ACTA SOCIETATIS SCIENTIARUM FENNICÆ
TOM. XLVIII. N:o 5.

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# MICROPLANKTON

## FROM THE FINNISH WATERS DURING THE MONTH OF MAY 1912

BY

CAROLINE LEEGAARD

HELSINGFORS 1920
PRINTED BY THE FINNISH LITERARY SOCIETY

# PREFACE.

I beg to acknowledge my indebtedness to Professor H. H. Gran, of Christiania, for his having kindly placed at my disposal the Finnish plankton material collected in 1912; I beg also to express my sincere gratitude to Dr. K. M. Levander, professor of zoology at the Helsingfors University, for the way in which he has promoted my research by recommending this paper for insertion in the „Acta" of the Finnish Society of Sciences, as well as to the Society for the hospitality it has extended to my treatise.

Christiania, September 27, 1919.

CAROLINE LEEGAARD.

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# INTRODUCTION.

Since the centrifuge has been introduced by LOHMANN among the methods of studying plankton, the quantitative investigations of the diminutive organisms have been possible. To preserve the water samples for later examination GRAN (1912) used Flemmings stronger solution. At the meeting of the International Council in Copenhagen April 1912 it was decided, that in May-June samples should be collected according to GRAN's method. Much of the material has already been investigated, and the results are to be found in „The Plankton Production" by H. H. GRAN. The Finnish material collected in the month of May 1912 will be dealt with in the following treatise.

Fig. 1. Position of the Stations.

The samples were taken at six stations, the geographical positions of which are shown in the map of the figure 1 and noted in the table below:

*Table I. The Positions of the Stations.*

| Station | Date | Position | | Depth of the Bottom in Metres |
|---|---|---|---|---|
| F 41 | May 11 | N. 60° 17′,5 | E. 27° 57′ | 50 |
| F 50 | — 12 | 59° 50′ | 25° 37′ | 77 |
| F 61 | — 15 | 59° 26′ | 23° 9′ | 99 |
| F 74 | — 16 | 59° 1′ | 21° 3′ | 190 |
| F 30 | — 19 | 61° 4′ | 19° 35′ | 123 |
| F 23 | — 20 | 62° 40′ | 19° 31′ | 140 |

The samples were for the most part taken from the following depths: 0 metres, 5 m., 10 m., 20 m., 30 m., 40 m., 50 m., 60 m., 80 m., 100 m.

At those stations where the depth did not reach 100 metres (Table 1), the deepest samples were taken a short distance from the bottom. At the station F 74 the deeper samples are wanting.

Almost all the samples were much fouled by detritus brought into the sea by the rivers. On account of the shallowness of the water the wind and waves easily stir up the deposits of the bottom, so that the plankton samples will not be as clean as those from the open and deep ocean.

The centrifugal method has been employed. Samples of 50 cc., 25 cc. or 10 cc. being centrifugated the numbers of individuals (cells) have been counted. In the tables containing the results of the observations all records are given in numbers of individuals (cells) pr. litre. At the head of the tables are given the depth of the sample and some hydrographical data, viz: temperature, salinity and oxygen tension, all taken from the „Jahrbuch 1912“ by Dr. ROLF WITTING (Finländische hydrographisch-biologische Untersuchungen. No. 12). Below the hydrographical data are given the quantities of each water sample examined. In some instances it has been necessary to count the contents of two quantities of the same sample. When in the tables two values are given, as for instance 50 (10), this indicates that a few species which occur very abundantly have been enumerated in a sample of 10 cc., while all the others have been enumerated in a sample of 50 cc. One special diatom, namely Achnanthes taeniata, occurred so abundantly, that the examination of this species was rather difficult even in such a small quantity of water as 10 cc.

The material will be arranged in the following way:

Chapter I. The Separate Species and their Distribution.
Chapter II. Survey of the Stations.
Chapter III. Remarks on the Conditions of Life and the Quality of the Plankton.

Of course this one series of samples taken at almost the same time cannot give absolutely reliable information as to the habits of life of the different species. We must content ourselves by comparing them with the plankton from better known regions and drawing our own conclusions as to the distribution and the conditions of life of the plankton dealt with here.

# CHAPTER I.

## THE SEPARATE SPECIES AND THEIR DISTRIBUTION.

With some few exceptions the different species can be classified into three groups:

Diatomaceae.
Peridiniales.
Ciliata.

The groups will be discussed in the order mentioned abow, and afterwards some remarks will be made on those species, which are to be grouped otherwise. Of course the groups mentioned have no equal systematic value; this basis of classification is rather a practical one employed on this special plankton.

The species of the different groups will be dealt with alphabetically.

The material examined consisted of following species:

*Diatomaceae.*

A. Oceanic species.

Achnanthes taeniata
Chaetoceras debile
— Wighami
Coscinodiscus lacustris
— sp.
Fragilaria cylindrus
Leptocylindrus minimus
Melosira hyperborea
Navicula Granii
— Vanhöffenii
Nitzschia longissima
Skeletonema costatum
Thalassiosira baltica

B. Forms that live in brackish or fresh water. Marine littoral forms.

Amphiprora decussata
Asterionella formosa
Cocconeis Placentula
— Scutellum
Diatoma tenue
Melosira distans
— granulata
Navicula cryptocephala
— gracilis
— major
— Placentula
— rhynchocephala
— viridula
Nitzschia Sigma f. elongata
— sp.
Rhabdonema arcuatum
Rhoicosphenia curvata
Stauroneis Heufleri
Synedra affinis
— pulchella
— radians

*Peridiniales.*

Dinophysis baltica
Glenodinium bipes
Gonyaulax catenata
Peridinium finlandicum
— sp. { achromaticum (?) / balticum (?) }

*Ciliata.*

Didinium Gargantua
Laboea compressa
— conica
— delicatissima
— vestita
Lohmanniella oviformis
— stellaris n. sp.
Mesodinium rubrum
Tintinnopsis beroidea
— tubulosa

*Rhizopoda.*

Difflugia lobostoma

*Silicoflagellata.*

Ebria tripartita

*Systematically Unknown Forms.*

Radiosperma corbiferum
Xanthidium multispinosum

Some solitary nauplii were found, but their species could not be determined for want of sufficient material. This was also the case with a very few cells of Peridiniales and various more or less spherical cells, perhaps ova, Infusoria or only the contents of broken walled individuals.

A few cells of pollen of foliferous trees and firs had been driven out into the sea.

After this summary we shall proceed to the discussion of the separate species.

## DIATOMACEAE.

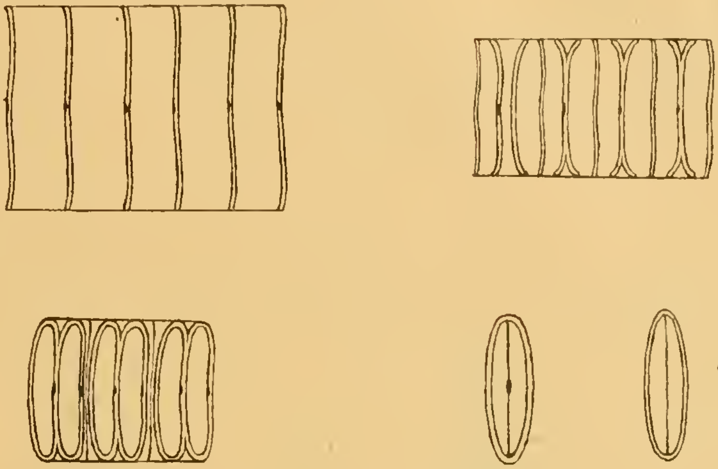
### A. OCEANIC SPECIES.

#### *Achnanthes taeniata* Grun.

(Fig. 2.)

1880 Cleve and Grunow, p. 22, pl. 1, f. 5.
1894—95 Cleve II, p. 189.
1896 a Cleve, p. 5.
1896 b Cleve, p. 4, 13.
1897 b Gran, p. 9, pl. 1, f. 10.
1897 Östrup, p. 329, 353, pl. 2, f. 15.
1905 Jörgensen, p. 105, pl. 8, f. 27.
1908 Gran. p. 122.
1910 Meunier, p. 326, pl. 33, f. 41-44.

When the low salinity of the Finnish waters was taken into consideration it was probable, that a rather poor plankton would be found. On that account this treatise was begun with some scepticism, but the results were encouraging. Especially Achnanthes taeniata was very interesting, occurring very abundantly, particularly in the inmost part of the Gulf of Finland, where the River Neva carries much nutritive water into the sea. The maximum number of cells pr. litre was here four millions. The cells are



a. b. c. d.

Fig. 2. *Achnanthes taeniata.*

a. Chain without spores.
b. The first walls of the resting-spores are formed.
c. Chain with resting-spores.
d. Resting-spores in front-view.

$\frac{950}{1}$

very small compared with many other plankton-organisms; but when the long chains occur in such large quantities as here, they can be observed with the naked eye.

Achnanthes taeniata of May gave very interesting material for studying the development of the resting-spores. Every phase of development was to be found from the delicately-walled cells to the thick-walled finished resting-spores. The slender-walled cells were often very beautifully preserved with quite distinct H-formed chromatophores.

During the formation of the resting-spores the contents of the cells will be coloured black by the osmic acid in the preserving fluid. The spores being formed by cell-division are apparently placed two in each cell. At the same time the chains will twist into spirals.

The breadth of the chains examined was 13—30 $\mu$.

Both the thin-walled chains and those with resting-spores occurred at every station, the resting-spores for the most part dominating. This species occurred most abundantly in the Gulf of Finland, especially at the inmost station (F 41). The maximal number of cells pr. litre amounting to 2600000 cells without resting-spores and 1305000 resting-spores was found at the depth of 5 metres. At this station the spore-free cells still dominate. Towards the bottom the number of the resting-spores increase in proportion to the thin-walled cells, this fact confirming the rule, that the heavy resting-spores will sink more rapidly than the lighter thin-walled cells. But any considerable sinking could not be noticed yet. The richly laden upper layers of the water indicate that this species is still in energetic development.

At the other two stations in the Gulf of Finland, viz: F 50 and F 61, great numbers of Achnanthes taeniata are to be found, decreasing from east to west. At these stations the resting-spores prevail, and the development has proceeded further that at station F 41. While the maximum has not sunt anything worth mentioning at station F 50, we find it at the depth of 40 metres at station F 61. The diatom is here decreasing, having begun to sink towards the bottom, the greater number of the cells forming resting-spores.

At the two stations F 23 and F 30 in the Gulf of Bothnia the behaviour of this species is rather different. At the most northerly station (F 23) we find it pretty numerous with the maximum in the upper layers of the water, but at the same time with resting-spores dominating. The last mentioned fact indicates the retrogression of the species. At station F 30 probably this diatom, occurring in very few cells has almost finished its development and will soon disappear from the plankton.

At station F 74 in the northern part of the Baltic it is found somewhat more abundantly than at station F 30, the resting-spores being numerous and the maximum number of cells occurring at the depth of 30 metres.

## *Chaetoceras debile* Cleve.

(Fig. 3.)

1894 Cleve, p. 13, pl. 1, f. 2.
1895 Östrup, p. 456, pl. 7, f. 89.
1895 Ch. vermiculus Schütt, p. 39, f. 7 a—c.
1908 Gran, p. 92.
1910 Meunier, p. 242, pl. 27, f. 19—23.
1913 Meunier, p. 43, pl. 7, f. 1—11.

A few solitary specimens of some resting spores were to be found. These had two spines on one of the valves and were very probably belonging to Chaetoceras debile. The breadth of the chains being very little (8—12 $\mu$) the two little wort-like structures of the typical Ch. debile were not distinctly developed; but Meunier (1913) has given a drawing of this species with resting-spores (pl. 7, f. 11), which are quite similar to those of the Finnish material.

Fig. 3. *Chaetoceras debile.* Resting-spores. $\frac{1000}{1}$.

This diatom is not specified in the tables, being only distinguishable from the other Chaetoceras-spores on closer examination and higher magnifying powers, than used when counting. But it can be said with great certainty, that this species occurred in minimal numbers compared with Chaetoceras Wighami, which will be dealt with beneath.

The specimens drawn were found at station F 23 at the depths of 0 and 10 metres. It is not noted from the other stations, but the possibility that is has been overlooked is not improbable.

### *Chaetoceras Wighami* Brightw.

(Fig. 4.)

1856 a Brightwell, p. 108, pl. 7, f. 19—36.
1856 b Brightwell, pl. 8, f. 19—36.

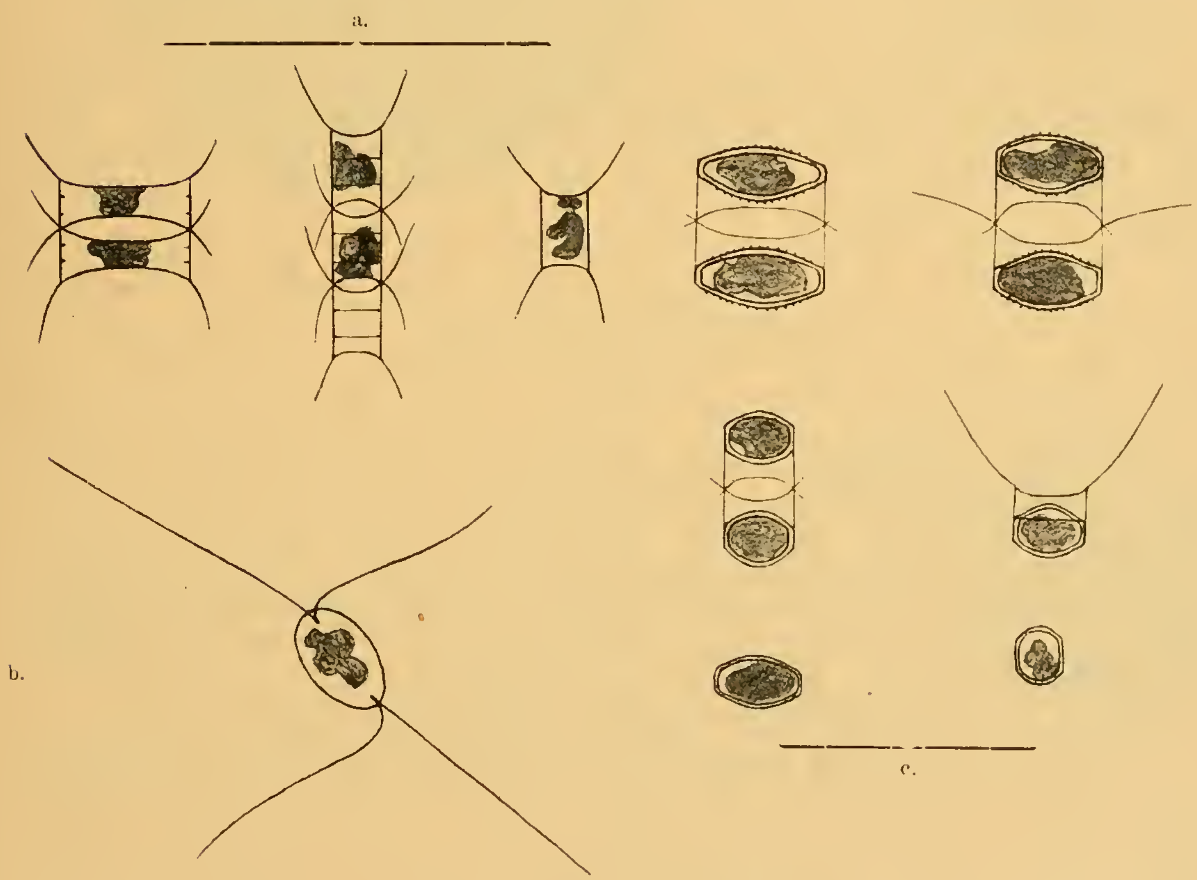



Fig. 4. *Chaetoceras Wighami.*

a. Cells without spores.
b. Cell in front-view.
c. Resting-spores.

$\frac{1000}{1}$.

1896 Ch. bottnicum Cleve, at Aurivillius, p. 14, pl. 1.
1897 a Ch. biconcavum Gran, p. 27, pl. 3, f. 46.
1897 a Ch. Wighami Gran, p. 27.
1901 Levander, p. 6. 13.
1908 Gran, p. 88.
1910 Meunier, p. 244, pl. 27, f. 26.
1913 Meunier, p. 42, pl. 6, f. 32—34.

Chaetoceras Wighami was found at every station occurring both as very thin-walled cells and as resting-spores. The cells were either observed singly or in short chains consisting of very few cells. The resting-spores lying one in each cell were decorated on both valves with fine spines, which were easily seen on the larger cells, but were very indistinct on the smaller ones.

The breadth of the chains was 6—17 μ, the greater number of the resting-spores however not exceeding 10 μ.

At station F 41 Ch. Wighami occurred rather numerously being here without resting-spores, while only a few straggling cells or spores were found at the stations F 50, F 61, F 74 and F 30. At station F 23 the resting-spores were dominating with maximal number at the depth of 30 metres. At this station it is still fairly numerous, but no doubt in regression.

### *Coscinodiscus lacustris* Grun.

(Fig. 5.)

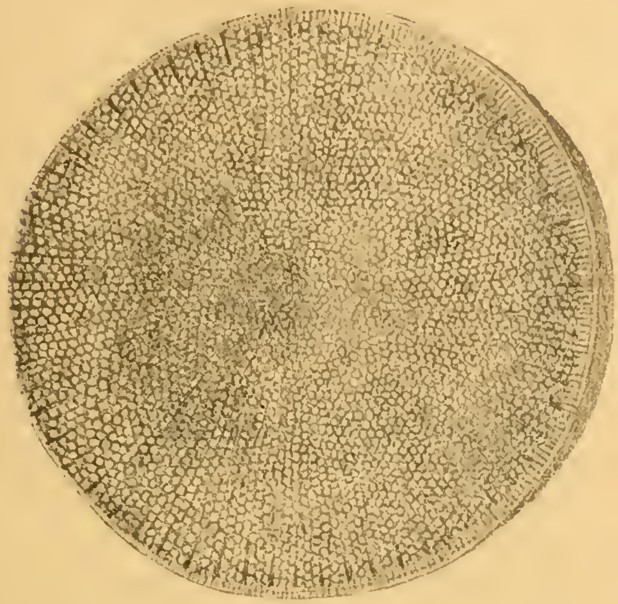
1884 Grunow, p. 85, pl. 4, f. 30—33.
1899 Van Heurck, p. 525.
1910 Meunier. p. 274, pl. 30, f. 33—34.

The undulated valve of Coscinodiscus lacustris having one excentric concavity and one excentric convexity can be dissolved into narrow sectors consisting of 3 (2—4) rows of pores. The sectors are separated by thickened lists just inside the margin, while the very border of the valve is very delicately radially striped.

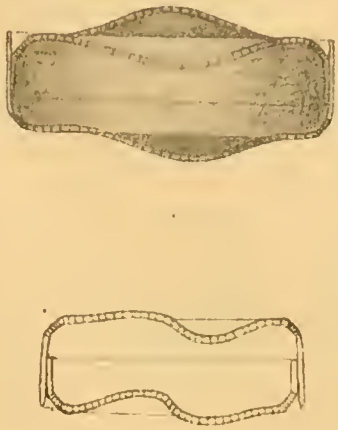
The size was highly varied, the diameter ranging between 20 μ and 70 μ.

In spite of Coscinodiscus lacustris being a very characteristic species, when it was deprived of its contents by intense heating, it was rather difficult to determine this species, when it was counted, as the contents were of a dense black colour. When looking at the valve it was particularly difficult to distinguish the small cells of this species from those of Thalassiosira baltica. On that account the numbers put down in the tables concerning these two species are not quite exact. Under Coscinodiscus lacustris are noted every cell, which has been determined with certainty as this diatom, while those, of which the identification is uncertain, are counted as Thalassiosira baltica, this species on closer examination appearing to be the dominating one.

Coscinodiscus lacustris occurred in small quantities at every station fairly equally distributed. The greatest number was 1520 cells pr. litre (station F 23, 0 metres). At



a.



b.

Fig. 5. *Coscinodiscus lacustris.*

a. Cells in front-view. $\frac{1100}{1}$.

b. Cells in side-view. $\frac{1250}{1}$.

some of the stations the largest quantities were found in the middle and deeper water-layers (F 41, F 50, F 61, F 74). On the contrary at station F 30 the maximum number was found at the depths of 5 - 10 metres. Station F 23 besides having the greatest number of cells in the surface water (1520 cells pr. litre) also produced a secondary maximum (1440 cells pr. litre) at the depths of 40—50 metres.

This relatively rich occurrance towards the deep layers can naturally be explained, when we consider the fact, that Coscinodiscus lacustris is a heavy form, which will easily sink.

Fig. 6. *Coscinodiscus sp.* $\frac{1050}{1}$.

## *Coscinodiscus sp.*

(Fig. 6.)

Here and there a little thick-walled Coscinodiscus with cup-shaped valve was to be found. The pores being remote at the central part of the valve approached each other towards the edge. The margin of the valve was supplied with fine radial stripes.

A few specimens of this species occurred at stations F 74 and F 61.

### *Fragilaria cylindrus* GRUN.

(Fig. 7.)

1884 Grunow. p. 55, pl. 2, f. 13.
1897 b Gran, p. 20, pl. 1, f. 4—5.
1905 Jörgensen, p. 102, pl. 6, f. 9.
1908 Gran, p. 115.

Fragilaria cylindrus occurring constantly with Achnanthes taeniata could be distiguished from the latter by the very narrow linear cells, which are discribed in the „Nordisches Plankton". The breadth of the chains according to the Finnish material which has been examined was 14—35 $\mu$.

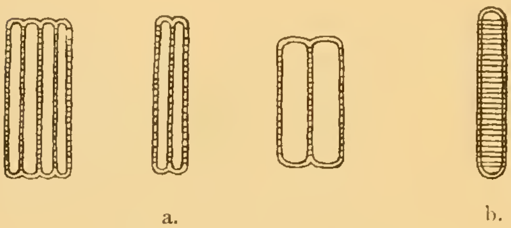


Fig. 7. *Fragilaria cylindrus.*
a. Cells in side-view.
b. Cell in front-view.
$\frac{950}{1}$.

This species was not numerous except at station F 41, occurring here in the upper water-layers with the maximum number of 268800 cells pr. litre at the surface. Farther west in the Gulf of Finland it diminishes, and the maximum is found in the deeper layers (stations F 50 and F 61). In the northern part of the Baltic (station F 74) it occurs only singly; in the Gulf of Bothnia it is wanting at the southern station (F 30), while it is found in small quantities at the northern one (F 23) with the maximum number of 8600 cells pr. litre at the depth of 30 metres.

### *Leptocylindrus minimus* GRAN.

(Fig. 8.)

1915 Gran, p. 72.

A few chains occurred consisting of narrow cylindrical cells with rounded ends. The contents of the cells were coloured by the fixing-fluid, so that three dark bodies

Fig. 8. *Leptocylindrus minimus.*
$\frac{1000}{1}$.

appeared, one in the middle of the cell and one at each end. This indicates, that the cells contain two chromatophores connected by a central part with the nucleus. This species is very probably the same as the Leptocylindrus minimus of Gran (1915).

The diameter of the cells was 4 $\mu$.

This species occurred singly at stations F 23, F 74 and F 41.

## *Melosira hyperborea* (Grun.).

(Fig. 9.)

1880—85 Melosira nummuloides var? hyperborea Van Heurck, pl. 85, f. 3—4.
1895 Östrup, p. 462.
1896 b Schütt, p. 59.
1897 b Gran, p. 4.
A. Schmidt Atlas, pl. 182, f. 24.
1897 M. nummuloides + M. Juergensii Vanhöffen, p. 265, pl. 3, f. 16—18.
1900 a Gran, p. 52, pl. 3, f. 11—15.
1908 Gran, p. 13.
1910 Meunier, p. 271, pl. 30, f. 16—21.

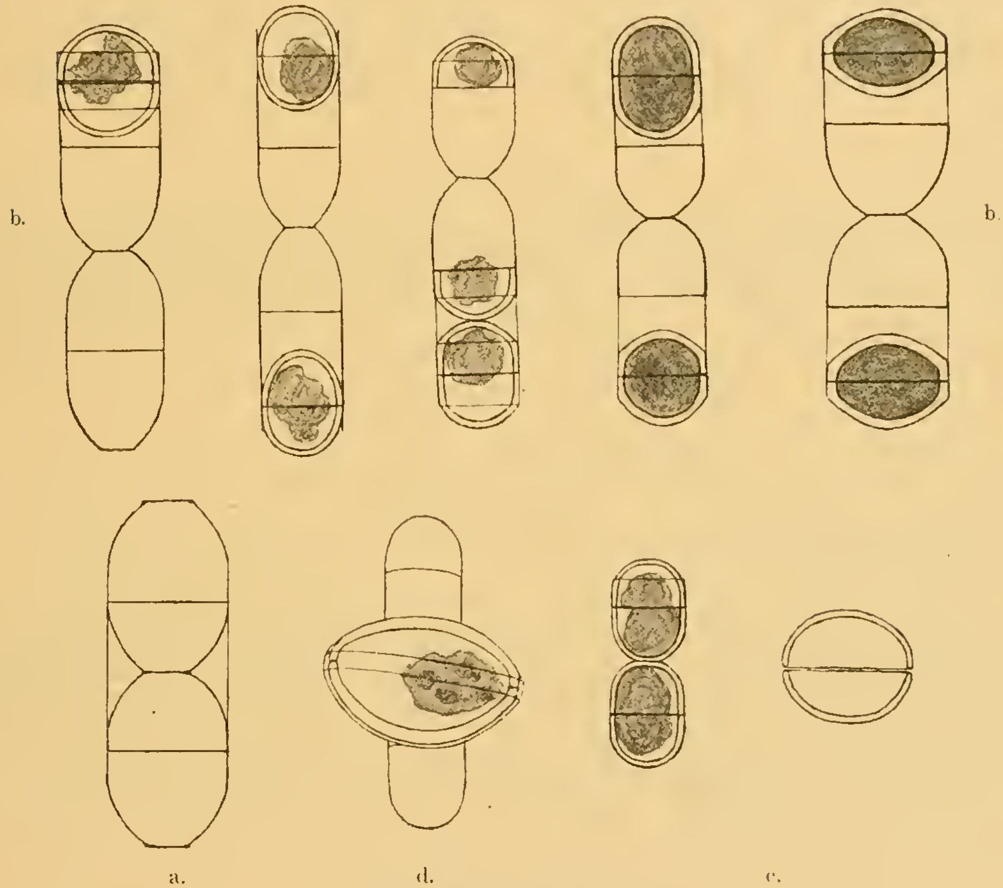



Fig. 9. *Melosira hyperborea.*
a. Cells without resting-spores.
b. Cells with resting-spores.
c. Resting-spores. d. Auxospore. $\frac{1000}{1}$.

Melosira hyperborea was either found in short chains, often containing resting-spores, or as single resting-spores. At the same time many separate valves were found.

An auxospore appeared at station F 50 at the depth of 40 metres. It was very remarkable in that a thick-walled resting-spore was lying inside the thin-walled auxospore. The formations of the auxospore and the resting-spore have in this case developed without any intermediate link of thin-walled cell-generations. The diameter of the cells was 10—23 μ, that of the auxospore 25 μ.

Only at station F 41 in the upper water-layers the chains without resting-spores dominate those containing spores. In the deeper layers we have quite the opposite case, but here this species is rather scarce. At stations F 50, F 61 and F 23 a few cells without resting-spores occurred, while the species is totally lacking at stations F 30 and F 74.

This diatom is not particularly numerous at any of the stations. The greatest numbers noticed are 20100 cells pr. litre of the sporeless cells (station F 41, 10 metres) and 15500 cells pr. litre of the resting-spores (station F 41, 5 metres).

The resting-spores were fairly equally distributed over all the stations in quantities, which varied between some hundreds and some thousands of cells pr. litre.

### *Navicula sp.*

A few chain-forming Navicula-cells were found at some of the stations. On closer examination it appeared, that they belonged to the two species, Navicula Granii and Navicula Vanhöffenii. These two species were not distinguishable from each other, when they were counted. Scattered specimens occurred at stations F 41, F 50, F 61 and F 23.

### *Navicula Granii* (Jörgensen).

(Fig. 10.)

1905 Stauroneis Grani Jörgensen, p. 107, pl. 7, f. 25.
1908 Gran, p. 124.
1910 Stauropsis Granii Meunier, p. 321, pl. 33, f. 26—27, 33—36.

The chain in the illustration was found in some intensely heated material from station F 41, 10 metres. The breadth of the chain, 42 μ, was somewhat smaller than that which is given in the „Nordisches Plankton“ (50—57 μ); but the plankton-diatoms of the Finnish territory often being relatively small (a fact which will be discussed later, page 39) this circumstance need not offer any objection as to the determination of the species.

### *Navicula Vanhöffenii* Gran.

(Fig. 11.)

1896 a Navicula septentrionalis Cleve, p. 11, pl. 1, f. 9, non Libellus? septentrionalis Östrup 1895.
1897 b Gran, p. 21, pl. 1, f. 1—3.

1905 Jörgensen, p. 105, pl. 7, f. 22.
1908 Gran, p. 124.
1910 Stauropsis Vanhöffenii Meunier, p. 322, pl. 33, f. 46.

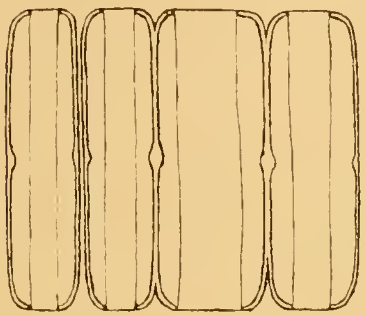


Fig. 10. *Navicula Granii.* $\frac{950}{1}$.

Fig. 11. *Navicula Vanhöffenii.* $\frac{1150}{1}$.

Most of the Navicula-chains belonged to this species. It occurred in single cells or in chains consisting of 2—4 cells. One chain having the breadth of 45 μ has been drawn; it was found at station F 50 at the depth of 10 metres.

### *Nitzschia longissima* (Breb.) Ralfs.

(Fig. 12.)

1880—85 Van Heurck Synopsis, p. 185, pl. 70, f. 1—4.
1899 Karsten, p. 114, f. 178.
1908 Gran, p. 131.
1910 Meunier, p. 337, pl. 34, f. 41—46, 65.

This species occurred sparsely at two of the stations, viz: F 23 and F 41. While it was found in every sample from the surface to the depth of 60 metres at station

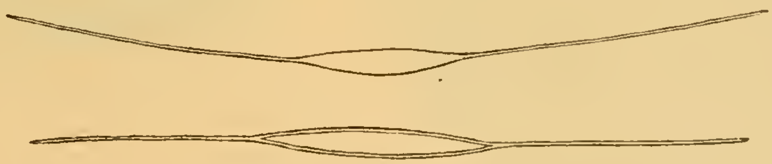


Fig. 12. *Nitzschia longissima.* $\frac{1000}{1}$.

F 23, it was only observed in the sample from the surface at station F 41. It is noted as littoral by Gran; yet according to Van Heurck it is no real form of the brackish water. The length of the cells was about 100 μ.

### *Skeletonema costatum* (GREV.)

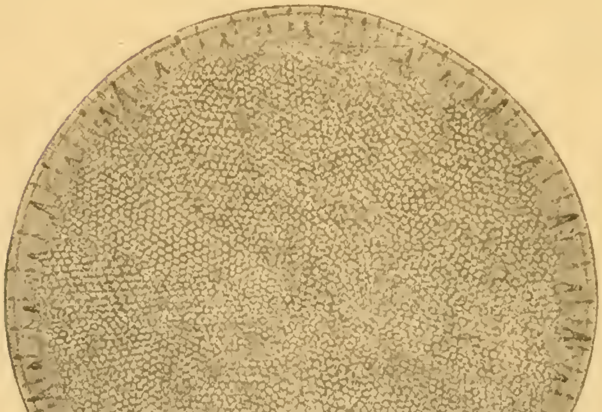
1866 Melosira costata Greville, p. 77, pl. 8, f. 3—6.
1878 Skeletonema costatum Cleve, p. 18.
1883 Van Heurck Synopsis, pl. 91, f. 4. 8.
1893 Schütt, p. 568, pl. 30, f. 1—2.
1898 Karsten, pl. 1, f. 1—7.
1900 Schütt, p. 482, pl. 12, f. 1—10.
1908 Gran, p. 15.
1910 Meunier, p. 259, pl. 28, f. 33—36.

Some few delicate chains were found at stations F 61, F 30 and F 23. The diameter of the cells was 4 $\mu$.

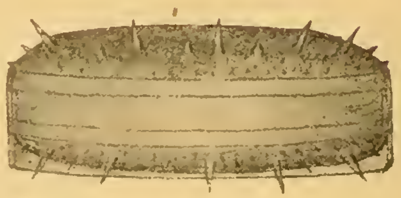
### *Thalassiosira baltica* (GRUN.).

(Fig. 13.)

1880 Coscinodiscus polyacanthus v. baltica Grunow, at Cleve and Grunow, p. 112.
1884 Grunow, p. 81, pl. 3, f. 17 a—b.
1891 Coscinodiscus balticus Cleve, p. 68.
1901 Thalassiosira baltica Ostenfeld, p. 290, f. 3.
1908 Gran, p. 18.



a.



b.

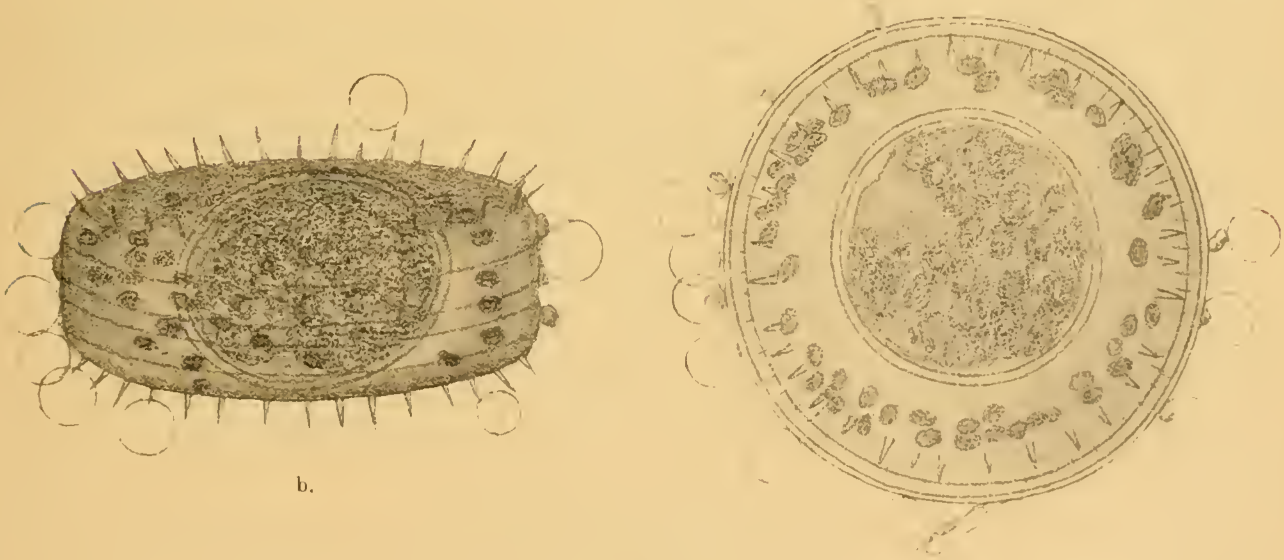
Fig. 13. *Thalassiosira baltica.*
a. Cell in front-view. $\frac{1150}{1}$.
b. Cell in side-view. $\frac{1100}{1}$.

As mentioned above it was difficult to distinguish this species from the Coscinodiscus lacustris. When using high magnifying powers on glowed material it was possible to see the structure of the valve distinctly. The valve is flat with delicately rounded edge. The pores are lying in radial rows being almost parallel within rather large sectors. On the specimen drawn, the diameter of wich was 67 $\mu$, were found about 14 sectors with 12—18 rows within each sector nearest the edge. The central pores are a little more scattered than the peripheral ones. Along the margin of the valve three series of spines could be seen. The row nearest the centre consisted of scattered large spines of varying size, while the two outer rows were formed of delicate spines. The spines of the row nearest the edge were placed just outside the small ones of the inner row. Generally two spines of each of the outer rows were found between two of the large spines of the innermost row. The margin of the valve had fine radial lines.

The size was inconstant, the diameter varying from 20 to 100 $\mu$.

As to the distribution it is once more to be noticed, that the numbers of the tables are a little too high. Some of the cells ought to have been noted as Coscinodiscus lacustris; but when the material was strongly heated it appeared that Thalassiosira baltica was generally more numerous than Coscinodiscus lacustris.

This diatom was found at all the stations and in every depth in quantities, which with the reservations mentioned varied between 120 cells pr. litre (station F 41, 50 metres) and 35400 cells pr. litre (station F 30, 80 metres). At the stations of the Gulf of Bothnia (F 23 and F 30) this species was more numerous than at the other stations.



b. a.

Fig. 14. *Thalassiosira baltica* with parasite.

a. Cell in front-view.

b. Cell in side-view.

$\frac{1200}{1}$

At all the stations except station F 41 some of the Thalassiosira-cells had enclosed in themselves a globular body, no doubt a parasite. (Fig. 14.) The cell-wall of the latter appeared to be of other material than the silicious cover of the diatom, the wall of the parasite turning violet when treated with chloroïodide of zinc. The contents of the parasite consisted of black-tinged grains larger than the chromatophores of the host-cell. Several little bubbles were found surrounding the parasite-carrying Thalassiosira-cells. These bubbles turned pale violet with chloroïodide of zinc, and they were not noticed in the healthy Thalassiosira-cells.

The parasite being some preliminary undetermined Chytridiaceae is probably not the species Olpidium mentioned by Gran, Meunier and Ostenfeld.

1900b Gran, p. 123, pl. 9, f. 8—9.
1910 Olpidium phycophagum Meunier, p. 222, pl. 25 etc.
1913 Kolderup Rosenvinge, p. 145.
1916 Ostenfeld, p. 158.

## B. FORMS THAT LIVE IN BRACKISH OR FRESH WATER. MARINE LITTORAL FORMS.

Besides the oceanic diatoms mentioned several species were found belonging to brackish and fresh water or to the littoral flora.

For the most part only solitary specimens were found of the species. Only Diatoma tenue occurred in rather large numbers, brackish water being its natural habitat; so it was thriving well in the Gulf of Finland, where the water had a low salinity.

As it was very difficult to determine the species when counting, they were all included in the tables under the same heading as given to this chapter with the exception of Diatoma tenue.

The occurrance of all these diatoms was mainly limited to the upper layers of station F 41, the most easterly station in the Gulf of Finland. At stations F 50, F 61 and F 23 a few specimens were found, while they were totally missing at stations F 74 and F 30.

The species noted have for the most part been determined on heated material according to the „Synopsis" of Van Heurck. The following species were found:

### *Amphiprora decussata* Grun. (?)

(Fig. 15 a.)

V. H. S. pl. 22, f. 13.
1894—95 Cleve I, p. 18.

Marine. One single fragment was found (station F 41, 10 metres).

### *Asterionella formosa* Hassal var. *gracillima* (Hantzsch) Grun.

(Fig. 15 d.)

V. H. S. p. 154, pl. 51. f. 19—24.
1908 Gran, p. 119.

Several cells of this species occurred at station F 41. Fresh water.

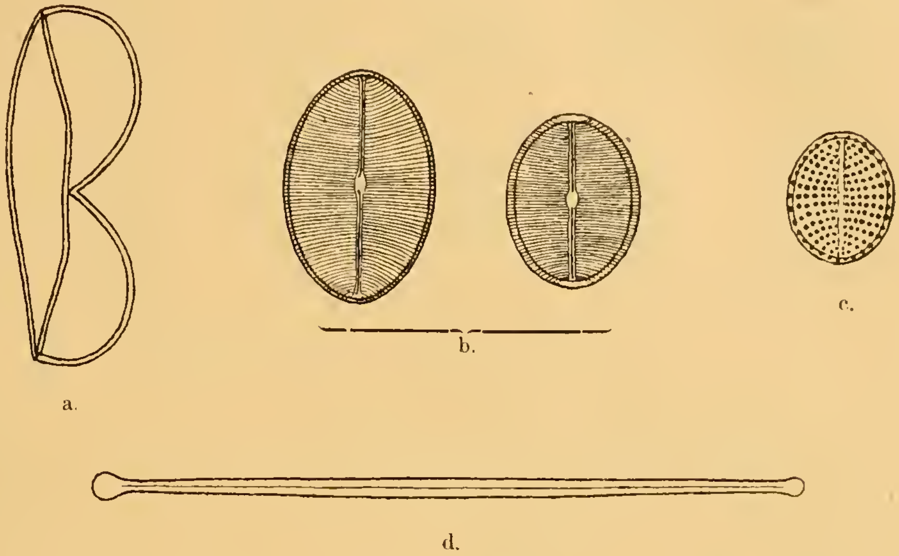


Fig. 15. $\frac{1000}{1}$.

a. *Amphiprora decussata?*
b. *Cocconeis Placentula.*
c. *Cocconeis Scutellum.*
d. *Asterionella formosa.*

### *Cocconeis Placentula* Ehr.

(Fig. 15 b.)

V. H. S. p. 133, pl. 30, f, 26—27.

Brackish and fresh water.

### *Cocconeis Scutellum* Ehr.

(Fig. 15 c.)

V. H. S. p. 132, pl. 29, f. 1—12

Marine.

## *Diatoma tenue* Ag.

(Fig. 17 b.)

V. H. S. p. 160, pl. 50, f. 1—15, 17—22.
1901 Levander.

This linear diatom from the brackish water was flourishing in the upper nutritive layers of station F 41. The greatest number was 47000 cells pr. litre (5 metres). At stations F 50, F 61 and F 23 only a few specimens occurred, while this species was missing at stations F 30 and F 74.

The length of the cells varied from 53 $\mu$ to 64 $\mu$.

## *Melosira distans* Kütz.

V. H. S. p. 199, pl. 86, f. 17—35

Fresh water.

## *Melosira granulata* (Ehr.) Ralfs.

V. H. S. p. 200, pl. 87, f. 7—27.
1910 Meunier, p. 273, pl. 30, f. 28.

Fresh water.

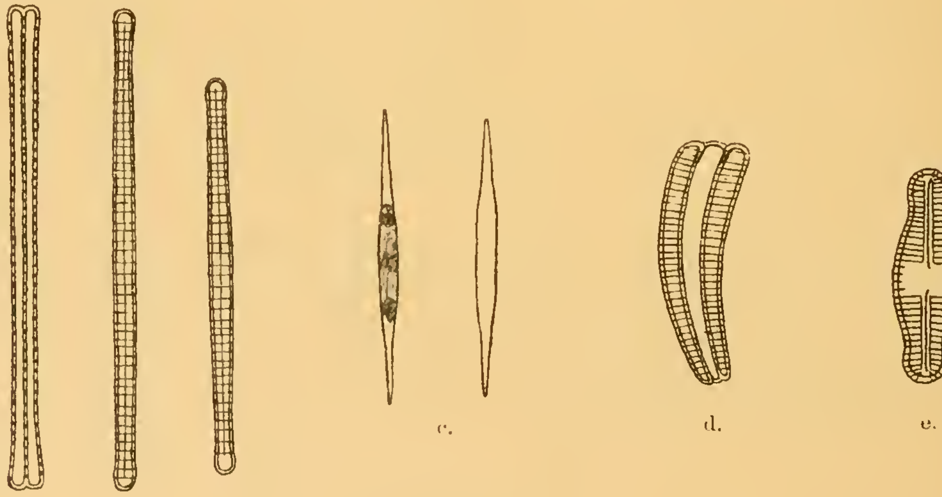




Fig. 17. $\frac{1000}{1}$.

a. *Nitzschia Sigma f. elongata.*
b. *Diatoma tenue.*
c. *Nitzschia sp.*
d. *Rhoicosphenia curvata.*
e. *Stauroneis Heufleri.*

## *Navicula cryptocephala* Kütz.

(Fig 16 f.)

V. H. S. p. 84. pl. 8, f. 2.

Fresh water.

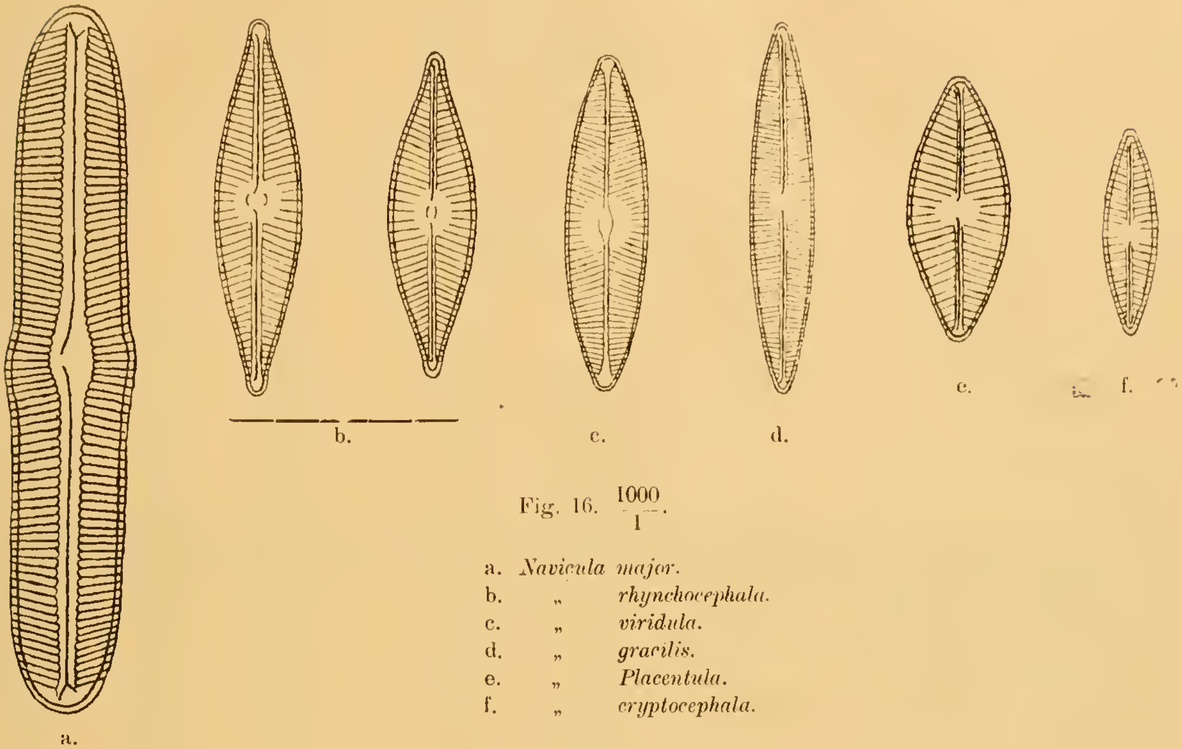



Fig. 16. $\frac{1000}{1}$.

a. *Navicula major.*
b. „ *rhynchocephala.*
c. „ *viridula.*
d. „ *gracilis.*
e. „ *Placentula.*
f. „ *cryptocephala.*

## *Navicula gracilis* Kütz.

(Fig. 16 d.)

V. H. S. p. 83, pl. 7, f. 7—8.

Fresh water.

## *Navicula major* Kütz.

(Fig. 16 a.)

V. H. S. p. 73, pl. 5, f. 3—4.

Fresh water.

## *Navicula Placentula* Ehr.

(Fig. 16 e.)

V. H. S. p. 87, pl. 8, f. 26—28.

Brackish water.



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### *Navicula rhynchocephala* KÜTZ.

(Fig. 16 b.)

V. H. S. p. 84, pl. 7, f. 30.

Brackish water.

### *Navicula viridula* KÜTZ.

(Fig. 16 c.)

V. H. S. p. 84, pl. 7, f. 25.

Fresh water.

### *Nitzschia Sigma f. elongata* W. SM.

(Fig. 17 a.)

V. H. S. p. 179, pl. 66, f. 7.

Brackish water.

### *Nitzschia sp.*

(Fig. 17 c.)

Small linear cells with tapering ends seen from the valve-side. This species occurred here and there at stations F 23, F 61, F 50 and F 41.

### *Rhabdonema arcuatum* (AG.) KÜTZ.

(Fig. 18 d.)

V. H. S. p. 166, pl. 54, f. 14.

Marine littoral form.

### *Rhoicosphenia curvata* GRUN.

(Fig. 17 d.)

V. H. S. p. 127, pl. 26, f. 1—3.

Fresh and saline water.

### *Stauroneis Heufleri* GRUN.

(Fig. 17 e.)

V. H. S. pl. 4, f. 1 A.
1894—95 Cleve I, p. 130.

Fresh water.

### *Synedra affinis* Kütz.

(Fig. 18 b.)

V. H. S. p. 153, pl. 41, f. 13.
1910 Meunier, p. 310, pl. 32, f. 54.

Saline and brackish water.

### *Synedra pulchella* Kütz.

(Fig. 18 a.)

V. H. S. p. 149, pl. 40, f. 28—29.
1910 Meunier, p. 311, pl. 32, f. 53.

Brackish and fresh water.

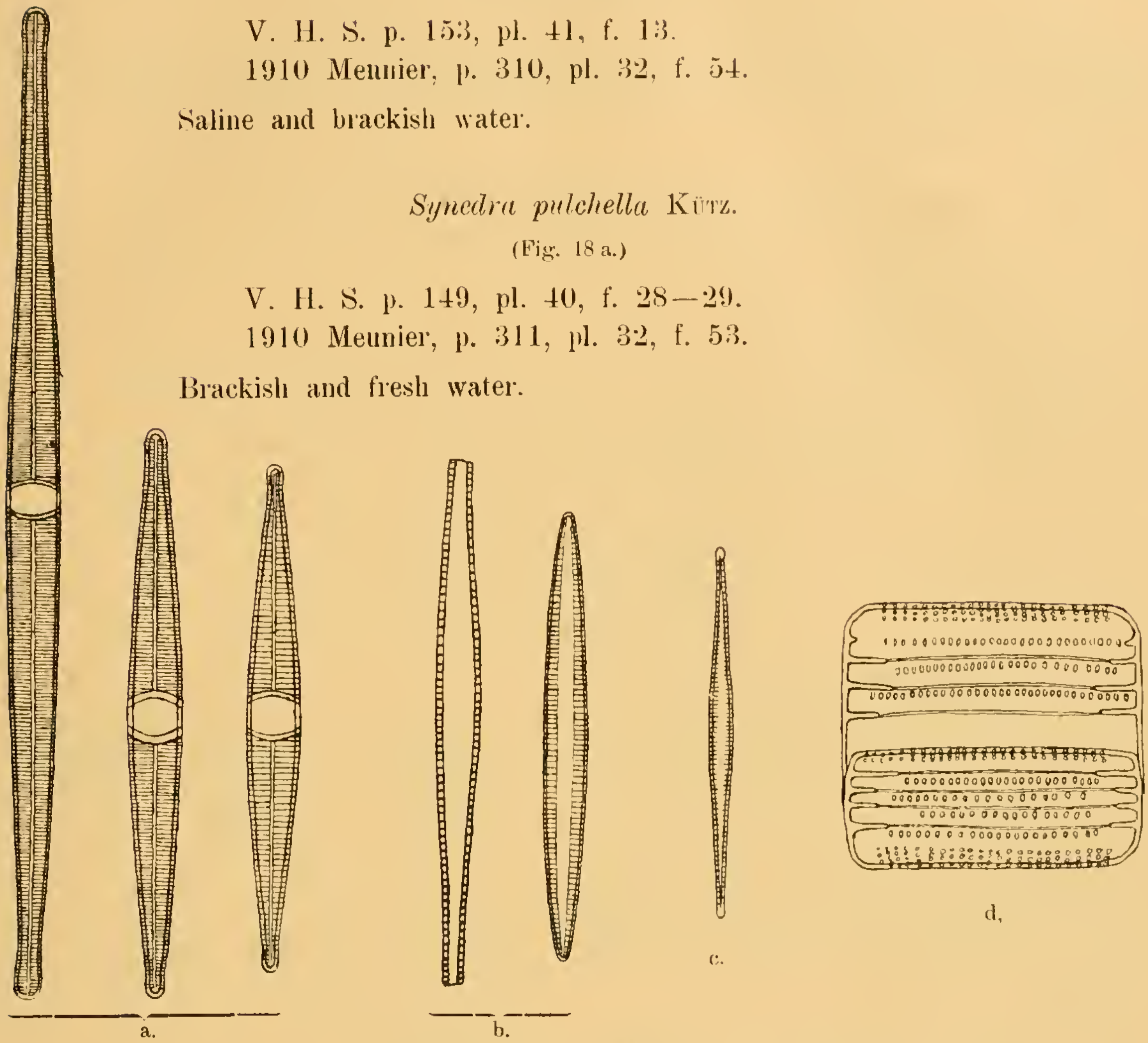



Fig. 18. $\frac{1000}{1}$.

a. *Synedra pulchella.*
b. „ *affinis.*
c. „ *radians.*
d. *Rhabdonema arcuatum.*

### *Synedra radians* (Kütz.) Grun.

(Fig. 18 c.)

V. H. S. p. 151, pl. 39, f. 11.

Fresh water.

In addition some single cells were found, which could not be determined being very indistinct or lying in an awkward position in the preparation.

## PERIDINIALES.

Compared with the diatoms the peridineae were very poorly represented, only a few species and specimens being found. The only exception was Gonyaulax catenata.

### *Dinophysis ovum* Schütt var. *baltica* Paulsen.

(Fig. 19 a.)

1900 Levander, p. 15, f. 1.
1908 Paulsen, p. 17.

This species occurred in small quantities at all the stations. The greatest number was 300 cells pr. litre (station F 50, 0 metres).

The length of the cells was about 50 μ, the breadth about 35 μ.

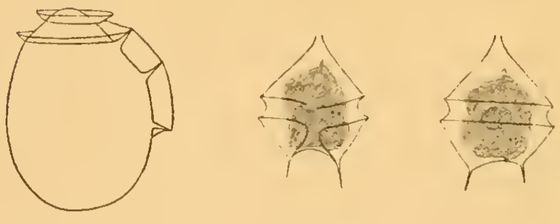
### *Glenodinium bipes* Paulsen.

(Fig. 19 b.)

1904 Paulsen, p. 21, f. 3—4.
1905 Lemmermann, p. 21.
1905 Peridinium minusculum Pavillard, p. 57, pl. 3, f. 7—9.
1908 Paulsen, p. 25.
1910 Meunier, p. 45, pl. 3, f. 18.

Glenodinium bipes was found at all the stations, most numerous at station F 23 with the maximum of 920 cells pr. litre in the depth of 30 metres. At stations F 30, F 74, F 50 and F 61 it occurred rather sparingly, and from station F 41 it is only noted once.

The length of the cells with spines was about 40 μ, the breadth about 27 μ.



a. b.

Fig. 19. $\frac{550}{1}$.

a. *Dinophysis baltica.*
b. *Glenovinium bipes.*

### *Glenodinium sp.*

Some small Glenodinium-cells occurred here and there, but not sufficiently numerous for exact determination. The species was scarcely Glenodinium danicum Paulsen, rather perhaps Glenodinium trochoideum Stein, noted from the Baltic in the „Nordisches Plankton". 1908 Paulsen, p. 23—25.

## *Gonyaulax catenata* (Levander) Kofoid.

(Fig. 20.)

1894 b Peridinium catenatum Levander.
1894 a Levander, p. 51, pl. 2, f. 22.
1897 Vanhöffen, pl. 5, f. 5.
1900 Cleve, p. 256.
1908 Paulsen, p. 63.
1910 Amylax catenata Meunier, p. 52, pl. 1 bis, f. 46—47, pl. 3, f. 28—34.
1911 Gonyaulax catenata Kofoid, p. 287.
1912 Jörgensen, p. 9.

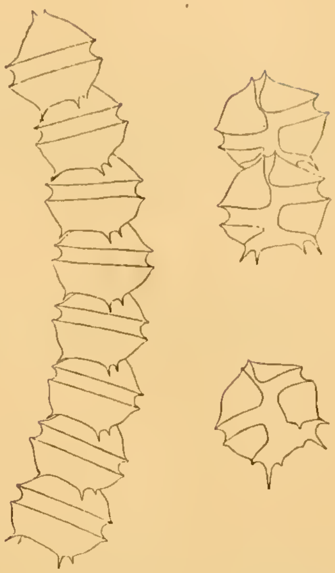


Fig. 20. *Gonyaulax catenata.* $\frac{500}{1}$.

It was very remarkable to find this peculiar peridineae, which occurred in chains consisting of up to ten cells. It was fairly common at all the stations except station F 30. At the last mentioned station the maximum was only 520 cells pr. litre (5 metres). It was more numerous in the Gulf of Finland than in the Gulf of Bothnia. At station F 41 it reaches the number of 65600 cells pr. litre (5 metres), at station F 50 the number of 56820 cells pr. litre (5 metres) and at station F 61 the number of 80440 cells pr. litre (0 metres). At the same time stations F 23 and F 74 generally show smaller numbers.

The breadth of the chains was 27—33 μ.

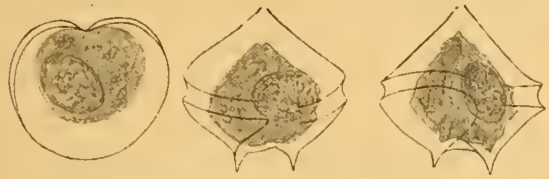


Fig. 21. *Peridinium finlandicum.* $\frac{475}{1}$.

## *Peridinium finlandicum* Paulsen.

(Fig. 21.)

1894 a P. divergens Levander, p. 51, pl. 2, f. 23, non Ehrenberg.
1900 P. divergens var. Levanderi Lemmermann.
1907 Paulsen, p. 15, f. 19.
1908 Paulsen, p. 51.

Peridinium finlandicum was found in small numbers fairly equally distributed in all the samples, especially from the Gulf of Finland. The maximum number was 500 cells pr. litre (station F 41, 0 metres). The breadth of the cells was 40—47 μ.

### *Peridinium sp.*

Some few Peridinium-cells were not determined, the material being too scarce. It is very probable, that they belonged to the two species *Peridinium balticum* (Levander) Lemmermann and *Peridinium achromaticum* Levander. Cells that were not determined occurred at all the stations. 1908 Paulsen, p. 62, 65.

### *Indeterminable Peridineae.*

Some cells being very indistinct could not be determined. No doubt they belonged to the genera Peridinium, Glenodinium and Gymnodinium.

## CILIATA.

In the material examined some animal plankton-forms especially ciliata were found. They were not in dominating numbers at any of the stations. Mesodinium rubrum occurred rather equally distributed over the whole area, and the Tintinnopsis-houses were very remarkable on account of their large proportions compared with many of the diatoms for instance.

### *Didinium Gargantua* Meunier

(Fig. 22.)

1910 Meunier, p. 154, pl. 15, f. 12.

This large form was found once and only on the second examination of the samples. For that reason it will not be found in the tables. It appeared at station F 50 in the depth of 10 metres. The breadth of the cell was 45 μ.

The specimen drawn was globular with two rings of cilia and protruding mouth, the gullet reaching very deep into the cell-body.

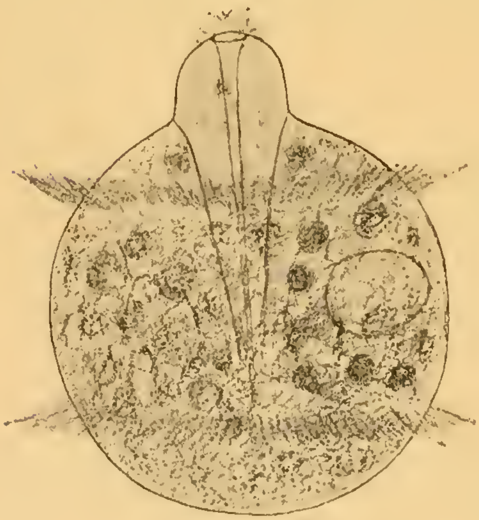


Fig. 22. *Didinium Gargantua.* $\frac{1150}{1}$.

### *Laboea sp.*

1915 Leegaard.

Specimens of this genus were very scattered. Some of the cells being indistinct were not determined. The following species were noted:

### *Laboea compressa* Leeg.

Occurrence: Station F 74, 0—20 metres.

*Laboea conica* Lohm.

1908 Lohmann, p. 171 (299), pl. 17, f. 18—20.
1910 Conocylis striata Meunier, p. 148, pl. 11, f. 22, pl. 23, f. 13.

Occurrence: Station F 23, 30 metres and station F 30, 40 metres.

*Laboea delicatissima* Leeg.

Occurrence: Stations F 50, F 61, F 74 and F 23.

*Laboea vestita* Leeg.

Occurrence: At all the stations.

*Lohmanniella oviformis* Leeg.

(Fig. 23.)

1915 Leegaard, p. 28.

This species occurred here and there at stations F 23, F 74, F 61, F 50 and somewhat more numerously at station F 41 in the upper water-layers, where the maximum was 3600 cells pr. litre in the depth of 5 metres.

*Lohmanniella stellaris* n. sp.

(Fig. 24.)

This infusoria is a somewhat flattened globule with the peristome at one of the flat sides. On the margin of the peristome, which has the form of an hexaster, a small number of short thick cilia could be seen, and outside these cilia a broad border of fine cilia or cilia-lamellas was found. The front half of the cell with the peristome and the cilia is more globular than the back half, which has the form of a truncated cone. The cell has no covering, it is not tinged with the chloroïodide of zinc.

Fig. 23.
*Lohmanniella oviformis.*
$\frac{1300}{1}$.

The material examined was constantly turned black by the preserving-fluid and was rather indistinct. On that account the description given above is incomplete, and the species will only be better known after closer study. It was difficult to determine the real proportions of the cilia as well as the details of the peristome.

The species has been placed under the genus Lohmanniella on account of the form of the cells and because the covering is missing. Closer examination will prove, whether this name of genus ought to be kept or not.

The breadth of the cell-body was 37—47 $\mu$.

Lohmanniella stellaris occurred at all the stations, most numerously at station F 74 with the maximum number of 1540 cells pr. litre in the depth of 20 metres. It was

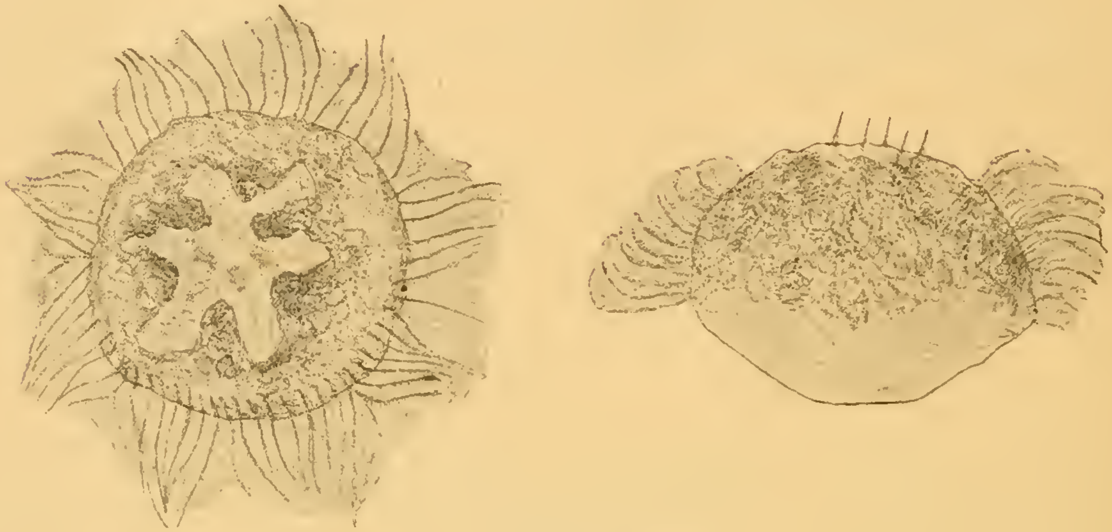


Fig. 24. *Lohmanniella stellaris.* $\frac{1200}{1}$.

often found too at stations F 23 and F 61, while it was sparsely distributed at stations F 30, F 50 and F 41.

### *Mesodinium rubrum* (LOHM.)

(Fig. 25.)

1908 Halteria rubra Lohmann, p. 175 (303), pl. 17, f. 19.
1910 Cyclotrichium sp. Meunier, p. 164, pl. 15, f. 7, pl. 20, f. 17.
1913 Hamburger und von Buddenbrock, p. 25.

While Mesodinium-cells with mouth-cavity were not found, the closed form occurred very frequently. The cells are oval with a drawn in central part, which is provided with a circle of cilia. The cells are filled up with a granular mass, which according to Lohmann consists of flagellates living in symbiosis with the Mesodinium-individuals.

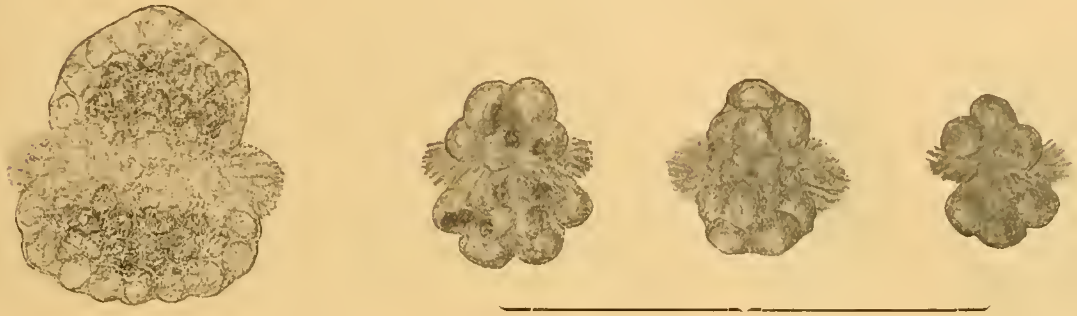
Apparently two sorts of these cells occurred, some large ones (length about 40—50 $\mu$) and some small ones (length about 20—30 $\mu$). But cells of the sizes between 30 and 40 $\mu$ existed too, yet they were comparatively rare.

The larger cells were rather assymmetrical as to the plan of the circle of cilia, one of the ends being flat and broad, the other a little higher and somewhat acute. The cells were filled with a number of grains, while the cilia were numerous and fine.

The smaller cells on the other hand were more equally formed at both ends. The contents consisted of a few grains, and the circle of cilia was not so dense as on the larger form.

It is a very doubtful case, as to whether we have two species, intermediate forms existing as mentioned above.

In the tables the two forms are separated from each other and noted as forma



a. b.

Fig. 25. *Mesodinium rubrum.*
a. F. major.
b. F. minor.
$\frac{950}{1}$

major and forma minor. The separation may be of some interest, if it should turn out later, that we have two different species.

Mesodinium rubrum is rather common though not very numerous at all the stations. Frequently the smaller form is more numerous than the larger one, but the relation between them can change from sample to sample at the same station (F 61), and at station F 74 the larger form was the dominating one.

The maximum number of the smaller form was 4440 cells pr. litre (station F 23, 5 metres), while that of the larger was 2740 cells pr. litre (station F 61, 10 metres).

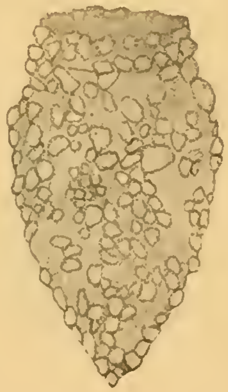


Fig. 26.
*Tintinnopsis beroidea.*
$\frac{950}{1}$

### *Tintinnopsis beroidea* (Stein) Levander.

(Fig. 26.)

1867 Stein II, p. 154.
1887 Daday, p. 547—548, pl. 19.
1900 Levander, p. 18.

The covering was formed as a narrow pitscher with acute base and a little drawn in opening. It was smaller than the following species (Tintinnopsis tubulosa), the length was 53 $\mu$, the breadth 32 $\mu$.

A few specimens of this species occurred at stations F 61 and F 74.

### *Tintinnopsis tubulosa* (LEVANDER.)

(Fig. 27—28.)

1900 Levander, p. 18—19.
1910 Meunier, pl. 12, f. 5—8, 10—11.

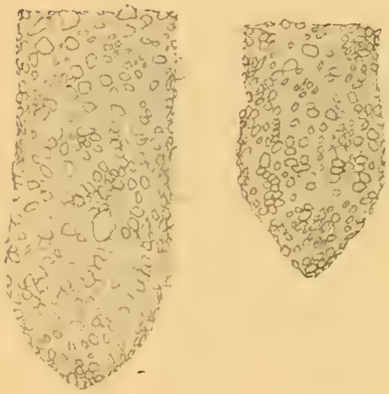

a. b.

Fig. 27. *Tintinnopsis tubulosa.*
a. F. major.
b. F. minor.
$\frac{475}{1}$.

The covering of this specimen was cylindrical with rounded or somewhat tapering base, which was often more or less widened. The length of the upper cylindrical part varied, being shorter than the lower widened part in some of the coverings, while others were almost of the same length as the lower part. Levander has (1900, p. 18) drawn a covering with the upper part considerably longer than the widened lower part. All these forms show different phases of growth on the marginal zone of the house. There is no reason to consider the different forms as varieties. When counting the cells I have distinguished the equally cylindrical form with rounded lower part (forma lineata) from the shorter form with acute widened lower part (forma minor) and the longer form with acute widened lower part (forma major). It may be of some interest to see, how the species varies, without attributing too great importance to the different forms.

The acute forms were the more common while the form with rounded base occurred rarely.

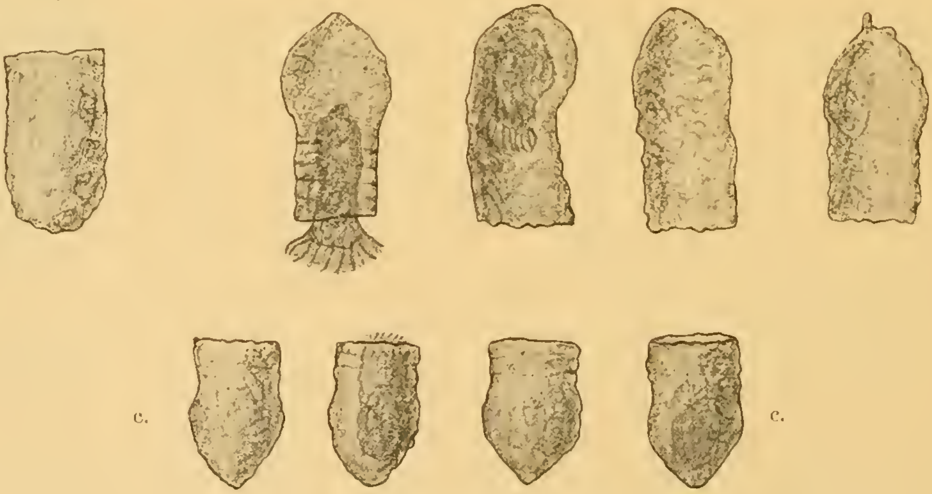



Fig. 28. *Tintinnopsis tubulosa.*
a. F. lineata.
b. F. major.
c. F. minor.
$\frac{280}{1}$.

The length of the coverings was 94—110 μ, the breadth of the opening was 35—45 μ, the breadth of the lower widened part was 37—51 μ.

Forma minor occurred at all the stations with the maximum of 680 cells pr. litre (station F 23, 20 metres), while forma major was found at stations F 50, F 61, F 74, F 30 and F 23 with the maximum of 200 cells pr. litre (station F 23, 10 metres), and forma lineata was scarce at stations F 41, F 50, F 61 and F 23.

### *Tinlinnopsis sp.*

A few cells were not determined as they were lying unfavorably in the preparation; but they belonged no doubt to one or other of the species before mentioned.

### *Undetermined Ciliata.*

Now and then some small round or oval ciliata, which could not be definitely determined appeared in the material.

## RHIZOPODA.

### *Difflugia lobostoma* Leidy.

1894 a Levander, p. 16, pl. 1, f. 10—13.

This solitary representative of rhizopoda in the material was an amoeba with almost globular covering, which contained small particles of sand. The pseudopod-opening was narrow.

It occurred very seldom (stations F 23, F 74 and F 50).

## SILICOFLAGELLATA.

### *Ebria tripartita* (Schum.) Lemm.

(Fig. 29.)

1908 Lemmermann, p. 32.

This species occurred in small quantities at all the stations. The maximum number was 1320 cells pr. litre (station F 50, 5 metres).

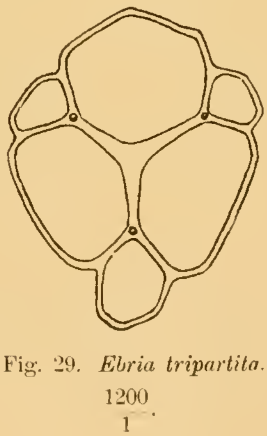


Fig. 29. *Ebria tripartita.* $\frac{1200}{1}$.

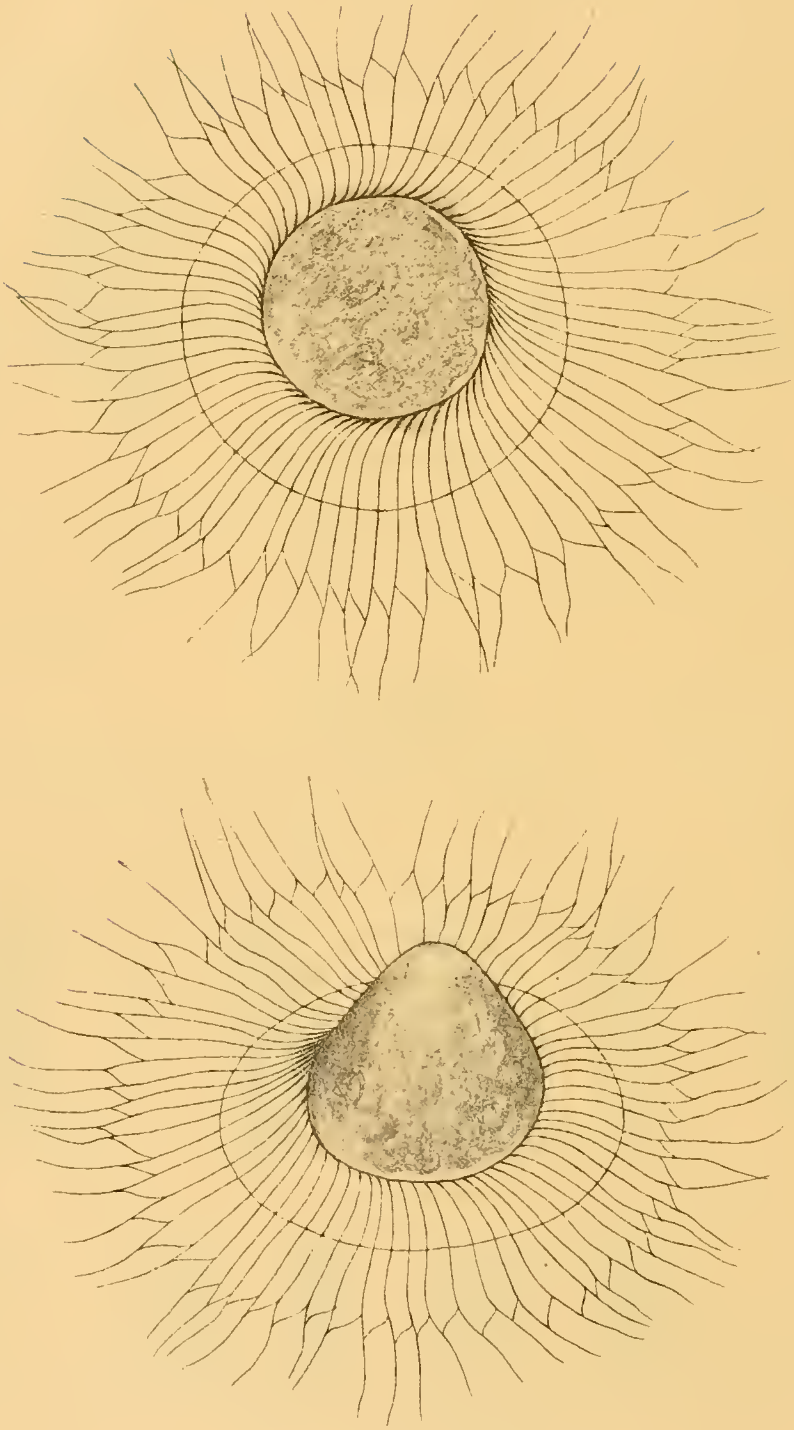


Fig. 30. *Radiosperma corbiferum.* $\frac{700}{1}$.

## SYSTEMATICALLY UNKNOWN FORMS.

### *Radiosperma corbiferum* Meunier.

(Fig. 30.)

1910 Meunier, p. 96, pl. 6, f. 16—18.

The cell-body is conical with rounded end. The base of the cone is surrounded by a funnel-shaped parachute, consisting of a rosette of S-shaped threads connected by a ring at a little distance from the cell-body and further out by obliquely placed threads. The parachute is not coloured with chloroïodide of zinc and is not totally distroyed by being sligtly heated. It consists very probably of chitin.

The diameter of the cell-body without parachute was about 42 μ.

This remarkable form is not very rare, it is noted from all the stations except F 50. In spite of the greatest number of individuals only being 200 cells pr. litre (station F 74), this species strongly attracted the attention on account of its size and the beautiful shape of its parachute.

### *Xanthidium multispinosum* Moebius.

(Fig. 31.)

1908 Trochisia multispinosa Lemmermann, p. 17.
1910 Kyste chitineux Meunier, pl. 23, f. 21.

This little cell is no doubt the resting-stage of some organism. The diameter was about 16 μ.

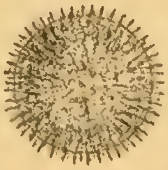


Fig. 31. *Xanthidium multispinosum.* $\frac{1100}{1}$

It occurred at all the stations in small quantities, most equally distributed at station F 23 with the maximum of 320 cells pr. litre in the depth of 30 metres.

# CHAPTER II.

## SURVEY OF THE STATIONS.

### STATION F 23.

On examination of the samples from the surface to the bottom we find at this station rather homogeneous conditions throughout. While the temperature decreases from 1,63° (0 metres) to 0,60° (80 metres) and increases up to 1,42° (100 metres), the salinity is fairly constant, viz: 5,43 $^0/_{00}$ from the surface to the depth of 40 metres and increasing up to 5,64 $^0/_{00}$ in the deeper layers. The oxygen-tension is registrated in four depths; the water is somewhat supersaturated from the surface to the depth of 50 metres; at the bottom on the contrary the quantity of oxygen has sunk to 83 $^0/_0$ of the saturation-quantity.

The plankton-distribution too shows homogeneous conditions, being fairly equal from 0 metres to 50 metres, the numbers decreasing a little in the deeper layers. Especially the diatoms, but also the peridineae and ciliata were fairly richly represented. The dominating species were the following:

Achnanthes taeniata }
Chaetoceras Wighami } without and with resting-spores.
Melosira hyperborea }
Fragilaria cylindrus
Thalassiosira baltica
Gonyaulax catenata
Mesodinium rubrum.

As a standard of the distribution we may take the sum of the diatoms in the different layers (table II):

*Table II. St. F 23. Number of cells pr. litre.*

| Depth (Metres) | 0 | 5 | 10 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|
| Diatoms | 94280 | 107200 | 116920 | 112040 | 131400 | 108760 | 99840 | 70860 | 53720 | 27800 |

With regards to the diatoms which have formed resting-spores (Achnanthes taeniata, Chaetoceras Wighami and Melosira hyperborea) we notice, that they are rapidly decreasing. The resting-spores are much more numerous than the spore-less cells; at the same time Chaetoceras Wighami is sinking, the maximum lying in the depth of 30 metres.

It is difficult to come to any conclusion as to the vegetating period of the spore-less forms from the material examined. Compared with station F 30, which will be dealt with next, station F 23 has a richer plankton than F 30, which is situated to the south of F 23 and has nearly the same hydrographical conditions. On that account it is very probable, that the plankton of station F 30 is decreasing, while that of station F 23 is not as far developed as that of station F 30. Probably the plankton of station F 23 will also be reduced. This circumstance is indicated by the fact that among the plankton many arctic forms are found, which will not thrive in warm water. The arctic forms will be mentioned later (p. 38).

## STATION F 30.

The hydrographical data do not differ much from those of the previous station. The temperature, salinity and the oxygen tension show somewhat higher numbers than at station F 23. The temperature decreases from 1,83° (0 metres) to 1,62° (40 metres) and then increases again to 2,26° (100 metres). The salinity varies in the upper layers above 50 metres between 5,59 $^0/_{00}$ and 5,57 $^0/_{00}$ and increases deeper to 6,20 $^0/_{00}$ (100 metres). The water is supersaturated with oxygen at any rate to the depth of 60 metres; observations from 90 metres and 122 metres show smaller numbers (89 $^0/_0$ and 89,4 $^0/_0$).

This station too is an example of great homogenity both as regards to the hydrographical data and the distribution of the plankton. The organisms are found fairly equally to the depth of 80 metres, then they decrease to the depth of 100 metres. While most of the species occur in small numbers, the diatom Thalassiosira baltica takes a peculiar position, occurring more numerously than at the previous station. The fact that its maximum (35400 cells pr. litre) lies as deep as 80 metres, while the surface only contains 8720 cells pr. litre, shows that the time of active production for this vegetating-period must be over. It looks as if the development of this species follows after that of the spore-forming diatoms mentioned above. At this station Achnanthes taeniata and Chaetoceras Wighami are about to disappear. It is not yet cleared up, as to whether Thalassiosira baltica forms resting-spores and disappears from the plankton or if it is found pelagically all the year round.

Besides Thalassiosira baltica the diatom Melosira hyperborea with resting-spores and the ciliat Mesodinium rubrum occurred in numbers worth mentioning.

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The following stations, F 41, F 50, F 61 and F 74 ly in a line stretching from east to west from the head of the Gulf of Finland to the most northerly part of the Baltic. Some species, for instance Achnanthes taeniata, decrease westwards from station to station, while others, such as Thalassiosira baltica, Gonyaulax catenata and Mesodinium rubrum, occur fairly equally at all the stations.

## STATION F 41.

This station was interesting on account of the very rich occurrence of Achnanthes taeniata, which showed the maximum of 3905000 cells pr. litre in the depth of 5 metres.

This station was distinguished from the other stations by the difference, which existed between the upper and the deeper layers of the water. This fact is not shown very distinctly by the temperature, which decreases from 3,60 (0 metres) to 1,31° (20 metres) and then increases to 3,26° (50 metres). But the salinity makes it very apparent being rather low (3,68 $^0/_{00}$—3,84 $^0/_{00}$) from 0 to 10 metres and considerably higher (5,32 $^0/_{00}$—6,35 $^0/_{00}$) from 20 to 50 metres. No observations of oxygen-tension were made.

The plankton-mass is found in the upper layers to the depth of 20 metres. We find, that the plankton-limit lies somewhat deeper than the hydrographical limit. This fact can be explained by the sinking of the plankton-organisms.

The water of the upper layers with low salinity has come from the river Neva, which has very nutritive water. It is probable that the flourishing state of the diatoms is owing to this rich supply of food from land.

The plankton was very poor in the water-layers deeper than 20 metres. Achnanthes taeniata was found in rather large numbers, but still reduced in comparison with those of the upper layers.

The following species were dominating:

Achnanthes taeniata with and without resting-spores.
Chaetoceras Wighami
Diatoma tenue
Fragilaria cylindrus
Melosira hyperborea with and without resting-spores.
Gonyaulax catenata.

Chaetoceras Wighami has not yet formed resting-spores. This diatom is probably increasing, while Achnanthes taeniata and Melosira hyperborea, which have formed resting-spores, are decreasing.

In order to illustrate the conditions of this station better, we will tabulate the numbers of the total sum of diatoms pr. litre and the numbers of Gonyaulax catenata pr. litre (table III):

*Table III. St. F 41. Number of cells pr. litre.*

| Depth (Metres) | 0 | 5 | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|---|
| Diatoms . . . . . | 3857900 | 4288600 | 3563200 | 1484420 | 188940 | 69740 | 28440 |
| Gonyaulax catenata . | 62000 | 65600 | 60800 | 61560 | 280 | 20 | 120 |

On account of the great supply of water from land a number of species of the fresh water was found at this station.

## STATION F 50.

This station has a lower temperature and a higher salinity than station F 41. The temperature decreases from 2,39° (0 metres) to 0,14° (30 metres), and then it increases towards deep water to 3,82° (75 metres). The salinity increases towards deep water from 5,05 ‰ (0 metres) to 9,16 ‰ (75 metres). Registrations of oxygen-tension are only made in the depths of 50 metres (73,4 %) and 76 metres (31,3 %).

The tables show the average decrease of the plankton towards the deep water. The sums of diatoms in the different depths are placed in the following table (table IV):

*Table IV. St. F 50. Number of cells pr. litre.*

| Depth (Metres) | 0 | 5 | 10 | 20 | 30 | 40 | 50 | 75 |
|---|---|---|---|---|---|---|---|---|
| Diatoms | 702460 | 769240 | 614480 | 669800 | 373620 | 316500 | 135240 | 92280 |

The table shows pretty equal distribution in the upper layers with the maximum in the depth of 5 metres. At this depth Gonyaulax catenata has its greatest number too.

The chief-species were:

Achnanthes taeniata without and with resting-spores.
Thalassiosira baltica
Gonyaulax catenata
Mesodinium rubrum.

Achnanthes taeniata was further developed here than at station F 41, in spite of the temperature being lower. But the water of station F 50 being less nutritif than at F 41, the formation of resting-spores has begun earlier at station F 50 than at F 41.

The resting-spores were far more numerous than the sporeless cells, especially in the upper layers. This indicates that the formation of spores has begun very recently, so that the sinking of the spores plays no part as yet.

## STATION F 61.

Both the temperature and the salinity are somewhat higher than at the beforementioned station (F 50). The temperature, that of the surface being 3,19°, was decreasing to 0,73° in the depth of 50 metres, and then it increased to 4,09° in the depth of 80 metres. The salinity was increasing from the surface (5,97 ‰) towards deep water and reached the amount of 9,47 ‰ in the depth of 80 metres.

The oxygen-tension is noted from the depths of 0 metres (102 %), 20 metres (100,3 %), 50 metres (94,5 %) and 98 metres (33,5 %).

This station is quite similar to the previous one with regards to the distribution of the plankton. We have the same species dominating, viz:

Achnanthes taeniata
Thalassiosira baltica
Gonyaulax catenata
Mesodinium rubrum.

Achnanthes taeniata was here passing over to the resting-stage. It appears to have developed further here than at station F 50, the maximum of the resting-spores having sunk to the depth of 40 metres.

## STATION F 74.

In comparison with the previously mentioned stations in the Gulf of Finland we find this station poorer concerning the plankton than those lying more to the east. This station is the most „oceanic" one of the whole area. It shows the highest temperature, the highest salinity and has probably the smallest amount of nutritive substances. The relatively high temperatures indicate, that this station has been less affected by the thawed water than the others.

The temperature varied in the same way as at the other stations, it amounted to 3,50° at the surface, to 1,88° at the depth of 50 metres and to 2,12° at the depth of 60 metres. The salinity was increasing from 6,82 ‰ (0 metres) to 7,23 ‰ (60 metres). The oxygen-tension was high too, 102 % in the depth of 0 metres, 102,1 % in the depth of 20 metres and 98,9 % in the depth of 50 metres.

The high oxygen-tension in the deep water indicates, that the water has been better mixed here than in the Gulf of Finland, the oxygen-tension of the deeper layers being very low there.

The most common species were following:

Achnanthes taeniata with resting-spores.
Thalassiosira baltica
Gonyaulax catenata
Lohmanniella stellaris
Mesodinium rubrum.

At this station Radiosperma corbiferum occurred with its maximum number, viz: 200 cells pr. litre.

The maximum numbers of most of the species worth mentioning were lying in the depths of 20—30 metres. This fact must be regarded as a secondary circumstance as the production takes place in the upper layers. Either the organisms must have sunk, or they have been brought downwards by vertical circulation.

Consequently the plankton-distribution too indicates the mixing of the water-layers just as the hydrographical data show it.

# CHAPTER III.

## REMARKS ON THE CONDITIONS OF LIFE AND THE QUALITY OF THE PLANKTON.

### SALINITY.

At all the stations the salinity was low, varying in the samples examined between 3,68 ‰ (station F 41, 0 metres) and 9,47 ‰ (station F 61, 80 metres). The salinities of the water at the bottom were as follows (table V):

*Table V. Salinities of the bottom.*

| Station | Salinity (‰) | Depth (Metres) |
|---|---|---|
| F 23 | 6,13 | 139 |
| F 30 | 6,22 | 122 |
| F 74 | 10,34 | 175 |
| F 61 | 9,76 | 98 |
| F 50 | 9,16 | 76 |
| F 41 | 6,35 | 50 |

Some of the species found can live in water of rather different salinity, while other forms are very sensible to differences of salinity.

We may mention some of the euryhaline species, viz:

Chaetoceras debile
Skeletonema costatum
Glenodinium bipes
Laboea sp.
Lohmanniella oviformis
Mesodinium rubrum
Tintinnopsis beroidea
Ebria tripartita.

These species, which are found over the whole Finnish area, also occur in the saline water of the Skager Rack and the North Sea.

On the contrary Diatoma tenue for instance is restricted to the inner part of the Gulf of Finland, where the water is only slightly saline; it is scarce or entirely lacking at the other stations, and it is not found at the open ocean.

## ICE-CONDITIONS.

From the maps of Witting (Jahrbuch 1912. pl. 3 and 4) we see that all the stations except F 41 have probably not been affected by the compact ice. Station F 50 was free from drift-ice on the $14^{th}$ of April and station F 41 on the $27^{th}$ of April. Such observations are lacking from the other stations.

At station F 41, where the winter-ice has lain, the diatoms have developed, when the melting of the ice has produced vertical circulation, and the ice at the same time has become so thin as to let the light pass down to the assimilating algae. The flourishing-period will here at station F 41 appear later than for instance at station F 74, where the water has been open all the winter. We have seen, that station F 41 has its maximum no doubt about the month of May, while the maximum of station F 74 very probably can be found earlier in the year.

Those places which are covered with ice longest are situated nearest to land. On that account they have a rich supply of food from the shore during the period of thawing. This fact has contributed to the rich production of station F 41, which has been mentioned earlier (p. 5).

At all the other stations, where the conditions vary gradually from the surface to the bottom, the cooling of the upper layers has produced vertical circulation, so that the nutritive substances have risen to the upper layers, and the organisms have begun to develop.

It appears that the plankton-forms of the material examined from the month of May for the most part are strongly decreasing.

## ARCTIC SPECIES.

When comparing the Finnish plankton with that of the other oceans, it is very remarkable, that so many species are common to the Arctic Ocean and the Finnish area. On the other hand the Cattegat, the Skager Rack and the North Sea have other plankton-forms, some few species excepted. On comparing the results of these examinations and the data of the „Nordisches Plankton" (1908) and Meunier (1910) we find the following species occurring in the Arctic Ocean as well as in the waters surrounding Finland:

Achnanthes taeniata
Chaetoceras debile
Chaetoceras Wighami
Coscinodiscus lacustris

Melosira hyperborea
Navicula Granii
— Vanhöffenii
Nitzschia longissima
Skeletonema costatum
Thalassiosira baltica (= Coscinodiscus polyacanthus var. baltica 1880 Cleve and Grunow, p. 112).

Cocconeis Scutellum
Melosira granulata
Rhabdonema arcuatum
Synedra affinis
— pulchella

Glenodinium bipes
Gonyaulax catenata

Didinium Gargantua
Laboea conica
Lohmanniella oviformis (1910 Meunier, pl. 18, f. 20).
Mesodinium rubrum
Tintinnopsis beroidea (?)
— tubulosa

Radiosperma corbiferum
Xanthidium multispinosum (1910 Meunier, pl. 23, f. 21).

Some of these species are found in those parts of the ocean, which connect the Arctic Ocean and the Baltic; but others have not been noted from the connecting area. These are:

Achnanthes taeniata
Coscinodiscus lacustris
Fragilaria cylindrus
Melosira hyperborea
Navicula Granii
— Vanhöffenii
Nitzschia longissima
Thalassiosira baltica

Gonyaulax catenata

Tintinnopsis tubulosa

Didinium Gargantua

Radiosperma corbiferum.

As has been suggested by Jörgensen (1912, p. 10) these species must be looked upon as relics from that time, when the Arctic Ocean was directly connected with the Baltic.

## SIZE OF THE SPECIES.

At first sight it looked as if many of the plankton-forms from the Finnish area had very small dimensions. We shall compare the sizes of some of the species of the Finnish material with the sizes, which are given in the „Nordisches Plankton" (table VI):

*Table VI. Size of the different species.*

| Species | Finnish material | Nord. Plankton |
|---|---|---|
| | Largeness (μ) of the chains | |
| Achnanthes taeniata | 13 — 30 | 11 — 40 |
| Chaetoceras debile | 8 — 12 | 12 — 39 |
| — Wighami | 6 — 17 | 7 — 15 |
| Fragilaria cylindrus | 14 — 35 | 6 — 32 |
| Melosira hyperborea | 10 — 23 | 14 — 30 |
| Navicula Granii | 42 | 50 — 57 |
| — Vanhöffenii | 45 | 29 — 45 |
| Skeletonema costatum | 4 | 7 — 16 |
| Gonyaulax catenata | 27 — 33 | 23 — 24 |

It appears that the chain-forming diatoms are small, for instance:

Achnanthes taeniata
Chaetoceras debile
Melosira hyperborea
Navicula Granii
Skeletonema costatum.

The occurrence of small forms in the brackish water of the Gulf of Finland agree with that fact, that the small forms have a larger area relatively to the volume than the big ones. Consequently they will easily keep themselves afloat in the brackish water.

But not all the forms are small. Fragilaria cylindrus and Gonyaulax catenata for instance exceed the size, which is noted in the „Nordisches Plankton“, and other species such as Thalassiosira baltica and Coscinodiscus lacustris show sometimes very large cells.

But a long series of observations is required before it is possible to express any decided opinion on this subject.

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T A B L E.  Q U A N T I T A T I V E  O C C U R R E N C E  O F  T H E  P L A N K T O N.

| Station | F 23 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (Metres) | 0 | 5 | 10 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| Temperature (°C.) | 1,63 | 1,60 | 1,58 | 1,60 | 1,58 | 1,30 | 1,37 | 1,39 | 0,60 | 1,42 |
| Salinity (‰) | 5,43 | 5,43 | 5,43 | 5,43 | 5,43 | 5,43 | 5,45 | 5,46 | 5,50 | 5,64 |
| Oxygen-tension (%) | 103,6 | | | 102,7 | | | 102,1 | | | |
| Quantity (cc.) examined | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 50 | 50 | 50 |
| *Diatomaceae.* | | | | | | | | | | |
| 1 Achnanthes taeniata | 4000 | 1760 | 5040 | 4000 | 2800 | 3600 | 4000 | 3160 | 2560 | 980 |
| 2 „ „ with rest.-sp. | 25960 | 30800 | 36100 | 34840 | 30320 | 32020 | 22120 | 22580 | 15700 | 11080 |
| 3 Chaetoceros Wighami | 760 | 2500 | 2320 | 1320 | 1460 | 400 | 700 | | | |
| 4 „ „ with rest.-sp. | 35600 | 30800 | 35360 | 37200 | 56840 | 34480 | 36080 | 14240 | 3800 | 700 |
| 5 Coscinodiscus lacustris | 1520 | 120 | 160 | 840 | 800 | 1440 | 1440 | 360 | 740 | 140 |
| 6 „ sp. | | | | | | | | | | |
| 7 Fragilaria cylindrus | 2640 | 4400 | 7120 | 6200 | 8600 | 5440 | 4320 | 1580 | 620 | |
| 8 Leptocylindrus minimus | | 440 | | 600 | | | | 80 | | |
| 9 Melosira hyperborea | | 120 | 280 | | 120 | | 120 | 100 | 140 | 120 |
| 10 „ „ with rest.-sp. | 8480 | 9400 | 12320 | 8800 | 11440 | 8720 | 8960 | 7760 | 6260 | 3340 |
| 11 Navicula sp. | 560 | 1000 | 1320 | 840 | 1080 | 880 | 800 | 600 | | 20 |
| 12 Nitzschia longissima | 80 | 40 | 280 | 120 | 240 | 40 | 120 | 60 | | |
| 13 Skeletonema costatum | | | | | | | 200 | | | |
| 14 Thalassiosira baltica | 13880 | 16320 | 15640 | 16000 | 17240 | 20200 | 20080 | 20040 | 23500 | 11280 |
| 15 „ „ with parasite | 40 | 160 | 240 | 240 | 200 | 240 | 120 | 140 | 140 | 60 |
| 16 Forms that live in br. or fr. water; Marine littoral forms | 760 | 280 | 680 | 80 | 360 | 400 | 120 | 120 | 260 | 60 |
| 17 Diatoma tenue | | | | | | | | 40 | | 20 |
| 18 Sum of diatoms | 94280 | 107200 | 116920 | 112040 | 131400 | 108760 | 99840 | 70800 | 53720 | 27800 |
| *Peridiniales.* | | | | | | | | | | |
| 19 Dinophysis baltica | | | 40 | 80 | | 120 | | | 140 | 40 |
| 20 Glenodinium bipes | 560 | 440 | 560 | 920 | 680 | 280 | 160 | 220 | 40 | 20 |
| 21 „ sp. | 160 | 160 | 120 | | 80 | 40 | 160 | | | 40 |
| 22 Gonyaulax catenata | 2880 | 4880 | 2200 | 3440 | 4000 | 1000 | 960 | 400 | 340 | 600 |
| 23 Peridinium finlandicum | 240 | 160 | 80 | 240 | | 120 | 80 | 40 | 120 | 40 |
| 24 „ sp. | | 80 | | | | | | | | |
| 25 Peridiniales indeterm. | | 40 | | | | 40 | | | | 40 |
| *Ciliata.* | | | | | | | | | | |
| 26 Laboea compressa | | | | | | | | | | |
| 27 „ conica | | | | | 40 | | | | | |
| 28 „ delicatissima | 160 | 160 | 80 | 600 | 200 | | | | | |
| 29 „ vestita | 200 | 300 | 280 | 120 | 680 | | | | | |
| 30 „ sp. | | | | | 120 | 40 | 80 | 20 | | |
| 31 Lohmanniella oviformis | 80 | | | 40 | | | | 20 | | 20 |
| 32 „ stellaris n. sp. | 480 | 480 | 200 | 480 | 520 | 120 | 320 | 120 | 60 | 20 |
| 33 Mesodinium rubrum f. major | 1080 | 1120 | 800 | 1080 | 600 | 320 | 280 | 480 | 300 | 120 |
| 34 „ „ f. minor | 3000 | 4440 | 2560 | 4120 | 4280 | 2080 | 3600 | 2240 | 1160 | 200 |
| 35 Tintinnopsis beroidea | | | | | | | | | | |
| 36 „ tubulosa f. major | 80 | 80 | 200 | 100 | 120 | 160 | 80 | 40 | | 40 |
| 37 „ „ f. minor | 560 | 440 | 560 | 680 | 280 | 160 | 80 | 40 | 40 | 40 |
| 38 „ „ f. lineata | | | | 40 | | | | 20 | | |
| 39 „ sp. | | | | | | | | | | |
| 40 Ciliata indeterm. | 120 | 160 | 200 | 240 | 120 | | | | | 20 |
| *Rhizopoda.* | | | | | | | | | | |
| 41 Difflugia lobostoma | | 40 | | | | | | 40 | | |
| *Silicoflagellata.* | | | | | | | | | | |
| 42 Ebria tripartita | 40 | 400 | 120 | 200 | 440 | 160 | 280 | 120 | 60 | 60 |
| *Crustacea.* | | | | | | | | | | |
| 43 Nauplii | 40 | 40 | | | | | | | | |
| *Systematically Unknown Forms.* | | | | | | | | | | |
| 44 Radiosperma corbiferum | | | | 120 | | 80 | 80 | 40 | 40 | 40 |
| 45 Xanthidium multispinosum | 40 | 160 | 100 | 160 | 320 | 120 | 120 | 100 | | |
| 46 Pollen of foliferous trees | 200 | 200 | 320 | 80 | 120 | 40 | 120 | 340 | 200 | 120 |
| 47 „ of firs | | | | | | | | | | |
| 48 Round cells | | | | | | | | | | |
| 49 Indeterminable cells | 80 | | 80 | | | | | 40 | 20 | 40 |

| Station | F 30 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (Metres) | 0 | [illegible] | 10 | 20 | 30 | 40 | 50 | 60 | 80 | 100 |
| Temperature (°C.) | 1,83 | 1,64 | 1,68 | 1,64 | 1,65 | 1,62 | 1,64 | 1,64 | 1,71 | 2,26 |
| Salinity (‰) | 5,50 | 5,57 | 5,57 | 5,57 | 5,59 | 5,59 | 5,59 | 5,61 | 5,77 | 6,20 |
| Oxygen-tension (%) | 104,1 | | | 103,3 | | | 102,7 | 103,8 | | |
| Quantity (cc.) examined | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *Diatomaceae.* | | | | | | | | | | |
| 1 Achnanthes taeniata | | 440 | | | | | | | | |
| 2 „ „ with rest.-sp. | | | 120 | 80 | | 160 | 460 | 100 | 300 | 80 |
| 3 Chaetoceros Wighami | | | | | | 20 | | | | |
| 4 „ „ with rest.-sp. | 60 | 160 | 140 | 40 | 80 | 140 | 80 | 160 | 20 | 320 |
| 5 Coscinodiscus lacustris | 340 | 700 | 720 | 640 | 100 | 200 | 160 | 120 | 300 | |
| 6 „ sp. | | | | | | | | | | |
| 7 Fragilaria cylindrus | | | | | | | | | | |
| 8 Leptocylindrus minimus | | | | | | | | | | |
| 9 Melosira hyperborea | | | | | | | | | | |
| 10 „ „ with rest.-sp. | 1040 | 4180 | 2340 | 1620 | 1420 | 2400 | 2300 | 1980 | 1960 | 3400 |
| 11 Navicula sp. | | | | | | | | | | |
| 12 Nitzschia longissima | | | | | | | | | | |
| 13 Skeletonema costatum | 80 | | | 240 | 260 | | | 80 | | |
| 14 Thalassiosira baltica | 8720 | 21980 | 20960 | 23200 | 23520 | 23820 | 25380 | 29020 | 35400 | 17880 |
| 15 „ „ with parasite | | 20 | 40 | 100 | 60 | 60 | 20 | 80 | 80 | |
| 16 Forms that live in br. or fr. water; Marine littoral forms | 40 | | | | | | | 280 | | |
| 17 Diatoma tenue | | | | | | | | | | |
| 18 Sum of diatoms | 10280 | 27540 | 24320 | 25920 | 25740 | 26800 | 28400 | 31820 | 38120 | 21680 |
| *Peridiniales.* | | | | | | | | | | |
| 19 Dinophysis baltica | 40 | 20 | 20 | 40 | | 40 | 60 | 20 | | |
| 20 Glenodinium bipes | | 40 | 60 | 20 | 20 | 40 | 20 | 20 | | |
| 21 „ sp. | | 20 | | | | 20 | | 20 | | |
| 22 Gonyaulax catenata | 120 | 520 | 280 | 280 | 280 | 340 | 340 | 500 | 180 | 40 |
| 23 Peridinium finlandicum | 20 | 60 | | | | | 20 | | 60 | 100 |
| 24 „ sp. | | 20 | | 20 | 40 | | 40 | 60 | 20 | |
| 25 Peridiniales indeterm. | | | | | | | | | | |
| *Ciliata.* | | | | | | | | | | |
| 26 Laboea compressa | | | | | | | | | | |
| 27 „ conica | | | | | | 20 | | | | |
| 28 „ delicatissima | | | | | | | | | | |
| 29 „ vestita | | 80 | 20 | 60 | 60 | 180 | 40 | | | |
| 30 „ sp. | | | | | | | | | | |
| 31 Lohmanniella oviformis | | | | | | | | | | |
| 32 „ stellaris n. sp. | 20 | 20 | 80 | 80 | 20 | 40 | 20 | 80 | 60 | |
| 33 Mesodinium rubrum f. major | 600 | 500 | 420 | 600 | 600 | 400 | 160 | 350 | 120 | 160 |
| 34 „ „ f. minor | 280 | 1560 | 1100 | 1100 | 600 | 1560 | 700 | 1260 | 340 | 300 |
| 35 Tintinnopsis beroidea | | | | | | | | | | |
| 36 „ tubulosa f. major | | | 20 | | | | 60 | 20 | 20 | |
| 37 „ „ f. minor | | | 20 | 20 | | 20 | 20 | 20 | 60 | 20 |
| 38 „ „ f. lineata | | | | | | | | | | |
| 39 „ sp. | 20 | 20 | | 20 | 20 | | | | | |
| 40 Ciliata indeterm. | 40 | | | | | 80 | 60 | | | |
| *Rhizopoda.* | | | | | | | | | | |
| 41 Difflugia lobostoma | | | | | | | | | | |
| *Silicoflagellata.* | | | | | | | | | | |
| 42 Ebria tripartita | 100 | 60 | 80 | 60 | | 20 | 100 | 40 | | 20 |
| *Crustacea.* | | | | | | | | | | |
| 43 Nauplii | | | | | | | | | | |
| *Systematically Unknown Forms.* | | | | | | | | | | |
| 44 Radiosperma corbiferum | 20 | | 20 | | | 60 | 60 | | 40 | |
| 45 Xanthidium multispinosum | 20 | 20 | | 20 | | 20 | | | | 20 |
| 46 Pollen of foliferous trees | 100 | 120 | 80 | 40 | 60 | 40 | 80 | 160 | | 20 |
| 47 „ of firs | | | | | | | | | 20 | |
| 48 Round cells | 120 | 140 | 80 | 20 | 20 | 200 | 100 | 300 | 40 | |
| 49 Indeterminable cells | | | | | | | | | | |

| Station | F 74 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth (Metres) | 0 | 5 | 10 | 20 | 30 | 40 | 50 | 60 |
| Temperature (°C.) | 3,50 | 3,42 | 3,05 | 2,89 | 2,73 | 2,53 | 1,88 | 2,12 |
| Salinity (‰) | 6,82 | 6,82 | 6,82 | 6,82 | 6,85 | 6,94 | 7,05 | 7,23 |
| Oxygen-tension (%) | 102,0 | | | 102,1 | | | 98,9 | |
| Quantity (cc.) examined | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *Diatomaceae.* | | | | | | | | |
| 1 Achnanthes taeniata | 160 | 240 | | 900 | 460 | 160 | 320 | |
| 2 „ „ with rest.-sp. | 5040 | 7920 | 9100 | 16880 | 24000 | 10080 | 9600 | 2420 |
| 3 Chaetoceros Wighami | | | | 20 | | | | |
| 4 „ „ with rest.-sp. | 40 | 100 | | 20 | 60 | 60 | 20 | 20 |
| 5 Coscinodiscus lacustris | | 40 | 80 | 80 | 80 | 60 | 40 | 400 |
| 6 „ sp. | 20 | | | | 20 | 40 | | 60 |
| 7 Fragilaria cylindrus | | | | | | | 80 | 60 |
| 8 Leptocylindrus minimus | | | 400 | 340 | | | 160 | |
| 9 Melosira hyperborea | | | | | | | | |
| 10 „ „ with rest.-sp. | 220 | 260 | 120 | 280 | 460 | 160 | 280 | |
| 11 Navicula sp. | | | | | | | | |
| 12 Nitzschia longissima | | | | | | | | |
| 13 Skeletonema costatum | | | | | | | | |
| 14 Thalassiosira baltica | 2120 | 2880 | 4020 | 1100 | 4580 | 4060 | 3400 | 3020 |
| 15 „ „ with parasite | 20 | 60 | 60 | 20 | | | | 60 |
| 16 Forms that live in br. or fr. water; Marine littoral forms | | | | | | | | |
| 17 Diatoma tenue | | | | | | | | |
| 18 Sum of diatoms | 7620 | 11500 | 13840 | 22440 | 29700 | 14600 | 13900 | 6040 |
| *Peridiniales.* | | | | | | | | |
| 19 Dinophysis baltica | 60 | 20 | 20 | 40 | 80 | | 20 | |
| 20 Glenodinium bipes | 40 | | 80 | 40 | 20 | | | 120 |
| 21 „ sp. | | 20 | 20 | | 40 | | | 20 |
| 22 Gonyaulax catenata | 1900 | 8160 | 30800 | 35120 | 12300 | 7660 | 6020 | 8500 |
| 23 Peridinium finlandicum | 20 | 20 | 20 | 20 | 40 | 60 | 100 | 60 |
| 24 „ sp. | 60 | 40 | 160 | 80 | 20 | | | 60 |
| 25 Peridiniales indeterm. | | | | | | | | |
| *Ciliata.* | | | | | | | | |
| 26 Laboea compressa | 40 | 220 | 100 | 40 | | | | |
| 27 „ conica | | | | | | | | |
| 28 „ delicatissima | | 60 | 40 | 20 | | | | |
| 29 „ vestita | | 40 | 120 | 20 | | | | |
| 30 „ sp. | | | | 20 | | | | 40 |
| 31 Lohmanniella oviformis | | | 20 | 20 | | | | |
| 32 „ stellaris n. sp. | 1020 | 1340 | 1240 | 1740 | 1120 | 380 | 180 | |
| 33 Mesodinium rubrum f. major | 240 | 900 | 2100 | 2680 | 940 | 200 | 340 | 840 |
| 34 „ „ f. minor | | 140 | 220 | 520 | 700 | 140 | 140 | 80 |
| 35 Tintinnopsis beroidea | | | | 20 | | | | |
| 36 „ tubulosa f. major | | 60 | 140 | 40 | 60 | | 60 | 60 |
| 37 „ „ f. minor | | | | 20 | 20 | 40 | 100 | 60 |
| 38 „ „ f. lineata | | | | | | | | |
| 39 „ sp. | | | | | 20 | | | |
| 40 Ciliata indeterm. | 20 | | 20 | 20 | 20 | 20 | | |
| *Rhizopoda.* | | | | | | | | |
| 41 Difflugia lobostoma | 20 | 40 | | | | | | |
| *Silicoflagellata.* | | | | | | | | |
| 42 Ebria tripartita | 240 | 300 | 180 | 720 | 340 | 120 | 100 | 20 |
| *Crustacea.* | | | | | | | | |
| 43 Nauplii | | | | | | | | |
| *Systematically Unknown Forms.* | | | | | | | | |
| 44 Radiosperma corbiferum | 200 | 140 | 120 | 160 | 160 | 200 | 180 | 80 |
| 45 Xanthidium multispinosum | | 20 | 20 | | | | | 20 |
| 46 Pollen of foliferous trees | 20 | 160 | | 300 | 140 | | 20 | 20 |
| 47 „ of firs | | | | 20 | | | | |
| 48 Round cells | 20 | | 40 | 20 | 20 | 20 | | 20 |
| 49 Indeterminable cells | 20 | 40 | | 60 | | | | |

| Station | F 61 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (Metres) | 0 | 5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
| Temperature (°C.) | 3,19 | 3,13 | 3,01 | 2,49 | 0,98 | 0,88 | 0,73 | 1,07 | 3,43 | 4,09 |
| Salinity (‰) | 5,97 | 5,95 | 6,04 | 6,38 | 6,73 | 6,82 | 6,83 | 6,94 | 8,55 | 9,47 |
| Oxygen-tension (%) | 102,0 | | | 100,3 | | | 94,5 | | | |
| Quantity (cc.) examined | 25 | 25 | 50 | 25 | 25 | 25 | 25 | 50 | 50 | 50 |
| *Diatomaceae.* | | | | | | | | | | |
| 1 Achnanthes taeniata | 4120 | 6040 | 3360 | 6280 | 15000 | 65800 | 44400 | 27760 | 10400 | 1260 |
| 2 „ „ with rest.-sp. | 41000 | 48560 | 56400 | 49640 | 60240 | 77120 | 61200 | 35720 | 22640 | 12380 |
| 3 Chaetoceros Wighami | | | | | | | 120 | | | |
| 4 „ „ with rest.-sp. | | | | | | 40 | | | | |
| 5 Coscinodiscus lacustris | | 80 | | | 600 | 840 | 1080 | 1200 | 40 | |
| 6 „ sp. | | | | 40 | 120 | | | 180 | 80 | |
| 7 Fragilaria cylindrus | 360 | 120 | 20 | | 80 | 320 | 280 | 240 | 560 | 300 |
| 8 Leptocylindrus minimus | | | | | | | | | | |
| 9 Melosira hyperborea | | | | | 200 | | | 100 | | |
| 10 „ „ with rest.-sp. | 400 | 680 | 140 | 680 | 680 | 1400 | 1320 | 80 | 40 | 40 |
| 11 Navicula sp. | 160 | 200 | | 40 | 160 | | 120 | | | |
| 12 Nitzschia longissima | | | | | | | | | | |
| 13 Skeletonema costatum | | | | 160 | | | 160 | | | |
| 14 Thalassiosira baltica | 1440 | 2200 | 1980 | 1760 | 4700 | 5720 | 14480 | 9380 | 1400 | 460 |
| 15 „ „ with parasite | | | | | 120 | 40 | 40 | 100 | 20 | 20 |
| 16 Forms that live in br. or fr. water; Marine littoral forms | | | 20 | 40 | | | 40 | 20 | 60 | |
| 17 Diatoma tenue | | | | | | | | 20 | 60 | 80 |
| 18 Sum of diatoms | 47480 | 57880 | 61020 | 58640 | 81900 | 151280 | 123240 | 74800 | 35300 | 14540 |
| *Peridiniales.* | | | | | | | | | | |
| 19 Dinophysis baltica | 160 | 120 | 80 | 40 | 40 | | | | | 20 |
| 20 Glenodinium bipes | 80 | 200 | 160 | | 40 | | | 20 | | |
| 21 „ sp. | | 120 | 260 | 160 | 40 | | | 140 | | 40 |
| 22 Gonyaulax catenata | | | | | | | | | | |
| 23 Peridinium finlandicum | | | | | | | | | | |
| 24 „ sp. | | | | | | | | | | |
| 25 Peridiniales indeterm. | | | 40 | | | | | 20 | | |
| *Ciliata.* | | | | | | | | | | |
| 26 Laboea compressa | | | | | | | | | | |
| 27 „ conica | | | | | | | | | | |
| 28 „ delicatissima | 80 | 60 | | 40 | | | | | | |
| 29 „ vestita | 40 | 40 | 200 | | | | 40 | | | |
| 30 „ sp. | | 120 | 80 | 80 | | | 40 | | | |
| 31 Lohmanniella oviformis | | 80 | 240 | | | | | | | |
| 32 „ stellaris n. sp. | 560 | 920 | 1220 | 520 | 120 | | | | | |
| 33 Mesodinium rubrum f. major | 920 | 1320 | 2740 | 240 | 400 | 120 | 240 | 320 | 300 | 20 |
| 34 „ „ f. minor | 1040 | 1000 | 1380 | 240 | 280 | 320 | 720 | 120 | | |
| 35 Tintinnopsis beroidea | 40 | 80 | 140 | 80 | | | | | 20 | |
| 36 „ tubulosa f. major | | | 100 | | 40 | | | 20 | | |
| 37 „ „ f. minor | | 120 | 60 | 40 | 40 | | | 20 | | |
| 38 „ „ f. lineata | 40 | 80 | 40 | | | | | | | |
| 39 „ sp. | | | | | | | | | | |
| 40 Ciliata indeterm. | 80 | 120 | 260 | 80 | 200 | 80 | | | | |
| *Rhizopoda.* | | | | | | | | | | |
| 41 Difflugia lobostoma | | | | | | | | | | |
| *Silicoflagellata.* | | | | | | | | | | |
| 42 Ebria tripartita | 440 | 180 | 460 | 120 | 280 | 560 | 620 | 80 | 80 | |
| *Crustacea.* | | | | | | | | | | |
| 43 Nauplii | | | | | | | | | | |
| *Systematically Unknown Forms.* | | | | | | | | | | |
| 44 Radiosperma corbiferum | 10 | | | | 40 | | 10 | | 20 | |
| 45 Xanthidium multispinosum | | | | | | | 40 | | | |
| 46 Pollen of foliferous trees | 120 | 40 | 160 | 240 | 120 | 40 | 400 | | 20 | 80 |
| 47 „ of firs | | | | | | | | | | |
| 48 Round cells | 40 | 80 | 100 | 160 | 160 | 120 | | | 20 | |
| 49 Indeterminable cells | | | 20 | | 40 | 80 | | | | |

| Station | F 50 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth (Metres) | 0 | 5 | 10 | 20 | 30 | 40 | 50 | 75 |
| Temperature (°C.) | 2,39 | 2,21 | 2,20 | 0,72 | 0,14 | 0,49 | 1,09 | 3,82 |
| Salinity (‰) | 5,05 | 5,05 | 5,07 | 5,46 | 6,09 | 6,46 | 6,94 | 9,16 |
| Oxygen-tension (%) | | | | | | | 73,4 | |
| Quantity (cc.) examined | 50 (10) | 50 (10) | 50 (10) | 50 (10) | 50 (10) | 50 (10) | 50 (25) | 25 |
| *Diatomaceae.* | | | | | | | | |
| 1 Achnanthes taeniata | 42900 | 40000 | 29400 | 210300 | 103300 | 81900 | 37080 | 52800 |
| 2 „ „ with rest.-sp. | 650400 | 718800 | 574800 | 449600 | 286900 | 227300 | 95560 | 32440 |
| 3 Chaetoceros Wighami | 40 | 80 | | | | 80 | | |
| 4 „ „ with rest.-sp. | | | | 40 | | 40 | | |
| 5 Coscinodiscus lacustris | | | 20 | | | 140 | | |
| 6 „ sp. | | | | | | | | |
| 7 Fragilaria cylindrus | 720 | 500 | 660 | 640 | 740 | 1520 | 680 | 5240 |
| 8 Leptocylindrus minimus | | | | | | | | |
| 9 Melosira hyperborea | | | | | | 40 | 40 | |
| 10 „ „ with rest.-sp. | 1000 | 720 | 900 | 1100 | 600 | 1280 | 540 | 360 |
| 11 Navicula sp. | | 60 | 100 | 20 | | 60 | 80 | |
| 12 Nitzschia longissima | | | | | | | | |
| 13 Skeletonema costatum | | | | | | | | |
| 14 Thalassiosira baltica | 7940 | 9140 | 8420 | 7900 | 2020 | 3960 | 1060 | 920 |
| 15 „ „ with parasite | 60 | 140 | 80 | 180 | 40 | 80 | 40 | |
| 16 Forms that live in br. or fr. water; Marine littoral forms | 40 | | | 20 | 20 | 100 | 100 | 280 |
| 17 Diatoma tenue | | | 100 | | | 20 | 60 | 240 |
| 18 Sum of diatoms | 702400 | 769240 | 614480 | 609800 | 373620 | 316500 | 135240 | 92280 |
| *Peridiniales.* | | | | | | | | |
| 19 Dinophysis baltica | 300 | 280 | 160 | 220 | 100 | 20 | | |
| 20 Glenodinium bipes | 40 | 80 | 80 | 20 | | 20 | | |
| 21 „ sp. | 100 | 80 | 100 | 120 | 160 | 40 | | |
| 22 Gonyaulax catenata | 32360 | 56820 | 42400 | 19240 | 6460 | 11860 | 820 | 800 |
| 23 Peridinium finlandicum | 160 | 480 | 180 | 240 | | 460 | 400 | |
| 24 „ sp. | 20 | 20 | | 20 | 40 | | 40 | |
| 25 Peridiniales indeterm. | | | | | | | | |
| *Ciliata.* | | | | | | | | |
| 26 Laboea compressa | | | | | | | | |
| 27 „ conica | | | | | | | | |
| 28 „ delicatissima | 20 | | | 80 | 20 | | | |
| 29 „ vestita | 100 | 80 | 280 | | | 60 | | |
| 30 „ sp. | 20 | 240 | 20 | | | 20 | | |
| 31 Lohmanniella oviformis | 300 | | 240 | 80 | 20 | 120 | 40 | |
| 32 „ stellaris n. sp. | 60 | 40 | 220 | 100 | 100 | 80 | | |
| 33 Mesodinium rubrum f. major | 760 | 820 | 760 | 140 | | 120 | 140 | 40 |
| 34 „ „ f. minor | 2040 | 2240 | 2220 | 1460 | 60 | 540 | 40 | 80 |
| 35 Tintinnopsis beroidea | | | | | | | | |
| 36 „ tubulosa f. major | | 40 | 80 | 20 | | 20 | 40 | |
| 37 „ „ f. minor | 160 | 340 | 140 | 40 | 40 | 40 | 20 | 40 |
| 38 „ „ f. lineata | | 20 | 60 | 40 | | | | |
| 39 „ sp. | | | | | | | | |
| 40 Ciliata indeterm. | 20 | 60 | 180 | 40 | 60 | 140 | 60 | |
| *Rhizopoda.* | | | | | | | | |
| 41 Difflugia lobostoma | 20 | | | 20 | 20 | | | |
| *Silicoflagellata.* | | | | | | | | |
| 42 Ebria tripartita | 640 | 1320 | 380 | 20 | 20 | 20 | | 160 |
| *Crustacea.* | | | | | | | | |
| 43 Nauplii | | | | | | | | |
| *Systematically Unknown Forms.* | | | | | | | | |
| 44 Radiosperma corbiferum | | | | | | | | |
| 45 Xanthidium multispinosum | 20 | | | | | 20 | | 440 |
| 46 Pollen of foliferous trees | 280 | 60 | 60 | 300 | 80 | 100 | 20 | 160 |
| 47 „ of firs | | 40 | | | | | | |
| 48 Round cells | 280 | 80 | 100 | 280 | 40 | 120 | 200 | |
| 49 Indeterminable cells | | | | | 20 | | 60 | 120 |

| Station | F 41 | | | | | | | No. |
|---|---|---|---|---|---|---|---|---|
| Depth (Metres) | 0 | 5 | 10 | 20 | 30 | 40 | 50 | |
| Temperature (°C.) | 3,60 | 3,44 | 2,73 | 1,31 | 2,80 | 3,10 | 3,26 | |
| Salinity (‰) | 3,68 | 3,68 | 3,84 | 5,32 | 6,09 | 6,22 | 6,35 | |
| Oxygen-tension (%) | | | | | | | | |
| Quantity (cc.) examined | 10 | 10 | 10 | 25 (10) | 50 | 50 | 25 | |
| *Diatomaceae.* | | | | | | | | |
| Achnanthes taeniata | 2230000 | 2600000 | 2740000 | 961000 | 79760 | 9900 | 9600 | 1 |
| „ „ with rest. sp. | 1265000 | 1305000 | 525000 | 495800 | 104260 | 59240 | 17160 | 2 |
| Chaetoceros Wighami | 19900 | 15000 | 10000 | | | | | 3 |
| „ „ with rest.-sp. | | | | | | | | 4 |
| Coscinodiscus lacustris | | | 100 | 3600 | | | | 5 |
| „ sp. | | | | | | | | 6 |
| Fragilaria cylindrus | 268800 | 266700 | 212300 | 14700 | 2860 | 160 | 1280 | 7 |
| Leptocylindrus minimus | | 1400 | 900 | 560 | | | | 8 |
| Melosira hyperborea | 15700 | 20800 | 90100 | 1400 | 280 | | | 9 |
| „ „ with rest.-sp. | 13300 | 15500 | 12900 | 2120 | 820 | 120 | 200 | 10 |
| Navicula sp. | | | 900 | 40 | | | | 11 |
| Nitzschia longissima | 400 | | | | | | | 12 |
| Skeletonema costatum | | | | | | | | 13 |
| Thalassiosira baltica | 7600 | 9800 | 13300 | 1840 | 880 | 140 | 120 | 14 |
| „ „ with parasite | | | | | | | | 15 |
| Forms that live in br. or fr. water; Marine littoral forms | 4800 | 8100 | 5500 | 380 | 80 | 180 | 80 | 16 |
| Diatoma tenue | 32400 | 47000 | 22200 | | | | | 17 |
| Sum of diatoms | 4857900 | 4258800 | 3563200 | 1484420 | 188940 | 69740 | 28440 | 18 |
| *Peridiniales.* | | | | | | | | |
| Dinophysis baltica | | 100 | 200 | 200 | | | | 19 |
| Glenodinium bipes | | | | 40 | | | | 20 |
| „ sp. | 100 | | 100 | 40 | | | | 21 |
| Gonyaulax catenata | 62000 | 65600 | 60800 | 61500 | 280 | 20 | 120 | 22 |
| Peridinium finlandicum | 500 | 100 | 400 | 240 | 20 | 20 | | 23 |
| „ sp. | | | | | 80 | | | 24 |
| Peridiniales indeterm. | | | | 40 | | | | 25 |
| *Ciliata.* | | | | | | | | |
| Laboea compressa | | | | | | | | 26 |
| „ conica | | | | | | | | 27 |
| „ delicatissima | | | | | | | | 28 |
| „ vestita | | 300 | | | | | | 29 |
| „ sp. | | | | | | | | 30 |
| Lohmanniella oviformis | 2300 | 3600 | 100 | 160 | | | | 31 |
| „ stellaris n. sp. | 100 | 200 | | | | | | 32 |
| Mesodinium rubrum f. major | 200 | 200 | | | | | | 33 |
| „ „ f. minor | 900 | 1800 | 2000 | 380 | | | 200 | 34 |
| Tintinnopsis beroidea | | | | | | | | 35 |
| „ tubulosa f. major | | | | | | | | 36 |
| „ „ f. minor | 100 | 100 | 100 | | | | | 37 |
| „ „ f. lineata | | 200 | | | | | | 38 |
| „ sp. | | | | | | | | 39 |
| Ciliata indeterm. | 300 | 200 | 100 | | 20 | | | 40 |
| *Rhizopoda.* | | | | | | | | |
| Difflugia lobostoma | | | | | | | | 41 |
| *Silicoflagellata.* | | | | | | | | |
| Ebria tripartita | | | 200 | | 40 | | | 42 |
| *Crustacea.* | | | | | | | | |
| Nauplii | | | | | | | | 43 |
| *Systematically Unknown Forms.* | | | | | | | | |
| Radiosperma corbiferum | | 100 | | | | | | 44 |
| Xanthidium multispinosum | | | | | | 20 | 80 | 45 |
| Pollen of foliferous trees | 300 | 200 | | | 20 | 20 | 40 | 46 |
| „ of firs | | | | | | | | 47 |
| Round cells | | 100 | 100 | | | | | 48 |
| Indeterminable cells | | | | | | | | 49 |