DET KONGELIGE DEPARTEMENT
FOR HANDEL, SJØFART, INDUSTRI, HÅNDVERK OG FISKERI

NORGES SVALBARD- OG ISHAVS-UNDERSØKELSER
LEDER: ADOLF HOEL

SKRIFTER OM SVALBARD OG ISHAVET

Nr. 67

ANTON JAKHELLN

OCEANOGRAPHIC INVESTIGATIONS IN EAST GREENLAND WATERS IN THE SUMMERS OF 1930—1932

(WITH 28 FIGURES IN THE TEXT AND 2 PLATES)

OSLO
I KOMMISJON HOS JACOB DYBWAD
1936

RESULTS OF THE NORWEGIAN EXPEDITIONS TO SVALBARD 1906—1926 PUBLISHED IN OTHER SERIES

(See Nr. 1 of this series.)

The results of the Prince of Monaco's expeditions (Mission Isachsen) in 1906 and 1907 were published under the title of 'Exploration du Nord-Ouest du Spitsberg entreprise sous les auspices de S. A. S. le Prince de Monaco par la Mission Isachsen', in Résultats des Campagnes scientifiques, Albert Ier, Prince de Monaco, Fasc. XL—XLIV. Monaco.

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With map: Spitsberg (Côte Nord-Ouest). Scale 1:100000. (2 sheets.) Charts: De la Partie Nord du Foreland à la Baie Magdalena, and Mouillages de la Côte Ouest du Spitsberg.

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SCHETELIG, JAKOB, Quatrième Partie. Les formations primitives. Fasc. XLIII. 1912. Fr. 16.00.

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Maps:

Bear Island. 1 : 25 000. 1925. Kr. 10,00.

Bear Island. 1 : 10 000. (In six sheets). 1925. Kr. 30,00.

East Greenland. Eirik Raudes Land from Sofiasund to Youngsund. 1 : 200 000. 1932. Kr. 5,00

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A. W. BRØGGERS BOKTRYKKERI A/S

Contents.

Preface.

The oceanographic observations dealt with in this paper were carried out on the Norwegian expeditions to East Greenland, sent out in the summer seasons of 1930, 1931 and 1932 by *Norges Svalbard- og Ishavs-undersøkelser* in Oslo.

Docent Adolf Hoel, Oslo, the head of the mentioned institution and leader of the 1931 expedition, and Dr. Anders K. Orvin, Oslo, the leader of the 1932 expedition, generously enabled me to carry out the observations onboard the "Polarbjørn" and gave me every possible opportunity to take oceanographic stations.

Part of the oceanographic equipment was kindly lent to the expeditions by *Det Geofysiske Institutt* in Bergen (Professor B. Helland-Hansen), The "Nautilus" Expedition, 1931 (Professor H. U. Sverdrup, Bergen), *Fiskeridirektoratet* in Bergen, Mr. J. Eggvin, Bergen, and others.

Lektor O. Edlund, Umeå, Sweden, has been good enough to furnish me with information about the soundings from The Norwegian "Conrad Holmboe" Expedition.

Mr. Finn Devold has taken the observations in 1930 and has kindly placed them at my disposal.

The foundations, *Roald Amundsens Fond til Fremme av Norsk Geografisk Forskning* and *Det Videnskapelige Forskningsfond av 1919* have enabled me to prepare the present paper and Professor Helland-Hansen has done me the great service of permitting me to carry out the work at *Det Geofysiske Institutt* in Bergen.

Dr. Håkon Mosby has favoured me with a great deal of practical advice, and Professor Sverdrup has most kindly revised my manuscript.

I wish to express my sincerest thanks to the mentioned institutions and persons.

The ice terminology used in the present paper is in accordance with that of *Atlas of Sea Ice* [Maurstad 1935].

Det Geofysiske Institutt, Bergen, April 1936.

I. Introductory Chapters.

a. Previous Investigations.

The northwestern part of the Norwegian Sea is one of the areas within which oceanographic conditions were first investigated by modern methods, namely during the "Belgica" Expedition in 1905 [Helland-Hansen and Koefoed 1909]. Already before that time, sporadic investigations had been made by some expeditions [Ryder 1895, Amdrup 1902 and Åkerblom 1904], but partly by means of inexact methods. Nansen [1906], Helland-Hansen and Koefoed [1909] and Helland-Hansen and Nansen [1909] give a critical estimate of the previous investigations. In their papers, the later investigations made by means of modern methods are also included, of which, for the northwestern area, the investigations of the "Belgica" Expedition are the most important. In their work of 1909, "The Norwegian Sea", Helland-Hansen and Nansen have availed themselves of all material accessible, and one finds here, as in the other works mentioned, an excellent account of the hydrographic conditions. Trolle [1913] has treated the investigations of the "Danmark" Expedition, and Nielsen [1928] has given a short account of the hydrographic conditions in the area.

The most characteristic feature of the hydrography of the area is the East Greenland Polar Current, which from the Polar Sea runs southwards along the coast of East Greenland. The water masses of this current acquire, as shown by Nansen [1902], their characteristic properties in the Polar Sea through the supply of fresh water from the great Siberian rivers and through the formation of ice in the winter. On account of the supply from the Siberian rivers the surface water is of low salinity. When ice freezes in the winter, the salt is mainly retained in the water, and thus, a layer of water is formed with a salinity of about 34 per mille, and a temperature near the freezing point, which at this salinity is about — 1.85 ° C. The thickness of this layer depends on the vertical distribution of density and on the extent of ice-formation. Together with the water thus formed, the less salty water in the top layers floats out of the Polar Sea southwards, and is pressed, on account of the earth's rotation, towards the east coast of Greenland. Compared with the other water masses in the Norwegian Sea, which are of Atlantic origin, the Polar water has a very low salinity, and is therefore lighter, although it is colder. The Polar Current carries great masses of sea-ice.

Under the Polar water there is water that is saltier and warmer (first shown by Ryder in 1891). It runs southwards with the Polar water, and gradually gets mixed with this water. According to Nansen [1906] and Helland-Hansen and Nansen [1909] it is probable that this water originates in the Norwegian Atlantic Current, which goes northwards along the eastern border of the deep basin of the northern Norwegian Sea, and turns westwards along the southern slope of the Nansen Ridge between Spitsbergen and Northern Greenland, and later submerges under the Polar Current. Under this warm layer there is a colder bottom layer.

The general hydrographical conditions will be discussed more thoroughly in connection with the vertical sections from 1931 and 1932.

b. Investigations in 1930, 1931 and 1932.

The Norwegian expeditions to East Greenland have had several tasks, for, besides serving as a basis for various scientific ends, the vessel was also to bring supplies to the Norwegian trapping-stations in East Greenland between 71½° and 74½° N.

On account of the ice conditions, the period during which ships can enter the fjords of East Greenland is rather short, and this fact, coupled with the numerous pursuits of the expeditions, limited to a very great extent the possibilities for oceanographic work in and outside of the fjords. In addition to unloading the supplies at the trapping-stations, the vessel had to keep in constant touch with the scientific shore-parties, and therefore had to move about in the fjords all the time. Oceanographic stations were taken when opportunity arose, and thus it was difficult to establish a system in the work.

In 1930 and 1931, the work comprised hydrographic stations with determinations of temperature and salinity, and, in 1931, also the collection of plankton. In 1932, hydrographic stations were taken, with determinations of temperature, salinity, oxygen content, hydrogen ion concentration, and phosphate content. Since determinations of nitrites at the first stations gave negative results, these examinations were omitted, as the contents of the water-bottles were barely sufficient for the other tests.

In 1931 the vessel was kept in the drift-ice from July 17 to 31, owing to unfavourable ice conditions. During this period 5 stations were taken, the positions of which are in some instances somewhat uncertain on account of fog. This applies especially to Stat. 2.

The stay inside the ice-belt lasted 3 weeks, and during this period 16 stations in the fjords and near the coast were taken. The stations 10—13 are taken at intervals of 6 hours on the same spot in connection with the investigations of the vertical migrations of plankton during 24 hours. Unfortunately, the series had to be interrupted, as assistance had to be rendered to an American vessel which had run aground.

In 1932, the vessel passed through the drift-ice very quickly. 2 stations were taken, but the position of one of them, Stat. 1, is inaccurate owing to fog. The vessel stayed inside the drift-ice belt for 1 month, from July 21 to August 21 and during this period 22 stations were taken in the fjords and near the coast. During the voyage out on August 21 ice conditions were very favourble, and *en route* a section of 4 stations over the shelf was worked. Unfortunately, time did not allow of more stations being taken, and the section could not therefore be prolonged to deeper waters.

In 1931 and 1932 the work was done onboard M/V "Polarbjørn" of Ålesund, and conducted by the present author, who has also undertaken all the temperature readings and the chemical determinations which were carried out onboard. The 10 stations from 1930 which are included in the discussion are taken by Mr. Finn Devold onboard S/S "Veslekari" of Ålesund (observations from the upper 75 m only).

The stations are entered partly on the bathymetrical chart, Plate 1 (stations in the East Greenland Polar Current and near the coast) and partly on the station chart, Plate 2, (stations near the coast and in the fjords).

c. Instruments and Methods.

The climatic conditions in the field covered by the expedition, are generally very favourable to oceanographic work in the summer, as fine, calm weather is frequent. In the drift-ice there is, furthermore, no rough sea, and this is also the case in the shore-lead and in the fjords. This advantage is especially great when the space on board the vessel is limited, as was the case onboard the "Polarbjørn".

In 1931, the hydrographic winch was placed aft, with the result that is was not possible to manoeuvre the vessel in order to keep the wire vertical, on account of the risk of getting it into the propeller. This year, the observations are therefore not always taken with a vertical wire, but the wire angle is indicated if it was of any importance. In 1932, the hydrographic winch was placed on the foredeck, and the vessel was manoeuvred in such a manner that all observations were taken with a vertical wire.

In the drift-ice, the positions for the various stations are determined by means of astronomic observations and dead reckoning. In periods of fog the determinations are based on dead reckoning only, and in such periods the positions are doubtful. Near the coast and in the fjords, the positions are determined by means of cross-bearings and directly plotted in the chart.

The soundings were taken with a Lucas sounding-machine.

All water samples, with the exception of the surface samples, were taken with Nansen's reversing water bottle [Helland-Hansen and Nansen 1926]. The hydrographic winch was operated by hand, and consequently not more than 6 water bottles were used in each haul, from greater depths not more than 4. Each water bottle was provided with 2 reversing thermometers, protected against pressure. In 1931, thermometers from the firms C. Richter, Franz Schmidt and Schmidt & Vossberg were used. In 1932, 12 protected reversing thermometers were used, 11 of which were of Richter & Wiese's new type D. A. E. with 1/20 degree graduation and plane scale. The 12th was from C. Richter. All of them had been tested by the *Physikalisch-Technische Reichsanstalt,* Charlottenburg, and were provided with certificates, with the exception of the 2 F. S. thermometers used in 1931. A couple of the thermometers used in 1931 had a tendency to fail, so that for this year, not all of the temperatures indicated in the tables of results have been determined by means of 2 thermometers. All of the thermometers of 1932 functioned excellently.

The *S,t*-diagrams and the temperature curves for each single station (the temperature conditions being rather uniform) show that we can suppose the tabulated values of temperature to be correct, even when only one thermometer has functioned. The accuracy of the temperature determinations can be estimated at 0.01 ° to 0.02 ° C.

The water samples for the determination of chlorinity were stored in 100 cc. bottles supplied with patent stoppers. The chlorinity was determined by means of the ordinary titration method at the laboratory of the Geophysical Institute in Bergen, after the return of the expedition. All of the samples from 1931 were titrated twice. The samples which showed a difference in salinity of more than 0.02 ‰ were titrated once more. In 1932, only those samples were titrated once more which, according to the salinity curves and the *S,t*-diagrams for the various stations, looked doubtful, and a third titration was undertaken if they showed a difference of more than 0.02 ‰ in salinity. The salinity was computed from the chlorinity, by means of Sund's oceanographical slide rule [Sund 1929], based on Knudsen's tables.

All the values of temperature, salinity, and density were controlled by means of *S,t*-diagrams and station curves (S, t and σ_t plotted against the depth).

The densities and the anomalies of the specific volume were also computed by means of Sund's slide rule, and the anomalies of the dynamic depth of the standard isobaric surfaces by means of numerical integration on a calculating machine. This method is very quick and convenient, and the accuracy is quite as good as by table calculations.

In 1932, water samples for determination of the oxygen content were taken at most stations and depths, but not from the sea surface, since the supply of Winkler-bottles was limited and the surface water is as a rule saturated with oxygen. As there was no laboratory on board, I had to bring the oxygen samples home, and the titration by means of the Winkler-method was done at the laboratory of the Geophysical Institute immediately after the return of the expedition early in September.

In 1932, samples were also taken for the determination of the hydrogen ion concentration and the phosphate content. The determination was done on board by means of Sund's colorimeter [Sund 1931]. On account of the glacier water in the fjords, the phosphate determinations were uncertain (comparison of the colours was difficult owing to finely suspended particles in the water samples); they are therefore not included in this work.

d. The Bathymetrical Chart.

The chart (Plate 1) has been constructed and based on the soundings from the following charts:

1. The British Admiralty Chart No. 2282 "Arctic Ocean and Greenland Sea" with corrections up to 1933.
2. The chart of *Det Kgl. Danske Søkort-Arkiv* in Copenhagen: No. 147, "Grønland med Omgivelser".
3. The chart of *Norges Svalbard- og Ishavs-undersøkelser* in Oslo from East Greenland. (The waters of Gael Hamke Bay — Foster Bay.)
4. The bathymetrical chart constructed by Trolle [1913].
5. The bathymetrical chart of Helland-Hansen and Nansen [1909].

Moreover, in addition to my own soundings from "Polarbjørn" 1931 and 1932, I have also availed myself of 27 soundings from the Norwegian "Conrad Holmboe" Expedition in 1923 (Table 1). In the fjords on the chart are marked some soundings which are taken in connection with the oceanographic stations dealt with here, and also one sounding from Nathorst's expedition in 1899 [Åkerblom 1904].

Since I have here given an account of the soundings I have used, I have deemed it unnecessary to enter the various soundings on the chart. Unfortunately, the sounding material at my disposal is scanty, and in some areas the soundings are very rare, as these areas probably are usually inaccessible owing to ice conditions. As far as I know, the only systematic sounding which has been done is the detailed sounding made by *Norges Svalbard- og Ishavs-undersøkelser* in Foster Bay, along Hudson Land and in Gael Hamke Bay and Clavering Fjord. It has therefore been easy to draw the isobaths here, but outside of this area

Table 1.
Soundings from the "Conrad Holmboe" Expedition 1923.

Station	Date	Lat. N	Long. W	Depth in metres
14	Aug. 1	74° 01′	15° 10′	212
15	2	16′	16° 10′	224
16	3	17′	17° 01′	203
17	6	73° 56′	07′	215
18	8	74° 01′	18° 00′	185
19	10	13′	17′	198
20	15	73° 49′	19° 17′	132
21	17	38′	08′	177
22	18	35′	16′	172
23	19	29′	42′	161
24	20	27′.5	23′	177
25	21	25′	18′	174
26	22	21′.5	11′	183
28	23	18′.5	20′	213
29	23	16′.5	20′	225
30	24	15′.5	19′	212
31	24	15′.5	17′	227
32	25	14′	13′	235
33	25	13′.5	13′	233
34	25	12′.5	15′	306
35	26	11′.5	17′	349
36	27	08′	16′	404
37	27	06′	18′	403
38	31	72° 48′	54′	206
39	Sept. 3	34′	20° 38′	264
40	5	22′	21° 16′	191
41	5	20′	19′	177

the course depends upon subjective judgment. It seems very doubtful whether some apparently improbable soundings should be accepted. The positions for the soundings may be doubtful in the ice, where it is generally foggy, and where the dead reckoning becomes uncertain, because it is not possible to keep a steady course. In constructing my batymetrical chart, I have disregarded 2 soundings, both of them on the British chart. The one 920 fathoms in 73° 55′ N and 15° 50′ W. I suppose the correct position is a little more south. The other one is quite near Holland Island outside Hudson Land — 178 fathoms in an area where numerous soundings have been taken by *N. S. & I. U.*, all of them showing an even depth of about 20 metres.

In order to show to what extent the isobaths are representative at the different places, I have used longer dashes in the isobaths where the soundings are dense. In the area which has been surveyed by *N. S. & I. U.* the isobaths are drawn with curves which are almost unbroken.

On account of the many reliable soundings in this area, it is easy to find the saddle depths for the thresholds at the mouths of Franz Josef Fjord (abt. 320 m), Clavering Fjord (abt. 170 m), Granta Fjord (abt. 12 m), Young Sound (abt. 60 m) and Dusén Fjord (abt. 90 m) (Spärck [1933] indicates the saddle depth to be 50 metres at Winter Islands, but it is apparently deeper nearer Ymer Island). The whole of Clavering Fjord with its branches has been sounded over, but I have not drawn the isobaths here, as they are lying very close and the scale of the chart is too small. As in the other fjords, I have only indicated the soundings at the oceanographic stations. 10 soundings in Geologist Fjord are entered in the chart.

The Danish expeditions with the "Godthaab" in 1931 and 1932 have taken a number of soundings in the fjords with an echo-sounding machine, and Spärck [1933] has constructed a bathymetric chart based on these soundings. The various soundings are unfortunately not indicated, and in those areas where a Norwegian detailed survey has been made, I have, in my oceanographic discussion, disregarded Spärck's indications of saddle depths if they do not agree with the Norwegian soundings. In Spärck's hydrographic section through "Godthaab Gulf" and Gael Hamke Bay, the threshold of the Clavering Fjord ("Godthaab Gulf") is indicated at 120 m, but it seems to be about 170 m.

When I constructed my bathymetrical chart, I had unfortunately no knowledge of the Danish soundings. According to these, the submarine fjord outside Gael Hamke Bay appears to be deeper than indicated on my bathymetrical chart.

Since this paper was prepared, a paper dealing with the echo-sounding work of the Louise A. Boyd Expedition to East Greenland, 1933, has appeared [Hitchcock 1935]. The recording echo-sounding machine from Messrs. Henry Hughes and Son, London, was used, and Hitchcock has prepared 47 detailed fjord profiles from the original sounding rolls. These soundings coincide very well with the previous wire-soundings and [according to Hitchcock, footnote 2] with the echo-soundings taken during the Danish Three-Year Expedition [Spärck 1933], with the exception of some soundings in the inner part of Franz Josef Fjord. According to Spärck, depths of nearly 1000 metres are met with here. In his bathymetrical chart some areas are indicated with depths exceeding 800 metres. The profiles of Hitchcock show an even bottom with a maximum depth of 772 metres in these areas, and this is confirmed by the wire-soundings of Nathorst and of the present author.

It is natural to presume that the greatest depths recorded by Spärck are erroneous, as it is improbable that such depths occur in the even bottom recorded by Hitchcock. Spärck gives no information about the echo-sounding machine he has used, and whether it was self-recording or not. Thus it is not possible to know on how many soundings his bathymetrical charts and sections are based. He himself remarks that "of course, no real detailed bathymetrical survey can be given".

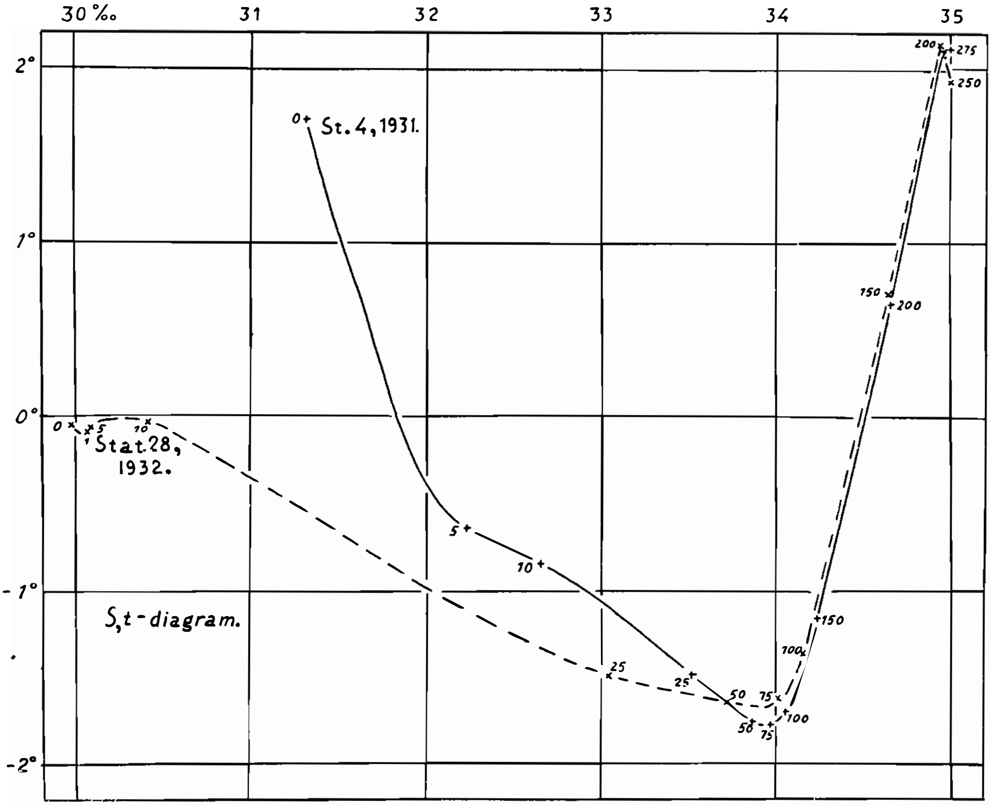

Fig. 1. *S,t*-diagram. Stats. 4, 1931 and 28, 1932.

e. Definition of the Different Water Masses by means of a *S,t*-Diagram.

Fig. 1 shows a *S,t*-diagram for Stats. 4, 1931 and 28, 1932. Both stations are situated on the continental shelf. *S,t*-diagrams were first introduced by Helland-Hansen [1918]. How they can be used to characterize different water masses, is shown by Jacobsen [1929] and Defant and Wüst [1930] [see also Thorade 1933].

On a *S,t*-diagram, a homogeneous water mass will be represented by a point, whereas a mixture of two homogeneous water masses is represented by a straight line between the two points signifying each of the water masses. An arbitrary point on such a connecting line represents a mixture in which the two water masses are present in a ratio inversely proportional to the distances to the respective points. If three homogeneous water masses are present, the curve in the *S,t*-diagram makes a break at the point that represents the middle layer, and if the mixing with the adjacent layers successively prevails throughout the layer, the curve in the proximity of this point will successively be rounded off.

On Fig. 1, the depth of observation is indicated in metres at the different points on the curves. It appears from the figure that the two curves are very similar. Between 34 and 35 ‰ they form a straight line. Unfortunately, there exist no observations from greater depths than 275 m (Stat. 4) and 250 m (Stat. 28). However, the curve for Stat. 28 shows a break between 200 m and 250 m (the temperature being lower at 250 m, than at 200 m), and the points are so near each other that there is every reason to believe that we are here dealing with the *core* of the warm underlayer. Salinity as well as temperature is exceptionally high for this warm layer as compared with the values found by previous investigations. I shall return to this later on. The warm underlying layer, which will be called the Atlantic water (A. W.) can, when both curves are considered, be attributed the qualities $S = 34.97$ ‰, $t = 2.10$ ° C. When the cold Polar water (P. W.) was formed it had probably a temperature near freezing point — that is about — 1.85 ° C for water of about 34 ‰ salinity. The salinity that corresponds to the straight part of the curve on Fig. 1, is 34.07 ‰, which, together with the temperature — 1.85 ° C, characterizes the Polar water in its origin. A mixture of equal quantities of A. W. and P. W. will have the characteristics $t = 0.13$ ° C and $S = 34.52$ ‰. It will therefore be natural to use this as a boundary between Polar water and Atlantic water, but for practical reasons, it is better to choose $t = 0$ ° C, corresponding to $S = 34.5$ ‰ as a limit. A mixture of 47 % A. W. and 53 % P. W. will show these characteristics. There do not exist observations from the core of the warm A. W. from other stations than these two. The other stations on the shelf are taken in shallower waters, and the core of the A. W. is situated too deep to penetrate into the fjords. Only P. W. and mixed water pass over the shelf.

The course of the curve for Stat. 4, 1931, shows that the water at 50—100 m, is comparatively unmixed Polar water. This station is taken early in the summer, on July 27, and the mixing is little advanced. The further course of the curve shows a mixing with the overlying water formed by the melting of the ice and supply of water from the coast, and also shows heating of the surface layer.

The curve for Stat. 28, 1932, shows that the Polar water at 50—100 m is more mixed this year, especially at 100 m. At 25 m, the water is considerably diluted with melting water. The surface heating reaches much deeper than for Stat. 4, 1931. Stat. 28, 1932, is taken later in the summer, on August 21.

f. Dynamic Calculations.

For the calculations, Sund's oceanographic slide rule is used [Sund 1929], which is based on the tables of Knudsen and those of Hesselberg and Sverdrup. By means of the slide rule, σ_t and the quantity $(\alpha - \delta_p)$ can easily be computed. Here, α is the specific volume *in situ* and δ_p is a correction, which is due to the compressibility, and which depends only on the pressure [Hesselberg and Sverdrup 1915]. The values of S and t for the standard depths are used for the corresponding standard isobaric surfaces, as one may disregard the error thus made. If we by $\alpha_{35,0,p}$ indicate the specific volume *in situ* in an ocean where the salinity everywhere is 35 ‰ and the temperature 0 °, we get

$$\alpha_{35,0,p} - \delta_p = 0.97264$$

which is the specific volume of water of 35 ‰ and 0 ° C under normal atmospheric pressure.

We have

$$(\alpha - \delta_p) - (\alpha_{35,0,p} - \delta_p) = \alpha - \alpha_{35,0,p} = \triangle\alpha.$$

By subtracting the constant 0.97264 from the computed quantity, $(\alpha - \delta_p)$ we thus obtain the anomaly of the specific volume, and the computation of the specific volume *in situ* itself, is avoided. In the tables of results is stated $10^5 . \triangle\alpha$, the 6th decimal of $\triangle\alpha$ being omitted, as it is only of arithmetical value.

The dynamic depth of a given pressure, p, is determined by

$$D = \int_0^p \alpha \, dp$$

If $D_{35,0,p}$ is the corresponding value for an ocean where the salinity is everywhere 35 ‰ and the temperature 0 °, we have

$$\triangle D = D - D_{35,0,p} = \int_0^p \alpha \, dp - \int_0^p \alpha_{35,0,p} \, dp = \int_0^p \triangle\alpha \, dp$$

where $\triangle D$ is the anomaly of the dynamic depth of the isobaric surface. The 6th decimal of $\triangle\alpha$ is considered in the computations, which corresponds to 5 decimals of $\triangle D$ (in dynamic metres). In the tables of results $10^4 . \triangle D$ is given, the 5th decimal of $\triangle D$ being omitted.

g. The Construction of the Velocity Sections.

Helland-Hansen [1905] has shown that

$$v - v_i = \frac{10}{\lambda L}(D'_A - D'_B) \qquad (1)$$

where v is the average velocity component (in *metres* per second) at right angles to the vertical section between the stations, A and B, at an upper isobaric surface, and v_i the corresponding quantity at a lower isobaric surface; D'_A and D'_B are the thickness (in dynamic metres) of the water layer between the upper and lower isobaric surface at the two stations; L is the distance (in *metres*) between the stations. $\lambda = 2\,\omega \sin\varphi$, where ω is the angular velocity of the earth's rotation and φ is the mean geographical latitude of the stations.

The formula is based on the circulation theorem of Bjerknes [1901]:

$$\frac{dC}{dt} = -\int^{S} \alpha \; dp - 2\omega \frac{dS}{dt} - R$$

on the assumption that approximate stationary conditions exist, ($\frac{dC}{dt}$ small), and that friction can be disregarded (R small).

By means of Formula 1, the distribution of the velocity components at right angles to a section can be computed, if observations exist down to a level where the velocity is supposed to be zero.

If one or more stations are taken in shallow waters where the depth is less than the depth of the "zero-level", the dynamic calculations can be performed by means of the method proposed by Nansen and Helland-Hansen [Helland-Hansen 1934], supposing that we know the distribution of the specific volume along the bottom down to the "zero-level". Thus the velocities above the shelf can be computed.

The vertical section III b (Stats. 14 and 25—28, 1932, Fig. 15, page 33) shows the distribution of $\triangle\alpha$ across the shelf from Foster Bay in August 1932. (For each station the depth of the $\triangle\alpha$-lines is found by graphical interpolation. In the following the word "isostere" will be used for the lines of constant $\triangle\alpha$, although the courses of these lines do not coincide with the courses of the isosteres, the differences between α and $\triangle\alpha$ being equal to $\alpha_{35,0,p}$ and thus varying with the pressure, p, or, with the depth.) Only Stat. 28 reaches a depth of 250 m. Nevertheless, we wish to calculate the current for the whole section in relation to the current at the 250-decibar surface as zero-level. The problem is to find the anomaly of the height[1] of the other isobaric surfaces over this layer, for all the stations in the section. For Stat. 28, this is easily done by means of $\triangle D' = \int_{p}^{250} \triangle\alpha \, dp$. However, this formula can also be applied to the other stations, by integrating along the vertical line of the station from the isobaric surface, $p = p$, to the bottom and along the bottom to the 250-decibar surface, according to the method mentioned above. In undertaking the numerical integration along the bottom, the values of $\triangle\alpha$ which are found from the $\triangle\alpha$-section are used.

1 Obviously D' can be replaced by the anomaly $\triangle D'$ in Formula 1.

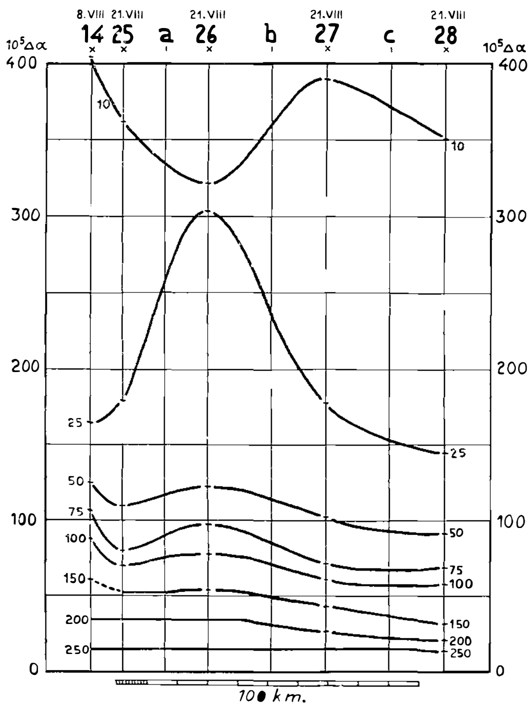

Fig. 2. $L, \Delta\alpha$-diagram. Standard isobaric surfaces 10—250 decibars (Section III, 1932).

From Sect. III b (Fig. 15) the depths where the isosteres intersect the bottom line are found, and from these the $\Delta\alpha$ values at the bottom for the standard isobaric surfaces are found by graphical interpolation.

In order to get as many values as possible for the construction of the velocity section, and thereby obtain a picture corresponding as closely as possible to the $\Delta\alpha$-section when there are great variations between the stations, some "subsidiary stations", a, b and c, are introduced in the section. In Fig. 2, a diagram is reproduced, where the abscissa is the distance between the stations, L, and the ordinate is $10^5 . \Delta\alpha$. The curves which are drawn are lines of constant pressure, and they are drawn for the pressures of the standard isobaric surfaces, 10, 25, ... 250 decibars, the values in the table of results column $10^5 . \Delta\alpha$ being used. The isobars "below the bottom" are drawn according to the graphically determined values along the bottom curve. For the subsidiary stations, a, b and c, $10^5 . \Delta\alpha$ values for the standard isobaric surfaces are now read off from Fig. 2 (the diagram was drawn on millimeter paper on a bigger scale). For the isobars 0—5, another diagram on a smaller scale was used.

The values of $10^5 . \Delta\alpha$ in Table 2 are partly taken from the tables of results, and partly from the $L, \Delta\alpha$-diagram.

Tables 2—5.

Velocity Computations for Sect. III (Stats. 14, 25—28, 1932).

Table 2. $10^5 . \triangle \alpha$.

Dcb. \ Stat.	14	25	a	26	b	27	c	28
0	789	535	605	655	524	414	395	383
1	[700]	534	605	655	500	399	383	376
5	427	478	550	588	467	398	382	375
10	404	361	335	321	357	390	371	350
25	164	178	255	302	240	177	154	144
50	124	110	115	122	116	102	93	92
75	106	80	88	98	87	71	68	69
100	90	70′	73	78	72	61	57	58
150	60	52′	52′	54	49	43	37	31
150	58′							
100	70′							
150	52′							
200	34′	34′	34′	34′	31	26	22	20
250	14′	14′	14′	14′	14′	14′	14′	13

Table 3. $10^4 . \triangle D'$.

Dcb. \ Stat.	14	25	a	26	b	27	c	28
0	2521	2295	2520	2704	2411	2085	1913	1827
1	2447	2241	2460	2638	2360	2044	1874	1789
5	2221	2039	2229	2390	2166	1885	1721	1639
10	2014	1830	2008	2162	1960	1688	1533	1458
25	1588	1425	1565	1695	1513	1263	1139	1088
50	1228	1065	1103	1165	1068	914	830	793
75	940	828	849	890	814	698	629	591
100	695	640	648	670	615	533	473	433
150	320	335	335	340	313	273	238	210
150	320							
100	640							
150	335							
200	120	120	120	120	113	100	90	83
250	0	0	0	0	0	0	0	0

Table 4. $10^4 . (\triangle D'_A - \triangle D'_B)$.

Dcb. \ Stat.	14—25	25—a	a—26	26—b	b—27	27—c	c—28
0	226	−225	−184	293	326	172	86
1	206	−219	−178	278	316	170	85
5	182	−190	−161	224	281	164	82
10	184	−178	−154	202	272	155	75
25	163	−140	−130	182	250	124	51
50	163	−38	−62	97	154	84	37
75	112	−21	−41	76	116	69	38
100	55	−8	−22	55	82	60	40
150	−25	0	−5	27	40	35	28
200	0	0	0	7	13	10	7
250	0	0	0	0	0	0	0

Table 5. $\nu - \nu_i$.

Dcb. \ Stat.	14—25	25—a	a—26	26—b	b—27	27—c	c—28
0	15.4	—11.5	—9.4	10.5	12.3	6.2	3.3
1	14.1	—11.2	—9.1	10.0	11.9	6.1	3.2
5	12.4	—9.7	—8.2	8.0	10.6	5.9	3.1
10	12.6	—9.1	—7.9	7.3	10.3	5.6	2.8
25	11.1	—7.2	—6.7	6.5	9.5	4.5	1.9
50	11.1	—1.9	—3.2	3.5	5.8	3.0	1.4
75	7.6	—1.1	—2.1	2.7	4.4	2.5	1.4
100	3.8	—0.4	—1.1	2.0	3.1	2.2	1.5
150	—1.7	0.0	—0.3	1.0	1.5	1.3	1.1
200	0.0	0.0	0.0	0.3	0.5	0.4	0.3
250	0.0	0.0	0.0	0.0	0.0	0.0	0.0

The deepest observation at Stat. 14 is from 150 metres where $10^5.\triangle\alpha = 60$. The conditions deeper are not known, but the station is connected with the other stations in the section by means of integration along the bottom over the crest at Stat. 25. The values along the bottom are marked with a prime.

Table 3 shows the result of the integration from the 250 decibar surface and upwards:

$$\triangle D' = -\int_{250}^{p} \triangle\alpha\, dp = \int_{p}^{250} \triangle\alpha\, dp = \int_{o}^{250} \triangle\alpha\, dp - \int_{o}^{p} \triangle\alpha\, dp = \triangle D_{250} - \triangle D$$

The table gives values of $10^4.\triangle D'$ which represent anomalies of the thickness of the water layer between a certain isobaric surface and the 250 decibar surface.

In Table 4 is given values of $10^4(\triangle D'_A - \triangle D'_B)$ where $\triangle D'_A$ and $\triangle D'_B$ are the values of $\triangle D'$ for the two stations, the number of which head the columns. Finally, Table 5 gives the quantity $\nu - \nu_i$. By means of this table Sect. III c (Fig. 5, page 27) showing the distribution of velocity, is constructed. The positive figures indicate components of velocity at right angles to the section in the main direction of the Polar Current, the negative ones indicate the components in the opposite, northern, direction.

The procedure here described is also applied in the case of Sects. I (Stats. 1—5 and 15, 1931) and II (Stats. 1—3, 1932). As for Sect. III, subsidiary stations are added for each 20 km or less; the number of such stations is 9 in Sect. I and 3 in Sect. II.

II. The East Greenland Polar Current.

a. The Water Transport of the Polar Current.

If the assumption is correct, that there is practically no current at the isobaric surface relatively to which the velocities have been computed ($v_i = 0$), then the water transport through the section can be calculated. These calculations can be performed in different ways. On the basis of Helland-Hansen's formula (1) the present author has derived a method by means of which the calculations can be easily performed.[1]

If $\bar{v}$ is the average velocity component between the sea-surface and the depth z_i (in metres) at right angles to the vertical section between the two stations, A and B, we have

$$\bar{v}\ z_i = \int_o^{z_i} v\ dz$$

The volume of the water which flows through the section in the unit of time is

$$V = L\ \bar{v}\ z_i = L \int_o^{z_i} v\ dz$$

cubic metres per second. By inserting (1) we obtain

$$V = \frac{10}{\lambda} \int_o^{z_i} (D'_A - D'_B)\ dz = \frac{10}{\lambda} (Q_A - Q_B) \quad \text{m}^3/\text{sec.} \tag{2}$$

where

$$Q = \int_o^{z_i} D'\ dz = \int_o^{z_i} \int_p^{p_i} \alpha\ dz\ dp = \int_{z_i}^{o} \int_{p_i}^{p} \alpha\ dz\ dp = \int_{z_i}^{o} \int_{z_i}^{z} \alpha\ dz\ dz \tag{3 a}$$

Here the replacement of the integration letter p by z means that, when integrating, instead of the pressure at the depth of observation we use the pressure (in decibars) which is expressed by the same figure as the depth (in metres). In these formulae z_i is the depth (in metres) of the isobaric surface $p = p_i$, relatively to which the velocity computations are performed. As before, D' is the thickness (in dynamic metres) of the layer between the isobaric surface $p = p_i$ and an arbitrary isobaric surface $p = p$. The significance of the other letters are the same as above.

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[1] A paper dealing with this method will be published in *Geofysiske Publikasjoner* (Vol. XI. No. 11).

Formula 3 a can also be written as follows:

$$Q = \int_o^{z_i} D' \, dz = D_i z_i - \int_o^{z_i} D \, dz \tag{3 b}$$

as

$$D' = D_i - D$$

where D_i is the dynamic depth corresponding to the depth z_i or to the isobaric surface $p = p_i$ and D is the dynamic depth of the arbitrary isobaric surface $p = p$, or corresponding to the depth z.

If the anomaly, $\Delta\alpha$, of the specific volume, α, is given, we obtain:

$$V = \frac{10}{\lambda}(\Delta Q_A - \Delta Q_B) \quad \text{m}^3/\text{sec.} \tag{4}$$

where

$$\Delta Q = \int_o^{z_i} \Delta D' \, dz = \int_{z_i}^{o} \int_{p_i}^{p} \Delta\alpha \, dz \, dp \tag{5 a}$$

or

$$\Delta Q = \int_o^{z_i} \Delta D' \, dz = \Delta D_i z_i - \int_o^{z_i} \Delta D \, dz \tag{5 b}$$

as

$$\Delta Q_A = Q_A - Q_{35,\,0,\,p}$$

$$\Delta Q_B = Q_B - Q_{35,\,0,\,p}$$

$Q_{35,\,0,\,p}$ is the value of Q if the salinity is 35 ‰ and the temperature 0 ° C from the sea-surface to the depth z_i.

When D or ΔD (the dynamic depth of the standard isobaric surfaces or the anomaly of this depth) is given, as is usual in modern oceanographic literature, the quantities Q or ΔQ are easily computed by means of (3 b) or (5 b).

By means of Formula 5 b the values of ΔQ has been found for the different stations (Table 6), the integrations for the stations, where the depth is smaller than 250 metres ($z_i = 250$ metres) being performed along the bottom according to the above mentioned method (page 16).

The depths at Stats. 1, 2 and 3, 1932, are less than 250 metres, and in that year there are no other stations in the neighbourhood by means of which the method of integration along the bottom can be applied. Nevertheless, I have extrapolated to that depth on the basis of the constant value of ΔQ along land for Stats. 15 and 16, 1931, and 4 and 20, 1932. The values are 19.1, 19.0, 19.0, and 19.1 respectively, and it is natural to choose the value 19.1 of the two northernmost of these stations as valid for Stat. 3, 1932, which is situated near the coast of Wollaston Foreland. (ΔQ can only vary slightly along land, if the

Table 6.

Transport Calculations, "Palarbjørn" 1931 and 1932. The Quantity V giving the Water Transport of the Polar Current outside of the Stations in million m³/sec.

	Stat.	1	2	3	4	5	6	15	16		
1931	$\triangle Q$ V	14.5 0.82	14.4 0.82	14 0 0.79	14.1 0.79	17.5 1.04	19.9 1.21	19.1 1.15	19.0 1.14		

	Stat.	1	2	3	4	14	20	25	26	27	28
1932	$\triangle Q$ V	12.4 0.67	17.5 1.04	19.1 1.15	19.0 1.14	17.2 1.01	19.1 1.15	15.7 0.91	17.4 1.03	13.6 0.75	11.5 0.60

total transport of the current does not vary, as the variation of the factor $\frac{10}{\lambda}$ is small at these high latitudes, and as there can be no transport across the coast except the insignificant supply from land.)

The greatest observation depth at Stats. 1 and 2 is 180 metres; direct graphical extrapolation of the anomaly of specific volume, $\triangle\alpha$, to 200 metres give the values $22 \cdot 10^{-5}$ and $45 \cdot 10^{-5}$ for the two stations respectively, but these values have been reduced to $21 \cdot 10^{-5}$ and $43 \cdot 10^{-5}$ respectively, as the depth of 200 metres is probably reached a little outside of the stations, and as the water layers are sloping towards the coast. According to the integration method the value $43 \cdot 10^{-5}$ must be valid for Stat. 3, 200 metres also; and for 150 metres at this station the value $70 \cdot 10^{-5}$ is found by means of the isostere section II b (Fig. 13, page 31). The value of $\triangle\alpha$ valid for 250 metres at Stat. 3 is still lacking, but it is easily found that this value must be $13 \cdot 10^{-5}$ if Formula 5 a is to give the above mentioned value of $\triangle Q$, 19.1. According to the integration method this value $13 \cdot 10^{-5}$ must also be valid for the two other stations, 1 and 2. The possible errors in these extrapolated values of $\triangle\alpha$ are probably within the limits $\pm 2 \cdot 10^{-5}$, and in the values of $\triangle Q$ thus found for Stats. 1 and 2 within the limits $\pm$ 0.2. The extrapolated values of $\triangle\alpha$ can of course be used for the velocity computations also.

By means of the values of the quantity $\triangle Q$ the vater transport between the different stations can be found according to Formula 4, but not the total water transport of the Polar Current, as none of the "Polarbjørn" stations is situated in deep water outside of the current. However outside of the current the conditions may be supposed to be very uniform with nearly horizontally layered water where the changes are limited to the uppermost layers. Thus the quantity $\triangle Q$ will be nearly constant and have the same value from one year to another outside of the current.

In 1905 the "Belgica" Expedition [Helland-Hansen and Koefoed 1909] took several stations in the region of the East Greenland Polar Current between Spitsbergen and East Greenland. From the temperature observations it appears that Stat. B.23 in 77° 25′ N, 4° 03′ W is situated outside of the current. (No trace of Polar water is found at the station.) This station was taken in July and the "Polarbjørn" stations in July and August, so that it is probable that the conditions were nearly the same outside of the current when all the stations were taken.

Performing the integration to 250 metres ve obtain the value $\triangle Q = 3.3$ for Stat. B.23. When this value is introduced for $\triangle Q_B$ and the value of the quantity $\triangle Q$ at one of the "Polarbjørn" stations is introduced for $\triangle Q_A$ in Formula 4 the quantity V will give the water transport of the Polar Current outside of the station and thus indicate the situation of the station relatively to the current. The values of V are therefore indicated above the station numbers in the vertical sections. They are given in Table 6.

As the integrations have been performed to 250 metres only, and the velocity at this depth is probably not exactly zero, the values of V in Table 6 may be too small. However it is possible to perform the integrations to 300 metres for "Polarbjørn" Stat. 20, 1932 (in Gael Hamke Bay). For comparison the integrations are performed to 300 metres for "Belgica" Stat. B.36 A (situated near the coast of East Greenland in 76° 37′ N, 18° 22′ W) also. When the integrations are performed to the same depth for Stat. B.23 we find $Q_B = 4.2$. The values of $\triangle \alpha$ are so small at the depth of 300 metres at Stats. 20 and B. 36 A that the velocity can be supposed to be insignificant and the values of the water transport found by means of these calculations to be nearly correct. We find that *the water transport of the East Greenland Polar Current was 1.60 million* m^3*/sec. in the summer of 1905* (between Stats. B.23 and B.36A) *while it was 1.32 million* m^3*/sec. in the summer of 1932* (outside of Stat. 20. Formula 4). Thus it is seen that considerable variations occur in the water transport of the Polar Current. (The difference cannot be explained as due to changes in the conditions of the water outside of the current, because the anomaly of the specific volume must in that case have been on an average $9 \cdot 10^{-5}$ lower from the sea-surface to the depth of 300 metres in 1932 than in 1905 at Stat. B.23, corresponding to values of temperature and salinity which are quite out of the question.)

None of the stations from 1931 can be used to find the total transport of the current on the basis of integrations to 300 metres, but the constant value of $\triangle Q$ along the coast shows that the total water transport of the current was probably the same in the summer of 1931 as in the following summer. The water masses dealt with are not exclusively composed of Polar water; the warm underlying water will also be included in the calculations, but since the velocities at a somewhat greater depth are very small, we may assume that the essential part of the water carried by the current is of Polar origin.

Iso-lines of amount of current ["*Strommenge*", Ekman 1929] are drawn on the bathymetrical chart (Plate 1) on the basis of the values of the quantity V in Table 6. (The "zero-level" of the calculations is 250 metres, and thus the values are too low, but nevertheless the iso-lines will illustrate the current conditions.) The iso-lines are drawn for every 0.1 million m^3/sec. Unfortunately the few and scattered stations allow of iso-lines being drawn off Wollaston Foreland and off Foster Bay only. The high value of V at Stat. 6, 1931, seems to indicate an eddy in Foster Bay inside of Bontekoe Island.

b. Velocity of the Polar Current.

Helland-Hansen and Koefoed [1909] state the following conditions in respect of the East Greenland Polar Current:

The current runs with varying velocity in the Greenland Sea.

It has its maximum velocity along the slope of the shelf.

The velocity of the surface layer varies according to the force and direction of the wind.

The velocity varies also according to the seasons. The melting of the ice tends to accelerate the current, and the freezing has the opposite effect.

At the surface, the velocity is greater than in the deeper layers, and it decreases rapidly with the depth. Already at a depth of 200 metres, the velocity seems very small.

In the northern part of the Greenland Sea, the average velocity at the surface along the slope of the shelf is about 30 centimetres per second. Further south, it depends on the cross-section of the current. Outside and south of Cape Dan, the velocity can be very great.

Along land, an area is found where the general movement is also to the south, but this movement is much slower than further out at sea. Polar-ice is also found there, but it is mixed with bay-ice, and this region is more navigable than the middle part of the current. There are well characterized tidal currents in this region.

Further out at sea, east of the axis of the current, the movement is small and varying.

Helland-Hansen and Koefoed have arrived at their conclusions by means of velocity computations based on the "Belgica" stations off North-Eastern Greenland in 1905, and on information about vessels which have drifted long distances with the current.

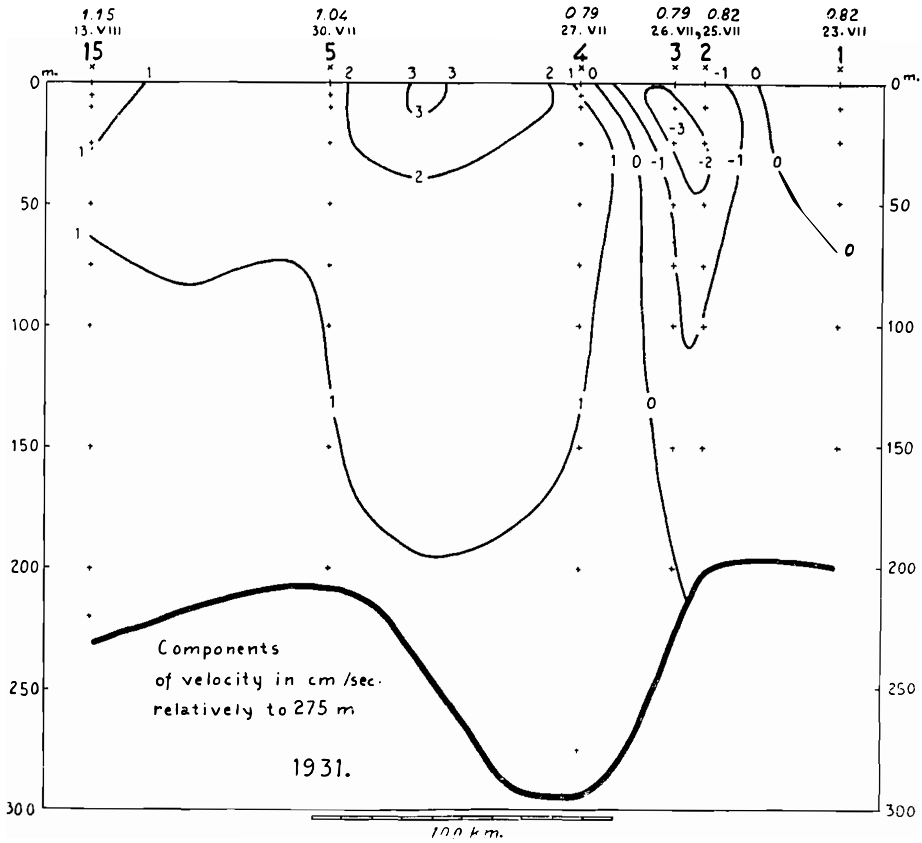

Fig. 3. Section I c, 1931. Components of velocity.

We consider the "Polarbjørn" sections:

Section I (1931). Station 1 is taken in the drift-ice just inside the ice-edge. Stat. 2 in close ice a little distance further in. Stats. 3 and 4 just outside the ice-edge, Stat. 5 far into the drift-ice, and finally Stat. 15 in the shore-lead in Gael Hamke Bay. As it appears from the bathymetrical chart (Plate 1); Stats. 1—4 are situated quite near the continental slope. Sect. I c (Fig. 3) shows that the velocity components are very small, which is obviously due to the fact that the section lies in the direction of the current along the slope of the shelf. The main direction of the section is NE—SW. The section shows that between Stats. 1 and 2, there is practically no current component at a right angle to the section, but between Stats. 2 and 3 there is a component in the direction NW, and this must be owing to the fact that Stat. 3 is situated further out on the shelf than Stat. 2. Between Stats. 3 and 4, the section is again lying nearly in the direction of the current, and between Stats. 4, 5 and 15, the current has a component in a southeastern direction.

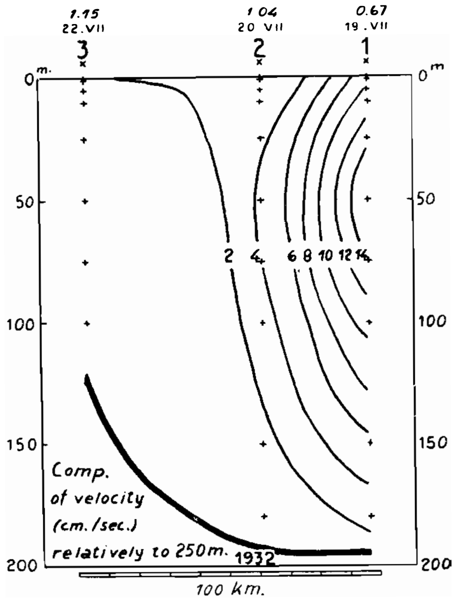

Fig. 4. Section II c, 1932. Components of velocity.

Stat. 5 is situated on a bank of the shelf outside Wollaston Foreland. The velocity is small over the bank.

Section II (1932) lies completely on the same bank. Stats. 1 and 2 are taken in the drift-ice and Stat. 3 in the shore-lead. The velocity section II c (Fig. 4) is, computed relatively to a depth of 250 metres, using the extrapolated values of $\triangle\alpha$ (Page 22). At Stat. 1 the velocity amounts to about 14 cm/sec. at a depth of 50 metres. West of Stat. 2, the velocity is small.

Section III (1932) is situated on the bank outside Bontekoe Island in Foster Bay. The velocity section shows that the current varies a great deal along the shelf here. Between the Stats. 14 and 25, there is a current component towards SW, between Stats. 25 and 26 towards NE, and between Stats. 26 and 28, again towards SW. The velocity components in this section (III c, Fig. 5) are considerable, up to 12—14 cm/sec. at the surface, decreasing to half the value at 50 metres depth, and at a depth of 150 metres, the velocity is insignificant. Judging by the bathymetrical conditions the current runs probably due south, east of Stat. 26. In that case, the velocity at the surface between Stats. 26 and 27, will be nearly 20 cm/sec. East of Stat. 27 the velocity is smaller, or the current runs here more in the direction of the section towards SE and follows the continental slope.

A study of the current conditions in this way, namely by means of vertical sections, is not very satisfactory, but the stations are too

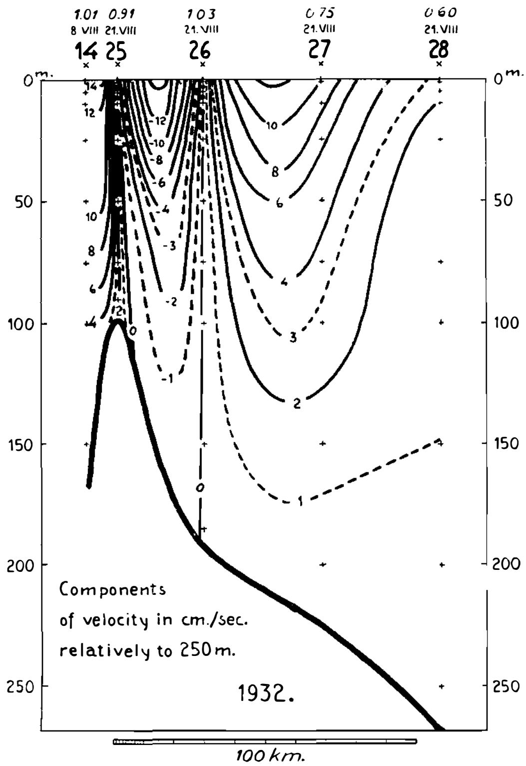

Fig. 5. Section III c, 1932. Components of velocity.

scattered to make possible a construction of charts of the dynamic topography of the isobaric surfaces.

Judging by the curves of the amount of current in the bathymetrical chart (Pl. 1), the current probably runs with considerable velocities along the steep continental slope, where Stats. 1—4, 1931, are situated, as according to Table 6, the main transport of the current passes east of Stat. 4. After having passed the submarine fjord, which intersects the shelf south of this station, the current is pressed over the bank outside Wollaston Foreland, and passes with comparatively small velocities and varying directions along the slack slope of the shelf, until it is again pressed over the bank outside Bontekoe Island in Foster Bay and attains greater velocities along the continental slope, which again is steeper here.

c. Distribution of Temperature and Salinity in the Polar Current.

The distribution of temperature and salinity in the sections is naturally closely related to the current conditions. Between stations far out in the current and those near land, a considerable difference in the distribution of temperature and salinity exists.

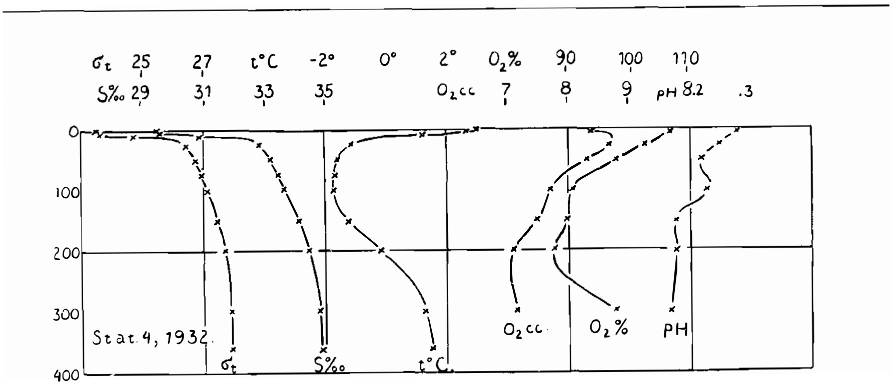

Fig. 6. Vertical distribution of observed elements and σ_t at Stat. 4, 1932.

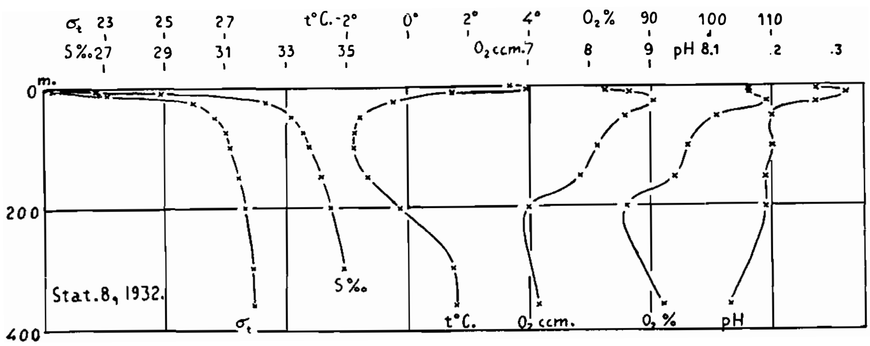

Fig. 7. Vertical distribution of observed elements and σ_t at Stat. 8, 1932.

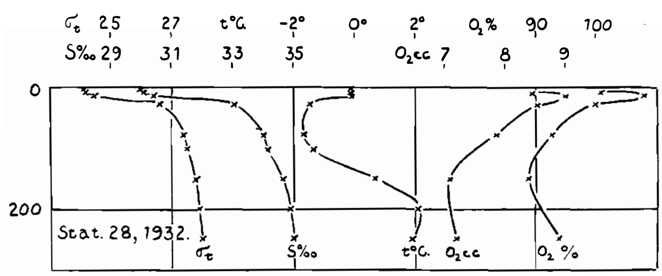

Fig. 8. Vertical distribution of observed elements and σ_t at Stat. 28, 1932.

The variations of temperature in the sections are very small as compared with those of salinity, and since, furthermore, the temperature has but little influence on the specific volume at low temperatures, the isohalines and the isosteres have nearly similar forms.

The total of the East Greenland Polar Current must be conceived as a barocline cover layer. Owing to the current, the layers slope to the right, and are on the whole, situated lowest at the stations where the quantity V has the highest values. In Sect. III, Stats. 14 and 26 have

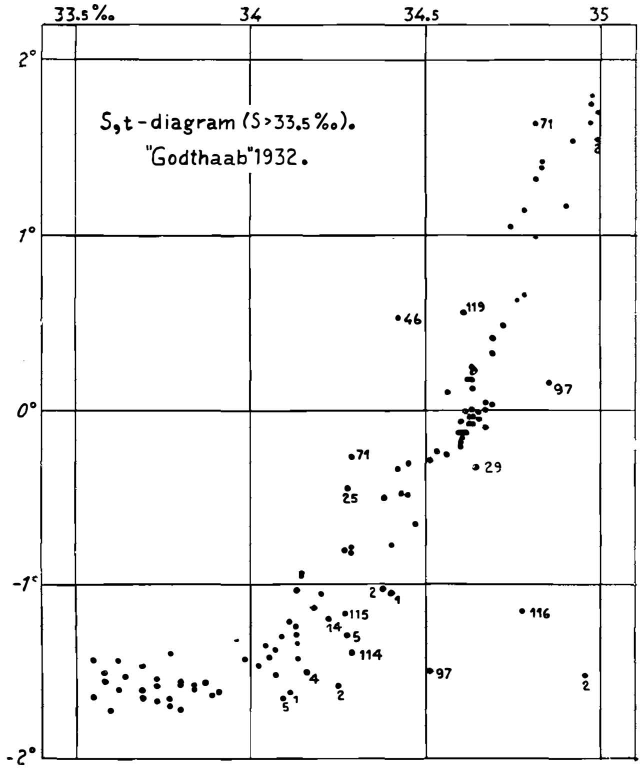

Fig. 9. *S*,*t*-diagram, "Godthaab", 1932.

high values of this quantity, and the isosteres and the isohalines are situated deeper. The value of the quantity *V* shows the situation of a station in relation to the current; in the sections, this value is therefore indicated above the station numbers.

The boundary between the Polar water and the Atlantic water, lies as shown above, nearly at 0 ° C and 34.5 ‰. It appears from the sections that the extent of the P. W. layer is greatest on the right hand side of the current (where *V* is high).

Figures 6, 7 and 8 show the distribution of the various observed elements and σ_t at Stats. 4, 8 and 28, 1932. Stats. 4 and 8 are situated at the mouth of Franz Josef Fjord and Davy Sound respectively. Stat. 28 is situated on the continental shelf. The salinity in the surface water of the Polar Current is comparatively low on account of the melting of the ice. It increases rapidly down to a depth of 25—50 metres, where it is about 33 ‰, further down it increases more slowly. The 34.5 ‰ isohaline (which approximately coincides with the 0 ° isotherm) is at Stat. 28 situated at a depth of about 135 metres and at Stats. 4 and 8, at depths of about 200 and 210 metres respectively. At Stat. 28 the 35 ‰ isohaline is reached at a depth of 250 metres.

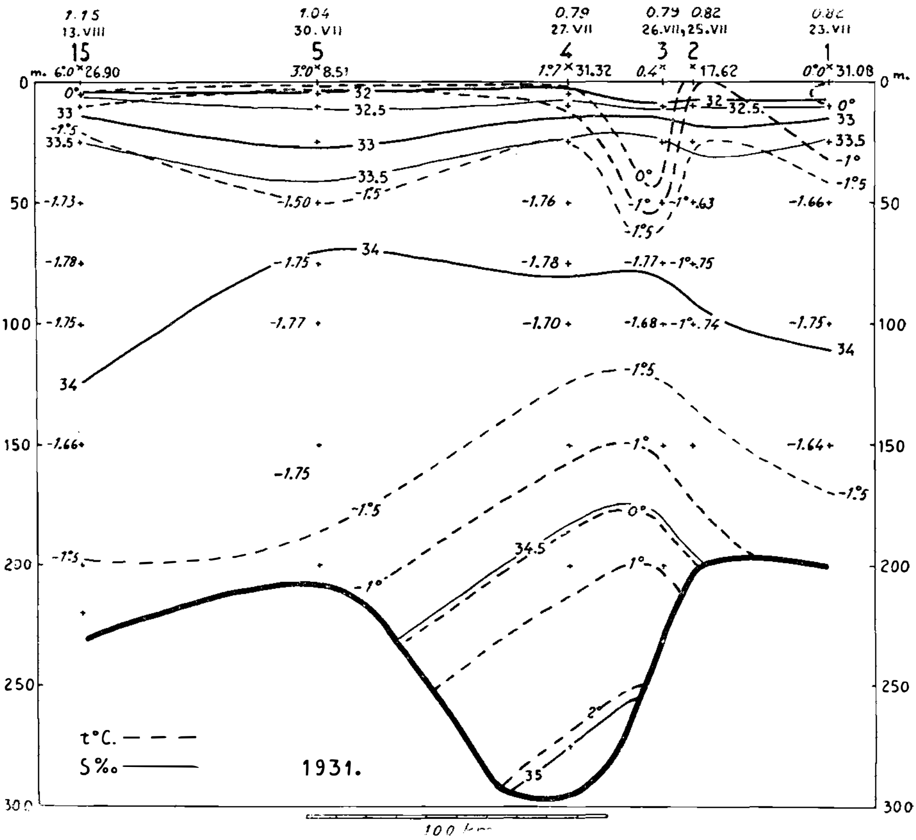

Fig. 10. Section I a, 1931. Temperature and salinity.

(Spärck [1933] finds that the Polar Current decreases in thickness from north to south, and bases this fact on the circumstance that, whilst the temperature outside Bontekoe Island in Foster Bay and off the mouth of Davy Sound is positive from a depth of 225 metres, he finds the temperature negative down to a depth of 300 metres in the submarine fjord outside Gael Hamke Bay. He gives the temperature as — 1.52 ° C and the salinity as 34.96 ‰. The latter value appears correct, but from my *S,t*-diagram for 1932 (Fig. 24, Page 51) the temperature would seem to be wrong. The error is perhaps due to a wrong sign introduced in the reading of the temperature.

In my discussion I have only to a small extent availed myself of the hydrographic observations of the Danish Expedition in 1932. Spärck does not mention anything about the hydrographic methods used, as biological investigations have been his main object, and hydrographic observations are as a rule only taken from a few depths at each station. In Fig. 9 I have plotted the observations from the "Godthaab" stations in a *S,t*-diagram. Comparing this diagram with my *S,t*-diagram in Fig. 24 it is seen that the Danish observations appear to be inaccurate. Direct comparisons of the observations from the inner deep-basins from the two expeditions seem to show that it is particularly the *salinity* determinations which are inaccurate.)

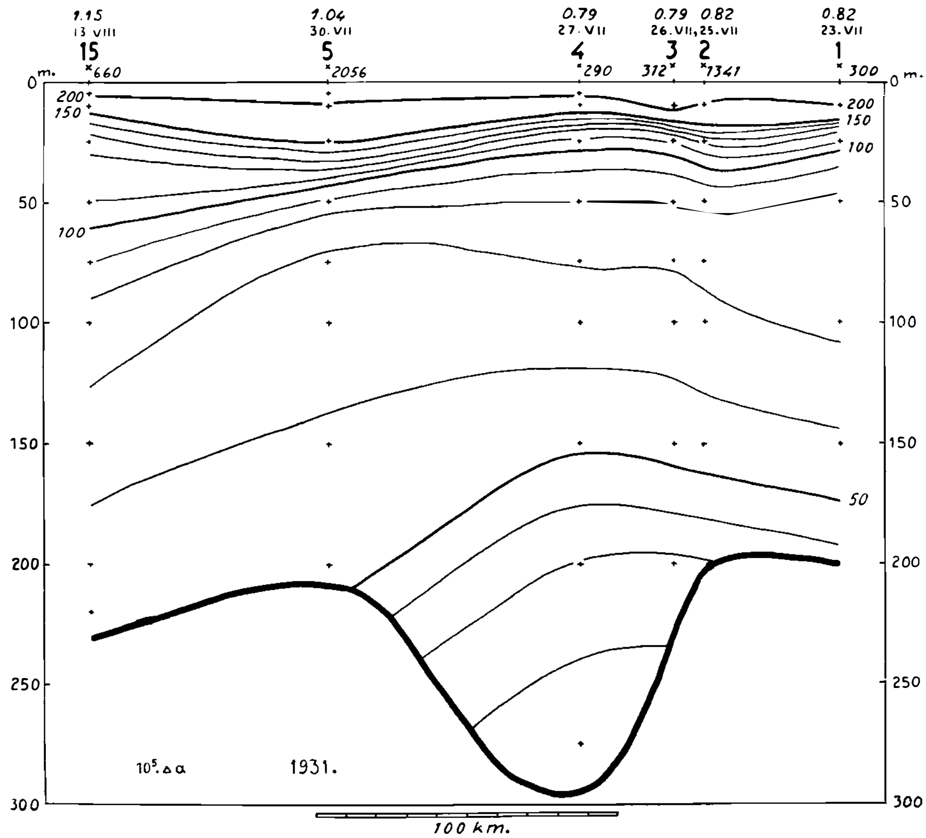

Fig. 11. Section I b, 1931. Anomaly of specific volume.

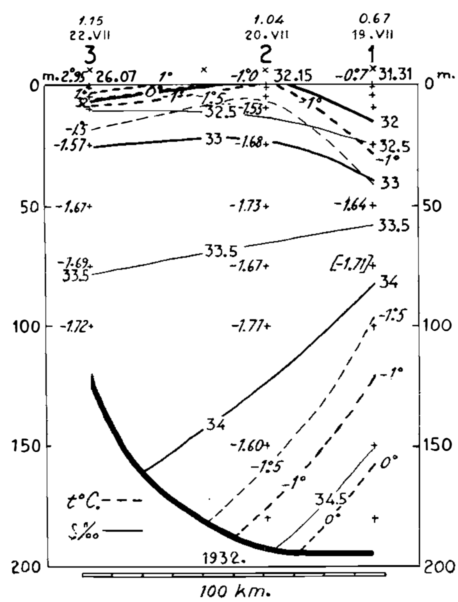

Fig. 12.

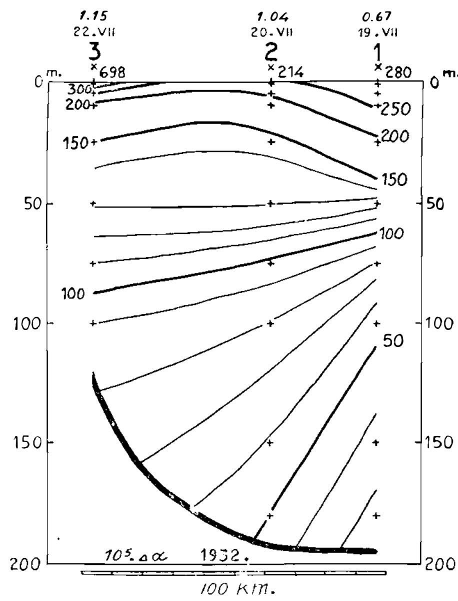

Fig. 13.

Fig. 12. Section II a, 1932. Temperature and salinity.
Fig. 13. Section II b, 1932. Anomaly of specific volume.

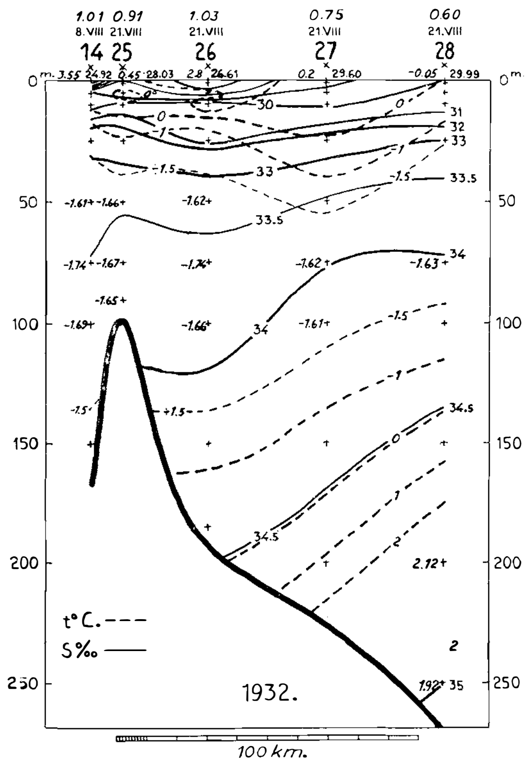

Fig. 14. Section III a, 1932. Temperature and salinity.

The temperature at the surface is about 0 ° C — it is in some instances a little higher at the stations taken in clearings in the drift-ice, where the solar radiation has been effective. The temperature decreases rapidly to below — 1.5 ° C at depths of 25 to 50 metres and is at a minimum of —1.65° to —1.80° C at depths of 75 to 100 metres. This minimum is lower and is situated deeper on the right hand side of the current than on the left. That the minimum is lower on the right hand side of the current can be explained by the fact that the velocity is here smaller and the mixing less effective. Further down the temperature increases, and as the water below the lower — 1.5 ° isotherm is a mixture of P. W. and A. W., the 0 ° isotherm is continuously in the proximity of the 34.5 $^0/_{00}$ isohaline, and the 2 °-isotherm in the proximity of the 35 $^0/_{00}$ isohaline.

Section I a in 1931 (Fig. 10) shows considerable variations of temperature and salinity in the surface layer. This is due to the fact that the distribution of the ice in 1931 had a special character, the polar-ice being composed of giant-floes, and the clearings, where the stations are taken, therefore had a tendency to remain open. In these clearings melting water accumulated, and was heated by radiation. The unusually

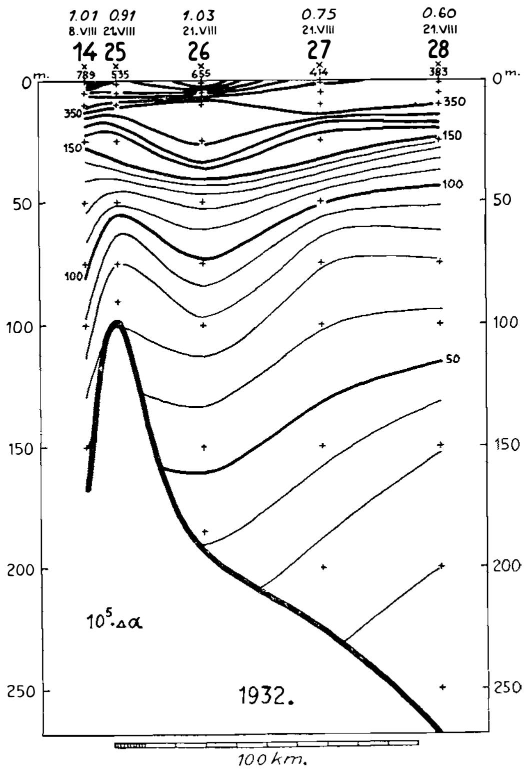

Fig. 15. Section III b, 1932. Anomaly of specific volume.

low surface salinity at Stat. 5, which is taken in a clearing in the middle of the ice after a period of fog, is obviously due to the melting of the ice in this period of small supply of radiant heat. Stat. 3 is taken outside the ice-edge in an ice-bay, after a long period of clear weather. Here, the heating can be traced to a depth of more than 50 metres. The fact that the temperature at the surface is not higher, must be due to the influence of the melting water.

Section II a in 1932 (Fig. 12) shows an admixture of melting water and heating at the surface at Stat. 3, which is situated in the shore-lead. At Stat. 1, the iso-lines of the surface layer are situated considerably deeper than at Stat. 2.

Section III a in 1932 (Fig. 14) shows fairly uniform salinity at the surface. The drift-ice was that year much more broken, and so late in the summer the melting of the ice was comparatively far advanced. Furthest to the left in the current, the surface salinity is higher and the surface temperature is lower than further to the right (*V* higher) where there is admixture of fjord-water. The heating of the water in the upper 50 metres has varied in the different parts of the section, and this difference must be due to varying ice conditions.

d. Oxygen Conditions in the Polar Current.

The oxygen content in the sea water increases by absorption from the air and owing to the photosynthetic activity of the phyto-plankton. It decreases by the respiration of the marine organisms, and by processes of oxydation. In the top layers, the water may become supersaturated with oxygen on account of the photosynthesis. At the surface itself, the oxygen percentage will be 100, but given calm weather and great stability of the surface layer (a great vertical gradient of density) a sample from the surface, which always includes water from *a little below* the surface as well, will show over 100 in percentage saturation because the water under the surface is supersaturated with oxygen.

Oxygen content and percentage saturation are shown in Sects. II d and III d. The vertical distribution at Stats. 4, 8 and 28, 1932, is seen from Figs. 6, 7 and 8. There are no observations from the surface; the water is supposed to be saturated with oxygen, and the computed values are entered in the tables, where they are enclosed in brackets. The oxygen content is about 8 cc/L. Under the surface it increases to a maximum which on the left side of the current (Stat. 28) lies at a depth of about 10 metres, whilst on the right side of the current it is situated at a depth of about 25 metres. Below this depth, the content of oxygen decreases to a minimum at a depth of from 150 (Stat. 28) to 200 m, and then, it increases slightly. The vertical distribution of the percentage saturation is about the same. The most important difference is that the percentage saturation increases more in the Atlantic water. In the warm water, the saturation oxygen content is smaller, and therefore the percentage saturation is greater.

In a diagram, corresponding to a *S,t*-diagram I have plotted the observations of oxygen against the corresponding salinity observations. Each observation of oxygen is represented by a dot. These dots do not gather along a marked line as the *S,t*-dots do, because the content of oxygen is not a conservative quality of the sea-water, as it depends on the bio-chemical processes. The S,O_2-points accumulate along a broad belt, and those values, which for no obvious reason fall decidedly outside of this belt, may be supposed to be erroneous. In this way I have been able to omit unreasonably high values at 100 metres, Stat. 14, 1932 and 200 metres, Stat. 28, 1932, as being erroneous.

Very little has been published about the distribution of oxygen in the northern part of the Norwegian Sea. Åkerblom [1904] has published some oxygen determinations which are fairly coincident with those from the "Polarbjørn" in 1932. He points out that the content of oxygen is not far from saturation in the East Greenland Polar Current, and that supersaturation appears at the depths of 10 and 25 metres.

In *Bulletin Hydrographique* [1931 and 1932] tables are printed for some stations from the "Johan Hjort" (*Fiskeridirektoratet*, Bergen) from the Norwegian Atlantic Current outside Lofoten in 1931 and in the waters between the northern coast of Norway and Bear Island and farther west in 1932. It appears from these tables, and especially from those for Stat. 137, 1931 (April 23, 68 ° 55 ′ N, 12 ° 45 ′ E) and for Stat. 385, 1932 (July 6, 74 ° 34.5 ′ N, 15 ° 00 ′ E, depth 1100 metres) that the oxygen content in the Atlantic Ocean is very homogeneous, and remains at about 7 cc/L, and just below 100 %.

At Stat. 137 Atlantic water (S > 35 ‰) is present from a depth of 25 m and down to 630 m (deepest observation; the depth at the station is not indicated). The oxygen content and percentage saturation in A. W. varies between 7.05 cc/L, 102 % (at a depth of 25 m) and 6.64 cc/L, 96 %.

At Stat. 385, A. W. is present from the surface and down to a depth of 600 m and the oxygen content and percentage saturation vary between 7.46 cc/L, 108 % (surface) and 6.84 cc/L (100 metres), 92 % (600 metres). In the pure A. W. the limits are 7.16—6.84 cc/L and 98—94 %.

On the whole, the Atlantic water has a percentage saturation very close to saturation in the Norwegian Atlantic Current as far north as Stat. 385 west of Bear Island.

Sverdrup [1933] has published the observations at the "Nautilus" stations north and north-west of Spitsbergen. Of these, Stat. 8 (September 5, 81 ° 01 ′ N, 4 ° 15 ′ E, 735 m) is situated on the southern slope of the Nansen Ridge between West Spitsbergen and Greenland, or, in the region of that part of the Atlantic Current which later forms the warm layer under the East Greenland Polar Current. At this station, A. W. appears from a depth of 200 metres down to 450 metres. The content of oxygen is slightly smaller than outside Lofoten and west of Bear Island. It varies between 7.02 cc/L (200 m) and 6.72 cc/L (450 m), disregarding the value 6.34 cc/L (345 m) which is perhaps incorrect, for the lowest value of oxygen content otherwise to be found in A. W. at the "Nautilus" stations is 6.70 cc/L and the highest 7.02 cc/L. The percentage saturation at Stat. 8 varies between 96 % (200 m) and 89 % (450 m) (disregarding the value 85 % at 345 m), thus it is a little less than for the two "Johan Hjort" stations, but this is mainly due to the fact that the temperature of the A. W. has fallen from between 6.43 ° and 4.63 ° C outside Lofoten and between 5.44 ° and 3.46 ° C west of Bear Island to between 3.24 ° C and 2.11 ° C, and in less measure to the fact that the content of oxygen itself has decreased.

The observations of oxygen from "Polarbjørn" 1932 show an oxygen content of about 7 cc/L in A. W. with a salinity of 34.5—35 ‰

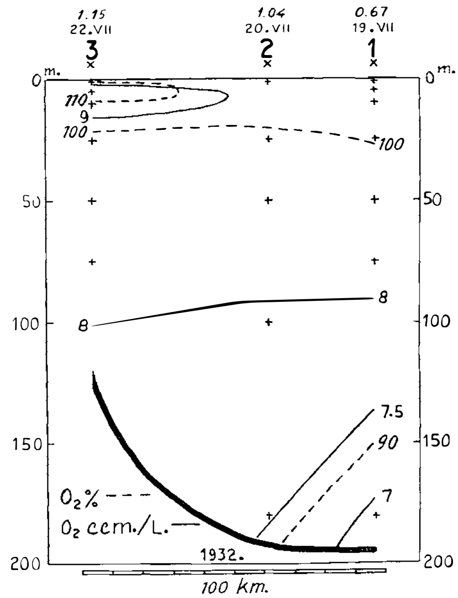

Fig. 16. Section II d, 1932. Content of oxygen and percentage saturation.

(where A. W. is mixed with P. W.). The percentage saturation is about 90. At 250 m, Stat. 28, the oxygen content is 7.20 cc/L, and the percentage saturation 94. These values seem somewhat high in relation to the above-mentioned observations from the "Nautilus" and the "Johan Hjort". In the Polar water, the oxygen content is decreasing from abt. 9 cc/L at salinity 33 ‰ to abt. 7 cc/L at 34.5 ‰. Sverdrup has obtained similar values at the "Nautilus" Stat. 4 in 81 ° 50 ′ N, 21 ° 30 ′ E, Aug. 30. 1931 in the Polar Sea, north of the North-East Land of the Spitsbergen Archipelago.

Section II d (Fig. 16) shows supersaturation of oxygen down to a depth of about 25 m. On the right side of the current, the supersaturation is greatest. This is perhaps due to a supply from land of nutrients offering favourable conditions for phytoplankton. It may also be due to the fact that on the right side of the current, the ice is more open, so that the solar radiation has free access and the photosynthesis is increased, or perhaps both effects may be present. Sverdrup [1929] has shown how in the surface layers on the North Siberian Shelf the oxygen content increased rapidly after the ice had broken up, and that a cover of ice reduces the development of phytoplankton.

The maximum of oxygen lies in Sect. II d at a depth of from 5 (Stat. 1) to 10 (Stat. 3) metres. The highest values are 9.21 cc/L (10 m) and 113 % (5 m) at Stat. 3. At greater depths, the iso-lines for O_2 cc/L and O_2 % have roughly the same course as the isotherms

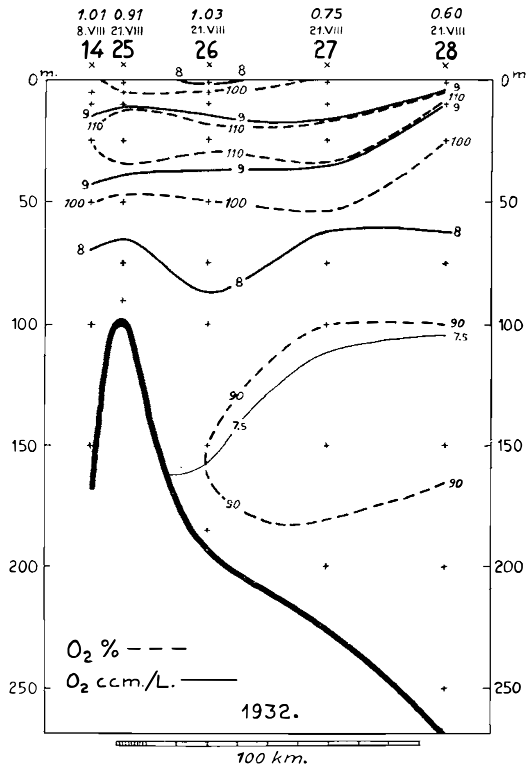

Fig. 17. Section III d, 1932. Content of oxygen and percentage saturation.

and isohalines in section II a. In A. W. there is about 7 cc/L and more than 90 % O_2.

Section III d (Fig. 17) shows somewhat altered conditions. This section is taken about one month later in the summer (with the exception of Stat. 14). Supersaturation of oxygen in this section is found as far down as about 50 metres and attains again a greater depth on the right side of the current, than on the left. At Stat. 28, the supersaturation reaches a depth of only 25 m. The maximum lies at a depth of 25 m except at Stat. 28, where it lies at a depth of about 10 m. The highest values are found at Stat. 25, at a depth of 25 m 9.82 cc/L and 116 %.

Farther down, the iso-lines for oxygen content and percentage saturation follow the isohalines and isotherms respectively, but the iso-line for 90 % saturation deviates somewhat. It encircles an area with minimum percentage saturation from a depth of 100—175 m which is barely touched by Stat. 26. The lowest value is 7.08 cc/L, 89 % which is found at a depth of 150 m at Stat. 28. At Stat. 27, 89 % is found at a depth of 150 metres. Here, the oxygen content is 7.29 cc/L.

The observations of oxygen from the East Greenland Polar Current show that the oxygen content in the Polar water proper corresponds to the conditions at the stations taken in the Polar Sea. The oxygen content in the underlying Atlantic water is unessentially different from the conditions in the Norwegian Atlantic Current outside of Lofoten, west of Bear Island, and north-west of West-Spitsbergen. The oxygen content at a depth of 250 metres at Stat. 28 is somewhat high, but the value may be erroneous, and it cannot disprove the conception that the warm layer under the Polar Current is a branch of the Norwegian Atlantic Current which has followed the southern slope of the Nansen Ridge, and then have submerged under the light Polar water. Besides, there is reason to believe that the conditions were extraordinary in the warm Atlantic water under the Polar Current in 1932, corresponding to the exceptional conditions in the Sognefjord Section in 1929, as pointed out by Helland-Hansen [1934]. (Compare page 61.)

Sections II d and III d also show that there has been a very considerable photosynthetic activity of the phytoplankton during the summer month that elapsed between the two sections being taken. During that time the ice has been exposed to considerable melting, and there has been more opportunity for penetration of solar radiation. At the end of August, the layer of supersaturation has attained twice the thickness of that at the end of July.

III. The Fjords.

a. The Water in the Fjords.

All the fjords dealt with in this paper are more or less marked threshold-fjords, and the hydrographic conditions of the fjords depend on this. The saddle depths of the thresholds determine the character and the renewal of the water masses which fill the inner deep-basins. The vertical distributions of salinity, temperature, and density, are roughly the same in the fjords as off the coast, with the differences that are due to the thresholds. Fig. 18 shows a station diagram for Stat. 16, 1932, in Geologist Fjord, which at the entrance has a threshold with a saddle depth of about 75 metres, and from this depth and to the bottom the water is almost homogeneous. The fjord has depths of down to 700 metres. The exact saddle depths of the thresholds can only be determined by means of detailed soundings. Even an exact length-profile of a fjord may give erroneous values for the saddle depths, if the profile has, accidentally, not been placed correctly at once. As an instance can be quoted Spärck's erroneous values for the saddle depths of Dusén Fjord and Clavering Fjord, mentioned on page 12. Spärck [1933] gives some hydrographic sections with profiles of the fjords. In

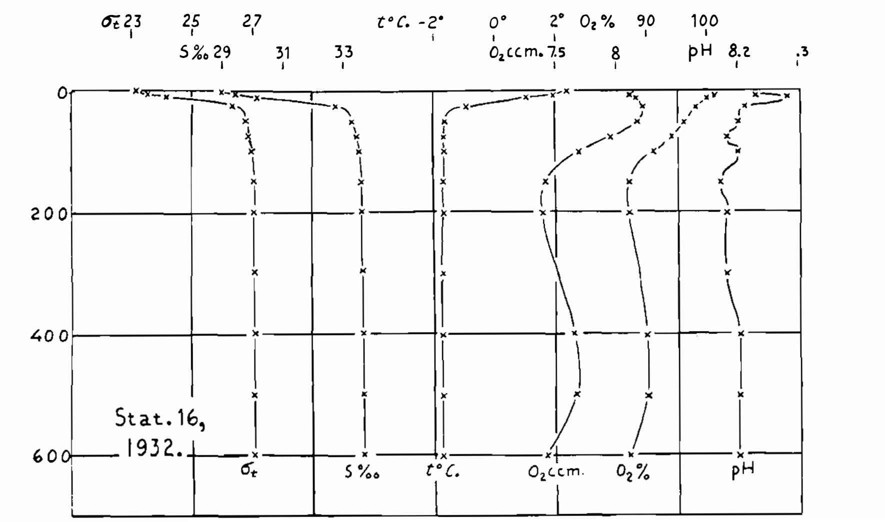

Fig. 18. Vertical distribution of observed elements and σ_t at Stat. 16, 1932, Geologist Fiord.

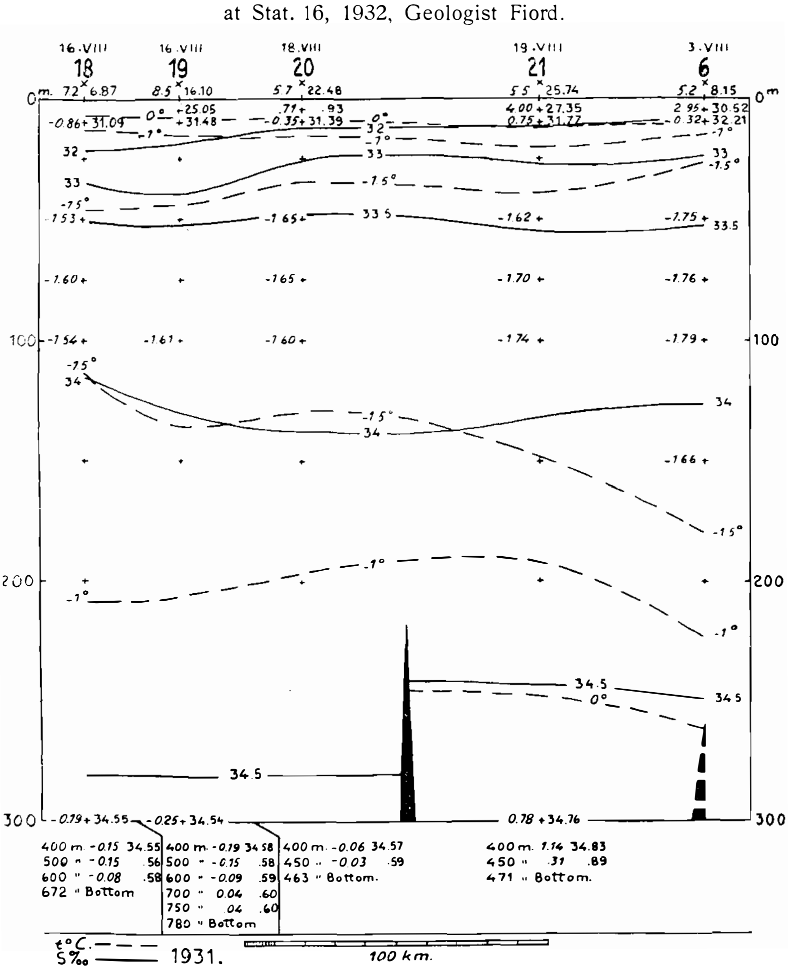

Fig. 19. Section IV, 1931. Temperature and salinity.

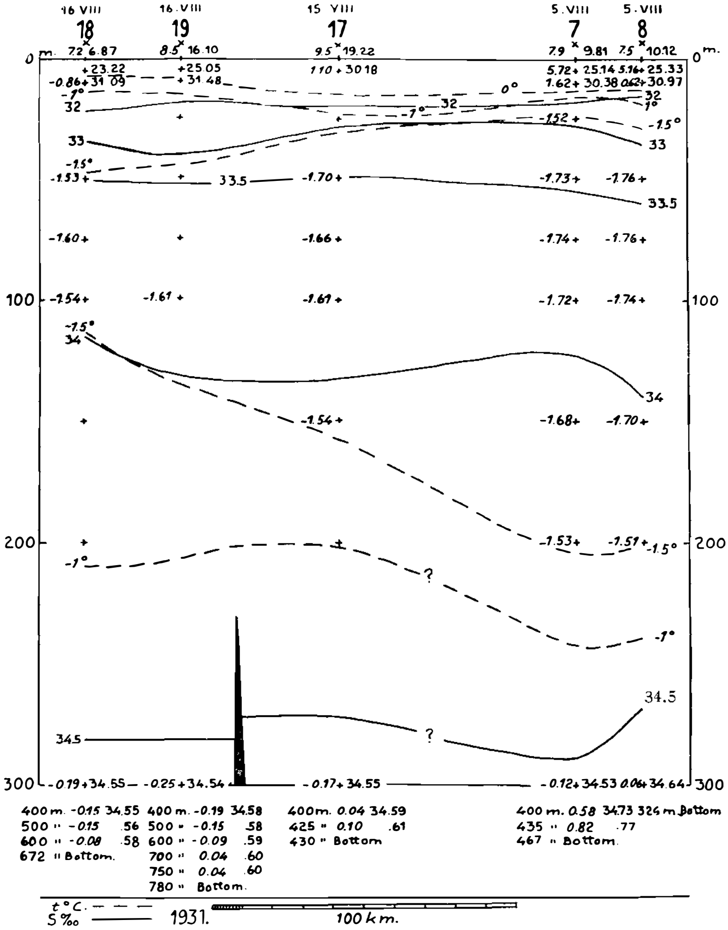

Fig. 20. Section V, 1931. Temperature and salinity.

my vertical sections along the fjords, IV, V and VI, I have used the thresholds which are plotted there.

The position of the sections appears from the station chart (Plate 2). Sect. IV (1931) is taken along Franz Josef Fjord with Stat. 18 at the very head of the fjord, and Stat. 6 in Foster Bay. Sect. V (1931) goes also from Stat. 18 at the head of Franz Josef Fjord, but is continued through Antarctic Sound and King Oscar Fjord to Stat. 8 some distance out in Davy Sound. Finally Sect. VI (1932) goes from Stat. 8 utmost in Davy Sound through King Oscar Fjord, Antarctic Sound, and Franz Josef Fjord to Stat. 4 at the mouth of this fjord.

As to the water masses that lie higher than the thresholds, the sections of salinity and temperature IV, V and VI a (Figs. 19, 20 and 21), show very uniform conditions in the various parts of the Franz Josef Fjord Complex. The most striking feature is that the isotherms

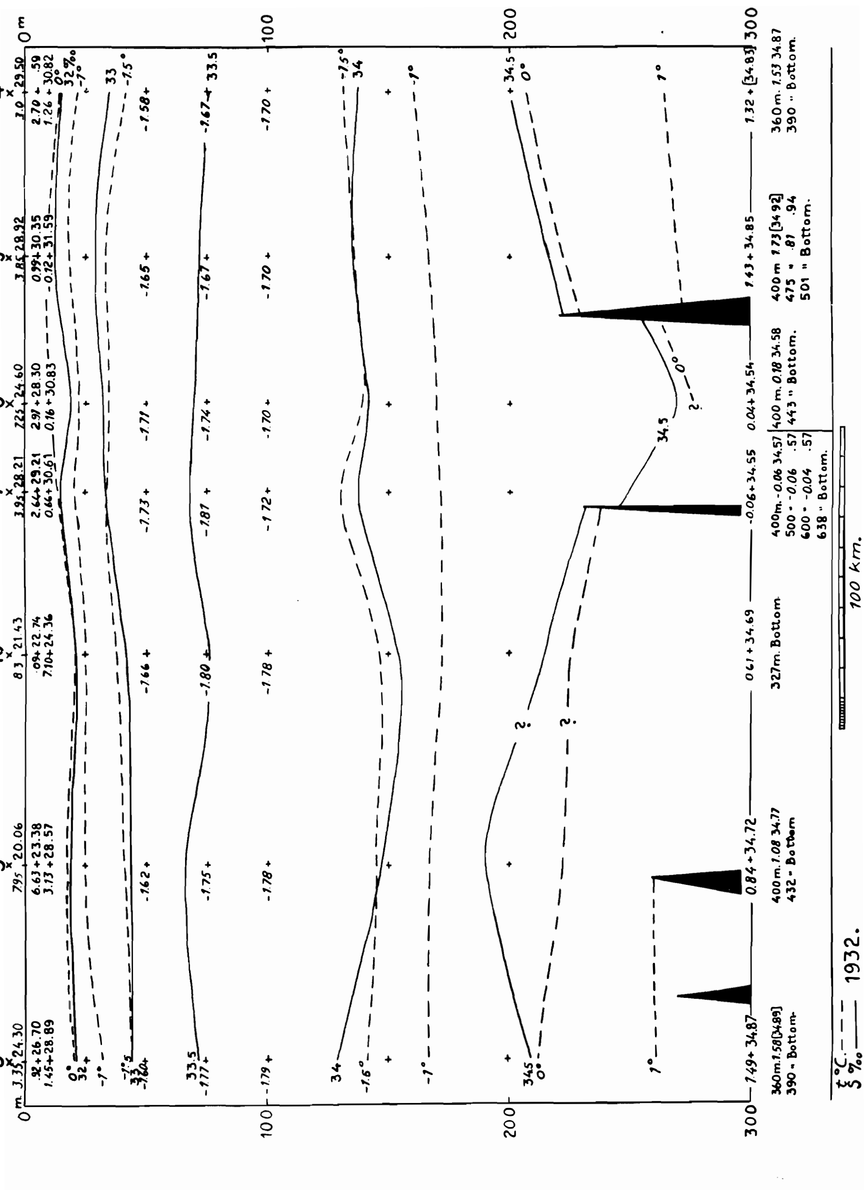

Fig. 21. Section VI a, 1932. Temperature and salinity.

— 1.5 ° and — 1 ° are sinking below the isohaline 34 ‰ to the right in Sects. IV and V in 1931. In these sections the effect of the supply of melting water is also noticeable, particularly at Stat. 18. The effect is seen as highly reduced surface salinity and an upward tendency of the 34 ‰ isohaline and — 1.5 ° isotherm. In Sect. VI, 1932, one can see how the iso-lines bend down at Stat. 10. I shall return to these circumstances later on.

b. Variations of the Surface Level due to Supply of Melting Water, Wind Stowing and Variations of the Air Pressure.

In order to give an idea of the level of the surface at the different localities of the fjord, Table 7 shows how much greater (h dynamic cm) the height of the surface over the 200-decibar surface is at various stations in the Franz Josef Fjord Complex as compared with Stat. 21 in 1931 and Stat. 5 in 1932. No threshold obstructs the free exchange of the water masses down to the 200-decibar surface, and if one can suppose this layer to coincide with a level surface, the value h will give the difference of level of the sea-surface.

Table 7.
Level Differences in Dynamic Centimetres.

	Stat.	6	7	8	17	18	19	20	21		
1931	h	1.5	5.1	5.6	3.6	6.5	4.2	2.9	0.0		
	Stat.	4	5	6	7	8	9	10	11	18	19
1932	h	1.3	0.0	2.9	1.7	5.5	9.6	12.7	14.2	5.0	1.4

Even if, as a rule, h is greater for the stations that are situated at the head of the fjord complex, than for those which are situated farther out, it is evident from Table 7 that there may be considerable local variations in the level. We shall deal further with these variations and their causes.

Stats. 18—21 in 1931 are taken during a period of very constant and calm weather conditions. There was a light air blowing down the fjord, but locally the wind might be a little stronger (foehn). Stats. 18—21, however, are all taken in calm weather. The quantity h decreases evenly down the fjord from Stat. 18 to Stat. 21. The difference in h between these stations is 6.5 dynamic cm on 150 km. This difference is apparently due to the supply of melting water from the glaciers. If the wind has had any effect those days, it must have been towards diminishing the differences in h. From Sect. IV, one can see the influence of the melting water on the top layers at Stat. 18. A computation of how much greater the height of the surface over the 25-decibar surface is at Stats. 18, 19 and 20, than at Stat. 21, gives 6.1, 3.4 and 2.6 dynam. centimeters respectively, which shows that it is the decrease of the density through admixture of melting water in the top layer which produces the difference of level of the sea-surface. As a consequence of the supply of melting water, there will be a current down the fjord in the surface layer, and as the upper layers are sloping on account of the difference of level the deeper layers will slope in the opposite direction, and in the greater depths there will be a weak reaction current running up the fjord.

Under other wind conditions, the variations in level will be quite different, as shown by Stat. 4—10, 1932 (Sect. VI). To illustrate the wind conditions, it is not possible to give figures that are representative of the whole of the Franz Josef Fjord Complex, because the observations of wind from the Norwegian meteorological station at Myggbukta or from the fjords are mainly dependent on the local topographical conditions. However, the synoptic weather charts from *Vervarslingi på Vestlandet,* Bergen, show that the weather was very calm during the last days of July 1932, whilst from Aug. 1, an easterly wind was blowing for 2½ days with a force up to 5 Beaufort. Stats. 4—7 are taken under calm weather conditions, and show small differences of level. If there has been any wind, it must have been down the fjord, and it has contributed to carry away the lighter water and smooth out the differences. Stats. 8—11 are taken after the breeze blowing towards land has stowed the water. The difference of level between Stats. 8 and 10 is 7.2 dynamic cm at a distance of 135 km. At Stat. 10, at a depth of 10 metres the water has an unusually low salinity, 24.36 ‰ and high temperature, 7.10 ° C. From Sect. VI a (Fig. 21) the result of the stowing is clearly seen in the course of the iso-lines at Stat. 10. Between Stats. 10 and 7 which are 54 km apart, the level difference is 11.0 dynamic cm, but during the time which has elapsed between these two stations, the wind has totally altered the picture. From Table 7, one can see that the stowing is still greater at Stat. 11 in Sofia Sound. Here, the salinity is only 23.88 ‰, and the temperature 6.88 ° C at a depth of 10 metres.

The influence of the wind on the level appears to be of the same order of magnitude as the influence of the supply of melting water in the summer. The wind will produce currents, directly as well as by stowing, but as regards the fjords, these conditions are not sufficiently elucidated, and direct measurements of the current are needed in order to draw quantitative conclusions. Nevertheless, we shall discuss the conditions at Stats. 17—19, 1932 still further. As one can see from Table 7, the difference in level between Stats. 18 and 19 is 3.6 dynamic cm at a distance of 4.4 km. Stats. 17—19 are taken across Franz Josef

Fjord in the course of 4 hours, when a fresh south-easterly breeze was blowing, which would produce a stowing at Stat. 17. The fjord is about 10 km wide where the section is taken. From Table III (Tables of results), one sees that at a depth of 10 metres at Stat. 17, $t = 4.80\,°$, $S = 27.55\,‰$ and $\sigma_t = 21.83$; at Stat. 18, in the middle of the fjord, $t = 3.03\,°$, $S = 29.00\,‰$ and $\sigma_t = 23.13$; and at Stat. 19, off the south-western shore, $t = 1.25\,°$, $S = 31.38\,‰$ and $\sigma_t = 25.15$. In other words, all the lighter water has been accumulated along the north-eastern shore of the fjord. The surface and the lighter top layers will thereby slope towards the north-east, and, as a compensation, the deeper layers will slope the opposite way. The solenoidal field which is established will cause currents along the fjord. As the conditions are decidedly not stationary, it is not correct here to use Helland-Hansen's formula (1), but as there is no possibility of calculating the acceleration of the circulation, I have below (Table 8) computed the current which would have been present if the conditions had been stationary. The current is calculated in relation to the 150-decibar surface. Positive

Table 8.

Velocities through the Section. Stats. 17—19, 1932.

Depth	0	5	10	25	50	75	100 m
Stats. 17—18	7	8	4	—8	—2	—1	—2 cm/sec.
» 18—19	58	43	27	0	—5	—5	—3 »

figures give current up the fjord. Between Stats. 17 and 18, no considerable current had been developed, probably due to the fact that the solenoidal field was not distinctly developed at the time when Stat. 17 was taken. Between Stats. 18 and 19 the current is fairly strong up the fjord at the surface, 58 cm/sec.; at a depth of 25 m the velocity is zero and at depths of 50—100 m a weak current runs down the fjord. The water at 150 m can be assumed to be at rest as calculations show that it has no motion relative to the water at 200 m.

In the same way the transport can be computed for stationary conditions. Calculations by means of Formula 4 give the result that between Stats. 17 and 19, only 1300 m^3/sec. is conveyed up the fjord. However, if we compute the transport down to only 25 metres, we get 38 000 m^3/sec. on the assumption that the average velocity at this depth is zero, but since it is —4 cm/sec., the quantity 0.04 . 25 . 8 800 m^3/sec. = 8 800 m^3/sec. must be subtracted. The result is a transport up the fjord of 29 200 m^3/sec., of which 27 300 are transported between Stats. 18 and 19. Between 25 and 150 m, an almost corresponding quantity 27 900 m^3/sec., is conveyed down the fjord. A summary of the transport through the section Stats. 17—19, 1932, is given in Table 9, where the positive figures give the flow up the fjord, and the negative down the fjord.

Table 9.

The Water Transport through the Section. Stats. 17—19, 1932.

	0—25 m	25—150 m	0—150 m
Stats. 17—18	1 900 m^3/sec.	—14 800 m^3/sec.	—12 900 m^3/sec.
» 18—19	27 300 »	—13 100 »	14 200 »
» 17—19	29 200 »	—27 900 »	1 300 »

The transport up the fjord goes mainly between Stats. 18 and 19, and in the upper 25 m. Down the fjord, the transport takes place across the whole width of the fjord in the deeper layers from 25—150 m.

Under approximately stationary conditions, the stowing of the surface water by the wind should thus lead to considerable movements of the water masses.

A change of the air-pressure differences will also cause movements of the water masses. An air-pressure difference of 5 millibar between 2 stations at a distance of 200 km (corresponding roughly to a force of wind of 5 Beaufort at the ground) will produce a difference in the surface level of about 5 cm between the two stations. This difference of level is not included in the computation of differences between the dynamic depths of the isobaric surfaces at the stations. Level differences produced by air-pressure differences are of the same order of magnitude as level differences produced by wind and by the admixture of melting water in the summer.

c. The Temperature and the Salinity of the Surface Layer.

For those stations where there are observations from the surface and from 5 and 10 metres, I have calculated the average temperature (t_{10}) and salinity (S_{10}) for the upper 10 m (Table 10). A temperature, t_{10}, above 5 ° C is found at Stats. 9, 10, 11, 12, 15 and 24 in 1932, and at Stat. 7 in 1931. At all these stations, S_{10} is below 25 ‰, with the exception of Stat. 24. At Stats. 8 and 20 in 1931 and 11, 12 and 14 in 1930 S_{10} is also below 25 ‰ but t_{10} is below 5 ° C.

At Stats. 9—11, 1932, the extraordinary conditions are caused by stowing due to the wind. The temperature is particularly high at Stats. 10 and 11, without the salinity being reduced correspondingly. Heating due to radiation will not reach far down, and because the stability is great near the surface, the heated water will not to any great extent mix with the underlying water. When, in spite of this, the temperature in the upper 10 m is so evenly high, as at Stats. 10 and 11, this is

Table 10.
Average Temperature (t_{10}) and Salinity (S_{10}) of the Upper 10 Metres at the Fjord Stations.

Year	Stat.	t_{10}	S_{10}	Year	Stat.	t_{10}	S_{10}	Year	Stat.	t_{10}	S_{10}
1930	11	4.17	24.17	1931	21	3.56	28.05	1932	13	4.62	26.49
	12	2.89	24.00	1932	4	2.42	29.88		15	7.61	16.97
	13	3.08	26.38		5	1.43	30.30		16	1.86	29.48
	14	3.97	24.13		6	3.31	28.01		17	4.94	27.29
	16	4.01			7	2.47	29.31		18	4.80	27.54
1931	7	5.24	22.75		8	3.16	26.65		19	2.95	29.83
	8	4.61	22.94		9	6.08	23.85		21	3.02	26.38
	9	2.81	29.16		10	7.89	22.82		22	2.57	28.75
	18		21.10		11	8.78	22.39		23	1.59	30.76
	19		24.42		12	6.28	21.01		24	5.90	26.82
	20	4.19	24.93								

apparently due to the fact that a thin surface layer from a great area has been stowed by the wind at a smaller area.

Similar conditions prevail in Granta Fjord innermost in Clavering Fjord, where Stat. 12 is taken a few days later, but after the stowing, there has apparently been a supply of cold melting water here, which has reduced the temperature and salinity in the surface.

At Stat. 15, 1932, at the head of Muskox Fjord, the salinity is very low, on an average only about 17 ‰ for the upper 10 m. The fjord is long and narrow, and the fresh water supply is not led away quickly. Besides, the salinity is low at the mouth of the fjord as well, as can be seen from Table 10, for Stat. 11, 1930. At the east side of Waltershausen Glacier in North Fjord, a large glacier river flows out, and therefore the salinity at the mouth of Muskox Fjord will be considerably reduced in the upper layers.

Stat. 24, 1932, is taken a little inside the mouth of Dusén Fjord. S_{10} is nearly 27 ‰ and t_{10} nearly 6 ° C. The fjord has no particular supply of melting water, but it is long and narrow, and the water in the surface layer is not so light that it flows away quickly.

Stat. 7, 1931, is situated not far outside the mouth of Segelsällskapet Fjord. At the surface the salinity is very low, 9.81 ‰, and the temperature high, 7.9 ° C, but these conditions are restricted to a fairly thin layer. At a depth of 5 m the salinity is already over 25 ‰, and at 10 m over 30 ‰. At Stat. 8, a little further down the fjord, conditions are similar and show an admixture of melting water at the surface.

At Stats. 18, 19 and 20 in 1931, S_{10} is below 25 ‰. Observations of temperature do not exist from 5 m at Stat. 18 and from 5 and 10 m at Stat. 19. From the salinity values and the conditions at Stat. 20, it is reasonable to suppose that the high temperature at the surface is limited to a thin surface layer only. As already mentioned, there is no stowing due to the wind here, but the salinity shows a considerable admixture of melting water.

Stats. 11, 12 and 14 in 1930, also show a low S_{10}, about 24 ‰, without t_{10} being particularly high. These stations are situated at the mouth of Muskox Fjord, at the west side of North Fjord (off the outlet of a river that does not directly come from a glacier) and at the mouth of Segelsällskapet Fjord respectively. There is no stowing of surface water, but a considerable admixture of melting water.

At the fjord stations 4, 5, 7, 16 and 23 in 1932, t_{10} is below 2.5 ° C and at Stats. 5 and 23, S_{10} is at the same time above 30 ‰, and at Stats. 4, 7 and 16, it is slightly below. At these stations the surface water has apparently been swept away by the wind.

The highest surface temperature is found at Stat. 17, 1931, in Antarctic Sound, 9.5 ° C, and the lowest at Stat. 16, 1932, in Geologist Fjord, 2.4 ° C.

In the East Greenland fjords, the surface water is continuously being formed by the supply of melting water from the glaciers, and is heated so considerably that temperatures up to 10 ° C are met with. At the surface the salinity may be very low, but increases rapidly downwards; at the same time the temperature decreases, so that the 0 ° isotherm and the 32 ‰ isohaline are found at a depth of somewhat more than 10 metres. This may be regarded as the average conditions at the end of July and at the beginning of August.

d. The Deeper Water Masses in the Fjords.

During the Danish "Danmark" Expedition to North East Greenland in 1906—08, Trolle [1913] investigated the seasonal variations in the sounds between Great Koldewey Island and Germania Land at about 76 ° 40 ′ N. He found that the salinity in the water layer 0—75 m increased in the course of the winter. The amount of salt which was separated when the ice was formed in the autumn, was not sufficient to account for the increase in salinity in the water layer 0—50 metres, and he therefore ascribes the increase to an admixture from deeper layers (page 371). During the autumn, when the formation of ice was most intense, the salinity of the surface was about 31 ‰. Something similar probably takes place in the fjords which are dealt with in the present paper, although conditions are very different from those in "Øresund". There, Trolle found an area of coastal water with low salinities, down to a comparatively great depth. The thickness of this coastal water layer at the mouth of "Øresund" varies considerably. In April—May, the 33 ‰ isohaline is situated at a depth of 160 metres, in August—September at 80 metres; and Trolle shows (*loc. cit.*, page 376) that this difference must be due to variations in the velocity of the

Polar Current. In the course of the winter the velocity increases, and owing to the rotation of the earth the slope of the layers becomes steeper, but in May—August the velocity and also the slope of the layers decreases, and near the coast the isohalines approach the surface. Ryder [1895, page 214] has found similar conditions in Scoresby Sound 1891—92. He finds that in the winter and in the spring the salinity in the deeper layers is lower than in August, but he makes no attempt to explain it, because he does not rely on the accuracy of the observations.

For the fjords dealt with in this paper, calculations show that even where the highest surface salinity occurs, an ice layer with a thickness of more than 3 metres must be formed to produce convection down to 75 metres, where, as a rule, temperature minimum is. However, when the formation of ice commences, the salinity at the surface will probably have increased because some of the surface water has been carried away and no fresh melting water has been supplied. But we cannot suppose that the water layer of minimum temperature has been formed in the fjords, as the ice formation is not sufficient. In the early summer after the ice has melted, the heating owing to radiation and admixture of warmer surface water will gradually penetrate downwards, but these processes will probably not affect conditions below 50 metres. The layer which is limited by the 33.5 ‰ and 34 ‰ isohaline is in Sects. IV, V, VI a and VII a situated between about 50 m and about 125—150 m and has a temperature below — 1.5 ° C. Here we have to deal with the Polar water proper.

e. Renewal of the Water studied by means of *S,t*-Diagrams.

In order to study the mixing of this P. W. with the underlying A. W. and compare with the conditions in the Polar Current itself, I have for salinities above 33.5 ‰ drawn the *S,t*-diagrams which are reproduced in Figs. 22, 23, 24 and 25. Fig. 22 shows a *S,t*-diagram in which the observations from "Polarbjørn", 1931 and 1932 are plotted. In the interval between 2 ° and — 1 ° C, the points fall near a line, but below — 1 ° they are more scattered. In Figs. 23 and 24, the observations are therefore plotted for each year separately. Below — 1 °, the points are again scattered, but they seem to accumulate along two different curves. On closer examination it appears that one of the curves is characteristic of observations from the stations on *the shelf* (Curves I a and I b), and that the other curve is characteristic of observations from stations in *the fjords* (Curves II a and II b). I have therefore plotted these observations with different signs (circles and dots respectively). Below — 1 ° C, Curves I and II have distinctly different courses, but it appears that also above — 1 ° C, the curves run differently. For the curves of 1931 this is especially obvious, but for the curves of 1932 it

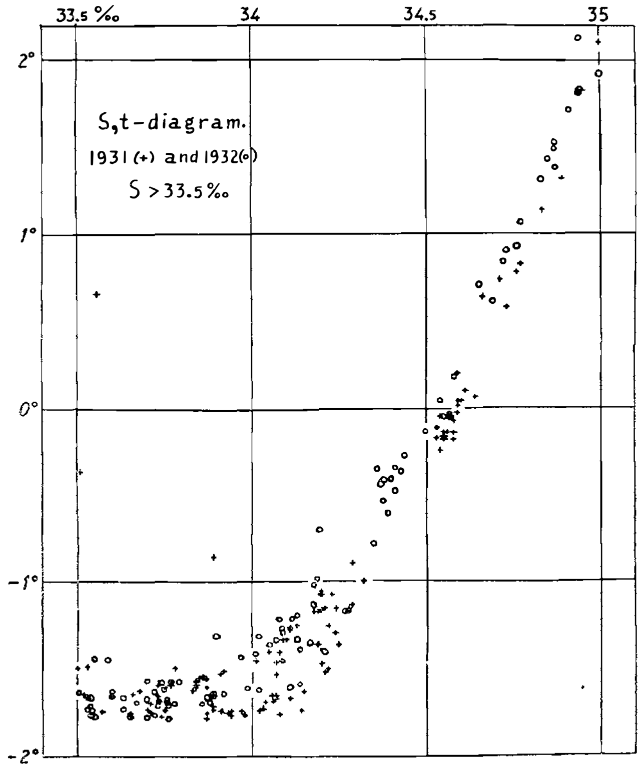

Fig. 22. *S,t*-diagram, "Polarbjørn" 1931 and 1932.

is more uncertain. (One value from Stat. 1, and one from Stat. 27 are situated on Curve II b at about 1 ° C.) In 1932, the two curves fall nearer each other than in 1931.

Curves I and II intersect, but no weight can be attributed to the very point of intersection, since in this area the course of Curve II may be accidental; here are included observations from the inner deep-basins, where the water may be of another character; it may be "older".

For some stations the points are situated partly on one, partly on the other curve, and partly between them. This applies to stations situated near the coast, but also to some stations in Davy-Sound and King Oscar Fjord. These observations are marked with crosses.

Curves I a and I b have a course in accordance with the curves in Fig. 1 (page 13). Curves II a and II b are more rounded in the proximity of 34 ‰, — 1.5 ° C and this shows, in accordance with what is mentioned on page 13, that the Polar water in the fjords is thoroughly mixed with warmer water. There is no reason to believe that the processes of mixing are more intense in the fjords than in the Polar Current, and the thorough mixing must therefore be due to the fact that it has been going on for a long time, or in other words, that the P. W.

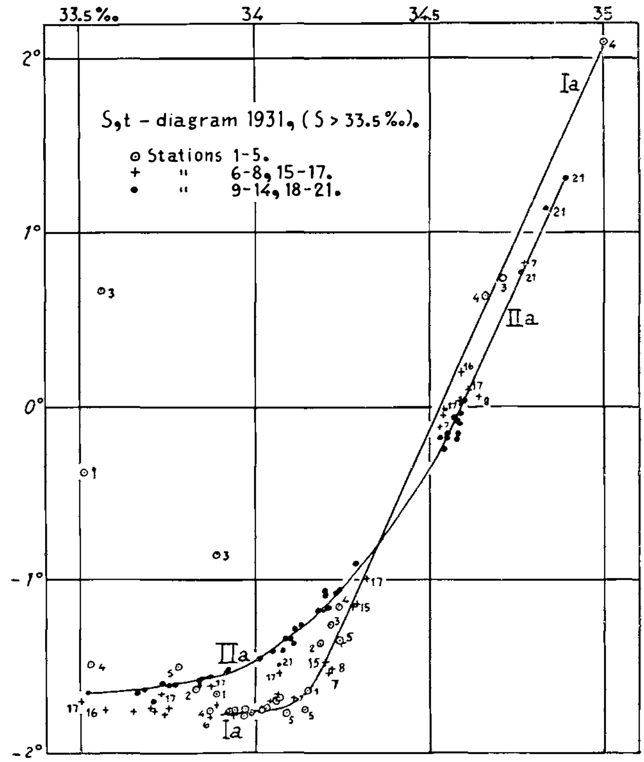

Fig. 23. *S,t*-diagram, "Polarbjørn" 1931.

is older in the fjords than outside. Figs. 23 and 24 show that there is a fairly marked transition between the conditions outside the coast and those in the fjords, since otherwise there would not have been such a marked accumulation of points along Curves I and II. Thus there is no continuous transition from the Polar Current, where the P. W. is constantly renewed to the inner part of the fjord where a slow renewal of P. W. takes place. On the contrary, sudden inbreaks of P. W. must occur, and it seems reasonable to connect these with the variation in the velocity of the Polar Current pointed out by Trolle (and Ryder), or with variations of the slope of the layers. The layers are most sloping in April—May, and least in August—October. From May to August, the salinity and accordingly, the density would increase in the deeper layers (deeper than about 75 m) and thereby the P. W. would penetrate more easily into the fjords. The reaction current in the fjords, which is due to the supply of melting water, would undoubtedly also facilitate the renewal of the P. W. in the summer. From a comparison between Fig. 23 and the station chart (Pl. 2) one can see how this inbreak of newer P. W. in 1931 to a certain degree is noticeable at Stats. 6, 15 and 16 off the coast, and can be traced in Davy-Sound and King Oscar

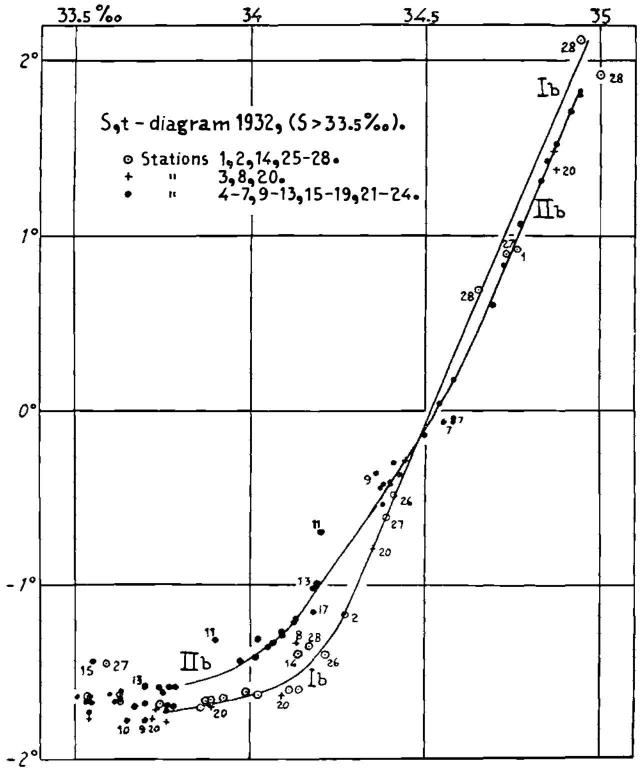

Fig. 24. *S,t*-diagram, "Polarbjørn" 1932.

Fjord to Antarctic Sound at Stats. 7, 8 and 17. (In Figs. 23 and 24 the station number has been inserted at all the points situated between Curves I and II near the salinity value 34 ‰.) A single observation at Stat. 21, inside the entrance of Franz Josef Fjord, is situated between the curves, but there is no reason to attach any importance to it. Until the middle of August (Stat. 17), the "new" P. W. has been able to penetrate as far as Antarctic Sound.

From Fig. 24 it is seen that in 1932 only a few observations fall between the two curves. As early as in the opening days of August (Stat. 8) the "new" P. W. has not got farther than the outer part of Davy Sound.

For salinities about 33.5 ‰ Curves I and II in Figs. 23 and 24 converge; this must be due to the winter cooling which has decreased the temperature of this water to freezing point, both in the fjords and outside of them.

In the water masses where the salinity is more than 34.5 ‰ the temperature is lower in the fjords than outside. This applies in particular to the year 1931 (Fig. 23). In 1932, there are only two observations

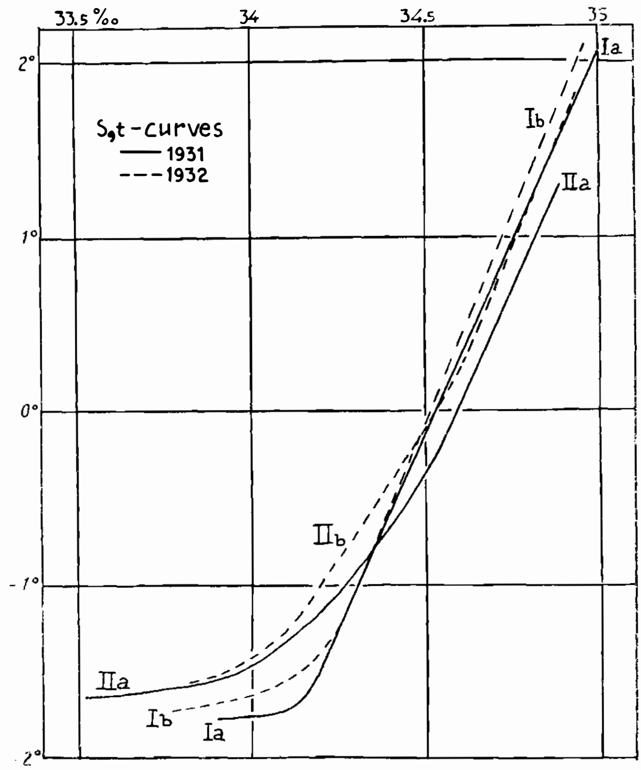

Fig. 25. *S,t*-curves, "Polarbjørn" 1931 and 1932.

from Stat. 28 that fall out of the *S,t*-curve II b at about these salinity values, and have a comparatively higher temperature.

The difference between Curves I and II in the Atlantic water area cannot be ascribed to a greater admixture of cold P. W. in the fjords than outside, for in that case the curves would not have intersected. The reason must be that the A. W. really was colder when it came into the fjords. The possibility that it has left the surface during a colder season than the A. W. which is under the P. W. in the Polar Current, may account for this.

The scanty material and the inadequate information from the region where the A. W. sinks under the P. W. do not permit of quantitative conclusions as to the difference of "age" of the water in the fjords and in the Polar Current. We see that the observations from Stats. 7, 8 and 17, 1931, with salinities above 34.5 ‰ fall on Curve II a, the "fjord curve", but these observations are from depths greater than the saddle depth, where a rapid renewal is not possible. At Stat. 20, 1932, there are some observations from the Atlantic water, which fall near Curve II b in Fig. 24, whereas the observations from the P. W. are situated at Curve I b. We can therefore conclude that the P. W. has been renewed before the A. W.

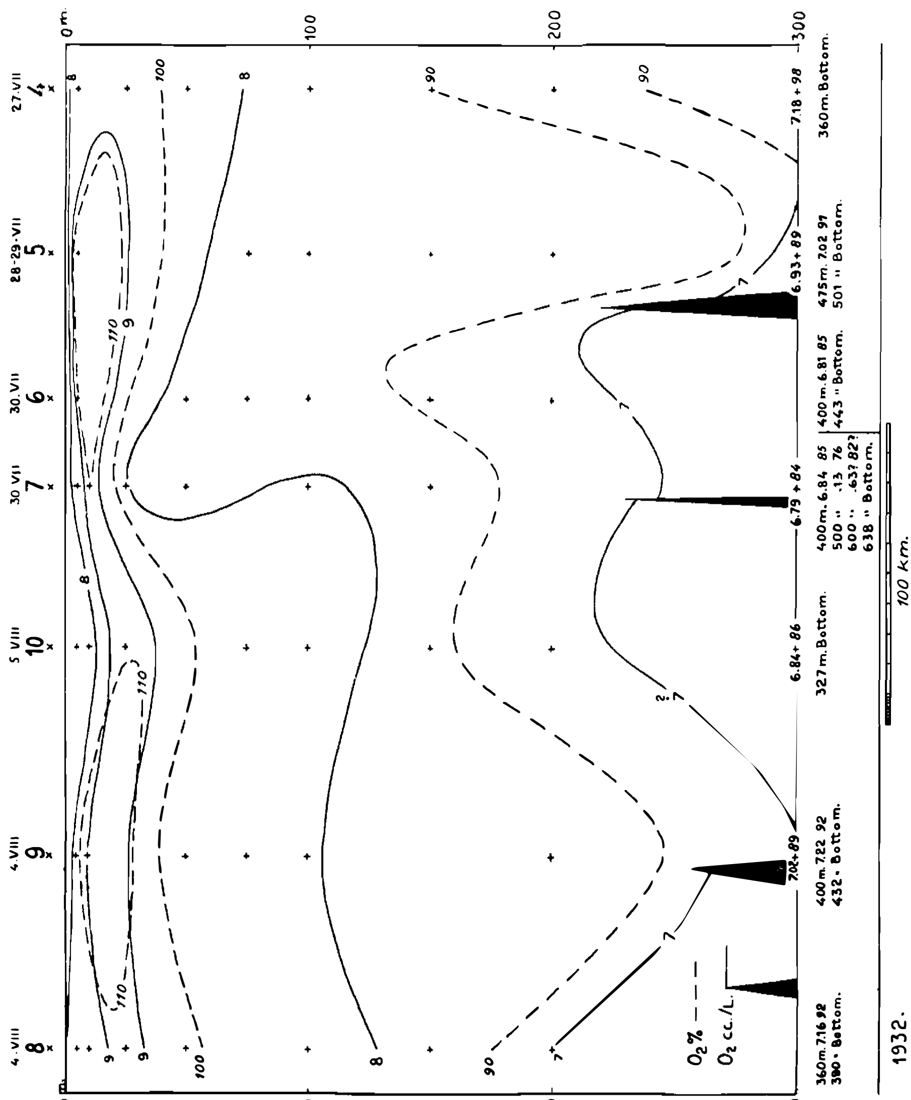

Fig. 26. Section VI b, 1932. Content of oxygen and percentage saturation.

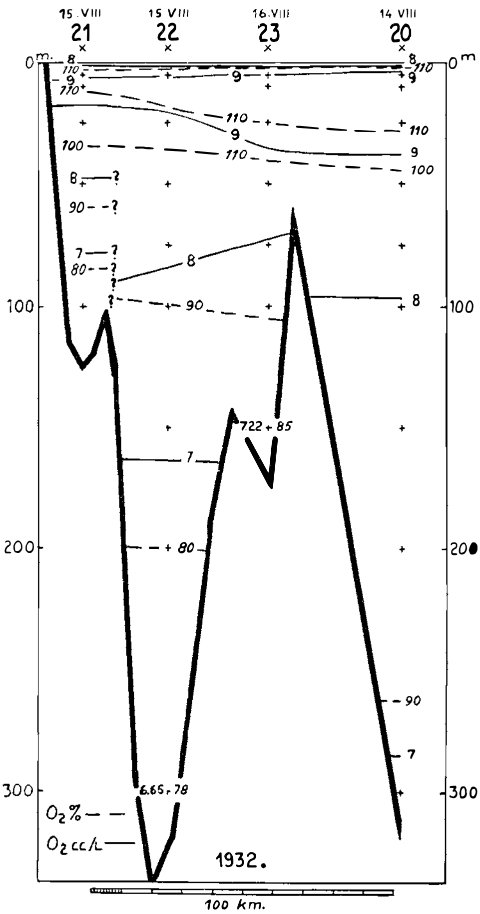

Fig. 27. Section VII b, 1932. Content of oxygen and percentage saturation.

f. Oxygen Conditions in the Fjords.

The oxygen conditions in the fjords are shown in the vertical sections VI b and VII b from 1932. (Figs. 26 and 27.) The content of oxygen varies considerably from one place to another. At Stats. 8—10, Sect. VI b, supersaturation reaches as far down as 50 m, and down to 100 m the oxygen content is more than 8 cc/L.

At Stats. 4—7, supersaturation reaches a depth of about 25 m, and already from 25—75 m the oxygen content is below 8 cc/L. This may depend on the time at which the ice broke up and the photosynthesis of the phytoplankton commenced. According to this, the ice is in 1932 supposed first to have broken up in Davy Sound—King Oscar Fjord, and later in Franz Josef Fjord, particularly in the inner part (Stat. 7). The stations in Davy Sound and King Oscar Fjord are taken one week later than those in Franz Josef Fjord, which will partly account for the observed feature.

The great bend of the iso-line of 8 cc/L at Stat. 7, is indicative of a movement of the P. W. through Antarctic Sound to Franz Josef Fjord, especially at a depth of abt. 100 m. At Stat. 10, there is an increase of content of oxygen and percentage saturation at 100 m which indicates the same feature. At Stat. 11 there are also high values of these quantities at 100 m, but from 75 m, oxygen determination is lacking. At Stats. 10 and 11, there is no particular supersaturation in the surface layer, because, as already mentioned, we have here to deal with stowing of the real surface water, and the photosynthesis has not yet had an opportunity to increase the content of oxygen very much above 100 %.

Section VII b shows that the conditions of oxygen in the top layers at Stat. 20 in Gael Hamke Bay and at Stat. 23 in Young Sound are similar to those in Davy Sound (Stats. 8 and 9, Sect.VIb) but at Stats. 21 and 22 in Tiroler Fjord, the photosynthesis has not reached a very great depth. The oxygen conditions will be dealt with in detail later.

g. Internal Waves and the Renewal of the Water in the Inner Deep-Basins.

As stated before, the water in the inner deep-basins is first of all determined by the saddle depth of the threshold. As an instance we shall first consider the vertical distribution of the observed quantities at Stat. 16, 1932, which is situated at the head of Geologist Fjord (Fig. 18, page 39).

The fjord is more than 50 km long, and in the inner part it has depths of down to 700 m. At the entrance there is a threshold, the saddle depth of which cannot be stated exactly. The shallowest sounding shows 73 m near the small island inside the entrance. At 50 m, the salinity at Stat. 16 is exactly the same as at Stat. 17 in Franz Josef Fjord, and higher than at Stats. 18 and 19 at the same place. (These 3 stations are taken the day after Stat. 16.) At 75 m, the salinity is a little lower at Stat. 16 than at Stat. 19. The saddle depth of the fjord is presumably between 50 and 75 m, probably nearer the latter value.

From 75 m to 150 m the salinity at Stat. 16 increases about 0.2 ‰, and then it remains fairly constant to the bottom, only with a faint increase. From 75 m and to the bottom, the temperature varies a little between — 1.66 ° and — 1.61 ° C. The content of oxygen has a slight maximum at about 25 m; then it decreases to about 75 m, and with small variations it remains about 7.5 cc/L to the bottom. At 400 and 500 m it is a little higher, and at 600 m a little lower. The conditions of the percentage saturation are nearly the same. The curve for hydrogen ion concentration, pH, also shows homogeneous conditions to the bottom.

(The content of oxygen and the percentage saturation in the surface layer are comparatively low, possibly due to a late breaking up of the ice.)

It is surprising that the long and deep fjord with the high threshold is so well aired to the bottom. At 600 m, the percentage saturation is 87, and the content of oxygen only about 0.4 cc/L less than in water with a corresponding temperature and salinity at Stat. 5 (75 m) in Franz Josef Fjord. The deficiency is only 0.2 cc/L at 400—500 m.

It appears from the abundant animal life which the zoologist of the expedition found at the bottom of the fjord, that the water in the deep-basin of Geologist Fjord is constantly being renewed.

It has previously been mentioned that the freezing of the ice cannot produce convection down to 75 m; therefore this cannot account for the renewal of the water in Geologist Fjord.

We shall consider the conditions in Clavering Fjord before we deal with the manner in which the water in the deep-basins of the fjords is renewed.

Between Clavering Island and Hudson Land there is a ridge on which Finsch Islands are situated. This ridge is low between Small and Great Finsch Island, and between Great Finsch Island and Clavering Island. Between the last named islands, we find the saddle depth of the ridge about 170 m, a little outside the sound between the islands, and nearer Great Finsch Island. This threshold isolates the deeper water layers in Clavering Fjord from Gael Hamke Bay.

Copeland Fjord, a branch of Clavering Fjord, is connected with Tiroler Fjord through a sound, but this sound is only 1 m deep and is therefore of no importance to the hydrography of the fjords.

Stat. 13, 1932, in Clavering Fjord, shows from a depth of 200 metres and to the bottom, comparatively homogeneous water, whose salinity and temperature are below the values we find at Stat. 20, 1932, in Gael Hamke Bay, at a depth of 200 m.

At Stat. 13 the oxygen content shows a maximum of 9.52 cc/L at 25 m. From this depth it decreases rapidly to 50 m, is again a little higher at 75 m, but from 75 m it decreases rapidly towards the bottom (disregarding the doubtful high value at 300 m) where at 400 m the values are 6.90 cc/L and 83 %.

Here, the ventilation is not so good as in Geologist Fjord, but it is fairly good since the oxygen content is only about 0.8 cc/L less than in water of corresponding temperature and salinity at Stat. 20.

If an inbreak of heavier water passes over the threshold, say, owing to the decrease in velocity of the Polar Current in the summer, this water will displace the water in the deep-basin inside. In the course of the winter this heavier water will be mixed with lighter water, and then, in its turn, it will be displaced by another inbreak of heavier water.

It is natural to assume that turbulence caused by horizontal currents due to internal waves brings about the mixing of the water in the deep-basin. Fjeldstad [1933] has theoretically shown that internal waves can occur in water masses where the distribution of density is continuous and that they can consequently arise independent of discontinuity layers.

The observations at Stats. 10—13, 1931 (Table II, Tables of results), which are taken at the same place in Clavering Fjord at intervals of 6 hours, show variations which must be due to internal waves. Stat. 9 is taken about 10 km further up the fjord, about 1½ hours earlier than Stat. 10.

Owing to the variations, we found at Stats. 10—13 nearly the same temperature and salinity at 380 m as at 300 m at Stat. 9. The vertical displacement should be about 80 m, as we must presume the *average* horizontal difference in salinity and temperature between Stats. 9 and 10—13 to be insignificant. (Detailed soundings show that the bottom is even between Stats. 9 and 10—13.)

At 200 m we have variations, which, according to the station curves of salinity and temperature for these stations, correspond to vertical displacements of about 25 m. At 100 m, vertical displacements of 20 m, at 50 m of 10, and at 25 m displacements of only a couple of metres occur.

It appears that, in Clavering Fjord, internal waves with considerable amplitudes are present, and it seems reasonable to account for the irregular bending of isohalines and isotherms in the sections from the other fjords as being the result of vertical displacements owing to internal waves.

On the basis of the material available, it is not possible to draw any conclusions as to the period length of these internal waves, but the waves probably bear some relation to the tides.

Tidal currents must play an important part in the renewal of the water masses in the fjords. Both The "Belgica" Expedition [Helland-Hansen and Koefoed, *loc. cit.*] and The "Danmark" Expedition [Trolle, *loc. cit.*] north of our region, proved the existence of considerable tidal currents. In 1933, the tides have been recorded at Small Finsch Island in Gael Hamke-Bay, and the records have been computed by Fjeldstad [Kjær and Fjeldstad 1934]. The tides have a semi-diurnal character, and the amplitude of the tidal component M_2 is 44.9 cm and consequently, the average difference between high water and low water about 90 cm.

h. Hydrographical Conditions in the various Fjords.

We shall next consider the hydrographical conditions in the various fjords.

The thresholds of the *Franz Josef Fjord Complex* are seen in Sect. VI (a and b, Figs. 21 and 26, pages 41 and 53). (Vega Sound is partly quite shallow, and Sofia Sound is separated from Foster Bay by a threshold of about 85 m, so that the renewal of the deeper water masses in the Franz Josef Fjord Complex must be effected through King Oscar Fjord and Franz Josef Fjord.) The thresholds are, as already mentioned, plotted according to Spärck [1933].

In Foster Bay the submarine continuation of Franz Josef Fjord is shallower, without any typical threshold. The water in the deeper layers will, however, be prevented from entering, since the saddle depth is about 320 m. The bottom water at Stats. 21, 1931 and 4, 5 and 18, 1932, is of the same nature as the corresponding water on the shelf. It consists of A. W. which is slightly diluted and has a somewhat lower oxygen content.

Inside of Stat. 5, 1932, a ridge runs across Franz Josef Fjord from Strindberg Peninsula (between Geologist Fjord and North Fjord) to Ymer Island; its saddle depth is 220 m.

This ridge and the ridge of saddle depth 230 m which separates Antarctic Sound from Franz Josef Fjord, determine the character of the bottom water in the inner part of Franz Josef Fjord. The salinity is about 34.6 ‰ and the temperature about 0 ° C. There is a difference between Stats. 6 and 7, 1932, which indicates that Spärck's threshold at Teuffelsschloss (between Stats. 6, 1932 and 20, 1931) is *higher* than stated by him (390 m). At a depth of 300 m the temperature at Stat. 6 is 0.04 ° C, while at Stat. 7, it is — 0.06 ° C. Farther down, the difference is still greater. It is perhaps possible that the water at one or other of the stations had recently been renewed, but at the same time this is improbable because, at both stations, the content of oxygen in the deeper water is a little lower than the content of the corresponding water at the stations outside of the ridges.

In the bottom water inside the Teuffelsschloss Ridge, temperature and salinity are the same in 1932 (Stat. 7) as in 1931 (Stats. 18 and 19).

According to Spärck, the inner part of *King Oscar Fjord* is separated from the outer part by a threshold at Ella Island, but he does not state the saddle depth. Stats. 17, 1931, and 10, 1932, should be situated in the same deep-basin. At Stat. 17, 425 m, the temperature is 0.10 ° C and the salinity 34.61 ‰, whilst at Stat. 10, 300 m, they are 0.61 ° C and 34.69 ‰ respectively. This difference must be due to an inbreak of heavier water in 1932, and not to a threshold. The fact is that Spärck has a station in 1932, at approximately the same locality as my Stat. 17, 1931, and also there the heavier (and warmer) water is found at 400 m.

At Stat. 10, the content of oxygen in the bottom water has been somewhat reduced.

Stats. 9 and 8, 1932, are separated by a threshold of about 260 m. (The situation of the threshold is questionable, because it looks as if Spärck has not used the same horizontal scale everywhere in the same section. The distances between the different stations, in his sections and in his chart, do not invariably correspond.)

At Stat. 15 in *Muskox Fjord* we find an unusually high temperature at 50—70 m. In the long and narrow fjord the summer heating has reached a considerable depth. The content of oxygen at 50—70 m is nearly equivalent to that at Stat. 5 in Franz Josef Fjord. In the surface layer the content of oxygen is comparatively small, which may indicate that it has been stowed by the wind, as was the case at Stat. 10, 1932 (page 55).

Dusén Fjord has a saddle depth of about 90 m. Stat. 24, 1932, is taken just inside at the mouth of the fjord. The deep-basin of this fjord is filled with Polar water and the oxygen conditions seem to indicate that the renewal of this water is poor. At 280 m, the content of oxygen is only 6.51 cc/L (77 %) or about 1.5 cc/L less than in the corresponding water in Foster Bay (Stats. 4 and 25, 1932).

The conditions in *Clavering Fjord* are mentioned previously.

At Stat. 12, 1932, in *Granta Fjord,* the depth is 80 m, whilst the saddle depth is only about 15 m. At 25—75 m the temperature appears low when compared with the temperature of the water at Stat. 13, in Clavering Fjord, which has a corresponding salinity. Since the content of oxygen is high, the explanation obviously cannot be that the processes of mixing are insufficient, but that the ice has broken up late, so that the summer heating has not penetrated far down. The temperature at the surface is about two degrees *lower* than at 5 m, a feature that I have not recorded at any other place in the fjords. The water at 5 m has presumably been supplied from outside — stowed in this fjord by the wind — and then lighter but colder melting water from the glacier has spread on top. The low content of oxygen at 5 m also indicates that this explanation is correct. A considerable supersaturation is found at 10 metres.

Sects. VII a and b (Figs. 28 and 27) show the conditions in *Gael Hamke Bay, Young Sound* and *Tiroler Fjord.* A threshold of a saddle depth of about 60 m separates Young Sound from Gael Hamke Bay. Below about 50 m Young Sound and Tiroler Fjord are filled with Polar water. The renewal of the water in the deep-basin of the fjord is poor.

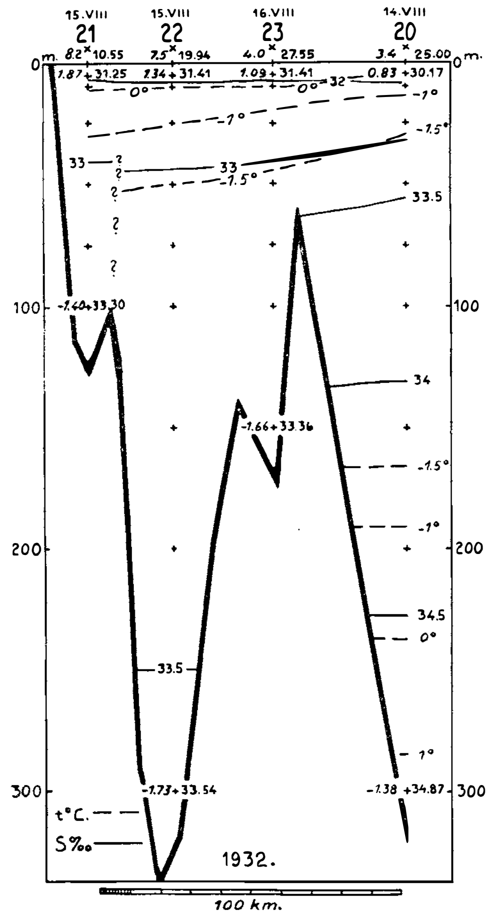

Fig. 28. Section VII a, 1932. Temperature and salinity.

In the bottom water of Tiroler Fjord the oxygen content is about 1.5 cc/L less than in corresponding water at Stat. 20.

The observations at Stat. 21 seem to indicate that there must be a threshold of a saddle depth less than 40 m in front of the innermost, narrow part of Tiroler Fjord. This is indicated by some question marks in Sects. VII a and b. At 100 m, Stat. 21, the oxygen content is about 1.3 cc/L lower than in the corresponding water at Stat. 22. The temperature at 50—100 m is very high in relation to the salinity. This is possibly due to the summer heating, even if, curiously enough, the content of oxygen has not increased simultaneously. It may be more reasonable to account for these conditions as being due to less winter cooling, as the oxygen conditions in the surface layer seem to indicate that the ice has broken up *later* in Tiroler Fjord than in Young Sound.

The reneval of the water in the deep-basins of the various fjords is very different. The difference between Geologist Fjord, Dusén Fjord, and Tiroler Fjord is especially striking. While Geologist Fjord (with a saddle depth of about 75 m) is very well aired, this is not the case in Dusén Fjord (Saddle depth 90 m) and Tiroler Fjord (Saddle depth 60 m). It cannot depend on the saddle depth, but possibly on various other conditions, as, for instance, the configuration of the fjord and of the threshold, which may influence the formation of internal waves.

IV. Variations from Year to Year.

At Fig. 25 (page 52) the curves at Figs. 23 and 24 are drawn in the same diagram. Judging from the Curves I a and I b, it seems as if the Polar water of a salinity about 34 ‰ was a little warmer in 1932 than in 1931. The fact that the ice was more open in 1932 and the heating by radiation more intense, may have been of a certain significance. It is also seen from Curves II a and II b that in the fjords the Atlantic water was warmer in 1932 than in 1931, whereas this was probably not the case in the Polar Current, but, on the whole, conditions for the two years are fairly homogeneous.

Åkerblom [1904] has taken some observations in Franz Josef Fjord in 1899, which show a temperature of — 0.63 ° C, with salinity 34.51 ‰ and — 0.80 ° C, with salinity 34.70 ‰. Both these observations cannot be correct, and the latter is probably wrong. According to Nansen [1906] Åkerblom's temperature observations are good, but the salinity determinations are poor.

Stats. 42—44 of the "Belgica" Expedition in 1905 show that at salinities about 34.5, the temperature is about — 0.60 ° C. The sections show that the maximum temperature of A. W. under the Polar Current is 1.40 ° C, and the corresponding salinity 34.90 ‰, but this water lies too deep to pass over the shelf and is found on the outside only.

Trolle (*loc. cit.*) has found 1.30 ° C as the highest temperature in A. W. in a section across the shelf in 1906; but the corresponding salinity is lacking. His highest salinity is 34.97 ‰ at a temperature of 1.12 ° C. According to the observations in 1906 and 1908, water of the salinity 34.5 ‰ had a temperature of about — 1.0 ° C. In 1908, the highest temperature in the A. W., 1.10 ° C corresponds to the salinity 34.96 ‰.

It is evident from this that there are considerable variations of temperature and salinity in the Atlantic water under the Polar Current. On account of the insufficiency of the material of observations at hand, it is not possible to give any details as to the nature of these variations. It must be pointed out that in 1931, and particularly in 1932, salinity as well as temperature are exceptionally high in the A. W., and that these conditions very probably correspond to the extraordinary conditions which were found by Helland-Hansen in the Atlantic Current off the western coast of Norway in 1928 and 1929. It appears that this extraordinary A. W. has been present off the coast of East Greenland as early as 1931, and has been still more prevalent in 1932. Such extraordinary conditions are also found by H. Mosby, north-east of Spitsbergen in 1931, as mentioned by Helland-Hansen.

The course of the 4 curves I a, I b, II a and II b in Fig. 25 is accounted for on the assumption that the extraordinary A. W. did not set in till the summer of 1931, and therefore the A. W. which was then in the fjords was colder. Thus Curve II a is lying separate, while Curves I a, I b and II b are more coincident. To the left in the current, where Stat. 28 is taken, the A. W. in August 1932 appears to have attained a still more extraordinary character; therefore Curve I b (which is drawn according to the observations at Stat. 28) does not completely coincide with Curves I a and II b.

Table 11.

Comparison of Salinity and Temperature Observations for the Different Years from 75 Metres at Fjord Stations at the same Locality.

Date	Year	Station	Locality	S ⁰/₀₀	t° C
Aug. 9	1930	14	Davy Sound	33.55	—1.80
» 5	1931	7	—	33.70	—1.74
» 4	1932	9	—	33.44	—1.75
Aug. 12	1930	16	King Oscar Fjord	33.64	—1.78
» 15	1931	17	—	33.73	—1.66
» 5	1932	10	—	33.49	—1.80
Aug. 19	1930	20	Sofia Sound	33.58	—1.79
» 5	1932	11	—	33.43	—1.73
Aug. 18	1930	17	Franz Josef Fjord	33.58	—1.78
» 16	1931	19	—	33.69	[—1.63]
July 30	1932	7	—	33.46	—1.81
Aug. 18	1931	20	Franz Josef Fjord	33.66	—1.65
July 30	1932	6	—	33.54	—1.74
Aug. 19	1931	21	Franz Josef Fjord	33.71	—1.70
» 12	1932	18	—	33.54	—1.67
Aug. 9	1931	9	Clavering Fjord	33.75	—1.61
» 7	1932	13	—	33.40	—1.67

I have made comparison between the observations at 75 m (where as a rule, the temperature minimum is found) in 1930, 1931 and 1932 at those places where observations exist for at least two years. (Table 11.) It appears from this that the water at this depth in 1931 was, on an average, warmer and saltier than in 1930 and 1932. It is seen from Sects. IV, V and VI a (Figs. 19, 20 and 21, pages 39—41), that the

33.5 ‰ isohaline is situated considerably higher in 1931 than in 1932. It is difficult to give any satisfactory explanation of this feature.

As shown above (page 23), considerable variations occur from year to year in the water transport of the Polar Current.

I shall not deal with the conditions of the hydrogen ion concentration here. I only want to point out that they are roughly the same as those found by Sverdrup [1933] in 1931 in the Polar water and the Atlantic water north and north-west of Spitsbergen.

Summary.

The material comprises 10 stations from the Franz Josef Fjord Complex in 1930 with observations from the upper 75 m only. In 1931, 21 stations and in 1932 28 stations from the fjords and the continental shelf. The first two years temperature and salinity determinations only were made, in 1932 also determinations of oxygen content and hydrogen ion concentration.

The Polar Current which carries cold water runs southward along the coast of East Greenland, and under this cold water is found warmer water of Atlantic origin. The different water masses are defined by means of a S,t-diagram (Fig. 1, page 13). The *Atlantic water* originates in the Norwegian Atlantic Current, and has passed along the Norwegian coast and up to Spitsbergen, then turning westward along the southern slope of the Nansen Ridge between Spitsbergen and North-East Greenland, and subsequently southward along the East Greenland Shelf. During its course it has submerged under the colder but less saline and therefore lighter water of polar origin. For the years 1931 and 1932, the water of the character $t = 2.10$ ° C and $S = 34.97$ ‰ is defined as the core of the Atlantic water. The *Polar water* has acquired its properties by the formation of ice and the separation of salt in the North Polar Sea. The water of salinity 34.07 ‰ and temperature -1.85 ° C, which is the temperature of freezing corresponding to this salinity, is defined as the core of the Polar water proper. Above the Polar water proper is found a surface layer consisting of Polar water diluted by melting water or freshwater supplied from land.

By means of a new method the water transport of the East Greenland Polar Current has been calculated. In the summer of 1905 it was about 1.60 million m^3/sec. (found on the basis of the "Belgica" stations), while it was about 1.32 million m^3/sec. in the summers of 1931 and 1932. Obviously, considerable variations from year to year thus occur in the water transport of the Polar Current.

For each of the "Polarbjørn" stations the value of a quantity, *V*, has been calculated (Table 6), giving the amount of water transported by the Polar Current outside of the station. These values are too small, for the calculations could not be performed to a depth with motionless water, but they show the situation of the stations in relation to the current, and they are therefore indicated above the station numbers in the vertical sections. By means of the values of *V*, iso-lines of amount of current have been drawn in the bathymetrical chart (Plate 1) for every 0.1 million m^3/sec.

The velocity computations show that the current follows the continental slope. Above the shelf the velocities are small. Off Foster Bay the components of velocity at right angles to sect. III (Stats. 14, 25—28) is nearly 12—14 centimeters per second whilst the total surface velocity in a southward direction probably attains 20 cm/sec. The velocity is greatest at the surface, and decreases to the half at 50 metres, and at 150 metres it is insignificant.

On account of the current the isotherms and isohalines slope towards land in the sections across the shelf. At the surface the salinity is comparatively low, and the temperature about 0 ° C, due to the melting of the ice. The salinity increases rapidly downwards, and at 25—50 m it is about 33 ‰ where the temperature is about — 1.5 ° C. Minimum of temperature (near freezing point) is at 75—100 m (the core of the Polar water proper). The 34.5 ‰ isohaline coincides with the 0 ° isotherm and is found at 150—200 m. The core of the Atlantic water is only found at Stats. 4, 1931, and 28, 1932 at 275 m and 250 m respectively. The depths of the other stations are smaller.

The oxygen content and the percentage saturation of oxygen in the Polar water is about the same as in the corresponding water at stations from the "Nautilus" Expedition in 1931, north of Spitsbergen. The oxygen conditions in the Atlantic water off East Greenland agree very well with those found at Sverdrup's stations on the southern slope of the Nansen Ridge. In the surface layer, the oxygen content is high and supersaturation occurs, which, at the end of August, penetrates twice as deep as at the end of July (1932). July: 10—25 m. August: 25—50 m. Supersaturation goes deepest and is greatest on the right side of the current, owing to the better conditions for the photosynthesis of phytoplankton: supply of nutrients from land, and more scattered drift-ice affording better access for the solar radiation. The percentage saturation has its maximum at a depth of 5—10 m, in July, and at 10—25 m in August. Highest values are 9.82 cc/L and 116 %.

The water masses in the fjords have the same character as those in the coastal current. The character of the water in the inner deep-basins depends mainly on the saddle depth of the fjord threshold. This deep-water is strikingly well aired, and this good airing must be due to a considerable turbulence caused by internal waves. Considerable internal waves are shown at a series of stations in Clavering Fjord. There is a great difference in the airing of the deep-water of the various fjords, and the saddle depth of the threshold would appear to play a secondary part in the airing of a fjord. In the deep-basins of Geologist Fjord, Dusén Fjord, and Tiroler Fjord with saddle depths 75, 90 and 60 m respectively, the deficiency of oxygen is about 0.2, 1.4 and 1.5 cc/L respectively, in relation to water of the same salinity and temperature outside the threshold. The percentage saturation is about 90, 80 and 80 % respectively. The fjord situated farthest from the coast, and deepest (Geologist Fjord), is best aired. The difference may be due to a difference in the conditions for the formation of internal waves.

The water of minimum temperature in the fjords, can only partly have been formed on the spot. The essential part has been supplied from the outside. It is the cold Polar water, however, which is here more mixed than outside in the Polar Current, and since there is no reason to assume that the mixing proceeds more rapidly in the fjords — the contrary is more probable — this must indicate that the water here is considerably "older" than on the outside. At some stations in the fjords, this water is, however, comparatively "newer", and it appears that the renewal must take place through inbreak of "new" water during the period of May—August, during which time the slope of the water layers of the Polar Current, according to Ryder [1895] and Trolle [1913], decreases on account of the decrease of the current's velocity. Thus, heavier water is enabled to penetrate into the fjords. Not only the Polar water, but also the underlying mixture of Polar water and Atlantic water, is renewed in this way. Besides, a continuous but slighter renewal caused by the tides certainly takes place in the winter as well.

In the summer, when the fjords are free from ice, and considerable quantities of melting water are supplied from land, this water will be mixed with the surface water and carried out to sea as a surface current. This causes a reaction current inwards at greater depths, which will also contribute to the renewal of the deeper water masses. Various conditions, also the oxygen conditions justify the supposition that in the deeper layers of the Franz Josef Fjord Complex a current passes in the summer in the direction Davy Sound—King Oscar Fjord—Antarctic Sound, and out of Franz Josef Fjord.

The top layers in the fjords are influenced by the formation of ice during the winter. During the summer melting water is supplied from land, with the result that the salinity in the top layers is decreased. During this season the wind has a great influence on the conditions at the surface, by stowing the surface water. The differences in level thus produced will in the summer be of the same order of magnitude as the differences in level due to the supply of melting water from the glaciers. As causes of currents they are therefore of the same importance. The oxygen conditions at the surface depend at the various places on the stowing of the wind, and in addition, on the date when the ice broke in the fjord.

In the fjords supersaturation of oxygen prevails in the top layers, and it is greater and reaches a greater depth than in the Polar Current. Conditions are the most favourable for the photosynthesis of the phytoplankton — supply of nutrients from land and no ice preventing the penetration of solar radiation.

In the years 1931 and 1932 the Atlantic water off East Greenland was of an exceptional character. The salinity in the core of the Atlantic water was up to 35 ‰, and the temperature above 2.10 ° C. The maximum temperatures previously found are all under 1.5 ° C, and the maximum salinity under 34.95 ‰ — with two exceptions (34.96 and 34.97). These extraordinary conditions are obviously the same as those first pointed out by Helland-Hansen off the Norwegian coast in the autumn of 1928, and also found by H. Mosby in the summer of 1931 north of Spitsbergen. It looks as if this extraordinary water appeared for the first time in 1931 off East Greenland, and that the water had a still more extraordinary character in the late part of the summer of 1932.

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Tables of Results.

Tables I, II, and III

give the vertical series from the stations of the "Veslekari" 1930, the "Polarbjørn" 1931 and the "Polarbjørn" 1932, respectively. The tables include direct observations, interpolated values, (printed in square brackets) and the results of dynamic calculations.

1. column, *G. M. T.* or *M. E. T.*: Hours and minutes when the observations were taken, in Greenwich Mean Time or Middle European Time (*G. M. T.* + 1 hour). The time recorded at any certain depth is valid also for the subsequent depths until a new time is recorded. The wire angle is also given in this column for a single station (8, 1931).
2. column, a: The argument a has a different meaning in different columns. It gives the depth in metres for the six columns 3, 4, 5. 8, 9 and 10, and it means pressure (in decibars) for the data in columns 6 and 7.
3. column, $t^\circ C$: The corrected temperature in centigrade.
4. column, $S\,^0/_{00}$: The salinity *per mille.*
5. column, σ_t: The usual indication of density, disregarding compression.
6. column, $10^5 \Delta\alpha$: The specific volume (taking into account compression) at the isobaric surface of a decibars, expressed in 10^{-5} units as the difference between the actual specific volume *in situ*, and the value which would have been found if the water had had a temperature of 0° C and a salinity of 35 ‰.
7. column, $10^4 \Delta D$: The dynamic depth from the sea-surface to the isobaric surface of a decibars, expressed as the difference (in tenthousandth parts of a dynamic metre) between the real dynamic depth in the actual conditions found in the water-layers, and the dynamic depth which would have been found in water of 0° C and 35 ‰.
8. column, O_2 cc/L: The content of oxygen, recorded in cubic centimetres per litre of sea-water.
9. column, O_2 %: The percentage saturation of the water with oxygen at a pressure of one atmosphere.
10. column, p_H: The hydrogen ion concentration, expressed by means of the exponent, *i. e.* the logarithm of the reciprocal value of the concentration itself.

Table I.

"Veslekari" 1930.

Stat. **11.** 7. **VIII. 1930.**
Muskox Fjord 236 m.

MET	a	t° C	S ‰	σ_t	$10^5 \Delta \alpha$	$10^4 \Delta D$
16—	0	7.93	17.44	15.58	1201	0
	5	2.88	23.73	18.95	876	519
	10	—1.02	31.78	25.57	243	799
	25	—1.59	33.00	26.57	147	1091
	40	—1.68	.38	.88	118	1291
	75	—1.68	.61	27.07	100	1672

Stat. **12.** 7. VIII. **1930.** North Fjord. 18 m.

MET	a	t° C	S ‰	σ_t	$10^5 \Delta \alpha$	$10^4 \Delta D$
22—	0	8.31	13.87	10.76	1671	0
	5	2.02	25.43	20.35	741	603
	10	—0.78	31.25	25.13	284	859

Stat. **13.** 8. VIII. **1930.**
Segelsällskapet Fjord. 96 m.

MET	a	t° C	S ‰	σ_t	$10^5 \Delta \alpha$	$10^4 \Delta D$
	0	7.69	19.62	15.31	1228	0
	5	2.33	27.33	21.85	597	456
	10	—0.03	31.25	25.11	287	677
	25	—1.25	32.55	26.20	183	1029
	50	—1.63	33.13	.68	137	1429
	75	—1.68	.52	.99	107	1733

Stat. **14.** 9. VIII. **1930.**
King Oscar Fjord. 230 m.

MET	a	t° C	S ‰	σ_t	$10^5 \Delta \alpha$	$10^4 \Delta D$
	0	5.66	14.54	11.51	1597	0
	5	.05	25.38	20.08	767	591
	10	0.14	31.21	25.08	289	855
	25	—1.65	32.63	26.27	176	1204
	50	—1.75	33.16	.70	135	1591
	75	—1.80	.55	27.02	105	1890

Stat. **15.** 12. VIII. **1930.**
King Oscar Fjord. 185 m.

MET	a	t° C	S ‰	σ_t	$10^5 \Delta \alpha$	$10^4 \Delta D$
16—	0	7.05	21.90	17.16	1049	0
	10	1.82	30.60	24.49	345	697
	25	—1.36	32.56	26.21	182	1093
	50	—1.70	33.20	.73	132	1485
	75	—1.77	.61	27.07	101	1775

Stat. **16.** 12. VIII. **1930.**
King Oscar Fjord. 200 m.

MET	a	t° C	S ‰	σ_t	$10^5 \Delta \alpha$	$10^4 \Delta D$
23—	0	6.76	21.79	17.11	1054	0
	5	3.93				
	10	1.43	31.20	24.99	297	676
	25	—1.63	32.85	26.45	159	1018
	50	—1.76	33.27	.79	126	1374
	75	—1.78	.64	27.09	98	1654

Stat. **17.** 13. VIII. **1930.**
Dickson Fjord. 570 m.

MET	a	t° C	S ‰	σ_t	$10^5 \Delta \alpha$	$10^4 \Delta D$
19—	0	9.10	18.17	14.01	1354	0
	10	—1.56	30.91	24.88	308	831
	25	—1.14	32.71	26.32	171	1191
	50	—1.55	33.31	.82	124	1559
	75	—1.65	.66	27.11	96	1834

Stat. **18.** 14. VIII. **1930.**
Röhss Fjord. 120 m.

MET	a	t° C	S ‰	σ_t	$10^5 \Delta \alpha$	$10^4 \Delta D$
	0	9.11	19.42	14.99	1259	0
	10	—1.54	27.35	21.99	584	921
	25	—1.69	32.36	26.05	197	1507
	50	—1.54	33.26	.78	128	1912
	75	—1.68	.66	27.11	96	2191

Stat. **19.** 18. VIII. **1930.**
Franz Josef Fjord. 638 m.

MET	a	t° C	S ‰	σ_t	$10^5 \Delta \alpha$	$10^4 \Delta D$
	0	7.13	19.63	15.38	1221	0
	10	0.56	31.07	24.94	303	762
	25	—1.33	32.56	26.21	182	1125
	50	—1.73	33.24	.77	129	1513
	75	—1.78	.58	27.04	102	1802

Stat. **20.** 19. VIII. **1930.**
Sofia Sound. 200 m.

MET	a	t° C	S ‰	σ_t	$10^5 \Delta \alpha$	$10^4 \Delta D$
14^{30}	0	4.49	26.13	20.73	704	0
	10	0.66	31.54	25.31	267	486
	25	—1.35	32.54	26.19	184	824
	50	—1.75	33.16	.70	135	1222
	75	—1.79	.58	27.04	102	1517

Table II.

"Polarbjørn" 1931.

Stat. 1. 23. VII. **1931.** 74° 56′ N, 12° 50′ W. 199 m.

GMT	a	t° C	S ‰	σ_t	$10^5\Delta\alpha$	$10^4\Delta D$
11 05	0	0.0	31.08	24.97	300	0
	10	.05	32.40	26.03	199	249
	25	—0.38	33.51	.94	112	482
	50	—1.66	.89	27.29	79	721
	75	[—1.76	.93]	.33	75	913
	100	—1.75	.97	.36	72	1097
	150	—1.64	34.15	.50	58	1422

Stat. 2. 25. VII. **1931.** 74° 40′ N, ca. 14° W. 202 m.

GMT	a	t° C	S ‰	σ_t	$10^5\Delta\alpha$	$10^4\Delta D$
11 10	0	—0.5	17.62	14.15	1341	0
12 00	10	—1.40	32.40	26.08	194	767
11 10	25	—1.47	33.30	.81	124	1006
	50	—1.63	.83	27.25	83	1266
	75	—1.75	.94	.34	74	1463
	100	—1.74	34.03	.41	67	1640
	150	—1.37	.19	.53	56	1949

Stat. 3. 26. VII. **1931.** 74° 35′ N, 14° 05′ W. 230 m.

GMT	a	t° C	S ‰	σ_t	$10^5\Delta\alpha$	$10^4\Delta D$
17 35	0	0.4	30.94	24.84	312	0
17 55	10	.33	31.93	25.64	236	274
17 35	25	.66	33.56	26.93	113	536
	50	—0.86	.89	27.27	81	779
	75	—1.77	.98	.37	71	969
	100	—1.68	34.07	.44	65	1139
	150	—1.26	.22	.55	54	1435
	200	0.74	.71	.85	27	1636

Stat. 4. 27. VII. **1931.** 74° 30′ N, 15° 05′ W. 294 m.

GMT	a	t° C	S ‰	σ_t	$10^5\Delta\alpha$	$10^4\Delta D$
15 35	0	1.7	31.32	25.07	290	0
	5	—0.64	32.23	.92	209	125
	10	—0.84	.66	26.27	175	221
	25	—1.49	33.53	27.00	107	433
14 50	50	—1.76	.87	.28	80	666
	75	—1.78	.98	.37	71	855
	100	—1.70	34.06	.43	65	1025
	150	—1.16	.24	.56	53	1320
	200	0.64	.66	.82	30	1525
	275	2.10	35.00	.98	15	1693

Stat. 5. 30. VII. **1931.** 74° 14′ N 17° 40′ W. 208 m.

GMT	a	t° C	S ‰	σ_t	$10^5\Delta\alpha$	$10^4\Delta D$
11 35	0	3.0	8.51	6.84	2056	0
	5	—1.37	32.02	25.77	223	570
	10	—1.45	.43	26.10	192	674
11 00	25	—1.40	.92	.50	154	933
	50	—1.50	33.78	27.20	87	1234
11 35	75	—1.75	34.02	.40	68	1429
11 00	100	—1.77	.08	.45	63	1594
	150	—1.75	.14	.50	59	1899
11 35	200	—1.35	.24	.57	52	2174

Stat. 6. 3. VIII. **1931.** Foster Bay. 276 m.

GMT	a	t° C	S ‰	σ_t	$10^5\Delta\alpha$	$10^4\Delta D$
11 50	0	5.2	8.15	6.49	2091	0
	5	2.95	30.52	24.37	356	612
	10	—0.32	32.21	25.89	212	754
	25	—1.48	33.05	26.61	144	1020
11 10	50	—1.75	.47	.95	111	1338
	75	—1.76	.71	27.15	92	1591
	100	—1.79	.87	.28	79	1806
	150	—1.66	34.07	.44	64	2164
	200	—1.37	.25	.58	51	2451
	260	—0.05	.54	.76	35	2707

Stat. 7. 5. VIII. **1931.** King Oscar Fjord. 467 m.

GMT	a	t° C	S ‰	σ_t	$10^5\Delta\alpha$	$10^4\Delta D$
1 10	0	7.9	9.81	7.62	1979	0
	5	5.72	25.41	20.05	770	687
	10	1.62	30.38	24.32	361	970
	25	—1.52	32.84	26.44	160	1360
	50	—1.73	33.42	.91	114	1703
	75	—1.74	.70	27.14	93	1961
	100	—1.72	.89	.30	78	2175
0 25	150	—1.68	34.11	.47	61	2522
	200	—1.53	.21	.55	53	2808
	300	—0.12	.53	.75	35	3248
	400	0.58	.73	.88	24	3544
	435	.82	.77	.89	23	3626

Stat. 8. 5. VIII. **1931.** King Oscar Fjord. 326 m.

GMT	a	t° C	S ‰	σ_t	$10^5\Delta\alpha$	$10^4\Delta D$
4 20	0	7.5	10.12	7.90	1952	0
	5	5.16	25.33	20.04	770	681
	10	0.62	30.97	24.85	310	951
	25	—1.37	32.73	26.35	169	1310
	50	—1.76	33.35	.86	120	1670
	75	—1.76	.65	27.10	97	1941
3 40	100	—1.74	.75	.18	89	2172
Wire	150	—1.70	34.04	.41	66	2560
angle	200	—1.51	.22	.56	53	2858
15°	300	0.06	.64	.83	28	3261

Stat. 9. 9. VIII. **1931.** Clavering Fjord. 375 m.

GMT	a	t° C	S ‰	σ_t	$10^5\Delta\alpha$	$10^4\Delta D$
17 00	0	6.7	22.56	17.71	995	0
	5	1.87	30.80	24.64	330	332
	10	0.81	32.49	26.05	197	463
	25	—1.57	33.15	.69	136	712
	50	—1.68	.44	.93	113	1024
	75	—1.61	.75	27.18	89	1277
	100	—1.52	.92	.31	76	1483
16 15	150	—1.41	34.05	.42	66	1839
	200	—1.26	.13	.48	60	2156
	300	—1.18	.19	.52	56	2737
	365	—1.06	.20	.52	56	3101

Table II (continued). *"Polarbjørn" 1931.*

Stat. **10.** 9. VIII. **1931.**
Clavering Fjord. 400 m.

GMT	a	t° C	S ‰	σ_t	$10^5 \Delta\alpha$	$10^4 \Delta D$
18^{35}	0	6.5	22.31	17.54	1013	
	25	−1.49	33.13	26.67	138	
	50	−1.66	.32	.83	122	
	100	−1.60	.77	27.20	88	
	200	−1.34	34.09	.45	63	
	380	−1.18	.18	.51	56	

Stat. **11.** 10. VIII. **1931.**
Clavering Fjord. 400 m.

GMT	a	t° C	S ‰	σ_t	$10^5 \Delta\alpha$	$10^4 \Delta D$
0^{25}	0	6.2	22.42	17.66	1000	
	25	−1.27	33.12	26.66	139	
	50	−1.72	.38	.88	118	
	100	−1.58	.84	27.25	82	
	200	−1.34	34.09	.45	63	
	380	−1.08	.20	.53	55	

Stat. **12.** 10. VIII. **1931.**
Clavering Fjord. 400 m.

GMT	a	t° C	S ‰	σ_t	$10^5 \Delta\alpha$	$10^4 \Delta D$
6^{25}	0	4.6	16.53	13.14	1438	
	25	−1.23	33.11	26.65	140	
	50	−1.71	.40	.90	116	
	100	−1.56	.87	27.28	80	
	200	−1.28	34.11	.46	62	
	380	−1.17	.20	.53	54	

Stat. **13.** 10. VIII. **1931.**
Clavering Fjord. 400 m.

GMT	a	t° C	S ‰	σ_t	$10^5 \Delta\alpha$	$10^4 \Delta D$
12^{25}	0	6.0	23.41	18.45	924	
	25	−1.23	33.11	.65	140	
	50	−1.68	.36	.86	119	
	100	−1.56	.85	27.26	81	
	200	−1.34	34.10	.45	62	
	380	−1.16	.21	.54	54	

Stat. **14.** 12. VIII. **1931.**
Copeland Fjord. 128 m.

GMT	a	t° C	S ‰	σ_t	$10^5 \Delta\alpha$	$10^4 \Delta D$
19^{30}	0	6.6	22.12	17.38	1027	0
	10	−0.37	32.76	26.34	170	597
	25	−1.55	33.18	.71	133	824
	50	−1.68	.37	.87	118	1139
	75	−1.63	.68	27.12	95	1405
	100	−1.55	.86	.27	81	1624
	120	−1.46	34.01	.38	70	1775

Stat. **15.** 13. VIII. **1931.**
Gael Hamke Bay. 230 m.

GMT	a	t° C	S ‰	σ_t	$10^5 \Delta\alpha$	$10^4 \Delta D$
18^{40}	0	6.0	26.90	21.19	660	0
	5	−0.04	32.14	25.82	218	220
	10	−0.96	.77	26.37	167	316
	25	−1.58	33.30	.81	124	534
18^{45}	50	−1.73	.49	.97	109	826
18^{05}	75	−1.78	.74	27.17	90	1074
	100	−1.75	.92	.32	76	1281
	150	−1.66	34.06	.43	65	1632
	200	−1.48	.20	.54	54	1931
	220	−1.16	.28	.60	49	2034

Stat. **16.** 14. VIII. **1931.**
Foster Bay. Abt. 265 m.

GMT	a	t° C	S ‰	σ_t	$10^5 \Delta\alpha$	$10^4 \Delta D$
12^{45}	0	3.4	19.44	15.52	1208	0
	5	[0.50]	31.49	25.28	271	370
	10	−0.77	32.69	26.30	173	481
	25	−1.77	33.33	.84	121	702
	50	−1.75	.57	27.04	103	982
	75	[−1.77]	.86	.26	82	1211
12^{00}	100	−1.78	.94	.34	74	1405
	150	−1.75	34.02	.40	68	1759
	200	−1.14	.29	.60	48	2049
	260	0.20	.59	.78	32	2291

Stat. **17.** 15. VIII. **1931.**
Antarctic Sound. 430 m.

GMT	a	t° C	S ‰	σ_t	$10^5 \Delta\alpha$	$10^4 \Delta D$
18^{15}	0	9.5	19.22	14.79	1279	0
	10	1.10	30.18	24.20	373	826
	25	−1.33	32.85	26.44	159	1225
	50	−1.70	33.50	.98	108	1560
	75	−1.66	.73	27.16	91	1809
	100	−1.61	.87	.28	80	2022
17^{40}	150	−1.54	34.07	.44	65	2383
	200	−1.00	.32	.62	47	2661
	300	−0.17	.55	.77	33	3062
	400	0.04	.59	.79	32	3387
	425	.10	.61	.81	30	3464

Stat. **18.** 16. VIII. **1931.**
Franz Josef Fjord. 672 m.

GMT	a	t° C	S ‰	σ_t	$10^5 \Delta\alpha$	$10^4 \Delta D$
13^{30}	0	7.2	6.87	5.37	2202	0
	5	[5.70]	23.22	18.33	936	784
	10	−0.86	31.09	25.01	296	1092
	25	−1.23	32.34	26.03	199	1463
	50	−1.53	33.49	.97	110	1849
	75	−1.60	.73	27.16	92	2100
12^{35}	100	−1.54	.91	.31	77	2311
	150	−1.37	34.11	.46	62	2659
	200	−1.08	.23	.55	53	2946
	300	−0.19	.55	.77	33	3378
11^{55}	400	−0.15	.55	.77	33	3709
	500	−0.15	.56	.78	32	4036
	600	−0.08	.58	.79	31	4352

Stat. **19.** 16. VIII. **1931.**
Franz Josef Fjord. 780 m.

GMT	a	t° C	S ‰	σ_t	$10^5 \Delta\alpha$	$10^4 \Delta D$
22^{40}	0	8.5	16.10	12.48	1514	0
	5	[5.70]	25.05	19.77	797	578
	10	[−0.60]	31.48	25.31	267	844
	25	[−1.28]	32.35	26.04	198	1192
	50	[−1.59]	33.42	.91	115	1583
	75	[−1.63]	.69	27.13	94	1843
22^{10}	100	−1.61	.84	.25	82	2063
	150	−1.41	34.08	.44	64	2427
	200	[−1.06	.24]	.56	53	2719
	300	−0.25	.54	.77	34	3152
	400	−0.19	.58	.80	31	3473
21^{20}	500	−0.15	.58	.80	31	3781
	600	−0.09	.59	.80	30	4087
	700	0.04	.60	.80	31	4392
	750	.04	.60	.80	31	4545

Table II (continued). *"Polarbjørn" 1931.*

GMT	a	t° C	S 0/00	σ_t	$10^5 \Delta \alpha$	$10^4 \Delta D$	GMT	a	t° C	S 0/00	σ_t	$10^5 \Delta \alpha$	$10^4 \Delta D$
Stat. **20.** 18. VIII. **1931.** Franz Josef Fjord. 463 m.							Stat. **21.** 19. VIII. **1931.** Franz Josef Fjord. 471 m.						
2^{50}	0	5.7	22.48	17.75	992	0	21^{00}	0	5.5	25.74	20.33	743	0
	5	.71	.93	18.10	958	487		5	4.00	27.35	21.74	608	338
	10	−0.35	31.39	25.23	274	795		10	0.75	31.77	25.49	250	552
	25	−1.33	32.93	26.51	153	1116		25	−1.18	32.97	26.54	150	853
3^{05}	50	−1.65	33.52	.99	107	1441	20^{35}	50	−1.62	33.42	.91	115	1184
2^{25}	75	−1.65	.66	27.11	96	1694		75	−1.70	.71	27.15	92	1442
	100	−1.60	.84	.25	82	1917		100	−1.74	.89	.30	78	1655
1^{35}	150	[−1.40]	34.05	.42	67	2289	19^{45}	150	−1.49	34.07	.43	65	2011
	200	−0.95	[.26]	.57	52	2584		200	−0.90	.29	.59	50	2297
	300	[−0.18	.53]	.76	35	3017		300	0.78	.76	.89	23	2660
	400	−0.06	.57	.78	32	3351		400	1.14	.83	.92	21	2878
	450	−0.03	.59	.80	31	3508	20^{35}	450	.31	.89	.95	18	2974

Table III.

"Polarbjørn" 1932.

MET	a	t° C	S 0/00	σ_t	$10^5 \triangle \alpha$	$10^4 \triangle D$	O_2 cc/L	O_2 0/0	p_H
				Stat. **1.** 19. VII. **1932.** Abt. 74° 10′ N abt. 16° 10′ W. 194 m.					
12 45	0	—0.7	31.31	25.18	280	0	[8.44]	[100]	
	1	—0.82	.37	.23	275		.73	103	8.25
	5	—0.86	.41	.26	272	138	.80	104	.23
	10	—0.89	.60	.42	257	270	.78	104	.24
	25	—0.93	32.45	26.11	191	606	.48	101	.21
	50	—1.64	[33.46]	.94	112	985	.08	95	.09
11 50	75	[—1.71]	.87	27.28	80	1225	.15	96	.23
	100	[—1.44]	34.21	.55	54	1393			<.08
	150	[—0.24]	.50	.73	37	1620			.12
	180	0.93	.76	.88	24	1712	6.93	88	<.06
				Stat. **2.** 20. VII. **1932.** 74° 23′ N 17° 00′ W. 192 m.					
15 20	0	—1.0	32.15	25.87	214	0	[8.45]	[100]	
	1	—0.98	.16	.87	214		.97	106	8.25
	5	—1.44	.30	26.00	202	104			
	10	—1.53	.36	.05	197	204			
	25	—1.68	33.03	.60	145	459	.41	99	.20
	50	—1.73	.20	.73	131	804	.47	99	.23
14 10	75	—1.67	.63	27.08	98	1092			
	100	—1.71	.86	.27	80	1315	7.90	93	.20
	150	—1.60	34.14	.49	59	1663			
	180	—1.18	.27	.59	50	1827·	.58	91	<.09
				Stat. **3.** 22. VII. **1932.** Off Wollaston Forleand. 119 m.					
12 25	0	2.95	26.07	20.80	698	0	[8.00]	[100]	
	1	1.21	30.83	24.71	324		.84	110	8.46
	5	0.81	31.68	25.41	257	239	9.16	113	.43
	10	—1.19	32.42	26.09	193	351	.21	109	.27
	25	—1.57	.98	.55	149	608	8.39	99	.21
11 00	50	—1.67	33.19	.72	132	958	.33	97	.23
	75	—1.69	.47	.95	110	1262	.23	97	.26
12 25	100	—1.72	.73	27.17	90	1512			.22
				Stat. **4.** 27. VII. **1932.** Foster Bay. 390 m.					
19 30	0	3.0	29.50	23.53	437	0	[7.79]	[100]	
	5	2.70	.59	.62	428	216	8.39	107	8.28
	10	1.26	30.82	24.70	325	404			
	25	—1.14	32.85	26.44	160	768	.68	103	.25
	50	—1.58	33.19	.72	132	1133	.33	98	.22
	75	—1.67	.49	.97	109	1435			
	100	—1.70	.67	27.12	95	1690	7.73	91	.23
18 25	150	—1.22	34.12	.47	62	2081	.52	90	.18
	200	—0.14	.50	.73	37	2329	.11	88	.18
	300	1.32	[.83]	.91	22	2624	.18	98	.17
	360	.53	.87	.92	21	2751			
				Stat. **5.** 28/29. VII. **1932.** Franz Josef Fjord. 501 m.					
0 30	0	3.85	28.92	23.00	487	0	[7.67]	[100]	
	5	0.99	30.35	24.34	360	212	9.05	111	8.30
	10	—0.12	31.59	25.38	260	367			
	25	—1.33	32.91	26.49	155	678			
	50	—1.65	33.27	.79	126	1029			
	75	—1.67	.53	27.00	106	1319	7.85	92	

Table III (continued). *"Polarbjørn" 1932.*

MET	a	t° C	S 0/00	σ_t	$10^5\Delta\alpha$	$10^4\Delta D$	O_2 cc/L	O_2 0/0	p_H
0^{30}	100	—1.70	33.76	27.19	88	1561	7.73	91	8.17
23^{20}	150	—1.27	34.09	.44	64	1941	.59	91	
	200	—0.37	.43	.68	41	2204	.63	94	.12
	300	1.43	.85	.91	21	2516	6.93	89	.17
	400	.73	[.92]	.95	19	2717			
	475	.81	.94	.96	18	2854	7.02	91	.23
		Stat. **6.**	30. VII. **1932.**	Franz Josef Fjord.	443 m.				
6^{30}	0	7.25	24.60	19.25	847	0	[7.31]	[100]	
	5	2.91	28.30	22.58	527	344	9.50	121	8.39
	10	0.16	30.83	24.76	319	555			
	25	—1.13	32.58	26.22	181	930			
	50	—1.71	33.35	.86	120	1306	7.92	93	.18
	75	—1.74	.54	27.01	105	1587	.95	93	.19
5^{30}	100	—1.70	.78	.21	87	1826	.93	94	.19
6^{30}	150	—1.37	34.05	.41	67	2210	.44	89	.20
5^{30}	200	—0.41	.38	.64	45	2489	.08	87	.16
	300	0.04	.54	.75	35	2890			.16
	400	.18	.58	.78	33	3232	6.81	85	.22
		Stat. **7.**	30. VII. **1932.**	Franz Josef Fjord.	638 m.				
13^{10}	0	3.95	28.21	22.43	542	0	[7.69]	[100]	
	5	2.64	29.21	23.32	456	250	8.58	109	8.39
	10	0.66	30.61	24.56	338	448	9.03	110	.32
	25	—1.21	32.69	26.31	172	831	8.02	95	.20
	50	— 1.73	33.37	.87	118	1194	7.76	91	.19
	75	—1.81	.46	.95	112	1480			
12^{05}	100	—1.72	.76	27.19	88	1728	8.05	95	.19
	150	—1.30	34.09	.44	64	2108	7.74	92	.17
	200	—0 54	.38	.65	44	2378			.17
	300	—0.06	.55	.76	34	2770	6.79	84	.12
11^{05}	400	—0.06	.57	.78	32	3101	.84	85	.12
	500	—0.06	.57	.78	32	3422	.13	76	.12
	600	—0.04	.57	.78	32	3743	.63	82	.12
		Stat. **8.**	4. VIII. **1932.**	Davy Sound.	Abt. 390 m.				
9^{55}	0	3.35	24.30	19.37	835	0	[8.03]	[100]	
	5	.92	26.70	21.23	656	373	.25	106	8.27
	10	1.45	28.89	23.14	474	655	.65	106	.32
	25	—0.44	32.32	25.98	203	1163	9.05	109	.27
	50	—1.60	33.15	26.69	136	1585	8.57	101	.20
	75	—1.77	.54	27.01	105	1886			
	100	—1.79	.76	.19	88	2127	.12	96	.20
8^{45}	150	—1.34	34.13	.48	60	2497	7.84	94	.19
	200	—0.28	.44	.69	41	2751	6.99	86	.19
	300	1.49	.87	.92	20	3058			
	360	.58	[.89]	.93	20	3257	7.16	92	.13
		Stat. **9.**	4. VIII. **1932.**	King Oscar Fjord.	432 m.				
17^{00}	0	7.95	20.06	15.62	1197	0	[7.40]	[100]	
	5	6.63	23.38	18.37	932	532	8.12	109	8.22
	10	3.13	28.57	22.78	508	893	9.09	116	.26
	25	—1.00	32.21	25.92	209	1431			
	50	—1.62	.96	26.54	150	1880	8.32	98	.20
	75	—1.75	33.44	.93	113	2208	.13	96	.19
	100	—1.78	.70	27.14	92	2464	.03	94	.19
15^{35}	150	—1.42	34.01	.38	69	2869			
	200	—0.36	.36	.63	47	3160	7.43	91	.16
	300	0.84	.72	.85	27	3528	.02	89	.17
	400	1.08	.77	.88	25	3787	.22	92	.16

Table III (continued). *"Polarbjørn" 1932.*

MET	a	t° C	S 0/00	σ_t	$10^5\Delta\alpha$	$10^4\Delta D$	O_2 cc/L	O_2 0/0	p_H
			Stat. **10.** 5. VIII. **1932.** King Oscar Fjord. 327 m.						
6^{55}	0	8.3	21.43	16.65	1098	0	[7.30]	[100]	
	5	.09	22.74	17.69	997	524	.48	103	
	10	7.10	24.36	19.08	863	989	.69	105	
	25	—0.84	32.39	26.05	196	1784	9.17	109	
	50	—1.66	33.15	.69	136	2198			
	75	—1.80	.49	.97	109	2503	8.04	94	
5^{30}	100	—1.78	.65	27.10	96	2760	.23	97	
	150	—1.44	.97	.35	72	3182	7.63	91	
	200	—0.41	34.40	.66	43	3472	.14	87	
	300	0.61	.69	.84	28	3826	6.84	86	
			Stat. **11.** 5. VIII. **1932.** Sofia Sound. 325 m.						
11^{20}	0	8.75	21.92	16.98	1066	0	[7.20]	[100]	
	5	.74	.88	.95	1069	534	.12	99	
	10	6.88	23.88	18.73	897	1025			
	25	—0.86	32.49	26.14	188	1839	9.10	108	
	50	—1.62	33.07	.63	142	2252			
	75	—1.73	.43	.92	113	2570			
10^{15}	100	—1.66	[.60]	27.06	101	2838	8.39	99	
	150	—1.32	.90	.29	78	3285	7.56	90	
	200	—0.70	34.20	.51	58	3625			
			Stat. **12.** 7. VIII. **1932.** Granta Fjord. 80 m.						
5^{45}	0	6.0	10.17	8.05	1938	0	[8.28]	[100]	
	5	8.06	22.29	17.34	1031	742	7.77	106	8.30
	10	2.99	29.28	23.36	453	1113	9.16	115	.25
	25	—1.26	32.66	26.28	174	1584	.03	107	.22
	50	—1.46	.79	.40	164	2006			
	75	—1.56	.89	.48	155	2404	8.06	96	.28
			Stat. **13.** 7. VIII. **1932**. Clavering Fjord. 420 m.						
16^{10}	0	5.05	25.03	19.82	793	0	[7.67]	[100]	
	5	.99	.34	.97	778	393	.59	101	8.22
	10	1.46	30.26	24.24	369	679	8.97	111	.24
	25	—0.82	32.78	26.37	166	1081	9.52	114	.19
	50	—1.65	33.16	.70	135	1457	8.42	99	.24
	75	—1.67	.40	.89	116	1770	.51	100	.18
	100	—1.58	.70	27.14	93	2031	7.84	93	.17
15^{25}	150	—1.32	34.02	.39	69	2436			
	200	—1.20	.13	.47	61	2761	.17	86	.16
	300	—1.02	.18	.51	57	3351	.96	96	.18
	400	—0.99	.19	.52	56	3916	6.90	83	.19
			Stat. **14.** 8. VIII. **1932.** Foster Bay. 168 m.						
20^{00}	0	3.55	24.92	19.85	789	0	[7.95]	[100]	
	5	1.85	29.53	23.63	427	304	8.39	105	8.28
19^{10}	10	0.54	.75	.88	404	512	.74	106	.28
	25	—1.47	32.79	26.40	164	937	9.34	110	.22
	50	—1.61	33.30	.81	124	1296	8.47	100	.18
	75	—1.74	.53	27.00	106	1583			
	100	—1.69	.74	.17	90	1828	(.68)	(102)	.17
	150	—1.40	34.14	.49	60	2200	7.62	91	.15

Table III (continued). *"Polarbjørn" 1932.*

MET	a	t° C	S ‰	σ_t	$10^5\Delta\alpha$	$10^4\Delta D$	O_2 cc/L	O_2 %	p_H
			Stat. **15.** 9. VIII. **1932.** Muskox Fjord. 75 m.						
23^{25}	0	8.35	10.17	7.86	1956	0	[7.84]	[100]	
	5	.18	15.45	12.01	1549	876	.91	104	8.27
	10	5.73	26.82	21.16	663	1429	8.00	107	.20
	25	—1.32	32.64	26.27	176	2058	.33	98	.15
	50	—1.45	33.34	.84	121	2429	7.81	92	
	70	—1.44	.55	27.01	105	2655	.78	92	.13
			Stat. **16.** 11. VIII. **1932.** Geologist Fjord. Abt.. 650 m.						
17^{35}	0	2.4	28.98	23.16	472	0	[7.94]	[100]	
	5	1.98	29.41	.53	437	227	8.11	101	8.23
	10	.08	30.13	24.16	377	431	.15	100	.28
	25	—0.90	32.75	26.36	167	839	.21	98	.21
	50	—1.59	33.27	.79	126	1205	.17	96	.20
	75	—1.66	.43	.92	114	1505	7.95	94	.18
16^{45}	100	—1.64	.51	.99	107	1781	.69	91	.20
	150	—1.63	.60	27.06	100	2300	.42	87	.17
	200	—1.62	.60	.06	100	2800	.39	87	.18
	300	—1.66	.62	.07	97	3787			.18
15^{30}	400	—1.62	.63	.08	96	4756	.64	90	.20
	500	—1.61	.63	.08	96	5717	.66	90	.20
	600	—1.64	.63	.08	95	6670	.44	87	.20
			Stat. **17.** 12. VIII. **1932.** Franz Josef Fjord. 166 m.						
10^{40}	0	5.0	27.22	21.55	626	0			
	5	4.98	.20	.54	627	313			
	10	.80	.55	.83	599	620			
	25	—1.05	32.72	26.33	170	1197			
10^{10}	50	—1.58	33.27	.79	126	1567			
	75	—1.68	.55	27.02	104	1856			
	100	—1.59	.74	.17	90	2099			
	150	—1.16	34.18	.51	57	2467			
			Stat. **18.** 12. VIII. **1932.** Franz Josef Fjord. 520 m.						
12^{40}	0	5.3	27.08	21.41	639	0			
	5	.44	.04	.36	644	321			
	10	3.03	29.00	23.13	475	601			
	25	—0.82	32.40	26.06	195	1103			
	50	—1.61	33.23	.76	129	1509			
	75	—1.67	.54	27.01	105	1802			
	100	—1.69	.76	.19	88	2043			
11^{30}	150	—1.34	34.07	.43	65	2426			
	200	—0.44	.37	.64	46	2703			
	300	1.31	.83	.91	22	3039			
	400	.71	.91	.94	19	3243			
	500	.83	.94	.96	19	3433			
			Stat. **19.** 12. VIII. **1932.** Franz Josef Fjord. 285 m.						
14^{05}	0	3.8	29.19	23.22	467	0			
	5	.38	.47	.47	442	227			
	10	1.25	31.38	25.15	283	408			
	25	—0.93	32.72	26.32	170	748			
	50	—1.57	33.22	.75	130	1124			
	75	—1.73	.47	.96	110	1424			
13^{35}	100	—1.68	.70	27.14	93	1678			
	150	[—1.22	34.08]	.43	65	2072			
	200	—0.35	.41	.67	43	2342			
	275	1.07	.77	.88	24	2595			

Table III (continued). *"Polarbjørn"* *1932.*

MET	a	t° C	S ‰	σ_t	$10^5\triangle\alpha$	$10^4\triangle D$	O_2 cc/L	O_2 %	p_H
		Stat. **20.** 14. VIII. **1932.** Gael Hamke Bay. 312 m.							
16^{20}	0	3.4	25.00	19.93	782	0	[7.97]	[100]	
	5	0.83	30.17	24.20	373	289	9.45	115	8.26
	10	—0.40	32.10	25.81	215	436	.80	118	.26
	25	—1.42	.78	26.39	165	720	.63	113	
	50	—1.66	33.41	.90	115	1070	8.29	98	.13
	75	—1.77	.72	27.16	91	1328	.09	95	.16
15^{15}	100	—1.70	.88	.29	79	1540	7.98	94	.18
	150	—1.64	34.09	.45	63	1894	.72	91	.17
	200	—0.79	.35	.64	46	2164	.60	92	.15
	300	1.38	.87	.93	19	2488	6.84	88	.24
		Stat. **21.** 15. VIII. **1932.** Tiroler Fjord. 122 m.							
14^{20}	0	8.2	10.55	8.18	1925	0	[7.84]	[100]	
	5	1.87	31.25	25.00	296	555	8.90	113	8.25
	10	0.14	32.47	26.08	194	678	9.11	111	.26
	25	—0.75	.85	.42	161	944	8.67	104	.22
	50	—1.37	33.06	.61	143	1324	7.94	94	.15
	75	—1.39	.26	.77	128	1662			.07
	100	—1.40	.30	.81	124	1977	6.29	75	.07
		Stat. **22.** 15. VIII. **1932.** Tiroler Fjord. 320 m.							
21^{50}	0	7.5	19.94	15.58	1201	0	[7.50]	[100]	
	5	1.34	31.41	25.16	281	370	8.93	112	8.25
	10	0.09	32.23	.89	212	494			
	25	—0.98	.81	26.40	163	775	.85	105	.24
	50	—1.50	33.05	.61	143	1159	.21	97	.20
	75	—1.62	.15	.69	135	1507	.28	97	.21
20^{45}	100	—1.62	.26	.78	127	1835	7.61	90	.26
	150	—1.66	.39	.89	116	2442	.09	83	$<$.08
	200	—1.69	.46	.95	110	3009	6.80	80	.08
	300	—1.73	.54	27.01	103	4078	.65	78	.09
		Stat. **23.** 16. VIII. **1932.** Young Sound. 168 m.							
1^{50}	0	4.0	27.55	21.90	593	0	[7.71]	[100]	
	5	1.09	31.41	25.18	279	218	9.08	113	8.27
	10	0.16	32.31	.95	206	339	.43	115	.28
	25	—1.19	.77	26.37	166	619	.37	111	.27
	50	—1.55	33.06	.62	142	1004	8.25	97	.19
1^{10}	75	—1.68	.17	.71	134	1349	7.99	94	.17
	100	—1.67	.28	.80	125	1673	.73	91	.15
	150	—1.66	.36	.86	119	2281	.22	85	.25
		Stat. **24.** 19. VIII. **1932.** Dusén Fjord. 300 m.							
14^{10}	0	6.1	26.73	21.05	674	0	[7.39]	[100]	
	5	5.91	.79	.12	667	335	.38	100	
	10	.67	.96	.28	652	665			
	25	0.82	31.95	25.63	237	1332	9.23	114	
	50	—1.31	33.05	26.60	144	1808	8.48	100	
	75	—1.65	.42	.91	114	2131	7.89	93	
13^{00}	100	—1.64	.46	.94	111	2413	.86	93	
	150	—1.62	.75	27.18	89	2912	.23	85	
	200	—1.59	.77	.19	87	3352	6.80	80	
	280	—1.59	.79	.21	85	4040	.51	77	

Table III (continued). *"Polarbjørn" 1932.*

MET	a	t° C	S 0/00	σ_t	$10^5\Delta\alpha$	$10^4\Delta D$	O_2 cc/L	O_2 0/0	p_H
		Stat. **25.** 21. VIII. **1923.** 73° 06′ N, 20° 43′ W. 98 m.							
11^{35}	0	0.45	28.03	22.50	535	0	[8.39]	[100]	
	1	.33	.04	.51	534		.24	98	
	5	−0.02	.75	23.10	478	253	.44	100	
	10	0.38	30.30	24.33	361	463	.92	108	
	25	−1.13	32.61	26.24	178	867	9.82	116	
10^{35}	50	−1.66	33.48	.96	110	1227	8.29	98	
	75	−1.67	.87	27.28	80	1465	7.89	93	
	90	−1.65	.92	.32	76	1582	.79	92	
		Stat. **26.** 21. VIII. **1932.** 72° 58′ N, 19° 59′ W. 191 m.							
14^{50}	0	2.8	26.61	21.25	655	0	[7.99]	[100]	
	1	.74	.61	.25	655		.95	99	
	5	0.93	27.36	.95	588	311	8.30	100	
	10	1.17	30.87	24.74	321	538	.42	104	
	25	−1.22	.90	.94	302	1005	9.50	111	
	50	−1.62	33.32	26.83	122	1536	8.53	100	
14^{20}	75	−1.74	.63	27.08	98	1812	.33	98	
	100	−1.66	.89	.29	78	2032	7.84	93	
	150	−1.41	34.21	.55	54	2362	.54	90	
	185	−0.48	.41	.67	43	2531	.43	91	
		Stat. **27.** 21. VIII. **1932.** 72° 43′ N, 19° 11′ W. 224 m.							
18^{50}	0	0.2	29.60	23.77	414	0	[8.35]	[100]	
	1	.31	.80	.93	399		.44	101	
	5	.37	.81	.93	398	203			
	10	.27	.91	24.02	390	400	.39	101	
	25	−0.06	32.68	26.26	177	825	9.39	114	
	50	−1.45	33.59	27.04	102	1174			
18^{15}	75	−1.62	.99	.37	71	1390	7.83	93	
	100	−1.61	34.11	.47	61	1555	.61	90	
	150	−0.61	.39	.66	43	1817	.29	89	
18^{50}	200	0.90	.73	.85	26	1991	.18	91	
		Stat. **28.** 21. VIII. **1932.** 72° 27′ N, 18° 24′ W. 268 m.							
23^{10}	0	−0.05	29.99	24.09	383	0	[8.38]	[100]	
	1	−0.08	30.08	.17	376		.45	101	
	5	−0.06	.10	.18	375	189			
	10	−0.03	.42	.44	350	370	9.00	108	
	25	−1.49	33.05	26.61	144	741	8.53	100	
	50	[−1.64	.72]	27.15	92	1035			
22^{25}	75	−1.63	34.02	.40	69	1235	7.86	93	
	100	−1.36	.17	.51	58	1393			
	150	0.70	.65	.80	31	1614	.08	89	
22^{35}	200	2.12	.94	.93	20	1740	(8.03)	(105)	
	250	1.92	35.00	28.00	13	1822	7.20	94	

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