
PLANKTON INVESTIGATIONS,

BY

R. M. CLARK, B.Sc.

CONTENTS.

	Page.
INTRODUCTION	167
THE PLANKTON OF THE FAEROE-SHETLAND CHANNEL	172
THE PLANKTON OF THE NORTHERN PART OF THE NORTH SEA	176
TABLE I. FAEROE-SHETLAND PLANKTON. DECEMBER, 1902, MAY AND AUGUST (PART), 1903	180
TABLE II. " " AUGUST (CONCLUDED) AND NOVEMBER, 1903	186
TABLE III. NORTH SEA PLANKTON. MAY, 1903	192
TABLE IV. " " " AUGUST, 1903	198
TABLE V. " " " NOVEMBER, 1903	204

PLANKTON INVESTIGATIONS,

BY

R. M. CLARK, B.Sc.

The collecting of plankton samples in connection with the Scottish part of the International North Sea Investigations may be said to have commenced with the Quarterly Cruises of May, 1903. A few collections had been made previously in the North Sea and in the Faeroe-Shetland Channel during the cruise of H.M.S. *Jackal* in December, 1902; but these were limited in number and were confined to surface gatherings. The advent of the *Goldseeker*, and her participation in the work of the Quarterly Cruises in May, made it possible to arrange for a more elaborate and detailed investigation of the plankton at the various hydrographical stations. During the Quarterly Cruises in May and August, 1903, samples of plankton have been collected at every hydrographical station in the North Sea and in the Faeroe-Shetland Channel. These samples have been obtained partly by means of horizontal hauls at the surface, partly by vertical hauls from a depth of 100 metres to the surface, or from near the bottom to the surface wherever a depth of 100 metres could not be reached. In the deep waters of the Faeroe-Shetland Channel, additional collections were made to secure samples of the plankton from greater depths, and to determine the nature of the organic life in water-layers of separate origin. Supplementary collections were made during the month of May at ten positions in the central area of the North Sea, and a large number of samples have been obtained throughout the year from the various positions along the east coast of Scotland visited by the *Goldseeker* during experimental fishery work.

To obtain as complete a representation as possible of the various forms of floating organisms, nets of different sizes and of different degrees of fineness have been employed, and a large amount of valuable material has now been accumulated.

The present Report will treat of the occurrence and distribution within the area investigated of the smaller organisms present in these collections, about whose distribution in the sea adjoining the east coast of Scotland very little previous information exists. Considering how much attention has been given during recent years to the study of these minute organisms of the plankton in the course of marine investigations abroad, and the value of the results already obtained towards a better understanding of the economy of the sea, it seems surprising that their study should have been so long neglected in this country.

That the sea contains vast numbers of minute floating animal and plant organisms has long been recognised, and their value as a source of food for the larger animals is also well known; but it must always be borne in mind that the basis of nutrition for all marine organisms is to be found in the plant life, and that vegetation plays as important a rôle in the sea as it does on the land. In the sea, the larger marine algae contribute their share, but for the purposes of general nutrition the vast swarms of floating Diatoms must account for a large part of the available food material. That Diatoms are devoured in quantities by many of the more sedentary marine animals is a well-established fact; and I have had frequent opportunities of observing how large a share they form of the food of the pelagic crustacea. Thus, as an indirect source of food for marine fishes, Diatoms are of great importance; but further evidence is required before it is possible to say how far fishes, either in the adult condition or in the earlier stages of their existence, feed directly on Diatoms or on other minute organisms of the plankton. Some years ago Mr. George Murray* published the results of an examination of the alimentary canals of several young flat-fish and small clupeoid fishes, taken during May in a tow-net gathering off the east coast of Scotland. He observed the presence of Diatoms in every case, and it appears evident that Diatoms are eaten directly

* G. Murray: Observations on Plant Plankton—Journal of Botany, Vol. 35, 1897, pp. 387-395.

by the young of certain fishes, at least during some periods of their life. To ascertain the relative nutritive value of various plankton organisms, Professor Brandt* of Kiel has subjected samples to chemical analysis and has published tables showing the percentage of organic substances present in each. Diatoms are seen to possess a comparatively low percentage of organic substances (34.8 per cent.), owing to the large amount of silica present in their composition (54.5 per cent.); but when one recollects in what vast quantities they frequently occur, their value as a source of organic food must not be overlooked.

As constituents of the plankton the Peridineae are of almost equal importance with the Diatoms, and often exceed them in bulk. Representatives of the group have occurred in every one of our samples, but in varying abundance. Certain areas of the North Sea almost destitute of Diatoms appear to be inhabited by large numbers of Peridineae, but usually throughout the summer months both Diatoms and Peridineae are well represented in every sample.

The researches of Brandt have shown that the Peridineae possess a higher nutritive value than the Diatoms, having a larger proportion of nitrogen and a high percentage of soluble carbohydrates. I have frequently endeavoured to obtain evidence of the presence of Peridineae in the alimentary canals of the larger organisms occurring in the plankton, but have been unable to detect them except in one sample from the Moray Firth, in which the excreta, presumably of pelagic Crustacea, contained undoubted fragments of the tests of Peridineae. Hensen, however, as the result of experiments with living Crustacea, has concluded that they feed more extensively on Peridineae than on Diatoms. There is no satisfactory proof as to how far the Peridineae are capable of forming organic substances after the manner of plants, and thus contributing to the available food supply for marine animals; still the fact that the Peridineae exist in large numbers throughout the winter in the Scottish coast plankton appears to conflict with a belief in their holophytic nutrition. It is usually the case that in the collections obtained by the use of fine-silk nets, Diatoms and Peridineae contribute the bulk of the sample, except where the green pelagic Alga, *Halosphaera viridis*, or the Flagellate, *Phaeocystis Poucheti*, occur in quantity.

Certain species of the Tintinnæ have apparently a wide distribution in the plankton, and frequently occur in large numbers. Their vertical extension is also very great, and, along with Crustacea, they form the bulk of the plankton in several of the deep-water hauls. About their methods of life and relation to other organisms very little is known.

Radiolarians are as a rule poorly represented. Samples from the Faeroe-Shetland Channel collected during the early part of the winter have contained a variety of species, but they rarely contribute to any appreciable extent to the bulk of the samples. In the gatherings made in the North Sea very few species of Radiolarians are present, and it has frequently happened that they have been entirely wanting.

Owing largely to the labours of Cleve, Ostenfeld, and other Scandinavian investigators, a great amount of information is now available concerning the distribution near the surface of marine plankton organisms in the North Sea and the North Atlantic, and much information has also been obtained as to the periodic changes in composition of the plankton of limited areas studied at intervals throughout the year. From a comparison of the results it is evident that the composition of the plankton at any locality is subject to a series of changes throughout the year, and that a more or less definite order of succession of forms tends to be repeated year after year. To some extent the changes taking place may be due to an alteration in the relative abundance of the various elements associated in the plankton; but it frequently happens that an entirely new combination of forms may appear on the scene to mingle with or even supplant the previous association.

* Brandt: Beiträge zur Kenntniss der chemischen Zusammensetzung des Planktons. Wissenschaftl. Meeresuntersuch. Bd. 3, Heft. 3. Kiel, 1898.

So marked is the tendency for certain of the plankton organisms to occur associated with one another that Cleve has established a series of plankton types, or communities, which may be said to characterise various regions of the sea at certain seasons of the year.

Cleve's plankton associations have been named after the predominant organism occurring in each, *e.g.*, in the combination known as the Chaetoplankton, the Diatom *Chaetoceras decipiens* is usually present in great abundance, and in the Styliplankton there is a predominance of *Rhizosolenia styliformis*. The plankton of the open ocean has been separated by Cleve into three great groups, Desmo-, Styli-, and Tricho-plankton, and each of these divisions is characterised by an assemblage of organisms leading an entirely oceanic life. Owing to the sensitiveness of these oceanic organisms to altered physical and chemical conditions, they tend to be reduced in numbers or to die out as they approach the coasts, and the composition of the plankton is further altered by the appearance of shallow-water or "neritic" species which find conditions favourable to their growth and development in the shallow waters near land. These neritic associations of plankton organisms are considered by Cleve to be modifications of the three oceanic groups. Thus the Desmoplankton, the oceanic plankton of tropical seas, contains but few Diatoms, but near land its composition is altered by the appearance of an abundance of Diatoms, and it is then designated "neritic Desmoplankton." The Styliplankton, the oceanic plankton of temperate seas, has two important neritic modifications, *viz.*, the Triposplankton and the Didymusplankton. The former contains an abundance of Copepods and Peridineae but few Diatoms; the latter, on the other hand, is rich in Diatoms, but has few Peridineae. The Trichoplankton is the oceanic plankton of Arctic waters and contains animal and plant life in abundance. From the Trichoplankton two neritic types are derived, the Siraplankton and the neritic boreal Trichoplankton. In addition to the above mentioned groups, Cleve has applied the term Chaetoplankton to an oceanic plankton of Arctic origin, which has for its principal constituent the Diatom, *Chaetoceras decipiens*, and which appears in winter and spring in the more northern parts of the Atlantic Ocean.

However, it must frequently happen that difficulty arises in determining to which of these groups an assemblage of plankton organisms should belong, as new combinations may be formed locally, and a species predominant one year may during another year be poorly represented. Yet Cleve's groupings of the plankton organisms have been recognised as generally applicable, and the terms employed to denote the associations are now in common use.

It is quite obvious that the movements and distribution of organisms floating in the sea must be regulated to a considerable extent by the strength and course of marine currents. This view has been confirmed not alone by the study of the general distribution of plankton organisms but also as a result of the examination of limited areas of the sea. A combined hydrographical and biological examination of the Skagerrack by Swedish investigators brought prominently into view the importance of the plankton as an aid to hydrography. It was shown that water-layers of different salinity and various origin contained distinct associations of plankton organisms. Assuming that these associations are characteristic of certain areas of the sea, and that they can be transported from considerable distances, the composition of the plankton would give a valuable clue to the source whence the water had originated, and, further, the horizontal and vertical distribution of the associated organisms could be employed to determine the boundaries and extent of the water-layers in which they occurred.

Cleve has proceeded farthest in this direction, and has expressed the opinion that the oceanic currents are characterised by definite plankton associations which are preserved during the movements of the water, and that when two regions of the sea have the same plankton organisms currents must connect the one with the other. The periodic variation in composition of the plankton at any locality is accounted for in

like manner, as being due to the successive arrival of currents of different origin, bearing plankton organisms or their germs from other districts. The Norwegian biologist, Dr. Gran, in his recent publications on marine plankton organisms, has taken exception to certain of Cleve's views, and maintains that there is no direct evidence of the transport of germs in currents, or of the conveyance of the whole mass of the plankton from widely-separated areas. In his most recent work,* Gran states it as his opinion that "the irregularities that appear in these periodical variations are not much greater than, for example, in the propagation of our annual marine algae, or among the animals of the depths. The development may be delayed during one year from hydrographical causes. Another year a species usually abundant may occur sparingly, or vice versa; but all these are exceptions which prove the rule. This constant occurrence of periodic variation has confirmed me in the distinct conviction that these variations are principally caused by the change of the seasons; that they are for the most part, biological phenomena affected by all the factors which have an influence on the development of organisms." Gran does not deny that plankton organisms are frequently drifted by currents for long distances and that the currents have a marked influence on the character of the plankton, but he considers that the indirect influence of the currents is much greater than the direct, in so far as they modify the external conditions of life and promote or retard the local development of organisms.

The study of the geographical distribution of plankton organisms has shown conclusively that some forms have their natural habitat and centres of distribution in Arctic waters, that others are of a southern type and find more favourable conditions of life in the warmer waters of the Atlantic; while yet others are at home in the North Sea, and have their centres of distribution there. In the case of some species, their distribution is more cosmopolitan; and it is difficult, in the present state of knowledge, to fix their proper habitat within definite limits. Certain leading types of the former groups have an area of distribution coinciding closely with the limits of the water in which they find the conditions most favourable for their existence, and thus they may be employed as indicators of the presence of waters hydrographically distinct, and of different origin. We may utilise in this way certain forms to denote the presence of Arctic, Atlantic, and North Sea water; but there will always be a fairly wide margin where the characteristic forms of both currents occur mixed with one another. As Gran has pointed out, the direct influence of the currents and their variation in strength may cause the boundaries between the regions of southern and northern forms to be shifted; and, in this connection, the study of the plankton may give much assistance in defining the limits of the currents and their variation in extent at different seasons.

In other ways, valuable clues may be obtained as to the presence of currents and their direction of flow from a study of the composition of the plankton. Some species of plankton organisms appear to have a greater power of resistance to altered conditions than others, and these may occur in the plankton at a considerable distance outside of their proper area. Such invaders, if they occur as subordinate components of the plankton along with native species, may be held to indicate currents of water flowing from the district to which these organisms properly belong.

Again, the marked difference in composition of the plankton from shallow-water coastal areas compared with that found in the deeper waters of the open sea may afford an important aid in detecting the presence of marine currents. At certain seasons of the year the waters of the sea near shore are invaded by large swarms of minute organisms, meroplanktonic Diatoms, which spend a part only of their existence in the plankton. These so-called "neritic" species can under favourable conditions

* H. H. Gran; *Das Plankton des Norwegischen Nordmeeres*—Report on Norwegian Fishery and Marine Investigations, Vol. ii., 1902, No. 5.

multiply with great rapidity, and may very soon become the most prominent elements of the coast plankton. They are liable to regular or irregular fluctuations in abundance, at one time increasing, at another time declining rapidly in numbers, or, it may be, disappearing altogether from the plankton. It is characteristic of most of these neritic Diatoms that a period of decline in numbers is accompanied by the formation of resting-spores, which presumably fall to the bottom and remain dormant until conditions favourable to their germination and active development have reappeared. It is thus probable that for a suitable habitat the neritic spore-forming organisms are limited to water sufficiently shallow to enable the resting spores to germinate, although, when brought under the influence of outflowing currents, these species may be found at considerable distances out to sea. The plankton of the open ocean is, on the other hand, characterised by many species of so-called "oceanic" Diatoms, holoplanktonic forms, suspended for the entire period of their existence in the water, without at any time, so far as is known, producing resting-spores. Associations of such oceanic forms extend into the coastal areas, but there they are liable to become mixed with the neritic species, at least during the warmer months of the year. If, then, we find in the open ocean water containing a mixture of neritic and oceanic forms, we are justified in concluding either that such water has been previously in contact with a coastal area, or that there has been an admixture of water flowing out from the coast.

Thus it is evident that in a variety of ways the study of marine plankton organisms can afford valuable aid to hydrographical investigations, and it is possible that the importance of the relation between hydrographical conditions and the life of marine fishes may depend less on the direct influence of currents and alterations in temperature and salinity than on the way these affect the distribution and control the development of the organisms in the plankton.

The study of marine plankton organisms is necessarily a task of considerable difficulty, requiring frequent and long-continued observations, and it is much to be regretted that, except in the case of one or two groups, we possess few previous records of their occurrence on the Scottish coasts. So far as I am aware, no attempt has hitherto been made to carry out a systematic investigation of the smaller organisms occurring in the plankton at any locality on the east coast of Scotland. In the Seventh and Eighth Annual Reports of the Fishery Board for Scotland, Professor M'Intosh has published the results of an examination of the pelagic fauna of the Bay of St. Andrews during the months of 1888. The report contains much information concerning the occurrence and vertical distribution of many of the larger plankton organisms for each month of the year, but the micro-plankton is not treated in detail, although the presence of Diatoms and Infusorians and their relative abundance is noted. In 1896, at the request of the Fishery Board for Scotland, Mr. George Murray carried out an extensive series of observations on the phytoplankton of the west coast of Scotland. The principal observations were made during three separate periods of the year: the first, in March and April; the second, in July and August; and the third, in December. In March and April collections were also made in the North Sea. In the published reports of the results of the examination of the samples, Mr. Murray has indicated very clearly the general features of the phytoplankton of the west coast at various seasons of the year and at different localities; a list is also given of the Diatoms present in nine typical samples sent to Professor Cleve for determination. With regard to the collections made on the east of Scotland, no detailed information is given, although the general character of the phytoplankton is indicated, and reference made to the relative abundance of the more characteristic Diatoms. Professor Cleve has published at different times the results of his examination of a large number of plankton samples collected near the surface along various steamer-routes in the North Sea. In his treatise on "The Seasonal Distribution of Atlantic Plankton Organisms" are to be found many records of their occurrence at various points near the east coast of Scotland. His observations are of great value and interest, but, so far as the east coast of Scotland is concerned, the records are too few and isolated to afford a satisfactory basis for comparison.

We have, therefore, endeavoured during the early stages of the present investigations to obtain as much information as possible about the distribution of the plankton organisms in the sea adjoining the east coast of Scotland. The series of collections made during visits of the *Goldseeker* to localities near the coast has done much to supply this information; but, owing to the stormy weather prevalent throughout the year, plankton collections from the open sea have been rarely obtained, and definite comparisons of the conditions in the open sea and near shore are not, in the meantime, possible.

Much light is thrown on the general features of the plankton of the open sea by the collections made during the quarterly cruises; these, however, are confined to the northern part of the area, and it is evident that their value would be much enhanced by supplementary observations during the intervening periods.

The results of the examination of the micro-plankton of samples obtained during 1902-3 is shown in the accompanying tables. In Tables I. and II., the collections made in the Faeroe-Shetland Channel during the quarterly cruises are treated separately; in the remaining tables the samples dealt with have been collected at various positions in the North Sea visited by the *Goldseeker* and the *Jackal* during quarterly cruises or at other times.

THE FAEROE-SHETLAND CHANNEL.

The composition and distribution of the plankton associations present in the Faeroe-Shetland Channel must be largely influenced by three hydrographical factors: (1) The strength and volume of the Atlantic water flowing northwards through the channel; (2) the drifting of the surface waters under the influence of local winds; (3) the invasion of the channel by a southward flowing current proceeding from the Norwegian Sea.

Of these factors the first has the most important influence on the composition of the plankton, for the great northward-flowing current carries with it the pelagic organisms inhabiting the waters of the North Atlantic Ocean. To estimate the extent of this influence it is necessary to know what associations of plankton organisms prevail in the Atlantic waters to the south and west of the Faeroe-Shetland Channel at different seasons of the year. Unfortunately, we have no direct observations for the year 1903, but, from the accounts published by Ostenfeld* of the results of the examination of a large number of surface samples collected on board steamers in the North Atlantic during 1897-99, information may be obtained as to the conditions likely to prevail during succeeding years. Ostenfeld has summarised the main features of the changes taking place in the plankton of this region as follows:—

“During winter (December-April) a poor Discoplankton occurs, consisting mostly of species of *Coscinodiscus*, intermixed with a great many other species which occur singly; during spring a rich Chaetoplankton and frequently a Nitzschiplankton are met with; the former is characterised by the presence of, e.g., *Chaetoceras atlanticum* and *decipiens* and the latter by *Nitzschia seriata* and *delicatissima* and the small *Chaetoceras schüttii* aff. and *pelagicum*.† Later in the summer these planktons are succeeded by Scotiaplankton, consisting mainly of the species of *Ceratium*; sometimes the Peridiniaceæ are replaced

* C. F. Wandel and C. Ostenfeld, Iagttagelser over Overfladevandets Temperatur, Saltholdighed og Plankton paa islandske og grønlandske Skibsrouter i 1897. København, 1898.

Martin Knudsen and C. Ostenfeld, Iagttagelser over Overfladevandets Temperatur, Saltholdighed og Plankton paa islandske og grønlandske Skibsrouter i 1898. København, 1899.

Martin Knudsen and C. Ostenfeld, Iagttagelser over Overfladevandets Temperatur, Saltholdighed og Plankton paa islandske og grønlandske Skibsrouter i 1899. København, 1900.

† I consider *Chaetoceras schüttii* aff. as = *Chaetoceras Willei*, and *Chaetoceras pelagicum* as = *Chaetoceras Ostenfeldii*.

by *Rhizosolenia styliformis* and several other species, and a Styliplankton is produced. Towards autumn *Halosphaera viridis* is met with in these associations, and it holds out beyond autumn, and after the other forms have disappeared it occurs as a Sphaeraplankton which during the winter occurs together with the Discoplankton or is replaced by it."

The following account of the composition of the plankton found in the Faeroe-Shetland Channel during the quarterly cruises will enable one to realise how far the changes taking place there coincide with the probable order of succession in the waters of the North Atlantic Ocean as indicated by Ostenfeld.

December, 1902.—Table I.—The plankton gatherings from the Faeroe-Shetland Channel are only five in number, and are confined to surface hauls. In composition the plankton is remarkably uniform, and may be regarded as a mixture of Sphaera- and Discoplankton, the predominant species being: *Halosphaera viridis*, *Coscinodiscus oculus iridis* and *C. radiatus*, *Thalassiothrix longissima* and *Ceratium tripos*. Associated with these, but far less abundant, we find a number of Diatoms and Peridineae of an almost entirely oceanic type, viz., *Chaetoceras atlanticum* and *C. decipiens*, *Euodia cuneiformis*, *Rhizosolenia styliformis*, *Ceratium furca*, *C. fusus*, *C. horridum*, and *C. reticulatum*. Isolated examples of several species of Radiolarians occur at Stations 14, 15 and 17, but few were present at Stations 13 and 19. It is noticeable that the various species of Diatoms are found in greatest quantity at Stations 15, 17 and 19, in water of a lower temperature and lower salinity than that prevailing at Stations 13 and 14.

May–June, 1903.—Table I.—Of the two plankton associations present in the December gatherings one, the Sphaeraplankton, has disappeared, and a Chaetoplankton with *Chaetoceras decipiens* as the predominant species has spread over the whole area of the Faeroe-Shetland Channel. The species of *Coscinodiscus* forming the Discoplankton of December are still well represented, but *Thalassiothrix longissima* and *Chaetoceras atlanticum* have both disappeared, and *Ceratium tripos* is present in reduced numbers.

Ostenfeld in describing the Nitzschiaplankton that frequently appears in spring in the waters of the North Atlantic Ocean, mentions four Diatoms as peculiarly characteristic of this association, viz., *Chaetoceras Ostenfeldii*, *C. Willei*, *Nitzschia seriata* and *N. delicatissima*. In Table I. the distribution of these Diatoms in the Faeroe-Shetland Channel in May–June is shown, and it is evident that a quite characteristic Nitzschiaplankton is present, but that it is confined to a zone of water situated towards the south side of the channel, and corresponding in position to Stations 13A, 14A, 19B and 20A. The water at these stations is distinguished by a high temperature and a high degree of salinity. In the area containing the Nitzschiaplankton two Diatoms are present, viz., *Bacteriastrum delicatulum* and *Dactyliosolen antarcticus*. Both species belong to a series of forms of southern origin, never found endemic in the waters of the North Sea nor in the Norwegian Sea, but, having a special capacity for making long journeys floating in the plankton, they are carried every year far to the northward in the waters of the Gulf stream. It is noteworthy that their distribution in the Faeroe-Shetland Channel during May–June is limited to the water containing the Nitzschiaplankton.

An association of plankton organisms occurs intermingled with the Nitzschiaplankton but occupying a wider area, though confined to the southern half of the Faeroe-Shetland Channel. It is characterised by an abundance of the Diatom *Rhizosolenia alata* associated with *Rhizosolenia semispina* and *Thalassiosira gravida* and several species of Peridineae.

The northern half of the Faeroe-Shetland Channel is occupied by a plankton comparatively poor in species, a plankton which may be considered a mixed Chaeto- and Discoplankton, and containing *Chaetoceras boreale* together with *C. decipiens*. Species of Peridineae are well represented but do not occur in great quantity.

The hydrographical observations made in the Faeroe-Shetland Channel during the May cruise indicate that the water in the southern half of the Channel possesses a higher salinity and temperature than is found prevailing further to the north and this is correlated with a marked difference in the plankton associations present in these two regions, the southern association being of a more pronounced Atlantic type.

In the collections made during December, 1902, neritic species of Diatoms were absent, but in May-June they appear in the plankton. In the collections from the south side of the channel neritic Diatoms, characteristic of the coast plankton of the Shetlands, make their appearance at Stations 13A, 14A, 19B and 20A. Typical forms are: *Chaetoceras constrictum* and *C. contortum*, *Rhizosolenia Stolterfothii*, *Thalassiothrix Frauenfeldii*, and a small variety of *Cerataulina Bergonii*. The extensive distribution of these neritic species in the sea to the north of the Shetlands and their occurrence so far from land are noteworthy, and would seem to indicate the presence of currents producing a northerly movement of the water throughout this area.

From the absence of neritic species in the collections obtained at Stations 16 and 17, it is evident that the neritic Diatom flora of the Faeroe Islands is confined during May to the immediate neighbourhood of the land, and, in this respect, a marked contrast is presented to the wide distribution of neritic forms in the sea to the north of the Shetlands.

In most of the samples obtained during the May cruise Peridineae are well represented. *Ceratium longipes*, which was absent from the December gatherings, is now widely distributed though not usually present in great quantity. *Ceratium macroceros* occurs very rarely. *Peridinium depressum* is generally rare, but is found in considerable numbers at Station 21A to the west of the Shetlands.

August, 1903.—Tables I., II.—The Chaetoplankton so widespread during the early summer has now almost disappeared from all the central regions of the Faeroe-Shetland Channel, though it is still in evidence towards the north margin of the Channel at Stations 16 and 17. The Discoplankton likewise has died out, and *Coscinodiscus oculus iridis* and *C. radiatus* are now represented by isolated examples. Of the Nitzschiplankton no trace remains.

Over a great extent of the Faeroe-Shetland Channel a plankton now prevails in which the Peridineae play the principal rôle, the Diatoms being represented by examples of such typical North Atlantic species as *Chaetoceras convolutum*, *C. criophilum*, and *C. currens*, *Corethron criophilum* and *Thalassiothrix longissima*. The species of Peridineae occurring in greatest quantity are: *Ceratium furca*, *C. fusus*, *C. longipes*, and *C. tripos*. *Ceratium horridum* is rare, except on the south side of the Channel at Stations 19A, 19B, 20A and 21A, where it is present in considerable quantity. *Dinophysis acuta*, *Peridinium depressum*, *P. divergens*, and *P. ovatum* occur associated with the above-mentioned species, but occupy a very subordinate position, and are entirely wanting in several of the samples. Two species of Radiolarians, *Plagiocantha arachnoides* and a species of *Acanthometron*, are present in some quantity at several localities, and the Tintinnæ are represented by *Cyttarocylis denticulata* and *Ptychocylis urnula*, both species occurring in moderate abundance in nearly all the collections.

The same association of species of *Rhizosolenia* as was found in the southern part of the Faeroe-Shetland Channel during May is still noticeable in August, but its area of distribution has extended northwards as far as Stations 15A and 18A, so that it is now spread over all the central and southern parts of the Channel.

The modification of the plankton communities by the introduction of neritic species as the neighbourhood of land is approached is very noticeable at Stations 16 and 17 to the east of the Faeroe Islands. This is especially the case at Station 16, where the samples contain a rich plankton of such

characteristic neritic species as *Chaetoceras constrictum*, *C. contortum*, *C. debile* and *Thalassiothrix Frauenfeldii*. In the collections taken at stations 16 and 17 during the May cruise no neritic species were detected, and it is evident that the plankton of the east coast of the Faeroes has now extended further seawards. On the other hand, although examples of neritic plankton Diatoms were found in May widely distributed in the sea to the north of the Shetlands, in August they do not occur, and the collections from Stations 13A, 14A, 19B and 20A contain no forms of undoubted neritic origin.

During the August cruise a series of vertical hauls were made with the Nansen closing-net at several stations and from various depths. All the collections obtained in this way contain examples of the same organisms as are found in the over-lying water; but they appear in very much-reduced numbers, and in the deeper regions occur but rarely. Vertical hauls were made at stations 14A from 650 m. - 550 m. and from 300 m. - 200 m.; in both collections Diatoms were wanting except for the presence of a few examples of *Coscinodiscus radiatus*. The Peridineae of the higher water-layers scarcely occur, but *Ceratium arcticum*, a species of northern or arctic origin, is present in both samples. A silicoflagellate, *Dictyocha speculum*, occurs in noticeable quantity, and in both hauls several species of Radiolarians are present, together with examples of *Cyttarocyclus denticulata* and *Globigerina bulloides*. The collections made at Station 15A at a depth of from 650 m. - 550 m. contain a larger number of species of Diatoms, but all, with the exception of *Coscinodiscus oculus iridis* and *C. radiatus*, are poorly represented. Peridineae occur in moderate quantity, and *Ceratium arcticum* is here likewise a noticeable feature. At Station 18A a vertical haul was made from 360m.-260m. Except for the presence of a number of examples of *Coscinodiscus radiatus*, *Ceratium arcticum* and *Cyttarocyclus denticulata*, Diatoms, Peridineae and Radiolarians are almost entirely wanting. In a gathering from 220 m. - 120 m. taken at the same station, *Ceratium arcticum* is again present, together with an increased number of representatives of the other groups. The deep-water vertical hauls taken at other stations during the August cruise present much the same features as those described above, but *Ceratium arcticum* is wanting in the collection from 350m.-250m. at Station 19A, although it is present at Stations 18A and 19B at very much the same depth.

November, 1903.—Table II.—Owing to the unfavourable weather prevailing during the month of November, collections of plankton were obtained from only two stations in the Faeroe-Shetland Channel; but these gatherings are sufficient to show that the composition of the plankton is almost identical with that present in December, 1902. *Halosphaera viridis*, which is absent from the plankton during May and August, has now reappeared, and it is associated with species of Diatoms and Peridineae similar to those characteristic of the plankton samples collected in December of the previous year. A marked increase is also evident in the number of species of Radiolarians, and the representatives of the Protozoa are similar to those found in the collections for December, 1902.

If we now compare the order of succession and the time of appearance of the plankton associations present in collections made in the Faeroe-Shetland Channel from December, 1902, to November, 1903, with that indicated by Ostenfeld as characteristic of the open water of the North Atlantic Ocean, a marked correspondence is seen to exist. The presence of a mixed Disco- and Sphaeraplankton in December, the appearance of the Nitzschaplankton in May, the predominance of species of *Ceratium* in August, and the reappearance of the Disco- and Sphaeraplankton in November, agrees entirely with the changes taking place in the region investigated by Ostenfeld.

The large volume of Atlantic water entering the Faeroe-Shetland Channel from the westward evidently carries with it the plankton associations of the North Atlantic Ocean, together with a number of species of a more southern origin. The extent to which these plankton associations are represented and

the frequency of occurrence of the southern forms will, no doubt, vary according to the volume of Atlantic water passing northwards through the Channel.

The study of the distribution of an individual species is often of much interest in connection with hydrographical investigations. The Diatom, *Coscinodiscus oculus iridis* is a commonly occurring species over a wide area of the North Atlantic Ocean and the Norwegian North Sea. It finds its optimum conditions of life in the colder waters of the sea, and in the Gulf Stream its yearly maximum corresponds with the period of minimum temperature. As the temperature rises during spring and summer this Diatom disappears from the warmer waters; its maximum tends to move northwards and is then frequently to be found in the limiting layers between warm and cold currents. The effect of rising temperature in displacing the area of distribution of this Diatom is well illustrated by a comparison of its distribution in the Faeroe-Shetland Channel at different seasons of the year.

Ceratium arcticum is an organism of a yet more northerly type. It has its maximum in the Arctic Seas, where it is present in great abundance, and it is widely distributed in the surface waters of the north and west parts of the Norwegian North Sea. It is not found as a native anywhere in the warmer currents of the Gulf Stream and we may consider its occurrence in the Faeroe-Shetland Channel as denoting the presence of water of a northern origin. No example of *Ceratium arcticum* was detected in collections obtained from the surface in the Faeroe-Shetland Channel or in the vertical hauls from a depth of 100 m. to the surface, but it was present in varying quantity in all hauls from greater depths, except at Station 19A, where it did not occur in the sample from 350 m. — 250 m. The hydrographical observations made during the August cruise appear to indicate that the deep-water plankton samples have usually been obtained from water whose probable source of origin is the Norwegian North Sea, and the presence of *Ceratium arcticum* may be held to support this view, while its absence in one of the collections made at Station 19A is in harmony with the hydrographical results, as these indicate the presence of Atlantic water extending to a considerable depth at that position.

The associations of neritic Diatoms characteristic of the coast waters of the Faeroe and Shetland Islands, if carried out to sea, may give information as to the presence and the direction of flow of currents, and the probable origin of the water in which the organisms occur; but, in the meantime, our knowledge of the plankton flora of the coasts of the Shetland Islands is too imperfect to permit of quite definite statements as to the source whence these have come.

THE NORTHERN PART OF THE NORTH SEA.

May, 1903.—Table III.—The plankton of the collections obtained at stations visited during the quarterly cruise in May exhibits a considerable diversity of type. At Stations 2, 3, 4 and 5 a plankton prevails comparatively poor in species and small in bulk. *Halosphaera viridis* is present in quantity but Diatoms are poorly represented, *Coscinodiscus radiatus* being the only species of common occurrence. *Chaetoceras decipiens*, so prevalent elsewhere in the North Sea during May, is here usually rare or absent. Peridineae are fairly abundant, *Peridinium depressum* being the most conspicuous form; while *Ceratium furca*, *C. fusus*, *C. longipes* and *C. tripos* occur in moderate quantity. The plankton, though comparatively scanty, bears a marked resemblance to that occupying the southern margin of the Faeroe-Shetland Channel and its presence here may be considered as an indication of the influence of Atlantic water.

At Stations 6 and 7 the plankton in its general features corresponds to that found at the preceding stations, but *Halosphaera* is absent from both hauls at Station 7, and occurs rarely at Station 6. *Chaetoceras decipiens*, on the other hand, is present in quantity. Especially noticeable, however, is the

great abundance at both stations of a small variety of *Cerataulina Bergonii*, a variety which I am inclined to consider a typical form of the coast plankton of the Shetland Islands. Except for its appearance at Stations 6 and 7, it has been found only in samples collected in the neighbourhood of the Shetland Islands, where it occurs in very great profusion. It seems probable therefore that the numerous examples of this Diatom found at Stations 6 and 7 had been drifted eastwards from the Shetland Islands in the waters of the Gulf Stream.

At Station 8 we enter an area where Peridineae predominate in the plankton and Diatoms are poorly represented, and this type of plankton continues with only slight modifications from Stations 8 to 12. Two important Peridineal associations, Longipesplankton and Triposplankton, are almost equally well represented in the plankton of this region. The Longipesplankton (Northern Peridinal Plankton, Ostenfeld) is usually distinguished by the prevalence of *Ceratium longipes*, *Peridinium depressum*, *P. ovatum* and *P. pallidum*, while *Ceratium tripos*, *C. macroceros*, *C. furca*, *C. fusus*, *Peridinium divergens* and *Dinophysis acuta* are characteristic forms of the Triposplankton. The species of the Longipesplankton are of a northern type, and this plankton community has its centre of distribution in the colder waters of the North Atlantic and Norwegian North Sea; while the Triposplankton is found in warmer waters and has its greatest distribution in regions of the sea further to the south.

At Stations 11 and 12, as the Faeroe-Shetland Channel is approached, the plankton retains much the same composition, but the characteristic forms of the Longipes- and Triposplanktons are much reduced in numbers.

At Station 21, to the north-west of Fair Isle, the small *Cerataulina bergonii* appears in quantity, while at Station 22 the plankton contains large numbers of *Nitzschia seriata* and *Rhizosolenia styliformis*.

The collections obtained during the quarterly cruise in May were supplemented by a series of samples from stations in a central area of the North Sea further to the south. These stations were visited by the *Goldseeker* towards the end of May, and samples of the plankton were obtained at each position by means of vertical and horizontal hauls. In Table III. the stations visited by the *Goldseeker* are distinguished from those of the quarterly cruise by the letter G placed before the number of the station. The composition of the plankton throughout the area differs considerably from that found in the more northern regions of the North Sea.

At Station G1 in latitude 56° 02' N. Triposplankton prevails. The Diatoms in greatest abundance are the oceanic species, *Chaetoceras decipiens* and *Rhizosolenia semispina*; while a number of neritic forms are also present in the plankton, though, strangely enough, several of the latter do not occur on the surface but appear to be confined to the deeper strata. The neritic species are represented by *Cerataulina Bergonii*, *Chaetoceras debile*, *Lauderia borealis*, *Rhizosolenia shrubsolei* and *R. stolterforlthii*.

At Stations G2, G3, G4 and G5 the plankton has much the same composition as at Station G1, but the Triposplankton is here almost confined to the surface water, while the neritic Diatoms are generally present in both vertical and surface hauls. *Ceratium macroceros*, one of the characteristic forms of the Triposplankton, is entirely wanting at Stations G5 and G6.

At Stations G7 and G8 the Peridineae have almost disappeared from the plankton, and neritic Diatoms occur but rarely. The oceanic *Chaetoceras decipiens* and *Coscinodiscus radiatus* are, however, present in large numbers, and *Nitzschia seriata* appears in great quantity at Station 7. *Halosphaera viridis* is also of common occurrence in the surface waters at both stations.

At Stations G9 and G10, except for the presence of large numbers of *Halosphaera* and many examples of *Coscinodiscus radiatus*, the plankton is extremely scanty, and the characteristic forms of the Triposplankton are almost entirely wanting.

From the preceding summary of the composition of the plankton collected in the North Sea in the latter part of May it is evident that a Triposplankton prevails over a very wide region. Towards the north between 61° and 62° N. latitude Longipesplankton occurs associated with the Triposplankton, while further to the south between 56° and 59° N. latitude the Triposplankton is combined with a mixed association of oceanic and neritic Diatoms. In the samples from the west side of the central area a marked reduction in numbers of both Diatoms and Peridineae is apparent until at Stations G9 and G10 an almost pure Sphaeraplankton prevails. In the region to the south and east of the Shetland Islands the plankton assumes a character which suggests the influence of Atlantic water.

August, 1903.—Table IV. shows the distribution of the plankton organisms found at stations visited during the quarterly cruise in August.

At Station 1 in the Moray Firth the plankton is of a distinctly neritic type. *Chaetoceras decipiens* and other oceanic Diatoms are found in quantity, but the majority of the diatoms present are neritic forms characteristic of coastal waters. The neritic species occurring most frequently at Station 1 are *Chaetoceras contortum*, *Rhizosolenia shrubsolei*, and *Thalassiosira gravida*, while *Chaetoceras debile*, *Coscinosira polychorda*, and *Guinardia flaccida* are also present in moderate numbers. The Peridineae are fairly abundant, *Ceratium longipes* being the predominant species.

Stations 2, 3, 4, 5, 21, and 26 may be grouped together, as the collections from all these stations contain plankton of much the same composition. In this plankton species of Peridineae characteristic of Tripos- and Longipesplankton predominate, but numerous Diatoms, partly of neritic, partly of an oceanic type are also present. *Rhizosolenia alata* occurs in great quantity in all the samples, and *Chaetoceras decipiens* appears frequently, while *Chaetoceras boreale*, *C. debile*, *Coscinodiscus radiatus*, *Guinardia flaccida*, *Lauderia borealis*, *Rhizosolenia shrubsolei*, and *R. styliformis* are present in nearly all the collections.

At Stations 6, 7, 9, and 10 a plankton of a somewhat different type is met with. Tripos- and Longipesplankton still predominate, but *Rhizosolenia alata*, in great quantity, is almost the only Diatom occurring in these samples. Two species of Radiolarians are present, and *Cyttarocylis denticulata* occurs frequently in most of the collections.

At Station 8 vertical hauls were made with the Nansen closing-net from depths of 355 m.—300 m. and from 200 m.—100 m. Diatoms and Peridineae occur rarely, a few samples of *Coscinodiscus radiatus* representing the former group. In the collection from 200 m.—100 m. the chief constituents of the plankton are *Protocystis tridens* and *Cyttarocylis denticulata*. It is noticeable that although *Rhizosolenia alata* is present in great abundance at Station 8 in the vertical haul from 100 m. to the surface, it is absent on the surface. In like manner several species of Peridineae appear to be wanting on the surface although present in the deeper strata. The hydrographical observations indicate that a layer of water of comparatively low salinity (30.29) occupies the surface at Station 8.

At Station 11 Triposplankton still prevails, but the characteristic forms of the Longipesplankton show a reduction in number. Few species of Diatoms occur, but *Corethron criophilum*, a visitor of southern origin, is present in quantity in both samples.

At Station 12, situated to the north of the Shetland Islands, *Rhizosolenia alata* is absent and the Peridineae of the Tripos- and Longipesplankton are less numerous. On the other hand, *Rhizosolenia semispina* makes its appearance in these samples in great abundance.

The plankton collected at Stations 23 and 24 is peculiar as the water at these stations is occupied almost exclusively by a rich Triposplankton and Diatoms are exceedingly rare.

The supplementary cruise undertaken by the *Goldseeker* in May was not repeated in August, so that observations from the more central area of the North Sea are wanting. It is quite evident, however, that the Triposplankton so prevalent in the North Sea in May still extends over a wide region as it is the dominant association of almost all the plankton samples collected during the August cruise.

At the more northerly stations the Triposplankton is associated with Longipesplankton, as was the case in May, but in August a distinct Longipesplankton is also found at the stations to the south of the Shetland Islands, and extends as far as Station 1 in the Moray Firth.

The Sphaeraplankton has disappeared from the entire area, for no example of *Halosphaera viridis* was detected in any of the samples.

Comparatively few species of Diatoms are present in the collections except along the section from Stations 1 to 5 and at Station 21 to the north-west of the Fair Isle where the plankton contains a number of neritic and oceanic Diatoms. In August the most conspicuous Diatom in the plankton is *Rhizosolenia alata*, which is present in the majority of the collections and usually in great abundance. In certain areas, as at Stations 6, 7, 9 and 10, *Rhizosolenia alata* is almost the only representative of the Diatoms, and at Stations 23 and 24 the water is occupied almost exclusively by a rich Triposplankton and Diatoms are exceedingly rare.

November 1903 Table V.—The samples of plankton collected in the North Sea during the quarterly cruise in November are limited to vertical and surface hauls from eleven stations, all situated in the north-west area.

In the collection for November the Diatoms are represented by an increased number of species, but with the exception of *Chaetoceras decipiens*, *Coscinodiscus radiatus*, and *Rhizosolenia styliformis*, they are mostly of rare occurrence. *Rhizosolenia alata* has declined very greatly in numbers, and is no longer a predominant form.

At Stations 1, 2, 21 and 26, Peridineae are few in number, but become more numerous at Stations 3 and 4, and at all the remaining stations a rich Triposplankton is found. Longipesplankton, on the contrary, is poorly represented, the characteristic forms appearing in very much reduced numbers. *Halosphaera viridis*, entirely wanting in the August collections, has now reappeared, and forms a conspicuous feature in all the samples.

When we compare the plankton of the North Sea with that found in the Faeroe-Shetland Channel it becomes evident that the changes in the character of the plankton in the North Sea are much less pronounced, and associations of plankton organisms once formed tend to persist with only slight modifications throughout the summer and autumn. The great current of Atlantic water flowing through the Faeroe-Shetland Channel is constantly bringing in new forms and new associations, and this tends to prevent the formation of an indigenous plankton. In the comparatively still waters of the North Sea plankton associations are formed which may be regarded as probably indigenous, and these can persist for a lengthened period of time.

The great majority of the organisms found in the plankton of the North Sea and the Faeroe-Shetland are common to both districts, but there are others which are peculiar to the warmer waters of the Gulf Stream, and if found in the North Sea may be looked upon as invaders that have been carried in by currents of Atlantic water. As examples of these invaders may be mentioned the Diatoms, *Corethron criophilum*, *Dactyliosolen antarcticus* and *D. mediterraneus*, and *Enodia cuneiformis*, and the occurrence of any of these forms in samples from the North Sea may be regarded as an indication of the presence of water of Atlantic origin. Species of Peridineae as, e.g., *Peridinium reticulatum*, *Dinophysis homunculus*, and *Gonyaulax polygramma*, may be employed in like manner, but the Radiolarians supply by far the largest number of forms peculiar to the Faeroe-Shetland Channel and characteristic of its waters.

TABLE I.

THE FAEROE-

Station	13.	14.	15.	17.	19.	13A.	14A.	15A.	15B.	16.	17.							
Date	10/12.	10/12.	11/12.	11/12.	11/12.	29/5.	29/5.	30/5.	30/5.	30/5.	31/5.							
Position { Latitude { Longitude	61° 10' N. 2° 09' W.	61° 23' N. 3° 25' W.	61° 38' N. 4° 39' W.	61° 13' N. 6° 34' W.	60° 35' N. 4° 28' W.	61° 11' N. 2° 00' W.	61° 20' N. 3° 06' W.	61° 31' N. 4° 08' W.	61° 40' N. 5° 09' W.	61° 46' N. 5° 50' W.	61° 13' N. 6° 34' W.							
Depth in Metres	0.	0.	0.	0.	0.	100 0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.			
Temperature ° C.	9° 45.	9° 45.	6° 95.	7° 95.	6° 85.	8° 72 -9° 66.	9° 66.	8° 02 -8° 66.	8° 66.	7° 25 -8° 51.	8° 51.	6° 70 -7° 06.	7° 06.	6° 79 -7° 16.	7° 16.	6° 75 -6° 88.	6° 88.	
Salinity—pro Mille	35.37.	35.30.	35.21.	35.28.	35.18.	35.32 -35.47.	35.47.	35.25 -35.36.	35.36.	35.21 -35.29.	35.29.	35.18 -35.22.	35.22.	35.13 -35.13.	35.13.	35.15 -35.18.	35.18.	
CHLOROPHYCEAE.																		
<i>Halosphaera viridis</i> , Schmitz	c	..	c	c	c	rr	..	..	..	..	r	..	..	..	..	..	..	1
DIATOMACEAE.																		
<i>Actinoptychus undulatus</i> , Ehb. .. .. .	..	..	..	..	..	rr	..	..	..	..	..	..	..	r	r	r	rr	2
<i>Asteromphalus heptactis</i> , Ralfs. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3
<i>Bacteriastrum delicatulum</i> , Clev. .. .. .	..	..	..	..	..	r	r	rr	..	..	..	..	..	..	..	..	..	4
<i>Biddulphia Baileyi</i> , W. Sm. .. .. .	..	..	..	..	..	..	..	..	rr	..	..	..	..	..	..	..	..	5
<i>Cerataulina Bergonii</i> , Perag. .. .. .	..	..	..	..	..	r	r	+	..	rr	..	..	..	..	..	..	..	6
<i>Chaetoceras atlanticum</i> , Clev.	r	r	+	c	+	..	..	..	..	..	..	..	..	..	..	..	..	7
— <i>boreale</i> , Bail. .. .. .	..	r	r	r	+	..	..	..	r	+	c	c	r	c	+	+	+	8
— <i>boreale</i> , var. <i>Brightwelli</i> .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9
— <i>constrictum</i> , Gran. .. .. .	..	..	..	..	..	cc	cc	c	r	..	..	..	..	..	..	..	..	10
— <i>contortum</i> , Schütt .. .. .	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	11
— <i>evolutum</i> , Castr. .. .. .	..	..	..	..	..	r	r	r	..	rr	+	..	..	..	..	..	..	12
— <i>criophilum</i> , Castr. .. .. .	..	..	r	..	r	..	rr	+	r	+	+	r	..	..	..	r	r	13
— <i>currens</i> , Clev. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	14
— <i>debile</i> , Clev. .. .. .	..	..	..	..	..	..	..	..	c	+	..	..	..	..	..	..	..	15
— <i>decepiens</i> , Clev. .. .. .	..	r	r	+	+	+	+	cc	c	cc	cc	cc	cc	cc	cc	cc	cc	16
— <i>Ostenfeldii</i> , Clev. .. .. .	..	..	..	..	..	c	cc	+	+	+	r	..	..	..	..	..	..	17
— <i>peruvianum</i> , Brightw. .. .. .	..	..	..	r	r	..	..	..	..	..	..	..	..	..	..	..	..	18
— <i>Willei</i> , Gran. .. .. .	..	..	..	..	..	cc	c	c	+	..	..	..	..	..	..	..	..	19
— <i>teres</i> , Clev. .. .. .	..	..	..	..	..	r	..	+	rr	rr	r	..	..	r	r	r	r	20
<i>Corethron criophilum</i> , Castr. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	21
<i>Coscinodiscus centralis</i> , Ehb. .. .. .	+	..	..	..	r	..	..	..	..	..	..	..	..	..	..	..	..	22
— <i>concinus</i> , W. Sm. .. .. .	..	..	..	..	..	+	r	r	r	..	r	..	+	..	r	..	..	23
— <i>excentricus</i> , Ehb. .. .. .	..	..	..	..	..	r	..	r	r	r	..	..	..	r	..	..	..	24
— <i>oculus iridis</i> , Ehb.	+	+	c	c	c	..	r	..	+	+	c	c	+	+	r	c	c	25
— <i>radiatus</i> , Ehb. .. .. .	..	..	c	+	+	r	..	+	+	+	+	c	+	cc	cc	cc	cc	26
<i>Dactyliosolen antarcticus</i> , Castr. .. .. .	..	..	r	rr	..	..	rr	..	..	..	..	..	..	..	..	..	..	27
— <i>mediterraneus</i> , var. <i>tenuis</i> , Clev. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	28
<i>Euodia cuneiformis</i> (Wallich)	rr	r	+	+	r	..	..	..	rr	..	..	..	..	..	..	..	..	29
<i>Hyalodiscus stelliger</i> , Bail. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	30
<i>Nitzschia delicatissima</i> , Clev. .. .. .	..	..	..	..	..	+	+	..	..	..	..	..	..	..	..	..	..	31
— <i>seriata</i> , Clev. .. .. .	..	..	..	..	..	c	c	+	..	..	..	..	..	..	..	..	..	32
— sp. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	33
<i>Paralia sulcata</i> (Ehb.) Clev. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	r	r	r	r	34

TABLE I.

SHETLAND CHANNEL, 1902-1903.

18A.			19A.			19B.		20A.		21A.		13A.		14A.				15A.			15B.		
31/5.			31/5.			31/5.		31/5.		1/6.		18/8.		18/8.				18/8.			19/8.		
60° 56' N. 5° 28' W.			60° 41' N. 4° 31' W.			60° 45' N. 3° 50' W.		60° 38' N. 3° 33' W.		60° 14' N. 2° 22' W.		61° 16' N. 2° 08' W.		61° 18' N. 2° 59' W.				61° 27' N. 3° 42' W.			61° 39' N. 4° 45' W.		
438-0.	100-0.	0.	900-0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	650-550.	300-200.	100-0.	0.	650-550.	100-0.	0.	220-170.	100-0.	0.
6° 17' at 400 m. -8° 26.	7° 20' -8° 26.	8° 26.	-0° 48' -8° 96.	7° 47' -8° 96.	8° 96.	7° 58' -9° 06.	9° 06.	8° 70' -9° 66.	9° 66.	7° 90' -9° 26.	9° 26.	8° 24' -10° 97.	10° 97.	-0° 12' at 600 m. -0° 63' at 500 m.	5° 22' -6° 95.	7° 83' -10° 97.	10° 97.	0° 72' at 600 m. -1° 09' at 500 m.	8° 18' -10° 92.	10° 92.	5° 83' -7° 93' at 150 m.	8° 09' -10° 17.	10° 17.
35° 15' at 400 m. -35° 27.	35° 22' -35° 27.	35° 27.	34° 92' -35° 28.	35° 20' -35° 28.	35° 28.	35° 26' -35° 34.	35° 34.	35° 31' -35° 38.	35° 38.	35° 26' -35° 33.	35° 33.	35° 23' -35° 19.	35° 19.	34° 90' -34° 90.	35° 07' -35° 19.	35° 23' -35° 19.	35° 19.	34° 94' -34° 94.	35° 26' -35° 23.	35° 23.	35° 08' -35° 24.	35° 24' -35° 19.	35° 19.
1	..	..	..	r	..	rr	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	rr	..	r	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	..	..	r	r	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6	..	..	..	..	..	rr	rr	..	r	cc	cc	..	..	..	..	..	..	..	rr	..	..	..	..
7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	rr	+	+	..	..	..	..	+	..	r	..	..	..	..	..	..	..	..	rr	r	..	rr	..
9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
10	rr	..	..	..	..	rr	c	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..
11	..	..	..	..	..	c	..	..	cc	..	..	..	..	..	..	..	..	..	..	..	..	..	..
12	+	r	..	+	+	+	..	..	+	..	..	..	..	..	..	rr	..	r	..	..	..	..	..
13	..	r	r	+	+	r	..	rr	..	..	..	..	..	..	..	..	..	..	r	r	..	r	..
14	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+	+	r	+	+	..	+	+
15	+	c	+	r	+	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
16	cc	cc	cc	cc	cc	cc	+	c	cc	+	+	r	..	..	..	..	rr	rr	rr	rr	rr	rr	rr
17	..	..	..	..	..	c	r	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	rr	r	..	..	..	..	r	rr	r	..	..	..
19	..	..	..	..	..	cc	+	..	cc	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20	r	r	+	r	r	..	r	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..
21	..	..	..	+	+	r	..	..	..	..	..	+	c	..	..	+	+	..	c	+	..	c	c
22	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
23	..	..	..	r	+	..	+	c	..	..	rr	..	..	..	..	..	..	..	..	..	..	..	..
24	..	..	..	..	..	rr	..	r	rr	..	rr	..	..	..	..	..	..	r	..	..	..	r	..
25	r	+	..	r	+	+	..	c	+	rr	..	r	..	..	..	..	..	+	..	..	rr	rr	..
26	+	c	..	+	c	+	+	cc	r	+	..	+	..	r	r	r	..	+	r	..	+	r	..
27	..	..	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
28	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
29	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rr	..	..	..	..	..	..	..
30	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
31	..	..	..	..	..	+	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
32	..	..	..	..	rr	..	c	r	..	c	..	r	..	..	..	..	..	..	..	..	..	..	..
33	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
34	r	..	r	rr	r	..	..	..	..	r	rr	..	..	..	..	..	..	rr	r	rr	..	rr	..

TABLE I.—continued.

SHETLAND CHANNEL, 1902-1903.

18A.			19A.			19B.		20A.		21A.		13A.		14A.				15A.			15B.				
31/5.			31/5.			31/5.		31/5.		1/6.		18/8.		18/8.				18/8.			19/8.				
60° 56' N. 5° 28' W.			60° 41' N. 4° 31' W.			60° 45' N. 3° 50' W.		60° 38' N. 3° 33' W.		60° 14' N. 2° 22' W.		61° 16' N. 2° 08' W.		61° 18' N. 2° 59' W.				61° 27' N. 3° 42' W.			61° 39' N. 4° 45' W.				
438-0.	100-0.	0.	900-0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	650-550.	300-200.	100-0.	0.	650-550.	100-0.	0.	220-170.	100-0.	0.		
6° 17' at 400 m. -8° 26'	7° 20' -8° 26'	8° 26'	-0° 48' -8° 96'	7° 47' -8° 96'	8° 96'	7° 58' -9° 06'	9° 06'	8° 70' -9° 66'	9° 66'	7° 90' -9° 26'	9° 26'	8° 24' -10° 97'	10° 97'	-0° 12' at 600 m. -0° 63' at 500 m.	5° 22' -6° 95'	7° 83' -10° 97'	10° 97'	0° 72' at 600 m. -1° 09' at 500 m.	8° 18' -10° 92'	10° 92'	5° 83' -7° 93' at 150 m.	8° 09' -10° 17'	10° 17'		
35° 15' at 400 m. -35° 27'	35° 22' -35° 27'	35° 27'	34° 92' -35° 28'	35° 20' -35° 28'	35° 28'	35° 26' -35° 34'	35° 34'	35° 31' -35° 38'	35° 38'	35° 26' -35° 33'	35° 33'	35° 23' -35° 19'	35° 19'	34° 90' -34° 90'	35° 07' -35° 19'	35° 23' -35° 19'	35° 19'	34° 94' -34° 94'	35° 26' -35° 23'	35° 23'	35° 08' -35° 24'	35° 24' -35° 19'	35° 19'		
35	rr	..	r	..	rr	+	c	c	..	cc	+	..	r	..	..	+	+	r	+	+	..	..	..
36	rr	..	..	..	..	..	c	c	..	c	..	..	+	+	..	..	r	r	rr	r	+	..	..	r
37	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
38	..	..	..	..	..	..	r	..	..	..	+	rr	..	..	..	..	..	..	..	..	..	..	..	..
39	..	..	..	..	..	..	c	r	..	..	+	+	..	r	..	..	r	r	rr	rr	r	..	r	r
40	..	..	..	..	..	..	r	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..
41	..	..	..	..	..	..	+	..	..	r	rr	..	..	..	..	..	..	..	..	..	..	..	..	..
42	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	..	r	r	+	..	..	r	..
43	rr	..	..	..	..	..	..	..	..	..	..	..	..	r	+	..	..	+	..	..	+	..	..	..
44	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
45	..	..	rr	r	r	..	r	+	..	c	+	c	r	+	..	..	+	c	r	+	+	..	r	r
46	..	..	r	r	r	..	rr	r	..	+	+	+	r	r	..	..	+	+	r	+	+	..	r	r
47	rr	..	rr	..	..	..	r	..	..	r	..	..	..	..	..	..	..	r	r	..	r	..	..	..
48	..	rr	..	..	..	..	..	..	..	rr	..	r	..	..	..	..	..	..	..	..	..	..	..	..
49	r	+	+	+	+	..	+	+	+	r	c	r	..	..	..	..	r	r	+	+	+	r	r	r
50	..	..	..	..	..	..	..	..	..	..	..	..	r	r	..	..	rr	r	..	..	r	r	rr	r
51	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
52	..	..	..	r	r	rr	r	+	..	+	+	+	r	+	rr	..	c	cc	+	c	c	+	r	+
53	r	..	..	..	r	r	r	+	..	r	..	rr	r	+	..	..	r	r	..	r	+	..	+	+
54	..	..	..	..	..	..	..	..	..	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..
55	rr	..	+	..	r	r	..	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
56	..	..	rr	..	..	..	..	..	..	rr	..	..	rr	+	..	..	r	..	r	rr	rr	..	rr	..
57	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
58	..	..	..	..	..	..	r	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..
59	rr	r	r	rr	..	r	..	+	r	..	+	c	+	+	..	r	..	..	rr	rr	..	+	..	..
60	..	..	..	..	..	..	rr	..	..	..	..	..	..	r	..	..	r	r	rr	r	..	rr	r	..
61	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62	r	r	+	..	..	rr	r	r	+	c	+	c	..	..	..	..	..	..	..	..	..	r	rr	..
63	..	..	r	..	..	..	r	..	r	..	+	..	rr	..	..	..	..	..	..	rr	..	..	rr	..
64	rr	+	r	..	..	..	r	rr	..	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..
65	rr	rr	..
66	rr	r	r	..	..	..	rr	rr	..	rr	..	..	..	..	+	..	..	..	..	..	..	..	..	..
67	..	..	..	..	..	..	..	..	..	..	..	..	r	..	r	..	..	..	r	..	..	..	rr	..
68	r	..	..	r	..	r	..	..	..	rr	..	..	r	..	r	..	..	r	r	..	..	..	r	rr
69	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	..	c	c	c	c	c	..	r	..

TABLE II.—continued.

THE FAEROE-SHETLAND

Station	16A.		16.		17.		18A.				
	19/8.		19/8.		20/8.		20/8.				
Date	61° 49' N. 5° 36' W.		62° 00' N. 6° 12' W.		61° 12' N. 6° 33' W.		60° 57' N. 5° 47' W.				
	Position { Latitude { Longitude		100-0. 0.		100-0. 0.		100-0. 0.		360-280. 220-120. 100-0. 0.		
Depth in Metres	8° 07' 10° 00. -10° 00.		9° 02' 9° 45. -9° 45.		8° 75' 9° 02. -9° 02.		6° 40' 7° 96' -7° 44' at 200 m. -8° 35' at 250 m.		8° 35' 10° 02. -10° 02.		
Temperature °C.	35° 21' 35° 19. -35° 19.		35° 14' 35° 14. -35° 14.		35° 28' 35° 26. -35° 26.		35° 16' 35° 23' -35° 21. at 200 m. -35° 26.		35° 26' 35° 28. -35° 28.		
Salinity—pro Mille											
DIATOMACEAE—cont.											
<i>Rhizosolenia alata</i> , Btw... .. .	rr	..	rr	..	..	..	..	..	rr	+	35
— <i>semispina</i> , Hensen	rr	rr	..	..	..	..	..	..	rr	r	36
— <i>Shrubslei</i> , Clev... .. .	..	..	..	..	..	..	..	..	..	..	37
— <i>Stolterfothii</i> , Perag. .. .. .	..	..	..	..	..	..	..	..	..	..	38
— <i>styliformis</i> , Btw... .. .	..	..	cc	cc	cc	cc	..	..	..	+	39
<i>Thalassiosira gravida</i> , Clev. .. .. .	..	..	r	r	..	..	..	..	..	..	40
<i>Thalassiothrix Frauenfeldii</i> , Grun. .. .. .	..	..	+	+	r	..	..	..	..	..	41
— <i>longissima</i> , Clev. et Grun. .. .. .	..	..	r	r	..	..	..	r	+	+	42
PERIDINIALES.											
<i>Ceratium arcticum</i> , Ehb. .. .. .	..	..	..	..	..	..	+	+	..	..	43
— <i>arietinum</i> , Clev. .. .. .	..	..	..	..	..	..	..	..	..	..	44
— <i>furca</i> , (Ehb.) Duj.	r	r	..	..	..	..	..	r	r	c	45
— <i>fuscus</i> , (Ehb.) Duj.	r	r	..	..	r	..	..	rr	+	+	46
— <i>horridum</i> , Clev. .. .. .	..	..	..	..	..	r	..	r	..	r	47
— <i>lineatum</i> (Ehb.) .. .. .	..	..	..	..	..	..	..	..	..	..	48
— <i>longipes</i> , Bail.	r	+	r	..	r	+	..	..	+	+	49
— <i>macroceros</i> , Ehb.	rr	r	..	..	..	r	..	..	rr	r	50
— <i>reticulatum</i> (Pouchet) .. .. .	..	..	..	..	..	..	..	..	..	..	51
— <i>tripos</i> (O. F. Müll.) .. .. .	..	+	..	..	rr	r	r	+	+	c	52
<i>Dinophysis acuta</i> , Ehb. ... .. .	..	rr	..	r	..	..	..	rr	..	r	53
— <i>homunculus</i> , Clap. et Lachm. .. .. .	..	..	..	..	..	..	..	..	..	..	54
— <i>rotundata</i> , Clap. et Lachm. .. .. .	..	..	rr	rr	..	..	..	..	..	..	55
<i>Diplopsalis lenticula</i> , Bergh. .. .. .	..	..	..	..	..	rr	..	r	..	r	56
<i>Gonyaulax polygramma</i> , Stein. .. .. .	..	..	..	..	..	..	..	..	..	r	57
— <i>spinifera</i> , (Cl. et L.) Diesing .. .. .	..	..	..	..	..	..	..	..	..	..	58
<i>Peridinium depressum</i> , Bail. .. .. .	..	..	+	+	r	r	..	r	..	..	59
— <i>divergens</i> , Ehb.	rr	rr	..	..	..	..	..	..	rr	..	60
— <i>oceanicum</i> , (Vanh.) Jörg. .. .. .	..	..	..	..	..	..	..	..	..	..	61
— <i>ovatum</i> , Pouchet .. .. .	..	..	+	+	+	r	r	..	..	..	62
— <i>pallidum</i> , Ostf.	rr	..	r	r	..	..	..	..	..	rr	63
— <i>pellucidum</i> , (Bergh) Schütt .. .. .	..	..	r	r	..	..	..	..	..	..	64
SILICOFLAGELLATAE.											
<i>Dictyocha fibula</i> , Ehb. .. .. .	..	rr	..	..	..	..	..	..	..	..	65
— <i>speculum</i> , Ehb. .. .. .	..	..	..	..	..	..	..	..	..	rr	66
RADIOLARIA.											
<i>Acanthochiasma Krohnii</i> , Hkl. .. .. .	..	..	..	..	..	..	..	..	..	..	67
<i>Acanthometron elasticum</i> , Hkl. .. .. .	..	..	..	..	..	..	..	rr	rr	..	68
— sp. .. .. .	..	rr	..	..	..	..	..	+	c	+	69
<i>Acanthostaurus Nordgaardii</i> , Jörg. .. .. .	..	..	..	..	..	..	..	rr	..	..	70
— <i>pallidus</i> (C. et L.), var. <i>subulata</i> .. .. .	..	..	..	..	..	..	..	..	r	r	71

TABLE II.—continued.

CHANNEL, AUGUST—NOVEMBER, 1903.

19A.				19B.				20A.			21A.		19B.		21A.		
20/8.				21/8.				21/8.			21/8.		30/11.		30/11.		
60° 40' N. 4° 50' W.				60° 26' N. 4° 02' W.				60° 17' N. 3° 36' W.			60° 02' N. 3° 13' W.		60° 22' N. 4° 04' W.		60° 04' N. 3° 14' W.		
600-500.	350-250.	100-0.	0.	548-460.	320-220.	100-0.	0.	215-115.	100-0.	0.	100-0.	0.	200-100.	0.	75 0.	0.	
3°24 -5°36.	8°41 -8°77.	9°44 -11°72.	11°72.	4°42 -5°65 at 400 m.	6°00 ? -7°40 ?	8°58 -10°91.	10°91.	9°15 -9°25 at 100 m.	9°25 -11°25.	11°25.	9°34 -11°55.	11°55.	9°31 -9°30.	9°14.	9°46 -9°54.	9°54.	
35°07 -35°07.	35°31 -35°33.	35°33 -35°36.	35°36.	35°03 -35°10 at 400 m.	35°16 -35°24 at 200 m.	35°26 -35°26.	35°26.	35°26 -35°38.	35°38 -35°42.	35°42.	35°36 -35°31.	35°31.	35°38 -35°38.	35°45.	35°23 -35°21.	35°21.	
35	r	rr	cc	cc	..	..	c	+	rr	c	c	cc	cc	..	.	rr	..
36	..	..	rr	r	..	..	r	+	..	r	+	+	c	..	..	..	..
37	..	..	..	..	..	..	..	..	..	..	r	+	+	..	..	..	..
38	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
39	r	r	c	c	..	..	..	rr	r	c	c	+	+	r	r	r	r
40	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
41	..	..	..	..	..	..	..	..	..	..	..	..	..	r	r	..	..
42	r	..	+	+	..	..	+	+	..	r	+	..	..	r	+	+	..
43	+	..	..	..	+	r	..	..	r	..	..	..	..	..	..	..	..
44	..	..	rr	rr	..	..	..	..	..	..	..	..	..	..	rr	..	..
45	rr	r	c	c	rr	..	c	c	rr	c	c	r	+	..	r	r	r
46	rr	rr	c	c	..	..	+	c	rr	c	c	r	+	..	..	..	.
47	r	rr	+	c	r	..	+	+	r	+	+	..	r	c	c	c	+
48	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..
49	..	..	+	..	r	+	r	..	..	r	r	..	r	..	..	rr	..
50	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
51	..	..	..	..	..	..	..	..	..	..	..	..	..	r	r	..	..
52	+	rr	cc	cc	r	..	c	c	..	c	cc	r	+	c	cc	c	+
53	..	..	r	r	..	..	+	+	..	..	r	r	r	..	rr	..	..
54	..	..	..	rr	..	..	..	..	..	..	rr	..	..	..	..	..	..
55	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
56	..	..	r	r	..	..	..	rr	..	rr	..	r	r	rr	rr	..	..
57	..	..	+	+	..	..	rr	rr	..	..	..	..	rr	..	r	+	..
58	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
59	..	..	r	..	..	..	r	..	..	..	..	r	r	..	..	..	..
60	..	..	+	+	..	..	+	r	..	r	+	..	..	r	r	..	r
61	rr	..	r	r	..	..	..	r	..	r	r	..	..	r	r	r	r
62	..	..	rr	..	..	..	r	..	rr	..	..	..	+	rr	rr	..	..
63	rr	..	+	+	..	rr	r	..	..	..	r	r	r	..	r	rr	..
64	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..
65	..	.	r	r	..	..	..	..	..	..	rr	..	..	rr	r	..	..
66	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
67	..	..	..	..	rr	..	..	..	..	..	..	..	..	r	r	..	..
68	r	+	rr	..	r	r	r	..	r	..	..	..	..	r	r	..	..
69	r	r	+	+	r	r	c	c	+	+	+	c	+	..	rr	..	..
70	..	r	..	..	..	..	..	..	r	..	..	..	..	..	..	..	..
71	..	..	r	r	..	..	r	+	..	r	..	r	..	r	r	..	..

TABLE II.—continued.

CHANNEL, AUGUST—NOVEMBER, 1903.

19A.				19B.				20A.			21A.		19B.		21A.	
20/8.				21/8.				21/8.			21/8.		30/11.		30/11.	
60° 40' N. 4° 50' W.				60° 26' N. 4° 02' W.				60° 17' N. 3° 36' W.			60° 02' N. 3° 13' W.		60° 22' N. 4° 04' W.		60° 04' N. 3° 14' W.	
600-500.	350-250.	100-0.	0.	548-460.	320-220.	100-0.	0.	215-115.	100-0.	0.	100-0.	0.	200-100.	0.	75-0.	0.
3° 24 -5° 36.	8° 41 -8° 77.	9° 44 -11° 72.	11° 72.	4° 42 -5° 65 at 400 m.	6° 00 ? -7° 40 ?	8° 58 -10° 91.	10° 91.	9° 15 -9° 25 at 100 m.	9° 25 -11° 25.	11° 25.	9° 34 -11° 55.	11° 55.	9° 31 -9° 30.	9° 14.	9° 46 -9° 54.	9° 54.
35° 07 -35° 07.	35° 31 -35° 33.	35° 33 -35° 36.	35° 36.	35° 03 -35° 10 at 400 m.	35° 16 -35° 24 at 200 m.	35° 26 -35° 26.	35° 26.	35° 36 -35° 38.	35° 36 -35° 42.	35° 42.	35° 36 -35° 31.	35° 31.	35° 38 -35° 38.	35° 45.	35° 23 -35° 21.	35° 21.
72	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
73	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
74	..	..	..	..	..	..	..	..	..	..	..	..	rr	..	..	..
75	..	rr	..	..	..	..	..	..	..	..	..	..	rr	rr	..	..
76	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..
77	r	..	..	rr	rr	..	..	..	..	..	..	..	..	..	..	..
78	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
79	..	..	..	..	..	..	..	..	..	..	..	..	r	..	..	..
80	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
81	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
82	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
83	..	..	..	..	..	..	..	..	..	..	..	..	..	r	..	..
84	..	rr	..	rr	..	..	..	..	..	..	..	..	..	..	..	..
85	rr	..	..	..	..	..	..	r	..	..	..	..	r	r	..	..
86	..	..	..	..	..	..	..	..	..	..	..	..	..	rr	..	..
87	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
88	..	..	..	..	..	..	..	..	..	..	..	..	rr	..	..	..
89	..	..	..	..	..	..	..	..	..	..	..	..	r	r	..	..
90	..	..	..	..	..	..	..	..	..	..	..	..	rr	..	..	..
91	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
92	..	..	..	..	..	r	r	..	r	..	..	..	..	r	rr	..
93	r	..	..	r	+	+	..	+	..	..	..	..	r	r	rr	..
94	rr	+	+	rr	..	..	..	+	r	..	..	..	..	..	..	..
95	rr	..	..	..	..	..	..	..	..	..	..	..	r	..	..	..
96	+	r	+	+	r	+	+	+	+	+	+	r	r	r	+	+
97	r	r	+	+	rr	..	+	+	r	r	r	..	rr	r	..	..
98	r	r	r	..	+	r	..	+	r	r	r	r	r	r	..	r
99	rr	..	r	..	rr	..	rr	..	..	..	..	..	r	..	..	..
100	..	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..

TABLE III.

SEA, MAY, 1903.

12.		21.		22.		G. 1.		G. 2.		G. 3.		G. 4.		G. 5.		G. 6.		G. 7.		G. 8.		G. 9.		G. 10.		
27/5.		1/6.		2/6.		28/5.		28/5.		27/5.		27/5.		27/5.		26/5.		26/5.		26/5.		26/5.		25/5.		
61° 02' N. 1° 10' W.		59° 46' N. 2° 11' W.		59° 38' N. 0° 41' W.		56° 02' N. 0° 31' E.		56° 35' N. 0° 59' E.		57° 26' N. 1° 41' E.		58° 06' N. 2° 14' E.		58° 38' N. 2° 40' E.		59° 25' N. 1° 48' E.		58° 52' N. 1° 22' E.		58° 13' N. 0° 49' E.		57° 50' N. 0° 30' E.		56° 46' N. 0° 24' W.		
100-0.	0.	100-0.	0.	80-0.	0.	84-0.	0.	92-0.	0.	93-0.	0.	82-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	73-0.	0.	
8° 00' ? -9° 06.	9° 08.	7° 65 -8° 71.	8° 71.	6° 88 -9° 16.	9° 16.	6° 31 -9° 30.	9° 30.	6° 07 at 80 m. -9° 25.	9° 25.	6° 16 at 80 m. -9° 50.	9° 50.	6° 23 -9° 75.	9° 75.	6° 29 at 80 m. -9° 30.	9° 30.	6° 80 -9° 30.	9° 30.	6° 49 -9° 25.	9° 25.	6° 44 -8° 80.	8° 80.	6° 77 -8° 50.	8° 50.	6° 90 at 60 m. -8° 50.	8° 50.	
35° 31 -35° 38.	35° 38.	35° 31 -35° 22.	35° 22.	35° 31 -35° 34.	35° 34.	34° 93 -34° 86.	34° 86.	34° 91 at 80 m. -34° 84.	34° 84.	35° 07 at 80 m. -34° 97.	34° 97.	34° 99 at 60 m. -34° 92.	34° 92.	35° 01 at 80 m. -34° 96.	34° 96.	35° 27 -34° 62.	34° 62.	35° 10 -35° 08.	35° 08.	35° 17 -34° 99.	34° 99.	35° 20 -35° 08.	35° 08.	34° 86 -34° 75 at 10 m.	34° 75 at 10 m.	
1	..	r	..	..	r	r	..	..	r	r	r	r	+	+	+	+	+	c	+	c	+	cc	+	cc	c	cc
2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	..	..	..
5	c	cc	cc	cc	..	..	+	r	+	c	..	r	cc	cc	cc	c	r	r	..	..	..	..	..	..	..	..
6	..	rr	..	..	..	..	..	..	..	rr	..	..	..	r	..	..	..	..	..	..	..	..	..	..	..	..
7	..	r	..	..	+	r	..	..	..	c	c	c	+	+	c	+	rr	+	+	r	r	..	..	..	..	..
8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	r	..	..	..	..	..	..	..	..
11	..	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
12	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
13	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
14	..	r	..	..	r	rr	+	..	+	+	r	..	r	+	..	..	..	..	..	..	..	..	..	..	..	..
15	r	c	+	c	cc	cc	cc	cc	cc	cc	cc	cc	c	cc	c	cc	rr	..	cc	cc	+	c	r	..	..	..
16	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
17	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
18	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
19	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	rr	..	..	+	r	..	..	..	..	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..
21	..	..	..	..	r	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
22	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
23	+	r	r	rr	+	r	..	..	..	..	..	+	..	rr	+	+	r	r	..	r	..	rr	+	rr	r	r
24	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rr	..	..	..	+	..	..	..	..
25	..	+	..	..	..	..	+	..	r	..	rr	..	..	..	r	r	..	..	+	..	r	..	r	..	+	r
26	+	+	..	r	..	..	..	..	r	..	..	..	..	+	..	+	r	+	..	c	..	+	+	c	r	c
27	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
28	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
29	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
30	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
31	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
32	..	..	..	..	..	..	r	+	+	+	r	..	+	+	+	..	+	+	..	..	..	..	..	..	..	..
33	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
34	..	..	rr	..	..	..	+	..	c	c	c	..	c	c	c	+	r	rr	rr	..	..	..	..	..	..	..

TABLE III.—continued.

THE NORTH

Station	2.		3.		4.		5.		6.		7.		8.		9.		10.		11.		
Date.. .. .	22/5.		22/5.		23/5.		23/5.		26/5.		26/5.		26/5.		26/5.		26/5.		27/5.		
Position { Latitude { Longitude	58° 38' N. 1° 46' W.		59° 10' N. 1° 27' W.		59° 28' N. 1° 20' W.		59° 40' N. 1° 14' W.		60° 37' N. 0° 30' E.		61° 09' N. 2° 00' E.		61° 32' N. 2° 50' E.		61° 34' N. 2° 05' E.		61° 38' N. 0° 43' N.		61° 43' N. 0° 43' W.		
	100-0.		100-0.		100-0.		100-0.		100-0.		100-0.		100-0.		100-0.		100-0.		100-0.		
Temperature °C.	7° 25 -7° 86.	7° 86.	7° 31 -8° 36.	8° 036.	7° 50 -8° 16.	8° 16.	7° 64 at 90 m. -7° 86.	7° 86.	7° 69 -8° 46.	8° 46.	8° 00 -8° 56.	8° 56.	7° 80 -7° 96.	7° 96.	7° 82 -8° 66.	8° 66.	8° 02 -9° 06.	9° 06.	7° 76 -9° 06.	9° 06.	
Salinity—pro Mille	35.29 -35.23.	35.23.	35.29 -35.42.	35.42.	35.35 -35.32.	35.32.	35.35 at 90 m. -35.35.	35.35.	35.36 -35.35.	35.35.	35.35 -35.31.	35.31.	35.29 -32.77.	32.77.	35.24 -34.99.	34.99.	35.28 -35.36.	35.36.	35.23 -35.33.	35.33.	
DIATOMACEAE—cont.																					
Leptocylindrus danicus, Clev.	+	r	..	..	..	..	..	35
Nitzschia closterium, (Ehbg.) W. Sm.	36
— delicatissima, Clev.	37
— seriata, Clev.	r	..	..	..	..	..	..	..	..	..	..	r	38
Paralia sulcata, (Ehbg.) Clev.	r	+	r	r	r	..	r	r	..	..	..	..	..	rr	..	..	..	..	..	r	39
Rhizosolenia alata, Brightw.	+	r	+	..	r	r	..	+	..	..	+	+	+	..	..	..	..	r	+	40
— faroensis, Ostf.	41
— semispina, Hensen	r	42
— setigera, Brightw.	43
— Shrubsolei, Clev.	r	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rr	44
— Stolterfothii, Perag...	rr	..	..	..	..	..	..	..	..	..	..	45
— styliformis, Brightw.	r	r	+	r	r	+	..	..	+	..	..	..	..	..	..	..	..	..	..	46
Skeletonema costatum, Grev.	47
Thalassiosira gelatinosa, Hensen	48
— gravis, Clev...	49
— Nordenskiöldii, Clev.	50
Thalassiothrix frauenfeldii, Grun.	rr	..	..	..	..	..	..	..	..	r	r	51
— longissima, Clev. et Grun.	52
PTEROSPERMATACEAE.																					
Hexasterias problematica, Clev.	rr	..	53
Pterosperma dictyon, (Jörg.) Ostf.	+	..	r	..	..	..	..	54
— Mobiusii, (Jörg.) Ostf.	rr	..	..	..	..	..	..	rr	..	..	..	r	+	rr	r	..	..	rr	rr	55
— Vanhöffenii, (Jörg.) Ostf...	56
Xanthidium hystrix, Clev.	rr	..	..	..	..	..	57
— multispinosum, Clev.	58
PERIDINIALES.																					
Ceratium arcticum, Ehbg.	rr	..	..	..	..	..	..	..	..	59
— bucephalum, Clev.	r	r	..	..	..	..	..	..	60
— furca, (Ehbg.) Duj.	+	+	+	+	+	r	r	+	r	+	e	cc	r	cc	r	e	+	+	61
— fusus, (Ehbg.) Duj.	+	+	+	+	r	r	r	r	+	+	r	r	e	+	..	+	r	+	r	r	62
— horridum, Clev.	r	..	..	..	..	r	r	+	rr	..	..	..	..	..	..	+	r	..	63
— lineatum (Ehbg.)	rr	..	..	..	..	..	..	..	..	..	..	..	+	..	+	..	r	..	..	64
— longipes, Bail.	+	e	+	+	r	..	..	r	..	+	r	cc	cc	r	cc	+	cc	+	cc	e	65
— macroceros, Ehbg.	e	e	..	c	r	e	r	+	66
— tripos (O. F. Müll.)	+	+	+	+	+	+	+	r	+	+	r	+	cc	cc	+	cc	+	cc	r	e	67
Dinophysis acuta, Ehbg.	+	r	r	r	+	+	r	+	r	68
— norvegica, Clap. et Lachm.	+	..	rr	..	..	69
— rotundata, Clap. et Lachm.	r	..	..	..	..	..	..	..	..	..	..	..	r	+	r	..	..	r	..	70
Diplopsalis lenticula, Bergh.	+	rr	+	+	..	..	..	..	..	..	rr	r	71
Gonyaulax spinifera, (Cl. et L.) Diesing	rr	..	..	..	..	..	..	..	r	..	..	..	..	..	+	..	+	..	..	72

TABLE III.—continued.

SEA, MAY, 1903.

12.		21.		22.		G. 1.		G. 2.		G. 3.		G. 4.		G. 5.		G. 6.		G. 7.		G. 8.		G. 9.		G. 10.			
27/5.		1/6.		2/6.		28/5.		28/5.		27/5.		27/5.		27/5.		26/5.		26/5.		26/5.		26/5.		25/5.			
61° 02' N. 1° 10' W.		59° 46' N. 2° 11' W.		59° 36' N. 0° 41' W.		56° 02' N. 0° 31' E.		56° 35' N. 0° 59' E.		57° 28' N. 1° 41' E.		58° 06' N. 2° 14' E.		58° 38' N. 2° 40' E.		59° 25' N. 1° 48' E.		58° 52' N. 1° 22' E.		58° 13' N. 0° 49' E.		57° 50' N. 0° 30' E.		56° 46' N. 0° 24' W.			
100-0.	0.	100-0.	0.	80-0.	0.	84-0.	0.	92-0.	0.	93-0.	0.	82-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	73-6.	0.
8° 00' ? -9° 06.	9° 06.	7° 65' -8° 71.	8° 71.	6° 88' -9° 16.	9° 16.	6° 31' -9° 30.	9° 30.	6° 07' at 80 m. -9° 25.	9° 25.	6° 16' at 80 m. -9° 50.	9° 50.	6° 23' -9° 75.	9° 75.	6° 29' at 80 m. -9° 30.	9° 30.	6° 80' -9° 30.	9° 30.	6° 49' -9° 25.	9° 25.	6° 44' -8° 80.	8° 80.	6° 77' -8° 50.	8° 50.	6° 90' at 60 m. -8° 50.	8° 50.	8° 50.	
35° 31' -35° 38.	35° 38.	35° 31' -35° 22.	35° 22.	35° 31' -35° 34.	35° 34.	34° 93' -34° 86.	34° 86.	34° 91' at 80 m. -34° 84.	34° 84.	35° 07' at 80 m. -34° 97.	34° 97.	34° 99' at 60 m. -34° 92.	34° 92.	35° 01' at 80 m. -34° 96.	34° 96.	35° 27' -34° 62.	34° 62.	35° 10' -35° 08.	35° 08.	35° 17' -34° 99.	34° 99.	35° 20' -35° 08.	35° 08.	34° 86' -34° 75 at 10 m.	34° 75 at 10 m.	34° 75	
73	rr	rr	..	..	..	r	..	r	r	..	..	r	r	..	..	..	..	..	..	..	..	..	..	..	..	..
74	c	+	c	c	+	c	r	+	..	r	..	c	c	+	c	cc	cc	rr	..	+	+	+	rr	+	+	+	
75	..	+	..	..	..	r	r	..	r	+	+	+	..	..	..	+	+	..	..	r	..	..	..	..	..	..
76	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
77	c	c	+	c	r	r	c	r	+	+	+	c	+	r	r	c	..	..	..	r	r	r	..	r	..	..
78	r	+	+	r	r	r	..	rr	..	r	+	..	r	rr	r	+	+	r	..	..	..	..	..	..	..	..
79	..	+	..	..	..	..	..	..	r	..	..	+	r	..	..	r	+	..	..	..	..	..	..	..	..	..
80	..	..	..	..	..	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
81	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rr	..	..	..	..	..	..	..	..	..	..
82	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
83	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
84	rr	..	..	..	..	..	..	rr	..	rr	..	..	rr	..	..	..	..	..	..	..	..	..	..	..	..	..
85	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	rr	..	..	..	..	..
86	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
87	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
88	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
89	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
90	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
91	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
92	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
93	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
94	+	+	..	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
95	c	r	..	..	..	..	..	..	..	..	..	..	..	..	rr	r	..	..	..	..	r	rr	..	..	..	..
96	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
97	..	..	..	..	..	..	..	rr	..	..	..	..	..	rr	..	..	..	..	..	..	..	..	..	..	..	..
98	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

TABLE IV.

SEA, AUGUST, 1903.

	8.				9.		10.		11.		12.		21.		23.		24.		25.		26	
	12/8.				13/8.		13/8.		13/8.		13/8.		21/8.		14/8.		14/8.		17/8.		17/8.	
	61° 32' N. 9° 10' E.				61° 34' N. 2° 05' E.		61° 37' N. 0° 45' E.		61° 43' N. 0° 43' W.		61° 02' N. 1° 09' W.		59° 46' N. 2° 21' W.		59° 31' N. 0° 37' E.		58° 55' N. 0° 04' E.		58° 11' N. 0° 32' W.		58° 09' N. 1° 50' W.	
	355-300.	200-100.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	90-0.	0.	128-0.	0.	93-0.	0.	108-0.	0.	60-0.	0.
6° 31 -6° 26.	6° 88 -6° 34.	6° 34 -13° 50.	13° 50.	8° 33 -12° 29.	12° 29.	8° 85 -12° 16.	12° 16.	9° 15 -11° 82.	11° 82.	8° 70 -12° 07.	12° 07.	10° 17 -11° 57.	11° 57.	6° 79 -12° 40.	12° 40.	6° 89 -12° 60.	12° 60.	8° 30 at 100 m. -12° 25.	12° 25.	9° 90 -11° 80.	11° 80.	
35° 10 -35° 08.	35° 16 -34° 96.	34° 96 -30° 29.	30° 29.	35° 29 -34° 36.	34° 36.	35° 40 -35° 18.	35° 18.	35° 36 -35° 31.	35° 31.	35° 31 -35° 27.	35° 27.	35° 15 -35° 05.	35° 05.	35° 26 -34° 66.	34° 66.	35° 23 -34° 94.	34° 94.	35° 25 -35° 17.	35° 17.	35° 08 -34° 90.	34° 90.	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	+	+	+	..	r	..	..	..	..	+	..	+	r	..	ff	..	..	..	..	r	+
27	
28	
29	
30	
31	ff	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
32	
33	
34	r	r	
35	

TABLE IV.—continued.

THE NORTH

Station	1.		2.		3.		4.		5.		6.		7.		
	11/8.		11/8.		11/8.		11/8.		11/8.		12/8.		12/8.		
Date	58° 00' N. 2° 14' W.		58° 36' N. 1° 46' W.		59° 10' N. 1° 27' W.		59° 26' N. 1° 20' W.		59° 40' N. 1° 14' W.		60° 40' N. 0° 27' E.		61° 09' N. 2° 00' E.		
Position { Latitude { Longitude	54-0.	0.	102-0.	0.	108-0.	0.	89-0.	0.	97-0.	0.	100-0.	0.	138-128.	100-0.	0.
Depth in Metres	10° 60 -11° 50.	11° 50	9° 46 -11° 25.	11° 25.	10° 11 at 100 m. -10° 80.	10° 80.	9° 69 at 80 m. -10° 80.	10° 80.	10° 80 at 80 m. -10° 20.	10° 20.	8° 33 -12° 37.	12° 37.	7° 62 at 139 m.	8° 08 -12° 98.	12° 98.
Temperature °C.	34° 88 at 60 m. -34° 80.	34° 80.	35° 23 -34° 99.	34° 99.	35° 25 at 100 m. -35° 21.	35° 21.	35° 30 at 80 m. -35° 25.	35° 25.	35° 28 at 80 m. -35° 26.	35° 26.	35° 33 -35° 20.	35° 20.	35° 29.	35° 29 -33° 57.	33° 57.
Salinity—pro Mille															
DIATOMACEAE—cont.															
Nitzschia closterium, (Ehbg.) W. Sm. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	36
— delicatissima, Clev. .. .. .	..	..	+	+	..	..	..	..	..	..	..	..	..	..	37
— seriata, Clev.	r	..	+	r	..	r	..	..	..	..	..	..	..	..	38
Paralia sulcata, (Ehbg.) Clev.	r	r	..	..	r	rr	rr	r	r	+	..	..	..	..	39
Rhizosolenia alata, Brightw. .. .. .	..	..	cc	cc	cc	cc	cc	cc	cc	cc	cc	cc	+	cc	40
— farøensis, Ostf. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	41
— semispina, Hensen	+	+	+	r	+	+	..	..	..	r	..	..	..	..	42
— setigera, Brightw. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	43
— Shrubsolei, Clev.	c	c	+	+	c	rr	+	r	+	+	..	..	..	..	44
— Stolterfothii, Perag. .. .. .	..	..	r	rr	..	..	..	..	..	..	..	..	..	..	45
— styliformis, Brightw. .. .. .	..	..	+	r	+	r	+	+	+	+	..	..	..	..	46
Skeletonema costatum, Grev. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	47
Thalassiosira gelatinosa, Hensen .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	48
— gravida, Clev.	c	c	c	c	+	+	+	+	+	+	..	..	..	..	49
— Nordenskiöldii, Clev. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	50
Thalassiothrix Frauenfeldii, Grun. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	51
— longissima, Clev. et Grun. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	52
PTEROSPERMATACEAE.															
Hexasterias problematica, Clev. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	53
Pterosperma dictyon, (Jörg.) Ostf. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	54
— Möbiusii, (Jörg.) Ostf. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	rr	55
— Vanhöffenii, (Jörg.) Ostf. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	rr	56
Xanthidium hystrix, Clev. .. .. .	..	rr	..	rr	..	..	..	..	..	rr	..	rr	..	..	57
— multispinosum, Clev.	rr	r	..	..	..	..	..	..	..	..	..	..	..	..	58
PERIDINIALES.															
Ceratium arcticum, Ehbg. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	59
— bucephalum, Clev. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	60
— furca, (Ehbg.) Duj.	+	+	cc	c	c	c	c	cc	c	c	r	cc	..	+	61
— fusus, (Ehbg.) Duj.	+	+	+	c	+	c	+	+	r	+	..	+	rr	+	62
— horridum, Clev.	r	r	..	r	..	..	rr	r	..	..	..	..	..	..	63
— lineatum (Ehbg.)	r	r	r	+	r	+	r	r	r	r	..	r	..	..	64
— longipes, Bail.	cc	+	c	c	c	c	+	+	c	c	..	..	r	..	65
— macroceros, Ehbg. .. .. .	..	..	+	+	r	+	r	+	+	+	rr	cc	r	cc	66
— tripos (O. F. Mill.)	+	+	cc	cc	c	c	c	c	c	c	+	c	+	c	67
Dinophysis acuta, Ehbg.	+	+	+	c	+	c	+	+	+	+	r	+	..	+	68
— norvegica, Clap. et Lachm. .. .. .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	69
— rotundata, Clap. et Lachm. .. .. .	..	r	..	r	..	..	..	..	..	..	..	rr	..	..	70
Diplopsalis lenticula, Bergh. .. .. .	..	..	r	+	..	..	..	+	..	+	+	r	..	..	71
Gonyaulax spinifera, (Cl. et L.) Diesing.	r	r	r	c	+	+	c	+	c	c	..	r	..	..	72

TABLE IV.—continued.

SEA, AUGUST, 1903.

	8.				9.		10.		11.		12.		21.		23.		24.		25.		26.	
	12/8.				13/8.		13/8.		13/8.		13/8.		21/8.		14/8.		14/8.		17/8.		17/8.	
	61° 32' N. 3° 10' E.				61° 34' N. 2° 05' E.		61° 37' N. 0° 45' E.		61° 43' N. 0° 43' W.		61° 02' N. 1° 09' W.		59° 46' N. 2° 21' W.		59° 31' N. 0° 37' E.		58° 55' N. 0° 04' E.		58° 11' N. 0° 32' W.		58° 09' N. 1° 50' W.	
	355-300.	200-100.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	90-0.	0.	128-0.	0.	93-0.	0.	108-0.	0.	60-0.	0.
	6° 31 -8° 26.	6° 88 -6° 34.	6° 34 -13° 50.	13° 50.	8° 33 -12° 29.	12° 29.	8° 85 -12° 16.	12° 16.	9° 15 -11° 82.	11° 82.	8° 70 -12° 07.	12° 07.	10° 17 -11° 57.	11° 57.	6° 79 -12° 40.	12° 40.	6° 89 -12° 60.	12° 60.	8° 30 at 100 m. -12° 25.	12° 25.	9° 90 -11° 80.	11° 80.
	35° 10 -35° 08.	35° 16 -34° 96.	34° 96 -30° 29.	30° 29.	35° 29 -34° 36.	34° 36.	35° 40 -35° 18.	35° 18.	35° 36 -35° 31.	-35° 31.	35° 31 -35° 27.	35° 27.	35° 15 -35° 05.	35° 05.	35° 26 -34° 66.	34° 66.	35° 23 -34° 94.	34° 94.	35° 25 -35° 17.	35° 17.	35° 08 -34° 90.	34° 90.
36
37
38	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
39	rr	..	..	..	..	..	..	..	..	..	..	..	r	..	..	..	..	..	..	..	..	rr
40	cc	..	c	c	cc	cc	c	+	..	..	r	+	..	..	..	..	cc	cc	cc	cc
41	r	+	..	..	..	..	..	..	..	..
42	r	+	cc	cc	r	..	..	..	..	..	..	..	+	r
43
44	+	+	r	..	+	+
45	rr
46	r	..	..	..	+	+	+	+	c	+	..	..	..	..	r	r	r	..
47
48
49	+	+
50
51
52	+	+
53
54
55	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
56	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
57	rr	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
58	rr	..
59
60
61	+	..	c	c	c	+	+	c	..	..	c	c	cc	c	cc	cc	cc	cc	cc	cc
62	c	..	c	c	c	+	c	e	..	..	r	+	cc	c	cc	c	c	c	c	cc
63	r	..	..	..	..	..	rr	..	..	..	..	..	..	..	..	..	r	r
64	r	..	..	..	..	..	..	rr	..	..	..	..	..	rr	+
65	r	r	..	..	c	c	+	c	+	+	+	+	c	cc	rr	rr	..	..	r	..	cc	c
66	r	+	c	c	cc	cc	cc	cc	c	c	+	+	r	r	c	c	c	c	c	c	+	+
67	+	+	cc	cc	cc	cc	cc	c	c	cc	+	c	c	c	c	c	c	+	cc	cc	cc	cc
68	r	r	..	+	+	+	..	..	..	..	r	..	c	c	+	c	c	c	+	c
69	r	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
70	rr	..	rr	..	..	..	..	..	..	..	..	..	..	rr	..	rr	r
71	r	..	..	..	r	..	r	..	rr	..	rr	..	+	+	r	+	+	..	..	+
72	r	+	..	..	..	..	..	..	+	..	..	..	+	+	c	+

TABLE V.

SEA, NOVEMBER, 1903.

5.		21.		22.	23.		24.		25.		26.		
18/11.		29/11.		23/11.	23/11.		23/11.		23/11.		18/11.		
59° 40' N. 1° 14' W.		59° 46' N. 2° 21' W.		59° 36' N. 0° 41' W.	59° 31' N. 0° 37' E.		58° 55' N. 0° 04' E.		58° 11' N. 0° 32' W.		58° 09' N. 1° 50' W.		
102-0.	0.	75-0.	0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	
9°·29 —9°·25.	9°·25.	8°·99 —8°·54.	8°·54.	—	6°·86 —7°·85.	7°·85.	6°·80 —8°·05.	8°·05.	8°·71 —8°·65.	8°·65.	9°·83 —9°·45.	9°·45.	
35·26 —35·26.	35·26.	35·10 —35·21.	35·21.	—	35·28 —35·14.	35·14.	35·21 —35·03.	35·03.	35·23 —35·21.	35·21.	34·96 —34·96.	34·96.	
1	c	c	+	c	c	+	+	+	c	c	c	c	c
2	r	...	...	...	...	...	...	...	rr
3
4	r	rr	...	...	...	...	...	...	...	+	r
5
6	rr	rr	rr	r	...	r	...	...
7	rr	rr	...	rr	rr	rr	...	rr	rr	r	r	...	...
8	rr	...	...
9
10
11
12	rr	...	rr	...	rr	...	...	...	...	rr	...	...	...
13	r	...
14	r	...	...	...	...	...	...	...	...	...	...
15	+	+	r	+	+	...	r	r	+	+	r	+	r
16	rr	...
17
18
19	...	rr	...	...	...	...	...	...	...	...	...	rr	...
20

TABLE V.—*continued.*

THE NORTH

Station	1.		2.		3.		4.		
Date	13/11.		18/11.		18/11.		18/11.		
Position { Latitude Longitude	58° 00' N. 2° 54' W.		58° 36' N. 1° 46' W.		59° 10' N. 1° 27' W.		59° 26' N. 1° 20' W.		
	Depth in Metres	70-0.	0.	95-0.	0.	95-0.	0.	95-0.	0.
Temperature °C.	9°·80 —9°·95.	9°·95.	8°·91 —9°·65.	9°·65.	9°·66 —9°·55.	9°·55.	9°·55 —9°·35.	9°·35.	
Salinity—pro Mille	34·76 —34·76.	34·76.	34·98 —34·98.	34·98.	35·12 —35·16.	35·16.	35·14 —35·14.	35·14.	
DIATOMACEAE— <i>cont.</i>									
Corethron criophilum, Castr. ... ..	...	...	...	...	...	rr	...	...	21
Coscinodiscus centralis, Ehb. ... ..	...	...	...	...	...	...	+	r	22
— concinnus, W. Sm.	r	+	...	rr	r	...	...	...	23
— excentricus, Ehb. ... ..	...	...	+	+	+	+	+	+	24
— oculus iridis, Ehb. ... ..	...	...	...	...	...	...	...	...	25
— radiatus, Ehb.	+	+	+	+	+	+	+	c	26
— sp. ... ..	...	...	...	...	...	...	...	...	27
Coscinosira polychorda, Gran. ... ..	...	...	...	...	...	...	...	...	28
Dactyliosolen antarcticus, Castr. ... ..	...	...	...	...	...	rr	...	rr	29
Ditylum Brightwellii, West ... ..	...	rr	rr	...	...	...	...	...	30
Euodia cuneiformis, (Wallich) ... ..	...	...	...	...	...	...	...	...	31
Guinardia flaccida, Perag. ... ..	...	...	...	...	...	...	...	...	32
Hyalodiscus stelliger, Bail.	r	r	...	...	...	r	r	rr	33
Lauderia borealis, Gran.	r	...	...	...	...	...	...	...	34
Leptocylindrus danicus, Clev. ... ..	...	...	...	...	...	...	...	...	35
Nitzschia closterium, (Ehb.) W. Sm. ... ..	...	...	...	...	...	...	...	...	36
— delicatissima, Clev. ... ..	...	...	...	...	...	...	...	...	37
— seriata, Clev. ... ..	...	...	...	...	...	...	...	...	38
Paralia sulcata, (Ehb.) Clev.	+	...	rr	r	r	...	+	...	39
Rhizosolenia alata, Brightw.	r	...	r	r	+	+	+	+	40
— faröensis, Ostf. ... ..	...	...	...	...	...	...	...	...	41
— semispina, Hensen ... ..	...	...	...	...	...	...	...	...	42
— setigera, Brightw.	r	r	...	...	rr	...	...	...	43

TABLE V.—*continued.*

SEA, NOVEMBER, 1903.

5.		21.		22.	23.		24.		25.		26.		
18/11.		29/11.		23/11.	23/11.		23/11.		23/11.		18/11.		
59° 40' N. 1° 14' W.		59° 46' N. 2° 21' W.		59° 36' N. 0° 41' W.	59° 31' N. 0° 37' E.		58° 55' N. 0° 04' E.		58° 11' N. 0° 32' W.		58° 09' N. 1° 50' W.		
102-0.	0.	75-0.	0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	
9°·29 —9°·25.	9°·25.	8°·99 —8°·54.	8°·54.	—	6°·86 —7°·85.	7°·85.	6°·80 —8°·05.	8°·05.	8°·71 —8°·65.	8°·65.	9°·83 —9°·45.	9°·45.	
35·26 —35·26.	35·26.	35·10 —35·21.	35·21.	—	35·28 —35·14.	35·14.	35·21 —35·03.	35·03.	35·23 —35·21.	35·21.	34·96 —34·96.	34·96.	
21	...	...	...	...	...	...	...	...	...	...	...	...
22	rr	r	r	r	+	rr	rr	...	r	r	r	+	+
23	...	...	...	...	...	...	...	...	...	...	...	r	r
24	+	+	r	+	+	r	r	...	+	+	r	+	+
25	...	...	...	...	...	...	...	...	...	...	...	...	...
26	c	c	+	+	+	+	+	r	+	+	+	+	c
27	...	...	...	...	...	...	...	...	...	...	...	...	...
28	...	...	...	...	...	...	...	...	...	...	...	...	...
29	rr	rr	...	r	...	...	...	...	...	...	rr	...	...
30	...	...	...	...	...	...	...	...	...	...	...	...	...
31	...	rr	...	...	...	...	...	...	...	...	...	...	...
32	...	...	...	...	...	+	r	r	r	r	r	...	rr
33	rr	...	rr	rr	...	...	...	...	...	...	...	r	...
34	...	...	...	...	...	...	...	...	...	...	rr	...	...
35	...	...	...	...	...	...	...	...	...	...	...	...	...
36	...	...	...	...	...	...	...	...	...	...	...	...	...
37	...	...	...	...	...	...	...	...	...	...	...	...	...
38	...	...	...	...	...	...	...	...	...	...	...	...	...
39	r	r	r	r	r	...	...	...	...	r	...	+	r
40	r	r	r	r	...	+	+	r	r	+	+	r	r
41	...	...	...	...	...	...	...	...	...	...	...	...	...
42	...	...	...	...	...	...	...	...	...	...	...	...	...
43	...	...	...	...	...	...	...	...	...	...	...	rr	...

TABLE V.—*continued.*

THE NORTH

Station	1.		2.		3.		4.		
	13/11.		18/11.		18/11.		18/11.		
Date	58° 00' N. 2° 54' W.		58° 36' N. 1° 46' W.		59° 10' N. 1° 27' W.		59° 26' N. 1° 20' W.		
Position (Latitude) Longitude	70-0.	0.	95-0.	0.	95-0.	0.	95-0.	0.	
Depth in Metres	9°·80 —9°·95.	9°·95.	8°·91 —9°·65.	9°·65.	9°·66 —9°·55.	9°·55.	9°·54 —9°·35.	9°·35.	
Temperature °C.	34·76 —34·76.	34·76.	34·98 —34·98.	34·98.	35·12 —35·16.	35·16.	35·14 —35·14.	35·14.	
Salinity—pro Mille									
DIATOMACEAE— <i>cont.</i>									
Rhizosolenia Shrubsolei, Clev.	+	r	+	...	+	r	+	+	44
— Stolterfothii, Perag. ... ..	...	...	...	...	...	...	...	...	45
— styliformis, Brightw.	rr	r	r	r	+	+	+	+	46
Skeletonema costatum, Grev.	r	rr	...	...	...	...	...	...	47
Thalassiosira gelatinosa, Hensen	+	c	r	...	...	...	...	...	48
— gravis, Clev. ... ..	...	...	...	...	...	...	...	...	49
— Nordenskiöldii, Clev. ... ..	...	...	...	...	...	...	...	...	50
Thalassiothrix Frauenfeldii, Grun.	r	r	...	...	...	...	...	...	51
— longissima, Clev. et Grun. ... ..	...	...	...	...	rr	r	r	rr	52
PTEROSPERMATACEAE.									
Hexasterias problematica, Clev. ... ..	...	...	...	...	...	...	...	...	53
Pterosperma dictyon, (Jörg.) Ostf. ... ..	...	...	...	...	...	...	...	...	54
— Möbiusii, (Jörg.) Ostf. ... ..	...	...	...	...	...	...	...	...	55
— Vanhöffenii, (Jörg.) Ostf. ... ..	...	...	...	...	...	...	...	...	56
Xanthidium hystrix, Clev.	rr	...	...	...	...	...	...	...	57
— multispinosum, Clev. ... ..	...	...	...	...	...	...	...	...	58
PERIDINIALES.									
Ceratium arcticum, Ehb. ... ..	...	...	...	...	...	...	...	...	59
— bucephalum, Clev. ... ..	...	...	...	...	...	...	...	...	60
— furca, (Ehb.) Duj.	r	...	r	r	r	+	+	+	61
— fusus, (Ehb.) Duj.	r	...	r	r	+	+	+	+	62

TABLE V.—*continued.*

SEA, NOVEMBER, 1903.

	5.		21.		22.	23.		24.		25.		26.	
	18/11.		29/11.		23/11.	23/11.		23/11.		23/11.		18/11.	
	59° 40' N. 1° 14' W.		59° 46' N. 2° 21' W.		59° 36' N. 0° 41' W.	59° 31' N. 0° 37' E.		58° 55' N. 0° 04' E.		58° 11' N. 0° 32' W.		58° 09' N. 1° 50' W.	
	102-0.	0.	75-0.	0.	0.	100-0.	0.	100-0.	0.	100-0.	0.	100-0.	0.
	9°·29 —9°·25.	9°·25.	8°·99 —8°·54.	8°·54.	—	6°·86 —7°·85.	7°·85.	6°·80 —8°·05.	8°·05.	8°·71 —8°·65.	8°·65.	9°·83 —9°·45.	9°·45.
	35·26 —35·26.	35·26.	35·10 —35·21.	35·21.	—	35·28 —35·14.	35·14.	35·21 —35·03.	35·03.	35·23 —35·21.	35·21.	34·96 —34·96.	34·96.
83	FF	...	F	...	FF	...	...
84
85
86
87	...	FF	F	...	...	...	...	...	FF	...	...	...	...
88
89
90
91	FF	...	...	...	...	FF	...	...	...	F	...
92	...	FF	...	...	...	...	...	...	...	FF	FF	...	...
93	...	F	...	...	...	...	...	...	...	...	...	...	...
94	+	F	+	C	F	F	...	...	...	...	...	+	F
95	FF	F	...	F	...	...	...	...	...	...	...	...	...
96	+	F	F	F	...	...	...	...	...	...	...	+	+
97	FF	...	FF	...	...	...	...	...	...	...	...
98