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Phytoplankton Distribution in the Norwegian Sea in June, 1952 and 1953

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CONTENTS

PREFACE

During the «G. O. Sars» cruises in May—June 1952 and 1953, organized by the Fisheries Directorate, Bergen, water samples for phytoplankton studies were collected in the Norwegian Sea (Fig. 1). The majority of these were examined according to Utermöhl's sedimentation method. In connection with the quantitative study of the population, special taxonomic-morphological studies were made. In the present paper the results of the quantitative survey, previously incorporated in a manuscript submitted to the University of Oslo, will be treated, while results from the morphological-taxonomic studies have been published separately (Ramsfjell 1959, a, b, c).

The author wishes to express his sincere thanks to the staff of the Research Division of the Fisheries Directorate, Bergen, who collected the material and placed the water samples and hydrographic data at his disposal; to the editor of Fiskeridirektoratets Skrifter for accepting the paper for publication and to Professor Trygve Braarud who prepared the present abbreviated report for publication in English.

INTRODUCTION

During the years immediately prior to and after 1900 the phytoplankton of the Norwegian Sea was subjected to extensive studies by means of net methods. (For literature see Halldal 1953). The main general results of these studies were presented in Gran's comprehensive monograph, «Das Plankton des Norwegischen Nordmeeres» (1902), where he divided the upper strata into three biogeographic regions, the Tripos-, the Asterionella- and the Clio-region. During the following 50 years this paper was the most important source of information on the phytoplankton of the Norwegian Sea, although additional observations were later made on net plankton from special areas (Paulsen 1904 and 1911, Ostenfeld 1913 and Meschkat 1939).

After the introduction of quantitative methods in phytoplankton surveys, first the centrifuge method and subsequently the sedimentation method, a number of investigations were carried out, mainly covering the southern part of the area. Of special importance is the all-year study of samples collected at Weather ship M, worked up by Halldal (1953). In Fig. 1 the various investigations are indicated and also, for each of them, the location of the stations where samples were collected, including those for the observations dealt with in this paper. (The surveys covering the coastal waters of Norway are not included). In addition to these mention may also be made of an all-year study, mainly of net plankton, in the Barents Sea and the Bear Island area by Marshall (1957). Results from these numerous studies on the phytoplankton population and the background for the observed variations, with time and locality, will be dealt with in the following presentation of the observations from the «G. O. Sars»-cruises in May—June 1952 and 1953.

In their monograph «The Norwegian Sea», Helland-Hansen and Nansen (1909) reviewed all available information on the topography and the hydrography of the area. During recent years extensive surveys, dealing with the topography and the hydrography of the offshore waters of the Norwegian Sea, have been undertaken — especially by Icelandic, Norwegian and Russian institutions. However, these are not yet incorporated in a general review which might replace Hel-

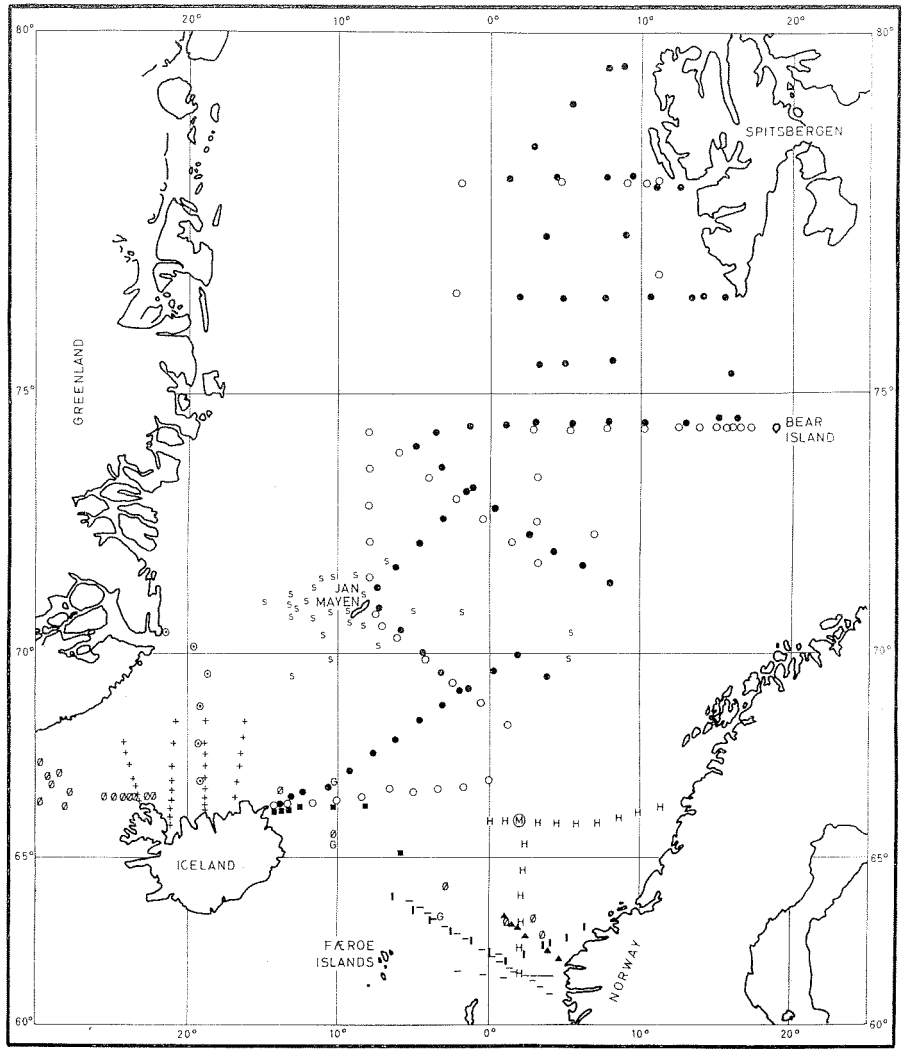

Fig. 1. Phytoplankton investigations in the Norwegian Sea before 1954 with the use of the centrifuge or sedimentation methods.

G	Gran (1912)	⊙	Steemann Nielsen (1935)
—	Gran (1915)	M	Halldal (1953)
I	Gran (1929)	H	Halldal (1953)
Ø	Braarud (1935)	+	Thórdardóttir (1956)
▲	Braarud, Gaarder & Grøntved (1953)	S	Smayda (1958)
■	Steemann Nielsen (1935)	●	Stations in June 1953
		○	Stations in June 1952

land-Hansen and Nansen's classical study. In Fig. 2 is reproduced a chart of the surface currents of the Norwegian Sea, published by Alekseev and Istoshin (1956).

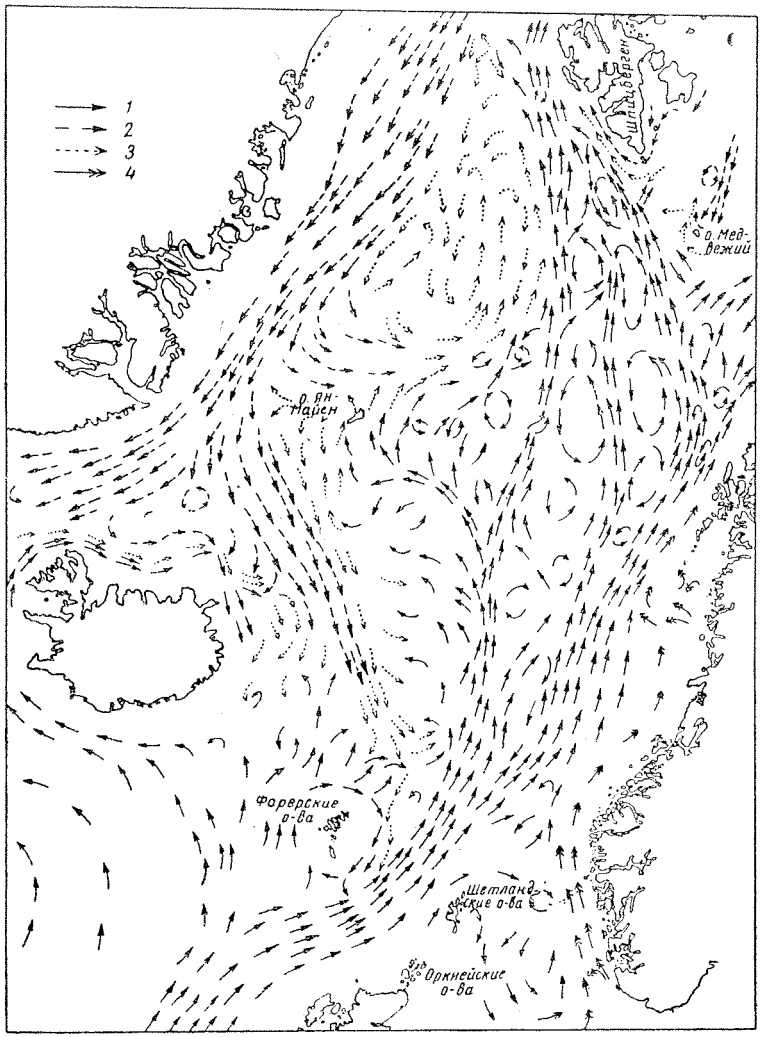

Fig. 2. Surface currents of the Norwegian Sea, according to Alekseev and Istoshin (1956). 1: warm water. 2: cold water. 3: mixed water. 4: coastal water.

The hydrography of the Norwegian Sea is characterized by the northward transport of Atlantic water, introduced across the Iceland –Faeroe–Shetland line, and the likewise northbound drift of Norwegian coastal waters. Influx of Polar water takes place north and south of Spitsbergen and, in even larger quantities, through the East Greenlandic Polar Current, which partly leaves the area through the Denmark Strait, partly contributes to the East Icelandic Arctic current. North and east of Iceland the occurrence of local coastal water and influx of Atlantic water through the Denmark Strait are

essential features of the hydrographic situation. In the central parts of the Norwegian Sea branches of these main currents, and products of their mixing with adjoining water masses, form more or less stationary eddy systems. This produces an intricate, ever-changing pattern of water masses, complex in origin and hydrographical character. On the basis of the hydrographical data from the «G. O. Sars» cruises in 1952 and 1953, we shall consider the relationship between the nature of the water masses at the time of observation and the observed phytoplankton populations, thus hoping to contribute a fairly detailed analysis of the phytoplankton populations and the conditions for phytoplankton growth in various parts of the area.

THE PHYTOPLANKTON DISTRIBUTION WITHIN VEGETATION AREAS I—IX AND ITS HYDROGRAPHICAL BACKGROUND

MATERIAL AND METHODS

Fig. 3 shows the location of the «G. O. Sars» stations where samples used for quantitative phytoplankton studies were collected. They are, with few exceptions, located within Gran's Clio-region, and in both years were worked in the course of June. At each station samples were collected from 3—4 levels, from the surface down to 25—30 m, and at least two of these were examined, the number depending upon the stability conditions at the stations in question. 100 ml sea water from the water bottles were preserved with neutralized formalin and after about 24 hours' sedimentation, 2 ml and 50 ml subsamples were subjected to examination in an inversed microscope at magnifications of 180x and 60x respectively. After counting, specimens offering taxonomic problems were examined in an ordinary microscope after transfer by means of a Haller Nielsen apparatus (1950). The quantitative plankton data for each station are presented in tables which are deposited at the Research Division of the Fisheries Directorate, Bergen. Only a few of them are included in this paper (Tables 12—30). Exerpt tables for each section are presented, showing the horizontal and vertical distribution of the most numerous or characteristic species or groups of species (Tables 1—11). These tables also contain available data on temperature and salinity.

On the basis of the phytoplankton data the area of investigation has been divided into a number of vegetation areas (I—IX, Fig. 10, p. 113) characterized by plankton societies which were uniform in their main

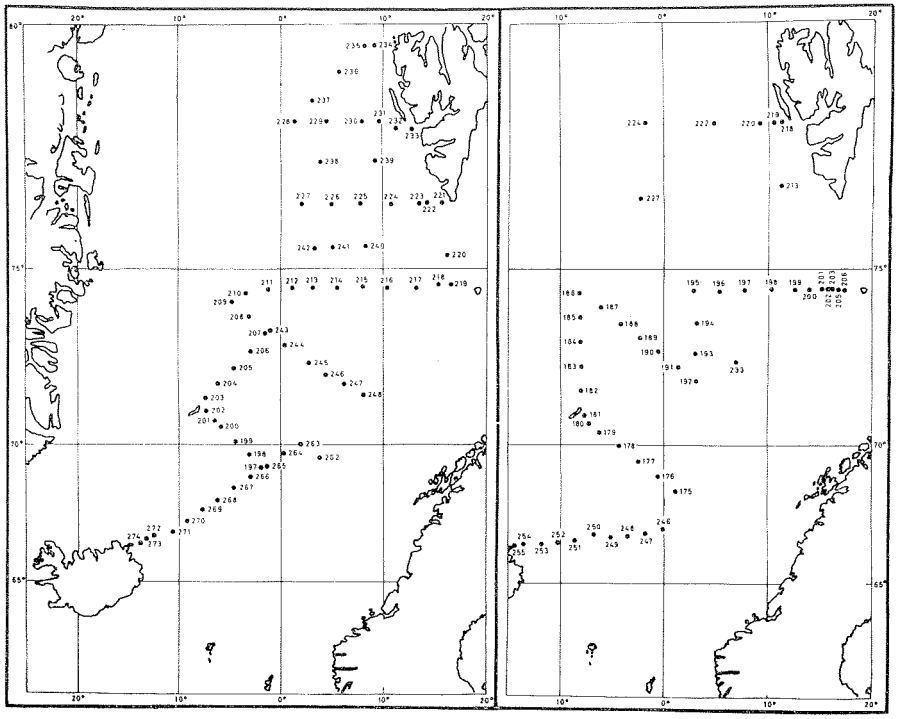

Fig. 3. Phytoplankton stations in June 1952 (right) and in June 1953 (left).

features, although exhibiting minor qualitative and quantitative differences which were considered less essential. In the following, conditions within each of these areas will be described and discussed in conjunction with the vegetation charts in Fig. 10 and Tables 1–30.

THE HYDROGRAPHICAL SITUATION DURING THE CRUISES

The hydrographical situation at each station is illustrated by means of t–S diagrams (Figs. 4 and 5) and stability diagrams (Figs. 6 and 7) and is dealt with in some detail in connection with the phytoplankton data.

Regarding the temperature and salinity distribution, four groups of stations (indicated by A, B, C and D in the figures) may be discerned and are most clearly distinguished in the material from 1953.

Group A is characterized by a pronounced increase in salinity from the surface down to 75 m, where Atlantic water was present. The temperature shows a similar increase downwards. The shape of the t–S curve is characteristic for the group. At some of the border stations the Atlantic component was prevalent even at the surface. Stability was rather pronounced in most cases. The stations are located in

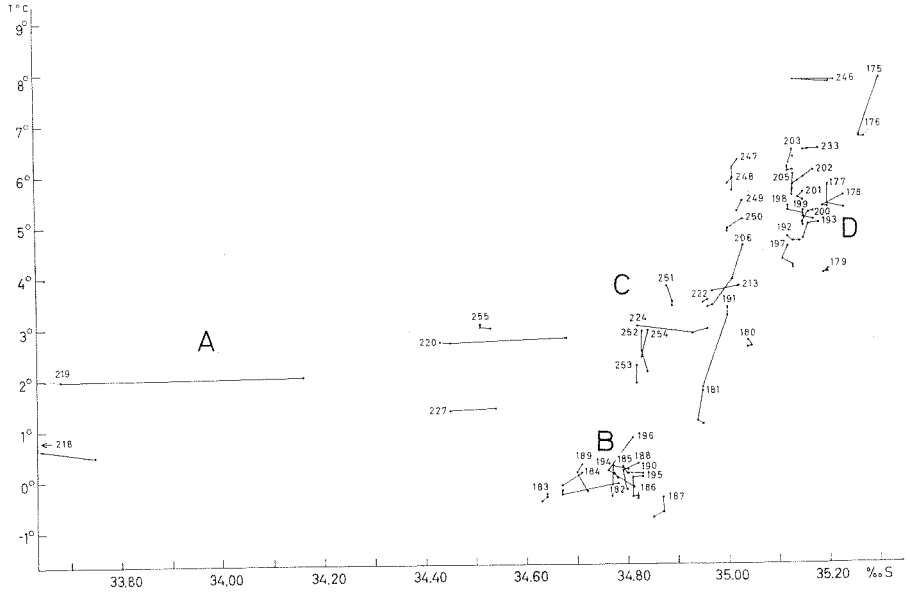

Fig. 4. t-S diagram for the 1952 stations, 0—25m.

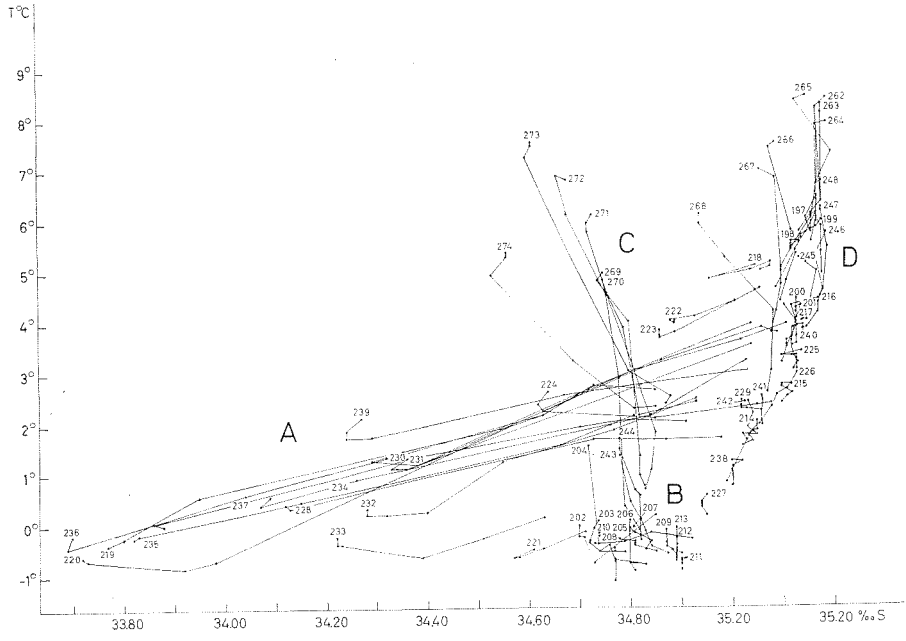

Fig. 5. t-S diagram for the 1953 stations 0—75m.

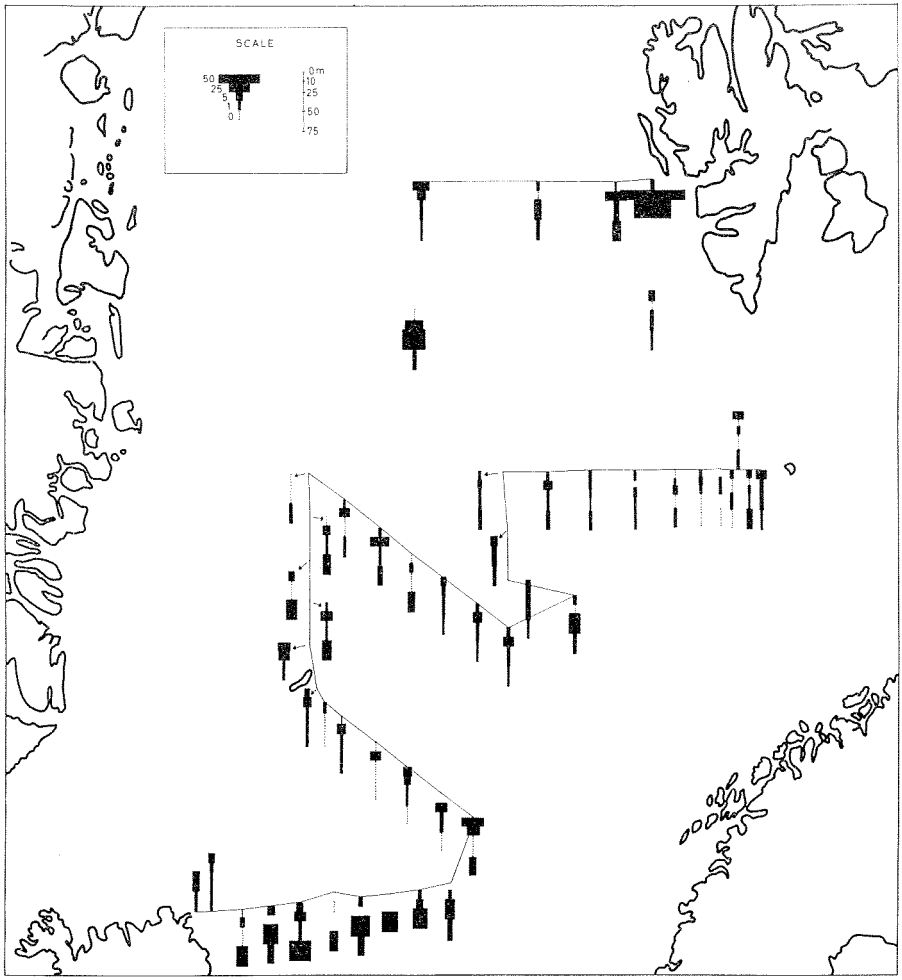

Fig. 6. Stability diagrams for the 1952 stations. The scale gives the values for $\frac{d_{\sigma t}}{dz} \times 10^3$.

cold-water currents off Bear Island and Spitsbergen and in those parts of vegetation areas I and II where Polar water from the East Greenlandic Current was present (see Fig. 3).

In group B temperature and salinity showed very little variation at each station and likewise from station to station. The water masses of these stations were of Polar or Arctic origin, having been subjected to a certain degree of heating in the period prior to the date of sampling. The stations are located in vegetation area III.

As may be seen from Fig. 5 group C is clearly distinguished from the other groups of stations. The stations are located in vegetation

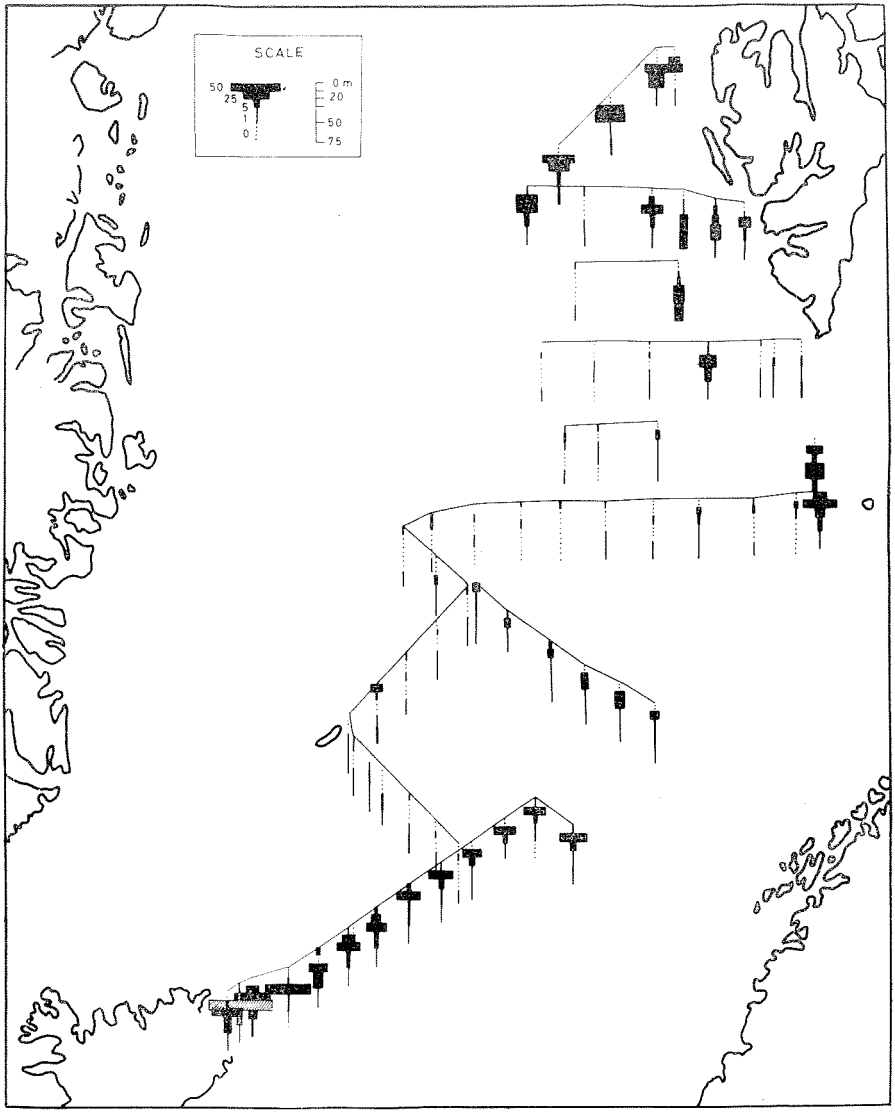

Fig. 7. Stability diagrams for the 1953 stations. The scale gives the values for $\frac{d_{\sigma t}}{dz} \times 10^3$.

areas IV, V and VI. Although the water masses are of different origin, the temperature and salinity distribution is not very different. The 1953 stations are characterized by a remarkably high temperature at the surface as compared with that observed at the corresponding stations the year before. The temperature shows a decrease of several degrees downwards, while salinity increases. In 1953 stability was

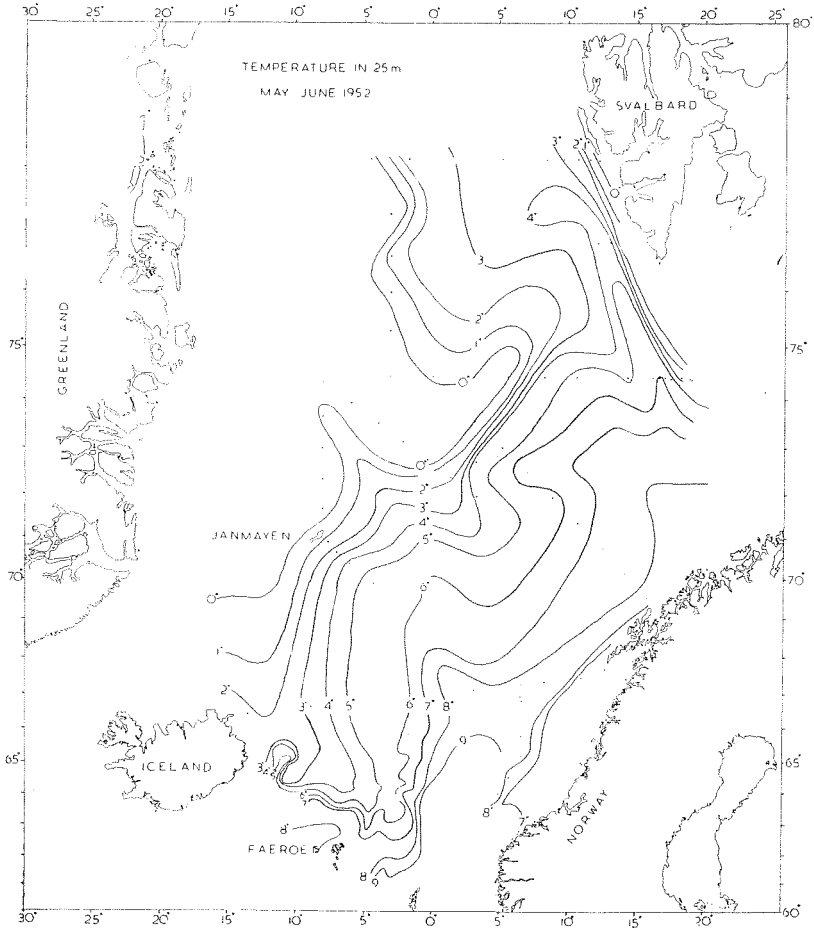

Fig. 8. Isotherms for the 25 m-level in May—June 1952. From Wiborg (1955).

pronounced at these stations. In 1952 the temperature in the upper 25 m was 3—4 degrees lower than in 1953 and salinity a little higher.

Group D is the most heterogeneous of the four groups. It comprises stations with Atlantic water which, at some of them, had been mixed with less saline waters. Characteristic for the group is high salinity ($> 35\ ^0/_{00}$). Temperature varied between 2° and 8°C at the surface. The stations are located in the central parts of the Norwegian Sea, from the southernmost to the northernmost sections, within vegetation areas VI, VII and VIII in 1952 and VI, VII, VIII and IX in 1953.

Fig. 8 from Wiborg (1955) illustrates how, at the time when

our samples for 1952 were collected, cold water masses penetrated south-eastward between Iceland and Jan Mayen. Also illustrated are the north- and southbound drifts in the northern part of the Norwegian Sea at the same time.

1. THE COASTAL WATERS OF THE SVALBARD[1] REGION. (VEGETATION AREA I, TABLES 4, 6, 11, 21, 22, 30.)

The water masses investigated off Bear Island and along the west coast of Spitsbergen are distinguished as a separate vegetation area. The surface layers are more or less influenced by Polar water, drifting southwards along the south-eastern side of Spitsbergen. A branch of this Polar current turns northwards and flows along the western coast of Spitsbergen. The current is relatively shallow and variable, flowing on top of Atlantic water (cp. t—S curves, Group A, Figs. 4 and 5).

We may first consider the observations from 1953, as these are more numerous and cover the largest part of the area.

The vegetation was of an Arctic or Boreal, neritic character and dominated by diatoms. The prominent species were: *Chaetoceros furcellatus, C. socialis, Fragilaria oceanica* and *Thalassiosira nordenskioeldi. Thalassiosira gravida* was also common, but not as numerous as *T. nordenskioeldi. Amphiprora hyperborea* and *Bacteriosira fragilis* occurred in smaller numbers within the whole area and formed a characteristic component of the vegetation.

The dinoflagellates were relatively well represented, especially by species of *Gymnodiniaceae*. A small autotrophic form, *Gyrodinium grenlandicum,* which was found to have a wide distribution in the Norwegian Sea, was most numerous, while *Exuviaella baltica* and several *Peridinium* species occurred more scantily.

At all stations a few cells of coccolithophorids, presumably introduced with Atlantic water, were recorded. A common and characteristic species within this area was the chrysophycean *Phaeocystis poucheti.* Among the ciliates *Laboea conica* occurred in the greatest numbers.

The vegetation within the coastal waters of Svalbard was abundant and rather uniform in its main features, but local variations occurred. St. 221, in the vicinity of Sørkapp, was especially rich in cold water-species, the majority of them being recorded only at this station (see Table 21). *Achnanthes taeniata, Biddulphia aurita, Navicula grani, N. pelagica, Porosira glacialis* and *Thalassiosira hyalina* were pre-

[1] Svalbard includes Spitsbergen and Bear Island.

sent, while *Phaeocystis poucheti* and ciliates were not recorded. The relative abundance of the various species was different from that observed in the remainder of the area. When compared with the situation at the other stations it seems as if the vernal increase had been retarded, presumably due to low temperature and the lack of any pronounced stability within the upper 75 m. Unfavourable ice conditions at this station may also have reduced the submarine light supply so as to cause a retardation of diatom growth. The average border for an ice cover of 50–100 % in April during the period 1919–1943 indicates that the ice cover near the coast is especially dense along the southern part of Spitsbergen (Thomsen and Lorck 1956). The low degree of stability and the presence of an ice cover earlier in the season would presumably have counteracted the exhaustion of the nutrient supply within these water masses.

The other three stations in the Sørkapp-section showed definite admixture of Atlantic water, even at the surface. Nevertheless the vegetation was as pronouncedly Arctic-Boreal as in the main part of the area. Notable was the occurrence of relatively large populations of *Eucampia zoodiacus,* which had a westerly distribution in the area. As at St. 221, stability was low and the relatively large populations of typically Arctic species in water with a temperature as high as 3–4°C may find its explanation in favourable trophic conditions as a result of vertical admixture of deep water. Braarud (1937) found that cold water species grow well at higher temperatures also, provided the nutrient supply is ample.

In June 1952 observations were made at three stations in the coastal waters off Isfjorden. The observations indicated that a later stage of the annual phytoplankton cycle had been reached. Fewer Arctic species were recorded and the most important ones, *Chaetoceros furcellatus* and *Fragilaria oceanica,* occurred in smaller populations than in 1953. The most prominent species belonged to the genus *Thalassiosira, T.bioculata* occurring in large populations and predominating among the diatoms. In 1953, only a few specimens of this species were recorded. *Eucampia zoodiacus* was also more common in 1952, while in the same year *Phaeocystis poucheti* was only observed at the 25 m level.

On the whole the populations in 1952 consisted of fewer species occurring in smaller numbers and the cells were poorly silicified. At 25 m the populations were considerably larger than at higher levels, which is also a condition characteristic of the later stages of the spring development.

The hydrographic situation in 1952 gives a reasonable explana-

tion of the more advanced stage of the phytoplankton cycle observed in that year. The temperature was between 1 and 2 degrees higher at the surface, while the salinity was somewhat lower, presumably due to melting of the ice. The discontinuity layer, located between 10 and 25 m, was very pronounced, representing an obstruction to the supply of nutrients from beloy (Fig. 6).

Our observations for June indicate that the spring increase is initiated in May, possibly in April. Since the actual time depends upon light supply and stability, it is influenced accordingly by the ice conditions in the area. Normally, ice covers less than 50 % of the coastal waters west of Spitsbergen from May on, but it does not disappear completely till June. Until then the ice reduces the light supply within the coastal region as a whole and the spring period of abundant populations may be prolonged.

In the Bear Island region Marshall (1957) found that the spring increase in the bank area starts in the course of April and proceeds towards the north-east as the ice border withdraws. He also observed that conditions in June varied from one year to another, but populations were generally small and the nutrient supplies exhausted at this time. In summer, Marshall recorded a poor plankton, more Atlantic in character, in the stabilized water masses covering the coastal banks. As the hydrographic situation and the phytoplankton conditions are, as far as we can judge, so similar, in the Bear Island area and northwards along the coast of Spitsbergen, it may be expected that the seasonal development takes a similar course. In this area the ecological factor which, after the winter, is most decisive for plant production and seasonal changes in the population, seems to be the stability factor. In April an adequate light supply coupled with a pronounced stratification gives occasion for a quick growth, but after a month or two the winter supply of nutrients is being exhausted and the supply from deeper levels is impeded by the great density gradient. During summer the plankton algae are, therefore, unable to take full advantage of the continuous light supply during day and night which would otherwise allow production of large populations.

In 1953, the neritic vegetation on the western side of Svalbard extended further to the west than in 1952 and the plankton characteristic of Atlantic water did not play an important part at the stations showing admixture of Atlantic water. In 1952, however, the phytoplankton of the mixed waters had a uniform oceanic character with *Fragilaria nana* as the prominent species. *F.nana* is a small species, which ought to have possibilities of thriving even with low nutrient concentrations, and is generally occurring in stratified

waters after a period of phytoplankton abundance. The large populations of this species at the border of the area in 1952 may therefore serve as an indication that the annual phytoplankton cycle in that year had reached an advanced stage at the time of our observation. The differences in salinity and temperature are so small that they cannot be directly responsible for the differences between the vegetations observed in 1952 and 1953.

2. STATIONS BETWEEN SPITSBERGEN AND GREENLAND, ON THE WESTERN SIDE OF THE ATLANTIC CURRENT. (VEGETATION AREA II, TABLES 5, 6.)

All observations in this area were made in 1953. The stations represent localities situated on the border between various water masses. Hydrographically they may be divided into two groups. In the upper 75 m the northernmost stations showed the influence of both Atlantic and Polar water. The Atlantic character of the waters became more pronounced with increasing depth, as in the coastal waters off Spitsbergen (cf. Group A, Fig. 5). At the southernmost stations (238 and 227) the waters represented a mixture of Atlantic and Arctic water. They belonged to group B (Fig. 5), and showed a low degree of stability.

The phytoplankton within area II was of a type similar to that observed in the coastal waters of Svalbard. *Amphiprora hyperborea* and *Bacteriosira fragilis* were not recorded, but otherwise the same species occurred. The populations of most of the diatoms were generally smaller and more variable, with the exception of that of *Thalassiosira gravida* which was as abundant, or even more so, than at the stations off Spitsbergen. The northernmost stations on the border near area I were the richest ones, and there the largest populations of *Thalassiosira gravida* were recorded.

In June 1952, the plankton at stations 224 and 227, which in 1953 would have been located well within area II, had a composition similar to that of the vegetation recorded in Atlantic water and in the border zone near the coastal waters of Svalbard. *Fragilaria nana* was the predominant species, accompanied by unusually large populations of the ciliate genera *Acanthostomella* and *Laboea*. The water masses represented a mixture of Atlantic and Polar water, which was wedged in between stations 224 and 227, a fact disclosed by hydrographic observations made between the two stations. Neritic plankton was not present at the border stations, presumably due to the fact that the spring development had terminated and the nutrient supply was exhausted.

At the northernmost stations in area II, where a pronounced stability was recorded, the spring increase seemed to be at its close, with indications of a change into summer conditions and poor phytoplankton. In the southern part, the situation was different, vertical mixing having delayed the increase, which was still in its prime. The composition of the phytoplankton in the latter phase showed an affinity to that observed further south, as indicated by the presence of *Chaetoceros decipiens, C.wighami* and *Eucampia zoodiacus,* but the populations were far smaller than in area III, where conditions of growth seemed favourable, in spite of the fact that stability was very low. The turbulent activity may, however, have been radically different in the two localities.

Observations from the East Greenlandic Polar Current proper are lacking. It may, however, be assumed that the plankton development starts in the outskirts, where Polar water flows on top of Atlantic water and where the ice cover becomes less dense than in the central part of the current. (Braarud 1935).

3. CENTRAL POLAR-ARTIC WATER MASSES NORTH-NORTHEAST OF JAN MAYEN. (VEGETATION AREA III, TABLES 2—5, 8—10, 16, 17, 27.)

The water masses of vegetation area III exhibit small variations in the distribution of temperature and salinity. In Figs. 4 and 5 the t—S curves for these stations are to be found in group B. Exceptions are the two northernmost stations (241 and 242) where a pronounced influence from Atlantic water is noticeable.

The phytoplankton observed in 1952 and 1953 differed considerably, mainly in quantity, but also in composition. The densely hatched part of the area had a very rich plankton in 1953 (see Fig. 10, left) and we may first consider conditions there.

Thalassiosira gravida overshadowed all the other species. *T.nordenskioeldi* played a subordinate role, similar to that of *T.gravida* in the coastal waters of Spitsbergen. *Chaetoceros decipiens* was fairly abundant at these stations and large, oceanic species of the subgenus *Phaeoceros* had a rather uniform and general occurrence within the area. Smaller species of *Chaetoceros, furcellatus* and *socialis,* were common, although their populations were smaller than observed in the Spitsbergen waters. *Thalassiosira hyalina* and *Coscinosira polychorda* occurred regularly in fairly large populations, while outside this rich cold water area they were seldom observed. A number of other diatom species were common.

The dinoflagellate populations were small. Most common were

Exuviaella baltica and *Gyrodinium grenlandicum*. Although not abundant, the coccolithophorid *Crystallolithus hyalinus* was recorded at all stations of area III with the exception of two. *Phaeocystis poucheti* and the ciliates were not as common and regular in their occurrence within this area as in the coastal waters of Svalbard.

At stations 241 and 242, where the waters at the surface were about 3° C warmer than in the remainder of the hatched area, the relative abundance of the species was exceptional. Although *Thalassiosira gravida* was the predominant species, other species, e.g. *T.nordenskioeldi, Chaetoceros* spp., *Eucampia zoodiacus* and *Exuviaella baltica* were relatively more abundant here than at the other stations. These stations are examples of localities in the mixing area between cold and warm water masses, where the phytoplankton was very abundant.

In the more openly hatched part of area III the phytoplankton was in general far from as abundant and poorer in species (cp. Table 16), but the main features of the vegetation were the same. *Thalassiosira gravida* was the commonest of the larger forms, while some of the smaller forms were more numerous here than in the northern part of area III. These latter include: *Fragilaria nana, Exuviaella baltica, Crystallolithus hyalinus* and the ciliates *Laboea conica* and *Woodania conicoides. Asteromphalus robustus* was a rather common species which hardly ever occurred in other water masses.

At the central stations in the densely hatched area (211–213) the waters had a temperature and salinity very similar to Arctic bottom water which Eggvin (personal comm.) has shown was most probably formed in that area in 1953. Salinity varied between 34.89 and 34.91 $^{0}/_{00}$ within the upper 75 m and temperature, which decreased with depth, was below 0°C even at the surface. Although stability was extremely low, the large phytoplankton populations would indicate that no extensive vertical mixing had taken place immediately prior to the time of observation. The large populations of *Thalassiosira gravida* (including numerous auxospores) indicate that, within the region where the bottom water was formed, conditions of growth for the phytoplankton were very good at the end of May–beginning of June 1953. It may be assumed that the phytoplankton increase had not lasted long. In view of the temperature at the stations and the predominant cold air currents from north-west in May it may be assumed that it was late in the month before any degree of stabilization was established.

At the stations outside the «bottom water region» a later stage of the spring development was recorded and, at stations 243 and 244

which were worked about two weeks later than the others, the *Thalassiosira* plankton had declined still more.

The earlier onset of the spring development in the southernmost part of the area near Jan Mayen than in that further north is probably due to differences in the turbulent activity within the two parts of area III. Although stability was somewhat greater in the southern area than in the «bottom water area», it was still very low and we are inclined to suggest that the southern part of area III represented water masses with low stability, but nevertheless with a moderate turbulent activity or one should rather say with little vertical mixing.

In 1952, the composition and distribution of the phytoplankton were rather uniform within the whole of area III. The population was somewhat more scanty than in the poorest part in 1953 and fewer species were recorded. Neritic cold-water species were extremely scarce, while *Thalassiosira gravida* occurred at most of the stations, but mostly in small quantities. The vegetation was mainly characterized by the occurrence of oceanic species of *Chaetoceros: atlanticus, borealis* (mainly f.*concavicornis)* and *convolutus. Rhizosolenia hebetata* f.*semispina* played a considerably greater role this year than in 1953 and was not uncommon, while dinoflagellates were scarcer. Furthermore, the populations of *Laboea conica* and *Woodania conicoides* were generally somewhat larger.

The vegetation seems to indicate that in 1952 the samples were collected at a later stage of the annual phytoplankton cycle than in 1953. The fact that no appreciable populations of Arctic-neritic diatoms were recorded, and the abundance of *Chaetoceros* species support this assumption. Observations by Jørgensen (1900) from stations north-west of Jan Mayen in June—July show a society in this area similar to that observed in 1952.

At two stations in the outskirts of the area (181, 196) the populations were larger than was otherwise the case. These stations represent water masses where products of mixing between Arctic and Atlantic water occurred in the upper layers. The plankton abundance at these stations is presumably due to admixture of deeper water masses to the euphotic layer. In this way an amelioration of the nutrient supply occurred, which latter would, according to our interpretation of the conditions within the area as a whole, otherwise have been too small to support effective growth of the population.

In seeking the causes of the later development of the spring plankton of this area in 1953, as compared with 1952, it seems reasonable to assume that different wind and ice conditions in the

two years afford the explanation. In May and June 1952 winds from the north-east and east may have pressed the masses of ice towards Greenland. In May 1953, on the other hand, winds from the north-west prevailed, and may have led to a dispersal of the ice further out into the Norwegian Sea. As these masses of air were cold the vernal heating of the surface layers may have been delayed. The few observations on the ice conditions show that from April to June 1953 the ice had been transported eastward and that the ice in June had a more easterly distribution than is normally the case (Thomsen and Lorck 1956).

In the area where bottom water was formed in 1953, Eggvin (personal comm.) has found that this does not take place every year. Delays in the spring phytoplankton development such as were observed in 1953, may have a similar irregular occurrence.

Observations in the first half of June by Wiborg (1955) have shown that our area III had at this time of the year zooplankton populations which were extremely large. Grazing would be an important factor at this time for the quantitative distribution of the phytoplankton. The picture which we have tried to draw above, of the background for the observed differences within area III can, therefore, only include the broad features.

Smayda (1958) has examined surface samples from Vesterisen during the period from the last half of March to the end of April 1955 (see Fig. 1). A considerable increase in the diatom population was observed in the course of April, but at none of the stations were any large populations of any species recorded. The commonest diatoms were *Fragilaria nana, Thalassiosira gravida, T.bioculata, Chaetoceros* spp., *Fragilaria oceanica, Achnanthes taeniata* and *Nitzschia frigida.* At most of the stations the temperature was −1,5°C or slightly lower. These observations indicate an onset of the spring increase in this area which fits well into the picture obtained by our 1952–3 observations later in the season.

4. THE SECTIONS OFF ICELAND. (VEGETATION AREAS IV, V, VI AND VII. TABLES 1, 7, 12–14, 23–25).

In Fig. 9 the horizontal variation in temperature and salinity at various levels within the sections towards Iceland in 1952 and 1953 is illustrated. In accordance with Helland-Hansen and Nansen (1909), one may distinguish 4 types of water masses, of different origin and character in the area east of Iceland:

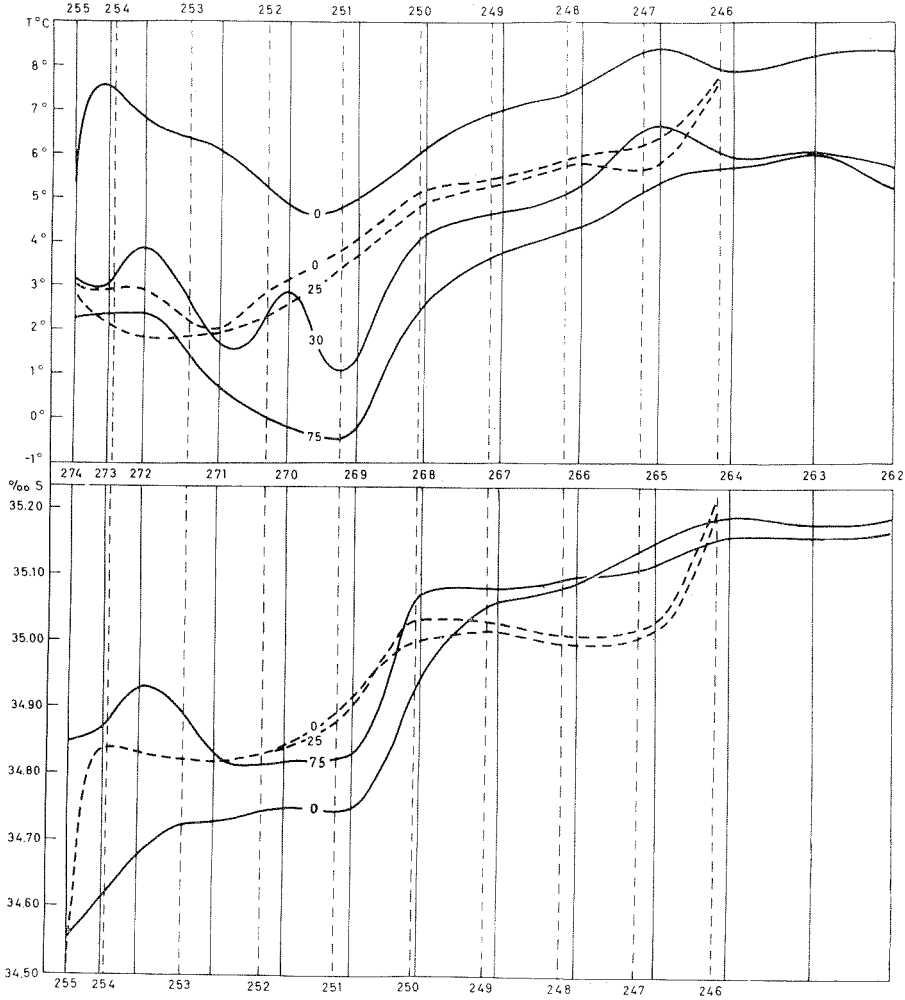

Fig. 9. Variations in temperature and salinity at various depths within the sections towards Iceland. Continuous lines represent the 1953-stations 274—262, interrupted lines the 1952-stations 255—246.

1. Coastal water from the Icelandic Coastal Current of relatively low salinity.
2. Water masses belonging to the East Icelandic Arctic Current. These showed the lowest temperatures within the area.
3. Mixed water with components of Atlantic water and of Arctic water from the East Icelandic Arctic Current.
4. Atlantic water.

The various types of water may most easily be traced in the

salinity graphs for 1952. In 1953 the borders between the water masses were less clear on account of extensive mixing. In accordance with these differences in the hydrographic situations in the two years, the phytoplankton was essentially different from year to year. Each of the four types of water masses was found to have phytoplankton populations which exhibited many common features. On the basis of an analysis of the plankton societies the stations are grouped in four different vegetation areas (IV, V, VI, VII). Considerable variations occur within each area and the limits are not easily drawn.

In 1953 a characteristic feature of the vegetation was the mixed oceanic and neritic character of the societies encountered in the East Icelandic Arctic Current and the water masses of more or less pronounced Atlantic nature to the east. Neritic species like *Chaetoceros debilis* and *Thalassiosira gravida* occurred even at the outermost Atlantic water station. On the other hand, relatively large populations of coccolithophorids occurred in Arctic water. The complexity of the plankton societies was obviously a result of the mixture of water masses containing oceanic and neritic communities.

In the following a brief description is given of the vegetation in each of the four vegetation areas, IV—VII.

a. The Icelandic Coastal Current. Vegetation area IV.

The vegetation of the coastal waters was characterized by the occurrence of the neritic dinoflagellates *Peridinium triquetrum* and *P. trochoideum* and the absence of coccolithophorids. The diatom vegetation was poorer in species and individuals than that of the East Icelandic Arctic Current, where it was very abundant. The dinoflagellates were represented by a great number of species (see Table 12). At each of the stations in this area the plankton was characterized by special features, both qualitatively and quantitatively. At St. 273 *Goniaulax tamarensis* occurred in fair numbers; at St. 272 the vegetation exhibited affinities to societies further to the east, through the occurrence of coccolithophorids and of *Exuviaella baltica* and by its general poverty as compared with that of adjacent stations in the section. Notable also are the populations of *Coscinosira poroseriata* (Ramsfjell 1959 b), which also occurs in the Spitsbergen area and was recorded by Thórdardóttir (1956) at stations north of Iceland in July—August. The local variations in the quantitative composition of the phytoplankton indicate that conditions of growth or grazing intensity varied, while the qualitative differences may have been due to

local supplementation of each station's initial populations by admixture of water masses containing different vegetations. In the coastal region off Langanes admixture of water from the East Icelandic Arctic Current and from various parts of the region north of Iceland may occur.

When the samples were collected at the end of June, a period of lively growth seemed to be near its close. The large populations of *Chaetoceros debilis* and *C.densus* at the 30 m level at St. 273 is an indication of such a situation. Highly stratified waters with a homogeneous top layer, 20–30 m thick, would seem to be unfavourable for maintenance of an effective supply of nutrients after exhaustion of the early spring supply. Steemann Nielsen (1935) observed an initial spring increase off the east coast of Iceland in the second half of May with *Thalassiosira* spp. and *Fragilaria nana* as the commonest diatoms.

In 1952 the diatom as well as the dinoflagellate components were very poor as compared with those of the populations recorded in 1953. The vegetation was a *Chaetoceros* society, somewhat different from that encountered in 1953. This society was recorded from St. 255 in coastal waters and from St. 254, which hydrographically belonged rather to the East Icelandic Arctic Current. In view of the low temperature of the water masses in 1952 one might have expected to find a phytoplankton representing an earlier stage of the spring development, but the diatom society reminded rather of the *Chaetoceros* plankton which in Norwegian coastal waters succeeds *Thalassiosira* plankton of the early spring increase. The dinoflagellate component was poor, but this was also the case in 1952 in Spitsbergen waters, where the phytoplankton represented later stages in the annual cycle.

b. The East Icelandic Arctic Current. Vegetation area V.

In this water mass, and at stations where Arctic water was present, the vegetation was very heterogeneous. In 1952, as well as in 1953, some of the largest populations recorded east of Iceland were those of the most pronouncedly Arctic waters, but otherwise the populations were variable and very different in the two years.

In 1953, a very abundant phytoplankton occurred at stations 270 and 271. Prominent diatoms were *Chaetoceros* spp., *Nitzschia delicatissima, Rhizosolenia hebetata* f. *semispina* and *Thalassiosira gravida.* The dinoflagellate component was rich in species (cp. Table 13) and fairly large populations of *Exuviaella baltica* and *Gyrodinium grenlandicum* occurred. It is noteworthy that coccolithophorids were

even more common and, as at typically Atlantic stations, were characteristic organisms in the East Icelandic Arctic Current.

The water masses encountered at St. 269 were probably the most purely Arctic ones within the whole section, but their vegetation had a definitely temperate-oceanic character with coccolithophorids, *Exuviaella baltica, Chaetoceros* spp. and *Rhizosolenia styliformis* as the most prominent members. No other station east of Iceland had such large populations of *Coccolithus pelagicus* and *Exuviaella baltica.* The stations showed affinity to eastern regions, the vegetation including *Chaetoceros atlanticus* and *Rhizosolenia styliformis,* but the diatom population was so poor that it stands rather isolated within the section.

The vegetation within this area indicates that during the period prior to the date of sampling, conditions for phytoplankton growth had varied a great deal and that extensive exchange had taken place with waters on the sides of the current. The vertical distribution of the plankton and the stability conditions indicate that the spring maximum first occurred on the western side, on the border towards the Icelandic coastal waters, and advanced eastward.

I 1952 the Chaetoceros vegetation was not prominent and the phytoplankton had a more pronounced neritic character. Through their mass occurrence *Nitzschia delicatissima* and *Eucampia zoodiacus* marked the society encountered at the two easternmost stations in area V. *Exuviaella baltica* was the commonest dinoflagellate in 1952 as was the case in 1953. Otherwise the dinoflagellate plankton was poor, as were the coccolithophorid populations, occurring in the eastern part. St. 252 was exceptionally rich in phytoplankton, characterized by a prominence of early spring forms such as *Thalassiosira* spp., and, to a lesser degree, of *Bacteriosira fragilis* and *Fragilaria oceanica.* The same species were also recorded at the coldest station in the section, St. 253, but in this case they were mainly resting spores. This fact may presumably be taken as a sign that the development was more advanced there.

Previous investigations yield information on the phytoplankton within parts of the East Icelandic Arctic Current at other seasons. Steemann Nielsen (1935) observed that water masses off Langanes in the last half of May were about to become stabilized and that the spring increase had then just started. Observations by Gran (1912) show that stability may be pronounced as early as the end of May, with the spring increase in progress and *Chaetoceros borealis* f. *concavicornis* and *Thalassiosira bioculata* as the most prominent species. In August the phytoplankton in these water masses was found to be very poor (Gran 1902, Braarud 1935).

c. Stations with a mixture of Arctic and Atlantic water. Vegetation area VI.

In 1952 the stations of area VI formed a natural group, both as regards their hydrography and their phytoplankton. The vegetation was clearly different from that recorded in the adjacent waters on both sides of the area. It was characterized by the occurrence of the large species *Rhizosolenia styliformis* and *Thalassiothrix longissima*. Neither the diatom component nor the dinoflagellate component were qualitatively or quantitatively as rich as those of the corresponding water masses in 1953. The commonest organisms were small forms such as *Fragilaria nana* and coccolithophorids, but they were not really abundant. At St. 250, which otherwise had a society similar to that of the other stations in the area, unusually large populations of *Exuviaella baltica* were recorded.

In 1953 St. 268 exhibited the most extensive mixing between Atlantic water and water from the East Icelandic Arctic Current. The abundant population, of a varied composition, reminded one of that observed in the more Arctic water masses near Iceland. The abundance of phytoplankton in the upper 20 m may be taken as evidence of lively growth at the time of sampling. Of special interest is the joint occurrence of *Rhizosolenia styliformis* and *Thalassiothrix longissima* which, as in 1952, were associated and had a restricted distribution around this station. In view of the large size of *Rhizosolenia styliformis* its populations were surprisingly large (max. 2 140/L). The distribution of these two species exemplifies the occurrence of special plankton societies in the border area between Atlantic and Arctic water masses. Gran (1929) observed a similar society in corresponding water masses north of the Faeroe Islands in July.

d. Atlantic water masses off Iceland. Vegetation area VII.

The observations from the Atlantic water masses of this region will be dealt with in connection with observations from other Atlantic waters.

5. ATLANTIC WATER MASSES TO THE WEST AND NORTH OF THE NORWEGIAN ATLANTIC CURRENT. (VEGETATION AREAS VII, VIII, IX. TABLES 1—11, 14, 15, 18, 19, 26, 28.)

All our Atlantic stations are located within or on the border of Gran's Clio-region, which not only included the more or less Arctic surface layers of the Norwegian Sea, but also Atlantic water masses with a vegetation of Arctic rather than Atlantic character (Gran 1902).

(As Gran's regions were distinguished on the basis of net plankton samples collected during the summer, the distribution of ceratia played an important part in the demarkation of the regions and the description of their vegetation.)

In June 1952 and 1953 the populations in Atlantic water were essentially different from those observed in the other water masses investigated. They were characterized by the abundance of minute organisms such as *Fragilaria nana,* coccolithophorids and non-identified, naked flagellates and non-motile monads. A rather monotonous phytoplankton of this type was recorded in 1952 within the vegetation areas VII and VIII. Off Spitsbergen this type of vegetation prevailed in waters which were not strictly Atlantic. In 1953, conditions were more variable, as larger diatoms occurred at a number of stations.

a. The phytoplankton situation in June 1952.

Although the general features of the vegetation of the Atlantic waters within the region were uniform, considerable variation in the quantitative and qualitative composition of the plankton was recorded, most pronounced going from north to south.

The diatom component was relatively poor in species, being most varied in the section south-east of Jan Mayen, where *Chaetoceros* species and a few other species occurred mostly in small numbers. The only diatoms which formed an important part of the population were *Fragilaria nana* and, to a lesser degree, *Nitzschia closterium,* which both occurred mainly within vegetation areas VII and VIII and in many cases in very great numbers. A common feature in their distribution is that their populations were small south of 71° N, the latitude of Jan Mayen. *Fragilaria nana* was very numerous at all stations north of this latitude, while *Nitzschia closterium* had its main occurrence in the central western localities in area VIII. According to the distribution of these species the Atlantic water masses of this region may be referred to as of three types:

1. Atlantic water masses to the south-east of Jan Mayen with small populations of both species.
2. Central, western water masses with large populations of both species.
3. Water masses in the vicinity of Bear Island and west of Spitsbergen with large populations of *Fragilaria nana* and small populations of *Nitzschia closterium.*

The actual temperature and salinity data for the stations do not

give any basis for an explanation of the differences in the occurrence of these two species, but the isotherms for June 1952 (Fig. 8) illustrate the presence of three currents of Atlantic water which do coincide with the three types of Atlantic water indicated above; these are a protruding tongue of Atlantic water towards north-west in the Jan Mayen region, another one towards the west, south of Bear Island, and the Atlantic Spitsbergen Current west of Spitsbergen.

The dinoflagellate vegetation was poor and not characteristic, consisting mainly of *Exuviaella baltica* and gymnodinians. The former occurred at all stations, in varying quantities, being somewhat more abundant west of Spitsbergen than in the southern part.

The coccolithophorids were the most characteristic group of organisms in the Atlantic water. *Calciopappus caudatus, Coccolithus huxleyi, C.pelagicus* and *Anthosphaera robusta* had the widest distribution and were most abundant. *Crystallolithus hyalinus* was also recorded within the whole region, but in smaller populations. At the southern localities, *Pontosphaera pietschmanni, Acanthoica quattrospina* and *Ophiaster hydroideus* were recorded in small quantities.

The water masses to the west of Bear Island and Spitsbergen were relatively poor in coccolithophorids. The largest populations were recorded from area VII and in the central and southern parts of area VIII. The relative abundance of the main species was variable. At and in the vicinity of St. 246 in area VII, *Coccolithus huxleyi* was very abundant and at the same station *Anthosphaera robusta* was recorded in considerable numbers. Nearer Jan Mayen the latter species outnumbered *Coccolithus huxleyi* and in the central parts of area VIII they were equally abundant. At the last mentioned localities *Calciopappus caudatus* was the predominant coccolithophorid. These fluctuations appear to be related to the complex current conditions in this region.

Another characteristic and widely distributed plankton species in Atlantic water was the flagellate *Chilomonas marina.* The most marked feature in its distribution was the occurrence of large populations at three neighbouring Atlantic Spitsbergen Current stations to the west of Bear Island.

Ciliates formed an important part of the plankton society at some of the stations, mainly in border areas. *Woodania conicoides* was the commonest species within area VIII. In the northern part of the area the small tintinnid *Acanthostomella* was recorded in rather large numbers. *Laboea strobila,* which was the commonest species of this genus at St. M (Halldal 1953), was only observed at the southernmost stations.

The plankton samples from area VIII were collected during the period from 2nd to 15th June, the stations 193 and 233 located within the same type of water, with a time interval of 9 days. During this period the phytoplankton exhibited a great increase in most of the species. *Fragilaria nana, Nitzschia closterium* and *Chilomonas marina* increased their populations manifoldly. *Calciopappus caudatus* and *Coccolithus huxleyi* also showed considerable increase, while there was only a minor rise in the *Anthosphaera robusta* population. The population of *Exuviaella baltica* declined during the same period.

The recorded seasonal increase in the coccolithophorid population does not accord with the changes recorded at St. M by Halldal (1953). He found that while the population of *Fragilaria nana* and the phytoplankton as a whole showed a quick increase in June, the coccolithophorids had a period of decreasing populations, lasting from early June to the middle of July. A comparison between the phytoplankton populations at St. M and within area VII and VIII in June shows that the latter regions had much larger populations. A noteworthy qualitative difference was the occurrence of *Nitzschia closterium* and *Calciopappus caudatus* in our samples.

b. The phytoplankton situation in June 1953.

In June 1953 conditions in the Atlantic waters were in various ways different from those observed in 1952. The vegetation was in general considerably richer, both qualitatively and quantitatively and neritic species played a greater part, not only at the border stations, but in water masses with purely Atlantic character as well.

The phytoplankton distribution within areas VII, VIII and IX differed so much that we shall treat them separately.

x. Atlantic water masses south-east of Jan Mayen. Vegetation area VII.

The societies encountered in these central water masses had much the same character as those of area VI. The main difference was the smaller populations of coccolithophorids and of *Exuviaella baltica* and *Rhizosolenia styliformis* in area VII. The populations of *Chaetoceros* were also smaller, while *Nitzschia delicatissima* was the more important.

During the three weeks which elapsed between samplings of the two sections in area VII great changes took place, both as to the character of the water masses and as to their phytoplankton. Vernal heating of the surface layers led to the formation of a pronounced discontinuity layer between 10 and 20 m (cf. Fig. 7). Large populations of *Nitzschia delicatissima* appeared and *Chaetoceros densus*

showed a definite increase in numbers. The populations of the other species of *Phaeoceros* stayed at the same level. The dinoflagellate component became more abundant and more varied in its composition, while there were no essential changes in the coccolithophorid population. The large populations, mainly at the surface, indicate favourable conditions of growth at the end of June. The changes in the composition of the plankton during the interval between the two sets of observations may partly be due to succession, but an admixture of other water masses, introducing new initial populations, may also be taken into account. The appearance of *Phaeocystis poucheti* at the 4 outermost stations in the section towards Iceland, where it was associated with neritic species such as *Chaetoceros debilis* and *Thalassiosira gravida,* may possibly be due to admixture of water masses of different origin.

The vegetation recorded from area VII was different from that noted during one year's weekly observations at St. M (Halldal 1953). There is, however, one common feature: a decline in the coccolithophorid population took place during a period when diatoms showed a marked increase.

xx. Central Atlantic water masses north-east of Jan Mayen. Vegetation area VIII.

There were great differences between the diatom populations recorded in the western and the eastern sections, and between the stations within the latter section. Nevertheless there were so many similarities in the vegetation of the Atlantic water masses in area VIII that it may be assumed that conditions of growth were much the same.

All the main groups of phytoplankton were generally well represented. Most characteristic were large populations of *Exuviaella baltica, Fragilaria nana, Nitzschia closterium* and coccolithophorids. *Calciopappus caudatus* was the predominant species of the latter group which otherwise consisted of those species showing prominence in 1952.

In the easternmost section large populations of the neritic species *Chaetoceros debilis* and *Thalassiosira gravida* were recorded, but they had a very uneven distribution within the section, as was also the case with other species of *Chaetoceros*. The hydrographic observations did not give any clue to the causes of these variations, but they are probably due to uneven supplies of initial populations.

The difference in size of the populations recorded from the western and the north-eastern parts of area VIII may be due to the

fact that two weeks elapsed between observations in the two sections. During this period the water masses became stabilized and an improvement of growth conditions may thus have taken place. In June the vegetation seemed to follow a course in its development similar to that observed in area VII, the increase being most pronounced in diatoms and least pronounced in coccolithophorids, a group which was only represented at the 30 m level at a couple of stations.

The fairly uniform character of the vegetation within area VIII may indicate that a direct current connection existed between the two sections in 1953. This explanation is supported by the current pattern for this region, shown in current chart reproduced in Fig. 2 (p. 9). The arrows indicate a north-easterly drift of the waters within vegetation area VIII, from its western to its eastern part.

A comparison between stations 233 (1952) and 247 (1953) shows many similarities in hydrography as well as in the plankton. There is, however, an indication that stability was established somewhat earlier in 1952 than in the following year and consequently the spring increase may have started earlier. This assumption finds support in the fact that in 1952 the populations of *Fragilaria nana* were several times as large as at the corresponding station in 1953.

xxx. Atlantic water masses west of Bear Island and Spitsbergen. Vegetation area IX.

On its northbound drift the Norwegian Atlantic Current and its continuation, the Atlantic Spitsbergen Current, mix with other water masses. The admixture of Polar and Arctic waters off Spitsbergen in 1953 was clearly demonstrated by both the hydrographical and the phytoplankton material. At the majority of the Atlantic stations societies of phytoplankton, which consisted of oceanic and neritic species, were encountered. In area IX the oceanic component was predominant or solely present, while in other localities with more mixed water masses the phytoplankton was predominantly neritic. We have previously observed that the two northernmost stations in area III had a very abundant neritic plankton whereas oceanic species quantitatively played a subordinate role. Hydrographically the character of the waters was more Atlantic than Arctic.

At the central, southernmost stations in area IX the vegetation was much the same in the two years, *Fragilaria nana* occurring in about the same numbers, while *Nitzschia closterium* played a less important part in both years. Neritic species which were scanty in the purest Atlantic water masses, occurred in considerable quantities at

the border stations. Conditions at St. 218, on the border of the Polar waters at Bear Island, are noteworthy. The vegetation did not show any affinity to that recorded on the western side, although the waters were definitely Atlantic. This seems to indicate that Atlantic waters, containing a vegetation which was different from that of the Atlantic waters to the west, had been introduced at this station. *Nitzschia delicatissima* may be regarded as a characteristic species.

St. 240 was worked a week later than the other stations in area IX. Here stability was more pronounced than was otherwise the case. The establishment of stable water masses seems to have given occasion to a quick growth of *Fragilaria nana* and *Nitzschia closterium* as well as of *Exuviaella baltica* and *Calciopappus caudatus*. It would appear that the increase in the phytoplankton population was inititated at about the same time in the Atlantic waters between Iceland and Spitsbergen.

In 1952, the northernmost Atlantic stations were warmer than during the same period in 1953 and the possibilities of a somewhat earlier stabilization of the surface layers and subsequently of a relatively early increase in the phytoplankton population may be expected. We have seen how *Fragilaria nana* occurred in large populations within a wide region in 1952, a fact which would suggest that this had been the case, while the dinoflagellate and coccolithophorid components were less numerous than in the subsequent year (St. 240), a feature which may have been the result of a reduction of these components in the same way as observed in June at St. M by Halldal (1953).

Marshall (1957) studied the seasonal changes in the net plankton at Atlantic stations west of Bear Island. He recorded small populations in May as well as in June. During the latter month the diatoms which prevailed in the net samples were species of *Chaetoceros*. Later in the summer large populations of *Thalassiothrix longissima* and *Rhizosolenia* spp. occurred.

When reviewing the main features of the phytoplankton conditions in June 1952 and 1953 within the Atlantic water masses of the Norwegian Sea, it is useful to make a comparison with the observations covering a whole year made by Halldal (1953) at St. M. The dates of our observations fall within the summer period, as distinguished by Halldal, and characterized by him in the following way: «the summer-period from May to September, when an increase took place and the population stayed high.» The background for the

increase was the presence of stabilized surface layers, established in the last half of May. In spite of intensive grazing the population increased towards a maximum in July. The diatom component was most varied in its composition towards the end of the summer period and in autumn. In June the vegetation was characterized by a predominance of *Fragilaria nana* which reached its maximum in early July. Apart from *Coccolithus pelagicus,* which reached its maximum in the middle of May, the common coccolithophorids were most abundant in late August and early September. The dinoflagellate component was also most varied in its composition in late summer and early autumn, but *Exuviaella baltica* occurred in maximal abundance as early as the end of June.

Our observations from 1953 show that the surface layers of the Atlantic water masses became stabilized during the first half of June. As was observed at Station M, this change in the hydrographic situation was accompanied by a quick increase in the total population of phytoplankton, although the composition of the plankton society was different in the two cases. There was considerable variation in the actual societies recorded within the Atlantic water in 1953. Special features of area VII were occurrence of large populations of *Nitzschia delicatissima* and *Chaetoceros densus,* its poverty in coccolithophorids, in the first as well as in the last of the two sections, and its lack of large populations of any of the dinoflagellates, although there was an increase in the number of species during this period. Within area VIII conditions were most variable. In the recently stabilized water masses in the eastern part of the section large populations of *Chaetoceros debilis* and *Thalassiosira gravida* occurred, while otherwise *Fragilaria nana* and *Nitzschia closterium* were on the whole the commonest and most prominent species within the area. *Exuviaella baltica* and coccolithophorids seemed to enjoy favourable conditions of growth within this area, the former exhibiting a rate of reproduction reaching that of the diatoms. In area IX (St. 240) the first signs of stabilization of the surface layers seem to have lead to a quick increase in the diatoms *Fragilaria nana* and *Nitzschia closterium,* and in *Exuviaella baltica* and *Calciopappus caudatus.* The populations of these species at St. 240 were several times as large as at the Atlantic stations to the north and south, which were worked one week earlier.

In June 1952, the phytoplankton societies of the Atlantic water were not as varied in their composition as in 1953 and the quantities were more uniform. *Fragilaria nana* was the predominant species and, at some stations, abundant populations of *Nitzschia closterium* and of coccolithophorids were recorded. The large populations signify that

the samples were collected during the summer period, which for various reasons did not occur at the same time in the two years and exhibited different phytoplankton conditions. In 1952 initial populations seem to have contained fewer species than i 1953 and the hydrographic situation which is presumably a prerequisite for the seasonal increase in the growth rate of the population, seems to have been established earlier. The distribution of the phytoplankton to the north-east of Jan Mayen in 1952 and 1953 indicated different current conditions in this area in the two years.

The picture of the phytoplankton distribution in the Norwegian Sea which can be drawn on the basis of the material available, is in many ways incomplete. Observations are still lacking from large parts of the area, and those which have been made cover only part of the year, and have been obtained from cruises which were primarily concerned with observations for other purposes. A satisfactory investigation of the phytoplankton and its conditions of growth would require a far more extensive plankton programme and would necessitate the use of more than one vessel during various seasons.

SUMMARY

1. The quantitative observations which have been made up to now (cp. Fig. 1) have demonstrated that the Norwegian Sea is an area where great variations are encountered in the phytoplankton vegetation.

2. Within the cold water masses on the western side of Bear Island and Spitsbergen the vegetation during the spring maximum is characterized by Boreal- and Arctic-neritic diatoms and *Phaeocystis poucheti*. A pronounced discontinuity layer within the upper strata during spring and summer presumably restricts the supply of nutrients from lower levels. It may, therefore, be expected that a poor phytoplankton society prevails after the spring maximum in June. The observations seem to indicate that a society with the small diatom *Fragilaria nana* as the predominant species succeeds the abundant neritic vegetation in the layers bordering Atlantic water.

3. The predominant species in the cold water masses off Spitsbergen are different from those recorded from the East Greenland Polar current in the Denmark Strait during the corresponding period of the annual cycle.

4. In the Polar — Arctic water masses north to north-east of Jan Mayen the spring increase seems to have a fairly early onset, and is over in June, although the surface layers are still homogeneous to a point below the compensation depth. The observations indicate that, in spite of the lack of any pronounced density gradients, turbulent activity may be small.

The investigations in June 1953 showed that when bottom water is formed in this area, the onset of the population's spring increase is delayed. As soon as the sinking of the heavy, cooled surface water is terminated, the population increases. The vegetation was composed of oceanic as well as of neritic species.

5. In the Atlantic water masses observations are as yet too scanty to allow the presentation of a general picture of the phytoplankton distribution and seasonal changes. We restrict ourselves to stressing how variable conditions may be within any given area. In June 1953 three vegetation areas could be discerned within the Atlantic water masses where observations were made and to a certain extent they could be correlated with currents. In other parts of the Atlantic water masses in the Norwegian Sea the hydrographic conditions may be even more variable and it is to be expected that they may induce a corresponding variation in the phytoplankton.

Light, stability and grazing may be expected to control the development of the phytoplankton populations in Atlantic water during spring and summer. The available investigations have shown how the establishment of a certain degree of stabilization leads to a quick increase in the population, which at this time has diatoms as its main component and important supplements of coccolithophorids and dinoflagellates.

6. Three different currents, apart from the Icelandic coastal current, pass through a section to the east of Iceland. The phytoplankton observations have demonstrated that there are also three corresponding vegetation areas, which, however, show signs of lateral mixing between the water masses of the currents.

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TABLES

Populations are recorded as number of cells per litre.

.. indicates that the species in question was not observed. Where the numbers or symbols are not given, the sample was not examined.

List of tables.

A. Section tables, including hydrographical data and records for selected species or genera.

B. Tables for selected stations, including complete records on populations. Hydrographical data may be found in the section tables.

Table 1.

Stations Date (1953)		274 24/6	273 24/6	272 24/6	271 23/6	270 23/6
	Depth (m)					
Temperature, °C	0	5.35	7.53	6.78	6.09	4.80
	10	.25	.47	.86	5.93	.49
	20	4.91	.25	.10	.77	.55
	30	3.22	3.01	3.85	1.78	2.87
Salinity, $^0/_{00}$	0	34.56	34.61	34.68	34.73	34.75
	10	34.56	34.61	34.66	34.72	34.76
	20	34.53	34.60	34.68	34.72	34.76
	30	34.69	34.80	34.79	34.85	34.78
Diatoms:						
Chaetoceros atlanticus	0	..	..	..	..	..
	20		..	..	..	..
	30	..	..	..	..	..
— *borealis* (f. *concavicornis* and f. *varians* included)	0	..	..	..	..	3 760
	20		..	..	440	4 260
	30	..	..	..	8 300	3 800
— *debilis*	0	1 300	400	..	7 400	460
	20		..	..	5 800	600
	30	460	99 000	..	54 000	80
— *densus*	0	..	60	..	2 700	76 000
	20		..	..	3 100	99 000
	30	..	44 000	1 200	2 200	52 500
— *furcellatus*	0	236 000	29 000	..	24 500	..
	20		6 500	..	13 000	..
	30	102 000	2 000	500	705 000	..
Nitzschia delicatissima	0	..	..	9 000	17 500	245 000
	20		..	..	35 000	250 000
	30	..	7 000	14 000	415 000	147 000
Rhizosolenia hebetata f. *semispina*	0	340	60	..	680	10 000
	20		20	..	220	25 500
	30	..	20	20	14 500	6 000
— *styliformis*	0	..	..	..	..	..
	20		..	..	..	..
	30	..	..	..	..	..
Thalassiosira gravida	0	40	..	20	680	1 360
	20		..	..	1 060	920
	30	460	..	..	25 200	720
— *sp.*	0	..	..	10 600	..	..
	20		..	19 200	..	..
	30	..	1 440	4 460	..	..

269 23/6	268 22/6	267 22/6	266 22/6	265 22/6	264 22/6	263 21/6	262 21/6
4.95	6.09	6.97	7.48	8.40	7.86	8.23	8.34
4.79	5.88	6.79	7.35	8.32	7.81	8.06	8.17
3.97	5.24	5.01	5.73	7.28	6.33	6.42	6.30
1.31	4.15	4.67	5.27	6.65	5.92	6.03	5.73
34.75	34.94	35.06	35.09	35.15	35.19	35.18	35.19
34.74	34.94	35.09	35.08	35.13	35.17	35.18	35.17
34.80	34.99	35.10	35.12	35.20	35.17	35.17	35.18
34.82	35.09	35.10	35.13	35.17	35.17	35.15	35.17
400	3 040	220	240	220	1 540	520	1 240
40	1 680						
280	1 280	..	..	920	960	..	..
4 560	5 100	..	..	..	380	60	440
40	5 220						
..	1 840	..	..	140	..	..	..
..	17 020	..	..	..	60	100	1 220
120	100						
..	..	..	..	..	160	..	..
3 060	95 500	..	18 200	11 100	5 900	11 700	16 600
80	31 500						
..	2 580	..	2 900	1 100	3 420	100	..
..	..	..	..	..	..	..	..
..	..						
..	..	..	..	..	..	..	..
..	94 000	17 000	60 000	402 000	397 000	587 000	360 000
40	24 000						
500	29 000	29 000	11 000	30 000	81 000	12 000	12 500
240	4 000	..	..	10	..	..	..
..	300						
..	..	..	..	..	..	10	..
680	1 420	70	30	..	..	..	..
..	2 140						
520	..	..	..	..	70	..	..
..	..	..	..	..	360	580	1 280
..	..						
..	..	..	..	180	700	180	700
..	120	..	..	680	..	460	..
..	400						
..	..	..	..	120	..	..	..

Table 1. (*cont.*).

Stations Date (1953)		274 24/6	273 24/6	272 24/6	271 23/6	270 23/6
	Depth (m)					
Dinoflagellates:						
Dinophysis	0	20	40	40	60	340
	20		120	40	80	440
	30	40	..	40	..	..
Exuviaella baltica	0	9 500	3 000	2 000	11 500	31 000
	20		500	4 000	9 500	31 000
	30	9 500	500	49 000	11 000	25 500
Gymnodiniaceae	0	23 200	1 460	20	500	58 340
	20		880	60	2 540	41 520
	30	54 860	11 540	4 500	5 620	8 720
Peridinium	0	6 600	16 980	1 240	60	220
	20		4 220	1 860	120	220
	30	1 180	840	40	360	200
Coccolithophorids:						
Calciopappus caudatus	0	..	..	..	8 500	3 500
	20		..	2 000	2 000	3 500
	30	..	..	6 000	500	4 500
Coccolithus huxleyi	0	..	..	..	3 000	..
	20		..	..	2 500	500
	30	..	..	1 500	2 500	..
— *pelagicus*	0	..	20	..	7 000	10 000
	20		60	1 000	6 500	4000
	30	20	20	14 500	5 500	21 500
Other forms:						
Chilomonas marina	0	20	1 000	1 000	..	500
	20		500	500	2 500	1 500
	30	20	500	1 500	40	1 500
Phaeocystis poucheti	0	..	..	..	..	..
	20		..	..	..	..
	30	..	r	..	..	..
Small forms not classified	0	110 000	30 000	14 000	250 000	29 000
	20		34 000	190 000	420 000	50 000
	30	115 000	16 000	140 000	55 000	39 000
Laboea conica	0	280	1 260	880	220	220
	20		..	560	60	200
	30	440	580	..	..	..
— *strobila*	0	160	160	20	100	620
	20		60	520	..	1 040
	30	200	520	..	..	..

269 23/6	268 22/6	267 22/6	266 22/6	265 22/6	164 22/6	263 21/6	262 21/6
520	480	80	20	600	..	40	40
60	..						
..	..	..	..	..	..	..	..
4 500	21 000	..	1 000	2 000	2 500	3 500	15 000
42 500	13 000						
30 500	1 000	1 000	..	..	1 000	20	2 000
21 040	14 180	1 100	8 620	20 540	16 360	10 020	15 600
10 520	9 520						
2 500	6 000	4 500	1 500	5 600	3 600	2 000	14 580
40	820	20	180	260	260	280	140
20	..						
40	40	..	..	..	..	..	..
10 000	2 500	4 000	1 500	..	2 500	3 000	10 500
5 500	7 000						
5 000	8 000	..	500	..	..	..	8 000
..	4 000	500	2 500	8 500	4 500	3 000	3 500
2 000	1 500						
3 000	2 500	3 500	1 000	1 000	..	1 000	3 000
3 500	2 000	4 000	3 000	1 500	1 500	1 000	3 500
14 500	5 500						
34 500	3 000	1 000	500	1 000	500	500	2 000
1 000	..	4 500	13 500	2 500	3 500	4 000	7 500
2 500	500						
500	40	1 000	4 500	3 000	4 500	500	3 000
..	..	..	..	c	c	c	c
..	..						
..	..	..	..	..	r	..	..
62 000	175 000	215 000	365 000	195 000	185 000	195 000	335 000
52 000	115 000						
48 500	70 000	80 000	48 000	50 000	60 000	33 000	220 000
200	480	520	6 000	2 620	1 820	7 000	4 300
..	120						
..	..	..	..	..	..	80	20
1 620	200	580	520	220	220	1 020	920
180	..						
..	..	..	..	..	..	20	..

Table 2.

Stations Date (1953)		206 2/6	205 2/6	204 2/6
	Depth (m)			
Temperature, °C	0	0.04	—0.20	1.53
	10	—0.11	.48	—0.57
	20	.11	.51	.43
	30	.15	.57	.41
Salinity, ‰	0	34.80	34.77	34.72
	10	.80	.77	.74
	20	.80	.77	.76
	30	.80	.77	.76
Diatoms:				
Asteromphalus robustus	0	440	820	520
	30	800	1 780	2 080
Chaetoceros atlanticus	0	20	..	360
	30	..	80	..
— *decipiens*	0	260	..	60
	30	80	..	..
— *densus*	0	..	..	..
	30	..	..	..
Fragilaria nana	0	43 000	17 500	6 500
	30	32 000	13 500	29 000
Nitzschia closterium	0	..	..	..
	30	..	..	..
Thalassiosira gravida	0	9 600	760	1 700
	30	7 300	760	4 020
— *hyalina*	0	..	..	..
	30	..	..	..
— *nordenskioeldi*	0	..	..	..
	30	..	..	..
Dinoflagellates:				
Exuviaella baltica	0	11 000	11 000	3 500
	30	10 000	5 000	7 500
Gymnodiniaceae	0	11 720	2 020	3 600
	30	7 060	5 120	5 060
Peridinium	0	540	40	540
	30	80	500	1 020
Coccolithophorids:				
Anthosphaera robusta	0	..	..	..
	30	..	..	..
Calciopappus caudatus	0	..	..	..
	30	..	..	..
Coccolithus huxleyi	0	..	..	..
	30	..	..	..

203 1/6	202 1/6	201 1/6	200 31/5	199 31/5	198 31/5	197 31/5
0.21	−0.05	4.26	4.40	5.94	5.54	6.06
.04	.26	.21	.39	.81	.54	.08
−0.10	.27	.13	.39	.75	.45	.69
.38	.29	3.87	.39	.69	.43	.63
..	34.70	35.14	35.13	35.18	35.13	35.16
34.74	.70	.13	.13	.17	.12	.17
.73	.71	.13	.13	.16	.12	.15
.72	.71	.13	.13	.15	.12	.14
1 260	1 780	20	..	..	..	..
1 900	1 780	..	20	..	..	..
520	..	..	360	20	1 740	740
40	..	60	..	120	1 820	1 360
1 580	..	1 400	1 120	..	..	..
380	140	600	400	..	..	..
..	..	1 940	2 300	600	5 520	2 260
..	..	1 160	1 900	1 520	11 700	3 700
23 500	26 500	115 000	44 500	5 000	1 000	8 000
32 500	27 500	38 000	40 000	9 500	2 000	26 000
..	..	41 000	22 000	2 500	1 500	1 500
..	..	36 000	16 500	2 000	1 000	4 000
61 400	3 560	..	..	..	..	..
32 000	4 240	..	..	..	..	..
4 500	..	..	(60)	..	..	..
1 060	140	..	..	..	..	..
23 180	..	..	..	..	..	..
7 500	..	..	..	..	..	..
14 500	12 000	49 000	29 500	6 000	1 000	5 000
20 500	6 500	20 000	35 000	5 000	2 500	13 000
7 300	5 920	29 200	15 800	1 540	2 040	2 020
11 540	4 700	17 620	16 080	3 520	4 500	5 040
1 080	1 020	20	1 520	..	..	40
20	500	40	560	..	20	20
..	..	7 500	9 000	2 500	1 000	500
..	..	8 000	9 500	2 000	1 000	4 500
..	..	115 000	70 000	3 500	2 500	2 500
..	..	85 000	88 000	1 500	3 500	7 000
..	..	4 500	8 000	3 000	500	5 500
..	..	5 500	14 000	4 000	4 000	4 500

Table 2. (Cont.)

Stations Date (1953)		206 2/6	205 2/6	204 2/6
	Depth (m)			
Coccolithus pelagicus	0	20	40	..
	30	..	60	20
Crystallolithus hyalinus	0	1 000	1 500	80
	30	1 000	1 000	2 500
Other forms:				
Chilomonas marina	0	20	..	20
	30	..	..	20
Small forms not classified	0	300 000	200 000	75 000
	30	220 000	105 000	250 000
Laboea conica	0	280	640	1 400
	30	20	..	100
— *strobila*	0	20	240	340
	30	180	..	..
Woodania conicoides	0	200	1 000	3 000
	30	..	20	80

203 1/6	202 1/6	201 1/6	200 31/5	199 31/5	198 31/5	197 31/5
20	80	3 500	3 000	2 500	2 500	4 000
120	20	5 000	5 000	5 500	3 500	2 500
1 000	1 000	3 000	500	..	..	..
1 000	2 000	1 500	1 000	..	..	..
..	..	8 500	1 500	18 500	19 000	8 000
..	..	2 000	3 000	5 500	9 500	11 000
187 500	195 000	850 000	280 000	260 000	190 000	105 000
165 000	185 000	600 000	625 000	230 000	225 000	285 000
580	300	360	3 600	100	620	3 700
20	40	40	400	40	..	..
100	240	..	..	100	1 020	680
..	..	..	..	100	20	..
2 000	1 000	1 000	9 500	1 000	1 000	2 000
20	..	40	500	500	500	40

Table 3.

Stations Date (1953)		209 3/6	208 2/6
	Depth (m)		
Temperature, °C	0	—0.15	—0.26
	10	.39	.41
	20	.38	.41
	30	.40	.36
Salinity, ‰	0	34.87	34.74
	10	.87	.73
	20	.87	.74
	30	.87	.79
Diatoms:			
Asteromphalus robustus	0	..	..
	30	..	120
Chaetoceros atlanticus	0	560	..
	30	620	120
— *debilis*	0	..	..
	30	..	..
— *decipiens*	0	4 300	..
	30	2 400	20
— *densus*	0	..	..
	30	..	..
Fragilaria nana	0	11 500	27 500
	30	20 000	28 000
Nitzschia closterium	0	..	..
	30	..	..
Thalassiosira gravida	0	77 000	1 020
	30	137 000	2 320
Dinoflagellates:			
Exuviaella baltica	0	3 500	4 000
	30	2 500	4 500
Gymnodiniaceae	0	2 420	4 400
	30	3 020	6 880
Peridinium	0	140	200
	30	180	220
Coccolithorids:			
Anthosphaera robusta	0	..	..
	30	..	..
Calciopappus caudatus	0	..	..
	30	..	..
Coccolithus huxleyi	0	..	..
	30	..	..
— *pelagicus*	0	..	..
	30	..	..

207 2/6	243 14/6	244 14/6	245 14/6	246 14/6	247 15/6	248 15/6
—0.10	1.34	1.67	5.10	5.72	6.20	6.70
.19	0.41	.46	4.93	.59	.15	.64
.23	.08	0.65	0.04	.05	5.41	5.97
.24	—0.15	.54	3.97	4.55	4.54	.82
34.80	34.78	34.78	35.15	35.19	35.18	35.18
.81	.80	.78	.17	.17	.18	.17
.82	.82	.81	.15	..	.19	.17
.82	.83	.82	.14	.18	.18	.18
40	360	1 800	20	..	..	..
40	840	3 340	..	..	..	..
800	60	..	3 080	..	..	180
620	..	..	20	..	..	..
..	..	..	1 660	345 000	..	580 000
..	..	..	..	100	..	..
860	..	..	20	840	..	5 200
2 000	..	..	..	40	..	..
..	..	..	27 000	80	..	980
..	..	..	..	..	..	..
49 000	8 500	54 000	70 000	69 000	280 000	135 000
35 000	95 000	21 000	27 500	40 000	140 000	58 000
..	..	..	65 000	19 000	150 000	93 000
..	..	..	21 500	14 500	63 500	50 000
64 460	160	..	..	120 000	2 400	24 000
86 460	260	300	..	900	380	1 000
10 000	..	..	193 000	28 000	65 000	144 500
8 000	21 000	..	..	..	500	2 000
4 800	1 300	2 000	32 500	25 000	16 000	24 500
3 920	7 500	4 000	5 000	9 040	7 000	16 500
320	360	100	2 080	3 060	1 000	1 020
280	40	40	40	..	40	520
..	..	..	..	..	1 500	4 000
..	..	..	1 500	26 000	21 500	8 500
..	..	..	..	..	72 000	50 000
..	..	..	34 000	56 000	76 500	34 500
..	..	..	..	..	8 000	9 000
..	..	..	3 500	12 000	8 000	10 500
20	..	..	..	..	..	2 000
20	20	500	8 000	9 000	5 000	3 500

Table 3. (Cont.)

Stations Date (1953)		209 3/6	208 2/6
	Depth (m)		
Crystallolithus hyalinus	0	..	20
	30	..	80
Other forms:			
Chilomonas marina	0	..	..
	30	..	..
Small forms not classified	0	45 000	85 000
	30	48 000	160 000
Laboea conica	0	100	140
	30	..	..
Lohmanniella oviformis	0	40	500
	30	20	500
Woodania conicoides	0	500	3 500
	30	20	20

207 2/6	243 14/6	244 14/6	245 14/6	246 14/6	247 15/6	248 15/6
500	..	..	..	..	13 500	12 000
280	20	2 500	1 000	500	500	4 500
..	20	20	4 500	1 000	7 000	12 500
20	20	..	1 500	1 000	500	10 500
170 000	110 000	125 000	1 600 000	190 000	950 000	1830 000
105 000	225 000	235 000	225 000	190 000	500 000	500 000
400	2 240	120	1 600	4 500	520	1 200
100	20	1 060	..	..	..	..
60	..	..	1 500	1 500	9 500	12 500
40	500	500	..	2 000	500	500
500	4 000	80	2 000	12 500	5 000	460
20	100	40	..	60	80	..

Table 4.

Stations Date (1953)		210 3/6	211 3/6	212 3/6
	Depth (m)			
Temperature, °C	0	−0.21	−0.42	−0.30
	10	.32	.72	.45
	20	.37	.71	.61
	30	.41	.74	.64
Salinity, ‰	0	34.74	..	34.89
	10	.78	34.90	.89
	20	.81	.91	.89
	30	.81	.90	.89
Diatoms:				
Bacteriosira fragilis	0	..	..	320
	30	1 040	..	80
Chaetoceros atlanticus	0	220	1 200	520
	30	440	740	160
— *decipiens*	0	2 560	12 500	17 000
	30	2 460	16 000	15 600
— *furcellatus*	0	95 000	35 500	100 000
	30	125 000	71 000	75 000
Eucampia zoodiacus	0	820	1 700	1 360
	30	480	920	340
Fragilaria nana	0	10 000	10 500	6 000
	30	38 000	4 000	8 500
— *oceanica*	0	..	19 000	35 000
	30	..	17 800	8 640
Nitzschia delicatissima	0	4 500	27 000	16 000
	30	9 500	22 000	14 000
Thalassiosira gravida	0	146 000	175 000	230 000
	30	139 000	165 000	275 000
— *hyalina*	0	3 400	3 720	1 240
	30	3 800	4 020	2 400
— *nordenskioeldi*	0	14 300	15 000	6 900
	30	14 100	10 100	14 400
Dinoflagellates:				
Exuviaella baltica	0	3 500	500	2 000
	30	1 000	3 500	5 500
Gymnodiniaceae	0	6 900	2 180	3 860
	30	5 100	2 020	5 580
Peridinium	0	200	580	1 240
	30	240	620	240

213 3/6	214 4/6	215 4/6	216 4/6	217* 4/6	218 4/6	219 5/6	220 5/6
−0.09	1.99	2.71	4.38	4.25	5.07	−0.40	− 0.61
.52	.90	.70	.26	3.99	4.80	0.56	.68
.57	.81	.66	3.87	.63	4.98	1.91	.85
.60	.78	.54	.64	.58	5.13	3.01	.69
34.89	35.05	35.12	35.17	35.14	35.05	33.77	33.72
.89	.05	.10	.12	.13	34.96	.95	.74
.89	.05	.10	.13	.12	35.04	34.56	.92
.89	.04	.12	.13	.11	.08	.81	.98
..	..	..	..	..	..	..	600
..	..	..	..	..	..	1 040	
280	..	..	..	..	260	20	..
300	..	..	..	..	100	..	
22 500	280	..	..	..	1 160	..	..
26 500	120	..	..	..	820	..	
62 500	280	..	..	80	110 500	368 000	293 500
40 500	40	..	..	..	60 000	491 000	
2 600	100	40	..	20	..	60	480
560	20	..	..	..	..	..	
12 500	10 500	53 500	106 000	218 000	..	..	..
17 500	15 000	45 000	16 000	205 000	..	..	
5 000	..	..	..	..	..	..	8 200
4 600	..	..	..	..	..	500	
13 500	4 000	..	..	..	22 500	1 000	..
7 500	..	..	..	..	10 000	60	
211 000	7 500	80	140	..	6 520	360	2 300
136 000	4 600	120	..	..	5 520	680	
1 940	..	..	..	..	..	..	..
..	..	..	..	..	..	..	
19 200	940	..	..	..	360	960	15 400
10 400	600	..	..	..	..	1 260	
4 000	7 500	2 000	4 500	10 000	500	500	120
2 000	15 500	..	..	5 000	..	..	
3 400	1 740	1 040	9 580	13 140	42 960	27 600	8 940
1 620	3 000	500	1 500	17 500	13 560	4 580	
280	100	20	2 500	3 500	20	760	380
120	80	..	..	500	20	500	

* 0 and 20 m examined

Table 4. (Cont.)

Stations Date (1953)		210 3/6	211 3/6	212 3/6
	Depth (m)			
Coccolithophorids :				
Calciopappus caudatus	0	..	..	..
	30	..	..	..
Coccolithus huxleyi	0	..	..	..
	30	..	..	..
Crystallolithus hyalinus	0	..	120	40
	30	..	40	500
Other forms :				
Phaeocystis poucheti	0	r	r	r
	30	c	r	r
Laboea conica	0	180	80	400
	30	280	..	..
Woodania conicoides	0	500	1 000	1 000
	30	..	..	..

213 3/6	214 4/6	215 4/6	216 4/6	217* 4/6	218 4/6	219 5/6	220 5/6
..	7 500	7 500	9 500	10 500	..	..	..
..	4 500	9 500	5 500	12 000	..	..	
..	2 500	500	6 000	6 500	..	..	..
..	1 000	2 000	..	9 500	..	..	
40	1 500	500	..	1 500	..	..	..
120	1 000	500	1 000	500	..	..	
r	..	..	..	..	c	r	r
r	..	..	..	..	c	rr	
320	1 900	2 400	580	240	560	100	120
..	20	..	..	..	..	..	
1 000	2 500	10 500	2 500	2 500	500	20	..
..	20	..	..	..	..	20	

* 0 and 20 m examined

Table 5.

Stations Date (1953)		242 13/6	241 13/6	240 13/6	227 7/6
	Depth (m)				
Temperature, °C	0	2.38	2.49	3.93	0.54
	10	.17	.39	.85	.40
	20	1.86	1.97	.58	.36
	30	.70	.68	.50	.36
Salinity, $^0/_{00}$	0	35.03	35.06	35.14	34.95
	10	.04	.06	.12	.94
	20	.03	.05	.12	.94
	30	.05	.03	..	.94
Diatoms:					
Amphiprora hyperborea	0	..	..	..	..
	30	..	..	..	..
Bacteriosira fragilis	0	..	..	..	..
	30	..	..	..	..
Chaetoceros furcellatus	0	195 000	330 000	..	6 000
	30	65 000	190 000	..	20 000
— *socialis*	0	375 000	838 000	..	11 000
	30	200 000	442 000	..	19 500
— *wighami*	0	22 500	15 000	..	28 000
	30	10 500	12 000	..	35 000
Eucampia zoodiacus	0	22 500	6 200	1 000	720
	30	2 400	6 700	..	1 760
Fragilaria nana	0	72 000	77 000	735 000	9 000
	30	25 000	40 000	375 000	6 500
— *oceanica*	0	1 600	35 000	..	100
	30	1 400	1 000	..	140
Nitzschia closterium	0	6 000	3 000	150 000	..
	30	7 000	2 000	60 000	40
— *delicatissima*	0	39 000	59 000	8 500	..
	30	18 000	56 000	1 500	10 500
Thalassiosira gravida	0	220 000	187 000	..	1 440
	30	60 000	160 000	..	2 880
— *nordenskioeldi*	0	84 000	86 500	..	6 100
	30	16 000	35 000	..	10 400
Dinoflagellates:					
Exuviaella baltica	0	20 500	6 500	44 000	3 500
	30	9 500	11 000	..	3 500
Gymnodiniaceae	0	5 000	8 000	11 720	1 400
	30	3 020	4 000	5 540	2 980
Peridinium	0	2 340	1 560	2 500	160
	30	20	360	540	2 080

226 6/6	225 6/6	224 6/6	223 5/6	222 5/6	221 5/6	238 12/6	239 12/6
2.93	3.35	2.61	3.79	4.00	—0.52	1.18	2.10
.61	.23	.36	.67	3.93	.67	.18	1.83
.50	.23	.21	.65	.98	.68	.11	.70
.26	.23	.07	.67	4.06	.66	.10	.68
35.13	35.14	34.64	34.86	34.89	34.61	35.00	34.27
.11	.10	.62	.86	.89	.57	.02	.24
.09	.13	.63	.86	.88	.57	.00	.25
.08	.12	.85	.86	.93	.58	.00	.29
..	..	380	360	320	940	..	420
..	..	..	680	200	440	..	160
..	..	640	780	1 300	4 240	..	20
..	..	1 100	1 660	380	7 060	..	460
2 000	..	179 000	280 000	225 000	15 000	17 500	198 000
2 000	..	74 000	257 000	162 000	17 500	8 500	320 000
2 500	100	293 500	307 500	285 000	138 000	53 000	93 000
4 000	540	26 500	273 500	153 000	270 000	60 500	293 000
..	120	2 920	2 040	1 600	38 000	83 000	..
120	640	80	10 900	2 100	65 000	49 000	400
..	..	5 100	10 220	5 540	280	680	6 000
..	..	360	6 560	3 140	300	1 200	4 000
55 000	61 000	13 500	3 000	4 000	..	18 000	..
40 000	67 000	15 500	2 000	4 000	..	13 500	..
..	..	5 200	17 600	9 500	104 000	..	5 200
..	..	..	15 200	6 560	86 000	520	16 400
10 500	9 000	2 000	1 500	780	500	..	2 000
7 500	8 500	2 000	500	340	1 500	500	6 000
1 000	..	23 500	23 500	24 500	4 000	1 500	64 000
1 500	80	14 000	10 500	10 000	40	7 000	79 000
620	40	3 420	4 320	2 840	8 400	3 980	1 460
3 800	..	1 420	3 420	2 600	10 480	3 200	6 680
180	..	44 560	45 800	44 700	16 100	7 440	10 200
700	1 020	5 480	45 060	23 100	13 900	16 700	30 000
12 000	5 500	2 500	1 000	2 000	..	..	..
1 500	6 500	..	500	1 000	40	2 000	..
6 840	5 640	19 640	20 460	96 080	600	1 140	17 500
140	18 660	9 000	13 660	21 060	680	3 000	18 500
280	40	4 180	40	80	100	660	860
120	1 000	600	60	20	140	120	700

Table 5. (Cont.)

Date (1953)		242 13/6	241 13/6	240 13/6	227 7/6
	Depth (m)				
Coccolithophorids :					
Calciopappus caudatus	0	8 000	8 000	50 000	1 000
	30	11 500	8 000	72 000	..
Coccolithus huxleyi	0	..	..	9 000	..
	30	..	..	7 000	..
Crystallolithus hyalinus	0	500	100	2 500	40
	30	3 500	1 000	160	500
Other forms :					
Phaeocystis poucheti	0	r	r	..	r
	30	r	c	..	r
Laboea conica	0	880	1 400	280	620
	30	..	..	..	120
Woodania conicoides	0	..	..	4 000	1 000
	30	..	..	40	120

226 6/6	225 6/6	224 6/6	223 5/6	222 5/6	221 5/6	238 12/6	239 12/6
27 000	3 500	2 500	..	..	..	..	..
29 500	15 500	1 500	..	..	..	500	1 500
2 000	2 000	..	..	500	..	..	..
1 500	3 500	..	500	..	..	..	..
540	+	..	..	..	..	..	..
1 500	+	..	..	..	..	20	..
..	..	c	c	c	..	c	c
..	..	r	c	c	..	cc	cc
460	100	2 600	460	300	..	11 000	1 200
40	20	..	260	120	..	20	..
500	300	2 500	500	80	..	5 500	180
..	40	40	100	80	..	..	..

Table 6.

Stations / Date (1953)		234 11/6	235 11/6	236 11/6
	Depth (m)			
Temperature, °C	0	0.56	—0.19	—0.20
	10	.39	.25	.42
	20	.88	.24	0.60
	30	2.10	0.45	2.14
Salinity, $^0/_{00}$	0	34.09	33.83	33.70
	10	.07	.82	.69
	20	.26	.80	34.04
	30	.84	34.15	.63
Diatoms:				
Amphiprora hyperborea	0	..	..	..
	30	..	..	..
Bacteriosira fragilis	0	..	..	..
	30	..	..	60
Chaetoceros furcellatus	0	146 000	211 500	84 500
	30	132 000	166 500	61 000
— *socialis*	0	322 500	260 000	228 500
	30	201 000	158 500	43 000
Eucampia zoodiacus	0	480	..	..
	30	..	..	..
Fragilaria oceanica	0	920	320	3 200
	30	1 320	3 400	720
Nitzschia delicatissima	0	61 500	21 500	28 500
	30	18 500	36 500	25 000
Thalassiosira gravida	0	9 900	12 200	7 940
	30	17 420	9 800	4 200
— *nordenskioeldi*	0	28 060	30 820	28 540
	30	29 700	15 060	3 620
Dinoflagellates:				
Exuviaella baltica	0	500	1 500	80
	30	40	60	..
Gymnodiniaceae	0	9 200	8 540	9 220
	30	12 160	12 680	8 220
Peridinium	0	720	800	420
	30	660	120	80
Coccolithophorids:				
Total numbers	0	..	..	..
	30	1 000	..	..

237 11/6	228 7/6	229 7/6	230 7/6	231 8/6	232 8/6	233 8/6
0.00	0.39	2.41	1.33	1.30	0.31	—0.25
.06	.33	.28	.26	.11	.19	.39
1.32	..	.23	.18	.11	.20	.39
.89	1.65	.24	3.20	.11	.24	.66
33.88	34.12	35.02	34.32	34.36	34.28	34.22
.86	.13	.02	.29	.33	.28	.22
34.37	.13	.02	.38	.34	.32	.23
.69	.73	.02	.86	.36	.40	.39
..	..	..	1 060	720	100	40
..	..	..	460	320	..	640
40	20	20	860	680	240	60
..	..	40	1 520	320	..	..
61 500	26 000	58 500	441 000	383 000	614 500	562 000
57 000	49 500	35 500	210 500	449 000	895 500	265 500
14 000	2 000	3 000	552 000	356 500	92 500	253 000
1 000	3 500	3 000	94 000	354 000	447 500	212 500
..	..	..	940	1 400	..	..
..	100	60	300	1 740	..	..
1 860	40	360	31 160	15 900	2 200	4 020
760	300	800	12 120	18 880	1 140	5 100
33 000	11 500	17 000	41 500	28 000	21 000	15 500
39 500	26 500	21 000	540	51 500	39 000	17 500
2 680	1 400	700	3 700	3 680	1 660	2 520
4 820	2 260	480	1 800	6 180	4 220	2 760
1 880	100	40	94 480	36 420	34 000	45 860
540	160	80	13 540	47 300	49 300	5 620
80	500	500	1 000	140	100	40
..	20	1 000	20	80	..	..
5 680	10 060	5 160	17 360	15 340	15 960	10 640
5 120	9 800	3 940	2 300	10 700	8 360	3 180
580	760	2 180	540	420	520	340
140	140	2 180	80	420	120	60
60	580	560	60	560	20	..
..	80	580	540	1 580	..	40

Table 6. (Cont.)

Stations		234	235	236
Date (1953)		11/6	11/6	11/6
	Depth (m)			
Other forms:				
Phaeocystis poucheti	0	c	c	c
	30	c	c	c
Acanthostomella	0	20	40	120
	30	..	120	240
Laboea conica	0	440	520	1 180
	30	120	20	..

237 11/6	228 7/6	229 7/6	230 7/6	231 8/6	232 8/6	233 8/6
c	c	c	r	c	c	c
c	c	c	c	c	c	c
240	260	720	120	80	..	..
460	180	400	140	60	..	..
3 540	1 600	1 280	900	1 560	2 180	400
..	..	680	..	360	..	20

Table 7.

Stations Date (1952)		255 24/6	254 24/6	253 24/6
	Depth (m)			
Temperature, °C	0	3.04	2.91	2.20
	10	2.98	.39	.22
	25	.96	.07	1.87
Salinity, ‰	0	34.51	34.84	34.82
	10	.51	.83	.82
	25	.53	.84	.82
Diatoms:				
Chaetoceros	0	60 300	46 040	200
	25	59 960	50 280	280
Eucampia zoodiacus	0	..	..	..
	25	..	..	80
Fragilaria nana	0	..	..	5 000
	25	..	..	6 000
Nitzschia delicatissima	0	..	3 500	14 000
	25	1 500	11 000	11 000
Rhizosolenia hebetata	0	..	120	40
f. *semispina*	25	..	20	260
— *styliformis*	0	..	..	..
	25	..	..	..
Thalassiosira gravida	0	..	700	4 500
	25	220	1 200	7 000
— *nordenskioeldi*	0	..	60	120
	25	..	80	180
Thalassiothrix longissima	0	..	..	..
	25	..	..	..
Dinoflagellates:				
Exuviaella baltica	0	20	..	13 500
	25	..	..	5 000
Gymnodiniaceae	0	1 500	1 020	4 660
	25	2 140	2 100	1 500
Peridinium	0	280	80	620
	25	60	40	1 120
Coccolithophorids:				
Anthosphaera robusta	0	..	..	..
	25	..	..	..
Calciopappus caudatus	0	..	..	500
	25	..	..	..
Coccolithus huxleyi	0	..	..	..
	25	..	..	..
— *pelagicus*	0		500	1 500
	25	40	60	500

252 23/6	251 23/6	250 22/6	249 22/6	248 22/6	247 22/6	246 21/6
2.91	3.77	5.05	5.42	5.87	6.22	7.75
.48	.45	4.87	.23	.75	.06	.76
.31	.37	.82	.24	.74	5.61	.73
34.83	34.88	35.03	35.03	35.01	35.02	35.21
.83	.89	.00	.02	.00	.01	.13
..	.89	.00	.02	.00	.01	.20
4 440	1 620	1 160	340	80	1 100	..
4 880	120	1 320	180	420	1 980	..
495 000	312 000	..	..	500	..	..
360 000	275 000	..	..	..	..	..
41 000	10 000	9 000	6 000	120 000	115 000	60 000
20 000	8 000	3 000	6 000	185 000	37 000	65 000
660 000	235 000	1 000	..	..	..	..
350 000	190 000	..	..	..	..	1 500
1 040	200	300	80	..	60	..
360	20	200	100	..	220	..
..	50	20	680	..	620	..
..	..	160	880	280	200	..
153 000	60	..	..	40	2 800	..
122 000	140	..	..	1 480	800	..
70 500	..	..	..	..	..	..
53 000	..	..	..	..	..	..
..	20	860	300	..	140	..
..	20	1 020	180	40	400	..
30 500	12 000	179 000	1 000	2 000	7 500	500
12 500	10 000	161 000	2 500	3 500	4 000	..
11 500	1 000	1 500	1 000	500	60	2 000
20 500	4 000	3 500	..	1 040	500	20
2 920	40	..	..	20	40	120
3 540	680	20	..	40	20	40
..	..	5 500	500	2 500	1 000	1 000
..	1 000	6 000	500	2 000	500	1 000
..	..	6 000	7 000	12 500	19 000	38 000
500	3 000	1 500	12 000	8 000	10 000	11 000
..	..	3 000	15 000	11 000	35 000	135 000
..	4 000	13 500	15 000	12 000	21 500	172 000
500	11 000	7 000	2 500	2 000	3 000	500
500	14 500	3 500	3 000	500	3 500	2 500

Table 7. (Cont.)

Stations Date (1952)		255 24/6	254 24/6	253 24/6
	Depth (m)			
Other forms:				
Chilomonas marina	0	..	2 000	..
	25	..	500	..
Phaeocystis poucheti	0	..	..	c
	25	..	r	c
Laboea conica	0	2 600	80	600
	25	620	20	..
— *strobila*	0	180	..	80
	25	80	..	..
Woodania conicoides	0	..	..	80
	25	..	..	..

252 23/6	251 23/6	250 22/6	249 22/6	248 22/6	247 22/6	246 21/6
1 500	1 000	6 500	2 500	6 500	13 000	46 000
1 000	1 500	7 500	4 000	8 500	12 500	36 000
..	..	..	..	..	..	..
r	..	r	..	..	r	..
2 800	380	..	..	40	60	180
..	40	40	40	40	..	100
..	..	20	360	340	820	400
..	..	40	180	700	20	140
3 500	67 000	1 000	1 000	5 000	2 500	4 000
..	1 500	2 500	100	3 000	120	5 000

Table 8.

Stations		185	184*	183
Date (1952)		5/6	4/6	4/6
	Depth (m)			
Temperature, °C	0	0.23	0.12	— 0.29
	10	.10	— 0.09	.35
	25	.10	.14	.43
Salinity, ‰	0	34.79	34.71	34.64
	10	.80	..	.64
	25	.83	.67	.63
Diatoms:				
Chaetoceros atlanticus	0	180	1 100	420
	25	..	1 440	760
— *borealis* (f. *concavicornis* incl.)	0	80	900	1 180
	25	520	720	1 600
— *decipiens*	0	..	160	..
	25	..	140	60
— *simplex* var. *calcitrans*	0	2 000	15 500	500
	25	..	20 000	..
Fragilaria nana	0	23 000	22 000	17 000
	25	23 500	27 000	20 000
Rhizosolenia hebetata f. *semispina*	0	..	320	240
	25	..	240	100
Thalassiosira gravida	0	..	3 300	2 100
	25	160	2 700	800
Dinoflagellates:				
Exuviaella baltica	0	500	3 000	2 000
	25	2 500	1 500	1 500
Peridinium	0	..	40	40
	25	20	..	20
Coccolithophorids:				
Anthosphaera robusta	0	..	..	..
	25	..	..	..
Calciopappus caudatus	0	..	..	..
	25	..	..	..
Coccolithus huxleyi	0	..	..	..
	25	..	..	..
— *pelagicus*	0	20	..	..
	25	20	40	20

* 0 and 10 m examined.

182 4/6	181 3/6	180 3/6	179 3/6	178 2/6	177 2/6	176 2/6	175 2/6
−0.10	1.72	2.68	4.07	5.50	5.72	6.92	7.78
.32	.12	.58	3.99	.29	.33	.63	6.66
.22	.05	.55	4.05	.30	.27	.65	.64
34.78	34.95	35.04	35.20	35.23	35.20	..	35.30
.67	.94	.05	.19	.19	.20	35.27	.26
.67	.95	.04	.20	.20	.23	.26	.26
120	..	..	..	880	..	..	..
560	..	..	..	..	..	..	200
2 040	180	..	..	360	240	..	200
2 400	..	..	..	700	100	..	180
60	140	..	..	440	220	..	380
120	..	..	..	440	280	..	140
10 000	..	..	..	..	..	..	..
1 000	..	..	..	..	..	..	..
19 000	30 000	42 500	50 000	40 000	150 000	45 000	62 000
4 000	28 000	40 000	86 000	51 000	163 000	63 000	100 000
520	660	..	..	..	..	..	..
540	200	..	..	..	..	..	..
180	16 560	180	..	..	..	..	..
80	16 020	100	..	..	..	..	..
1 000	4 000	6 500	2 000	2 000	3 000	1 500	3 000
..	2 500	3 500	2 000	1 000	4 000	500	2 500
..	40	..	..	..	..	1 000	500
20	60	40	..	..	20	520	..
..	500	2 000	5 500	2 500	8 000	10 500	9 500
..	..	3 000	9 500	2 000	7 500	6 500	10 000
..	30 500	61 500	41 000	3 500	21 000	23 500	36 000
..	18 000	45 500	35 000	3 500	18 000	21 000	23 000
..	..	..	1 500	1 000	3 500	34 000	35 000
..	..	..	1 000	3 500	5 000	15 000	38 000
..	3 500	1 500	100	40	500	1 500	1 500
..	8 500	360	500	240	1 500	2 000	440

Table 8. (Cont.)

Stations		185	184*	183
Date (1952)		5/6	4/6	4/6
	Depth (m)			
Other forms:				
Chilomonas marina	0	..	..	..
	25	..	..	..
Laboea conica	0	2 020	1 340	2 380
	25	220	760	..
— *strobila*	0	..	..	..
	25	..	..	..
Woodania conicoides	0	..	2 500	12 500
	25	3 000	3 500	..

* 0 and 10 m examined.

182 4/6	181 3/6	180 3/6	179 3/6	178 2/6	177 2/6	176 2/6	175 2/6
..	..	..	2 000	17 000	22 000	6 000	13 000
..	..	..	2 500	14 500	28 000	5 000	15 000
40	680	1 240	..	20	40	..	..
140	520	400	..	..	..	..	..
..	..	100	..	340	260	80	60
120	..	..	..	180	20	..	20
..	..	1 000	20	500	5 000	500	..
..	..	1 500	40	500	2 500	..	..

Table 9.

Stations Date (1952)		186 5/6	187 5/6	188* 5/6
	Depth (m)			
Temperature, °C	0	—0.10	—0.37	0.29
	10	.34	.67	.17
	25	.38	.77	— 0.22
Salinity, ‰	0	..	34.87	34.82
	10	34.82	.87	.79
	25	.82	.85	.80
Diatoms:				
Chaetoceros atlanticus	0	2 700	360	180
	25	200	1 800	520
— *borealis* (f. *concavicornis* incl.)	0	1 260	1 380	340
	25	740	3 100	940
— *convolutus*	0	..	..	180
	25	60	220	20
Fragilaria nana	0	5 500	5 000	18 000
	25	17 500	7 500	30 000
Nitzschia closterium	0	..	..	..
	25	..	..	..
Rhizosolenia hebetata f. *semispina*	0	..	..	260
	25	40	40	..
Thalassiosira gravida	0	..	..	660
	25	200	..	1 200
Dinoflagellates:				
Exuviaella baltica	0	500	500	..
	25	..	..	..
Peridinium	0	20	540	60
	25	20	20	20
Coccolithophorids:				
Anthosphaera robusta	0	..	..	..
	25	..	..	..
Calciopappus caudatus	0	..	..	..
	25	..	..	..
Coccolithus huxleyi	0	..	..	..
	25	..	..	..
— *pelagicus*	0	..	..	+
	25	60	..	..

189 5/6	190 6/6	191 6/6	192 6/6	193 6/6	194 7/6	233 15/6
0.28	0.19	3.34	4.71	4.98	..	6.43
.13	.25	.18	.62	.95	0.12	.38
—0.24	—0.35	1.70	.62	.66	.00	.41
34.71	34.80	35.00	35.12	35.18	34.79	35.18
.70	.77	.00	.13	.16	.77	.15
.72	.77	34.95	.14	.15	.78	.16
100	9 200	240	80	..	..	..
120	820	520	..	..	1 240	..
1 680	3 440	100	..	..	400	..
120	120	..	..	..	320	..
520	1 900	60	..	..	4 840	40
40	1 100	..	..	..	6 000	..
10 000	18 000	60 000	150 000	335 000	19 000	1750 000
22 500	16 000	55 000	115 000	400 000	10 000	1675 000
..	..	2 500	10 000	21 000	..	185 000
..	..	..	30 000	44 000	..	190 000
20	420	..	..	..	880	..
..	..	..	..	..	160	..
..	540	..	..	..	..	..
..	160	..	..	..	120	..
..	..	2 500	14 500	9 500	..	4 000
500	20	..	11 000	4 500	..	2 500
100	200	40	..	1 000	80	1 020
..	..	..	..	1 000	..	..
..	..	1 500	5 000	9 000	..	8 500
..	..	..	6 500	5 500	..	10 500
..	..	35 000	27 000	46 000	..	70 000
..	..	11 000	23 000	47 000	..	68 000
..	..	1 000	4 500	6 500	..	13 000
..	..	..	3 000	7 500	..	20 000
..	20	500	60	40	20	1 500
20	500	5 500	80	120	40	..

Table 9. (Cont.)

Stations		186	187	188*
Date (1952)		5/6	5/6	5/6
	Depth (m)			
Other forms:				
Chilomonas marina	0	..	..	..
	25	..	..	..
Small forms not classified	0	55 000	12 000	17 000
	25	40 000	5 000	15 000
Laboea conica	0	1 260	980	680
	25	160	..	1 380
Woodania conicoides	0	10 500	2 000	2 500
	25	1 500	20	2 500

* 0 and 10 m examined.

189 5/6	190 6/6	191 6/6	192 6/6	193 6/6	194 7/6	233 15/6
..	..	1 500	4 000	9 500	..	69 000
..	..	..	2 000	3 000	..	75 000
40 000	7 000	40 000	85 000	175 000	17 500	170 000
60 000	8 000	45 000	215 000	150 000	25 000	360 000
2 480	2 120	1 600	..	60	1 800	40
40	..	140	20	..	..	..
4 000	1 000	2 500	2 500	120	2 500	2 000
4 500	2 000	1 500	500	60	40	500

Table 10.

Stations Date (1952)		195 7/6	196 7/6	197 7/6
	Depth (m)			
Temperature, °C	0	0.06	0.80	4.41
	10	.02	.17	.26
	20	—0.35	..	.15
	25	..	—0.17	..
	30	—0.35	..	4.11
Salinity, $^0/_{00}$	0	34.83	34.81	35.12
	10	.81	.76	.11
	20	.81	..	.13
	25	..	34.81	..
	30	34.82	..	35.13
Depths examined (m)		0 & 20	0 & 25	0 & 20
Diatoms:				
Chaetoceros atlanticus	0	1 240	2 340	380
	25	520	6 340	..
— *furcellatus*	0	..	190 000	..
	25	..	7 500	..
Fragilaria nana	0	7 500	41 000	251 000
	25	21 500	21 500	236 000
Nitzschia closterium	0	.20	..	23 500
	25	20	..	30 500
Rhizosolenia hebetata f. *semispina*	0	220	1 020	20
	25	..	160	..
Thalassiosira gravida	0	..	82 000	180
	25	160	13 500	..
Dinoflagellates:				
Exuviaella baltica	0	500	40	7 500
	25	200	100	7 500
Gymnodiniaceae	0	340	1 840	5 000
	25	500	1 500	8 500
Coccolithophorids:				
Coccolithus huxleyi	0	..	..	5 000
	25	..	..	2 500

198 8/6	199 8/6	200 8/6	201 8/6	202 8/6	203 8/6	205 8/6	206 8/6
5.31	5.20	5.22	5.77	5.99	6.41	5.94	4.55
.21	.14	.18	.56	.86	.07	.63	3.88
..	.10	4.96	.46	.78	.00	.63	.38
..	..	..	..	..	..	..	..
5.15	5.05	4.92	5.42	5.71	6.02	5.57	3.35
35.12	35.15	35.17	..	35.17	35.13	35.13	35.03
.12	.15	.16	35.15	.15	.12	.13	.01
.12	.15	.15	.14	.14	.12	.13	34.97
..	..	..	..	..	..	..	..
35.15	35.17	35.15	35.15	35.13	35.13	35.13	35.96
0 & 20	0	0 & 20	0 & 10	0 & 30	0	0	0 & 20
..	..	..	..	..	..	..	..
..		..	..	..			..
..	..	..	..	..	..	..	26 500
..		..	..	..			53 000
151 000	215 000	297 000	188 000	190 000	135 000	178 000	41 000
125 000		225 000	143 000	100 000			22 000
5 000	14 500	35 000	7 500	..	500	1 500	20
10 500		28 000	3 500	1 000			20
..	..	..	..	..	..	..	220
..		..	..	..			100
..	..	..	..	..	..	..	6 200
..		..	..	..			7 380
3 000	500	1 000	20	500	500	500	500
2 500		60	1 000	500			500
14 500	2 140	5 600	3 020	8 560	2 000	4 080	6 460
14 500		12 580	2 000	5 520			5 180
4 000	6 000	7 000	3 500	2 500	500	4 000	500
4 500		11 000	4 000	1 500			..

Table 10. (Cont.)

Stations Date (1952)		195 7/6	196 7/6	197 7/6
	Depth (m)			
Other forms:				
Chilomonas marina	0	..	..	100
	25	..	..	2 500
Small forms not classified	0	45 000	140 000	550 000
	25	225 000	95 000	690 000
Acanthostomella	0	40	20	820
	25	20	60	60
Laboea conica	0	1 020	260	140
	25	40	..	..
Woodania conicoides	0	16 500	..	1 500
	25	..	..	500

198 8/6	199 8/6	200 8/6	201 8/6	202 8/6	203 8/6	205 8/6	206 8/6
4 500	3 000	3 500	6 000	33 500	32 500	18 000	4 000
3 500		2 000	2 000	26 000			2 500
630 000	200 000	220 000	160 000	167 000	68 000	120 000	26 000
680 000		570 000	160 000	135 000			40 000
360	360	20	940	400	1 720	380	80
320		40	240	40			..
40	40	40	660	40	260	2 160	1 740
..		..	40	..			..
2 000	1 500	2 000	5 000	1 500	4 500	2 000	5 000
60		..	1 500	..			..

Table 11.

Stations Date (1952)	Depth (m)	227 14/6	224 13/6	222 13/6	220 12/6	219 12/6	218 12/6	213 10/6
Temperature, °C	0	1.35	2.98	3.50	2.70	2.09	1.39	3.75
	10	.35	.84	.43	.69	1.99	.35	.66
	25	.38	.91	..	.76	2.03	0.49	.67
Salinity, ‰	0	34.45	34.82	34.96	34.43	..	33.18	35.02
	10	.45	.93	.95	.45	33.68	.14	34.97
	25	.54	.96	.94	.68	34.16	.75	.97
Diatoms:								
Chaetoceros furcellatus	0		..	..	29 500	56 500	55 000	..
	10	..	..	..	20 000	55 000	26 500	..
	25	..		..	..	113 000	212 000	..
Eucampia zoodiacus	0		320	500	147 500	100 000	43 000	..
	10	440	20	2 000	152 000	76 000	36 000	..
	25	360		500	58 000	210 000	44 500	..
Fragilaria nana	0		157 000	217 000	80 000	..	..	70 000
	10	203 000	124 000	313 000	268 000	..	..	49 000
	25	190 000		215 000	305 000	13 500	..	48 000
— *oceanica*	0		..	..	1 200	..	1 800	..
	10	..	260	..	4 000	7 500	1 600	..
	25	..		..	..	2 000	5 600	..
Thalassiosira bioculata	0		..	..	2 140	520	20	..
	10	..	..	..	2 020	720	100	..
	25	..		..	280	16 000	12 000	..
— *gravida*	0		..	..	520	880	3 560	..
	10	..	..	..	300	1 840	2 200	..
	25	..	..	..	..	3 980	16 000	..
— *nordenskioeldi*	0		..	..	30 000	20 000	30 000	..
	10	..	..	..	40 000	32 000	44 000	..
	25	..		..	20 000	150 000	165 000	..
Dinoflagellates:								
Exuviaella baltica	0		3 000	12 000	4 000	80	1 000	3 000
	10	200	4 000	11 500	3 000	1 000	20	4 000
	25	6 000		18 000	6 000	2 000	2 000	4 000
Gymnodiniaceae	0		220	15 500	9 800	11 920	11 000	9 500
	10	10 500	2 340	22 000	9 100	6 420	9 000	7 500
	25	12 000		19 000	17 760	17 640	28 500	4 500
Peridinium	0		220	1 500	2 020	480	1 820	..
	10	1 000	1 500	1 500	280	500	1 360	..
	25	2 520		1 500	4 500	580	340	..

Table 11. (Cont.)

Stations		227	224	222	220	219	218	213
Date (1952)		14/6	13/6	13/6	12/6	12/6	12/6	10/6
	Depth (m)							
Coccolithophorids:								
Total numbers	0		..	720	2 000	100	20	1 500
	10	..	540	5 000	40	..	..	2 000
	25	..		1 140	4 500	1 000	..	1 060
Other forms:								
Chilomonas marina	0		500	2 000	1 000	20	20	7 500
	10	500	500	3 500	3 000	500	40	5 500
	25	2 000		1 000	2 500	1 500	20	1 500
Small forms not classified	0		..	560 000	800 000	25 000	50 000	360 000
	10	205 000	27 000	1 000 000	990 000	75 000	62 000	325 000
	25	225 000		750 000	820 000	140 000	74 000	240 000
Acanthostomella	0		1 640	1 240	2 500	320	220	580
	10	3 220	1 620	520	2 000	320	120	500
	25	1 040		760	360	1 020	100	200
Laboea conica	0		3 360	40	240	100	40	..
	10	1 960	19 500	..	40	60	40	..
	25	..		20	..	..	1 420	..
Lohmanniella oviformis .	0		20	4 500	3 500	2 500	1 000	9 000
	10	1 000	1 500	1 500	7 000	3 500	100	6 000
	25	2 500		4 000	6 000	1 000	500	2 000

Table 12.

St. 273, June 24, 1953.

Depth in metres	0	10	20	30
Diatoms :				
Chaetoceros debilis	400	2 040	..	99 000
— *decipiens*	..	..	..	480
— *densus*	60	240	..	44 000
— *furcellatus*	29 000	65 000	6 500	..
— — , resting spores	..	..	..	2 000
— *septentrionalis*	1 000	1 000	..	113 000
Leptocylindrus danicus	3 140	2 120	..	60
— *minimus*	16 000	13 000	6 000	..
Nitzschia closterium	500	2 500	500	8 000
— *delicatissima*	..	1 000	..	7 000
Rhizosolenia alata	180	60	20	20
— *fragilissima*	220	140	160	3 040
— *hebetata* f. *semispina*	60	40	20	20
Thalassiosira bioculata	80	20	20	..
— — var. *raripora*	3 000	1 000	1 500	1 500
— sp.	..	..	..	1 440
Centric diatoms not classified	..	500	..	..
Pennate diatoms not classified	..	..	..	500
Dinoflagellates :				
Amphidinium sp.	60	40	20	80
Ceratium longipes	20	20	20	..
Cladopyxis claytoni	20	500	..	..
Dinophysis grani	40	60	100	..
— *norvegica*	..	..	20	..
Exuviaella baltica	3 000	1 000	500	500
Glenodinium lenticula	100	220	80	..
Goniaulax spinifera	260	160	60	..
— *tamarensis*	380	180	100	20
— — , cysts	..	40	20	80
Gymnodinium lohmanni	620	760	240	440
— sp.	800	780	620	20
Gymnodiniaceae	..	1 500	1 000	2 500
Gyrodinium grenlandicum	..	..	..	8 500
Peridinium brevipes	520	540	40	..
— *conicoides*	..	..	20	20
— *denticulatum*	..	..	..	180
— *depressum*	20	..	20	20
— *globulus* var. *ovatum*	20	60	20	40
— — var. *quarnerense*	..	..	..	40
— *grani*	20	20	40	20
— *pallidum*	40	60	..	..
— *pellucidum*	40	40	..	40

Table 12 (cont.).

Depth in metres	0	10	20	30
— *pentagonum*	20	40	40	..
— *roseum*	300	480	40	..
— *triquetrum*	6 000	5 500	1 000	..
— *trochoideum*	10 000	8 500	3 000	500
Phalocroma rotundatum	40	60	20	..
— sp.	40	..	..	..
Coccolithophorids :				
Coccolithus pelagicus	20	40	60	20
Other flagellates :				
Chilomonas marina	1 000	1 000	500	500
Dinobryon pellucidum	2 500	1 000	..	..
Monosiga marina	1 000	1 000	500	..
Phaeocystis poucheti	..	..	..	r
Flagellates and monades not classified	30 000	20 000	34 000	16 000
Ciliates :				
Acanthostomella, (empty *loricae*)	40	20	40	80
Didinium parvulum	..	500	40	..
Laboea conica	1 260	1 400	..	580
— *emergens*	1 000	3 500	2 000	500
— *strobila*	160	20	60	520
— sp.	40	60	40	20
Lohmanniella oviformis	20	20	..	..
— *spiralis*	20	..	..	..
Parafavella	40	..	..	..
— (empty *loricae*)	200	140	80	420
Ptychocylis	20	20	20	20
Salpingella	40	..	20	..
— (empty *loricae*)	..	..	..	40
Woodania conicoides	20	40	..	..
Ciliates not classified	120	120	40	20

Table 13.

St. 270, June 23, 1953.

Depth in metres	0	20	30
Diatoms:			
Chaetoceros borealis	3 300	4 060	3 340
— — f. *varians*	460	200	460
— *brevis*	4 600	1 100	280
— *concavicornis* f. *volans*	6 000	1 500	..
— *debilis*	460	600	80
— *decipiens*	1 200	720	140
— *densus*	76 000	99 000	52 500
— *laciniosus*	160	40	..
— sp.	2 000	..	..
Coscinodiscus sp.	..	..	20
Eucampia zoodiacus	520	1 020	20
Fragilaria nana	..	1 500	4 500
— sp.	..	300	300
Leptocylindrus minimus	320	100	1 000
Nitzschia closterium	500	1 500	1 500
— *delicatissima*	245 000	250 000	147 000
Rhizosolenia alata	1 640	360	5 500
— *fragilissima*	80	200	60
— *hebetata* f. *semispina*	10 000	25 500	6 000
— — f. *hiemalis*	..	..	100
Thalassiosira bioculata var. *raripora*	1 000	1 000	4 500
— *gravida*	1 350	920	720
— *nordenskioeldi*	..	840	..
Thalassiothrix longissima	20	40	..
Pennate diatoms not classified	100	100	120
Dinoflagellates:			
Amphidinium sp.	..	..	40
Ceratium arcticum	100	40	..
Cladopyxis claytoni	..	40	1 000
Dinophysis grani	340	440	..
Exuviaella baltica	31 000	31 000	25 500
Goniaulax parva	..	1 000	20 500
— sp.	..	20	20
Gymnodinium lohmanni	740	1 520	180
Gymnodiniaceae	500	5 000	2 500
Gyrodinium grenlandicum	57 000	35 000	6 000
Paulsenella chaetoceratis	1 000	500	360
Peridinium breve	..	20	..
— *brevipes*	20	80	40
— *curvipes*	60	..	..
— *globulus* var. *quarnerense*	40	..	140
— *grani*	..	..	20

Table 13 (cont.).

Depth in metres	0	20	30
— *minusculum*	1 000	500	500
— *pellucidum*	100	20	..
— *pyriforme*	..	40	..
— *roseum?*	..	60	..
— sp.	..	20	..
Phalacroma ruudi	40	..	..
Dinoflagellates not classified	..	1 000	..
Coccolithophorids:			
Calciopappus caudatus	3 500	3 500	4 500
Coccolithus huxleyi	..	500	..
— *pelagicus*	10 000	4 000	21 500
Other flagellates, etc.:			
Chilomonas marina	500	1 500	1 500
Distephanus speculum	250	250	20
Monosiga marina	7 000	8 500	3 500
Pterosperma spp.	4 000	3 500	1 500
Flagellates and monades not classified	29 000	50 000	39 000
Ciliates:			
Acanthostomella	40	..	40
— (empty *loricae*)	280	740	660
Laboea conica	220	200	..
— *constricta*	..	..	160
— *emergens?*	120	80	280
— *strobila*	620	1 040	..
Lohmaniella spiralis	..	..	60
Parafavella, (empty *loricae*)	40	100	..
Ptychocylis, (empty *loricae*)	..	20	40
Salpingella	20	60	40
Woodania conicoides	40	80	..

Table 14.

St. 265, June 22, 1953.

Depth in metres	0	30
Diatoms:		
Asteromphalus heptactis	140	..
Cerataulina bergoni	700	..
Chaetoceros affinis	1 200	..
— *atlanticus*	220	920
— *borealis*	..	140
— *densus*	11 100	1 100
Coscinodiscus oculus iridis	20	40
— sp.	..	60
Nitzschia closterium	4 500	500
— *delicatissima*	420 000	30 000
Rhizosolenia fragilissima	1 300	280
— *hebetata* f. *semispina*	20	..
Thalassiosira bioculata var. *raripora*	7 500	500
— *gravida*	..	180
— sp.	680	120
Thalassiothrix longissima	60	..
Pennate diatoms not classified	7 000	2 500
Dinoflagellates:		
Ceratium arcticum	180	..
— *fusus*	20	..
Cladopyxis claytoni	40	..
Dinophysis borealis	480	..
— *grani*	100	..
— *norvegica*	20	..
Exuviaella apora	480	..
— *baltica*	2 000	..
Goniaulax parva	1 500	..
— sp.	..	500
Gymnodinium lohmanni	1 460	100
— sp.	580	..
Gymnodiniaceae	11 000	3 500
Gyrodinium grenlandicum	7 500	2 000
Peridinium curvipes	20	..
— *depressum*	40	..
— *globulus* var. *quarnerense*	20	..
— *islandicum*	20	..
— *laticeps*	20	..
— *pallidum*	20	..
— *pellucidum*	60	..
— *pyriforme*	60	..
Phalacroma rotundatum	120	..
Dinoflagellates not classified	80	..

Table 14 (cont.).

Depth in metres	0	30
Coccolithophorids :		
Coccolithus huxleyi	8 500	1 000
— *pelagicus*	1 500	1 000
Coccolithophorids not classified	500	..
Other flagellates :		
Chilomonas marina	2500	3 000
Distephanus speculum	40	..
Monosiga marina	4 500	..
Phaeocystis poucheti	c	..
Flagellates and monades not classified	195 000	50 000
Ciliates :		
Acanthostomella, (empty *loricae*)	40	20
Lohmanniella oviformis	1 000	1 000
— *spiralis*	60	40
Laboea acuminata	60	..
— *conica*	2 620	..
— *emergens*	1 000	..
— *strobila*	280	..
Woodania conicoides	80	..
Ciliates not classified	120	100

Table 15.

St. 197, May 31, 1953.

Depth in metres	0	30
Diatoms:		
Chaetoceros atlanticus	740	1 360
— *borealis*	200	40
— *cinctus*, resting spores	..	500
— *debilis*	800	1 080
— *decipiens*	20	40
— *densus*	2 260	3 700
— *teres*	..	140
Corethron hystrix	40	..
Coscinodiscus oculus iridis	120	220
Fragilaria nana	8 000	26 000
Nitzschia closterium	1 500	4 000
— *delicatissima*	1 500	1 500
Thalassionema nitzschioides	40	..
Thalassiosira bioculata var. *raripora*	..	500
— *sp.*	..	40
Thalassiothrix longissima	100	..
Centric diatoms not classified	..	1 000
Pennate diatoms not classified	3 000	10 500
Dinoflagellates:		
Cladopyxis claytoni	..	500
Exuviaella baltica	5 000	13 000
Gymnodinium lohmanni	20	40
Gymnodiniaceae	1 500	2 500
Gyrodinium grenlandicum	500	2 500
Peridinium minusculum	20	20
— *pentagonum*	20	..
Dinoflagellates not classified	..	1 500
Coccolithophorids:		
Acanthoica quattrospina	..	500
Anthosphaera robusta	500	4 500
Calciopappus caudatus	2 500	7 000
Coccolithus huxleyi	5 500	4 500
— *pelagicus*	4 000	2 500
Other flagellates, etc.:		
Carteria sp.	1 500	1 000
Chilomonas marina	8 000	11 000
Distephanus speculum	1 500	250
Monosiga marina	15 500	29 000,
Pterosperma sp.	..	500
Flagellates and monades not classified	105 000	285 000

Table 15 (cont.).

Depth in metres	0	30
Ciliates:		
Acanthostomella, (empty *loricae*)	20	40
Laboea emergens	500	500
— *conica*	3 700	..
— *strobila*	680	..
— sp.	20	..
Lohmanniella oviformis	500	500
— *spiralis*	..	20
Woodania conicoides	2 000	40
Ciliates not classified	..	1 000

Table 16.

St. 206, June 2, 1953.

Depth in metres	0	30
Diatoms:		
Asteromphalus robustus	440	800
Chaetoceros atlanticus	20	..
— *convolutus*	280	100
— *decipiens*	260	80
— *furcellatus*	3 000	1 000
— *socialis*	5 500	1 000
— *wighami*	..	200
Coscinodiscus curvatulus	..	100
— *excentricus?*	80	60
Coscinosira polychorda	40	40
Fragilaria nana	43 000	32 000
Nitzschia delicatissima	1 500	..
Rhizosolenia alata	20	..
Thalassiosira bioculata var. *raripora*	500	..
— *gravida*	9 600	7 300
Pennate diatoms not classified	140	100
Dinoflagellates:		
Cladopyxis claytoni	20	20
Exuviaella baltica	11 000	10 000
Gymnodinium lohmanni	220	60
Gymnodiniaceae	1 500	1 000
Gyrodinium grenlandicum	10 000	6 000
Peridinium curvipes	20	..
— *brevipes*	..	20
— *minusculum*	500	80
— *pyriforme?*	20	..
Phalacroma ruudi	..	20
Dinoflagellates not classified	1 000	500
Coccolithophorids:		
Coccolithus pelagicus	20	..
Crystallolithus hyalinus	1 000	1 000
Other flagellates:		
Carteria sp.	10 000	1 500
Chilomonas marina	20	..
Distephanus speculum var. *octenarius*	..	40
Monosiga marina	10 000	2 500
Flagellates and monades not classified	300 000	220 000

Table 16 (cont.).

Depth in metres	0	30
Ciliates:		
Acanthostomella	180	120
— (empty *loricae*)	60	80
Laboea conica	280	20
— *emergens*	160	20
— *strobila*	20	180
— sp.	..	20
Lohmanniella oviformis	500	500
Ptychocylis	..	20
Woodania conicoides	200	..
Ciliates not classified	20	40

Table 17.

St. 212, June 3, 1953.

Depth in metres	0	30
Diatoms:		
Bacteriosira fragilis	320	80
Chaetoceros atlanticus	520	160
— *borealis* f. *concavicornis*	440	40
— *convolutus*	2 560	1 800
— *debilis*	160	700
— *decipiens*	17 000	15 600
— *furcellatus*	100 000	75 000
— *socialis*	120 000	90 000
— — resting spores	6 000	10 000
— *laciniosus*	2 500	..
— *wighami*	1 920	3 000
— sp. (cf. *affinis*)	..	100
— sp. (cf. *septentrionalis*)	..	500
Coscinodiscus sp.	280	360
Coscinosira polychorda	3 400	4 540
Eucampia zoodiacus	1 360	340
Fragilaria oceanica	35 000	8 000
— — resting spores	..	640
— *nana*	6 000	8 500
Nitzschia delicatissima	16 000	14 000
Porosira glacialis	80	360
Rhizosolenia alata	80	660
— *hebetata* f. *semispina*	160	160
Thalassiosira bioculata	800	920
— *fallax*, resting spores	..	100
— *gravida*	230 000	275 000
— — resting spores	..	40
— *hyalina*	1 240	2 400
— *nordenskioeldi*	6 900	14 400
Thalassiothrix longissima	40	40
Pennate diatoms not classified	120	80
Dinoflagellates:		
Dinophysis grani	..	20
Exuviaella baltica	2 000	5 500
Gymnodinium lohmanni	360	80
Gymnodiniaceae	1 000	1 000
Gyrodinium grenlandicum	2 500	4 500
Peridinium brevipes	40	40
— *curvipes*	160	100
— *grani*	..	40
— *islandicum*	40	20
— *minusculum*	1 000	20

Table 17 (cont.).

Depth in metres	0	30
— *subinerme*	..	40
— sp.	40	20
Phalacroma rotundatum	40	..
Dinoflagellates not classified	440	..
Coccolithophorids :		
Coccolithus pelagicus	..	20
Crystallolithus hyalinus	40	500
Other flagellates :		
Dinobryon pellucidum	..	1 000
Distephanus speculum	20	..
— — var. *octenarius*	20	..
— — var. *septenarius*	500	500
Monosiga marina	..	1 000
Phaeocystis poucheti	r	r
Flagellates and monades not classified	25 000	50 000
Ciliates :		
Acanthostomella, (empty *loricae*)	160	80
Laboea conica	400	..
— *strobila*	..	20
— sp.	..	20
Lohmanniella oviformis	40	1 000
Parafavella	40	..
Ptychocylis, (empty *loricae*)	40	..
Salpingella	40	20
Woodania conicoides	320	..

Table 18.

St. 248, June 15, 1953.

Depth in metres	0	30
Diatoms:		
Chaetoceros atlanticus	180	..
— *borealis*	40	..
— *concavicornis* f. *volans*	500	..
— *debilis*	580 000	..
— *decipiens*	5 200	..
— *densus*	980	..
— *teres*	140	..
— *laciniosus*	200	..
— sp.	3 500	..
Corethron hystrix	60	..
Eucampia zoodiacus	20 500	..
Fragilaria nana	135 000	58 000
Nitzschia closterium	93 000	50 000
— *delicatissima*	8 500	..
Rhizosolenia fragilissima	240	..
Thalassiosira bioculata var. *raripora*	3 000	1 500
— *gravida*	24 000	1 000
Centric diatoms not classified	5 500	3 000
Pennate diatoms not classified	7 000	2 220
Dinoflagellates:		
Exuviaella baltica	144 500	2 000
Goniaulax gracilis	..	1 000
— *spinifera*	..	20
Gymnodinium lohmanni	5 000	500
Gymnodiniaceae	7 000	13 000
Gyrodinium grenlandicum	12 500	3 000
Peridinium minusculum	1 000	500
— sp.. (cf. *grenlandicum*)	20	20
Phalacroma ruudi	500	..
Dinoflagellates not classified	4 000	2 500
Coccolithophorids:		
Acanthoica quattrospina	500	..
Anthosphaera robusta	4 000	8 500
Calciopappus caudatus	50 000	34 500
Coccolithus huxleyi	9 000	10 500
— *pelagicus*	2 000	3 500
Crystallolithus hyalinus	12 000	4 500
Coccolithophorids not classified	500	1 000

Table 18 (cont.).

Depth in metres	0	30
Other flagellates:		
Carteria sp.	7 000	..
Chilomonas marina	12 500	10 500
Distephanus speculum	250	..
Monosiga marina	28 000	7 500
Flagellates and monades not classified	1 830 000	500 000
Ciliates:		
Acanthostomella	220	80
— (empty *loricae*)	360	180
Didinium parvulum	..	500
Laboea conica	1 200	..
— *emergens*	4 500	..
— *vestita*	4 500	..
— sp.	460	40
Lohmanniella oviformis	12 500	500
Parafavella, (empty *loricae*)	420	80
Woodania conicoides	460	..

Table 19.

St. 216, June 4, 1953.

Depth in metres	0	30
Diatoms:		
Chaetoceros sp.	140	..
Fragilaria nana	106 000	16 000
Nitzschia closterium	11 500	500
Thalassionema nitzschioides	40	..
Thalassiosira bioculata var. *raripora*	4 000	1 500
— *gravida*	140	..
Centric diatoms not classified	60	..
Pennate diatoms not classified	60	140
Dinoflagellates:		
Exuviaella baltica	4 500	..
Gymnodinium lohmanni	80	..
Gymnodiniaceae	5 500	..
Gyrodinium grenlandicum	4 000	1 500
Peridinium minusculum	2 500	..
Dinoflagellates not classified	3 000	..
Coccolithophorids:		
Anthosphaera robusta	..	4 000
Calciopappus caudatus	9 500	5 500
Coccolithus huxleyi	6 000	..
— *pelagicus*	500	2 500
Crystallolithus hyalinus	..	1 000
Other flagellates:		
Carteria sp.	4 000	..
Chilomonas marina	4 000	1 500
Distephanus speculum	500	500
Monosiga marina	2 000	..
Flagellates and monades not classified	160 000	135 000
Ciliates:		
Acanthostomella	260	..
— (empty *loricae*)	40	40
Laboea conica	580	..
— *emergens*	..	20
Lohmanniella oviformis	1 000	1 000
Woodania conicoides	900	..
Cilates not classified	40	1 000

Table 20.

St. 218, June 4, 1953.

Depth in metres	0	30
Diatoms:		
Chaetoceros atlanticus	260	100
— *convolutus*	..	300
— *debilis*	1 120	1 260
— *decipiens*	1 160	820
— *furcellatus*	62 500	..
— — resting spores	48 000	60 000
— *socialis*	20 000	..
— — resting spores	17 000	2 000
— sp. (cf. *septentrionalis*)	500	..
Coscinodiscus curvatulus	180	..
Nitzschia closterium	600	..
— *delicatissima*	22 500	10 000
Rhizosolenia alata	..	40
Thalassionema nitzschioides	120	100
Thalassiosira bioculata var. *raripora*	10 500	12 000
— *gravida*	6 500	5 520
— — resting spores	20	..
— *nordenskioeldi*	300	..
— — resting spores	60	..
Centric diatoms not classified	500	1 500
Pennate diatoms not classified	40	280
Dinoflagellates:		
Amphidinium sp.	20	..
Cladopyxis claytoni	..	500
Exuviaella baltica	500	..
Gymnodinium lohmanni	440	60
Gymnodiniaceae	6 500	500
Gyrodinium grenlandicum	36 000	13 000
Peridinium grenlandicum	20	..
— *pellucidum*	..	20
Dinoflagellates not classified	40	500
Coccolithophorids:		
Anthosphaera robusta	40	..
Coccolithus pelagicus	40	500
Other flagellates:		
Chilomonas marina	6 000	3 500
Monosiga marina	3 000	..
Phaeocystis poucheti	c	c
Flagellates and monades not classified	37 500	21 000

Table 20 (cont.).

Depth in metres	0	30
Ciliates:		
Acanthostomella	20	..
Laboea conica	560	..
Lohmanniella oviformis	500	..
Woodania conicoides	100	..
Ciliates not classified	120	..

Table 21.

St. 221, June 5, 1953.

Depth in metres	0	30
Diatoms:		
Achnanthes taeniata (?)	36 000	30 000
Amphiprora hyperborea	940	420
Bacteriosira fragilis	4 220	7 040
— — resting spores	20	..
Biddulphia aurita	440	320
Chaetoceros debilis	300	480
— *furcellatus*	15 000	17 500
— *socialis*	138 000	270 000
— — resting spores	320	120
— *wighami*	38 000	65 000
— sp. (cf. *septentrionalis*)	1 000	500
Eucampia zoodiacus	280	300
Fragilaria oceanica	104 000	86 000
Licmophora sp.	200	40
Navicula grani	140	2 000
— *pelagica*	1 800	360
Nitzschia closterium	500	1 500
— *delicatissima*	4 000	40
— *frigida*	..	140
— *paradoxa*	..	100
— *seriata*	280	400
Pleurosigma sp.	20	20
Porosira glacialis	1 840	1 520
Thalassiosira bioculata	20	240
— — var. *raripora*	..	500
— *gravida*	8 200	10 260
— — resting spores	200	220
— *hyalina*	1 800	1 600
— *nordenskioeldi*	16 100	13 900
Pennate diatoms not classified	1 500	1 000
Dinoflagellates:		
Exuviaella baltica	..	40
Glenodinium sp.	..	20
Gymnodinium lohmanni	100	180
Gymnodiniaceae	500	500
Peridinium breve	..	20
— *brevipes*	40	..
— *globulus* var. *quarnerense*	..	20
— *grenlandicum*	20	..
— *minisculum*	20	120
— sp.	20	..

Table 21 (cont.).

Depth in metres	0	30
Coccolithophorids :		
Anthosphaera robusta	20	..
Other flagellates :		
Chilomonas marina	20	..
Flagellates not classified	100	220
Flagellates and monades not classified	13 500	14 500
Ciliates :		
Laboea emergens	20	..
Lohmanniella oviformis	100	..
Ciliates not classified	20	60

Table 22.

St. 231, June 8, 1953.

Depth in metres	0	30
Diatoms:		
Amphiprora hyperborea	720	320
Bacteriosira fragilis	680	320
Chaetoceros borealis f. *concavicornis*	80	..
— *debilis*	1 200	120
— *decipiens*	240	..
— *furcellatus*	292 500	335 000
— — resting spores	90 500	114 000
— *karianus*	..	2 000
— *socialis*	317 500	320 000
— — resting spores	39 000	34 000
— *teres*	..	160
— sp. (cf. *septentrionalis*)	2 500	2 500
Coscinodiscus excentricus	..	40
Eucampia zoodiacus	1 400	1 740
Fragilaria nana	..	2 000
— *oceanica*	14 900	17 600
— — resting spores	1 000	1 280
Nitzschia closterium	2 000	1 500
— *delicatissima*	28 000	51 500
— *paradoxa*	460	60
— *seriata*	120	..
Rhizosolenia alata	40	..
Thalassiosira bioculata	400	900
— — var. *raripora*	16 500	19 000
— *gravida*	3 360	5 960
— — resting spores	320	220
— *nordenskioeldi*	35 400	44 660
— — resting spores	1 020	2 640
Pennate diatoms not classified	340	1 500
Dinoflagellates:		
Amphidinium sp.	40	20
Cladopyxis claytoni	60	20
Dinophysis norvegica	20	20
Exuviaella apora	40	20
— *baltica*	140	80
Glenodinium sp.	80	80
Gymnodinium lohmanni	1 360	800
— sp.	940	880
Gymnodiniaceae	4 000	2 500
Gyrodinium grenlandicum	9 000	6 500
Peridinium brevipes	80	80
— *conicoides*	20	20

Table 22 (cont.).

Depth in metres	0	30
— *grenlandicum*	40	..
— *islandicum*	..	20
— *minusculum*	140	80
— *monacanthus*	..	20
— *pellucidum*	140	200
Dinoflagellates not classified	40	20
Coccolithophorids :		
Anthosphaera robusta	20	..
Calciopappus caudatus	500	1 000
Coccolithus huxleyi	..	500
— *pelagicus*	40	80
Other flagellates :		
Cateria sp.	1 000	..
Chilomonas marina	1 000	1 500
Corbicula socialis	r	r
Dinobryon pellucidum	r	..
Distephanus speculum	..	20
Monosiga marina	9 000	9 000
Phaeocystis poucheti	c	c
Flagellate not classified	1 520	1 920
Flagellates and monades not classified	77 000	65 000
Ciliates :		
Acanthostomella	60	..
— (empty *loricae*)	20	60
Laboea conica	1 560	360
— *emergens*	80	..
— *vestita*	40	20
Lohmanniella oviformis	3 500	1 500
Parafavella, (empty *loricae*)	40	..
Ptychocylis, (empty *loricae*)	60	20
Woodania conicoides	140	..
Ciliates not classified	180	200

Table 23.

St. 255, June 24, 1952.

Depth in metres	0	25
Diatoms:		
Chaetoceros borealis	..	60
— *debilis*	14 500	6 500
— *densus*	5 300	1 900
— *furcellatus*	5 000	15 000
— — resting spores	15 000	22 500
— *laciniosus*	1 000	1 500
— *subsecundus*	15 000	5 500
— sp. (cf. *septentrionalis*)	4 500	7 000
Leptocylindrus sp.	5 000	..
Nitzschia delicatissima	..	1 500
— *seriata*	940	120
Rhizosolenia alata	20	20
Thalassiosira sp.	..	220
Centric diatoms not classified	..	60
Pennate diatoms not classified	2 000	..
Dinoflagellates:		
Exuviaella baltica	20	..
Glenodinium lenticula	60	20
Goniaulax tamarensis	40	..
Gymnodinium boreale	..	1 500
— *lohmanni*	1 000	140
Gyrodinium grenlandicum	500	500
Peridinium brevipes	..	20
— *denticulatum*	20	..
— *depressum*	..	20
— *globulus* var. *ovatum*	20	..
— *triquetrum*	20	..
— *trochoideum*	100	20
— sp.	20	..
Coccolithoplorids		
Coccolithus pelagicus	..	40
Other flagellates:		
Monosiga marina	..	500
Flagellates and monades not classified	22 500	11 500
Ciliates:		
Acanthostomella (empty *loricae*)	20	20
Laboea conica	2 600	620
— *emergens*	180	20
— *constricta*	60	60
— *strobila*	180	80
Ptychocylis, (empty *loricae*)	..	40
Tintinnus	..	20
Ciliates not classified	20	..

Table 24.

St. 252, June 23, 1952.

Depth in metres	0	25
Diatoms:		
Asteromphalus robustus	1 000	20
Bacteriosira fragilis	1 800	2 220
Chaetoceros borealis	60	..
— — f. *varians*	360	320
— *concavicornis* f. *volans*	20	40
— *debilis*	..	20
— *densus?*	3 000	500
— sp.	1 000	4 000
Coscinodiscus sp.	..	20
Eucampia zoodiacus	495 000	360 000
Fragilaria nana	41 000	20 000
— *oceanica*	26 500	21 500
Leptocylindrus minimus	..	8 500
Nitzschia delicatissima	660 000	350 000
Rhizosolenia hebetata f. *semispina*	1 040	360
Thalassionema nitzschioides	..	80
Thalassiosira bioculata var. *raripora*	32 000	36 000
— *gravida*	153 000	122 000
— *hyalina?*	1 000	..
— *nordenskioeldi*	65 000	25 000
— — resting spores	5 500	28 000
Pennate diatoms not classified	5 000	4 500
Dinoflagellates:		
Cladopyxis claytoni	..	20
Dinophysis grani	60	..
Exuviaella baltica	30 500	12 500
Goniaulax parva	500	..
— sp.	20	80
Gymnodinium lohmanni	1 500	500
Gymnodiniaceae	..	1 000
Gyrodinium grenlandicum	10 000	19 000
Peridinium brevipes	80	20
— *globulus* var. *quarnerense*	60	340
— *grenlandicum*	220	180
— *minusculum*	2 500	3 000
— *pellucidum*	60	..
Dinoflagellates not classified	8 000	1 000
Coccolithophorids:		
Calciopappus caudatus	..	500
Coccolithus pelagicus	500	500
Discosphaera sp.	..	500

Table 24 (cont.).

Depth in metres	0	25
Other flagellates:		
Chilomonas marina	1 500	1 000
Monosiga marina	1 000	500
Phaeocystis poucheti	..	r
Flagellates and monades not classified	80 000	50 000
Ciliates:		
Acanthostomella, (empty *loricae*)	340	220
Laboea conica	2 800	..
Lohmanniella oviformis	500	..
Salpingella	..	20
Woodania conicoides	3 500	..
Ciliates not classified	..	2 000

Table 25.

St. 248, June 22, 1952.

Depth in metres	0	25
Diatoms:		
Chaetoceros atlanticus	..	160
— *borealis*	20	..
— *densus*	60	260
Coscinodiscus oculus iridis	80	40
Eucampia zoodiacus	500	..
Fragilaria nana	120 000	185 000
Nitzschia closterium	..	500
Rhizosolenia styliformis	..	280
Thalassiosira gravida	40	1 480
Thalassiothrix longissima	..	40
Pennate diatoms not classified	500	2 500
Dinoflagellates:		
Ceratium arcticum	60	20
Exuviaella apora	20	40
— *baltica*	2 000	3 500
Gymnodiniaceae	..	40
Gyrodinium grenlandicum	500	1 000
Peridinium pallidum	..	20
— *pyriforme*	..	20
— sp. (cf. *elongatum*)	20	..
Dinoflagellates not classified	..	500
Coccolithophorids:		
Anthosphaera robusta	2 500	2 000
Calciopappus caudatus	12 500	8 000
Coccolithus huxleyi	11 000	12 000
— *pelagicus*	2 000	500
Discosphaera sp.	500	..
Other flagellates, etc.:		
Chilomonas marina	6 500	8 500
Halosphaera viridis	..	20
Monosiga marina	1 500	2 000
Flagellates and monades not classified	185 000	150 000
Ciliates:		
Acanthostomella, (empty *loricae*)	20	..
Laboea conica	40	40
— *strobila*	340	700
— *vestita* (?)	2 500	1 000
— sp.	140	80
Lohmanniella oviformis	500	..
Woodania conicoides	5 000	3 000
Ciliates not classified	20	..

Table 26.

St. 175, June 2, 1952.

Depth in metres	0	25
Diatoms:		
Chaetoceros atlanticus	..	200
— *borealis*	200	180
— *debilis*	..	260
— *decipiens*	380	140
— *densus*	440	460
— sp. (cf. *wighami*)	..	40
Corethron hystrix	..	80
Coscinodiscus oculus iridis	..	100
— sp.	20	20
Fragilaria nana	62 000	100 000
Nitzschia closterium	1 500	10 500
— *delicatissima*	2 500	4 000
Rhizosolenia fragilissima	..	160
Thalassionema nitzschioides	..	180
Thalassiosira bioculata var. *raripora*	2 500	500
Pennate diatoms not classified	1 000	2 500
Centric diatoms not classified	..	1 000
Dinoflagellates:		
Exuviaella apora	40	20
— *baltica*	3 000	2 500
Gymnodinium boreale	..	20
Gymnodiniaceae	..	1 000
Gyrodinium grenlandicum	1 000	..
Peridinium minusculum	500	..
Coccolithophorids:		
Acanthoica quattrospina	..	500
Anthosphaera robusta	9 500	10 000
Calciopappus caudatus	36 000	23 000
Coccolithus huxleyi	35 000	38 000
— *pelagicus*	1 500	440
Crystallolithus hyalinus	..	20
Pontosphaera pietschmanni	500	500
Coccolithophorids not classified	500	1 000
Other flagellates:		
Chilomonas marina	13 000	15 000
Distephanus speculum	20	20
Monosiga marina	4 500	6 000
Flagellates and monades not classified	110 000	135 000
Ciliates:		
Acanthostomella, (empty *loricae*)	80	100
Laboea strobila	60	20
Lohmanniella oviformis	500	..
Parafavella, (empty *loricae*)	..	40

Table 27.

St. 187, June 5, 1952.

Depth in metres	0	25
Diatoms:		
Chaetoceros atlanticus	360	1 800
— *borealis*	180	40
— — f. *concavicornis*	1 200	3 060
— *convolutus*	..	220
— *decipiens*	..	60
— *simplex*	..	1 000
— — var. *calcitrans*	..	24 000
— sp.	..	60
Coscinosira polychorda	100	20
Fragilaria nana	5 000	7 500
Porosira glacialis	..	100
Rhizosolenia alata	..	20
— *hebetata* f. *semispina*	..	40
Pennate diatoms not classified	60	..
Dinoflagellates:		
Dinophysis grani	..	40
Exuviaella baltica	500	..
Gymnodinium lohmanni	60	..
Peridinium curvipes	40	..
— *islandicum*	..	20
— *minusculum*	500	..
Other flagellates:		
Distephanus speculum	..	100
— — var. *octenarius*	..	20
Monosiga marina	3 000	..
Flagellates not classified	2 500	25 000
Flagellates and monades not classified	12 000	5 000
Ciliates:		
Acanthostomella, (empty *loricae*)	20	..
Laboea conica	980	..
Parafavella, (empty *loricae*)	..	40
Woodania conicoides	2 000	20
Ciliates not classified	80	..

Table 28.

St. 233, June 15, 1952.

Depth in metres	0	25
Diatoms:		
Chaetoceros convolutus	40	..
— sp.	60	..
Corethron hystrix	160	140
Eucampia zoodiacus	500	..
Fragilaria nana	1 750 000	1 675 000
Nitzschia closterium	185 000	190 000
— *delicatissima*	114 000	35 000
Thalassiosira bioculata var. *raripora*	6 000	3 500
Centric diatoms not classified	2 000	..
Pennate diatoms not classified	9 000	7 000
Dinoflagellates:		
Exuviaella baltica	4 000	2 500
Gymnodinium boreale	..	7 000
Gymnodiniaceae	7 500	6 500
Gyrodinium grenlandicum	1 500	500
Peridinium depressum	20	..
— *minisculum*	1 000	..
Phalacroma ruudi	500	500
Dinoflagellates not classified	..	500
Coccolithophorids:		
Anthosphaera robusta	8 500	10 500
Calciopappus caudatus	70 000	68 000
Coccolithus huxleyi	13 000	20 000
— *pelagicus*	1 500	..
Crystallolithus hyalinus	1 500	40
Ophiaster hydroideus	..	500
Pontosphaera pietschmanni	..	500
Other flagellates:		
Chilomonas marina	69 000	75 000
Monosiga marina	45 000	47 000
Flagellates and monades not classified	170 000	360 000
Ciliates:		
Acanthostomella, (empty *loricae*)	100	100
Laboea conica	40	..
Lohmanniella oviformis	500	..
Parafavella, (empty *loricae*)	..	20
Woodania conicoides	2 000	500

Table 29.

St. 202, June 8, 1952.

Depth in metres	0	30
Diatoms:		
Chaetoceros decipiens	20	..
— sp. (cf. *brevis*)	400	..
Fragilaria nana	190 000	100 000
Licmophora sp.	200	..
Nitzschia closterium	..	1 000
— *delicatissima*	1 500	..
Thalassiosira bioculata var. *raripora*	1 000	..
Pennate diatoms not classified	9 000	6 000
Dinoflagellates:		
Exuviaella baltica	500	500
Gymnodinium lohmanni	60	20
Gymnodiniaceae	5 000	2 500
Gyrodinium grenlandicum	3 500	3 000
Peridinium minusculum	20	20
— sp.	..	20
Phalacroma ruudi	..	40
Dinoflagellates not classified	60	..
Coccolithophorids:		
Anthosphaera robusta	500	1 000
Calciopappus caudatus	+	+
Coccolithus huxleyi	2 500	1 500
Crystallolithus hyalinus	+	+
Other flagellates:		
Chilomonas marina	33 500	26 000
Distephanus speculum	20	..
Monosiga marina	500	500
Flagellates and monades not classified	167 000	137 000
Ciliates:		
Acanthostomella	200	..
— (empty *loricae*)	200	40
Laboea conica	40	..
— *emergens*	20	..
Lohmanniella oviformis	3 000	200
Parafavella, (empty *loricae*)	..	20
Woodania conicoides	1 500	..
Ciliates not classified	160	600

Table 30.

St. 218, June 12, 1952.

Depth in metres	0	10	25
Diatoms:			
Amphiprora hyperborea	..	..	40
Chaetoceros atlanticus	..	40	..
— *convolutus?*	..	..	20
— *furcellatus*	54 000	26 500	212 000
— — resting spores	1 000	..	40
— *socialis*	..	..	38 500
Eucampia zoodiacus	43 000	36 000	44 500
Fragilaria oceanica	1 800	1 600	5 600
Melosira juergensi	80	..	..
Nitzschia closterium	140	500	2 000
Thalassiosira bioculata	20	100	12 000
— *gravida*	3 500	2 000	16 000
— — resting spores	60	..	..
— *nordenskioeldi*	30 000	44 000	165 000
Pennate diatoms not classified	2 000	4 000	4 000
Dinoflagellates:			
Cladopyxis claytoni	1 000	500	..
Exuviaella baltica	1 000	20	2 000
Glenodinium spitsbergense	..	40	..
Gymnodinium lohmanni	4 000	500	2 500
Gymnodiniaceae	6 000	7 500	24 000
Gyrodinium grenlandicum	1 000	1 000	2 000
Peridinium americanum?	..	..	20
— — *cysts*	..	..	20
— *brevipes*	160	120	100
— *conicoides*	20	..	20
— *globulus* var. *quarnerense*	20	..	40
— *grenlandicum*	..	..	20
— *islandicum*	..	20	..
— *minusculum*	1 000	500	..
— *pellucidum*	620	720	120
Phalacroma ruudi	60	100	20
Dinoflagellates not classified	2 000	1 000	..
Coccolithophorids:			
Anthosphaera robusta	20	..	..
Other flagellates, etc.:			
Chilomonas marina	20	40	20
Distephanus speculum	40	20	..
Monosiga marina	2 500	2 000	2 000

Table 30 (cont.).

Depth in metres	0	10	25
Phaeocystis poucheti	..	..	r
Sphaeropsis spumosa	..	20	20
Flagellates and monades not classified	50 000	62 000	74 000
Ciliates :			
Acanthostomella	80	20	60
— (empty *loricae*)	140	100	40
Laboea conica	40	40	1 420
— *emergens*	..	..	120
— sp. (cf. *compressa*)	..	40	..
Lohmanniella oviformis	1 000	160	500
Ptychocylis	..	20	240
Tintinnopsis	40	..	..
Woodania conicoides	..	..	20
Ciliates not classified	1 000	1 000	1 500

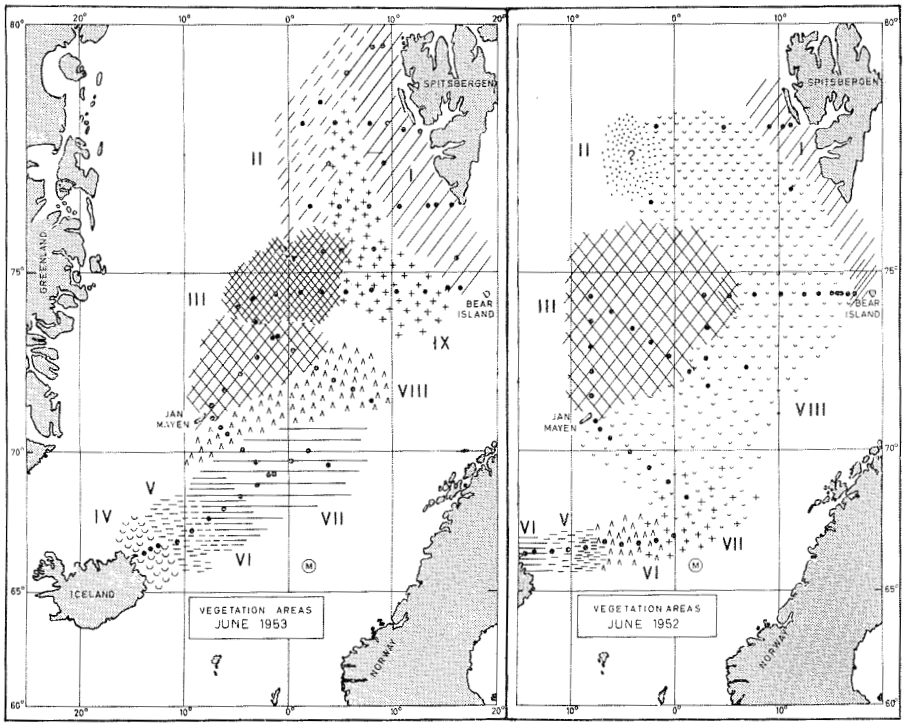

Fig. 10. Vegetation areas in the Norwegian Sea in June 1952 and 1953.