constant associates cannot of course be given in this case.

Ecology. Flødegaardens Dam and the Hokkerup pond are highly eutrophic ponds, situated in open land, contaminated by cattle or geese and ducks. On the 3 dates mentioned above for Flødegaardens Dam the compound quotient reached the values $\frac{34}{1} = 34$, $\frac{46}{2} = 23$ and $\frac{35}{4} = 8.75$ (cp. also Table III). On July 1st, 1926 pH was 8.2. A couple of calcium analyses from 1927 and 1930 showed 90 and 82 mg CaO per litre.

The myxophycean quotient of the Hokkerup pond was $\frac{1}{0}$, the chlorophycean $\frac{15}{0}$, the diatom $\frac{2}{1}$, the euglenine $\frac{17}{15}$, and the compound quotient $\frac{35}{0}$. On the said date pH was 8.5.

Chlorococcales.

Chlorellaceae.

Micractinium pusillum Fresenius.

E. Lemmermann 1900, p. 90, t. 3, figs. 1—10 (*sub nomine Richteriella botryoides* Lemm.). *Fig. nostra* 11.

In Blankeborg II the species was very common on May 4th, 1930 (temp. 17° C.). The vegetative cells which were spherical or broadly ellipsoidical and 7—10.5 μ in

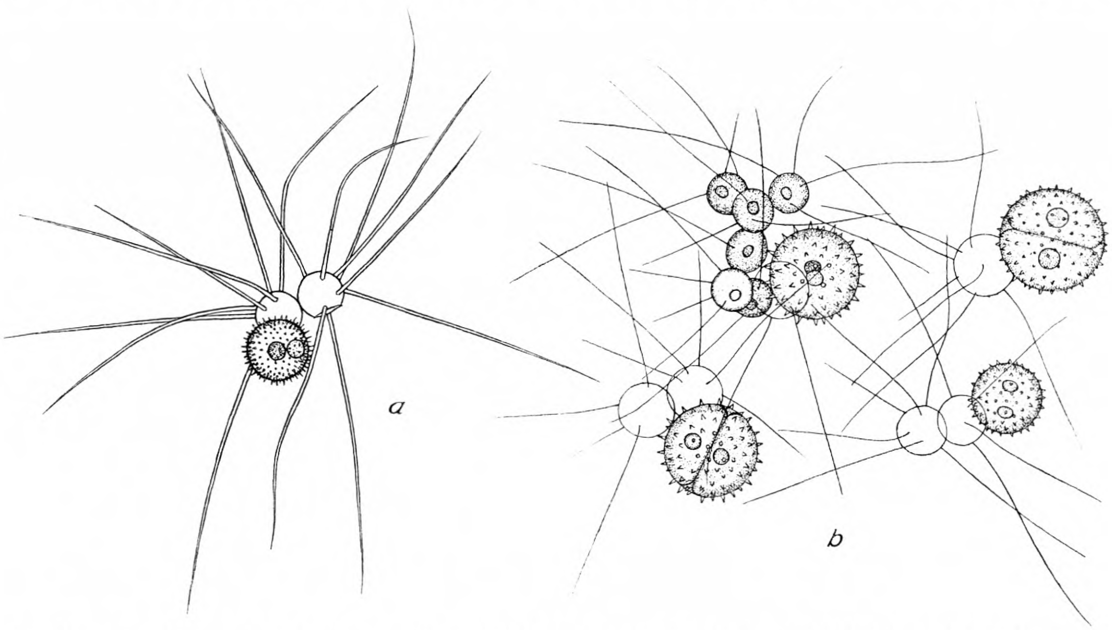

Fig. 11. *Micractinium pusillum* Fres.; *a* from Flødegaardens Dam, April 6th, 1928, *b* from Blankeborg II, May 4th, 1929. 800×.

size, each had up to 7 long, thin and flexible bristles. Some of the colonies frequently contained some spherical, prickled "spores" with a diameter of 12—17 μ. These resting stages were also found individually, but in such cases 1 or 2 empty *Micractinium* cells nearly always adhered to them. Among 20 spores examined only one had no adhering emtpy cells, and in this case it or they may of course have fallen off. The interior of the resting stage was distinctly composed of 2 equally great plasma parts, each with its pyrenoid. It is an obvious conclusion that the contents of the two adhering, empty cells have come out, have copulated and then surrounded themselves with a firm, prickly wall.

If this has really happened, we here have an instance of a sexual propagation within the family *Oocystaceae*, on which H. Printz in his treatment of the *Chlo-*

rophyceae in ENGLER und PRANTL's "Natürlichen Pflanzenfamilien" (2. Aufl., vol. 3, 1927, p. 116) says, "Geschlechtliche Fortpflanzung ist bisher ganz unbekannt!"

Quite the same phenomenon was observed in Flødegaardens Dam. *Micractinium pusillum* here reached an enormous maximum on April 6th, 1928, during which many zygotes of the same kind as those of Blankeborg II were observed. In the same pond a few zygotes were seen on April 17th, 1927. These facts from the well examined ponds of East Funen seem to indicate that the copulation normally takes place in April-May at temperatures between 8 and 17° C.

After the description given above had been worked out, the study of F. MOEWUS' excellent treatise in Ergebn. d. Biol., vol. 18, 1941, called my attention to the fact that KORSCHIKOFF in 1937 has observed copulation of gametes in *Micractinium pusillum* (*loc. cit.* p. 302—03, fig. 3d). KORSCHIKOFF maintains that it is a question of oogamy, which also appears distinctly from the drawing. The present Danish findings, however, indicate an isogamous copulation unless the two equally great plasma parts in the zygote are the result of the first division stage of the content of the zygote. Whether the zygote is formed within a *Micractinium* cell, the wall of which is then burst and cast off, or the zygote completes its development outside the Micractinium cell, remains an open question.

Oocystaceae.

Oocystis crassa Wittrock var. **minor** nov. var.

Fig. nostra 12.

Diagnosis. A typo cellulis minoribus differt. Cellulae ellipsoideae, 1.4—1.6 plo longiores quam latiores, cum chromatophoris 2—8, vulgo 4, in singulis cellulis parietalibus, singulis pyrenoidibus instructis. Membrana apicalis interdum leviter incrassata. Cellulis solitariis raro in coloniis 2- vel 4-cellularibus consociatis intra membranam matricalem semper adpressam. Coloniae cum 8 cellulis rarissime observatae. Longitudo cellularum 12—16 μ, latitudo 7—11.5 μ.

Hab. In Store Dam, Selandia, Dania, libere natans.

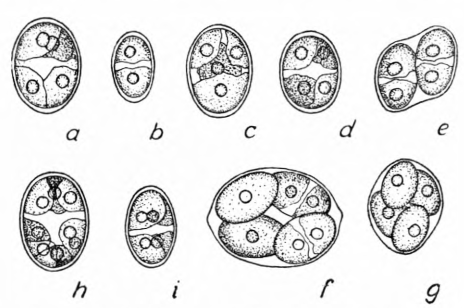

Fig. 12. *Oocystis crassa* Wittr. var. *minor* n. var. from Store Dam, *a*—*g* from November 2nd, 1929, *h*—*i* from September 21st, 1929. 800×.

Systematics. During the examination of WITTROCK's original material of *Oocystis crassa* (*Algae exsiccatae* no. 355) it was observed that the cells are 1.2—1.6, mostly 1.3—1.5 times longer than broad. The length of the cells was 16.5—22.5 μ, and the breadth 11—16 μ. On the basis of several measurings

Printz (1913, p. 175) gives the lengths 14—26 μ and the breadths 10—20 μ and on t. 4, fig. 14 brings a good original illustration of *Oocystis crassa*.

The shape of the cells in the original material is typically ellipsoidical; about this the diagnosis also says that the cells are 'breviter ovatis'. However, other investigators like G. S. West refer colonies with subfusiform cells to *Oocystis crassa* (Treatise 1904, p. 227, fig. 97 C—D), and Printz's *Oocystis crassa* f. *major* (1913, p. 176, t. 4, fig. 15) even has distinctly fusiform cells. Whether this is legitimate for the present remains an open question.

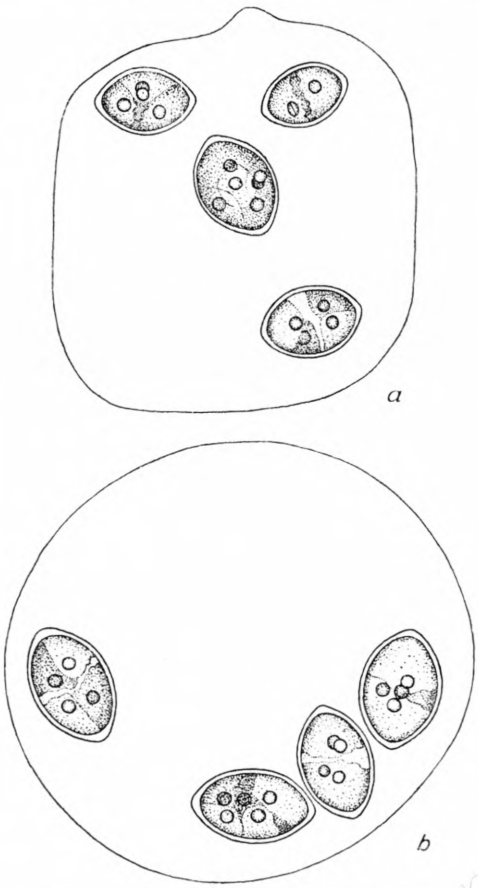

Fig. 13. *Oocystis natans* Lemm.; *a* from Mossø, August 18th, 1929, 560 ×; *b* from Salten Langsø, August 19th, 1929, 800 ×.

To begin with I identified the specimens illustrated in *Fig. nostra* 13 as *Oocystis crassa*; the cells are fusiform, 1.3—1.6 times longer than broad, 19—25 μ long and 12—18 μ broad, the colonies 76—102 μ long and 71—83 μ broad. As the number of chromatophores, however, normally is only 4, it will no doubt be more correct to call them *Oocystis natans* though the chromatophores do not seem to be stellately lobed.

The shape of cell in another species, *Oocystis Borgei* (see Printz 1913, p. 173, t. 4, figs. 1—2), is quite like that of *Oocystis crassa*, i. e. ellipsoidical. According to measurings of the original figures of Snow (reproduced in Printz's paper quoted above) the ratio between length and breadth of the cells is 1.3—1.35—1.4—1.45—1.5 and in Borge's original figure (1900, t. 1, fig. 3) 1.35—1.4—1.45, in other words ratios corresponding exactly to those of the original material of *Oocystis crassa*. Even if the colonies pictured in *Fig. nostra* 14 have cells with a normal of 2 or 4 chromatophores, each with one pyrenoid, and a length of 17—20 μ and a breadth of 12—15 μ, it will presumably be more correct to include them under *Oocystis Borgei*.

Periodicity. *Oocystis crassa* var. *minor* is a eurythermic plankton form with a temperature amplitude of 0.5—23.5° C. It plays a prominent part in the plankton of Store Dam.

At the beginning of July 1929 it was rare, but already in August it became very common (about 3000 cells and colonies per ml on August 17th at a temperature of 17° C.). Throughout September and October (temp. 18—8.5° C.) it also predominated in the plankton of Store Dam. During this comparatively long period the water of the pond was green from the numerous *Oocystis* cells. The great maximum of 10.700 cells (and colonies) per ml occurred on November 2nd at a temperature of 6° C. From this date it decreased rapidly and was rare already on November 28th. During the winter months it was very rare, and it was not until May and June that it attained a slightly higher frequency though it did not in any way reach a dominating position within the plankton.

Sociology. *Oocystis crassa* var. *minor* was found in the following associations:

July 6th, 1929: *Gy ex*-association (variety rare).
Aug. 17th, — : *Oo cr mi*-association (about 3000 cells and colonies per ml) with *Gy ex* as subdominant (about 2800 cells per ml); variety very common.
Sep. 9th, — : *Oo cr mi*-association (variety very common).
— 21st, — : *Oo cr mi*-association (variety very common).
Oct. 11th, — : *Oo cr mi*-association (variety very common).
— 30th, — : *Oo cr mi*-association (variety very common).
Nov. 2nd, — : *Oo cr mi*-association (10.700 cells and colonies per ml); variety abundant.
— 28th, — : *Tra vo*-association (variety rare).
Dec. 16th, — : *Tra vo*-association (variety rare).
Jan. 15th, 1930: *Gle ac*-association (variety very rare).
Mar. 1st, — : *Gle ac*-association (variety very rare).
May 28th, — : *Gy ex- Sye ac an*-association (variety rare).
June 16th, — : *Tra vo*-association with *Gy ex* as subdominant (variety rare).

Besides being itself the dominant form of associations *Oocystis crassa* var. *minor* occurs in dinophycean associations of *Gymnodinium* and *Glenodinium*, euglenine associations of *Trachelomonas* and diatomaceous associations of *Synedra*.

The most constant associates were *Trachelomonas volvocina*, which occurred in 100 % of the number (13) of samples that contained *Oocystis crassa* var. *minor*, *Peridinium palatinum* and a *Chlamydomonas* species, presumably identical with *Chl. cingulata* var. *globulifera*, both of which occurred in 85 % of the samples, and *Trachelomonas intermedia*, which occurred in 77 % of the samples.

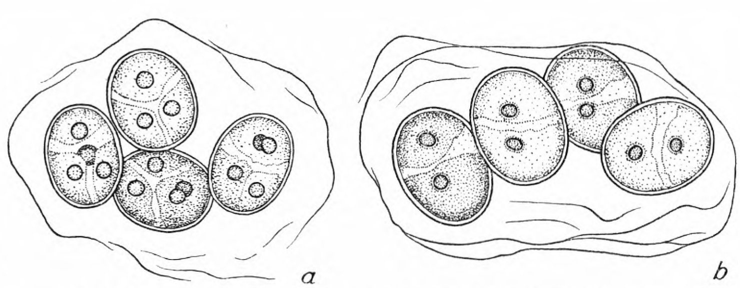

Fig. 14. *Oocystis Borgei* Snow; *a* from Hostrup Sø, July 24th, 1926; *b* from Tissø, July 13th, 1929. 800×.

Ecology. Store Dam is a forest-bordered, eutrophic pond approaching mixotrophy, with ample vegetations of *Helodea canadensis*. Values of the compound quotient are found on p. 112. The following data briefly illustrate certain features of the ecology of *Oocystis crassa* var. *minor*: pH 7.4—8.5, content of CaO 92—97.9 mg/l, consumption of $KMnO_4$ 48-65 mg/l, contents of PO_4-P 0.005—0.015 mg/l, NH_3-N 0.08—0.2 mg/l, NO_3-N 0—1 mg/l, Fe 0.03—0.3 mg/l.

Oocystis Marssonii Lemm.

Lemmermann 1899, p. 24, t. 1, figs. 15—19; Printz 1913, p. 176, t. 4, figs. 16—17. *Fig. nostra* 15.

Diagnosis. Cells ellipsoidical, subfusiform or subcylindrical with rounded or subacute apices, sometimes a little asymmetrical, 1.5—2 times longer than broad. As regards the point last-mentioned it is worth noticing that even "ellipsoidical" cells may sometimes be asymmetrical relatively to the longitudinal axis of the cell. Apices not or only very slightly thickened. 1—3 chromatophores in every cell, with or without pyrenoid. Sometimes oil droplets occur in the cells. Cells very rarely single, as a rule united into 4-celled, sometimes 8-celled, very rarely 2-celled colonies. Membrane of mother cell sometimes without, sometimes with apical, rounded thickenings. Cells 6.5—14 μ long, 3.5—9 μ broad; 4-celled colonies according to 10 measurings 15—60 μ long and 10—50 μ broad; 8-celled colonies according to 3 measurings 27—87 μ long and 21—83 μ broad.

Distribution. Widely distributed (see Tables II and IV), no doubt a cosmopolite.

Systematics. In his diagnosis Lemmermann says: cellulis ovatis vel interdum fusiformibus; Printz's figures cited above only show fusiform cells. On the other hand there is a discrepancy between Lemmermann's diagnosis (Cellulis circ. 1.5 plo longioribus quam latioribus) and his figures which demonstrate an axial ration of 1.75—2. In the Danish material the measurements of the cells were 6.5—13 $\mu \times$ 3.5—9 μ with an axial ration of 1.5—2.

As will appear from *Fig. nostra* 15c one colony may contain both cells of a long ellipsoidical shape and subfusiform cells. In other colonies subcylindrical cells may have subacute apices (Fig. 15h), and in one locality as for instance Frederiksborg Slotssø or Badstue-Ødam the membrane of the colonies and the shape of the cells may vary extensively within the scope of the extended description of species (see Fig. 15f—i, a—b).

Printz (loc. cit.) is of opinion that *Oocystis Marssonii* may be regarded as a variety of *Oocystis crassa*. In my opinion the species is nearer related to *Oocystis lacustris*, the chromatophores of which are also present in a number of 1—3 per cell, as a rule 2, and often situated terminally. Chodat's fig. 22 of *O. lacustris* (in Printz's paper) incidentally shows the same as *Fig. nostra* 15c, viz. that one and the same colony may contain both ellipsoidical and fusiform cells. In his monographical treatment of the *Oocystis* species PRINTZ makes a point of the presence or absence of pyrenoid; from personal experience I am of opinion that this character is by no means constant in a green alga.

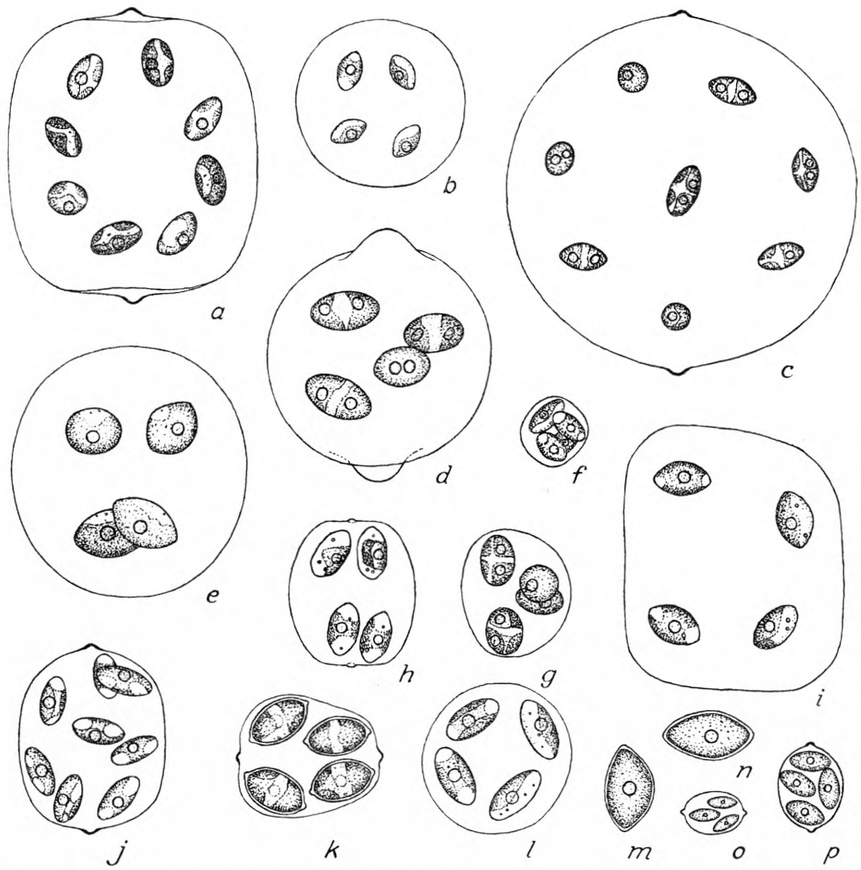

Fig. 15. *Oocystis Marssonii* Lemm.; *a*—*b* from Badstue-Ødam, October 5th and September 5th, 1929; *c* from Teglgaard Sø, September 6th, 1929; *d* from a pond in Ragebøl at Alssund, August 30th, 1937; *e* from Flødegaardens Dam, September 15th, 1928; *f*—*i* from Frederiksborg Slotssø, August 21st and September 6th, 1929, April 3rd and May 13th, 1930; *j* from Gadevang Mose, July 6th, 1929; *k* from Skaansø in Salling, July 5th, 1938; *l* from Vandingsdam, July 6th, 1929; *m*—*p* from Blankeborg I, June 28th, 1925 and August 18th, 1928. *a, b, c, f, g, h, i, j, l, o* an *p* 560×, *d, e, k, m* and *n* 800×.

Oocystis parva West (1893) is very closely allied to *Oocystis Marssonii* (1898); if identical the alga should be named *Oocystis parva*.

It would be of interest through experiments with pure cultures (clones) of *Oocystis* species to clear up which variations are only modifications (see p. 180). During such experiments it should be examined whether a cell is ellipsoidical when seen from one side and fusiform when seen from the other or whether 2 types of cells may in fact be present in the same colony.

Hydrodictyaceae.

Pediastrum alternans n. sp.

Fig. nostra 16.

Diagnosis. Coenobia 64- vel 32-cellularia, ex foraminibus parvis, subsemicircularibus vel subtriangulis perforata. Cellulae marginales in medio sinu profundo et late rotundato et cum cornibus binis, longis, cavis, proximaliter plusminusve in-

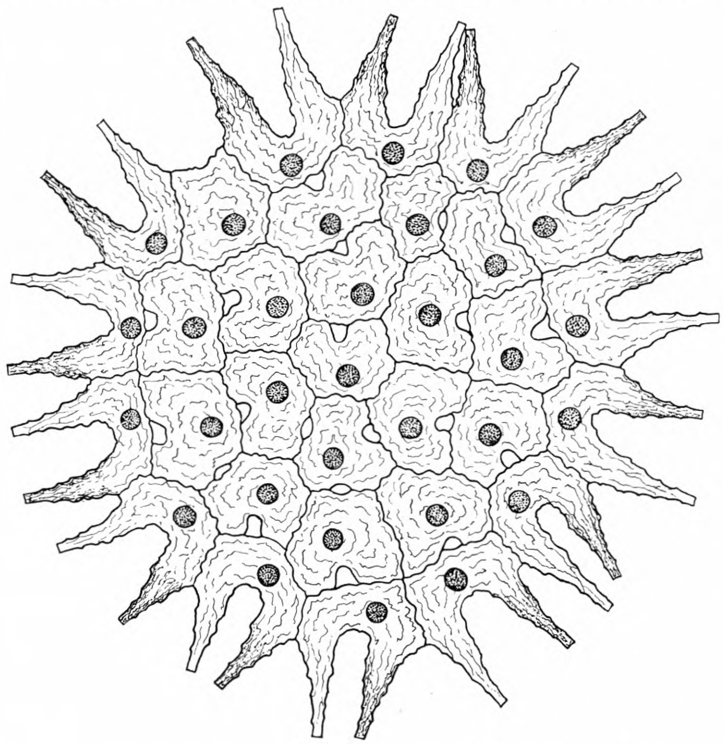

Fig. 16. *Pediastrum alternans* n. sp. from Mossø, August 18th, 1929. 800 ×.

flatis, apicaliter truncatis, circiter 2-$2^1/_2$ plo longioribus quam est spatium inter fundum sinus et membranam intimam, alternis deflexis ad latera diversa. Cellulae mediae coenobii quinquangulae vel sexangulae. Membranae inter cellulas plusminusve undulatae; membrana ceterum rugulis delicatissimis et irregularibus instructa.

Hab. In Mossø, Jutlandia septentrionali, Dania, libere natans.

Systematics. This new species comes nearest to *Pediastrum angulosum* Menegh. (Bigeard 1934—36, p. 344), the coenobia of which may exhibit small perforations (Bigeard loc. cit., p. 37, fig. 49). The cells of *Pediastrum angulosum* also have a very deep emargination between the two processes (both being, however, situated in the plane of the coenobium) deeper than the sinus between the adjacent processes of two neighbouring cells; its membrane is likewise provided with ridges. *Pediastrum alternans* thus differs in having extremely delicate ridges (those of *Pediastrum angulosum* are much coarser and more regularly disposed), by its long processes more or less inflated at the base, every second process being directed obliquely downwards, every second obliquely upwards; further the adjacent cell walls are more or less undulate and the perforations as a rule smaller then the pyrenoids. Of 10 coenobia 3 were 32-celled and 7 were 64-celled.

Pediastrum Boryanum Menegh. forma.

Fig. nostra 17.

Diagnosis. Coenobia 32-cellularia, a foraminibus satis magnis, ellipticis vel triangulis cum marginibus convexis perforata. Cellulae marginales cum cornibus binis, longis, cavis, proximaliter non inflatis, circiter duplo longioribus quam est

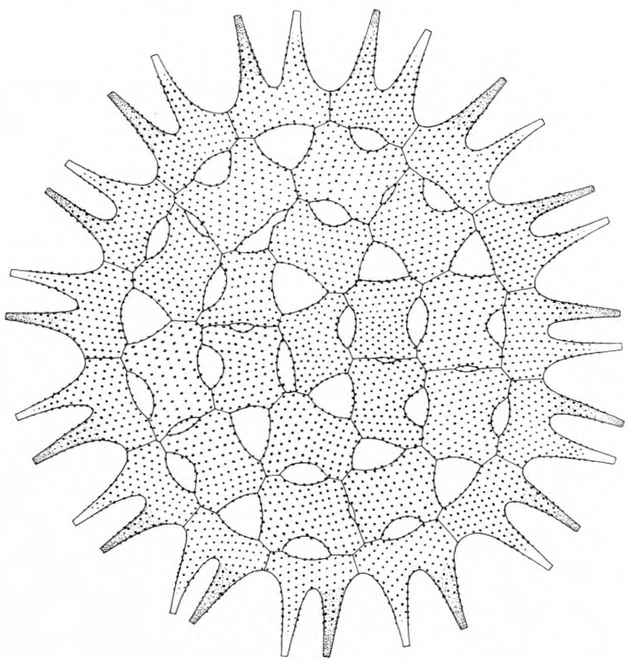

Fig. 17. *Pediastrum Boryanum* Menegh. forma from Mossø, August 18th, 1929. 800 ×.

spatium inter fundum sinus et membranam intimam, alternis deflexis ad latera diversa. Membrana cellulae granulis satis densis instructa.

Hab. In Mossø, Jutlandia septentrionali, Dania, libere natans.

Systematics. As the occurrence of perforations is a relative criterion, the surface structure of the membrane a reliable one, the coenobia in question are called

Pediastrum Boryanum. The granules are disposed in oblique decussating series, 8—10 series pro 10 μ. The form seems to be closely allied to *Pediastrum Boryanum* var. *longicorne* f. *granulata* (Brunnthaler 1915, p. 101, fig. 61 d). Apart from the rather large perforations the marginal cells of the present coenobia are somewhat different as to the granulation and the shape of the processes.

Krieger has described and figured a very similar form from the raised bog at Diebelsee in Germany (1929, p. 285, t. 3, fig. 9). It was called *Pediastrum duplex* var. *longicorne* nov. var. *punctatum*, a name which also I originally intended to use!

Both *Pediastrum* forms were found in an *Api fl-Mio aer ma*-association with *Mio vi* and *Ste as* as subdominants. Its qualitative composition appears from Table II, its plankton quotients are found in Table I.

Mossø is distinctly eutrophic; its compound quotient was $\frac{35}{6}$ = 5.8 on August 18th, 1929. pH was 8.0, and the surface water contained PO_4-P 0.005 mg/l, NH_3-N 0.2 mg/l, NO_3-N 0 mg/l (the quantities of the bottom water are given in Table I). According to Brønsted & Wesenberg-Lund (1912, p. 478) Mossø contained 60 mg CaO per litre in July 1909.

Coelastraceae.

Coelastrum microporum Näg. f. **astroidea** (de-Not.) mihi.

Syn.: *Coelastrum astroideum* de-Notaris 1867, p. 80, t. 9, fig. 93 pro parte. *Coelastrum sphaericum* in Chodat 1902, p. 231, fig. 156. – *Fig. nostra* 18.

Diagnosis. A typo coloniis 4- vel 8-cellularibus differt. Cellulis in stratis duobus ordinatis; in coloniis 4-cellularibus duo strata cellularum binarum gradus arci 90 inter se contorta; in coloniis 8-cellularibus duo strata cellularum quaternarum gradus arci 45 inter se contorta. Coloniae a vertice visae cum foramine oblonge quadrangulo, minore quam sunt cellulae finitimae. Cellulae subovatae, interdum sphaericae, raro subconiformes apicibus late rotundatis; margo extremus saepe leviter incrassatus. Longitudo cellularum 5.5—12.5 μ, latitudo 4—12.5 μ; diametro coloniarum 13—29.5 μ.

Hab. In Flødegaardens Dam, Blankeborg I et II et stagno prope Stjerneskansen, Fionia orientali; Birkerød Sø, Hulsø, Frederiksborg Slotssø, Vandingsdam, Gadevang Mose, Store Dam, Badstue-Ødam, Sortedam II, Jægerbakke Dam et Lynge Vandingsdam, Selandia; stagno prope Hokkerup, Jutlandia meridionali, Dania, libere natans.

Systematics. De-Notaris in t. 9, fig. 93 depicts a 4-celled colony (= f. *astroidea* mihi, but the cells are erroneously drawn as if they were situated in one plane) and two 16-celled colonies (= *Coelastrum microporum*), all three with rather pointed cells. As far as I understand his diagnosis, which is written in Italian, he has seen 8-celled colonies in the characteristic position where they appear like 5-rayed stars with one cell above the centre of the colony (see *Fig. nostra* 18 *a*, *c* and *h*).

Between the cells of the Danish colonies I never observed a square opening of a size as that shown in DE-NOTARIS' figure.

Incidentally each of the 4 layers of cells in 16-celled colonies is twisted 45° as compared to the layer situated above.

It is a fact that in certain ponds the colonies are always 4- or 8-celled; 16- or 32-celled colonies were never observed. This is true of Flødegaardens Dam, Blanke-

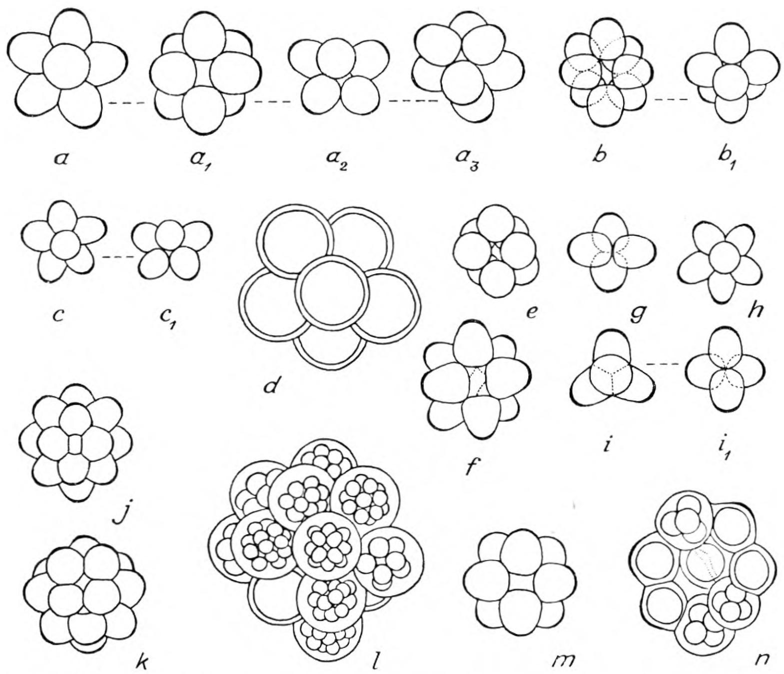

Fig. 18. *Coelastrum microporum* Näg. f. *astroidea* (de Not.) mihi. *a*, a_1, a_2, a_3, *b*, b_1, *c* and c_1 from the Hokkerup pond, September 14th, 1944; *d* and *e* from Blankeborg II, July 25th, 1928; *f* from Birkerød Sø, August 12th, 1929; *g*, *h*, *i* and i_1 from Flødegaardens Dam, June 19th, 1928; *j*—*n* from Sortedam II, *j*, *k* and *n* from July 1st, 1929, *l* and *m* from May 17th, 1930. a_1, *b*, *e*, *f*, *g*, i_1, *j*, and *m* vertical views, a_2 and c_1 lateral views. 800 ×.

borg II, Store Dam, Vandingsdam, Jægerbakke Dam, pond at Stjerneskansen E. of Nyborg, Birkerød Sø, Lynge Vandingsdam and pond at the beginning of the road to Hokkerup from the Søgaard Road.

In other ponds are found both 4-, 8- and 16-celled colonies (Badstue-Ødam, Sortedam II and Blankeborg I), but never 32-celled colonies.

In lakelets like Frederiksborg Slotssø both 8-, 16-, and 32-celled colonies are found.

In the larger Danish lakes I never observed 4- or 8-celled colonies; here the colonies were always 16- or 32-celled.

All these facts show that a very close relationship exists between *Coelastrum microporum* and '*Coelastrum astroideum*', so close indeed that it must be supposed that '*Coelastrum astroideum*' is only a modification of *Coelastrum microporum*, indigenous to small bodies of water and ample nutrition. In this paper it has therefore been termed *Coelastrum microporum* f. *astroidea* (de-Notaris). The proof of the correctness of this hypothesis, however, can only be found from culture experiments.

It is interesting to notice that the colonies show a pronounced tendency to double (or quadruplicate) their cell-number during the maximum as will appear from the following survey.

Coelastrum microporum and f. *astroidea* in Frederiksborg Slotssø.

Dates	Frequency	32- : 16- : 8-celled colonies
May 1st, 1930	rrr	0 : 0 : 1
— 10th, —	r	0 : 6 : 6
— 21st, —	r +	0 : 10 : 4
— 31st, —	c	65 : 51 : 0
June 16th, —	+	1 : 25 : 5

Coelastrum microporum and f. *astroidea* in Badstue-Ødam.

Dates	Frequency	16- : 8- : 4-celled colonies
June 6th, 1929	rrr	0 : 2 : 0
— 20th, —	c	73 : 16 : 0
July 1st, —	c	73 : 16 : 0
— 5th, —	+	41 : 25 : 0
— 12th, —	r +	15 : 12 : 2
— 17th, —	r	6 : 10 : 5
— 26th, —	rr	3 : 7 : 2
Aug. 10th, —	rrr	1 : 5 : 0
— 23rd, —	rrr	0 : 1 : 0

However, it is not in all ponds that *Coelastrum microporum* turns 16- or 32-celled during the maximum; even under its favourable conditions of living they remain 8- and 4-celled:

Coelastrum microporum f. *astroidea* in Flødegaardens Dam.

Dates	Frequency	8- : 4-celled colonies
July 4th, 1927	c	50 : 2
June 5th, 1928	c	44 : 16
— 19th, —	c	50 : 28

Periodicity. In Flødegaardens Dam f. *astroidea* in 1927 appeared on May 1st (temp. 8° C.) and reached a considerable maximum on July 4th (temp. 19° C.); for the rest of the year it was very rare and was seen for the last time on December 1st (temp. 6.5° C.). In 1928 it reappeared on May 6th (temp. 17.5° C.); the considerable maximum in this year occurred on June 5th and 19th (temp. 12.5—15° C.), and the form was also rather common on July 13th (temp. 26.5° C.); during the rest of the year it was very rare and was seen for the last time on December 28th (temp. 1.5° C.). In 1929 it appeared already on April 11th (temp. 4.5° C.); the comparatively inconspicuous maximum occurred on June 2nd (temp. 16° C.), after which the species was found only in small quantities for the rest of the year, the last time on December 27th (temp. 0.5° C.). In 1930 the form was still found on January 6th (temp. 4° C.), but then it disappeared and did not turn up again until April 19th (temp. 8° C.) when it was rare as in May and June, at which time the examination was terminated.

In the likewise regularly examined Blankeborg II f. *astroidea* was found only in July, August and October without ever forming a maximum during the period 1928—30.

In the well-examined Jægerbakke Dam the form was always remarkably rare and was found only between October and January and in May.

In Vandingsdam the form also occurred in small quantities within the period June—December 1929 and May—June 1930.

In Badstue-Ødam, however, f. *astroidea* throve well, reaching a considerable maximum on June 20th and July 1st (temp. 22.5 and 16.5° C.). During July its frequency decreased uniformly, and for the rest of the year it was very rare. The last colonies were seen as late as January 15th, 1930 (temp. 3° C.). As was the case in the ponds mentioned above it disappeared completely during the ice period and did not turn up again until April 25th, 1930 (temp. 12.5° C.); from this date till the termination of the examination on June 16th it was very rare.

As will appear from the survey mentioned above (p. 46) f. *astroidea* occurred together with *Coelastrum microporum* in Frederiksborg Slotssø. The form was not infrequent on June 11th, 1929 (temp. 15° C.), but during the rest of the year it showed a highly sporadic occurrence and was observed for the last time on December 16th (temp. 4.5° C.). In 1930 it did not appear until May 1st (temp. 15° C.) and after this date was comparatively rare in May and June in contrast to the main species, which, as shown on p. 46, reached a considerable maximum at the end of May.

In Sortedam II, where the species and form also occurred together, though only in the samples from June (1929 and 1930), f. *astroidea* in 1929 was found only on June 8th (temp. 16.5° C.) and December 16th (temp. 3° C.), both times being very rare. In 1930 it did not appear until April 26th (temp. 12° C.) and was very rare on this date as well as in May and June.

In the well-examined Gadevang Mose f. *astroidea* was observed only on July 6th, 1929 (temp. 16° C., very rare).

In Blankeborg I, which was examined fortnightly for 4 years, the form was only observed with certainty on June 10th, 1930 (temp. 19° C., very rare).

In the pond E. of Stjerneskansen at Nyborg f. *astroidea* was very rare on June 16th, 1938 (temp. 19.5° C.).

In the regularly examined pond Store Dam the appearance of the form was very sporadic: it occurred only on July 6th, November 2nd and 28th, December 16th, 1929 and June 16th, 1930, and was always very rare.

In the pond situated at the beginning of the road to Hokkerup from the Søgaard road f. *astroidea* was not infrequent on September 14th, 1944.

In Birkerød Sø f. *astroidea* was observed in very small quantities on July 22nd (temp. 23° C.) and August 12th, 1929 (temp. 20.5° C.).

In Hulsø the form occurred together with the main species on August 8th and December 23rd, 1946; the form was rare in both samples.

Sociology. *Coelastrum microporum* f. *astroidea*

Myxophyceae associations	Euglenineae associations	Bacillariophyceae associations	Chrysophyceae associations	Cryptophyceae associations	Bacteria associations
1 *Ana af in te* -assoc.	1 *Eug ob* -assoc.	4 *Cyc st su* -assoc.	2 *Chry ma* -assoc.	4 *Crym ov* -assoc.	2 *La hy* -assoc.
1 *Ana fl* -assoc.	8 *Tra vo* -assoc.	1 *Frg cr* -assoc.	1 *Chry mi* -assoc.		
1 *Ana in* -assoc.		1 *Mel gr an* -assoc.	1 *Din di* -assoc.		
1 *Mio fl ma* -assoc.		7 *Rhi lo* -assoc.	1 *Syu sp* -assoc.		
7 *Mio ho* -assoc.		11 *Ste Ha* -assoc.	1 *Ura vo* -assoc.		
1 *Os Ag* -assoc.			1 assoc. of an indeterminable *Chrysophycea*		

In Lynge Vandingsdam very small quantities of f. *astroidea* occurred on June 30th and August 6th, 1947.

If we confine ourselves to the ponds and lakelets that were examined fortnightly for at least one year, the following general conclusions may be made with regard to this widely distributed green alga. The vegetation period of *Coelastrum microporum* f. *astroidea* ranges from April (May) to December (very rarely January) at temperatures between 0.5 and 26.5° C., the form thus being eurythermic. In February and March, however, when the ponds at any rate periodically are covered with ice, f. *astroidea* was never observed. A maximum was by no means reached by the form in all the ponds, not even during a period of 4 years. In the few ponds where a considerable maximum occurred, it was reached in June—the beginning of July (rarely in May) at temperatures between 12.5 and 22.5° C.

was found in the following 119 associations:

Chlorococcales associations	Volvocales associations	Desmidiaceae associations	Ulothricales associations	Dinophyceae associations	Mixed associations	
1 *Ank fa spa* -assoc.	3 *Chla Re mi* -assoc.	1 *Cl ac va* -assoc.	2 *Ul pe* -assoc.	1 *Ce hi* -assoc.	*Mio fl* *Os Ag*: 1	*Ank co mi* *Eug pr*: 1
3 *Dic pu* -assoc.	1 *Chla Re* -assoc.			1 *Gy ex* -assoc.	*Mio ho* *Ank co mi*: 1	*Sye ac an* *Din so*: 1
1 *Ki mi* -assoc.					*Mio ho* indeterm. green alg.: 1	*Ste Ha* *Sye ac an*: 1
1 *Na be* -assoc.					*Mio ho* *Ki mi* *Ni ac*: 2	*Crym ov* *Chla Re mi*: 1
1 *Oo cr mi* -assoc.					*Mio ho* *Ki mi* *Ste Ha*: 1	*Se ca* *Chla Re mi* *Ste Ha* *Tst st*: 1
5 *Sce arm* -assoc.					*La hy* *Teë mi*: 1	*Crym ov* *Ank fa spi* *Sce arm*: 1
1 *Sce ec* -assoc.					*Mio ho* *Ank fa* *Ank fa spi*: 1	*Ste Ha* *Tst st*: 1
1 *Sce fa* -assoc.					*Mio ho* *Ank fa spa* *Sce arm*: 1	*Pa mo* *Ste Ha*: 1
2 *Se ca* -assoc.					*Ki mi* *Ank fa se br*: 1	*Sce fa* *Sce arm*: 1
3 *Teë mi* -assoc.					*Cyc Me* *Ste Ha*: 1	*Teë mi* *Sce arm*: 1
4 *Tst st* -assoc.					*Ank co mi* *Ank fa spi*: 1	*Sce fa* *Ped du* *Tra vo*: 1
1 *Trochiscia* -assoc.						*Coa mi as* *Cru qu*: 1
4 indeterm. -assoc.						

Briefly stated the associations were dominated first and foremost by the following *Chloroccoccales*: *Ankistrodesmus*, *Crucigenia*, *Dictyosphaerium*, *Kirchneriella*, *Nannokloster*, *Oocystis*, *Pediastrum*, *Scenedesmus*, *Selenastrum*, *Tetraëdron*, *Tetrastrum* and *Trochiscia* and by the following Diatoms: *Cyclotella*, *Fragilaria*, *Melosira*, *Nitzschia*, *Rhizosolenia*, *Stephanodiscus* and *Synedra* and by the following blue-green algae: *Anabaena*, *Microcystis* and *Oscillatoria*.

In addition *Chrysophyceae* play no small part in the picture of the sociology of *Coelastrum microporum* f. *astroidea* with genera like *Chrysococcus*, *Dinobryon*, *Synura* and *Uroglena*.

The form is not so frequently found in euglenine associations (*Trachelomonas* and *Euglena*), cryptophycean associations of *Cryptomonas*, *Volvocales* associations (*Chlamydomonas* and *Pandorina*), *Ulothricales* associations of *Ulothrix*, Bacteria associations of *Lampropedia*, dinophycean associations of *Ceratium* and Desmid associations of *Closterium*.

Coelastrum microporum f. *astroidea* reveals its unmistakably "eutrophic" character through the many *Chloroccoccales*, centric Diatoms and blue-green algae that dominate in its associations.

The most constant associates were *Scenedesmus armatus*, which occurred in 90.75 $^0/_0$ of the number (119) of samples that contained *Coelastrum microporum* f. *astroidea*, and *Microcystis holsatica*, which occurred in 75.6 $^0/_0$ of the samples.

Ecology. The phytoplankton quotients for Flødegaardens Dam, Blankeborg I and II, Jægerbakke Dam, Vandingsdam, Badstue-Ødam, Frederiksborg Slotssø, Sortedam II, Gadevang Mose, and Lynge Vandingsdam are found in Table III. The quotients of Hulsø are found in Table I, those of the Hokkerup pond on p. 156 and those of Store Dam on p. 112. From Birkerød Sø they are given on p. 149 for July 22nd, 1929; on August 12th, 1929 the plankton consisted of a *Mio fl-Os Ag*-association with a total of 31 species; the myxophycian quotient was $\frac{8}{3}$, the chlorophycean quotient $\frac{17}{3}$, the diatom quotient $\frac{0}{0}$, the euglenine quotient $\frac{2}{25}$, and the compound quotient $\frac{27}{3} = 9$. In the pond E. of Stjerneskansen, which incidentally was filled up between 1939 and 1942, the plankton consisted of a *Trochiscia* association with *Act Ha* as subdominant, a total of 20 species; the quotients (mentioned in the same order as above) were: $\frac{0}{0}$, $\frac{12}{0}$, $\frac{0}{0}$, $\frac{6}{12}$, $\frac{18}{0}$.

All the said localities that contain *Coelastrum microporum* f. *astroidea* are eutrophic. The great majority of them are contaminated and highly eutrophic, a few of them even to such a degree that they approach the saprotrophic phase (Hokkerup pond, Lynge Vandingsdam); only one of them is slightly eutrophic ("mesotrophic", Blankeborg I). In other words f. *astroidea* may be characterized as a plankton organism that is confined to ponds and lakelets and is found only in eutrophic localities. Its optimal development takes place under highly—extremely eutrophic conditions. It was never found in the oligotrophic types of ponds, nor in the genuine saprotrophic; in slightly eutrophic localities it shows a poor development.

The following data are expressive of its ecological demands: pH 6.3—9.4, CaO 7.3—97.9 mg/l, consumption of $KMnO_4$ 32—97 mg/l, contents of PO_4-P 0—1.25 mg/l, NH_3-N 0.05—1.5 mg/l, NO_3-N 0—3 mg/l, Fe 0.01—0.45 mg/l (Blankeborg II contained 153.5 mg of CaO per litre on January 6th, 1930).

Ulotrichales.

Ulotrichaceae.

Ulothrix pelagica n. sp.

Fig. nostra 19.

Diagnosis. Trichomata uniseriata, simplicia, cylindracea, recta vel irregulariter flexuosa. Cellulae elongatae, 5—23 plo longiores quam latiores, membrana tenuissima. Chromatophorus unus, parietalis, partem interiorem majorem membranae cellulae obtegens, granulis amylaceis parvissimis numerosis instructus; pyrenoides abest. Cellula terminalis saepe acuminata. Longitudo cellularum 7—34 μ, latitudo 1—1.5 μ.

Hab. In Flødegaardens Dam, Fionia; Badstue-Ødam, Gadevang Mose, Frederiksborg Slotssø, Selandia; Sønderborg Mølledam, Jutlandia meridionali, Dania, libere natans.

Systematics. Of thin *Ulothrix* species *Ulothrix limnetica* var. *minor* Teiling is known (1912, p. 276). It is likewise without pyrenoid and is stated to have 6—11 μ long and 2 μ broad cells and a 1 μ thick sheath. I am indebted to Dr. Einar Teiling for his sending a copy of his drawing of *Ulothrix limnetica* var. *minor* from the only 4 m deep Råstasjön near Stockholm. For comparison's sake I have reproduced this copy in *Fig. nostra* 20, and it shows that *Ulothrix pelagica* is more closely related to Teiling's variety than to the following species. Further G. S. West (1915, p. 81, fig. 5) has described a spirally twisted species (also without pyrenoid), *Ulothrix spiroides*, the cells of which are only 1 μ broad and 4.5—8.5 μ long. *Ulothrix pelagica* differs from both of these forms by its pointed endcell and its uncommonly long cells, 5—23 times longer than broad.

In staining material of *Ulothrix pelagica* with chlor-zinc-iodide it was observed that the very delicate cell-wall turned slightly violet and the many granules of the chromatophore deep violet like in the cells of *Actinastrum Hantzschii* of the same sample. Both cell-wall and chromatophore consequently contain carbohydrates. Pyrenoids were always absent.

By low magnification *Ulothrix pelagica* is easily mistaken for *Tribonema taeniatum* Pascher (see *Fig. nostra* 21). This *Xanthophycea*, specimens of which were found in the plankton from Hostrup Sø and Esrom Sø but never in the plankton of Danish ponds, is known by the H-shaped pieces of the cell-wall, its somewhat

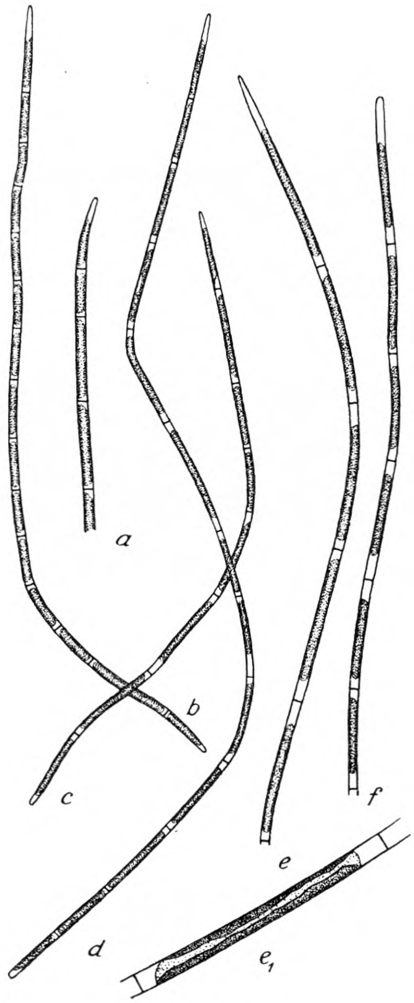

Fig. 19.

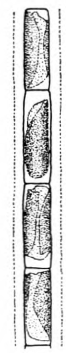

Fig. 20.

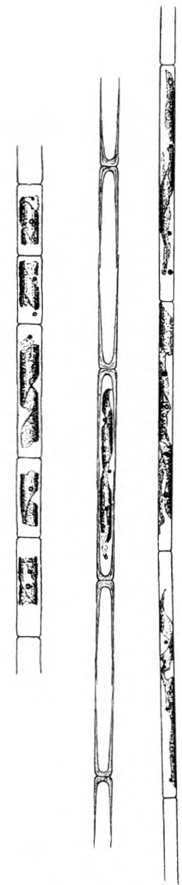

Fig. 21.

Fig. 19. *Ulothrix pelagica* n. sp.; *a—d* from Flødegaardens Dam, *a—b* from July 5th, 1928, *c—d* from June 2nd, 1929; *e*, e_1 and *f* from Badstue-Ødam, December 16th, 1929. e_1 1600 ×, the other figures 800 ×.

Fig. 20. *Ulothrix limnetica* Lemm. var. *minor* Teiling from Råstasjön, Sweden. After the original drawing made by Dr. Einar Teiling.

Fig. 21. *Tribonema taeniatum* Pascher from Hostrup Sø, July 24th, 1926. 800 ×.

greater thickness (2.5—4 μ) and by the fact that neither cell-wall nor chromatophores turn bluish violet in chlor-zinc-iodide; the length of the cells were 11—47 μ.

Periodicity. In Flødegaardens Dam the species was not seen in 1926 or 1927 but appeared in 1928 on June 19th (temp. 15° C.) and reached a great maximum on July 5th (temp. 15.75° C.). It then disappeared, but during the period September—December (temp. 19.5—1.5° C.) it was present in the plankton in small but comparatively constant quantities. In 1929 it was very rare when the ice broke at the beginning of April (temp. 6.5° C.), grew common during May and reached a great maximum on June 2nd (temp. 16° C.), only to disappear before July; the species reappeared in small amounts on December 16th (temp. 2.5° C.). In 1930 only a few specimens were observed on January 6th (temp. 4° C.).

In Badstue-Ødam the species only appeared during the cold season, from October 23rd, 1929 till February 17th, 1930 (temp. 9.5—0.5° C.) with a small maximum on December 16th (temp. 4° C.).

In Frederiksborg Slotssø *Ulothrix pelagica* was found only in April 1930 in very small quantities (temp. 5.5—12° C.).

In Gadevang Mose it was seen only on June 28th and July 6th, 1929 (temp. 20.75 and 16° C., respectively). The inconsiderable maximum in this pond occurred on July 6th.

Besides in these regularly examined ponds *Ulothrix pelagica* also occurred in Sønderborg Mølledam in September 1934.

It is no easy matter to determine the periodicity of this eurythermic species. In Flødegaardens Dam and Gadevang Mose the maxima occurred in June or July (temp. 15.75—16° C.) though not every year. In Frederiksborg Slotssø it appeared in April only. In Badstue-Ødam the species within the period July 1929—June 1930 surprisingly reached a small but distinct maximum in December (temp. 4° C.)! If, however, we look at the occurrence of the species in Flødegaardens Dam within the same period, we find the corresponding feature that here it appeared only in December—January (temp. 2.5—4° C.).

Sociology. The species occurred in the following associations:

Flødegaardens Dam.

June	19th,	1928:	*Mio ho*—indeterm. green algae-association with *Ank fa* and *Ank fa spi* as subdominants (the species very rare).
July	5th,	— :	*Mio ho-Ul pe*-association with *Ank fa spi*, *Chry mi* and *Coa mi as* as subdominants (the species very common).
Sep.	7th,	— :	*Mio ho*-association (the species very rare).
—	15th,	— :	dito.
—	21st,	:	*Mio ho-Ni ac*-association (the species very rare).
Oct.	1st,	— :	*Ki mi-Mio ho-Ni ac*-association (the species very rare).
—	10th,	— :	dito.
—	22nd,	— :	*Ki mi-Mio ho-Ste Ha*-association (the species rare).
Nov.	18th,	— :	*Ste Ha*-association with *Mio ho* and *Ki mi* as subdominants (the species very rare).
Dec.	28th,	— :	*Ste Ha*-association (the species very rare).
Apr.	2nd,	1929:	dito.
—	11th,	— :	*Ste Ha*-association with *Mia pu* as subdominant (the species very rare).

April 30th, 1929: *Ste Ha-Chry mi*-association (the species very rare).
May 10th, — : *Ste Ha*-association with *Tst st* and *Tra vo* as subdominants (the species not infrequent).
— 22nd, — : *Ul pe*-association with *Cru qu* as subdominant (the species common)
June 2nd, — : *Ul pe*-association (the species very common).
— 19th, — : *Tra vo*-association with *Sce arm* as subdominant (the species very rare).
Dec. 16th, — : *Tst st*-association with *Ank fa spi* and *Sce arm* as subdominants (the species very rare).
Jan. 6th, 1930: *Tst st*-association (the species very rare).

Badstue-Ødam.

Oct. 23rd, 1929: *Crym ov*-association with *Chry ma* as subdominant (the species very rare).
Nov. 30th, — : *Chry ma-Crym ov*-association (the species very rare).
Dec. 16th, — : *Chry ma-Crym ov-Ul pe*-association (the species rather common).
Jan. 15th, 1930: *Chry ma*-association (the species very rare).
— 31st, — : *Gle ac*-association (the species very rare).
Feb. 17th, — : *Ank fa mi lo*-association with *Chry mi* as subdominant (the species very rare).

Frederiksborg Slotssø.

Apr. 1st, 1930: *Trochiscia*-association (about 24.400 cells per ml) with *Ste Ha* as subdominant (about 10.400 cells per ml), (the species very rare).
Apr. 3rd, — : *Ste Ha*-association (the species very rare).
— 25th, — : *Ste Ha*-association with *Sce arm* as subdominant (the species very rare).

Gadevang Mose.

June 28th, 1929: *Din di*-association with *Syu sp* and *Ce hi* as subdominants (the species very rare).
July 6th, — : *Din di*-association (the species not infrequent).

Sønderborg Mølledam.

Sep. 7th, 1934: *Mel gr an*-association with *Sce fa* as subdominant (the species rare).

Ulothrix pelagica itself may be the dominant form of plankton associations; moreover it is found first and foremost in myxophycean associations of *Microcystis* and diatomaceous associations of *Stephanodiscus*, *Melosira* and *Nitzschia*; further in chlorophycean ass.s of *Kirchneriella*, *Tetrastrum*, *Ankistrodesmus* and *Trochiscia* and chrysophycean ass.s of *Dinobryon* and *Chrysococcus*; rarely in euglenine associations of *Trachelomonas*, cryptophycean ass.s of *Cryptomonas* and dinophycean ass.s of *Glenodinium*.

The most constant associates were *Scenedesmus armatus*, which occurred in 87 % of the number (31) of samples that contained *Ulothrix pelagica*; *Stephanodiscus Hantzschii* (84 %), *Ankistrodesmus falcatus* and *Trachelomonas volvocina*, both of which were found in 77.5 % of the samples.

Ecology. *Ulothrix pelagica* is a typical pond form. It was found only in highly eutrophic ponds, some of them of the mixotrophic phase. The phytoplankton quotients for Flødegaardens Dam, Badstue-Ødam, Frederiksborg Slotssø and Gadevang Mose are found in Table III; the only values to be mentioned here are those of the compound quotient: Flødegaardens Dam 8.75—43, Badstue-Ødam 10—12.7, Frederiksborg Slotssø 8—10 and Gadevang Mose 11—22.

In Sønderborg Mølledam the compound quotient on September 7th, 1934 was $\frac{24}{0}$, in other cases $\frac{16}{1}$ and $\frac{18}{1}$ (see p. 179).

Some data illustrating the ecology of *Ulothrix pelagica* are: pH 6.3—9.4, content of CaO 14.6—82 mg/l, consumption of $KMnO_4$ 43—52 mg/l, contents of PO_4-P 0.015—0.095 mg/l, NH_3-N 0—1.5 mg/l, NO_3-N 0—3 mg/l, Fe 0.3 mg/l.

Conjugales.

Desmidiaceae.

Closterium Baillyanum Breb. var. parvulum Grönblad.

Grönblad 1919, p. 13, t. 1, figs. 14—16.

Systematics. Measurements of the Danish specimens from Præstesø, June 28th, 1930:

450 μ × 31 μ, ratio 14.5.
468 μ × 30 μ, ratio 15.6, 8 + 11 pyrenoids.

Lille Gribsø, September 19th, 1926:

365 μ × 27 μ, ratio 13.5, apices 13—15 μ.
385 μ × 28 μ, — 13.8.
427 μ × 30 μ, — 14.2.
473 μ × 33 μ, — 14.3.

From the two localities mentioned the measurements accordingly were 365—473 μ × 27—33 μ, and the cells were 13.5—15.6 times longer than broad. In his diagnosis Grönblad gives the dimensions 281—391 μ × 24—30 μ, apices 13—15 μ broad; his 4 measurings show that the cells were only 11—13 times longer than broad. Grönblad further mentions (1919, p. 8) that Heimerl in 1891 found specimens with the measurements 300—470 μ × 27—32 μ.

Carl Huzel (1936, p. 78, t. 9, figs. 28—29; t. 15, figs. 1—4) gives similar dimensions for the variety as Grönblad; his fig. 28 shows a ratio of 12. In Huzel's cultures of var. *parvulum* most individuals were considerably longer than in nature, up to 580 μ, and had girdle-bands beside the connecting bands. These culture individuals, which Huzel and Grönblad consider abnormal forms, according to t. 15, figs. 1—3 are 15.2—15.8—15.9 times longer than broad: in this respect they are not very different from one of the measured individuals from Præstesø.

Dr. Rolf Grönblad, to whom I am indebted for opinions on the Danish specimens and several other desmids, approved of the determination and remarked that the shape of the cell is like that of *Closterium Baillyanum*, the membrane like that of *Closterium didymotocum*. W. and G. S. West gave *Closterium Baillyanum* as a synonym for *Closterium didymotocum* (Monograph I, p. 116).

While the specimens mentioned above do not deviate much from Grönblad's individuals, the following 2 specimens are so slender, that they may be regarded as a new form.

Store Gribsø, September 19th, 1926:

385 $\mu \times 18\ \mu$, ratio 21; apices 11—12 μ, not striate, 10 + 11 pyrenoids.

Lille Gribsø, September 19th, 1926:

502 $\mu \times 28\ \mu$, ratio 18, apices 13.5—15 μ, 7 striae pro 10 μ.

f. **tenuis** n. f.

Fig. nostra 22.

A varietate cellulis gracilioribus differt. Longitudo 385—502 μ, latitudo 18—28 μ, ratio axium 18—21. Membrana cellulae ochracea, levis vel cum 7 striis pro 10 μ.

Hab. In Lille Gribsø et Store Gribsø prope Hillerød, Dania, libere natans.

Periodicity and Sociology. The variety and the form were found in Præstesø on June 24th—28th, 1930 (temp. 20—21° C.), in Lille Gribsø on September 19th, 1926, June 28th, 1929 (temp. 19.25° C.) and August 28th, 1929 (temp. 21° C.) and in Store Gribsø on September 19th, 1926. In all these summer samples it was very rare except in the sample from August 28th, in which it was rare.

In Præstesø it occurred on June 24th—28th, 1930 in an *Ana fl*-association (variety very rare).

In Lille Gribsø:

Sep. 19th, 1926: association of a minute *Tetrasporale*(?) with *Sti ba* as subdominant (variety and form very rare).

June 28th, 1929: net plankton, *Ura am*-association; nannoplankton, *Se ca*-association (variety very rare; see Table IV).

Aug. 28th, 1929: *Cos as st*-association with *Sti ba* as subdominant (variety rare; see Table IV).

In Store Gribsø the form was found on September 19th, 1926 in a *Per Wi*-association (form extremely rare; see Table II).

In other words the variety and the form have been found in a myxophycean association of *Anabaena*, a chrysophycean association of *Uroglena*, a dinophycean association of *Peridinium* and in chlorophycean associations of *Selenastrum*, *Cosmarium* and an indeterminable *Tetrasporale* (?).

The constant associates of the variety were *Ankistrodesmus falcatus* (with variety), which occurred in 100 $^0/_0$ of the number (4) of samples that contained *Closterium Baillyanum* var. *parvulum*; *Glenodinium pusillum*, *Peridinium Willei*, *Stichococcus bacillaris*, *Selenastrum Westii*, *Cosmarium asphaerosporum* var. *strigosum*, *Cosmarium subarctoum* f. *minor* and *Arthrodesmus triangularis* were found in 75 $^0/_0$ of the samples.

Ecology. The two lakelets Præstesø and Lille Gribsø are clear lakes standing between oligotrophy and eutrophy. The compound quotient in Præstesø on June 28th, 1930 was $\frac{21}{17} = 1.2$, in Lille Gribsø on September 19th, 1926 (net- + nannoplankton) $\frac{3}{6} = 0.5$, on June 28th, 1929 $\frac{4}{7} = 0.6$ for net plankton and $\frac{7}{4} = 1.75$ for nannoplankton, on August 28th, 1929 (net- + nannoplankton) $\frac{5}{9} = 0.55$.

Store Gribsø is a somewhat larger, 13 m deep, oligotrophic lake of the dystrophic phase. The compound quotient was $\frac{0}{1} = 0$ on September 19th, 1926; see further Table I.

The variety was found at pH 4.9—7.1. On August 12th and September 12th the content of CaO in Lille Gribsø was 2.2 and 2.5 mg/l, respectively, and in August 1929 the following data were observed in the same lake: PO_4-P 0 mg/l, NO_3-N 0.02 mg/l, NH_3-N 0.1 mg/l, consumption of $KMnO_4$ 38 mg/l.

Carl Huzel found the variety at pH values between 5.3 and 6.8.

The form was found at the pH value 5.4 in Store Gribsø, which is also lime-deficient (see Table I).

Closterium gracile Breb. var. **elongatum** West f. **longissima** n. f.

Fig. nostra 23.

Diagnosis. Cellulae gracillimae, e sex mensionibus 96—119 plo longiores quam latiores, lineares, ad apices subtruncatae et leviter inflexae, longe attenuatae. Membrana glabra, pallide ochracea, sine suturis transversis. Pyrenoidibus in utraque semicellula 10—16 in serie unica dispositis. Locellis apicalibus brevissimis, circiter 10 μ longis. Longitudo cellularum 379—475 μ, latitudo $3^1/_2$—4 μ, latitudo apicum 2.3—2.5 μ.

Hab. In Grovsø prope Oxbøl, Jutlandia, Dania, libere natans.

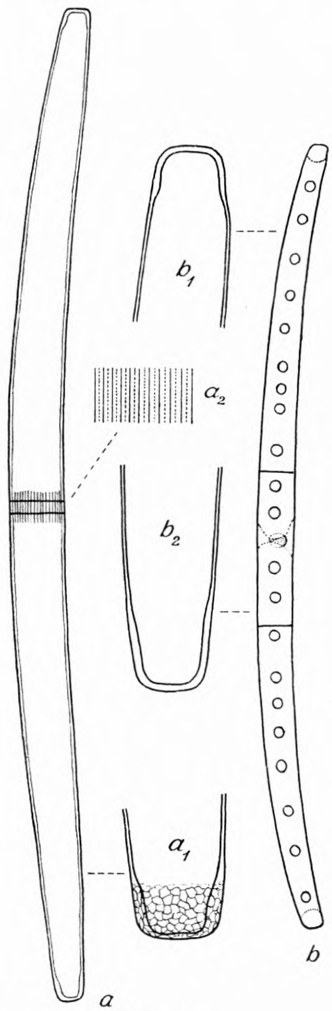

Fig. 22.

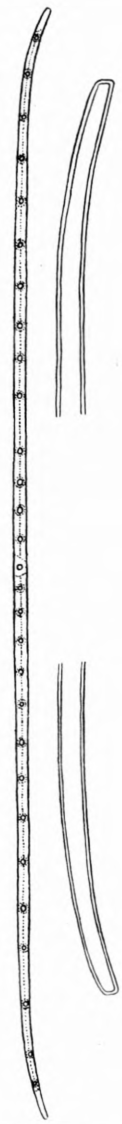

Fig. 23.

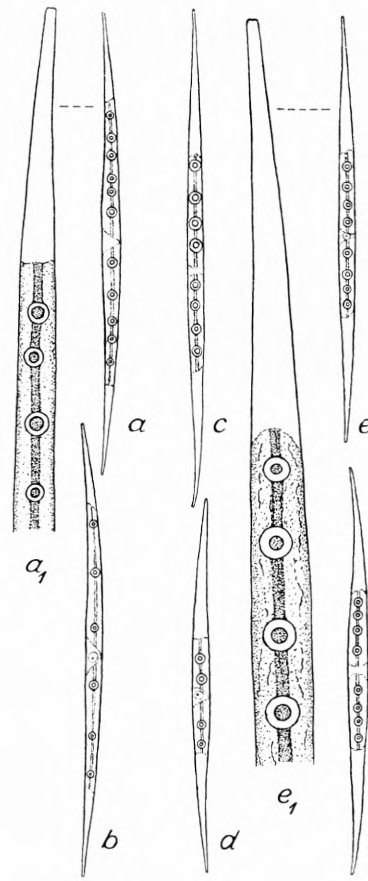

Fig. 24.

Fig. 22. *Closterium Baillyanum* Breb. var. *parvulum* Grönblad f. *tenuis* n. f. a, a_1 and a_2 from Lille Gribsø, September 19th, 1926; b, b_1 and b_2 from Store Gribsø, September 19th, 1926. a and b 260×, a_1, b_1 and b_2 apices, 800×, a_2 the striation on the middle of the cell, 800×.

Fig. 23. *Closterium gracile* Breb. var. *elongatum* West f. *longissima* n. f. from Grovsø, June 27th, 1930. 350× and 1070×(apices).

Fig. 24. *Closterium idiosporum* West; a, a_1 and b from turf pit at Store Jenshøj, June 25th, 1930; c, d, e, e_1 and f from Sortemose at Farum Sø, April 28th, 1929. a_1 and e_1 800×, the other figures 260×.

According to W. & G. S. West (Monograph I, 1904, p. 168, t. 21, figs. 14—16) the variety is 85—95 times as long as broad and reaches a length of 276—360 μ; its apices are not subtruncate, and the wall is not brownish (according to information by letter from Dr. Rolf Grönblad, to whom drawing and measures have been shown, var. *elongatum* may have a brownish wall). The number of the pyrenoids and the lengths of the terminal vacuoles do not appear from West's description and figures. In spite of these differences it is perhaps hardly legitimate to term the present individuals *Closterium gracile* Breb. var. *fuscatum* nov. var., which I originally intended.

A short description of Grovsø and its plankton on June 27th, 1930 (temp. 18° C., pH 5.4) when *Closterium gracile* var. *elongatum* f. *longissima* was comparatively rare, is found sub *Closterium juncidum* Ralfs var. *elongatum* Roy et Biss. f. *truncata* n. f. (see p. 60).

Closterium idiosporum West.

W. and G. S. West: Monograph I, 1904, p. 180, t. 23, figs. 20—21.—*Fig. nostra* 24.

This rare species was found in the turf pit S. of Store Jenshøj at Oxbøl, Jutland, and in Sortemose at Farum Sø, N. Seeland. The individuals were straight, slightly curved or slightly sigmoid and had truncate, 1.8—2 μ broad apices; the inner margin was sometimes slightly tumid, especially in the individuals from Sortemose.

According to 4 measurings of specimens from Sortemose the length was 188—252 μ, the breadth 8.5—10 μ, ratio 21—28, 2—4 pyrenoids per semicell, terminal vacuoles 62—73 μ.

10 measurings of specimens from the turf pit at Store Jenshøj gave the lengths 195—235 μ, the breadths 8—10 μ, ratio $20\frac{1}{2}$—29, 3—8 pyrenoids per semicell, terminal vacuoles 40—46 μ.

As will be seen the Danish individuals are a little slenderer ($20\frac{1}{2}$—29 times longer than their diameter) than the British ones (20—23 times), show a somewhat greater variation in length (188—252 μ against 221—238 μ) and a breadth of 8—10 μ against the 10—10.5 μ of the British specimens.

The species was very rare on April 28th, 1929 in Sortemose and on June 25th, 1930 in turf pit at Store Jenshøj (temp. 18° C.).

In Sortemose *Closterium idiosporum* occurred in a *Cos de*-association with *Ce co* as subdominant. In the turf pit at Store Jenshøj it was also very rare in an *Aso su-Oe It*-association (see Table IV). In other words it was found only in green algae associations.

Both localities mentioned are acid, oligotrophic turf pits of the dystrophic type. The phytoplankton quotients of the turf pit at Store Jenshøj (pH 4.0) appear from Table III. The plankton of Sortemose was composed of 31 species with the following quotients: myxophycean quotient $\frac{1}{19}$, chlorophycean $\frac{2}{19}$, diatom $\frac{0}{0}$, euglenine $\frac{2}{3}$ and the compound quotient $\frac{5}{19} = 0.25$.

Closterium juncidum Ralfs var. **elongatum** Roy et Biss. f. **truncata** n. f.

Fig. nostra 25.

Diagnosis. Cellulae graciles et elongatae, 38—52 plo longiores quam latiores, subrectae, ad apices truncatae et leviter incurvatae, aequaliter attenuatae. Membrana ochracea, subtiliter striata, striis 5 pro 5 μ in media cellula, spatium inter strias non semper aequidistantes, 1—1.2 μ. Suturae transversales non observatae. Pyrenoidibus in utraque semicellula 19—26 in serie unica dispositis. Locellis apicalibus brevissimis, 5—$7\frac{1}{2}$ μ longis, corpuscula gypsi singula includentibus. Longitudo cellularum 378—512 μ, latitudo 10 μ, latitudo apicum 5—6 μ.

Hab. In Grovsø prope Oxbøl, Jutlandia, Dania, libere natans.

It is stated about this variety that it is 35—45 times longer than broad, 295—473 μ long and 8.5—13 μ broad. If it is like the main species in other respects, the present individuals differ in having truncate apices and only one moving gypseous granule in each of the terminal vacuoles. According to West's Monograph I, t. 14, figs. 10—14 the terminal vacuoles are also considerably longer in the main species than in the present individuals.

The form was rare in Grovsø on June 27th, 1930 (temp. 18° C., pH 5.4). The plankton was at this time a typical desmid-flagellate plankton with *Arthrodesmus incus* var. *extensus*, *Arthr. octocornis*, *Closterium setaceum* var. *elongatum*, *Clost. intermedium*, *Clost. Dianae* var. *arcuatum*, *Clost. gracile* var. *elongatum* f. *longissima* n. f., *Cosmarium subtumidum* f. *parva* n. f., *Staurastrum brachiatum*, *Staur. hirsutum* and the flagellates *Uroglena americana* and *Dinobryon sertularia* var. *protuberans* as particularly characteristic organisms though they were not frequent in the plankton.

The dominant organism was *Arthrodesmus incus* var. *extensus*, the total number of species was 29, and the phytoplankton quotients were instructive: myxophycean quotient $\frac{2}{18}$, chlorophycean quotient $\frac{6}{18}$, diatom quotient $\frac{0}{1}$, euglenine quotient $\frac{1}{5}$, compound quotient $\frac{9}{18} = 0.5$.

Grovsø is oligotrophic. The very shallow pond is surrounded by heath and is overgrown with vast thickets of reed swamps. Boisen Bennike (1943, p. 34) examined it on July 19th, 1940 and found that pH was 6.7, the colour corresponded to 0.12 mg/l methylorange, the consumption of $KMnO_4$ was 36 mg/l and the content of CaO was very small.

Closterium polystictum Nyg. var. **breviusculum** n. var.

Fig. nostra 26.

Diagnosis. Cellulae longae, graciles, subrectae vel ad apices leviter incurvae, e decem mensionibus 32—45 plo longiores quam latiores. Medium cellulae rectum, cylindricum, ad apices chromatophororum paulum attenuatum; ex hoc loco cellula ad apicem abrupte acutata. Membrana glabra, achroo, sine suturis transversis. Py-

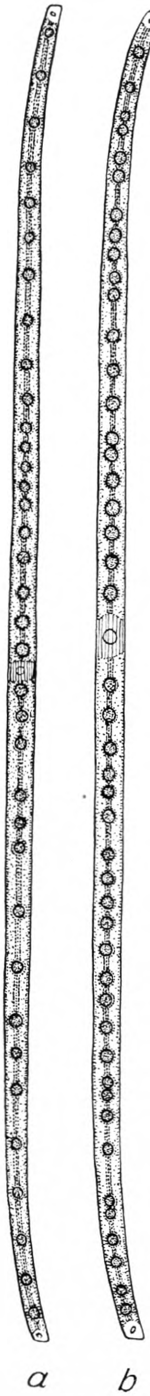

Fig. 25.

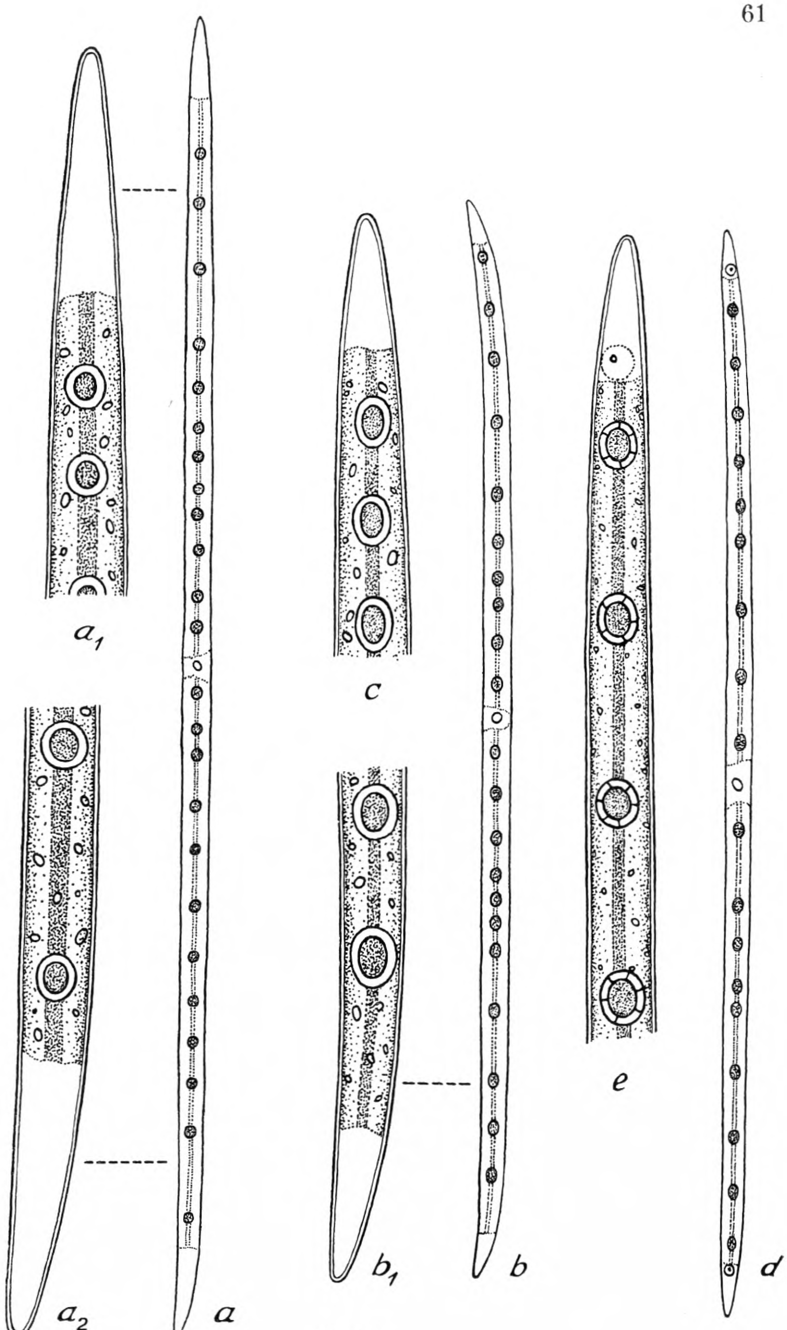

Fig. 26.

Fig. 25. *Closterium juncidum* Ralfs var. *elongatum* Roy et Biss. f. *truncata* n. f. from Grovsø, June 27th, 1930. *a* 350× and *b* 465×.

Fig. 26. *Closterium polystictum* Nyg.; *a*, a_1 and a_2 are delineated from the type material of Vaal River, Transvaal. *b*—*e* var. *breviusculum* n. var.; *b*, b_1 and *c* from Flyndersø, July 6th, 1938, *d*—*e* from Nordborg Sø, July 11th, 1938. *a*, *b* and *d* 350×, a_1, a_2, b_1, *c* and *e* 1070×.

renoidibus in utraque semicellula 8—13 (vulgo 10) in serie unica dispositis. Locellis apicalibus brevibus, 17—20 μ longis, corpuscula gypsi singula includentibus. Longitudo cellularum 323—418 μ, latitudo 9—11 μ; cellulae ad fines chromatophororum 6—7 μ latae.

Hab. In Flyndersø, Jutlandia septentrionali, et Nordborg Sø, Alsia, Dania, libere natans.

Systematics. For the sake of comparison I have drawn a typical specimen of *Closterium polystictum* from the original material (Vaal River, Vereeniging, Transvaal, July 25th, 1928). The cell ends of the Danish specimens are seen to look like the South African ones, and they are of the same thickness. The main species measures 479—585 μ in length, 9—11 μ in breadth, is 48—60 times as long as broad, has 12—16 pyrenoids per semi-cell and terminal vacuoles of 25—43 μ length; at the ends of the chromatophores the breadth was 6.5—8 μ. The variety thus differs from the main species by its shorter cells, the smaller number of pyrenoids (as a rule only 10) and the shorter terminal vacuoles. In fact var. *breviusculum* stands between the main species and var. *Nordstedtii* Krieger (1937, p. 266, t. 13, fig. 4), the latter being 9 μ broad but only 207—245 μ long.

On the periodicity of the species can only be said that it was comparatively common on July 6th, 1938 (temp. 18° C.) in Flyndersø and occurred sparsely in Nordborg Sø on July 11th, 1938 (temp. 18° C.). On December 9th, 1940 it was not present in the plankton of Nordborg Sø.

Sociology. In Flyndersø the plankton of the said time may be characterised in this way: *Api fl*-association, 34 species, myxophycean quotient $\frac{7}{4}$, chlorophycean quotient $\frac{8}{4}$, diatom quotient $\frac{8}{4}$, euglenine quotient $\frac{0}{15}$, compound quotient $\frac{23}{4} = 5.75$. In Nordborg Sø a typical *Oo Ma* association occurred in July 1938 with *Cl ac va* as subdominant, 34 species, myxophycean quotient $\frac{6}{6}$, chlorophycean quotient $\frac{12}{6}$, diatom quotient $\frac{3}{2}$, euglenine quotient $\frac{2}{18}$, compound quotient $\frac{23}{6} = 3.8$.

Ecology. Both Nordborg Sø and Flyndersø are rich in plankton and typically eutrophic in spite of the fact that the latter lies in heathy land. In Nordborg Sø, which is no doubt rich in CaO, pH was 8.8, in Flyndersø 9.0 on the dates mentioned.

Closterium setaceum Ehrb. var. **elongatum** West.

W. and G. S. West: 1905, p. 499, t. 6, fig. 21.—*Fig. nostra* 27.

Cells very slender, almost straight, according to 10 measurements 38—65 times longer than broad. The central part of the cells of a slender spindle-shape, both sides equally convex; the wall of a pale brown colour and with a fine longitudinal striation, 7—8 striae per 5 μ in the middle of the cell, the distance between the striae 0.7—0.8 μ. The ends very long, slender, bristle-like, palish brown, at the apices rounded and slightly curved. Chromatophores short, with 3—7, mostly 4 pyrenoids per semicell. Terminal vacuoles with only one moving granule situated at the end of the chromatophores. Cells 396—469 μ long, 7—11 μ broad, apices 2 μ broad.

Occurrence: Grovsø at Oxbøl, SW. Jutland, pelagic.

The variety, which was observed only in quite a few localities of the world, differs from the main species in so many points, that it might be legitimate to consider it a separate species. *Closterium setaceum* is only 25—40 times longer than broad; its chromatophores normally contain only 2 pyrenoids per semicell; its striation is a little coarser: 5—6 striae per 5 μ; its apices are but 0.7—1.5 μ broad, and each of the terminal vacuoles contains 3—4 moving granules.

The species was rather common in the Grovsø plankton on June 27th, 1930 (temp. 18° C., pH 5.4). A comment on the composition of the plankton and on the locality is found under the discussion of *Closterium juncidum* Ralfs var. *elongatum* Roy et Biss. f. *truncata* n. f. (see p. 60).

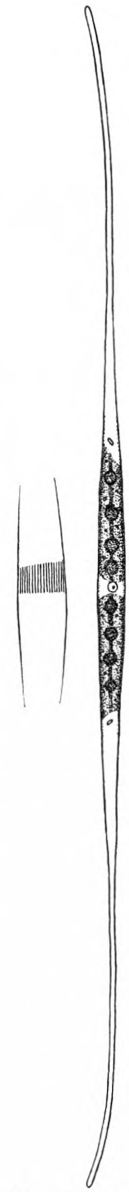

Fig. 27. *Closterium setaceum* Ehrenb. var. *elongatum* West from Grovsø, June 27th, 1930. 350× and 560×.

Closterium Venus Kg. f. **torta** (Griff.) mihi.

Syn. *Closterium tortum* Griffiths (1925, p. 90, t. 1, figs. 4—6); "*Closterium Venus* Kg?" J. Woloszynska 1914, p. 192, fig. 1 B.—*Fig. nostra* 28.

Diagnosis. Cellulae parvae, ad apices subacutos aequaliter attenuatae, $9\frac{1}{2}$—10 plo longiores quam latiores, valde curvatae, dorso convexo, gradus arci 151—164 metienti. Semicellulae inter se contortae, saepe tantum ut formae sigmoideae vulgares sint. Membrana levis, sine colore et suturis transversis. Pyrenoidibus in utraque semicellula 1—3, vulgo 2, in serie unica dispositis. Locellis apicalibus corpuscula gypsi singula includentibus. Longitudo cellularum 81—90 μ, latitudo 8—9 μ, locelli apicales 10—28 μ longi.

Hab. In Nordborg Sø, Alsia, et Furesø, Selandia, Dania, libere natans.

Griffiths gives the dimensions 90—100 μ × 8—10 μ; his specimens contained 3 (or 4) pyrenoids per semicell.

In the eutrophic lake Nordborg Sø, which presumably is rich in CaO (see Johs. Iversen 1929, p. 322) pH was 8.8 and the temperature 18° C. on July 11th, 1938. The species was not infrequent in the plankton of the lake, but in spite of the fact that nearly a hundred individuals were seen not a single "normal" (not twisted) specimen was found! On the said date the plankton community mainly consisted of *Oocystis Marssonii* Lemm., *Closterium acutum* Breb. var. *variabile* Krieger, *Scenedesmus armatus* Chodat and *Microcystis aeruginosa* Kg. Among the rest of the 30 more or less common species special attention must be drawn to the two characteristic desmids *Cosmarium biretum* Breb. var. *trigibberum* Nordst. and a new variety of *Closterium polystictum* Nygaard (see p. 62 where the phytoplankton quotients of the sample are given). It is a rare thing to find a plankton community in which the *Closterium* species prevail to such a degree, especially when the water is polluted and at the same time of a comparatively strong alkalinity.

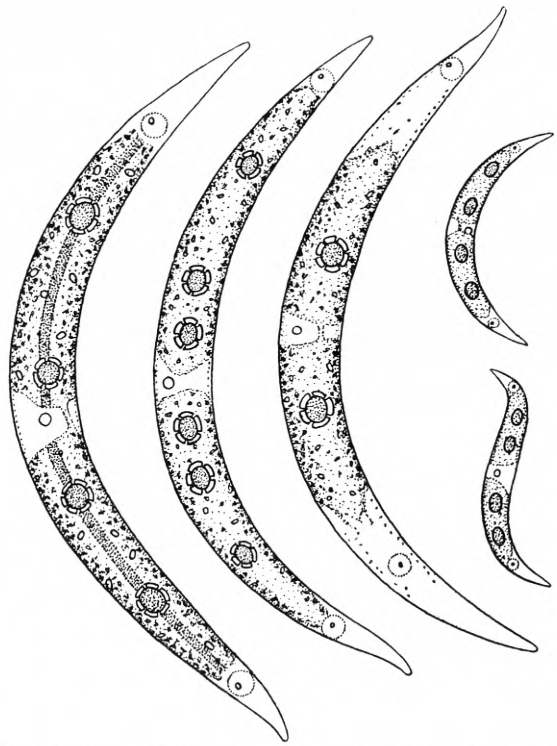

Fig. 28. *Closterium Venus* Kg. f. *sigmoidea* n. f. from Nordborg Sø, July 11th, 1938. 1070× and 350×.

In Furesø a few individuals of f. *torta* were observed on September 1st, 1946 at a temperature of 17.5° C. and pH 8.4. The plankton consisted of a typical *Ce hi* association (15 individuals per ml) with 54 species, myxophycean quotient $\frac{15}{8}$, chlorophycean quotient $\frac{10}{8}$, diatom quotient $\frac{3}{8}$, euglenine quotient $\frac{0}{25}$, compound quotient $\frac{28}{8} = 3.5$.

In a small article (1925, pp. 158—63) G. Deflandre mentions sigmoid forms of 2 Closterium species, *Cl. Leibleinii* Kg. and *Cl. acerosum* Ehrb. In the former species the cells under culture were twisted, but the chromatophores unaltered; in the latter a spiral twisting of the chromatophores could be found both in the twisted and untwisted, cultivated individuals. Under the same conditions of cultivation the two species at the same time produced sigmoid forms, which generally speaking cannot therefore be regarded as accidental or morbid forms, but as forms that could be produced experimentally if we knew the physical-chemical conditions under which they arise. No doubt Deflandre is right in supposing that sigmoid forms are modifications produced by special ecologic factors though it has not yet been tried whether they will "revert" under normal conditions of life.

Closterium Venus Kg. has a very wide geographical distribution. In their great monograph the experienced algologists W. & G. S. West say nothing about a spiral twisting of the cells. In the tropic Victoria Nyanza, however, J. Woloszynska found sigmoid specimens "in allen Proben zerstreut", and now we also know the sigmoid form from the temperate lakes Marbury Mere, England, Nordborg Sø and Furesø, Denmark. In these three localities there is occasionally a realization of the special physical-chemical conditions that compel *Closterium Venus* Kg. to produce the sigmoid modification.

Cosmarium subarctoum Racib. var. **latum** n. var.

Fig. nostra 29.

Diagnosis. Cellulae parvae, tam longae quam latae, non profunde constrictae, sinu acutangulo mox ampliato. Semicellulae transverse ellipsoideae, a vertice visae ellipticae, ratio axium 1: circiter $1\frac{1}{2}$. Membrana punctata. Longitudo cellularum 20—22 μ, latitudo 19—22 μ, latitudo isthmi 11—12 μ, crassitudo 12 μ.

Hab. In Kalgaard Sø in medio Jutlandiae, Dania, libere natans.

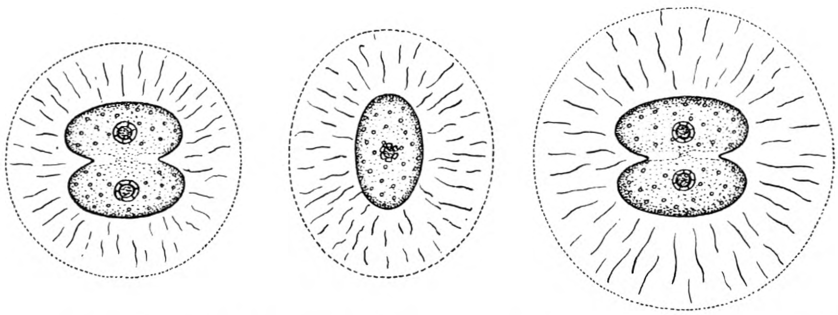

Fig. 29. *Cosmarium subarctoum* Racib. var. *latum* n. var. from Kalgaard Sø, May 17th, 1929. 750×.

This new variety differs from the type by its comparatively broad semicells. In the month of May it was surrounded by a nearly spherical gelatinous envelope with a radiate fibrillary structure. In June, however, the individuals like the rest of the desmids present were without gelatinous envelope.

Cosmarium subarctoum Racib. var. *latum* was found in Kalgaard Sø on May 17th, 1929 in several specimens, on June 23rd, 1929 in small quantities.

On May 17th the plankton was dominated by *Tabellaria fenestrata* Kg. var. *asterionelloides* Grun. and var. *intermedia* Grun. f. *asterionelloides* Bachm. (see Bachmann 1907, p. 68, Fig. VIII, 15—16; both are connected by transition forms). The phytoplankton quotients were very instructive: myxophycean quotient $\frac{1}{8}$, chlorophycean quotient $\frac{1}{8}$ and diatom quotient $\frac{0}{3}$, euglenine quotient $\frac{0}{2}$, compound quotient $\frac{2}{8} = 0.25$. On June 23rd, the phytoplankton was dominated by *Uroglena americana*; myxophycean quotient $\frac{2}{6}$, chlorophycean quotient $\frac{3}{6}$ and diatom quotient $\frac{0}{2}$, euglenine quotient $\frac{1}{5}$, compound quotient $\frac{6}{6} = 1$, (see Table II where the composition of the phytoplankton of Kalgaard Sø is given).

Kalgaard Sø is a clear and shallow, approximately oligotrophic lake; pH was 6.9 on June 23rd, 1929, and the same day it was impossible to make out the least traces of phosphate, ammonia and nitrate.

Cosmarium subtumidum Nordst.

West: Monograph, vol. II, 1905, p. 192, t. 63, figs. 18—20; incl. var. *Klebsii* West (*loc. cit.*, p. 193, t. 63, figs. 21—23).

In the place cited above W. and G. S. West say, "This variety (var. *Klebsii*) differs so little from the type that it is scarcely possible to distinguish between them". I fully accept this point of view. The authors state the ratio (in vertical view) of axes to be $\frac{1}{1.84}$. 4 measurings of Danish material gave the results $\frac{1}{1.76}$ $\frac{1}{1.8}$ $\frac{1}{1.82}$ $\frac{1}{2.05}$. The Danish specimens showed the following sizes: length 30.5—40 μ, breadth 29—40 μ, thickness 17—19 μ, breadth of isthmus 9—10 μ.

Distribution: Furesø, Nors Sø, Skaansø, Blankeborg I, dune lake at Højsande, shallow turf pit near Store Jenshøj at Oxbøl, pelagic.

Systematics. The species bears some resemblance to *Cosmarium depressum* Lund. var. *planctonicum* Reverdin (in "Dansk Planteplankton", 1945, given as *Cosmarium depressum* Lund. var. *limneticum* West), which is also pelagic and is characteristic of eutrophic lakes. *Cosmarium depressum* var. *planctonicum*, however, is much smaller and shorter than broad. The Danish specimens measured 19—24 μ in length, 22—27 μ in breadth, 9.5—12 μ in thickness, and the breadth of isthmus was 7.5—8.5 μ. The ratio of axes (in vertical view) also differs from that of *Cosmarium subtumidum*, being $\frac{1}{2.3-2.4}$ for the Danish material.

Periodicity. As will appear from the following section *Cosmarium subtumidum* was found only in the months of May—August, especially in August, at temperatures between 14 and 21° C.: in Blankeborg I, which was examined repeatedly for several years, it occurred only in the August samples (temp. 16.5—21° C.) and was never seen during the rest of the year. Accordingly, the species is periodic and meso- to polythermic, though chiefly polythermic. It was rare or very rare in all the samples and appears to thrive mainly in July-August.

Sociology. The species occurred in the following associations:

Blankeborg I (see Table IV).

Aug. 1st, 1926: *Din di*-association with *Per Vo* as subdominant (the species very rare).

— 15th, — : *Ce hi*-association (the species very rare).

Aug. 17th, 1927: *Ce hi*-association with *Din di* as subdominant (the species very rare).

Aug. 18th, 1928: *Din di*-association with *Ce hi* as subdominant (the species very rare).

Nors Sø (see Table II).

Jul. 18th, 1925: *Ana ci-Mio fl ma*-association with *Ce hi*, *Eut gl* and *Sta pi tr* as subdominants (the species rare).

June 13th, 1927: *Ana fl*-association with *Ank la* and *Eut gl* as subdominants (the species very rare).
May 13th, 1929: *Din di*-association with *Din so st* as subdominant (the species very rare).
Aug. 31st, — : *Cyc Kü ra*-association with *Cyc co* as subdominant (the species rare).
Aug. 18th, 1939: *Ana fl-Mio fl ma*-association (the species very rare).

Furesø (see Table II).

Aug. 7th, 1932: *Ana fl-Asi fo*-association (the species rare).

Store Jenshøj turf pit (see Table IV).

June 25th, 1930: *Aso su-Oe It*-association (the species rare).

Skaansø (see Table IV).

July 4th, 1938: *Din cy pa*-association (the species very rare).

Dune lake at Højsande, Læsø (see Table IV).

June 30th, 1925: *Tsp Ny*-association with *El ge* as subdominant (the species very rare).

This means that *Cosmarium subtumidum* was found in myxophycean (*Anabaena*, *Microcystis*), dinophycean (*Ceratium*), chrysophycean (*Dinobryon*), diatomaceous (*Cyclotella*, *Asterionella*) and chlorophycean associations (*Tetraspora*, *Asterococcus*).

The constant associates were *Ceratium hirundinella*, which occurred in 92 $^0/_0$ of the number (13) of samples that contained *Cosmarium subtumidum*; *Botryococcus Braunii* and *Pediastrum Boryanum* (85 $^0/_0$).

Ecology. The species, which is found both in small waters and in our largest lakes, seems to be very adaptive, occurring in very different biotopes. Store Jenshøj turf pit is oligotrophic of the dystrophic phase, Skaansø and dune lake at Højsande are oligotrophic lakelets of the acidotrophic phase, whereas Blankeborg I is a slightly eutrophic turf pit of the mixotrophic phase; Nors Sø is also slightly eutrophic, and Furesø, our deepest lake, is moderately eutrophic. Tables I and III give the compound quotients for all these localities. In the highly eutrophic lakes and ponds, however, *Cosmarium subtumidum* is unknown; apparently it endures only a very slight contamination of the water.

The species was found at pH values between 4.0 and 8.3 and at a lime content of 43.1—91 mg CaO per litre though the lower limit is no doubt below 5 mg/l. In Blankeborg I the consumption of $KMnO_4$ was found to be 77—81 mg/l, but in the oligohumic Skaansø and dune lake at Højsande the consumption of $KMnO_4$ was no doubt below 10 mg/l and presumably much higher than 81 mg/l in Store Jenshøj turf pit with its very brown water.

f. **punctata** n. f.

Fig. nostra 30.

Diagnosis. A typo cellulis regularioribus et dispersioribus punctatis differt. Longitudo cellularum 35—42 μ, latitudo 34—39 μ, crassitudo 17 μ, latitudo isthmi 10.5—11.5 μ.

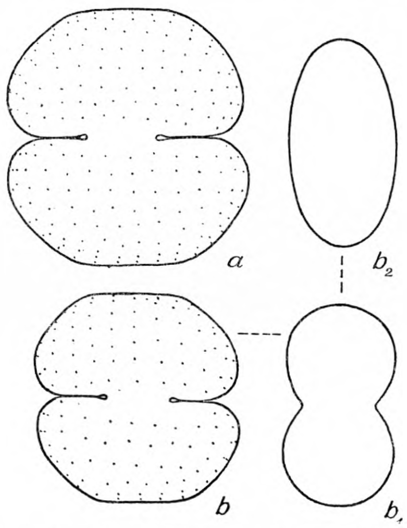

Fig. 30. *Cosmarium subtumidum* Nordst. f. *punctata* n. f. from Slaaen Sø, September 4th, 1929; *a*—*b* front views, b_1 lateral view, b_2 vertical view. 800×.

Hab. In Slaaen Sø, Jutlandia, Longet Sø prope Nyborg, Fionia, et Furesø, Selandia, Dania, libere natans.

Systematics. In their Monograph, vol. II, t. 63, fig. 23 the Wests picture a specimen of *Cosmarium subtumidum* var. *Klebsii* with punctate cell-wall; these points are completely disorderly. The cell-wall of the f. *punctata* individuals is not nearly so densely punctate, and the points show a distinct tendency of an order of longitudinal and transversal series. One measuring of the axes (in the vertical view) gave the ratio $\frac{1}{2}$.

Periodicity. As will appear from the section on sociology the form was found only in July, August and September in the plankton of the 3 localities mentioned; it was always rare or very rare.

Sociology. The form was found in the following 4 associations:

Slaaen Sø.

Sep. 4th, 1929: *Ce hi*-association (the form very rare).

Furesø.

Aug. 21st, 1943: *Mel gr an*-association (the form very rare).
Sep. 1st, 1946: *Ce hi*-association (the form very rare).

Longet Sø at Nyborg.

July 28th, 1926: *Per Wi*-association containing *Merismopedia major*! (the form rare).

Accordingly, *Cosmarium subtumidum* f. *punctata* occurred in dinophycean associations of *Ceratium* and *Peridinium* and a diatom association of *Melosira*.

The constant associates were *Dinobryon divergens*, which occurred in 100 %
of the number (4) of samples that contained the form; the following species occurred in 3 of the samples: *Sphaerocystis Schroeteri*, *Closterium aciculare*, *Cosmarium depressum* var. *planctonicum*, *Staurastrum avicula*, *Staurastrum gracile*, *Stephanodiscus*

Astraea, *Asterionella formosa*, *Fragilaria crotonensis*, *Synedra ulna*, *Ceratium hirundinella* and *Microcystis holsatica*.

Sociology. Slaaen Sø is a very clear lake, cold in summer and standing between eutrophy and oligotrophy (compound quotient 1.2); Furesø is also clear but moderately eutrophic (compound quotients 4.4—3.5—3.5) with a lime content of 54.5—65.4 mg CaO per litre (Brønsted and Wesenberg-Lund 1912, p. 453); see further Table I. Longet Sø at Nyborg is a large, slightly eutrophic pond of the mixotrophic phase, partly overgrown with reed swamps; on the date mentioned pH was 7.8 and the consumption of $KMnO_4$ 61 mg/l. A few other data of the ecology of *Cosmarium subtumidum* f. *punctata*: pH 7.8—8.4, contents of PO_4-P 0.07 mg/l, NH_3-N 0.05 mg/l, NO_3-N 0 mg/l.

f. **parva** n. f.

Fig. nostra 31.

Diagnosis. A typo cellulis multo minoribus differt. Longitudo cellularum 16—18.5 μ, latitudo 15—18 μ, crassitudo 8—10 μ, latitudo isthmi 5—7 μ, ratio axium (semicellulae a vertice visae) 1:1.8—1.9.

Hab. In Grovsø prope Oxbøl, et Madum Sø, Jutlandia, Dania, libere natans.

Systematics. This variety resembles the type in all respects with the exception of the size, which is about half as great. K. Münster Strøm describes a var. *minor* of *Cosmarium subtumidum* (1919, p. 7, t. 2, figs. 14, 14a, 14b). The apex of this variety, however, is semicircular, not flattened as in f. *parva*, and its cells are much longer than broad.

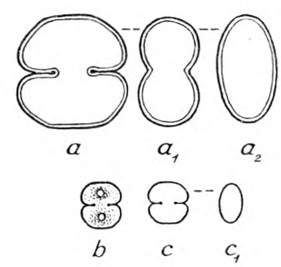

Fig. 31. *Cosmarium subtumidum* Nordst. f. *parva* n. f.; a, a_1 and a_2 (800×) from Madum Sø, June 24th, 1928; b, c and c_1 (350×) from Grovsø, June 27th, 1930. a, b and c front views, a_1 lateral view, a_2 and c_1 vertical views.

Periodicity. *Cosmarium subtumidum* f. *parva* was found only in the month of June. In Grovsø it was not infrequent on June 27th, 1930 (temp. 18° C.), but in Madum Sø it was very rare in both samples from June.

Sociology. The form occurred in the following 3 associations:

Grovsø.

June 27th, 1930: *Ar in ex mi*-association (the form not infrequent).

Madum Sø.

June 24th, 1928: *Din cy pa*-association (the form very rare).

June 24th, 1929: *Din cy pa*-association with *Per Wi* as subdominant (the form very rare).

Cosmarium subtumidum f. *parva* thus occurred in a desmid association of *Arthrodesmus* and in two chrysophycean associations of *Dinobryon*.

Ecology. Both lakes are oligotrophic, Grovsø mainly of the dystrophic phase. Madum Sø, however, belongs to the acidotrophic phase: its pH was 4.6—5.1, and its water was sometimes just as clear as in the alpine lakes of Central Europe (consumption of $KMnO_4$ 4—6.6 mg per litre): on June 24th, 1929 the transparency was more than 8 m! The lime content of this lake was only 2.4—4 mg CaO per litre. Further data of the ecology of *Cosmarium subtumidum* f. *parva* are: pH 4.8—5.4, contents of PO_4-P, NH_3-N and NO_3-N: 0 mg/l.

Euastrum occidentale West var. **danicum** nov. var.

Fig. nostra 32.

Diagnosis. A typo cellulis minoribus cum granulis 13—14 in utroque latere semicellulae differt. Longitudo cellularum 54—58 μ, latitudo 46—50 μ, crassitudo 21—27 μ, latitudo isthmi 11.5—14 μ, latitudo apicis 12—15 μ.

Hab. In Nors Sø, Jutlandia boreali, Dania, libere natans.

Systematics. The specimens pictured deviate so much from West's specimens in the size and number of the granules, that it seems legitimate to consider the Danish specimens a new variety. W. Krieger is of opinion that *Euastrum occidentale* West is a *Cosmarium* species (Rabenhorst Kryptogamenflora, Bd. 13, 1937, p. 657); however, the apical sinus and the concave side-walls justifies the use of the generic name of *Euastrum*. The variety should also be compared with *Cosmarium Turpinii* Breb. and varieties (West's Monograph of the British Desmidiaceae, vol. 3, 1908, p. 189, t. 82, figs. 16—17 and t. 83, figs. 1—3), which *i.a.* is different, however, in having 1—2 central tumours, set with big granules, on the frontal side of either semicell. From *Cosmarium Botrytis* Menegh. var. *emarginatum* Hansg. (West *loc. cit.* p. 6, t. 103, fig. 8), which also has 13—15 granules along each of the side-walls of either semicell, it differs by its distinctly concave side-walls.

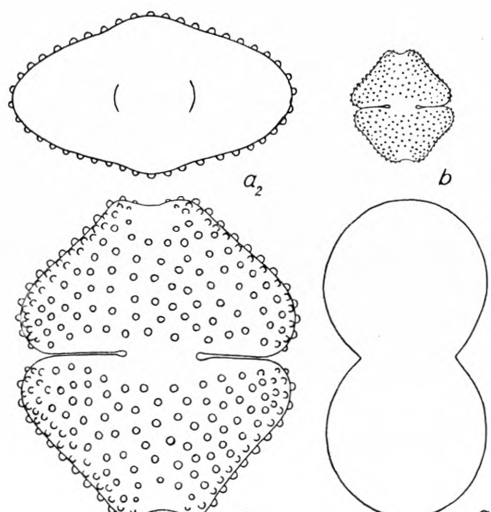

Fig. 32. *Euastrum occidentale* West var. *danicum* n. var. from Nors Sø, August 18th, 1939. *a*—*b* front views, a_1 lateral view, a_2 vertical view. *a*, a_1 and a_2 800×, *b* 260×.

Euastrum occidentale var. *danicum* was found only in a few specimens in Nors Sø on August 18th, 1939 (legit Sigurd Olsen). At this time the plankton of the lake consisted of a myxophycean association characterized by *Ana-*

baena flos aquae and *Microcystis flos aquae* var. *major*; the qualitative composition of the association appears from Table II.

Nors Sø is slightly eutrophic, the compound quotient reaching the following values during a series of years: $\frac{27}{12} = 2.25$, $\frac{22}{10} = 2.2$, $\frac{16}{8} = 2$, $\frac{11}{5} = 2.2$ and $\frac{24}{12} = 2.0$, the last-mentioned value applying to August 18th, 1939. Though the lake is situated on cretaceous bottom, its content of CaO is only 43.1—52 mg/l. The found pH values range between 7.3 and 8.3 (NYGAARD 1938, p. 605, BOYE PETERSEN 1943, p. 23).

Arthrodesmus incus Hass. var. **extensus** Andersson.

ANDERSSON (BORGE) 1890, p. 13, t. 1, fig. 7; BORGE 1913, p. 25, t. 2, fig. 23. *Fig. nostra 33.*

Systematics. In the original description BORGE states: Longitudo 17—20 μ, latitudo 13—14 μ. His fig. 23 (quoted above) shows the following measurements:

	BORGE's fig. 23 (1 ind. measured)	Grovsø (8 ind.s measured)	Turf pit NE. of Skaansø; B. Mose II and L. Gribsø (13 individuals measured)	
Long. cum spin.	32 —33 μ	27 —36 μ	18.5—30 μ	19 —25 μ
Long. sine spin.	19 μ	18.5—21 μ	12 —16 μ	13.5—15.5 μ
Lat. cum spin.	31 —32 μ	34 —42 μ	18 —30 μ	23 —32 μ
Lat. sine spin.	14 —15.5 μ	13 —16.5 μ	11 —14.5 μ	11 —14 μ
Long. spin.	10.5—13 μ	13 —16 μ	4.5—11 μ	8 —10 μ
Lat. isthmi	5 μ	5 — 6.5 μ	5 — 6 μ	5 — 6 μ
Crassitudo	..	6 — 7 μ	..	..

It appears from this table, in which the 3rd vertical column is from the turf pit NE. of Skaansø while the last vertical column represents Bøndernes Mose II and Lille Gribsø, and from *Figurae nostrae* 31 and 32 that the specimens from turf pit NE. of Skaansø, Bøndernes Mose II and Lille Gribsø may be regarded as f. *minor* n. f. while the specimens from Grovsø are probably identical with var. *extensus* though their spines are longer and apex is flat. Incidentally, both form and variety are found in Grovsø though f. *minor* is very rare; no transition forms between f. *minor* and var. *extensus* were observed.

f. **minor** n. f.

Fig. nostra 34.

A varietate cellulis et spinis brevioribus differt; longitudo sine spinis 12—16 μ, cum spinis 18.5—30 μ, latitudo sine spinis 11—14.5 μ, cum spinis 18—32 μ, latitudo isthmi 5—6 μ, longitudo spinarum 4.5—11 μ.

Hab. In stagno turfaceo prope Skaansø, Jutlandia, et in Bøndernes Mose II et Lille Gribsø prope Hillerød, Dania, libere natans.

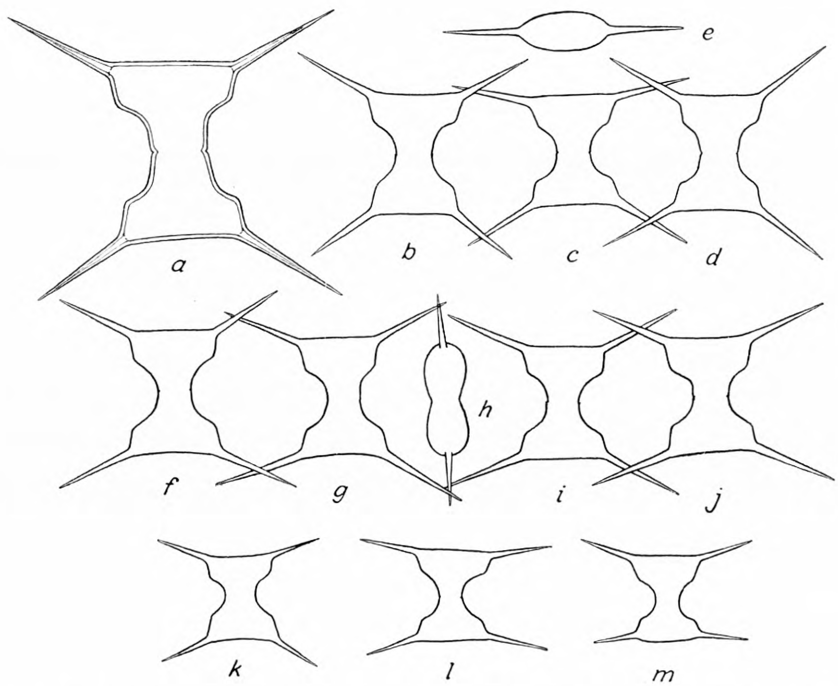

Fig. 33. *a—j*: *Arthrodesmus incus* Hass. var. *extensus* Anderss. from Grovsø, June 27th, 1930; *k—m*: f. *minor* n. f. from the same locality and date. *e* vertical view, *h* lateral view, the other figures front views. *a* 1200 ×, *b—m* 800 ×.

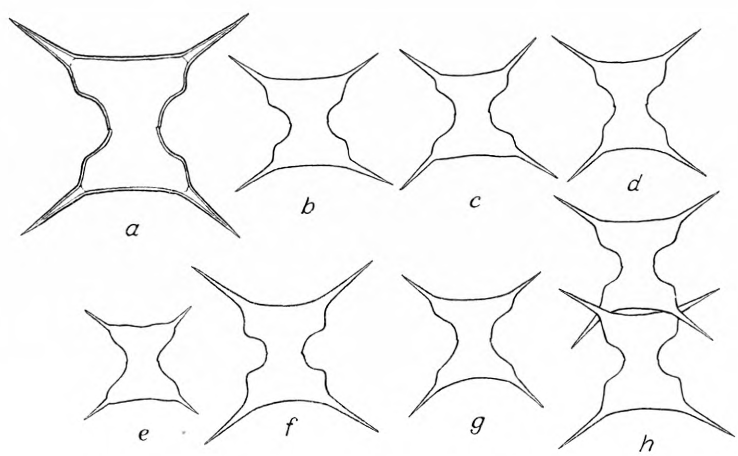

Fig. 34. *Arthrodesmus incus* Hass. var. *extensus* Anderss. f. *minor* n. f.; *a—d* from Bøndernes Mose II, June 18th, 1929; *e—h* from turf pit NE of Skaansø, July 4th, 1938. *a* 1200 ×, *b—h* 800 ×.

Periodicity. In Bøndernes Mose II var. *extensus* f. *minor* occurred from June till the beginning of October 1929 at temperatures between 9.5 and 24° C. It was always very rare except in the sample from August 12th, (temp. 21.5° C.) in which it was rare. During the remaining months of the year it was not found and therefore seems to be meso- to polythermic.

In Lille Gribsø, which was also examined regularly, it was extremely rare: only a few specimens were seen on July 5th, 1929 (temp. 18° C.). In the turf pit NE. of Skaansø, which was nearly overgrown with *Sphagnum cuspidatum*, the form was rare on July 4th, 1938 (temp. 18.5° C.).

In Grovsø var. *extensus* was the dominant form of the plankton on June 27th, 1930 (temp. 18° C.).

Sociology. Var. *extensus* f. *minor* was found in the following associations:

Bøndernes Mose II.

June 18th, 1929 July 5th, — — 17th, — Aug. 12th, — — 22nd, — Sep. 7th, — — 22nd, —	*Crym ov cu*-association (form very rare; Aug. 12th, rare).
Oct. 9th, — June 16th, 1930	*Crym ov cu*-association with *Tra vo* as subdominant (form very rare).

Turf pit NE. of Skaansø.

July 4th, 1938: *Sta br*-association with *Sta de lo* as subdominant (form rare); see Table IV.

Lille Gribsø.

July 5th, 1929: *Se ca*-association with *Se We* as subdominant (form very rare).

Var. *extensus* was found in the following association:

Grovsø.

June 27th, 1929: *Ar in ex*-association (the variety common and the form very rare); see p. 60.

Arthrodesmus incus var. *extensus* f. *minor* thus occurred in cryptophycean associations of *Cryptomonas*, desmid associations of *Staurastrum* and *Arthrodesmus* and a chlorophycean association of *Selenastrum*. Var. *extensus* itself may be a dominant organism.

The most constant associates were *Cryptomonas ovata* var. *curvata*, *Goniostomum semen*, *Staurastrum dejectum* and *Trachelomonas volvocina*, which occurred in 75 $^0/_0$ of the number (12) of samples that contained *Arthrodesmus incus* var. *extensus* f. *minor*.

Ecology. Bøndernes Mose II and the turf pit NE. of Skaansø are small, very lime-deficient, oligotrophic turf pits of the dystrophic phase, and Lille Gribsø is a likewise very lime-deficient, but clear, 'mesotrophic' little forest lake; the phytoplankton quotients of these three localities are found in Table III. Grovsø is discussed on p. 60. A few data from the ecology of *Arthrodesmus incus* var. *extensus* f. *minor* are: pH 4.2—5.4, CaO (2.2—)2.9 mg/l, consumption of $KMnO_4$ 166—202 mg/l (in Lille Gribsø 38 mg/l on August 22nd, 1929), contents of PO_4-P 0 mg/l, NH_3-N 0.9—1.25 mg/l (in Lille Gribsø 0.1 mg/l on August 22nd, 1929), NO_3-N 0 mg/l and Fe 0.25 mg/l.

Arthrodesmus incus var. *extensus* was found at the pH value 5.4.

Staurastrum barbulae n. sp.

Fig. nostra 35.

Diagnosis. Cellulae mediocres; longitudo cum processibus paulo minor quam latitudo cum processibus; sinus extrorsum valde ampliatus, apice acuto. Corpus semicellulae cyathiforme vel subcylindricum, margine dorsali plano; anguli in processus longos, valde divergentes, rectos vel leviter curvatos, perspicue dentatos, terminaliter quadri- vel quinquecuspidatos extenuantes, quisque processus seriebus dentium 9—11 ordinatus. Anulus granulorum vel spinarum minimarum in utraque parte isthmali semicellulae. Cellulae a vertice visae triangulares, lateribus corporis concavis, raro rectis vel leviter convexis. Apex semicellulae cum 3 spinis intramarginalibus, robustis, ad 2.5 μ longis, vel 3 seriebus intramarginalibus spinarum quinarum minorum ordinatus; saepe spinae singulae vel binae reliquis robustiores, quae valde defectae esse possunt. Longitudo sine processibus 37—39 μ, cum processibus 59—69 μ, latitudo cum processibus 67.5—77 μ, latitudo isthmi 9—10 μ.

Hab. In Mørksø et Skaansø, Jutlandia boreali, Dania, libere natans.

Systematics. To begin with I considered the individuals to be triradiate forms of *Staurastrum leptocladum* Nordstedt (see G. M. Smith 1924, p. 102, t. 78, figs. 1—7; W. and G. S. West 1895, p. 79, t. 9, figs. 12—13). This species, quite apart from its being always biradiate, differs from the present specimens in having 11—19 denticulations on its very long arms, which always terminate in 2 spines, and in showing a pronounced inflation of the isthmal part of the body of the semicell and a distinct convexity of the dorsal part.

As will appear from *Fig. nostra* 35 there is a considerable variation in the apical ornamentation: there are all transition forms between the two extremes, the 3 strong, intramarginal spines situated in the 3 symmetry planes and the 3 intramarginal series with about 5 spines in each.

Staurastrum barbulae should also be compared with *Staurastrum Sebaldii* var. *ornatum* forma Grönblad (1942, p. 42, t. 5, fig. 10), which has an apical ornamentation of spines much like that of certain individuals within the form cycle of *Staurastrum barbulae*. GRÖNBLAD's form, however, is much more robust: length and breadth

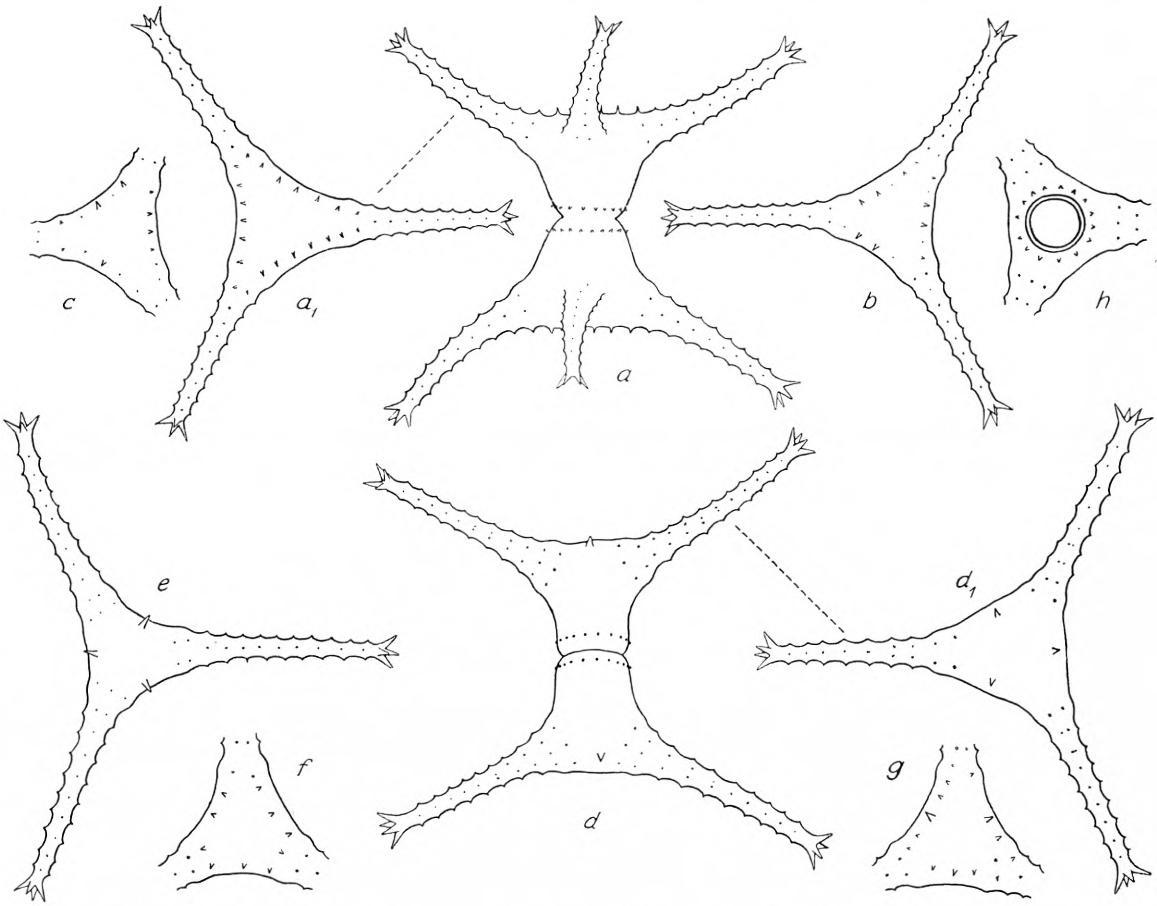

Fig. 35. *Staurastrum barbulae* n. sp.; *a*, a_1, *b* and *c* from Mørksø, July 6th, 1938; *d*, d_1, *e*, *f*, *g* and *h* from Skaansø, July 4th, 1938. *a* and *d* front views; the other figures vertical views with exception of *h*: basal view. 800 ×.

with processes 122 and 137 μ, respectively; breadth of isthmus 23 μ; besides this the isthmal granulation is quite different. The processes, which are dentate on the dorsal side only, are strongly tapering from the proximal to the distal part while the processes of *Staurastrum barbulae* with their dentation on all sides are slightly tapering from the base to the top.

Staurastrum cingulum G. M. SMITH and its varieties have quite another apical ornamentation and the sides of the body (seen in vertical view) are undulate or dentate.

Periodicity. The species was found only in the beginning of July, 1938 (temp. 17.5—18° C.) in the two lakes mentioned. It was rare in both samples, and nothing can be said about the periodicity of the species on this basis.

Sociology. The species occurred in the following associations, the qualitative composition of which appears from Table IV:

Skaansø, July 4th, 1938: *Din cy pa*-association (the species very rare).
Mørksø, — 6th, — : *Per Wi*-association (the species very rare).

In other words *Staurastrum barbulae* was found in a *Dinobryon* association and a *Peridinium* association.

Ecology. Both Skaansø and Mørksø are oligotrophic lakes, the former on open heath, the latter surrounded by spruce forest; Table III gives their phytoplankton quotients. The compound quotient was $\frac{4}{10} = 0.4$ and $\frac{2}{4} = 0.5$, respectively. pH was 5.6 in Skaansø, 4.9 in Mørksø.

Staurastrum Bergii n. sp.

Fig. nostra 36.

Diagnosis. Cellulae mediocres, longitudine aequale ac est latitudo sine spinis, profunde constrictae, sinu acutangulo, extrorsum modice ampliato. Semicellulae a fronte visae concinne ellipticae vel subellipticae cum margine ventrali convexiore quam est margo dorsalis; anguli in processus brevissimos vix protracti vel prorsus sine processibus; quisque angulus 4 spinis divergentibus, rectis instructus; margo dorsalis semicellulae 6 vel 8 verrucis parvis, applanatis, emarginatis instructus; ab quaque verruca series una verticalis granulorum parvorum, acutorum exit, quae isthmum semicellulae fere attingit. Semicellulae a vertice visae triangulae cum lateribus rectis vel leviter concavis, 6- vel 8-denticulatis et undique serie una 6 vel 8 verrucarum intramarginalium, parvarum instructae; ab quaque verruca series una radialis granulorum parvorum et acutorum exit; medium semicellulae glabrum; anguli in processus brevissimos vix producti vel prorsus sine processibus, sed 4 spinis rectis, divergentibus ordinati. Semicellulae a basi visae cum 3 vel 4 seriebus concentricis granulorum parvorum et acutorum in quoque tri-

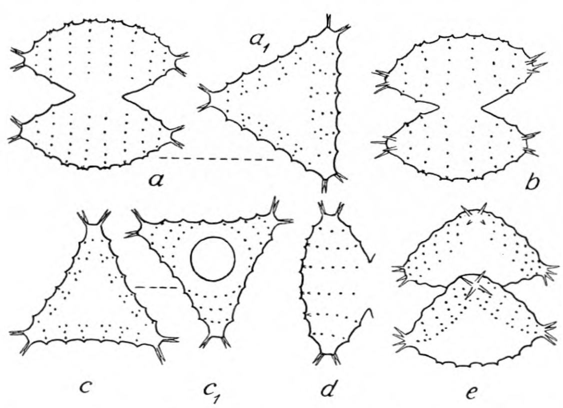

Fig. 36. *Staurastrum Bergii* n. sp. from Eriophorum moor, July 9th, 1947. *a*, *b* and *d* front views, a_1 and *c* vertical views, c_1 basal view. 800×.

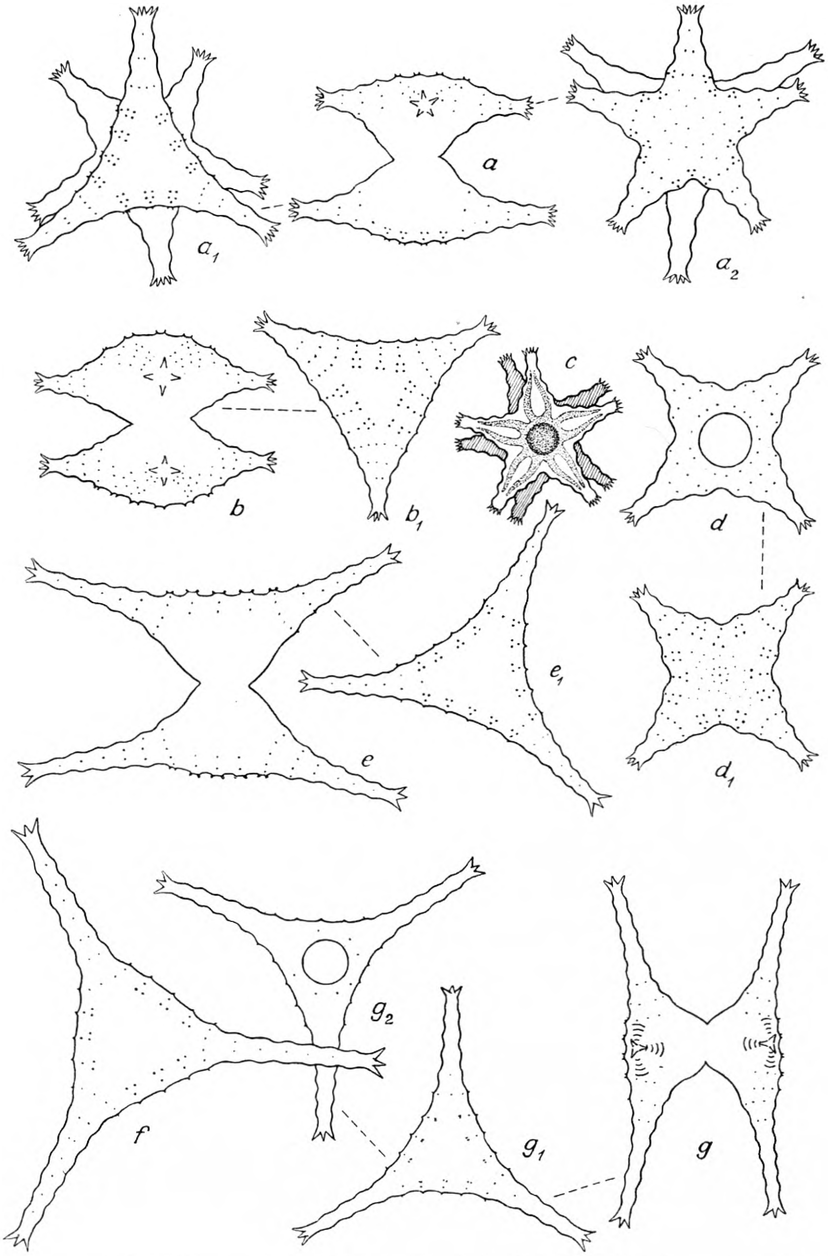

Fig. 37. *Staurastrum gracile* Ralfs; *a*, a_1, a_2, *b*, b_1, *c*, *d* and d_1 from Sortedam II, *a*, a_1 and a_2 demonstrate a 3-+5-radiate specimen, *b* and b_1 a 3-radiate, *c* a 5-radiate specimen, all from September 18th, 1929, *d* and d_1 demonstrate a 4-radiate specimen from June 8th, 1929; *e* and e_1 from Mossø, August 18th, 1929; *f* from Salten Langsø, August 19th, 1929; *g*, g_1 and g_2 from Slaaen Sø, September 4th, 1929; *a*, *b*, *e* and *g* front views, a_1, a_2, b_1, *c*, d_1, e_1, *f* and g_1 vertical views, *d* and g_2 basal views. All figures 800× except *c*, 560×.

ente semicellulae. Longitudo cellularum 22.5—25 μ = latitudo sine spinis, latitudo isthmi 7—8 μ, longitudo spinarum 2—3 μ.

Hab. In palude *Eriophori* prope Sorø, Selandia, Dania, libere natans.

Systematics. For our undergraduates' curriculum in 1947 Professor Kaj Berg on July 9th took a plankton sample, which was unique by its richness in both species and individuals of *Desmidiaceae*. Among other things it contained enormous quantities of a *Staurastrum* species, which I have named after Professor Berg. The species has an ornamentation that is much like that of *Staurastrum gracile* (see *Fig. nostra* 37). In Sortedam II, where *Staurastrum gracile* occurs in tri-, quadri- and quinqueradiate forms, even as tri- + quinqueradiate individuals (cp. Grönblad 1942, p. 41, t. 4, figs. 21—22), the triradiate specimen pictured (*Fig. nostra* 37 b—b_1) has the same ornamentation and shape of semicell as *Staurastrum Bergii*, but it has distinct arms.

Staurastrum hexacerum Wittr. (see W. and G. S. West's Monograph, vol. 5 by Nellie Carter, 1923, p. 138, t. 142, figs. 11—14), however, has very short arms and nearly the same dimensions as *Staurastrum Bergii*, but its cells are broader than long and have 5—6 concentric series of granules round each third of the semicell, no emarginate verrucae on the apex and only 3 tiny spines on the end of each of the very short arms.

Periodicity. As will appear from the section on sociology *Staurastrum Bergii* reached a great maximum on July 9th, 1947. During the following months it constantly decreased in frequency and was seen for the last time in the October sample. On March 20th, 1948 it had not yet reappeared; the species thus seems to be a typical summer form.

Sociology. The species occurred in the following associations:

July	9th,	1947:	*Sta Be*-association with *Dic pu* as subdominant (the species very common).
Aug.	6th,	— :	*Tra ch*-association (the species rather common).
Sep.	6th,	— :	*Tra ch*-association (the species not infrequent).
Oct.	4th,	— :	*Tra*-association (the species very rare).

On October 4th the dominant species were *Trachelomonas Manginii*, *Tr. intermedia*, *Tr. volvocina* and its var. *compressa*, *Tr. hispida* var. *coronata*, *Tr. bernardinensis*, etc.

Ecology. The species, which was often surrounded by a roundish gelatinous envelope, is no doubt tychoplanktic. A comment on the characteristic locality, in which it occurred, is given under *Euglena phacoides* n. sp. on p. 166. The water of the margin is brownish and slightly acid (pH 6.5—6.8), but contaminated by cattle.

Staurastrum Bieneanum Rabh. var. **angulatum** nov. var.

Fig. nostra 37 *bis.*

Diagnosis. A typo semicellulis non-punctatis, angulatioribus, angulariter rotundatis differt; cellulis vix longioribus quam latioribus. Longitudo cellularum 42—45 μ, latitudo 39—43 μ, latitudo isthmi 10—12 μ.

Hab. In Jægerbakke Dam in Hillerød, Dania, libere natans.

Systematics. *Staurastrum Bieneanum* Rabh. (see the Wests' monograph IV, p. 135, t. 120, figs. 4—6) has a distinctly punctate cell-wall and the angles of both front and vertical views are subacute, the dorsal margin is rather regularly convex (but truncate or slightly retuse in the middle). The new variety differs in all these respects as evident from Fig. 37 *bis*; especially the apical part of the semicell is more or less trapeziform. Some of the Danish specimens have angles a little more acutely rounded than shown in Fig. 37 *bis a*, but never so much as in the cited fig. 4 b in the Wests' monograph.

E. Messikommer (1927, II, t. 1, fig. 13) has figured *Staurastrum Bieneanum* var. *ellipticum* Wille. This variety, however, has punctulations arranged in concentric series around the angles; further the semicells are subelliptic in front view. Messikommer's and my individuals are very similar in vertical view, but not in the shape of the dorsal margin in front view; besides the Swiss specimens are irregularly punctate.

The variety was found in small quantities (6 cells pro 5 ml) in Jægerbakke Dam on November 25th, and December 4th, 1944. The pond was icebound and the temperature of the water 2° C. I am indepted to professor C. Wesenberg-Lund and professor Kaj Berg for sending me plankton and water samples from the two dates mentioned.

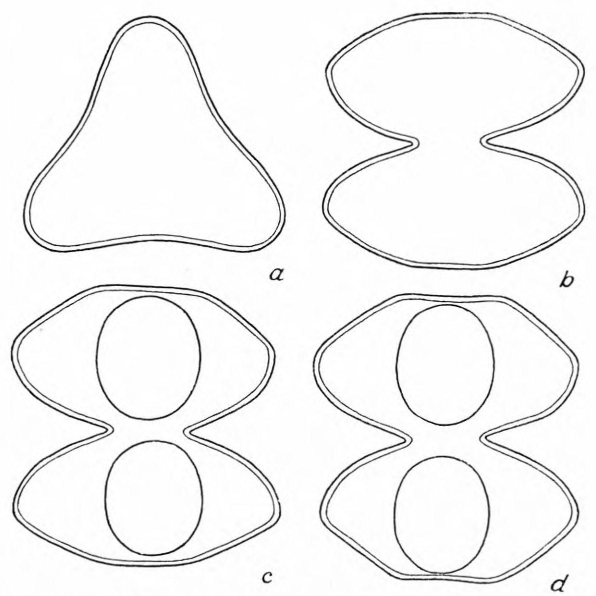

Fig. 37 *bis*. *Staurastrum Bieneanum* Rabh. var. *angulatum* nov. var. from Jægerbakke Dam, November 25th, 1944; *a* vertical view, *b*—*d* front views. 800×.

It is peculiar to find this desmid in Jægerbakke Dam since it was never observed by the regular examination every fortnight during the period of June 1929 to June 1930. Further it is peculiar that a pelagic desmid occurs so late as in December when ponds are freezing up. The net plankton was quite dominated by *Eudorina elegans*, though *Gonium sociale* and *Volvox aureus* also played a rather prominent part; the latter, too, has never been observed previously in Jægerbakke Dam. The real dominant was, however, *Geminella minor* which occurred in enormous quantities in the water sample; it had apparently passed through the pores of the tow-net.

Staurastrum cingulum G. M. Smith var. **inflatum** nov. var.

Fig. nostra 38.

Diagnosis. Cellulae mediocres; longitudo cum processibus latitudine cum processibus aequilonga vel minor; cellulae profunde incisae, sinu aperto, sed intime acuto. Corpus semicellulae a fronte visum inflate poculiforme, lateribus convexis, apice perspicue vel valde convexo, 3—4 verrucis parvis ordinato; sub illis verrucis series obliquae vel verticales granulorum acutorum et minimorum; corpus saepe cum anulo isthmali granulorum minimorum; anguli superiores corporis in processus longos, tenues, 5—9-undulatos, valde divergentes, leviter incurvos, raro rectos abrupte producti sunt. Corpus semicellulae a vertice visum triangulum cum lateribus rectis vel vix convexis, tenuiter denticulatis, et cum 3 seriebus intramarginalibus verrucarum parvarum, rarissime spinarum vel granulorum bigeminorum, 3—4 pro serie; quisque angulus in processum longum, tenuem, 5—9-(rarissime 4-)undulatum, rectum productus, terminaliter 4 spinis parvis et divergentibus instructus. Longitudo sine processibus 20—28 μ, cum processibus 35.5—53 μ, latitudo sine processibus 13.5—20 μ, cum processibus 36—69 μ, latitudo isthmi 6—8 μ.

Hab. In Mossø, Salten Langsø et Hostrup Sø, Jutlandia, et Frederiksborg Slotssø, Selandia, Dania, libere natans.

Systematics. The fact that the sides of the body in vertical view are denticulate on account of the radial series of granules centering in the small verrucae on apex and the occurrence of a basal ring of acute granules shows that the individuals are closely related to *Staurastrum cingulum* (see G. M. Smith 1924, p. 84, t. 72, figs. 12—14). The 3 verrucae of each series in small individuals may be reduced into one central spine + 2 granula bigemina (see *Fig. nostra* 38). The present variety is characterized by its inflated, nearly round bodies of semicell and by the abrupt transition between the body and the thin, highly divergent processes, which are not denticulate but undulate both in front view and vertical view.

There is no small likeness between *Staurastrum cingulum* var. *inflatum* and *Staurastrum tetracerum* var. *validum* West (Monograph, vol. V, 1923, t. 149, fig. 5), which apparently has a *cingulum* granulation, cp. Nygaard 1945, t. 4, fig. 59. By medium magnification I once observed a var. *inflatum* individual, one semicell of which was bibrachiate while the other was triradiate. The sparse material, however, does not allow us to decide whether or not *Staurastrum tetracerum* var. *validum* is only a bibrachiate modification of *Staurastrum cingulum* var. *inflatum*.

Periodicity. In the three lakes Hostrup Sø, Salten Langsø and Mossø (all in Jutland) the variety occurred in very small quantities in June and August. In the regularly examined lakelet Frederiksborg Slotssø, where it was also very rare in all

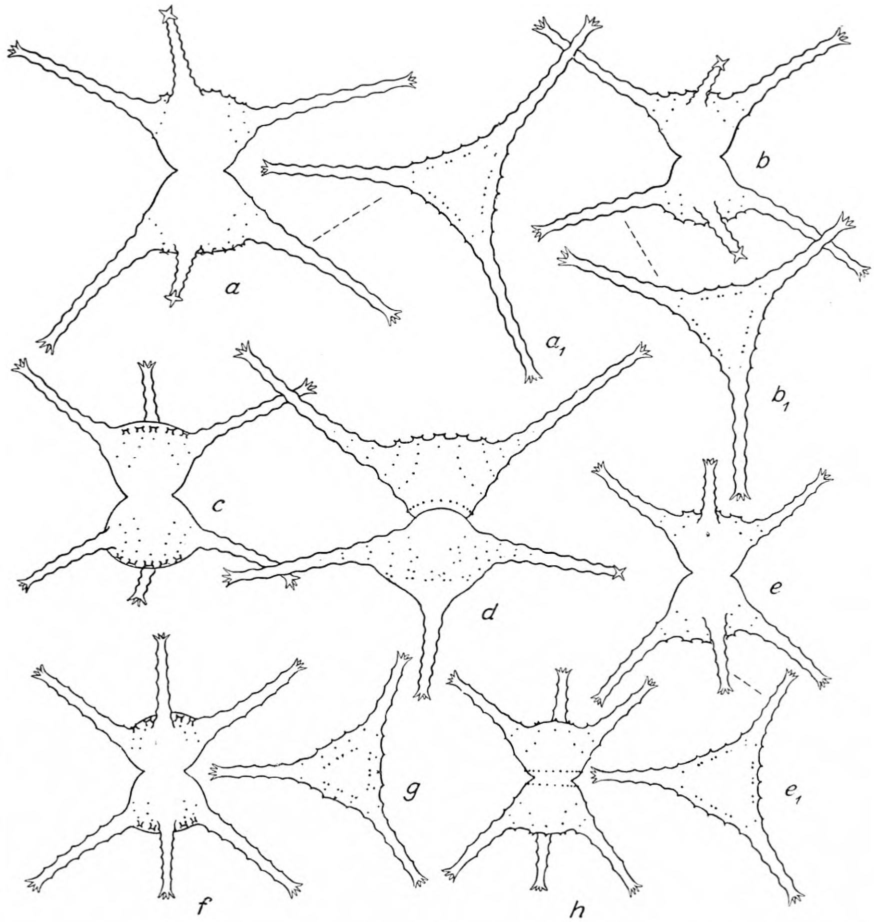

Fig. 38. *Staurastrum cingulum* G. M. Smith var. *inflatum* n. var.; a—a_1 from Salten Langsø, August 19th, 1929; b, b_1, c and d from Mossø, August 18th, 1929; e—e_1 from Hostrup Sø, June 23rd, 1925; f, g and h from Frederiksborg Slotssø, July 3rd, 1929. a, b, c, e, f and h front views, d oblique front view, a_1, b_1, e_1 and g vertical views. 800 ×.

samples containing it (in July, rare) the variety was observed between April and November at temperatures between 3.5 and 22° C., but not during the rest of the year.

Staurastrum cingulum var. *inflatum* thus seems to be periodical and eurythermic with a vegetation period during the warm half of the year. A distinct maximum was not observed.

Sociology. The variety was found in the following associations:

Hostrup Sø.

June 23rd, 1925: *Api fl*-association with *Coo Nä* as subdominant (the variety rare); see Table II.

Salten Langsø.

Aug. 19th, 1929: *Ste As-Mio aer ma*-association with *Api fl*, *Mel am*, *Mio fl ma* and *Mio pu* as subdominants (the variety very rare); see Table II.

Mossø.

Aug. 18th, 1929: *Api fl-Mio aer ma*-association with *Mio vi* and *Ste As* as subdominants (the variety very rare); see Table II.

Frederiksborg Slotssø.

June 11th, 1929: net plankton, *Ana in*-association with *Mio fl* + *Mio fl ma* as subdominants (see Table IV; the variety very rare). Nannoplankton, *Sce arm*-association (see Table IV; the variety very rare).

July 3rd, — : *Ana fl*-association with *Mio fl* and *Os Ag* as subdominants (the variety rare).

Aug. 21st—24th, 1929: *Os Ag*-association with *Sce arm* as subdominant (the variety very rare).

Sep. 2nd—6th, 1929: *Os Ag*-association with *Mio pu ra* as subdominant (the variety very rare).

Oct. 3rd—5th, 1929: *Os Ag*-association with *Mio pu ra* as subdominant (the variety very rare).

Oct. 22nd—25th, 1929: *Mio pu ra*-association with *Os Ag* and *Sce arm* as subdominants (the variety very rare).

Nov. 21st, 1929: *Sce arm*-association with *Mio pu ra* as subdominant (the variety very rare).

Apr. 22nd—25th, 1930: *Ste Ha*-association with *Sce arm* as subdominant (the variety very rare).

May 10th—13th, 1930: *Sce arm*-association with *Ste Ha* as subdominant (the variety very rare).

June 16th, 1930: *Sce arm*-association (the variety very rare).

In the great majority of cases *Staurastrum cingulum* var. *inflatum* occurs in associations of blue-green algae (*Aphanizomenon*, *Anabaena*, *Oscillatoria* and *Microcystis*), which incidentally constitute a great part of some of the following associations: diatom associations (*Stephanodiscus*) and green algae (*Scenedesmus*).

The most constant associates were *Microcystis flos aquae*, *Microcystis holsatica*, *Coelosphaerium Nägelianum* and *Dictyosphaerium pulchellum*, which were found in 100 % of the number (13) of samples that contained *Staurastrum cingulum* var. *inflatum*. *Microcystis aeruginosa* var. *major* and *Pediastrum Boryanum* (with varieties) occurred in 92 % of the samples; *Microcystis flos aquae* var. *major*, *Anabaena flos aquae*, *Melosira granulata* and *Scenedesmus armatus* in 85 % and *Microcystis minutissima*, *Microcystis pulverea* var. *racemiformis*, *Microcystis viridis*, *Oscillatoria Agardhii*, *Stephanodiscus Hantzschii*, *Oocystis Marssonii* and *Pediastrum duplex* in 77 % of the samples.

It appears from this that *Staurastrum cingulum* var. *inflatum* sociologically is a most characteristic Desmid. Very few other *Staurastrum* species occur in associations that are pre-eminently dominated by blue-green algae, and the constant associates of which in the great majority of cases are also blue-green algae, particularly *Microcystis* species.

Staurastrum cingulum var. *inflatum* thus seems to be a decidedly characteristic form of eutrophic waters. As a *Staurastrum* species it is moreover interesting by the fact that it is able to thrive in contaminated water.

Ecology. All the lakes containing *Staurastrum cingulum* var. *inflatum* are decidedly eutrophic, only the rather lime-deficient Hostrup Sø of the mixotrophic phase. As will appear from Tables I and III the compound quotient for Mossø was $\frac{35}{6} = 5.8$ on August 18th, 1929, for Salten Langsø $\frac{35}{4} = 8.75$ on August 19th, 1929 and for Hostrup Sø $\frac{32}{6} = 5.3$ on June 23rd, 1925. In accord with the fact that its water is somewhat contaminated the small lake Frederiksborg Slotssø reached slightly higher values of the compound quotient: on June 11th, 1929 $\frac{24}{3} = 8$ for the net plankton and $\frac{36}{4} = 9$ for the nannoplankton; on September 23rd, 1929 $\frac{40}{4} = 10$.

A few other data of the ecology of *Staurastrum cingulum* var. *inflatum* are: pH 7.6—9.4, CaO about 12—71 mg/l, consumption of $KMnO_4$ 39—53 mg/l, contents of PO_4-P 0.005—1.5 mg/l, NH_3-N 0.1—1.25 mg/l, NO_3-N 0—0.25 mg/l and Fe 0.01 mg/l.

Staurastrum cingulum G. M. Smith var. **obesum** G. M. Smith.

1922, p. 354, t. 12, figs. 3—5.—*Fig. nostra* 39 *a*—a_1, *b*—b_1 and *d*.

The Danish individuals had ± highly divergent arms tipped with 4 or 5 small spines. Vertical view triangular with sides of cell body slightly concave and always denticulate; cell body with an intramarginal row of granula bigemina (= the verrucae in front view); from each of these pairs of granules a row of granules always proceeds at right angles to the sides of the cell body. Length with processes 39—59 μ, without processes 31.5—37 μ, breadth with processes 59—71 μ, breadth of isthmus 8.5—10 μ.

Distribution: In the plankton of Tissø and Hampen Sø.

Systematics. In G. M. Smith's specimens the verrucae were apparently reduced into simple, acute granules. Among the observed, verrucate individuals of var. *obesum* in the plankton of Tissø, however, I found a single specimen (*Fig. nostra* 39 *c*) that should undoubtedly be referred to var. *tortum* G. M. Smith; its breadth with processes was 54—58 μ.

Periodicity. *Staurastrum cingulum* var. *obesum* was found only on September 23rd, 1929 in Hampen Sø and on July 13th, 1929 in Tissø. In both samples it was very rare.

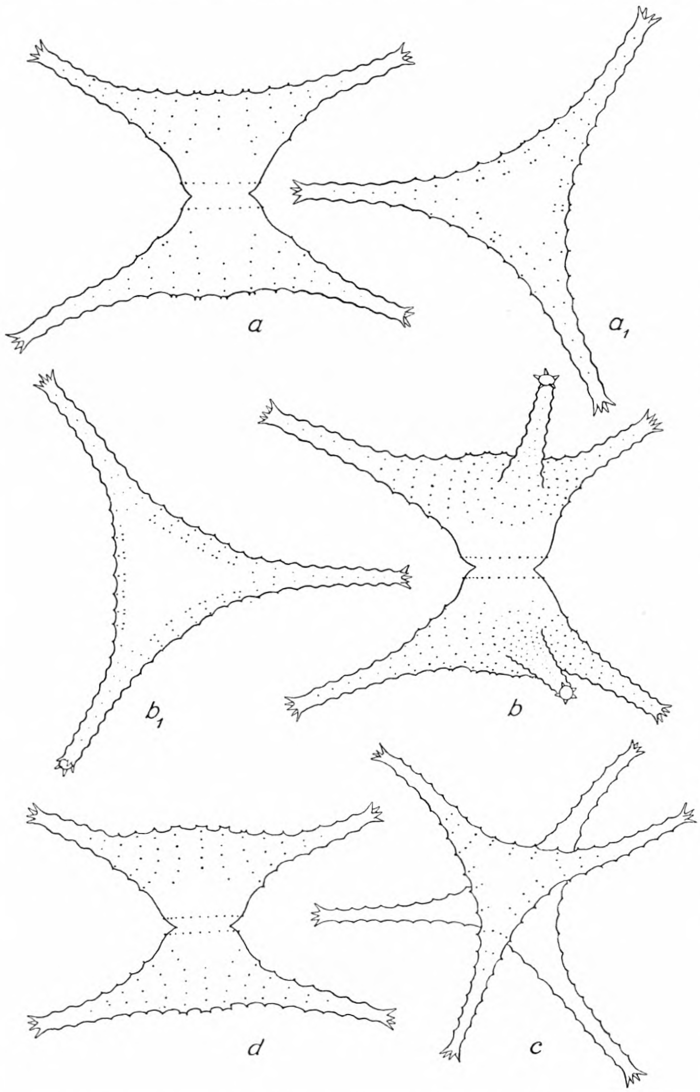

Fig. 39. *Staurastrum cingulum* G. M. Smith; *a*, a_1, *b* and b_1 var. *obesum* G. M. Smith from Tissø, July 13th, 1929; *d* var. *obesum* from Hampen Sø, September 23rd, 1929; *c* var. *tortum* G. M. Smith from Tissø, July 13th, 1929. *a*, *b* and *d* front views, a_1, b_1 and *c* vertical views. 800 ×.

Sociology. The variety was found in a *Ta fe-Ana Ha ma*-association and an *Asi fo - Mel gr*-association, respectively. The qualitative composition of these two associations is given in Table II.

Ecology. Hampen Sø is a clear, oligotrophic lake; Tissø a large, typically eutrophic lake. Their phytoplankton quotients are found in Table I; the compound quotients in Hampen Sø reached the values $\frac{6}{13} = 0.5$, $\frac{2}{5} = 0.4$, $\frac{5}{10} = 0.5$ and $\frac{9}{13} = 0.7$, in Tissø the values $\frac{40}{8} = 5$ and $\frac{26}{6} = 4.3$. In Hampen Sø a few analyses for lime gave the values 4—6.5, in Tissø 107.8—125.6 mg CaO per litre.

Staurastrum cingulum var. *obesum* was found at the pH values 7.2 and 8.4, contents of PO_4-P 0 mg/l, NH_3-N 0.1 mg/l, and NO_3-N 0 mg/l.

Staurastrum Smithii

Teiling

var. **verrucosum** nov. var.

Fig. nostra 40.

Diagnosis. A typo in hoc modo differt: corpus semicellulae a vertice visum 4 verrucis parvis instructum, duabus in utroque latere. Processus 8—14 denticulis et 3 vel 4 spinis terminalibus ordinatus. Longitudo cum processibus 62—68 μ, sine processibus 13—16 μ, latitudo cum processibus 54—70 μ, latitudo isthmi 6—7.5 μ, crassitudo 8—9 μ.

Hab. In Tissø, Selandia, Dania, libere natans.

In 1921 GRÖNBLAD (p. 61, t. 5, figs. 31—32) described a *Staurastrum tetracerum* var. *biverruciferum*. This variety differs from *Staurastrum tetracerum* by the same characteristics as var. *verrucosum* from *Staurastrum Smithii* (G. M. SMITH 1924, p. 98,

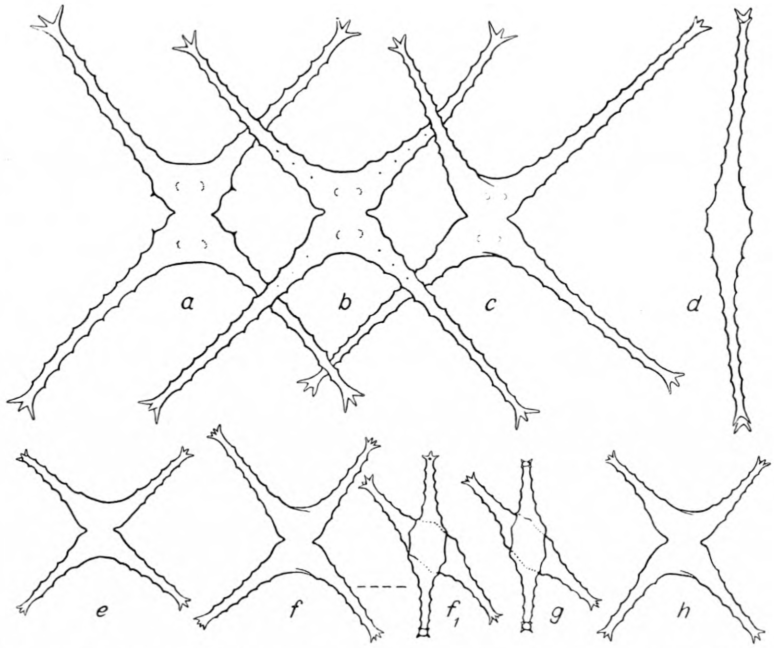

Fig. 40. *a—d*: *Staurastrum Smithii* Teiling var. *verrucosum* n. var. from Tissø, August 10th, 1927, and July 13th, 1929; *a—c* front views, *d* vertical view, 800 ×. *e—h*: *Staurastrum tetracerum* Ralfs var. *biverruciferum* Grönbl. from Blankeborg I, August 18th, 1928; *e*, *f* and *h* front views, f_1 and *g* vertical views, 800 ×.

t. 76, figs. 17—20, sub nomine *St. contortum* Smith). The last mentioned species has up to 10 denticulations per process, var. *verrucosum* 8—14 denticulations. *Staurastrum tetracerum* and its varieties have only 4—6 denticulations per process.

The variety was found in the plankton of Tissø on August 10th, 1927 and on July 13th, 1929; in both samples it was rare.

It occurred in a *Ly li*-association with *Os Ag* as subdominant and in an *Asi fo-Mel gr*-association; the qualitative composition of these two associations appears from Table II.

Tissø is a typically eutrophic, large lake, the phytoplankton quotients of which are found in Table I; on the two dates mentioned the compound quotient was $\frac{40}{8} = 5$ and $\frac{26}{6} = 4.3$. A few chemical data also appear from Table I; it remains to be added that *Staurastrum Smithii* var. *verrucosum* was found at the pH values 8.4 and 8.8, CaO 125.6 mg/l, PO_4-P 0 mg/l, NO_3-N 0 mg/l.

Staurastrum crenulatum Näg. var. **britannicum** Messik.

Messikommer 1927, p. 107, t. 5, fig. 8, t. 6, figs. 1—2; 1943, t. 15, fig. 3.

Forma 1 (*Fig. nostra* 41). Corpus semicellulae a fronte visum subfusiforme, margine ventrali convexiore quam est margo dorsalis, cum processibus crassis, brevibus, parallelis, 2—3-undulatis, terminaliter cum 4 spinis; a basi visum cum 6 spinis isthmalibus; a vertice visum triangulatum, cum lateribus laevibus atque cum 2 verrucis intra quodque latus. Quisque processus in parte proximali et dorsali cum 2 verrucis plusminusve longis et angustis, ceterum cum 1—3, saepe 2 seriebus con-

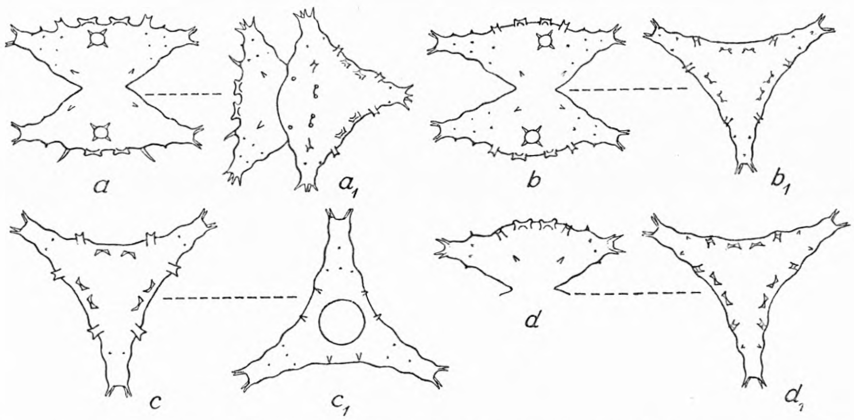

Fig. 41. *Staurastrum crenulatum* Näg. var. *britannicum* Messik. forma 1 from Blankeborg I, August 6th, 1929 (*c* and c_1, however, from August 18th, 1928). *a*, *b* and *d* front views, a_1 oblique front view, b_1, *c* and d_1 vertical views, c_1 basal view. 800×.

centricis granulorum parvorum. Longitudo cellularum 22—23 μ, latitudo 30—35 μ, latitudo isthmi 6.5—7 μ.

Hab. In Blankeborg I, Fionia, Dania, libere natans.

Forma 2 (*Fig. nostra* 42). Corpus semicellulae a fronte visum plusminusve cyathiforme cum apice plano vel convexo, raro subfusiforme, margine ventrali convexiore quam est margo dorsalis, cum processibus subangustis, brevibus vel mediocris, 4-undulatis, convergentibus vel parallelis, terminaliter cum 3 spinis; a basi visum cum 2—4 granulis isthmalibus et parvis apud basem cujusque processus; a vertice visum triangulatum, cum 2 (4) verrucis parvis vel 2 spinis intra quodque latus laeve. Quisque processus, cum 3—4 seriebus concentricis granulorum parvorum, raro inarmatus. Longitudo cellularum 16—23.5 μ, latitudo 24.5—40 μ, latitudo isthmi 4—5.5 μ.

Hab. in Blankeborg I, Fionia, Klitsø prope Højsande, Læsø, Vedsted Sø, Jutlandia meridionali, Furesø, Selandia, Dania, libere natans.

Systematics. To begin with I believed in the specimens of *Fig. nostra* 42 *d* to have found a new variety of *Staurastrum oxyacantha* Archer; however, renewed examinations proved that in certain individuals the spines were replaced by granula bigemina (Fig. 42 *a*) and in others (Fig. 42 *b*) there were both spines and granula bigemina on one and the same semicell.

In forma 1 the two characteristic, long verrucae at the basis of each arm may be transformed into long spines, as demonstrated in Fig. 41 *a*; but in this form I have never observed that the verrucae on the apex of the cell body may be transformed into spines.

The specimens from Blankeborg I (*forma* 2) measured 19—23.5 μ in length, 24.5—40 μ in breadth, 5—5.5 μ in breadth of isthmus.

The specimens from Vedsted Sø, Furesø and dune lake at Højsande measured 16—18 μ in length, 25—30 μ in breadth, 4—5 μ in breadth of isthmus.

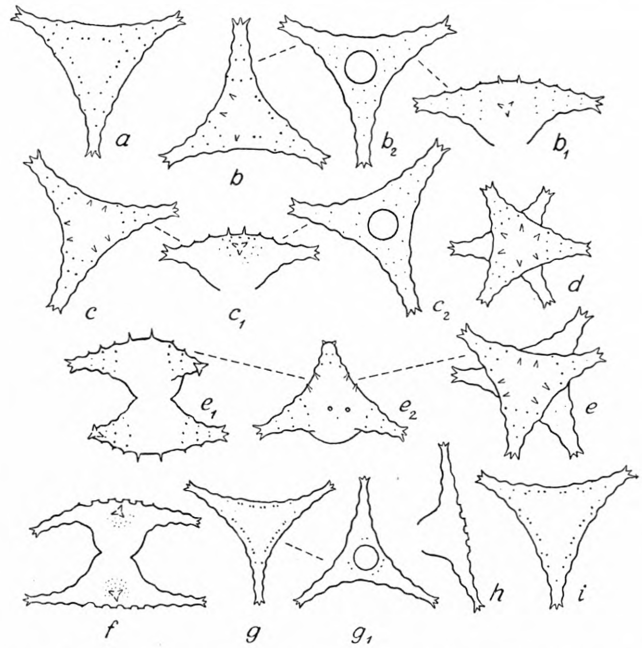

Fig. 42. *Staurastrum crenulatum* Näg. var. *britannicum* Messik. forma 2; *a*, *b*, b_1, b_2, *c*, c_1, c_2, *d*, *e*, e_1, e_2 and *i* from Blankeborg I, August 18th, 1928 (*i*, however, from August 6th, 1929); *f*, *g*, g_1 and *h* from Vedsted Sø, July 27th, 1926. *a*, *b*, *c*, *d*, *e*, *g*, and *i* vertical views, e_2 oblique vertical view, b_1, c_1, e_1, *f* and *h* front views, b_2, c_2 and g_1 basal views. All figures 800 × with exception of *d*, 430 ×.

So it seems that within the form cycle of *Staurastrum crenulatum* var. *britannicum* there exist at any rate 2 forms (possibly 3, including the one from Vedsted Sø, Furesø and dune lake at Højsande). However, I do not venture to characterize them as named forms because they are difficult to delimit and because intermediary forms apparently exist. Such a form was described and pictured by Grönblad (1920, p. 60, t. 3, figs. 62—63); this individual is quite like *forma* 2, but it has 6 isthmal spines like *forma* 1. From the material of the Sunda Expedition Krieger (1932, t. 19, fig. 10) further depicts a form that is quite like *forma* 1 though the 6 isthmal spines are lacking. However, it is not totally excluded that Krieger's form is identical with *forma* 1 because the isthmal spines are difficult to see if the contents of the cell are preserved. Compare also Messikommer 1928, p. 210, t. 9, fig. 18 (*Staurastrum oxyacantha*).

Periodicity. *Staurastrum crenulatum* var. *britannicum* was found only in June, July and August (temp. 16.5—19.5° C.) as will appear from the section on sociology. It was very rare in all samples.

Sociology. The species was found in the following associations:

Dune lake at Højsande.

June 30th, 1925: *Tsp Ny*-association with *El ge* as subdominant.

Vedsted Sø.

July 27th, 1926: *Ce hi si*-association with *Ana te lo* as subdominant.
— 2nd, 1927: *Ce hi si*-association.

Blankeborg I.

Aug. 16th, 1925: *Per Vo*-association with *Ce hi* as subdominant.
— 15th, 1926: *Ce hi*-association.
— 17th, 1927: net plankton, *Ce hi*-association; nannoplankton, *Cos pu - El ge bi*-association.
— 18th, 1928: net plankton, *Din di*-association; nannoplankton, association of an indeterminable green alga with *Mio mi* as subdominant.
— 6th, 1929: *Din di*-association.
June 10th, 1930: association of an indeterminable *Chrysophycea* with *Cyc co* and *Teë mi* as subdominants.

Furesø.

Aug. 21st, 1943: *Mel gr an*-association.

The qualitative compositions of all these associations appear from Tables II and IV. The species accordingly occurred in dinophycean associations of *Ceratium* and *Peridinium*, chlorophycean associations of *Elakatothrix*, *Tetraspora* and the Desmid *Cosmarium*, chrysophycean association of *Dinobryon* and a diatom association of *Melosira*.

The most constant associates were *Ceratium hirundinella*, which occurred in 100 $^0/_0$ of the number (12) of samples that contained *Staurastrum crenulatum* var. *britannicum*; *Oocystis Marssonii* occurred in 92 $^0/_0$ of the samples, *Botryococcus Braunii*, *Pediastrum Boryanum*, *Dinobryon divergens*, *Asterionella formosa* and *Glenodinium munusculum* in 75 $^0/_0$ of the samples.

Ecology. The dune lake at Højsande and Vedsted Sø are oligotrophic, oligohumic lakelets, Blankeborg I a slightly eutrophic turf pit of the mixotrophic phase while Furesø is a large, moderately eutrophic, oligohumic lake. The plankton quotients of these localities appear from Tables I and III. This very limited material seems to show that *Staurastrum crenulatum* var. *britannicum* is confined to oligotrophic—mesotrophic—moderately eutrophic waters, both small bodies of water and larger lakes.

Staurastrum crenulatum var. *britannicum* was found at pH values between 5.7 and 8.2, consumption of $KMnO_4$ 49—81 mg/l, NO_3-N 0 mg/l.

Furesø, however, is clear (14 mg/l of $KMnO_4$ observed), and the two oligotrophic lakes are even clearer. In Furesø the content of lime according to Brønsted

& Wesenberg-Lund (1912, p. 453) varied between 54.5 and 65.4 mg/l of CaO, and in Blankeborg I a couple of analyses gave the values 82.3 and 91 mg/l (Nygaard 1938, p. 671, 673). Both Vedsted Sø and particularly the dune lake at Højsande are undoubtedly much poorer in lime.

Staurastrum curvatum West f. **brevispina** n. f.

Fig. nostra 43.

A typo spinis brevioribus differt. Longitudo cellularum sine aculeis 19—28 μ, cum aculeis 30—44 μ, latitudo sine aculeis 23—28.5 μ, cum aculeis 35—42 μ, latitudo isthmi 6—8 μ, longitudo aculeorum 6.5—12.5 μ.

Hab. In Klitsø prope Højsande, Læsø, Dania, libere natans.

The form is characterized by its short spines, those of the main species being 20—23 μ long according to West and Carter (Monograph V, 1923, p. 19, t. 130, figs. 15—16). Moreover the spines of f. *brevispina* often seem to form right, sometimes even obtuse angles *inter se* (the cell seen in front view) whereas the spines apparently always form acute angles in the main species.

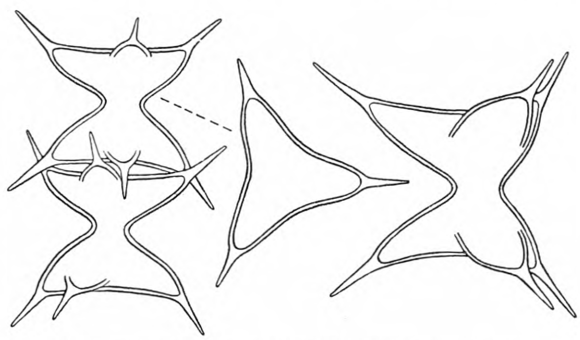

Fig. 43. *Staurastrum curvatum* West f. *brevispina* n. f. from Klitsø at Højsande, June 30th, 1925. 800×.

Only a few specimens of the form were observed in the oligotrophic dune-lake at Højsande on June 30th, 1925. As will be seen from Table III the compound quotient on this date was $\frac{15}{18} = 0.8$. The form occurred in a *Tsp Ny*-association with *El ge* as subdominant; its qualitative composition is given in Table IV.

Staurastrum cuspidatum Breb. var. **acuminatum** n. var.

Fig. nostra 44.

Diagnosis. A typo semicellulis (a fronte visis) latioribus, subfusiformibus vel raro subtriangularibus differt. Longitudo sine aculeis 28—34 μ, cum aculeis 29—51 μ, latitudo sine aculeis 30—39 μ, cum aculeis 58—73.5 μ, latitudo isthmi 5.5—6.5 μ, aculei recti, leviter incurvati vel recurvati, 14—24 μ longi sunt.

Hab. In Hampen Sø, Jutlandia, Dania, libere natans.

Systematics. In *Staurastrum cuspidatum* and its varieties (see West and Carter, Monograph V, 1923, pp. 23—26, tt. 132—133) it is a distinctive feature that the length without spines is a little greater than the breadth without spines. This is also true of G. M. Smith's North American specimens (1924, p. 74, t. 68, figs. 27—34) in spite of the fact that their spines are 15—20 μ long and at times somewhat divergent. In var. *acuminatum* nov. var., however, the length without spines is always smaller

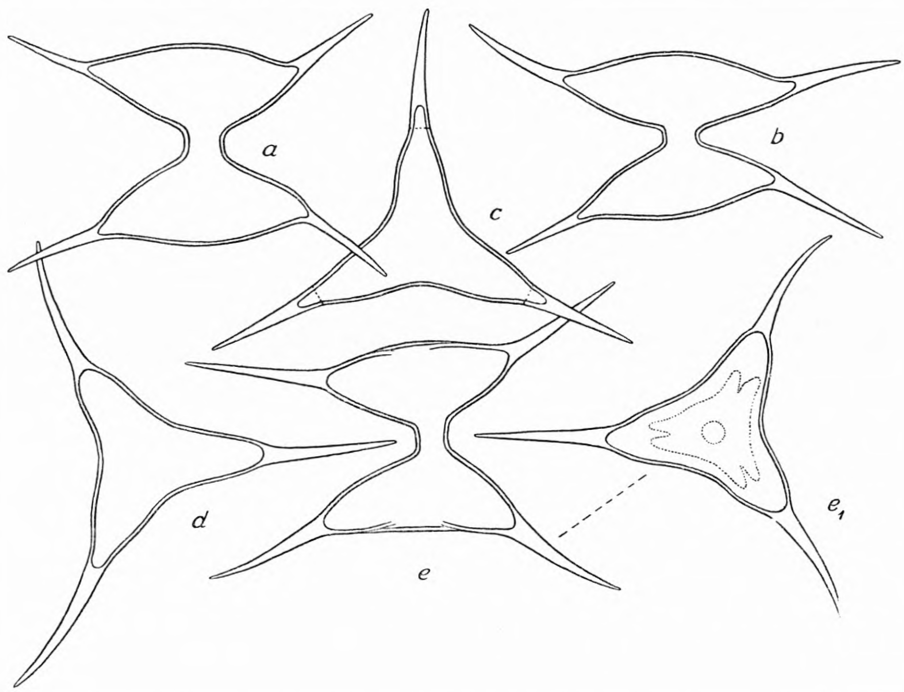

Fig. 44. *Staurastrum cuspidatum* Breb. var. *acuminatum* n. var. from Hampen Sø, *a* from May 17th, 1929, *b* and *c* from August 15th, 1927, *d*, *e* and e_1 from June 23rd, 1929; *a*, *b* and *e* front views, *c*, *d* and e_1 vertical views. 800 ×.

than the breadth without spines so that the semicells are often fusiform in front view. Consequently, the variety should therefore perhaps be considered a new species.

From *Staurastrum curvatum* West var. *elongatum* G. M. Smith (1924, p. 73, t. 69, figs. 10—15) var. *acuminatum* differs by its semicells, which in front view show a convex shape of sides and apex while var. *elongatum* Smith in front view has triangular semicells with nearly straight sides and a level or concave apex.

Periodicity. In Hampen Sø the variety was only found in May, June, August and September (there are no plankton samples from July) as will appear from the following section; it was very rare in these months except in June when it was not infrequent.

Sociology. *Staurastrum cuspidatum* var. *acuminatum* occurred in the following associations, the qualitative composition of which appears from Table II.

Aug. 15th, 1927: *Ta fe as - Ma ca*-association with *Ar cr lo* and *Coo Nä* as subdominants (variety very rare).
May 17th, 1929: *Per bi - Ta fe as*-association with *Per Wi* as subdominant (variety very rare).
June 23rd, — : *Ura am*-association (variety not infrequent).
Sep. 23rd, — : *Ta fe as - Ana Ha ma*-association with *Ce hi* as subdominant (variety very rare).

The variety thus occurred in associations distinguished by diatoms (*Tabellaria*), *Chrysophyceae* (*Mallomonas*, *Uroglena*), *Dinophyceae* (*Peridinium*) and blue-green algae (*Anabaena*).

The associates that occurred in all the 4 samples that contained *Staurastrum cuspidatum* var. *acuminatum* were: *Eudorina elegans* forma, *Arthrodesmus triangularis*, *Staurastrum granulosum*, *Xanthidium antilopaeum*, *Ceratium hirundinella*, *Peridinium cinctum* and *Coelosphaerium Nägelianum*.

Ecology. As will appear from Table I Hampen Sø is an (approximately) oligotrophic lake; on the 4 dates mentioned under the sociology the compound quotient was $\frac{6}{13} = 0.5$, $\frac{2}{5} = 0.4$, $\frac{5}{10} = 0.5$ and $\frac{9}{13} = 0.7$, respectively. pH varied between 5.4 and 8.5, but mostly ranged about the neutral point. The water was clear, the consumption of $KMnO_4$ in 2 analyses was 17 and 21 mg/l. Moreover the water was very poor in lime, 4—6.5 mg CaO per litre; its paucity in nutrients appears from the figures: PO_4-P 0 mg/l, NH_3-N 0.05—0.1 mg/l, NO_3-N 0—0.01 mg/l (the results of an analysis from February are found in Table I).

Staurastrum danicum n. sp.

Fig. nostra 45.

Diagnosis. Cellulae mediocres, longitudine cum processibus minore quam est latitudo cum processibus, profunde constrictae, sinu valde dilatato, rectangulato vel subrectangulato, cum lateribus rectis vel subrectis. Corpus semicellulae a fronte visum late coniforme cum lateribus fere rectis vel levissimis convexis; apice plano vel vix convexo, seriebus spinarum vel granulorum bigeminorum instructo. Anguli semicellulae sensim in processus divergentes et 5—8-denticulatos producti; processus terminaliter 4 spinis satis robustis et basaliter seriebus concentricis granulorum parvorum et acutorum ordinati. Corpus semicellulae a vertice visum triangulum, lateribus leviter concavis raro rectis; membrana intra margines undique serie 4 (raro 2—3) spinarum (terminalium interdum robustiorum quam mediarum) vel 4 (raro 2—3) granulorum bigeminorum ornata. Longitudo sine processibus 23—27 μ, cum processibus 37—41 μ, latitudo cum processibus 48—63 μ, latitudo isthmi 7—9 μ, spinae apicales ad 3 μ longae.

Hab. In Holmsø, Jutlandia occidentali, Dania, libere natans.

Systematics. This species is characterized by the rectangular or subrectangular sinus, the lateral sides of the body being straight or slightly convex. The 3 corners of the body taper into the straight and highly divergent arms. The apical ornamentation is variable, either exclusively with 4 spines in each intramarginal

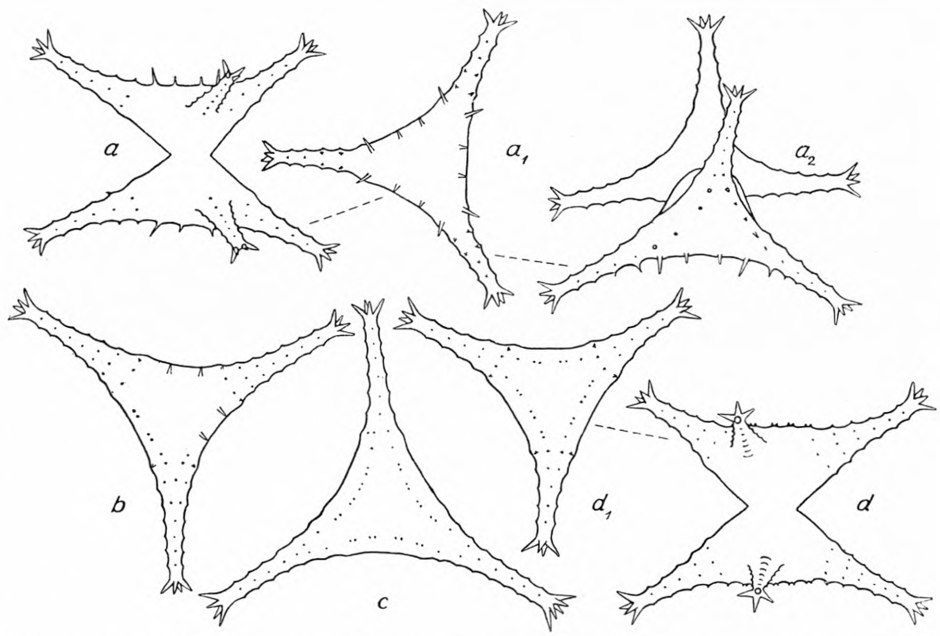

Fig. 45. *Staurastrum danicum* n. sp. from Holmsø, June 26th, 1930; *a* and *d* front views, a_1, *b*, *c* and d_1 vertical views, a_2 oblique vertical view. 800×.

series (see *Fig. nostra* 45 a_1) or with 4 granula bigemina in each series (see *Fig. nostra* 45 *c*) or with a mixture of these two characters (see *Fig. nostra* 45 *b*).

Periodicity and Sociology. The species was very rare in a *Per Wi*-association in Holmsø on June 26th, 1930 (temp. 17.5° C.).

Ecology. According to Table II this maximally 2 m. deep, clear heath lake, which is very rich in *Lobelia Dortmanna*, is oligotrophic of the acidotrophic phase. On the date mentioned the compound quotient was only $\frac{4}{10} = 0.4$, and pH was 4.6.

Staurastrum danicum n. sp. forma.

Fig. nostra 46.

Diagnosis. Hoc modo a typo differt: granula apicis semper valde reducta, aut simplicia aut trigemina; spinae terminales processuum robustiores quam in typo. Longitudo sine processibus 25—26 μ, cum processibus 44—50 μ, latitudo cum processibus 58—63 μ, latitudo isthmi 8—10 μ.

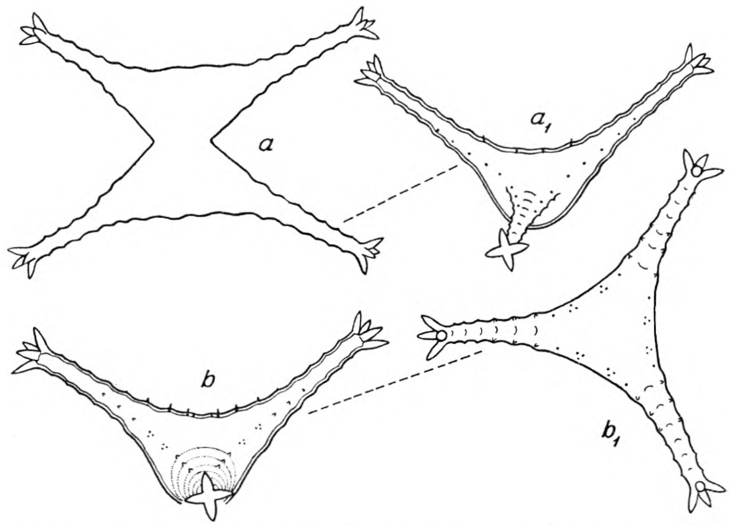

Fig. 46. *Staurastrum danicum* n. sp. forma from turf pit S of Store Jenshøj, June 25th, 1930; *a* front view, b_1 vertical view, a_1 and *b* oblique front views. 800×.

Hab. In stagno turfaceo prope Store Jenshøj, Jutlandia occidentali, Dania, libere natans.

Systematics. The strong endspines and the simple or trigeminate granules show that the individuals are hardly quite identical with those from Holmsø.

Periodicity and Sociology. The form was rare in an *Aso su-Oe It*-association on June 25th, 1930 (temp. 18° C.).

Ecology. The large, shallow turf pit S. of Store Jenshøj at Oxbøl is distinctly oligotrophic of the dystrophic phase. The compound quotient for the date mentioned was as low as $\frac{1}{10} = 0.1$, and pH was 4.0.

Staurastrum dejectum Bréb. f. **mediocris** n. f.

Fig. nostra 47.

Diagnosis. A typo aculeis mediocribus differt. Longitudo cellularum sine aculeis 17—20 μ, cum aculeis 21—26 μ, latitudo sine acu-

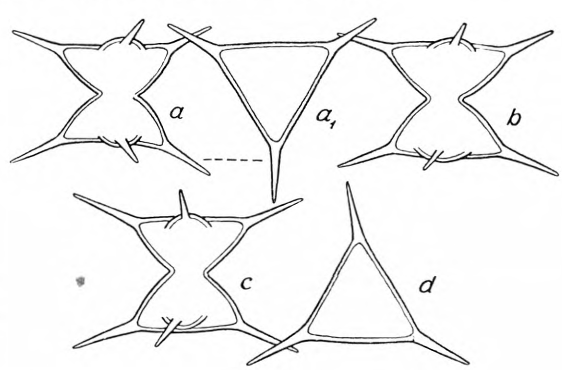

Fig. 47. *Staurastrum dejectum* Bréb. f. *mediocris* n. f. from turf pit NE of Skaansø, July 4th, 1938; *a*, *b* and *c* front views, a_1 and *d* vertical views. 800×.

leis 16—19 μ, cum aculeis 30—38 μ, latitudo isthmi 5.5—6.5 μ, longitudo aculeorum 7.5—12 (saepe 9—11) μ.

Hab. In Bøndernes Mose II, Selandia, et stagno turfaceo prope Skaansø, Jutlandia boreali, Dania, libere natans.

f. **longispina** n. f.

Fig. nostra 48.

Diagnosis. A typo aculeis longis differt. Longitudo cellularum sine aculeis 19—20 μ, cum aculeis 25—31.5 μ, latitudo sine aculeis 18.5—22 μ, cum aculeis 39—53 μ, latitudo isthmi 6—6.5 μ, longitudo aculeorum 13—18 μ.

Hab. In Holmsø, Grovsø et stagno turfaceo prope Store Jenshøj, omnes apud Oxbøl, Jutlandia occidentali, et in "Cirkelsø", Jutlandia meridionali, Dania, libere natans.

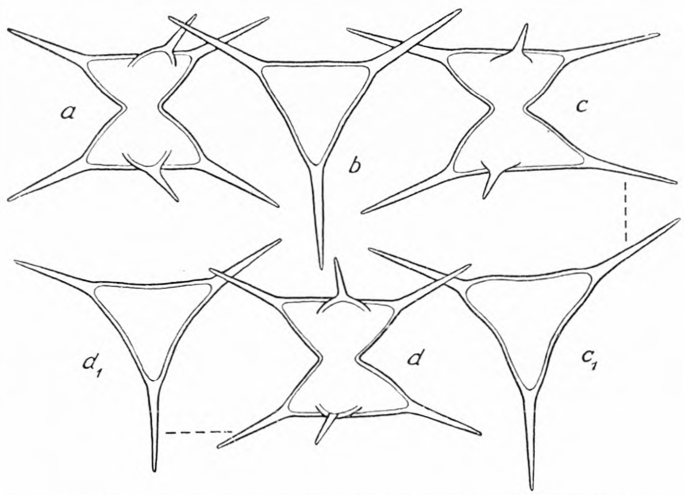

Fig. 48. *Staurastrum dejectum* Breb. f. *longispina* n. f. from Holmsø, June 26th, 1930; *a*, *c* and *d* front views, *b*, c_1 and d_1 vertical views. 800×.

Systematics. WEST and CARTER (Monograph V, 1923, p. 7, t. 129, figs. 9—12) have included different forms under the species *Staurastrum dejectum*; the measurements given are: longitudo sine aculeis 18—27 μ, latitudo sine aculeis 17—27 μ, latitudo isthmi 5—8 μ, longitudo aculeorum 3—8 μ. It must be supposed that these measurements refer to the main species (fig. 9), which accordingly must have short spines.

In Holmsø the comparatively rich material showed the length of the spines, according to 24 measurings, varied between 13 and 18 μ. The few individuals occurring in the turf pit at Store Jenshøj, which is situated in the same tract as the following locality, had a length of spines of 13—16 μ, while the spines of the Grovsø individuals had a length of 14—16 μ.

In Bøndernes Mose II and the turf pit NE. of Skaansø the spines of nearly all the individuals measured had a length of 9—11 μ (30 measurings).

I have found no transition stages between the spine lengths of these two form groups, and so I consider it proper to distinguish between them taxonomically. No doubt they are 2 local races, but ecologically they seem to present no very great difference.

Also BORGE mentions a form (1930, p. 43, t. 2, fig. 39) in which the longitudo sine spinis = latitudo sine spinis = 21—22 μ; longitudo cum spinis 28—29 μ, latitudo cum spinis 43 μ; latitudo isthmi 7 μ. This form is much like fig. 10 in WEST and CARTER (*loc. cit.*); its length of spines is not stated, but—as far as can be judged from the drawing fig. 39—the individual should be referred to f. *mediocris*.

Periodicity. In the said three localities near Oxbøl *Staurastrum dejectum* f. *longispina* was found in small quantities in June 1920 (temp. 17.5—18° C.) as will appear from the following section. F. *mediocris* occurred rather abundantly in the turf pit NE. of Skaansø in July 1938 (temp. 18.5° C.). In the regularly (fortnightly) examined Bøndernes Mose II it was observed in very small quantities throughout the period June 18th—October 29th, 1929 (temp. 8—24° C.); it did not reappear until June 16th, 1930 (temp. 21° C.).

Staurastrum dejectum f. *mediocris* thus seems to be periodical and meso- to polythermic (temp. 8—24° C.) with its vegetation period within the time of June—October.

Sociology. *Staurastrum dejectum* occurred in the following associations:

The Sphagnum bog "Cirkelsø".

July 23rd, 1926: *Sta po di*-association (f. *longispina* very rare).

Holmsø.

June 26th, 1930: *Per Wi*-association (f. *longispina* rare); see Table IV.

Turf pit at Store Jenshøj.

June 25th, 1930: *Aso su - Oe It*-association (f. *longispina* very rare); see Table IV.

Grovsø.

June 27th, 1930: *Ar in ex*-association (f. *longispina* very rare).

Turf pit NE. of Skaansø.

July 4th, 1938: *Sta br*-association with *Sta de me* as subdominant (rather common); see Table IV

Bøndernes Mose II.

June 18th, 1929
July 5th, —
— 17th, —
Aug. 12th, —
— 22nd, —
Sep. 7th, —
— 22nd, —
} *Crym ov cu*-association (f. *mediocris* very rare).

Oct. 9th, — : *Crym ov cu*-association with *Tra vo* as subdominant (f. *mediocris* very rare).

— 29th, — : *Tra vo*-association (f. *mediocris* very rare).

June 16th, 1930: *Crym ov cu*-association with *Tra vo* as subdominant (f. *mediocris* very rare); see Table IV.

In other words *Staurastrum dejectum* was found in associations dominated by *Dinophyceae* (*Peridinium*), *Chlorophyceae* (*Asterococcus*, *Oedogonium*, the desmids *Staurastrum* and *Arthrodesmus*), *Cryptophyceae* (*Cryptomonas*) and *Euglenineae* (*Trachelomonas*).

The most constant associates were *Arthrodesmus incus* var. *extensus* f. *minor* and *Cryptomonas ovata* var. *curvata*, which occurred in 73 $^0/_0$ and 80 $^0/_0$, respectively, of the number (15) of samples that contained *Staurastrum dejectum*.

Ecology. As will appear partly from Table III and p. 15, all the 6 ponds mentioned are oligotrophic, the clear Holmsø of the acidotrophic phase (compound quotient $\frac{4}{10} = 0.4$), the other 5 of the dystrophic phase, Grovsø (compound quotient $\frac{7}{18} = 0.4$), turf pit at Store Jenshøj (compound quotient $\frac{1}{10} = 0.1$), turf pit NE. of Skaansø (compound quotient $\frac{3}{10} = 0.3$), Bøndernes Mose II (compound quotient $\frac{5}{8} = 0.6$), and the Sphagnum bog "Cirkelsø" (compound quotient $\frac{2}{5} = 0.4$).

Accordingly, *Staurastrum dejectum* mostly occurred in highly acid, brown turf pits in raised bogs.

A few ecological data of the species: pH 4.0—5.4, CaO 2.9 mg/l, consumption of $KMnO_4$ 114—202 mg/l (in Holmsø hardly above 15 mg/l), contents of PO_4-P 0 mg/l, NH_3-N 0.9—1.25 mg/l, NO_3-N 0 mg/l, and Fe 0.25 mg/l.

Staurastrum Iversenii n. sp.

Fig. nostra 49.

Diagnosis. Cellulae mediocres, quarum longitudo cum processibus multo minor quam latitudo cum processibus est, profunde constrictae, sinu aperto, sed intime acuto. Corpus semicellulae a fronte visum late obconicum cum lateralibus valde undulatis (interdum cum spinis in tumoribus); apice plano 4 verrucis parvis instructo, quarum duae mediae robustiores quam sunt duae extremae; sub illis verrucis corpus cum serie horizontali 4 granulorum robustorum et acutorum, interdum cum duabus seriebus inter se parallelis et horizontalibus, 4 granula pro serie. Anguli

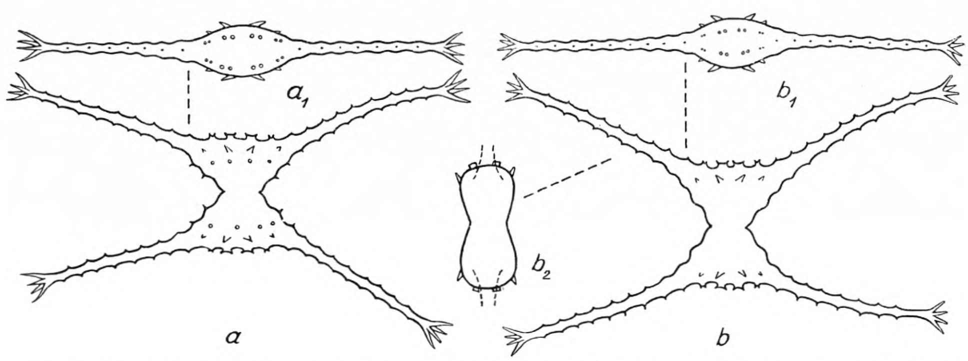

Fig. 49. *Staurastrum Iversenii* n. sp. from Vedsted Sø, July 27th, 1926; *a* and *b* front views, a_1 and b_1 vertical views, b_2 lateral view. 800 ×.

superiores corporis in processus longos, aculeatos vel 7—9-denticulatos, valde divergentes, leviter recurvatos, raro rectos producti. Corpus semicellulae a latere visum obconicum vel subobovatum, apice convexo; a vertice visum bibrachiale, fusiforme, duabus seriebus verrucarum intramarginalium (4 pro serie) et 4 granulis margi-

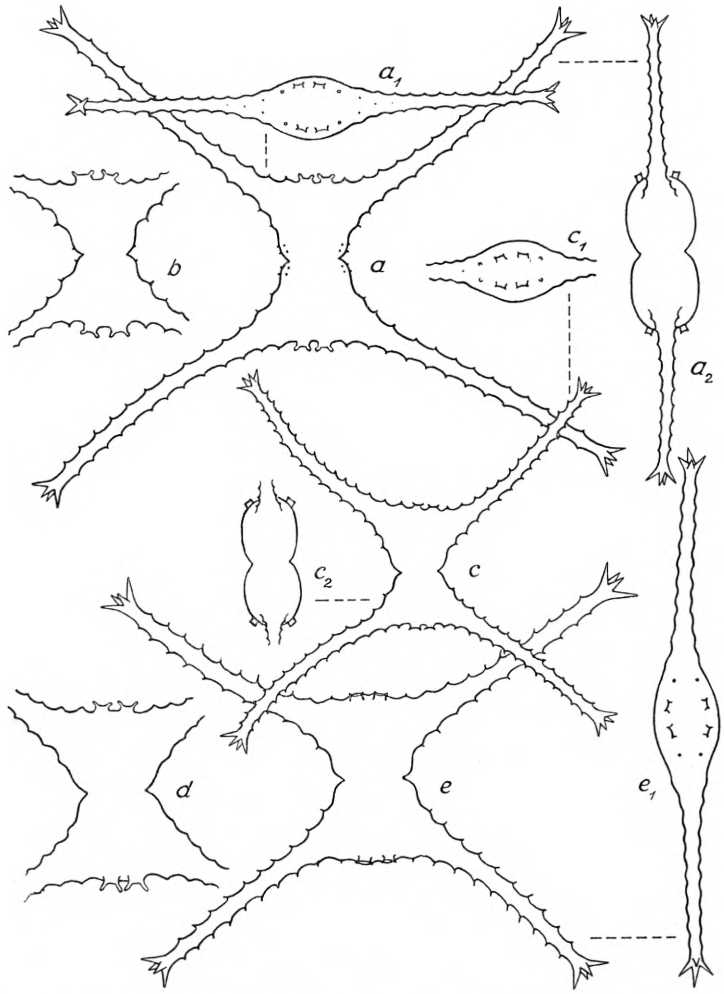

Fig. 50. *Staurastrum Bullardii* G. M. Smith var. *alandicum* Teiling; *a*, a_1, a_2, *b*, *c*, c_1 and c_2 from Slaaen Sø, September 4th, 1929; *d*, *e* and e_1 from Tissø, August 10th, 1927. *a*, *b*, *c*, *d* and *e* front views, a_1, c_1 and e_1 vertical views, a_2 and c_2 lateral views. All figures 800× except *c*, c_1 and c_2 560×.

nalibus, robustis et acutis ordinatum; duae mediae verrucae robustiores sunt quam duae extremae et retroflexae a medio lateris corporis. Uterque angulus in processum longum, tenuem, 7—9-undulatum, rectum productus, terminaliter cum 4 spinis satis longis, introflexis vel rectis. Longitudo sine processibus 20—21.5 μ, cum processibus

38—47 μ, latitudo 70—76 μ, crassitudo 9 μ, latitudo isthmi 5.5—6 μ, longitudo spinarum terminalium 3—4.5 μ.

Hab. In Vedsted Sø, Jutlandia meridionali, Dania, libere natans.

Systematics. The species bears some resemblance to *Staurastrum Bullardii* G. M. Smith var. *alandicum* Teiling (1942, p. 213, figs. 6—7), which is also biradiate and, in lateral view, has the same shape of body (the Danish specimens of Teiling's variety, however, in lateral view show an elliptical-cylindrical corpus with hemispherical ends, and besides this these individuals have incurved processes, see *Fig. nostra* 50. However, the processes of *Staurastrum Iversenii* are slightly recurved (or straight) while the processes of var. *alandicum* are slightly incurved (or straight), and the one or two horizontal series of pointed granules on the frontal part of corpus, which are found in *Staurastrum Iversenii*, are totally absent in *Staurastrum Bullardii* var. *alandicum*. Moreover the new species in all dimensions is smaller than var. *alandicum*.

Periodicity and Sociology. On the periodicity nothing can be stated but the fact that the species was found in the plankton of Vedsted Sø (collected by Dr. Johs. Iversen) on July 27th, 1926 and July 2nd, 1927.

Both samples, in which it was very rare, were dominated by *Ceratium hirundinella* f. *silesiacum* associations, the qualitative composition of which appears from Table II.

Ecology. Vedsted Sø at Haderslev is a clear, acid (pH 5.7—6.0), small but 15 m deep lake, approximately oligotrophic. Johs. Iversen has given an account of its vegetation of hydrophytes (1929, p. 312). Table I shows that the compound quotient was $\frac{9}{9} = 1$ and $\frac{3}{6} = 0.5$ on the two dates mentioned.

Staurastrum longiradiatum West forma.

Fig. nostra 51.

Diagnosis. Differs from the original specimens in having the divergent processes tipped with 4 end-spines and in showing a deeper crenation or dentation of the upper than of the lower margin of processes. Length without processes 32 μ, with processes 42 μ, breadth with processes 82 μ, breadth of isthmus 7 μ.

Hab. In Blankeborg I, Funen, Denmark, limnetic.

Systematics. The found individual comes nearest to West's original specimens from North America (1896, p. 267, t. 17, fig. 23), which measured 25—30 μ in length, 67—77 μ in breadth (incl. processes), the breadth of the isthmus being 6—7.5 μ. G. Morgan Smith's North American individuals, which together with the Australian specimens from the Yan Yean Reservoir should be regarded as a special variety, are much larger, measuring 41—49 μ in length, 73—108 μ in breadth (incl. processes) and 8.5—10 μ in breadth of the isthmus; but their special characteristic is the more elongate cell-body (G. M. Smith 1924, p. 90, t. 74, figs. 5—11). The species seems to be rare; the Wests do not mention it in their Monograph of the British Desmidiaceae.

Periodicity. The species occurred in only one of the 95 examined samples from Blankeborg I, which were collected regularly between 1926 and 1930. In spite of renewed examinations of further plankton material from August 17th, 1927 (temp. 19.5° C.) I only managed to find the individual pictured here.

Sociology. The said specimen was found in a *Ce hi*-association with *Din di* as subdominant. In Table IV we find the qualitative composition of this association.

Ecology. Blankeborg I is a slightly eutrophic turf-pit of the mixotrophic phase (see Table III, which i. a. gives its phytoplankton quotients). On August 17th, 1927 the compound quotient of the net plankton was $\frac{21}{12} = 1.75$. On the same day pH was 7.6, and on August 5th of the same year the consumption of $KMnO_4$ was 81 mg/l. According to 2 analyses the calcium content of Blankeborg I was 82.3 and 91 mg CaO per litre.

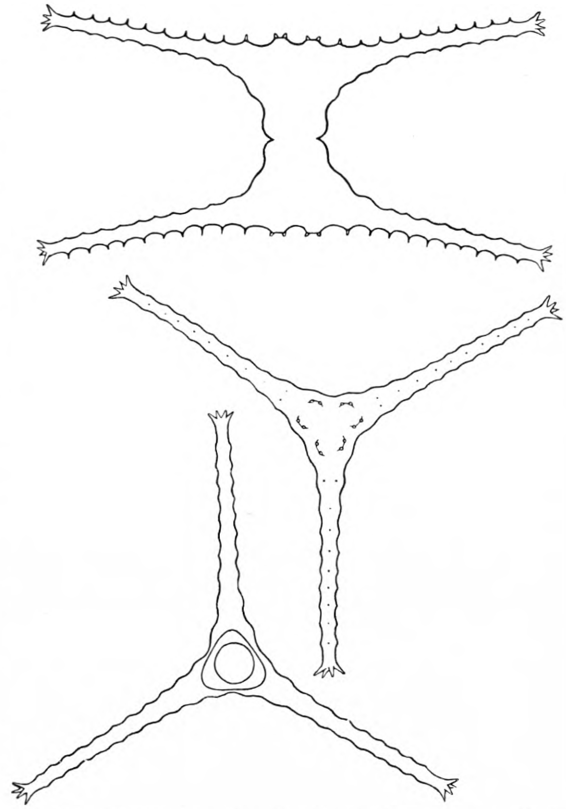

Fig. 51. *Staurastrum longiradiatum* West forma from Blankeborg I, August 17th, 1927. 800×.

Staurastrum pendulum n. sp.

Fig. nostra 52.

Diagnosis. Cellulae mediocres, quarum longitudo cum processibus minor quam latitudo cum processibus est, profunde constrictae; sinus extrorsum valde ampliatus, apice acutiore vel fere sublineari; isthmus angustus. Semicellulae inter se contortae, a fronte visae corpore obsemicirculari, apice concavo vel subplano sunt. Anguli semicellulae in processus trispinosos, sublongos, leviter vel distincte attenuatos producti sunt cum margine superiore dentatiore quam margo inferior et margines laterales; processus divergentes extremitatibus recurvatis. A vertice visae semicellulae triangulares, marginibus corporis rectis vel concavis, undulatis vel dentatis, quisque margo seriebus duabus spinarum simplicium parvarum ordinatus; in medio apice 6 puncta minutissima in sexangulo regulari ordinata. Longitudo cellularum sine processibus 20—21 μ, cum processibus 30—32 μ, latitudo cum processibus 42—54 μ, latitudo isthmi 6—6.5 μ.

Hab. In Hostrup Sø, Jutlandia meridionali, Dania, libere natans.

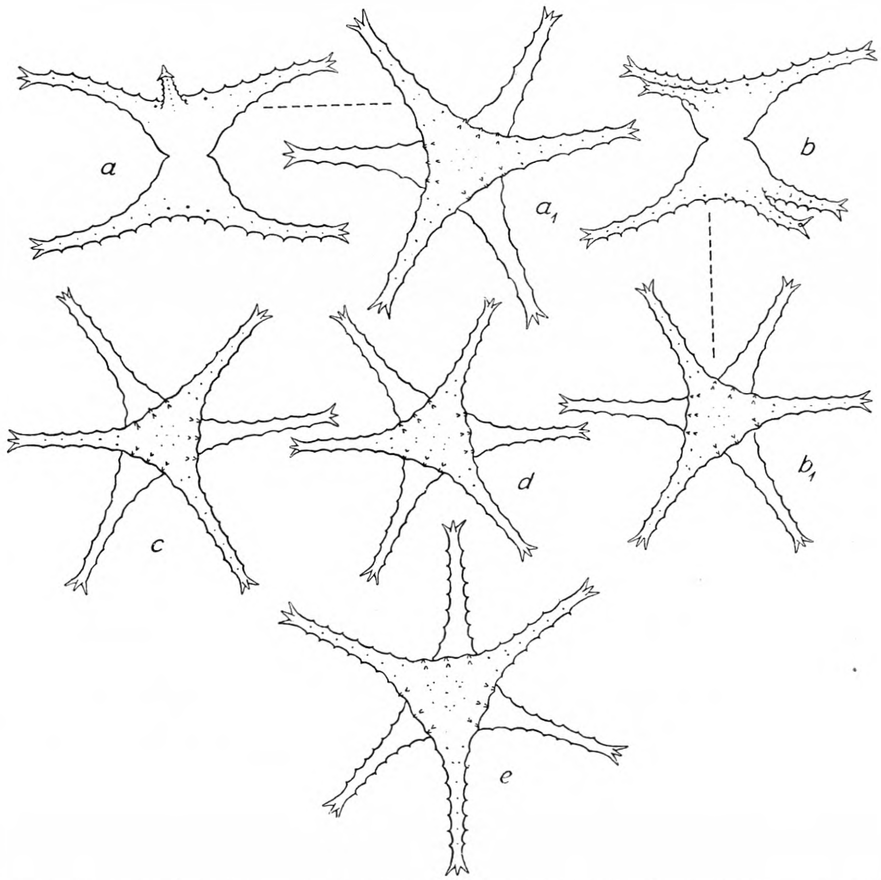

Fig. 52. *Staurastrum pendulum* n. sp. from Hostrup Sø, July 24th, 1926 (a, a_1, b, b_1), and July 5th, 1927 (c, d and e). a—b front views, the other figures vertical views. 800 ×.

Systematics. The species is characterized by its divergent, near the point recurvate processes and by the two parallel series of 3 spines at each side on the apex of the semicell; the semicells were always twisted at the isthmus. Every second of the tiny points in the hexagon in the middle of apex may be trebled (see Fig. 52e).

The species is closely related to *Staurastrum saltator* Grønblad (1938, p. 56, fig. 2, 4) which has the same habit and size, but quite another apical ornamentation (only 6 intramarginal spines in all) and show smooth, convex sides of the semicell body in vertical view; further the arms of *Staurastrum saltator* are tipped with 4 minute spines.

Periodicity. The species was found in Hostrup Sø on July 24th, 1926, July 5th, 1927 and May 21st, 1929. In these samples it was rare with the exception of the 1927 sample where it was not infrequent.

Sociology. *Staurastrum pendulum* occurred in the following associations, the qualitative composition of which appears from Table II:

July 24th, 1926: *Fra cr*-association with *Trb tae* as subdominant (the species very rare).
— 5th, 1927: *Coo Nä*-association (the species not infrequent).
May 21st, 1929: *Trb tae*-association (the species rare).

The species thus occurred in a diatomaceous (*Fragilaria*), a myxophycean (*Coelosphaerium*) and a xanthophycean association (*Tribonema*).

Ecology. The about 7 m deep Hostrup Sø is a eutrophic lake of the mixotrophic phase. As shown in Table I the compound quotient reached the values 6.4—3.3—4.5—4.5. The lake is lime-deficient, according to Johs. Iversen (1929, p. 315) with 12 mg CaO per litre; the same author mentions that pH varied between 6.4 and 8.8. On July 24th, 1926 pH was 7.3 and the consumption of $KMnO_4$ 50 mg/l.

Staurastrum pingue Teiling var. **tridentata** n. var.

Fig. nostra 53.

Diagnosis. Hoc modo a typo differt: apex semicellulae 3 spinis et 3 granulis bigeminis sic instructus, ut ad quodque latus semicellulae (a vertice visae) una spina et unum granulum bigeminum sint. Processus cum 3—5 spinis terminalibus. Corpus semicellulae ad basem cum granulis nonnullis. Semicellulae binae semper inter se contortae. Longitudo cellularum sine processibus 29—31.5 μ, cum processibus 40—63 μ, latitudo cum processibus 56—75 μ, latitudo isthmi 7 μ.

Hab. In Nors Sø, Jutlandia septentrionali, Dania, libere natans.

Systematics. This variety is conspicuous by the fact that every second *granulum bigeminum* of the apex is developed into a rather strong spine and by its constantly twisted semicells. In quite a few individuals (cp. Fig. 53d) there are but 2 spines but 4 *granula bigemina* on the apex; in such an individual, however, the proximal spines of the processus situated immediately beside the reduced spine are more developed than in the other two processes.

Periodicity. The variety was found only in the summer months: on July 18th, 1925 (temp. 21° C.) when it was common in the plankton of Nors Sø, and on August 18th, 1939 (*legit* Sig. Olsen) when it was very rare.

Sociology. The variety was found in the following 2 associations:

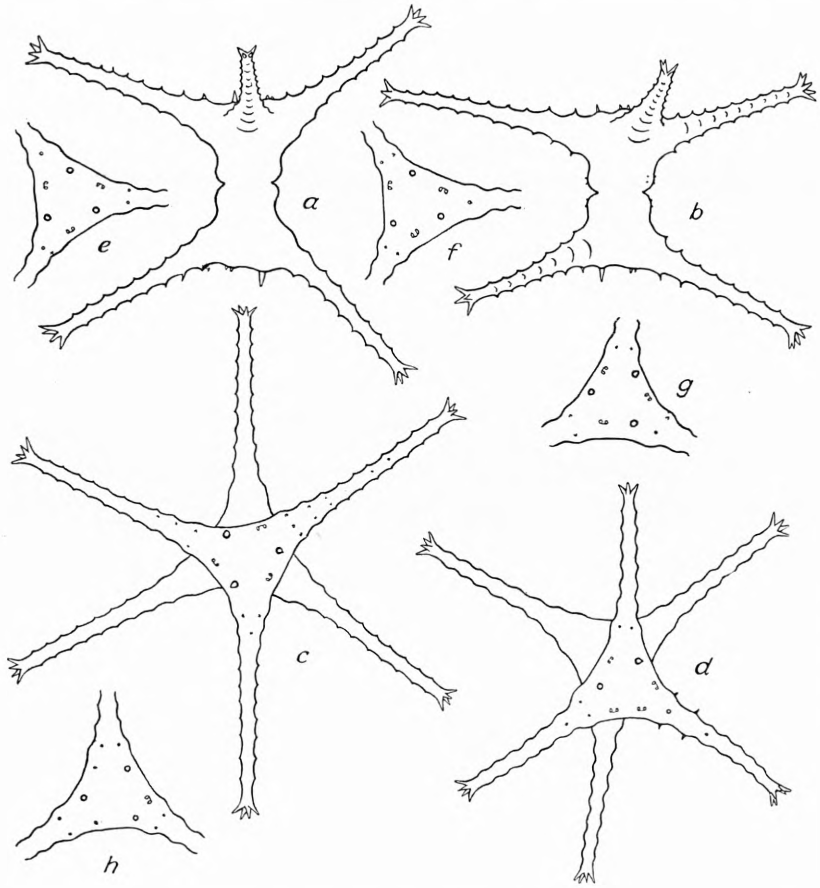

Fig. 53. *Staurastrum pingue* Teiling var. *tridentata* n. var. from Nors Sø, July 18th, 1925. *a—b* front views, *c—d* vertical views, *e—h* 4 other semicells in vertical view showing the apical ornamentation. 800×.

July 18th, 1925: *Ana ci* - *Mio fl ma*-association with *Ce hi* and *Eut gl* and the variety in question as subdominants.

Aug. 18th, 1939: *Mio fl ma* - *Ana fl*-association with *Coo Kü* as subdominant (the variety very rare).

The qualitative composition of these two associations appears from Table II.

Like the main species (Teiling 1942, p. 66, figs. 3—5) *Staurastrum pingue* var. *tridentata* thus occurs in associations characterized by blue-green algae (*Microcystis* and *Anabaena*).

Ecology. Nors Sø is a slightly eutrophic ("mesotrophic") lake situated on a substratum of cretaceous deposits (see Table I). The calcium content, however, is not very great, according to 2 analyses only 43.1—52 mg CaO per litre. The measured pH values range between 8 and 8.3. On July 18th, 1925 the compound quotient reached the value $\frac{27}{12} = 2.25$, on August 18th, 1939 the value $\frac{24}{12} = 2.0$.

Staurastrum polymorphum Breb. var. **divergens** nov. var.

Fig. nostra 54.

Diagnosis. Cellulae parvae, tam longae quam latae vel longitudine (cum processibus) paulo minores quam latitudine (cum processibus), profunde constrictae; sinus apertus, saepe rectangulus, cum apice acuto vel subacuto. Semicellulae a fronte

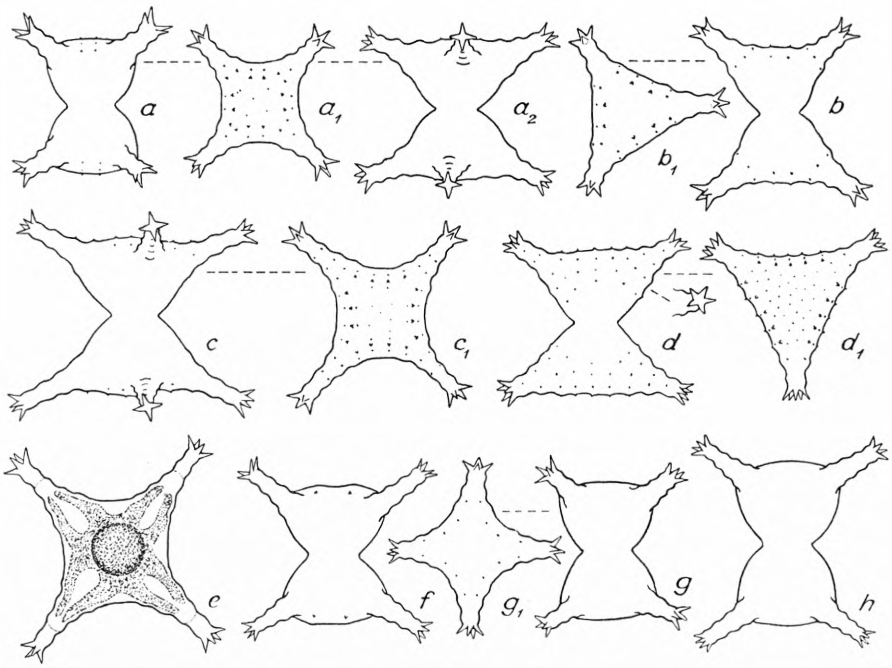

Fig. 54. *Staurastrum polymorphum* Breb. var. *divergens* n. var.; a, a_1, a_2, b, b_1, c and c_1 from turf pit NE of Skaansø, July 4th, 1938; d and d_1 from Bøllemosen, September 5th, 1946; e and f from a dystrophic turf pit near Eggesø, Salling, July 4th, 1938; g and g_1 from "Cirkelsø," July 23rd, 1926; h from Bøndernes Mose II, September 7th, 1929. a, a_2, b, c, d, f, g and h front views, a_1, b_1, c_1, d_1, e and g_1 vertical views. 800 ×.

visae cum corpore cyathiformi vel subconiformi; margo dorsalis subconvexus, raro fere planus, levis vel tenuiter denticulatus, margines laterales leviter ad valde convexi; angulis superioribus in processus breves interdum brevissimos, bi- ad quadrinodulosos, valde divergentes productis, terminaliter cum 4, raro 5 spinis satis robustis et brevibus. Semicellulae a vertice visae quadriradiatae, interdum triradiatae; latera corporis concava, raro recta, leves vel tenuiter denticulata; apex corporis levis vel cum uno serie 8 punctulorum vel cum 2—4 seriebus marginalibus inter se parallelis granulorum minimorum et acutorum, interdum valde reductorum, serie interiore validissima; granulis etiam in series breves et radiatae ordinatis; apex medius levis vel punctulatus. Longitudo sine processibus 22.5—28 μ, cum processibus 28—36 μ, distantia inter apices processuum proximorum 25—38 μ, inter apices processuum oppositorum 33—48 μ, latitudo isthmi 7—8.5 μ.

Hab. In Bøndernes Mose I et II, Bøllemosen, Selandia; in palude turfacea prope Skaansø et palude turfacea prope Hvidemose, Jutlandia septentrionali; in palude turfacea prope Krusaa Dam et "Cirkelsø" prope Søgaard, Jutlandia meridionali, libere natans.

Systematics. According to W. and G. S. West's Monograph (vol. 5, 1923, p. 125, t. 142, fig. 24, t. 143, figs. 1—3) *Staurastrum polymorphum* has converging or parallel processes with 3—4 very poorly developed terminal spines; further the apex of the semicells is distinctly convex. Messikommer (1943, p. 37, t. 15, fig. 2) also depicts *Staurastrum polymorphum* with parallel arms and highly convex apex; the drawing of the same author in the 1927 paper (t. 2, fig. 27) shows a specimen with slightly convex apex and very slightly divergent arms.

In my opinion it will therefore be legitimate to consider the individuals the arms of which are highly divergent and provided with 4—5 comparatively strong terminal spines as a special variety: var. *divergens* nov. var. The *Staurastrum polymorphum* depicted by A. Donat (1926a, t. 3, fig. 6) is most likely identical with this new variety. His individuals evidently have a smooth apex like the individual pictured in *figura nostra* 54 *h*. Compare also Grönblad 1921, p. 58, t. 5, figs. 17—20.

Periodicity. The variety seems to be periodical and to be a typical summer form: it was seen only during the period May—October at temperatures between 7° and 21.5° C. In the former of the two regularly examined turf pits Bøndernes Mose I and II it was observed only in June—August, in the latter, however, in May—October. It never occurred in the winter samples from these two localities. As will appear from the following section the variety may be rare or not infrequent in June—July, but is always very rare in May and August—October.

Sociology. The variety occurred in the following associations:

Bøndernes Mose I.

June 28th, 1929: *Crym ov cu*-association (the variety very rare), see Table IV.
Aug. 22nd, — : *Crym ov cu*-association with *Gos se* as subdominant (the variety very rare).

Bøndernes Mose II.

Aug. 22nd, 1929: *Crym ov cu*-association (the variety very rare), see Table IV.
Sep. 7th, — : *Tra vo*-association with *Crym ov cu* as subdominant (the variety very rare).
— 22nd, — : *Crym ov cu*-association (the variety very rare).
Oct. 29th, — : *Tra vo*-association (the variety very rare).
May 24th, 1930: *Crym ov cu*-association with *Tra vo* as subdominant (the variety very rare).
June 16th, — : *Crym ov cu*-association with *Tra vo* as subdominant (the variety rare), see Table IV.

Large turf pit 1 km W. of Hvidemose, Salling.

July 4th, 1938: *Sta al*-association (the variety rare).

Nearly overgrown turf pit NE. of Skaansø.

July 4th, 1938: *Sta br*-association with *Sta de lo* as subdominant (the variety rare), see Table IV.

Sphagnum bog ("Cirkelsø") S. of Søgaard Sø, North Sleswick.

July 23rd, 1926: *Sta po di*-association (the variety not infrequent).
July 16th, 1939: *Crym ov*-association (the variety very rare).

Large turf pit N. of the Krusaa Dam.

Aug. 18th, 1945: *Crym ov cu*-association (the variety very rare).

The variety thus occurs in cryptophycean (*Cryptomonas*), euglenine (*Trachelomonas*) and chlorophycean (*Staurastrum*) associations.

The most constant associate was *Cryptomonas ovata* (var. *curvata*), which occurred in 85 $^0/_0$ of the samples (13) containing *Staurastrum polymorphum* var. *divergens*.

Ecology. All the localities mentioned are oligotrophic turf pits of the dystrophic phase. In all of them submerse *Sphagnum* species were growing (*Sphagnum cuspidatum*). Concerning the plankton quotients see Table III.

Of *Staurastrum polymorphum* A. Donat says, "Allgemein verbreitet und häufig in Sphagneten. Kosmopolit und Ubiquist." This characteristic possibly applies to the main species; according to the description given above var. *divergens* cannot at all be a ubiquist: on the contrary it seems to be confined to *Sphagnum* bogs with their brown, very acid water (pH < 4.5). The ecological demands of the variety are indicated by the following values: pH 3.7—4.4, CaO 2.9—5 mg/l, consumption of $KMnO_4$ 114—205 mg/l, PO_4-P 0 mg/l, NH_3-N 0.9—1.25 mg/l, NO_3-N 0 mg/l, Fe 0.25 mg/l.

Staurastrum Pseudosebaldii Wille var. **simplicius** West.

Monograph of the British Desmidiaceae, Vol. 5, 1923, t. 149, fig. 13.—*Fig. nostra* 55.

Systematics. This variety occurred in small quantities in the plankton from Holmsø, SW-Jutland, on June 26th, 1930. The individuals were 33 μ long, 35—42 μ broad; the breadth of isthmus was 8.5—9.5 μ. The spines were replaced by tiny sticks or even *granula bigemina*. The processes were tipped with 4, rarely 5 spines.

The association that contained the variety was dominated by *Peridinium Willei*; its qualitative composition appears from Table IV.

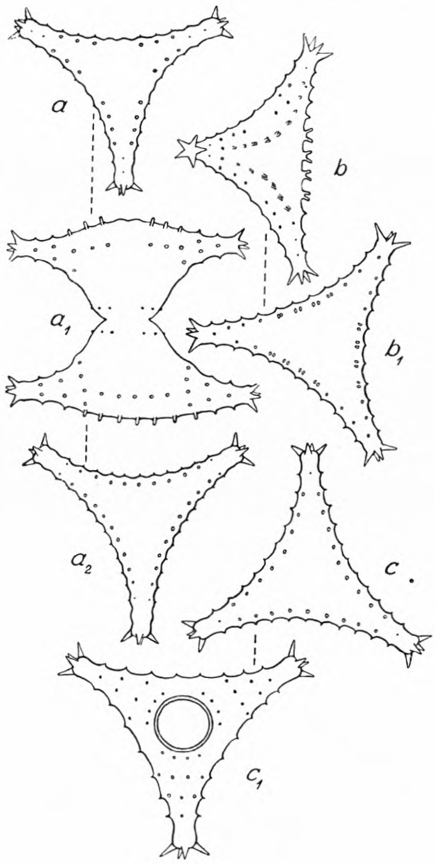

Fig. 55. *Staurastrum pseudosebaldii* Wille var. *simplicius* West from Holmsø, June 26th, 1930. *a*, a_2, b_1, and *c* vertical views, a_1 front view, c_1 basal view, *b* oblique vertical view. 800×.

Holmsø is an oligotrophic heath lake with colourless water; pH was 4.6. Its phytoplankton quotients are listed in Table III; let it be enough to mention that in the sample containing var. *simplicius* the compound quotient was $\frac{4}{10} = 0.4$.

Staurastrum Sebaldii Reinsch var. **ornatum** Nordstedt f. **planctonica** Teiling.

Teiling 1947, p. 227, fig. 20; Grönblad 1942, p. 42, figs. 1—3 and Messikommer 1942, p. 174, fig. 1, *sub nomine Staurastrum Manfeldtii* Delp. var. *planctonicum* Lütkemüller.—*Fig. nostra* 56.

Diagnosis. Cells fairly large, breadth with processes somewhat greater (1—1.5 times) than length with processes. Sinus widely open and acute-angled. Semicells cyathiform, rarely cylindrical at the base, dorsal margin flattened or slightly convex. Apex of semicell body with one row of tri- or bidentate verrucae along the margin, each edge with 2—4 verrucae. Angles of semicells continued into rather long, distinctly divergent processes with 7—8 (rarely 9) deep undulations, the dorsal ones being more prominent and stronger denticulate than the ventral ones; the processes are straight or slightly bent, gradually extending from the body and tipped with 3 (rarely 4) divergent spines. Lateral margins of the body furnished with 3 subbrachial and 3 isthmal granula groups or often only the latter. Vertical view triangular; the corpus smooth, sometimes finely punctate, with straight to very slightly concave, smooth, very rarely subundulate sides; processes in vertical view faintly undulate. Cells 41—50 μ long without processes, 60—83 μ long with processes, breadth with processes 72—96 μ, breadth of isthmus 9.5—13 μ.

Hab. In Lunz Untersee in Austria and Mossø, Furesø, Tissø, Esrom Sø, Salten Langsø and Vedsted Sø in Denmark, pelagic.

Systematics. Originally I intended to term the Danish individuals *Staurastrum planctonicum* Teil. f. *duplex* n. f. or *Staurastrum Sebaldii* var. *ornatum* f. *duplex* n. f. because Teiling (1947, p. 227) claims that "if Lütkemüller's taxonomical estimation is to be maintained, the biverrucate[1] form must be called *St. Sebaldii* var. *ornatum*

[1] Emphasized by me.

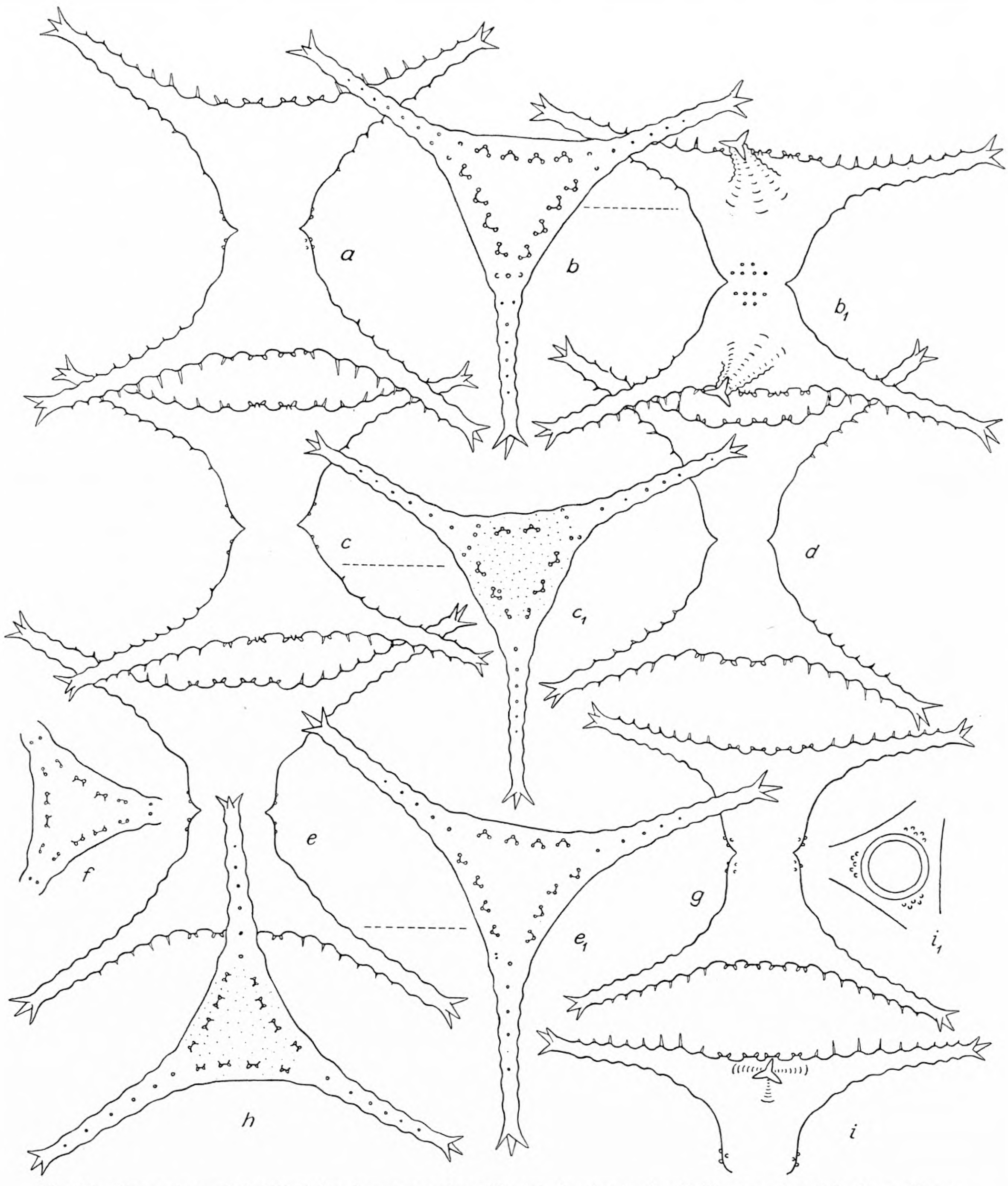

Fig. 56. *Staurastrum Sebaldii* Reinsch var. *ornatum* Nordst. f. *planctonica* Teiling; *a*, *b* and b_1 from Mossø, August 18th, 1929; *c*, c_1 and *d* from Tissø, August 10th, 1927; *e*, e_1 and *f* from Furesø, August 21st, 1943; *g*, *h*, *i* and i_1 from Vedsted Sø, July 2nd, 1927. *a*, b_1, *c*, *d*, *e*, *g* and *i* front views, *b*, c_1, e_1 and *f* vertical views, i_1 basal view. 800 ×.

forma *planctonica*." However, about fig. 20, which in the explanation of the text-figures is called *Staurastrum Sebaldii* var. *ornatum* f. *planctonica*, TEILING says "Most specimens (Fig. 20) possessed a cup-shaped semicell and a marginal row of four[1] forked spines (verrucae) towards the processes turning into simple spines." So there can be no doubt that LÜTKEMÜLLER's *Staurastrum Manfeldtii* var. *planctonicum*, pictured by TEILING and MESSIKOMMER in the places cited above, is identical with the Danish specimens; I have therefore defined this form and extended the diagnosis of *Staurastrum Sebaldii* var. *ornatum* f. *planctonica* to include individuals with 4 verrucae also. As will appear from the said drawing by MESSIKOMMER and my Fig. 56 c_1 and *f* the apical verrucae adjoining the processes may be more or less reduced. *Staurastrum planctonicum* Teiling (1946, p. 77, figs. 30, 32) comes very near to this pelagic form of *Staurastrum Sebaldii* var. *ornatum*.

The dimensions of the delineated Danish specimens are: length without processes 43—50.5 μ, with processes 60—83 μ, breadth with processes 75—96 μ, breadth of isthmus 9.5—12.5 μ.

In Esrom Sø all specimens were biverrucate and always furnished with isthmal granulation, but the corpus was mostly cylindrical near the isthmus, rarely cyathiform as in a slender individual of 50 μ in length. Otherwise the length was only 37—40 μ, with processes 57—61 μ; the breadth 78 μ with processes and the breadth of the isthmus 9 μ; 4 terminal spines.

Periodicity. In this country the species was found only in the months of July, August and September at temperatures between 16.5 and 20° C., but the material is too small for an establishment of its period of vegetation. The species always occurred in small quantities; besides in the plankton samples given in Table II it was found on July 29th and September 1st, 1947 in Furesø and on September 8th, 1929 in Esrom Sø.

Sociology. The species occurred in the following associations:

Esrom Sø.

Sep. 8th, 1929: *Ce hi*-association (the species rare).

Mossø.

Aug. 18th, 1929: *Api fl - Mio aer ma*-association with *Mio vi* and *Ste As* as subdominants (the species very rare).

Tissø.

Aug. 10th, 1927: *Ly li*-association with *Os Ag* as subdominant (the species very rare).

Furesø.

Aug. 7th, 1932: *Ana fl - Asi fo*-association (the species very rare).

Aug. 21st, 1943: *Mel gr an*-association (the species very rare).

Sep. 1st, 1946 (July 29th and Sep. 1st, 1947): *Ce hi*-association (the species very rare).

[1] Emphasised by me.

Vedsted Sø.

July 27th, 1926 and July 2nd, 1927: *Ce hi*-association (f. *silesiacum*, the species rare).

In other words the species occurs in associations characterised by blue-green algae (*Microcystis*, *Lyngbya*, *Oscillatoria*, *Aphanizomenon* and *Anabaena*), diatoms (*Melosira*, *Stephanodiscus* and *Asterionella*) and by *Ceratium hirundinella*.

The most constant associates were *Ceratium hirundinella*, which occurred in 100 per cent. of the samples (8 in all) that contained *Staurastrum Sebaldii* var. *ornatum* f. *planctonica*, *Dictyosphaerium pulchellum* in 88 per cent. of the samples and the following species in 75 per cent. of the samples: *Botryococcus Braunii*, *Microcystis flos aquae*, *Peridinium cinctum*, *Sphaerocystis Schroeteri* and *Stephanodiscus Astraea*.

Ecology. All the Danish lakes mentioned are eutrophic with the exception of the approximately oligotrophic Vedsted Sø. Tables I and II, respectively, show the plankton quotients and the qualitative composition of the plankton. Suffice it to mention here that the compound quotient for Vedsted Sø was $\frac{3}{6} = 0.5$ and $\frac{9}{9} = 1$, for the moderately eutrophic Furesø $\frac{42}{12} = 3.5$, $\frac{28}{8} = 3.5$ and $\frac{22}{5} = 4.4$, and for the 3 distinctly eutrophic lakes Tissø $\frac{40}{8} = 5$, Mossø $\frac{35}{6} = 5.8$ and Esrom Sø $\frac{19}{3} = 6.3$. In the last-mentioned lake the dominant *Ceratium hirundinella* reached an absolute frequency of 10 cells per ml on September 8th, 1929.

Staurastrum Sebaldii var. *ornatum* f. *planctonica* thus seems to be much more common in eutrophic than in oligotrophic lakes of this country, in which respect it is quite like *Staurastrum planctonicum* Teiling (1947, p. 222). It is questionable whether *Staurastrum Sebaldii* var. *ornatum* f. *planctonica* is so rare as supposed by Teiling (1947, p. 222).

Some data of the ecology of the form are: pH 5.7—8.8, CaO 125.6 mg/l, PO_4-P 0.005 mg/l, NH_3-N 0.2 mg/l, NO_3-N 0 mg/l. According to Brønsted and Wesenberg-Lund (1912, p. 478) Mossø contained 60 mg CaO per litre, Furesø (1912, p. 453) between 54.5 and 65.4 mg CaO per litre; no doubt Vedsted Sø is much poorer in calcium.

Staurastrum uniseriatum n. sp.

Fig. nostra 57.

Diagnosis. Cellulae mediocres, quarum latitudo cum processibus circiter 1.75 plo longior quam longitudo cum processibus est, profunde constrictae, sinu acutangulo, mox ampliato. Corpus semicellulae a fronte visum cyathiforme vel subcylindricum in parte isthmali, apice vix convexo vel plano, cum 2, raro 4 verrucis parvis ordinato; anguli superiores semicellulae in processus breves vel mediocres, rectos, basaliter coniformes, 4- ad 7-undulatos, paralleles vel leviter divergentes, rarissime vix convergentes, terminaliter cum 4 spinis parvis, leniter producti; sub quoque processu granulum unum prope isthmum. Corpus semicellulae a vertice visum triangulum, lateribus glabris, leviter concavis vel rectis, undique 2, raro 4 verrucis intramarginalibus instructum; angulus unusquisque in processus 4- ad 7-undulatos productus. Longitudo sine processibus 22—29 μ, cum processibus 20—32 μ, latitudo cum processibus 33—51 μ, latitudo isthmi 5—6 μ.

Hab. In Hulsø, Store Dam, Badstue-Ødam et Frederiksborg Slotssø, Selandia; Blankeborg I, Fionia; Slaaen Sø, Jutlandia, Dania, libere natans.

Systematics. This species, which in lists of plankton is no doubt often given as *Staurastrum gracile*, is characterized by the facts that the body of semicell in vertical view has smooth sides without indications of undulations or granules and is provided

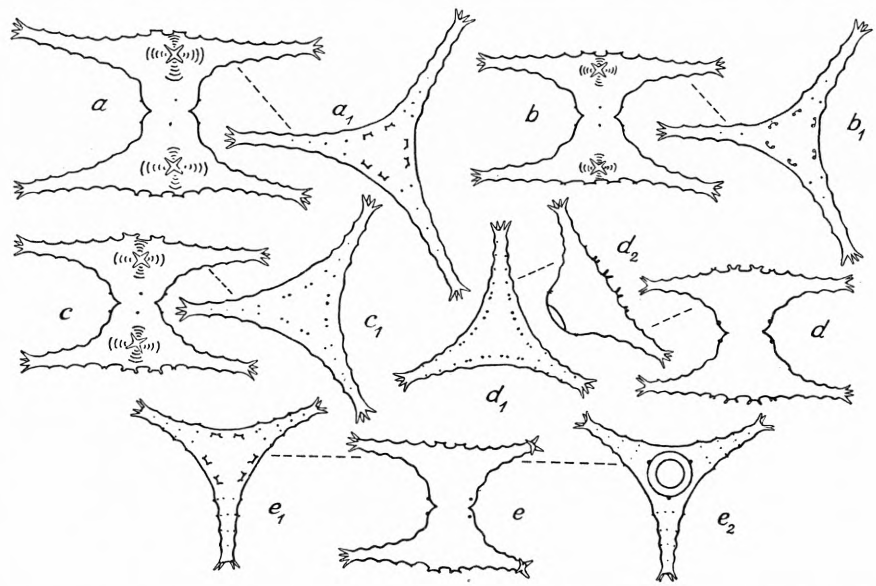

Fig. 57. *Staurastrum uniseriatum* n. sp.; a—a_1 from Slaaen Sø, September 4th, 1929; b—b_1 from Hulsø, August 8th, 1946; c—c_1 from Blankeborg I, August 16th, 1925; d, d_1 and d_2 from Eriophorum moor at Sorø, July 9th, 1947; e, e_1 and e_2 from Store Dam, August 17th, 1929. a—e front views, a_1—e_1 vertical views, d_2 oblique front view, e_2 basal view. 800×.

with but one row of 2, rarely 4 small verrucae within each lateral margin. The species is further recognizable by its parallel or slightly divergent, non-denticulate processes, under each of which there is only one granule near the isthmus.

Whether fig. 9D in G. M. Smith's paper on the phytoplankton of Wisconsin (1924, p. 88, *sub nomine Staurastrum gracile* Ralfs) is identical with *Staurastrum uniseriatum* cannot be decided because the specimen is not shown in front view; but as the number of verrucae is considerably higher than 2—4, this is hardly probable.

In Cedercreutz and Grönblad's paper on the *Desmidiaceae* of Åland (1936) the specimens pictured on t. 1, figs. 23—24 *sub nomine Staurastrum gracile formae* (possibly also 22, but not 21) are identical with *Staurastrum uniseriatum*.

In Nygaard's paper on the plankton of Lake Ohoitiel in the Key Islands and

Toba Lake on Sumatra (1926) the individuals from Lake Ohoitiel (*sub nomine Staurastrum gracile*, p. 212, t. 5, figs. 50—52) are typical specimens of *Staurastrum uniseriatum*. A re-examination of the plankton material has confirmed this view. Also figs. 74 and 76 (*sub nomine Staurastrum gracile*, from Toba Lake) of t. 7 are no doubt identical with *Staurastrum uniseriatum*, whereas fig. 75 is a special form, considerably broader in the body of semicell.

Also KRIEGER has found *Staurastrum uniseriatum* in Toba Lake and given a good illustration of it (1932, p. 200, t. 18, fig. 13) and described it as *Staurastrum gracile* var. *ornatum* Krieger. However, a *Staurastrum ornatum* Turner has previously been described, and so KRIEGER's name of variety cannot be made into a name of species.

There is hardly any doubt that also the individuals pictured by NORDSTEDT from New Zealand (1888, p. 38, t. 4, figs. 10—11) are identical with *Staurastrum uniseriatum*; this is also indicated by the measurements and the remark of the diagnosis on the slightly divergent or parallel processes.

In GRÖNBLAD's paper on the *Desmidiaceae* of Lappland (1942) an individual is described and pictured (p. 41, t. 4, fig. 22) *sub nomine Staurastrum gracile forma* (?), which should likewise be referred to *Staurastrum uniseriatum*.

"*Staurastrum gracile*" on t. 4, fig. 60 in "Dansk Planteplankton" (NYGAARD 1945) is identical with *Staurastrum uniseriatum*.

From these examples it will be seen that *Staurastrum uniseriatum* is a species with a very wide geographical distribution.

Periodicity. As will appear from the section Sociology the species was observed only during the period May—September at temperatures between 13 and 21.5° C.; it was always very rare. 4 of the 6 localities mentioned were examined regularly every fortnight for at least a whole year, and so it may be said with a rather high degree of certainty that *Staurastrum uniseriatum* is a periodical, meso- to polythermic desmid with its vegetation period in the summer half-year.

Sociology. The species was found in the following associations:

Hulsø.

Aug. 8th, 1946: *Rhi lo*-association with *Coo Nä*, *Mel am*, *Mel gr*, *Mio fl* as subdominants (the species very rare).

Slaaen Sø.

Sep. 4th, 1929: *Ce hi*-association (the species very rare).

Blankeborg I.

Aug. 16th, 1925: *Per Vo*-association with *Ce hi* and *Coo Nä* as subdominants (the species very rare).

Aug. 15th, 1926: *Ce hi*-association (the species very rare).

Badstue-Ødam.

June 6th, 1929: *Mel gr an*-association with *Sye ac an* as subdominant (the species very rare).

Aug. 23rd, 1929: *Frg cr*-association with *Ana af in te* and *Cyc st su* as subdominant (the species very rare).

Frederiksborg Slotssø.

Sep. 6th, 1929 }
— 17th, — } *Os Ag*-association with *Mio pu ra* and *Sce arm* as subdominants (the species very rare).
— 23rd, — }

May 13th, 1930: *Sce arm*-association with *Ste Ha* as subdominant (the species very rare).

Store Dam.

July 6th, 1929: *Gy ex*-association (the species very rare).

Aug. 17th, — : *Oo cr mi - Gy ex*-association (the species very rare; 20 individuals seen).

Sep. 21st, — : *Oo cr mi*-association with *Tra vo* as subdominant (the species very rare).

June 16th, 1930: *Tra vo*-association with *Gy ex* as subdominant (the species very rare).

In other words *Staurastrum uniseriatum* was found in diatomaceous (*Rhizosolenia*, *Melosira* and *Fragilaria*) and dinophycean associations (*Ceratium*, *Peridinium* and *Gymnodinium*); further in chlorophycean (*Scenedesmus*, *Oocystis*), myxophycean (*Oscillatoria*) and euglenine associations (*Trachelomonas*).

The most constant associate was *Trachelomonas volvocina*, which occurred in 78 % of the number (14) of samples that contained *Staurastrum uniseriatum*.

Ecology. All the localities mentioned are more or less eutrophic. The very clear lakelet Slaaen Sø is the least eutrophic, the compound quotient being $\frac{12}{11} = 1.1$ on September 4th, 1929; the contaminated lakelet Frederiksborg Slotssø is one of the most eutrophic of these waters, the compound quotient being $\frac{40}{4} = 10$ on September 23rd, 1929. Blankeborg I ("mesotrophic") and Hulsø are both eutrophic ponds of the mixotrophic phase; the compound quotient of the former was $\frac{16}{9} = 1.8$ on August 16th, 1925 and $\frac{22}{10} = 2.2$ on August 15th, 1926; in Hulsø it was $\frac{35}{5} = 7$ on August 8th, 1946. In the eutrophic pond Badstue-Ødam, which is approaching mixotrophy, the compound quotient was $\frac{20}{2} = 10$ on June 6th, 1929 and $\frac{38}{3} = 12.7$ on August 23rd, 1929. In the pond Store Dam, which is also transitional, the compound quotient was $\frac{7}{1} = 7$ on July 6th, 1929, $\frac{10}{5} = 2$ on August 17th and $\frac{13}{2} = 6.5$ on June 16th, 1930.

It must be emphasized here that in this country *Staurastrum uniseriatum* was found only in eutrophic and alkaline waters. *Staurastrum gracile*, however, was found both in oligotrophic waters (also those of the dystrophic phase) and in eutrophic waters (including those of the mixotrophic phase).

Moreover *Staurastrum gracile* to a much higher degree seems to be indigenous to lakes than *Staurastrum uniseriatum*, which is more properly an inhabitant of lakelets and ponds. However, the said occurrence of *Staurastrum uniseriatum* in the large and very deep Toba Lake on Sumatra shows that it is not always confined to smaller bodies of water.

On the basis of my limited Danish material (12 localities for *Staurastrum gracile*, 6 for *Staurastrum uniseriatum*) I venture to advance the opinion that the "ecological spectrum" of *Staurastrum gracile* is not so narrow as that of *Staurastrum uniseriatum* as regards both pH, contents of humic substances and the size and quantitative nutrition of the water bodies.

A few ecological data of *Staurastrum uniseriatum* are: pH 7.6—9.1, CaO 70.6—75.3 mg/l, consumption of $KMnO_4$ 54—65 mg/l, contents of PO_4-P 0.005—0.25 mg/l, NH_3-N 0.05—0.1 mg/l, NO_3-N 0—0.01 mg/l and Fe 0.03 mg/l.

f. **bicornis** n. f.

Fig. nostra 58.

A typo semicellulis bibrachiatis differt. Longitudo sine processibus 24—25 μ, cum processibus 26—33 μ, latitudo cum processibus 47—51 μ, latitudo isthmi 5.5 μ, crassitudo 9 μ.

Hab. In Hulsø, Selandia, Dania, libere natans.

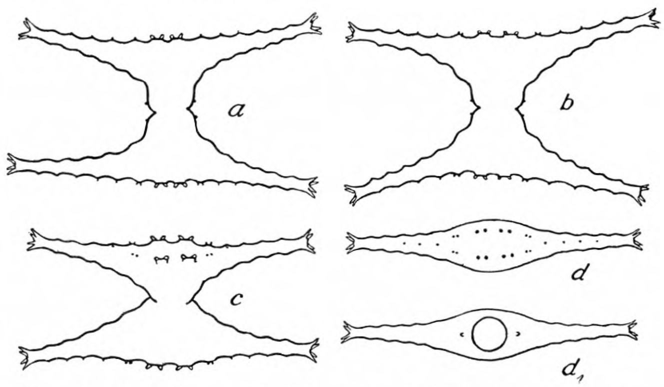

Fig. 58. *Staurastrum uniseriatum* n. sp. f. *bicornis* n. f. from Hulsø, August 8th, 1946; *a*—*b* front views, *c* oblique front view, *d* vertical view, d_1 basal view. 800 ×.

The form was found only in Hulsø on August 8th, 1946 in the association mentioned on p. 112 (see Table II). Hulsø is typically eutrophic of the mixotrophic phase.

Staurastrum vestitum Ralfs var. **parvum** nov. var.

Fig. nostra 59.

Diagnosis. A typo cellulis minoribus cum processibus quadridentatis et valde divergentibus differt. Longitudo sine processibus 15 μ, cum processibus 22 μ, latitudo cum processibus 31—33 μ, latitudo isthmi 5.5 μ.

Hab. In Holmsø prope Oxbøl, Jutlandia occidentali, Dania, libere natans.

The variety is easily distinguished from the main species (West and Carter: Monograph, vol. 5, p. 158, t. 151, figs. 9—11; t. 152, figs. 5—6) by its small cells with highly divergent processes; the cells of the main species are 28—43 μ long (without proc.), 46—90 μ broad (with proc.) and its processes are convergent or parallel.

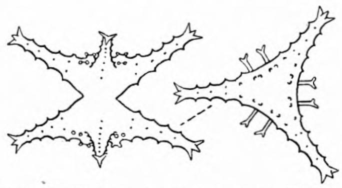

Fig. 59. *Staurastrum vestitum* Ralfs var. *parvum* n. var. from Holmsø, June 26th, 1930. 800×.

The new variety bears a greater resemblance to *Staurastrum vestitum* var. *subanatinum* West (*loc. cit.*, p. 159, t. 153, fig. 5), which also has divergent processes; but var. *subanatinum* has 7—9-dentate processes and cells of more than twice the size of the cells of var. *parvum*.

The variety was found in very small quantities in Holmsø (N. of Esbjerg) on June 26th, 1930 (temp. 17.5°C.). As will appear from Table III Holmsø is oligotrophic of the acidotrophic phase (pH 4.6); on the said date the compound quotient of this clear heath lake with its extremely poor plankton was only $\frac{4}{10} = 0.4$. The plankton association in which *Staurastrum vestitum* var. *parvum* occurred was dominated by *Peridinium Willei*; its qualitative composition appears from Table IV.

Sphaerozosma vertebratum Ralfs f. **quadrata** n. f.

Fig. nostra 60.

Diagnosis. A typo cellulis constrictioribus et quadratioribus differt. Longitudo cellulae 0.73—0.9 latitudinis. Sinus linearis; apex cellulae planus vel levissime convexus. Membrana disperse punctata. Longitudo cellularum 16—19 μ, latitudo 20—22 μ, crassitudo 12 μ, latitudo isthmi 7—9 μ.

Hab. In Hampen Sø, Jutlandia, Dania, libere natans.

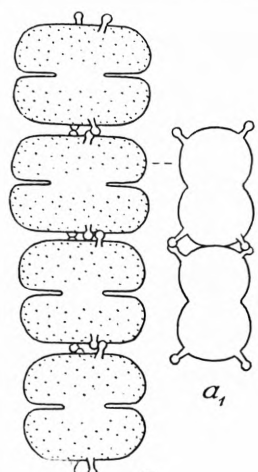

Fig. 60. *Sphaerozosma vertebratum* Ralfs f. *quadrata* n. f. from Hampen Sø, June 23rd, 1929. *a* front view, a_1 lateral view. 800×.

Systematics. The form is characterized by its subquadratic cells with linear sinus. V. et P. Allorge's form (1930, p. 42, t. 31, fig. 10) is probably identical with f. *quadrata*. *Sphaerozosma vertebratum* var. *depressum* Grönblad (1920, p. 83, t. 1, figs. 2—4), however, is something quite different because its cells are about twice as broad as long (19 $\mu \times$ 36—39 μ).

Periodicity. The form was observed only on August 15th, 1927 and June 23rd, 1929, but not in the April, May and September samples. So it is possibly a high summer form, which was always very rare in the plankton of Hampen Sø.

Sociology. *Sphaerozosma vertebratum* f. *quadrata* was found in the following 2 associations:

Aug. 15th, 1927: *Ma ca-Ta fe as*-association with *Ar cr lo* and *Coo Nä* as subdominants (the form very rare).

June 23rd, 1929: *Ura am*-association (the form very rare).

The form thus occurred in a chrysophycean association of *Uroglena* and a mixed association of the Chrysomonade *Mallomonas* and the Diatom *Tabellaria*.

Ecology. Hampen Sø is an approximately oligotrophic, lime-deficient (CaO 4—6.5 mg/l) and clear lake, the pH of which is subject to great and rapid variations; for further details see Iversen 1929, p. 314 and Nygaard 1938, p. 685. On both days mentioned above the compound quotient was $\frac{6}{13} = 0.5$ and $\frac{5}{10} = 0.5$; see further Table I. On August 15th, 1927 Johs. Iversen (1929, p. 286) found that pH near hydrophytes varied between 5.4 and 8.4; the open waters, however, were mostly slightly acid and rarely exceeded the neutral point. Other ecological data of *Sphaerozosma vertebratum* f. *quadrata* are: pH 6.9, CaO 6—6.5 mg/l, PO_4-P 0 mg/l, NH_3-N 0.05 mg/l and NO_3-N 0.01 mg/l.

Chrysophyceae.

Chrysomonadales.

Euchromulinaceae.

Chromulina pygmaea n. sp.

Fig. nostra 61.

Diagnosis. Cellulae solitariae, sphaericae vel late ellipsoideae, raro cylindricae apicibus rotundatis, submetabolicae. Periplastus delicatissimus et levis. Chromatophorus unus, brunneus, aut parvus, plusminusve apicalis et patellaris, aut major, parietalis, medianus et abrupte anuliformis, sine pyrenoide. Stigma longe ovale, in parte anteriori cellulae, saepe in margine chromatophori. Flagellum unum, $1\frac{1}{2}$ longitudinis cellulae. Cellulae 4—7 μ longae, 3—5 μ latae.

Hab. In Jægerbakke Dam prope Hillerød, Dania, libere natans.

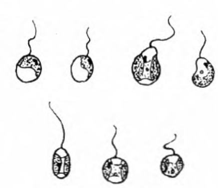

Fig. 61. *Chromulina pygmaea* n. sp. from Jægerbakke Dam, February 17th, 1930. 750×.

Systematics. The species differs from the other *Chromulina* species described by its very small dimensions and its round —broadly ellipsoidical cells with one chromatophore. The two most closely related species, *Chromulina Rosanoffii* and *Chr. Woroniniana* (Pascher 1913, p. 15, fig. 12; p. 15, fig. 11) have no stigma and show somewhat greater dimensions.

Periodicity. The species was seen for the first time under the ice on February 17th, 1930 (temp. 1° C.) when it was not infrequent just as on April 1st. On April 7th the species was common at a temperature of 6° C. During the rest of the month it was rather common or not infrequent, and on May 16th it was rare and then disappeared from the plankton of Jægerbakke Dam. In the other months of the year it was never seen.

Accordingly, *Chromulina pygmaea* is eurythermic but apparently not perennial. Its vegetation period was February—May, and its maximum occurred at the beginning of April.

Sociology. The species was found in the following associations:

Feb. 17th, 1930: *Ki mi*-association with *Din cy al* as subdominant (the species not infrequent).

Apr. 1st, 7th, and 10th, 1930: *Din se pr*-association (the species respectively not infrequent, common and rather common).

Apr. 26th, 1930: *Ge mi*-association with *Din se pr* as subdominant (the species not infrequent).

May 16th, — : *Ank fa spa - Mio ho - Sce arm*-association (see Table IV; the species rare).

In other words *Chromulina pygmaea* was found in chlorophycean associations of *Kirchneriella*, *Geminella*, *Ankistrodesmus* and *Scenedesmus*, and in chrysophycean associations of *Dinobryon*; the associations are rarely characterized by blue-green algae (*Microcystis*).

The constant associates were *Ankistrodesmus falcatus* var. *spiralis*, *Scenedesmus armatus*, *Cryptomonas ovata* and *Anabaena tenericaulis*, which occurred in 100 $^0/_0$ of the number (6) of samples that contained *Chromulina pygmaea*. *Chlamydomonas kakosmos*, *Scenedesmus falcatus*, *Geminella minor*, *Dinobryon bavaricum* and *Microcystis holsatica* were found in 83 $^0/_0$ of the samples.

Ecology. Jægerbakke Dam is a small, highly eutrophic pond, sheltered from winds, conspicuous by its lime deficiency (see further Table III). For the ascertainment of the periodicity, sociology and the ecological data of *Chromulina pygmaea* only such samples were used in which the species was observed with certainty though it is very probable that it was also present in the month of March. pH 7.2—7.8, CaO 9—10.6 mg/l, consumption of $KMnO_4$ 27 mg/l, contents of PO_4-P 0.005—0.015 mg/l, NH_3-N 0.05—0.6 mg/l, NO_3-N 0—0.01 mg/l (Fe 0.45 mg/l on January 31st, 1930).

Kephyrion impletum n. sp.

Fig. nostra 61 *bis.*

Diagnosis. Loricae minimae, tenues, sine colore, fere tam longae quam latae, quarum pars basalis subconica sed postremus late rotundata, pars antica coniformis vel subcylindracea apice truncata et lateribus concavis est; in media lorica inflatio anularis et transversalis est. Protoplastus loricam fere ad oram implet, chromatophoro uno parietali et ochraceo; in medio protoplasto sphaera leucosini adest. Flagellum unum protoplasto 2—3-plo longius. Longitudo loricae 7.5—9.5 μ, latitudo 7—9 μ, latitudo orae 3.5—4.5 μ.

Hab. In stagno prope Sønderborg, Dania, libere natans.

Systematics. This new species is closely allied to *Kephyrion Rubri-claustri* Conrad (Huber-Pestalozzi 1941, p. 70, fig. 86A), likewise a coldwater form. The latter is, however, smaller, 5—7 $\mu \times 5$ μ, the houses are more elongated, and its protoplast does not fill up the house, the colour of which is yellow to pale brown.

Kephyrion impletum was found under the ice on a field pool north of Søndre Landevej in Sønderborg, North Sleswick, on February 27th, 1938 by a temperature of 2.5° C. The plankton of this eutrophic pool was highly dominated of *Chlamydomonas Serbinowii*; of the other prominent constituents should be mentioned *Cryptomonas ovata*, *Mallomonas Teilingii* and *Mallomonas akromos* (both with cysts) and *Chlorogonium maximum*. On March 25th, 1945 pH was 8.4.

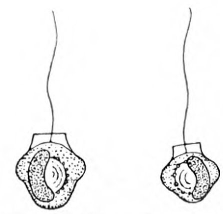

Fig. 61 bis. *Kephyrion impletum* n. sp. from a field pool north of Søndre Landevej in Sønderborg, February 27th, 1938. 1070×.

Mallomonadaceae.

Mallomonas areolata n. sp.

Fig. nostra 62.

Diagnosis. Cellulae cylindraceae apicibus rotundatis vel fusiformibus, tamen in statu cystophoro oviformibus, 23—38 μ longis, 6—11 μ latis. Squamis siliceis in series spirales axi longiore transverse ordinatis, 5—6.5 μ longis, 3.5—5 μ latis, v-descriptione et loco depresso cum seta affixa. Setis rectis vel leviter curvatis, in latere uno tenuiter denticulato, 20—45 μ longis, imprimis ad apicem anteriorem congregatis. Flagello cellulae longitudine aequilongo vel paulo longiore. Duobus chromatophoris luteo-brunneis instructis. Cystae ellipsoideae, perspicue punctatae, spinosae videntur, spinis verum ad superficiem extremam ordinatis, interdum collis brevissimis instructis, 13.5—18 μ longae, 11—15.5 μ latae. Protoplasma tota cellulae ad natum cystae consumitur.

Hab. In Gadevang Mose, Selandia, Dania, libere natans.

In Sortedam II on April 4th—10th, 1930, I found a *Mallomonas* species that is probably identical with *Mallomonas areolata* (Fig. 63). The cells were 24—25 μ in length, 11—13 μ in breadth (including, however, individuals containing spores). The scales, much like those of *Mallomonas areolata* in the v-shaped markings, were 6 μ long and 4 μ broad. The cysts were 13—15 μ long, 10—11.5 μ broad but with a denser punctuation than in the individuals from Gadevang Mose. The silicious bristles—if they be appurtenant—were straight or slightly curved, finely and unilaterally denticulate and 22—34 μ long. However, in the samples from April 4th and 10th the following species were found: *Mallomonas akrokomos*, *M. reginae*, *M. species*$_1$, *M. semiglabra* n. sp., *M. tessellata* and *M. tridentata* n. sp. or *Teilingii*, none of which have denticulate bristles (except perhaps *M. sp*$_1$, the bristles of which are unknown); and so it is just possible that the bristle figured is appurtenant. However, the material is too sparse and heterogenous for a safe establishment whether or not this is a *Mallomonas areolata*.

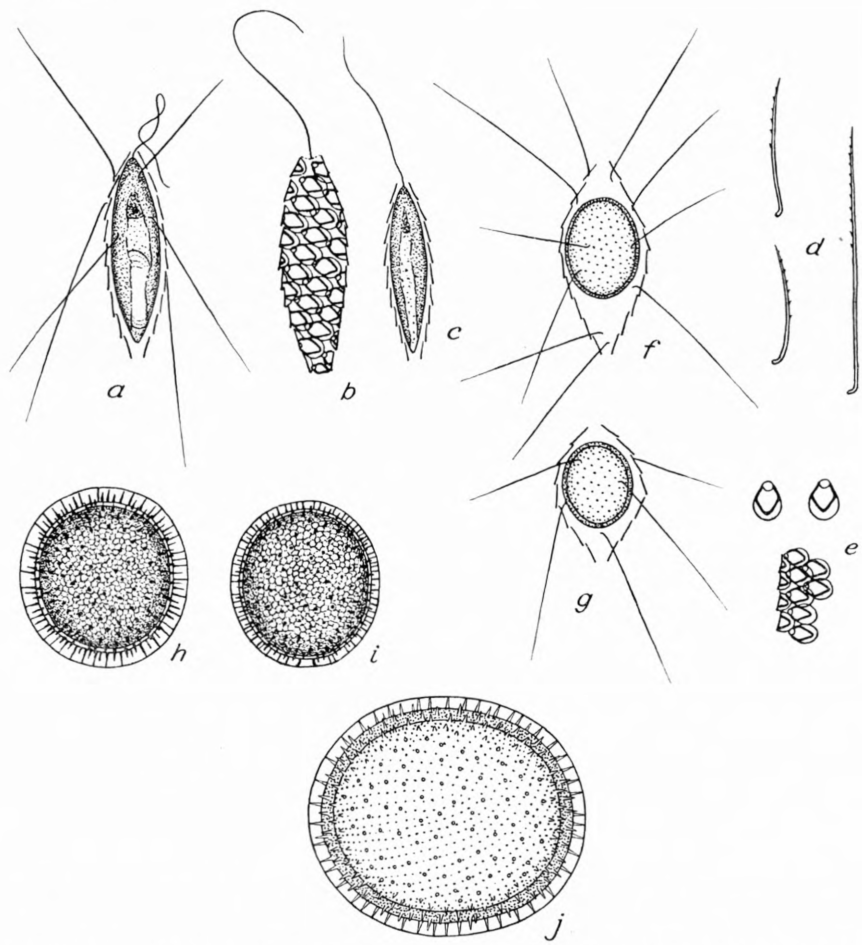

Fig. 62. *Mallomonas areolata* n. sp. from Gadevang Mose, April 28th, 1930. *a*, *c*, *f* and *g* are drawn after living material; *b*, *d* and *e* after material dried up on a cover-slip (all figures 800×). *h*, *i* and *j* cysts drawn after material heated on a cover-slip (*h*—*i* 1600×, *j* 2400×).

Systematics. *Mallomonas areolata* belongs to the *tonsurata* group on account of its ovate scales with v-shaped markings and the denticulate bristles, which are principally found at the anterior end of the cell. From *Mallomonas tonsurata*, *M. alpina* and *M. elongata* it differs by the shape, size and structure of the cysts, from the first two further by the shape of the cell and the larger scales, etc., from the last one further by its smaller dimensions, the relatively great length of the flagellum, the length of the bristles, etc.

Periodicity. In Gadevang Mose the species was first seen on March 15th, 1930 (temp. 5° C.), several individuals occurring. The rather high maximum was reached on April 1st (9° C.). The formation of cysts took place in April, especially during the latter half of the month, and at the beginning of May. After the middle of May the species had totally disappeared from the plankton. In Sortedam II it was observed at the beginning of April at temperatures of 3.5 and 8° C. In other words it is a typical spring organism (March—May), the limits of temperature being 3.5 and 18.5° C., and the maximum development occurring at temperatures below 10° C.

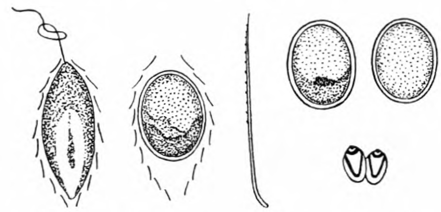

Fig. 63. *Mallomonas areolata* n. sp.? from Sortedam II, April 10th, 1930. 800×.

Sociology. In Gadevang Mose the species was found in the following associations:

Mar. 15th, 1930: Association of a unicellular green alga with *Ma ak* as subdominant (*M. areolata* not infrequent).
Apr. 1st, — : *Crym ov*-association with *Ma ak* as subdominant (*M. areolata* common).
— 7th, — : *Crym ov* - *Ste Ha* - association (*M. areolata* not infrequent).
— 10th, — : *Ste Ha*-association with *Crym ov* as subdominant (*M. areolata* rare).
— 22nd, — : *Crym ov*-association with *Ste Ha* as subdominant (*M. areolata* rare).
— 28th, — : *Ste Ha*-association (*M. areolata* not infrequent).
May 1st, — : *Ste Ha*-association (*M. areolata* rare).
— 10th, — : *Ste Ha*-association (*M. areolata* rare).

In Sortedam II the species presumably occurred in the following associations:

Apr. 1st, 1930: *Ank fa se el* - *Crym ov*-association (*M. areolata* very rare).
— 10th, — : *Crym ov*-association with *Chla ac* as subdominant (*M. areolata* rare).

In other words *Mallomonas areolata* occurs in flagellate associations of *Cryptomonas*, in diatom associations of *Stephanodiscus* and in green algae associations, *i. a.* of *Ankistrodesmus.*

The most constant associates were *Cryptomonas ovata* and *Stephanodiscus Hantzschii*, which occurred in 100 % of the number of samples (10) that contains *Mallomonas areolata*; *Mallomonas akrokomos* and *Chlamydomonas Reinhardii* (+var. *minor*) reached 80 %.

Ecology. In spite of the enormous *Stephanodiscus Hantzschii* maximum in spring the somewhat contaminated and a little overshadowed Gadevang Mose is not a quite typically mixotrophic pond (see Table III). After its abundant development of plankton in April when the plankton shows a totally "eutrophic" character it becomes distinctly acid during early summer and develops no trace whatever of water bloom of blue-green algae in summer or autumn but an enormous maximum of *Ceratium hirundinella.* Data of the ecology of *Mallomonas areolata* are: pH 7.1—8.6, calcium content 15.6—15.9 mg of CaO per litre, consumption of $KMnO_4$ 72 mg/l, contents of NH_3-N 0.2—0.35 mg/l, NO_2-N 0—0.16 mg/l, PO_4-P 0.11—0.175 mg/l and Fe 0.3 mg/l.

Mallomonas heterothricha n. sp.

Fig. nostra 64.

Diagnosis. Cellulae ellipsoideae, duplo longiores quam latiores, 16—21 μ longae, 8—10 μ latae. Squamis siliceis rotundatis—late ovalibus, levibus, parvis, 2—2.5 μ longis, in lineis spiralibus satis praecipiter ascendentibus superficie cellulae locatis. Setae formarum duarum: vel 18—25 μ longae, rectae, mobiles, interdum apicaliter paulo recurvatae; vel 7—13 μ longae, curvae, immobiles. Quae leves atque omnes ad apicem cellulae aggregatae et tantum hic occurrentes sunt. Numerus setarum longarum plerumque 8, numerus brevium 5—8. Flagellum $\frac{1}{3}$—$\frac{1}{2}$ corporis longitudinis. Duobus chromatophoris luteo-brunneis instructae sunt. Cystae ignotae.

Hab. In Teglgaard Sø, Selandia, Dania, libere natans.

Systematics. When alive this species is easily distinguished from all other *Mallomonas* species by its 2 kinds of bristles. The small curved ones stand like the stretchers of a put-up umbrella from the anterior end of the cell and are rather immovable; the mobility of the long straight bristles amounts to nearly 90°. In swimming individuals nearly all the long bristles are standing almost parallel to the longitudinal axis of the cell whereas in resting individuals they are directed obliquely sidewards so as to stand nearly square to the longitudinal axis. If these observations under the coverslip apply in the free natural bodies of freshwater, we have here a *Mallomonas* species which to a special degree is able to vary its sinking rate (as compared to its active motion) when not swimming actively.

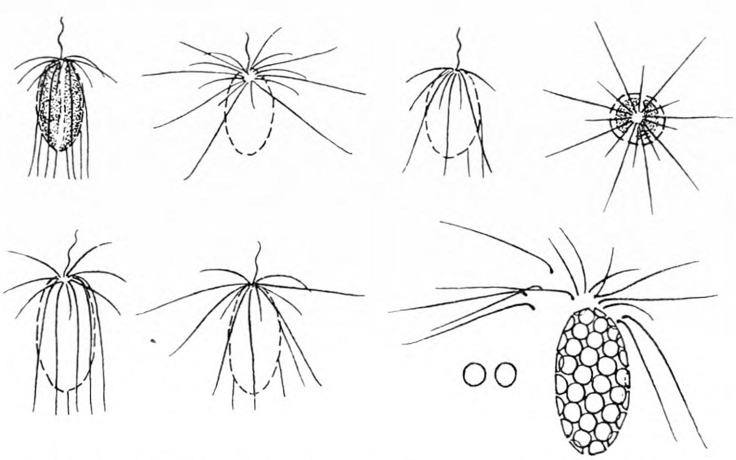

Fig. 64. *Mallomonas heterothricha* n. sp. from Teglgaard Sø, October 7th, and 14th, 1929. Last figure 1070×, the others 850×.

Periodicity. A few specimens appeared on October 3rd, 1929 (temp. 12° C.) in Teglgaard Sø, and the species was last seen on November 30th, 1929 (temp. 6° C.). The highest frequency of *Mallomonas heterothricha* occurred on October 23rd—25th (temp. 8.5° C.), the species, however, being in no way predominant. This *Mallomonas* was never observed in any of the other ten months of the year. It must therefore be considered an oligo- to mesothermic autumnal form with an amplitude of temperature between 4 and 12° C. and with a maximum development at the end of October at 8.5° C.

Sociology. The species occurred in the following associations:

Oct.	3rd,	1929:	*Chry mi*-association (*M. heterothricha* very rare).
—	7th,	— :	*Din di*-association (*M. heterothricha* rare).
—	14th,	— :	*Chry mi*-association (*M. heterothricha* very rare).
—	23rd,	— :	*Chry mi*-association (*M. heterothricha* not infrequent).
—	25th,	— :	*Ste Ha*-association (*M. heterothricha* rather common).
Nov.	2nd,	— :	*Chry mi*-association (*M. heterothricha* not infrequent).
—	16th,	— :	*Crym ov*-association (*M. heterothricha* rare).
—	28th,	— :	*Ste Ha*-association (*M. heterothricha* not infrequent).
—	30th,	— :	*Crym ov*-association (*M. heterothricha* very rare).

Mallomonas heterothricha thus occurs in flagellate associations of *Chrysococcus*, *Cryptomonas* and *Dinobryon* and in a diatom association of *Stephanodiscus*.

The most constant associates were *Chrysococcus minutus*, *Scenedesmus armatus* and *Stephanodiscus Hantzschii*, which occurred in 100 % of the samples (9) that contained *Mallomonas heterothricha*; *Cryptomonas ovata* reached 90 %.

Ecology. The eutrophic pond Teglgaard Sø is situated in open land and nearly overgrown with reed swamps. Both inlets and outlets are present. The species occurred at pH values between 7.4 and 7.6, at a calcium content of 53.4—55.7 mg of CaO per litre and a consumption of 37 mg $KMnO_4$ per litre. Other data are: NH_3-N 0.2 mg/l, NO_3-N 0—0.01 mg/l, PO_4-P 0,01 mg/l; on January the Fe content was 0.45 mg/l.

Mallomonas oviformis n. sp.

Fig. nostra 65.

Diagnosis. Cellulae late oviformes, 23—24 μ longis, 19—20 μ latis. Squamis siliceis ovalibus, inter se semitectis, in lineis spiralibus axi longiore transverse ordinatis, levibus et prope duplo longioribus quam latioribus, 6—7 μ longis, 3—4 μ latis. Setis rectis, levibus, satis paucis, in superficie cellulae dispersis, $\frac{1}{4}$—1 cellulae longitudinis, 6—25 μ longis. Flagello corpori aequilongo, ab apice subacuto cellulae exoriente. Duobus chromatophoris luteofuscis instructae. In parte posteriore cellulae globulum leucosini et vacuola contractilia observata sunt. Cystae ignotae.

Hab. In Rønhavegaard Dam, Alsia, Dania, libere natans.

Systematics. This new species differs from *Mallomonas ovum* Schiller (1926, p. 15, fig. 7; incomplete description) in the shape of the cells and the location of the scales, possibly also in their shape, which is not described by SCHILLER. The species should also be compared with *Mallomonas semiglabra* n. sp. (p. 124), in which, however, the flagellum of half the length of the body is situated in the broadly rounded part of the cell, and the scales of which are smaller with half their surface punctate, the smooth part having only a slight depression in which the bristle is fixed.

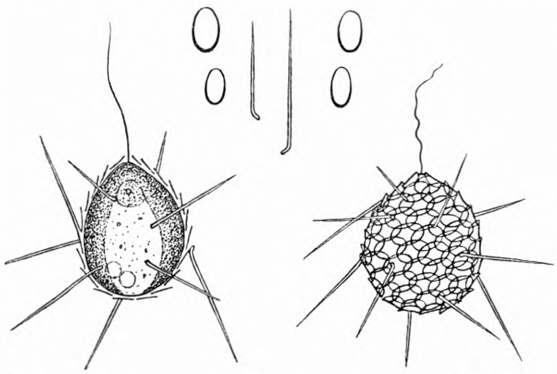

Fig. 65. *Mallomonas oviformis* n. sp. from Rønhavegaard Dam, March 12th, 1944. 800×.

The species was represented by a few individuals in Rønhavegaard Dam on March 12th and 19th, 1944 (temp. 4.5 and 6° C.) and is possibly a cold water form like *Mallomonas semiglabra*. On March 8th and 22nd, 1945 the species failed to reappear.

Mallomonas oviformis was very rare in the following two associations:

Mar. 12th, 1944: *Chrom No mi*-association with *Chla Re* as subdominant.
— 19th, — : *Chrom No mi*-association with *Ste Ha* as subdominant.

Rønhavegaard Dam is a highly eutrophic pond, which is polluted *i. a.* by swimming birds. Such an enormous development of plankton is rare in March; the water had an intense and deep blue-green colour from the large quantities of *Chroomonas* and *Chlamydomonas*. At the said time pH was 8.2 at 3 p. m.

Mallomonas pediculus Teiling var. **echinospora** n. var.

Fig. nostra 66.

Diagnosis. Cellulae late ellipsoideae vel oviformes, 18—26 μ longae, 14—17 μ latae, 1.25—1.6 plo longiores quam latiores. Squamae siliceae in lineis spiralibus, oviformes, 6 μ longae, 4 μ latae, ad apicem anteriorem loco depresso et hic seta affixa est, ceterum leves cum v-descriptione (cellulae vivae squamis rhombeis tectae videntur). Setis acutis, retroflexis, corpore aequilongis, per superficiem totam cellulae extendentibus, 14—24 μ longis, valde arcuatis, in apicibus non recurvatis, in latere convexo serie spinarum tenuissimarum instructae. Flagello $\frac{1}{2}$—$\frac{3}{4}$ longitudinis cellulae, raro cellulae longitudine aequilongo. Duobus chromatophoris luteo-brunneis instructis. Cystis globosis, spinis tenuibus tectis, 17—18 μ in diametro, foramine $2\frac{1}{2}$ μ lato.

Hab. In Badstue-Ødam, Selandia, Dania, libere natans.

Systematics. This variety, the silicious bristles of which lie close to the cell when it swims is distinguished from *Mallomonas acaroides* Perty by the character of the bristles, the relative length of the flagellum and the size and structure of the cysts. According to W. KRIEGER (1930, p. 292, Fig. 35) the bristles of *Mallomonas acaroides* are recurvate at the tip and have only 2 denticles near the apices; the flagellum is as long as the body, and the verrucose cysts are 20—22 μ in diameter. It is well-known that the *Mallomonas tonsurata* group (*M. tonsurata*, *M. alpina* and *M. elongata*), the scales of which have the same characteristic v-shaped markings, includes species with denticulate bristles. These species, however, are conspicuous by having the greater part of their bristles directed forward fountain-like; moreover only the front half or two thirds of the cell are covered with bristles.

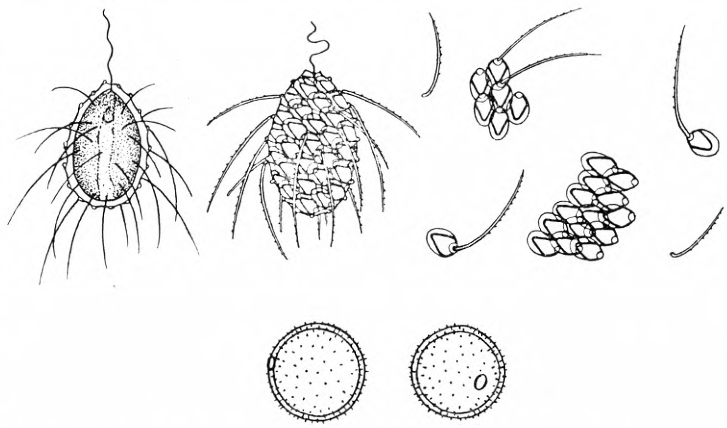

Fig. 66. *Mallomonas pediculus* Teiling var. *echinospora* n. var. from Badstue-Ødam, May 6th, 1931. 800×.

After this part of the manuscript had been terminated and translated, Dr. EINAR TEILING sent me his paper "Zur Phytoplanktonflora Schwedens", 1946. When I had studied more closely the *Mallomonas* species described in his paper, it became clear to me that my "*Mallomonas Mülleri*" n. sp. was closely related to *Mallomonas pediculus* Teiling. According to TEILING's information to me the latter species has smooth cysts, and so the Danish individuals have been classed as a new variety of *Mallomonas pediculus*.

Periodicity. *Mallomonas pediculus* var. *echinospora* was observed for the first time on April 3rd, 1930 in Badstue-Ødam. In this month it was sometimes very rare or absent, sometimes common. Between May 10th and 31st (temp. 12—20.5° C.) it was rather common in the plankton of the pond, particularly on May 21st (temp. 17° C.). Already on June 16th it was absent. The formation of cysts took place during the latter half of May (temp. 17—20.5° C.). In the plankton sample taken with townet on May 6th, 1931 the species was common.

Mallomonas pediculus var. *echinospora* thus seems to be eurythermic, in April and May occurring within an interval of 6—20.5° C. The maximum development of this spring form took place in May (temp. about 17° C.).

Sociology. The variety was found in the following associations:

Apr. 3rd, 1930: *Ste Ha*-association with *As fo* and *Sye ac an* as subdominants (*Mallomonas* not infrequent).

Apr. 22nd, 1930:		*Sye ac an*-association with *Ura vo* as subdominant (*Mallomonas* very rare).
— 25th,	— :	*Din so - Sye ac an*-association (*Mallomonas* common).
May 10th,	— :	*Ste Ha - Sye ac an - Ura vo*-association (*Mallomonas* not infrequent, about 1.700 individuals per ml).
— 16th,	— :	*Ura vo*-association (*Mallomonas* not infrequent).
— 21st,	— :	*Ura vo*-association (*Mallomonas* common).
— 31st,	— :	*Cy st su*-association (*Mallomonas* rather common).
— 6th, 1931:		*Sye ac an*-association with *Dia el* and *Syu Pe* as subdominants (*Mallomonas* common).

In other words *Mallomonas pediculus* var. *echinospora* mainly occurs in diatom-associations of *Cyclotella*, *Stephanodiscus* and *Synedra*, but also in flagellate associations of *Dinobryon* and *Uroglena*.

The most constant associates were *Synedra acus* var. *angustissima* and *Uroglena volvox*, which occurred in 100 % of the number of samples that contained *Mallomonas pediculus* var. *echinospora*. *Anabaena incrassata*, *Asterionella formosa*, *Chrysococcus minutus*, *Cyclotella Meneghiniana*, *Glenodinium edax*, *Scenedesmus armatus*, *Stephanodiscus Hantzschii*, *Trachelomonas intermedia* and *Trach. volvocina* occurred in 88 %, *Cryptomonas ovata* and *Peridinium palatinum* in 75 % of the samples.

Ecology. Badstue-Ødam is somewhat overshadowed, has inlets and outlets and ranges between the eutrophic and the mixotrophic types of water. A synopsis of the ecology of *Mallomonas pediculus* var. *echinospora*: pH 8.4—9.4, consumption of $KMnO_4$ 44—57 mg/l, contents of CaO 81.4—82.2 mg/l, Fe 0.02 mg/l, NO_3-N 0—0.35 mg/l, NH_3-N 0.05—0.1 mg/l, and PO_4-P 0.005—0.01 mg/l.

Mallomonas semiglabra n. sp.

Fig. nostra 67.

Diagnosis. Cellulae obovatae, saepe ad partes posteriores subacutatae, 20—$22\frac{1}{2}$ μ longae, 14—17 μ latae. Squamis siliceis ovalibus, in lineis spiralibus ordinatis, ascensu parvo, 4—$4\frac{1}{2}$ μ longis, $2\frac{1}{4}$—3 μ latis, tantum in parte dimidia punctatis; pars levis in apice locum depressum parvum habet, in quo seta fixa est. Setis levibus, rectis, 9—21 μ longis, in superficie omni cellulae dispersis. Flagello $\frac{1}{2}$ cellulae longitudinis. Duobus chromatophoris luteo-brunneis instructae. Cystis oviformibus, tenuiter punctulatis, magnitudine cellularum. Protoplasma totum cellulae ad natum cystae consumitur.

Hab. In Spejldam, Hesteskodam et Sortedam II, Selandia, Dania, libere natans.

Systematics. This species differs from all those formerly described by its characteristic scales. Moreover the cell seems to be set with round, punctate scales because the smooth part of one scale is situated immediately above the punctate part of the neighbouring scale. In this way the species gets a superficial resemblance to *Mallomonas reginae* Teil., but it will always be possible to see the true structure of the scale from dry-slides. Besides this the scales of the latter species are larger: 5.5—7.5 μ long and 4—5.5 μ broad.

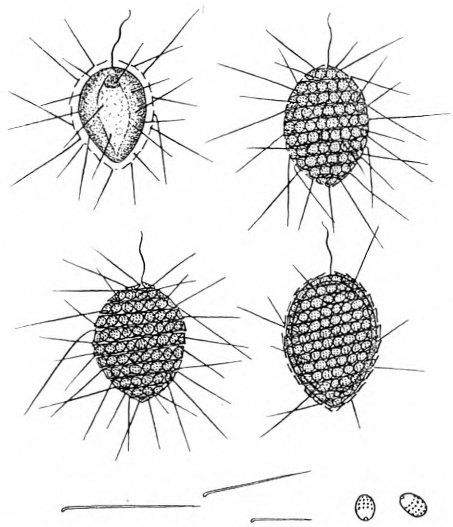

Fig. 67. *Mallomonas semiglabra* n. sp. from Spejldam, March 15th, and April 1st, 1930. 800 ×.

Periodicity. *Mallomonas semiglabra* appeared in Spejldam on November 22nd, 1929 when the temperature had fallen to 4° C. During the following winter months it was extremely rare and was even lacking in several of the samples. A more frequent occurrence was not observed until the beginning of March 1930, and particularly on March 15th (temp. 3° C.), when the ice was going to melt, the individuals were so numerous that they prevailed in the plankton. Most of them were finishing the formation of spores. Already at the beginning of April (temp. 4.5—6° C.) the species had disappeared from Spejldam; in the examination of the living plankton only one egg-shaped cyst was observed on April 4th (temp. 4.5° C.). In Hesteskodam, however, which drains directly into Spejldam, a few specimens were seen on April 4th (temp. 5° C.). In Sortedam II it did not appear until March 15th, 1930 (temp. 4.5° C.) when it was comparatively frequent. At the beginning of April (temp. 3.5—8° C.) it was rare; the last occurrence was observed on April 10th. The species was never found during the warm half of the year.

Accordingly, *Mallomonas semiglabra* must be characterised as typically oligothermic or a stenothermic cold water form because it was found only at temperatures between 0.5 and 8° C. Its maximum occurred in March (temp. 3—4.5° C.) during the breaking of the ice.

Sociology. The species was observed in Spejldam in the following associations:

Nov. 22nd, 1929: *Ma ak - Tra vo*-association (*M. semiglabra* very rare).
Feb. 17th, 1930: *Crym ov - Chla ac*-association (*M. semiglabra* very rare).
Mar. 1st, — : *Chla ac*-association with *Mallomonas* sp_1 as subdominant (*M. semiglabra* rare).
— 15th, — : *Ma se*-association with *Ank fa se br* as subdominant (*M. semiglabra* common).

Apr. 4th, 1930: *Ank fa se br*-association (*M. semiglabra* very rare).

In Hesteskodam it was only present in this association:

Apr. 4th, 1930: *Mio ho* with *Ank fa se br* as subdominant (*M. semiglabra* very rare).

In Sortedam II the species occurred in the following associations:

Mar. 15th, 1930: *Mallomonas* sp_1-association with *Crym ov* and *Ma ak* as subdominants (*M. semiglabra* rather common).
Apr. 4th, — : *Crym ov* - *Ank fa se el*-association (*M. semiglabra* not infrequent).

This means that the species mostly occurs in flagellate associations of *Cryptomonas*, *Mallomonas* and *Trachelomonas*, more rarely in green algae associations of *Chlamydomonas* and *Ankistrodesmus* and in a blue-green algae association of *Microcystis*.

The most constant associates were *Ankistrodesmus falcatus* var. *setiformis*, *Glenodinium edax*, *Chlamydomonas acidophila*, *Mallomonas akrokomos* and *Trachelomonas volvocina*, which all occurred in 75 $^0/_0$ of the number of samples (8) that contained *Mallomonas semiglabra*.

Ecology. Both Spejldam and Hesteskodam are rather overshadowed ponds draining into Frederiksborg Slotssø. Hesteskodam in particular is polluted (mem. *Euglena sanguinea*), and both of them are eutrophic—mixotrophic with their great maximum of *Cyanophyceae* in late summer (Spejldam: *Aphanizomenon flos aquae*; Hesteskodam: *Microcystis aeruginosa* + *Anabaena Viguieri*). Sortedam II is a typical mixotrophic, greatly overshadowed pond. A synopsis of the ecology of the species: pH 6.8—8.0, consumption of $KMnO_4$ 37—84 mg/l, contents of CaO 36.4—42.9 mg/l, Fe 0.17 mg/l, NO_3-N 0.06—0.43 mg/l, NH_3-N 0.08—0.55 mg/l and PO_4-P 0.015—0.03 mg/l.

Mallomonas sphagnicola n. sp.

Fig. nostra 68.

Diagnosis. Cellulae magnae, cylindricae vel longe ellipsoideae apicibus rotundatis vel subacutis, 3.1—4.7 plo longiores quam latiores. Laminis tegumenti magnis, 1.5—1.8 plo longioribus quam latioribus, 7—9 μ longis, 4—5.5 μ latis, ellipticis, raro subcuneatis, cum v-descriptione et margine striatulo, 10—12 striis pro 4 μ, medio indistincte punctulatis vel striatulis, in series spirales axi longiore transverse ordinatis. Superficies tota cellulae setis numerosis, glabris vel indistincte denticulatis, rectis vel leviter curvatis, 19—43 μ longis tecta. Chromatophori bini, luteo-brunnei, parietales et longi. Nucleus in parte anteriore cellulae. Flagellum breve, $\frac{1}{3}$—$\frac{1}{2}$ longitudinis cellulae, 20—25 μ longum. Vacuola contractilia quattuor in parte posteriore cellulae, raro vacuolum unum in parte anteriore. Longitudo cellularum 56—69 μ, latitudo 13—20 μ.

Hab. In Bøndernes Mose I et II prope Hillerød, Selandia, stagno turfaceo prope Skaansø, Jutlandia, Dania, libere natans.

Systematics. The species differs from all other previously described *Mallomonas* species by its big scales with marginal striation and a v-shaped marking, and so it might just as well be termed *Mallomonas megalepis* n. sp. The scales of most species seem to be 2—5 μ in size, a few of them (*M. Teilingii* and *M. tridentata* n. sp.)

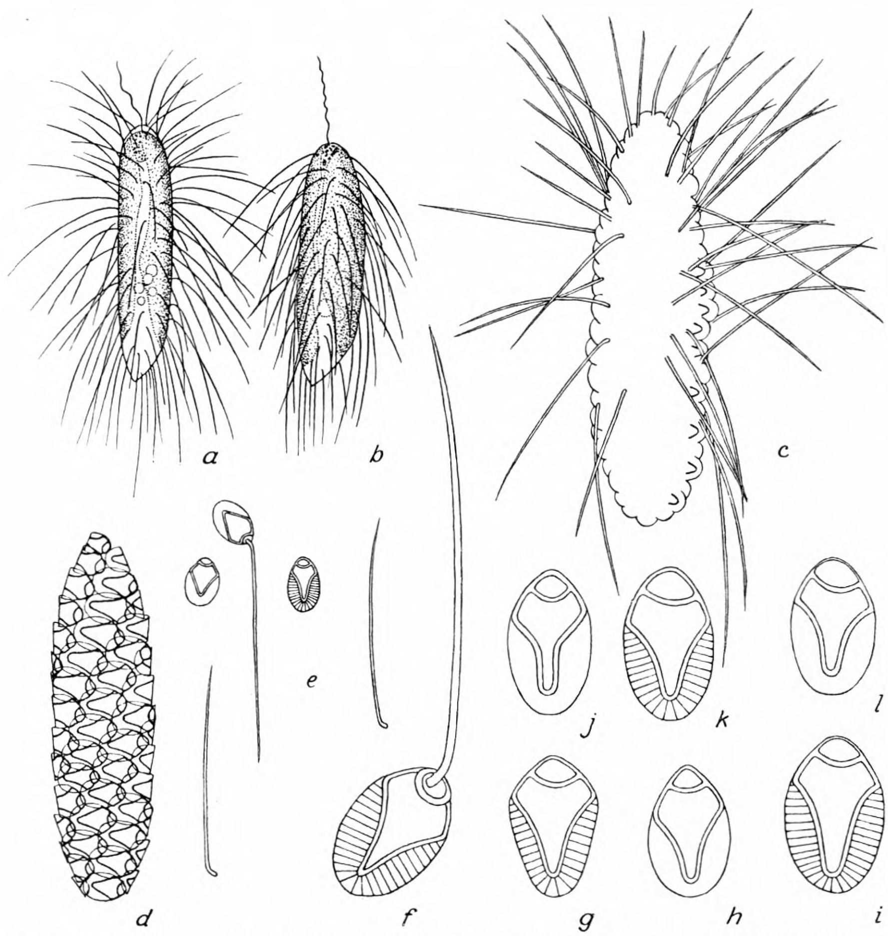

Fig. 68. *Mallomonas sphagnicola* n. sp. from Bøndernes Mose II; *a*—*b* are delineated from living material, September 7th, 1929, 550 ×; *c*—*l* from dried-up material, June 16th, 1930; *e*—*l* silicified scales and bristles. *c*, *d* and *e* 800 ×, *f*—*l* 2400 ×.

have densely punctate scales of 6—8 μ; only *M. caudata* have scales of the same dimensions as *Mallomonas sphagnicola*, but it is well-known that the scales of the former are completely smooth and nearly round.

After this part of the manuscript had been finished and translated I received Bourrelly's interesting paper (1947) on the algae of la Forêt de Fontainebleau. In this paper Bourrelly has described *Mallomonas Leboimii* (p. 4, t. 3, figs. 12—16), a very characteristic species with scales which as to form and structure are quite similar to those of *Mallomonas sphagnicola* n. sp.; they are, however, considerably larger (10—12 $\mu \times$ 6—7 μ) than the scales of *Mallomonas sphagnicola*. *Mallomonas Leboimii* further differs in having relatively shorter cells (35—50 $\mu \times$ 10—22 μ), strongly dentate bristles and a flagellum of the same length as the cell.

Periodicity. During the examination of the living plankton from Bøndernes Mose I and II the species was found in Bøndernes Mose II in all months of the year (1929) except February, March and April, *i. e.* not during and immediately after the freezing-up of the pond. It reached its highest frequencies in the September samples and the sample from June 1930 without ever being very conspicuous. In this locality the species was eurythermic, occurring at temperatures between 2.5 and 21° C.

In Bøndernes Mose I, however, the species was distinctly periodical: it was seen only in the September samples at temperatures of 15.5 and 11.5° C.

In the turf pit NE of Skaansø the species was not infrequent on July 4th, 1938 (temp. 18,5° C.).

In contrast to several *Mallomonas* species, the maxima of which occur about the time when the ice breaks in the ponds, *Mallomonas sphagnicola* thus seems to reach its optimum development in September at temperatures between 11.5 and 16.5° C. If this eurythermic species is diacmic, its second vegetation period most probably occurs in June.

Sociology. The species occurred in the following associations:

Bøndernes Mose II.

July 5th, 1929: *Crym ov cu*-association with *Tra vo* as subdominant (the species rare).
Aug. 22nd, — : *Crym ov cu*-association (the species very rare).
Sep. 7th, — : *Tra vo*-association with *Crym ov cu* as subdominant (the species not infrequent).
— 22nd, — : *Crym ov cu*-association (the species not infrequent).
Oct. 9th, — : *Crym ov cu*-association with *Tra vo* as subdominant (the species rare).
— 29th, — : *Tra vo*-association (the species rare).
Nov. 24th, — : *Crym ov*-association (the species rare).
Dec. 16th, — : *Crym ov*-association (the species very rare).
Jan. 15th, 1930: *Tra vo*-association with *Eug pr* as subdominant (the species very rare).
May 24th, — : *Crym ov cu*-association (the species very rare).
June 16th, — : *Crym ov cu*-association with *Tra vo* as subdominant (the species not infrequent).

The qualitative composition of the associations from August 22nd, 1929 and June 16th, 1930 appears from Table IV.

Bøndernes Mose I.

July 5th, 1929: *Crym ov cu*-association with *Gos se* as subdominant (the species very rare).

Sep. 7th, 1929: *Crym ov cu*-association with *Gos se* as subdominant (the species not infrequent).
— 22nd, — : ditto.

Turf pit NE of Skaansø.

July 4th, 1938: *Sta br*-association with *Sta de lo* as subdominant (the species not infrequent).

In other words the species occurs in Flagellate associations (*Cryptomonas* and *Trachelomonas*) and a desmid association of *Staurastrum*.

The most constant associates were *Cryptomonas ovata* (var. *curvata*), which occurred in 93 $^0/_0$ of the number of samples (15) that contained *Mallomonas sphagnicola*; *Goniostomum semen* occurred in 80 $^0/_0$ and *Trachelomonas volvocina* in 73 $^0/_0$ of the samples.

Ecology. Bøndernes Mose I and II are two small oligotrophic turf-pits of the dystrophic phase, situated in a raised bog of Gribskov. The turf pit NE of Skaansø is quite similar. They have quaking bog of *Sphagnum cuspidatum*. The following are dates from the ecology of *Mallomonas sphagnicola*: pH 4.1—4.4, CaO 0.8—5 mg/l, consumption of $KMnO_4$ 176—202 mg/l, content of PO_4-P 0 mg/l, NH_3-N 0.9—1.6 mg/l, NO_3-N 0 mg/l, and Fe 0.25 mg/l.

Mallomonas tessellata Nyg.

Nygaard 1945, p. 52, fig. 18.—*Fig. nostra* 69.

Diagnosis. The *setae* are not dispersed over the surface of the cell as stated in the original diagnosis. An examination of living cells from the *Eriophorum* moor at Sorø and Store Gribsø showed that they were found only on the front end of the cell and in a number of 4—5; they are always more or less curved, and their length is about $^3/_4$ that of the cell.

According to 40 measurings of cells, both sterile and carrying cysts, the cells are 18—44 μ long, 10—18 μ broad, ratio of axes 1.7—3 (average 2.26). 24 measurings of cysts proved them to be 17—23 μ long, 11—15 μ broad, ratio of axes 1.2—1.8 (average 1.5), shape ellipsoidical. 20 measurings of the thick, more or less curved, pointedly oval scales gave lengths of 4—9.5 μ, breadths of 2—4.5 μ (mostly 6—8 $\mu \times$ 3—4 μ) with 3—9 points along each side.

Distribution. Sortedam II, Hesteskodam, Store Gribsø and *Eriophorum* moor, Seeland, Store Øxsø and Løvenholm Langsø, Jutland, pelagic.

Systematics. Bourrelly (1947, p. 5, t. 4, figs. 17—20) has emendated Conrad's description of *Mallomonas lychenensis* (see Huber-Pestalozzi 1941, p. 94, fig. 111 A), now including individuals with 5—7 apical siliceous bristles. Both *Mallomonas lychenensis* and *Mallomonas tessellata* have the apical scales ("Oralschuppen") in common, see Fig. nostra 69A. The reason why I have not referred *Mallomonas* *tessellata* as a synonym to *Mallomonas lychenensis* is that a renewed examination of more than 100 cysts from the Danish material has proved that the cysts never possess a 6—9 μ broad collar as demonstrated in HUBER-PESTALOZZI's and BOURRELLY's text-figures cited above. The exactly ellipsoidical cysts of *Mallomonas tessellata* are

Fig. 69. *Mallomonas tessellata* Nyg.; *a*—*j* from Store Øxsø, May 23rd, 1929; *k*—*ø* and *A* from Eriophorum moor, *k*—*v* and *æ* from March 20th, 1948, *x*, *y* and *z* from January 10th, 1948; *B* from Sortedam II, April 1st, 1930. Only the outlines of the cells are drawn except *h*, *i* and *z*, *A* apical scales ("Oralschuppen"), *j* and *ø* scales, *x* vertical view. Magnification of the cells 710 ×, of the scales 2140 ×.

only provided with a 3—4.5 μ broad aperture in the apical part; very rarely they are slightly thickened around this aperture.

Periodicity. Among the localities mentioned above Sortedam II was examined fortnightly for a whole year and the *Eriophorum* moor monthly for 12 months. In Sortedam II the species was totally absent from June 1929 till the beginning of March 1930. It did not appear until March 15th when the ice was beginning to break, and the temperature was 4.5° C., and at the beginning of April (temp. 3.5—8° C.) a few individuals carrying cysts were found in the plankton. It was seen for the last time on April 10th.

In the *Eriophorum* moor it was lacking in all samples from July—November 1947, but a few specimens appeared on December 13th (temp. 3° C.). On January 10th, 1948, when the moor was about to freeze up (temp. 1° C.), it was rather common, and on February 21st, when the ice was 8 cm thick and the temperature 2° C., it was common, and now a few individuals were beginning to form cysts. On March 20th, when the moor was free from ice and the temperature had risen to 7.5° C., the species was common, too, and most of the individuals were carrying cysts. On April 17th (temperature 15.5° C) *Mallomonas tessellata* was rare; the specimens contained cysts. On May 14th, June 13th, and July 13th the species was not observed.

As will appear from the following section the species also occurred in May and September and even in August (temp. 27° C.).

Accordingly, *Mallomonas tessellata* must be characterized as eurythermic, occurring at temperatures between 1 and 27° C. Its maximum development, during which it may be the dominant form of the plankton, falls within the period between January and the beginning of April at temperatures between 1 and 8° C.; even under the ice it may be common. The formation of cysts was observed from February to the beginning of April.

Sociology. The species occurred in the following associations:

Sortedam II.

Mar. 15th, 1930: *Ma* sp_1-association with *Ma ak* and *Crym ov* as subdominants (the species rare).
Apr. 1st, — : *Crym ov*-association (the species very rare).
— 4th, — : *Crym ov - Ank fa se el*-association (the species very rare).
— 10th, — : *Crym ov*-association with *Chla ac* as subdominant (the species very rare).

Eriophorum moor.

Dec. 13th, 1947: *Gle Lo - Per Wi*-association (the species very rare).
Jan. 10th, 1948: *Gle Lo*-association (the species rather common).
Feb. 21st, — : *Ma te*-association with *Gle Lo* as subdominant (the species common).
Mar. 20th, — : *Syu Pe - Ma te*-association (the species common).
Apr. 17th, — : *Chrysococcus*-association (the species rare).

Hesteskodam.

Apr. 4th, 1930: *Ank fa se br*-association (the species not infrequent).

Store Øxsø.

May 23rd, 1929: *Asi fo*-association (the species rare).

Store Gribsø.

June 18th, 1929: *Crym ov*-association (the species very rare).
Jan. 4th, 1947: *Ma ak*-association (the species very rare).

Løvenholm Langsø.

Sep. 9th, 1929: *Ma ca*-association (the species rare).
Aug. 1st, 1948: *Bo Br*-association (the species very rare).

Mallomonas tessellata thus occurred in cryptophycean associations of *Cryptomonas*, chrysophycean associations of *Mallomonas* and *Synura*, more rarely in dinophycean associations of *Glenodinium* and *Peridinium*, chlorophycean associations of *Ankistrodesmus* and diatom associations of *Asterionella*.

The most constant associates were *Synura Petersenii* and *Euglena acus*, which occurred in 70 % of the number (13) of samples that contained *Mallomonas tessellata*.

Ecology. The species is uncommonly adaptive, at least to the same degree as *Mallomonas caudata*. All the waters that contain *Mallomonas tessellata* are more or less rich in humus, the smallest amount of which is perhaps found in Hesteskodam whereas Løvenholm Langsø contains quite extraordinary quantities (see Table I). The species was found in an extremely eutrophic pond with brownish water (Hesteskodam), in a highly eutrophic pond of the mixotrophic phase (Sortedam II) and in 3 oligotrophic lakes of the dystrophic phase (Løvenholm Langsø, Store Øxsø and Store Gribsø). The *Eriophorum* moor is more difficult to place within the system (see p. 166 where *i. a.* its plankton composition is given), but it is a fact that its water was brown when *Mallomonas tessellata* occurred in it and that it is contaminated by cattle. The plankton quotients of the 3 oligotrophic lakes appear from Table I, those of Hesteskodam are mentioned on p. 211, and the quotients of Sortedam II are found in Table III.

The following data speak of the very different environments in which *Mallomonas tessellata* lives: pH 4.1—7.5, content of CaO 3—42.9 mg/l, consumption of $KMnO_4$ 86—several hundred mg/l, contents of PO_4-P 0—0.03 mg/l, NH_3-N 0.4—0.55 mg/l, NO_3-N 0—0.43 mg/l; on January 31st, 1930 Sortedam II contained 0.35 mg Fe per litre.

Mallomonas tridentata n. sp.

Fig. nostra 70.

Diagnosis. Cellulae cylindricae vel longe ellipsoideae, in parte posteriore saepe subacutae, 50—81 μ longae, 16—20 μ latae, in natione cystae turgidae, ad 24 μ latae. Squamis siliceis ovalibus vel rotunde angulatis, tenuiter punctatis, in series spirales axi longiore transverse ordinatis, $4^1/_2$—$6^1/_2$ μ longis, 3—5 μ latis. Setis levibus, satis parcis, ad apices cellulae restrictis, 17—33 μ longis. Flagello corpori aequilongo vel paulo longiore. In parte anteriore cellulae nucleus submagnus situs. Duobus chromatophoris instructis, prope ad partem posteriorem cellulae attinentibus. Cystis longe obovatis vel fusiformibus, in parte posteriore acutis, in parte anteriore subtruncatis, et hic tribus verrucis instructis, 41—57 μ longis, 17—21 μ latis. Protoplasma et chromatophori cellulae a nata cysta prorsus non consumuntur.

Hab. In Vandingsdam et Sortedam II prope Hillerød, Dania, libere natans.

Systematics. In the vegetative state this species differs from *Mallomonas Teilingii* Conrad (1927, p. 465, Fig. 19; Krieger 1930, p. 286, Fig. 28) in the cell dimensions being a little larger and the scales smaller. When carrying cysts, however, the two species could not possibly be mistaken. For the rest both species were found together in Sortedam II in the plankton from the month of March.

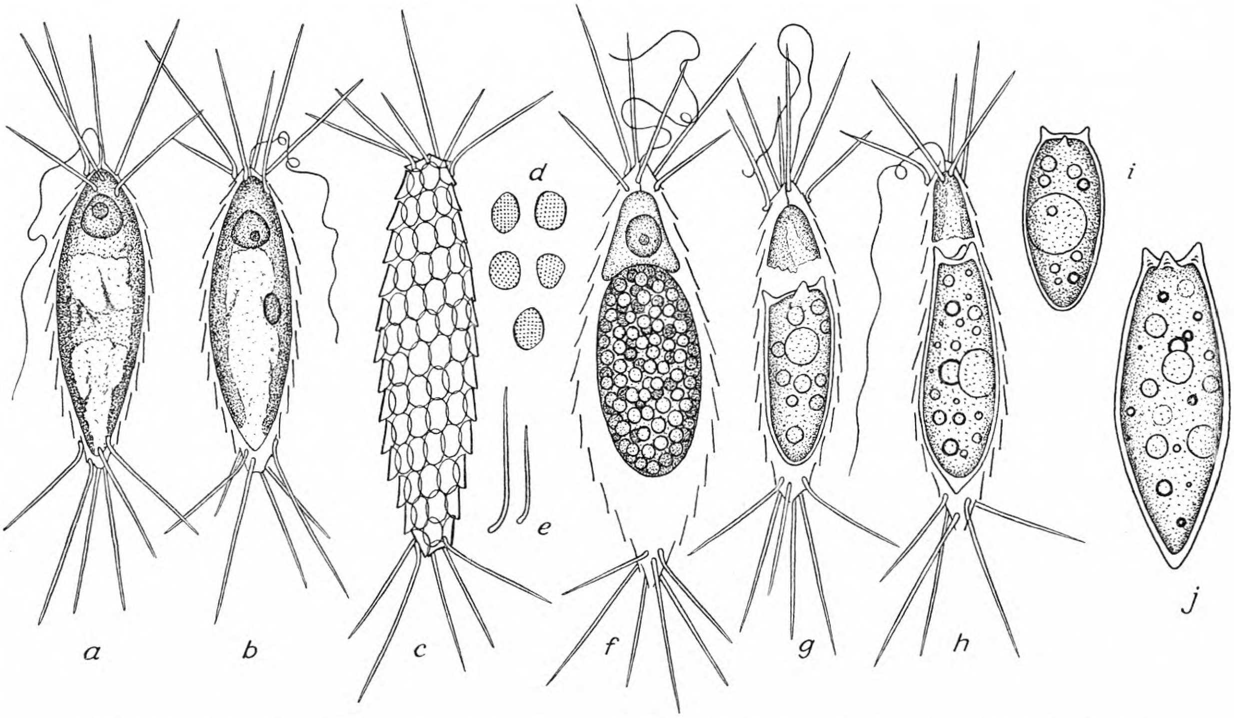

Fig. 70. *Mallomonas tridentata* n. sp.; *a—e*, *g—j* from Vandingsdam, March 15th, 1930; *f* from Sortedam II, March 15th, 1930. The punctulations of the silicified scales (*d*) are not delineated in fig. *c*. *g—h* are cells carrying cysts, *i—j* isolated cysts. *a—f* and *j* 800 ×, *g*, *h* and *i* 640 ×.

Periodicity. In Vandingsdam the species was observed only within the period between January 15th and April 1st, 1930. During the whole month of January it was extremely rare but gradually grew more and more frequent until it reached its highest development on March 15th (temp. 0° C.), at which time it was rather common in the plankton (48 individuals per ml). On April 1st it was rare again and was not found in the living plankton examined on April 7th. It failed to appear during the other months of the year. The formation of spores was observed for the first time on March 15th when a few individuals (3 $^0/_0$) carried spores. On April 1st only 2 individuals were found to carry spores and further 2 free spores were seen in the plankton of the pond. At the end of the vegetative period nearly all the *Mallomonas tridentata* individuals had apparently formed spores. In Sortedam II (where also *Mallomonas Teilingii* was present) a sure occurrence of the species in the plankton was established on March 15th, 1930 only (temp. 4.5° C.), at which time a few specimens containing cysts occurred.

In other words the species is a stenothermic cold water form or distinctly oligothermic because it was observed only at temperatures between 0 and 4.5° C.

Sociology. The species occurred in the following associations in Vandingsdam:

Jan. 15th, 1930: *Tra vo*-association with *Sce arv* as subdominant (*M. tridentata* very rare).
— 31st, — : *Tra vo*-association with *Sce arv* as subdominant (*M. tridentata* very rare).
Feb. 17th, — : *Tra vo*-association (*M. tridentata* not infrequent).
Mar. 1st, — : *Tra vo*-association (*M. tridentata* not infrequent).
— 15th, — : *Chla ac* - *Chla ps*-association (*M. tridentata* rather common).
Apr. 1st, — : Indeterminable flagellate—*Tra vo*-association (*M. tridentata* rare).

In Sortedam II it was found only in the following association:

Mar. 15th, 1930: *Mallomonas* sp_1-association with *Crym ov* and *Ma ak* as subdominants (*M. tridentata* rare).

In other words *Mallomonas tridentata* principally occurred in flagellate associations of *Trachelomonas* and *Mallomonas* and in a green algae association of *Chlamydomonas*. In Sortedam II it occurred together with a number of *Mallomonas* species on March 15th, 1930: *M. akrokomos*, *M. semiglabra*, *M.* sp_1, *M. tessellata*, *M. Teilingii* and an indeterminable species of the *M. alpina* group.

The most constant associates were *Chlamydomonas pseudoplatyrhyncha* and *Trachelomonas volvocina*, which occurred in 86 % of the number of samples (7) that contained *Mallomonas tridentata*.

Ecology. Sortedam II is a typically eutrophic pond of the mixotrophic phase and highly overshadowed, while the polluted pond Vandingsdam, which has no inlets or outlets should rather be considered a transition stage between pronounced eutrophy and mixotrophy. Some ecological data of the species are: pH 6.6—7.1, consumption of $KMnO_4$ 67—87 mg/l, contents of CaO 18.7—42.9 mg/l, NH_3-N 0.25—0.4 mg/l, NO_3-N 0—0.55 mg/l, PO_4-P 0.018—0.04 mg/l and Fe 0.35—0.85 mg/l (the figures for iron basing only on the analyses from January).

Mallomonas sp_1.

Fig. nostra 71.

Cells spindle-shaped or vase-shaped with pointed posterior end, often curved, 15—29 μ long, 5—8 μ broad. Scales about 3 μ in size, form and structure unknown. Bristles also unknown. Flagellum $^1/_2$—$^3/_4$ time length of body. 2 brown chromatophores present. Cysts ellipsoidical or narrowly obovate, 9.5—13 μ long, 6—6.5 μ broad, smooth; position of the cyst in posterior end of the cell. Only part of the protoplasm is used for the formation of the cyst.

In Spejldam, Sortedam II and Teglgaard Sø, NE-Seeland, pelagic.

Originally I intended to call this new *Mallomonas* species *Mallomonas curvata*, but both bristles and scales are so little known, that I consider it more correct to give it the provisional name of *Mallomonas* sp_1. In spite of reiterated attempts with several dry-slides I never managed to establish the exact character of the scales. They are

Fig. 71. *Mallomonas* sp_1; upper row: cells from Spejldam, March 1st, 1930; lower row: cells from Sortedam II, April 1st, 1930. 800×.

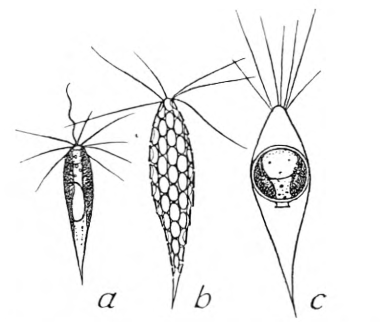

Fig. 71 bis. *Mallomonas akrokomos* Ruttner; *a* from Gadevang Mose, September 21st, 1929; *b* from field pool N of Søndre Landevej, Sønderborg, February 27th, 1938; *c* from Badstue-Ødam, March 15th, 1930. *a* and *c* 750×, *b* 1070×.

probably pyriform or ovate, in the latter case with a v-shaped marking. These 2 types of scales were found close to the dry individuals of *Mallomonas* sp_1, but it remains an open question which of the types is appurtenant.

For the sake of comparison some drawings of *Mallomonas akrokomos* Ruttner are given in Figura nostra 71 bis. The siliceous scales are elliptical not triangular as Conrad has stated (see Huber-Pestalozzi 1941, p. 93, fig. 109), their margins are touching each other and the measurements are $2\ \mu \times 1\ \mu$. Further the collar of the cyst is often antapically directed.

Periodicity. In Spejldam the species occurred only in March 1930: it was common on March 1st (temp. 1.5° C.) and rare on March 15th (temp. 3° C.). Both times cysts were observed. In Sortedam II a few individuals of the species appeared on February 17th, 1930 (temp. 1° C.); on March 1st (temp. 1.5° C.) it was common but the great maximum was not reached until March 15th (temp. 4.5° C.) when cysts were observed. After this it decreased in frequency, and the last few specimens were observed on April 10th (temp. 8° C.). In Teglgaard Sø a few individuals occurred throughout November 1929; the species showed a somewhat higher frequency in March 1930 with an inconsiderable maximum on March 15th (temp. 2.5° C.). In this locality the last individuals were seen on April 22nd (temp. 7° C.).

In other words the species is decidedly oligothermic with a temperature amplitude of 0.5—8° C. and a distinct maximum with formation of cysts in March at temperatures between 0.5 and 4.5° C.

Sociology. The species occurred in Spejldam in the following associations:

Mar. 1st, 1930: *Chla ac*-association (*Mallomonas* sp_1 common).
— 15th, — : *Ma se*-association with *Ank fa se br* as subdominant (*Mallomonas* sp_1 very rare).

In Sortedam II the species occurred in these associations:

Feb. 17th, 1930: phytoplankton very scarce, association perhaps dominated by *Gle Lo* and *Ma Te* (*Mallomonas* sp_1 very rare).
Mar. 2nd, — : *Ma* sp_1-association (*Mallomonas* sp_1 common).
— 15th, — : *Crym ov* - *Ma* sp_1-association with *Ma ak* as subdominant (*Mallomonas* sp_1 very common).
Apr. 1st, — : *Crym ov*-association (*Mallomonas* sp_1 rather common).
— 4th, — : *Crym ov* - *Ank fa se el*-association (*Mallomonas* sp_1 rare).
— 10th, — : *Crym ov*-association with *Chla ac* as subdominant (*Mallomonas* sp_1 rare).

In Teglgaard Sø the species was seen in the following associations:

Nov. 2nd, 1929: *Chry mi*-association (*Mallomonas* sp_1 very rare).
— 16th, — : *Crym ov*-association (*Mallomonas* sp_1 very rare).
— 30th, — : *Crym ov*-association (*Mallomonas* sp_1 very rare).
Mar. 1st, 1930: *Ank fa se br*-association (*Mallomonas* sp_1 very rare).
— 15th, — : *Chry mi* - *Crym ov* - *Ste Ha*-association (*Mallomonas* sp_1 not infrequent).
Apr. 22nd, — : *Crym ov* - *Syu Pe* - *Syu ec*(?)-association (*Mallomonas* sp_1 very rare).

The species thus principally occurred in flagellate associations dominated by *Cryptomonas*, *Mallomonas*, *Synura* and *Chrysococcus*, more rarely in green algae associations of *Ankistrodesmus* and *Chlamydomonas*.

The most constant associates were *Cryptomonas ovata* and *Stephanodiscus Hantzschii*, which occurred in 86 and 79 $^0/_0$ resp., of the number of samples (14) that contained *Mallomonas* sp_1.

Ecology. Both Spejldam and Sortedam II are greatly overshadowed ponds of some coolness in summer; Teglgaard Sø lies in open land. All of them have inlets and outlets. Spejldam stands between eutrophy and mixotrophy, Sortedam II is typically eutrophic of the mixotrophic phase and Teglgaard Sø is a eutrophic pond, partly overgrown with reed swamp. Some data of the ecology of the species: pH 6.8—

8.0, consumption of $KMnO_4$ 49—89 mg/l, contents of CaO 40—59.5 mg/l, NH_3-N 0.15—0.6 mg/l, NO_3-N 0.01—2.5 mg/l, PO_4-P 0.01—0.055 mg/l, Fe 0.35 mg/l in Sortedam on January 31st and 0.45 at the same time in Teglgaard Sø.

Coccolithophoridaceae.

Hymenomonas stagnicola Kampt.

Kamptner 1930, p. 150; Conrad 1928, p. 64, figs. 6—7 *sub nomine Pontosphaera stagnicola* Chodat et Rosillo.—*Fig. nostra* 72.

Cells spherical, about 20 μ in diameter, with a yellowish brown patelliform chromatophore. The envelope with numerous, close-set, oval coccoliths, about 2 μ long and 1 μ broad.

Distribution. Badstue-Ødam and Teglgaard Sø, Seeland; Flødegaardens Dam, Funen, pelagic.

Systematics. As the coccoliths are numerous and densely situated on the surface of the envelope, the correctness of the determination is hardly dubious though no flagella were observed in the Danish specimens. All determinations were made with living plankton material. A renewed examination of the most important samples and of the quantitative slides gave a negative result, presumably because the coccoliths had been decomposed by the formic acid of the formalin.

Periodicity. *Hymenomonas stagnicola*, which was originally found by Chodat and Rosillo in a pond near Geneva in 1925, is rare in this country where it was observed only in April-June at temperatures between 12.5 and 24° C. and in September (temp. 18.5° C.). The 3 localities mentioned above were examined regularly every fortnight for at least one year and so it may be said with some degree of certainty that the species is periodical and meso- to polythermic.

Sociology. The species was found in the following associations:

Badstue-Ødam.

Sep. 5th, 1929: *Ana af in te*-association with *Os li ac* as subdominant (the species not infrequent).

Apr. 26th, 1930: *Din so - Sye ac an*-association with *Ma pe ec* as subdominant (the species very rare).

May 16th, — : *Ura vo*-association (694 colonies per ml; the species very rare).

June 16th, — : *Crym ov*-association with *Ana af in te* and *Cyc st su* as subdominant (the species very rare).

Flødegaardens Dam.

June 10th, 1930: association of indeterminable green alga with *Chry mi* as subdominant (the species very rare).

Teglgaard Sø.

Apr. 29th, 1930: *Din di*-association with *Chry mi*, *Sye ac an* and *Syu Pe - Syu ec*(?) as subdominant (the species very rare).

In other words the species primarily occurred in associations characterized by *Chrysophyceae* (*Dinobryon*, *Uroglena*), further in diatomaceous (*Synedra*), myxophycean (*Anabaena*), chlorophycean and cryptophycean (*Cryptomonas*) associations.

The most constant associate was *Trachelomonas intermedia*, which occurred in 100 % of the number (6) of samples that contained *Hymenomonas stagnicola*; the following were found in 83 % of the samples: *Cyclotella Meneghiniana*, *Stephanodiscus Hantzschii*, *Asterionella formosa*, *Synedra acus* var. *angustissima*, *Glenodinium edax* and *Trachelomonas volvocina*.

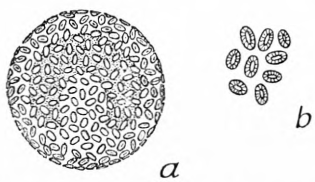

Fig. 72. *Hymenomonas stagnicola* Kampt. from Badstue-Ødam, September 5th, 1929. *a* 1070×, *b* 2140×.

Ecology. Flødegaardens Dam is a small, polluted, very highly eutrophic pond, always alkaline and rich in lime; Badstue-Ødam is also eutrophic, alkaline and rich in lime, but not nearly so polluted; see further Table III. Teglgaard Sø is a comparatively large, shallow and alkaline pond, overgrown with reed swamps; the following data speak for its eutrophy: On June 22nd, 1929 the plankton consisted of a *Rhi lo - Ste Ha*-association (65 species) with the myxophycean quotient $\frac{1}{3}$, the chlorophycean $\frac{21}{3}$, the diatom $\frac{5}{6}$, the euglenine $\frac{13}{22}$ and the compound quotient $\frac{40}{3} = 13.3$. On August 23rd, 1929: *Pa mo*-association with *Mel am* and *Ank co mi* as subdominants (40 species); the plankton quotients mentioned in the same order as above were $\frac{2}{4} - \frac{11}{4} - \frac{3}{6} - \frac{6}{13} - \frac{22}{4} = 5.5$. On June 16th, 1930: *Crym ov*-association (34 species) with the plankton quotients $\frac{2}{1} - \frac{7}{1} - \frac{6}{9} - \frac{2}{9} - \frac{17}{1} = 17$.

A few data of the ecology of *Hymenomonas stagnicola* are: pH 7.7—8.8, CaO 59.5—82.2 mg/l, consumption of $KMnO_4$ 44—57 mg/l, contents of PO_4-P 0—0.01 mg/l, NH_3-N 0.05—0.1 mg/l, NO_3-N 0—0.01 mg/l, Fe 0.02 mg/l,

Synuraceae.

Synura.

In my 1945 paper (Dansk Plante-Plankton, p. 24, Fig. 17) *Synura uvella* Ehrb. var. *punctata* Awerinzew is given as a characteristic form of oligotrophic localities of the dystrophic phase. This form is identical with *Synura sphagnicola* Korshikov (1929, p. 287; 1927, p. 450, t. 7 *sub nomine Skadowskiella sphagnicola* Korshikov) and in the living state is recognizable by the small haematochrome granules in the peripheral part of the cell. On May 24th, 1930 living colonies from Bøndernes Mose I were placed in osmic acid: the red granules did not change their colour. If they had in fact been oil-droplets as stated in Pascher's Süsswasserflora, Heft 2, 1913, p. 51, they would have turned black.

Synura Petersenii Korshikov (1929, p. 283, t. 11, figs. 54—58, text-figure A) is widely distributed both in large Danish lakes and in Danish ponds; this is also true of *Synura sphagnicola* (see Tables II and IV). *Synura spinosa* Korshikov (1929, p. 281, t. 11, figs. 38—41) is comparatively common, but I have only found it in ponds (see Table IV). *Synura echinulata* Korshikov and *Synura glabra* Korshikov (1929, p. 282 and p. 285, t. 11, figs. 42—53 and figs. 59—65) I have only seen in the *Eriophorum* moor on March 20th, 1948 when they occurred sparsely together with large amounts of *Synura Petersenii* colonies and smaller quantities of *Synura spinosa* colonies (see further under *Mallomonas tessellata* p. 131).

On April 22nd, 1930 Teglgaard Sø contained *Synura Petersenii* and a form of *Synura echinulata*, the scales of which, however, were of the same size as those of *Synura spinosa* and were furnished with 2—3 minute apical teeth.

Certain colonies of this sample had red granules in the anterior part of the living cells, but in the dry slide no scales of *Synura sphagnicola* were found. So it seems that beside this species one (or some) of KORSHIKOV's other *Synura* species may have haematochrome granules in the peripheral part of the cells.

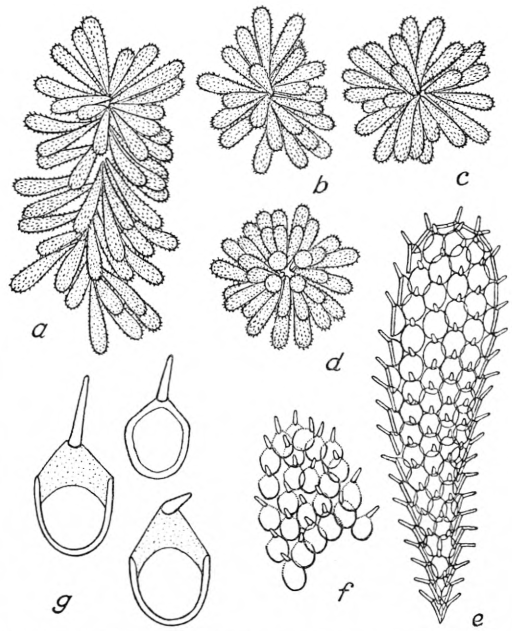

Fig. 72 bis. *Synura Adamsii* G. M. Smith from Ryven Sjön, Sweden; *a*—*d* four colonies fixed in formalin, *e* a single cell (only the scales are drawn), *f*—*g* scales from material dried up on a cover-slip. *a*—*d* 260 ×, *e*—*f* 1200 ×, *g* 3600 ×.

Dr. EINAR TEILING kindly sent me a Swedish plankton sample containing *Gemellicystis neglecta*. In this sample, where *Tabellaria fenestrata* var. *asterionelloides* and *Mallomonas caudata* Krieger (non Iwanoff) were the dominating organisms, colonies of the rare *Synura Adamsii* G. M. Smith were found (see HUBER-PESTALOZZI 1941, p. 144, fig. 200). Some of these colonies were isolated by means of my micro-manipulator. Each of the cells had two chromatophores, but also the basal part of the cell was provided with short spines. As the structure of the scales is unknown I give a figure (Fig. nostra 72 bis) of this interesting species from Ryven Sjön, Sweden. The dimensions of the scales were 3—4.5 $\mu \times 2.3$—3 μ, length of spines 1.5—2.7 μ. As distinct from the spines of the closely related species *Synura spinosa* Korsh. the spines of *Synura Adamsii* are not situated in the scale plane as shown in Fig. nostra 72 bis *e*. In the sample I found 36 species; the myxophycean quotient was $\frac{9}{6} = 1.5$, the chlorophycean $\frac{5}{6} = 0.8$, the diatom $\frac{4}{3} = 1.3$, the euglenine $\frac{0}{14} = 0$ and the compound quotient $\frac{18}{6} = 3$ which indicates moderate eutrophy.

Bacillariophyceae.

Centrales.

Discoideae.

Cyclotella Meneghiniana Kg. emend. Nyg.

Syn.: *Cyclotella Meneghiniana* Kg. var. *spinifera* Nygaard, Dansk Plante-Plankton, 1945, p. 52, t. 1, fig. 21.—*Fig. nostra* 73 and 73 *bis.*

To the original diagnosis should be added: typus spinis parvis inter costas instructus.

Distribution. Sandbjerg Sø at Alssund, Miang Dam on Als, Flyndersø in North Jutland, pond at Sønder Landevej, Sønderborg, all in Jutland; Flødegaardens Dam at Nyborg, Funen; Badstue-Ødam, Vandingsdam, Hesteskodam, Frederiksborg Slotssø, Badstue-Dam, Hulsø and pond in Fælledparken, København, all in North-East Seeland.

Systematics. In the beginning I considered the spines an optical illusion but after having reverted to the problem several times in the process of time I am now certain that there are in fact spines on *Cyclotella Meneghiniana.* At high focussing they are seen as small black dots, but they sometimes appear with the greatest distinctness in girdle-view or on obliquely situated shells. The fact that experienced scientists like van Heurck, Grunow, A. Schmidt, Fr. Hustedt a. o. observed no such spines seemed to indicate that they are not present, and so it was presumably legitimate to put up var. *spinifera* Nyg. A close examination of slide No. 478 in Henri Van Heurck's Types du Synopsis de Diatomées de Belgique, has shown, however, that minute spines are really present on the individuals of *Cyclotella Meneghiniana* (see Fig. nostra 73 bis).

On August 28th, 1926 *Cyclotella Meneghiniana* with long bristles (Fig. 73) were observed in the plankton of Flødegaardens Dam. This is the first time that such bristles have been observed in singly living *Cyclotella* species!

Periodicity. In Sandbjerg Sø it reached a very great maximum in the plankton on September 4th, 1938 (temp. 17° C.). This was not the case on September 4th, 1937 or on September 3rd, 1939 though the species was present. On August 6th, 1939 and August 26th, 1944 it was common or rather common. In Badstue-Ødam, which was examined regularly, it was probably perennial though extremely rare in the winter months and not present in all the winter samples. A distinct maximum occurred on September 23rd, 1929 (temp. 13.5° C.); the species was also comparatively common on October 3rd—12th (temp. 12.5—10° C.) occurring in short chains with up to 4 individuals in each! In Flødegaardens Dam, where *Cyclotella*

Meneghiniana was periodical, it reached a distinct maximum on August 28th, 1926; in 1927 there was no maximum, but in 1928 there was one on September 21st (temp. 14° C.). In 1929 the highest frequency of the species was found on September 15th.

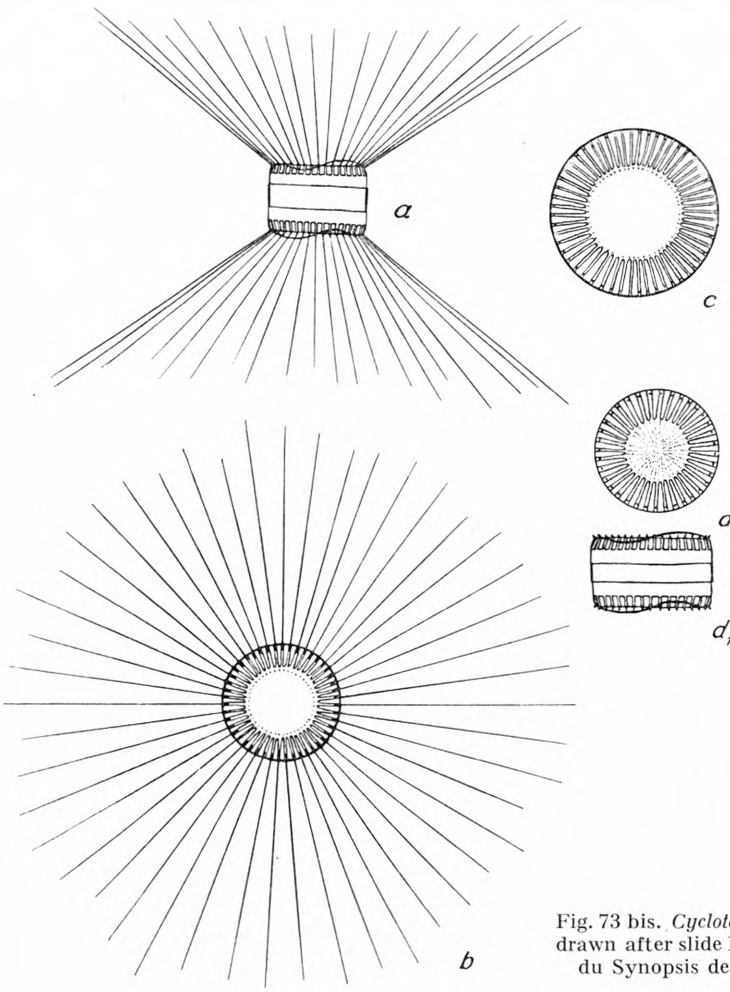

Fig. 73. *Cyclotella Meneghiniana* Kg. emend. Nyg.; *a—b* individuals carrying silicified bristles from Flødegaardens Dam, August 28th, 1926; *c* from Flyndersø, July 3rd, 1938; *d—d_1* from Sandbjerg Sø, September 4th, 1938. 800 ×.

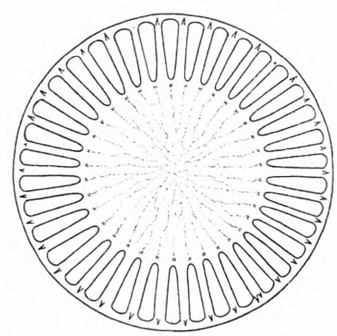

Fig. 73 bis. *Cyclotella Meneghiniana* Kg. emend. Nyg. drawn after slide No. 478 in Henri van Heurck: Types du Synopsis des Diatomées de Belgique. 2400 ×.

In Frederiksborg Slotssø very small quantities were seen in the autumn and the beginning of the winter of 1929.

Altogether we may conclude that the optimal development of *Cyclotella Meneghiniana* normally falls in September at temperatures between 13.5 and 17° C. It is sometimes common also in July-August and in October. It seems to occur somewhat sporadically or rather to be facultatively periodical, being perennial in certain localities and periodical through several years in others. The species must be considered eurythermic with a temperature amplitude of 2.5—26.5° C.

Sociology. *Cyclotella Meneghiniana* was found in 92 samples. The following is a survey of the associations because it would be unpractical to give them in the usual way:

Associations containing *Cyclotella Meneghiniana.*

The relative frequencies of *Cyclotella* and the dates of the samples are given parenthetically.

Bacteria	*Flagellatae*	*Myxophyceae*	*Diatomeae*	*Chlorophyceae*
La hy (rr, $^{5}/_{9}$-29)	*Chry ma* (r, $^{28}/_{10}$-29)	*Ana fl* (rrr, $^{30}/_{7}$-27)	*Cyc Me* (c, $^{28}/_{8}$-26)	*Ank fa sp* (rrr, $^{5}/_{6}$-28)
La hy (r, $^{15}/_{9}$-29)	*Chry ma* (rrr, $^{23}/_{11}$-29)	*Api fl* (rr, $^{6}/_{7}$-38)	*Cyc Me* (ccc, $^{4}/_{9}$-38)	*Ank co mi*—*Mio ho* (+, $^{23}/_{9}$-29)
La hy — *Teë mi* (rrr, $^{4}/_{10}$-29)	*Chry ma* (r, $^{15}/_{1}$-30)	*Mio ho* (rrr, $^{20}/_{7}$-27)	*Cyc st su* (rr, $^{21}/_{5}$-39)	*Ank fa se br* (rrr, $^{4}/_{4}$-30)
	Crym ov (rr, $^{12}/_{9}$-29)	*Mio ho* — indeterm. *Chlorophyceae* (rrr, $^{13}/_{7}$-28)	*Cyc st su* (rr, $^{10}/_{8}$-29)	*Ank fa sp* (rrr, $^{29}/_{10}$-26)
	Crym ov (rrr, $^{23}/_{10}$-29)	*Mio ho* (r, $^{20}/_{7}$-28)	*Cyc st su* (rr, $^{17}/_{8}$-29)	*Chla Re mi* (rr, $^{15}/_{8}$-27)
	Crym ov (r, $^{16}/_{6}$-30)	*Mio ho* (r, $^{2}/_{8}$-28)	*Cyc st su* (rr, $^{3}/_{9}$-29)	*Chla Re mi* (rr, $^{30}/_{8}$-27)
	Din di (c, $^{28}/_{7}$-26)	*Mio ho* (rrr, $^{2}/_{9}$-28)	*Cyc st su* (r, $^{31}/_{5}$-30)	*Chla Re mi* (rr, $^{23}/_{10}$-27)
	Din so (r, $^{18}/_{9}$-29)	*Mio ho* (rrr, $^{7}/_{9}$-28)	*Dia vu gr* (rrr, $^{21}/_{2}$-44)	Indeterm. *Chlorophyceae* (rr, $^{2}/_{7}$-29)
	Din so — *Cyc co* (r, $^{16}/_{5}$-30)	*Mio ho* (rr, $^{15}/_{9}$-28)	*Frg ca* (rr, $^{19}/_{6}$-25)	Indeterm. *Chlorophyceae* (rrr, $^{10}/_{6}$-30)
	Din so — *Sye ac an* (r, $^{25}/_{4}$-30)	*Mio ho* — *Ni ac* (r+, $^{21}/_{9}$-28)	*Frg cr* (rrr, $^{23}/_{8}$-29)	*Dic pu* — *Din di* (rr, $^{1}/_{7}$-26)
	Din so am (rrr, $^{14}/_{6}$-28)	*Mio ho* — *Tra hi* (rrr, $^{9}/_{9}$-29)	*Mel gr* (+, $^{1}/_{10}$-38)	*Ul pe* — *Mio ho* (rrr, $^{5}/_{7}$-28)
	Tra vo (rrr, $^{1}/_{12}$-27)	*Os Ag* (rrr, $^{6}/_{9}$-29)	*Mel gr an* (rr, $^{6}/_{6}$-29)	*Ul pe* (rrr, $^{2}/_{6}$-29)
	Ura vo (r, $^{1}/_{5}$-30)	*Os li* (rr, $^{4}/_{9}$-37)	*Mel gr an* (rrr, $^{21}/_{8}$-43)	*Ki mi* — *Mio ho* — *Ni ac* (rrr, $^{1}/_{10}$-28)
	Ura vo (r, $^{16}/_{5}$-30)		*Mel gr* + *an* (c, $^{6}/_{8}$-39)	*Ki mi* — *Mio ho* — *Ni ac* (rrr, $^{10}/_{10}$-28)
	Ura vo (r, $^{21}/_{5}$-30)		*Ni ac* (rrr, $^{2}/_{8}$-40)	*Pa mo* (rr, $^{14}/_{8}$-38)
			Rhi lo (r, $^{20}/_{6}$-29)	*Sce arm* (rrr, $^{21}/_{11}$-29)
			Rhi lo (r, $^{1}/_{7}$-29)	*Sce arm* (rr, $^{16}/_{12}$-29)
			Rhi lo (r, $^{5}/_{7}$-29)	*Sce arm* (rr, $^{15}/_{1}$-30)
			Rhi lo (r, $^{17}/_{7}$-29)	*Sce arm* — *Teë mi* (rr, $^{23}/_{10}$-29)

Bacteria	*Flagellatae*	*Myxophyceae*	*Diatomeae*	*Chlorophyceae*
			Rhi lo (rrr, $^{26}/_{7}$-29)	*Sce arv* — *Dic pu* (rrr, $^{19}/_{6}$-29)
			Ste du (rrr, $^{16}/_{6}$-25)	*Sce ec* (+, $^{26}/_{8}$-44)
			Ste Ha (rrr, $^{17}/_{4}$-27)	*Se ca* (rrr, $^{9}/_{11}$-27)
			Ste Ha (rrr, $^{1}/_{5}$-27)	*Spc Sc* (rr, $^{12}/_{7}$-40)
			Ste Ha (rr, $^{2}/_{6}$-27)	*Teë mi* (rr, $^{21}/_{10}$-29)
			Ste Ha (rrr, $^{18}/_{11}$-28)	*Tet st* (rrr, $^{17}/_{5}$-27)
			Ste Ha (c +, $^{15}/_{9}$-38)	
			Ste Ha (r +, $^{3}/_{10}$-29)	
			Ste Ha — *Cyc Me* (c, $^{5}/_{10}$-29)	
			Ste Ha (r +, $^{12}/_{10}$-29)	
			Ste Ha (rrr, $^{15}/_{3}$-30)	
			Ste Ha (rrr, $^{1}/_{4}$-30)	
			Ste Ha (rrr, $^{3}/_{4}$-30)	
			Ste Ha (rrr, $^{2}/_{4}$-29)	
			Ste Ha — *Sye ac an* — *Ura vo* (rr, $^{22}/_{4}$-30)	
			Ste Ha — *Sye ac an* — *Ura vo* (r, $^{10}/_{5}$-30)	
			Sye ac an (rr, $^{22}/_{4}$-30)	

As will be seen the species was found in 36 Diatom associations of *Cyclotella*, *Diatoma*, *Fragilaria*, *Melosira*, *Nitzschia*, *Rhizosolenia*, *Stephanodiscus* and *Synedra*, 25 green alga associations of *Ankistrodesmus*, *Chlamydomonas*, *Dictyosphaerium*, *Ulothrix*, *Kirchneriella*, *Pandorina*, *Scenedesmus*, *Sphaerocystis*, *Tetraëdon* and *Tetrastrum*, 15 Flagellate associations of *Chrysococcus*, *Cryptomonas*, *Dinobryon*, *Trachelomonas* and *Uroglena*, 13 blue-green alga associations of *Anabaena*, *Aphanizomenon*, *Microcystis* and *Oscillatoria* and 3 bacterial associations of *Lampropedia*. Among the

36 Diatom associations no less than 11 are dominated by *Stephanodiscus Hantzschii*, which in high production is characteristic of eutrophy, and among the 13 blue-green alga associations 6 are dominated by *Microcystis holsatica*, which in high production indicates a high degree of eutrophy; if regard is paid to mixed associations, the former is found in 14, the latter in 13 associations.

The most constant associates were *Scenedesmus armatus* and *Microcystis holsatica*, which were found in 82 and 77 per cent., respectively, of the number of samples (92) that contained *Cyclotella Meneghiniana*.

Ecology. Both Sandbjerg Sø, Miang Dam, Flyndersø, Flødegaardens Dam, Hesteskodam, Frederiksborg Slotssø, Badstue-Dam and the pond in Fælledparken, København are typically eutrophic waters, lying in open land and nearly all of them with both inlets and outlets; several of them are highly polluted. The pond at Sønderborg, Badstue-Ødam and Vandingsdam stand between eutrophy and its mixotrophic phase whereas the overshadowed Hulsø is decidedly mixotrophic. The great Danish pH material allows us to say that the pH limits for *Cyclotella Meneghiniana* are probably not far beyond 7.4 and 9.2, most pH values lying above 8. Among the other environmental factors may be mentioned: consumption of $KMnO_4$ 40—57 mg/l, contents of CaO 27—90 mg/l, Fe 0.02—0.3 mg/l, NH_3-N 0.05—1.25 mg/l, NO_3-N 0—3 mg/l, and PO_4-P 0—1.5 mg/l, figures that are characteristic for this eutraphentous species.

Cyclotella stelligera Cleve et Grunow var. **subglabra** nov. var.

Fig. nostra 74.

Diagnosis. A forma typica hoc modo differt: pars centralis valvae incompte et saepe inconspicue punctata, non striata; pars marginalis lata, striis instructa. Cellulae minutissimae, 4—11 μ in diametro, $2^1/_2$—6 μ altae, distantia inter strias 0.6—1.1 μ.

Hab. In Badstue-Ødam, Hulsø et Furesø, Selandia; Sandbjerg Sø, Jutlandia meridionali, Dania, libere natans.

Systematics. The small *Cyclotella* species are difficult to determine, even under the best lenses (numerical aperture 1.40). The individuals pictured in Fig. 74 are drawn from material mounted in realgar. The individuals from Badstue-Ødam were only 5—8 μ in diameter, 2.5—4 μ high, and the distance between the *striae* was 0.6—0.7 μ. On May 21st, 1939 the individuals from Sandbjerg Sø were quite similar (4—7 μ in diameter, distance between the *striae* 0.56—0.75 μ); on September 4th, 1938, however, the individuals were somewhat larger: diameter 5—11 μ, height 3—6 μ, distance between *striae* 0.8—1.1 μ.

In structure the variety described differs from *Stephanodiscus Hantzschii* by the total lack of marginal spines and radial series of points from the centre to the margin of the valve. Apart from this the two forms are different in a biological respect as will appear from the following section.

Periodicity. Among the 4 localities mentioned Badstue-Ødam was examined fortnightly throughout the period June 1929—June 1930. By the end of July the variety appeared in very small quantities, but in August it reached an enormous maximum (at temp. 18—20° C.), which in a somewhat reduced state continued till the beginning of September. At the end of this month the species was comparatively rare, and it was seen for the last time on November 2nd (temp. 5.5° C.). It did not reappear until May 10th, 1930 (temp. 12° C.) and at the end of this month once more reached an enormous maximum at a temperature of 20.5° C. In June 1930 the variety was only common in the plankton.

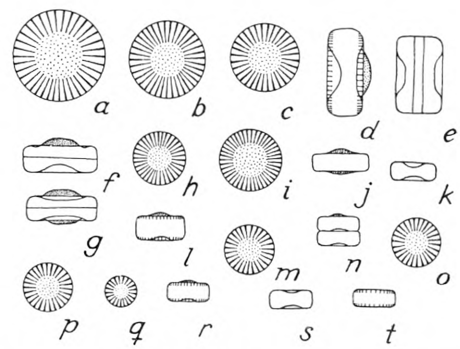

Fig. 74. *Cyclotella stelligera* Cleve et Grunow var. *subglabra* n. var.; *a*—*g* from Sandbjerg Sø, September 4th, 1938; *h*—*l* from Badstue-Ødam, August 17th, 1929; *m*—*t* from Sandbjerg Sø, May 21st, 1939. *a, b, c, h, i, m, o, p* and *q* vertical views, the other figures lateral views. 1070 ×.

In Sandbjerg Sø the variety was comparatively common on September 4th, 1938 (temp. 17° C.), but was not found on August 14th, 1938 when the temperature was 26.5° C. Both on May 21st, 1939 and on May 15th, 1940 the variety reached an enormous maximum.

In Hulsø the variety was rare in June 1928 and in Furesø it was also rare on August 21st, 1943.

From this very limited material one will be inclined to draw the following conclusions. *Cyclotella stelligera* var. *subglabra* is periodical, not occurring between December and April. It reaches 2 enormous maxima in the course of the year, both at temperatures of 18—20.5° C., one in May, the other in August (— September).

In comparison it may be stated that *Stephanodiscus Hantzschii* in Badstue-Ødam very normally reached a considerable maximum in October 1929 and an enormous maximum in April 1930. The latter declined during May, so that *Stephanodiscus Hantzschii* was rare on May 31st, at the very time when *Cyclotella stelligera* var. *subglabra* was abundant.

Sociology. The variety occurred in the following associations:

Badstue-Ødam.

July 26th, 1929: *Rhi lo*-association (variety very rare).
Aug. 10th, — : *Cyc st su*-association with *Frg cr* as subdominant (variety abundant).
— 17th, — : ditto.
— 23rd, — : *Frg cr*-association with *Ana af in te* and *Cyc st su* as subdominants (variety common).
Sep. 3rd, — : *Cyc st su*-association with *Ana af in te* as subdominant (variety very common).
— 5th, — : *Ana af in te*-association with *Os li ac* as subdominant (variety rather common).

Sep. 12th, — : *Crym ov*-association (variety rather common).
— 23rd, — : *Ank co mi - Mio ho*-association with *Ste Ha* as subdominant.
Nov. 2nd, — : *Chry ma - Crym ov*-association (variety very rare).
May 10th, 1930: *Ste Ha - Sye ac an - Ura vo*-association (variety rare).
— 21st, — : *Ura vo*-association (variety not infrequent).
— 31st, — : *Cyc st su*-association (variety abundant).
June 16th, — : *Crym ov*-association with *Ana af in te* and *Cyc st su* as subdominants (variety common).

Sandbjerg Sø.

Sep. 4th, 1938: *Cyc Me*-association with *Ste Ha* as subdominant (variety rather common).
May 21st, 1939: *Cyc st su*-association (variety abundant).
— 15th, 1940: ditto.

Hulsø.

June 14th, 1928: *Din so am*-association (variety rare).

Furesø.

Aug. 21st, 1943: *Mel gr an*-association (variety rare).

Cyclotella stelligera var. *subglabra* itself may form associations; otherwise it mostly occurs in diatom associations of *Melosira*, *Cyclotella*, *Stephanodiscus*, *Rhizosolenia*, *Fragilaria* and *Synedra*, to a less degree in chrysophycean associations of *Chrysococcus*, *Uroglena* and *Dinobryon*, myxophycean associations of *Microcystis* and *Anabaena*, cryptophycean associations of *Cryptomonas* and chlorophycean associations of *Ankistrodesmus*.

The most constant associates were *Scenedesmus armatus*, which occurred in 89 % of the number (18) of samples that contained *Cyclotella stelligera* var. *subglabra*; *Coelastrum microporum* + forma *astroidea*, *Asterionella formosa* and *Cyclotella Meneghiniana*, all of which occurred in 83 % of the samples and *Pediastrum duplex* and *Cryptomonas ovata*, which occurred in 78 %.

Ecology. All 4 localities mentioned above are eutrophic; Furesø is a large, moderately eutrophic lake, Sandbjerg Sø a small, extremely eutrophic lake, Badstue-Ødam a typically eutrophic pond approaching mixotrophy and Hulsø a small, eutrophic forest lake of the mixotrophic phase. The plankton quotients for Furesø and Hulsø appear from Table I, for Badstue-Ødam from Table III, and for Sandbjerg Sø they are given on p. 204. The compound quotients are: for Furesø $\frac{22}{5} = 4.4$, $\frac{42}{12} = 3.5$ and $\frac{28}{8} = 3.5$, Hulsø $\frac{25}{1} = 25$ and $\frac{35}{7} = 5$, Badstue-Ødam $\frac{20}{2} = 10$ and $\frac{38}{3} = 12.7$, Sandbjerg Sø $\frac{31}{0}$, $\frac{26}{1}$, $\frac{39}{1}$, $\frac{34}{1}$, $\frac{39}{1}$, $\frac{31}{1}$ and $\frac{23}{1}$.

A few data of the ecology of the variety are: pH 7.8—8.8, content of CaO 75.3—81.4 mg/l (113.1 in Sandbjerg Sø on August 19th, 1945), consumption of $KMnO_4$ 54—57 mg/l (in Furesø about 10—20 mg/l), contents of PO_4-P 0—0.01 mg/l, NH_3-N 0.08—0.15 mg/l, NO_3-N 0—0.3 mg/l and Fe 0.02 mg/l.

Cryptophyceae.

Cryptomonadales.

Cryptomonadaceae.

Cryptochrysis minor n. sp.

Fig. nostra 75.

Diagnosis. Cellulae parvae, a latere visae subobovatae, ventraliter plusminusve applanatae sunt; latus ventrale brevius quam latus dorsale est; cellulae in parte anteriore oblique truncatae, posteriore attenuatae et rotundatae sunt. Unus chromatophorus dorsalis aureus, pyrenoide in latere dorsali instructus. Sulcus ventralis granula in duobus seriebus ordinata habet. Gula abest. Duo flagella, dimidia longitudine cellulae, in partem apicalem sulci inserta sunt. Longitudo cellularum 8—9 μ, latitudo 3—5 μ.

Hab. In Peblinge Sø, Hafnia, Dania, libere natans.

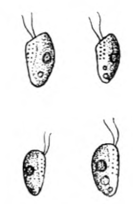

Fig. 75. *Cryptochrysis minor* n. sp. from Peblinge Sø in København, June 12th, 1930. 750×.

The species differs from *Cryptochrysis commutata* Pascher, which has been seen several times in Danish ponds, and from *C. polychrysis* Pascher by having only one chromatophore and by its small size.

Cryptochrysis minor swims in the same way as *Cryptomonas ovata* Ehrb. and like the latter is able to make very quick jumps. It was very common in Peblingesø on June 12th, 1930 at a temperature of 18.5° C. and pH 8.5. This shallow pond, which is situated in the middle of København, was rather poor in plankton, and the filtered plankton contained a great deal of detritus. On the said date the most numerous organism of the plankton—besides *Cryptochrysis minor*—was *Stephanodiscus Hantzschii* Grun.

Rhodomonas lacustris Pasch. et Ruttn.

Pascher's Süsswasserflora, Heft 2, 1913, p. 103, figs. 157—158.—*Fig. nostra* 76.

Cells obovate—cylindrical, twice as long as broad, not flattened, to some extent obliquely blunted in front, with flatter ventral than dorsal side. Edges of ventral furrow set with granules. Subapically inserted 2 nearly equally long flagella, the longer of which is a little shorter than the cell. One reddish-brown chromatophore with a distinct tinge of carmine; it possesses a deep, dorsal, longitudinal incision, which may give it the look of having 2 chromatophores. One non-axial pyrenoid halfway up the cell. Apically 1 big, pulsating vacuole; antapically the nucleus. Length of cells 14—15.5 μ, breadth 7—8 μ.

Occurrence: Esrom Sø and Furesø, NE-Seeland.

Systematics. It is with some hesitation that I identify the present individuals as *Rhodomonas lacustris* because the greatest breadth of the cells is not found so near the apex as in the type material and because the latter does not possess the dorsal incision of the chromatophore. Further the length is stated by RUTTNER & PASCHER to be only 10—13 μ (breadth 5—8 μ).

Periodicity. The species was seen only in Esrom Sø on September 8th, 1929 (temp. 16.5° C.) and in Furesø on September 1st, 1946 (temp. 17.5° C.).

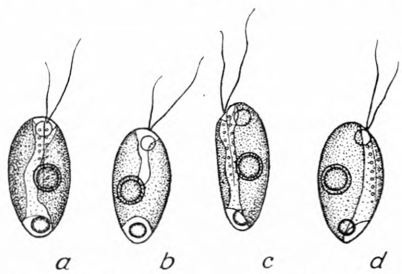

Fig. 76. *Rhodomonas lacustris* Pasch. et Ruttn. from Esrom Sø, September 8th, 1929. *a* ventral view, *b* dorsal view. 1100×.

Sociology. On September 8th, 1929 *Rhodomonas lacustris* was rare in the plankton of Esrom Sø, which consisted of a *Ce hi*-association, 10 *Ceratium* cells per ml, 37 species, the myxophycean quotient $\frac{6}{3}$, the chlorophycean quotient $\frac{7}{3}$, the diatom quotient $\frac{6}{5}$, the euglenine quotient $\frac{0}{13}$ and the compound quotient $\frac{19}{3} = 6.3$. On September 1st, 1946 it was also rare in the plankton of Furesø, which also consisted of a *Ce hi*-association, 15 *Ceratium* cells per ml, 54 species, the myxophycean quotient $\frac{15}{8}$, the chlorophycean quotient $\frac{10}{8}$, the diatom quotient $\frac{3}{5}$, the euglenine quotient $\frac{0}{25}$ and the compound quotient $\frac{28}{8} = 3.5$. In both cases the species thus occurred in *Ceratium hirundinella* associations.

Ecology. Both Furesø and Esrom Sø range among the largest Danish lakes; both are situated in tracts of moraine clay. It appears from BRØNSTED's and WESENBERG-LUND's investigations on Furesø (1912, pp. 440—42) and from KAJ BERG's investigations on Esrom Sø (1938, p. 30) that the oxygen graphs in late summer are "klinograd", typical of eutrophy. KAJ BERG has calculated $O_2\frac{H}{E}$ for Esrom Sø, for three years getting 0.29 (September), 0.28 (August) and 0.25 (August). THIENEMANN (1928, p. 37) has calculated the same fraction for Furesø, getting the values 0.51 (July), 0.39 (August) and 0.50 (September), which shows us that both lakes are eutrophic and that Esrom Sø is more eutrophic than Furesø, which, incidentally, also appears from the values of the compound quotient given above.

According to BRØNSTED & WESENBERG-LUND (1912, p. 455—56) the calcium content of Furesø ranges between 54.5 and 65.4 mg CaO per litre, according to KROGH & LANGE (1931, p. 33) between 56.0 and 64.8 mg CaO per litre. In Esrom Sø the calcium content according to BRØNSTED & WESENBERG-LUND (1912, p. 475), KAJ BERG (1938, p. 28) and NYGAARD (1938, p. 684) varies between 45.9 and 58.8 mg CaO per litre.

In Furesø pH according to NYGAARD (1938, p. 684), BOISEN BENNIKE (1943, p. 21) and SIG. OLSEN (1944, p. 21) ranges between 7,5 and 8,6 (8,4 on September 1st, 1946 when *Rhodomonas lacustris* was found). In Esrom Sø pH according to KAJ BERG (1938, p. 28), NYGAARD (1938, p. 684) and BOISEN BENNIKE (1943, p. 21) varies between 7.5 and 8.7. From 3 measurings in the summer half-year the last-mentioned author found that the colour of these two lakes, expressed in "Ohle-units," was 1 and 4 for Furesø and 3 for Esrom Sø.

Chroomonas acuta Utermöhl.

UTERMÖHL 1925, p. 399, fig. 34.—*Fig. nostra* 77.

Cells pyriform with an oblique and ventrally bent tail, provided with a lateral, intensely bluish-green, sometimes darkly olivaceous chromatophore with a distinct lateral pyrenoid in the vicinity. The 2 cilia, which are 5—8 μ long ($\frac{2}{3}$—$\frac{8}{9}$ of the cellular length) are inserted somewhat below the apex of the cell. Granulated furrow absent. Cells 8—10 μ long, 3—5 μ broad.

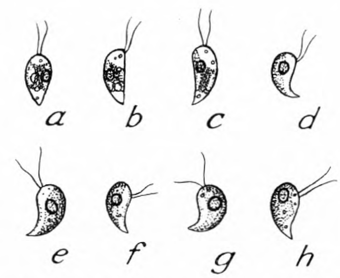

Fig. 77. *Chroomonas acuta* Utermöhl; *a*—*b* from pond in western Stavnsholt, June 26th, 1929; *c*—*h* from Birkerød Sø, July 22nd, 1929. 750×.

In Birkerød Sø, Bistrup Dam and a small pond in the western Stavnsholt, NE-Seeland.

The cells were very agile. When swimming they rotate about the longitudinal axis, so that the oblique tail seems to pendulate from one side to the other. The individuals are also able to rotate on the spot at an enormous rate.

Periodicity. Unlike UTERMÖHL's individuals from eastern Holstein, which were apparently oligo- to meso-thermic, the Danish specimens occurred only during the summer months June, July and September. In Birkerød Sø the species appeared in small quantities on July 22nd, 1929 (temp. 23° C.). Also in the small pond of Stavnsholt only a few specimens were observed on June 26th, 1929 (temp. abt. 20° C.). In Bistrup Dam a few individuals were found on September 20th, 1929 (temp. 14° C.).

Sociology. *Chroomonas acuta* occurred in the following associations:

Birkerød Sø.

July 22nd, 1929: *Mio fl*-association with *Mio Bo* and *Os Ag* as subdominants (*Chroomonas* very rare). 27 species, myxophycean quotient $\frac{7}{2}$, chlorophycean quotient $\frac{12}{2}$, diatom quotient $\frac{1}{0}$, euglenine quotient $\frac{2}{19}$, compound quotient $\frac{22}{2} = 11$.

Bistrup Dam.

Sep. 20th, 1929: *Le ps - Eug pr*-association (*Chroomonas* very rare).

Small pond in western Stavnsholt.

June 26th, 1929: 90 % of the species were *Chlorococcales* (sample lost), *Chroomonas* very rare.

In other words the species occurred in associations characterised by blue-green algae (*Microcystis*), Euglenines (*Lepocinclis, Euglena*) and green algae (*Chlorococcales*). Constant associates cannot be given on account of the paucity of the material.

Ecology. Both Birkerød Sø and the pond of Stavnsholt are highly eutrophic waters situated in open land. In the former pH was 9.4, in the latter 9.8 on July 22nd, 1929. On August 12th, 1929 the water of Birkerød Sø contained 62.1 mg of CaO and 1.25 mg of PO_4-P per litre. Bistrup Dam is much more polluted than these two localities and must be called saprotrophic. On August 12th, 1929 this slightly alkaline pond contained 118.7 mg of CaO, 12 mg of NH_3-N, 0.25 mg of NO_3-N and 6 mg of PO_4-P per litre!

Chroomonas breviciliata n. sp.

Fig. nostra 78.

Diagnosis. Cellula pyriformis, cauda obliqua, chromatophoro laterali, valde aerogineo instructa. Pyrenoides invisibilis. Flagella bina, aequilonga, 5—7 μ longa, $\frac{1}{3}$—$\frac{1}{2}$ longitudinis cellulae, subapicaliter inserata. Sulcus granulatus deest. In antica parte cellulae vacuolum contractilium observatum. Cellulae 14—18 μ longae, 5—7 μ latae.

Hab. In Sortedam II prope Hillerød, Dania, in coloniis *Sphaerocae volvocis.*

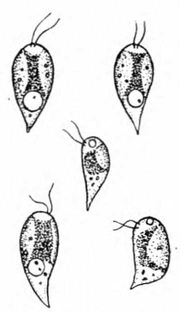

Fig. 78. *Chroomonas breviciliata* n.sp. from Sortedam II, July 10th, 1929. 750×.

Systematics. This species bears some resemblance to *Chroomonas acuta*, from which it differs by its larger dimensions, shorter cilia and lack of a visible pyrenoid.

Periodicity and sociology. The species was found only on July 10th, 1929 (temp. 16° C.) in Sortedam II. *Chroomonas breviciliata* was rare in the *Ce hi*-association occurring then and showing 25 *Ceratium* cells per ml., 23 species, myxophycean quotient $\frac{0}{1}$, chlorophycean quotient $\frac{7}{1}$, diatom quotient $\frac{0}{0}$, euglenine quotient $\frac{6}{7}$, compound quotient $\frac{13}{1} = 13$.

Ecology. Sortedam II is a highly overshadowed, typically eutrophic pond of the mixotrophic phase. A few data of the ecology of the species are: pH 7.4, CaO 37.5 mg/l, NO_3-N 0.03 mg/l, PO_4-P 0.06 mg/l.

Chroomonas Nordstedtii Hansg. f. **minor** n. f.

Fig. nostra 79.

Diagnosis. Cellulae 7.5—9.5 μ longae, 3.5—5 μ latae, 1.9—2.4 plo longiores quam latiores, dorsaliter valde convexae, ventraliter rectae vel leviter tumidae, apicaliter saepe leviter excavatae, non vel paulum compressae, cum parte posteriore rotundata. Chromatophorus solitarius, pallide aerugineus; pyrenoides conspicuus, dorsalis. Gula abest. Flagella bina, inaequalia, subapicaliter inserta, quorum longius paene eadem longitudine est ac cellula, brevius autem $\frac{3}{4}$ longitudinis cellulae.

Hab. In Rønhavegaard Dam, Alsia, Dania, libere natans.

Chroomonas Nordstedtii Hansg. is stated (Pascher's Süsswasserflora, Heft 2, 1913, p. 104, Fig. 161) to be 9—16 μ long and 4—8 μ broad; otherwise there seems to be no substantial differences from the present specimens.

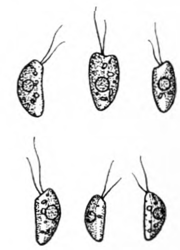

Fig. 79. *Chroomonas Nordstedtii* Hansg. f. *minor* n. f. from Rønhavegaard Dam, March 12th, 1944. 800×.

The species was observed in enormous quantities in Rønhavegaard Dam on March 12th and 19th, 1944 (temp. 4.5 and 6° C.); on March 8th (temp. 4° C.) and 22nd (temp. 7.5° C.), 1945 it was not infrequent. During the summer months of 1945 it was not observed. Most likely the species is a cold water form.

On March 12th, 1944 the plankton of Rønhavegaard Dam consisted of a *Chrom No mi*-association with *Chla Re* and *Ste Ha* as subdominants, on March 19th of a *Chrom No mi*-association with *Ste Ha* as subdominant. On March 8th and 22nd, 1945 the plankton communities were dominated by *Ste Ha* with *Eug mi* as subdominant.

Rønhavegaard Dam is a highly eutrophic pond, which is polluted *i. a.* by swimming birds. Such an enormous development of plankton is rarely observed in March; in 1944 its water had an intense and deep bluish-green colour originating from the large quantities of *Chroomonas* and *Chlamydomonas*, in 1945 it was intensely brownish-green from *Stephanodiscus Hantzschii*, *Euglena minima* and others. At these times pH was 8.2—9.6 at 3 p. m.

Dinophyceae.

Dinoflagellata.

Gymnodiniaceae.

Gymnodinium.

With a few exceptions (for instance *Gymn. tenuissimum*) the species of this genus can only be determined alive and after a careful and time-wasting observation. In this paper special attention is paid to the look and the course of the longitudinal furrow, which can only be seen by means of the immersion objective. The examination of the cold water forms is particularly difficult, but I managed to get a good image of the longitudinal furrow of *Gymn. tenuissimum* by carrying out the examination in a cold room though the lenses of the microscope often dimmed. In the figures of J. Schiller in Archiv für Protistenkunde, Bd. 56, 1926, p. 33 (figs. 29 a—c) the longitudinal furrow of this species stretches far onto epivalva; according to my experience its longitudinal furrow does not reach epivalva at all (see *fig. nostra* 94). In Dansk Planteplankton (NYGAARD 1945, t. 3, fig. 14) the chromatophores are too dark; they are generally ochraceous.

In the following I propose a classification of the *Gymnodinium* species basing on the build and the situation of the longitudinal furrow.

Survey of the Danish species of the genus Gymnodinium.

I. Gymnodinia rectisulcata. Longitudinal furrow straight, stretching some way onto epivalva.

A. Chromatophores blue-green; stigma lacking.

1. Hypovalva ob-bulbiform, chromatophores 4—7 μ in size, longitudinal furrow somewhat above middle crossed by a pointed, oblique process from epivalva . . . . *Gymn. acidotum* n. sp. (Fig. 80 et 95)
2. Hypovalva nearly hemispherical, chromatophores 3—4 μ large, no process from epivalva at longitudinal furrow . . . *Gymn. aeruginosum* Stein (Fig. 81)

B. Chromatophores ochraceous, reddish-brown or dark-brown.

1. Cells very much flattened, 6—9 μ thick, stigma of horseshoe form, carmine, both epi- and especially hypovalva mucronate, length 28—44 μ, breadth 22—35 μ . . . . *Gymn. leopoliense* Wolosz. (Fig. 82)
2. Cells slightly compressed, 1—1½ times broader than thick; stigma lacking.
   α. Hypovalva coniform or bulbiform, chromatophores numerous, small, dark-brown, cells large (75 μ × 47 μ or larger) . . . .
   Gymn. fuscum Stein (Fig. 83)
   β. Hypovalva broadly rounded, chromatophores ochraceous or reddish-brown.
      a. Epivalva much smaller than hypovalva, nucleus situated above middle of cell, cells 27.5—34 μ long, 22.5—29 μ broad . . . .
      Gymn. inversum Nyg. (Fig.s 84, 98)
      b. Epivalva of the same size as epivalva, nucleus central, cells 39—50 μ long, 22.5—34 μ broad . . . .
      Gymn. inversum var. *elongatum* n. var. (Fig.s 85, 99)

C. Chromatophores lacking. Both Hypo- and Epivalva coniform, the latter apically with double emargination, cells comparatively large (48 μ × 33 μ)
Gymn. helveticum Pen. (Fig. 86)

II. Gymnodinia infractisulcata. Longitudinal furrow sharply bent where it is intersected by the transversal furrow, the former thus stretching some way onto epivalva. Length 32—45 μ, breadth 27—32 μ[1] . . . . . *Gymn. mirum* Uterm. (Fig. 87)

[1] In Dansk Planteplankton, 1945, p. 32, the measurements are misprinted.

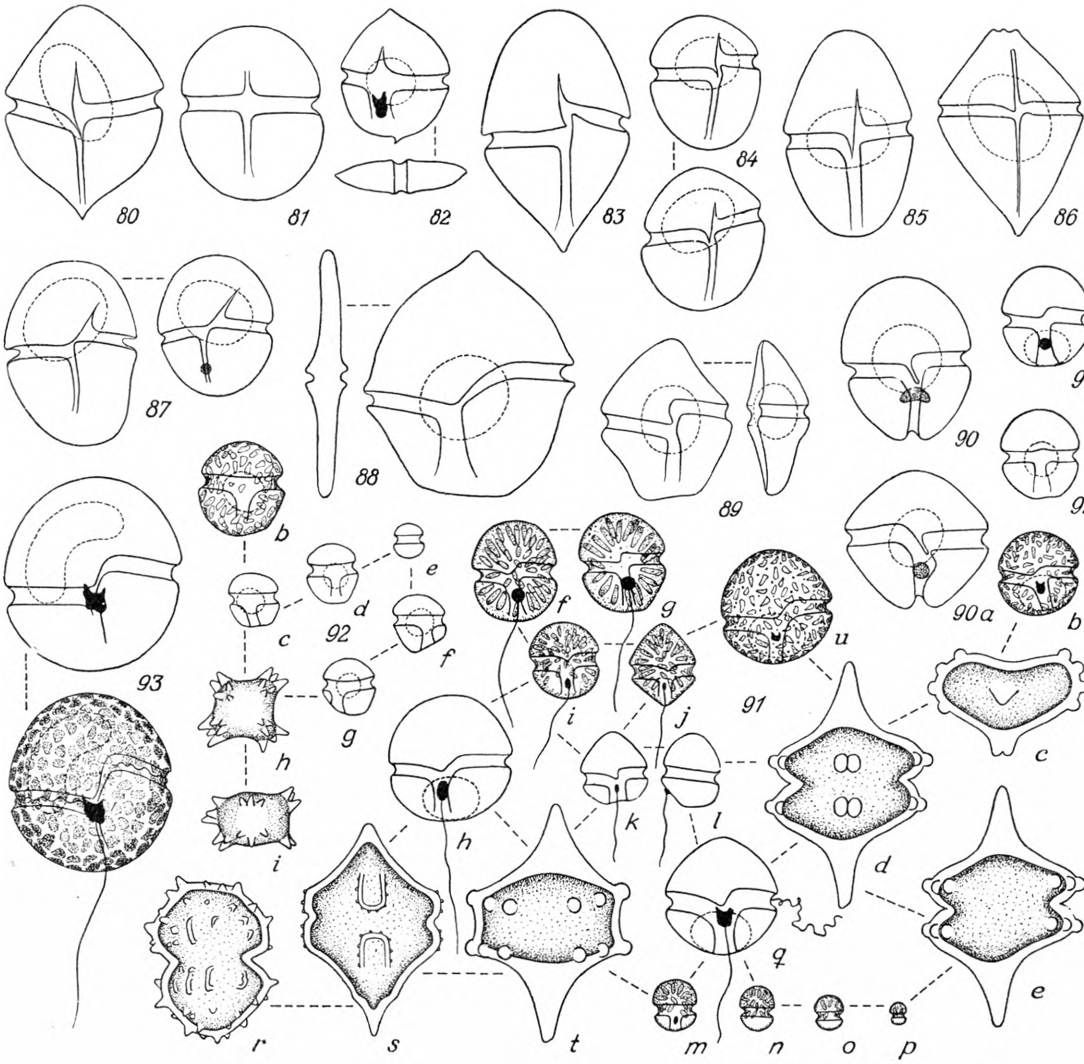

Fig. 80—93. Danish *Gymnodinium* species. 80: *G. acidotum* n. sp. from the pond at Hokkerup, September 14th, 1944, 800×. 81: *G. aeroginosum* Stein from Sortedam II, August 23rd, 1929, 560×. 82: *G. leopoliense* Wolosz. in ventral and lateral view from Andedam in Strødam, May 30th, 1930, 560×. 83: *G. fuscum* Stein from Lille Gribsø, August 22nd, 1929, 430×. 84: *G. inversum* Nyg. from Frederiksborg Slotssø, April 3rd, 1930, 560×. 85: *G. inversum* var. *elongatum* n. var. from Furesø, May 7th, 1931, 560×. 86: *G. helveticum* Penard (colourless) from Badstue-Ødam, April 25th, 1930, 560×. 87: *G. mirum* Uterm. from Lille Gribsø, July 5th and August 22nd, 1929, 560× and 430×. 88: *G. tenuissimum* Lautb. from Emdrup Sø at København, March 26th, 1946, 525×. 89: *G. hiemale* Wolosz. from Fønstrup Dam, November 24th, 1929, 560×. 90: *G. excavatum* Nyg. from Store Dam, August 17th, 1929, 560×. 90a: *G. excavatum* var. *dextrorsum* n. var. from Frederiksborg Slotssø, September 6th, 1929, 560×. 91: *G. paradoxum* Schill., *a* from Jægerbakke Dam, August 14th, 1929, 560×; *b*—*e* from Blankeborg I, *b* from June 10th, 1930, 560×, *c*, *d* and *e* cysts from August 17th, 1927, *c* vertical view, *d* and *e* dorsal and ventral view, 800×; *f*—*t* from Jægerbakke Dam, *f*—*g* from August 14th, 1929, 560×, *h*—t from September 18th, 1929, *h*—*q* 560×, *r*—*t* cysts 800×; *u* from Fønstrup Dam, November 24th, 1929. 92: *G. paradoxum* f. *astigmosa* Nyg., *a* from Jægerbakke Dam, February 17th, 1930, 560×, *b*—*i* from Vandingsdam, April 7th, 1930, 560×; *h* and *i* cysts, *h* vertical view, *i* lateral view. 93: *G. neglectum* Lindem. from pond at Søndre Landevej, Sønderborg, January 3rd, 1937, 800×.

III. Gymnodinia abruptisulcata. Longitudinal furrow does not reach onto epivalva.

A. Cells very much compressed, $2\frac{1}{2}$—5 times broader than thick, 10—11 μ thick, with an asymmetrical, subacute epivalva, a subtruncate or slightly emarginate hypovalva; stigma lacking. Typical cold water forms.

1. Cells in principle flat, 55—70 μ long, 45—60 μ broad, fields 5—6 μ broad *Gymn. tenuissimum* Lautb. (Fig. 88 et 94)
2. Cells in principle plano-convex, 30—38 μ long, 25—31 μ broad, fields 3.5—4.5 μ broad .... *Gymn. hiemale* Wolosz. (Fig. 89)

B. Cells slightly compressed, 1—$1\frac{1}{2}$ times broader than thick.

1. Hypovalva antapically deeply emarginate, upper part of longitudinal furrow crossed by an oblique, finger-shaped process from epivalva.
   a. Transversal furrow sinistrorse... *Gymn. excavatum* Nyg. (Fig.s 90, 96)
   b. Transversal furrow dextrorse .... *Gymn. excavatum* var. *dextrorsum* n. var. (Fig.s 90 a, 97)
2. Hypovalva antapically rounded or somewhat flattened.
   a. Nucleus broadly ellipsoidical, situated in hypovalva or centrally, comparatively distinct.
      α. With stigma; cysts in principle fusiform with equatorial constriction and 6 groups of big granules near the latter .... *Gymn. paradoxum* Schill.[1] (Fig. 91)
      β. Without stigma; cysts flatly cubiform, with 3 obtuse, short spines at each of the 8 edges... *Gymn. paradoxum* f. *astigmosa* Nyg. (Fig. 92)
   b. Nucleus sausage-shaped, curved, situated in left part of epivalva (in ventral view), always indistinct when alive .... *Gymn. neglectum* Lindem. (Fig. 93)

J. Schiller deals with the Dinoflagellates in an uncritical and sometimes vague way in Rabenhorst's Kryptogamenflora, Bd. 10, 3. Abt., 1932. The figures are not always accurate reproductions of the original drawings, and strange to say the original drawings are sometimes discarded for the benefit of more or less irrelevant drawings published later on. The work does not reach the standard of for instance Hustedt's treatment of the Diatoms and Krieger's treatment of the Desmids.

Gymn. lacustre Schiller (*loc. cit.*, p. 374, fig. 383) is incompletely described and depicted and should undoubtedly be rejected.

Gymn. rotundatum Schiller (non Klebs!) and *Gymn. obesum* Schiller (*loc. cit.*, pp. 407 and 391, figs. 427 a—i and 405 a—g) are both identical with *Gymn. mirum* Utermöhl (all three are found in Attersee!)

Gymn. undulatum Wolosz. (1925) is undoubtedly identical with *Gymn. hiemale* Wolosz. (1917).

[1] Identical with *Gymnodinium coronatum* Woloszynska? or var. *glabra* Woloszynska? (1917, p. 120, t. 11, figs. 10—19, t. 13, figs. I—L, N).

Gymn. hiemale Skvortzow (1927) is probably identical with *Gymn. rotundatum* Klebs. *Gymnodinium paradoxum* f. *astigmosa* is closely related to the latter species (Klebs, 1912, pp. 392, 439, fig. 5).

Schiller may be right when saying that *Peridinium ornamentosum* Lindemann and *Peridinium* (*Gonyaulax*) *Jensenii* Nygaard are synonymous with *Peridinium africanum* Lemmermann.

As regards *Peridinium gatunense* Nyg. I am of the opinion expressed in my 1932 paper that it should only be considered a variety of *Peridinium cinctum* Ehrb. Schiller's original figures of this dinoflagellate (*loc. cit.* p. 156, figs. 155 a—e) represent individuals that have nothing to do with *Peridinium cinctum* Ehrb. var. *gatunense* Nyg.

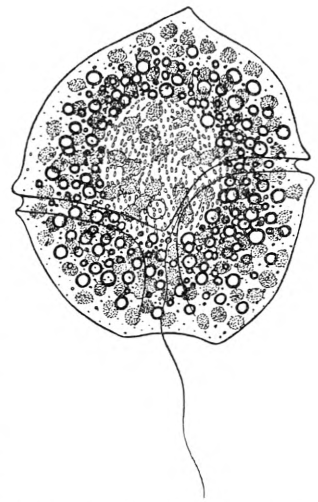

Fig. 94. *Gymnodinium tenuissimum* Lautb. from Emdrup Sø, March 26th, 1946. Front view and lateral view. 800×.

Most likely both *Glenodinium emarginatum* Klebs and *Peridinium* (*Glenodinium*) *imperfectum* Klebs, which were both found in the same pond at Buitenzorg (1912, pp. 394, 439 and 441, figs. 6 and 15) are identical with *Glenodinium geminum* Lindemann (or *Glenodinium guildfordense* Lindemann).

Gymnodinium acidotum n. sp.

Fig. nostra 95.

Diagnosis. Cellulae dorsiventraliter paulum applanatae, a fronte visae late pyriformes. Epivalva coniformis est atque apice rotundato instructa; hypovalva magnitudine simili, subbulbiformis, extremo abrupte acuminata est. Sulcus longitudinalis augustus, rectus, a polo antapicali hypovalvae partim in epivalvam attinens, ubi angulum acutum versus apicem cellulae directum format. Ab epivalva corpus acutum rectum vel leviter curvatum declive sulcum longitudinalem transgreditur. Membrana delicata, hyalina, sine structura visibili. Nucleus medius, ellipsoideus vel subcylindricus, apicibus rotundatis. Chromatophori satis magni (4—7 μ), discoidei, subangulati, valde aeruginei sunt. Stigma destitutum, sed corpuscula rubida 1—2 saepe prope sulcum transversalem occurrunt. Longitudo cellularum 33—37 μ, latitudo 24—30 μ.

Hab. In stagno parvo prope Søgaard, Jutlandia meridiana, Dania, libere natans.

This species differs from the previously described blue-green *Gymnodinia* by its bulbous hypovalva, the structure of its longitudinal furrow, its subconiform epivalva and its few big chromatophores.

Gymnodinium acidotum was comparatively rare on September 14th, 1944 in the pond that is situated near the beginning of the Hokkerup road from the Graasten-Søgaard road, and which is highly polluted by geese and ducks. pH was 8.5. In this highly eutrophic pond the rich plankton consisted of an *Ank co mi* - *Eug*-association with *Chrym ov* and *Tra vo* as subdominants; among the other 37 organisms should be mentioned the characteristic *Trachelomonas granulata* Swir. Myxophycean quotient $\frac{1}{0}$, chlorophycean quotient $\frac{15}{0}$, diatom quotient $\frac{2}{1}$, euglenine quotient $\frac{17}{15}$, compound quotient $\frac{35}{0}$.

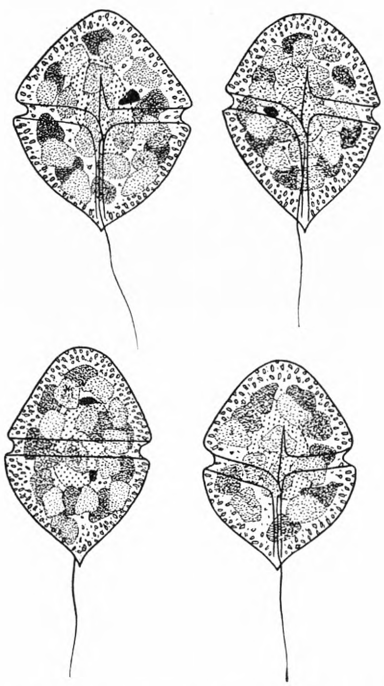

Fig. 95. *Gymnodinium acitodum* n. sp. from the pond near the beginning of the Hokkerup road from the Graasten-Søgaard road, September 14th, 1944. 800 ×.

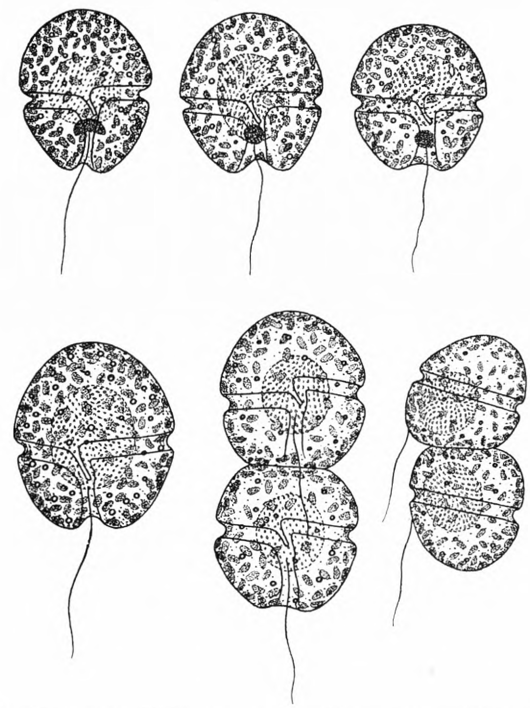

Fig. 96. *Gymnodinium excavatum* Nyg.; upper row of cells from Store Dam, July 6th, August 17th, 1929, and May 28th, 1930, 640 ×; lower row of cells from Sandbjerg Sø, September 4th, 1937, 800 ×.

Gymnodinium excavatum Nyg.

Dansk Plante-Plankton, 1945, p. 52, Fig. 20.—*Fig. nostra* 96.

Hab. In Brune Øje and Store Dam, NE-Seeland and Sandbjerg Sø in North Sleswick.

Systematics. This species is easily distinguished from all other previously described *Gymnodinium* species by its deeply emarginate antapical pole and the finger-shaped process at the intersection of the longitudinal and the latitudinal furrow. One individual was seen to creep out of its cell-wall, which remained as an extremely thin crumpled membrane without structure. In spite of intense searching I never managed in this species to find the plate structure that is characteristic of *Gymno-*

dinium. The division of the cell takes place in the free motile state (see Fig. 96) and without any tearing of the thin cell-wall.

In Archivum Balatonicum I, 1927, t. 6, fig. 3, G. Entz pictures a *Gymnodinium* species (in dorsal view), which he calls *Gymnodinium palustre*, but which is more probably identical with *Gymnodinium excavatum*.

Periodicity. In Brune Øje and Store Dam the species developed only during the warm season, May—October 1929, at temperatures between 9.5 and 23.5° C.; accordingly, it is periodic and meso- to polythermic. In June 1929 *Gymnodinium excavatum* was rare in the two ponds, but in August—September (temp. 14—19° C.) it reached its highest development; the great maximum occurred on August 17th: about 3100 individuals per ml in Brune Øje and about 2800 individuals per ml in Store Dam. During September its frequency decreased rapidly, and after the middle of October it disappeared completely from the plankton. It did not reappear in the plankton of these ponds until May 1930.

In Sandbjerg Sø, which unlike Brune Øje and Store Dam was not examined every 10. or 14. day throughout a whole year, the species, strange to tell, was not observed in the August samples, but in nearly all the September samples. On September 4th, 1937 it was rather common in the plankton; on September 15th and October 1st, 1938 and on September 3rd, 1939 the species was very rare in the plankton of Sandbjerg Sø.

Sociology. *Gymnodinium excavatum* occurred in the following associations:

Brune Øje.

June 19th, 1929: *Chry mi*-association (about 8000 cells per ml), *Gy ex* rare, about 75 per ml.

— 28th, — : *Din di*-association (about 200 colonies or about 1000 cells per ml), *Gy ex* rare, about 100 per ml.

July 6th, — : *Chry mi*-association (about 1500 cells per ml), *Gy ex* rare, about 100 per ml.

— 16th, — : *Crym ov*-association (about 2000 cells per ml), *Gy ex* rather common, about 500 per ml.

— 23rd, — : *Per pa*-association, *Gy ex* rather common.

— 26th, — : *Chry mi*-association (about 1800 cells per ml) with *Chla* (about 1200), *Per pa* (about 1200), *Sye ac* (about 1200) and *Tra vo* (about 1100) as subdominants, *Gy ex* rather common, about 500 per ml.

Aug. 10th, — : *Chla*-association (670 cells per ml) with *Crym ov* (550) as subdominant, *Gy ex* not infrequent, 360 per ml.

— 17th, — : *Gy ex*-association (about 3100 cells per ml) with *Per pa* and *Tra vo* as subdominants (about 2800 and 2500 per ml, respectively).

— 24th, — : *Chry mi* - *Tra vo*-association (1400 and 1350 cells per ml, respectively) with *Chla* and *Per pa* (1070 and 1020, resp.) as subdominants, *Gy ex* common, 920 per ml.

Sep. 3rd, 1929: *Chla - Gy ex*-association (both about 1600 cells per ml).
— 9th, — : *Gy ex*-association with *Chla* as subdominant, *Gy ex* common.
— 13th, — : *Chla*-association (about 900 cells per ml), *Gy ex* rare, about 100 per ml.
— 21st, — : *Per pa*-association with *Chla* as subdominant, *Gy ex* rare.
Oct. 11th, — : *Per pa*-association with *Syu Pe*, *Tra in* and *Per bi* as subdominants, *Gy ex* very rare.
May 21st, 1930: *Ura vo*-association with *Din so* and *Din di* as subdominants, *Gy ex* rare.
June 16th, — : *Sye ac an*-association with *Per pa* as subdominant, *Gy ex* rare.

Store Dam.

July 6th, 1929: *Gy ex*-association, *Gy ex* common.
Aug. 17th, — : *Oo cr mi*-association (about 3000 cells and colonies per ml) with *Gy ex* (about 2800 cells per ml) as subdominant.
Sep. 9th, — : *Oo cr mi*-association with *Gy ex* as subdominant.
— 21st, — : *Oo cr mi*-association, *Gy ex* not infrequent.
May 28th, 1930: *Gy ex - Sye ac an*-association, *Gy ex* common.
June 16th, — : *Tra vo*-association with *Gy ex* as subdominant, *Gy ex* rather common.

Sandbjerg Sø.

Sep. 4th, 1937: *Os li*-association with *Mia pu* as subdominant, *Gy ex* common.
— 15th, 1938: *Ste Ha*-association with *Mel gr* as subdominant, *Gy ex* very rare.
Oct. 1st, — : *Mel gr*-association with *Ste Ha* as subdominant, *Gy ex* very rare.
Sep. 3rd, 1939: *Ana sp tu - Ste Ha*-association with *Mel gr* as subdominant, *Gy ex* very rare.

In other words *Gymnodinium excavatum* principally occurs in chrysophycean associations (*Chrysococcus*, *Dinobryon* and *Uroglena*) and in diatomaceous associations (*Synedra*, *Stephanodiscus* and *Melosira*); besides it was found in myxophycean (*Oscillatoria*, *Anabaena*), chlorophycean (*Chlamydomonas*, *Oocystis*), dinophycean (*Peridinium*), cryptophycean (*Cryptomonas*) and euglenine (*Trachelomonas*) associations.

The most constant associates were *Trachelomonas volvocina*, which occurred in 100 % of the samples (26) containing *Gymnodinium excavatum*, and *Glenodinium edax* (88 %), *Cryptomonas ovata* (83 %) and *Peridinium palatinum*, *Chlamydomonas* sp. and *Trachelomonas intermedia* (all three 77 %).

Ecology. Store Dam and Brune Øje are very lime-rich ponds of the eutrophic type approaching the mixotrophic phase. They are connected by a short canal. Brune Øje is highly overshadowed by spruce and therefore cold in summer; it shows a higher degree of eutrophy than Store Dam. On August 17th, 1929 the myxophycean quotient was $\frac{1}{0}$, the chlorophycean quotient $\frac{4}{0}$, the diatom quotient $\frac{1}{2}$, the euglenine quotient $\frac{2}{4}$ and the compound quotient $\frac{8}{0}$ by 21 species. Desmids were not observed at all in Brune Øje, but in May 1930 a few floating masses of algae occurred, consisting mainly of the saprobic *Oscillatoria chlorina*. In Store Dam the quotients (mentioned in the same order as above) were on June 6th, 1929: $\frac{1}{1}$, $\frac{4}{1}$, $\frac{0}{1}$, $\frac{2}{4}$ and $\frac{7}{1} = 7$, on August 17th $\frac{1}{5}$, $\frac{6}{5}$, $\frac{0}{1}$, $\frac{3}{7}$ and $\frac{10}{5} = 2$ and on June 16th, 1930 $\frac{0}{2}$, $\frac{6}{2}$, $\frac{2}{2}$, $\frac{5}{6}$ and $\frac{13}{2} = 6.5$; the values 7, 2 and 6.5 for the compound quotient thus indicate a marked eutrophy. Sandbjerg Sø, however, is much more contaminated; in this 5 m deep, slightly overshadowed and lime-rich[1] pond the compound quotient reached the following values: $\frac{31}{0}$, $\frac{26}{1}$, $\frac{39}{1}$, $\frac{34}{1}$, $\frac{39}{1}$, $\frac{31}{1}$ and $\frac{23}{1}$ (see also p. 204), thus ranging between 23 and 39.

Some of the ecological data of *Gymnodinium excavatum* are: pH 7.3—8.6, CaO 95.7—118.5 mg/l, consumption of $KMnO_4$ 45—65 mg/l, content of PO_4-P 0—0.04 mg/l, NH_3-N 0.1—0.2 mg/l, NO_3-N 0—0.25 mg/l, Fe 0.03—0.2 mg/l (as far as the iron is concerned the figures are based on June analyses alone).

var. **dextrorsum** n. var.

Fig. nostra 97.

Diagnosis. A typo fossa transversali perspicue dextrorsa differt. Chromatophori elongati, subirregulares. Longitudo cellularum 33—35 μ, latitudo 31—35 μ.

Hab. In Frederiksborg Slotssø prope Hillerød, Dania, libere natans.

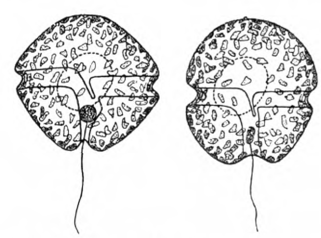

Fig. 97. *Gymnodinium excavatum* Nyg. var. *dextrorsum* n. var. from Frederiksborg Slotssø, September 6th and October 5th, 1929. 560 ×.

In Badstue-Dam *Gymnodinium excavatum* was not infrequent on May 16th, 1930, but it does not appear from my notes on the examination of the living plankton whether the main species or the variety was observed. However, Badstue-Dam and Frederiksborg Slotssø are connected with each other, and so it is likely that the organism found in Badstue-Dam is var. *dextrorsum*.

Periodicity. This characteristic variety with its dextrorsal transversal furrow seems to be eurythermic: it was observed during the period September—November at temperatures between 18.5° and 3.5° C.; in Frederiksborg Slotssø it was not observed during the rest of the year. It was always rare in the plankton, but on September 17th, 1929 (temp. 18.5° C.) more than 10 individuals were seen, and on September 23rd (temp. 14.5° C.) the frequency may have been about 30 individuals per ml (the countings of the rare species are too inexact for a precise statement of the frequency).

Sociology. The variety occurred in the following associations in Frederiksborg Slotssø:

[1] 113.1 mg CaO per litre on August 19th, 1945.

Sep. 6th, 1929: *Os Ag*-association (variety very rare).
— 17th, — : *Os Ag*-association (variety rare).
— 23rd, — : *Os Ag*-association (about 12.400 trichomes per ml), variety rare.
Oct. 5th, — : *Os Ag*-association (variety very rare).
Nov. 21st, — : *Sce arm*-association (variety very rare).

This means that the variety occurs in myxophycean associations (*Oscillatoria*) and a chlorophycean association (*Scenedesmus*).

The most constant associates were *Pteromonas angulosa*, *Dictyosphaerium pulchellum*, *Oocystis Marssonii*, *Pediastrum Boryanum*, *Scenedesmus armatus*, *Staurastrum tetracerum* var. *validum*, *Melosira granulata*, *Trachelomonas intermedia*, *Trach. volvocina*, *Coelosphaerium Nägelianum*, *Gomphosphaeria lacustris*, *Microcystis flos aquae*, *Micr. pulverea*, *Micr. viridis*, *Micr. aeruginosa* and its var. *major*, *Anabaena flos aquae* and *Oscillatoria Agardhii*, which occurred in 100 $^0/_0$ of the number of samples (5) that contained *Gymnodinium excavatum* var. *dextrorsum*. The following species occurred only in 80 $^0/_0$ (4) of the samples: *Chlamydomonas Reinhardii*, *Pandorina morum*, *Pediastrum duplex* var. *reticulatum*, *Scenedesmus falcatus*, *Tetraëdron limneticum* var. *simplex*, *Closterium gracile*, *Stephanodiscus dubius* and *Lyngbya limnetica*.

Ecology. Frederiksborg Slotssø is highly eutrophic (Table III gives the phytoplankton quotients, and the qualitative composition of the plankton on September 23rd, 1929 appears from Table IV). Suffice it to mention that the compound quotient was $\frac{24}{3} = 8$, $\frac{36}{4} = 9$ and $\frac{40}{4} = 10$ for 3 summer samples. Some of the ecological data of the variety are: pH 7.6—9.1, CaO 69.3—72.2 mg/l, consumption of $KMnO_4$ 40—42 mg/l, content of NO_3-N 0—0.35 mg/l, NH_3-N 0.05—1.25 mg/l, PO_4-P 0.25—1.5 mg/l; two analyses from January and June gave 0.15 and 0.01 mg/l of Fe.

Gymnodinium inversum Nygaard.

Berg and Nygaard 1929, p. 294, t. 5, figs. 28—36. Nygaard 1945, p. 29, t. 3, fig. 11. *Fig. nostra* 98.

Diagnosis. Cells ellipsoidical, dorsiventrally slightly compressed; both epi- and hypovalva broadly rounded; hypovalva considerably bigger than epivalva. Transversal furrow sinistrorse, longitudinal furrow reaching far down on hypovalva and continuing straightly a little way onto epivalva where it ends pointedly; at the intersection between longitudinal and transversal furrow a pointed process protrudes straightly towards the hypovalvar part of the longitudinal furrow. The cell-wall extremely thin. The nucleus broadly oval, mainly situated in epivalva. Chromatophores numerous, round—oblong or elongated and somewhat irregular, 2—4 μ long, brown. Stigma lacking. Length of cells 27—36 μ, breadth 22—29 μ, thickness 20—27 μ.

Distribution: In Frederiksborg Slotssø, Lyngby Sø and Furesø, NE-Seeland, Denmark, pelagic.

Systematics. My 1929 description of the species contains no information on the look of the longitudinal furrow, and so a more detailed diagnosis of the species has been given here. The species perhaps shows the closest relation to *Gymnodinium mirum* Utermöhl (1925, p. 408, Fig. 35 *a—o*; synonyms *Gymn. obesum* Schiller and *Gymn. rotundatum* Schiller non Klebs in Rabenhorst's Kryptogamenflora, X. Bd., 3. Abt., 1932, pp. 391 and 407, Fig.s 405 *a—g* and 427 *a—i*, both of which are found in Attersee together with *Gymn. mirum*!), the longitudinal furrow of which, however, shows a sharp bend where it is tranversed by the transversal furrow, the epivalva of which is of nearly the same size as hypovalva and the chromatophores of which are often olivaceous; besides this it has no pointed process from epivalva towards the hypovalvar part of the longitudinal furrow.

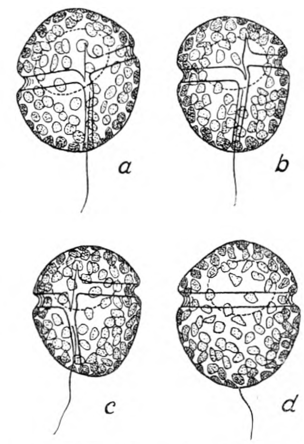

Fig. 98. *Gymnodinium inversum* Nyg.; *a—b* from Frederiksborg Slotssø, April 3rd, 1930; *c—d* from Furesø, May 7th, 1931. 560 ×.

Periodicity. In Frederiksborg Slotssø *Gymnodinium inversum* occurred only in the months of February, March and April, 1930 (temp. 1—12° C.). During the other 9 months of the year it was never observed in the plankton. Its highest development, during which it was not very conspicuous, was reached at the end of April (temp. 12° C.). In Furesø a dozen individuals were seen on May 7th, 1931, when the temperature was exceptionally low (5.5° C.). In Lyngby Sø the species was not infrequent on March 25th, 1946 (temp. 3.5° C.). In 1927 the species was not infrequent in Frederiksborg Slotssø on March 12th (temp. 5.5° C.), cp. Berg & Nygaard 1929, p. 295.

In other words this typically vernal form is oligo- to mesothermic, occurring at temperatures between 1 and 12° C.

Sociology. The species occurred in the following associations:

Frederiksborg Slotssø.

Feb. 17th, 1930: *Ste Ha*-association (the species very rare).

Mar. 1st, — : association dominated by minute green algae cells (about 120.000 individuals per ml, more than 90 % of which are *Trochiscia granulata* f. and the rest perhaps *Stichococcus*) with *Ste Ha* as subdominant (about 19,500 cells per ml); the species very rare).

— 15th, — : *Ste Ha*-association with *Mel it su* as subdominant (the species very rare).

Apr. 1st, — : *Trochiscia granulata* f.-association (about 24,000 cells per ml, 2.5—3.5 μ large) with *Ste Ha* as subdominant (about 13,000 cells per ml); the species rare (about 100 individuals per ml).

Apr. 3rd, 1930: *Ste Ha*-association (the species rare).
— 25th, — : *Ste Ha - Sce arm*-association (the species not infrequent).

Furesø.
May 7th, 1931: *Asi fo*-association (the species rare).

Lyngby Sø.
Mar. 25th, 1946: *Beggiatoa*(?)-association (the species not infrequent).

This means that *Gymnodinium inversum* was observed in diatom associations (*Stephanodiscus*, *Asterionella*) and in chlorophycean associations (*Trochiscia* and *Scenedesmus*).

The constant associates were *Chlamydomonas Reinhardii* and *Stephanodiscus Hantzschii*, which occurred in 100 $^0/_0$ of the number of samples (8) that contained *Gymnodinium inversum*. *Ankistrodesmus falcatus* var. *acicularis* f. *longissima*, *Micractinium pusillum*, *Scenedesmus armatus*, *Melosira italica* subsp. *subarctica* and *Cryptomonas ovata* were found in 87.5 $^0/_0$ and *Chlamydomonas bicocca*, *Asterionella formosa*, *Glenodinium aciculiferum*, *Glen. edax* and *Microcystis pulverea* var. *racemiformis* in 75 $^0/_0$ of the samples.

Ecology. All 3 lakes are eutrophic. In Furesø the values of the compound quotient were found to be 3.5, 3.5 and 4.4, while Frederiksborg Slotssø showed the values 8, 9 and 10. Some ecological data of the species are: pH 7.8—9.4, CaO 66.8—71 mg/l (in Furesø the annual variation of calcium was 54.5—65.4 mg CaO per l according to Brønsted & Wesenberg-Lund, 1912), consumption of $KMnO_4$ 14—48 mg/l, NH_3-N 0.02—0.2 mg/l, NO_3-N 0.03—1.1 mg/l, PO_4-P 0.015—0.16 mg/l. Analyses of the iron content of Frederiksborg Slotssø in January and June gave 0.15 and 0.01 mg/l of Fe, respectively.

var. **elongatum** nov. var.

Fig. nostra 99.

Diagnosis. A typo hoc modo differt: epivalva subconica et hypovalva subsemisphaerica aequales sunt; cellulae multo elongatiores quam cellulae typi, e 5 mensionibus 1.4—1.7 plo longiores quam latiores. Nucleus late ellipsoideus, in media cellula. Chromatophori numerosi, rufo-brunnei, rotundati—ovales (3—4 μ) vel elongati et subirregulares (—5 μ longi, 1—2 μ lati). Longitudo cellularum 39—50 μ, latitudo 22.5—34 μ.

Hab. In Furesø et Emdrup Sø, Selandia, Dania, libere natans.

Systematics. This variety is easily distinguished by its long cells with the subconiform epivalva, by its straight longitudinal furrow and by its reddish-brown chromatophores. In Emdrup Sø there was a very distinct difference in colour between

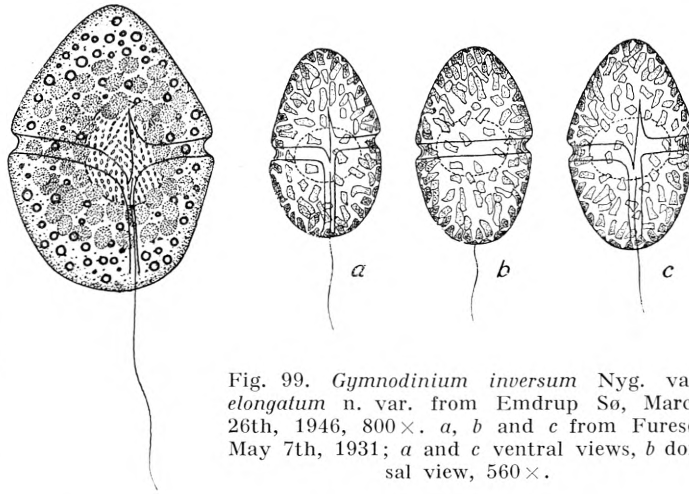

Fig. 99. *Gymnodinium inversum* Nyg. var. *elongatum* n. var. from Emdrup Sø, March 26th, 1946, 800×. *a*, *b* and *c* from Furesø, May 7th, 1931; *a* and *c* ventral views, *b* dorsal view, 560×.

the ochraceous chromatophores of *Gymnodinium tenuissimum* and the reddish-brown chromatophores of *Gymnodinium inversum* var. *elongatum*.

Periodicity. The variety was only seen on May 7th, 1931 in Furesø at a temperature of 5.5° C. when it was very rare in the plankton, and on March 26th, 1946 in Emdrup Sø (temp. 5° C.) where it was very rare, too. The material is too small for a decision whether the variety is a cold water form.

Sociology. The variety occurred in the following 2 associations:

Furesø.

May 7th, 1931: *Asi fo*-association (variety very rare).

Emdrup Sø.

Mar. 26th, 1946: *Gle ac*-association with *Ste Ha* as subdominant (variety very rare).

The variety thus appeared in a diatom association (*Asterionella*) and a dinoflagellate association (*Glenodinium*).

Ecology. As will appear from Table I Furesø is a clear, alkaline, moderately eutrophic lake; Emdrup Sø is a small lake, somewhat polluted (by ducks and other swimming birds); on July 29th, 1941 the compound quotient was $\frac{6}{0}$ and on November 29th, 1946 (temp. 5.5° C., pH 7.9) $\frac{32}{2} = 16$, which indicates a high degree of eutrophy.

Euglenineae.

Euglenaceae.

Euglena phacoides n. sp.

Fig. nostra 100.

Diagnosis. Cellulae mediae, elongate fusiformes, compressae, e duodecim mensionibus cellularum in statu metabolico 2.1—3.7 plo longiores quam latiores, sic submetabolicae, ut cellulae paulo supra medium anulariter inflentur. Pars anterior cellulae gracilis, interdum leviter curvata, apice oblique truncato-rotundata; pars posterior longe attenuata et acutissima. Periplastus delicatus, distincte et spiraliter striatus, 6—9 striis pro 10 μ. Chromatophori numerosi, discoidei, parietales, sine pyrenoidibus. Granula paramylacea multa, parva, bacilliformes vel longe ellipsoidea, supra medium cellulae. Nucleus centralis vel paulum infra mediam cellulam situs, atque late ellipsoideus est. Flagellum circiter $\frac{1}{2}$ longitudinis cellulae, in gula lageniformi insertum. Stigma ovale in parte anteriore apud gulam situm est. Longitudo

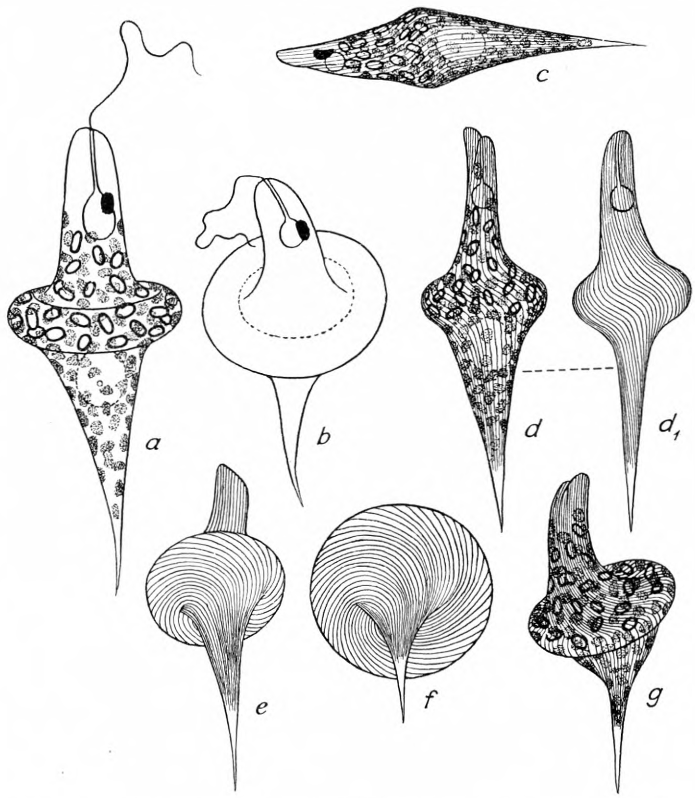

Fig. 100. *Euglena phacoides* n. sp.; *a*—*f* from Bistrup Dam, *a*—*b* from July 11th, 1929 (the striation is not delineated), *c* from September 20th, 1929, *d*, d_1, *e* and *f* from November 16th, 1929; *g* from Sortedam II, April 10th, 1930. *d* front view, d_1 lateral view, *f* oblique basal view. *a*—*b* 840 ×, *c* 560 ×, *d*—*g* 800 ×.

cellularum 56—78(95) μ, latitudo 16—28 μ; anulus 8—9 μ crassus, ad 30 μ in diametro.

Hab. In Bistrup Dam, Sortedam II, Lynge Vandingsdam et palude Eriophori prope Sorø, Selandia, Dania, libere natans.

Systematics. The species looks like *Euglena proxima* and *Euglena acus*, but differs from both of these terete species in being distinctly compressed; this is easily seen when the swimming individual slowly rotates round its own longitudinal axis. Unlike *Euglena proxima* the individuals of *Euglena phacoides* are unable to assume a spherical shape. *Euglena phacoides* is easily distinguished by the fact that in the metabolic state it forms a pronounced or even enormous ring-shaped thickening a little above or in the middle of the cell; in this state it is able to approach its anterior part to the point of its posterior part. *Euglena acus*, however, is very disinclined to show metaboly; it is only very slowly and with difficulty that it grows shorter and much thicker, but roughly speaking it retains its fusiform shape. Swimming individuals of *Euglena phacoides* from Eriophorum moor measured up to 95 μ in length.

Periodicity. *Euglena phacoides* was found in 8 months of the year, April—November, at temperatures between 5° and 19° C. In December, January, February and March no samples were taken in Bistrup Dam, which showed the most frequent occurrence of the species, and so it cannot be safely established whether the species is eurythermic, which seems very probable: in Bistrup Dam it was common in the plankton on November 16th, 1929 (temp. 5° C.; 60 individuals per ml); on October 24th, 1929 its frequency was 8 individuals per ml, and in the summer samples it was very rare. In Sortedam II it was observed only on April 10th, 1930 and in Lynge Vandingsdam on June 30th and August 6th, 1947; all the 3 samples showed very small quantities. In the *Eriophorum* moor S. of Sorø *Euglena phacoides* was not found in the samples from July, August, September and October 1947, but it appeared on November 15th (temp. 2.5° C.), December 13th (temp. 3° C.) and January 10th, 1948 (temp. 1° C.); it was very rare on these three occasions. On February 21st (temp. 2° C., ice 8 cm thick) the species was rare; it disappeared in the *Eriophorum* moor before March 20th (temp. 7.5° C.) and was no more present in the April sample. On the basis of the sparse material it is perhaps legitimate to conclude that *Euglena phacoides* seems to reach its maximum development during the cold season.

Sociology. The species was found in the following associations:

Bistrup Dam: all associations were dominated by Bacteria and "Chlorobacteria" in enormous quantities; the following organisms are given as the most frequent non-bacterial species of the samples though their frequencies are but smal fractions of those of the Bacteria.

July 11th, 1929: *Ank fa se br* and *Le ps* (the species very rare).
Sep. 9th, — : the species very rare.
— 20th, — : *Eug pr* and *Le ps* (the species very rare).
Oct. 24th, — : *Phu pl* (6 individuals per ml) and *Le ps* (the species not infrequent).
Nov. 16th, — : *Euglena phacoides* and *Phu os* (the species common).
Apr. 12th, 1930: *Chla ol* (the species not infrequent).
May 1st, — : *Phu os* and *Le ps* (the species very rare).

In Table IV we find the qualitative composition of the associations from October 24th and November 16th, 1929.

Sortedam II.

Apr. 10th, 1930: *Crym ov*-association with *Chla ac* as subdominant (the species very rare).

Lynge Vandingsdam.

June 30th, 1947: *Tra vo*-association with *Chla ci* as subdominant (the species very rare).

Aug. 6th, — : *Eug ob*-association (23,300 individuals per ml) with Bacteria and and *Se ca* as subdominants (the species very rare).

The qualitative composition of the two last-mentioned associations appears from Table IV.

Eriophorum moor.

Nov. 15th, 1947: *Sce arm*-association with *Gy ne* as subdominant (the species rare).

Dec. 13th, 1947: *Gle Lo - Per Wi*-association (the species very rare).

Jan. 10th, 1948: *Gle Lo*-association (the species very rare).

Feb. 21st, 1948: *Chry ma - Ma te* - association with *Gle Lo* as subdominant (the species rare).

In other words *Euglena phacoides* occurs in associations characterized by Bacteria and "Chlorobacteria" together with green algae, *Chlorococcales* (*Ankistrodesmus* and *Scenedesmus*), Flagellates (*Cryptomonas*), Dinoflagellates (*Glenodinium* and *Peridinium*) and Euglenines (*Euglena*, *Phacus* and *Lepocinclis*).

The most constant associates cannot be given because no single species occurred in as much as 75 % of the number of samples (14) that contained *Euglena phacoides*; in 75 % of the samples, however, large quantities of Bacteria were present.

Ecology. Bistrup Dam was a distinctly saprotrophic pond, Sortedam II a polluted eutrophic pond of the mixotrophic phase and Lynge Vandingsdam an enormously polluted eutrophic pond approaching saprotrophy. Table III gives the phytoplankton quotients of these three ponds. Suffice it to mention here that in Bistrup Dam the compound quotients for October 24th, and November 16th, 1929 were $\frac{9}{0}$ and $\frac{8}{0}$, respectively, the euglenine quotients for the same dates $\frac{8}{1} = 8$ and $\frac{8}{0}$, respectively. In Lynge Vandingsdam the compound quotients for June 30th and August 6th, 1947 were $\frac{31}{1} = 31$ and $\frac{29}{0}$, respectively, and the euglenine quotients for the same dates $\frac{18}{12} = 1.5$ and $\frac{21}{7} = 3$, respectively. The *Eriophorum* moor is an almost overgrown fen, the narrow peripheral water edge of which during the summer months contains a marked Desmid plankton (up to 33 Desmids per sample!); the water, the pH of which during the investigation varied between 6.4 and 6.9, is polluted by cattle grassing near its margin. Each of the three samples mentioned above from the *Eriophorum*-moor contained so much as 9 or 10 euglenines.

Accordingly, it must be legitimate to consider *Euglena phacoides* a mesosaprobic-polysaprobic organism. A few data of the ecology of the species are: pH 6.4—9.0, CaO about 40—118.7 mg/l (Aug. 12th, 1929, Bistrup Dam), consumption of $KMnO_4$ 84 mg/l (April 26th, 1930, Sortedam II), content of NH_3-N 0.55—20 mg/l, NO_3-N 0.06 mg/l and PO_4-P 0.015—4 mg/l.

Lepocinclis fusiformis Lemm. var. **amphirhynchus** nov. var.

Fig. nostra 101.

Diagnosis. Cellulae citriformes, polis valde productis, $1\frac{1}{4}$—$1\frac{1}{2}$ plo longiores quam latiores, apicaliter productae et truncatae, antapicaliter abrupte et obtuse acutatae sunt. Stigma compositum, ovale, prope partem apicalem. Flagellum 1—$1\frac{1}{2}$ longitudinis cellulae. Chromatophori multi et disciformes. Granula paramylacea grandia, lateralia et anularia. Pellicula sine colore, spiraliter striata, 9—10 striis pro 10 μ, secunda quaeque interdum praecipue conspicua; directio striarum a vertice visa contra itionem horologii. Longitudo cellularum 30—35 μ, latitudo 22.5—26 μ.

Hab. In Sortedam II prope Hillerød, Dania, libere natans.

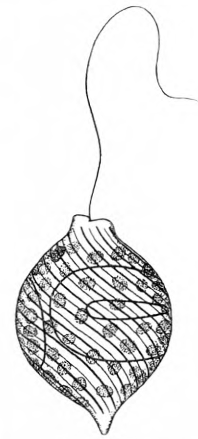

Fig. 101. *Lepocinclis fusiformis* Lemm. var. *amphirhynchus* n. var. from Sortedam II, September 12th, 1929. 800×.

Systematics. The variety differs from the main species by its highly protruding poles (see W. Conrad 1934, p. 225, fig. 30). Habitually it shows some likeness to *Lepocinclis sphagnophila* Lemm. (Pascher's Süsswasserflora, Heft 2, 1913, p. 134, fig. 229), which, however, according to the figure is twice as long as broad, according to the two measurements given nearly 3 times longer than broad! According to Conrad (*loc. cit.* p. 244) this species is dubious. I have not chosen to call the new variety var. *sphagnophila* (Lemm.) mihi because the identity of Lemmermann's and my specimens is improbable.

Periodicity. A total of 7—8 specimens of the described variety were observed in Sortedam II and only in the month of September: on September 3rd, 5th and 12th, 1929; during the remaining 11 months it was not observed. Being observed only at temperatures between 16 and 18.5° C. it thus seems to be polythermic.

Sociology. The variety was found in the following association containing 12 euglenines:

Crym ov-association with *Ste Ha*, *Gy aer* and *Eug ac* as subdominants (the variety very rare).

Ecology. Sortedam II is a highly overshadowed pond, cold in summer, eutrophic of the mixotrophic phase, sometimes completely covered with *Lemna*; see Table III. The following are a few data of the ecology of the variety in question: pH 7.1—7.15, CaO 39.1 mg/l, consumption of $KMnO_4$ 104 mg/l, contents of PO_4-P 0.015 mg/l, NH_3-N 0.2 mg/l and NO_3-N 0 mg/l.

Phacus anomalus Fritsch et Rich var. **pullus gallinae** nov. var.

Fig. nostra 102.

Diagnosis. Cellulae parvae, paulum compressae, a fronte visae concinne ellipticae, e 11 mensionibus 1.2—1.6 plo longiores quam latiores, cum fossa 3—4 μ lata,

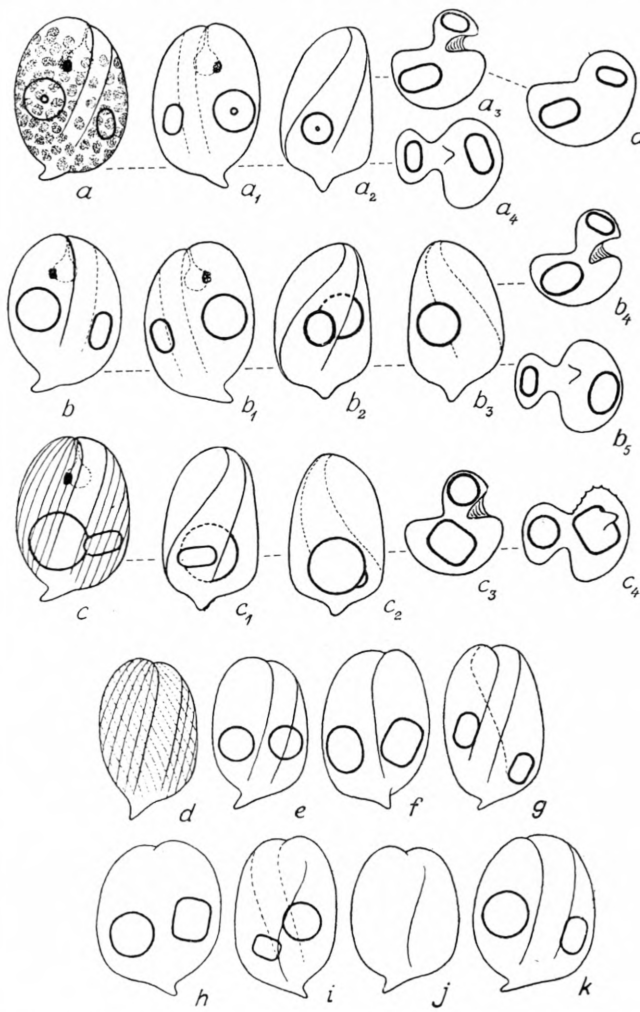

Fig. 102. *Phacus anomalus* Fritsch et Rich var. *pullus-gallinae* n. var. from Lynge Vandingsdam, June 30th, 1947. *a, b, c, d, e, g, j* and *k* ventral views, a_1, b_1, *f*, *h* and *i* dorsal views, a_2, b_2, b_3, c_1 and c_2 lateral views, a_3, b_4 and c_3 vertical views, a_4, b_5 and c_4 basal views, a_5 vertical view by deep focussing. 800×.

ventrali, decliviter longitudinali, fere partem posteriorem cellulae attingenti. Pars posterior cum cauda breviter coniformi, obtusa, obliqua et leviter curvata. A vertice visa cellula ex partibus duabus valde inaequalibus constare videtur, quarum altera major semicircularis, altera minor capiti avis similis. Cellula a latere visa dorsaliter subrecta, ventraliter valde convexa; pars minor ("ala") obliqua, cuneata apparet, ab apice cellulae ad partem posteriorem attingens. Granula paramylacea bina disciformia vel brevissime cylindracea angulis valde rotundatis, interdum cum foramine medio; alterum, quod in "ala" cellulae situm est, minus est quam alterum in "corpore" cellulae. Pellicula interdum decleviter et tenuiter striata, 8 striis pro 10 μ.

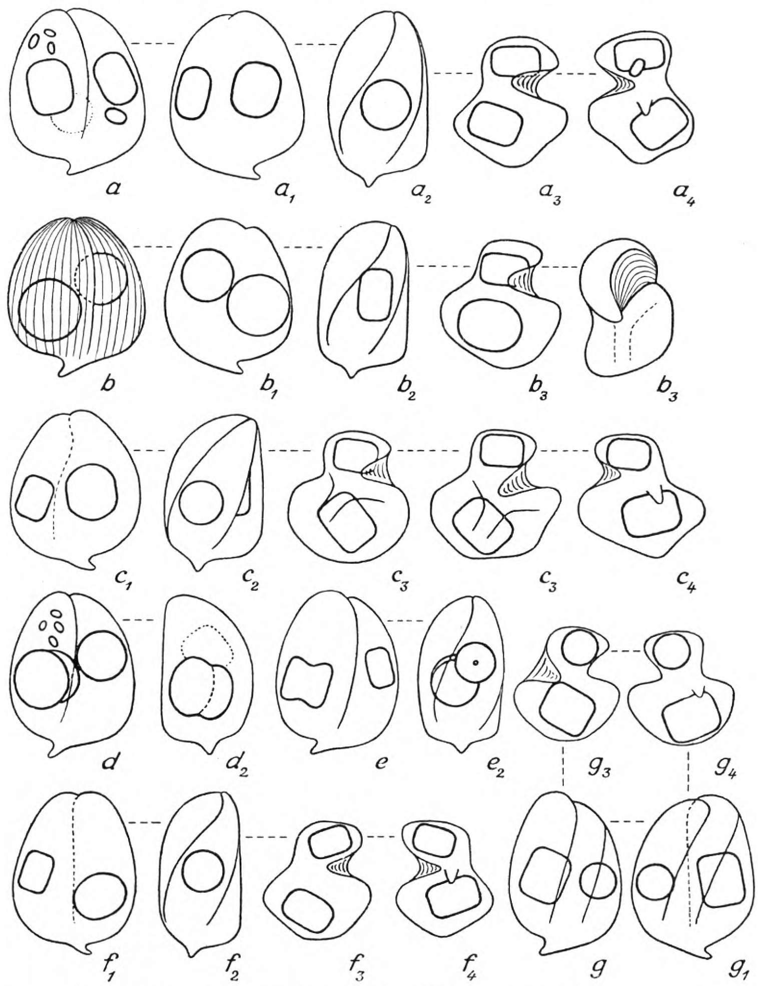

Fig. 103. *Phacus anomalus* Fritsch et Rich from Griqualand West, sample 844. a, b, d, e and g ventral views, a_1, b_1, c_1, f_1 and g_1 dorsal views, a_2, b_2, c_2, d_2, e_2 and f_2 lateral views, a_3, b_3, c_3, f_3 and g_3 vertical views, a_4, c_4, f_4 and g_4 basal views. 800×.

Chromatophori numerosi, parvi, disciformes. Stigma ovale vel rotundum in parte anteriore apud gulam lagenae-formem. Longitudo cellularum sine cauda 21.5—26 μ, latitudo 16—20.5 μ, crassitudo "corporis" 14—15 μ, crassitudo "alae" 7—10 μ; longitudo caudae circiter 2—3 μ.

Hab. In Lynge Vandingsdam, Selandia prope Sorø, Dania, libere natans.

Systematics. I am highly indebted to Professor F. E. Fritsch, London, for the reception of type material of *Phacus anomalus* Fritsch et Rich. *Fig. nostra* 103 shows some drawings of individuals in various positions.

Fritsch and Rich (1929, p. 73, fig. 24 *H—N*) give the following measurements: long. cell. sine spin. 24—27 μ, lat. 26—27 μ (fig. 24 *I* is only about 20 μ broad), crass. corp. 17—22 μ, crass. alae 11—12 μ. They further illustrate the typical *Phacus anomalus* cell in fig. 24 *I*; it is egg-shaped in front view.

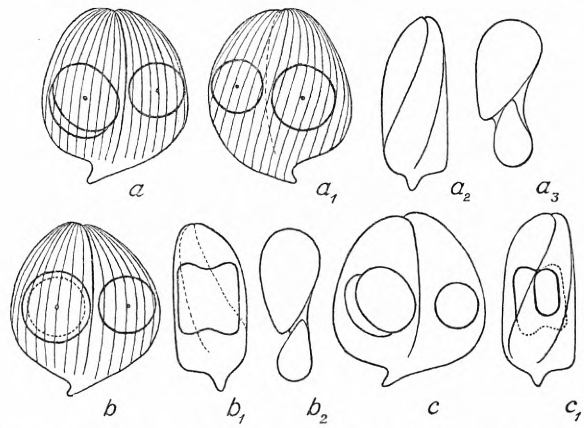

Fig. 104. *Phacus curvicauda* Swirenko emend. Nygaard from Blankeborg I, August 17th, 1927. *a*, *b* and *c* ventral views, a_1 dorsal view, a_2, b_1 and c_1 lateral views, a_3 and b_2 vertical views. 800 ×.

My measurings of the type material for 8 individuals gave the following dimensions: long. cell. sine cauda 23.5—27 μ, lat. 19—22 μ, crass. corp. 14—21 μ, crass. alae 10—12 μ, in other words a good correspondence with the measurings of Fritsch and Rich, though I never found cells that are as broad as long. In the 8 individuals measured the ratio of axes was 1.1—1.4, averaging 1.25. There were 8 striae pro 10 μ.

Var. *pullus gallinae* differs from the main species by its elliptical shape of cells in front view. According to 11 measurings the ratio of axes is 1.2—1.6, 1.4 in mean, which shows that the cells of the variety are comparatively longer than those of the main species. In vertical (or basal) view the corpus of the variety is hemispherical, that of the main species often somewhat angular though it may be hemispherical.

Phacus curvicauda Swirenko (see A. Pochmann 1942, p. 155, figs. 48—51) is not easily distinguished from *Phacus anomalus*. Apparently Swirenko pictures it only in front view, in which position it is completely like *Phacus anomalus*. The individuals figured by Pochmann in Fig. 50 are hardly identical with those of Fig. 49, the difference between the vertical views being too great.

Fig. nostra 104 shows some individuals which I have called *Phacus curvicauda* Swirenko emend. Nygaard and I will here try to give this species a clearer definition. The individuals from Blankeborg I were broadly egg-shaped in front view, and the paramylon grain of corpus was cylindrical or clepsydriform. A very conspicuous fact, however, is that corpus is thinner, so that the cells are much more flattened than in *Phacus anomalus* and its var. *pullus gallinae*. Long. cell. sine cauda 26—28 μ, lat. 24—26 μ, crass. corp. 10—12 μ, crass. alae 7—9.5 μ, long. caudae 2.5—4 μ, 6—8 striis pro 10 μ.

The specimen figured in "Dansk Plante-Plankton", fig. 90 (*sub nomine Phacus alata* var. *latviensis*), which originates from Blankeborg I on June 2nd, 1927, in all respects corresponds to the individuals from Blankeborg I on August 17th, 1927, August 18th, 1928 and June 10th, 1930.

Sociology. The species was found only in the following 2 associations:

June 30th, 1947: *Tra vo*-association with *Chla ci* and Bacteria as subdominants (the species rare).

Aug. 6th, — : *Eug ob*-association (23.300 individuals per ml) with *Se ca* and Bacteria as subdominants (the species very rare).

The qualitative composition of these two associations appears from Table IV. In other words *Phacus anomalus* var. *pullus gallinae* was found in associations dominated by Euglenines (*Euglena*, *Trachelomonas*).

Ecology. The material does not allow any conclusions on the vegetation period or the maximum of the species. Lynge Vandingsdam is a very shallow, highly contaminated watering pond on the transition stage between eutrophy and saprotrophy. At 10 a. m. on August 6th, 1947 the temperature was 19.5° C. and pH 9.0; the compound quotient was $\frac{29}{0}$ and the euglenine quotient no less than $\frac{21}{7} = 3$, which shows quite an extraordinary richness in Euglenines. On June 30th the compound quotient was $\frac{31}{1} = 31$ and the euglenine quotient $\frac{18}{12} = 1.5$.

Phacus Manginii Lefèvre var. **inflatus** nov. var.

Fig. nostra 105.

Diagnosis. A typo cellulis majoribus cum margine ventrali inflato et cum axe longitudinali dorsiventraliter et leviter curvato differt; carina minus projecta quam in typo. Longitudo cellularum cum cauda 50—52 μ, sine cauda 36—38 μ, latitudo 29—30 μ, crassitudo 10—14 μ, cauda circiter 14 μ longa, 5—7 striae pro 10 μ.

Hab. In Sortedam II prope Hillerød, Dania, libere natans.

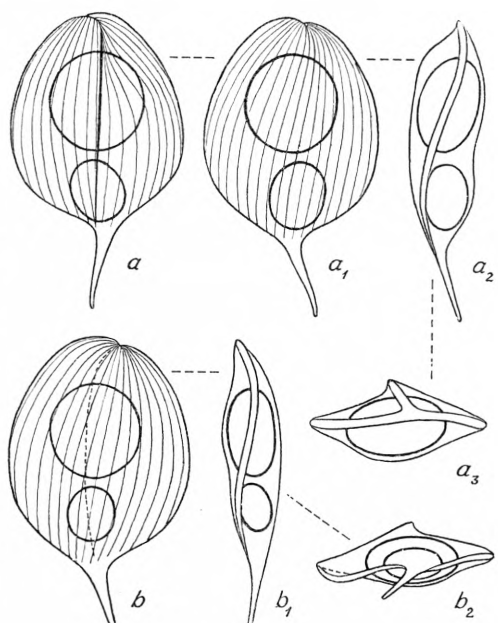

Fig. 105. *Phacus Manginii* Lef. var. *inflatus* n. var. from Sortedam II, July 1st, 1929; *a* dorsal view, a_1 and *b* ventral views, a_2 and b_1 lateral views, a_3 vertical view, b_2 basal view. 800×.

Systematics. The dorsal keel is not so protruding as in the main species (Pochmann 1942, p. 149, figs. 40 *a*—*i*), but it is running longitudinally over the whole of the convex, dorsal surface. In front view the cells are very regularly egg-shaped. The big round and the smaller ellipsoidical and antapical paramylon granule are situated in the longitudinal axis of the cell; in lateral view both of them turn out to be compressed. On the ventral side of the cell there are two inflations, one off each paramylon granule.

Periodicity. The variety was observed in Sortedam II in June, July and September and at the beginning of October at temperatures between 11.25 and 21° C. It was always rare; the most individuals were seen in the sample from September 5th, 1929 (temp. 16° C.).

Sociology. *Phacus Manginii* var. *inflatus* occurred in the following associations:

June	8th,	1929:	*Ce hi*-association with *Cl Kü* and *Ana fl* as subdominants (the variety very rare); see Table IV.
July	1st,	— :	*Ce hi*-association with *Ma ca* as subdominant (the variety very rare); see Table IV.
—	10th,	— :	*Ce hi*-association with *Ma ca* and *Tra ve* as subdominants (the variety very rare).
Sep.	5th,	— :	*Crym ov*-association with *Phu su*, *Gy aer* and *Ste Ha* as subdominants (the variety rare).
—	23rd,	— :	*Crym ov*-association (the variety very rare); see Table IV.
Oct.	7th,	— :	ditto.
June	16th,	1930:	*Dic pu*-association with *Dic Eh* as subdominant (the variety very rare).

In other words the variety occurred in dinophycean (*Ceratium*), cryptophycean (*Cryptomonas*) and chlorophycean (*Dictyosphaerium*) associations.

The constant associates were *Scenedesmus armatus*, which occurred in 100 % of the number of samples (7) that contained *Phacus Manginii* var. *inflatus*; *Trachelomonas hispida* and *Trach. volvocina* (both 86 %). (*Ankistrodesmus falcatus*, *Dictyosphaerium pulchellum*, *Scenedesmus arcuatus*, *Oocystis Marssonii*, *Cyclotella Meneghiniana* and *Gymnodinium aeruginosum* in only 71 % of the samples, the last-mentioned perhaps in more because not all samples were examined alive).

Ecology. Sortedam II is a highly overshadowed, shallow, eutrophic pond of the mixotrophic phase, sheltered from winds and contaminated by ducks and other swimming birds. On July 17th, 1929 the whole surface of the pond was covered by *Lemna*. The following data can be given concerning the ecology of *Phacus Manginii* var. *inflatus*: pH 7.1—7.4, CaO 34—39.1 mg/l, consumption of $KMnO_4$ 75—93 mg/l, contents of PO_4-P 0.005—0.095 mg/l, NH_3-N 0.15—0.2 mg/l, NO_3-N 0—0.03 mg/l, Fe 0.1 mg/l.

Phacus suecicus Lem. var. **inermis** nov. var.

Fig. nostra 106.

Diagnosis. Cellulae ellipsoideae, raro subtrapeziformes, valde applanatae, e 11 mensionibus 1—1.5 (vulgo 1.2) plo longiores quam latiores (excl. cauda). Pars anterior leviter excavata cum verruca parva, conica, centrali, per quam flagellum exit. Cauda obliquior, non vel leviter curvata. Stigma grande, subangulatum. Pellicula glabra, vel in utroque latere cellulae circiter 13—16 striis longitudinalibus tenuissimis instructa est. Inter strias interdum series granulorum tenuissimorum (circiter

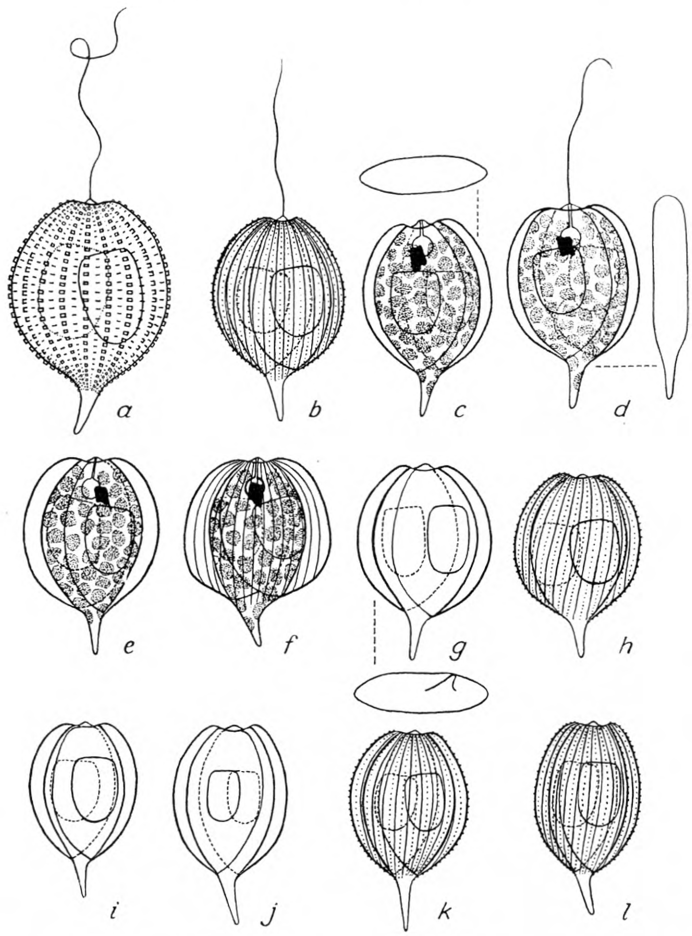

Fig. 106. *Phacus suecicus* Lemm.; *a* from Sortedam II, August 23rd, 1929, 800×. *b*—*l* var. *inermis* n. var. from Bøllemosen, September 5th, 1946. *b*, *h*, *k* and *l* are striated and punctuated individuals (eyespot, chromatophores, reservoir and nucleus are omitted). *c*, *d*, *e*, *g*, *i* and *j* represent smooth individuals (eyespot, chromatophores, reservoir and nucleus are omitted in *g*, *i* and *j* in order to demonstrate the look of the paramylon grains). *f* is a striated individual. *c* shows an individual in vertical and front view, *d* in front and lateral view, *g* in front and basal view. The lower lying paramylon grain is stippled in all the figures. 800×.

30 granula pro serie). In media cellula circiter 9 granula pro 10 μ, ad fines serierum granula minores et constipatiores. Granulis paramylaceis binis, grandibus, inverse stapediformibus. Flagello cellulae longitudine aequilongo. Chloroplastis multis, parvis, rotundis vel angulatis. Nucleus grandis, sphaericus, basalis est. Longitudo cellu-

larum 23—26.5 μ, latitudo 17—24 μ, crassitudo 6—7.5 μ; cauda 6.5—9 μ longa; 6—7 striae pro 10 μ in media cellula.

Hab. In Bøllemosen, Selandia, et Flødegaardens Dam, Fionia, Dania, libere natans.

The variety differs from the main species by its smooth or delicately striated cells; if granules are present, they are always very much reduced. Besides the dimensions of the variety are smaller than those of the main species.

Strange to say A. Pochmann, who in his monography (1942) has subjected the *Phacus* species to a close study, did not observe the stirrup-shaped paramylon granules in *Phacus suecicus*. All *Phacus suecicus* observed by me in Danish localities had paramylon granules of this shape (cp. Nygaard 1945, t. 2, fig. 35, drawn from living material); as mentioned the same is true of var. *inermis*. In my opinion, however, it would be as illegitimate to set up a new species on the basis of these characteristic paramylon granules as to retain a "species" like *Phacus multiannulatus* Pochmann (loc. cit., p. 206, Fig. 118).

Phacus suecicus var. *inermis* was observed on September 5th, 1946 in Bøllemosen where it was infrequent in a *Dic pu*-association with *Ma ca* as subdominant; beside these two characteristic indicatory species *Dinobryon pediforme* was rather common in the plankton. In Flødegaardens Dam the variety was seen on August 3rd, 1939, where it was very rare in a *Dic pu*-association with *Ste Ha* as subdominant.

Bøllemosen is probably oligotrophic of the dystrophic phase: at the said time the water was very brown, and pH was 4.9. Flødegaardens Dam is a contaminated, highly eutrophic pond; on August 3rd, 1939 the compound quotient was $\frac{35}{4} = 8.75$.

In an ecological respect the described variety thus holds a somewhat exceptional position among the *Phacus* species, the great majority of which are found in eutrophic (and mixotrophic ponds.)

Trachelomonas chlamydophora n. sp.

Fig. nostra 107.

Diagnosis. Cellulae magnae, saepe obovatae apice subtruncato, raro ellipsoideae, rarissime cordiformes, quaeque cellula tegimento gelatinoso, 4.5—5 μ crasso circumdata. Theca ochracea, saepe punctulata, 4—5 punctulis pro 5 μ, raro scaberula vel tenuissime et disperse spinulosa, in primis ad fines. Apex collo brevissimo, 1—1.5 μ alto et 4 μ lato instructus est. Pellicula protoplasti tenuiter et spiraliter striata, 16—17 striis pro 10 μ. Nucleus magnus, rotundus, in parte posteriore cellulae situs est. Chromatophori multi, subrotundi; granula paramylacea numerosa, ellipsoidea vel breviter bacilliformia; stigma rubrum satis magnum in parte anteriore cellulae apud vacuolum; flagellum circiter $1\frac{1}{2}$ longitudinis cellulae. Longitudo cellularum sine mucilagine 39—42 μ, latitudo 30—35 μ.

Hab. In palude Eriophori prope Sorø, Dania, libere natans.

Systematics. At first I considered the individuals in question to be identical with *Trachelomonas hispida* Stein var. *punctata* Lemm. (Deflandre 1926, p. 651, figs. 209—211, 215—217); especially Deflandre's fig. 211 is very similar in outline. Deflandre, however, gives the measurements 26—32 $\mu \times$ 19—23 μ for the variety

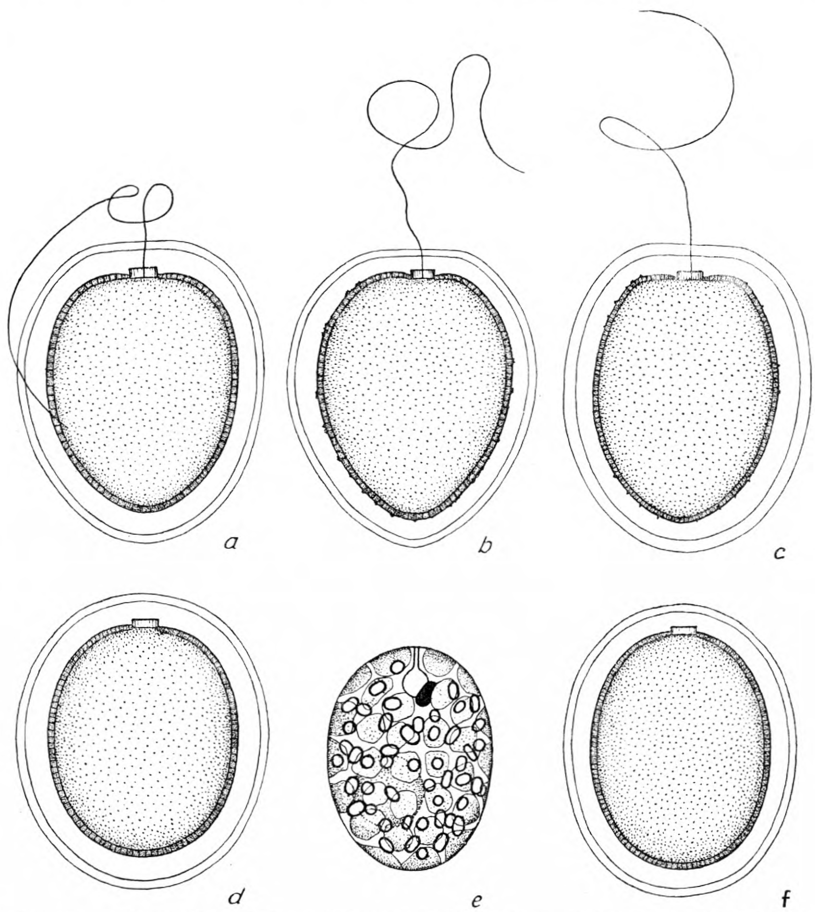

Fig. 107. *Trachelomonas chlamydophora* n. sp. from the Eriophorum moor; *a*—*e* from August 6th, 1947, *f* from July 9th, 1947. *e* the naked protoplast. 800 ×.

mentioned; further it has no collum, and the gelatinous envelope is lacking. Consequently, the two forms cannot be identical.

Within the genus *Trachelomonas* only a single species was hitherto known to possess a thick gelatinous envelope outside the cell, viz. *Trachelomonas mucosa* Swirenko (Deflandre 1926, p. 72, t. 2, fig. 154). This species exhibits the same dimensions as *Trachelomonas chlamydophora*, but its cells are ellipsoidical and provided with a rather long collum, which measures 3×4.5 μ; further its flagellum is 2—3 times as long as the cell.

The dimensions of *Trachelomonas mucosa* Swir. var. *brevicollis* Skvortz. are only 28—35 $\mu \times$ 16—25 μ.

In material fixed in formalin the gelatinous envelope of *Trachelomonas chlamydophora* is not visible.

Periodicity. The species was very rare on July 9th, 1947, but common on August 6th and September 6th at temperatures of 19.5—19° C. On October 4th (temp. 13° C.) the species had become rare again, and it was not observed in the samples from November, December, January, February, March and April. So *Trachelomonas chlamydophora* seems to be periodical and meso- to polythermic, obtaining a considerable maximum in August—September at temperatures about 19° C.

Sociology. The species was found in the following associations:

July 9th, 1947: *Sta Be*-association with *Dic pu* as subdominant (the species very rare).
Aug. 6th, — : *Tra ch*-association (the species common).
Sep. 6th, — : *Tra ch*-association (the species common).
Oct. 4th, — : *Tra*-association (the species rare); see p. 78.

The species thus occurred in associations dominated by the desmid *Staurastrum*, the Chrysophycea *Synura* and the euglenine *Trachelomonas*.

Ecology. The *Eriophorum* moor is mentioned on p. 166. Its water is brownish and slightly acid (pH was 6.5—6.8 at the times when *Trachelomonas chlamydophora* occurred) and somewhat contaminated by cattle grazing near the margin.

Uncoloured flagellates.

Bicoecaceae.

Bicoeca turrigera n. sp.

Fig. nostra 107 *bis.*

Diagnosis. Loricae parvae, e 13 mensionibus 1.3—1.7-plo longiores quam latiores, ampullaceae et teretes, postremus conicae sunt; pars antica cylindracea vel subconica apice truncato cum ora incrassata, sub medio plusminusve inflata est, atque conus basalis semper verruca parva et conica instructus; loricae vulgo incoloratae, interdum pallide ochraceae, transverse anulatae sunt, pars antica cum 8—10 anulis pro 5 μ, conus basalis cum 5 raro 6 anulis pro 5 μ; margo loricae a fronte visae dense et tenuiter dentatus. Protoplastus multo minor quam lorica, sine colore, vulgo sphaericus, raro obovatus, pedicello contractili lateraliter inserto protoplasto circiter $2\frac{1}{2}$-plo longiore basi loricae affixus, oram loricae attingens; nucleo plusminusve centrali. Flagellum unum cellula ad 4-plo longius, lateraliter insertum. Longitudo loricae 15.5—20 μ (vulgo 16—17.5 μ), latitudo 9—15.5 μ (vulgo 10.5—11.5 μ), latitudo orae 7—11.5 μ (vulgo 7.5—8.5 μ); diameter protoplasti 4—8 μ (vulgo 5—6 μ).

Hab. In Fønstrup Dam prope Hillerød, Dania, libere natans.

Systematics. This new species is easily distinguished from *Bicoeca planctonica* Kisselew (Huber-Pestalozzi 1941, p. 284, fig. 353) and *Bicoeca* (*Bicocoeca*) *multiannulata* Skuja (1948, p. 298, t. 34, figs. 6—11) by the shape of the house and the protoplast.

The protoplast is able to retire lightning-swift from the edge of the house to its basis.

Periodicity. Fønstrup Dam was explored every fortnight during a whole year, but the species was only observed in August and September 1929 by temperatures of 13—16.5° C. It always occurred in small quantities except on September 7th (temp. 13° C.), where it was rather common. Allready on September 22nd it had disappeared. Accordingly the organism must be considered meso- to polythermic.

Sociology. *Bicoeca turrigera* was found in associations of different flagellates as i. e. *Cryptomonas*, *Synura*, *Euglena*, *Lepocinclis*, *Phacus*, and especially *Trachelomonas volvocina*. The plankton was always exceedingly poor in individuals in August and September, only on September 7th, it was distinctly dominated by one organism, and just *Bicoeca turrigera*.

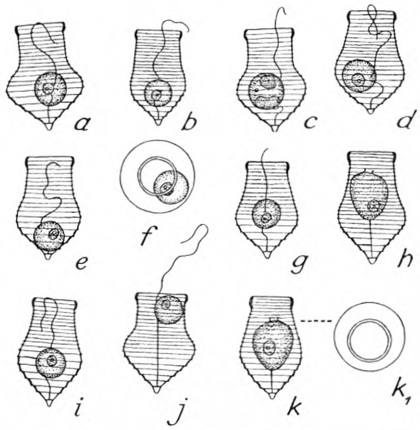

Fig. 107 bis. *Bicoeca turrigera* n. sp. from Fønstrup Dam, September 7th, 1929. *e*, *i* and *j* are drawn after living material, the other figures after material fixed in formalin. *f* and k_1 vertical views, the others front views. 800 ×.

Ecology. Fønstrup Dam (see Nygaard 1938, p. 528, t. 4, figs. 15—16) is a neutral-alkaline forest pond, rich in submerged vegetation, but poor in plankton, ammonia, nitrate and phosphate. Here is a little contribution to the ecology of the species: pH 7.0—7.2, content of CaO 63.3—68.6 mg/l, consumption of $KMnO_4$ 90 mg/l, contents of PO_4-P 0.05—0.06 mg/l, NH_3-N 0.15—0.3 mg/l, NO_3-N 0 mg/l.

Myxophyceae.

Chroococcales.

Chroococcaceae.

Microcystis.

In 1941 Einar Teiling gave an account of the difference between the 3 widely distributed species *Microcystis aeruginosa* Kg. emend. C. Wesenberg-Lund, *Microcystis flos aquae* Kirchner emend. C. Wesenberg-Lund and *Microcystis viridis* Lemm. Wesen-

BERG-LUND was the first to clearly apprehend the difference between *Microcystis aeruginosa* and *Microcystis flos aquae* in the consistency of the gelatinous envelope. However, TEILING paid no regard to the size of the cells, and the key in his 1942 paper (p. 63—64) is determined only for *Microcystis* species with cells larger than 5 μ.

TEILING's definition of the 3 species, which appears distinctly from his instructive Fig.s 1—7, Fig.s 8—9 and Fig. 12, is very practical and no doubt represents a significant progress within the systematics of *Microcystis*. In order to examine whether TEILING's characteristics of species within this difficult genus are hereditary constants or only modifications I made, on July 4th, 1945, 6 clones of *Microcystis flos aquae* (from Mølledammen, Sønderborg) in 6 different culture fluids, *i. a.* in ultra-filtered Mølledam water of various dilutions. On July 20th there was no development of *Microcystis* in any of the glasses, and on August 26th the clones were discarded because no *Microcystis* would develop. The failure of these pure culture experiments is no doubt caused by the fact that there was no constant, slight stirring of the water, for instance by means of a slow up- and downward moving of a plate in the culture fluid throughout the experiment.

In order to demonstrate how the said 3 *Microcystis* species are defined in this paper a small survey is given here:

A. Mucilage sharply delimited, with highly refractive margin; colonies composed of lobulate, rounded partial colonies.
   1. Cells 3—4.5 μ .... *Microcystis aeruginosa*
   2. Cells 5—7 μ .... *Microcystis aeruginosa* var. *major* Wittr.

B. Mucilage without visible or with indistinct delimination; colonies of nebulous shape.
   1. Cells 3—4.5 μ .... *Microcystis flos aquae*
   2. Cells 5—7 μ .... *Microcystis flos aquae* var. *major* nov. var.

C. Margin of mucilage distinct, but not highly refractive, set with small, rounded bulges; partial colonies somewhat angular, with cells arranged in ± distinct series or planes;
   Cells 5—7 μ .... *Microcystis viridis*

Microcystis chroococcoidea West var. **minor** nov. var.

Fig. nostra 108.

Diagnosis. Coloniae parvae, subrotundae, e 6—15 cellulis compositae, sine mucilagine conspicua. Cellulae rotundae, satis dense conglomeratae, olivaceae, subhomogenae, sine vacuolis. Diam. cellularum 2.5—3 μ, diam. coloniarum 7—11.5 μ.

Hab. In Mølledammen in Sønderborg, Dania, libere natans.

The main species differs from this characteristic variety by its larger cells (4—7 μ) and colonies (14—33 μ); besides it occurred in quite another *milieu*, an antarctic salt lake (W. & G. S. West 1911, p. 296, t. 26, figs. 107—114). F. E. Fritsch & E. Stephens further reports the main species from South Africa (1921, p. 60: diam. of cells 4 μ).

The variety was found in enormous quantities in the plankton from Sønderborg Mølledam on August 26th, 1944. This pond is highly eutrophicated by various swimming birds (ducks, swans etc.), which are often fed by the inhabitants of the town. On the said date the plankton was dominated by *Microcystis chroococcoidea* var. *minor* and *Oscillatoria limnetica* var. *acicularis* n. var. f. *brevis* n. f.; the sample contained 24 species, and the myxophycean quotient was $\frac{7}{1}$, the chlorophycean quotient $\frac{8}{1}$, the diatom quotient $\frac{0}{1}$, the euglenine quotient $\frac{3}{14}$ and the compound quotient $\frac{18}{1} = 18$, which indicates a high degree of eutrophy.

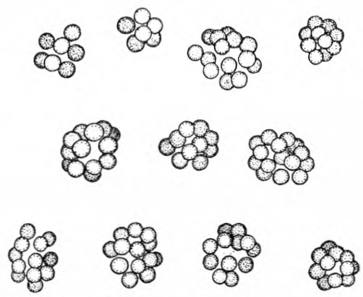

Fig. 108. *Microcystis chroococcoidea* West var. *minor* n. var.; 11 colonies from Mølledammen in Sønderborg, August 26th, 1944. 800 ×.

Microcystis flos aquae Kirch. em. W.-L. var. **major** nov. var.

A typo cellulis majoribus differt; diameter cellularum 5—7 μ.

Hab. In Nors Sø, Birkerød Sø, Hulsø et Frederiksborg Slotssø, Dania, libere natans.

Here and under the following *Microcystis* species the only intention is to define the variety or species and not to give a detailed account of its distribution, periodicity, sociology or ecology since this would require a renewed trial of the whole of my great plankton material from Danish lakes and ponds.

Microcystis holsatica Lemm.

E. Lemmermann 1910, p. 77.—*Fig. nostra* 109.

Hab. Nors Sø, Furesø, Hostrup Sø, Mossø, Tissø, Sorø Sø, Salten Langsø, Nordborg Sø, Huno Sø, Sandbjerg Sø, Tranekjær Sø, Frederiksborg Slotssø, Badstue-Ødam, Vandingsdam, Spejldam, Hulsø, Teglgaard Sø, Sortedam II, Badstue-Dam, Longet Sø at Nyborg, Flødegaardens Dam, Blankeborg I & II, Jægerbakke Dam and Pond at Ragebøl, pelagic.

For several years I considered *Microcystis holsatica* to be identical with the closely related species *Microcystis pulverea* Mig. var. *incerta* (Lemm.) Crow. As the cells of the Danish colonies are 1 μ in diameter and the colonies are irregularly shaped and may be clathrate, it will be correct provisionally to identify them as *Microcystis holsatica* though they have an invisible—exceptionally indistinctly visible—margin of the mucilage.

According to diagnosis and picture (LEMMERMANN 1901, p. 93, t. 4, fig. 8) *Microcystis pulverea* var. *incerta* has spherical-ellipsoidal colonies with a distinct, later on "zerfliessende Gallerthülle", and the cells are stated to be 1—2 μ in diameter. In 1930 Prof. C. H. OSTENFELD presented me with an exsiccate of the plankton from Vombsjön in Schonen, containing *Microcystis incerta* Lemm. (determ. E. LEMMERMANN); reiterated examinations of soaked material from this exsiccate, however, gave no adequate picture of the species. According to LEMMERMANN (1910, pp. 76—77)

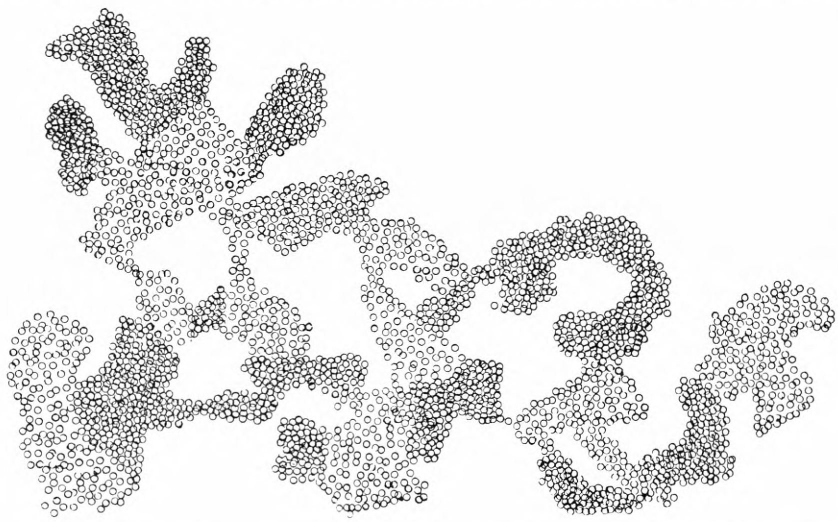

Fig. 109. *Microcystis holsatica* Lemm., a large, clathrate colony from Jægerbakke Dam, September 18th, 1929. 800 ×.

Microcystis incerta is widely distributed in the lakes of Brandenburg, whereas *Microcystis holsatica* seems to be comparatively rare.

Only in the sample from Sandbjerg Sø, September 3rd, 1939, I did see a *Microcystis* species that corresponded fairly well to *Microcystis incerta*, the colonies being mostly roundish, rarely oblong and a little irregular; however, the cells measured 1 μ in diameter, and the margin of the colonial mucilage was invisible.

Future investigations will no doubt prove the two species to be identical.

Also CROW (1923, p. 65) maintains that "the margin of the colonial mucilage is clearly defined". We are much in need of a thorough revision of the genus *Microcystis*, mainly based on pure or unialgal cultures, cultivated under different ecological conditions.

Such culture experiments and on the whole all culture experiments with plankton organisms should not be confined to such artificial substrata as agar and gelatine, but the conditions of growth should be made as natural as posible. Unless they are 'specialists' the organisms should be cultivated in a suspension of earth saturated in a cold state and sterilized not by boiling but by filtration through bacterium-proof asbestos filters as recommended by FRANZ MOEWUS for experiments on germination of zygotes. Moreover the culture fluid should be constantly stirred, for instance by moving a plate slowly up- and downwards in the fluid or—what is no doubt much easier—by letting all the cultures rotate slowly on a turn-plate.

Microcystis minutissima W. West.

1912, p. 41.—*Fig. nostra* 110.

I have often been in doubt whether *Microcystis minutissima* or *Aphanothece clathrata* West var. *brevis* Bachmann (1923, p. 165, t. 3, figs. 1—2) were before me because every kind of transition occurred between colonies in which the cells are distinctly crowded in clusters (Hunø Sø), thus being totally identical with W. West's specimens, and colonies the cells of which are more diffuse (Jægerbakke Dam, Blankeborg I, Furesø, Tissø). Even in the last-mentioned ponds and lakes colonies may be found in which the cells are crowded in some places.

The Danish colonies always had an invisible margin of the mucilage, and the cells measured 1.1—2 μ in length and 0.9—1 μ in breadth. Only in Furesø colonies were observed to be slightly clathrate (not at all like the original drawing quoted from Bachmann); but according to Naumann (1925, p. 47) this character seems to be a modification depending on the low intensity in the movement of the water, and so these colonies, too, have been termed *Microcystis minutissima*.

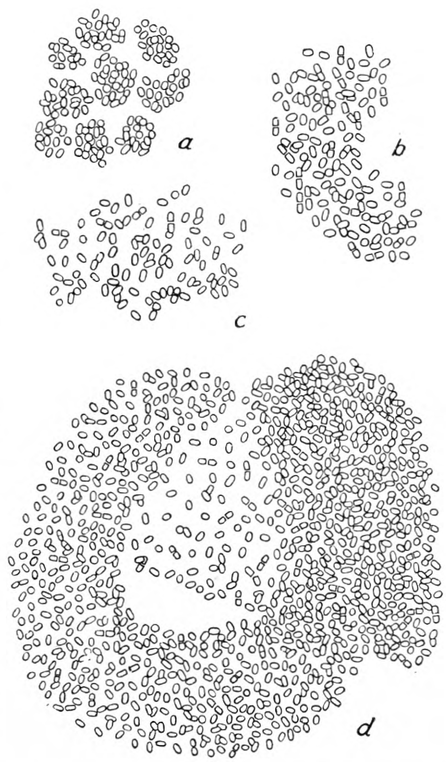

Fig. 110. *Microcystis minutissima* West; *a* from Hunø Sø, Møen, September 17th, 1937; *b* from Blankeborg I, August 18th, 1928; *c* from Jægerbakke Dam, July 17th, 1929; *d* from Furesø, August 21st, 1943. 800×.

Distribution. Seeland: Jægerbakke Dam, Frederiksborg Slotssø, Hulsø, Furesø, Tissø; Møen: Hunø Sø; Funen: Blankeborg I; North Jutland: Nors Sø, Hampen Sø, Salten Langsø; North Sleswick: Hostrup Sø.

Microcystis pulverea Migula.

Migula in Kryptogamenflora von Deutschland, Deutsch-Österreich und der Schweiz, Bd. II, 1907, p. 36.—*Fig. nostra* 111.

Colonies irregularly shaped, with rounded edges, very rarely sausage-shaped, without or with very indistinctly visible margin of mucilage, several (up to 8) united in mucilage which normally also has an invisible margin; exceptionally, the latter is visible and irregularly lobulate, but is never highly refractive as in *Microcystis aeruginosa*. Cells very densely situated, 2—2.5 μ in diameter, rarely 3 μ, without air vacuoles; partial colonies 15—62 μ in size.

Hab. In Blankeborg II, Jægerbakke Dam, Flødegaardens Dam, Lille Gribsø, Hostrup Sø and Nors Sø, pelagic.

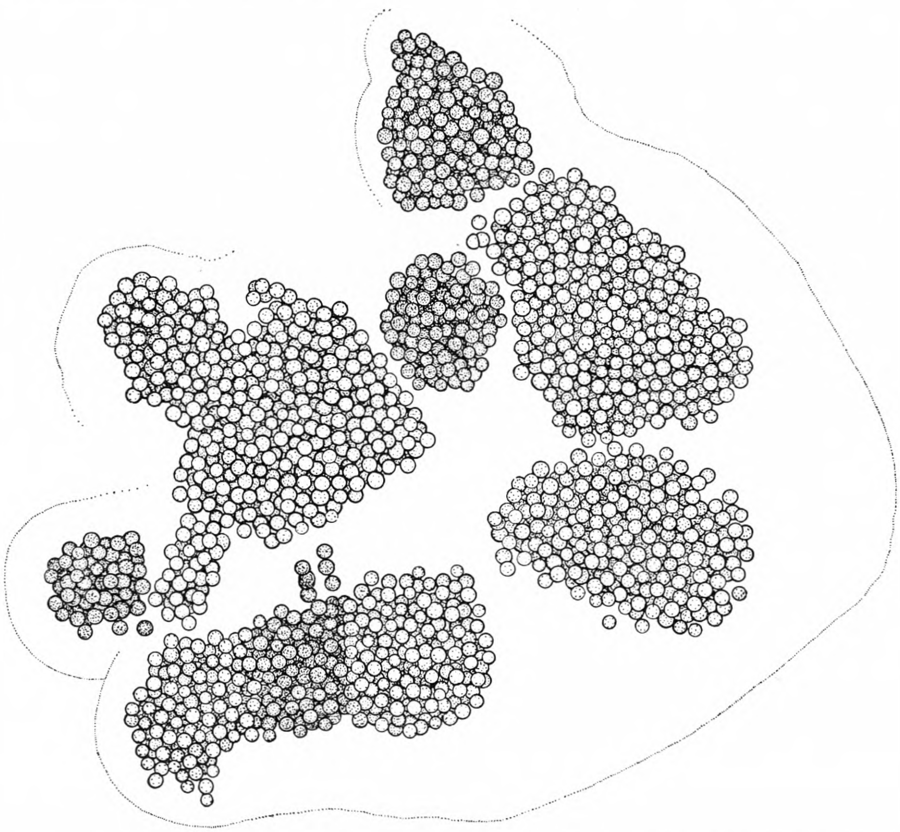

Fig. 111. *Microcystis pulverea* Mig. from Hostrup Sø, June 23rd, 1925. 800×.

According to the original diagnosis *Microcystis pulverea* has a visible margin of the mucilage; my experience shows that pelagic *Microcystis* colonies with cells of 2—2.5 μ generally have no visible margin of the mucilage, but in potassium acetate slides it may be comparatively distinct when the immersion objective is used. However, *Microcystis parasitica* Kg., which is stated to have an indistinct margin of the mucilage, is hardly before us since this species is said normally to be attached to water-plants.

var. **racemiformis** nov. var.

Fig. nostra 112.

Diagnosis. Coloniae parvae, subracemiformes, subrotundatae vel irregulares, lobulatae, interdum ex coloniis minimis compositae. Mucilago cum margine perspicuo raro indistincto vel destituto. Cellulae rotundae, aeruginosae, tenuiter granulatae, dense conglomeratae, sine vacuolis, 1.5—2 μ in diametro. Dimensio coloniarum 8.5—27 μ.

Hab. In Frederiksborg Slotssø, Lille Gribsø, Sortedam II, Gadevang Mose, Vandingsdam, Jægerbakke Dam et Flødegaardens Dam, Dania, libere natans.

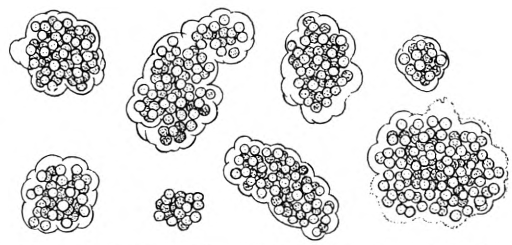

Fig. 112. *Microcystis pulverea* Mig. var. *racemiformis* n. var. from Vandingsdam, August, 10th 1929. 800×.

This variety differs from the main species by its small lobulate colonies with distinct margin of the mucilage and by its smaller, densely clustered cells. From the very closely related species *Microcystis exigua* Zalessky (1926, p. 34, t. 10, fig. 4) it differs by the small bulges of the surface of its mucilage, every bulge appearing to belong to its cell.

The diagnosis given above refers to the colonies from Vandingsdam where the variety was periodical and reached a great maximum in August—September.

In Frederiksborg Slotssø the colonies were mostly larger than in Vandingsdam, the mucilaginous envelope as a rule was indistinct, also in colonies smaller than 20 μ, but might be visible as a line near one side of the colony. Generally the colonies had a regular oval shape and frequently measured 40—50 μ in length and about 25 μ in breadth. The older colonies had no visible edge of the mucilage and were irregular of shape, in rare cases even clathrate and 60—65 μ long and 20—45 μ broad. These types of colonies were found all the year round in Frederiksborg Slotssø and also in Jægerbakke Dam.

Also the large amounts of colonies found in Hesteskodam on September 10th, 1929 only exceptionally had a finely bulged edge of the mucilage. Here the colonies were small and round (14—15 μ × 13—14 μ) or oval (25 μ × 21 μ), rarely longish (102 μ × 30 μ).

In spite of the fact, therefore, that the edge of the mucilage is often indistinct I refer these colonies to *Microcystis pulverea* var. *racemiformis* because the cells measured 1.75—2 μ in diameter and were always densely clustered.

Microcystic robusta Nyg.

Ostenfeld and Nygaard 1925, p. 8, figs. 1—4; Nygaard 1926, p. 204, t. 2, figs. 17—18; t. 3, figs. 22—23.—*Fig. nostra* 113a.

Both the Central American and the Malayan material contained both colonies with distinctly refractive margin of mucilage and rounded, lobulate partial colonies

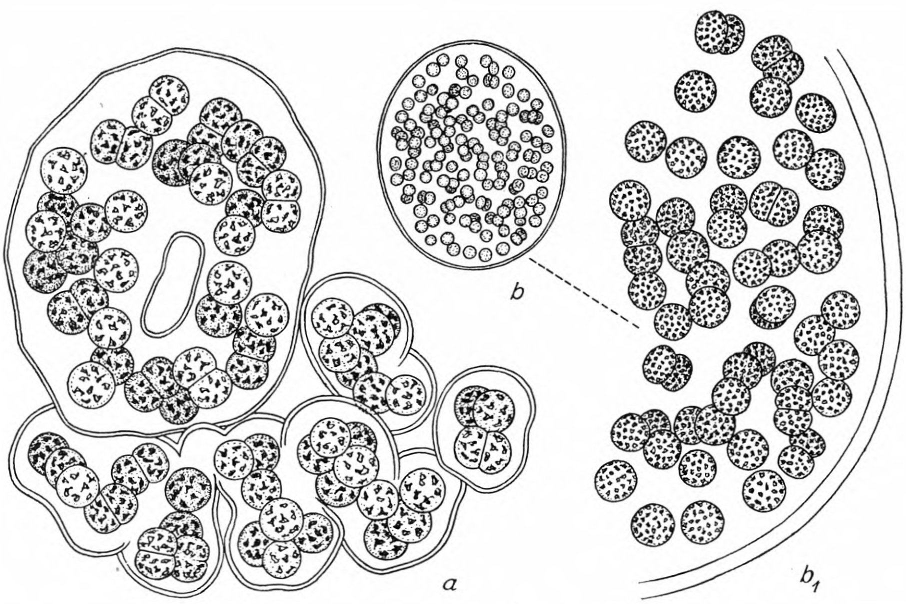

Fig. 113. *Microcystis robusta* Nyg.; *a* from Furesø, August 21st, 1943, 800×; ? *b* from Mørksø, July 6th, 1938. 260× and 800×.

and colonies without visible surface of the mucilage. The size of the cells in the original material from Guatemala was 6—9 μ, from Panama 5—8 μ and from Key Islands 5—8.5 μ.

In this country the species was safely established in Furesø only where I found it in a plankton sample from August 21st, 1943, sent to me by E. Fjerdingstad. The association was dominated by *Melosira granulata* var. *angustissima*; its qualitative composition appears from Table II. The cells had a diameter of 6.5—8.5 μ; the very few colonies observed were small and had lobulate, rounded partial colonies with clearly defined, highly refractive margin of the mucilage. It is questionable whether *fig. nostra* 113b from the plankton of Mørksø is also a *Microcystis robusta*; the colony was ellipsoidical, 114 $\mu \times 92$ μ, the cells 6—7.5 μ in diameter, but the material is too sparse for a closer identification.

If researches of the future show that TEILING's criterions of species are hereditarily determined, *Microcystis robusta* must presumably be distinguished as

Microcystis aeruginosa var. *robusta* and
Microcystis flos aquae var. *robusta*.

Dactylococcopsis scenedesmoides n. sp.

Fig. nostra 113 *bis.*

Diagnosis. Cellulae curvate baculiformes, $5\frac{1}{2}$—7-plo longiores quam latiores, in medio plusminusve infractae et dorsaliter subinflatae, apicibus paulo vel distincte tenuioribus et interdum leviter recurvatis et subcapitatis, in coloniis seriatis et quadri- vel bicellularibus consociatae. Membrana cellulae tenuissima, cytioplasma pallide aeruginosum, dense et tenuiter granulosum. Longitudo cellularum 12.5—21.5 μ, latitudo 2—3.5 μ.

Hab. In Jægerbakke Dam in Hillerød, Dania, libere natans.

Systematics. This new species differs from all previously described *Dactylococcopsis*-species by the *Scenedesmus*-like arrangements of the cells. Fig. nostra 113 bis shows, however, that the colonies of *Dactylococcopsis scenedesmoides* are by far not so compactly builded as the colonies of the green alga *Scenedesmus*. The pressure of the coverglasses on the permanent slides containing *Dactylococcopsis scenedesmoides* is sufficient to loosen the cells of the colonies.

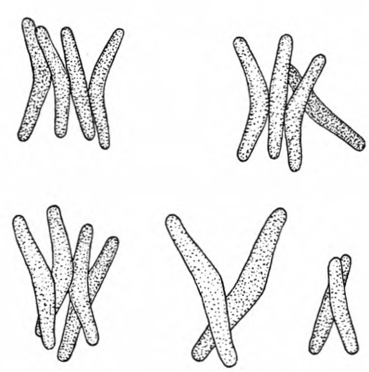

Fig. 113 bis. *Dactylococcopsis scenedesmoides* n. sp. from Jægerbakke Dam, October and November 1929. 1070×.

Periodicity. Jægerbakke Dam was explored regularly every fortnight during a whole year, from June 1929 to June 1930. *Dactylococcopsis scenedesmoides* occurred in all samples from the period of October to January (temperature 12—1° C) and in a single sample from May (temperature 23.25° C.) as will appear from the following section. No maximum was observed, the quantities of the organism always being very small. The species thus was eurythermic. It is possibly perennial; the fact that it was not observed in the periods of June to September and February to April may be explained by its marked scarceness.

Sociology. *Dactylococcopsis scenedesmoides* was found in the following associations:

Oct. 3rd, 1929: *Mio ho*-association (the species very rare).
— 14th, — : ditto.
— 23rd, — : *Mio ho*-association with *Os li* and *Sce arm* as subdominants (the species very rare).
Nov. 2nd, — : *Sce arm*-association with *Mio ho* as subdominant (the species very rare).
— 16th, — : *Mio ho*-association with *Ank fa se br* and *Sce arm* as subdominants (the species very rare).
— 30th, — : *Ank fa se br*-association with *Crym ov*, *Mio ho* and *Sce arm* as subdominants (the species very rare).
Dec. 16th, — : *Ank fa se br* - *Ki mi*-association with *Ank fa spa* and *Mio ho* as subdominants (the species very rare).
Jan. 15th, 1930: *Ki mi*-association with *Ank fa se br* and *Chla ka* as subdominants (the species very rare).
— 31st, — : ditto.
May 31st, — : *Mio ho*-association (the species very rare).

Dactylococcopsis scenedesmoides thus occurred in associations dominated by blue-green algae (*Microcystis*) and green algae (*Scenedesmus*, *Ankistrodesmus*, *Kirchneriella*).

The most constant associates were *Ankistrodesmus convolutus* var. *minutus*, *Ankistrodesmus falcatus* var. *setiformis* f. *brevis* and var. *spiralis*, *Microcystis holsatica*, *Oscillatoria limnetica* and var. *acicularis*, *Scenedesmus armatus*, *Scenedesmus falcatus* f. *tortuosa*, *Selenastrum Westii*, all of which were found in 100 $^0/_0$ of the number of samples (10) containing *Dactylococcopsis scenedesmoides*. *Ankistrodesmus falcatus* and var. *spirilliformis*, *Chlamydomonas kakosmos*, *Microcystis minutissima*, *Scenedesmus quadricauda* and *Tetraëdron caudatum* var. *longispinum* occurred in 90 $^0/_0$, *Anabaena tenericaulis* and *Chlamydomonas retroversa* in 80 $^0/_0$ of the samples.

Ecology. Jægerbakke Dam is a partly overshadowed, highly eutrophic pond, sheltered by winds; it is peculiar in being poor in calcium. The undermentioned dates all refer to the period of October to January; pH was 9.8 on May 31st, 1930. The species was found by pH 6.9—7.7, content of CaO 7.3—9.7 mg/l, consumption of $KMnO_4$ 28—32 mg/l, contents of PO_4-P 0—0.008 mg/l, NH_3-N 0.08—0.75 mg/l, NO_3-N 0—0.01 mg/l; on january 31st the content of Fe was 0.45 mg/l.

Hormogoneales.

Oscillatoriaceae.

Oscillatoria Borneti Zukal f. **tenuis** Skuja.

H. Skuja 1929, p. 18, t. 1, fig. 16.

The specimens, which corresponded closely to the diagnosis, had a thickened hood (calyptra) on the endcell as shown in Pascher's Süsswasserflora, Heft 12, Cyanophyceae, Fig. 434. Skuja states the thickness of f. *tenuis* to be 5.5—7 μ while the main species measures 12—16 μ. The present individuals were about 8 μ thick.

This presumably tychoplanktic and easily recognizable organism is possibly a summer form in Northern Europe. Skuja found it in two localities in Estonia in July. In this country it occurred in very small quantities in Kalgaard Sø on June 23rd, 1929 (but not in May 1929) and rather sparsely in Præstesø on June 24th—28th, 1930 (temp. 20—21° C.).

On June 23rd, 1929 the plankton of Kalgaard Sø consisted of an *Ura am*-association. On June 28th, 1930 the plankton of Præstesø consisted of an *Ana fl*-association; among the Desmids of this lake *Staurastrum arctiscon* is noteworthy. The phytoplankton quotients appear from Table I and the composition of the associations from Table II.

Both lakes, which contain vegetations of *Lobelia Dortmanna*, are clear and chiefly neutral (Kalgaard Sø pH 6.9 and Præstesø pH 7.0—7.1 on the dates mentioned); in July 1940, however, Boisen Bennike (1943, p. 34) found pH to be > 9.0, a colour of 10 "Ohle-units" and a $KMnO_4$ consumption of 37 mg/l in Præstesø. In Kalgaard Sø it was impossible on June 23rd, 1929 to find the slightest trace of phosphate, ammonia and nitrate!

Oscillatoria limnetica Lemm. var. **acicularis** nov. var.

Fig. nostra 114.

Diagnosis. Trichomata solitaria, recta vel leviter curvata, ad dissepimenta non constricta, pallide aeruginosa, 1—1.5 μ lata. Dissepimenta saepe difficulter visibilia. Cytioplasma cellularum homogenea, longitudo cellularum 8—12 μ. Cellula terminalis longe acuminata, spinacea, recta, sine calyptra.

Hab. In Badstue-Ødam et Jægerbakke Dam prope Hillerød, et Hostrup Sø in Jutlandia, Dania, libere natans.

Systematics. The variety differs from *Oscillatoria limnetica* by its non-constricted, slightly narrower trichomes with spine-like end-cells. In the fixed material from Badstue-Ødam the dissepiments were invisible; the cell lengths of 8—12 μ were measured in living material. Not even the use of the best immersion objectives made it possible to see any constriction whatever, neither in living nor in fixed material.

During the great *Oscillatoria limnetica* maximum in Sandbjerg Sø on September 4th, 1937 trichomes were found that apparently had pointed end-cells. However, a close examination of both living and fixed material showed that this rough and rather abrupt pointing is due to degeneration of the end-cell. Such a phenomenon was never observed in trichomes of *Oscillatoria limnetica* var. *acicularis* (and, incidentally, not in the trichomes of *Oscillatoria limnetica* from Badstue-Ødam and Jægerbakke Dam).

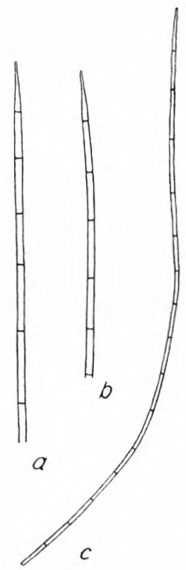

Fig. 114. *Oscillatoria limnetica* Lemm. var. *acicularis* n. var. from Badstue-Ødam, September 5th, 1929. *a—b* 800×, *c* 560×.

It appears from Tables II and IV in which Danish ponds and lakes *Oscillatoria limnetica* and its var. *acicularis* are found. The main species is found in 11 localities, the variety in 4; with one exception (Sønderborg Mølledam, see below) these 4 localities contain both the main species and the variety.

Accordingly, only the main species was found in Sandbjerg Sø (see Nygaard 1945, t. I, fig. 14); its trichomes were 2 μ thick and the cells 3.5—12 μ (generally 5—7 μ) long. In Badstue-Ødam and Jægerbakke Dam, where both the main species and the variety occurred together, the trichomes of the main species were 1.5 μ thick and its cells 4—10 μ long. According to Lemmermann (1910, p. 112, Fig. 5 on p. 91) the thickness of the cells is 1.5 μ and their length 4—12 μ.

In his vague description of thin *Oscillatoria* species G. Playfair (1914, pp. 129—132, t. 6) has pictured and described Australian forms that are similar to *Oscillatoria limnetica* and its var. *acicularis*. His *Oscillatoria splendida* Grev. var. *limnetica* (Lemm.) Playfair is not, as supposed by him, identical with *Oscillatoria limnetica* Lemm. and *Lyngbya limnetica* Lemm. on account of the lack of constriction, the smooth tapering of the trichomes towards apices and the two granules at each dissepiment. Playfair's var. *limnetica* (Lemm.), var. *amylacea* and presumably f. *clarescens* Playf. (all of *Oscillatoria splendida*) should be considered synonymous with *Oscillatoria splendida* Grev. Playfair's *Oscillatoria splendida* forma (1914, p. 132, t. 6, figs. 8 *a—d*) are identical with a *Chamaesiphon* species, no doubt *Chamaesiphon incrustans* Grun. f. *longissima* Wille.

Periodicity. As will appear from the sociological survey *Oscillatoria limnetica* var. *acicularis* is perennial. In Jægerbakke Dam it reached a high maximum in August 1929 (temp. 17—22.5° C.); but also in June and July the variety was common whereas it was rare during the other months of the year; during the ice period it was not observed at all.

In Badstue-Ødam the considerable maximum was reached at the beginning of September 1929 (temp. 18—18.5° C.). Already before the middle of this month it disappeared though quite a few individuals were observed on November 30th, December 16th and January 15th, 1930. The variety, which apparently find better conditions in Jægerbakke Dam, did not reappear until June 16th, 1930 (temp. 24° C.) when it was common.

In Hostrup Sø the variety was common on July 5th, 1927.

In other words *Oscillatoria limnetica* var. *acicularis* is a eurythermic plankton form (amplitude of temperature 1—28.5° C.) with a distinct maximum in August or September (temp. 17—22.5° C.).

Sociology. The variety occurred in the following associations:

Jægerbakke Dam.

June 12th, 1929: *Mio mi*-association with *Ana Vi da*, *Mio ho* and *Ra pe* as subdominants (the variety rather common); see Table IV.
— 18th, — : *Mio mi*-association with *Ana te*, *Ana Vi da*, *Mio ho* and *Sce arm* as subdominants (the variety rather common).
— 27th, — : *Mio mi*-association with *Ana Vi da* as subdominant (the variety rather common).
July 4th, — : *Mio mi*-association with *Ana Vi da* as subdominant (the variety rather common).
— 11th, — : *Ana Vi da*-association with *Mio mi* as subdominant (the variety rather common).
— 17th, — : *Ana Vi da* - *Sce arm*-association with *Mio mi*, *Mio ho* and *Os li ac* as subdominants (the variety common).
— 27th, — : *Ana Vi da*-association with *Mio ho* as subdominant (the variety rather common).
Aug. 10th, — : *Ana Vi da* - *Mio ho* - *Os li ac* - *Sce arm*-association (the variety very common).
— 21st, — : *Ana Vi da* - *Mio ho* - *Os li ac*-association with *Mio mi* and *Sce arm* as subdominants (the variety very common).
Sep. 2nd, — : *Ana Vi da*-association with *Mio ho* as subdominant (the variety rare).
— 13th, — : *Ana Vi da* - *Mio ho*-association (the variety very rare).
— 17th, — : *Mio ho*-association with *Sce arm* as subdominant (the variety very rare); see Table IV.
Oct. 3rd, 14th, 23rd, 1929: *Mio ho*-association with *Sce arm* as subdominant (the variety very rare).
Nov. 2nd, 1929: *Sce arm*-association with *Mio ho* as subdominant (the variety rare).
— 16th, — : *Mio ho*-association with *Sce arm* and *Ank fa se br* as subdominants (the variety rare).
— 30th, — : *Ank fa se br*-association with *Crym ov*, *Mio ho* and *Sce arm* as subdominants (the variety very rare).
Dec. 16th, — : *Ank fa se br* - *Ki mi*-association (the variety very rare).

Jan. 15th, 1930: *Ki mi*-association with *Ank fa se br* and *Chla ka* as subdominants (the variety very rare).
— 31st — : ditto.
Mar. 15th, — : *Ki mi*-association (the variety very rare).
Apr. 10th, — : *Din se pr*-association (the variety very rare).
— 22nd, — : *Din se pr*-association with *Ge mi* as subdominant (the variety very rare).
May 1st, — : *Ge mi*-association (the variety very rare).
— 10th, — : ditto.
— 21st, — : *Mio ho*-association with *Sce arm* as subdominant (the variety rare).
— 31st, — : ditto.
June 16th, — : *Mio ho*-association with *Ana si* and *Sce arm* as subdominants (the variety rare).

Badstue-Ødam.

Aug. 10th, 1929: *Cyc st su*-association with *Frg cr* as subdominant (the variety not infrequent).
— 17th, — : ditto.
— 23rd, — : *Frg cr*-association with *Ana af in te* and *Cyc st su* as subdominants (the variety not infrequent); see Table IV.
Sep. 3rd, — : *Cyc st su*-association with *Ana af in te* and *Os li ac* as subdominants (the variety common).
— 5th, — : *Ana af in te*-association with *Os li ac* a subdominant (the variety common).
— 12th, — : *Crym ov*-association with *Ank co mi*, *Cyc st su* and *Sce arm* as subdominants (the variety rare).
Nov. 30th, — : *Chry ma - Crym ov*-association (the variety very rare).
Dec. 16th, — : ditto.
Jan. 15th, 1930: *Chry ma*-association (the variety very rare).
June 16th, — : *Crym ov*-association with *Ana af in te* and *Cyc st su* as subdominants (the variety common).

Hostrup Sø.

June 23rd, 1925: *Api fl*-association (the variety very rare); see Table II.
July 5th, 1927: *Coo Nä*-association with *Api fl* and *Os li ac* as subdominants (the variety common); see Table II.

It appears from this that *Oscillatoria limnetica* var. *acicularis* mainly occurs in myxophycean (*Microcystis*, *Anabaena*, *Oscillatoria*, *Aphanizomenon*, *Coelosphaerium*) and chlorophycean associations (*Scenedesmus*, *Ankistrodesmus*, *Kirchneriella* and *Geminella*), but also in chrysophycean (*Dinobryon*, *Chrysococcus*), diatomaceous (*Cyclotella*, *Fragilaria*) and cryptophycean associations (*Cryptomonas*).

The most constant associates were *Scenedesmus armatus*, which occurred in 100 % of the samples (40) that contained *Oscillatoria limnetica* var. *acicularis*; *Micro-*

cystis holsatica (95 %), *Oscillatoria limnetica* (92.5 %), *Scenedesmus falcatus* (80 %) and *Ankistrodesmus falcatus* var. *spirilliformis* (77.5 %).

Ecology. Jægerbakke Dam is a highly eutrophic, lightly overshadowed, small pond, conspicuous by its lime-deficiency (7.3—11.2 mg CaO per litre); there are no in- or outlets. The eutrophic pond Badstue-Ødam, which is somewhat overshadowed but has both in- and outlets, approaches the mixotrophic phase: throughout the year its consumption of $KMnO_4$ may vary slightly about the accepted border value of 50 mg per litre. Hostrup Sø is a moderately eutrophic, comparatively large lake of the mixotrophic phase, lime-deficient (12 mg CaO per litre were observed); see further Tables I and III.

Some few data of the ecology of *Oscillatoria limnetica* var. *acicularis*: pH 6.6—9.8, CaO 7.3—80 mg/l, consumption of $KMnO_4$ 27—57 mg/l, contents of PO_4-P 0—0.035 mg/l, NH_3-N 0—0.75 mg/l, NO_3-N 0—3 mg/l, Fe 0.02—0.45 mg/l.

f. **brevis** n. f.

Fig. nostra 115.

Diagnosis. Trichomata solitaria, irregulariter curvata, raro subrecta vel sigmoidea, sine mucilagine visibile, 20—75 μ longa, circiter 1 μ lata, apicibus binis inaequaliter acutatis, quorum alter acutus, alter acuminatus; cytioplasma incompte granulosum.

Hab. In Mølledammen in Sønderborg, Dania, libere natans.

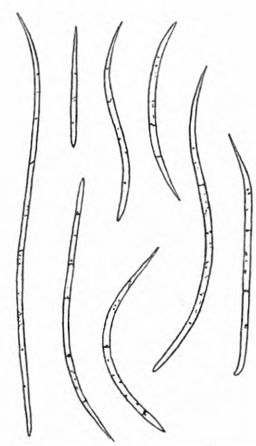

Fig. 115. *Oscillatoria limnetica* Lemm. var. *acicularis* n. var. f. *brevis* n. f. from Mølledammen in Sønderborg, August 26th, 1944. 800 ×.

It is with some hesitation that I refer this organism to the form cycle of *Oscillatoria limnetica* var. *acicularis*. The contents are somewhat granular and heterogeneous and in spite of a careful examination under the immersion objective it was impossible to decide whether dissepiments were actually present or only seemed to be so in consequence of the position of some granules. The trichomes are very characteristic, one end being tapering and spine-like (as in *Oscillatoria limnetica* var. *acicularis*), the other being abruptly pointed.

On the admixture of iodine dissolved in potassium iodide the trichomes stained with a palish brown like *Merismopedia tenuissima*, *Oscillatoria Agardhii* and *Anabaena flos aquae*; *Microcystis chroococcoidea* var. *minor* (see p. 178), however, stained with an intense reddish-brown colour. So there is hardly any doubt that the organism is in fact a blue-green alga.

Within the *Dactylococcopsis* genus species are known to be just as thin and long, for instance the spirally twisted *Dact. irregularis* G. M. Smith (1921, p. 6, figs. 26—28), but these long and thin species do not show the same characteristic difference of the ends as the present trichomes. If the latter do not really possess dissepiments, they may be called *Dactylococcopsis inaequalis* n. sp.

The form occurred in enormous quantities in Mølledammen, Sønderborg on August 26th, 1944. The plankton association, the quotients of which are given on p. 179, was dominated by *Oscillatoria limnetica* var. *acicularis* f. *brevis* and *Microcystis chroococcoidea* var. *minor*.

Sønderborg Mølledam is a highly eutrophic pond, contaminated by swimming birds, which are often fed; on August 26th, 1944 the compound quotient was $\frac{18}{1} = 18$. In the summer months there is often a considerable water-bloom, pH then being > 9.

Nostocaceae.

Synonyms within the **Anabaena** genus.

Anabaena contorta Bachmann is a young stage of *Anabaena flos aquae* Breb. *Anabaena limnetica* G. M. Smith is a synonym for *Anabaena planctonica* Brunnth.

"*Anabaena planctonica* Brunnth." as pictured by G. M. Smith with a spherical spore is a synonym for *Anabaena Scheremetievi* Elenk. var. *recta* Elenk. f. *rotundospora* Elenk.

Anabaena Scheremetievi Elenk. is a doubtful species, for according to the description it includes forms of variuos thicknesses. Var. *recta* Elenk. f. *rotundospora* Elenk. and var. *incurvata* Elenk. may be retained being conspicuous by their spherical spores remote from the heterocysts; whether they are "8.5—9 μ vel 11—12 μ (rarius 13 μ) latis" does not appear from the specific descriptions. For the same reason it is difficult to establish the possible identity of var. *recta* Elenk. f. *ovalispora* Elenk. with *Anabaena planctonica* Brunnth. I also consider var. *incurvata* Elenk. f. *ovalispora* Schkorb. a little doubtful as the thickness of the trichomes is said to range between 6 and 12 μ and the breadth of the heterocysts between 7.5 and 13 μ! This form possibly includes elements of *Anabaena spiroides*. Var. *Ukraïnica* Schkorb. is possibly identical with var. *incurvata* Elenk.

Anabaena cylindrica Lemm. var. *marchica* Lemm. is presumably identical with *Anabaena subcylindrica* Borge.

E. Fjerdingstad (1945, p. 14, text-figure 1) speaks of 3 forms of *Anabaena planctonica* Brunnth., but they must undoubtedly fall under the variational range of the main species because the spherical spores are young, immature spores unless they have had a homogeneous content or a thick wall; this does not appear from text-figure 1.

Anabaena affinis Lemm. var. **intermedia** Griffiths. f. **tenuis** n. f.

Fig. nostra 116.

Diagnosis. Trichomata solitaria et recta, cellulis vegetativis aerugineis, cum vacuolis, sphaericis vel paulo brevioribus quam latioribus, $6\frac{1}{2}$—9 μ latis. Heterocystis similibus, 8.5—12 μ latis. Sporis semper ab heterocystis remotis, singulis vel binis, initio subsphaericis, postea ellipsoideis et postremo breve cylindricis apicibus hemisphaericis, 1.3—1.8 plo longioribus quam latiores, 22—26 μ longis, 12.5—18 μ latis. Episporio levi, sine colore.

Hab. In Badstue-Ødam, Selandia, Dania, libere natans.

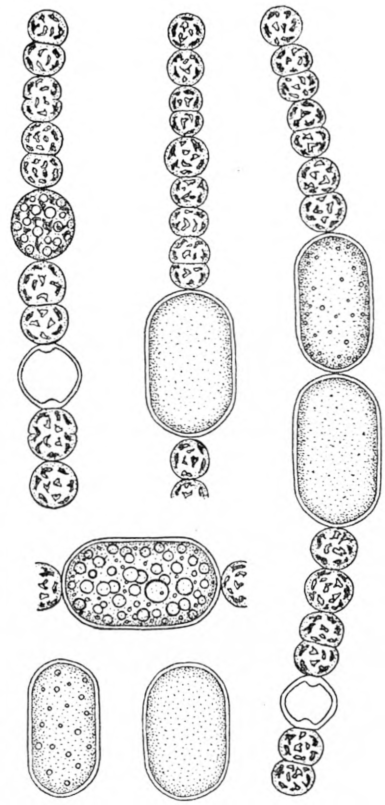

Fig. 116. *Anabaena affinis* Lemm. var. *intermedia* Griff. f. *tenuis* n. f. from Badstue-Ødam, September 5th, 1929. 800×.

Systematics. This variety differs from the main species by its broader spores. In the Kryptogamenflora der Mark Brandenburg, 3. vol., p. 183 Lemmermann gives the length of the spores of the main species as 20—26 μ (i. e. the same as the present variety) whereas the breadth is only 9.5—12 μ. In other words the spores of the main species may be more than twice as long as broad, but according to 12 measurements the present spores were only 1.3—1.8 (mostly 1.5) times longer than broad (see Fig. 116). Fig. 374 (after G. M. Smith) in Pascher's Süsswasserflora, Heft 12, is no typical *Anabaena affinis* because the spore is only about 1.3 times longer than broad.

It appears from the diagnosis that there is no complete agreement with Griffith's description (1925, t. 1, fig. 8) of the English specimens, the Danish specimens from the Badstue-Ødam being 6.5—9 μ, the English specimens 8—10 μ thick. The small difference in the size of the heterocysts is hardly of systematic value. This is confirmed, and in full, by Lotte Canabæus' close studies on the varying size of the heterocysts at different concentrations of sodium chloride, conditions of light and oxygen tensions (1929, pp. 9, 20 and 21). Canabæus emphasizes (*loc. cit.*, p. 36) the vegetative cells as the most invariable element of an *Anabaena* species. Even if there may be an exceptional variation of the shape, the thickness of the cells is apparently one of the best systematic characters. It will therefore be more correct to classify the individuals from the Badstue-Ødam as *Anabaena affinis* Lemm. var. *intermedia* Griffiths f. *tenuis* mihi.

In the Furesø, on August 7th, 1932, an *Anabaena* species was observed that is no doubt identical with *Anabaena affinis* var. *intermedia* (see Fig. 117). The vegetative cells measured 7.5—8.5 μ in breadth, were spherical or a little shorter than broad; the heterocysts 9—10 μ in diameter; the spores, sometimes occurring in series of 2, were always found remote from the heterocysts and measured 21.5—27 μ in length, 15—16 μ in breadth; a few measurements showed the ratio between length and breadth to be 1.4—1.7. The fact that the spores were not cylindrical with hemispherical ends but ellipsoidical, may be due to their not being quite mature.

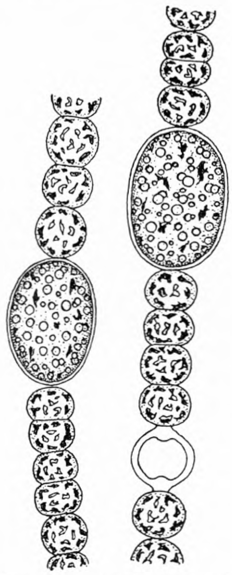

Fig. 117. *Anabaena affinis* Lemm. var. *intermedia* Griff. from Furesø, August 7th, 1932. 800 ×.

Periodicity. In the Badstue-Ødam *Anabaena affinis* var. *intermedia* f. *tenuis* was observed in small quantities on June 6th, 1929 at the beginning of the examination. Both in July and the former half of August the sterile trichomes occurred sparsely, but at the end of August and the beginning of September (temp. 18—18.5° C.) it had a great maximum and even formed water bloom during the first days of September, at which time it was fertile. Already on September 12th there were only a few spores left in the plankton, and during this month every trace of it disappeared. In 1930 the first, sterile trichomes appeared already on April 10th (temp. 10° C.), but it was not until the end of the investigation on June 16th (temp. 24° C.) that it became common and showed a beginning fertility. This early beginning of the formation of spores is possibly connected with the unusually hot and sunny early summer of 1930.

Strange to say no traces of this form were observed in the Badstue-Ødam on September 5th, 1941.

In the Furesø *Anabaena affinis* var. *intermedia* was comparatively rare, but showed a beginning fertility on August 7th, 1932 (temp. 20° C.).

Accordingly, *Anabaena affinis* var. *intermedia* f. *tenuis* must be characterized as meso- to polythermic with its period of vegetation in April-September (range of temperature 8.5—24° C.) and with the maximum development and formation of spores normally occurring in August-September at temperatures between 18 and 20° C. and pH values of 8.2—8.5.

Sociology. In the Badstue-Ødam the form was found in the following successive associations, the brackets stating its estimated frequency in the associations.

June 6th, 1929: *Mel gr an - Sye ac an*-association (*Anabaena* very rare).
July 26th, — : *Rhi lo*-association (*Anabaena* very rare).
Aug. 10th, 17th, and 23rd, 1929: *Cyc st su - Frg cr*-association with *Sce arc ca* as subdominant (*Anabaena* gradually rather common).
Sep. 3rd, 1929: *Cyc st su*-association (*Anabaena* common).

Sept. 5th, 1929: *Ana af in te*-association with *Os ac*, *Os li* and *Sce arm* as subdominants.
— 12th, — : *Crym ov*-association (*Anabaena* very rare).
— 23rd, — : *Ank co mi* - *Mio ho*-association (*Anabaena* very rare).
Apr. 10th, 1930: *Ste Ha* - *Sye ac an*-association (*Anabaena* very rare).
— 25th, — : *Din so* - *Sye ac an*-association with *Ma pe ec* as subdominant (*Anabaena* very rare).
May 1st, — : *Ura vo*-association with *Ste Ha* and *Sye ac an* as subdominants (*Anabaena* very rare).
— 21st, — : *Ura vo*-association with *Ma pe ec* as subdominant (*Anabaena* rare).
— 31st, — : *Cyc st su*-association (*Anabaena* rather rare).
June 16th, — : *Crym ov*-association with the following subdominants: *Ana af in te*, *Cyc st su*, *Os li ac* and *Os li*.

As will be seen the form—apart from the association formed by itself in September—is found in diatom-associations composed of *Melosira*, *Synedra*, *Rhizosolenia*, *Cyclotella* and *Fragilaria* and in flagellate-associations with *Uroglena*, *Dinobryon* and *Cryptomonas* as dominants.

The most constant associates were *Asterionella formosa* and *Cyclotella Meneghiniana*, which occurred in 93 $^0/_0$ (13) of the number of samples (14) that contained *Anabaena affinis* var. *intermedia* f. *tenuis*. *Microcystis holsatica*, *Scenedesmus armatus* and *Pediastrum duplex* var. *clathratum* occurred in 86 $^0/_0$ of the samples, while *Anabaena incrassata*, *Dinobryon sociale*, *Cryptomonas ovata*, *Ankistrodesmus falcatus* (with forms), *Fragilaria crotonensis* and *Trachelomonas intermedia* were found in 78 $^0/_0$ of the samples.

In the Furesø the plankton on August 7th, 1932 was dominated by *Anabaena flos aquae* (fertile), *Asterionella formosa* and *Ceratium hirundinella*.

Ecology. Both the Badstue-Ødam and the Furesø are permanently alkaline, eutrophic waters, the former, however, approaching the stage of mixotrophy (the consumption of $KMnO_4$ ranges between 40 and 57 mg per litre). Both of them have inlets and outlets. The Badstue-Ødam is a somewhat overshadowed, shallow pond whereas the Furesø is one of our largest lakes with clear water (consumption of $KMnO_4$ 7.5—14 mg per litre).

Anabaena affinis var. *intermedia* f. *tenuis* has been found at pH values of 7.6—8.8, at a consumption of $KMnO_4$ of 44—57 mg/l and at the following contents of CaO 75.3—82.2 mg/l, NH_3-N 0.05—0.1 mg/l, NO_3-N 0—0.35 mg/l, PO_4-P 0—0.02 mg/l and Fe 0.02 mg/l.

Anabaena heterospora n. sp.

Fig. nostra 118.

Diagnosis. Trichomata solitaria, recta vel leviter curvata, pallide aeruginosa, 75—450 μ, plerumque 200—250 μ longa. Cellulae sphaericae vel subsphaericae, cum vacuolis, 4—6.5 μ longae, 5—6 μ latae. Heterocystae prope orculaeformes vel subsphaericae, 5.5—8 μ, saepe 6—7 μ latae. Sporae plerumque ab heterocystis remotes; in duobus modis formatis: aut cellulae in circuitu crescantes magnae sphaericae erunt, postea longe ellipsoideae et fortasse postremo cylindricae apicibus semisphaericis instructae; aut cellulae in longitudine crescantes cylindricae erunt, postea post aliquod incrementum crassitudinis cylindricae apicibus semisphaericis instructae. Sporis maturis singulis vel binis, 3.25—4 plo longioribus quam latiores, 26—33 μ longis, 8—9 μ latis. Episporio levi, sine colore, tenui, apicibus leviter incrassatis instructo.

Hab. In Blankeborg II et III, Fionia, Dania, libere natans.

Systematics. As far as I know none of the *Anabaena* species described till now have spores of a double origin. In spite of the difference in the development the spores obviously end by growing uniform. This is possibly only a semblance of a likeness, for the study of the preserved material seems to indicate that the phase developing through the spherical stage is possibly the result of a copulation (see Fig. 118) whereas the phase developing through the cylindrical stage is possibly simpler.

The species shows some likeness to *Anabaena affinis* Lemm., the heterocysts of which, however, are 7.5—10 μ broad, and the spores of which are at first spherical, later on elliptic, and finally nearly cylindrical with rounded apices, 9.5—12 μ broad, 17—26 μ long. As will be seen the cylindrical stage of development is lacking in the individuals of Lemmermann; their spores are also much shorter and broader than those of the present specimens.

The species should also be compared with *Anabaena solitaria* Klebahn (1895, p. 270, t. 4, fig. 25), the trichomes of which, however, are 8 μ thick and the heterocysts somewhat larger than in *Anabaena heterospora*; the dimensions of the spores are very similar to those of *Anabaena heterospora*, but Klebahn does not mention anything about the double origin of the spores.

The spherical or ovate, immature spores may be 12 μ broad. The cylindrical spores with granulated contents (not quite mature) measure 6—11 μ in thickness, 19.5—35 μ in length; according to 9 measurements they are $2\frac{1}{3}$—4 times longer than broad.

Periodicity. In Blankeborg II the species was found in a fertile state on July 17th—20th, 1928 (the examination of this pond was started on the former of these dates). At this time, when the temperature was 22—17.5° C., there were but few individuals left from a supposed maximum in June-July. During the month of August the species disappeared completely. In 1929 it reappeared on May 12th (temp. 16° C.) and grew more and more common until the maximum occurred on June 17th (temp. 19.25° C.) when the trichomes slowly began to form spores. This must have been completed before July 1st, for after this time the species was observed no more in this year. In 1930 the species did not appear until May 24th (temp. 19° C.), and at the end of the investigation on June 10th (temp. 21.5° C.) it was common but sterile.

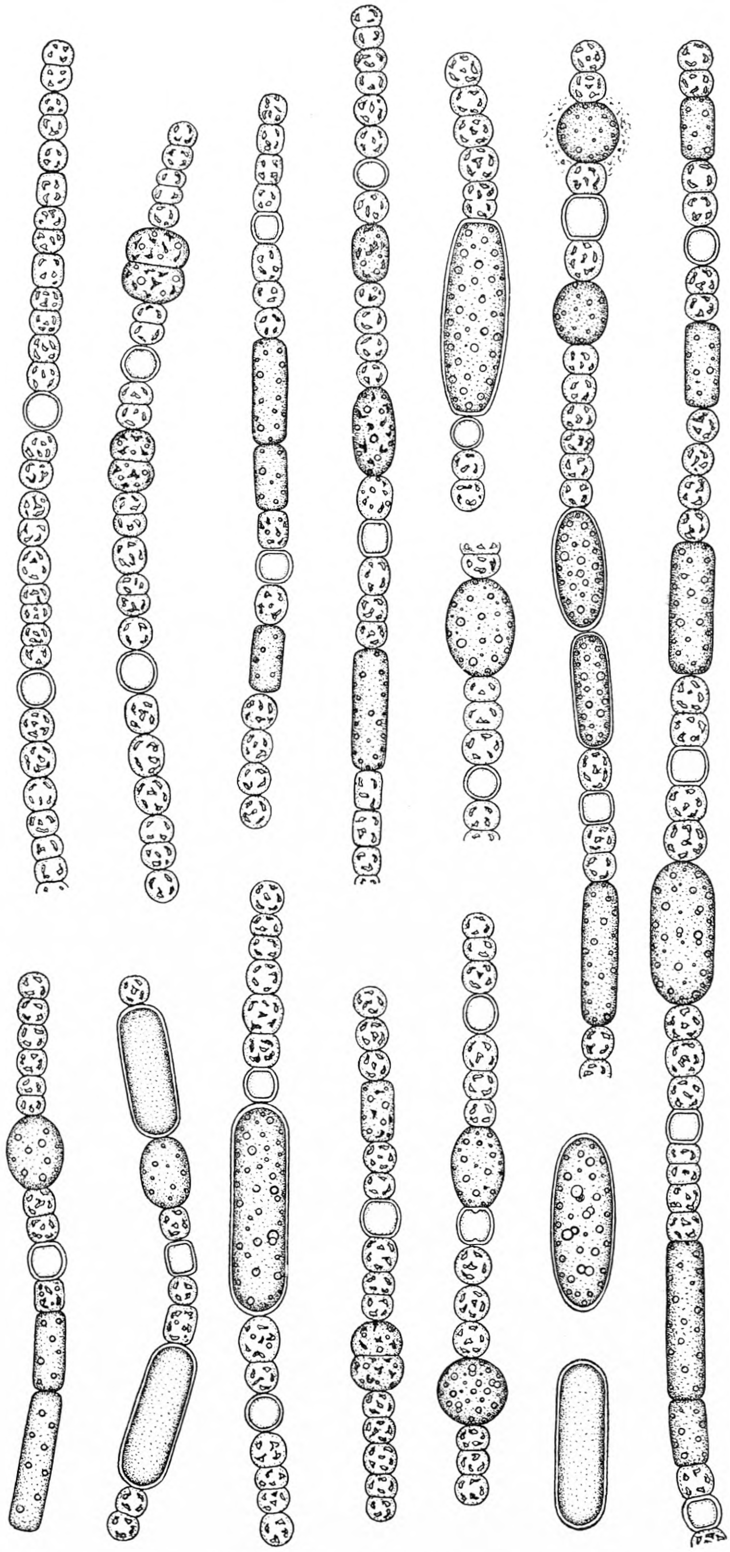

Fig. 118. *Anabaena heterospora* n. sp. from Blankeborg II and III. 800×.

In Blankeborg III the cold year of 1929 was obviously most unfavourable to the development of the species, but it was found in 1930 when it appeared already on April 19th (temp. 8.5° C.) and reached a great maximum on May 23rd (temp. 19.5° C.). The formation of spores did not begin until about June 10th (temp. 20.5° C.) when the species occurred sparsely in the plankton.

Anabaena heterospora must thus be considered a typical warm water form, more accurately meso- to polythermic with a period of vegetation from April to August (8.5—21.5° C.), sometimes only in May and June. It was never observed during the rest of the year. Its maximum, at the end of which the formation of spores takes place, occurs at temperatures of 19—20° C., from the end of May till well into July.

Sociology. The species was found in Blankeborg II in the following successive associations:

July 17th—20th, 1928:	*Na be*-association with *Ste Ha* and *Chla ci* as subdominants (*Anabaena* rare).
— 25th, 1928:	*Chla*(?)-association with *Na be* as subdominant (*Anabaena* very rare).
Aug. 2nd, — :	*Chla*(?)-association with *Ste Ha* as subdominant (*Anabaena* very rare).
— 13th, — :	*Ste Ha*-association with *Per pa* as subdominant (*Anabaena* very rare).
— 28th, — :	*Ste Ha*-association (*Anabaena* very rare).
May 12th, 1929:	*Se ca - Ste Ha*-association (*Anabaena* very rare).
— 21st, — :	*Chla Re mi*-association with *Os li* as subdominant (*Anabaena* very rare).
June 2nd, — :	*Os li*-association (*Anabaena* not infrequent).
— 17th, — :	*Ana he - Cru qu*-association (*Anabaena* common).
May 24th, 1930:	*Ste Ha*-association with *Chla Re mi* and *Crym ov* as subdominants (*Anabaena* rare).
June 10th, — :	*Ste Ha*-association with *Se ca* as subdominant (*Anabaena* rather common).

It appears from this that *Anabaena heterospora* mainly occurs in green algae-associations, composed of *Nannokloster*, *Chlamydomonas*, *Selenastrum* and *Crucigenia* and in diatom-associations dominated by *Stephanodiscus*.

The constant associates were *Stephanodiscus Hantzschii* and *Peridinium palatinum*, which occurred in 100 % of the number of samples (12) that contained *Anabaena heterospora*; *Scenedesmus armatus* occurred in 92 % of the samples.

Ecology. Both Blankeborg II and Blankeborg III are mixotrophic turf pits (consumption of $KMnO_4$ 70—88 mg/l) situated in fennish ground, the former somewhat overshadowed and contaminated, the latter in open country. They have neither inlets nor outlets; their calcium content in the winter of 1930 was no less than 153.5 and 134 mg of CaO per litre, respectively. They are therefore always alkaline: pH 7.6—8.5 (for No. II in 1928—29) and pH 7.7—8.1 (for No. III in 1928—29). In 1928 and 1929 pH was 8.1—8.5 at the time at which *Anabaena heterospora* occurred in Blankeborg II.

Anabaena sigmoidea n. sp.

Fig. nostra 119.

Diagnosis. Trichomata solitaria, irregulariter spiralia, subsigmoidea, circularia vel semicircularia, sine mucilagine visibili; spirae 20—37 μ latae sunt. Cellulae vege-

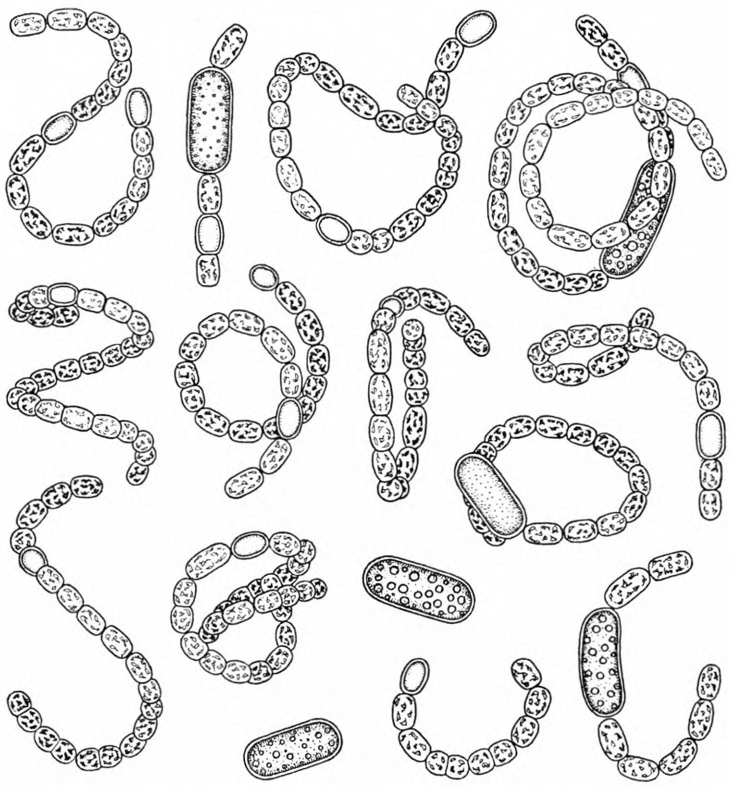

Fig. 119. *Anabaena sigmoidea* n. sp. from Jægerbakke Dam, July 18th, 1929. 800×.

tativae cylindricae angulis rotundatis vel apicibus semisphaericis, vel longe ellipsoideae vel dolioliformes, cum vacuolis, 1—2$\frac{1}{3}$ plo longiores quam latiores, 4—8 μ longae, 3—4 μ latae. Heterocystae ellipsoideae vel cylindicae apicibus semisphaericis, raro orculaeformes, 5.5—7.5 μ longae, 4—5 μ latae. Sporae semper ab heterocystis remotes, solitariae, rectae vel leviter curvatae, cylindricae apicibus semisphaericis, e

6 mensionibus 2.1—2.9 plo longiores quam latiores, 16—21.5 μ longae, 7.5—8.5 μ latae, episporio levi, sine colore.

Hab. In Jægerbakke Dam prope Hillerød, Dania, libere natans.

Systematics. The species is much like *Anabaena circinalis* Hansgirg (1892, p. 68, fig. 23; LEMMERMANN 1910, p. 187, figs. 6—7 on p. 159; GEITLER 1925, p. 324; HANSGIRG's *A. circinalis* is not even given as synonym in GEITLER's investigation on the Cyanophyceae in RABENHORST's Kryptogamenflora, Bd. 14, 1932). HANSGIRG's specimens, however, have spores that are 4—5 times longer than broad (24—30 $\mu \times 6$ μ) and have a brownish wall.

We only get an adequate impression of the trichomes of an *Anabaena* species if we examine them before the coverslip is placed upon the suspension of plankton on the slide. It turned out that among the many trichomes of *Anabaena sigmoidea* examined only one was in fact spirally twisted (see Fig. 119 left); the very most of them were irregularly twisted spiral fragments.

Periodicity. The species was periodical: it was only observed within the period May—October at temperatures between 11 and 28.5° C., thus being meso- to polythermic. The species reached its highest development on June 16th, 1930 (temp. 28° C.) when it was common in the plankton of Jægerbakke Dam; it was not infrequent on May 31st (temp. 23.25° C.). In the summer months of 1929 it was present in very small quantities; only in certain samples from June, July and August (temp. 20.5—28.5° C.) the trichomes were so numerous, that they could be given the relative frequency degree of "rare". The species also requires much heat to enter into the fertile stage: formation of spores was observed only on July 11th—18th, 1929 (temp. 22.5—28.5° C.) and on June 16th, 1930 (temp. 28° C.).

In other words this periodical species is distinctly a high summer form with its maximum in June—July.

Sociology. The species was found in the following associations:

June 12th, 1929: *Mio mi*-association with *Ana Vi da*, *Mio ho* and *Ra pe* as subdominants (the species very rare); see Table IV.

— 18th, — : *Mio mi*-association with *Ana te*, *Ana Vi da*, *Mio ho* and *Sce arm* as subdominants (the species very rare).

— 27th, — : *Mio mi*-association with *Ana Vi da* as subdominant (the species rare).

July 11th, — : *Ana Vi da*-association with *Mio mi* as subdominant (the species rare).

— 17th, — : *Ana Vi da* - *Sce arm*-association with *Mio mi*, *Mio ho* and *Os li ac* as subdominants (the species rare).

— 27th, — : *Ana Vi da*-association with *Mio ho* as subdominant (the species very rare).

Aug. 10th, — : *Ana Vi da* - *Mio ho* - *Os li ac*-*Sce arm*-association (the species rare).

Aug. 21st, 1929: *Ana Vi da - Mio ho - Os li ac*-association with *Mio mi* and *Sce arm* as subdominants (the species very rare).

Sep. 2nd, — : *Ana Vi da*-association with *Mio ho* as subdominant (the species very rare).

Oct. 3rd, — : *Mio ho*-association with *Sce arm* as subdominant (the species very rare).

May 16th, 1930: *Ank fa spa - Mio ho - Sce arm*-association (the species very rare); see Table IV.

— 21st, — : *Mio ho*-association (the species very rare).

— 31st, — : *Mio ho*-association with *Sce arm* as subdominant (the species not infrequent).

June 16th, — : *Mio ho*-association with *Ana si* and *Sce arm* as subdominants (the species common).

Anabaena sigmoidea thus occurred in associations mainly dominated by blue-green algae (*Microcystis*, *Anabaena* and *Oscillatoria*), but also certain green algae (*Scenedesmus*, *Ankistrodesmus* and *Radiococcus*) were a distinct feature of these myxophycean associations.

The most constant associates were *Microcystis holsatica*, *Scenedesmus armatus* and *Scenedesmus falcatus*, which occurred in 100 $^0/_0$ of the samples (14) containing *Anabaena sigmoidea*. Species like *Microcystis minutissima*, *Oscillatoria limnetica* and its var. *acicularis*, *Ankistrodesmus falcatus* var. *spirilliformis* occurred in 93 $^0/_0$ of the samples while *Anabaena tenericaulis*, *Anabaena Viguieri* var. *danica*, *Chlamydomonas kakosmos* and *Chlamydomonas retroversa* were found in 86 $^0/_0$ of the samples.

Ecology. Jægerbakke Dam is a wind-sheltered, highly eutrophicated, small and shallow pond, conspicuous by its deficiency in lime. As will appear from Table III the compound quotient for June 12th, 1929 was $\frac{30}{7} = 4.3$ and for May 16th, 1930 $\frac{35}{2} = 17.5$. Some data of the ecology of *Anabaena sigmoidea* are: pH 7—9.8, CaO 7.8—10.9 mg/l, consumption of $KMnO_4$ 35—49 mg/l, PO_4-P 0—0.005 mg/l, NH_3-N 0.05—0.1 mg/l, NO_3-N 0 mg/l and Fe 0.02 mg/l.

Anabaena spiroides Klebahn var. **tumida** Nyg.

Dansk Planteplankton 1945, p. 52, t. I, fig. 11.—*Fig. nostra* 120.

Trichomes single, free floating, spirally twisted, without directly visible gelatinous envelope, windings 33—53 μ broad, 10—20 (—35) μ high; vegetative cells spherical or subspherical, mostly somewhat shorter than broad, 6.5—9 μ (mostly 7—8 μ) broad, 4—9.5 μ long, with pseudo-vacuoles; the heterocysts spherical, 8—10 μ broad; spores always remote from the heterocysts, often in series of 2—4, at first ovate, later on somewhat asymmetrical (nearly straight at the inner side), 10—13.5 μ broad, 18—23 μ long, 1.7—2.1 times longer than broad, with smooth, colourless outer layer.

In Sandbjerg Sø, Sundeved, Lille Søgaard Sø, North Sleswick and Flynder Sø, North Jutland, pelagic.

Systematics. This variety is closely related to var. *contracta* Klebahn (1895, p. 265, t. 4, figs. 14—15), the windings of which, however, are only 20—25 μ broad,

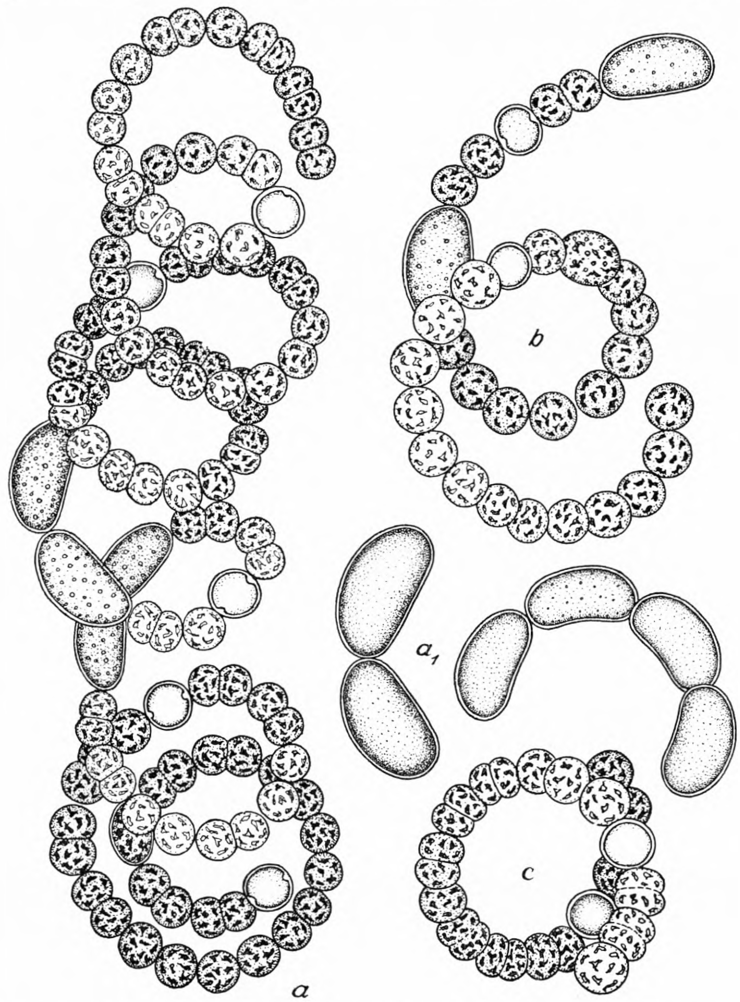

Fig. 120. *Anabaena spiroides* Klebahn var. *tumida* Nyg.; a—a_1 from Sandbjerg Sø (a from September 10th, 1937, a_1 mature spores from October 1st, 1938); b from Flyndersø, July 6th, 1938; c from Lille Søgaard Sø, July 25th, 1926. 800×.

and the immature spores of which are spherical and no less than 14 μ broad. It does not appear from the literature whether or not the spores of var. *contracta* may occur in series.

Periodicity. In September 1937 this variety was so common, that it formed water-bloom. During the period between August 14th and October 1st, 1938 (temp.

26.5—14.5° C. and pH 8.8—8.3) it was at first comparatively rare in the plankton of Sandbjerg Sø; gradually, however, it grew frequent, especially at the beginning of October when both this and *Anabaena Scheremetievi* Elenk. var. *recta* Elenk. f. *rotundospora* Elenk. were actively forming spores. In August 1939 it occurred in large quantities (August 6th, temp. 22° C.) and has no doubt been forming water-bloom in calm weather. In September (temp. 21.6° C., pH 8.4) the variety was even more abundant in the plankton. Also in August 1944 it was common. Thus the late summer (at temperatures between 22 and 15° C.) seems to be the most favourable time for the development of *Anabaena spiroides* var. *tumida*.

In Lille Søgaard Sø var. *tumida* was found to be common in the plankton on July 25th, 1926, but rare on August 27th of the same year (pH 8.3). In the large lake of Flynder Sø the variety was found on July 6th, 1938 (temp. 18° C., pH 9.0).

Sociology. In Sandbjerg Sø (see p. 159) the form was found in the following associations:

Sep. 4th, 1937: *Os li*-association with *Mia pu* and *Gy ex* as subdominants (*Anabaena* rather rare).
— 10th, — : ditto.
Aug. 14th, 1938: *Pa mo*-association with a spherical green alga as subdominant (*Anabaena* rare).
Sep. 4th, — : *Cyc Me*-association with *Ste Ha* as subdominant (*Anabaena* rare).
— 15th, — : *Ste Ha*-association with *Mel gr* as subdominant (*Anabaena* comparatively rare).
Oct. 1st, — : *Mel gr*-association with *Ste Ha* as subdominant (*Anabaena* common).
Aug. 6th, 1939: *Mel gr*-association with *Ana sp tu* and *Cyc Me* as subdominants (*Anabaena* common).
Sep. 3rd, — : *Ana sp tu* - *Ste Ha*-association with *Mel gr* as subdominant (*Anabaena* very common).
Aug. 26th, 1944: *Sce ec*-association (*Anabaena* common).

In Lille Søgaard Sø *Anabaena spiroides* var. *tumida* was found in the following associations:

July 25th, 1926: *Ana pl te*-association with *Api fl Kl* and *Mel gr + an* as subdominants (*Anabaena* common).
Aug. 27th, — : *Ana fl* - *Api fl Kl*-association with *Mel gr + an* as subdominants (*Anabaena* very rare).

In Flynder Sø the variety was comparatively rare on July 6th, 1938 when the lake contained a typical *Api fl*-association.

In other words *Anabaena spiroides* var. *tumida* principally occurs in blue-green algae-associations with *Oscillatoria*, *Anabaena* and *Aphanizomenon* as dominants and in diatom-associations, dominated by *Cyclotella*, *Stephanodiscus* and *Melosira*, more rarely in green algae-associations (*Pandorina* and *Scenedesmus*).

The most constant associate was *Coelastrum microporum*, which was found in 90 % of the number of samples (10) that contained *Anabaena spiroides* var. *tumida*. *Cyclotella Meneghiniana*, *Dictyosphaerium pulchellum*, *Melosira granulata* and its var. *muzzanensis* occurred in 80 % of the samples.

Ecology. Sandbjerg Sø is a highly eutrophic lakelet, which in August 1945 contained 113 mg of CaO per litre. Lille Søgaard Sø is also eutrophic. Flynder Sø is a comparatively large, eutrophicated moor lake, the calculated calcium content of which is stated by Boisen Bennike to be 40 mg of "CaO" per litre for July 1940 (1943, p. 20). By way of illustrating the trophic degree of 2 of these lakes I give the different quotients for their *Nannoplankton*.

Lakes	Sandbjerg Sø							Flynder Sø
Dates of sample-collecting.	10–IX 1937	14–VIII 1938	4–IX 1938	15–IX 1938	1–X 1938	6–VIII 1939	3–IX 1939	6–VII 1938
Total number of species ..	41	31	50	42	49	38	36	34
myxophycean quotient....	$\frac{6}{0}$	$\frac{7}{1}$	$\frac{9}{1}$	$\frac{4}{1}$	$\frac{5}{1}$	$\frac{8}{1}$	$\frac{5}{1}$	$\frac{7}{4}$
diatom quotient..........	$\frac{3}{1}$	$\frac{3}{0}$	$\frac{7}{3}$	$\frac{5}{1}$	$\frac{5}{0}$	$\frac{6}{1}$	$\frac{4}{1}$	$\frac{8}{4}$
chlorophycean quotient ...	$\frac{14}{0}$	$\frac{13}{1}$	$\frac{15}{1}$	$\frac{21}{1}$	$\frac{17}{1}$	$\frac{14}{1}$	$\frac{9}{1}$	$\frac{8}{4}$
euglenine quotient........	$\frac{8}{20}$	$\frac{3}{20}$	$\frac{8}{24}$	$\frac{4}{25}$	$\frac{12}{22}$	$\frac{3}{22}$	$\frac{5}{14}$	$\frac{0}{15}$
compound quotient.......	$\frac{31}{0}$	$\frac{26}{1} = 26$	$\frac{39}{1} = 39$	$\frac{34}{1} = 34$	$\frac{39}{1} = 39$	$\frac{31}{1} = 31$	$\frac{23}{1} = 23$	$\frac{23}{4} = 5.75$

Besides conveying an impression of the fluctuations of the different quotients in September of 3 successive years the quotients of Sandbjerg Sø show much higher values than those of Flynder Sø. The small body of water of Sandbjerg Sø is contaminated from the neighbouring habitations to a much higher degree than Flynder Sø, which is situated in a thinly populated moor district.

The few data that can be given of the ecology of the species are pH 8.3—9.0 and CaO (40—)113 mg/l.

Anabaena spiroides Klebahn var. **minima** Nyg.

Dansk Planteplankton, 1945, p. 52, t. I, fig. 12.—*Fig. nostra* 121.

Trichomes single, pelagic, densely and often irregularly spirally twisted, with up to 25 windings per trichome. Cells spherical, 4—5 μ broad, containing pseudovacuoles. The heterocysts spherical, 5.5—6 μ broad. Spores broadly ovate, single or 2 in series, always remote from the heterocysts, 11—12.5 μ long, 8—10.5 μ broad, 1.2—1.4 times as long as broad.

f. *compacta* Nyg. (Fig. 121 *b*, *c*, c_1, c_2, and c_3). Spirals 11—16 μ broad, 4—12 μ high.

In Sandbjerg Sø at Alssund and Emdrup Sø at Copenhagen.

f. *remota* Nyg. (Fig. 121 *a*—a_1). Spirals 17—27 μ broad, 9—21 μ high.

In Lille Søgaard Sø at Aabenraa, North Sleswick.

In Sandbjerg Sø f. *compacta* was found on August 14th, 1938 (very rare) and August 6th, 1939 (not infrequent). In Emdrup Sø f. *compacta* was very abundant in the plankton on July 29th, 1941. In Lille Søgaard Sø f. *remota* was rather common on July 25th, 1926, but was lacking on August 27th of the same year.

In contrast to var. *tumida Anabaena spiroides* var. *minima* seems to be a distinct high summer form: it was found only in July and August at temperatures between 22 and 26.5° C.

Sociology. In Sandbjerg Sø *Anabaena spiroides* var. *minima* f. *compacta* was found in the following associations:

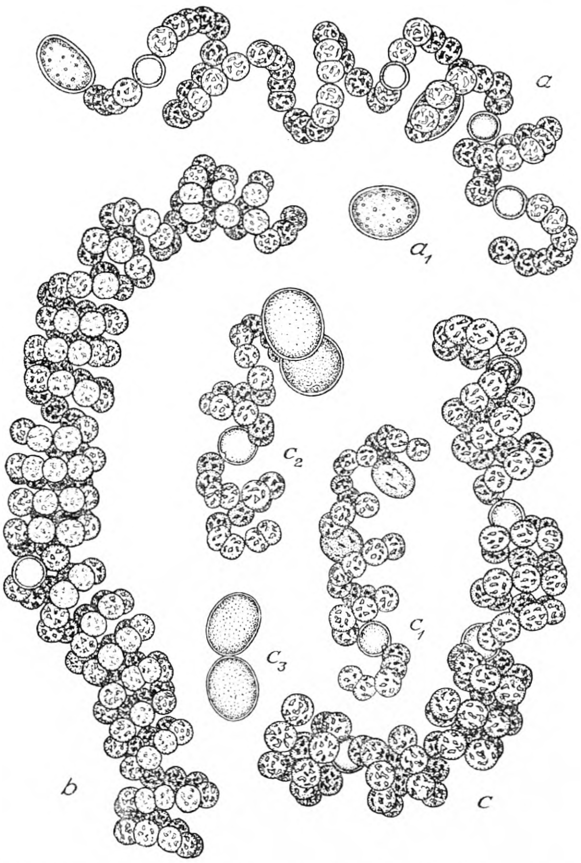

Fig. 121. *Anabaena spiroides* Klebahn var. *minima* Nyg.; *a*—a_1 f. *remota* Nyg. from Lille Søgaard Sø, July 25th, 1926; *b*, *c*, c_1, c_2 and c_3 f. *compacta* Nyg., *b* from Emdrup Sø, July 29th, 1941, *c*, c_1, c_2 and c_3 from Sandbjerg Sø, August 6th, 1939, c_2 and c_3 showing mature spores. 800×.

Aug. 14th, 1938: *Pa mo*-association with a spherical green alga as subdominant.
— 6th, 1939: *Mel gr*-association with *Ana sp tu* and *Cyc Me* as subdominants.

In Emdrup Sø it dominated on

July 29th, 1941: *Ana sp mi*-association with *Pho le* as subdominant.

In Lille Søgaard Sø *Anabaena spiroides* var. *minima* f. *remota* was rather common on

July 25th, 1926: *Ana pl te*-association with *Api fl Kl* and *Mel gr* + *an* as subdominants.

In other words *Anabaena spiroides* var. *minima* was observed in blue-green algae-associations with *Anabaena* and *Aphanizomenon*, a diatom-association with *Melosira* and a green algae-association with *Pandorina* as dominants.

Survey of the spirally twisted *Anabaena* species.

Name	Breadth of windings	Height of windings	Breadth of cells	Shape of cells	Diameter of heterocysts	Position of spores	Length and breadth of spores
A. spiroides Kleb.	45—54 μ	40—50 μ	6.5—8 μ	nearly spherical or somewhat shorter than broad	7 μ	adjoining the hetero-cysts (?)	
var. crassa Lemm.	45—70 μ	17—55 μ	11—14 μ	spherical or somewhat shorter than broad	10—17 μ	remote from the heterocysts	27—42 μ long, 15—25 μ broad
var. latizona Nyg.	75—120 μ (generally 90—100 μ)	20—50 μ	11—14 μ	spherical or somewhat shorter than broad	12—14 μ	remote from the heterocysts	24—30 μ long, 17—20 μ broad
var. tumida Nyg.	33—50 μ	10—20 μ	6.5—9 μ (7—8 μ)	spherical or somewhat shorter than broad	8—10 μ	remote from the heterocysts	18—23 μ long, 10—13.5 μ broad
var. Talyschensis Wor.	50—59 μ	16.5-19 μ	8—9 μ	only 2—3 μ long	8 μ	?	?
var. contracta Kleb.	20—25 μ	10—15 μ	7—8 μ	nearly spherical	7 μ	remote from the heterocysts	?
var. minima Nyg.	11—27 μ	4—21 μ	4—5 μ	spherical	6 μ	remote from the heterocysts	11—12.5 μ long, 8—10.5 μ broad
var. spiroides (Wor.) mihi	9—12 μ	20—30 μ	6 μ	nearly spherical	?	remote from the heterocysts	14—17.3 μ long, 8—9.4 μ broad
var. africana mihi	30-37.5 μ	15—22 μ	5—6 μ	spherical or somewhat shorter than broad	6—7 μ	remote from the heterocysts	16—16.5 μ long, 10—11 μ broad
A. reniformis Lemm.	16—17 μ	?	4 μ	longish (7—8 μ)	nearly spherical (about 4 μ in diameter)	?	?
A. Utermöhli (Ut.) Geitl.	17—30 μ	27—40 μ	4—4.5 μ	longish (4—6.5 μ)	4.7—5.7 μ × 4—4.5 μ	adjoining the heterocysts	19—20 μ long, 7—8 μ broad

The most constant associates were *Anabaena spiroides* var. *tumida*, *Trachelomonas intermedia*, *Pediastrum Boryanum* and *Scenedesmus armatus*, which were found in 75 $^0/_0$ of the number of samples (4) that contained *Anabaena spiroides* var. *minima*.

Ecology. Sandbjerg Sø, Lille Søgaard Sø and Emdrup Sø are highly eutrophic lakelets (cp. the survey of the phytoplankton quotients for Sandbjerg Sø on p. 204). On Aug. 14th, 1938 pH was 8.8 in Sandbjerg Sø; on Aug. 19th, 1945 the lake contained 113 mg CaO per litre.

In my opinion *Anabaena flos aquae* Breb. var. *intermedia* Woronich f. *spiroides*, as described by the Russian author from a lake in the Caucasus, is a variety of *Anabaena spiroides*, and I propose to term it:

Anabaena spiroides Kleb. var. *spiroides* (Woronich) mihi.

The specimens from the Transvaal described by me (Nygaard 1932, p. 121, Fig. 6) under the name of *A. flos aquae* Breb. var. *intermedia* Woronich f. *spiroides* Woronich correspond well to the Caucasian ones except in the size of the spiral windings which is different. In the Caucasian specimens the breadth of the windings were 9—12 μ and their height 20—30 μ, but those of the individuals from South Africa are 30—37.5 μ in width and 15—22 μ in height. These specimens from the Transvaal I therefore propose to call

Anabaena spiroides Kleb. var. *africana* mihi.

The schematic survey above will show the differences between the described varieties of *Anabaena spiroides* Klebahn and closely related species.

Anabaena tenericaulis n. sp.

Fig. nostra 122.

Diagnosis. Trichomata solitaria, recta vel minute flexuosa, sine tegumentis gelatineis visibilibus, 90—220 μ, plerumque 100—200 μ longa, ad apices leviter attenuata, cellulis vegetativis longe cylindraceis, pallide aerugineis, cum vacuolis, saepe 2—3 plo longioribus quam latioribus, $3\frac{1}{2}$—8 μ longis, 2—$2\frac{1}{2}$ μ (raro 3 μ) latis. Cellula terminalis rotundata. Heterocystae cum tegumentis laxis, cylindricae apicibus rotundatis vel ellipsoideae, raro subsexangulatae, 4—7 μ longae, 2—3 μ latae sunt. Sporis solitariis, cylindraceis apicibus rotundatis, semper ab heterocystis remotis, $2\frac{1}{2}$—$3\frac{1}{2}$ plo longioribus quam latiores, $13\frac{1}{2}$—23 μ longis, 5—$6\frac{3}{4}$ μ latis, episporio levi et sine colore.

Hab. In Jægerbakke Dam, Selandia, Dania, libere natans.

Systematics. This euplanktic species is closely related to *Anabaena Jonssonii* Boye Petersen 1923, (p. 299, Fig. 11), *Anabaena minutissima* Lemm. and *Anabaena delicatula* Lemm. (Lemmermann 1910, p. 182 and 183). In these species both the vegetative cells and the heterocysts have another shape than in *Anabaena tenericaulis*,

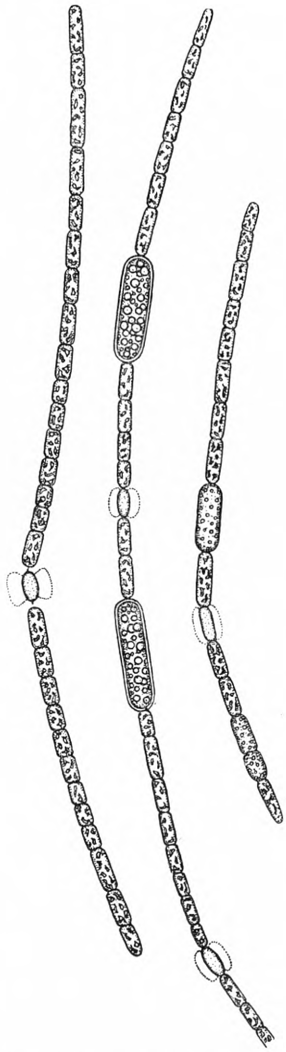

Fig. 122. *Anabaena tenericaulis* n. sp. from Jægerbakke Dam, May 16th, 1930. 800 ×.

which is conspicuous by its long, cylindrical cells. A closer comparison will show that there are also other points of difference.

Anabaena tenericaulis is by the present author placed as an *Anabaena* because of the lacking colourless endcells of the trichome; moreover it never occurs in bundles (compare also *Aphanizomenon gracile* Lemm. in which the spores are more elongated). The cylindrical spores, the slightly attenuated trichomes, and the long-elliptical heterocysts, however, give reason to assume that near relations consist between the genera *Anabaena* and *Aphanizomenon*.

Fig. 122 right shows a spore which is possibly composed of 2 cells; this has been noticed several times. As, however, 2 mature spores have never been observed to occur in series, it is possible that the spores are formed by a fusion of 2 adjoining cells, in other words that a sexual propagation takes place (cp. p. 197 and Nygaard 1932, p. 121).

Periodicity. The species is perennial and eurythermic, having been found at all temperatures between 0 and 28° C. It reached its highest development in May—June, especially on June 12th—18th (by temperatures of 23.75—25.25° C. and a pH value of 9.4) when it was very common in the plankton. Both in July and August it was extremely rare; throughout the autumn and the winter and at the beginning of the spring it occurred sparsely in Jægerbakke Dam (strange to say it was just as common in the middle of February under 8—9 cm of ice as in May!). The formation of spores began in May and terminated during June, this occurring at temperatures between 18 and 28° C. As a characteristic feature in the biology of the species may be mentioned that between October and April heterocysts were lacking in the trichomes (again with the exception of the sample from the middle of February when nearly all trichomes had heterocysts!). It was not until the beginning of May that some of the trichomes were carrying heterocysts, and in June, at any rate, all trichomes contained heterocysts. In August there were trichomes both with and without heterocysts.

Sociology. The species occurred in the following associations in Jægerbakke Dam:

June 12th, 1929: *Mio mi*-association with *Ana Vi da*, *Mio ho* and *Ra pe* as subdominants (*A. tenericaulis* common).

June 18th, 1929: *Mio mi*-association with *Ana Vi da*, *Mio ho* and *Sce arm* as subdominants (*A. tenericaulis* very common).
— 27th, — : *Mio mi*-association with *Ana Vi da* as subdominant (*A. tenericaulis* not infrequent).
July 4th, — : *Mio mi*-association with *Ana Vi da* as subdominant (*A. tenericaulis* rare).
— 11th, — : *Ana Vi da*-association with *Mio mi* as subdominant (*A. tenericaulis* rare).
— 17th, — : *Ana Vi da* - *Sce arm*-association with *Mio mi*, *Mio ho* and *Os li ac* as subdominants (*A. tenericaulis* very rare).
— 27th, — : *Ana Vi da*-association with *Mio ho* and *Sce arm* as subdominants (*A. tenericaulis* very rare).
Aug. 10th, — : *Ana Vi da* - *Mio ho* - *Os li ac* - *Sce arm*-association (*A. tenericaulis* very rare).
Oct. 3rd, — : *Mio ho*-association with *Sce arm* as subdominant (*A. tenericaulis* very rare).
— 23rd, — : *Mio ho*-association with *Sce arm* and *Os li* as subdominants (*A. tenericaulis* very rare).
Nov. 2nd, — : *Sce arm*-association with *Mio ho* as subdominant (*A. tenericaulis* very rare).
— 16th, — : *Mio ho*-association with *Ank fa se br* and *Sce arm* as subdominants (*A. tenericaulis* very rare).
— 30th, — : *Ank fa se br*-association with *Crym ov*, *Mio ho* and *Sce arm* as subdominants (*A. tenericaulis* very rare).
Jan. 15th, 1930: *Ki mi*-association with *Ank fa se br* and *Chla ka* as subdominants (*A. tenericaulis* very rare).
— 31st, — : *Ki mi*-association with *Ank fa se br* and *Chla ka* as subdominants (*A. tenericaulis* rare).
Feb. 17th, — : *Ki mi*-association with *Chla ka* as subdominant (*A. tenericaulis* not infrequent).
Mar. 1st, — : *Din cy al* - *Ki mi*-association (*A. tenericaulis* very rare).
— 15th, — : *Ki mi*-association (*A. tenericaulis* very rare).
Apr. 1st, — : *Din se pr*-association with *Sce arm* as subdominant (*A. tenericaulis* rare).
— 7th, — : *Din se pr*-association with *Chromulina pygmaea* as subdominant (*A. tenericaulis* very rare).
— 10th, 1930: *Din se pr*-association (*A. tenericaulis* rare).
— 22nd, — : *Din se pr*-association with *Ge mi* as subdominant (*A. tenericaulis* very rare).
— 26th, — : *Ge mi*-association with *Din se pr* as subdominant (*A. tenericaulis* rare).
May 1st, — : *Ge mi*-association (*A. tenericaulis* very rare).

May 10th, 1930: *Ge mi*-association (*A. tenericaulis* not infrequent).
— 16th, — : *Ank fa spa - Mio ho - Sce arm*-association (*A. tenericaulis* rather common).
— 21st, — : *Mio ho*-association with *Sce arm* as subdominant (*A. tenericaulis* not infrequent).
— 31st, — : *Mio ho*-association with *Sce arm* as subdominant (*A. tenericaulis* rare).
June 16th, — : *Mio ho*-association with *Ana si* and *Sce arm* as subdominants (*A. tenericaulis* rather common).

It appears from this that *Anabaena tenericaulis* is mainly found in blue-green algae associations of *Microcystis* species (with small cells) and *Anabaena*, and green algae associations of *Scenedesmus*, *Ankistrodesmus*, *Kirchneriella* and *Geminella*; besides it may occur in flagellate associations of *Dinobryon*.

The most constant associates were *Microcystis holsatica* and *Scenedesmus armatus*, which occurred in 97 $^0/_0$ of the number of samples (29) that contained *Anabaena tenericaulis*; they are followed by *Ankistrodesmus falcatus* var. *spiralis* with 93 $^0/_0$, *Oscillatoria limnetica* and *Scenedesmus falcatus* with 90 $^0/_0$, *Chlamydomonas kakosmos* and *Oscillatoria limnetica* var. *acicularis* with 83 $^0/_0$, *Chlamydomonas retroversa* with 79 $^0/_0$ and *Ankistrodesmus falcatus* and *Microcystis minutissima* with 76 $^0/_0$.

Ecology. Jægerbakke Dam is a small, highly eutrophic pond, sheltered from winds and with no inlets or outlets. It is conspicuous by its low calcium content. On the ecology of *Anabaena tenericaulis* the following data may be given: pH 6.6—9.8, calcium content 7.3—11.2 mg of CaO per litre, consumption of $KMnO_4$ 27—49 mg/l, contents of NH_3-N 0—0.75 mg/l, NO_3-N 0—0.015 mg/l, PO_4-P 0—0,015 mg/l and Fe 0.02—0.45 mg/l.

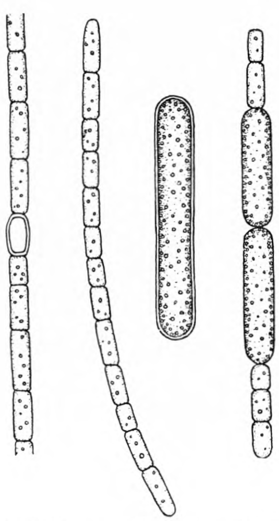

Fig. 123. *Anabaena tenericaulis* n. sp. var. *longispora* n. var. from Vedsted Sø, July 27th, 1926. 800×.

var. **longispora** nov. var.

Fig. nostra 123.

Diagnosis. Trichomatibus rectis vel leviter curvatis. Cellulis vegetativis cylindraceis, pallide aerugineis, 5—10 μ longis, 2—3 μ latis, protoplasmate subtiliter granuloso. Heterocystis orculaeformibus, 7 μ longis et 4 μ latis. Sporis solitariis vel binis, cylindraceis apicibus rotundatis, semper ab heterocystis remotis, in statu maturo ad 40 μ longis et 6 μ latis, ad 6.5 plo longioribus quam latiores.

Hab. In Vedsted Sø, Jutlandia meridiana, Dania, libere natans.

This euplanktic variety, which is somewhat robuster than the main species *Anabaena tenericaulis*, was observed in small quantities in the plankton of Vedsted Sø on July 27th, 1926. The lake is approximately oligotrophic. Its water is clear, Ca-deficient, and on the said date pH was 5.7.

The variety, the requirements of which are thus quite different from those of the main species, occurred in a typical *Ce hi*-association; as to the phytoplankton quotients see Table I.

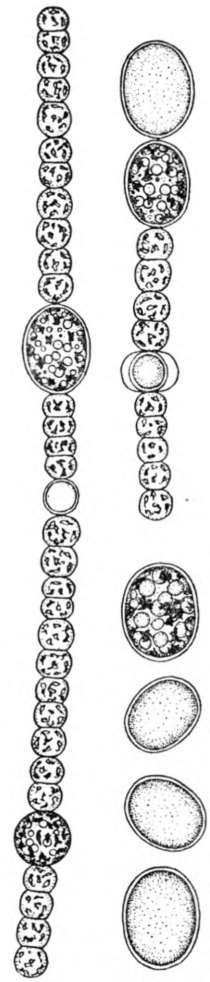

Fig. 124. *Anabaena Viguieri* Dénis et Frémy from Hesteskodam, September 10th, 1929. 800 ×.

Anabaena Viguieri Dénis et Frémy.

Geitler 1932, p. 878, fig. 560a.—*Fig. nostra* 124.

Systematics. The Danish individuals correspond completely to the diagnosis and figure cited above. The vegetative cells were spherical or barrel-shaped, 5—7 μ broad; the heterocysts were spherical, 5—7.5 μ in diameter; the spores according to 14 measurings were 1.2—1.4 times longer than broad, 13.5—18 μ long, 11—13 μ broad.

Distribution: Hesteskodam at Hillerød, pelagic.

Periodicity. The species was rare on July 17th, 1929 (temp. 23.5° C.), common on August 24th (temp. 17.5° C.) and abundant on September 10th (temp. 16.5° C.). On the date last-mentioned all trichomes were actively forming spores.

Sociology. *Anabaena Viguieri* was found in the following associations:

July 17th, 1929: *Mio fl ma*-association.
Aug. 24th, — : *Mio fl ma*-association.
Sep. 10th, — : *Ana Vi*-association with *Mio pu ra* as subdominant.

Beside in its self-formed association *Anabaena Viguieri* occurred only in myxophycean associations of *Microcystis*.

Ecology. Hesteskodam is a highly eutrophicated pond, which in May 1930 at the margin was covered by neuston formed by a blood-red *Euglena* and *Euglena proxima*. On July 17th (nannoplankton, 25 species) the myxophycean quotient was $\frac{11}{2}$, the chlorophycean quotient $\frac{6}{2}$, the diatom quotient $\frac{0}{1}$, the euglenine quotient $\frac{3}{17}$ and the compound quotient $\frac{20}{2} = 10$. On September 10th the corresponding values (nannoplankton, 20 species) were $\frac{11}{2}$, $\frac{5}{2}$, $\frac{1}{0}$, $\frac{1}{16}$ and $\frac{18}{2} = 9$. The species was found at pH 8.8—9.4 and content of NO_3-N 0 mg/l.

var. **danica** nov. var.

Fig. nostra 125.

Diagnosis. A forma typica cellulis ellipsoideis et sporis majoribus differt. Cellulae vegetativae 5—11 μ longae, 5.5—7 μ latae; heterocystae sphaericae, 7—8.5 μ in diametro; sporae e 4 mensionibus 1.2—1.4 plo longiores quam latiores, 18—19 μ longae, 13—16 μ latae.

Hab. In Jægerbakke Dam prope Hillerød, Dania, libere natans.

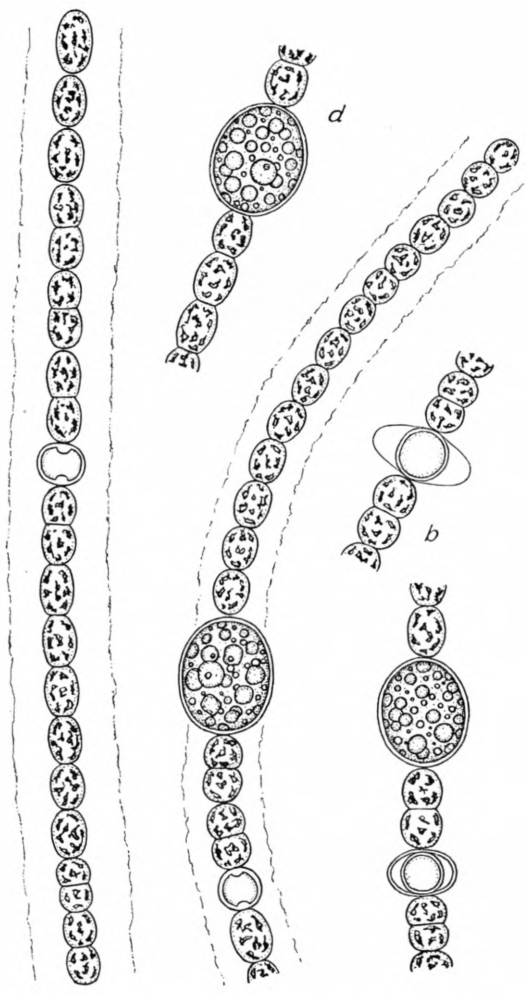

Fig. 125. *Anabaena Viguieri* Dénis et Frémy var. *danica* n. var. from Jægerbakke Dam; *a*—*c* from July 18th, *d*—*e* from September 13th, 1929. 800×.

Systematics. The trichomes are always surrounded by a thick gelatinous sheath; the cells are normally ellipsoidical, but spherical immediately after the division. The episporium may have a pale tawny colour. The spores figured in Fig. nostra 125 are not completely ripe; a ripe spore, characterized as usual by its homogeneous content, measured 18 μ in length and 13 μ in breadth.

Periodicity. Between June 12th and September 13th the variety was very common in the plankton. Strange to say this great and long maximum at temperatures between 17 and 28.5° C. did not end with an active formation of spores; nearly all of the very few spores observed were seen during the first half of September (temp. 17.5—19° C.). During the autumn the frequency of the variety decreased steadily, and on December 16th (temp. 3° C.) it was very rare. Apart from the problematic occurrence on February 17th, 1930 (temp. 1° C.) the variety was not found in the plankton of Jægerbakke Dam between December 16th and May 1st. In May it was very rare and at the end of the investigation on June 16th it was rare.

In other words *Anabaena Viguieri* var. *danica* is eurythermic with a temperature amplitude of 3—28.5° C. It was not observed with certainty in the months of January—April but reached a great and continuous maximum in June—September.

Sociology. The variety was found in the following associations:

June 12th, 1929: *Mio mi*-association with *Ana Vi da*, *Mio ho* and *Ra pe* as subdominants; see Table IV.
— 18th, — : *Mio mi*-association with *Ana te*, *Ana Vi da*, *Mio ho* and *Sce arm* as subdominants.
— 27th, — : *Mio mi*-association with *Ana Vi da* as subdominant.
July 4th, — : ditto.
— 11th, — : *Ana Vi da*-association with *Mio mi* as subdominant.
— 17th, — : *Ana Vi da - Sce arm*-association with *Mio mi*, *Mio ho* and *Os li* as subdominants.
— 27th, — : *Ana Vi da*-association with *Mio ho* as subdominant.
Aug. 10th, — : *Ana Vi da - Mio ho - Os li ac - Sce arm*-association.
— 21st, — : *Ana Vi da - Mio ho - Os li ac*-association.
Sep. 2nd, — : *Ana Vi da*-association with *Mio ho* as subdominant.
— 13th, — : *Ana Vi da - Mio ho*-association.
— 18th, — : *Mio ho*-indeterminable green alga-association (variety rather common); see Table IV.
— 23rd, — : *Mio ho*-association (variety rather common).
Oct. 3rd, — : ditto.
— 14th, — : *Mio ho*-association (variety rare).
— 23rd, — : *Mio ho*-association with *Sce arm* as subdominant (variety very rare).
Dec. 16th, 1929: *Ank fa se br - Ki mi*-association (variety very rare).
May 1st, 1930: *Ge mi*-association (variety very rare).
— 21st, — : *Mio ho*-association (variety very rare).
June 16th, — : *Mio ho*-association with *Ana si* and *Sce arm* as subdominants variety rare).

It appears from this that *Anabaena Viguieri* var. *danica* in the great majority of cases was found in myxophycean associations of *Microcystis* and *Oscillatoria* and could also form associations itself; it further occurred in chlorophycean associations of *Scenedesmus*, *Ankistrodesmus*, *Kirchneriella* and *Geminella*.

The most constant associates were *Scenedesmus armatus*, *Scenedesmus falcatus*, *Microcystis holsatica*, *Microcystis minutissima*, which occurred in 100 $^0/_0$ of the number (20) of samples that contained *Anabaena Viguieri* var. *danica*. *Ankistrodesmus falcatus* var. *spirilliformis*, *Oscillatoria limnetica* and its var. *acicularis* occurred in 95 $^0/_0$ of the samples, *Chlamydomonas retroversa* and *Ankistrodesmus falcatus* in 85 $^0/_0$, *Chlamydomonas kakosmos* and *Ankistrodesmus falcatus* var. *spiralis* in 80 $^0/_0$, *Selenastrum Westii* and *Sphaerozosma granulatum* in 75 $^0/_0$ of the samples.

Ecology. Jægerbakke Dam is a very highly eutrophicated, but lime-deficient pond. This small, highly wind-sheltered pond is situated in a park at Hillerød. Its phytoplankton quotients appear from Table III.

The species was found at pH 7.05—9.8, content of CaO 7.3—10.9 mg/l, consumption of $KMnO_4$ 28—49 mg/l, contents of PO_4-P 0—0.015 mg/l, NH_3-N 0—0.01 mg/l, Fe 0.02 mg/l.

Addendum.

After the completion and translation of the manuscript I received two valuable papers, viz. H. SKUJA's "Taxonomie des Phytoplanktons einiger Seen in Uppland, Schweden" (Symb. Bot. Upsal., vol. 9, 1948) and E. TEILING's "Staurodesmus, genus novum" (Bot. Notiser 1948).

During a short stay in Uppsala at Professor Skuja's and in Linköping at Dr. Teiling's I had an opportunity to discuss some of my new species with these two scientists. The following will render an account of the results of our discourses.

Euglena phacoides n. sp. (p. 163) is identical with *Euglena spathirhyncha* Skuja (1948, p. 196, t. 22, figs. 17—20).

Chlamydomonas clavata n. sp. (p. 30) is probably identical with *Chlamydomonas gloeophila* Skuja (1948, p. 85, t. 9, figs. 1a—i).

Closterium polystictum Nyg. forma (Skuja 1948, p. 153, t. 18, figs. 1—3) is undoubtedly identical with *Closterium polystictum* Nyg. var. *breviusculum* n. var. (p. 60) even if the range of variation is larger (280—570 $\mu \times$ 6.5—11.5 μ).

SKUJA is of opinion that *Closterium Baillyanum* Breb. var. *parvulum* Grönblad f. *tenuis* n. f. (p. 56) ought to be named *Closterium Baillyanum* var. *tenue* n. var. I agree with Professor Skuja in this view.

The same author has referred *Closterium tortum* Griffiths to *Closterium parvulum* Näg. as var. *tortum* (Griff.) Skuja (1948, p. 154), while I have referred it to *Closterium Venus* Kg. as f. *torta* (Griff.) mihi (p. 63). In their Monograph of the British Desmidiaceae, vol. 1, p. 138, W. and G. S. WEST write: "The curvature of *Closterium Venus* (150—160° of arc) distinguishes it from *Closterium parvulum* (120—140° of arc), and it is invariably of smaller dimensions (51—81 $\mu \times$ 7—10.5 μ, while those of *Closterium parvulum* are 96—121 $\mu \times$ 11—14,5 μ) . . . . . and there are rarely more than two pyrenoids in each chloroplast." SKUJA's specimens measured 90—160 μ in length thus being considerably longer than the Danish specimens (81—90 μ long). GRIFFITHS states the measurements 90—100 $\mu \times$ 8—10 μ for *Closterium tortum* Griff., consequently it is thinner than *Closterium parvulum*, but it has 3—4 pyrenoids per semicell. The Danish specimens evidently are more closely allied to *Closterium Venus* than to *Closterium parvulum* if we lay stress on their great curvature (151—164° of arc) and the dimensions.

Arthrodesmus incus Hass. var. *extensus* Anderss. (p. 71) is perhaps identical with *Staurodesmus Joshuae* Teiling (1948, p. 66, figs. 1—7, 9—10).

Arthrodesmus incus Hass. var. *extensus* Anderss. f. *minor* n. f. (p. 71) may be regarded as *Staurodesmus extensus* (Anderss.) Teiling f. *minor* mihi (see TEILING 1948, p. 67, fig. 11).

Staurastrum curvatum West f. *brevispina* n. f. (p. 89) may be named *Staurodesmus curvatus* (West) f. *brevispina* mihi.

Staurastrum cuspidatum Breb. var. *acuminatum* n. var. (p. 89) may be named *Staurodesmus cuspidatus* Ralfs subsp. *tricuspidatus* Teiling var. *acuminatus* mihi (see TEILING 1948, p. 60).

Staurastrum dejectum Breb. f. *mediocris* n. f. and f. *longispina* n. f. (p. 93—94) may be regarded as two local races of *Staurodesmus Spencerianus* Teiling subsp. *Spencerianus* Teiling (1948, p. 68, figs. 37—38, 42—43).

Dr. HUBER-PESTALOZZI is of opinion that my *Rhodomonas lacustris* (see p. 147) is a new species. I agree with him in this and propose to call it *Rhodomonas ovalis* n. sp.

The author's grateful thanks are due to Dr. HUBER-PESTALOZZI, Professor SKUJA and Dr. TEILING for advice and criticism.

5. A simple Micro-Manipulator.

For the isolation of one microscopical cell is often used a fine capillary tube, the point of which is inserted into the water-drop with the organisms; under microscopic control a single cell can then be sucked into the capillary tube. The difficulty of this operation consists in keeping the tube so quiet, that the point of it at a magnification of for instance 100 times can in fact be held quietly in front of the organism, which in many cases has a size of only 10—25 μ. I shall therefore describe a small invention, which I hope will meet a desideratum because the small apparatus can be fastened to the objective of the microscope; by means of the mechanical stage of the microscope the organism can be moved to the mouth of the fastened capillary tube and sucked up.

Construction. As shown in Fig. 126 the apparatus may consist of a block of metal, 55 mm long, 15 mm broad and 10 mm high, or, to avoid scratches on the side-walls of the objective, of a corresponding piece of ebonite or the kind of pressed material that is used for insulating purposes by the electric industry. In one end there is a vertical hole (diam. for instance 12 mm) for the objective and a deep incision, so that the walls of the hole can be fastened round the objective by means of a threaded bolt. On the side-wall of the other end is placed a retaining plate, so that the capillary tube can be pressed against one vertical wall of the block by means of 3 screws. Small pieces of felt or thin plates of cork glued to the walls of the block and the retaining plate prevent the breaking of the tube.

The capillary tube is a 5 mm glass tube, one end of which has been drawn into a long, thin point forming an angle of about 135° with the tube; at the other end of the tube a small but high nut with a threaded bolt to match is fastened by means of glass-cement. It is very important that the bolt should fit exactly into the thread of the nut and that it is greased with a tough lubricant, for instance the kind used for the glass-taps of burettes because it is necessary to make the passage of the bolt through the nut completely air-tight. It is desirable to have a set of capillary tubes, the points of which are for instance 25, 50, 100 and 500 μ thick.

When the apparatus is to be used, the block is fastened to the objective, after which the capillary tube chosen is placed in such a position that the mouth of the

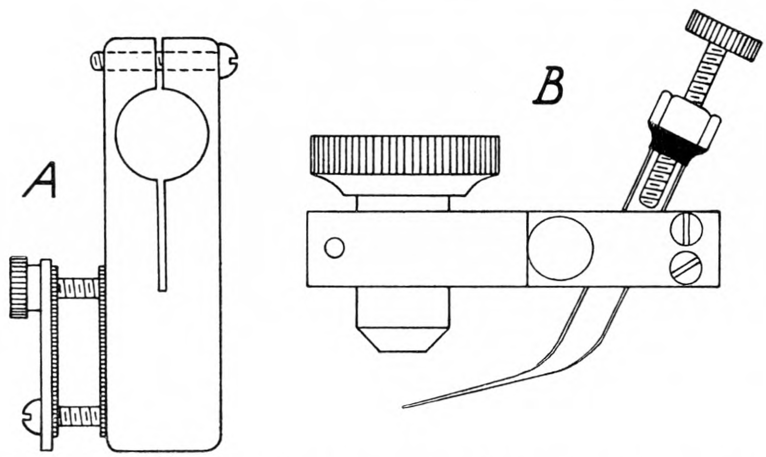

Fig. 126. *A*: the micro-manipulator in vertical view without the capillary tube; *B*: the micro-manipulator with the capillary tube in lateral view, mounted on the objective of the microscope.

tube is clearly visible in the centre of the field of vision (magnification about 100 times) and the point is nearly horizontal.

Application. If a single microscopical organism is to be selected from a suspension of organisms in water, it cannot be done by lowering the empty capillary tube into the drop on the slide. The capillary action, which increases with the diminishing diameter of the tube, will immediately carry water with numerous organisms into the tube. The tube must be allowed to suck up sterile water and by turning the threaded bolt a convenient column of water remains; if the tube is then let down into the suspension by lowering the tubus of the microscope, no organisms will be sucked up. By means of the mechanical stage the slide is now placed in such a position that the organism selected is situated before the mouth of the tube; a slight counter-clockwise turning of the threaded bolt of the capillary tube will then carry the cell into the tube, after which the capillary tube is removed from the suspension with the other organisms by raising the tubus of the microscope.

If one or several organisms are wanted for the cultivation of clones, the following procedure may be used. After the selection of one cell the slide with the suspension is replaced by a sterile slide, on which a sterile coverslip is placed. The tubus of the microscope is lowered until the point of the capillary tube touches the coverglass; a slight clockwise turning of the threaded bolt will now press a droplet of water containing the chosen cell on to the coverslip. At a magnification of for instance 200 times it should now be ascertained that the droplet contains one and only one cell. If this is the case, the coverglass can be slipped from the slide into the sterile fluid in which the species is to be cultivated.

The apparatus can also be used for the making of permanent slides of new or rare species, of which only a few individuals were found among many others, for instance desmid individuals in a plankton sample. Some drops of glycerine should be added to the sample, which is then placed on a watch-glass or in a salt-cellar to allow a slow evaporation of the water. The specimens wanted can now be selected from the glycerine suspension and placed in a droplet of pure glycerine on a slide for the usual ready-making of the slide.

If durable slides are wanted, the micro-organisms should not be mounted in a concentrated solution of potassium acetate. In 1930 I made more than 400 slides of plankton mounted in potassium acetate; all of them were sealed with the first class Rützow's Varnish. To-day nearly all of these slides have dried up, which would hardly have happened if glycerine had been used instead of potassium acetate.

In the literature the vapours of osmic acid are often recommended for the fixation of flagellates. I have tried to fix *Euglena gracilis* in this way, but the result was very poor because the long cells of this organism within a fraction of a second contracted into clots before they died. For such difficult kinds of objects I recommend the following method. A little of the *Euglena* suspension is spouted into 2—3 ml of $\frac{1}{2}$ % osmic acid, by which procedure the cells are fixed instantaneously. After a sedimentation of 5—10 minutes the osmic acid is sucked off, and the glass is filled with diluted formalin. After decantation repeatedly the rising water is replaced by 5—10 ml of 10 % glycerine with one drop of formalin. The suspension may now be poured into a watch-glass or a salt-cellar, so that the water may evaporate slowly, and it is now possible from the suspension in glycerine to make a first-class slide showing the *Euglena gracilis* individuals in exactly the same shape as when they were alive. Besides the chromatophores and the nucleus are very clearly visible in such a slide.

For plankton organisms of all sizes may be used a method invented at the Limnological Institute of Lund, Sweden. Small fragments of coverglass or mica are placed round a glycerine drop of a suitable size, containing one or several specimens of the organism. A slight heating will make the paraffin arranged in small grains along one of the edges of the coverslip melt and force its way under the coverglass where it surrounds the droplet of glycerine. After it has cooled down the slide is finished.

I should recommend to use minute spheres or pieces of modelling wax instead of splits of coverglass, 4 pieces of $\frac{1}{2}$—1 mm size around the droplet of glycerine. The advantage of this method is that the coverglass may be pressed close to the objects thus allowing the use of immersion objectives by the examination.

As it proved apparent that an air-bubble is formed in the glycerine in about three months, or even that the glycerine was totally absorbed by the paraffin, I should recommend to replace the paraffin by paraffin oil, at which the heating besides can be avoided. The slide should finally be sealed with e. g. Canada Balsam or Rützow's Varnish.

The author wishes to render his best thanks to the Board of Carlsberg Fondet for grants enabling the accomplishment of these studies on Danish phytoplankton. He also wishes to express his gratitude to the Board of Rask-Ørsted Fondet for means enabling the translating of this paper. Heart-felt thanks are due to Professor Kaj Berg for his great interest in the work of the author and for many proofs of support throughout the years. He is finally indebted to his translator, C. H. Vogelius Andersen, Superintendent of Police, for good collaboration during the translation of the manuscript.

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6. List of new Localities.

Arreskov Sø, South Funen.
July 7th, 1946: Temp. 20°, nannoplankton.
Badstue-Ødam, NE-Seeland.
September 5th, 1941: netplankton and waterbloom (coll. by Jørgen Bock).
Ballegaard Mølledam at Avnbøl, North Sleswick.
February 11th, 1944: nannoplankton.
Bøllemosen, North Seeland.
September 5th, 1946: pH 4.9, nannoplankton.
May 17th, 1948: Temp. 22°, pH 4.2, netplankton.
Chara-pond in Bagmose E. of Aunslev, East Funen.
August 9th, 1926: pH 8.1, consumption of $KMnO_4$ 61 mg per l, netplankton.
Egen Mølledam, Als.
March 11th, 1943: oligohumic, nannoplankton.
February 25th, 1944: icebound, nannoplankton.
May 20th, 1945: temp. 12.5°, pH 8.4, nannoplankton.
November 21st, 1945: temp. 5.6°, pH 7.8, mesohumic, nannoplankton.
Emdrup Sø at Copengagen.
July 29th, 1941: nannoplankton (coll. by Jørgen Bock).
March 26th, 1946: temp. 5°, free from ice, nannoplankton.
November 29th, 1946: temp. 5.5°, pH 7.9, nannoplankton, 5 ml sample.
Eriophorum moor at Suserup, Seeland.
July 9th, 1947: pH 6,8, netplankton, 7 liter sample.
August 6th, 1947: temp. 19.5°, pH 6.8, netplankton, 1 ml sample.
September 6th, 1947: temp. 19°, pH 6.5—6.8, netplankton, 10 ml sample.
October 4th, 1947: temp. 13°, pH 6.6, netplankton, 10 ml sample.
November 15th, 1947: temp. 2.5°, pH 6.9, netplankton, 10 ml sample.
December 13th, 1947: temp. 3°, pH 6.6, netplankton, 10 ml sample.
January 10th, 1948: temp. 1°, partly icebound, pH 6.4, nannoplankton, 10 ml sample.
February 21st, 1948: temp. 2°, covered with 8 cm thick ice, pH 6.4, nannoplankton, 10 ml sample.
March 20th, 1948: temp. 7.5°, pH 6.6, net- and nannoplankton, 10 ml sample.
April 17th, 1948: temp. 15.5°, pH 6.8, net- and nannoplankton, 10 ml sample.
May 14th, 1948: temp. 20°, pH 6.9, net- and nannoplankton. 10 ml sample.
June 13th, 1948: temp. 20°, pH 6.6, net- and nannoplankton, 10 ml sample.
July 13th, 1948: temp. 22°, pH 6.8, net- and nannoplankton, 10 ml sample.
Field pond at the 32 km stone of main road 8, North Sleswick.
October, 4th 1942: temp. 16.5°, polyhumic, nannoplankton.
Field pond at Lysabild, Als.
March 11th, 1943: oligohumic, nannoplankton.
February 13th, 1944: nannoplankton.

Field pond between Sønderskoven and Høruphav, Als.
November 11th, 1944: temp. 4°, oligohumic, nannoplankton.
February 22nd, 1945: free from ice, oligohumic, nannoplankton.
Field pool North of Søndre Landevej at Sønderborg, North Sleswick.
February 27th, 1938: temp. 2.5°, icebound, nannoplankton.
March 25th, 1945: temp. 11°, pH 8.4, nannoplankton.
Field pool at the road from Aabenraa to Søgaard, North Sleswick.
September 14th, 1944: pH 7.9, nannoplankton.
Field watering pond at Augustenborg, Als.
December 21st, 1944: temp. 1°, pH 7.6, nannoplankton.
Graasten Slotssø, North Sleswick.
November 15th, 1942: nannoplankton.
Gurre Sø, North Seeland.
November 21st, 1945: nannoplankton.
April 2nd, 1946: nannoplankton.
October 28th, 1946: nannoplankton (all coll. by Lektor B. Asmund).
Hammersø, North Bornholm.
August 26th, 1947: nannoplankton.
Hulsø, North Seeland.
August 8th, 1946: netplankton.
December 23rd, 1946: ice 10 cm thick, temp. 0.5°, pH 7.5, nannoplankton, netplankton 20 ml sample, depth 3.9 m.
April 5th, 1947: temp. 3°, nearly quite icebound, pH 7.0, netplankton, nannoplankton.
September 4th, 1947: netplankton.
Hundslev Bydam, North Sleswick.
March 12th, 1943: temp. 3.5°, oligohumic, nannoplankton.
Jægerbakke Dam at Hillerød, North Seeland.
November 25th, 1944: temp. 1—2°, nannoplankton.
December 4th, 1944: temp. 2°, nannoplankton, 500 ml sample (coll. by Professor Kaj Berg).
Jægerdammen at Augustenborg, Als.
February 27th, 1944: oligohumic, nannoplankton.
Kidskelund Gadekær at Krusaa, North Sleswick.
August 18th, 1945: temp. 18.3°, pH 7.1, nannoplankton.
Klaresø in Teglstrup Hegn, North Seeland.
June 14th, 1947: pH 6.0, netplankton.
Klosterdam in Sønderborg, Als.
February 28th, 1945: temp. 7.5°, pH 8.4, nannoplankton.
March 25th, 1945: temp. 11°, pH 7.6, nannoplankton.
Krusaa-Dam (contaminated) near the 30 km stone at mainroad 8 (Sønderborg—Tønder), North Sleswick.
October 4th, 1942: temp. 16.5°, nannoplankton.
September 11th, 1944: pH 4.8, nannoplankton.
April 27th, 1945: temp. 9.5°, pH 4.8, neuston of Euglena, nannoplankton.
July 22nd, 1945: temp. 20.0°, pH 5.0, nannoplankton.
August 18th, 1945: temp. 18.5°, pH 4,9, 5.5 mg CaO per l, consumption of $KMnO_4$ 196 mg per l, neuston of Euglena, nannoplankton, 1000 ml sample.
September 21st, 1945: temp. 16°, nannoplankton.
October 28th, 1945: temp. 11.5°, pH 4.8, nannoplankton, 1000 ml sample.
November 30th, 1945: temp. 7.5°, pH 4.8, nannoplankton, 1000 ml sample.
December 30th, 1945: temp. 1.5°, partly icebound, pH 4.9, nannoplankton, 1000 ml sample.

Ladegaard Dam at Sønderborg, Als.
February, 17th 1938: temp. 2°, icebound, nannoplankton.
Lodne Mose at Broager, North Sleswick.
March 17th, 1943: oligohumic, nannoplankton.
February 26th, 1944: oligohumic, nannoplankton.
Lundesøen in Als.
February 20th, 1944: temp. 3.5°, nannoplankton.
Lundsø at Avnbøl, North Slewick.
March 14th, 1943: temp. 4°, oligohumic, nannoplankton.
Lyngby Sø, North Seeland.
March 25th, 1946: temp. 3.5°, partly icebound, nannoplankton.
Lynge Kirkedam at Sorø, Seeland.
November 15th, 1947: temp. 2°, partly covered with thin ice, pH 7.8, nannoplankton, 10 ml sample.
December 13th, 1947: temp. 3°, pH 7.6, nannoplankton, 10 ml sample.
January 10th, 1948: temp. 0.5°, pH 7.8, nannoplankton, 10 ml sample; partly icebound.
February 21st, 1948: temp. 1°, covered with 10 cm thick ice, pH 8.6, nannoplankton, 10 ml sample.
March 20th, 1948: temp. 7.5°, pH 8.6, nannoplankton, 10 ml sample.
April 17th, 1948: temp. 12.5°, pH 8.6, nannoplankton, 10 ml sample.
June 13th, 1948: temp. 20°, pH 7.6, nannoplankton.
Lynge Vandingsdam at Sorø, Seeland.
June 30th, 1947: 1000 ml sample.
August 6th, 1947: temp. 19.5°, pH 9.0, nannoplankton, 1 ml sample.
September 6th, 1947: quite dried up!
October 4th, 1947: 50—100 l water in the pond, temp. 13.5°, pH 7.8, nannoplankton, 10 ml sample.
November 15th, 1947: covered with thin ice, temp. 2°, pH 7.7, nannoplankton, 10 ml sample.
December 13th, 1947: temp. 3°, pH 7.8, nannoplankton, 10 ml sample.
January 10th, 1948: temp. 0.5°, pH 7.8, nannoplankton, 10 ml sample.
February 21st, 1948: temp. 1°, covered with 10 cm thick ice, pH 8.4, nannoplankton, 10 ml sample.
March 20th, 1948: temp. 7°, pH 8.3, net- and nannoplankton, 10 ml sample.
April 17th, 1948: temp. 14.5°, pH 8.5, net- and nannoplankton, 10 ml sample.
May 14th, 1948: temp. 18°, pH 8.8, nannoplankton, 10 ml sample; nearly overgrown with *Batr. aquatile*.
June 13th, 1948: temp. 20°, pH 9.2, nannoplankton, 10 ml sample. *Chara vulgaris* at the margin.
July 25th, 1948: temp. 24°, pH 9.1, nannoplankton, 10 ml sample. *Chara vulgaris* abundant everywhere in the pond together with *Batrachium aquatile* and *Batr. trichophyllum*.
Løvenholm Langsø, Jutland.
August 1st, 1948: temp. 27°, pH 4.1, netplankton, nannoplankton, 10 ml sample, superhumic!
Maribo Sø, Lolland.
October 27th, 1946: nannoplankton (coll. by Adjunkt K. Viderø).
Marl-pit at Økobbel, Als.
November 18th, 1941: icebound, pH 7.8, nannoplankton.
Mørksø in Salling, North Jutland.
July 6th, 1938: temp. 18.5°, pH 4.9, oligohumic, nannoplankton.
Mølledammen in Sønderborg, Als.
August 1st, 1937: water-bloom.

September 10th, 1941: nannoplankton.
August 30th, 1943: nannoplankton.
August 26th, 1944: nannoplankton.
November 25th, 1944: nannoplankton.
January 11th, 1945: nannoplankton.
July 4th, 1945: pH 9.4, nannoplankton.

Nordborg Sø, Als.
July 11th, 1938: nannoplankton.
July 19th, 1938: 1000 ml sample.
May 21st, 1940: nannoplankton.
September 23rd, 1940: nannoplankton.
December 9th, 1940: nannoplankton.

Pond I at Dybbøl Kirkegaard, North Sleswick.
March 10th, 1943: temp. 3.5°, oligohumic, nannoplankton.

Pond II at Dybbøl Kirkegaard, North Sleswick.
March 11th, 1943: temp. 4°, nannoplankton.

Pond at Mommark Færgegaard, Als.
February 15th, 1944: oligohumic, nannoplankton.

Pond at Mommark School, Als.
February 15th, 1944: oligohumic, nannoplankton.

Pond situated near the beginning of the Hokkerup road from the Graasten—Søgaard road, North Sleswick.
September 14th, 1944: pH 8.5, nannoplankton.

Pond at Høbbet NE of Faaborg, Funen.
July 7th, 1946: nannoplankton.

Pond in Ragebøl, North Sleswick.
August 30th, 1937: nannoplankton.
April 2nd, 1938: nannoplankton.
December 10th, 1940: covered with thin ice, nannoplankton.

Pond W of Rønhavegaard, Als.
March 12th, 1944: temp. 4.5°, nannoplankton.
December 17th, 1944: temp. 1°, icebound, nannoplankton.

Pond at Søndre Landevej, Sønderborg, Als.
January 3rd, 1937: temp. 4.5°, nannoplankton.
January 16th, 1937: icebound, netplankton.
January 1st, 1940: temp. 1.5°, pH 7.4, covered with 10 cm thick ice, nannoplankton.
July 12th, 1940: temp. 17°, pH 7.4, nannoplankton.
December 14th, 1941: temp. 5.5°, pH 7.7, nannoplankton.
October 23rd, 1943: temp. 11°, pH 7.4, 2000 ml sample.
December 29th, 1943: temp. 4.5°, nannoplankton.
February 6th, 1944: temp. 2°, 500 ml sample.
February 21st, 1944: temp. 0.5°, icebound, nannoplankton.
April 8th, 1944: temp. 6.5°, nannoplankton.
July 16th, 1944: nannoplankton.
November 17th, 1944: temp. 6°, pH 8.1, nannoplankton.
February 22nd, 1945: free from ice, nannoplankton.
March 25th, 1945: temp. 10°, pH 8.5, water level very high, nannoplankton.
August 10th, 1945: pH 7.6, nannoplankton.

Pond at Snogbæk, North Sleswick.
March 10th, 1943: temp. 4°, oligohumic, nannoplankton.

Pond in Sundsmark, Als.
November 8th, 1942: temp. 8.3°, pH 7.8, nannoplankton.
January 3rd, 1944: temp. 4°, nannoplankton.
July 20th, 1944: polyhumic, nannoplankton.
January 25th, 1945: covered with 7 cm thick ice, oligohumic, nannoplankton.
Pond (inundated grass field) W of Sønderskoven, Als.
March 13th, 1945: temp. 7.5°, pH 8.4, oligohumic, nannoplankton.
March 25th, 1945: temp. 11°, pH 8.1, nearly dried up, nannoplankton.
Pond W of Sønderskoven, Als.
March 25th, 1945: temp. 11°, pH 8.0, oligohumic, nannoplankton.
Pond (shallow) in the forest of Sønderskoven, Als.
December 14th, 1944: temp. 1.7°, pH 6.2, polyhumic, nannoplankton.
March 12th, 1945: nannoplankton.
Pond (small) in the new cemetery of Sønderborg, Als.
March 25th, 1945: temp. 11°, pH 8.4, oligohumic, nannoplankton.
Pool in the garden of Sønderborg Statsskole.
August 31st, 1944: temp. 18°, pH 8.5, nannoplankton.
September 11th, 1944: nannoplankton.
November 30th, 1944: temp. 6.5°, pH 7.1, polyhumic, nannoplankton.
Rønhavegaard Dam, Als.
March 12th, 1944: temp. 4.5°, pH 8.2, nannoplankton, 1000 ml sample.
March 19th, 1944: temp. 6°, nannoplankton.
December 10th, 1944: temp. 2.3°, pH 7.8, mesohumic, nannoplankton.
January 13th, 1945: temp. 1.5°, ice 3 cm thick, pH 7.9, oligohumic, nannoplankton.
March 8th, 1945: temp. 4°, pH 8.8, nannoplankton.
March 15th, 1945: temp. 7°, nannoplankton.
March 22nd, 1945: temp. 7.5°, pH 9.6, nannoplankton.
April 30th, 1945: temp. 10°, nannoplankton.
May 23rd, 1945: temp. 15.7°, pH 9.6, nannoplankton.
June 30th, 1945: temp. 17°, pH 9.3, nannoplankton.
July 20th, 1945: temp. 23.6°, pH 9.4, nannoplankton.
August 25th, 1945: temp. 17.3°, pH 9.8, nannoplankton, enormous production.
November 2nd, 1945: temp. 10.5°, nannoplankton.
Sandbjerg Sø at Alssund.
June 16th, 1925: temp. 17°, netplankton.
September 4th—10th, 1937: netplankton and nannoplankton.
August 14th, 1938: temp. 26.8°, pH 8.8, nannoplankton.
August 15th, 1938: 3000 ml sample.
September 4th, 1938: temp. 17°, pH 8.4, nannoplankton.
September 15th, 1938: temp. 14.5°, pH 8.3, nannoplankton.
October 1st, 1938: temp. 17.5°, pH 8.3, nannoplankton,
May 21st, 1939: nannoplankton.
August 6th, 1939: temp. 22°, nannoplankton.
September 3rd, 1939: temp. 21.6°, pH 8.4, nannoplankton.
May 15th, 1940: nannoplankton.
November 22nd, 1941: nannoplankton.
November 29th, 1941: nannoplankton.
February 27th, 1944: partly icebound, nannoplankton.
August 19th, 1944: water-bloom.
August 19th, 1945: 113.1 mg CaO per litre.

Skaansø in Salling, North Jutland.
July 4th, 1938: temp. 17.5°, pH 5.6, oligohumic, netplankton and nannoplankton.
Skørsø in Salling, North Jutland.
July 5th, 1938: temp. 18°, pH 4.6, nannoplankton.
Sorø Sø in Seeland.
June 30th, 1947: netplankton.
September 6th, 1947: temp. 19.5°, pH 7.9, netplankton, 1 ml sample.
Sortesø in Teglstrup Hegn, NE-Seeland.
June 14th, 1947: pH 4.7, netplankton.
Skovby Gadekær, Als.
November 9th, 1944: temp. 4.5°, pH 8.9, oligohumic, nannoplankton.
Sphagnum bog ("Cirkelsø") S of Søgaard Sø, North Sleswick.
July 16th, 1939: temp. 21.5°, pH 4.3, nannoplankton.
Steenstrup Skovdam S of Sorø, Seeland.
July 12th, 1947: netplankton.
Store Gribsø, NE-Seeland.
August 17th, 1946: temp. 19°, pH 4.3, 200 ml sample, netplankton.
January 4th, 1947: temp. 0°, ice 15 cm thick, pH 4.4, nannoplankton.
June 19th, 1947: netplankton, 100 ml sample.
May 6th, 1948: temp. 13°, pH 4.1, net- and nannoplankton, 10 ml sample.
Sædmose at Høgebjerg, Asserballe, Als.
November 10th, 1940: nannoplankton.
Tjustrup Sø in Seeland.
August 8th, 1941: netplankton.
July 30th, 1943: netplankton.
July 16th, 1946: netplankton, 20°.
July 2nd, 1947: netplankton.
Turf pit in Almsted Lyng, Als.
October 28th, 1940: polyhumic, nannoplankton.
Turf pit at Bromme Plantage, Seeland.
May 24th, 1947: netplankton.
July 3rd, 1947: netplankton.
Turf pit at Dødringe, Seeland.
May 24th, 1947: netplankton.
Turf pit in Hundslev, North Sleswick.
March 11th, 1943: temp. 3.5°, polyhumic, nannoplankton.
Turf pit 1 km W of Hvidemose in Salling, North Jutland.
July 4th, 1938: temp. 18°, pH 4.4, polyhumic, net- and nannoplankton.
Turf pit S of Kier, Als.
November 30th, 1944: temp. 5.5°, pH 7.4, mesohumic, nannoplankton.
Turf pit, nearly overgrown, NE of Skaansø in Salling, North Jutland.
July 4th, 1938: temp. 18.5°, pH 4.3, polyhumic, nannoplankton.
Turf pit near Suserup Skov, Seeland.
July 3rd, 1947: netplankton.
Turf pit N of Krusaa-Dam, North Sleswick.
August 18th, 1945: temp. 18.6°, pH 3.7, polyhumic, nannoplankton.
November 30th, 1945: temp. 7.5°, pH 3.8, polyhumic, nannoplankton.
Ulkebøl Gadekær, Als.
March 31st, 1943: nannoplankton.
Western village pond in Skovby, Als.
November 23rd, 1944: temp. 8°, pH 7.3, polyhumic, nannoplankton.

7. List of Abbreviations.

Act Ha = *Actinastrum Hantzschii* Lag.
Ana af in te = *Anabaena affinis* Lemm. var. *intermedia* Grif. f. *tenuis* n. f.
Ana ci = *Anabaena circinalis* Hansg.
Ana fl = *Anabaena flos aquae* Breb.
Ana Ha ma = *Anabaena Hassalii* Kg. var. *macrospora* Wittr.
Ana he = *Anabaena heterospora* n. sp.
Ana in = *Anabaena incrassata* Nyg.
Ana pl = *Anabaena planctonica* Brunnth.
Ana si = *Anabaena sigmoidea* n. sp.
Ana sp mi = *Anabaena spiroides* Kleb. var. *minima* Nyg.
Ana sp tu = *Anabaena spiroides* Kleb. var. *tumida* Nyg.
Ana su = *Anabaena subcylindrica* Borge
Ana te = *Anabaena tenericaulis* n. sp.
Ana te lo = *Anabaena tenericaulis* n. sp. var. *longispora* nov. var.
Ana Vi = *Anabaena Viguieri* Dénis et Frémy
Ana Vi da = *Anabaena Viguieri* Dénis et Frémy var. *danica* n. var.
Ank co mi = *Ankistrodesmus convolutus* Corda var. *minutus* Rabh.
Ank fa = *Ankistrodesmus falcatus* Ralfs
Ank fa mi du = *Ankistrodesmus falcatus* Ralfs var. *mirabilis* West f. *dulcis* Nyg.
Ank fa mi lo = *Ankistrodesmus falcatus* Ralfs var. *mirabilis* West f. *longiseta* Nyg.
Ank fa se br = *Ankistrodesmus falcatus* Ralfs var. *setiformis* Nyg. f. *brevis* Nyg.
Ank fa se el = *Ankistrodesmus falcatus* Ralfs var. *setiformis* Nyg. f. *elongata* Nyg.
Ank fa spa = *Ankistrodesmus falcatus* Ralfs var. *spiralis* G. S. West
Ank fa spi = *Ankistrodesmus falcatus* Ralfs var. *spirilliformis* West
Ank la = *Ankistrodesmus lacustris* Ostenf.
Api fl = *Aphanizomenon flos aquae* Ralfs
Api fl Kl = *Aphanizomenon flos aquae* Ralfs var. *Klebahnii* Elenk.
Ar cr lo = *Arthrodesmus crassus* West f. *longispina*
Ar in ex mi = *Arthrodesmus Incus* Hass. var. *extensus* Anders. f. *minor* n. f.
Asi fo = *Asterionella formosa* Hass.
Aso su = *Asterococcus superbus* Scherff.
Ba Bo = *Bambusina Borreri* Delp.
Bo Br = *Botryococcus Braunii* Kg.
Ca ag = *Carteria agloëformis* n. sp.
Ce co = *Ceratium cornutum* Clap. et Lachm.
Ce hi = *Ceratium hirundinella* Schrank
Ce hi si = *Ceratium hirundinella* Schrank f. *silesiacum* Schröder
Chla ac = *Chlamydomonas acidophila* Nyg.
Chla ci = *Chlamydomonas cingulata* Pascher
Chla ka = *Chlamydomonas kakosmos* Moewus

Chla ol = *Chlamydomonas oleosa* n. sp.
Chla ps = *Chlamydomonas pseudoplatyrhyncha* Pasch.
Chla Re = *Chlamydomonas Reinhardii* Dang.
Chla Re mi = *Chlamydomonas Reinhardii* Dang. var. *minor* Nyg.
Chrom No mi = *Chroomonas Nordstedtii* Hansg. f. *minor* n. f.
Chry ma = *Chrysococcus major* Nyg.
Chry mi = *Chrysococcus minutus* Nyg.
Cl ac va = *Closterium acutum* Breb. var. *variabile* Krieger
Cl Kü = *Closterium Kützingii* Breb.
Coa mi as = *Coelastrum microporum* Näg. f. *astroidea* (de Not.) mihi
Coo Kü = *Coelosphaerium Kützingianum* Näg.
Coo Nä = *Coelosphaerium Nägelianum* Unger
Cos as st = *Cosmarium asphaerosporum* Nordst. var. *strigosum* Nordst.
Cos de = *Cosmarium depressum* Lund.
Cos pu = *Cosmarium pusillum* Archer
Cru qu = *Crucigenia quadrata* Morren
Crym ov = *Cryptomonas ovata* Ehrb.
Crym ov cu = *Cryptomonas ovata* Ehrb. var. *curvata* Lemm.
Cyc co = *Cyclotella comta* Kg.
Cyc Kü ra = *Cyclotella Kützingiana* Twait. var. *radiosa* Fricke
Cyc Me = *Cyclotella Meneghiniana* Kg. emend. Nyg.
Cyc st su = *Cyclotella stelligera* Grun. var. *subglabra* n. var.
Dia el = *Diatoma elongatum* Ag.
Dia vu gr = *Diatoma vulgare* Bory var. *grandis* Grun.
Dic Eh = *Dictyosphaerium Ehrenbergianum* Näg.
Dic pu = *Dictyosphaerium pulchellum* Wood
Din cy al = *Dinobryon cylindricum* Imhof var. *alpinum* Bachm.
Din cy pa = *Dinobryon cylindricum* Imhof var. *palustre* Lemm.
Din di = *Dinobryon divergens* Imhof
Din se pr = *Dinobryon sertularia* Ehrb. var. *protuberans* Krieger
Din so = *Dinobryon sociale* Ehrb.
Din so am = *Dinobryon sociale* Ehrb. var. *americanum* Bachm.
Din so st = *Dinobryon sociale* Ehrb. var. *stipitatum* Lemm.
El ge = *Elakatothrix gelatinosa* Wille
El ge bi = *Elakatothrix gelatinosa* Wille f. *biplex* Nyg.
Eug ac = *Euglena acus* Ehrb.
Eug mi = *Euglena minima* Francé
Eug ob = *Euglena oblonga* Schm.
Eug pr = *Euglena proxima* Dang.
Eut gl = *Eutetramorus globosus* Walton
Frg cr = *Fragilaria crotonensis* Kitton
Frg ca = *Fragilaria capucina* Desm.
Ge mi = *Geminella minor* Heering
Gle ac = *Glenodinium aciculiferum* Lindem.
Gle Lo = *Glenodinium Lomnickii* Lindem.
Gos se = *Goniostomum semen* Diesing
Gy ex = *Gymnodinium excavatum* Nyg.
Gy ne = *Gymnodinium neglectum* Lindem.
Gy aer = *Gymnodinium aeruginosum* Stein
Ki mi = *Kirchneriella microscopica* Nyg.
La hy = *Lampropedia hyalina* Schröter

Le ps	=	*Lepocinclis pseudo-texta* Conrad
Le te	=	*Lepocinclis texta* Lemm.
Ly li	=	*Lyngbya limnetica* Lemm.
Ma ak	=	*Mallomonas akrokomos* Pascher et Ruttner
Ma ca	=	*Mallomonas caudata* Krieger, non Iwanoff
Ma pe ec	=	*Mallomonas pediculus* Teiling var. *echinospora* n. var.
Ma se	=	*Mallomonas semiglabra* n. sp.
Ma Te	=	*Mallomonas Teilingii* Conrad
Mel am	=	*Melosira ambigua* Müller
Mel gr	=	*Melosira granulata* Ralfs
Mel gr an	=	*Melosira granulata* Ralfs var. *angustissima* Müller
Mel it su	=	*Melosira italica* Kg. subsp. *subarctica* Müll.
Mer te	=	*Merismopedia tenuissima* Lemm.
Mia pu	=	*Micractinium pusillum* Fres.
Mio bo	=	*Microcystis Botrys* Teiling
Mio fl	=	*Microcystis flos aquae* Kirchner, emend. W.-L., Teiling
Mio fl ma	=	*Microcystis flos aquae* var. *major* n. var.
Mio ho	=	*Microcystis holsatica* Lemm.
Mio mi	=	*Microcystis minutissima* West
Mio pu	=	*Microcystis pulverea* Mig.
Mio pu ra	=	*Microcystis pulverea* Mig. var. *racemiformis* n. var.
Mio vi	=	*Microcystis viridis* Lemm., Teiling
Mio aer	=	*Microcystis aeruginosa* Kg. emend. W.-L., Teiling
Mio aer ma	=	*Microcystis aeruginosa* var. *major* Wittr.
Na be	=	*Nannokloster belonophorus* Pascher
Ni ac	=	*Nitzschia acicularis* Grun.
Oe It	=	*Oedogonium Itzigsohnii* de Bary
Oo cr	=	*Oocystis crassa* Wittr.
Oo cr mi	=	*Oocystis crassa* Wittr. var. *minor* n. var.
Oo Ma	=	*Oocystis Marssonii* Lemm.
Os Ag	=	*Oscillatoria Agardhii* Gom.
Os li	=	*Oscillatoria limnetica* Lemm.
Os li ac	=	*Oscillatoria limnetica* Lemm. var. *acicularis* n. var.
Pa mo	=	*Pandorina morum* Bary
Ped du	=	*Pediastrum duplex* Meyen
Per bi	=	*Peridinium bipes* Stein
Per pa	=	*Peridinium palatinum* Lautb.
Per Vo	=	*Peridinium Volzii* Lemm.
Per Wi	=	*Peridinium Willei* Huitf.-Kaas
Pho le	=	*Phacotus lenticularis* Ehrb.
Phu os	=	*Phacus oscillans* Klebs
Phu pl	=	*Phacus platyaulax* Pochm.
Phu py	=	*Phacus pyrum* Stein
Phu su	=	*Phacus suecicus* Lemm.
Ra pe	=	*Radiococcus pelagicus* Teiling
Rhi lo	=	*Rhizosolenia longiseta* Zach.
Sce arc ca	=	*Scenedesmus arcuatus* Lemm. var. *capitatus* G. M. Smith
Sce arm	=	*Scenedesmus armatus* Chodat
Sce arv	=	*Scenedesmus arvernensis* Chodat
Sce ec	=	*Scenedesmus ecornis* Chodat
Sce fa	=	*Scenedesmus falcatus* Chodat

Se ca	=	*Selenastrum capricornutum* Printz
Se We	=	*Selenastrum Westii* G. M. Smith
Spc Sc	=	*Sphaerocystis Schröteri* Chodat
Sta al	=	*Staurastrum alternans* Breb.
Sta Be	=	*Staurastrum Bergii* n. sp.
Sta br	=	*Staurastrum brachiatum* Ralfs
Sta de lo	=	*Staurastrum dejectum* Breb. f. *longispina* n. f.
Sta de me	=	*Staurastrum dejectum* Breb. f. *mediocris* n. f.
Sta pi tr	=	*Staurastrum pingue* Teiling var. *tridentatum* n. var.
Sta po di	=	*Staurastrum polymorphum* Breb. var. *divergens* n. var.
Ste As	=	*Stephanodiscus Astraea* Grun.
Ste du	=	*Stephanodiscus dubius* Hustedt
Ste Ha	=	*Stephanodiscus Hantzschii* Grun.
Sti ba	=	*Stichococcus bacillaris* Näg.
Sye ac	=	*Synedra acus* Kg.
Sye ac an	=	*Synedra acus* Kg. var. *angustissima* Grun.
Sye te	=	*Synedra tenera* Smith
Syu ec	=	*Synura echinulata* Korsch.
Syu Pe	=	*Synura Petersenii* Korsch.
Syu sp	=	*Synura spinosa* Korsch.
Ta fe as	=	*Tabellaria fenestrata* Kütz. var. *asterionelloides* Grun.
Teë mi	=	*Tetraëdron minimum* Hansg.
Teë mu	=	*Tetraëdron muticum* Kütz.
Tet st	=	*Tetrastrum staurogeniaeforme* Lemm.
Tra ch	=	*Trachelomonas chlamydophora* n. sp.
Tra hi	=	*Trachelomonas hispida* Stein
Tra in	=	*Trachelomonas intermedia* Dang.
Tra ve	=	*Trachelomonas verrucosa* Stokes
Tra vo	=	*Trachelomonas volvocina* Ehrb.
Trb tae	=	*Tribonema taeniatum* Pascher
Tsp Ny	=	*Tetraspora Nygaardii* Teiling
Tst st	=	*Tetrastrum staurogeniaeforme* Lemm.
Ul pe	=	*Ulothrix pelagica* n. sp.
Ura vo	=	*Uroglena volvox* Ehrb.
Ura am	=	*Uroglena americana* Calkins

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9. Index.

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TABLE II

Table II. Composition of the phyto-

Species	(Dystrophic)													Oligo-	
	Løvenholm Langsø			Store Øxsø		Store Gribsø			Madum Sø			Vedsted Sø		Kalgaard Sø	
	22.V.29	9.IX.29	1.VIII.48	10.IV.27	23.V.29	19.IX.26	18.VI.29	17.VIII.46	24.VI.28	23.V.29	24.VI.29	27.VII.26	2.VII.27	17.V.29	23.VI.29
Myxophyceæ															
Anabæna affinis var. intermedia	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— circinalis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— flos aquæ	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr
Anabæna Hassalii var. macrospora	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— incrassata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— planctonica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Anabæna Scheremetievii var. recta f. rotundospora	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— spiroides var. crassa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— subcylindrica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Anabæna tenericaulis var. longispora	..	..	..	..	..	..	..	..	..	..	..	r +	..	..	..
Aphanizomenon flos aquæ	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chroococcus limneticus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chroococcus limneticus var. carneus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— turgidus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Coelosphærium Kützingianum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Coelosphærium Nägelianum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gomphosphæria aponina	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lyngbya limnetica	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..
Merismopedia elegans	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— glauca	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..
— tenuissima	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Microcystis flos aquæ	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— minutissima	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— pulverea	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Microcystis holsatica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— robusta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— stagnalis var. pulchra	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Microcystis viridis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— æruginosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. major	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Oscillatoria limnetica var. acicularis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Agardhii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Borneti f. tenuis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr

[1] f. tenuis. [2] var. limnetica. [3] Cells 3–4,5 μ. [4] Cells 4,5–6,5 μ: var. major nov. var. (p. 179). [5] Type: rr, var. major: c +.

(lankton from 16 Danish lakes,

tophic						Eutrophic																(Mixotrophic)					
Hampen Sø					Præstesø	Slaaen Sø	Nors Sø						Furesø					Tissø		Mossø	Salten Langsø	Hostrup Sø				Hulsø	
11.IV.27	15.VIII.27	17.V.29	23.VI.29	23.IX.29	28.VI.30	4.IX.29	18.VII.25	13.VI.27	13.V.29	31.VIII.29	22.II.30	18.VIII.39	26.IX.26	7.V.31	7.VIII.32	21.VIII.43	1.IX.46	10.VIII.27	13.VII.29	18.VIII.29	19.VIII.29	23.VI.25	24.VII.26	5.VII.27	21.V.29	14.VI.28	8.VIII.46
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..	rrr	rrr	rr	..	cc	rrr	rr	cc	rrr	r	..	c	+	..	c	..	rr	..	..	r	rrr	..	..	rrr	..	..	..
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..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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Table I

Species	(Dystrophic)														Olig-
	Løvenholm Langsø			Store Øxsø		Store Gribsø			Madum Sø			Vedsted Sø		Kalgaard Sø	
	22.V.29	9.IX.29	1.VIII.48	10.IV.27	23.V.29	19.IX.26	18.VI.29	17.VIII.46	24.VI.28	23.V.29	24.VI.29	27.VII.26	2.VII.27	17.V.29	23.VI.29
Oscillatoria limnetica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— neglecta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Phormidium mucicola	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Trichodesmium lacustre	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Euglenineæ															
Euglena acus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— oxyuris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lepocinclis texta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Phacus caudata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— torta	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..
— pleuronectes	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..
Phacus circulatus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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Dinophyceae															
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Ceratium hirundinella	rrr	rrr	..	..	..	..	rrr[1]	rrr[1]	..	..	..	+[5]	cc[5]	rr	r+
Diplopsalis acuta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Glenodinium dinobryonis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— edax	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— gymnodinium	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Glenodinium munusculum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gymnodinium inversum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. elongatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gymnodinium mirum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— paradoxum f. astigmosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Peridinium bipes	..	..	..	..	..	..	..	..	..	..	..	..	..	r	..
Peridinium cinctum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr
— eximium	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..
— Volzii (= guestrowiense)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Peridinium Willei	..	rrr	..	..	r+	+	rr	cc	r+	r	+	rrr	rr	..	rrr

[1] f. brachyceroides. [2] f. carinthiacum. [3] f. furcoides? [4] f. piburgense. [5] f. silesiacum. [6] forma with about 20—25 minute with 5 coarse striae pro 10 μ, striation in vertical view clockwise; cells basal flattened, 47 $\mu \times 45$ μ.

(continued).

trophic						Eutrophic																(Mixotrophic)					
	Hampen Sø				Præstesø	Slaaen Sø	Nors Sø						Furesø					Tissø		Mossø	Salten Langsø	Hostrup Sø				Hulsø	
11.IV.27	15.VIII.27	17.V.29	23.VI.29	23.IX.29	28.VI.30	4.IX.29	18.VII.25	13.VI.27	13.V.29	31.VIII.29	22.II.30	18.VIII.39	26.IX.26	7.V.31	7.VIII.32	21.VIII.43	1.IX.46	10.VIII.27	13.VII.29	18.VIII.29	19.VIII.29	23.VI.25	24.VII.26	5.VII.27	21.V.29	14.VI.28	8.VIII.46
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..	r[2,5]	rr[2]	rr[2]	+[2]	..	cc	c[2]	+	r	rrr	..	rrr	r	rrr	+	+	cc	c	rr	rr	+	rrr	r[2,5]	rrr[2]	rrr[3]	rrr[5]	+[4]
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punctate striae pro 10 μ, striation in vertical view counter-clockwise; cells ovate, 29 $\mu \times 22$ μ. [7] Lepocinclis pseudotexta Conrad

Table II

Species	(Dystrophic)														Oligo-
	Løvenholm Langsø			Store Øxsø		Store Gribsø			Madum Sø			Vedsted Sø		Kalgaard Sø	
	22.V.29	9.IX.29	1.VIII.48	10.IV.27	23.V.29	19.IX.26	18.VI.29	17.VIII.46	24.VI.28	23.V.29	24.VI.29	27.VII.26	2.VII.27	17.V.29	23.VI.29
Cryptophyceæ															
Chroomonas Nordstedtii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cryptochrysis commutata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cryptomonas ovata	..	..	..	..	..	..	ccc[1]	..	..	..	..	..	..	..	..
Rhodomonas lacustris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Bacillariophyceae															
Asterionella formosa	..	..	..	r+	cc	..	..	..	..	..	..	..	..	..	..
Attheya Zachariasi	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cyclotella comta	..	..	..	rr[6]	..	..	..	..	..	..	..	..	..	..	..
— Kützingiana var. parva	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cyclotella Kützingiana var. radiosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Meneghiniana	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— stelligera var. subglabra	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cymatopleura elliptica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— solea	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Diatoma elongatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fragilaria capucina	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— construens	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— crotonensis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fragilaria Harrisonii var. dubia	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Melosira ambigua	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Stephanodiscus Binderanus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Melosira granulata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. angustissima	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. muzzanensis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Melosira sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— islandica subsp. helvetica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— italica subsp. subarctica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Melosira varians	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Nitzschia acicularis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rhizosolenia longiseta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Stephanodiscus Astræa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. minutula	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— dubius	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

[1] see p. 7. [2] var. mesolepta. [3] var. venter. [4] var. binodis. [5] also f. tenuis. [6] dead cells.

(continued).

trophic						Eutrophic																		(Mixotrophic)					
Hampen Sø					Præstesø	Slaaen Sø	Nors Sø						Furesø					Tissø		Mossø	Salten Langsø	Hostrup Sø				Hulsø	
11.IV.27	15.VIII.27	17.V.29	23.VI.29	23.IX.29	28.VI.30	4.IX.29	18.VII.25	13.VI.27	13.V.29	31.VIII.29	22.II.30	18.VIII.39	26.IX.26	7.V.31	7.VIII.32	21.VIII.43	1.IX.46	10.VIII.27	13.VII.29	18.VIII.29	19.VIII.29	23.VI.25	24.VII.26	5.VII.27	21.V.29	14.VI.28	8.VIII.46
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Table II

Species	(Dystrophic)													Oligo-	
	Løvenholm Langsø			Store Øxsø		Store Gribsø			Madum Sø			Vedsted Sø		Kalgaard Sø	
	22.V.29	9.IX.29	1.VIII.48	10.IV.27	23.V.29	19.IX.26	18.VI.29	17.VIII.46	24.VI.28	23.V.29	24.VI.29	27.VII.26	2.VII.27	17.V.29	23.VI.29
Stephanodiscus Hantzschii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Surirella ovalis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Synedra acus var. angustissima	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Synedra capitata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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— ulna var. amphirhyncus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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Tabellaria fenestrata	..	..	..	..	..	rrr[2]	..	..	..	..	..	..	..	c[3]	rrr[3]
— flocculosa	..	..	..	r	rr	rrr	..	rrr	rrr	..	rrr	rrr	..	rrr	..
Chrysophyceæ															
Chrysococcus minutus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dinobryon bavaricum	..	..	..	..	..	rrr	..	..	..	..	..	..	..	rrr	rr
— cylindricum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dinobryon cylindricum var. alpinum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. palustre	..	..	..	..	..	..	..	..	cc	..	c	rrr	..	..	..
— divergens	..	..	..	..	..	..	..	..	..	..	..	..	..	rr	r
Dinobryon divergens var. Schauinnslandii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— pediforme	..	..	..	..	..	..	..	c	..	..	..	..	..	..	..
— sociale var. americanum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dinobryon sociale var. stipitatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mallomonas caudata Krieg. non Iwan	r+	cc	rr	..	..	rrr	c	r+	..	..	..	..	..	..	..
— tessellata	..	rr	rrr	..	rr	..	rrr	..	..	..	..	..	..	..	..
Mallomonas tonsurata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Synura Petersenii	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr
— sphagnicola	rrr	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..
Synura spinosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Uroglena volvox	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— americana	..	..	..	..	..	..	..	..	..	cc	rrr	..	..	rrr	cc
Volvocales, Ulothricales, Oedogoniales, Xanthophyceae															
Asterococcus superbus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chlamydomonas bicocca	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— cingulata var. globulifera	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..

[1] and the main species: rrr. [2] var. intermedia. [3] var. asterionelloides and var. intermedia f. asterionelloides. [4] var. asterionel-

(continued).

trophic						Eutrophic																(Mixotrophic)					
Hampen Sø					Præstesø	Slaaen Sø	Nors Sø						Furesø					Tissø		Mossø	Salten Langsø	Hostrup Sø				Hulsø	
11.IV.27	15.VIII.27	17.V.29	23.VI.29	23.IX.29	28.VI.30	4.IX.29	18.VII.25	13.VI.27	13.V.29	31.VIII.29	22.II.30	18.VIII.39	26.IX.26	7.V.31	7.VIII.32	21.VIII.43	1.IX.46	10.VIII.27	13.VII.29	18.VIII.29	19.VIII.29	23.VI.25	24.VII.26	5.VII.27	21.V.29	14.VI.28	8.VIII.46
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+	c[4]	c[4]	+[4]	c[4]	..	r[2]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	..	..
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Table II

Species	(Dystrophic)													Oligo-	
	Løvenholm Langsø			Store Øxsø		Store Gribsø			Madum Sø			Vedsted Sø			
	22.V.29	9.IX.29	1.VIII.48	10.IV.27	23.V.29	19.IX.26	18.VI.29	17.VIII.46	24.VI.28	23.V.29	24.VI.29	27.VII.26	2.VII.27	17.V.29	23.VI.29
Chlamydomonas clavata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Reinhardii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Eudorina elegans	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Eutetramorus globosus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gloeocystis gigas	..	..	rrr	..	..	..	..	..	..	rrr	..	..	..	..	..
— planctonica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gloeocystis sp.	..	..	..	..	..	..	..	..	..	..	rrr	..	..	r+	..
Gonium pectorale	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ophiocytium capitatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pandorina morum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Phacotus lenticularis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Schultziella pseudovolvox	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sphærocystis Schroeteri	..	..	..	..	..	..	..	..	..	rrr	..	r	+	..	..
Tetraspora Nygaardii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Tribonema taeniatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Tribonema sp.$_1$	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— sp.$_2$	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Geminella minor	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Volvox aureus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chlorococcales															
Actinastrum Hantzschii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ankistrodesmus falcatus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. spirilliformis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. setiformis f. brevis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ankistrodesmus lacustris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Botryococcus Braunii	rr	r+	c	..	..	..	..	r+	rrr	..	rrr	rrr	rrr	rrr	rrr
— protuberans	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Coelastrum cambricum var. intermedium	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— microporum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— reticulatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Crucigenia quadrata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. minima	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— rectangularis	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..

[1] forma with a regularly lobate surface.

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(continued).

trophic						Eutrophic																(Mixotrophic)					
Hampen Sø					Præstesø	Slaaen Sø	Nors Sø						Furesø					Tissø		Mossø	Salten Langsø	Hostrup Sø				Hulsø	
11.IV.27	15.VIII.27	17.V.29	23.VI.29	23.IX.29	28.VI.30	4.IX.29	18.VII.25	ø 13.VI.27	13.V.29	31.VIII.29	22.II.30	18.VIII.39	26.IX.26	7.V.31	7.VIII.32	21.VIII.43	1.IX.46	10.VIII.27	13.VII.29	18.VIII.29	19.VIII.29	23.VI.25	24.VII.26	5.VII.27	21.V.29	14.VI.28	8.VIII.46
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rrr[1]	rrr[1]	rr[1]	r[1]	rrr[1]	..	rrr	r	rrr	..	..	..	rrr[1]	..	..	..	r	..	..	..	..	..	..	..	..	..	..	..
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Table I

Species	(Dystrophic)														Oligo-
	Løvenholm Langsø			Store Øxsø		Store Gribsø			Madum Sø			Vedsted Sø		Kalgaard Sø	
	22.V.29	9.IX.29	1.VIII.48	10.IV.27	23.V.29	19.IX.26	18.VI.29	17.VIII.46	24.VI.28	23.V.29	24.VI.29	27.VII.26	2.VII.27	17.V.29	23.VI.29
Crucigenia tetrapedia	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dictyosphærium Ehrenbergianum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— pulchellum	..	..	..	..	..	..	..	..	..	..	..	rr	..	..	..
Elakatothrix gelatinosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr
— — f. biplex	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— viridis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Kirchneriella contorta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— lunaris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— obesa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lagerheimia quadriseta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Micractinium pusillum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Nephrocytium ecdysiscepanum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Oocystis Borgei	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— natans	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Marssonii	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	rrr
Oocystis solitaria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pediastrum alternans	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— biradiatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pediastrum Boryanum	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. longicorne	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. perforatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pediastrum angulosum var. araneosum	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..
— duplex	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..
— — var. brachylobum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pediastrum duplex var. clathratum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. pulchrum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. reticulatum	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..
Pediastrum duplex var. subgranulatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— glanduliferum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Kawraiskyi	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pediastrum muticum var. longicorne	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— simplex	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Tetras	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

[1] var. pygmæa. [2] f. glabra. [3] f. granulata. [4] var. tetraodon. [5] forma (see *Fig. nostra* 17).

continued).

rophic						Eutrophic																(Mixotrophic)					
Hampen Sø					Præstesø	Slaaen Sø	Nors Sø						Furesø					Tissø		Mossø	Salten Langsø	Hostrup Sø				Hulsø	
11.IV.27	15.VIII.27	17.V.29	23.VI.29	23.IX.29	28.VI.30	4.IX.29	18.VII.25	13.VI.27	13.V.29	31.VIII.29	22.II.30	18.VIII.39	26.IX.26	7.V.31	7.VIII.32	21.VIII.43	1.IX.46	10.VIII.27	13.VII.29	18.VIII.29	19.VIII.29	23.VI.25	24.VII.26	5.VII.27	21.V.29	14.VI.28	8.VIII.46
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Table II

Species	(Dystrophic)														Oligo-
	Løvenholm Langsø			Store Øxsø		Store Gribsø			Madum Sø			Vedsted Sø		Kalgaard Sø	
	22.V.29	9.IX.29	1.VIII.48	10.IV.27	23.V.29	19.IX.26	18.VI.29	17.VIII.46	24.VI.28	23.V.29	24.VI.29	27.VII.26	2.VII.27	17.V.29	23.VI.29
Quadrigula closterioides	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scenedesmus arcuatus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— armatus	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	..	..
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— denticulatus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— quadricauda	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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— spinoso-aculeolatus?	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Selenastrum Bibraianum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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Tetraëdron enorme f. minor	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— limneticum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Tetraëdron limneticum var. simplex	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— minimum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— trigonum var. gracile	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Tetrastrum apiculatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Westella botryoides	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Conjugales (Desmidieae)															
Arthrodesmus convergens	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— crassus	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rr
— triangularis	..	..	..	..	..	..	..	..	..	..	rrr	rr	rrr	rrr	..
Closterium aciculare	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— acutum var. variabile	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Baillyanum var. parvulum	..	..	..	..	..	rrı[1]	..	..	..	..	..	..	..	..	..
— intermedium forma	..	..	r	..	..	..	..	..	..	..	..	..	..	..	..
Closterium Kützingii	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..
— Leibleinii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Pritchardianum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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Closterium Venus f. torta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cosmarium angulosum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Botrytis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cosmarium connatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Cucurbita	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..
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11.IV.27	15.VIII.27	17.V.29	23.VI.29	23.IX.29	28.VI.30	4.IX.29	18.VII.25	13.VI.27	13.V.29	31.VIII.29	22.II.30	18.VIII.39	26.IX.26	7.V.31	7.VIII.32	21.VIII.43	1.IX.46	10.VIII.27	13.VII.29	18.VIII.29	19.VIII.29	23.VI.25	24.VII.26	5.VII.27	21.V.29	14.VI.28	8.VIII.46
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Species	(Dystrophic)															Oligo-
	Løvenholm Langsø			Store Øxsø		Store Gribsø			Madum Sø			Vedsted Sø		Kalgaard Sø		
	22.V.29	9.IX.29	1.VIII.48	10.IV.27	23.V.29	19.IX.26	18.VI.29	17.VIII.46	24.VI.28	23.V.29	24.VI.29	27.VII.26	2.VII.27	17.V.29	23.VI.29	
Cosmarium depressum var. planctonicum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
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— punctulatum var. subpunctulatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Cosmarium pygmæum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
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— subarctoum var. latum	..	..	..	..	..	..	..	..	..	..	..	..	..	r	rr	
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— subtumidum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
— — f. punctata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Cosmarium subtumidum f. parva	..	..	..	..	..	..	..	..	rrr	..	rrr	..	..	..	..	
— tetraophtalmum	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	
— Turpinii var. podolicum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
Desmidium Swartzii	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	
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Euastrum elegans	..	..	..	..	..	..	..	..	rrr	..	rrr	..	..	..	..	
Euastrum occidentale var. danicum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
— pinnatum	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	
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Gonatozygon monotænium var. pilosellum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
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trophic						Eutrophic																(Mixotrophic)					
Hampen Sø					Præstesø	Slaaen Sø	Nors Sø						Furesø					Tissø		Mossø	Salten Langsø	Hostrup Sø				Hulsø	
11.IV.27	15.VIII.27	17.V.29	23.VI.29	23.IX.29	28.VI.30	4.IX.29	18.VII.25	13.VI.27	13.V.29	31.VIII.29	22.II.30	18.VIII.39	26.IX.26	7.V.31	7.VIII.32	21.VIII.43	1.IX.46	10.VIII.27	13.VII.29	18.VIII.29	19.VIII.29	23.VI.25	24.VII.26	5.VII.27	21.V.29	14.VI.28	8.VIII.46
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Table II

Species	(Dystrophic)													Oligo-	
	Løvenholm Langsø			Store Øxsø		Store Gribsø			Madum Sø			Vedsted Sø		Kalgaard Sø	
	22.V.29	9.IX.29	1.VIII.48	10.IV.27	23.V.29	19.IX.26	18.VI.29	17.VIII.46	24.VI.28	23.V.29	24.VI.29	27.VII.26	2.VII.27	17.V.29	23.VI.29
Sphærozosma vertebratum f. quadrata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Spondylosium planum	..	..	..	..	..	..	..	..	..	..	..	..	..	rr	rrr
Spondylosium pulchellum	..	..	..	..	..	..	..	..	rrr	rrr	..	..	..	..	..
Staurastrum alternans	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..
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Staurastrum apiculatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Arctiscon	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— avicula	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Staurastrum pingue var. tridentatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Brebissonii	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..
— brevispinum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Staurastrum Bullardii var. alandicum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— cuspidatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. canadense	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..
Staurastrum cuspidatum var. acuminatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. maximum	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rr
— denticulatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Staurastrum dejectum var. inflatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— furcigerum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— gracile	..	..	..	rrr	rrr	..	..	..	rrr	rr	r	..	..	..	..
Staurastrum crenulatum	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	..	..
— cingulum var. inflatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— cingulum var. obesum f. bibrachiata[1]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Staurastrum granulosum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— hirsutum	..	..	rrr	..	..	..	..	..	..	..	rrr	..	..	..	..
— — f. minor	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..
Staurastrum inflexum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Iversenii	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	..	..
— Manfeldtii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Staurastrum muticum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— oxyacantha	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— paradoxum?	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Staurastrum pelagicum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— pendulum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

[1] Syn. Staurastrum Thunmarkii Teiling.

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ophic						Eutrophic																(Mixotrophic)					
Hampen Sø					Præstesø	Slaaen Sø	Nors Sø						Furesø					Tissø		Mossø	Salten Langsø	Hostrup Sø				Hulsø	
11.IV.27	15.VIII.27	17.V.29	23.VI.29	23.IX.29	28.VI.30	4.IX.29	18.VII.25	13.VI.27	13.V.29	31.VIII.29	22.II.30	18.VIII.39	26.IX.26	7.V.31	7.VIII.32	21.VIII.43	1.IX.46	10.VIII.27	13.VII.29	18.VIII.29	19.VIII.29	23.VI.25	24.VII.26	5.VII.27	21.V.29	14.VI.28	8.VIII.46
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Table

Species	(Dystrophic)								Olig						
	Løvenholm Langsø			Store Øxsø		Store Gribsø			Madum Sø			Vedsted Sø		Kalgaard Sø	
	22.V.29	9.IX.29	1.VIII.48	10.IV.27	23.V.29	19.IX.26	18.VI.29	17.VIII.46	24.VI.28	23.V.29	24.VI.29	27.VII.26	2.VII.27	17.V.29	23.VI.29
Staurastrum cingulum var. obesum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Staurastrum Sebaldii var. ornatum f. planctonica	..	..	..	..	..	..	..	..	..	..	..	rr	rr	..	..
— planctonicum var. bullatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— tetracerum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Staurastrum Smithii var. verrucosum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— uniseriatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — f. bicornis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Staurastrum pingue	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— vestitum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Xanthidium antilopæum	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rrr	rrr
Xanthidium armatum	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..
— concinnum var. Boldtianum	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..

[1] var. validum.

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trophic						Eutrophic																(Mixotrophic)					
Hampen Sø					Præstesø	Slaaen Sø	Nors Sø						Furesø					Tissø		Mossø	Salten Langsø	Hostrup Sø				Hulsø	
11.IV.27	15.VIII.27	17.V.29	23.VI.29	23.IX.29	28.VI.30	4.IX.29	18.VII.25	13.VI.27	13.V.29	31.VIII.29	22.II.30	18.VIII.39	26.IX.26	7.V.31	7.VIII.32	21.VIII.43	1.IX.46	10.VIII.27	13.VII.29	18.VIII.29	19.VIII.29	23.VI.25	24.VII.26	5.VII.27	21.V.29	14.VI.28	8.VIII.46
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Table I. The phytoplankton quotients of 16 Danish lakes.

( ) round the figures for the calcium content denote that they are calculated from alkalinity (Boisen Bennike 1943). ( ) round the total number of species, the dominants and the quotients mean that only nannoplankton is at hand and that the material is moreover inconsiderable. [ ] round the dominant indicate that it is not very common in the sample.

Localities	Type	Substratum	Dates	pH	Content of Kalcium, mg CaO per l.	Consumption of $KMnO_4$, mg per l.	Phosphate mg P per l.	Ammonia mg N per l.	Nitrate mg N per l.	Total number of species	Phytoplankton association (dominants)	Frequency, per ml	Myxophyceæ / Desmidieæ	Chlorococcales / Desmidieæ	Centrales / Pennales	Euglenineæ / Myxophyceæ + Chlorococcales	*The Compound Quotient* = Myx. + Chlor. + Centr. + Eugl. / Desmidieæ	References
Løvenholm Langsø (Djursland)	oligotrophic (dystrophic phase)	stratified sand	11.IV.27 22.V.29 9.IX.29 27.VII.40 1.VIII.48	4.0 .. 4.1 4.0 4.1	3 .. .. (7) ..	.. .. .. 537! ..	.. .. 0.03	.. .. 0.5	.. .. 0.025	.. 5 7 .. 7	.. [Ma ca] Ma ca .. Bo Br	.. ..	.. 0/0 1/0 .. 0/3 = 0	.. 2/0 2/0 .. 1/3 = 0.3	.. 0/0 0/0 .. 0/0	.. 0/0 = 0 0/3 = 0 .. 0/1 = 0	.. 2/0 3/0 .. 1/3 = 0.3	J. Iversen 1929, p. 307. G. Nygaard 1938, p. 685. Boisen Bennike 1943, p. 20.
Store Øxsø (North Jutland)	oligotrophic (dystrophic phase)	stratified sand	10.IV.27 18.VII.27 23.V.29 4.VII.40	4.2 4.2 .. 4.0	.. 3 .. (1)	 99	.. ..	.. ..	.. ..	8 .. 7 ..	[As fo] .. As fo ..	.. ..	.. .. 0/2 = 0 ..	.. .. 0/2 = 0 ..	?1/3 = 0.3 .. 0/3 = 0 ..	.. .. 0/0 ..	.. .. 0/2 = 0 ..	J. Iversen 1929, p. 309. G. Nygaard 1938, p. 686. Boisen Bennike 1943, p. 20.
Store Gribsø (North Seeland)	oligotrophic (approximately dystrophic phase)	stratified sand	19.IX.26 18.VI.29 10.II.31 15.VI.40 17.V.41 4.VIII.41 17.VIII.46	5.4 4.7 4.3 5.1 5.9 5.8 4.3	.. .. .. (6) (4) (4) ..	.. .. .. 49 52 48 ..	.. 0	.. ..	.. 0	6 5 7	[Per Wi] Ma ca .. .. Per Wi	.. .. 0.23 Per Wi	0/1 = 0 0/1 = 0 .. .. 0/0	0/1 = 0 0/1 = 0 .. .. 1/0	0/2 = 0 0/0 .. .. 0/1 = 0	0/0 0/0 .. .. 0/1 = 0	0/1 = 0 0/1 = 0 .. .. 1/0	Poulsen 1928: 15 mg CaO per l; pH 5.5—6.5. G. Nygaard 1938, p. 686. Boisen Bennike 1943, p. 20; Cl. Petersen: 12 mg CaO per l, pH 4.5—6.0, 33—63 mg $KMnO_4$ per l; 1943, p. 56.
Madum Sø (North Jutland)	oligotrophic (acidotrophic phase)	stratified sand	14.VII.26 18.VI.27 24.VI.28 23.V.29 24.VI.29 9.IX.29 5.II.30 6.III.31 4.VII.40	} 4.5—4.8 .. .. 4.8 4.6 5.1 4.9 4.8	3—3.5 .. .. 4 2.4 (1)	4 .. .. 6.6 6.3 24!	.. .. .. 0 0 0 0 ..	.. .. .. 0 0 0 0.15 ..	.. .. .. 0 0 0.04 0.11 ..	.. 12 6 23	.. Din cy pa Ura am Din cy pa	.. .. 0.48 colonies	.. 0/8 = 0 0/2 = 0 0/15 = 0	.. 1/8 = 0.1 0/2 = 0 2/15 = 0.1	.. 0/1 = 0 0/0 0/2 = 0	.. 0/1 = 0 0/0 0/2 = 0	.. 1/8 = 0.1 0/2 = 0 2/15 = 0.1	Transparency > 8 m. J. Iversen 1929, p. 309. G. Nygaard 1938, p. 685. Boisen Bennike 1943, p. 20.
Hampen Sø (Central Jutland)	(approximately) oligotrophic	stratified sand	11.IV.27 15.VIII.27 17.V.29 23.VI.29 23.IX.29 23.II.31 8.VII.40	6.3 5.4—8.5 .. 6.9 7.2 .. 6.7	.. 6—6.5 .. .. .. 4 (9)	.. .. 17 21	.. .. .. 0 { 0 m: 0; 10 m: 0 } 0.005 ..	.. .. .. 0.05 { 0 m: 0.1; 10 m: 0.08 } 0.05 ..	.. .. .. 0.01 { 0 m: 0; 10 m: 0 } 0.17 ..	13 27 20 25 33	Ura am Ta fe Per bi + Ta fe Ura am Ta fe + Ana Ha	.. .. 1.5 Ta-colonies 1.2 Ana-trich.	.. 3/13 = 0.2 2/5 = 0.4 3/10 = 0.3 4/13 = 0.3	.. 3/13 = 0.2 0/5 = 0 2/10 = 0.2 5/13 = 0.4	0/2 = 0 0/1 = 0 0/2 = 0 0/2 = 0 0/2 = 0	.. 0/6 = 0 0/2 = 0 0/5 = 0 0/9 = 0	.. 6/13 = 0.5 2/5 = 0.4 5/10 = 0.5 9/13 = 0.7	J. Iversen 1929, p. 286 and 314. G. Nygaard 1938, p. 685. Boisen Bennike 1943, p. 20.
Vedsted Sø (North Sleswick)	approximately oligotrophic	stratified sand	27.VII.26 2.VII.27	5.7 6.0	.. ..	(oligo-humic)	.. ..	.. ..	.. ..	25 12	[Ce hi] Ce hi	.. ..	2/9 = 0.2 0/6 = 0	6/9 = 0.7 3/6 = 0.5	0/1 = 0 0/0	1/8 = 0.1 0/3 = 0	9/9 = 1 3/6 = 0.5	J. Iversen 1929, p. 312. G. Nygaard 1938, p. 687.
Kalgaard Sø (Central Jutland)	approximately oligotrophic	stratified sand	17.V.29 23.VI.29	.. 6.9	.. ..	(oligo-humic)	.. 0	.. 0	.. 0	21 22	Ta fe Ura am	.. ..	1/8 = 0.1 2/6 = 0.3	1/8 = 0.1 3/6 = 0.5	0/3 = 0 0/2 = 0	0/2 = 0 1/5 = 0.2	2/8 = 0.25 6/6 = 1	G. Nygaard 1938, p. 685.
Præstesø (S.W. Jutland)	inter-mediate	dune-sand	28.VI.30 18.VII.40	7.1 > 9.0	.. (12)	(rather oligohumic) 37	.. ..	.. ..	.. ..	51 ..	Ana fl ..	.. ..	8/17 = 0.5 ..	11/17 = 0.65 ..	0/2 = 0 ..	2/19 = 0.1 ..	21/17 = 1.2 ..	G. Nygaard 1938, p. 681. Boisen Bennike 1943, p. 34.
Slaaen Sø (Central Jutland)	inter-mediate	stratified sand	4.IX.29	8.0	..	(oligohumic)	{ 0 m: 0.07; 10 m: 0.12 }	{ 0 m: 0.05; 10 m: 0.33 }	{ 0 m: 0; 10 m: 0.01 }	40	Ce hi	..	1/11 = 0.1	2/11 = 0.2	6/8 = 0.75	3/3 = 1	12/11 = 1.1	Transparency 8 m. G. Nygaard 1938, p. 686.
Nors Sø (Thy)	slightly eutrophic	Cretaceous, stratified sand and dune-sand	18.VII.25 13.VI.27 13.V.29 31.VIII.29 22.II.30 18.VIII.39 14.VII.40	.. 8.3 .. 8.2 8.0 .. 8.3	.. 52 .. .. 43.1 .. (48)	.. (oligohumic) .. .. (oligohumic) .. 22	.. .. .. 0 0	.. .. .. 0.05 0	.. .. .. 0 0.07	51 43 41 (20) (7) 44 ..	Ana ci + Mio fl Ana fl Din di (Cyc Kü ra) (As fo) Ana fl + Mio fl ..	.. ..	12/12 = 1 10/10 = 1 8/8 = 1 (4/5 = 0.8) .. 10/12 = 0.8 ..	13/12 = 1.1 9/10 = 0.9 6/8 = 0.75 (4/5 = 0.8) .. 8/12 = 0.7 ..	2/4 = 0.5 3/4 = 0.75 2/10 = 0.2 (2/2 = 1) (2/2 = 1) 3/2 = 1.5 ..	0/25 = 0 0/19 = 0 0/14 = 0 (1/8 = 0.1) .. 3/16 = 0.2 ..	27/12 = 2.25 22/10 = 2.2 16/8 = 2 (11/5 = 2.2) .. 24/12 = 2 ..	J. Iversen 1929, p. 322. G. Nygaard 1938, p. 685. Boisen Bennike 1943, p. 20.
Furesø (North Seeland)	moderately eutrophic	moraine clay	26.IX.26 10.III.31 7.V.31 7.VIII.32 3.VI.40 31.V.41 21.VIII.43 1.IX.46	8.2 7.8 .. .. 8.0 .. .. 8.4	.. 62 .. .. (68) (67)	.. 14 .. .. 20 23	.. 0.015	.. 0.1	.. 0.18	18 .. 24 36 .. .. 76 54	Frg cr Ste Ha As fo Ana fl + As fo .. .. Mel gr an Ce hi	.. .. 15 Ce hi	5/0 .. 0/0 10/5 = 2 .. .. 17/12 = 1.4 15/8 = 1.9	0/0 .. 0/0 7/5 = 1.4 .. .. 17/12 = 1.4 10/8 = 1.25	5/1 = 1 .. 6/8 = 0.75 5/3 = 1.7 .. .. 8/11 = 0.7 3/5 = 0.6	0/5 = 0 .. 1/0 0/17 = 0 .. .. 0/34 = 0 0/25 = 0	10/0 .. 7/0 22/5 = 4.4 .. .. 42/12 = 3.5 28/8 = 3.5	Brønsted and Wesenberg-Lund 1912: 54.5—65.4 mg CaO per l. G. Nygaard 1938, p. 684. Boisen Bennike 1943, p. 21. Sigurd Olsen 1944: pH 7.5—8.6.
Mossø (Central Jutland)	eutrophic	stratified sand	18.VIII.29 24.VII.40	{ 0 m: 8.0; 15 m: 7.0 } 9.0	.. (59)	.. 32	{ 0 m: 0.005; 15 m: 0.005 } ..	{ 0 m: 0.2; 15 m: 0.25 } ..	{ 0 m: 0; 15 m: 0.01 } ..	49 ..	Api fl + Mio ær ..	.. ..	12/6 = 2 ..	16/6 = 2.7 ..	7/5 = 1.4 ..	0/25 = 0 ..	35/6 = 5.8 ..	Brønsted and Wesenberg-Lund 1912: 60 mg CaO per l. G. Nygaard 1938, p. 685. Boisen Bennike 1943, p. 21.
Tissø (West Seeland)	eutrophic	moraine clay	10.VIII.27 13.VII.29 19.II.31	{ 0 m: 8.8; 11 m: 8.4 } 8.4 ..	125.6 .. 107.8	 48	.. 0 0.02	.. 0 0.15	.. 0 m: 0 bottom: 0.35 1.5	58 40 ..	Ly li As fo + Mel gr ..	195 Ly-trich.	16/8 = 2 7/6 = 1.2 ..	17/8 = 2.1 14/6 = 2.3 ..	6/2 = 3 5/4 = 1.25 ..	1/33 = 0 0/20 = 0 ..	40/8 = 5 26/6 = 4.3 ..	G. Nygaard 1938, p. 687.
Salten Langsø (Central Jutland)	eutrophic	stratified sand	19.VIII.29	8.4	..	..	0.01	..	0.01	46	Ste As + Mio ær ma	..	12/4 = 3	14/4 = 3.5	9/4 = 2.25	0/22 = 0	35/4 = 8.75	Brønsted and Wesenberg-Lund 1912: 36.5 mg CaO per l. G. Nygaard 1938, p. 686.
Hostrup Sø (North Sleswick)	eutrophic (approximately mixotrophic phase)	stratified sand and gravel	23.VI.25 24.VII.26 5.VII.27 21.V.29	.. 7.3 6.4—8.8 ..	.. .. 12 ..	.. 50	.. ..	.. ..	.. ..	47 37 44 31	Api fl Frg cr Coo Nä Trb tae	.. ..	16/6 = 2.7 6/7 = 0.9 11/6 = 1.8 7/4 = 1.75	13/6 = 2.2 16/7 = 2.3 15/6 = 2.5 10/4 = 2.5	2/4 = 0.5 1/2 = 0.5 1/5 = 0.2 1/4 = 0.25	1/29 = 0 0/22 = 0 0/26 = 0 0/17 = 0	32/6 = 5.3 23/7 = 3.3 27/6 = 4.5 18/4 = 4.5	J. Iversen 1929, p. 315. G. Nygaard 1938, p. 685.
Hulsø (North Seeland)	eutrophic (mixotrophic phase)	moraine clay	14.VI.28 8.VIII.46 10.VI.40 2.VII.40	.. .. 7.7 7.6	.. .. (56) (81)	53 .. 69 74	.. ..	.. ..	.. ..	41 57	Din so am Rhi lo	.. ..	3/1 = 3 10/5 = 2	9/1 = 9 11/5 = 2.2	9/6 = 1.5 7/4 = 1.75	4/12 = 0.3 7/21 = 0.3	25/1 = 25 35/5 = 7	J. Iversen 1929, p. 316. G. Nygaard 1938, p. 686. Boisen Bennike 1943, p. 35.

Table III. The phytoplankton quotients of 20 Danish ponds.

Localities	Type	Substratum	Dates	pH	CaO mg per l	Consumption of $KMnO_4$ mg per l	PO_4-P mg per l	NH_3-N mg per l	NO_3-N mg per l	Sort of plankton	Total number of species
Bøndernes Mose I	oligotrophic (dystrophic phase)	stratified sand	28.VI.1929	4.2 yearly variation 3.7—4.3	5 yearly variation 0.3—5.9	yearly variation 136—205	yearly variation 0	yearly variation 0.75—1.5	yearly variation 0	netplankton nannoplankton	15 8
Bøndernes Mose II	oligotrophic (dystrophic phase)	stratified sand	22.VIII.1929 16.VI.1930	4.4 4.2 yearly variation 4.1—4.6	yearly variation 0.2—2.9	202 194 yearly variation 153—202	0 yearly variation 0	0.9 yearly variation 0.9—2.0	0 yearly variation 0	nannoplankton nannoplankton	19 19
Store Jenshøj turf pit	oligotrophic (dystrophic phase)	dune sand	25.VI.1930	4.0		polyhumic				netplankton	14
turf pit NE of Skaansø	oligotrophic (dystrophic phase)	fluvioglacial sand	4.VII.1938	4.3		polyhumic				netplankton	18
Holmsø	oligotrophic (azidotrophic phase)	dune sand	26.VI.1930	4.6		oligohumic				nannoplankton	15
Skaansø	oligotrophic (azidotrophic phase)	fluvioglacial sand	4.VII.1938	5.6		oligohumic				netplankton	21
Mørksø	oligotrophic (azidotrophic phase)	fluvioglacial sand	6.VII.1938	4.9		oligohumic				netplankton	9
Klitsø at Højsande	oligotrophic (azidotrophic phase)	dune sand	30.VI.1925			oligohumic				netplankton	42
Lille Gribsø	approximately oligotrophic (intermediate)	stratified sand	28.VI.1929 28.VI.1929 28.VIII.1929	4.9 4.9 yearly variation 4.8—5.0?	yearly variation 1.1—4	yearly variation 33—47	yearly variation 0—0.02	yearly variation 0.05—0.2	yearly variation 0—0.02	netplankton nannoplankton net + nannopl.	18 17 22
Blankeborg I	slightly eutrophic (mixotrophic phase)	moraine clay	16.VIII.1925 15.VIII.1926 17.VIII.1927 17.VIII.1927 18.VIII.1928 18.VIII.1928 6.VIII.1929 10.VI.1930	7.7 7.6 7.6 8.0 8.0 8.2 variation for 2 years 7.1—8.3	according to 3 analyses 82—91	according to 4 analyses 49—81	according to 3 analyses 0—0.005	values between 0.2 and 0.35 observed	values between 0 and 0.17 observed 0	netplankton netplankton netplankton nannoplankton netplankton nannoplankton nannoplankton nannoplankton	38 45 60 55 51 71 44 61
Blankeborg II	eutrophic (mixotrophic phase)	moraine clay	15.VIII.1926 25.VII.1928 25.VII.1928 28.VIII.1928 28.VIII.1928 10.VI.1930	8.1 8.3 8.3 8.1 8.1 yearly variation 7.6—8.5	according to 1 analysis 153.5	according to 2 analyses 70—88	according to 3 analyses 0.015—0.6	0.2 values between 0.2 and 0.9 observed 0.3	0.01 values between 0 and 1.3 observed 0.025	netplankton netplankton nannoplankton netplankton nannoplankton nannoplankton	28 17 24 20 21 31
Sortedam II	eutrophic (mixotrophic phase)	moraine clay	8.VI.1929 1.VII.1929 23.IX.1929	7.2 7.1 yearly variation 6.8—7.6	37.5 yearly variation 30.1—45.2	yearly variation 75—104	yearly variation 0—0.095	yearly variation 0.15—1.0	yearly variation 0—3	netplankton nannoplankton nannoplankton	49 43 41
Gadevang Mose	eutrophic (mixotrophic phase)	stratified sand	6.VII.1929 10.VII.1929	6.3 yearly variation 6.3—8.6	yearly variation 14.6—19.3	yearly variation 66—89	yearly variation 0.03—0.35	yearly variation 0.2—1.0	yearly variation 0—0.17	nannoplankton netplankton	39 21
Vandingsdam	eutrophic (mixotrophic phase)	stratified sand	28.VI.1929 28.VI.1929 24.VIII.1929	7.7 7.7 7.0 yearly variation 6.6—9.0	yearly variation 14.3—27	87 yearly variation 51—92	yearly variation 0—0.075	yearly variation 0.08—1.0	yearly variation 0—0.55	netplankton nannoplankton nannoplankton	30 41 35
Badstue-Ødam	eutrophic	moraine clay and stratified sand	6.VI.1929 23.VIII.1929	7.6 8.5 yearly variation 7.4—9.0	yearly variation 68.4—82.2	54 yearly variation 40—57	yearly variation 0—0.035	yearly variation 0.05—0.3	yearly variation 0—3.0	netplankton nannoplankton	36 61
Frederiksborg Slotssø	eutrophic	moraine clay and stratified sand	11.VI.1929 11.VI.1929 23.IX.1929	9.2 9.2 yearly variation 7.6—9.7	yearly variation 64.4—72.2	yearly variation 39—53	yearly variation 0.015—1.5	yearly variation 0—1.25	yearly variation 0—1.1	netplankton nannoplankton nannoplankton	35 49 54
Jægerbakke Dam	eutrophic	stratified sand	12.VI.1929 17.IX.1929 16.V.1930	9.4 8.9 yearly variation 6.6—9.8	yearly variation 7.3—11.2	yearly variation 27—49	yearly variation 0—0.015	yearly variation 0—0.75	yearly variation 0—0.01	net + nannopl. nannoplankton nannoplankton	42 46 53
Flødegaardens Dam	eutrophic	moraine clay	1.VII.1926 28.VII.1926 20.VII.1927 7.IX.1928 19.VIII.1929 10.VI.1930 3.VIII.1939	8.2 8.2 8.1 variation for 2 years 7.6—9.2	according to 2 analyses 82—90	47 on November 6th, 1929	0.25 on July 31st, 1929	values between 0.3 and 1.5 observed	values between 0 and 0.35 observed	nannoplankton netplankton nannoplankton nannoplankton nannoplankton nannoplankton nannoplankton	44 42 58 50 51 67 45
Lynge Vandingsdam	eutrophic (approximately saprotrophic phase)	moraine clay	30.VI.1947 6.VIII.1947	9.0		paper-filtered water pale green-brownish				nannoplankton nannoplankton	42 33
Bistrup Dam	eutrophic (saprotrophic phase)	moraine clay	12.VIII.1929 24.X.1929 16.XI.1929	7.8	118.7	water pale green-brownish	6.0	12.0	0.25	nannoplankton nannoplankton nannoplankton	5 10 10

Localities	Phytoplankton assoc. (dominants)	Frequency individuals per ml	plankton quantity mg per l	average quantity of plankton for one year	Myxophyceæ / Desmidieæ	Chlorococcales / Desmidieæ	Centrales / Pennales	Eugleninеæ / Myxophyceæ + Chlorococcales	The Compound Quotient = Myx. + Chlor. + Centr. + Eugl. / Desmidieæ	Contamination	Other plants
Bøndernes Mose I	Crym ov cu Crym ov cu	ca. 7500 Crym	3.6 yearly variation 0.4—15.4	5.3 mg/l	$^{0}/_{6} = 0$ $^{0}/_{4} = 0$	$^{1}/_{6} = 0.2$ $^{1}/_{4} = 0.25$	$^{0}/_{2} = 0$ $^{0}/_{1} = 0$	$^{1}/_{1} = 1$ $^{0}/_{1} = 0$	$^{2}/_{6} = 0.3$ $^{1}/_{4} = 0.25$	naturally contaminated (by rotten leaves?); smell of H_2S, when icebound	Sphagnum cuspidatum
Bøndernes Mose II	Crym ov cu Crym ov cu		2.7 3.5 yearly variation 0.4—4.9	2.2 mg/l	$^{1}/_{8} = 0.1$ $^{2}/_{8} = 0.25$	$^{2}/_{8} = 0.25$ $^{1}/_{8} = 0.1$	$^{0}/_{1} = 0$ $^{0}/_{1} = 0$	$^{2}/_{3} = 0.7$ $^{2}/_{3} = 0.7$	$^{5}/_{8} = 0.6$ $^{5}/_{8} = 0.6$		Sphagnum cuspidatum
Store Jenshøj turf pit	Aso su				$^{0}/_{10} = 0$	$^{1}/_{10} = 0.1$	$^{0}/_{0}$	$^{0}/_{1} = 0$	$^{1}/_{10} = 0.1$	÷	Batrachospermum vagum, Sphagnum cuspidatum
turf pit NE of Skaansø	Sta br				$^{0}/_{10} = 0$	$^{3}/_{10} = 0.3$	$^{0}/_{0}$	$^{0}/_{2} = 0$	$^{3}/_{10} = 0.3$	÷	Nearly overgrown with Sphagnum cuspidatum
Holmsø	Per Wi				$^{1}/_{10} = 0.1$	$^{3}/_{10} = 0.3$	$^{0}/_{0}$	$^{0}/_{4} = 0$	$^{4}/_{10} = 0.4$	÷	Lobelia Dortmanna very common
Skaansø	Din cy pa				$^{1}/_{10} = 0.1$	$^{3}/_{10} = 0.3$	$^{0}/_{1} = 0$	$^{0}/_{4} = 0$	$^{4}/_{10} = 0.4$	÷	
Mørksø	Per Wi				$^{1}/_{4} = 0.25$	$^{1}/_{4} = 0.25$	$^{0}/_{2} = 0$	$^{0}/_{2} = 0$	$^{2}/_{4} = 0.5$	÷	Lobelia Dortmanna very common. Nuphar luteum
Klitsø at Højsande	Tsp Ny				$^{6}/_{18} = 0.3$	$^{8}/_{18} = 0.45$	$^{0}/_{1} = 0$	$^{1}/_{14} = 0.1$	$^{15}/_{18} = 0.8$	÷	Lobelia Dortmanna and Littorella uniflora very common
Lille Gribsø	Ura am Se ca Cos as st		2.9 yearly variation 2.0—9.6	5.1 mg/l	$^{2}/_{7} = 0.3$ $^{2}/_{4} = 0.5$ $^{1}/_{9} = 0.1$	$^{2}/_{7} = 0.3$ $^{5}/_{4} = 1.25$ $^{4}/_{9} = 0.45$	$^{0}/_{1} = 0$ $^{0}/_{1} = 0$ $^{0}/_{1} = 0$	$^{0}/_{4} = 0$ $^{0}/_{7} = 0$ $^{0}/_{5} = 0$	$^{4}/_{7} = 0.6$ $^{7}/_{4} = 1.75$ $^{5}/_{9} = 0.55$	÷	Nuphar luteum and Potamogeton natans
Blankeborg I	Per Vo Ce hi Ce hi { Cos pu, El ge bi } Din di green alga Din di Chrysophyceæ		yearly variation 1.19—12.85. 3.24 yearly variation 1.82—5.61. 3.70 12.77 yearly variation 2.63—12.77. 5.24	4.24 mg/l (2.VI.1927—20.V.1928). 3.51 mg/l (6.VI.1928—21.V.1929). 4.99 mg/l (2.VI.1929—23.V.1930).	$^{3}/_{9} = 0.3$ $^{5}/_{10} = 0.5$ $^{3}/_{12} = 0.25$ $^{1}/_{9} = 0.1$ $^{4}/_{14} = 0.3$ $^{4}/_{13} = 0.3$ $^{6}/_{9} = 0.7$ $^{5}/_{9} = 0.55$	$^{9}/_{9} = 1$ $^{11}/_{10} = 1.1$ $^{15}/_{12} = 1.25$ $^{15}/_{9} = 1.7$ $^{9}/_{14} = 0.6$ $^{23}/_{13} = 1.8$ $^{11}/_{9} = 1.2$ $^{17}/_{9} = 1.9$	$^{2}/_{3} = 0.7$ $^{1}/_{5} = 0.2$ $^{2}/_{8} = 0.25$ $^{2}/_{9} = 0.2$ $^{2}/_{6} = 0.3$ $^{2}/_{8} = 0.25$ $^{1}/_{7} = 0.1$ $^{4}/_{7} = 0.6$	$^{2}/_{12} = 0.2$ $^{5}/_{16} = 0.3$ $^{6}/_{18} = 0.3$ $^{5}/_{16} = 0.3$ $^{5}/_{13} = 0.4$ $^{7}/_{27} = 0.25$ $^{2}/_{17} = 0.1$ $^{6}/_{22} = 0.3$	$^{16}/_{9} = 1.8$ $^{22}/_{10} = 2.2$ $^{26}/_{12} = 2.2$ $^{23}/_{9} = 2.55$ $^{20}/_{14} = 1.4$ $^{36}/_{13} = 2.8$ $^{20}/_{9} = 2.2$ $^{32}/_{9} = 3.55$	no appreciable contamination	Batrachium circinnatum, Polygonum amphibium, Chara fragilis
Blankeborg II	Pa mo Pa mo + Ste Ha Dic pu { Per pa, Ste Ha } Ste Ha Ste Ha		4.41 yearly variation 1.58—18.79. yearly variation 2.51 2.51—27.55. 5.92	5.49 mg/l (17.VII.1928—17.VI.1929). 10.73 mg/l (1.VII.1929—10.VI.1930).	$^{2}/_{4} = 0.5$ $^{3}/_{1} = 3$ $^{2}/_{0}$ $^{3}/_{1} = 3$ $^{3}/_{1} = 3$ $^{3}/_{0}$	$^{7}/_{4} = 1.75$ $^{6}/_{1} = 6$ $^{12}/_{0}$ $^{6}/_{1} = 6$ $^{11}/_{1} = 11$ $^{15}/_{0}$	$^{2}/_{5} = 0.4$ $^{1}/_{2} = 0.5$ $^{1}/_{1} = 1$ $^{1}/_{1} = 1$ $^{1}/_{1} = 1$ $^{1}/_{1} = 1$	$^{1}/_{9} = 0.1$ $^{0}/_{9} = 0$ $^{1}/_{14} = 0.1$ $^{0}/_{9} = 0$ $^{0}/_{14} = 0$ $^{1}/_{18} = 0.05$	$^{12}/_{4} = 3$ $^{10}/_{1} = 10$ $^{16}/_{0}$ $^{10}/_{1} = 10$ $^{15}/_{1} = 15$ $^{20}/_{0}$	soiled by ducks	Lemna minor, Patamogeton natans, Polygonum amphibium
Sortedam II	Ce hi Ce hi Crym ov	95 Ce hi	3.7 4.1 yearly variation 0.4—18.2	5.9 mg/l	$^{8}/_{10} = 0.8$ $^{1}/_{4} = 0.25$ $^{2}/_{3} = 0.7$	$^{16}/_{10} = 1.6$ $^{18}/_{4} = 4.5$ $^{15}/_{3} = 5$	$^{2}/_{4} = 0.5$ $^{1}/_{2} = 0.5$ $^{2}/_{1} = 2$	$^{2}/_{24} = 0.1$ $^{10}/_{19} = 0.5$ $^{8}/_{17} = 0.5$	$^{28}/_{10} = 2.8$ $^{30}/_{4} = 7.5$ $^{27}/_{3} = 9$	soiled by ducks	Lemna minor, L. trisulca, L. polyrrhiza, Pot. natans, Pot. obtusifolius, Cer. demersum, Hydrocharis morsus ranæ
Gadevang Mose	Din di { Din di, Syu sp }		2.4 yearly variation 0.6—11.2	3 mg/l	$^{3}/_{1} = 3$ $^{2}/_{1} = 2$	$^{16}/_{1} = 16$ $^{8}/_{1} = 8$	$^{3}/_{2} = 1.5$ $^{1}/_{1} = 1$	$^{0}/_{19} = 0$ $^{0}/_{10} = 0$	$^{22}/_{1} = 22$ $^{11}/_{1} = 11$	contaminated by waste-water	Lemna minor, Nymphæa alba, Potam. natans, Riccia fluitans, Calla palustris
Vandingsdam	Chla Re Dic pu Tee mi		18.4 59.8 yearly variation 0.9—92.4	24.6 mg/l	$^{1}/_{1} = 1$ $^{2}/_{1} = 2$ $^{3}/_{1} = 3$	$^{14}/_{1} = 14$ $^{25}/_{1} = 25$ $^{15}/_{1} = 15$	$^{2}/_{1} = 2$ $^{2}/_{0}$ $^{2}/_{1} = 2$	$^{6}/_{15} = 0.4$ $^{4}/_{27} = 0.15$ $^{6}/_{18} = 0.3$	$^{23}/_{1} = 23$ $^{33}/_{1} = 33$ $^{26}/_{1} = 26$	soiled by cattle and ducks	No limnophytes but Cladophora on stones
Badstue-Ødam	Mel gr an Frg cr		8.8 yearly variation 1.6—11	5.5 mg/l[1]	$^{7}/_{2} = 3.5$ $^{9}/_{3} = 3$	$^{7}/_{2} = 3.5$ $^{18}/_{3} = 6$	$^{5}/_{5} = 1$ $^{4}/_{6} = 0.7$	$^{1}/_{14} = 0.1$ $^{7}/_{27} = 0.25$	$^{20}/_{2} = 10$ $^{38}/_{3} = 12.7$	contaminated	Batrachium circinnatum, Nuphar luteum
Frederiksborg Slotssø	Ana in Sce arm Os Ag	12400 Os Ag	11.2 yearly variation 1—21.4	10.6 mg/l[1]	$^{13}/_{3} = 4.3$ $^{11}/_{4} = 2.75$ $^{16}/_{4} = 4$	$^{6}/_{3} = 2$ $^{17}/_{4} = 4.25$ $^{15}/_{4} = 3.75$	$^{5}/_{2} = 2.5$ $^{7}/_{3} = 2.3$ $^{6}/_{1} = 6$	$^{0}/_{19} = 0$ $^{1}/_{28} = 0$ $^{3}/_{31} = 0.1$	$^{24}/_{3} = 8$ $^{36}/_{4} = 9$ $^{40}/_{4} = 10$	contaminated by waste-water	Potamogeton crispus, Myrioph. spicatum, Polygonum amphibium
Jægerbakke Dam	Mio mi Mio ho		22.9 yearly variation 3.9—93.2	44.2 mg/l	$^{7}/_{7} = 1$ $^{8}/_{3} = 2.7$ $^{5}/_{2} = 2.5$	$^{21}/_{7} = 3$ $^{17}/_{3} = 5.7$ $^{28}/_{2} = 14$	$^{0}/_{0}$ $^{0}/_{0}$ $^{0}/_{0}$	$^{2}/_{28} = 0.1$ $^{6}/_{25} = 0.25$ $^{2}/_{33} = 0.1$	$^{30}/_{7} = 4.3$ $^{31}/_{3} = 10.3$ $^{35}/_{2} = 17.5$	contaminated	Helodea canadensis, Polygonum amphibium
Flødegaardens Dam	Sce ec Din di Mio ho Mio ho Mio ho green algæ Dic pu		yearly variation 3.1—81.4. 31.5 108.4 yearly variation 8.6—173.8. 68.4 33.9 yearly variation 6.1—137.3. small quantity	22.22 mg/l (2.VI.1927—21.V.1928). 62.96 mg/l (5.VI.1928—22.V.1929). 47.3 mg/l (2.VI.1929—23.V.1930).	$^{4}/_{1} = 4$ $^{5}/_{1} = 5$ $^{3}/_{1} = 3$ $^{3}/_{0}$ $^{4}/_{1} = 4$ $^{4}/_{2} = 2$ $^{2}/_{4} = 0.5$	$^{21}/_{1} = 21$ $^{19}/_{1} = 19$ $^{31}/_{1} = 31$ $^{29}/_{0}$ $^{31}/_{1} = 31$ $^{33}/_{2} = 16.5$ $^{21}/_{4} = 5.25$	$^{2}/_{3} = 0.7$ $^{2}/_{5} = 0.4$ $^{2}/_{2} = 1$ $^{3}/_{2} = 1.5$ $^{2}/_{2} = 1$ $^{3}/_{2} = 1.5$ $^{2}/_{4} = 0.5$	$^{7}/_{25} = 0.3$ $^{3}/_{24} = 0.1$ $^{7}/_{34} = 0.2$ $^{6}/_{32} = 0.2$ $^{4}/_{35} = 0.1$ $^{6}/_{37} = 0.2$ $^{10}/_{23} = 0.4$	$^{34}/_{1} = 34$ $^{29}/_{1} = 29$ $^{43}/_{1} = 43$ $^{41}/_{0}$ $^{41}/_{1} = 41$ $^{46}/_{2} = 23$ $^{35}/_{4} = 8.75$	soiled by cattle	Potamogeton crispus, Pot. natans, Polygonum amphibium, Batrachium circinnatum. Stratiotes aloides (♀) invaded the pond in the period of 1940—43
Lynge Vandingsdam	Tra vo Eug ob	43000 Eugl.[2])	> 500		$^{0}/_{1} = 0$ $^{0}/_{0}$	$^{12}/_{1} = 12$ $^{7}/_{0}$	$^{1}/_{2} = 0.5$ $^{1}/_{2} = 0.5$	$^{18}/_{12} = 1.5$ $^{21}/_{7} = 3$	$^{31}/_{1} = 31$ $^{29}/_{0}$	soiled by cattle	Potamogeton natans
Bistrup Dam	Bacteria Bacteria Bacteria	{ 8 Eug ph, 6 Phu pl } { 60 Eug ph, 9 Phu pl }			$^{0}/_{0}$ $^{1}/_{0}$ $^{0}/_{0}$	$^{1}/_{0}$ $^{0}/_{0}$ $^{0}/_{0}$	$^{0}/_{0}$ $^{0}/_{0}$ $^{0}/_{0}$	$^{3}/_{1} = 3$ $^{8}/_{1} = 8$ $^{8}/_{0}$	$^{4}/_{0}$ $^{9}/_{0}$ $^{8}/_{0}$	strongly soiled by inflow from a stable	No limnophytes

[1] The average value is in reality a little larger the samples from may and one from april not being counted.
[2] 23300 Euglena oblonga, 9900 E. gracilis, 7600 E. granulata, 1700 E. acus and 300 E. oxyuris per ml.

TABLE IV

Table IV. Composition of the phyto-

Species	(Dystrophic)					Oligotrophic														
	Bøndernes Mose I	Bøndernes Mose II		Store Jenshøj turf pit	turf pit NE of Skaansø	Holmsø	Skaansø	Mørksø	Klitsø at Højsande	Lille Gribsø			Blankeborg I							
	28.VI.29	22.VIII.29	16.VI.30	25.VI.30	4.VII.38	26.VI.30	4.VII.38	6.VII.38	30.VI.25	28.VI.29	28.VI.29	28.VIII.29	16.VIII.25	15.VIII.26	17.VIII.27	17.VIII.27	18.VIII.28	18.VIII.28	6.VIII.29	10.VI.30
Bacteria																				
Lampropedia hyalina	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
"Chlorobacteria"	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Myxophyceae																				
Anabaena affinis var. intermedia f. tenuis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— augustumalis var. marchica	..	rrr	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— sigmoidea	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Anabaena flos aquae	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— heterospora	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— incrassata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Anabaena planctonica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— spiroides var. crassa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— tenericaulis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Anabaena Viguieri var. danica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— spp. (sterile)	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	..	rrr	..	rrr	..	..
Aphanizomenon flos aquae	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Aphanocapsa elachista	..	..	..	..	..	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..
— — var. conferta	..	..	rrr	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..
Arthrospira Jenneri	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chroococcus limneticus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr
— — var. carneus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. elegans	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chroococcus turgidus	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..
Coelosphaerium dubium	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..
— Kützingianum	..	..	..	..	..	..	..	..	rrr	..	..	..	..	rrr	..	..	..	rrr	rrr	..
Coelosphaerium Nägelianum	..	..	..	..	..	..	..	..	..	..	..	..	c +	rr	..	rrr	rrr	+	+	rrr
Eucapsis alpina	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gloeothece distans	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
Gomphosphaeria aponina	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— lacustris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lyngbya limnetica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..

[1] When the same date is given twice against the same pond, the left-hand date stands for the nannoplankton

plankton from 20 Danish ponds.[1]

(Mixotrophic)						Eutrophic																									(Saprotrophic)			
Blankeborg II						Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Ødam		Frederiksborg Slotssø			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.26	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI.47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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sample, the right-hand date for the net plankton sample.

Table IV

Species	(Dystrophic) Bondernes Mose I	Bondernes Mose II		Store Jenshøj turf pit	turf pit NE of Skaansø	Oligotrophic Holmsø	Skaansø	Mørksø	Klitsø at Højsande	Lille Gribsø			Blankeborg I							
	28.VI.29	22.VIII.29	16.VI.30	25.VI.30	4.VII.38	26.VI.30	4.VII.38	6.VII.38	30.VI.25	28.VI.29	28.VI.29	28.VIII.29	16.VIII.25	15.VIII.26	17.VIII.27	17.VIII.27	18.VIII.28	18.VIII.28	6.VIII.29	10.VI.30
Merismopedia Marssonii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— punctata	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
— tenuissima	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Microcystis elabens	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
Microcystis flos aquae	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Microcystis flos aquae var. major	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— holsatica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr
— minutissima	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	..	c	rr	rrr	rrr
Microcystis pulverea	..	..	..	..	..	..	..	..	..	r	rrr	..	..	..	..	..	..	..	..	..
— — var. racemiformis	..	..	..	..	..	..	..	..	..	rr	rrr	..	..	..	..	..	..	..	..	..
— robusta?	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..
Microcystis viridis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— aeruginosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. major	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	..	..	..	rrr	rrr	..
Oscillatoria limnetica var. acicularis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Agardhii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— chlorina	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Oscillatoria limnetica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	rrr
— neglecta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Phormidium mucicola	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rhabdoderma Gorskii var. spiralis	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
Trichodesmium lacustre	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Euglenineae																				
Euglena acus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	rrr	..	..
— Ehrenbergii	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rrr	..	..	..	..
— gracilis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Euglena granulata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— oblonga	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— oxyuris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Euglena phacoides	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— pisciformis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— proxima	rrr	rrr	r	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rrr	rrr	rrr	..

(continued).

(Mixotrophic) Eutrophic (Saprotrophic)

Blankeborg II						Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Ødam		Frederiksborg Slotssø			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.26	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI.47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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Table IV

Species	(Dystrophic) Bøndernes Mose I 28.VI.29	Bøndernes Mose II 22.VIII.29	Bøndernes Mose II 16.VI.30	Store Jenshøj turf pit 25.VI.30	turf pit NE of Skaansø 4.VII.38	Oligotrophic Holmsø 26.VI.30	Skaansø 4.VII.38	Mørksø 6.VII.38	Klitsø at Højsande 30.VI.25	Lille Gribsø 28.VI.29	Lille Gribsø 28.VI.29	Lille Gribsø 28.VIII.29	Blankeborg I 16.VIII.25	Blankeborg I 15.VIII.26	Blankeborg I 17.VIII.27	Blankeborg I 17.VIII.27	Blankeborg I 18.VIII.28	Blankeborg I 18.VIII.28	Blankeborg I 6.VIII.29	Blankeborg I 10.VI.30
Euglena rubra?	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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[1] var. coronata.

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(Mixotrophic) Eutrophic (Saprotrophic)

Blankeborg II						Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Ødam		Frederiksborg Slotssø			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.26	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI.47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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Table IV

Species	(Dystrophic)					Oligotrophic														
	Bøndernes Mose I	Bøndernes Mose II		Store Jenshøj turf pit	turf pit NE of Skaansø	Holmsø	Skaansø	Mørksø	Klitsø at Højsande	Lille Gribsø			Blankeborg I							
	28.VI.29	22.VIII.29	16.VI.30	25.VI.30	4.VII.38	26.VI.30	4.VII.38	6.VII.38	30.VI.25	28.VI.29	28.VI.29	28.VIII.29	16.VIII.25	15.VIII.26	17.VIII.27	17.VIII.27	18.VIII.28	18.VIII.28	6.VIII.29	10.VI.30
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— Lefevrei	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— nigra	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Trachelomonas planctonica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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— zmiwika	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dinophyceae																				
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Ceratium cornutum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— hirundinella	..	..	..	..	..	..	rrr	..	rrr	..	..	..	c	cc	rrr	cc	r	c	r	rrr
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— gymnodinium	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Glenodinium Lomnickii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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— pusillum	..	..	..	..	..	..	rrr	..	..	rr	r	rr	..	..	..	..	..	..	..	..
Gymnodinium excavatum var. dextrorsum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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— mirum	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..
Gymnodinium paradoxum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	rr
— — f. astigmosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— æruginosum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gyrodinium hyalinum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Peridinium bipes	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	rrr	rr	rrr	rrr	..	rrr
— cinctum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..
Peridinium Cunningtonii var. pseudoquadridens	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..
— palatinum	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	rr	..	r	rrr	rrr
— palustre	..	..	rrr	..	rr	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..
Peridinium Volzii	..	..	..	..	..	..	..	..	..	..	..	..	cc	r +	rrr	rrr	r	rr	r	rrr
— Willei	..	..	..	..	..	r	rrr	+	rr	..	rrr	rr	rrr	..	..	rrr	..	r	..	..

[1] Syn.: Glenodinium berolinense (Lemm.) Lindemann.

(continued).

(Mixotrophic) Eutrophic (Saprotrophic)

	Blankeborg II					Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Ødam		Frederiksborg Slotsso			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.28	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI.47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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Table IV

Species	(Dystrophic)					Oligotrophic														
	Bøndernes Mose I	Bøndernes Mose II		Store Jenshøj turf pit	turf pit NE of Skaansø	Holmsø	Skaansø	Mørksø	Klitsø at Højsande	Lille Gribsø			Blankeborg 1							
	28.VI.29	22.VIII.29	16.VI.30	25.VI.30	4.VII.38	26.VI.30	4.VII.38	6.VII.38	30.VI.25	28.VI.29	28.VI.29	28.VIII.29	16.VIII.25	15.VIII.26	17.VIII.27	17.VIII.27	18.VIII.28	18.VIII.28	6.VIII.29	10.VI.30
Chloromonadineae																				
Gonyostomum semen	r	rr	r+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cryptophyceae																				
Chroomonas acuta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cryptomonas ovata	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	rrr	..	..	rrr
— — var. curvata	+	cc	cc	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cyanomonas americana	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Bacillariophyceae																				
Asterionella formosa	..	..	..	..	..	..	..	..	..	..	..	..	r	rr	rr	r+	r	rrr	rr	rrr
Cyclotella comta	..	..	..	..	..	..	..	..	..	..	..	..	rr	rrr	r	rrr	r	rr	rr	c
— Kützingiana var. parva	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cyclotella Meneghiniana	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rrr	..	rrr	rrr	..	rrr
— pseudostelligera	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— stelligera	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cyclotella stelligera var. subglabra	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cymatopleura elliptica	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	rrr	rrr	rrr	..	..
Diatoma elongatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	..	..	..	..
Diatoma vulgare	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Eunotia alpina	rrr	rr	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— formica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Eunotia lunaris var. capitata	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— robusta var. diadema	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..
Fragilaria capucina	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr[2]	..	rrr[2]	..	rrr[2]	rrr[2]
Fragilaria construens var. subsalsa	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	rrr	..	..
— — var. venter	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
— crotonensis	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rrr	rrr	rrr	rrr	rrr	rrr
Melosira ambigua	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr
— granulata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. angustissima	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— varians	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

[1] determination not sure. [2] var. mesolepta.

(continued).

(Mixotrophic) Eutrophic (Saprotrophic)

Blankeborg II						Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Ødam		Frederiksborg Slotssø			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.26	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI.47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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Table IV

Species	(Dystrophic)					Oligotrophic														
	Bøndernes Mose I	Bøndernes Mose II		Store Jenshoj turf pit	turf pit NE of Skaansø	Holmsø	Skaansø	Morksø	Klitsø at Højsande	Lille Gribsø			Blankeborg I							
	28.VI.29	22.VIII.29	16.VI.30	25.VI.30	4.VII.38	26.VI.30	4.VII.38	6.VII.38	30.VI.25	28.VI.29	28.VI.29	28.VIII.29	16.VIII.25	15.VIII.26	17.VIII.27	17.VIII.27	18.VIII.28	18.VIII.28	6.VII.29	10.VI.30
Nitzschia acicularis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..
— palea	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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Nitzschia vermicularis	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rrr	rrr	rrr	..	rrr	..
Rhizosolenia longiseta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Stephanodiscus Astraea	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	rrr
Stephanodiscus dubius	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Hantzschii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Synedra acus var. angustissima	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	..	r	rrr	rrr	rrr
Synedra capitata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	..	rrr	rrr	rrr
— ulna	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	rrr	..	..	rrr	rrr
Tabellaria binalis	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..
Tabellaria fenestrata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..
— flocculosa	..	..	..	..	..	..	rr	..	..	rrr	rr	rr	..	..	..	..	rrr	..	..	..
Chrysophyceae																				
Chromulina pygmaea	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chrysococcus major	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— minutus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dinobryon bavaricum	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
— cylindricum var. palustre	..	..	..	..	..	..	c	..	..	..	..	..	..	..	..	..	..	..	..	..
— divergens	..	..	..	..	..	..	..	..	..	..	..	..	r+	r	rr	c	rr	cc	ccc	r
Dinobryon divergens var. Schauinnslandii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rrr
— pediforme	rrr	rrr	rrr	rrr	rrr	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..
— sertularia	..	..	..	..	..	..	..	..	..	..	..	..	rr	rrr	..	r	rr	rr	..	..
Dinobryon sociale	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rr	..	..	..	..	..
— — var. americanum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..
— suecicum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hymenomonas stagnicola	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mallomonas akrokomos	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— caudata[1]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— reginae	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

[1] *Mallomonas caudata* Krieger (non Iwanoff).

(continued).

(Mixotrophic) Eutrophic (Saprotrophic)

Blankeborg II						Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Odam		Frederiksborg Slotssø			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.26	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI. 47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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Table IV

Species	(Dystrophic)					Oligotrophic														
	Bøndernes Mose I	Bøndernes Mose II		Store Jenshøj turf pit	turf pit NE of Skaansø	Holmsø	Skaansø	Mørksø	Klitsø at Højsande	Lille Gribsø			Blankeborg I							
	28.VI.29	22.VIII.29	16.VI.30	25.VI.30	4.VII.38	26.VI.30	4.VII.38	6.VII.38	30.VI.25	28.VI.29	28.VI.29	28.VIII.29	16.VIII.25	15.VIII.26	17.VIII.27	17.VIII.27	18.VIII.28	18.VIII.28	6.VIII.29	10.VI.30
Mallomonas sphagnicola	..	rrr	r	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— tonsurata	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	rrr	..	..
— tridentata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mallomonas sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Synura Petersenii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— sphagnicola	rrr	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Synura spinosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Uroglena volvox	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— americana	..	..	..	..	..	..	..	..	r +	c +	+	..	..	..	..	..	..	..	..	..
Undeterm. Chrysophyceae	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	cc
Volvocales, Ulothricales, Oedogoniales, Xanthophyceae																				
Asterococcus superbus	..	..	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Carteria cordiformis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— fornicata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Carteria globulosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— stellifera	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chlamydomonas acidophila	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chlamydomonas capitis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— cingulata	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— clathrata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chlamydomonas clavata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Dinobryonis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— gloeocystiformis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chlamydomonas kakosmos	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— latifrons	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— longistigma	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chlamydomonas oleosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— pseudoplatyrhyncha	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr
— Reinhardii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	rrr	..
Chlamydomonas Reinhardii var. minor	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— retroversa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chlorogonium acus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

[1] Only cysts. [2] The main species + var. globulifera.

continued).

Mixotrophic) Eutrophic (Saprotrophic)

Blankeborg II						Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Odam		Frederiksborg Slotssø			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.26	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI.47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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Table IV

Species	(Dystrophic) Bøndernes Mose I 28.VI.29	Bøndernes Mose II 22.VIII.29	Bøndernes Mose II 16.VI.30	Store Jenshøj turf pit 25.VI.30	turf pit NE of Skaansø 4.VII.38	Oligotrophic Holmsø 26.VI.30	Skaansø 4.VII.38	Mørksø 6.VII.38	Klitsø at Højsande 30.VI.25	Lille Gribsø 28.VI.29	Lille Gribsø 28.VI.29	Lille Gribsø 28.VIII.29	Blankeborg I 16.VIII.25	Blankeborg I 15.VIII.26	Blankeborg I 17.VIII.27	Blankeborg I 17.VIII.27	Blankeborg I 18.VIII.28	Blankeborg I 18.VIII.28	Blankeborg I 6.VIII.29	Blankeborg I 10.VI.30
Chlorogonium minimum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Coccomonas sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dysmorphococcus Fritschii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Eudorina elegans	..	..	..	..	..	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..
Eutetramorus globosus	..	..	..	..	..	..	..	..	..	..	..	..	+	rrr	rrr	rr	rr	rrr	r	..
Gemellicystis neglecta	..	..	..	..	..	..	..	..	..	..	r	..	..	..	..	..	..	..	..	..
Gloeocystis ampla	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
— gigas	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..
— planctonica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rr	..	rr	..	..	rr
Gonium pectorale	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— sociale	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Oedogonium Itzigsohnii	..	..	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ophiocytium capitatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	rrr	..	..	..
— longispinum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pandorina morum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Phacotus angustus?	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— lenticularis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pteromonas aculeata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pteromonas angulosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— spinosa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Spermatozopsis exultans	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sphaerocystis Schröteri	..	..	..	..	..	..	rrr	..	rr	..	..	..	..	..	rrr	..	..	..	..	..
Stichococcus bacillaris	..	..	..	..	..	..	..	..	..	+	..	cc	..	..	..	..	..	..	..	..
Tetraspora Nygaardii	..	..	..	..	..	..	..	..	c +	..	..	..	..	..	..	..	..	..	..	..
Geminella minor	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ulothrix pelagica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chlorococcales																				
Actinastrum Hantzschii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ankistrodesmus convolutus var. minutus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	r	..	..	rrr
— falcatus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	rrr
Ank. falcatus var. acicularis f. longissima	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..
— — — mirabilis f. dulcis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — — — f. longiseta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..

[1] determination not sure.

(continued).

(Mixotrophic) Eutrophic (Saprotrophic)

Blankeborg II						Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Odam		Frederiksborg Slotssø			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.26	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI.47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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Table IV

Species	(Dystrophic) Oligotrophic																			
	Bøndernes Mose I	Bøndernes Mose II		Store Jenshøj turf pit	turf pit NE of Skaansø	Holmsø	Skaansø	Mørksø	Klitsø at Højsande	Lille Gribsø			Blankeborg I							
	28.VI.29	22.VIII.29	16.VI.30	25.VI.30	4.VII.38	26.VI.30	4.VII.38	6.VII.38	30.VI.25	28.VI.29	28.VI.29	28.VIII.29	16.VIII.25	15.VIII.26	17.VIII.27	17.VIII.27	18.VIII.28	18.VIII.28	6.VIII.29	10.VI.30
Ank. falcatus var. setiformis f. brevis	..	..	..	..	..	..	..	..	..	+	rr	r	..	..	..	..	..	..	..	..
— — — — f. elongata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — — spiralis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ank. falcatus var. spirilliformis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rrr	..	..	rrr
— lacustris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— longissimus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Botryococcus Braunii	..	..	..	rrr	rrr	rrr	rr	rrr	rrr	..	..	rrr	rrr	rrr	..	rrr	rrr	rrr	rrr	..
Coelastrum microporum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr
— — f. astroidea	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr
Coelastrum reticulatum	..	..	..	..	..	..	..	..	..	..	..	..	r	rrr	rrr	rrr	rr	rrr	r+	+
Crucigenia quadrata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — var. minima[1]	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	rrr	r	rrr	rrr	rrr
Crucigenia rectangularis	..	..	..	..	..	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..
— tetrapedia[2]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Desmatractum indutum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dictyosphærium pulchellum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rrr	..	rr	..
Elakatothrix gelatinosa	..	..	..	..	rrr	..	r	..	r+	..	..	..	..	..	..	..	..	..	..	..
— — f. biplex	..	..	..	..	..	..	..	..	..	rr	..	..	..	rrr	c+	rrr	r	..	..	..
Eremosphæra viridis	..	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Franceia geminata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Golenkinia radiata	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hofmania Lauterbornii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Kirchneriella contorta	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..
— lunaris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..
Kirchneriella lunaris var. Dianae	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— microscopica	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— obesa	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lagerheimia ciliata	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rrr	rrr	rrr	..	..	rrr
— quadriseta	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— subsalsa	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	..	..	..	..	..	..
Lagerheimia wratislaviensis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Micractinium pusillum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Nannokloster belonophorus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

[1] Syn.: Cr. minima Brunnth. [2] incl. Crucigenia fenestrata.

(continued).

(Mixotrophic)															Eutrophic																(Saprotrophic)		
Blankeborg II						Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Ødam		Frederiksborg Slotssø			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.26	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI. 47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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Table IV

Species	(Dystrophic)					Oligotrophic															
	Bondernes Mose I	Bondernes Mose II		Store Jenshøj turf pit	turf pit NE of Skaansø	Holmsø	Skaansø	Mørksø	Klitsø at Højsande	Lille Gribsø			Blankeborg I							
	28.VI.29	22.VIII.29	16.VI.30	25.VI.30	4.VII.38	26.VI.30	4.VII.38	6.VII.38	30.VI.25	28.VI.29	28.VI.29	28.VIII.29	16.VIII.25	15.VIII.26	17.VIII.27	17.VIII.27	18.VIII.28	18.VIII.28	6.VIII.29	10.VI.30
Nephrocytium Agardhianum	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	rrr
— lunatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..
Oocystis Marssonii	..	..	..	..	..	..	rr	..	rrr	rr	..	..	rrr	rrr	rr	rrr	r	rrr	rrr	rr
Oocystis solitaria	r	rrr	rrr	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pediastrum angulosum var. araneosum	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
— biradiatum	..	..	..	..	..	rrr[1]	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pediastrum Boryanum	..	..	..	..	..	..	..	..	rrr	..	..	..	rrr	rrr	..	rrr	rrr	rr	rrr	rrr
— — var. brevicorne	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — — longicorne	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pediastrum Boryanum var. rugulosum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— duplex	..	..	..	..	..	..	..	..	rrr	..	..	..	..	rr	..	rrr	..	..	..	..
— — var. clathratum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Pediastrum duplex var. coronatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — — reticulatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Kawraiskyi	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..
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Radiococcus pelagicus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scenedesmus acutus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rrr	..	rrr	rrr
— arcuatus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	rr	..	..	..
— — var. capitatus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scenedesmus armatus	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	rr	..	rr	..	rrr	rrr
— arvernensis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..
— brasiliensis var. norvegica	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
Scenedesmus brevispina	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— dimorphus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— ecornis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	..	rrr	rrr	..
Scenedesmus falcatus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— incrassatulus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— opoliensis	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scenedesmus ovalternus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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— quadricauda	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..
? — tetradesmus var. parenchymaticus	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..

[1] determination not sure.

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Mixotrophic)																	Eutrophic														(Saprotrophic)		
Blankeborg II						Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Ødam		Frederiksborg Slotssø			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.26	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI.47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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Table IV

Species	(Dystrophic)					Oligotrophic													
	Bøndernes Mose I	Bøndernes Mose II		Store Jenshøj turf pit	turf pit NE of Skaansø	Holmsø	Skaansø	Morksø	Klitsø at Højsande	Lille Gribsø			Blankeborg I							
	28.VI.29	22.VIII.29	16.VI.30	25.VI.30	4.VII.38	26.VI.30	4.VII.38	6.VII.38	30.VI.25	28.VI.29	28.VI.29	28.VIII.29	16.VIII.25	15.VIII.26	17.VIII.27	17.VIII.27	18.VIII.28	18.VIII.28	6.VIII.29	10.VI.30
Schroederia setigera	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Selenastrum Bibraianum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— capricornutum	..	..	..	..	..	..	..	..	..	ccc	..	rr	..	..	r	..	rr	..	..	rrr
Selenastrum gracile	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Westii	..	..	..	..	..	..	..	..	..	+	rr	rr	..	..	..	..	..	..	..	..
Tetraedron caudatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rrr
Tetraedron hastatum var. palatinum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— limneticum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..
— — var. simplex	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Tetraedron minimum	..	..	..	..	..	..	..	..	..	..	..	..	r	rrr	r+	rrr	r	rr	r	c
— muticum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— planctonicum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	rrr
Tetraedron regulare Incus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Schmidlei var. euryacanthum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— trigonum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rrr	..	..
Tetraedron trigonum var. crassum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	rrr	..
— — — gracile	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr
— — — setigerum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Tetrallantos Lagerheimii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Tetrastrum apiculatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— heteracanthum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Tetrastrum staurogeniæforme	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..
Westella botryoides	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..
Undeterm. green algae	rrr	..	..	..	..	..	..	..	..	r+	r	rrr	..	..	r	..	cc	..	..	..
Conjugales (Desmidieae)																				
Arthrodesmus convergens	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
— Incus var. extensus f. minor	..	rrr	rrr	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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(Mixotrophic)														Eutrophic																	(Saprotrophic)		
Blankeborg II						Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Odam		Frederiksborg Slotsso			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.26	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI.47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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Table IV

Species	Bondernes Mose I	Bondernes Mose II		Store Jenshoj turf pit	turf pit NE of Skaanso	Holmso	Skaanso	Mørkso	Klitso at Hojsande	Lille Gribso			Blankeborg I							
	(Dystrophic)					Oligotrophic														
	28.VI.29	22.VIII.29	16.VI.30	25.VI.30	4.VII.38	26.VI.30	4.VII.38	6.VII.38	30.VI.25	28.VI.29	28.VI.29	28.VIII.29	16.VIII.25	15.VIII.26	17.VIII.27	17.VIII.27	18.VIII.28	18.VIII.28	6.VIII.29	10.VI.30
Closterium acutum var. variabile	rrr	rrr	rrr	rrr	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	rrr
— Baillyanum var. parvulum	..	..	..	..	..	..	..	..	..	..	rrr	rr	..	..	..	..	..	..	..	..
— Ehrenbergii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Closterium gracile	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..
— idiosporum	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— incurvum	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..
Closterium Kützingii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— moniliferum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— parvulum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Closterium striolatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— subulatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Venus	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
Cosmarium angulosum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— asphærosporum var. strigosum	..	..	..	..	rrr	..	..	..	..	r	..	ccc	..	..	..	..	rrr	..	..	..
— bioculatum f. depressa	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	rrr	..	rrr	rrr
Cosmarium Blyttii var. Novæ-Sylviae	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..
— contractum var. ellipsoideum	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
— — — minutum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cosmarium humile var. glabrum	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	rrr	..	..	rrr	..	..
— Kjellmannii var. grande	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— læve var. septentrionale	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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— Meneghinii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Nymannianum	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cosmarium præmorsum	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..
— punctulatum var. subpunctulatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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Cosmarium pygmæum	..	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— reniforme	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	rrr	..	..	..
— Sinostegos var. obtusius	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cosmarium subarctoum f. minor	..	..	..	..	..	..	..	..	..	rrr	..	rr	..	..	..	..	..	..	..	..
— subprotumidum var. Gregorii	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
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(Mixotrophic) Eutrophic (Saprotrophic)

Blankeborg II						Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Ødam		Frederiksborg Slotsso			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.26	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27.	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI. 47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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Table IV

Species	(Dystrophic) Oligotrophic: Bondernes Mose I	Bondernes Mose II	Bondernes Mose II	Store Jenshoj turf pit	turf pit NE of Skaansø	Holmsø	Skaansø	Mørksø	Klitsø at Højsande	Lille Gribsø	Lille Gribsø	Lille Gribsø	Blankeborg I	Blankeborg I	Blankeborg I	Blankeborg I	Blankeborg I	Blankeborg I	Blankeborg I	Blankeborg I
	28.VI.29	22.VIII.29	16.VI.30	25.VI.30	4.VII.38	26.VI.30	4.VII.38	6.VII.38	30.VI.25	28.VI.29	28.VI.29	28.VIII.29	16.VIII.25	15.VIII.26	17.VIII.27	17.VIII.27	18.VIII.28	18.VIII.28	6.VIII.29	10.VI.30
Euastrum bidentatum	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..
— binale	..	..	..	rrr	rrr	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — f. Gutwinskii	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Euastrum denticulatum	..	..	..	..	..	rrr	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..
— elegans	..	..	..	..	..	rrr	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..
— pinnatum	..	..	..	..	..	..	..	..	..	..	rrr	rrr	..	..	..	..	..	..	..	..
Euastrum verrucosum	..	..	.	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
— sp.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..
Bambusina Borreri	..	rrr	..	rrr	rrr	..	rrr	..	..	..	rrr	..	..	..	..	..	..	..	..	..
Gonatozygon Brebissonii	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..
Gonatozygon Kinahani	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Micrasterias truncata	..	..	..	rrr	..	..	..	..	..	..	rrr	rrr	..	..	..	..	..	..	..	..
Pleurotænium Ehrenbergii	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..
— trabecula	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..
Sphærozosma granulatum	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	rr	..	rrr	..
Spondylosium pulchellum	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Staurastrum alternans	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— apiculatum	..	..	..	..	..	..	..	..	rrr	..	..	..	rrr	..	..	rrr	rrr	rrr	..	rrr
Staurastrum Arachne	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
— avicula[1]	..	..	..	..	..	..	..	..	..	..	..	..	rr	rrr	..	rrr	..	rr	rrr	..
— barbulae	..	..	..	..	..	..	rrr	rrr	..	..	..	..	..	..	..	..	..	..	..	..
Staurastrum brachiatum	..	..	..	..	c	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— cingulum var. inflatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— crenulum var. brittannicum	..	..	..	..	..	..	..	..	rrr	..	..	..	rrr	rrr	rrr	rrr	rrr	rrr	rrr	rrr
Staurastrum curvatum f. brevispina	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
— cuspidatum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	rrr	..	rrr
— — var. divergens	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
Staurastrum danicum	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— — forma	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— dejectum[2]	..	rrr	rrr	rrr	+	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Staurastrum Dickiei	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
— erasum[3]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	rrr	rrr	rrr	rrr
— furcigerum	..	..	..	..	..	..	..	..	..	..	..	..	rr	rr	rrr	rr	rrr	rrr	rrr	..

[1] see Nygaard 1945, fig. 80 (sub nomine Staurastrum lunatum). [2] f. mediocris and f. longispina, see p. 93 and 94.

(continued).

(Mixotrophic) Eutrophic (Saprotrophic)

Blankeborg II						Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Ødam		Frederiksborg Slotssø			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.26	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI. 47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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[1] see R. Grönblad 1942, p. 40—41, t. 4, fig. 14.

Table IV

Species	(Dystrophic)					Oligotrophic														
	Bøndernes Mose I	Bøndernes Mose II		Store Jenshøj turf pit	turf pit NE of Skaansø	Holmsø	Skaansø	Mørksø	Klitsø at Højsande	Lille Gribsø			Blankeborg 1							
	28.VI.29	22.VIII.29	16.VI.30	25.VI.30	4.VII.38	26.VI.30	4.VII.38	6.VII.38	30.VI.25	28.VI.29	28.VI.29	28.VIII.29	16.VIII.25	15.VIII.26	17.VIII.27	17.VIII.27	18.VIII.28	18.VIII.28	6.VIII.29	10.VI.30
Staurastrum gracile	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	rr	..	rrr	rrr	..
— longiradiatum var.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..
— laeve	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
Staurastrum Manfeldtii[1]	..	..	..	..	..	..	..	..	..	..	..	..	rrr	r	rrr	r +	rrr	r	..	..
— monticulosum var. pulchrum	rr	rr	rrr	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— paradoxum var. parvum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Staurastrum polymorphum var. divergens	rrr	rrr	rr	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— Pseudosebaldii var. simplicius	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— teliferum	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..
Staurastrum tetracerum var. biverruciferum	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rr	r	rr	+	rr	..	rrr
— — — validum	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— uniseriatum	..	..	..	..	..	..	..	..	..	..	..	..	rrr	rrr	..	..	..	..	..	..
Staurastrum vestitum var. parvum	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..
— sp.	rrr	..	..	..	..	..	..	..	..	..	..	rrr	..	..	..	..	..	..	..	..
Tetmemorus granulatus	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Xanthidium antilopæum	..	rrr	rrr	..	..	..	rrr	..	rrr	..	..	rrr	..	..	..	..	..	..	..	..
— concinnum var. Boldtianum	rrr	..	rrr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

[1] see Nygaard 1945, fig. 79.

(continued).

(Mixotrophic) Eutrophic (Saprotrophic)

Blankeborg II						Sortedam II			Gadevang Mose		Vandingsdam			Badstue-Ødam		Frederiksborg Slotssø			Jægerbakke Dam			Flødegaardens Dam							Lynge Vandingsdam		Bistrup Dam		
15.VIII.26	25.VII.28	25.VII.28	28.VIII.28	28.VIII.28	10.VI.30	8.VI.29	1.VII.29	23.IX.29	6.VII.29	10.VII.29	28.VI.29	28.VI.29	24.VIII.29	6.VI.29	23.VIII.29	11.VI.29	11.VI.29	23.IX.29	12.VI.29	17.IX.29	16.V.30	1.VII.26	28.VII.26	20.VII.27	7.IX.28	19.VIII.29	10.VI.30	3.VIII.39	30.VI.47	6.VIII.47	12.VIII.29	24.X.29	16.XI.29
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