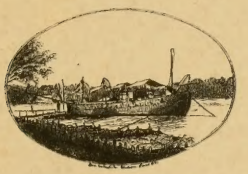
Report

of

The Danish Biological Station

to

The Board of Agriculture.



VII.

1897.

By

C. G. Joh. Petersen,
Ph. D.

1898.

From

The Danish Biological Station.

VII.

1897.

Kjøbenhavn.
Centraltrykkeriet.
1898.

Plankton Studies in the Limfjord.

(With 1 Map and 4 Tables.)

By C. G. Joh. Petersen.

1897.

While the Biological Station was at work in the Limfjord, at Nykøbing on Mors, in 1895 and 96, the **Plankton** was often examined, and I was astonished at the great difference in its appearance at the various times, a difference which was found also by a closer microscopic examination. In both these years I had, in the autumn, observed an unquestionable immigration of *Noctiluca* together with *Pilema octopus (Rhizostoma Cuvieri),* the latter in large, beautiful specimens, and the former so numerous that, when it died and drifted ashore, it would cover the coast with a red coating which looked like tomato-soup. There can be no doubt that the two said organisms had drifted into the fjord from the North Sea (in the Cattegat they are not so common); ordinarily they do not live here: during the whole rest of the year they are not to be found in the Limfjord. When we see the rapid current which at times, particularly with a westerly wind, runs through the whole fjord from the west to the east, in some places almost like a river, we can easily understand such an immigration; nor did I doubt that the changes which I found from time to time in the finer plankton, particularly among the *Diatomaceæ*, must be explained in the same way, by an *immigration* with *the current* from the west or from the east. It would be a good thing, however, to prove that this was really the case, and I seized the opportunity to do so with so much the greater pleasure, as another question in which I was interested might be solved at the same time. This question concerned the *density of the plankton in our fjords*, compared to its density in the Swedish and Norwegian fjords and in our more open waters. By seeing Professor *Otto Pettersson* carry out some plankton-gatherings in the *Gullmarefjord* (later on also while travelling in Norway), I had got the idea that our fjords were evidently much richer in plankton than those

of Scandinavia, and to prove this it was necessary only to make some casts with one of *Hensen's* »quantitative« plankton nets in various places and compare the weight or volume of the plankton I found with that from the open waters. If this gathering took place from outside the western mouth of the Limfjord, through the fjord, and ending in the Cattegat, I should see also whether the plankton of the Limfjord agreed with that of the Cattegat or with that of the North Sea at this moment, and thus learn whether it had come by the current from the east or from the west.

The result of such an investigation, undertaken onboard the gun-boat »Hauch« in the days from 22.—31. October 1896, is seen in table I. The *Diatomaceæ* and *Peridinieæ* are here determined by Mr. *H. Gran*, whom I thank with all my heart for doing this work, a work which I value so much the higher, as I know that he is one of the greatest authorities on this subject. The letter r in the tables indicates that the organism in question is rare, c that it is common, cc and ccc that it is very common, and + that it is neither rare nor common. Mr. *Gran* has hitherto used these marks in this way, but I confess that they are only of a very relative signification; and here particularly, where the question is of somewhat quantitative determinations of the whole mass of the plankton, other designations ought to be used in future, which do not speak of »rare« or »common« without further determination and, indeed, without our knowing whether they mean »common« or »rare« in the *specimens which have been gathered* or in the *volume of water* in which they have been taken. I could imagine that we, by future investigations of this kind, preferred to determine the occurrence of the plankton organisms in the volume of water from which they are taken, only by the weight, in gram, of the plankton, and confined ourselves, in our work with the specimens, to give information of how great a proportion (in weight or volume) of *the whole mass that is gathered* the various species form; one species forms about half of it, one nearly the whole, one c. $^1/_4$, one c. $^1/_{10}$, one c. $^1/_{100}$; here is something, at any rate, in which the thought can rest, and I should think it is as easy to do so, as it is to use the present designations.

For the preliminary orientation which I here wish to give, the designations used by Mr. *Gran* may be employed however, when we remember that cc and ccc indicates an occurrence which is perhaps 100, nay 1000 times greater than r.

As the table shows we made *one excursion* through the Limfjord in October—November 1896, *another* in April 1897 in the »Sea-eagle«, and finally a

third excursion in July 1897, also in the »Sea-eagle«, all three starting from the North Sea off Thyboron, and continuing through the Limfjord; the numbers at the top of the table (I) refer to the map, page 23. On our first and second excursion we went into the Cattegat (Nr. 12—13), on the first even into the Baltic Sea (Nr. 14 between Falsterbo and Stevns). The table further shows how many fathoms we fished through (from the bottom to the surface); everywhere only vertical hauls were taken with the ordinary *Hensen's* plankton-bag, with an opening of $^1/_{10}$ □ meter. On the first excursion we used a bag we had borrowed from *Hensen*, on the second and third a bag of the same size, made by ourselves, with one of *Apstein's* buckets underneath, instead of one of *Hensen's*. We made a comparison, however, between the fishing-power of the two bags, the result of which showed that it was about the same. The mass of the plankton was determined, during the first excursion, onboard, simply by immersion in water in cc; on the two last excursions, after returning home, by weighing it, in gram, the plankton having been kept in weak spirit. The latter method is somewhat more accurate, if only the plankton is dried equally much every time. This is pretty easily done, by filtering it through a circular piece of silk gauze, which is then moved about on dry filtering-paper, till it only just leaves a trace of moisture on the paper, in the form of quite small separate points. The number of cc got by pressing away the plankton turned out to be nearly corresponding to the number of grams got by weighing; they are therefore both stated in the tables under the heading of »Gram«. On the other hand it gives a considerable difference, whether the fresh plankton is weighed in water or kept in spirit in this way, particularly if the spirit is strong; but also this is, I think, of slight moment with regard to the question with which we have here to do.

On our first excursion the salinity was measured by means of an aerometer in order to give some orientation also in hydrographic matters.

As above mentioned Mr. *Gran* has determined both *Peridinieæ* and *Diatomaceæ*. The latter he has divided into *oceanic* and *neritic*, and among the neritic he has classed all species in which resting-spores have been found, moreover also some rare species in which we may suppose that resting-spores will be found, and finally 3 common ones: *Skeletonema costatum, Guinardia flaccida,* and *Leptocylindrus danicus*. He says, however, that it is not always easy to distinguish between neritic and oceanic Diatomaceæ with any certainty.

It would have been a good thing, if the plankton, all through, could have been determined, particularly with respect to the *animals;* this, however,

has not been possible. The various larval forms of *bivalves, snails, annelida, echinoderms*, which appear in it, are scarcely of any greater importance for the present investigation, however, and of other animals that may be said to be common in the plankton gathered in, there are nearly only *copepoda*; these into the bargain are all common species. To separate the animals from the plants in the plankton, so that they might be weighed separately, is impossible. Centrifugalising has been tried, but with no success. If we want more than a rough estimate, there is nothing left but counting, as *Hensen* has introduced it. I suppose that the number of animals, in general, is much less variable than that of the plants (Diatomaceæ), a rule wich also *Hensen* emphatically lays down.

A glance at the table shows us that, on all three excursions, in October 1896 as well as in April and July 1897, the quantity of plankton in the North Sea (1), in spite of the great depth which was fished through (8—9 fathoms), is only 0,5—1,5 gram, while in the fjord, where the water is not nearly so deep, it most frequently is much greater, up to 16 and 27*) gram on a depth of respectively 3 and 5 fathoms. I am sorry that four glasses, containing the richest plankton belonging to the second excursion, have been broken on their way home from Norway. Besides the measurements here stated I have a great many more from the Limfjord from the first excursion, which I have left out, however, to give a clearer view; they showed also that there was a very rich plankton, particularly in the western part of the Limfjord, at the stations 3—4—5—6—7, many times richer, or denser, than the plankton in the North Sea. The smaller catches in the Limfjord, on the other hand, hail from places as 7 a in Hvalpsund, where the salinity is very low on account of the rivulets which here fall into the fjord, or from the long narrow eastern part from Løgstør to Hals (stations 9—11), where the salinity is also lower that at the western stations 4—7. Not even the Cattegat (see No. 12—13) could, in October, boast such a great quantity of plankton per surface unit as the western part of the Limfjord, and in the Baltic Sea there was scarcely any diatom-plankton whatever at that time.

On the basis of the measurements before us, it may then be said *that the western part of the Limfjord in its main course (stations 3—7), from spring till autumn, at least at the three points of time when we studied it, had a plankton whose weight per* □ *meter surface of the sea, even irrespective of the slight*

*) These two numbers are the results of measurements of fresh plankton, and they are considerably greater than they would have been, if we had weighed plankton that had been kept for some time.

depth of the fjord, was greater than that of the plankton of the North Sea and in the narrow eastern part of the Limfjord (stations 9—10). We cannot imagine, therefore, or at any rate only with great difficulty, that this dense plankton of the western part of the Limfjord, in its present form can have been carried into the fjord by a current from the east; but *it is peculiar to the fjord on account of its great density.* It was not positively proved by this, to be sure, that the plankton in the Limfjord is denser than in the Norwegian and Swedish fjords, but only that it was of less density in the North Sea and Cattegat. When one has seen, however, how transparent the water is in the deep Scandinavian fjords, just as in the Skager Rack and the North Sea, one cannot after this doubt any more that our shallow fjords have the densest plankton; but they have such a plankton only at certain times of the year. (See later on.) A closer investigation of the component parts of the Limfjord-plankton shows further (See the table) that other species are predominant here than in the plankton of the North Sea or the eastern part of the Limfjord.

On our first excursion thus *Chætoceros debile* formed the main mass of the plankton of the western Limfjord, but it was not found in the North Sea where, on the other hand, *Rhizosolenia styliformis* was dominant. In the eastern part of the Limfjord *Ch. debile* was quite rare, and the mass of the plankton was here very insignificant. In the Cattegat, finally, quite, another diatom replaced it, viz. *Rhizosolenia alata.* The first station in the Limfjord (No. 2) was very much like the North Sea, but it is here also that the water pours into the fjord.

On the second excursion, station 2 also resembles the North Sea very much; for the rest, it is strange to see that no *peridinieae* at all occur in the fjord at this time of the year; they do not appear till we reach Nr. 11 immediately by the Cattegat.

On our third excursion, in July, we find *peridinieae* throughout the whole fjord, and not a few *diatoms* are found also in the North Sea, but the common *Chætoceros debile, Ch. contortum,* and *Skeletonema costatum* do not occur there, nor are they found in the narrow eastern part of the Limfjord.

As the weight of the plankton per □ meter showed us, so it is shown also by the component parts of the plankton: the occurrence of the diatom-plankton in the western part of the Limfjord cannot be explained simply by its pouring in with the water from the North Sea or from the Cattegat; it must breed, in an independent way, in the Limfjord, so that, as a rule, it has neither the same density, appearance, or composition as the plankton in the neighbouring waters; it occurs, in short, as a peculiar diatom-plankton.

I have said that we cannot imagine — or that we can do so only with difficulty — that the Limfjord-plankton, as it is different from that of the North Sea, can have come from the North Sea in the form in which it occurs in the fjord. For we could imagine this to be the case only, by supposing that the plankton in the North Sea, every time the investigations were undertaken, some days before had been like the Limfjord-plankton, but then again had changed before the day of the investigation; this should have taken place all three times. Nothing is known of such sudden changes in the plankton of the North Sea; on the contrary, it has been proportionally very little changed even at the different times of the year (See the table), so that it may be left quite out of consideration that the plankton of the Limfjord on these three excursions might be imagined to hail from the North Sea. But we might imagine that some single specimens of all the species that occur in the plankton of the fjord, though extremely few in number and therefore not observed in these samples, are carried in from the sea, so that we might say that the »germs« at any rate hail from the sea, whence they must come again every year, carried in, consequently, by the current. The Limfjord then should have the power to develop some species in great masses and to destroy others; but it should not be able to develop any diatom-plankton whatever, if only pure water without any diatom-»germs« poured into it. Although I do not believe in this possibility, I must acknowledge it as such. The question may be settled perhaps by germination experiments with the diatom-germs contained in the bottom-clay of the Limfjord or in the North Sea water. Should it be proved then that the water of the North Sea, which apparently contains but a very meager »styli-plankton«, by being exposed only to somewhat changed physico-chemical conditions (by getting into the Limfjord) can change its plankton, so that it must be characterized as a »didymus-plankton« (See later on), then it shows that it is not so much the direction in which the volume of water moves, which the plankton follows, as the physico-chemical conditions of the volume of water itself, and that the plankton in an almost chameleonic way can change its appearance.

With respect to the difference between the plankton in and outside the Limfjord on our first excursion Mr. *Gran* says, that the North Sea has a »warm north-Atlantic plankton with neritic North Sea forms in small quantities *(Biddulphia mobiliensis)* = *oceanic 'styli-plankton'*«, while the Limfjord has a »neritic plankton with *Chætoceros debile* vastly predominant, and as subordinate component parts *Ch. didymum* and *Rhizosolenia setigera.*« He says that »this plankton might be called *the Didymus-plankton of the Limfjord,* if by this

designation we mean warm neritic harvest-plankton«. Also on the other excursions he finds a great difference between the plankton of the Limfjord and that of the North Sea. —

If the whole Limfjord had been formed by a series of brackish lakes with stagnant water, I should not have been astonished to find a different plankton in the different lakes; but when we see a current which generally runs east, or which at any rate much oftener runs east than the opposite way, enter through the western opening of the Limfjord and go on through the whole fjord, with so great speed that the narrow parts remind us of slowly running rivers, against whose current sailing vessels can but beat up with difficulty, then we should think, certainly, that every trace of differences in the plankton must disappear. We should expect the same result for all organisms as for *Noctiluca* and *Pilema octopus:* that the single specimens are driven through the whole fjord by the current from the North Sea, or are killed by the brackish water if they enter the more closed coves; but it appears *that the diatoms are capable of forming independent floras in the water while this is moving through the fjord,* so that a diatom-flora occurs already in Nissum-Bredning, reaches its maximum in Sallingsund, and dies away in the vicinity of Løgstør. *Organisms of so short duration of life as the diatomaceæ are therefore, evidently, only to a certain degree fit to follow the currents of the sea through longer periods or through longer distances.* The more uniform the natural conditions in the course of such a current are, as for instance in certain great oceanic currents, the more unchanged its diatom-flora will be sure to keep; but any current of somewhat greater length will, as a rule, be subject to changes, changes of light among others, and the diatomaceæ are highly sensitive to even the slightest of these changes. On the maps of the north-Atlantic plankton, published by Professor *P. T. Cleve* in his fine work: »A Treatise on the Phytoplankton 1897«, we see, for instance, that the plankton-types on the whole follow certain sea-currents, I suppose as long as the chemico-physical conditions of the water are the same, and I am sure that, within certain limits, we can here conclude from uniformity in the diatom-plankton to uniformity in the chemico-physical conditions of the water; but simply to conclude from uniformity in the diatom-plankton of two volumes of water to a yearly repeated current-connection between them seems to me to be unjustified. Just as fresh waters without any connection with one another can have uniform diatom-floras, so it is quite likely also that this can be the case with the seas. — As some authors seem to have found it difficult to explain the occurrence of certain arctic shore-diatomaceæ in the Baltic Sea, I shall as to this question refer

to my observations in »Hauchs Togter«, p. 462, and to my treatise »Om de skalbærende Molluskers Udbredningsforhold«, 1888, p. 44 seqq., on the occurrence of arctic animals in the Baltic Sea. I do not see that it is more difficult to understand the occurrence of the arctic diatomaceæ than that of the animals. It may even be explained in various ways; it is not *necessary* to presume that there are yearly currents connecting the arctic seas with the Baltic.

To be sure, it is possible that certain diatomaceæ are fitter than others to follow the currents, but I dare say that, as a rule, they can but with great caution by used as »floaters«, i. e. objects thrown into the water in order to follow the course of the current through long distances and under changing conditions. They can shoot up and die away so suddenly that I must compare it to the formation of a cloud which appears at every high mountain-top near the shore when it is met by the damp air from the sea. The cloud stands still in the air-current, certainly, but the single drops of water are constantly renewed, fresh ones being continually condensed on one side while others are dissolved into invisible mist on the other side of the cloud.*) —

As soon as it had been decided that the Biological Station in 1897 should commence investigations in more open seas, i. e. outside our narrow fjords, I set to work to construct an apparatus which could fish plankton in the deeper layers of the water without getting at the same time plankton from the surface water mixed into it. I tried to make a closing-apparatus to *Hensen's* ordinary »quantitative« plankton-net, so that the opening of the net might be closed at any depth by a falling weight, while the bag, as usual, is sunk *open* to the depth from which one wants to fish, exactly, consequently, as when it is used in the ordinary way. I succeeded at last in making a closing-apparatus which we could use, which closes the opening of the net with two plane and horizontal brass plates that stand perpendicular when the net is open. I shall put up the further description of this apparatus, as I should like to make it more perfect in its details before I describe its construction; as it is, however, it is certainly quite fit for use and, particularly, it closes perfectly tight while it is hauled up. As the first experiments I have made with it have really given

*) It would be interesting more closely to investigate the occurrence of the young oyster in the Limfjord, and to follow its development during the time when it appears in masses in the plankton. It would for instance be possible, I think, approximately to calculate how many grown-up oysters there live in the fjord, when we counted how many young ones they brought forth. It would certainly be much easier to undertake this investigation than *Hensen's* attempt at counting the plaice in the Baltic Sea.

results which have at least informed me of certain conditions of the plankton which I have not known or imagined thus, I shall give these results already now.

The first time I tried to use the new apparatus was the 5. May 1897, on 22 fathoms of water, north of Nordre Rønner near Læsø. (See table II, column 7.) Measurements of the salinity showed here that we had from the surface to a depth of 5 fathoms a salinity of $2{,}_{51}$—$2{,}_{57}$ p. ct., while the water on 10—20 fathoms was about $3{,}_{4}$ p. ct.; it was also somewhat colder down here, and while the current above ran northwards, it ran southwards below. Two quite different masses of water stood thus above one another here, a phenomenon which is rather common in the Cattegat; nay, it is almost the rule at most places here. I must suppose that these two masses of water had a very different plankton, and made a haul, therefore, with the closing-bag, from 20 fathoms perpendicularly upwards to 10 fathoms, where it was closed. A perpendicular column of 10 fathoms of the salt water was thus fished through, and proved to have rather a rich, brown diatom-plankton, which in spirit immediately turned grass-green. The bag was well rinsed, and then we made another haul from 5 fathoms to the surface. Also here was a rich diatom-plankton, but it was white and had an appearance not unlike cotton. Immediately, while on board, I felt convinced that these two masses of water had thus quite a different plankton, and this, in a way, is also correct; but a later investigation showed (See table II) that, after all, on the whole it is the same species of plankton we find in the plankton above and below, and that this particularly holds good with respect to the commonest species there: *Chætoceros boreale* and *Thalassiothrix Frauenfeldii;* a number of rare forms are, on the other hand, found in the deeper, salt water only. This result was a great surprise to me; first to find the plankton of the two masses of water quite different in colour, and then to see under the microscope that both sorts of plankton nevertheless, on the whole, consisted of the same species. Not till it dawned upon me that all, or at any rate nearly all, the diatomaceæ in the plankton of the upper water were colourless and filled with water, as also generally without any trace of cell-substance, *dead consequently*, while the same species in the deeper water were strongly coloured and *living,* I got the full understanding of the matter. As I have not had much to do with diatomaceæ, I have laid the question before Mr. *H. Gran,* and he has embraced my views of the matter.*)

*) After the above had been written, I saw in the »15. Annual Report of the Fishery Board for Scotland, 1896«, printed 1897, p. 215, that *G. Murray* had made a similar discov-

When we see that such masses of diatomaceæ, in this case *Chætoceros boreale* and *Thalassiothrix Frauenfeldii,* are carried into the Cattegat by the salt (c. $3,_4$ p. ct.) under-current, it seems quite probable that these masses, when they are killed by the lower salinity (c. $2,_5$ p. ct.) (and perhaps by the higher temperature), which they necessarily must meet farther southward, either sink to the bottom or drift out again, as their specific gravity is higher or lower than that of the water; such dead diatomaceæ are a very common phenomenon, I dare say, in our seas. Column 6 in the table, May 6., 97, consequently the day after the first observation, showed nearly the same conditions at Nordre Rønner, while column 8 shows that the living plankton at Hirtsholmene goes up to the very surface; but here the water is certainly also more than 3 p. ct. up to the very surface. The density of the plankton was here very considerable; more than 9 gr. were gathered from 5—0 fathoms.

Table II shows, however, that dead plankton was found also at other places than at Læsø. Far down the Sound and in the eastern Cattegat it occurred in May 1897, but always in water of a salinity lower than 3 p. ct. Having pointed out, as above mentioned, the rich diatom-plankton in the salt water and in the under-current, which comes from the north in the northern Cattegat, I wanted very much also to find this plankton farther northward in the Skager Rack, *whence I supposed it must come.* Unfortunately a fortnight passed before this could be done; I do not suppose, however, that the lapse of this time has had any considerable influence on the result. Columns 1—4 show the result of our plankton fishery in the Skager Rack from the very middle of this sea (Tromlingerne in Norway, in NW $^3/_4$ N, at a distance of 38 miles) towards the Skaw, at the surface as well as down on various depths; but nowhere, except near the Skaw, on 58 fathoms of water, the density of the plankton was found to be anything like that in the shallow northern Cattegat. *Ch. boreale* and *Thal. Frauenfeldii* were found here, certainly, but they were nowhere common; the *peridinieæ* were predominant. It was particularly the *oceanic* species of the diatomaceæ that occurred; of the *neritic* ones only *Leptocylindrus danicus* was of any greater importance.

The rich plankton with **Chætoceros boreale**, *consequently, did not come from the north; we must therefore compare the rich growth of the diatomeceæ in*

---

ery of dead diatomaceæ, particularly *Skeletonema*, in the upper water of some Scottish Lochs, and he says with respect to this: »I believe this phenomenon, which at first puzzled me greatly, to be due to the decline or loss of salinity of the water«. — He does not seem, however, to have undertaken any specical measurements of the salinity; but, speaking from my own experience, I have no doubt that he is right.

the salt water of the northern Cattegat to the equally local diatom-flora in the western expansions of the Limfjord. At both places we see a current running mainly in one certain direction, and yet its diatom-plankton is different at the different places. In the Limfjord we might easily point to certain conditions of the mass of water (the salinity) which are changing as we proceed eastward, but here in the Skager Rack and the northern Cattegat there are no such differences of salinity to refer to, and yet the plankton changes in the mass of water when this enters the Cattegat. That there must be, however, certain conditions (probably the shallower water), which produce this change, is evident; but it seems to me rather instructive to see, that the same mass of water, on the whole of its way across the bottom of the sea, actually, is not filled up by the same sort of plankton. *F. Schütt* says in his book »Das Planzenleben der Hochsee«: »Wie es möglich ist, dass sich verschiedene Floren ausbilden konnten bei dem fortwährenden Wechsel des Wassers, und wie es ferner möglich ist, dass sich an einer Stelle eine einmal gebildete Flora halten kann, da alle Individuen der Flora mit dem Strom naturgemäss fortwährend ihren Platz ändern und in ganz andere Gegenden, die gegenwärtig eine ganz andere Flora besitzen, fortgetragen werden, ja, wie weit hier überhaupt eine Stabilität herrscht oder ein stetiger unregelmässiger oder periodischer Wechsel, das sind Fragen und Probleme, die hier bloss angedeutet werden können, deren Lösung aber der Zukunft vorbehalten bleibt.«

In his »Analytische Plankton-Studien« he says, pp. 116—117: »Dass die Meeresströmungen in Wirklichkeit kein völliges Nivellierungsvermögen besitzen, sondern dass die klimatischer Verhältnisse des Meeres trotz der Strömungen doch eine grosse Rolle für die Ausbildung der Planktonmassen spielen, das lehrt« etc. »Wir müssen also annehmen, dass sich ein gewisser *Gleichgewichtszustand* eingestellt hat zwischen dem verändernden und dem gleichmachenden Princip.«

Schütt here expresses thoughts which are nearly identical with those that occurred to me by my study of our coast-plankton and our coast-currents. Unfortunately, so very little is known as yet of these things; it is certain, however, that the habitus of the diatom-plankton often changes much in a flowing mass of water, by little and little as the latter changes its place; and we must be very careful therefore when we use the diatomaceæ for the purpose of characterising the various currents in the sea, particularly as the various sorts of *diatom-plankton* as a rule are characterised, not so much by the perfect absence or presence of these or those species, as by the *number in*

which the specimens of the various species occur. — It does not seem to be the *diatomaceæ* only which occur in the said manner in a flowing mass of water; something like this is known also of the pelagic *foraminifera*, even out in the great oceanic currents. *John Murray* writes thus in *Natural Science*, vol. XI, July 1897, p. 21, where he discusses the distribution of the pelagic *foraminifera:* »The gradual disappearance of the tropical species, and their replacement by other species, as the colder water to the north and south of the equatorial regions is entered, has always appeared to me rather puzzling, especially when it is remembered that these changes take place in a continuous oceanic current, like the Gulf Stream, flowing from the equator towards the poles.« I take it for granted, however, that we must be able to find guide-organisms (analogous guide-fossils) in the plankton also, which could give us information of the parts of the globe from which they come; but not till we know the geographical distribution of these guide-organisms, and the conditions under which they live, we shall be able to get the full profit out of them and recognise them as guide-organisms. I must believe, for instance, that none of our specimens of *Ctenophores* properly belong to our seas within the Skaw, but often quite disappear from them till the currents carry them again in great numbers into the Cattegat. Whence these currents come I do not know, but they are scarcely identical with those that carry *Pilema octopus,* another supposed guide-organism, to the western Limfjord almost every autumn; perhaps they are the same currents as now and then carry *Clione limacina* to Bohuslän and the Little Belt. These animals, the *Ctenophores* as well as *Clione*, are so large that they could scarcely escape notice if they lived here constantly; at least it is this supposition which makes me look upon them as visitors here only, but I grant that the whole matter is in great need of renewed investigations. Probably we shall also among the smaller organisms, for instance among the diatomaceæ, be able to find such guide-organisms, and perhaps for instance *Rhizosolenia styliformis* is such a one; but it will be necessary, before it is raised to its dignity as such, to prove that it is not »stationary« in our seas at any time. It would be desirable to point out such organisms among the smaller organisms, for instance among the diatomaceæ, because they are so numerous that they are found nearly in every, even the smallest, sample of plankton.

The above mentioned rich diatom-plankton with *Ch. boreale* in the northern Cattegat can, as it is seen from table II, in which the localities are arranged from north to south, follow the bottom-current down through the

eastern Cattegat (the light-ship of Fladen) into the Sound at the isle of Hveen, as far as the deep water goes. In the Cattegat it is covered by a dead plankton, which however, the farther south we go, is mixed more and more with *Rhizosolenia alata,* whose light colours resemble those of the dead plankton very much. In the Sound, where the uppermost 3 fathoms have only a salinity of $0{,}_{83}$ p. ct., not even *R. alata* is found in the surface water, but only in the middle parts (c. 2 p. ct.), while the lowest water ($3{,}_{33}$—$3{,}_{20}$ p. ct.) has still a rich *Ch. boreale* plankton. The uppermost 3 fathoms of water here contain, upon the whole, scarcely anything but a few copepoda, and come certainly directly from the Baltic Sea. The last column is plankton from Bornholm. It contained *peridinieæ* and of *diatomaceæ* only *Chæt. danicum.*

The sea from Sjællands Odde (Schultz's Grund) as far as the Great Belt (Halskov) had very little plankton compared to the rest of the Cattegat. Is this the rule? As I have said, the northern and the middle parts of the Cattegat have the greatest quantities of plankton; but we cannot conclude from this that it is so always. The following table III from some weeks later shows, however, nearly the same with respect to the Skager Rack. It was this scarcity which in the autumn 1885 surprised *V. Hensen* so much that he supposed something must be the matter with the filtering power of the nets. There can therefore scarcely be any doubt that the Skager Rack and its deep fjords, as a rule, have not the quantities of plankton which the Cattegat has at certain times, whether calculated by surface-units or by cubics of water; the deeper waters of the Skager Rack contain but very little plankton. Whether the Skager Rack in winter time has a denser plankton than the Cattegat, is not known, but I doubt it very much.

Table III, from the month of July 1897, in the Skager Rack and the northern Cattegat, shows that *Rhizosolenia alata* has now become common in the upper water, and that *Guinardia flaccida* is very common in the bottom water; as to the rest the plankton is nearly as it was in May 1897.

In order to follow the composition of the plankton in the Limfjord during the whole year and so fill up the intervals between the 3 excursions described above, we fished plankton the whole winter, while the Station remained at Nykøbing on Mors, from October 1896 till April 24th, 1897, with fitting intervals. We made use of a *Hensen's* »quantitative« bag, and when the Station removed from this place, the matter was left in the hands of a fisherman at Nykøbing. He got an ordinary, small net for »qualitative« use, after it had been proved by experiments that it caught only about $^1/_4$ of *Hensen's* net. With this net he has continued the plankton fishery at the same place at Ny-

køb̊ing, so that a column of water of c. 4 fathoms has been fished through, but he has every time made 3 hauls with the net. It had been better if he had made 4 hauls; the weight of the plankton caught after the 24th of April 1897, in table IV, could then have been compared directly to the preceding statements of the weight, now they must be multiplied by $^4/_3$ if we want to do so.

Of course this method of using small bags for quantitative fishery is not quite satisfactory, but it is *considerably* cheaper and may very well be adopted for these preliminary investigations.

The result of these continued gatherings at Nykøbing is found in table IV.

There is a striking diminution in the quantity of plankton from October till November. The mean temperature in October was $10,_1$ ° C., but in November only $5,_3$ ° C. The salinity, on the other hand, was but little lower in November than in October.

The whole winter the plankton is very scarce; it does not shoot up again till towards spring-time, the peridinieæ later than the diatomaceæ. *Gran* says of this: »The Plankton of the Limfjord is, on the whole, more like that of the Cattegat than like that of the North Sea; it is, however, very different from both.

From the Cattegat plankton it differs particularly by the almost complete absence of just the commonest Cattegat forms, viz.:

Rhizosolenia alata (summer form),

Chætoceros constrictum (maximum: March—May),

— *curvisetum* (harvest form),

Leptocylindrus danicus (maximum: March—May).

Chætoceros debile I never saw in such huge quantities as from the Limfjord; moreover it is here rather a harvest form, while in the Cattegat and Skager Rack it has its maximum in spring.

In May and June the oceanic forms are predominating in the Limfjord *(Rhizosolenia Shrubsolii, Chætoceros boreale* and *decipiens),* and the plankton is quantitatively poorer; the rich neritic plankton of April has disappeared.

In July a neritic plankton, of many species, reappears. From July till October the changes are very gradual, as from February till April.

It is very interesting to see how the *neritic diatomaceæ* succeed one another. They begin in the middle of the winter with *Biddulphia aurita* (a genuine winter form which is widely distributed); then comes, in February, a new species *Lauderia cystifera.* It is very like the *L. confervacea Cl.* from

Greenland; but the latter is too insufficiently known to be identified with certainty. I think it is best therefore, provisionally, to give it a new name.

Then follows *Chætoceros diadema* and *sociale* with maximum (and resting-spores) in April; *Skeletonema costatum,* which seems to vegetate in great masses till a little after midsummer; somewhat later *Ch. debile*, which in October forms the main mass of the plankton. *Ch. contortum*, which in July is a character-form, is not yet found in April in greater quantities. All these species, which occur in the Limfjord in considerable numbers, are very widely distributed, with the exception of *Lauderia cystifera;* most of them are found, for instance, on the shores of Greenland and at Lofoden, where I never found the commonest Skager Rack forms, such as *Ch. constrictum, curvisetum, Schüttii,* or *Leptocylindrus danicus.*

Of *oceanic* forms a few are also found; these are very hardy, and can live nearly everywhere, particularly *Thalassiothrix Frauenfeldii* and *Chætoceros boreale.* They differ from the neritic forms by not forming resting-spores under unfavourable conditions; they either die or continue to live in quite small quantities. Single specimens of these species seem to occur *nearly everywhere in the sea,* as well in the open ocean as along the shores.«

It might appear from table IV as if, in May and June, unusually great masses of water had come in from the North Sea, with North Sea plankton in predominant quantities, which had supplanted the neritic plankton which otherwise belongs to the Limfjord; but the salinity, which is measured by the Meteorological Observatory at Oddesund, does not seem to indicate this. Possibly there is every year such a period at midsummer; future investigations, however, must prove that. In order to give the most necessary data for the consideration of this question from a hydrographic point of view, I shall state here from »Meteorologisk Aarbog« the measurements from Oddesund in 1896 and 1897, expressed in mean numbers for the various months.

Salinity at *Oddesund*, in 1896. Monthly means in p. ct.

Jan.	Febr.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.
2,87	3,03	2,96	3,02	3,08	3,16	3,22	3,25	3,16	2,99	2,91	2,89

and **Temperature** in °C. (Monthly means.)

1,0	3,0	3,2	7,1	12,6	17,2	17,7	16,5	14,2	10,1	5,2	1,1.

Salinity at *Oddesund*, in 1897. Monthly means in p. ct.

2,64	2,73	2,59	2,55	2,77	2,90	2,99	2,90	2,85	2,88

and **Temperature** in °C. (Monthly means.)

0,5	0,2	3,0	6,1	11,2	16,7	17,2	18,1	13,7	9,0.

These measurements have been carried out in the surface of the water, but where the depths are so inconsiderable as in the Limfjord there is no very great difference in temperature and salinity above and below. We see the considerable changes of temperature according to the season, from $0_{,2}$—$18_{,1}$ ° C., while the temperature at the bottom of the deep Scandinavian fjords is 6—8 ° C. all the year round. The salinity reaches its maximum in summer, but there is no slight difference between the two years, both with respect to salinity and temperature. —

As the Limfjord is a very peculiar water, the like of which will scarcely be found at many places in Europe, I shall give some information of it, in order to make it easier for the foreign reader to understand the peculiarities of this remarkable fjord. This is so much the more necessary as the foreign literature seems to attach some importance to the understanding of the conditions under which the plaice lives in the Limfjord, and, among others, the well-known English maritime biologist *E. W. L. Holt* has done me the honour of making this matter the subject of a close investigation in »Journ. Mar. Biol. Assoc.«, vol. V. 1897, pp. 82—88.

»As it is well known«, says *J. Collin* in his 'Limfjordens marine Fauna 1884', »the part of the Limfjord which is west of Løgstør might till the year 1825 be said to consist chiefly of a complex of larger and smaller fresh-water lakes, which were in connection with one another and had their joint outlet into the Cattegat through the long, proportionally narrow arm of the sea between Løgstør and Hals, the water of which according to circumstances entered with different force.«

It was in 1825 that the great irruption of the North Sea took place and changed the salinity, fauna, and flora of the fjord, so that the old fresh-water and brackish water fauna was driven into the narrowest creeks, and a salt-water fauna immigrated from the North Sea: oysters, lobsters, plaice, etc.

The mouth of the fjord by the North Sea (at Thyboron) is at the narrowest place only a few hundred yards broad, and is, where it is deepest, c. 3—4 fathoms: inside, on the »fjord-shallow«, as well as outside, on the »sea-bar«, the passage is broader, but also much shallower, c. 8—9 feet. On account of the »wanderings« of the sand, the depths change very much; and in order to keep a fairway for the vessels, it is necessary indeed, every year artificially to dig up the sand at the fjord-shallow by means of a sand pumping-ship. At the eastern mouth, by the Cattegat, they keep (artificially also) a depth of c. 18 feet, but at several places in the narrow eastern part of the fjord, the depth is at the deepest only 6—10 feet. The depth in the great western expansions

(»Bredninger«) may be said perhaps, on an average, to be 3—4 fathoms, and only quite exceptionally, in a few holes, a depth of 11—13 fathoms, is reached. — Though we can trace tide-currents at many places of the Limfjord — which most frequently, however, are very irregular — they cannot be said to exercise any perceptible influence on the height of the water, except at the very mouths, and even here the difference between high-water and low-water is only a few inches. — In the main course of the fjord, from the North Sea, east of Mors, past Løgstør to the Cattegat, a distance of c. 92 miles, we find, however, nearly always rather a considerable current in the water, running now eastward, now westward, most commonly, however, eastward. It seems as if this current differs very much in the different years. It is said, for instance, in some years to run, decidedly, much oftener eastward than westward; in other years this difference is not so marked, though it must be said that there always runs more water through the Limfjord eastward than westward. I think it even very improbable that any mass of water ever runs through the Limfjord from the Cattegat to the North Sea, as the average salinity of the year, in 1896, was $1,_{9}$ p. ct. at Aalborg, $3,_{0}$ p. ct. at Oddesund, and $3,_{3}$ p. ct. on the western shore of Jutland.

The strong currents in the narrow sounds, in the main course of the fjord, Thyborøn, Oddesund, Sallingsund, by Løgstør, etc., are weakened of course, when they reach the large, remote expansions in the western part.*) — On account of the inconsiderable depth of the fjord there is generally no difference in the temperature and salinity at the surface and at the bottom. When we have seen, how each of the frequent storms can put the light materials of the bottom in motion, so that the whole mass of water gets a yellowish colour, we understand that there is, as a rule, but one layer of water in the expansions of the Limfjord. In quiet weather the volumes of water which come pouring into the fjord from the rivulets, may certainly make an exception to the rule, but these exceptions are always very local and of very short duration. —

It will be understood, what an immense difference there is between a fjord like this with a mass of water, which is frequently renewed from bottom

*) In the above-mentioned article by *Holt*, thea uthor wants information of the speed of the current in the Limfjord, especially in order to judge, whether it canhave any influence on seining, for instance by gathering the arms of the seine. I shall state, therefore, that in the very expansions, particularly in the large ones, the current is generally not so strong that it has any perceptible influence on seining. His supposition, loc. cit., p. 82, that the seinings I have mentioned are undertaken »under practically identical conditions of tide, weather, temperature etc.« is therefore quite correct.

to surface, and one of the Scandinavian fjords of 1—200 fathoms' depth. It is only in the uppermost layers of the water that the latter in summer-time can reach the same degree of heat as the Limfjord-water, and as they are always rather deep quite near the shore, the warm volumes of water will, so to speak, never touch the bottom of these fjords, but only dash against the shores on a very narrow tract. The bottom of the fjord, on the other hand, is covered with water, which all the year round has a temperature of c. 6—8° C. It is easy to understand that the conditions of the growth of animal and vegetable life down here are so different from what we see in the Limfjord, but why the upper layers of water in the Scandinavian fjords have not so rich (dense) a plankton as the Limfjord, is not so readily percived, particularly because the same organisms are found at both places, though not in the same quantities. We might imagine that the diatomaceæ found better conditions of food in the Limfjord-water than in the deep northern fjords, as many substances, compounds of nitrogen for instance, no doubt are carried into the Limfjord from the surrounding fertile land. This thought has been expressed before by *V. Hensen* in order to explain the different densities of the plankton in general. We might imagine also that the deep fjords actually produced as much plankton in the surface-layers as the shallow ones, but that part of the organisms by little and little sink down through the cold layers below, while in the shallow fjords the motion of the water compels them to keep floating somewhat longer over the bottom, so that there are actually, at any given time, more organisms (particularly diatomaceæ) in the mass of water. It would be necessary then to point out such surface-forms in the deeper water of the deep fjords, and when this has not been done, the reason might be that so few investigations with closing-nets have been undertaken, partly also, that these forms will occur very scantily, because they are to be distributed in such great masses of water, and perhaps quickly sink through them, perhaps are even dissolved in them. It is indeed strange to see, how little we find on the bottom, even in the Limfjord, of the masses of diatomaceæ that have lived in its water. We might expect to find its bottom covered with silicious shells, but there are next to none. I must suppose that they are again dissolved in the water, for they are neither carried out east nor west. It is possible, however, that neither of the two said hypotheses to explain the different densities of the plankton is correct; we must have further investigations, before it is worth the while to discuss the question more closely. When we see the water from the Skager Rack, with its plankton of slight density, enter the Cattegat as a bottom current, and here immediately obtain a very dense plankton, it cer-

tainly seems that the *interaction of the water and the bottom of the sea* is alone sufficient to produce this denser plankton, a supposition which, when we think of the special growth and propagation of the diatomaceæ, is perhaps not quite impossible either. —

During these plankton studies a number of questions have crowded upon me, for the solution of which I still want the necessary information, such as: Are masses of fish-eggs carried from the North Sea into the Cattegat, and is it in this way that the plaice is preserved in the Cattegat in spite of the over-fishing? Which of our seas produces the greatest quantity of plankton per □ mile a year? Have our other fjords an independent diatom-flora like that of the Limfjord? Has the unequal density of the plankton of the Limfjord in the various years any perceptible influence on the sustenance of the stock of fish? Before these and similar questions can be solved, the plankton investigations must be carried on far more rationally, in all our seas and at all seasons, than it has hitherto been possible for me to do.

Map of the Limfjord with the Stations 1—11.

Table I.

Locality.	The North Sea.	The Limfjord.										The Cattegat.		The Baltic Sea.	The North Sea.	The Limfjord.										The North Sea.	The Limfjord.								
	1.	2.	3.	4.	5.	6.	7.	8.	7 a.	7 b.	9.	10.	12.	13.	14.	1.	2.	4.	5—6.	5—6.	5—6.	5—6.	5—6.	5—6.	5—6.	11.	1.	2.	3.	4.	5.	6.	6.	7.	8.	9.
Date.	22. Oct. 1896.	23. Oct. 1896.	23. Oct. 1896.	23. Oct. 1896.	23. Oct. 1896.	23. Oct. 1896.	24. Oct. 1896.	27. Oct. 1896.	20. Oct. 1896	26. Oct. 1896.	28. Oct. 1896.	28. Oct. 1896.	31. Oct. 1896.	1. Nov. 1896.	2. Nov. 1896.	21. April 1897.	22. April 1897.	22. April 1897.	22.-24. April 1897.	22.-24. April 1897.	22.-24. April 1897.	24. April 1897.	24. April 1897.	22.-24. April 1897.	27. April 1897.	19. July 1897.	19. July 1897.	19. July 1897.	19. July 1897.	19. July 1897.	19. July 1897.	18. July 1897.	18. July 1897.	18. July 1897.	18. July 1897.
Fathoms fished through.	9.	2	$2\frac{1}{2}$.	$2\frac{1}{2}$.	3.	5.	3.	3	2.	5.	3.	4.	$8\frac{1}{2}$.	21.	14.	9.	$2\frac{1}{2}$.	2.	$2\frac{1}{2}-3\frac{1}{2}$.	$2\frac{1}{2}-3\frac{1}{2}$.	$2\frac{1}{2}-3\frac{1}{2}$.	3.	$2\frac{1}{2}$.	$2\frac{1}{2}-3\frac{1}{2}$.	4.	8.	$1\frac{1}{2}$.	2.	2.	$2\frac{1}{2}$.	6.	4.	3.	$2\frac{1}{2}$.	$2\frac{1}{2}$.
Salinity, in per cent.		$3_{0.8}$.	$3_{0.4}$.	$2_{0.7}$.		$2_{0.8}$.	$2_{0.8}$.	$2_{0.71}$.		$2_{0.0}$.	$2_{0.8}$.	$2_{0.8}$.	$2_{0.0}$ — $2_{0.73}$.	$2_{0.4}$ — $3_{0.34}$.	$0_{0.6}$ — $0_{0.0}$.		$3_{0.0}$.	$2_{0.3}$.																		
Quantity, in Gram.	1.	c. 1.	$16_{0.}$	15.	16.	27.	$6_{0.}$	$3_{0.}$	$1_{0.}$	7.	2.	$0_{0.}$	10.	$9_{0.}$	c. $0_{0.}$	$0_{0.}$	c. $0_{0.}$	$0_{0.}$					$3_{0.}$	$1_{0.}$		$5_{0.}$	$1_{0.}$	$1_{0.}$	$2_{0.}$	$3_{0.}$	$6_{0.}$	$6_{0.}$	$3_{0.}$	3.	$1_{0.}$	1.
Dinobryum pellucidum	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	cc									
Peridineæ.																																			
Ceratium tripos	c	c	r	....	....	....	....	r	....	r	r	r	c	c	r	+	+	....	....	....	....	....	....	....	....	r	c	+	+	c	r	r	r	r	+	r
» » var. longipes	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r									
» fusus	r	....	r	r	r	....	r	+	+	....	+	r	r	r	....	+	+	....	....	....	....	....	....	....	....	....	+	+	+	+	r	r	r	r	+	r
» furca	c	+	+	r	r	r	r	r	r	r	r	r	r	r	....	....	....	....	....	....	....	....	....	....	....	....	+	+	+	c	r	+	r	r	+	
Peridinium divergens	+	....	....	....	....	....	....	r	r	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	+	....	....	....	r	r				
Oceanic Diatoms.																																			
Coscinodiscus oculus iridis Ehb.	r	r	....	....	....	....	....	r	....	r																									
» radiatus Ehb.	+	....	....	....	....	r	....	....	....	....	....	r	+	....	....	r	r																		
» concinnus Sm.	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	....	....	....	....	....	....	....	....	....	....	....	r	r							
Rhizosolenia semispina Hensen.	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	....	....	+	+	+	+	+	+	r	....	r	r	....	r	....	....	r	r	....	r	
» styliformis Brightw.	c	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	c									
» Schrubsolii Cl.	....	....	r	r	....	....	....	....	....	....	....	....	....	r	....	....	....	....	....	....	....	....	....	....	....	+	+	+	+	+	r	+	+	r	r	
» calcar avis. Schultze	....	r	r	+	....	....	....	r	....	....	r																								
» alata. Brightw.	....	....	....	....	....	....	....	....	....	....	....	....	ccc	ccc	....	....	....	....	....	....	....	....	....	....	+										
Chætoceros boreale. Bail.	....	....	....	r	....	....	....	....	....	....	....	....	r	r	....	....	....	r	+	c	+	c	+	r	c	r	....	....	....	....	....	r	....	r	
» v. densa. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	r	....	....	r	r	r			
» danicum. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	r	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	....	....	r	....			
» decipiens. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	r	....	....	....	....	....	r	+	....	+	....	....	c	+	+	r	+	r	r	r	r	r	r	
Thalassiothrix Frauenfeldii. Grun.	....	....	....	....	....	....	....	....	....	....	....	....	+	+	....	....	....	+	+	c	c	+	c	....	....	....	....	....	c	+	c	c	....	....	r	r
Neritic Diatoms.																																			
Coscinodiscus excentricus. Ehb.	....	....	....	....	....	....	....	r	r	....	....	....	+	....	....	+	r																		
» balticus. Grun.	....	...	....	....	....	....	....	....	....	....	....	....	....	....	r																				
Sceletonema costatum. Grev.	....	....	....	....	....	....	....	....	....	....	....	....	r	....	....	....	....	+	+	c	c	c	+	+	+	....	c	c	cc	cc	cc	cc	c		
Actinoptychus undulatus. Ehb.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r																			
Guinardia flaccida. Perag.	....	....	r	....	....	....	r	....	....	....	....	....	+	r	....	....	....	....	....	....	....	....	....	....	....	+	....	r	r	....	+	+	+		
Leptocylindrus danicus. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	....	....	....	....	....	r				
Rhizosolenia setigera. Brightw.	....	....	....	r	r	....	....	c	c	+	+	r	+	r	....	....	....	+	+	+	+	+	+	r	....	....	r	+	c	+	+	+	....	r	
» Stolterfotii. Perag.	....	....	+	+																															
Ditylum Brightwellii. West.	....	....	r	....	....	....	....	....	....	....	....	....	+	+																					
Cerataulina Bergonii. Perag.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	r	r			
Eucampia Zoodiacus. Ehb.	....	....	r	r	....	r	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r				
Biddulphia aurita. Lyngb.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	r	r	....	....	....	....	r	....	....	....									
» mobiliensis. Bail.	r	....	....	....	....	....	....	....	....	....	....	....	r	+	....	c	+	r	r	....	....	....	....	....	....	....	r								
Chætoceros Weissflogii. Shütt.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	+	r	+	r	r	r	r	r
teres. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	+	r	+	r	+	+	....	....									
contortum. Schütt.	....	....	....	....	....	....	....	....	....	....	....	....	r	....	....	....	....	....	....	r	r	....	r	r	+	....	cc	c	cc	c	c	+	c		
didymum. Ehb.	....	....	+	+	+	r	....	....	+	+	r	....	+	+	....	....	....	....	....	....	....	....	....	....	....	....	c	+	c	+	+	+	r		
lacinisum. Schütt.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	r	+	+	c	+	+	r	....	....	....	....	....	r				
breve. Schütt.	....	....	....	....	....	....	....	....	....	....	....	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r				
coronatum. Gran.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	r				
curvisetum. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	r	+	r				
debile. Cl.	....	....	ccc	ccc	ccc	ccc	c	cc	cc	ccc	c	r	+	+	....	....	....	....	....	....	....	....	....	....	....	....	r	r	....	r	+	r	+	r	r	r
diadema. (Ehb.) Gran.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	+	c	c	c	+	+	r	....	....	cc	c	cc	c	c	+	c	r	
leve. Schütt.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	r	+	c	c	....	....	....	....	....	r	....	....	r	....	....	r		
crinitum. Schütt.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	r				
externum. Gran.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	....	r	r	....	....	r	
Schüttii. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	+							
simile. Cl.	....	....	....	....	....	r	....	....	....	....	....	....	r	r	....	....	....	....	....	....	....	....	....	....	....	....	r	r	c	+	+	+	....	c	+	
subtile. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	r	....	....	....	....	....	....	....	....	....	r				
cinctum. Gran.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r				
sociale. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r								
scolopendra. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	r	....	r	....	....									
constrictum. Gran.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	r	r	....	....	....	....									
Asteromella spathulifera. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	+	r	....	....	....	....	....	....	....	....	....	....	....	r									
Nitzschia seriata. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r			
[Halosphæra viridis. Schmitz.]	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	r	....	....	....	....	....	....	....	....	r									

Table II.

Locality and Depth.	Troanlingerne in NW ¼ N. 38 Miles. c. 300 Fathoms.	Cape Skagen in SSE 34 Miles. c. 210 Fathoms.			The Light of Cape Skagen in SSW ½ W. 20 Miles. c. 130 Fathoms.			The Light of Cape Skagen in SE by S. 34 Miles. 130 Fathoms.		The Light of Cape Skagen in SW by S ½ S. 6 Miles. 58 Fathoms.			Nordre Ronner in S. 6 Miles. 21 Fathoms.	North of Nordre Ronner. 20 Fathoms.		Hirtshalsnæne in N by E. 3 Miles. c. 10 Fathoms.	The Light-ship of Fladen in NW by N. 4 Miles. 30 Fathoms.		Anholt Light in SW ½ W. 7 Miles. 23 Fathoms.	The Light-ship of Læsø Rende in N. 11 Fathoms.	The Sound. The Light-house of Hveen in S by E. 1¼ Miles. 20 Fathoms.			Schultz's Grund. 17 Fathoms.	The Great Belt. Halskov light-buoy. 30 Fathoms.			Bornholm. Nexø Light in W ¾ N. 3 Miles. 36 Fathoms.
Date.	21. May 1897.	21. May 1897.			22. May 1897.			21. May 1897.		20. May 1897.			6. May 1897.	5 May 1897.		6. May 1897.	26. May 1897.		26. May 1897.	25. May 1897.	30. May 1897.			19. June 1897.	18. June 1897.			24. June 1897.
Fathoms fished through.	0—5.	18-100.	0—5.	5—115.	10-190.	0—7.	10-120.	120—		0—3.	45—115.	0—20.	20—30.	30 50	0—5.	10—20.	0—5.	10—20.	20—29	0—3.	14—22.	0—3.	7—10.	0—3.	5—7.	10—18.	0—5.	9—15.	0—3.	5—8.	20—24	0—15.
Salinity, in per cent.	$\frac{3_{3\cdot0}}{3_{3\cdot8}}$	$\frac{3_{3\cdot8}-}{3_{3\cdot8}}$	$\frac{3_{3\cdot0}-}{3_{3\cdot2}}$	$\frac{3_{3\cdot1}}{}$		$\frac{2_{3\cdot0}-}{3_{3\cdot1}}$	$\frac{3_{3\cdot1}-}{3_{3\cdot2}}$	$\frac{3_{3\cdot8}}{}$		$\frac{3_{3\cdot5}-}{3_{3\cdot5}}$	$\frac{3_{3\cdot1}-}{3_{3\cdot0}}$	$\frac{2_{3\cdot0}-}{3_{3\cdot2}}$	$\frac{3_{3\cdot0}-}{3_{3\cdot0}}$	$\frac{3_{3\cdot0}-}{3_{3\cdot0}}$	$\frac{2_{3\cdot2}-}{2_{3\cdot3}}$	$\frac{3_{3\cdot2}-}{3_{3\cdot3}}$	$\frac{2_{3\cdot1}-}{3_{3\cdot2}}$	$\frac{3_{3\cdot2}-}{3_{3\cdot2}}$	$\frac{3_{3\cdot0}-}{3_{3\cdot2}}$	$\frac{1_{3\cdot1}-}{1_{3\cdot1}}$	$\frac{3_{3\cdot2}-}{3_{3\cdot2}}$	$\frac{3_{3\cdot2}-}{3_{3\cdot2}}$	$\frac{1_{3\cdot1}-}{1_{3\cdot2}}$	$\frac{3_{3\cdot0}-}{3_{3\cdot1}}$	$\frac{2_{3\cdot0}-}{2_{3\cdot0}}$	$\frac{3_{3\cdot2}-}{3_{3\cdot2}}$	$\frac{0_{8\cdot2}-}{0_{8\cdot2}}$	$\frac{2_{3\cdot2}-}{2_{3\cdot2}}$	$\frac{3_{3\cdot3}-}{3_{3\cdot3}}$	$\frac{1_{3\cdot0}-}{1_{3\cdot5}}$	$\frac{3_{3\cdot3}-}{3_{3\cdot1}}$	$\frac{1_{3\cdot1}-}{1_{3\cdot0}}$	$\frac{2_{3\cdot3}-}{2_{3\cdot5}}$	$\frac{3_{3\cdot0}-}{3_{3\cdot2}}$	$\frac{0_{3\cdot1}}{}$
Quantity, in Gram.	$0_{3\cdot5}$.	$2_{3\cdot5}$.	$0_{3\cdot5}$.	$1_{3\cdot5}$.	$1_{3\cdot5}$.	$1_{3\cdot5}$.	$1_{3\cdot5}$.	$0_{3\cdot5}$.		$0_{3\cdot5}$.	$0_{3\cdot5}$.	$3_{3\cdot5}$.	$0_{3\cdot5}$.	$1_{3\cdot5}$.	$3_{3\cdot5}$.	4.	$2_{3\cdot5}$.	3.	$9_{3\cdot5}$.	$0_{3\cdot5}$.	5.	4	c. $0_{3\cdot5}$.	$7_{3\cdot5}$.	$1_{3\cdot5}$.	$13_{3\cdot5}$.	c. $0_{3\cdot5}$.	$1_{3\cdot5}$.	$6_{3\cdot5}$.	$1_{3\cdot5}$.	$0_{3\cdot5}$.	$0_{3\cdot5}$.	$0_{3\cdot5}$.	2.	
Peridineæ.													dead.	liv.	dead.	liv.	liv.		dead.	liv.	liv.	dead.	liv.	dead.	liv.		dead.	liv.					
Ceratium tripos	c	....	—		....		r	r	c	....	r	r	r	....	....	....	....	....	....	r	....	+	....	....	....	....	r	....	....	+	....	—		
» » v. longipes	c	r	c	+	+	c	c	—	c	r	—	r	r	c	....	+	r	....	....	r	....	....	....	....	r	....	c	+	+	r	—	c	c	
» » v. Bucephalos	..	....	....	....	....	....	r																										
» » v. macroceros	..																																
» fusus	c	....	—	—	....	—	—	r	r	r	—	r	r																				
» furca	+	r	r	r	r	r	r	....	c	r	....	....	....	r	....																		
Peridinium divergens	+	r			+	r		....	c	+	r	c	c	c												r	c	....	....	r	....	—	—	
Dinophysis acuta	r	....	....	r	....	r																											
Diplopsalis lenticulata	....					r						r	c	c																			
Oceanic Diatoms.																																	
Coscinodiscus oculus iridis	....	....	....	r	r	....	....	r	....	r	....	r	r	....	....	....	....	....	....	....	....	....	....	r									
» radiatus	....	....	....	r	....	....	....	r	....	r	....	....	....	....	r	r	r	r	....	....	....	....	....	....	r								
» concinnus	....	....	....	....	r																												
Rhizosolenia styliformis	..	....	....	r	r	....	....	....	....	....	....	r																					
» semispina	....	....	r	r	....	....	....	....	....	r	....	....	....	—	....	—	r	....	....	....	....	....	....	—									
» alata	r	c	....	—	—	....	....	....	—	r	c	—	c	+	—	+	r	....	cc	c	c	ccc	cc	cc	c	....	c	+	cc	—	c	....	—	
» Shrubsolii	....	....	....	....	....	....	....	....	....	....	—	—	r	....	r																		
Dactyliosolen mediterraneus	....																																
Chætoceros atlanticum	....	r	....	....	....	....	....	r	....	....	r	....	....	r	....	r	....	....	....	....	r	....	r										
» borcale	—	r	r	r	r	—	r	....	r	r	c	....	cc	cc	cc	cc	cc	....	....	cc	cc	. .	ccc	+	cc	r	c	cc	r	r	r	r	c	
» danicum	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	....	c
» criophilum	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+																	
» decipiens	r	....	....	r	r	r	....	....	....	—	r	r	—	....	r	c	r	....	....	....	....	r	r	+	....	....	....	r	....	....			
Thalassiothrix Frauenfeldii	....	....	....	r	....	—							c	c	c	c	+	....	—	—	r	c	....	c		r	—	—	r	....	r	r	—	
» longissima	....	....	....	....	....	....	....	....	....	....	....	....	....	+	....	r	....	....	....	r	r	c	....	c		r	....	r	....	....	....	....	r	
Neritic Diatoms.																																	
Thalassiosira Nordenschiöldii	....	....	....	....	....	....	....	....	....	....	r	....	r	....	r	—	—	....	r	r	....	....	r	....	—	....	....	r					
» gravida	....	....	....	—	....	....	....	....	....	....	—	—	r	....	—	—	—	....	....	r	....	....	....	....	—								
Coscinodiscus polycordus	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	....	....	....	....	r					
» excentricus	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r																	
Actinoptychus undulatus	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	r																	
Lauderia annulata	....	....	....	....	....	....	....	....	....	....	....	r	....	....	....	....	r	....	....	....	....	....	r	....	....	+							
Guinardia flaccida	....	r	....	r	....	....	....	....	....	....	r	r	....	—	....	—	—	....	....	....	....	....	r										
Leptocylindrus danicus	—	cc	....	c	—	....	....	c	r	c	r	r	—	—	—	—	—	....	....	c	....	c	....	r	c	....	....	....	r				
Cerataulina Bergonii	....	....	....	....	....	....	....	....	....	r	....	....	....	....	....	....	....	....	....	....	....	r	....	....	r	....	....	....	....	....	....	r	
Rhizosolenia stolterfothii	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	
» setigera	....	....	....	....	....	....	....	....	....	r	....	....	....	r	....	r	....	....	....	....	....	....	....	c									
Encampia Zoodiacus	....	....	....	....	....	....	....	....	....	....	r	....	....	....	r																		
Pitylum Brightwellii	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r																	
Biddulphia aurita	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r																	
» mobiliensis	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	r	r																
Chætoceros contortum	....	....	....	r	....	....	....	....	....	r	....	r	....	r	....	r						r											
» breve	....	....	....	....	....	r	....	....	....	r	....	....	....	r	r	—	—	....	....	....	....	....	....	r	—	....	r	c	+	r	—	c	c	
» constrictum	r	r	r	....	....	....	....	....	....	r	....	....	....	r	r	—	—	....	....	....	....	....	....	r	—	....	r	c	+	r	—	c	c	
» curvisetum	....	....	....	r	....	....	....	....	r	—	....	....	c	c	—	r	+	....	c	—	....	—	....	r	—	....	....	r	....	r	....	....	r	
» debile	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r					
» scolopendra	....	....	....	r	....	....	....	r	....	....	....	c	r	r	r	....	....	....	....	r	....	....	....	....	....	....	....	c	....	....	....	....	r	
» crinitum	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r					
» didymum	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	r
» Willei	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Nitzschia seriata	....	....	....	....	....	....	....	....	r																								

Table III.

Locality and Depth.	NNE of Cape Skagen. 95 Fathoms.			Paternoster in NE. 8 Miles. 55 Fathoms.			The Light-ship of Cape Skagen in SSE. 3 Miles. 49 Fathoms.		Nordre Rønner in S ½ W. 10 Miles. 20 Fathoms.		Nordre Rønner in S. 20 Fathoms.	
Date.	13. July, 1897.			1. July, 1897.			1. July, 1897.		3. July, 1897.		9. July, 1897.	
Fathoms fished through.	0—10.	15—30.	40—90.	0—10.	18—29.	30—50.	0—10.	15—45.	0—7.	12—19.	0—5.	10—19.
Salinity, in per cent.	$\frac{3_{22}}{3_{198}}$	$\frac{3_{13}}{3_{148}}$	$\frac{3_{51}}{3_{151}}$	$\frac{2_{19}}{2_{186}}$	$\frac{3_{33}}{3_{140}}$	$\frac{3_{240}}{?}$	$\frac{3_{123}}{3_{137}}$	$\frac{3_{142}}{3_{150}}$	$\frac{2_{125}}{2_{173}}$	$\frac{3_{128}}{3_{131}}$	$\frac{2_{192}}{2_{192}}$	$\frac{3_{193}}{3_{138}}$
Quantity, in Gram.	1_{10}		1_{12}	3_{12}		0_{15}	1_{13}	0_{16}		0_{16}	3_{14}	1_{19}
Peridineæ.												
Ceratium tripos	cc	c	r	c	c	r	cc	c	c	....	+	c
» » v. longipes	+	+	r	r	c	....	r	c	....	r	r	
» » v. Bucephalos												
» » v. macroceros	+	+	....	....	....	r	r	....	....	....	r	
» fusus	c	c	r	+	c	+	r	+	+	r	r	c
» furca	....	....	....	+	+	....	+	r	....	r	....	r
Peridinium divergens	c	+	r	....	c	....	r	c	....	+	r	
Dinophysis acuta	....	r										
Diplopsalis lenticulata	....	....	....	....	+							
Oceanic Diatoms.												
Coscinodiscus oculus iridis. Ehb.	....	....	....	....	....	r						
» radiatus. Ehb.	....	....	....	....	....	r						
» concinnus. Sm.												
Rhizosolenia styliformis. Btw.	....	r	r	....	....	r	....	....	....	r	....	+
» semispina. Hensen.												
» alata. Btw.	cc	+	r	cc	c	r	cc	r	cc	....	cc	cc
» Shrubsolii. Cl.	r	c	cc	r	r	+	r	+	....	+	r	c
Dactyliosolen mediterraneus	...	....	r									
Chætoceros atlanticum. Cl.	....	....	r									
» boreale. Bail.	....	r	r	r								
» danicum. Cl.												
» criophilum. Castr.												
» decipiens. Cl.	....	....	....	....	....	....	....	r	....	....	....	r
Thalassiothrix Frauenfeldii. Grun.	....	....	....	r	....	....	....	....	r	....	r	
» longissima. Cl.	....	....	r									
Neritic Diatoms.												
Thalassiosira Nordenschiöldii. Cl.												
» gravida. Cl.												
Coscinodiscus polycordus. Gran.												
» excentricus. Ehb.												
Actinoptychus undulatus. Ehb.												
Lauderia annulata. Cl.	....	....	r									
Guinardia flaccida. Perag.	r	c	cc	r	c	cc	r	c	r	c	r	c
Leptocylindrus danicus. Cl.												
Cerataulina Bergonii. Perag.	....	....	....	r	....	....	....	....	r	....	r	
Rhizosolenia Stolterfothii. Perag.	....	....	r									
» setigera. Btw.												
Eucampia Zoodiacus. Ehb.												
Ditylum Brightwellii. West.												
Biddulphia aurita. Lyngb.												
» mobiliensis. Bail.												
Chætoceros contortum. Schütt.	....	....	r									
» breve. Schütt.												
» constrictum. Gran.	....	....	....	....	....	....	....	r				
» curvisetum. Cl.												
» debile. Cl.												
» scolopendra. Cl.												
» crinitum. Schütt.												
» didymum. Ehb.	....	....	r									
» Willei. Gran.	....	....	+									
Nitzschia seriata. Cl.												

Table IV.

Nykøbing on Mors. c. 5 fathoms fished through.

Date.	1896. 23. X.	16. XI.	23. XI.	30. XI.	19. XII.	1897. 3. I.	28. II.	8. III.	16. III.	24. III.	1. IV.	6. IV.	10. IV.	17. IV.	24. IV.	21. V.	29. V.	6. VI.	14. VI.	22. VI.	29. VI.	10. VII.	18. VII.	25. VII.	4. VIII.	14. VIII.	20. VIII.	28. VIII.	3. IX.	10. IX.	17. IX.	25. IX.	4. X.	14. X.	21. X.	1897. 27. X.
Quantity, in Gram.	c. 2_{10}.	1_{10}.	c. 0_{02}.	c. 0_{02}.	c. 0_{04}.	c. 0_{04}.	0_{33}.	1_{42}.	0_{09}.	1_{14}.	c. 1.	0_{89}.	1_{95}.	7.	3_{77}.	1_{17}.	2_{92}.	0_{98}.	0_{45}.	3_{90}.*)	1_{11}.	1_{95}.	1_{14}.	1_{15}.	2_{37}.	5.	5_{86}.	6_{80}.	5_{18}.	5.	2_{17}.	8_{16}.	3_{73}.	1_{17}.	0_{79}.	0_{18}.
Peridineæ.																																				
Ceratium tripos	....	+	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	r	+	c	c	+	r	+	+	r	r	r	r	....	r	r	r
» fusus	....	....	....	r	r	....	....	....	....	....	....	....	....	....	....	....	....	....	r	r	....	....	r	+	+	r	r	r	r	r	r	....	r	+	+
» furca	r	....	r	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	r	+	+	+	c	r	r	+	+	r	+	+	r	r	r	+	+
Peridinium divergens	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	r	....	.. .	r	r	r	r	....	r	....	r	r	....	r	....	r	....
Oceanic Diatoms.																																				
Coscinodiscus radiatus. Ehr.	r	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	....	....	....	r	....	....	....	....	....	r								
Rhizosolenia styliformis. Brightw.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	....	....	....	....									
» semispina. Hensen	....	....	....	....	....	....	r	....	....	....	....	....	r	....	+	....	....	r	r	....	....	r														
» Shrubsolii Cl.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	c	+	+	c	r													
» calcar avis. Schultze	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r														
Chætoceros boreale. Bail.	....	....	....	....	....	....	....	r	r	r	r	r	+	+	c	cc	cc	r	....	....	....	....	r													
» criophilum. Castr.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+	....	....	+	....	....	....	....	r	r								
» danicum. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	r							
» decipiens. Cl.	....	....	....	....	....	....	....	r	....	....	r	r	....	....	....	c	c	r	r	....	....	+	....	+	....	r										
Thalassiothrix Frauenfeldii. Grun.	....	....	....	....	....	....	....	+	+	+	+	+	+	+	c	c	....	r	r	....	....	....	r	cc												
Neritic Diatoms.																																				
Skeletonema costatum. Grev.	....	r	....	....	....	....	....	+	c	cc	cc	cc	cc	cc	c	....	....	....	....	....	....	+	r	r	....	....	....	....	....	....	....	....	....	....	....	r
Thalassiosira Nordenschiöldii. Cl.	....	....	....	....	....	....	....	....	r	....	....	....	r																							
Lauderia cystifera. n. sp.	....	....	....	....	....	....	+	c	c	+	r																									
Guinardia flaccida. Perag.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	r	+														
Rhizosolenia setigera. Brightw.	....	r	....	r	....	....	....	r	r	r	+	c	c	+	+	....	r	....	....	....	....	r	r	+	....	....	....	r	r							
Ditylum Brightwellii. West.	....	....	....	....	....	....	....	....	....	....	....	r	r																							
Litholesmium undulatum. Ehr.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r														
Encampia zoodiacus. Ehb.	r																																			
Biddulphia aurita. Lyngb.	....	....	....	....	....	r	c	cc	c	c	c	c	+	r	....	....	....	....	....	....	....	.. .	....	....	....	....	....	....	....	....	....	....	....	....	r	
» mobiliensis. Bail.	....	....	....	....	....	....	....	....	....	....	r	r																								
Chætoceros Weissflogii. Schütt.	....	....	....	....	....	....	....	....	....	....	r	....	....	r	....	....	....	....	....	....	....	+	....	+	+	....	....	+								
» teres. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	+																					
» contortum. Schütt.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....							r														
» didymum. Ehr.	r	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	r	+	r	r	+	+	+	r	r	r	r	r	r
» laciniosum. Schütt.	....	....	....	....	....	....	....	....	....	....	....	r	....	....	c																					
» breve. Schütt.	....	....	....	....	....	....	....	....	r																											
» simile. Cl.	....	....	....	....	....	....	....	r	r	r	r	r	r																						r	
» coronatum. Gran.	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	....	....	....	....	....	r	r						
» Schüttii. Cl.	r	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	r	....	+	c	c	r	r	....	....	r	....	....	r	....	r	
» debile. Cl.	ccc	+	....	....	....	....	....	....	+	+	+	+	....	c	....	....	....	....	....	....	....	+	r	+	c	cc	ccc	ccc	ccc	ccc	ccc	ccc	ccc	r	r	
» diadema. (Ehr.) Gran.	....	....	....	....	....	....	....	+	+	+	c	c	+	c	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	....	....	....	r			
» scolopendra. Cl.	....	....	....	....	....	....	....	....	....	r	r	r	....	....	r	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	r	r		
» sociale. Laudr.	....	....	....	....	....	....	....	r	+	r	+	r	r	r	r																					
» Wighami. Brightw.	....	....	....	....	....	....	....	....	r																											
» gracile. Schütt.	....	....	....	....	....	....	....	r																												
Asterionella spathulifera. Cl.	....	....	....	....	....	....	....	....	....	....	....	....	....	r																						
Achnanthes taeniata. Gran.	....	....	....	....	....	....	....	....	....	....	....	r																								
The temperature of the water, in °C., at Oddesund	9_{10}.	4_{10}.	4_{15}.	2_{15}.	0_{15}.	2_{15}.	1_{15}.	2_{15}.	2_{10}.	3_{15}.	3_{10}.	5_{15}.	5_{11}.	6_{11}.	8_{11}.	13_{15}.	14_{15}.	18_{10}.	18_{10}.	15_{15}.	19_{10}.	14_{15}.	19_{10}.	18_{10}.	20_{10}.	18_{10}.	17_{10}.	17_{15}.	16_{10}.	13_{10}.	14_{10}.	13_{15}.	11_{10}.	9_{10}.	10_{10}.	9_{15}.

* The great weight is here owing to larvæ of bivalves and snails.