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The Movements of a Cold Water Front

Temperature Variations along the Norwegian Coast based on Surface Thermograph Records

By

JENS EGGVIN

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A.s John Griegs Boktrykkeri, Bergen

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Preface

This paper deals with the sea temperature in the upper layers along the Norwegian coast, and in connection herewith the stability of the watermasses, currents and meteorological factors.

It will be shown how the two, relative new methods adopted in oceanographic research — permanent oceanographic stations in deep water and the registration of sea temperature on board coasting steamers and liners — prove effectively that they add to and supplement the material collected on the cruises of the research ships in the most valuable way. Further by the help of this combination of old and new research methods we have succeeded in solving important problems which would otherwise have been insoluable by only using the material from the cruises. We will inter alia try to show how we can follow the penetration of a cold water front along the south and west coasts of Norway and the consequence this may have to the forecast of especially oceanographic situations, which have proved to be of vital importance to the herring fishery in these fields.

In the spring of 1935 the Fisheries Directorate through the courtesy of the Vesterålens and the Stavangerske Steamship Companies, got self-registering sea-thermographs installed on board two vessels which between them ply along the whole of the Norwegian coast from Oslo to Kirkenes (E. Finnmark). In this way there was established a regular and continuous registration of sea temperature along the whole 2,726 kilometres stretch of the Norwegian coast. Between Bergen and Oslo there are eight and between Bergen and Kirkenes four runs each month.

The thermographs were mounted on board the S/S »Lofoten« of the Vesterålens and the S/S »Christiania« of the Stavangerske Steamship Co. The former runs between Bergen and Kirkenes, and the latter between Bergen and Oslo.

The »Christiania« made her first trip with the thermograph on 3rd April, and the »Lofoten« hers on the 6th May 1935. From that time onwards the registration has continued regularly except when the vessels were being docked and cleaned.

The present examination is based on the thermograph material from these steamers. Further there is to the extent considered necessary also made use of hydrographic material from the cruises of the Fisheries Directorate and from the permanent oceanographic station on the Sognesjø. Further thermograph material obtained from vessels plying from Bergen across the North Sea, and to Iceland has been made use of and also meteorological material.

I wish to express my sincere thanks to the officers on board who with eager interest have taken care of the thermographs and constructed charts of position. Special thanks are due to Chief Engineers B. CHRISTIANSEN and I. ABRAHAMSEN on board the S/S »Christiania« and Chief Engineers A. OLSEN and A. KVITVIK on board the S/S »Lofoten«. Further I desire to thank Dr. SVERRE PETTERSEN and Mr. FINN SPINNANGR in charge of Vervarslinga på Vestlandet at Bergen who kindly have placed meterological material at my disposal, and also Det Norske Meteorologiske Institutt in Oslo. I also wish to express my sincerest thanks to dr. A. DANNEVIG for leaving at my disposal hydrographic material collected by Flødevigen Utklekningsanstalt by Arendal. My best thanks are presented to Mr. OLAV AASEN, Mr. FINN KJELSTRUP-OLSEN and Mr. KR. M. WILHELMSEN who have assisted me with calculations and drawing of the figures. In particular I wish to acknowledge my indebtedness to Dr. J. N. CARRUTHERS and Mr. O. SUND for reading over and amending the English text.

I. Instruments

1. THE SEA-THERMOGRAPH

The sea-thermographs were supplied by Negretti & Zambra of London. They are constructed on the mercury-in-steel principle. The thermo-element consists of a steel tube filled with mercury having a capillary connection ending in a hollow spiral spring, or Bourdon tube, in the recorder (fig. 1). The inner end of the spiral spring is fixed to a horizontal rod moving with the oscillations of the spring. A light metal arm 23 cm in length and ending in a pen is fixed to the rod. The diagram paper is fixed on a clock drum of 24 hours run and provides for a diagram of a comparatively large size, 28 cm long and 12.8 cm high. It is, therefore, possible to read the instrument with an accuracy of one-tenth degree in temperature and 3 minutes in time.

The capillary will generally be exposed to other variations of temperature than those found where the temperature is to be measured. But the temperature changes in the medium surrounding the capillary have, practically speaking, no effect on the recording because the quantity of mercury in the capillary is trifling compared with that in the bulb. According to a statement from the makers the ratio is as 1 to 188. The diameter of the capillary is only 0.2 mm. A temperature difference of 19° C between bulb and capillary will not show more than 0.1° C on the thermogram.

Vibration caused by engines and propeller does not affect the registration. In a very heavy sea on the other hand, the pen may swing a little out from the diagram and back again. Thereby the temperature trace may be made so thick as to cover a part of the scale corresponding to 0.2 to 0.3° C. On such occasions a fairly accurate reading is obtained by assuming that the middle of the trace gives the temperature.

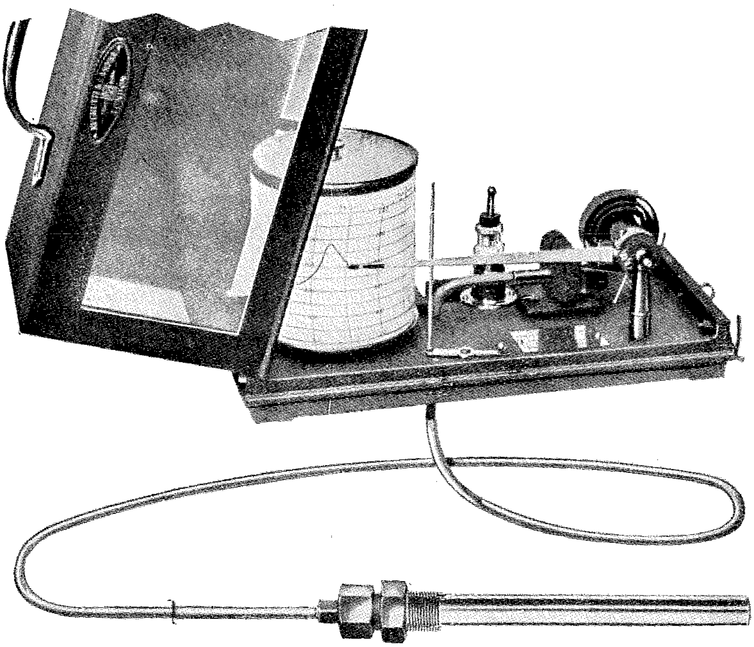

Fig. 1. The sea thermograph (photo: Negretti & Zambra)

2. INSTALLATION AND CONTROL OF THE SEA-THERMOGRAPHS

In order to obtain reliable results the instrument must be installed in such a manner that there is a large volume of water circulating around the mercury bulb, and the registering apparatus should be placed near by so as not to require too long a capillary.

The tube may be exposed to the sea through an opening in the side of the ship as was done in the Fisheries Directorate's research vessel, the »Johan Hjort«, when her first sea-thermograph was installed in 1924. There is also another arrangement which has been made use of. Through the intake to the engines flows a great volume of water directly from the sea, and it has been found to be more practical to locate the bulb there and to place the registering apparatus on a shelf in the engineroom. This arrangement has already been used in America since 1923 where sea-thermographs have been installed in vessels crossing the Pacific Ocean and parts of the Atlantic between North and South America, and also in vessels running across the Straits of Florida (1), (2), (22).

Apart from the three afore mentioned vessels, the Fisheries

Directorate have sea-thermographs installed in four of the Bergenske Steamship Co.'s ships running from Bergen across the North Sea and to Iceland.

The initiative as to installing sea-thermographs on board the »Johan Hjort« and on board Norwegian liners was Mr. OSCAR SUND's.

From a number of control-readings made by the present writer on board the six liners in which the Fisheries Directorate have installed sea-thermographs, it has been found that the temperature of the water flowing through the main intake pipe where the bulb is placed, is the same as that of the sea at the intake depth. As controll instruments reversing thermometers were used in the sea and an ordinary precision mercurial thermometer on board.

Instrument No. T/27325 was installed in the S/S »Christiania« and No. T/27326 in the S/S »Lofoten«.

From tests made in the laboratory before the installation, it was found that instrument No. T/27326 read 0.29° C too low at 5° C, and 0.21° C too low at 10° C and also at 15° C. The instrument had therefore to be adjusted. It was not found necessary to correct the thermograph in the »Christiania« as the error was found not to reach 0.1 degree just after installation. The thermographs are tested every now and then, and the engineer on watch checks the thermograph by means of a reliable ordinary thermometer on every voyage. These check readings are noted on forms which are attached to the thermograms. The time of arrival and departure from the ports of call are entered on the diagrams, and also any changes in speed (for instance on account of fog or snow). Charts of position are constructed by the mate for every voyage on board the ships trading across the North Sea and to Iceland. Thus, the temperature at any place en route can be found.

II. The Registration of the Sea-Thermograph Compared with other Observations

As the bulb is placed in the main intake pipe of the condenser, it is not the surface temperature which is registered, but that at a depth of about four metres. The depth may vary a few feet ($2\frac{1}{2}$—3) according to the trim of the vessel. In winter and autumn, however, the water is fairly homogeneous in the upper layer and therefore practically no difference exists between the temperature at the surface and that at a depth of four metres. Neither will there be any appreciable difference in summer in rough weather. It is otherwise in calm weather with sunshine during summer. Then, and especially after noon, there will be a higher temperature at the surface than at four metres. The difference will be less along the open coast than in closed-in waters. A striking example in the difference of the surface temperature (or rather that at 1 m) from the temperature at the depth at which the thermograph registers, is seen in fig. 8 which represents the temperature on the Sognesjø from May 1935 to July 1936. The full-drawn curve has been constructed from the thermograms, and the dotted line from fortnightly observations made at a depth of 1 metre with two precision reversing thermometers[1]). It will be seen that in spring and early summer the temperature at 1 metre than is a little higher, and in autumn when the cooling takes place a little lower, than it is at 4 metres. The difference is negligible, however, especially when it is considered that the thermograph curve is taken from a place lying 7 kilometres farther out to sea than the station represented by the dotted curve. If the thermograph curve and the other data had originated from exactly the same place, the difference might have been still less because the yearly amplitude decreases towards the open sea.

[1]) The observations were made by cand. mag. OLAV LEIRVÅG at the Fisheries Directorate's oceanographic station on the Sognesjø. Every fortnight or every week temperature observations and water samples are taken at all standard depths from 1 to 300 metres. The material is sent to the laboratory in Bergen for treatment.

Along the Norwegian Coast surface temperatures have been recorded for many years, at lighthouses as well as at meteorological stations. H. Mohn has in 1883 (18) given a survey of the surface temperature along the Norwegian Coast based on observations at eleven lighthouses. Aksel S. Steen continued the treatment of the material until 1903 (22). Helland-Hansen and Nansen have in 1920 (14) dealed with the surface temperature of the sea 1895—1910. The observations were taken at lighthouses on the south and west coasts of Norway (Torungen, Utsira, Hellisøy and Ona). The authors investigated relations between the air pressure and the surface temperature.

The scattered positions of the stations and certain inaccuracies characterising the bucket method used at them, inevitably result in a less reliable and representative picture of the surface temperature than that obtainable from continuous registration by thermograph. At the stations mentioned the temperature is recorded close to the seashore. From a wharf or pier a bucketful of sea water is hauled up and its temperature read on an ordinary mercury thermometer. Even if the observer takes proper care to see that the bucket has had time to take up the sea temperature before the reading, and even if his readings are as exact as possible and written down at once, inaccuracies will still attach to this procedure. In the summer for instance, the sun will warm the beach at low water and this will result in the surface water getting warmer when the flood tide sets in. In the winter the opposite will be the case, as the beach then gets cooled at low water. The temperature amplitude of the year will, therefore, be greater than if the records had been taken farther from the shore. Drainage of fresh water will influence the temperature to a greater degree close inshore than farther seawards. Such inaccuracies will not be a feature of the thermograms because the vessel mostly runs at a good distance from the shore; moreover the temperature is registered automatically. There is also another reason why the temperatures recorded by thermograph are to be preferred when making a comparison between surface temperature at different places and when studying its variations from season to season or from year to year — the registration is made at a depth of about 4 metres. The thin surface layer which is due to examination by the bucket method is as a matter of fact considerably more exposed to occasional local temperaturevariations caused by sunshine, rainsqualls and other precipitation than the water at a depth of about 4 metres is. It will therefore, be most correct to make use of the records of the sea-thermograph instead of trying to determine what degree of reliability can be assigned to observations made by bucket and thermometer. With regard to research in open sea we may agree with the statement of C. F. Brooks (2): »The thermograph record may be used as a standard by which the bucket observations can be judged, both as to their accuracy and as to their adequacy, in showing the general surface temperatures of the Gulf Stream here«.

In the following therefore, as far as the surface temperature is concerned, we prefer to use material obtained with registering sea-thermographs.

III. The Sea-Temperature

1. THERMOGRAMS FROM VARIOUS PARTS OF THE COAST AND AT DIFFERENT SEASONS

An example as to how the sea-thermograph registers can be seen in fig. 2 which relates to the south coast of Norway between Egersund and Arendal at different seasons — March, May, August and November.

It will be seen that the temperature in March is very even. It falls towards the east, being 3° C at Egersund, and only just over 1° C at Arendal. In May on the other hand, there are fairly great variations in the temperature. The summer heating has by then made itself felt in the surface layer. At the same time a great deal of melt-water reaches the sea from inland districts and uplands. Where this fresh water enters the sea, the surface temperature will be reduced. It is for this reason that the temperature along the coast varies so much at this time of the year. In June and July the temperature may be comparatively even. With strong winds from certain directions, varying according to the part of the coast, we get just at this time the greatest temperature variations. That is because there is such a great contrast between the temperature of the surface and of the deep water — which latter can, under certain wind conditions, be brought up to the surface. In May the wind may affect the temperature similarly, though not to the same extent.

As the summer heating penetrates into the deeper water we get more even temperatures. Thus, in September and October the variations in temperature are very slight. In November the cooling of the land will make itself felt partly through that the river water being now colder than the sea.

In January and February the surface water along the Skagerack Coast is considerably colder than the water immediately beneath it. A strong wind can then have just the opposite effect on the surface temperature to what it would have in June; it can either be instrumental in bringing warmer water up to the surface, or can press the warmer ocean water nearer to the land (see fig. 8, Jæren and Lindesnes). A violent churning up of the upper layers caused by strong wind or current,

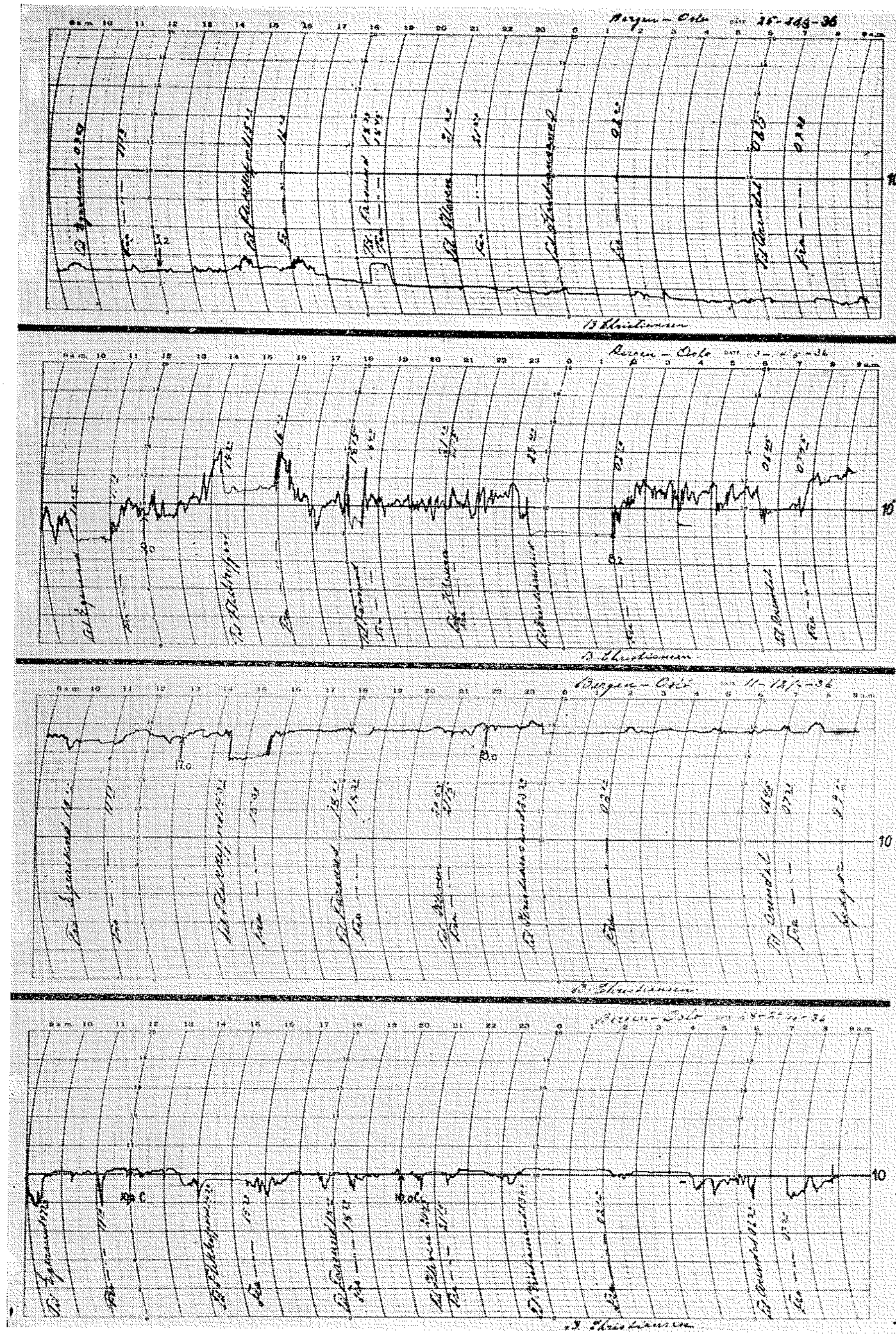

Fig. 2. Thermograms from the south coast in March, May, August and November. The 10° C line is in this and the four following figs. emphasized.

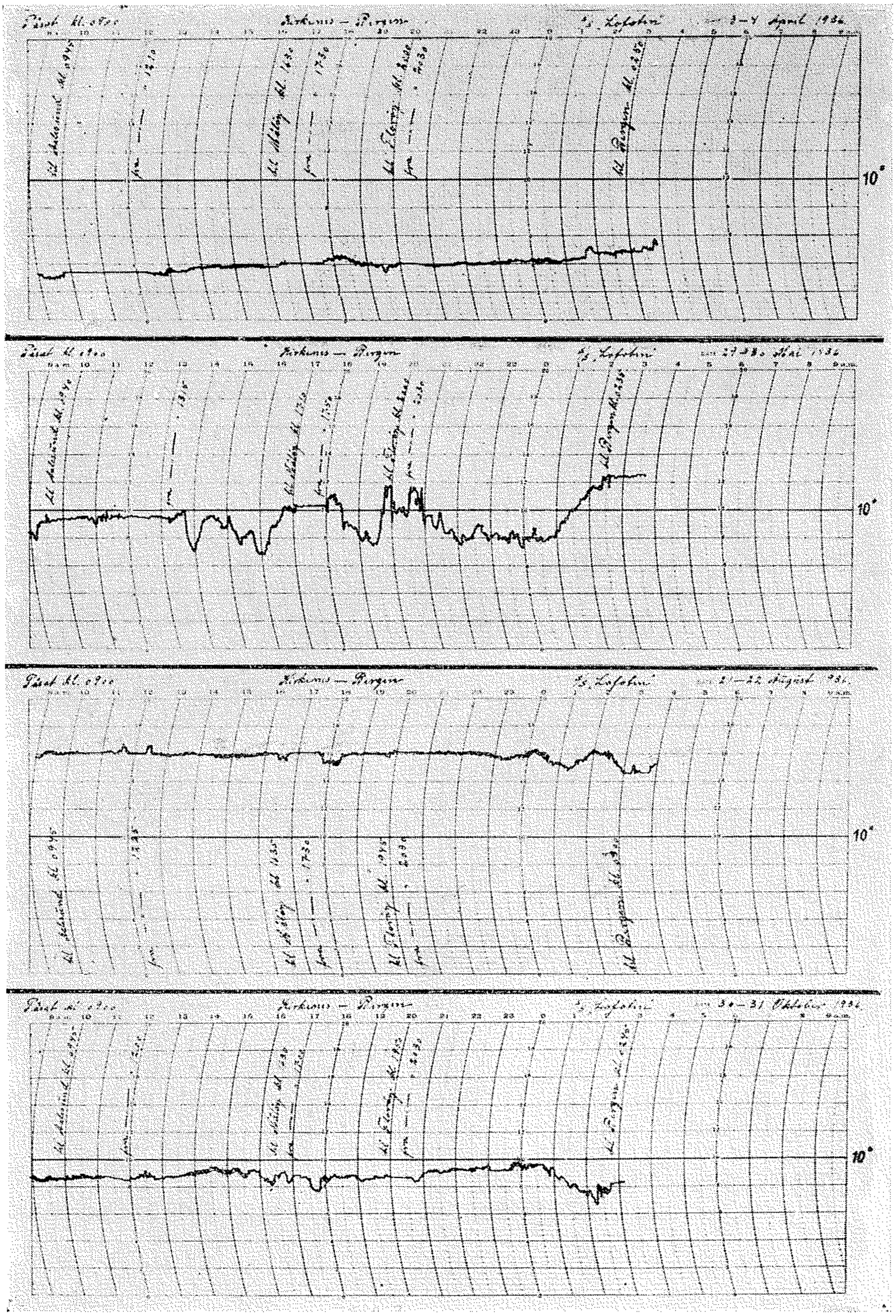

Fig. 3. Thermograms from the west coast at different seasons.

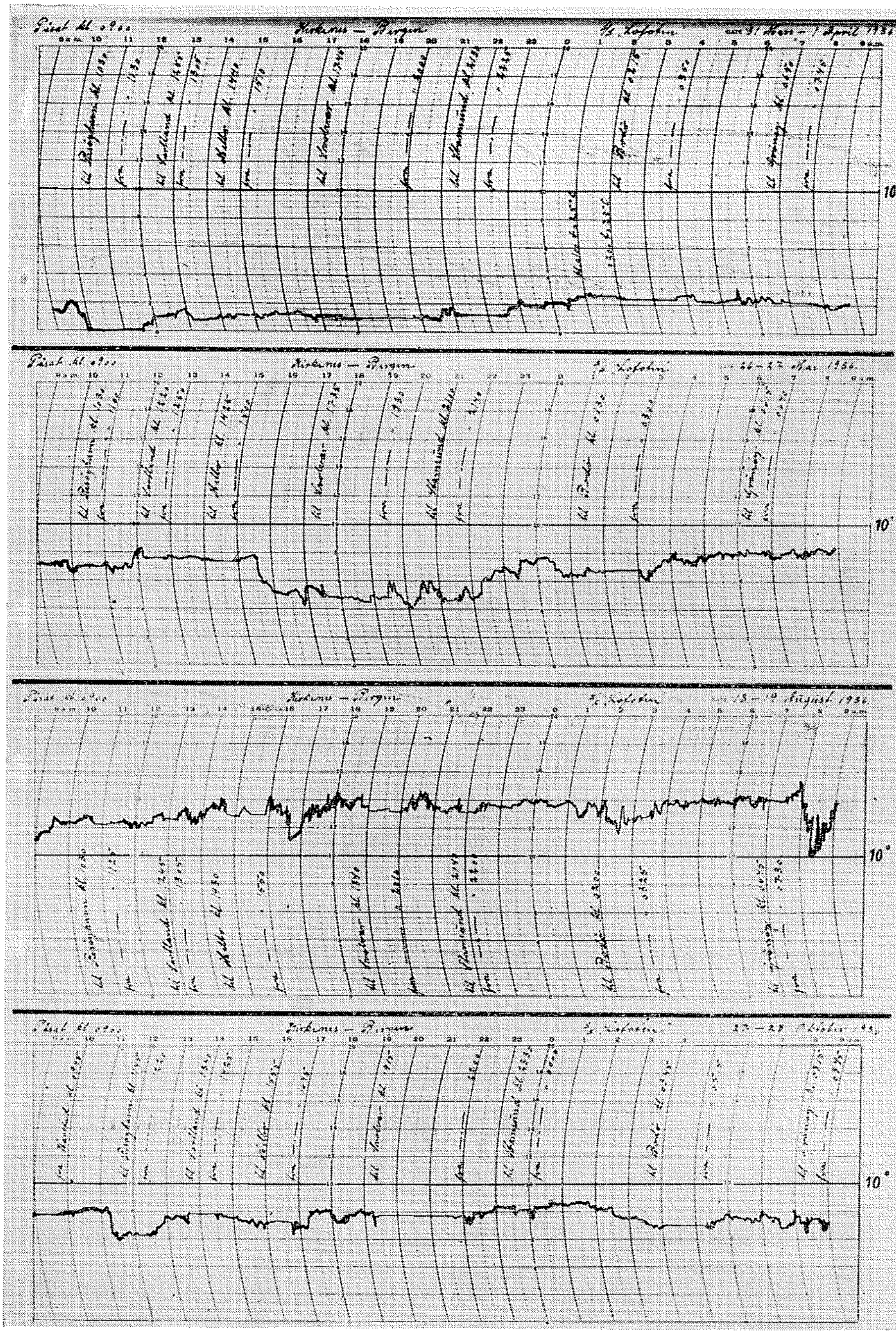

Fig. 4. Thermograms from the North Norway (Nordland) at different seasons.

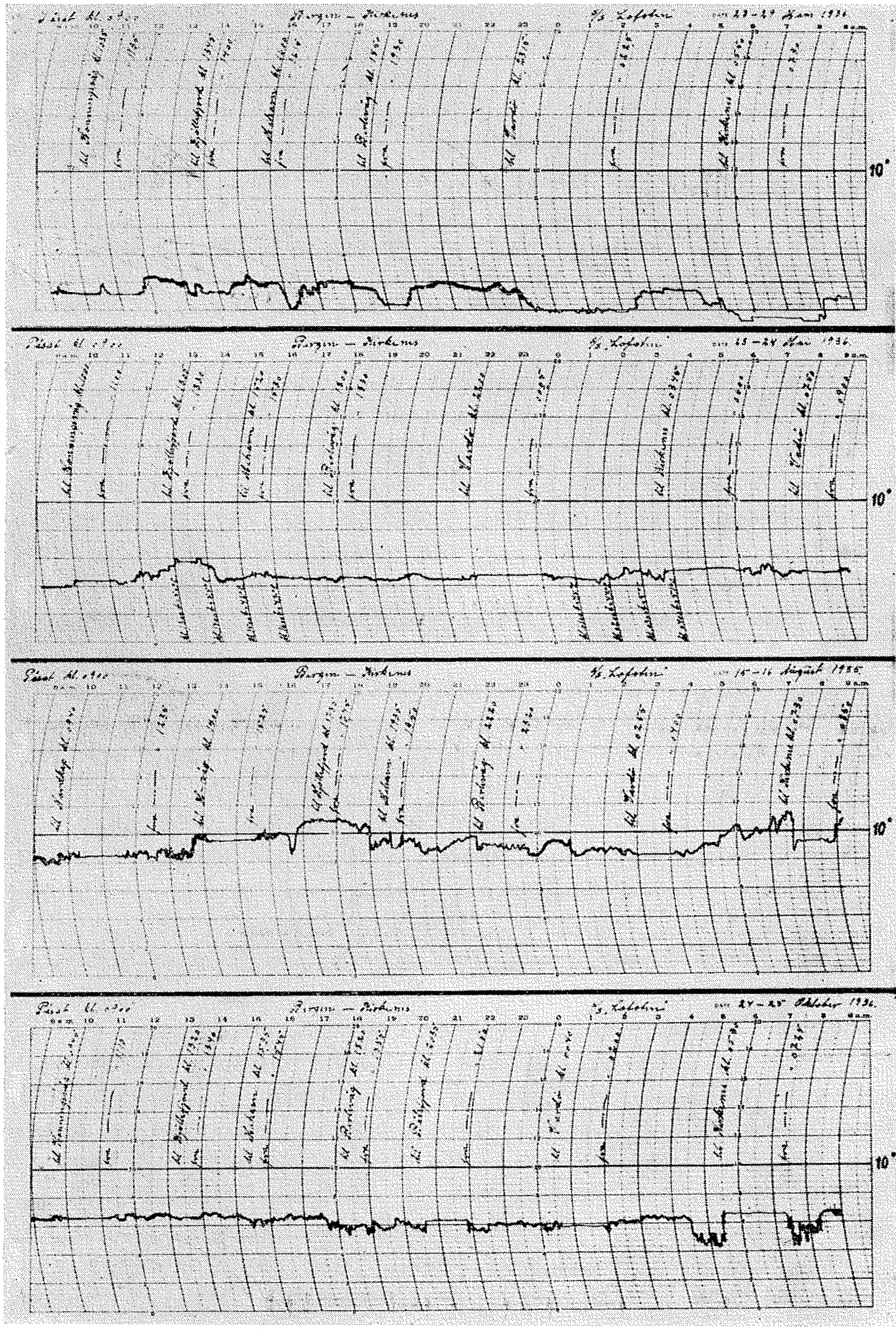

Fig. 5. Thermograms from the North Norway (Finmark) at different seasons.

may also bring about a rise in temperature. The power of the wind to bring about turbulent churning-up and mixing of the upper layers, is considerably greater in winter than in summer. The stability of the water masses is considerably less in winter on account of the winter cooling. Further, the air is colder and consequently heavier, for which reason its effect on the sea surface becomes so much greater.

On the west coast also (fig. 3) there are great variations of temperature in the month of May. As far as the North Norway is concerned these variations in temperature set in later (see figs. 4 and 5). This is in agreement with the fact that the summer heating sets in for good later here than it does on the south and west coast (page 50). The time when the great variations of temperature occur, may of course vary somewhat from year to year.

In order to show how the temperature varies along the different parts of the coast at the same time of year fig. 6 was prepared. It presents the first continous trace of sea temperature along the Norwegian coast between Oslo and the Varangerfjord obtained. The registration was carried out in May 1935 — from the 6th to the 12th.

A characteristic feature of this season is that as soon as the mouth of a fjord is passed, or a harbour is entered where much melt water is carried out into the sea, the temperature falls. It will be noticed that the greatest and most frequent variations in temperature occur along the south and west coast. Here the summer heating has made itself well felt just when many rivers and fjord mouths contain much cold melt water from the inner districts and highlands. The cold fresh water reduces the temperature in the sea where it flows out. The fresh water makes its presence known in another way also because it lies as a thin layer on top of the salter and heavier sea water. The stability therefore becomes great, and this will prevent heat being carried down by turbulence after the summer heating has manifested itself in the surface, i. e. after the fresh water has been warmed.

Along the coast of Finnmark too, the temperature curve falls when the mouths of the large fjords are passed or when land is approached. But there, as well as in North Norway generally, the variations in the temperature are considerably smaller than in the south of Norway. The two temperature minima between Honningsvaag and Mehamn relate to the mouths of the Porsangerfjord and Laksefjord.

The great fall in temperature from 6.6° C to 2.6° C, on approaching Trondheim, may for the moment seem surprising. But it is quite to be expected in view of the fact that the vessel is steaming up into the mouth of the river Nidelva which at this time carries great masses of melt-water.

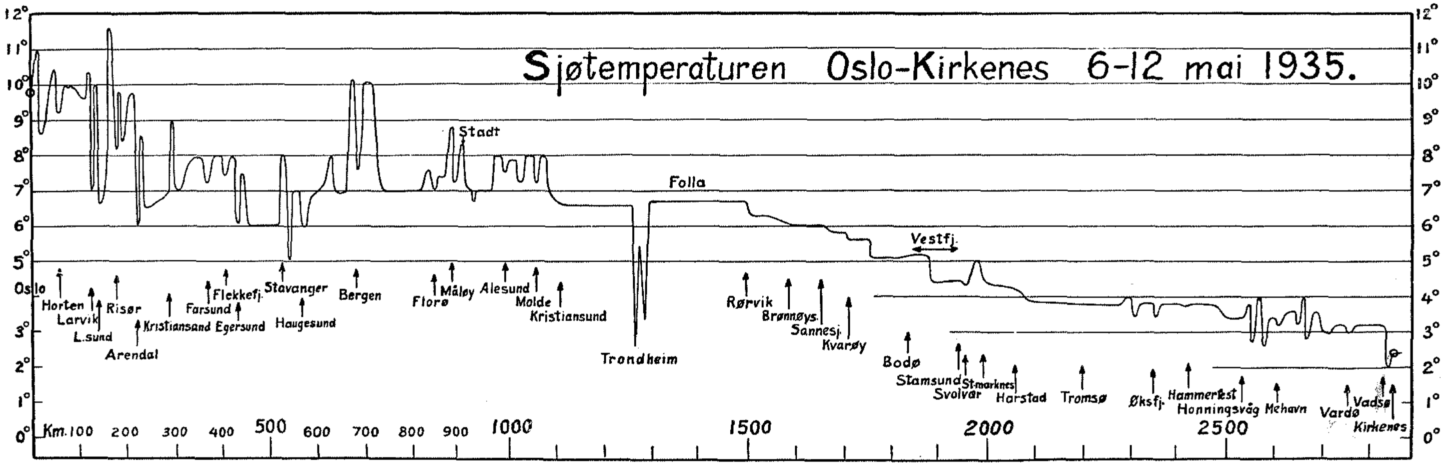

Fig. 6. The first continous trace of surface temperature along the Norwegian Coast between the Oslofjord and the Varangerfjord.

It will be seen that the temperature in Vestfjord is considerably lower along the Lofot side than along the mainland. This is due to the current system of the fjord. Along the mainland the resultant current comes directly from the south, whilst on the Lofot side it flows out bringing with it great masses of melt-water from inner branches of the fjord (Tysfjord and Ofoten). From Rørvik to Harstad we find a comparatively steady and considerable fall in temperature, though it remains constant from Harstad northwards to Honningsvaag.

2. THE SEASONAL VARIATIONS.

The following report and discussion are based on the temperatures at 25 different places evenly distributed along the coast. The data have been taken from the thermograms (tab. 17). The places were chosen among very open positions, either in the open sea as Lindesnes, Jæren, Stadt, Hustadvika, Folla, Lopphavet, Nordkyn and Østhavet, or at places with free access to the sea such as the Sognesjø, the Vestfjord, Revsbotn, etc. The Oslofjord, Trondheimfjord, and the Varangerfjord, will also be discussed. The position of places concerned will be seen on the chart (fig. 7) where each is marked with a dot in a circle. The crosses indicate meteorological observation stations. The positions are entered in tables 1 a and 1 b. With such a choice all disturbances of purely local nature are avoided. In a narrow sound e. g. the tidal currents can be very strong. Swirls can rise and the surface water may get mixed with deep water so that the surface temperature may be reduced in summer and raised in winter. Rystraumen south of Tromsø is a good example, and so too is Vatlestraumen south of Bergen[1]). On the other hand the sun can warm the water in a sound more quickly than that of the open sea. For this reason and for others our observations from chosen localities in the open sea will present a more correct picture of the real mean temperature of the sea along the Norwegian coast.

The following diagrams do not therefore take account of the temperature at the places of call along th coast, but give too, as nearly as possible the temperature of the open sea outside the places named on the figures. Exceptions are the Oslofjord, the Trondheimfjord and the Varangerfjord. These fjords have been included in order to show the difference in the annual course of the temperature in a fjord, and along the open coast.

Figs. 8, 9, and 10 illustrate the temperature at a depth of 4 metres

[1]) On Aug. 6th, 1936, the thermogram registered 8,6° C in Vatlestraumen, while in the fairway immediately north and south, the temperature was 13,0—13.5° C.

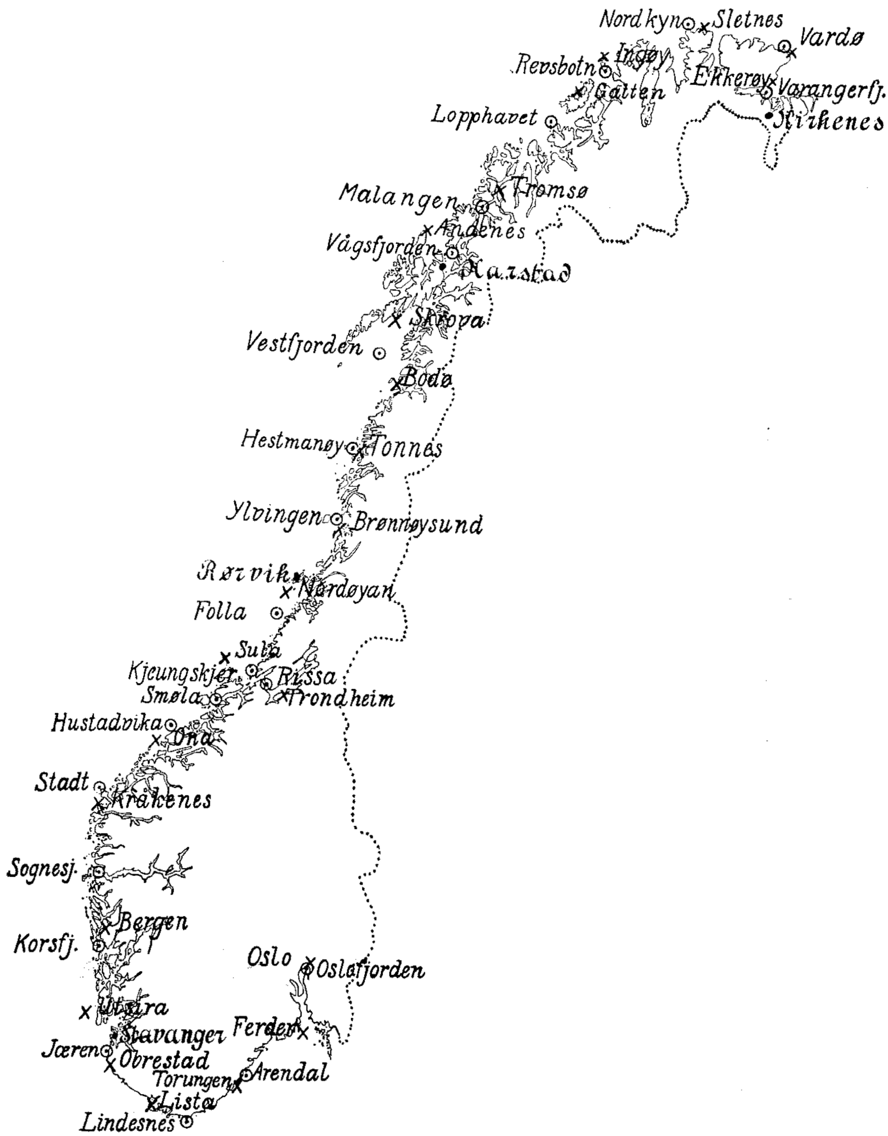

Fig. 7. ⊙ Places where the temperature is taken from the sea thermograms
× Meteorological observation stations.

Table 1 a.

Localities chosen for comparison of thermogram readings

Locality	N. Lat.	E. Long.
Oslofjord	59°52.3′	10°39.3′
Ferder	59°03.0′	10°28.5′
Arendal	58°23.8′	08°45.9′
Lindesnes	57°58.4′	07°04.6′
Jæren	58°43.3′	05°28.0′
Sletta	59°27.5′	05°12.8′
Korsfjorden	60°11.2′	05°12.7′
Sognesjøen	60°56.9′	04°45.8′
Stadt	62°12.2′	05°06.2′
Breisundet	62°25.1′	05°52.0′
Hustadvika	62°59.4′	07°05.0′
Smøla	63°22.5′	08°25.9′
Trondheimsfjord.	63°33.3′	09°51.5′
Kjeungskjer fyr	63°44.6′	09°32.9′
Folla	64°31.8′	10°30.3′
Ylvingen	65°35.7′	12°13.8′
Hestmanøy	66°31.8′	12°55.4′
Vestfjorden	67°46.0′	14°09.2′
Vågsfjorden	68°56.7′	17°03.3′
Malangen	69°29.7′	18°16.9′
Lopphavet	70°23.7′	21°43.5′
Revsbotn	70°50.6′	23°55.3′
Nordkyn	71°08.3′	27°39.1′
Vardø	70°28.2′	30°56.0′
Varangerfjorden	69°57.6′	29°54.4′

Table 1 b.

Meteorological stations.

Locality	N. Lat.	E. Long.
Oslo	59°55′	10°43′
Ferder	59°02′	10°32′
Torungen fyr ..	58°24′	08°48′
Lista	58°06′	06°34′
Obrestad	58°39′	05°34′
Utsira	59°18′	04°53′
Bergen	60°24′	05°19′
Kråkenes	62°02′	04°59′
Ona	62°52′	06°33′
Trondheim	63°26′	10°25′
Sula	63°51′	08°27′
Nordøyan	64°48′	10°33′
Brønnøysund ..	65°28′	12°12′
Tonnes	66°31′	13°00′
Bodø	67°17′	14°26′
Skrova	68°10′	14°40′
Andenes	69°20′	16°08′
Tromsø	69°39′	18°57′
Galten	70°44′	22°43′
Ingøy	71°04′	24°09′
Sletnes	71°05′	28°14′
Vardø	70°22′	31°06′
Ekkerøy	70°04′	30°06′

for each of the 25 localities from the spring of 1935 to July 1st, 1936. South of Bergen the registration commenced in the beginning of April, and north of Bergen in the beginning of May, 1935. Each individual observation from the thermograms is indicated by a circle. The curves show that on the Skagerack and west coast the lowest temperature is found in March. In the northern Norway areas minimum is met with in the beginning of April. In the Oslofjord the highest temperature is recorded in the middle of July (22° C), while the maximum at Vardø (8.5° C) is found at the end of August. On the other hand, the minimum temperature in the Oslofjord is lower than that at Vardø, being — 0,5° C as compared with 0.8° C. The amplitude is greatest in the Oslofjord, and then decreases towards north. At Vardø it is very small. Thus,

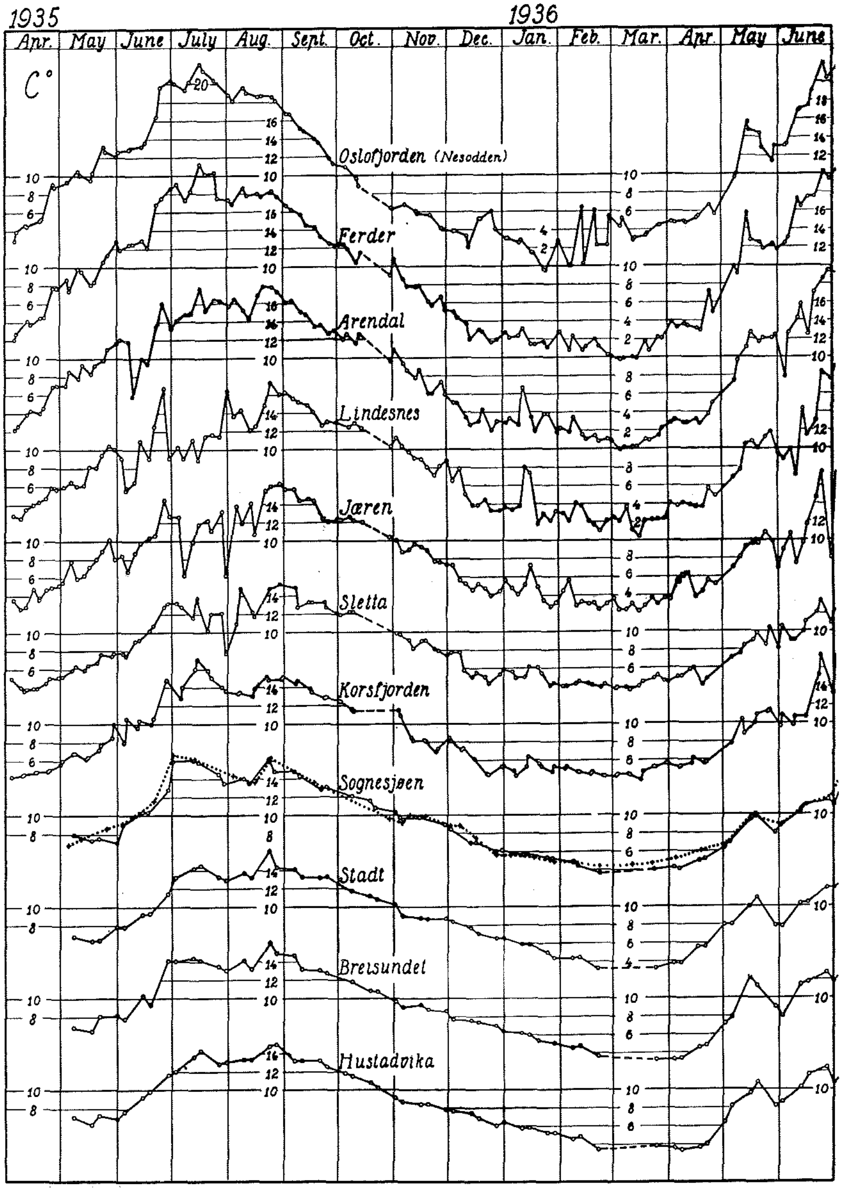

Fig. 8. Temperatures at fixed places along the Norwegian Coast plotted from the sea thermograms for each voyage from April, May respectively 1935, to June 1936. The dotted curve (Sognesjøen) represents observations made by help of two precision reversing thermometers in a depth of one meter.

in the Oslofjord, the difference between the highest summer temperature and the lowest winter temperature is 22.5° C, and at Vardø only 7.7° C. All the way from Lindesnes to Vardø there was a rise in the temperature during the second half of August, 1935. This is to be ascribed to the

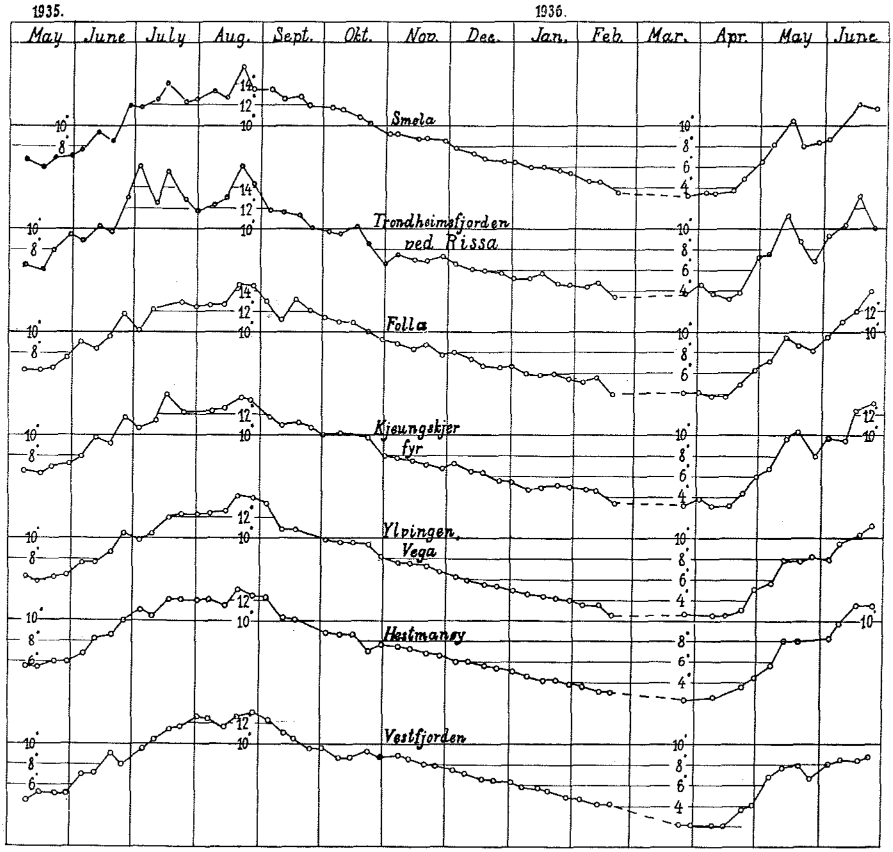

Fig 9. Temperature at fixed places along the Norwegian Coast plotted from the sea thermograms for each voyage from May 1935 to June 1936.

warm summer weather with much sunshine, contrasted with the weather during the first half of the month. On some diagrams there are characteristic jumps in the temperature. This is especially noticeable at Jæren and Lindesnes and is attributable to the wind conditions. It will be discussed later on.

3. THE MONTHLY MEANS

In fig. 22 the mean sea temperatures along the coast are set forth for May 1935 and May 1936.

It will be noticed that the temperature in May 1935 was highest in the Oslofjord, at 10.8° C, and that it fell evenly along the Skagerack Coast to a little above 7° C at Lista. From this place and as far north as the Sognesjø the temperature was comparatively even at about 7.4°. Along the Møre Coast it lies slightly below 7° then rises to 7.5°

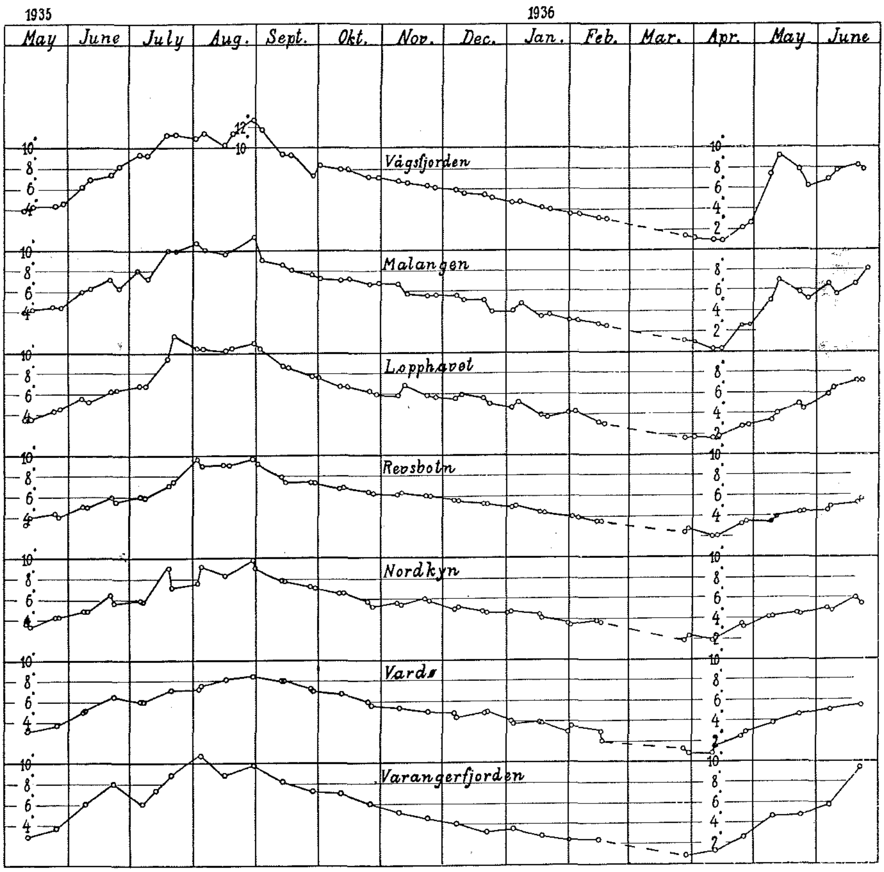

Fig. 10. Temperature at fixed places along the Norwegian Coast plotted from the sea thermograms for each voyage from May 1935 to June 1936.

at Rissa in the Trondheimfjord. Proceeding northwards from here it falls and in the Varangerfjord we find a temperature of only 3.2° C. Thus, the difference in temperature between the Oslofjord and the Varangerfjord is rather more than 7.5° C.

In May 1936 also, the temperature was highest in the Oslofjord and along the Skagerack Coast, and lowest at Revsbotn near Hammerfest, 4.0° C. Farther east it is slightly higher, 4.5° C in the Varangerfjord. It will be seen that the temperature between Haugesund and Bergen is higher than along the stretch between Lista and Stavanger.

The sea temperature on the Sognesjø, 69 km north of Bergen, is only 8.3° C; such a low temperature is not met again until we reach as far north as Rørvik. Comparing the means of May in the two years we find a considerably higher temperature in 1936 than in 1935. Only one place has a temperature as low in 1936 as in 1935, viz. Revsbotn. Along the whole coastline between Oslo and Bergen, the May temperature is 1.6° C higher in 1936 than in the previous year. The greatest difference is in the Vågsfjord with no less than 2.9° C. The two mean May temperatures of the entire coast were 6.1° C and 7.5° C respectively — a difference of 1.4 degrees.

The courses of the curves for June of these two years (fig. 23) present approximately the same picture as that for May. Thus, the temperature in June 1936 was higher than it was in 1935 except along the stretch between Hammerfest and Vardø. Here the temperature was a little lower than that of the previous year and the same was the case on the Sognesjø. The mean temperature of the entire coast was 8.7° C for June, 1935, whilst in 1936 it was 9.9° C. In the Oslofjord the temperatures were 15.1° C and 17.4° C respectively. It will be seen that in both years the temperature near Bergen (in the Korsfjord) was higher than at Jæren. On the Måløy—Rørvik section the temperature rises from 10.3° C to 11.6° C. The graph shows that the temperature tended to rise the previous year also along this section, though less conspicuously. The greatest fall in temperature is found on the stretch Oslofjord—Lista, and Kvarøy—Tromsø.

For the month of July also the temperature was higher in 1936 than in the previous year. In the middle of the entire coast the difference was 1.3° C (fig. 24). Between Oslo and Arendal in July, 1936, the temperature was between 17° C and 21° C, while along the Finnmark Coast it was about 7° C.

The graph for July shows a very pronounced minimum for the south coast, especially outside Lista and Jæren. At the latter place the temperature is only a very little higher in July than in June. A mean of about 11° C in July is exceptionally low for Lindesnes and Jæren. One must go north as far as Lofoten and Vesterålen in order to find such a low mean for July (table 3), but here also it was comparatively low in 1935. In 1936 the July temperature was 17.5° C at Jæren and 16.7° C at Lindesnes. Farther on it will be proved that the wind conditions are responsible for the low temperature, as the surface water is driven away from the coast, and cold water from the deep wells up to the surface.

On the average, for the entire coast, the warming-up from May to June is nearly equally as great as that from June to July (fig. 11).

If we divide the coast into the following sections: 1. Oslo—Stavanger; 2. Stavanger—Rørvik; 3. Rørvik—Harstad; 4. Harstad—Kirkenes, we notice that the rise in temperature from June to July is greatest in section 1. and 2. and smalest in section 4. (table 2).

By far the greatest rise is in the Oslofjord itself being in 1935 for instance 4.3° C from May to June, and 5.3° C from June to July (see fig. 11). Along the Finmark Coast the corresponding rise is 2.0° C and 1.8° C respectively.

From Oslo to Kragerø, and in the Bergen region, the July temperature lies above that of August, while along the other sections of the coast the August temperature was the warmer.

We thus arrive at the result that during August the upper layers of the sea are the warmest for the whole coast-line with the exception of the two above-mentioned areas. The excess temperatures in July and August are greatest in North Norway. Apart from fig. 11 this may also be seen from table 2.

Table 2. *Mean monthly surface temperatures.*

	Oslo, Stav-anger	Stav-anger, Rørvik	Rørvik, Harstad	Harstad, Kirkenes	The entire coast
	C°	C°	C°	C°	C°
May 1935	8.7	6.9	5.3	3.9	6.1
June »	11.9	9.9	7.9	5.9	8.7
July »	14.8	13.4	11.1	7.9	11.7
Aug. »	15.9	13.8	12.4	9.5	12.7
Sept. »	14.2	13.1	10.7	8.3	11.5
Oct. »	11.2	11.0	8.6	6.7	9.4
Nov. »	7.9	8.7	7.5	5.8	7.5
Dec. »	4.1	6.7	6.2	5.1	5.6
Jan. 1936	3.2	5.5	4.7	4.1	4.5
Feb. »	2.2	4.3	3.5	3.1	3.4
March »	1.9	3.8	2.4	2.0	2.6
April »	4.3	4.8	2.6	2.0	3.5
May »	10.1	8.8	7.0	4.6	7.5
June »	14.1	10.9	9.2	6.1	9.9
July »	18.2	14.5	12.2	8.2	13.0
Average for the year May 1935—April 1936	8.4	8.5	6.9	5.4	7.3

The fact that the temperature at Lista and Jæren is so much lower in July than in August, is due to the particular wind conditions in July, which were responsible for bringing cold water to the surface.

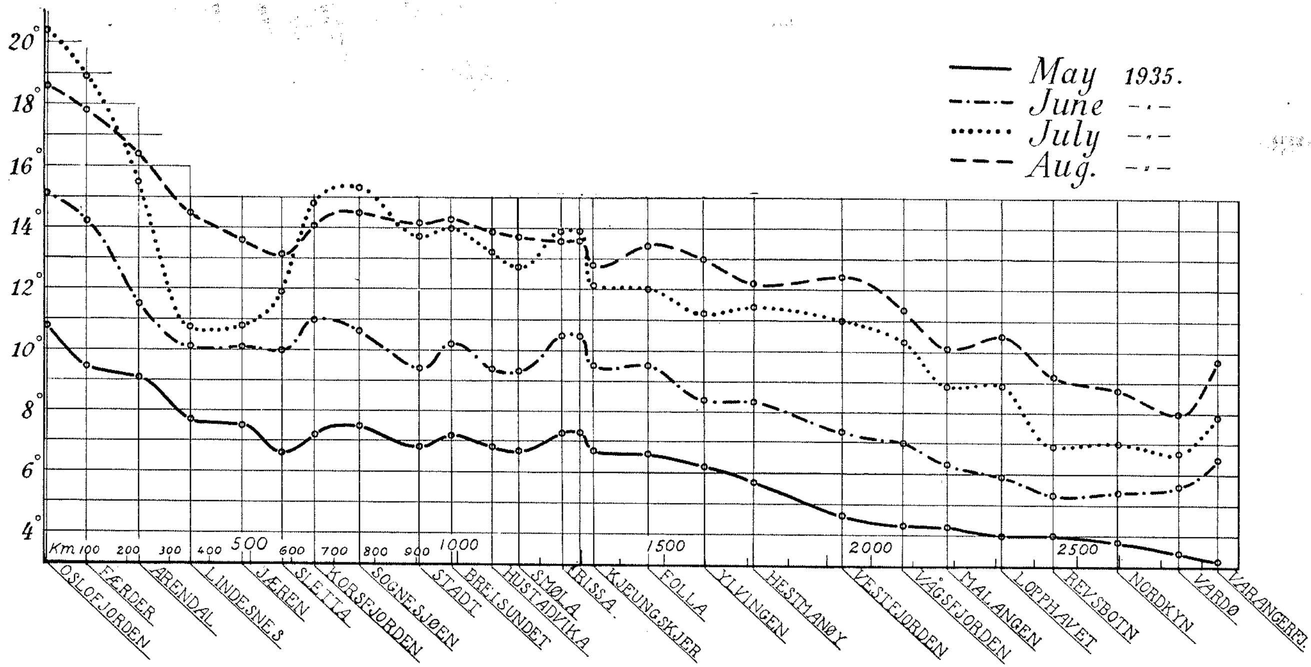

Fig. 11. The monthly means of the sea temperature May—August 1935.

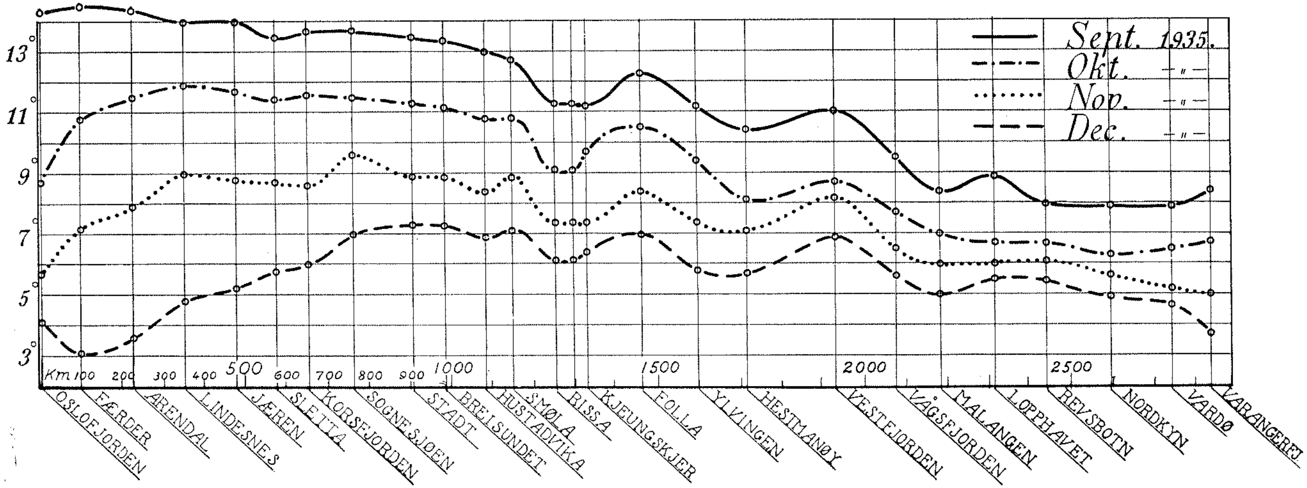

Fig. 12. The monthly means of the sea temperature September—December 1935.

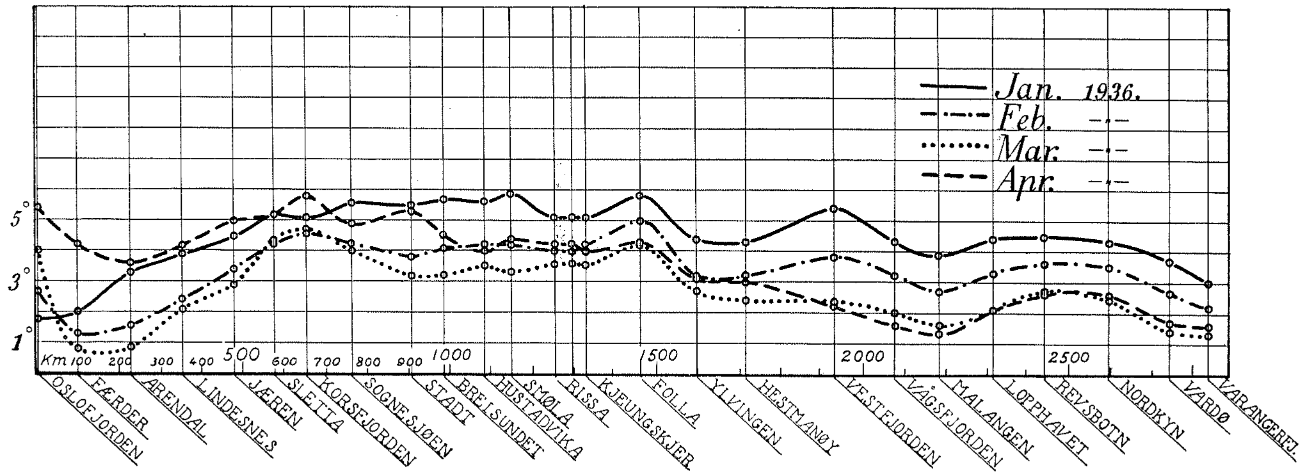

Fig. 13. The monthly means of the sea temperature January—April 1936.

The difference of temperature between these two months can not, therefore, be assumed to be characteristic for this area. As a mean for the whole coast, July shows 11.7° C and August 12.7° C (1935).

The fall in temperature from July to August in the Oslofjord was 1.8° C, and from August to September 4.3° C. From Florø to the Øksfjord in West Finnmark the temperature in September is almost the same as in July. From Hammerfest to Kirkenes on the other hand, the September temperature lies 1° C above the July value.

As will be observed in fig. 12, the temperature falls evenly from one month to the next during October, November and December. The greatest fall is found on the Skagerack Coast, and the smallest on the Lofoten—Vardø section. Along the Skagerack Coast the December temperature is lower than along the Finnmark coast. The same is the case in January, February and March. The coldest month is, as may be expected, March. The temperature is then 1.2° C higher at Finnmark than at Arendal for instance; there the sea temperature is below 1° C.

Along the Skagerack Coast the temperature is everywhere higher in April than in January, while the reverse is the case for the section Stavanger—Kirkenes, (see fig. 13). Here, to be sure, the April temperature is a little higher than in March, but is does not come up to the January value, and for that part of the coast to the north of Helgeland, the temperature is also lower in April than in February.

We can now calculate the mean temperature for the whole year from 1st May, 1935 to 30th April, 1936. This has been done and entered on fig. 14. The graph shows that the Oslofjord has the greatest annual mean at 9.3° C; then comes the Haugesund—Sogn section at 8.8° C. From Brønnøysund to Lofoten it is 7° C. The lowest value is found at East-Finnmark at about 5° C. The mean along the Skagerack Coast from Risør to Stavanger is lower than on the west coast. While the temperature remains fairly even from Brønnøysund to Lofoten it falls quite sharply from Lofoten to Tromsø. From here to Kirkenes the annual mean lies between 4.8° C and 5.7° C. It will be seen, that the difference between Finnmark and the Skagerack Coast is no more than 3.5° C. Finnmark has, as a matter of fact, a higher winter temperature than along the Skagerack Coast. Thereby the graph for the year becomes smoothed, so that the difference between north and south is not so conspicuous when the year is considered as a whole.

The months of the year that lie nearest the mean temperature are May and November. For these months the mean for the whole coast is 6.1 and 7.5° C respectively while the mean for the year is 7.3° C. Thus the months June to November lie above the mean, and the months

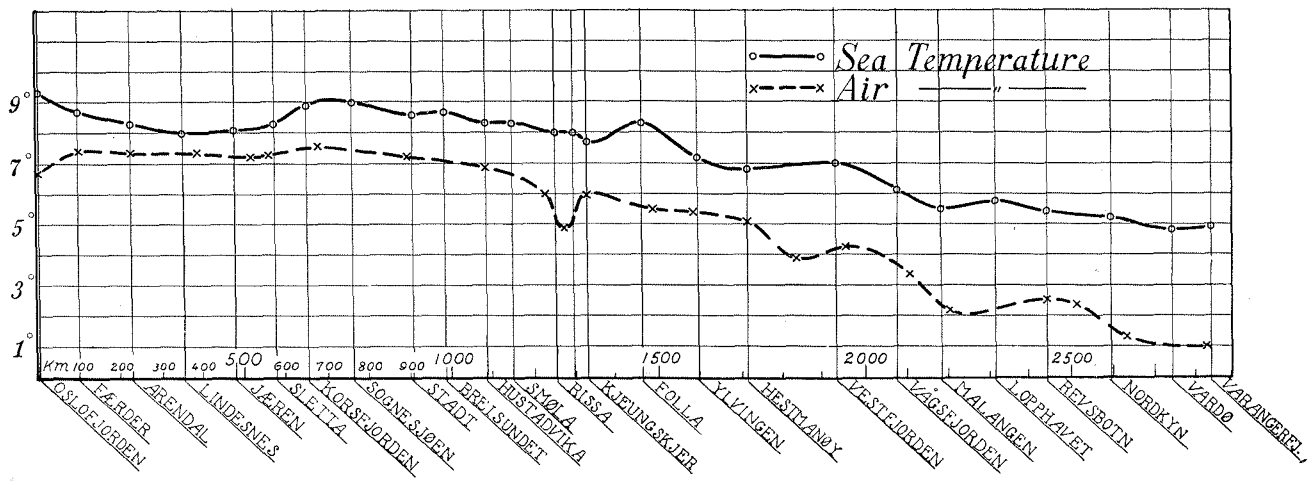

Fig. 14. The annual mean (May 1935 — April 1936) of the sea temperature (heavy line) and of the air temperature (dashed line).

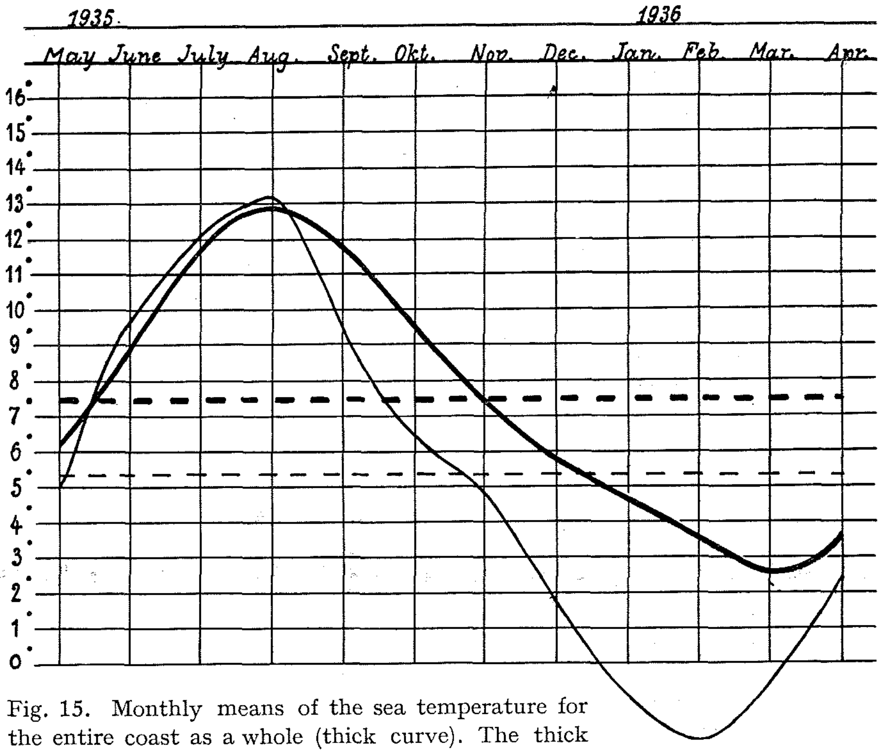

Fig. 15. Monthly means of the sea temperature for the entire coast as a whole (thick curve). The thick horizontal broken line represents the annual mean. The two thin curves represents the corresponding air temperatures.

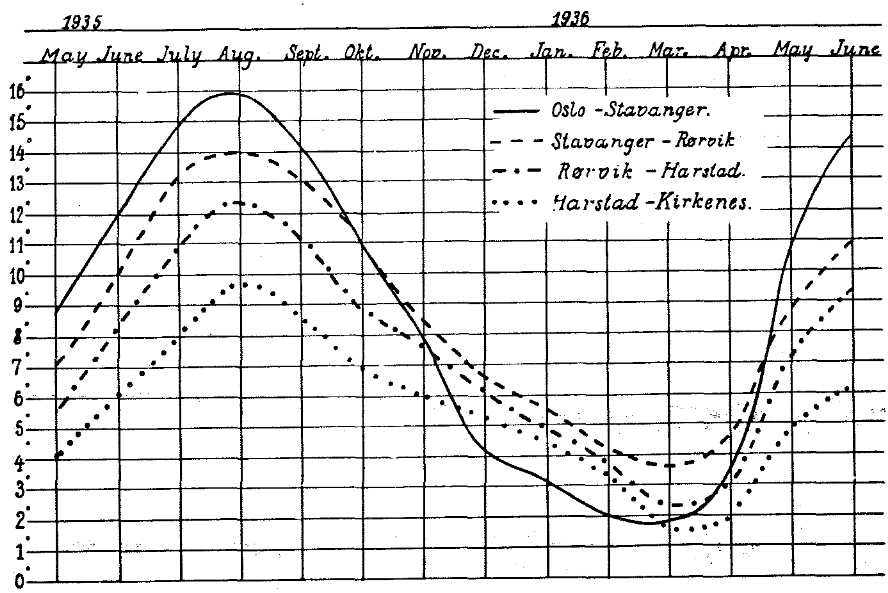

Fig. 16. Monthly mean sea temperature (May 1935 — June 1936) on different sections of the coast.

Table 3. *Monthly*

By the calculation of the means for the entire coast the observations are weighed
Trondheimsfjord is by this

	1935								
	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Oslofjorden	5.3	10.8	15.1	20.4	18.6	14.3	8.7	5.7	4.1
Ferder	4.5	9.5	14.2	18.9	17.8	14.5	10.8	7.2	3.1
Arendal	4.2	9.1	11.5	15.5	16.4	14.4	11.5	7.9	3.6
Lindesnes	4.0	7.7	10.1	10.8	14.5	14.0	11.9	9.0	4.8
Jæren	4.0	7.5	10.1	10.8	13.6	14.0	11.7	8.8	5.2
Sletta	4.2	6.6	10.0	11.9	13.1	13.5	11.4	8.7	5.8
Korsfjorden	4.7	7.2	11.0	14.8	14.1	13.7	11.6	8.6	6.0
Sognesjøen	—	7.5	10.6	15.3	14.5	13.7	11.5	9.6	7.0
Stadt	—	6.8	9.4	13.7	14.2	13.5	11.3	8.9	7.3
Breisundet	—	7.2	10.2	14.0	14.3	13.4	11.2	8.9	7.3
Hustadvika	—	6.8	9.4	13.2	13.9	13.0	10.8	8.4	6.9
Smøla	—	6.7	9.3	12.7	13.7	12.7	10.8	8.9	7.1
Rissa, Trondh.fjord	—	7.3	10.5	13.9	13.6	11.3	9.1	7.4	6.1
Kjeungskjær	—	6.7	9.5	12.1	12.8	11.2	9.7	7.4	6.4
Folla	—	6.6	9.5	12.0	13.4	12.3	10.5	8.4	7.0
Ylvingen	—	6.2	8.4	11.2	13.0	11.2	9.4	7.4	5.8
Hestmanøy	—	5.7	8.3	11.4	12.2	10.4	8.1	7.1	5.7
Vestfjorden	—	4.6	7.4	11.0	12.4	11.0	8.7	8.2	6.9
Vågsfjorden	—	4.3	7.0	10.3	11.3	9.5	7.7	6.5	5.6
Malangen	—	4.3	6.3	8.9	10.1	8.4	7.0	6.0	5.0
Lopphavet	—	4.0	5.9	8.9	10.5	8.9	6.7	6.0	5.5
Revsbotn	—	4.0	5.3	6.9	9.2	8.0	6.7	6.1	5.4
Nordkyn	—	3.8	5.4	7.0	8.7	7.9	6.3	5.6	4.9
Vardø	—	3.4	5.6	6.7	8.0	7.9	6.5	5.2	4.7
Varangerfjorden	—	3.2	6.5	7.9	9.7	8.4	6.7	5.0	3.7
The entire coast		6.1	8.7	11.7	12.7	11.5	9.4	7.5	5.6

December to May below. This will be evident from fig. 15 which shows the mean temperature for the whole coast with the time as abscissa. The thick horizontal broken line represents the yearly mean for the entire coast as a whole. The two thin curves represent the corresponding air temperatures.

The means have been calculated in the usual way, by measuring the area of the curves and then dividing by the length of the abscissa axis between the two limiting ordinates. The line 0° C is used as abscissa axis.

mean sea temperature.
relatively to the length of the coast stretch they are representing. Rissa in the calculation counted out.

1936

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1.8	2.7	4.0	5.4	12.0	17.4	20.8	20.1	13.7	8.2	5.7	3.3
2.0	1.3	0.8	4.2	11.3	16.3	19.5	18.8	14.8	9.9	7.6	5.8
3.3	1.6	0.8	3.6	10.3	14.7	17.8	17.8	15.2	10.9	8.3	6.5
3.9	2.4	2.1	4.2	9.2	12.5	16.7	16.7	14.8	10.8	8.7	7.7
4.5	3.4	2.9	5.0	8.6	11.0	17.5	15.9	13.7	10.0	8.9	7.6
5.2	4.2	4.3	5.2	8.3	10.7	16.8	15.8	14.1	10.5	8.7	7.5
5.1	4.6	4.7	5.8	9.6	11.8	16.9	16.5	14.3	11.3	8.2	7.3
5.6	4.2	4.0	4.9	8.4	10.5	15.6	15.8	13.6	10.4	7.8	6.6
5.5	3.8	3.2	5.3	9.1	10.3	14.1	15.4	13.6	10.1	8.2	6.6
5.7	4.1	3.2	4.5	9.8	11.0	14.2	15.2	13.7	10.0	7.8	6.2
5.6	4.2	3.5	4.0	8.9	10.7	12.8	15.0	13.6	9.8	7.5	6.5
5.9	4.2	3.3	4.4	8.6	10.7	13.1	14.4	13.3	9.4	7.4	6.2
5.1	4.0	3.6	4.2	8.5	10.9	14.3	13.4	12.3	8.7	6.1	5.4
5.1	4.2	3.5	4.0	8.4	11.0	12.3	13.6	12.3	9.0	6.7	6.1
5.8	5.0	4.2	4.3	8.1	11.6	13.1	14.0	12.6	9.5	7.2	6.4
4.4	3.2	2.7	3.1	7.2	9.8	12.1	13.2	11.4	9.3	6.8	5.4
4.3	3.2	2.4	3.0	7.1	10.1	12.3	13.0	11.3	8.4	6.6	5.3
5.4	3.8	2.3	2.2	6.6	8.5	12.3	13.3	11.4	9.4	7.1	5.6
4.3	3.2	2.0	1.6	7.2	7.7	11.6	12.3	10.2	7.9	6.7	5.4
3.9	2.7	1.6	1.3	5.5	6.8	8.7	10.8	9.2	7.3	6.5	5.2
4.4	3.3	2.1	2.1	4.1	6.7	9.1	10.8	9.2	7.3	6.3	5.2
4.5	3.6	2.7	2.6	4.0	5.2	7.2	9.4	8.5	7.3	6.5	5.5
4.3	3.5	2.4	2.6	4.2	5.4	7.2	9.7	8.4	7.9	5.9	5.2
3.7	2.7	1.4	1.7	4.0	5.3	7.0	8.8	8.2	6.5	5.6	5.0
3.0	2.2	1.3	1.6	4.5	7.4	8.1	10.1	8.4	7.0	5.5	4.7
4.5	3.4	2.6	3.5	7.5	9.9	13.0	13.8	11.9	9.1	7.2	6.0

If we graph the data of table 2 (fig. 16), we note that on the Oslo—Stavanger section, the months of May to September are warmer than at any other place along the coast. On the other hand this section has the lowest temperature in the months December to February. Even along the Finmark Coast it is warmer at this time of the year.

We have several instances of fish being frozen to death along the Norwegian Skagerack Coast. It has occurred in the open sea near land, and also during the transport of live cod in »well« boats running to Oslo.

Table 3. *Monthly mean*

	1937								
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Oslofjorden	1.9	0.2	2.6	7.3	12.6	15.8	20.4	19.1	15.4
Ferder	3.1	—1.0	—0.1	4.3	11.3	14.9	19.1	20.1	15.8
Arendal	4.3	—0.2	—0.6	3.0	9.7	12.6	17.3	19.1	14.9
Lindesnes	5.2	0.8	0.7	2.8	9.0	11.6	15.1	18.7	13.9
Jæren	5.3	2.0	1.9	3.4	8.1	11.6	14.0	18.4	14.0
Sletta	5.9	3.5	1.9	4.2	8.4	11.1	13.8	16.7	13.9
Korsfjorden	5.2	4.2	1.4	4.9	9.6	11.9	15.0	17.7	14.3
Sognesjøen	5.5	4.0	2.4	3.3	6.7	10.4	13.4	15.6	13.6
Stad	4.9	4.0	3.0	3.4	6.5	10.4	12.4	14.7	13.5
Breisundet	5.2	4.1	3.2	3.8	6.6	(10.7)	(12.7)	(14.8)	13.3
Hustadvika	4.9	3.6	3.5	3.8	6.6	10.2	12.5	14.0	13.0
Smøla	5.4	4.0	3.7	4.3	6.5	10.2	12.7	13.9	12.9
Rissa, Trondh.fjord	4.5	3.6	3.9	5.3	7.6	11.2	13.0	13.6	11.6
Kjeungskjær	5.1	3.4	3.2	4.5	6.7	10.4	12.4	13.9	11.8
Folla	5.0	3.6	3.2	4.5	6.1	9.7	13.0	14.0	12.2
Ylvingen	4.4	3.3	3.1	3.5	5.7	8.8	13.1	13.8	11.5
Hestmanøy	4.3	3.2	2.7	3.3	5.2	8.7	13.4	13.1	10.6
Vestfjorden............	4.3	2.6	2.4	3.3	5.4	8.2	13.3	13.3	10.8
Vågsfjorden	4.0	2.2	2.6	3.3	5.4	8.2	13.0	13.3	11.1
Malangen	3.8	2.5	2.4	3.0	4.6	7.4	10.5	11.3	10.4
Lopphavet	3.8	2.2	2.0	2.3	3.8	6.8	10.7	10.5	9.6
Revsbotn	4.3	2.5	1.6	2.3	3.3	5.3	8.6	8.9	8.4
Nordkyn	4.1	2.4	2.0	2.3	3.4	6.1	9.7	9.8	8.6
Vardø	3.8	2.4	1.5	2.1	3.2	5.9	7.8	9.4	8.4
Varangerfjorden	3.7	2.1	1.2	1.2	3.0	6.7	10.9	12.7	9.3
The entire coast	4.5	2.5	2.1	3.4	6.4	9.5	13.0	14.1	12.0

Along the Finmark Coast the temperature is so high during the middle of winter that no such calamity could have occurred.

The Oslo—Stavanger section has the greatest temperature amplitude, the difference between the lowest and highest monthly mean being 14° C (August 15.9° C, March 1.9° C). The amplitude decreases northwards: — Stavanger—Rørvik 10.0° C, Rørvik—Harstad 10.0° C, and Harstad—Kirkenes 7.3° C. Ferder 18.1° C. Nordkyn 6.3° C. As a comparison, it may be mentioned that the amplitude in the southern part of the Baltic is 14° C — 17° C, whilst in the inner bays of the Yellow Sea it is as much as 27° C according to KRÜMMEL (17).

These great temperature amplitudes occur (in the temperate zones) *sea temperature* (continued).

1937			1938									May 1935 — Apr. 1936
Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	
10.3	6.3	3.8	1.1	0.5	2.4	5.2	9.5	14.8	18.2	20.5	16.0	9.3
11.8	7.9	2.3	1.0	2.1	3.8	5.9	8.9	13.1	17.4	19.6	15.4	8.7
12.4	8.8	3.1	1.8	3.5	4.8	6.0	8.5	12.3	15.7	18.6	15.3	8.3
12.6	9.0	4.6	3.0	4.2	5.3	6.2	8.1	10.1	14.5	17.0	14.8	8.0
12.3	9.4	5.9	3.6	5.0	5.3	6.3	7.6	9.8	13.7	16.8	14.1	8.1
12.3	9.0	5.9	4.6	5.0	5.8	6.5	7.6	10.6	13.1	16.1	13.3	8.3
11.7	8.7	5.7	5.3	4.5	5.2	6.3	8.2	10.9	13.6	17.0	13.4	8.9
11.1	8.9	5.9	4.9	4.9	5.2	5.6	8.5	10.7	13.3	16.7	12.9	9.0
11.0	9.0	5.8	4.9	5.0	5.1	5.7	7.4	10.2	13.1	16.5	12.9	8.6
10.6	8.9	5.6	4.6	4.6	5.2	5.3	7.6	10.9	13.9	16.6	13.1	8.7
10.5	8.7	5.5	4.8	4.8	5.1	5.2	7.1	9.9	13.5	16.2	12.7	8.3
10.5	8.4	5.6	4.9	4.8	5.1	5.1	7.1	9.5	13.8	15.8	13.0	8.3
9.8	7.8	4.7	4.6	4.8	4.7	4.7	7.6	10.6	14.5	15.4	12.4	8.0
9.8	9.7	5.1	5.0	5.0	5.0	5.2	7.3	10.2	13.1	14.2	12.2	7.7
10.3	8.4	5.8	5.1	5.5	5.5	5.3	7.2	10.5	13.6	15.3	13.0	8.3
10.0	7.9	5.5	4.2	4.6	4.2	4.5	6.3	9.6	13.6	14.5	12.9	7.2
9.0	7.2	5.2	3.8	4.2	4.1	4.2	5.9	9.4	13.1	13.7	12.2	6.8
9.5	7.7	5.3	4.2	3.8	3.3	3.8	5.2	9.7	13.6	13.1	12.4	7.0
9.4	7.2	5.2	4.1	3.7	2.9	3.0	4.9	10.2	13.0	12.6	11.6	6.1
8.3	6.6	4.8	3.5	3.1	2.8	3.0	4.6	9.4	11.1	11.6	10.7	5.5
8.3	6.6	4.8	3.9	3.6	2.9	2.9	4.2	9.3	11.6	11.3	10.6	5.7
8.0	6.7	5.2	4.3	4.2	3.7	3.6	4.1	6.6	9.2	10.0	10.0	5.4
7.6	6.2	5.1	4.1	4.1	3.8	3.0	3.8	6.1	9.2	10.3	9.7	5.2
7.2	5.8	4.3	3.6	3.7	3.1	2.8	3.8	6.2	8.7	9.7	9.7	4.8
7.3	6.0	4.6	3.3	3.1	2.6	2.4	3.5	8.0	11.5	9.7	10.3	4.9
10.1	7.8	5.0	3.9	4.1	4.2	4.6	6.4	9.8	13.0	14.5	12.5	7.3

mostly where the stability in the upper layers is very great. Thereby the surface layers become strongly cooled in winter, and much warmed in summer. In the great oceans where the stability is comparatively slight the annual amplitude is small, even in the temperate zones. We find exceptions to this in parts of the ocean where sometimes cold and sometimes warm currents prevail — for instance in the area south and south-west of the New-Foundland Banks. There we find alternately warm water from the Gulf Stream, and cold water from the Labrador Current. In Japanese waters the warm Kurosio comes into »conflict« with the cold Oyasio. In both places the warm current shifts to the north in late summer. This results in a very great annual amplitude from 15° C to more than 20° C.

The least yearly amplitude (of 2° C or less)occurs in regions where ice is constantly drifting about, and in the tropics. In the Pacific Ocean between latitudes 10° N. and 10° S. the amplitude is below 1° C (17).

During the months of the year when the surface of the Trondheimfjord is colder than the coast water in general, it is observed that the temperature just outside the mouth of the fjord and for some distance northward is in most cases lower than it is either north or south of this place. Coming from the south the thermograms show a fall just outside the mouth of the Trondheimfjord and continue to show cold water for some distance to the north, after which they rise again. This seems to indicate that the surface water which comes out from the Trondheimfjord, flows northwards. This is also reasonable when we consider the deflecting force of the earth's rotation and it explains the fall of temperature at Kjeungskjær which lies to the north of the mouth of the fjord (see figs. 12 and 13).

IV. The Air-Temperature

The mean air temperature along the Norwegian Coast for each month from April 1935 to April 1936 will be found in figs. 17, 18 and 19. The curves are drawn from data supplied by Norges Meteorologiske Institutt; the monthly means for 22 meteorological observation posts distributed along the coast from Oslo to Kirkenes were dealt with (fig. 7).

Along the Skagerack Coast, July is the warmest month of the year (fig. 17). August, on the other hand, is the warmest month from Kristiansand to Kirkenes. This is in agreement with values found for the sea (see page 27). The coldest month is seen to be February as far as the air is concerned. In 1935, the greatest rise in the air temperature took place from May to June. In 1936 on the other hand, the greatest rise in temperature both of air and sea took place in April to May, these were 5.8° C and 4.0° C respectively. The air temperature rose from 2.5° C to 8.3° C, and the sea from 3.5° C to 7.5° C. (The means for the whole coast).

Considering the annual course of the air temperature we see that the monthly curves for the entire coast at certain places are by no means smooth. As is to be expected this is most conspicuous in the case of the three fjords which are included in the diagrams, viz. the Oslofjord, the Trondheimfjord and the Varangerfjord. The climate at these places is of more inland character than on the coast in general, with colder winters and warmer summers. Thus, the curves for the Trondheimfjord show a sharp rise in May to August as the temperature of the air is higher there than it is on the coast outside the Trondheimfjord, but it is lower during the remaining months of the year.

The sea thermograms show that it is only the months of June and July which have a marked maximum for the Trondheimfjord. In the months from September to January there is a distinct minimum. During the remaining months of the year there is no particular difference between the temperature in the part of the fjord considered, viz. Rissa, and the temperature on the coast outside.

When the annual course of the sea temperature in the Trondheimfjord appears less continental in the diagrams than the air temperature at Trondheim for instance, it must be remembered that the sea tempera-

Table 4. *Monthly mean*

	1935									Year 1935
	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Oslo	5.6	10.4	15.3	18.6	17.0	11.1	6.8	4.2	—1.4	7.0
Ferder	5.0	9.0	14.2	17.5	16.6	12.9	9.1	6.1	0.9	7.9
Torungen fyr ..	5.1	9.3	13.2	17.1	16.4	12.6	8.6	6.3	1.0	7.8
Lista	5.2	8.6	12.5	13.7	15.0	12.5	9.3	6.5	1.7	7.6
Obrestad	4.7	7.6	12.2	13.2	14.2	12.3	10.1	7.1	1.2	7.6
Utsira	4.7	7.1	11.5	13.3	14.1	12.0	8.7	7.0	3.2	7.6
Bergen	5.7	8.9	12.9	14.0	14.5	11.6	7.4	6.7	2.6	7.6
Kråkenes	4.6	6.2	11.0	12.6	14.1	11.5	7.9	7.1	3.7	7.3
Ona	4.4	5.6	9.6	12.2	13.5	11.2	7.8	7.4	3.9	7.0
Sula	4.5	5.0	9.4	11.4	12.8	10.1	7.1	6.0	3.3	6.4
Trondheim	3.4	5.6	12.5	13.2	13.7	9.2	4.7	3.5	—0.7	5.1
Nordøyan	3.9	4.7	9.1	11.3	12.8	9.7	6.4	5.4	3.2	6.0
Brønnøysund ..	3.7	4.7	10.0	12.2	13.3	9.4	6.1	4.9	2.6	5.6
Tonnes, Helgeland	3.5	4.4	9.8	12.3	13.1	9.0	6.1	5.1	2.4	5.5
Bodø	2.5	3.8	9.2	11.6	12.3	7.8	4.9	3.4	1.2	4.4
Skrova	2.3	3.2	8.1	11.3	12.4	7.9	5.3	4.4	2.1	4.8
Andenes	2.3	2.7	7.1	10.3	11.5	7.0	4.6	2.7	1.3	4.1
Tromsø	0.8	1.6	7.4	11.1	11.8	5.4	2.9	1.1	—1.0	2.8
Galten	0.7	1.9	6.8	10.9	11.9	5.7	3.3	2.2	—0.3	3.2
Ingøy	0.3	1.5	6.2	8.9	10.8	5.4	3.2	2.6	0.0	2.9
Sletnes	—0.6	0.9	6.1	7.6	10.2	5.1	2.4	1.0	—1.6	1.9
Vardø	—0.6	1.1	6.6	7.7	9.4	5.5	3.3	1.2	—1.6	1.8
Ekkerøy	—1.2	1.4	7.4	9.2	9.8	5.4	2.7	0.8	—2.7	1.5

ture in general has a less yearly amplitude than the air temperature. Rissa, the area where the sea temperature is measured, is, however, situated only 20 kilometres from the mouth of the Trondheimfjord, while Trondheim, where the meteorological station is placed, lies 54 kilometres from the mouth. The original thermograms show also that there are considerably greater variations in the sea temperature near Trondheim than out at Rissa.

With regard to Oslo we notice that the temperature is higher than it is on the Skagerack Coast from April to August, but lower from September to February.

If, making use of the same procedure as was employed for the sea *air temperature.*

1936												Year 1936
Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
−2.6	−4.3	0.9	4.4	12.6	17.6	17.6	16.7	10.2	4.9	2.6	1.9	6.9
−0.1	−1.8	0.6	3.7	10.9	16.3	17.6	17.2	12.3	7.7	5.4	4.7	7.9
0.1	−1.1	0.6	3.8	10.9	15.3	16.9	16.7	12.3	7.4	5.4	4.6	7.7
1.5	−0.6	2.2	4.1	10.9	13.4	16.4	15.6	12.5	8.1	5.6	5.6	7.9
2.1	−0.3	2.4	4.1	10.7	12.9	16.1	15.4	12.5	8.1	5.6	5.6	7.9
2.4	1.3	3.4	4.1	9.9	12.5	15.7	14.7	12.5	8.5	6.2	5.3	8.0
2.1	1.5	4.5	4.9	11.8	14.3	16.2	14.5	12.1	7.3	5.1	4.6	8.2
2.4	1.8	4.0	4.1	8.9	11.5	15.0	14.1	11.9	7.8	6.0	4.9	7.7
2.4	1.9	3.3	3.8	8.3	11.3	14.1	13.9	12.0	7.5	6.0	5.2	7.5
1.1	0.3	2.6	3.4	8.0	11.2	13.5	13.0	11.1	6.9	5.2	4.6	6.7
−2.5	−3.7	0.5	2.8	9.8	14.0	16.2	13.5	9.2	4.3	2.1	2.1	5.7
−0.6	−1.9	1.7	2.7	7.8	11.4	14.0	12.8	10.8	6.2	4.9	4.1	6.2
−1.3	−2.3	1.5	3.2	9.3	12.0	15.0	13.2	10.5	5.1	4.1	3.3	6.1
−1.8	−2.7	0.7	3.0	9.5	11.9	15.5	13.2	10.2	4.8	4.2	3.0	6.0
−3.8	−4.7	−0.8	1.7	8.8	11.4	15.0	13.0	9.3	3.4	3.4	1.9	4.9
−1.8	−2.6	−0.5	1.3	7.8	10.4	14.6	12.7	9.1	4.9	4.1	2.4	5.2
−2.2	−4.1	−1.3	1.1	6.3	9.7	11.5	11.8	8.4	4.4	3.2	1.5	4.2
−5.1	−6.9	−3.2	0.0	5.9	10.8	12.9	11.9	6.7	2.1	1.4	0.2	3.1
−4.1	−5.1	−2.8	0.5	4.9	10.1	12.0	12.3	6.9	3.4	2.2	1.0	3.4
−4.0	−4.4	−2.9	0.0	4.7	8.6	9.1	10.9	6.7	3.4	2.3	0.9	2.9
−5.0	−6.8	−4.4	−0.7	4.1	8.4	7.8	11.1	6.2	2.5	0.6	−0.6	1.9
−5.4	−7.5	−5.4	−0.5	4.5	8.3	8.4	10.9	6.4	2.5	0.4	−0.6	1.8
−6.9	−9.1	−6.2	−0.8	5.0	9.6	9.4	11.5	6.5	1.9	0.2	−1.1	1.7

temperature, we represent the annual course of the air temperature from 1st April, 1935, to 31st Aug., 1936, for the following sections of the coast: 1. Oslo—Stavanger; 2. Stavanger—Rørvik; 3. Rørvik—Harstad; 4. Harstad—Kirkenes, we obtain fig. 20. The numerical values are set forth in table 5. We there see that the sections of the coast where the annual amplitude is greatest are Oslo—Stavanger and Rørvik—Harstad, 18.2 and 17.8° C respectively. The section presenting the smallest amplitude is Stavanger—Rørvik with 13.9° C. The annual amplitude for the entire coast as a whole is 16.1° C. It will also be seen from the table that the mean temperature was 3.3° C higher in May 1936 and 1.9° C in June than in the same months of 1935.

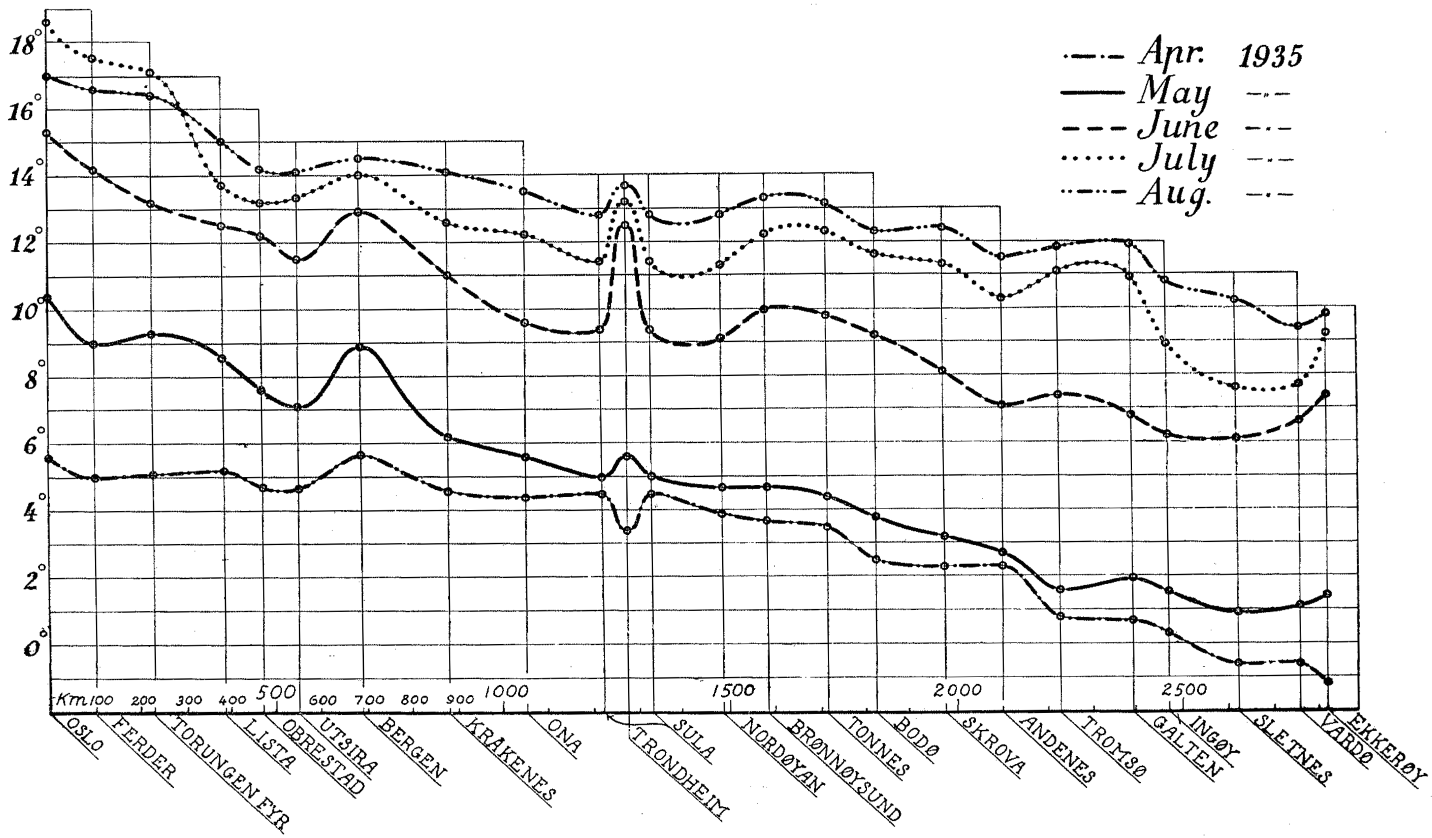

Fig. 17. Air temperature April — August 1935.

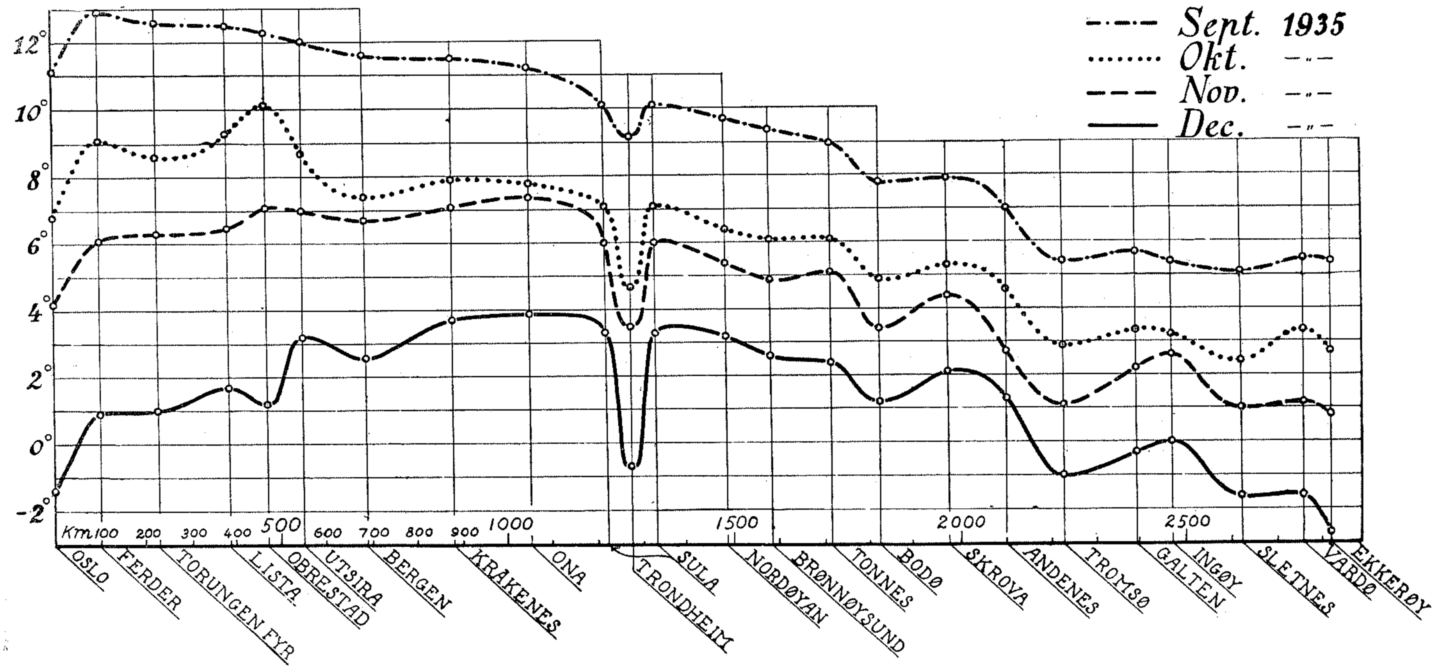

Fig. 18. Air temperature September — December 1933.

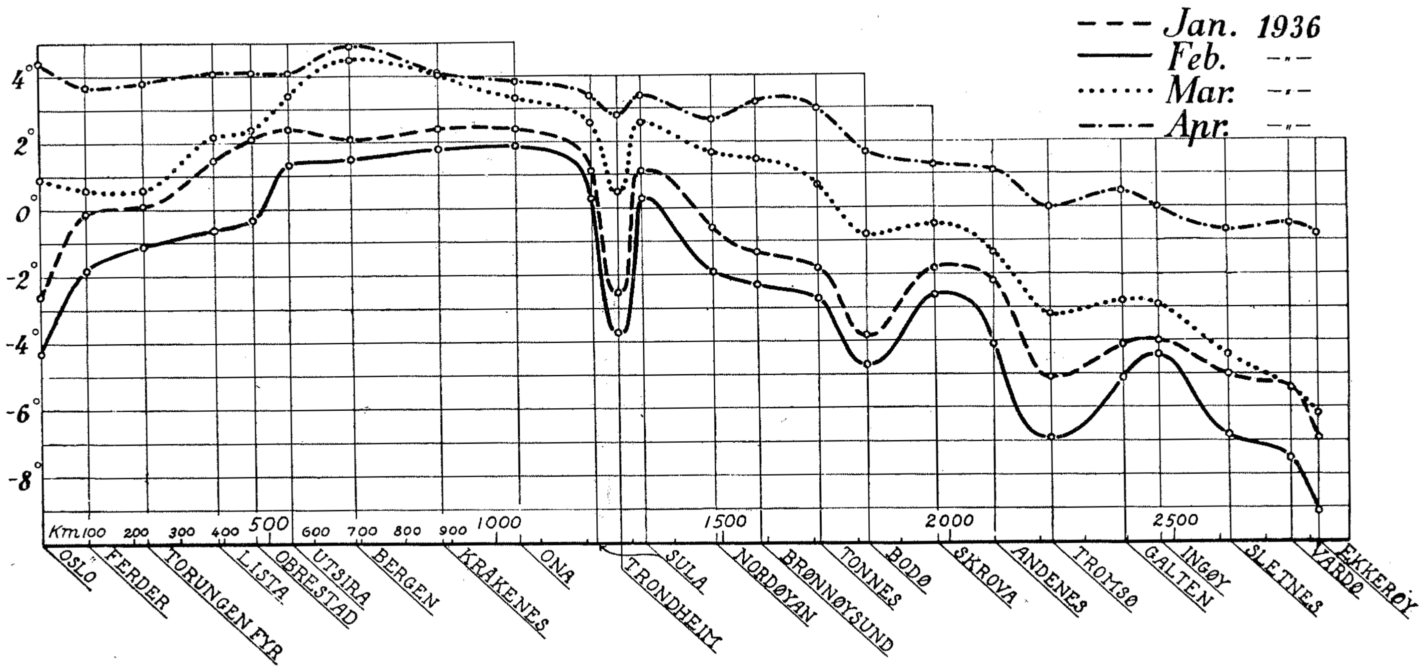

Fig. 19. Air temperature January — April 1936.

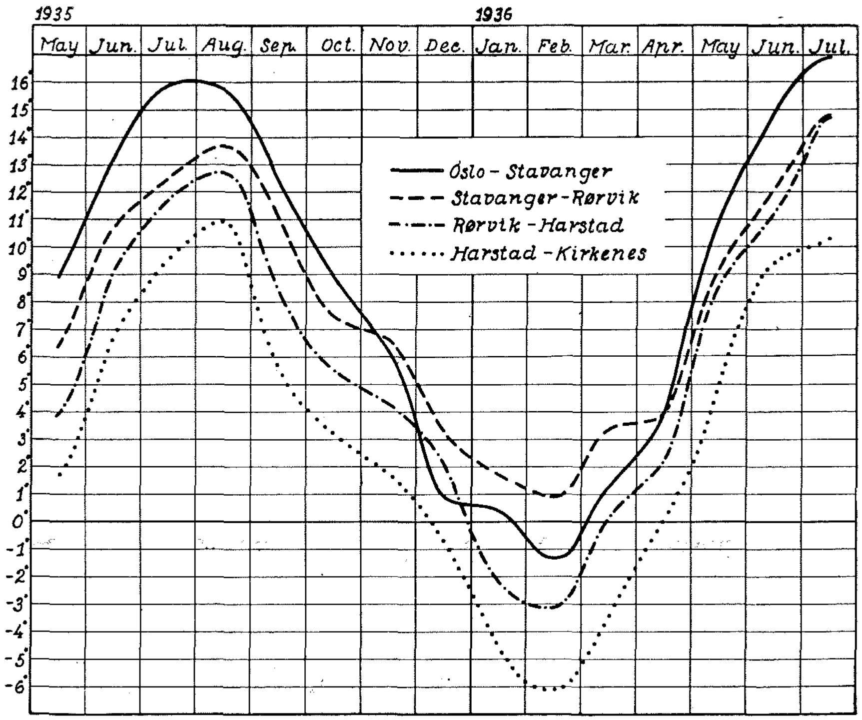

Fig. 20. Monthly mean air temperature (May 1935 — July 1936) on different sections of the coast.

Table 5. *Monthly mean air temperature.*

	Oslo, Stavanger	Stavanger, Rørvik	Rørvik, Harstad	Harstad, Kirkenes	The whole coast
April 1935	5.1	4.7	3.0	0.3	3.2
May »	8.9	6.4	3.9	1.6	5.0
June »	13.3	10.7	9.1	6.7	9.8
July »	15.9	12.5	11.7	9.5	12.1
Aug. »	15.8	13.7	12.7	10.9	13.1
Sept. »	12.4	11.1	8.4	5.6	9.3
Oct. »	8.9	7.5	5.5	3.2	6.2
Nov. »	6.2	6.6	4.3	1.7	4.7
Dec. »	0.9	3.3	2.1	— 0.7	1.5
Jan. 1936	0.4	1.7	— 2.2	— 4.5	— 1.1
Feb. »	— 1.3	0.9	— 3.1	— 6.1	— 2.3
March »	1.3	3.4	0.1	— 3.5	0.4
April »	4.0	3.9	2.2	0.0	2.5
May »	11.0	9.2	8.6	5.0	8.3
June »	14.9	12.1	11.2	9.4	11.7
July »	16.9	14.8	14.7	10.3	13.9
Aug. »	16.3	13.9	12.9	11.5	13.5

V. Sea-Temperature Compared with Air-Temperature

Fig. 21 shows the difference between the sea — and air temperatures on the above-mentioned sections of the coast from May 1935 to June 1936.

It will at once be noticed that there is a considerable difference between the sea and air temperatures during the greater part of the year, the sea temperatures being higher than those of the air. This is particularly conspicuous in winter, especially in North Norway (see table 6 also). It is only in June, July and August that the air is warmer than the sea. With regard to May it will be seen that the sea is a little warmer (on an average 1.1° C) than the air in 1935, while it is somewhat colder than the air in 1936. This arises from the fact that the average air temperature for the entire coast was no less than 3.3° C higher in 1936 than in the previous year, while the difference in the sea temperature was only 1.4° C. Fig. 21 shows also that during winter there is a considerably greater positive difference between the sea and air temperature in North Norway than in the south. Thus, in February the sea temperature is 9.2° C above the air temperature on the Harstad—Kirkenes section, while on the south coast it is only 3.5° C above. The corresponding figures for March are 5.5° C and 0.6° C respectively. Despite the fact that the normal air temperature at Vardø, for instance, is — 5.4° C in January — March, and for Arendal and Kristiansand — 0.3° and — 0.2° C respectively, the sea temperature in Finnmark is higher than it is on the south coast at this time of the year. The reason for the positive difference between the sea and air temperatures being so much greater in Troms and Finnmark than on the south coast is to be found in the oceanographic conditions which are very different in the north from the south coast of Norway. The water masses are considerably more stratified on the south coast than on the Finnmark Coast with a comparatively fresh layer of water on top of the salter and heavier bank water. The difference in density between these types of water is, on account of the great difference of salinity, so great that even the severest winter cold will not result in the sinking of the surface

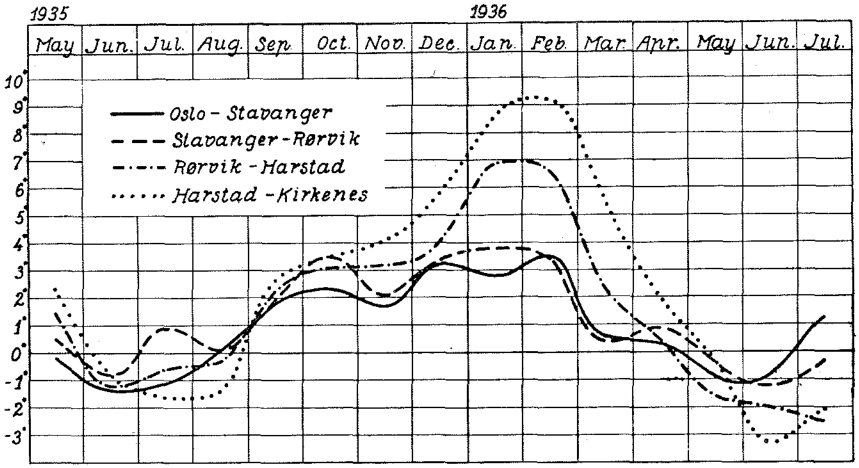

Fig. 21. Monthly mean difference between sea and air temperature (May 1935 — June 1936) on different sections of the coast.

layers through the underlying bank water — thereby letting the warmer water rise to the surface. The water layer taking part in the vertical circulation being thin, it will comparatively soon cool down and lose a great deal of its warmth by the air. Therefore, on account of the cooling of the air and the radiation of heat, the upper layers become cooled and may assume a temperature which is almost equal to that of the air.

Table 6. *Monthly mean difference between sea and air temperature.*

	Oslo, Stavanger	Stavanger, Rørvik	Rørvik Harstad	Harstad, Kirkenes	The whole coast
May 1935	— 0.2	0.5	1.4	2.3	1.1
June »	— 1.4	— 0.8	— 1.2	— 0.8	— 1.1
July »	— 1.1	0.9	— 0.6	— 1.6	— 0.5
Aug. »	0.1	0.1	— 0.3	— 1.4	— 0.4
Sept. »	1.8	2.0	2.3	2.7	2.2
Oct. »	2.3	3.5	3.1	3.5	3.2
Nov. »	1.7	2.1	3.2	4.1	2.8
Dec. »	3.2	3.4	4.1	5.8	4.1
Jan. 1936	2.8	3.8	6.9	8.6	5.6
Feb. »	3.5	3.4	6.6	9.2	5.7
March »	0.6	0.4	2.3	5.5	2.2
April »	0.3	0.9	0.4	2.0	1.0
May »	— 0.9	— 0.4	— 1.6	— 0.4	— 0.8
June »	— 0.8	— 1.2	— 2.0	— 3.3	— 1.8
July »	1.3	— 0.3	— 2.5	— 2.1	— 0.9

In North Norway, on the other hand, the water masses are considerably more homogeneous, and the vertical circulation arising from the winter cooling will be able to reach considerably deeper down, and thus constantly bring comparatively warm water up to the surface. The surface temperature will remain comparatively even and high at this time, only decreasing slowly. Thereby the temperature attains nearly the same value right from the surface down to fairly great depths. On the Finmark Coast this takes place in April and the first half of May. Thus, by measuring the temperature at the surface, we can also obtain some information about the temperature of the lower-lying layers at this time of the year. Such conditions make the use of thermographs exceedingly valuable in Finnmark, because the sea thermograph also supplies knowledge of the temperature even at the depths where the cod generally occurs. It is therefore very important that this distribution of temperature occurs at the season of the great cod fisheries in Finnmark.

In the Vestfjord also the cold coast water is thoroughly mixed and very homogeneous before and during the Lofoten fishery. The thickness of this layer varies from 40 to 125 metres in different years. By measuring the temperature near the surface one also obtains information on the condition far down in the sea. As an instance we will compare the data from the sea thermograph in the Vestfjord, 8 nautical miles SSE of Stamsund with the values obtained by measuring the temperature with reversing thermometer 2 nautical miles SE of Skråva Light (table 7). The latter observations are made at the Fisheries Directorate's permanent oceanographic station at Skråva. It will be seen from the table that from 17th December, 1935, to 18th January, 1936 the water masses maintain approximately the same temperature from the surface to a depth of 100 metres, and that from 29th January to 5th April, homothermy reigns in the uppermost 50—75 metres. Beside each column of temperatures in the table are entered the values taken from the sea thermograph. When we consider that these measurements in the Vestfjord, taken with thermograph and reversing thermometer are not from exactly the same place and were not made on the same day, we must admit that the agreement is good. The sea thermograph gives, therefore, before and during the Lofoten fishery not only the temperature at the depth where it is actually registering (about 4 metres), but the table shows that it can also afford knowledge of the temperature down to a depth of 100 metres. The changes taking place at the surface at this time are thus vertically far-reaching, and the thermograph registrations in this important fishing area are, consequently, of very great use.

If the masses of water along the Finnmark Coast were stratefied

Table 7. *The West Fjord. Serial observations near Skråva with reversing thermometers (TM) compared with thermograph registration (TG) off Stamsund.*

Depth	1935 DECEMBER 17th TM	11th TG	21st TM	19th TG	28th TM	25th TG	1936 JANUARY 4th TM	2nd TG	11th TM	7th TG	18th TM	16th TG	29th TM	22th TG	30th TG
1	6.53		6.58		6.06		6.05		5.50		5.02		4.86		
4		7.0		6.8		6.5		6.1		5.8		5.6		5.1	4.3
10	6.73		6.59		6.04		5.99		5.55		5.05		4.89		
25	6.65		6.58		6.03		5.99		5.54		5.01		4.87		
50	6.65		6.60		6.05		5.96		5.50		4.97		4.86		
75	6.63		6.60		6.03		5.94		5.50		4.86		4.48		
100	6 63		6.60		6.00		5.90		5.50		4.93		5.23		

1936

Depth	FEBRUARY 11th TM	13th TG	22nd TM	19th TG	MARCH 12th TM	12th TG	25th TM	26th TG	APRIL 5th TM	MARCH 31st TG	DECEMBER 12th TM	9th TG	28th TM	31st TG
1	4.13		3.61		2.39		2.67		1.77		6.05		5.28	
4		3.8		3.6		2.2		1.8		2.3		5.6		4.9
10	4.15		3.60		2.41		2.67		2.20		6.04		5.35	
25	4.12		3.59		2.46		2.67		2.52		6.08		5.34	
50	4.19		3.66		2.70		2.67		2.70		6.36		5.47	
75	4.51		3.70		3.29		2.68		3.29		7.14		6.24	
100	7.16		6.94		6.10		2.78		5.02		7.63		6.43	

similarly to what they are on the south coast, with great stability, then the severe winter cooling in Finnmark would comparatively soon cool the shallow water layer that could take part in the vertical circulation even to the freezing point. Finnmark would then be ice-bound for the greater part of the year, and living conditions would be considerably worse than now. No winter fishery would be able to take place and this would result in Finnmark becoming depopulated to a great extent. It is obvious therefore, how very important it is for Finnmark that there is so little difference between the temperature as well as the salinity of surface and bottom layers.

In fig. 16 we notice that the sea temperature is lowest in March at all parts of the coast. It will be noted however that on the Oslo—Stavanger section the difference between the February and March means is negligible — only 0.3° C, whilst the difference between March and April is 2.4° C. In Troms and Finmark on the other hand, it is March and April that present about the same temperature. This shows that the minimum sea temperature is attained later in North Norway than on the south coast, (see fig. 29). The vernal heating of the sea of course sets in unmistakable earlier on the south coast than it does at Finnmark.

In order to explain this more fully it is necessary to bear in mind that the ocean is principally heated by direct solar radiation penetrating the surface and getting absorbed by the surface water. It is only light of very short wavelengths that can go much farther into the depths, and, since the intensity of this radiation is very slight, it is only in the uppermost strata that much of the heat received by the ocean from the solar rays gets absorbed. The ocean is also heated by radiation from the atmosphere and a little heat is conducted from the air when it is warmer than the ocean. The ocean surface also receives a little heat by condensation of vapour, and also, when the sea is rough, warmer air gets mixed with it. On the other hand the ocean surface is cooled by evaporation, radiation, and conduction. The atmosphere absorbs short rays very poorly, and for this reason it only gets slightly warmed by the solar rays passing through it. The air becomes warmed chiefly from the underlying land and from the ocean surface by conduction and radiation, and it is cooled partly by conduction to sea and land when they are colder, and partly by radiation into space from all levels.

On the south coast the sun will reach such an altitude that the incoming radiation overbalances the cooling of the sea earlier in the year than in Finnmark. This will, under otherwise similar conditions, take place sooner with a low sea temperature than with a high. In February and March the sea temperature on the south coast is lower than in Finnmark (see fig. 15). Further, the air temperature in Finnmark is several degrees lower than the sea temperature from February to April, while on the south coast the difference between the air and sea temperatures is comparatively small at this time (table 6). As the air will take heat from the ocean as long as it is colder than the water surface, the fact that the air has a great cooling effect on the sea surface in Finnmark in March and April, but not on the south coast, must result in the summer heating taking place later at Finnmark than on the south coast.

From the above it is evident that the minimum temperature occurs later in Finnmark than on the south coast, this being due to the following 3 causes.

1. Difference in the sun's elevation.
2. Lower sea temperature in winter on the south coast, than at Finnmark.
3. Greater negative difference between the temperature of air and sea at Finnmark in March and April than at the south coast.

VI. Sea-Temperature in the upper Layers and Meteorological Conditions

1. HEATING AND COOLING OF THE OCEAN SURFACE

It will be seen from fig. 16 that the curves assume a very steep course in spring and the early summer, and less so in autumn and winter. This only means that the heating takes place quicker than the cooling. Whilst the heating extends over a period of 4—5 months, the cooling lasts for 7 months. The warming is strongest from April to May (1936) and amounts to 4.0° C as a mean for the whole coast. The cooling is strongest from September to October amounting to 2.1° C i. e. from 11.5° C to 9.4° C.

The longer duration of cooling than warming of the surface is due to the stability conditions. When the surface is cooled in autumn, the water at the surface becomes heavier than the underlying water and, therefore sinks. Warmer water takes its place, and it in turn also sinks. Thereby the cooling causes more or less thick layers of water dependent on the vertical distribution of salinity — to give up their heat. This takes time and prolongs the cooling of the surface. As is known, the warming in spring and summer is induced from above. When the surface is warmed the stability increases and counteracts a vertical circulation. Therefore it is only a comparatively thin layer that takes in the heat imparted to the sea by the sun and atmosphere. This is more conspicuous the greater the stability in the upper layers is, as for instance on the Norwegian Skagerack Coast. The result is that the temperature of the surface layer rises greatly because it takes a comparatively long time for turbulence to conduct heat to the depths.

2. SEA-TEMPERATURE, AIR-PRESSURE AND CLOUDINESS.

As mentioned on p. 26 the sea temperature was on an average 1.4° C higher for the whole coast in May 1936 than in May the previous year. On the Oslo — Bergen section the difference was no less than 1.6° C and through Vesteraalen about 3° C.

In order to explain this difference it will be necessary to compare the surface temperature with the meteorological conditions, not only with the air temperature but also with other factors such as cloudiness, sunshine and wind. The average distribution of air pressure for the two months in question proves to be somewhat different, as seen by planche 1. The charts are based on fivedaily mean air pressure charts, which were kindly placed at our disposal by dr. S. PETTERSEN in charge of Vervarslinga på Vestlandet at Bergen.

In May 1935, a low pressure area in the Barents Sea, and a high pressure area between Scotland and Iceland, produced a comparatively strong wind towards North Norway. And in South Norway also the prevailing wind was northerly. These masses of northern air were so cold that the mean air temperature fell 2° C under normal in North Norway, and 0°—2° C in the remainder of the land. The Skagerack Coast was an exception with the temperature a little above normal in places.

In May 1936, on the other hand, we had high pressure over Scandinavia and low pressure west of Iceland and in South Europe. This gave much clear weather along the Norwegian coast with southerly and southwesterly breezes in North Norway, and easterly wind in South Norway. These conditions resulted in the air temperature along the coast standing above normal by 2° C and at times up to more than 3° C. Fig. *22* shows that the air temperature in North Norway was 3°—5° C higher in May 1936 than in May 1935. The difference was 3.3° C on an average for the whole coast.

The distribution of air pressure resulted in a considerable difference in cloudiness along the coast. Now, as the direct solar radiation (as mentioned on page 50) is the most effective factor in the heating of the sea surface, it will be natural to compare the cloudiness along the coast during May in the two years. At the top of fig. *22* is shown the number of days in the month with cloudiness 0, 1, 2, 3 . . . 9 or 10. The observations were taken at 2 p. m. The dark columns denote May 1935 and the light ones May 1936. Such a picture is drawn up for each of the 4 sections of the coast. It will at once be seen that there was considerably more sunshine in May 1936 than in May 1935. This is most conspicuous with regard to the two middle sections, (Stavanger—Rørvik and Rørvik—Harstad).

On the last mentioned section there was no quite cloudless day in May 1935, while there were five such days in May, 1936. Only one day in May 1935 had cloudiness 1, but there were 8 such days in 1936. There were 13 days in May 1935 that were totally overcast, but only 5 in 1936. Towards the top of the figure the average cloudiness is

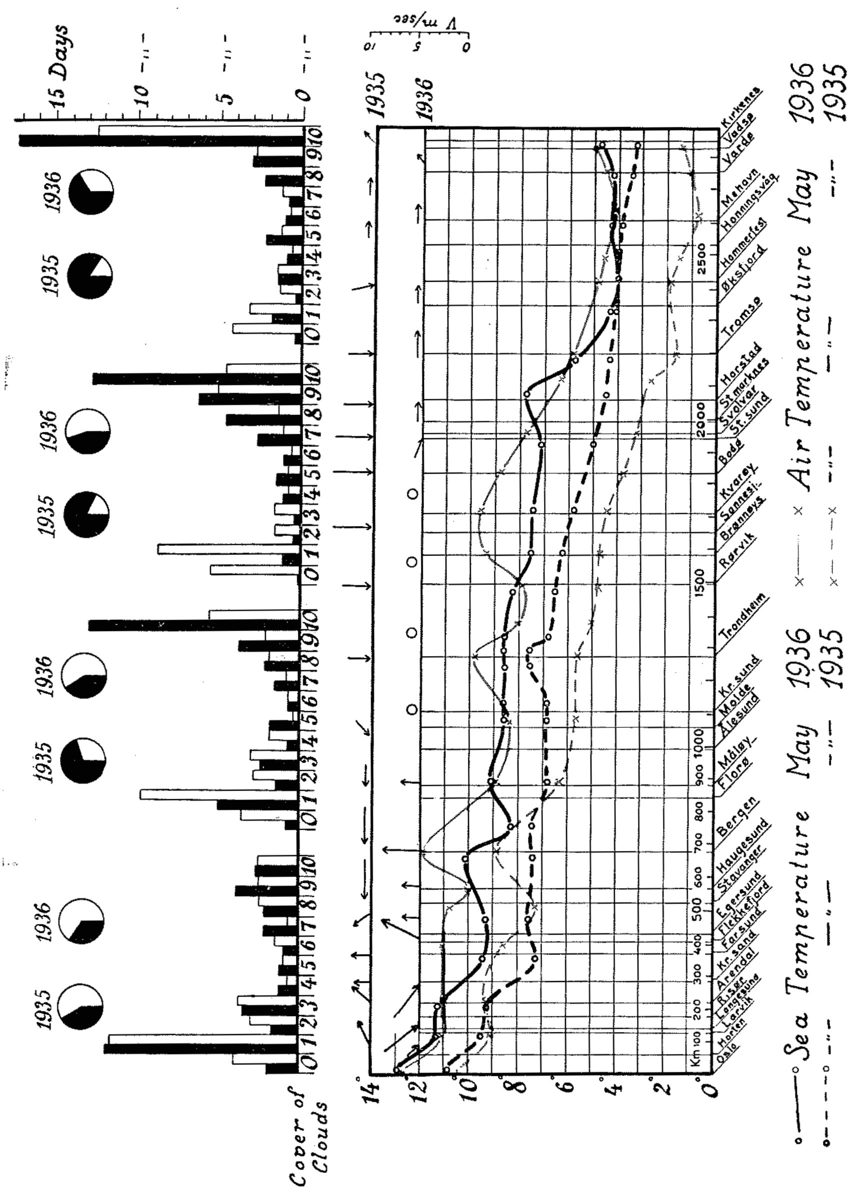

Fig. 22. Mean sea temperature (black curves) and mean air temperature (red curves) May 1935 and 1936. At the top of the figure is shown the number of days in the month with cloudiness 0, 1, 2, ..., 10. The dark columns denote May 1935 and the light ones May 1936. Such a picture is drawn up for each section of the coast, Oslo—Stavanger, S — Rørvik, R — Harstad, H — Kirkenes. Towards the top of the figure the average cloudiness (range 0 — 10) is shown by circles for the respective months and sections. Along the two lines above the temperature curves, the direction and force of the wind are shown by arrows in relation to the coast, assuming that one is standing on land and looking out to sea.

Table 8. *Cloudiness on the Coast of Norway.*

a. *Monthly means for each station.*

Station	1935			1936		
	May	June	July	May	June	July
Oslo	3.8	5.6	5.9	3.5	5.1	6.8
Ferder	3.8	5.0	4.2	3.3	4.6	6.3
Torungen	3.5	5.4	3.9	3.1	4.2	6.0
Lista	4.6	6.3	5.1	3.8	4.6	7.7
Utsira	5.8	6.9	6.8	3.9	5.7	7.4
Bergen	4.6	6.4	7.1	2.9	4.7	7.8
Kråkenes	7.2	8.2	9.1	5.4	6.3	8.5
Ona	7.2	6.8	7.6	3.6	5.1	7.6
Sula	7.9	7.5	8.7	4.5	7.2	8.7
Trondheim	8.2	7.3	7.7	3.1	6.2	7.5
Nordøyan	7.9	7.8	8.6	3.9	6.5	8.1
Brønnøysund	7.6	7.7	8.5	4.2	7.3	8.3
Tonnes	8.7	8.1	8.9	4.7	8.0	8.2
Bodø	8.1	7.5	8.8	4.1	7.9	7.5
Skråva	8.5	8.0	8.7	4.4	8.3	7.3
Andenes	8.4	7.8	8.5	5.2	7.9	7.3
Tromsø	8.2	7.3	7.8	4.8	7.2	6.1
Galten	8.6	8.2	8.2	7.4	8.1	7.4
Ingøy	8.6	8.3	8.1	7.4	6.8	7.2
Sletnes	9.1	8.5	8.6	7.9	7.8	9.2
Vardø	7.8	7.5	8.2	7.0	6.2	8.5
Ekkerøy	7.3	6.8	6.9	6.0	5.9	8.3

b. *Means calculated for larger sections of the coast (each 300—500 nautical miles).*

	Oslo—Stavanger		Stavanger—Rørvik		Rørvik—Harstad		Harstad—Kirkenes	
	1935	1936	1935	1936	1935	1936	1935	1936
May	3.9	3.4	6.9	3.9	8.2	4.4	8.4	6.5
June	5.6	4.6	7.3	5.9	7.8	7.9	7.8	7.1
July	4.8	6.7	7.9	7.9	8.7	7.8	8.0	7.6

shown (range 0—10) for the respective sections and months based on the daily regular observations. Along the two lines above the temperature curves, the force and direction of the wind are shown by arrows in relation to the coast, imagining one is standing on land with arms outstretched in the direction of the coastline and looking out to sea. If the wind blows to the right or left of the observer then this is shown by arrows leaning to the right, resp. left.

The difference in cloudiness would be less on the south coast than on the rest of the coast as the northerly air current in 1935 had to pass over land, and, consequently, to blow from the somewhat higher land to the north. This resulted in much clear weather in 1935 also (see fig. 22). The average cloudiness was for the Oslo—Stavanger section 3.9 and 3.4 for May 1935 and 1936 respectively. When there is, even so, a difference in the sea temperature of 1.4° C on this section it cannot be attributed to the difference in cloudiness or direct solar radiation.

Now it should be kept in mind that the Baltic current which carries water from the Baltic and the Kattegat makes itself greatly felt on the south coast of Norway. A great deal of that water which is off the south coast in May will be found further to the east and south in April and March. During these months there was however, no particular difference in the air temperature in the Baltic Sea and the Kattegat that should produce a higher sea temperature in 1936 than in 1935. It was quite otherwise as April had an air temperature 1°—2° C lower in 1936 than in the previous year.

The considerable difference of heat in the surface water off the south coast can, then, not be attributed to water coming from the south and east. On the other hand, it must be attributed to the fact that along the Skagerack Coast there was considerably more land-breeze in 1935 than there was in 1936. Thereby surface water was transported away from land. Consequently, this must have been substituted by the more deeply situated, colder water. In May, 1936, on the other hand, the wind-drift had a component directed in towards land, and, further, the temperature of the air was 2.1° higher than in the previous year.

We therefore arrive at the conclusion that the difference in the surface temperature along the Skagerack Coast must either be due to the particular wind conditions that prevailed in May in the two years, or to the difference in the air temperature, or to both of these factors — and not to the sun radiation as there was no perceptible difference with regard to it in the two months. Taking into consideration that the air possesses but very slight specific heat, and that its effect by direct contact with the sea is very slight, it must then be the second of the two factors mentioned, viz. the wind conditions that have been responsible for the difference in the sea temperature on the south coast in May in these two years.

Along the sections Stavanger—Rørvik and Rørvik—Harstad the difference in the sea temperature in May 1935 and May 1936 was 1.9° C and 1.7° C, while the corresponding difference in the air was 2.8° C and 4.7° C respectively. The great difference in the air temperature, particularly on the Rørvik—Harstad section is in agreement with the fact that the difference in cloudiness was also greatest along this section.

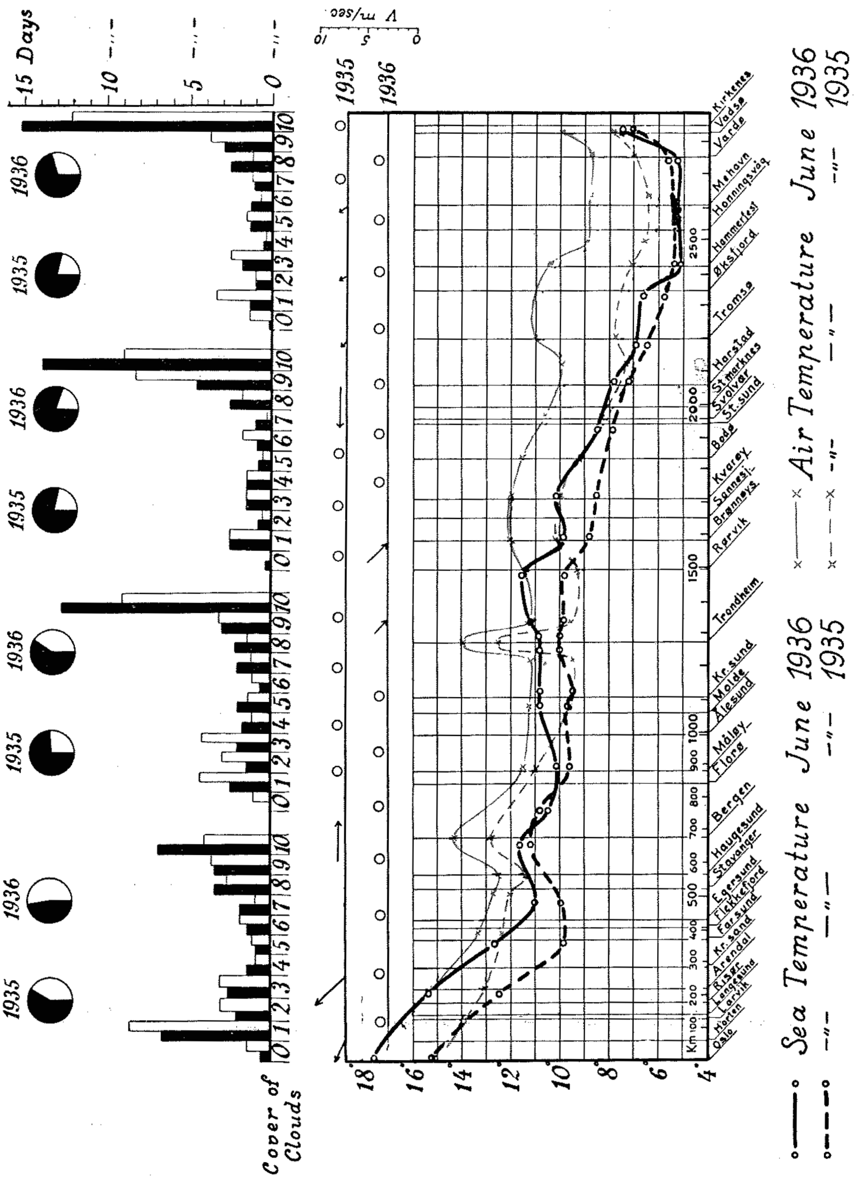

Fig. 23. Mean sea and air temperature, cloudiness and direction and force of the wind in relation to the coast, June 1935 and 1936. (For further explanation see fig. 22).

The air pressure was high and the weather was calm in 1936, while in 1935 northwesterly winds prevailed along this section (fig. 22 and Pl. I). On account of the stronger wind the water in 1935 became more mixed and the temperature of the upper layers of the sea would be reduced for that reason also. It will be observed that although the difference in air temperature and cloudiness was considerably greater on the Rørvik—Harstad section than on the Stavanger—Rørvik one, there was only a difference of 0.2° C in the rise of the sea temperature in the two areas and that in favour of the last mentioned section.

On the Finnmark Coast the air temperature was considerably higher in May 1936 than the previous year, the difference being 3.3° C. There was also considerably more sunshine in 1936 (fig. 22, table 8 b). Even so there is but slight difference in the sea temperature during the month of May in the two years in question. From Hammerfest to Vardø there is an average difference of barely one half degree. This is due to the fact that the stability of the water masses is found to be weaker the farther north and east one goes on the Norwegian coast — because the water masses become more homogeneous in the direction of the prevailing drift.

This is shown by fig. 25 which presents temperatures at 50, 100 and 200 meters, further salinities at the corresponding depths and the mean salinity at 10—50 meters along the coast between Arendal and the Murmanbank (69° 30' N. Lat., 35° 40.5' E. Long.). The curves are smoothed according to the formula $b' = (a + 2b + c)/4$. It will be noted that from Hammerfest to Vardø the water is very homogeneous in the upper 200 metres both in salinity and temperature. At Revsbotn near Hammerfest for instance the variation in this water column (June 2nd 1932) is only 0.20 $^0/_{00}$ S and 0.27° C. The smoothing of the curves tends to obliterate the great and abrupt decrease of stability between this point and the station immediatly to the south. Something similar is found also between other points[1]. The result is that the amount of heat received by the surface may easily spread down to considerable depths through turbulence and convection — and the heat distributed amongst such a great mass of water that heating per unit volume will be slight and the surface temperature will therefore change very little. Thus also if the surface is deprived of heat, loss of it will affect such a thick stratum that the fall in surface temperature will be slight. This is the principal reason why the annual amplitude is so small in East Finnmark and also why the temperature difference

[1]) As many details may vanish in smoothing the curves, this treatment has in the present paper been avoided as far as possible.

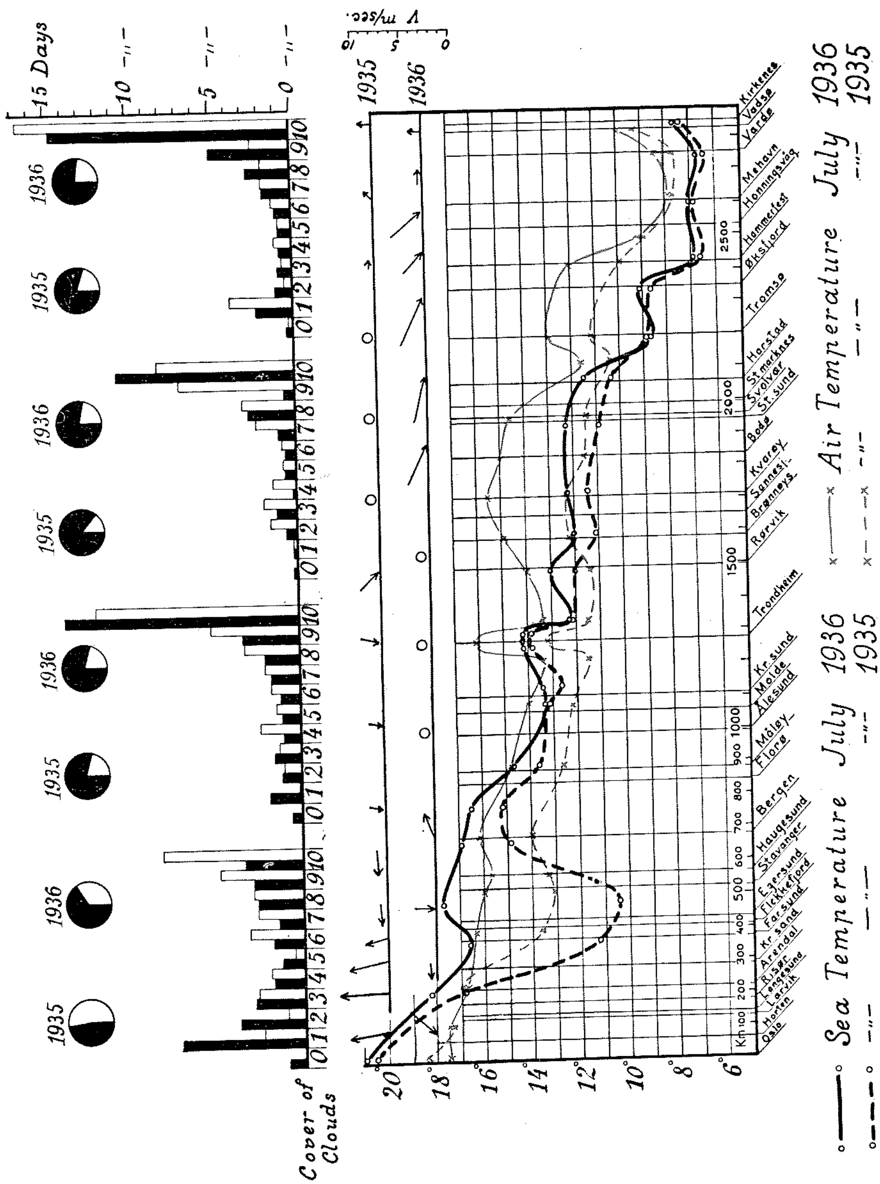

Fig. 24. Mean sea and air temperature, cloudiness and direction and force of the wind in relation to the coast, July 1935 and 1936. (For further explanation see fig. 22).

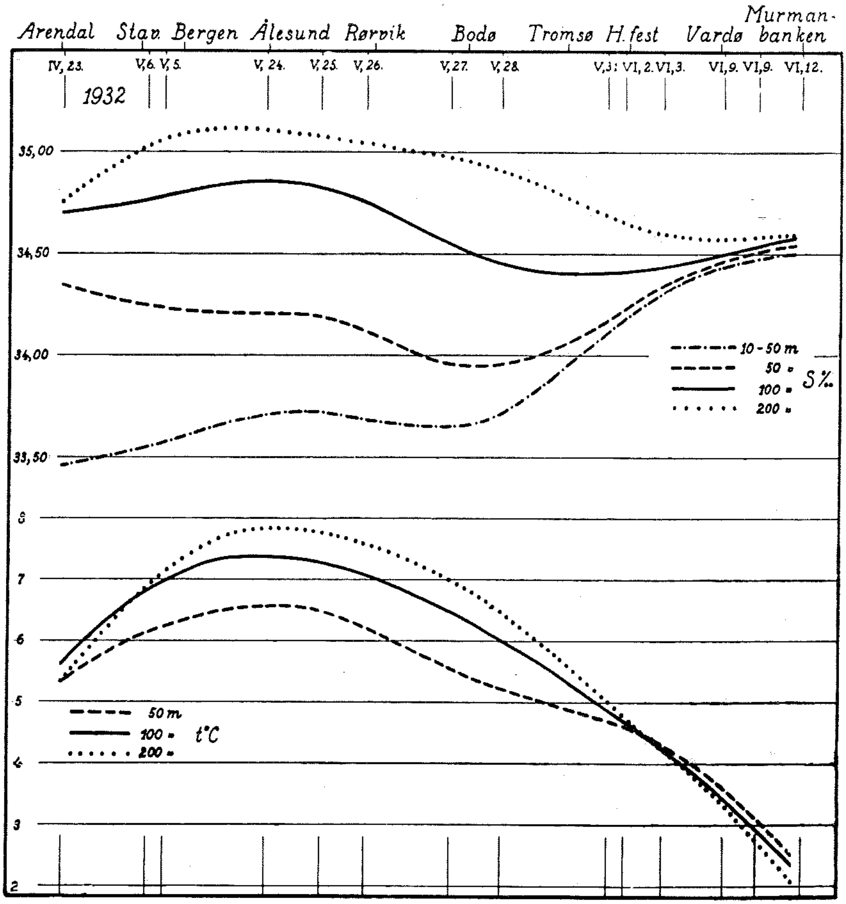

Fig. 25. Curves smoothed according to the formula b′ = (a + 2 b + c) /4. Temperatures at 50, 100 and 200 meters along the coast between Arendal and the Murman Bank (69° 30′ N., 35° 40,5′ E.).
Salinities at the corresponding depths and the mean salinity at 10—50 meters.

of the surface water in May 1935 and May 1936 was only 0.5° C, whilst the air temperature difference was no less than 3.3° C, and this despite the fact that the radiation was far greater in May 1936 than was the case in May 1935.

We thus arrive at the result that the farther north and north east on the coast we go, the less effect on the surface temperature will the meteorological factors have, such as cloudiness, air temperature and wind. An exception is formed by those fjords where great discharges of fresh water occasion greater stability in the upper layers.

In June the sea temperature was higher in 1936 than in 1935, but the difference was less conspicuous than in May on an average 1° C for the coast as a whole. There was also more sunshine and warmer air in June 1936 than in 1935, (fig. 23). The Rørvik—Harstad section was an exception with regard to cloudiness as there was, practically speaking, no difference. The fact that the air temperature was higher must be attributed to the fact that there was more southwesterly wind in 1936 along this part, and for that reason the winddrift also had a component directed in towards land in this area. If we compare the mean air pressure (Pl. I) we see that the prevailing wind was SW along the Skagerack Coast in June 1935. Thus the drift of the wind had a component directed away from land which must have hindered the heating of the surface. In June 1936, on the other hand, the weather was calmer and there was more sunshine. This then explains the fact that the difference in the surface temperature on this section for the two months of June was so great (fig. 23). Despite the fact that the air in June was considerably warmer in 1936 than in 1935 from Tromsø to Kirkenes (the difference being 2° C—3° C), and that there was more sunshine in 1936, the sea temperature was nearly the same during the two months. Between Hammerfest and Vardø the sea was even a trifle colder in June 1936 than in June 1935. The explanation is, to a great extent, the same as previously mentioned in respect of May, i. e. stability conditions. When the temperature is even lower than in 1935 it is due to the fact that the quantity of heat in the ocean off Finnmark was small in 1936 compared with the previous years. From the investigations undertaken by the Fisheries Directorate onboard the »Johan Hjort«, it appears that during the spring of 1936 the temperature in depths of 75 metres and down to the bottom was 0.5° C to 1 ° C lower than in 1934, for instance. (There is unfortunately no material at hand from East Finnmark for 1935). The current calculations show that considerably greater quantities of relatively warm Atlantic water were carried eastward during the spring of 1934 than in the spring of 1936, whilst the reverse was the case with coast water (8).

According to the mean air pressure (Pl. I) the prevailing wind in July 1935 was directed parallely to the coast with land to the left or away from the coast on the south-west and south coast of Norway (fig. 24). The surface water was then driven away from the coast and cold water from below welled up to the surface. In July 1936 the wind was directed more coastwards.

In fig. 11 it will be observed that it is just at Jæren and Lindesnes that such low mean temperatures as are shown on the graph for July 1935 are met with. On the average for the two places, the sea temperature is 2.65° C lower than the air temperature during the month in question. For the entire coast as a whole the difference is only 0.4° C in favour of the air (air 12.1° C sea 11.7° C). We might now ask whether this abnormally low sea temperature between Jæren and Lindesnes should not have such a cooling effect on the air as to be noticeable in this part.

In »A Review of the Air Temperature and Precipitation in Norway« (»En oversikt over luftens temperatur og nedbør i Norge«) for the year 1935, published by Det Norske Meteorologiske Institutt in 1936, we find on page 21, with regard to the temperature in July as compared with the normal temperature : —

»The prevailing temperature presented values under the normal in the northern part of the land, and above normal in the southern part. The limiting line running from the Sognefjord to Røros. The deficit in the northern part varies sligthly between 0° C and 1° C while the excess in the southern part rises from 0.5° C on the West coast to 1°—1.5° C on the East coast.[1]) *An exception here from is the stretch of coast from Lista to Lindesnes where there was a deficit of 0.5°—1° C*«.

Jæren is not specially mentioned but as the average temperature of the air in July was only 13.2° C at Obrestad, a deficit would have been present there also. At Lista the temperature was 1.1° C below normal. Normal: Lista 14.8° C, Skudesnes 13.9° C. Interpolation between these normals gives a deficit of 0.9° C at Obrestad.

Along the whole coast-line between Bergen and Oslo, as well as in the interior of the country, the air temperature is above the normal. It is only the Jæren—Lindesnes section that forms an exception with a value below normal. Now it happens that it is just along this section that we find an abnormally low sea surface temperature, not as the result of cooling factors, but because of the cold water brought from the deep to the surface. And it is very likely this cold water that has affected the climate in such a way that a temperature below the normal was recorded on land along this coast.

As to the relation between sea and air temperature, it may often be a difficult matter to decide which of them is the cause and which the effect. But in this case, there can be no doubt that it was the low temperature of the sea that was the cause since the distribution of air pressure was responsible for the cold, deeper-lying water being forced up to the surface (planche I, July 1935). Thereby the surface temperature for July was considerably reduced.

We have instances from other places also that cold water which has welled up to the surface close to the coast — through the effect of the wind — reduced the temperature of the air. For instance, on the west coast of South America and the north-west coast of Africa where the trade winds drive the surface water away from land, the colder, deeper lying water rises to the surface.

[1]) The italics are the present writers.

3. THE INFLUENCE OF THE WIND ON THE SEA-TEMPERATURE

As before mentioned very characteristic jumps in temperature occur in some cases at several places along the coast. Some of these changes are so great, and take place in such a short time, that they cannot be attributed to heating or cooling on account of radiation, nor to contact with air of a temperature different from that of the sea surface. These temperature changes occur however, only in limited areas at a time. They may be fairly great west of Lindesnes for instance, whilst no corresponding change is observed on the east side, and vice versa. The reason for this must be sought in the current conditions and above all currents caused by the wind.

Wind blowing over water will, on account of friction and viscosity of the air exercise a drag on the air film which is in immediate contact with the water and this results in a tangential pressure on the water in the direction of the wind. This effect is increased by the direct pressure exercised on the waves by the wind. The velocity (V) of the surface current which the wind sets up, is, according to EKMAN (10), proportional to the tangential pressure (T), and inversely proportional to the »Depth of frictional influence« D and the sine to the latitude (φ):

$$V = \frac{T \pi}{D \varrho \omega \sin \varphi \sqrt{2}}$$

where ϱ is the density of the water and ω the angular velocity of the earth.

In the higher latitudes this current rises to about 2 % of the wind velocity, in lower latitudes to about 4 %. As soon as the surface current is established the deflecting power of the rotation of the earth sets in and divers the current to the right of the wind in the northern hemisphere, and to the left in the southern. At the surface the angle between the direction of the wind and current is 45°, but in increases with depth so that the aggregate water transport is at right-angles to the direction of the wind — provided there be no land intercepting the transport, and that the sea is sufficiently deep. At smaller depths the angle concerned will be less.

If the wind comes from such a quarter that it blows surface water away from land, this water must be replaced by the deeper water. Thus the drift of the wind can be responsible for the drawning up of water to the surface from quite considerable depths. During summer this must result in the surface temperature falling quite considerably close to land. If the coast has an archipelago, then the fall of the temperature outside the islands will be greater than inside as the water transport between the sheltered area and the open sea is intercepted. Near land we must expect to find the greatest changes in temperature occasioned by the wind at unsheltered places. By comparing the several thermograms it will be seen that this actually is the case. It is at Jæren and Lindesnes that the greatest jumps in temperature take place (see figs. 8, 9 and 10). There are, of course, other such open stretches, such as Stadt, Hustadvika, Folla, The North Cape, etc. Such great jumps in temperature are, however, not met with in these places because the water is considerably less stratified there than on the south coast. Here in summer, there is a greater difference in the temperature at the surface and at a depth of 50 metres for instance, than there is on the coast to the north. The Baltic Current on the south coast which consists of water of low salinity, becomes so little mixed with salter water that the difference in specific gravity between the two types of water is fairly great. For this reason the water masses off the south coast are very stable and the vertical circulation, which as a rule is started by comparatively small changes of density at the surface, will, therefore, have difficulty in forcing itself down to any depth. In summer therefore, great temperature differences between the surface and the deeper layers will be met with. Northwards along the Norwegian coast the various types of water become mixed with each other, so that the salinity in the upper layers increases, while decreasing in the lower strata. Thereby the difference of density between the surface layers and the deeper ones becomes less, and consequently, the stability also decreases (fig. 25).

As an example of great temperature changes in the middle of summer it may be mentioned that from 24th to 29th June, 1936, the temperature off Jæren dropped no less than 9.4° C, viz. from 17.4° C to 8.0° C (see fig. 8). At some places it fell as low as to 6.5° C. During the whole of this time there was a prevailing northerly wind, ranging from a fresh breeze to a moderate gale. The diagrams show that the greatest fall in temperature occurred west of Lista, and on unsheltered stretches. East of Lista, on the other hand, the temperature remains normal. Fig. 26 presents the temperature between Egersund and Stavanger on 29th June, 1936. This distance was covered in about 4 ½ hours from 10.30 a. m. to 2.55 p. m. It will be noted that the temperature is very low, viz. between 6.5° C and 11° C between Egersund and Tungenes. But, rounding Tungenes and entering the Byfjord (at Stavanger) the temperature suddenly rises from 8.6° C to 17.1° C, i. e. by 8.5° C, over a distance covered in as little as 10 minutes. The cause of this great temperature difference between the Byfjord and the coast off

Jæren, is obvious. The resultant of the wind during this time (reckoned from 25th incl.) was from N 9° W at Skudenes, of force 4,5 and from N 30° W at Klepp, of force 3. According to EKMANS theory, the wind-drift thus got a component driving the surface water away from the coast. This would cause a depression of the surface near the coast, and a rise towards the west. Along the bottom, therefore, the pressure would decrease in towards land and, consequently, the water near the bottom would flow towards the coast and the south, because the deflecting power of the rotation of the earth would come into play here also. Thus, warm surface water would be removed and replaced by water from the deeper-lying layers.

According to the distribution of temperature in the water masses in this area at the time, (known from various Norwegian Fishery Investigation Cruises) the cold water off Jæren must have come from a depth of 30—50 metres. This corresponds with the bottom depth of a part of the area represented by the temperature curve in fig. 26.

In the Byfjord the warm surface water would not be driven out to sea by the wind — the effect of which would be that the surface water became ponded up against the west side of the fjord, where the temperature would therefore remain very high. If we look closer at fig. 26, we shall notice that inside Eigerøya, the temperature rises to 11° C. Here the transport of water away from the mainland would be retarded, but as soon as the islands are left behind the temperature sinks to a minimum. All the way to Jærens Rev it remains very low at 6.5° C to 8.5° C. It must be noted that this is at the end of June. As a comparison it may be mentioned that five days earlier, the temperature on this section was 16°—19° C. As soon as Jærens Rev is passed, we observe a distinct rise of about 3° C. At this spot the coastline bends comparatively sharply off to take up a N by E direction, and with the observed direction of wind it must have caused a less marked transport out from the coast to the north than to the south of the Rev. There is also another factor that may have been partly responsible for the higher temperature north of the Rev, namely, the fact that to the north there is a sort of archipelago and also shallows on the seaward side of the course of the ship. Just before reaching Tungenes, and while crossing the deep of the Haastein Fjord (which is open to the sea towards SW) the temperature falls a couple of degrees, but even so it remains higher than south of the Rev. It would seem therefore that both the archipelago with its shallows and the form of the coastline contribute to the somewhat higher temperature to the north of the Rev. In the profil (fig. 27) may also be seen the temperature on either side of the Tungenes peninsula, 17.1° C on the inside while on the outside it is only

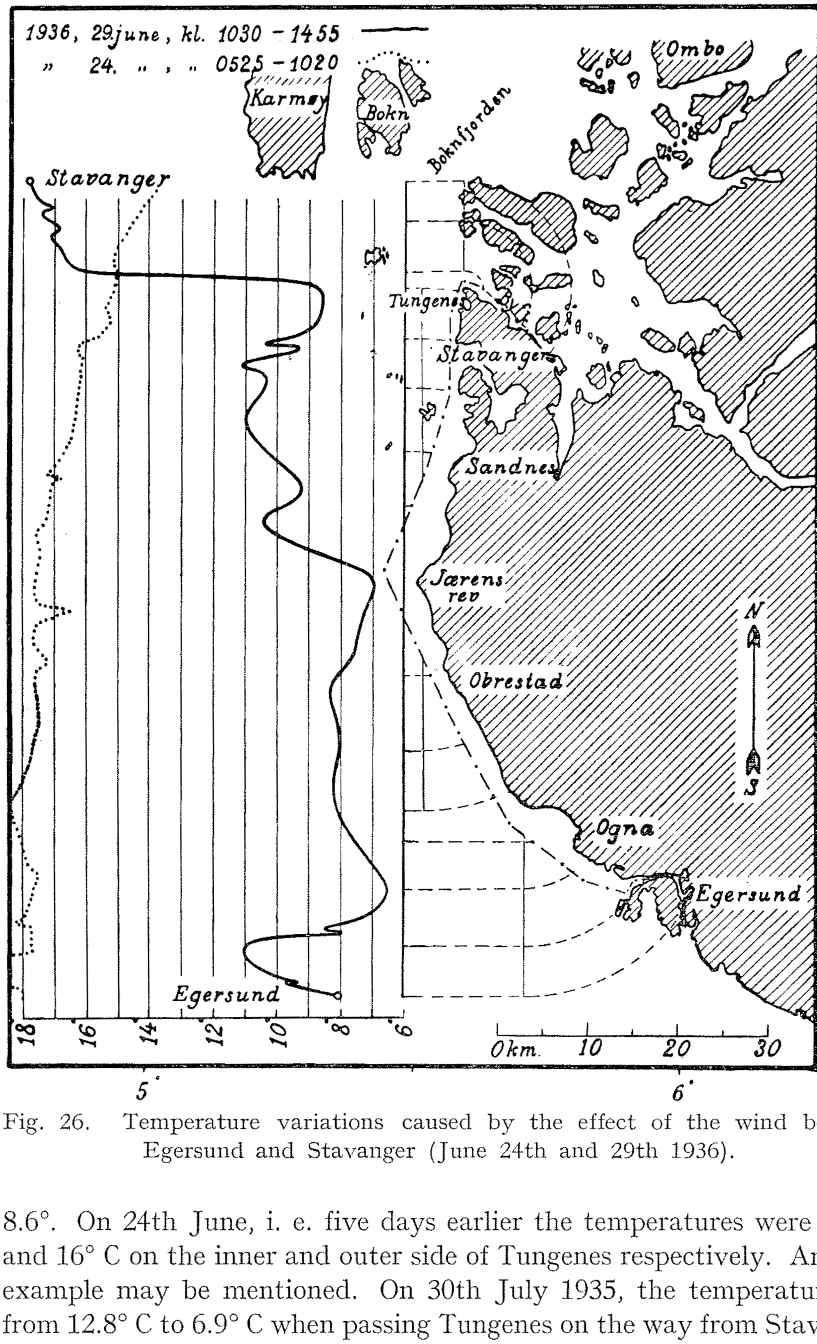

Fig. 26. Temperature variations caused by the effect of the wind between Egersund and Stavanger (June 24th and 29th 1936).

8.6°. On 24th June, i. e. five days earlier the temperatures were 15° C and 16° C on the inner and outer side of Tungenes respectively. Another example may be mentioned. On 30th July 1935, the temperature fell from 12.8° C to 6.9° C when passing Tungenes on the way from Stavanger to Egersund. The direction of the wind was approximately the same as in the case already mentioned, and of force 6. It is the Beaufort Scale which is used in this paper.

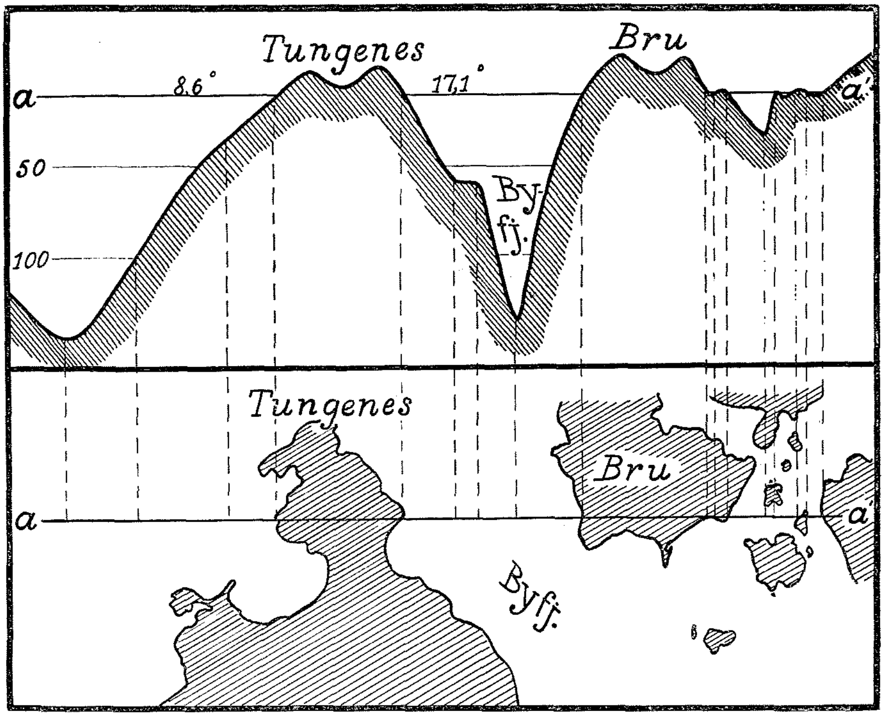

Fig. 27. Profile which shows the difference in sea temperature on the windward and lee side of the Tungenes Peninsula, June 29th, 1936.

Whilst in the afore-mentioned example of 28th and 29th June, 1936, there was a very low temperature from Lista to the Boknfjord, and a high temperature east of Lista, the situation was reversed on 6th and 7th July. Then the temperature west of Lista and all the way to Bergen was very high, between 16° C and 20° C with a mean of 18° C; from Lista eastwards it was very low. Between Kristiansand and Lista it scarcely averaged 9° C, and at Kleven it fell right down to 7.4° C. Between Kristiansand and Arendal the temperature was round about 12° C on an average. Wind on the 2nd to 5th July was from WSW and of force 4 on the average along the Skagerack Coast, and on the 6th it blew from W by N with force 3.3. Such winds would drive the surface water from land, and result in the cold deep water being drawn up to the surface causing the great fall in surface temperature mentioned. West of Lista on the other hand, the westerly wind would not drive the surface water away from land; this accords with the fact that there was no fall in the temperature at this place.

Likewise, between the two observations on 4th and 7th July, 1935, the temperature fell from 13.2° C to 6.2° C (see fig. 8) at Jæren, and between 28th and 30th July of the same year it dropped from 12.6° C to 6.2° C. On examining the wind conditions, it appears that on both occasions there was wind from NW by N of force from 5—7. Such strong wind would produce a surface current directed away from land, and this would result in the cold deep water being drawn up to the surface.

From the above it appears that northerly and north-westerly winds urge surface water away from the coast along the Jæren—Lista section and that, during summer, they considerably reduce the temperature there. Further, we find that winds from W and SW reduce the temperature on the east side of Lista, as they carry the surface water away from the land on this section. This is all in agreement with EKMAN'S theory, namely, that the surface water is deflected to the right of the wind in the northern hemisphere.

The effect is, as seen, quite a sharp fall of the temperature in the upper layers in summer. In winter on the other hand, the effect of such winds will be to cause a rise in sea surface temperature, because the deep water drawn up has, in that season, a considerably higher temperature than the surface water has.

As an example of this, it may be mentioned that between January 8th and 12th 1936, the temperature at Lindesnes rose by rather more than 4° C, and that at Jæren in the same period it rose by a little over 1° C (fig. 8). On 8th January the prevailing wind was E to ESE at Lindesnes. The surface temperature was then about 3.6° C — which is normal for this time of the year. On the 11th the wind was from W, and of force 6. On the temperature being measured on 12th January, (at 3 a. m.) it was found to have risen to 7.9° C, i. e. by 4.3° C. Also, during the following days, the transport of water away from land must have continued because the wind was from NW, and of force 3—6. The temperature at Lindesnes however, did not rise further but remained at the same high value as on 12th January. The fact that it did not rise further, even though water must have gone on being carried away from land, is quite natural; it had already reached the maximum temperature of the deep water. Whilst the temperature at Lindesnes, and to the east of it, rose to a maximum after the strong westerly winds of 11th January, we note only a slight rise at Jæren (1.1° C). This is understandable when we consider that the wind must have transported the surface water towards Jæren from the North Sea. The thermograms from the S/S »Ariadne« which runs in the Rotterdam trade, show that the water some nautical miles off the coast of Jæren is a couple of degrees warmer than it is near land at the time of year in question. Not until the NW'ly wind set in was there a transport of water away from land,

and then we had a sharp rise in the temperature at Jæren also. This example also proves that under favourable circumstances, a strong wind does not require more than 24 hours to bring water from a depth of 30—50 metres up to the surface. The prevailing winds during the period 8th—10th were from such a direction that they could not carry surface water away from land at Lindesnes. On 11th January there was as mentioned before, a great transport of water away from land at this place, and as early as the twelvth the temperature had reached a maximum.

From fig. 8 it will be seen that there were great variations in the sea temperature in the Oslo Fjord at the end of January and in February 1936. From January 24th—31st the temperature rose from — 0.5° C to 3.1° C. In the period from 26th to 30th January, the prevailing wind was from N and NE, and caused the warmer deep water to well up to the surface. The high temperature of 3.1° C, as would be expected, did not last for long, the wind on the 31st having veered to W at Ferder and ENE at Oslo. As early as 11 p. m. on the same day, the temperature had fallen to 2.4° C. On February 13th, at 10.30 p. m. the temperature had risen to 6.4° C. The day before, the wind was from NE and on the thirteenth it veered from W to NNW. This brought the before-mentioned high temperature of 6.4° C in the evening of February 13th. But only 25 hours later, the temperature fell again to 0.2° C. Observations show that at 2 p. m. on the 14th the wind was from SSE, and at 7 p. m. from SE and light. We note then that the surface temperature changes quickly from an abnormally high temperature to normal. On February 20th again, the temperature had risen to 6° C. In this case also there was a component of the wind which, even if slight, was directed out of the fjord during the three previous days. On 21st february the wind was from E and SE and then the temperature again sank to 2.2° C.

We conclude then that a northerly breeze rises the surface temperature quite considerably in the Oslo Fjord in winter, but that it very soon assumes a normal value after the effect of the wind has ceased or the winddrift gets a component directed towards the head of the fjord. That such a rise is due to warmer water drawn to the surface, is obvious.

Johan Hjort and H. H. Gran (15) report an uplift of certain water layers in the inner part of the Oslo Fjord in March 1897. Both temperature and salinity increased at that time towards the head of the fjord in the upper 40 metres. The writers considered the wind conditions to be the cause, and wrote: »The northerly winds having probably prevailed for a time, forced the surface water outwards, the inflowing undercurrent ascended as a necessary compensation«. From Jahrbuch des Norwegischen Meteorologischen Instituts 1897 it appears that the prevailing wind during the three weeks before the observations were made was from NNE, of force 1—2.

Investigations made by GRAN and GAARDER 1918 (11), BRAARUD and RUUD 1937 (4) have shown broadly spoken that a strong northerly component of the wind (observations from Ås) lowers the depth of water in Oslo Harbour while southerly winds dam the water up here. By means of the oxygen, phosphate and salinity distribution in the inner fjord, inside Drøbak, BRAARUD and RUUD show, in accordance with the observations made by HJORT and GRAN, that when northerly winds have carried the surface layers out of the inner basin compensation currents cause the deeper and more salt layers to rise there.

The surface water carried by the wind towards the coast is »heaped up« against the land in such a manner that the surface stratum becomes thicker than usual. The junction at the surface between the light coast water and the somewhat heavier bank water, and that between the latter and the still heavier water from the Atlantic, will alike then move nearer the land. The Atlantic water will not however, be able actually to reach the coast at the surface because it will partially be forced under the lighter layers nearer land. In the liner trading fortnightly between Bergen, Faroe and Iceland (the S/S Lyra of the Bergenske Steamship Co.) a sea thermograph was installed January 5th, 1933 by the Fisheries Directorate. The surface thermograms received show in winter as a rule, a very sharp temperature limit between the coast water and the branch of the Gulf Stream wich enters the Norwegian Sea. The latter is of considerably higher temperature (see further p. 110).

When pressed up against the coast and surface strata become thicker than usual, there will depth for depth be water of greater density further offshore. This must produce a convectional current in the upper layers directed along the coast in such manner that we have the land to the right when looking in the direction of the current. At the time, the water surface must be raised near the coast, and lowered seawards. The pressure therefore decreases seawards. Consequently the water above the bottom starts to drift away from land, but as soon as the current gets well started, the deflecting force of the earth's rotation asserts itself. It deflects the current to the right in such manner that a drift along the coast takes places in the same direction as that of the convectional current. This current is called the »stow« current in EKMAN'S terminology. This drift will not as a rule be able to exercise any perceptible change in the surface temperature — except when that is already very low or very high because deep water has been forced

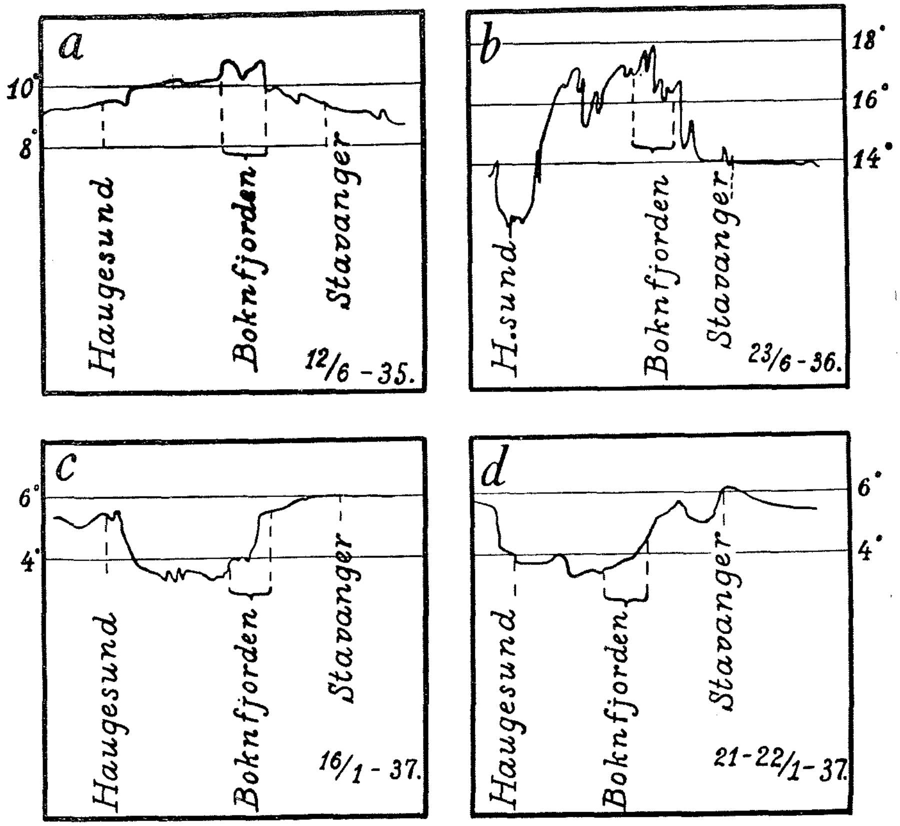

Fig. 28. Temperature variations by passing the mouth of a fjord.

up to the surface. In such cases the normal temperature will soon be restored. The pure winddrift may also be very instrumental in that way. As an example we may mention that between 10th and 14th June, 1936, the temperature rose from 7.1° C to 14.3° C at Lindesnes, and from 7.3° C to 9.6° C at Jæren. The wind was northerly from 8th — 11th and southerly from 12th — 14th of average force 3—4. The southerly wind would naturally stow the surface water towards land. Thereby the abnormally low temperatures near the coast were evened out. As will be seen from fig. 8, the temperature at Jæren continued to rise after the fourteenth, though this was not the case at Lindesnes. These findings are in agreement with the fact that the temperature at Jæren on the 14th had not reached its normal for the time of the year, while such was the case at Lindesnes.

In winter, cold water transported out of the fjords by the wind will cause a fall of temperature out in the island zone. HELLAND-

HANSEN and NANSEN have mentioned this condition in the treatise: »Temperaturschwankungen des nördlichen Atlantischen Oceans« which appeared in 1909 (14). They did not however cite any particular instance. Our thermograms show several instances where such is the case — for instance, when crossing the Boknfjord. Thus, figs. 28 c and d show that the temperature falls a couple of degrees when crossing Boknfjord on the trip from Haugesund to Stavanger, or vice versa. In both cases on the 16th and 22nd January, a SE'ly gale blew on the days prior to, and during the observations. That the temperature was lower on the north than on the south side of the fjord, agrees with the fact that the water transport out of the fjord under such conditions, would be greater on the northern side.

In summer the water of the fjord gets more heated than the water in the island zone. A great transport of water from the fjord will then cause a rise of temperature at the mouth of the fjord (see figs. 28 a and b). If there are skerries (»skjærgård«) on either side of the fjord-mouth, the temperature inside the skerries will remain about normal. Along an unbroken coast on the other hand, the temperature will, with a downfjord wind, fall quite considerably when the mouth of the fjord is crossed and the lee of the land is reached. An example of this may be cited: On July 30th, 1935, the temperature in the whole of the outer part of the Bømmelfjord and also at the mouth was 12° C—13° C, but, as soon as the fjordmouth was passed, and when crossing Sletta on the way to Haugesund, the temperature fell to 7.6° C.

4. ISOPLETH-DIAGRAM OF TEMPERATURE.

Fig 29 is a survey of the temperature in the upper layers along the whole coast of Norway. As in table 3 the mean temperature is entered for each month from May 1935 up to and including September 1938, for 25 different places evenly spaced along the coast. They are the positions listed above, with the only difference that the Trondheimfjord is omitted as it proved that the range of temperature in this fjord is affected by the inland climate and deviates from the course of the temperature at the real coastal stations. The terminal stations of the Oslofjord and the Varangerfjord are, however, included.

The area occupied by water warmer than 12° C is shaded, the denser the shading the warmer is the water, the symbol changes for every second degree up to and including 20° C. The oldest area (below 4° C) is dotted, the closer the dots the colder is the water.

The part of the coast that has the warmest surface water during

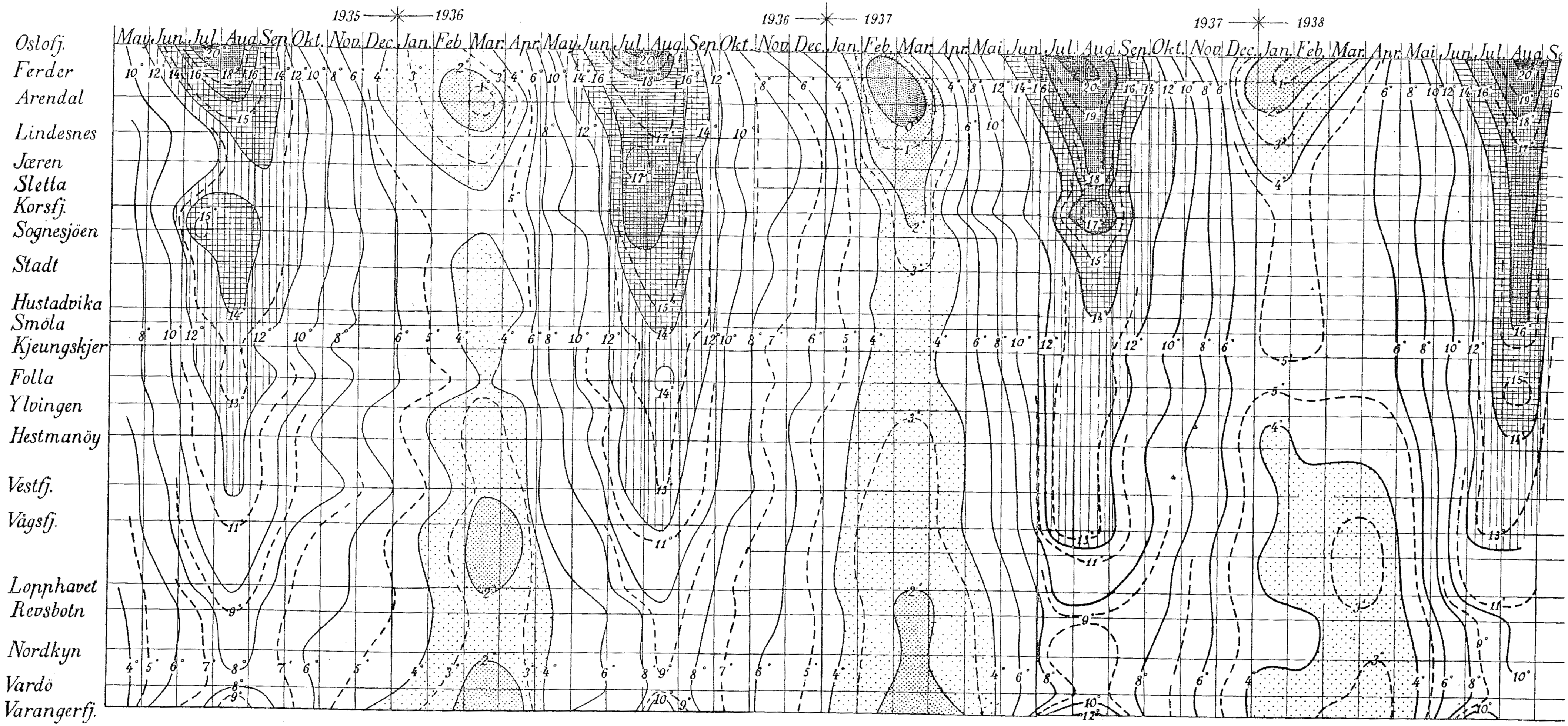

Fig. 29. Isopleth diagram of the monthly mean sea temperatures at 4m depth for May 1935 — September 1938 along the Norwegian Coast.

winter lies between Rørvik and Haugesund (see also figs. 12 and 13). Within these limits the warmest area will get more or less displaced from year to year. Thus, in 1936 it was situated between Haugesund and the Sognesjø, with highest March temperature of 4.7° C in the Korsfjord, near Bergen. The following year it was found farther north, namely, between Stadt and Folla, the water being warmest along the Hustadvika — Hitra stretch (3.7° C) in March. In 1938 the warmest area lay still farther north, namely at Folla, 5.1° C, and that was neither in February nor March but as early as January.

The lowest winter temperature, as already mentioned, is met with along the coast of the Skagerack. It will be seen by the figure that there exists no area in northern Norway where the monthly mean temperature is so low as 1° C., in 1938 it was not even down to 2° C. Along the coast of the Skagerack, however, there exist areas where the temperature is below 1° C. In 1937 there appeared considerable areas where the temperature was below 0° during the months of February and March. As will be stated herein the temperature in these areas was at times as low as — 1° C, and a little below that; during this time ice formed causing inconvenience to shipping and ultimately resulting in the conveyance of live fish to Oslo having to be entirely abandoned for some time.

It will be seen that the water was colder along the entire coast during February to April in 1937 than it had been the previous year. This was especially so in the case of the water along the south coast. Water below 0° C extended then from the Oslofjord to Kistiansand, whereas the previous year there was no place along the coast where the mean temperature was as low as 0° C. Water colder than 2° C and 3° C respectively did not extend farther west than to Lindesnes and Jæren respectively. The following year it was met with right up to Bergen and the Sognesjø respectively. In the Korsfjord, south of Bergen, the March temperature happened to be 3.3° C lower in 1937 than it was the preceding year, and 3.8° C lower than it proved to be in the following year. As regard the cause of this see page 82. The low temperature of the air in March 1937, compared with the year before and after, must also have played a part.

During the winter of 1938 the water was much warmer than it was in the two preceding years. Thus, along the whole stretch from the Karmøy to Helgeland, the lowest winter temperature (monthly mean) was above 4° C. There was an even warmer area along the coast — Trøndelag — where it exceeded 5° C. In the preceding winter, however, there was no spot along the coast where the corresponding minimum temperature reached so high as 4° C. Along the coast of Finnmark also it will be seen that the temperature was relatively high. While we otherwise find the lowest surface temperature in March, it will be seen by fig. 29 that the minimum in 1938 appeared as early as January along the entire stretch from the mouth of the Oslofjord to the Korsfjord, south of Bergen. Along the coast northward to Helgeland the difference is very slight between January and February, while the March temperature is higher. From the Vestfjord and northward it is March and April that present the lowest temperatures, the difference between the mean temperatures for these 2 months being negligible. In the case of the area between the Lopphav and the Varangerfjord, the minimum temperature is not reached before the month of April.

The coast of Norway, extending as it does over no less than 13.2 degrees of latitude and 27.5 degrees of longitude, it is obvious that the climatic and living conditions vary along the several places on the coast.

As we have already seen the sea temperature also varies of course along this long coast line from area to area. These variations are smaller than we should expect but this is due to the direction of the prevailing current and wind conditions, and also to the composition of the water masses; these in turn condition to a great extent the stability of the water masses. Thus, at certain times of the year there are great stretches along the coast where the difference of temperature is very slight, namely in May — June, and in the autumn also in the months of October — November. For instance the mean monthly temperature for June 1938, between the Lopphav at Finnmark and Lindesnes was between 9.3° C and 10.9° C, and between 7.7° C and 9.4°C in November 1937.

Further, the diagram shows that it is the coast of the Skagerack that presents the highest summer temperature, and that it decreases to the westward and northward, reaching a minimum off Vardø. At this place the highest monthly mean temperature (in August) corresponds, in 1935, to the November temperature in the Vestfjord, off Trøndelag and at Ferder; and to the temperature at Stadt in the beginning of December. The 2 following years the highest monthly mean for Vardø rose 1.0° C and 1.5° C respectively; this corresponds to the temperature along the stretch between the Vestfjord and Trøndelag in October. In 1938 the August temperature for Vardø rose still more, namely to 9.7° C, i. e. 1.8° C higher than in 1935.

Further, it will be seen that whereas water exceeding 15° C appeared along the coast of the Skagerack only, and along a small area off Sogn during the summer of 1935[1]), the following summer it extended all the

[1]) In the Bergen area the temperature occasionally rose to more than 15° C in July and August 1935, but the mean temperature of these months did not reach 15° C (see tables 17 and 3).

way from Oslo to Nordmøre, in 1937 to the Sognesjø and in 1938 right up to the mouth of the Trondheim Fjord, and also to Folla. Water of 14° C extended farther north in 1938 than in any other year discussed herein. On the other hand we note that the warm water, for instance that exceeding 16° C, did not keep its high temperature for any length of time in 1938. June and July were two relatively cold months in southern Norway. The first 2 weeks of August, however, made themselves conspicious by much sunshine and a high temperature of the air in this part. This, in conjunction with the fact that there was practically no wind to cause waves, resulted in the surface water rising greatly in temperature along the entire coast of the Skagerack and northward up to Folla. It culminated when this fine weather period ceased on August 14th. After that the surface temperature fell rapidly again. The cause of the rapid fall in temperature must be attributed to the fact that owing to the calm weather it was only the upper stratum that got affected by the radiated heat. Thus when the fine weather period came to an end, and the wind caused waves which in turn churned up the water masses in such manner that the heat stored in the thin surface stratum got mixed with a considerably thicker layer of water, this was bound to result in the surface temperature falling rapidly. The temperature of the air too was partly responsible, having now fallen to below that of the surface water, and furthermore the radiation decreased on account of less sunshine.

HARVEY (12) has proved, as regards the English Channel, that waves are very effective in bringing heat downwards, whereby the surface temperature falls.

By also taking into account the thermograph registrations obtained from the routes Stavanger—Rotterdam (the »Ariadne«), Stavanger—Newcastle—Bergen (the »Venus«), Bergen—Feie—Reykjavik (the »Lyra«) and Bergen—North Iceland (the »Nova«) we can draw up charts over the surface temperature before (August 5th—7th), during (11th — 14th) and after (19th — 21st) the high surface temperature about the middle of August. It then proves that the warmest water is not to be found close in by land on the west coast, but at some distance out in the Norwegian Channel. From this place the temperature falls in towards the archipelago, and westwards towards the western slope of the Norwegian Channel. It is warm Baltic water that here flows northwards. The chart shows that from August 11th — 14th, this tongue of warm water is above 22° C east of Kristianssand, then it decreases to 21° C off Jæren and to 20° C off Bergen (21° C in the Korsfjord on the 13th). Westward, against the border of the North Sea plateau, the temperature decreases to 18°. We have now got to the west of the Belt of Baltic water and out into the North Sea water (34 $^0/_{00}$—35 $^0/_{00}$) and further into Atlantic water (> 35 $^0/_{00}$).

Just a few days after the culmination of the temperature, the chart shows, August 19th — 21st, that the highest temperature at Lista—Bergen was only slightly above 17° C. Also now the highest temperature is met with a good distance out from land, in a narrow area in about the middle of the Norwegian Channel. On the stretch from Kristiansand to Jæren the temperature proves to be even below 14° close in by land. Here the winddrift has been at work bringing deep water up to the surface. Out on the eastern part of the North Sea plateau, south east of Jæren, too, the temperature has fallen from about 18° to less than 14° C.

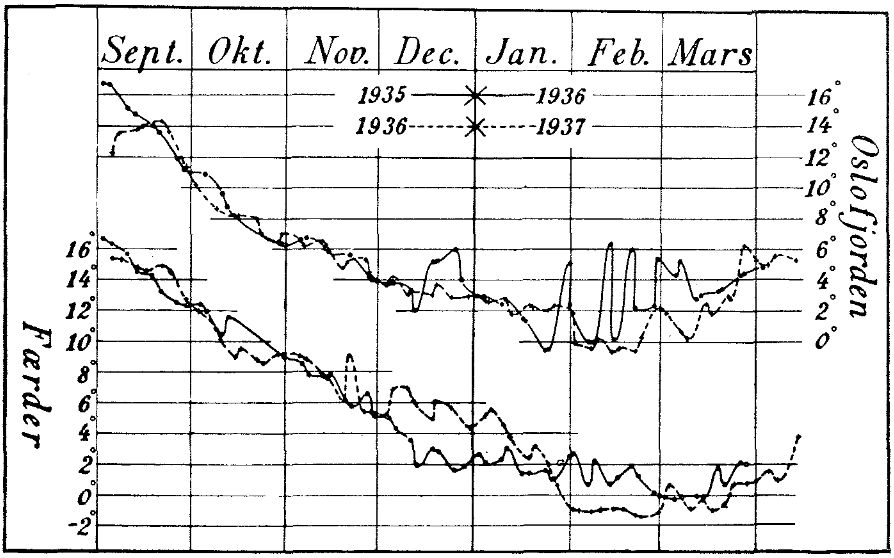

Fig. 30. Sea temperature at Ferder and Nesodden. Sept.—March 1935—36 and 1936—37.

VII. The Sea-Thermograph and Transport of Live Fish

We have several instances of fish being frozen to death on the Skagerack Coast, both of fish at liberty in the sea near land, and of cod during transport to Oslo in well boats. The critical temperature for cod is, according to experiments carried out at Flødevigens' Hatchery, minus 1° C (5).

During the winter of 1937, the water along the Skagerack Coast became so strongly cooled that freezing point was reached. Ice formed and became a great obstruction for shipping. The supply of live fish by sea to Oslo was also severely impeded and, for a time it was totally stopped. Thus, on February 14th—15th, some 50.000 kilograms of cod froze to death at the mouth of the Oslofjord. Half of this lot was on board two well boats from Helgeland and Kristiansund, and the remainder in Danish well boats — a great loss for the owners.

The thermograph installed on board the S/S »Christiania« by the Fisheries Directorate, showed that when the above-mentioned cargoes of fish were under way to Oslo, the temperature from Arendal eastward reached — 1° C and even a little below. It would therefore have been very difficult to keep the fish alive. This low temperature was found all the way up to the Oslofjord. At Oslo itself the temperature was somewhat higher.

In agreement with this it was found that some of the fish were on the point of dying, even on arrival at Arendal. At the mouth of the Oslofjord (as before mentioned) they died, whereas fish kept in floating at Oslo survived and did very well.

In December and the first half of January, the temperature along the Skagerack Coast remained fairly high; at Ferder it was some 2° C—3° C higher than the previous year (see fig. 30). As from January 21st, however, there was a radical and continuous fall outside Ferder from 3° C to — 1° C in the course of 10 days. The freezing point of the sea water was reached, and ice commenced to form. Figure 47 shows that to the west of Lindesnes the temperature was above zero on February

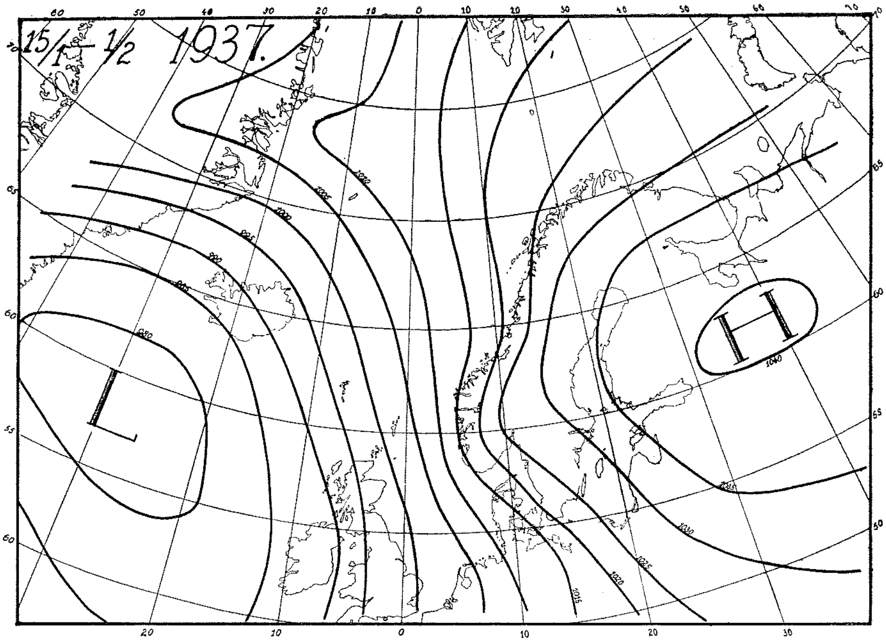

Fig. 31. Mean air pressure January 15th—February 1st, 1937.

12th — 14th but below to the east until nearing Oslo when it rose to about ½° C. From Bergen to Lindesnes the temperature fell from 5° C to 0° C.

The severe SE storms prevailing at the latter half of January and the beginning of February (fig. 31), which were responsible for several wrecks in the North Sea (Cp. the many heroic and glorious savings then by Norwegian sailors), would of necessity transport a mass of surface water from the Kattegat and the Belts, and this would be conveyed along the west coast of Sweden and to the south-east coast of Norway. Thereafter it would take a westerly course along the north side of the Skagerack. The water in the Kattegat and the Belts is, as is known, considerably less salt than that along the Skagerack Coast. Normally, the salinity in February is about 10‰ lower in the south of the Kattegat than at Ferder, and $20^0/_{00}$ lower in the part of the Baltic bordering on the Belts (7), fig. 32. The salinity on the Norwegian coast was consequently considerably reduced at the time in question. Observations made in February off Arendal by the Flødevigen Hatchery observers showed that in the upper 20 metres, the salinity was lower at that time than ever before observed in the month of February. The observations entered in table 9 were made one nautical mile SE of Store Torungen light.

On account of the low salinity, the surface water was much lighter than the underlying bank water. So even if the surface became conside-

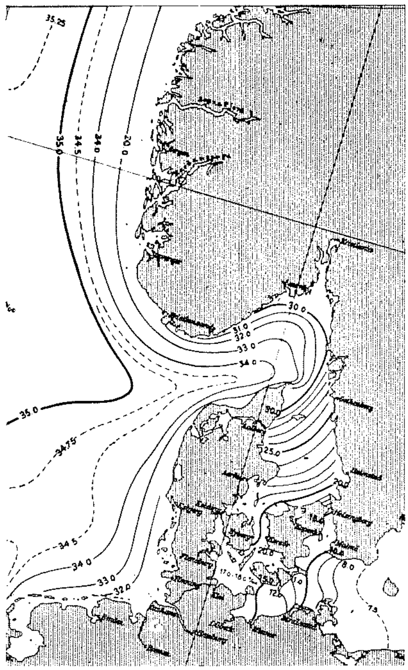

Fig. 32. Normal surface salinity in February (from Deutsche Seewarte (7)).

rably cooled it could not become heavy enough to sink down and allow the warmer water from below to well up. Consequently this surface water had to part with so much of its heat to the air that freezing point was reached. This, as before stated, resulted in the unfortunate ice obstructions and the killing of fish despite the fact that the mean air temperature along the Skagerack coast remained normal in February. In the western part of the Baltic, the temperature in January was 2° C — 3° C under normal, so that some of the water drifting towards the Norwegian coast was already considerably cooled before arrival there.

The great water masses carried towards the Norwegian coast from the Kattegat and the Baltic by the continuous south-easterly gales, had to flow westwards along the Norwegian coast. This gave rise to a very strong current which in February caused serious difficulties for the spring hering fishery.

It is along the southern section from Kristiansand eastward that the sea can get so strongly cooled that the critical temperature for several species of fish is reached. It is of the greatest importance for the transport of fish along this stretch of coast to know in advance what the temperature will be. By the aid of the sea thermographs installed on board the S/S »Christiania« and since January 1939 also on board

Tabel 9. *Winter salinity, temperature and density off Arendal.*

Depth	16 II 37	14 II 36	11 III 35	30 I 34	20 II 29	10 II 26	16 II 24
			Salinity:				
0	25,52	26,53	26,83	32,16	27,90	30,70	26,87
5	—	—	30,05	—	29,90	31,20	28,53
10	28.82	29.05	30.97	32.54	30.70	31.55	29.00
20	31.65	33.78	31.96	32.61	32.72	32.32	32.04
30	33.44	33.78	33.35	32.74	—	33.28	34.41
40	—	—	33.60	—	34.85	—	—
50	34.14	34.76	33.68	32.95	—	33.98	34.73
			Temperature:				
0	0.20	0.50	2.20	4.00	0.50	0.92	1.00
5	—	—	2.09	—	1.55	1.24	0.20
10	2.26	2.54	2.69	4.35	1.90	1.63	0.60
20	3.88	5.14	3.07	4.38	3.55	2.41	2.90
30	4.89	5.41	4.48	4.56	—	3.33	4.40
40	—	—	4.82	—	6.17	—	—
50	5.80	5.87	4.53	4.63	—	4.52	4.60
			σ_t				
0	20.50	21.29	23.85	25.55	22.43	24.63	21.61
5	—	—	24.04	—	23.95	25.00	22.96
10	23.03	23.20	24.73	25.81	24.57	25.26	23.28
20	25.16	26.73	25.48	25.86	26.04	25.82	25.56
30	26.47	26.70	26.45	25.95	—	26.50	27.30
40	—	—	26.61	—	27.43	—	—
50	26.92	27.39	26.70	26.11	—	26.94	27.53

the S/S »Kong Håkon«,[1]) which together ply along the section Oslo—Bergen four times a week, information as to the sea temperature along this stretch is obtained continuously. By comparing the air temperature and wind conditions with the observed sea temperature, it is possible to form an opinion as to the temperature of the sea even on days when no actual observations of sea temperature is made.

Those who are interested in conveying live fish (to Oslo for instance) will, on application to the Fisheries Directorate, receive information as to the temperature along the stretch in question. Thereby they will be able to ascertain the amount of risk involved in taking fish caıgoes along the Norwegian Skagerack Coast.

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[1]) In summer this instrument T/47327 is mounted on board the S/S »Lyngen« which plys between Tromsø and Svalbard.

VIII. The Movements of a Cold Water Front.

Penetration of the Baltic Current along the South and West Coast of Norway, during the winter 1937.

As mentioned on page 78 the severe south-easterly storms (fig. 31) that prevailed during the latter half of January and the beginning of February 1937 transported considerably masses of water of small salt content from the Kattegat and the Belts towards the Norwegian coast.

The effect of the presence of this type of water on the formation of ice along the Norwegian Skagerak Coast, and the subsequent obstacles that thereby arose for shipping has been previously mentioned, and the unfortunate influence which this cold water had on the transportation of live fish by sea to Oslo has been described.

It will be pointed out below how one can follow the movements of this type of water along the south and west coasts of Norway until all traces of it (after it has become mixed with other coast water) disappear on the Møre Coast. Further, we shall deal with the thickness and extent of the mass of water in question and with its speed of movement in the various areas.

We have the following material upon which to base our statements:

1. Six sections presenting salinity and temperature data from the coast and westwards between Egersund and the Bømmelfjord during the period February 12th to March 9th. And also two sections from Feie and westwards on January 7th and 27th.

2. Data on the salinity of surface samples obtained along the stretch from the Oslofjord to Vardø; these samples were collected by the same two coasting vessels as have a sea thermograph installed.

3. The thermograms from the above-mentioned two fast coasting vessels.

4. Observations of temperature and salinity made at the Fisheries Directorate's permanent oceanographic station on the Sognesjø.

1. THE EFFECTS OF THE WIND ON THE WATER MASSES OFF THE WEST COAST.

The continuous south-easterly storms along the west coast were certain to bring about a strong wind-drift of the upper layers, with one component directed off-shore, and another in a northerly direction. This naturally resulted in great masses of coast water being conveyed out from land and then urged northwards upon this being replaced by the deeper, more saline and warmer water, the compensatory current in the depths would take on a component directed towards land and towards the south. Consequently, in the month of February a comparatively very high salinity was present in the upper layers, which was succeeded by an unnormally low salinity in March and April. This occurred when the poorly saline, cold Baltic water, whose movement the same south easterly winds had accelerated, reached in to the west coast.

Because the difference in salinity, temperature and density between the two types of water mentioned became so unusually marked, it became an even simpler matter to follow the movements of the Baltic water along the west coast.

Two oceanographic sections from Feie towards west across the Norwegian Channel, taken on January 7th and 27th respectively, prove that during this period a radical change in the relative amounts of coast water and the Atlantic water has taken place (figs. 33 and 34). Whilst in the section taken on January 7th (prior to the storms setting in) there was 46 % coast water and the remainder Atlantic water, the quantity of coast water on January 27th (after the south-easterly winds had abated) had been reduced to a mere 7 %, the quantity of Atlantic water having increased correspondingly. The calculations are in both cases based on the stretch from Feie to 41 nautical miles off land, which is the length of the shorter section. Atlantic water was found to be present right up to the uppermost layer only 12 nautical miles off Feie, and close in by land it was found at a depth of 85 metres. On January 7th however it did not reach up to the surface at any place along the section. It was then found nearest to the surface at the outermost station, and at a depth of 75 metres; in by the coast it was present at a depth of 180 metres at the time. It will be noted that much water of pronounced Atlantic origin had set in. Thus, at the outermost station there is (on January 27th) water of more than 35.30 $^0/_{00}$ all the way from the surface to the bottom; it reaches in to the slope near the coast where, at the innermost station it is met with from a depth of 250 metres to the bottom. On January 7th, on the other hand, such saline water

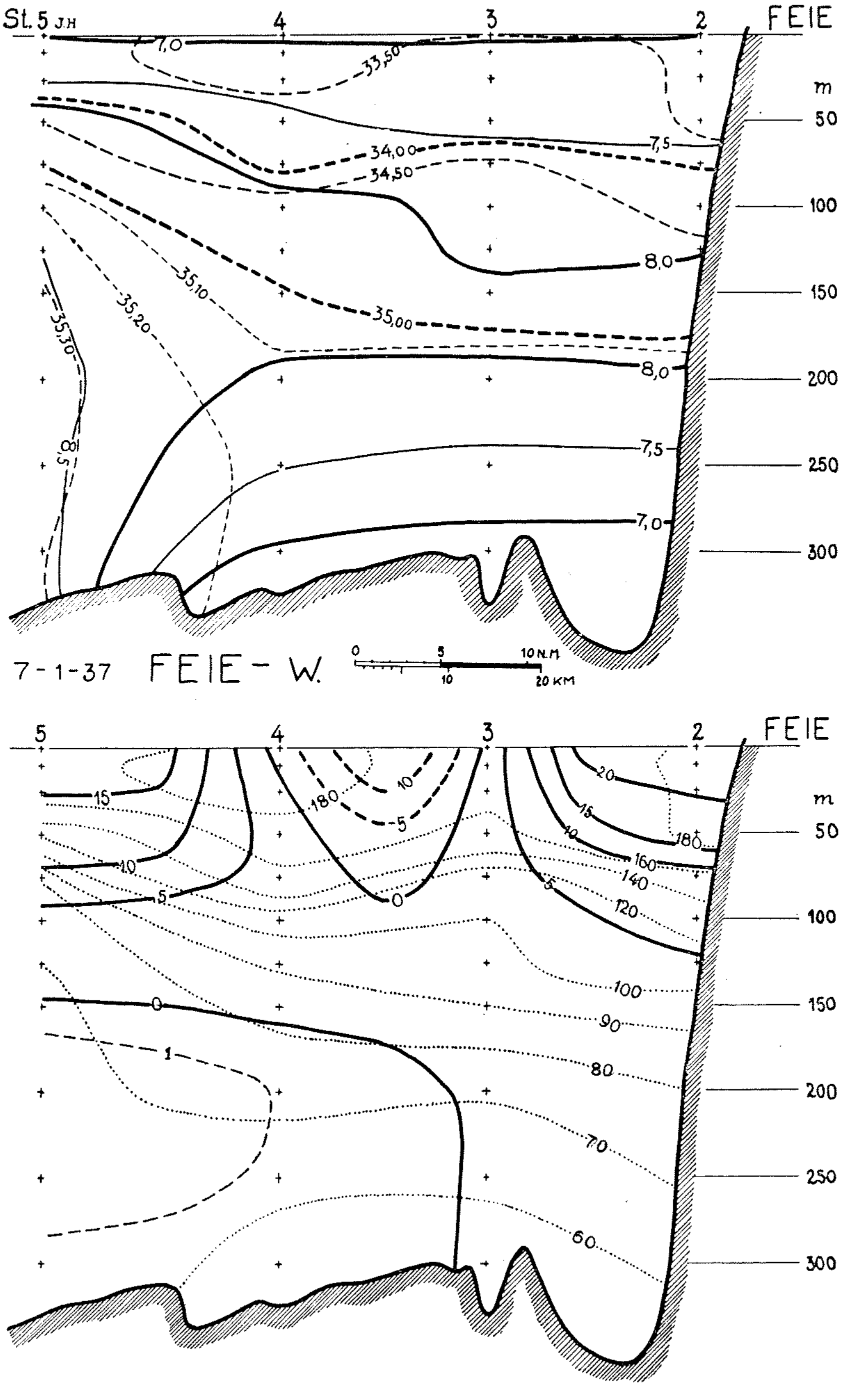

Fig. 33. Temperature- and salinity section of the Norwegian Channel west of Feie on January 7th, 1937. In the lower diagram the dotted curves are isosteres expressed as anomalies of specific volume .10^5. Solid lines current components to the north and broken lines current components to the south.

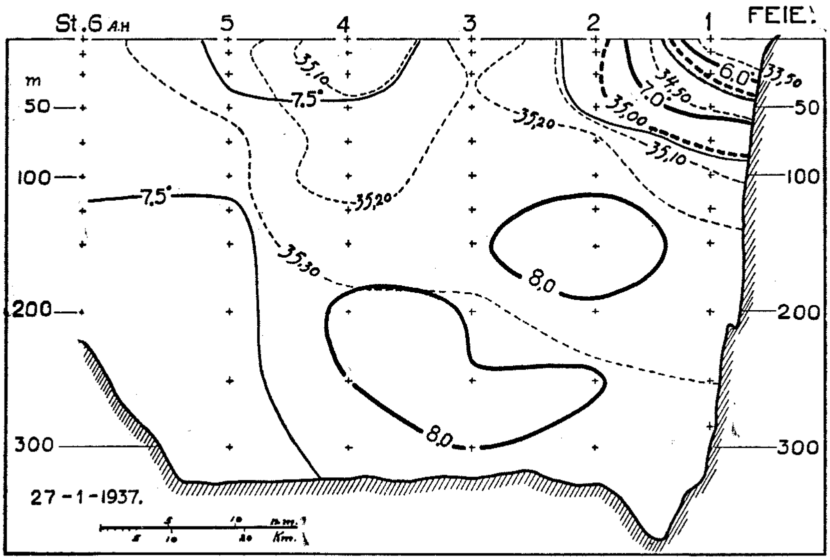

Fig. 34. Temperature- and salinity section of the Norwegian Channel west of Feie on January 27th, 1937.

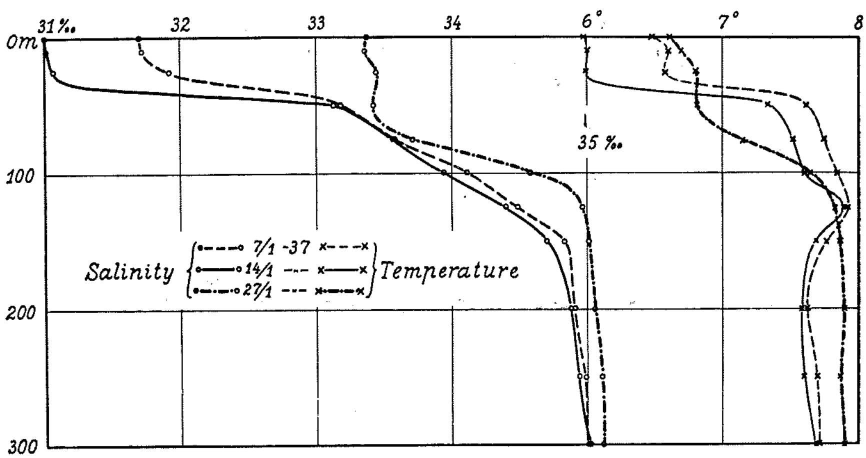

Fig. 35. Salinity and temperature on the Sognesjø January 7th, 14th and 27th, 1937.

Table 10. *Salinity* (S ‰), *temperature* ($t°$ C) *and* σ_t *on the Sognesjø January 7th—March 6th, 1937.*

The values in brackets are interpolated.

Depth	Salinity						Temperature						σ_t					
	Janary			February		March	January			February		March	January			February		March
Metres	7th	14th	27th	8th	20th	6th	7th	14th	27th	8th	20th	6th	7th	14th	27th	8th	20th	6th
1	31.70	31.00	33.37	33.41	33.42	30.40	6.48	5.97	6.61	5.04	4.54	2.13	24.91	24.42	26.20	26.43	26.50	24.31
10	.72	0.1	.36	.42	.51	.80	.60	6.00	.69	.05	.55	.43	.91	.43	.19	.44	.57	.61
25	.92	.06	.44	.48	.55	33.46	.57	5.99	.80	.12	.69	4.39	25.07	.47	.24	.48	.58	26.54
50	33.18	33.13	.42	.62	.76	.73	7.61	7.33	.81	.52	6.44	.79	.91	25.91	.22	.54	.66	.72
75	.58	.56	.71	.99	.94	.85	.74	.51	7.15	6.22	.88	5.25	26.21	26.23	.40	.75	.75	.76
100	34.11	.94	34.58	34.61	34.57	34.72	.84	.60	.64	7.39	7.12	7.16	.62	.52	27.02	27.08	27.09	27.19
125	.49	34.40	.96	.93	.84	—	.92	.89	.82	(.70)	.51	.29	.91	.84	.29	(.28)	.24	—
150	.83	.70	35.01	.99	.95	34.95	.76	.69	.86	.75	.62	.52	27.20	27.11	.33	.32	.31	.33
200	.91	.88	.06	35.05	35.04	35.11	.62	.58	.89	.81	.73	.65	.28	.26	.36	.36	.36	.43
250	.99	.94	.10	.16	.11	.11	.69	.60	.86	.82	.78	.57	.33	.30	.39	.45	.41	.45
300	35.01	35.03	.12	.18	.16	.14	.71	.69	.90	.84	.80	.47	.34	.37	.41	.46	.45	.48

was only found at the outermost station at depths of 145 metres to the bottom. That the deeper lying masses of water have been displaced is also evident from the temperature, as the bottom-water at station 4, and inshore of it, has become about 1° C warmer. The stability in the section was then considerably greater than on January 27th, because of the Atlantic water being stratified with great masses of coast water.

The time of the changing of the masses of water (which according to the foregoing must have taken place between the 7th and 27th January) can be more exactly determined by help of the observations at the permanent oceanographic station on the Sognesjø, since as well, apart from the two dates just mentioned, observations were there taken on January 14th (see fig. 35 and table 10). Hereby it is evident that the changing must have taken place between January 14th and January 27th. The Atlantic water has, during these days, risen 130 metres nearer to the surface, from a depth of 280 metres to 150 metres. It will be further noted that the deep water which has now flowed in, has both a higher temperature and higher salinity than that which was present previously. The surface temperature, which is usually falling at this time of the year, has, owing to warmer water being brought up to the surface from the depths, risen from 5.97° C to 6.61° C, and the salinity of the uppermost 25 metres has increased by as much as 2.39 $^0/_{00}$. The observations taken at this station are seen to be in good agreement with the two before mentioned oceanographic sections (figs. 33 and 34), as was to be expected.

The high salinity of the upper layer remained more or less unchanged till the end of February (fig. 38).

2. DIFFERENT RESEARCH METHODS COMBINED.

a) *Isopleth Diagram of Temperature.*

Fig. 29 presents an isopleth diagram of temperature and shows that the cold Baltic water made itself very conspicuous along the west coast during the winter of 1937, as water of average March temperature below 2° and 3° C reached as far as Bergen and the Sognesjø respectively. For further information on this matter see page 73.

b) *Sea-Water Samples taken on board the fast Coasting Vessels.*

Salinity is without doubt the best characteristic when it is wished to study the movements of this poorly saline type of water.

With this in view, water sample bottles were placed on board the two fast coasting vessels already provided with sea thermographs, viz.

Table 11. *Surface salinity (S ‰), temperature (t° C) and* σ_t *between the Oslofjord and the Varangerfjord February 19—March 7th, 1937.*

	Date Febr. 1937	Hrs.	S ‰	t° C	σ_t	Date March 1937	Hrs.	S ‰	t° C	σ_t
Oslofjorden (Nesoddt.) . .	21.	11.10 p. m.	28.41	—0.6	21.84	7.	11.15 p. m.	28.35	0.7	22.75
Ferder	»	7.00 p. m.	23.50	—1.2	18.89	»	6.00 p. m.	26.63	—0.1	21.40
Arendal (Torungen)	»	9.37 a. m.	23.82	0.0	19.14	»	6.00 a. m.	23.20	—0.8	18.65
Lindesnes	20.	6.40 p.m.	25.53	0.1	20.52	6.	6.30 p. m.	27.59	0.3	22.16
Jæren (Obrestad)	»	6.20 a. m.	26.55	0.4	21.28	»	6.15 a. m.	28.69	1.0	23.01
Korsfjorden	19.	3.00 p. m.	32.71	4.8	25.90	5.	2.45 p. m.	29.22	1.5	23.41
Sognesjøen	23.	1.30 a. m.	33.40	3.2	26.61	»	1.50 p. m.	29.91	2.3	23.91
Stadt	»	9.25 a. m.	33.75	3.6	26.85	»	3.30 p. m.	33.79	3.5	26.90
Hustadvika	»	7.03 p. m.	33.66	3.5	26.79	»	3.50 a. m.	33.84	3.6	26.93
Smøla	24.	0.15 a. m.	33.76	3.8	26.84	4.	9.55 p. m.	33.95	4.0	26.98
Rissa	»	3.35 a. m.	33.59	3.4	26.75	»	5.47 a. m.	33.72	4.0	26.79
Kjeungskjer fyr	»	2.05 p. m.	33.82	3.6	26.81	»	4.25 a. m.	34.00	3.1	27.10
Folla	»	6.10 p. m.	33.91	3.2	27.02	»	0.12 a. m.	33.98	3.3	27.07
Ylvingen	25.	1.00 a. m.	33.75	3.0	26.91	3.	5.05 p. m.	33.78	3.1	26.93
Hestmanøy	»	6.47 a. m.	33.91	2.5	27.02	»	11.18 a. m.	33.96	2.9	27.09
Vestfjorden										
22 n. m. SSE St.snd.)	»	3.55 p. m.	33.37	2.3	26.67	»	1.06 a. m.	33.40	2.5	26.67
(8 n. m. SSE St.snd)	»	5.00 p. m.	33.20	2.2	26.54	»	2.06 a. m.	33.35	2.5	26.63
Vågsfjorden	26.	10.10 a. m.	33.90	2.3	27.09	2.	5.50 a. m.	33.60	2.8	26.81
Malangen	»	1.50 p. m.	33.85	2.4	27.04	»	1.50 a. m.	33.89	2.5	27.06
Lopphavet	»	11.35 p. m.	34.03	1.9	27.22	1.	2.15 p. m.	34.13	2.4	27.27
Revsbotn	27.	7.10 a. m.	34.22	2.1	27.36	»	8.00 a. m.	34.28	1.8	27.43
Nordkyn	»	4.00 p. m.	34.39	1.9	27.51	28. Febr.	10.40 p. m.	34.40	2.0	27.51
Vardø	28.	2.05 a. m.	34.50	2.0	27.59	»	2.55 p. m.	34.48	2.0	27.58
Varangerfjorden	»	9.35 a. m.	34.37	1.8	27.50					

the S/S »Christiania« and the S/S »Lofoten«. A list giving the positions at which sea-water samples were to be taken, was also sent on board. When the vessel had arrived at a position stated on the list, the pilot was to inform the engineer who would then tap a sample from the intake pipe leading to the condenser, this being the same place as the location of the bulb of the sea thermograph. The parties responsible for the taking of the samples were the Chief Engineers, Mr. B. CHRISTIANSEN and Mr. A. NÆSS, and these gentlemen evidenced that the samples were taken at the stated positions for each series.

It is shown by table 14 that on February 21st and 22nd, there existed cold, saline water along the entire Skagerack Coast, past Lindesnes, and up to and including Jæren. The salinity of the water along this stretch lay between 23.50 and 26.55 ‰, the temperature being — 1.2° to 0.4° C. From Jæren to the Korsfjord, 26 km south of Bergen, however, the temperature, and salinity both rose greatly, increasing by 6.16 ‰ and 4.4° C respectively. From the Korsfjord to Stadt the salinity increased comparatively little. It remained steadily high along the whole coast northwards, with its greatest value at Finnmark where it exceeds 34 ‰. The σ_t column shows that the type of water from Jæren and thence eastwards is considerably lighter than the water from the Korsfjord and northwards is.

It is obvious, therefore, that the poorly saline, cold Baltic type of water had reached Jæren on February 20th though not so far north as to the Korsfjord at 2.30 p. m. on February 19th. On March 5th on the other hand, this type of water had not only reached up to the Korsfjord, but at least as far north as the Sognesjø.

At both these places the salinity compared with the previous observations, had fallen by 3.49 ‰, (see table 11); moreover, the temperature as well as the density had gone down. From Stadt and northward, however, the temperature and salinity have remained practically unchanged. Consequently, the type of water here in question had reached some place between the Sognesjø and Stadt on March 5th. From 2 p. m. on February 19th (at the Korsfjord) to 11.50 p. m. on March 5th (at the Sognesjø), it has moved more than 51 nautical miles in a northerly direction; this implies an average speed of more than 3.5 nautical miles per day. Further it is confirmed that the speed of the current must have been less than 16.6 nautical miles per day, as this type of water had reached to Obrestad on February 20th, but not to Stadt on March 5th. Reckoned in cm/sec. this implies an average speed of the current of between 7.5 and 35.6. It will be shown later that, judging from certain other material, the current speed was 9.4 naut. miles per day or 20.5 cm/sek.

Table 12. *Surface salinity, temperature and σ_t between Oslo and Bergen March 9th—12th, 1937.*

	Date March 1937	Hrs,	S ‰	t° C	σ_t
500 m from the quay in Oslo	9.	11.02 p. m.	28.55	3.1	22.77
Nesoddtangen	»	11.15 p. m.	28.35	0.3	22.77
Ferder	10.	3.30 a. m.	26.72	−0.8	21.49
5 naut. miles east Risør ..	»	11.30 a. m.	25.18	−0.8	20.24
Torungen	»	4.15 p. m.	24.63	−0.8	19.80
Gaasen fyr	»	6.10 p. m.	26.47	−0.2	21.27
Lindesnes	11.	2.40 a. m.	29.27	1.0	23.43
Jærens rev	»	1.15 p. m.	28.90	1.2	23.17
Boknfjorden..............	»	8.00 p. m.	28.23	0.6	22.61
Korsfjorden	12.	4.20 a. m.	28.90	0.9	23.13

As there were not, on board the S/S »Lofoten« (Bergen—Kirkenes) taken more water samples than those entered in the table, we cannot by this means follow the movements of the water northwards. A third series of salt water samples taken on board the S/S. »Christiania« March 9th—12th merely confirm that on the entire course (from Ferder to Bergen) there was poorly saline, cold water with salinity of 25.18 ‰—29.27 ‰ ,temperature being —0.8° to 1.2° C (table 12).

From both tables 11 and 12 it is shown that salinity, temperature and σ_t in the Oslofjord were considerably higher than they were at Ferder and along the coast westward to Kristiansand. This goes to prove that the cold, poorly saline water from the Kattegat and the Belts had not penetrated into the fjord.

Before going on to treat what still remains to be deduced from the sea thermograms, it will first be expedient to study other oceanographic material collected during this time on the west coast.

c) *Observations from the fixed oceanographic Station on the Sognesjø.*

With the help of the regular observations upon the temperature and salinity from the surface to a depth of 300 metres at the permanent oceanographic station, which the Fisheries Directorate maintains working on the Sognesjø, one would expect to be able to determine the thickness of the cold, poorly saline water, and to decide on what date it was first noticed at the station. It happens that the observations supply us with the necessary answers to these questions.

After the great rise of the salinity between January 14th and 27th, it remains comparatively high in the Sognesjø until, between February 20th and March 6th. Then a radical fall takes place in the salinity as well as the temperature of the upper layers. Thus, in the ten uppermost metres the salinity falls by no less than 2.83 $^0/_{00}$, down to 30.60 $^0/_{00}$, and the temperature drops from 4.55° to 2.27° C (see fig. 36, table 10). This proves, that the poorly saline, cold Baltic water must have reached north to the Sognesjø some time between February 20th and March 6th. The time tallies very well with what was obtained by means of salinity samples taken on board the express steamships. This type of water must, according to these, have reached the Sognesjø between February 23rd and March 5th.

The salinity in the Sognesjø continues to decrease, though more slightly, until it attains the minimum (29.9 $^0/_{00}$) on March 17th; then it increases again until the middle of May.

While the salinity of the upper layers here normally remains comparatively high from the New Year onwards, with an increase attaining a maximum in March—April, the salinity distribution presents quite an other course in 1937. In fig. 38 (table 13) the values of salinity, temperature and σ_t can be compared in January—April 1937, with the observations at hand from the Sognesjø for the corresponding period in 1935, 1936 and 1938. Activities commenced at this station on February 26th 1935[1]).

It will be seen that in the uppermost 25 to 50 metres, salinity and temperature as well as σ_t in 1937 differ considerably from other years. First, there is a fall in the 3 factors mentioned in the middle of January. This means that the south east wind conveyed the surface water from the fjord out to the station. Then, the continuous south-easterly storms resulted in the water from the depths (about 75 metres) being brought up to the surface. This situation, with high salinity, temperature and σ_t remained for about one month until the cold, poorly saline Baltic type of water reached up to the station. This resulted in the salinity in March and April being much lower than in the 2 previous years. As seen, the same applies to temperature and σ_t.

The difference in density was very great between the two types of water (fig. 37). It was, therefore, no easy matter for them to mix with each other.

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[1]) On account of unforeseen circumstances the observer was not in a position to take observations between February 19th and May 21st 1938.

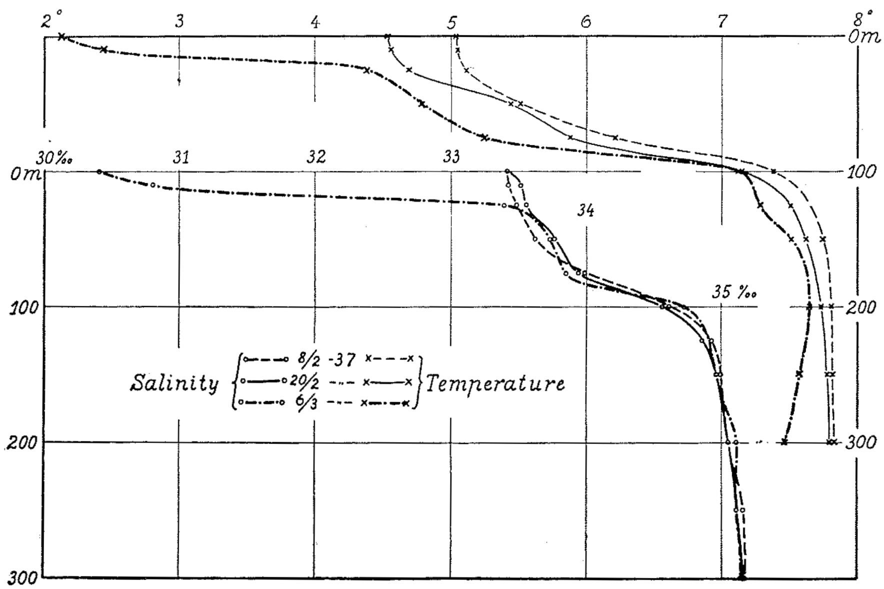

Fig. 36. Vertical distribution of salinity and temperature on the Sognesjø before and after the front has passed, February 8th and 20th and March 6th.

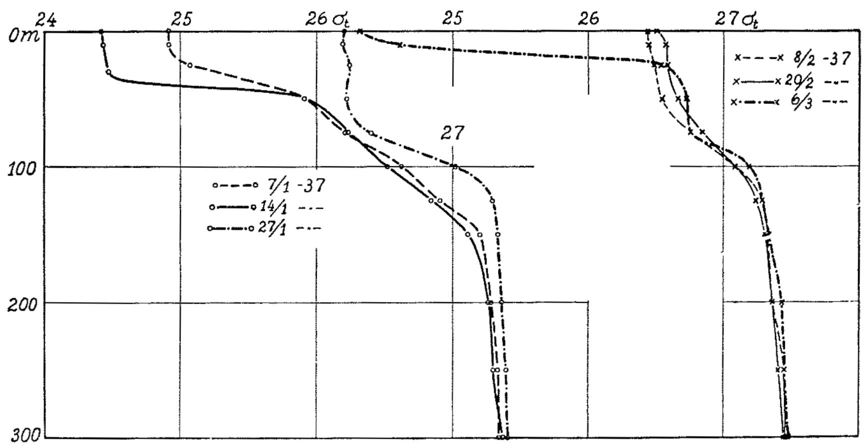

Fig. 37. σ_t on the Sognesjø from January 7th—March 6th.

The thickness of the Baltic water can be seen from fig. 38. The first time it was noted in the Sognesjø, on March 6th, it reached down from the surface to between 10 and 25 metres (see also fig. 36). As time passed the thickness increased to between 25 and 50 metres one month later.

Table 13. *Variations of the salinity, temperature and* σ_t *in various depths on for the correponding period in*

		January											
		1 meter				10 meters				25 metres			
S ‰	1936	4. 31.48	17. 32.12	28. 32.09		4. 31.63	17. 32.11	28. 32.26		4. 31.93	17. 32.49	28. 32.45	
	1937	2. 32.13	7. 31.70	14 31.00	27. 33.37	2. 32.14	7. 31.72	14. 31.01	27. 33.36	2. 32.32	7. 31.92	14. 31.06	27. 33.44
	1938	31.12-37 32.64				31.12-37 32.62				31.12-37 33.36			
t °C	1936	4. 5.62	17. 5.33	28. 4.76		4. 6.08	17. 5.38	28. 4.98		4. 6.47	17. 6.29	28. 5.45	
	1937	2. 7.04	7. 6.48	14. 5.97	27. 6.61	2. 7.04	7. 6.60	14. 6.00	27. 6.69	2. 7.16	7. 6.57	14. 6.99	27. 6.80
	1938	31.12-37 5.59				31.12-37 5.61				31.12-37 5.85			
σ_t	1936	4. 24.84	17. 25.38	28. 25.42		4. 24.90	17. 25.36	28. 25.53		4. 25.09	17. 25.45	28. 25.62	
	1937	2. 25.18	7. 24.91	14. 24.42	27. 26.20	2. 25.19	7. 24.91	14. 24.43	27. 26.19	2. 25.32	7. 25.07	14. 24.47	27. 26.24
	1938	31.12-37 25.75				31.12-37 25.73				31.12-37 26.30			

d) *Oceanographic Sections of the Spring Herring Area.*

During investigations in the spring herring area in February and March 1937, there were made between the south end of Karmøya and the south end of the Bømmeløy, 5 oceanographic sections from the shore and westwards, and also 2 stations west of Egersund. The locality of the sections will be seen from fig. 39. They are marked I and II, and were taken on February 12th — 15th, while III, IV and V were taken on March 8th — 11th.

In good agreement with what has been previously stated these sections (figs. 40—44) showing the distribution of the salinity, temperature and density, tell us that on February 12th to 15th there was comparatively salt and warm water present at the surface, while on March 8th to 11th quite another type of water has flowed in which was much colder and less saline.

The pronounced Baltic type of water previously mentioned has, then, reached the spring herring area between February 12th and March 11th.

the Sognesjø in January—April 1937 compared with the observations available 1935, 1936 and 1938.

	January											
	50 meters				100 meters				200 meters			
1936	4. 32.91	17. 33.38	28. 33.37		4. 34.78	17. 34.71	28. 34.82		4. 35.07	17. 35.06	28. 35.16	
1937	2. 33.33	7. 33.18	14. 33.13	27. 33.42	2. 34.19	7. 34.11	14. 33.94	27. 34.58	2. 34.93	7. 34.91	14. 34.88	27. 35.06
1938	31.12-37 34.25				31.12-37 34.87				31.12-37 —			
1936	4. 7.85	17. 7.84	28. 7.42		4. 8.69	17. 8.54	28. 8.51		4. 8.42	17. 8.28	28. 8.52	
1937	2. 7.72	7. 7.61	14. 7.33	27. 6.81	2. 7.89	7. 7.84	14. 7.60	27. 7.64	2. 7.66	7. 7.62	14. 7.58	27. 7.89
1938	31.12-37 6.77				31.12-37 7.92				31.12-37 7.51			
1936	4. 25.67	17. 26.05	28. 26.10		4. 27.02	17. 26.98	28. 27.08		4. 27.28	17. 27.30	28. 27.34	
1937	2. 26.03	7. 25.91	14. 25.91	28. 26.22	2. 26.68	7. 26.62	14. 26.52	28. 27.02	2. 27.30	7. 27.28	14. 27.26	27. 27.36
1938	31.12-37 26.88				31.12-37 27.20				31.12-37 —			

Two sections in a westerly direction from the Skudefjord at the southern end of Karmøy, show the salinity at the surface, on February 15th, to be 30.1 — 30.3 ‰; this indicates that the type of Baltic water in question had not reached that place then. The temperature lay between 2.5° C and 3.0° C (fig. 40, II). On March 11th, on the other hand, the salinity had decreased to between 28.1 and 28.5 ‰, and the temperature to from 0.3° C — 1.1° C (fig. 41, V). The thickness of this poorly saline water which now set in and become mixed with the water that was present previously at the surface can be reckoned at about 25 metres. The diagrams showing the anomalies of specific volume (figs. 40 and 41) simply show that this water is considerably lighter than that which was present on February 15th.

Sections from the Røvær running WNW (fig. 42, I) show that the type of water in question had not reached there on February 12th, as the salinity of the surface is 33.4 — 34.1 ‰, and the temperature 4.5° to 5.0° C. A corresponding section taken a little farther south between Utsira and the mainland shows, that it was present there on March 8th.

Table 13. (Continued). *Variations of the salinity, temperature and $\overline{\sigma_t}$ in*
observations available for the correponding

		February											
		1 meter		10 meters		25 meters		50 meters		100 meters		200 meters	
S ‰	1935		23. 33.32		23. 33.35		23. 33.35		23. 33.65		23. 34.74		23. 35.07
	1936	8. 32.24	22. 32.58	8. 32.27	22. 32.74	8. 32.27	22. 32.77	8. 32.45	22. 32.82	8. 34.16	22. 34.74	8. 35.01	22. 35.13
	1937	8. 33.41	20. 33.42	8. 33.42	20. 33.51	8. 33.48	20. 33.55	8. 33.62	20. 33.76	8. 34.61	20. 34.57	8. 35.05	20. 35.04
	1938	15. 32.62		15. 32.61		15. 32.98		15. 33.30		15. 34.79		15. 35.01	
t °C	1935		23. 5.83		23. 5.85		23. 5.87		23. 6.10		23. 7.94		23: 8.25
	1936	8. 4.78	22. 4.43	8. 4.79	22. 4.77	8. 4.74	22. 4.84	8. 4.99	22. 4.97	8. 7.97	22. 8.10	8. 8.28	22. 8.37
	1937	8. 5.04	20. 4.54	8. 5.05	20. 4.55	8. 5.12	20. 4.69	8. 5.52	20. 5.44	8. 7.39	20. 7.12	8. 7.81	20. 7.73
	1938	15. 4.26		15. 4.43		15. 5.01		15. 5.51		15. 7.41		15. 7.61	
σ_t	1935		23. 26.27		23. 26.29		23. 26.29		23. 26.50		23. 27.10		23. 27.31
	1936	8. 25.53	22. 25.83	8. 25.56	22. 25.93	8. 25.57	22. 25.95	8. 25.67	22. 25.97	8. 26.64	22. 27.07	8. 27.26	22. 27.34
	1937	8. 26.43	20. 26.50	8. 26.44	20. 26.57	8. 26.48	20. 26.58	8. 26.54	20. 26.66	8. 27.08	20. 27.09	8. 27.36	20. 27.36
	1938	15. 25.88		15. 25.82		15. 26.10		15. 26.29		15. 27.21		15. 27.36	

The upper layers of water have now become much less saline, being now from 27.3—28.3 ‰ at the surface (fig. 43, III). The thickness of this type of water proves here to be 25—40 metres, increasing in towards the land. Also the section from a little farther north, west of Bømmelhuk, presents a low salinity and low temperature on March 9th in the upper layers, being at the surface from 28.3 — 29.0 ‰, with temperature of from 1.1° C — 1.3° C respectively (fig. 44, IV). The thickness was approximately the same as that found between Utsira and the mainland on the previous day.

Two oceanographic stations taken at Røvær on February 12th and March 10th (fig. 45, table 14) show that the inflow of the current has taken place between these two dates. At the surface the salinity *various depths on the Sognesjø in January—April 1937 compared with the period in 1935, 1936 and 1938.*

	March											
	1 meter		10 meters		25 meters		50 meters		100 meters		200 meters	
1935	6.	20.	6.	20.	6.	20.	6.	20.	6.	20.	6.	20.
	32.64	33.19	32.73	33.25	32.95	33.28	33.40	33.64	34.61	34.81	35.05	35.03
1936	11.	22.	11.	22.	11.	22.	11.	22.	11.	22.	11.	22.
	33.03	32.84	32.99	32.85	33.08	33.06	33.18	33.90	34.64	34.82	35.01	35.10
1937	6.	17.	6.	17.	6.	17.	6.	17.	6.	17.	6.	17.
	30.40	29.89	30.80	30.18	33.46	31.68	33.73	33.74	34.72	34.80	35.11	35.14
1935	6.	20.	6.	20.	6.	20.	6.	20.	6.	20.	6.	20.
	4.65	5.08	4.78	5.10	5.05	5.12	5.70	5.64	7.58	7.71	8.19	8.11
1936	11.	22.	11.	22.	11.	22.	11.	22.	11.	22.	11.	22.
	4.53	4.67	4.57	4.64	4.64	7.71	4.73	5.75	7.76	7.91	8.06	7.57
1937	6.	17.	6.	17.	6.	17.	6.	17.	6.	17.	6.	17.
	2.13	1.88	2.43	1.89	4.39	3.14	4.79	5.01	7.16	7.12	7.65	7.46
1935	6.	20.	6.	20.	6.	20.	6.	20.	6.	20.	6.	20.
	25.86	26.25	25.92	26.30	26.07	26.32	26.15	26.54	27.05	27.19	27.30	27.30
1936	11.	22.	11.	22.	11.	22.	11.	22.	11.	22.	11.	22.
	26.18	26.02	26.15	26.03	26.21	26.19	26.28	26.73	27.05	27.16	27.29	27.44
1937	6.	17.	6.	17.	6.	17.	6.	17.	6.	17.	6.	17.
	24.31	23.92	24.61	24.15	26.54	25.26	26.72	26.70	27.19	27.24	27.43	27.49

and the temperature have decreased as much as 4.58 $^0/_{00}$ and 3.35° C respectively. Further it will be seen from the table that the stability of the water, $\frac{\triangle \alpha'}{\triangle Z} \cdot 10^{-7}$ has increased greatly after the front has passed. $\triangle \alpha'$ is the difference in specific volume (pressure considered) between the respective depths and $\triangle Z$ the difference between the corresponding depths.

The observations taken off the Egerøy show that the cold Baltic type of water had already reached there on February 26th, the salinity at the innermost station being 26.65 $^0/_{00}$, and the temperature only 0.26° at the surface (table 14).

The thickness of this water which has got slightly mixed with the

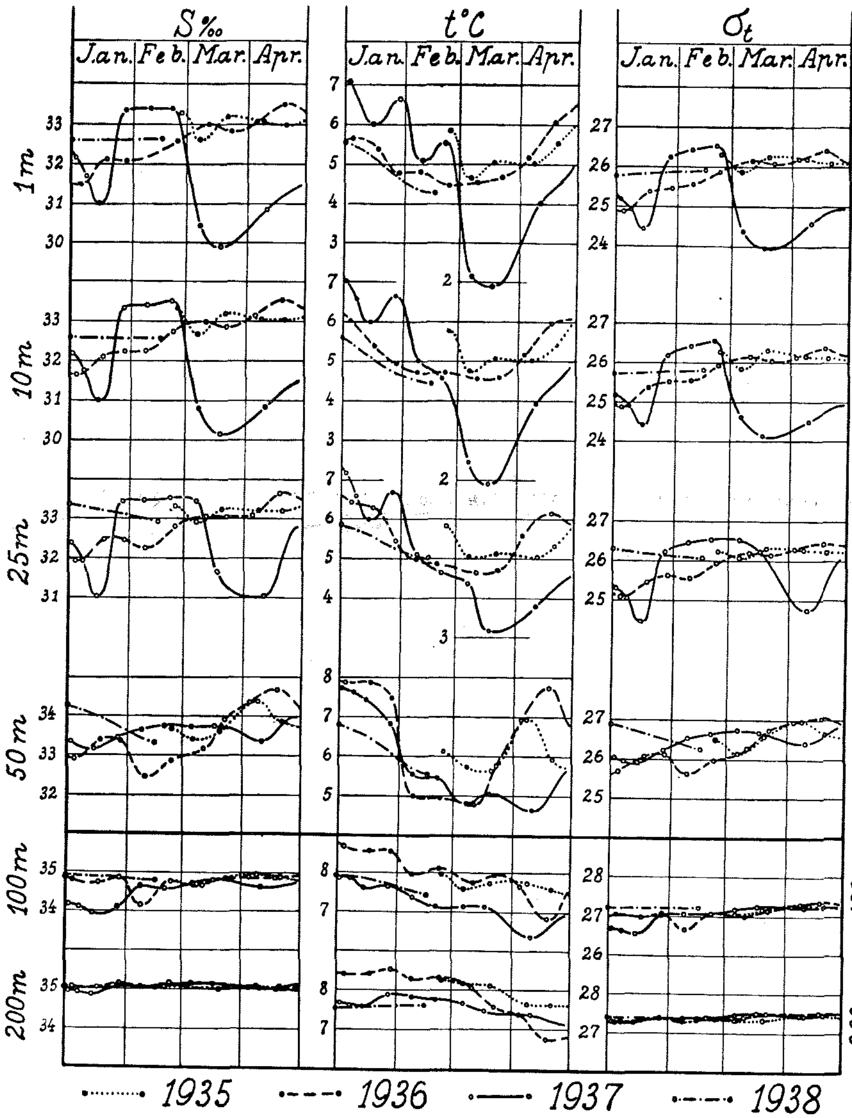

Fig. 38. Variations of the salinity, temperature and σ_t in various depths on the Sognesjø in January—April 1937 compared with the observations at hand for the corresponding period in 1935, 1936 and 1938.

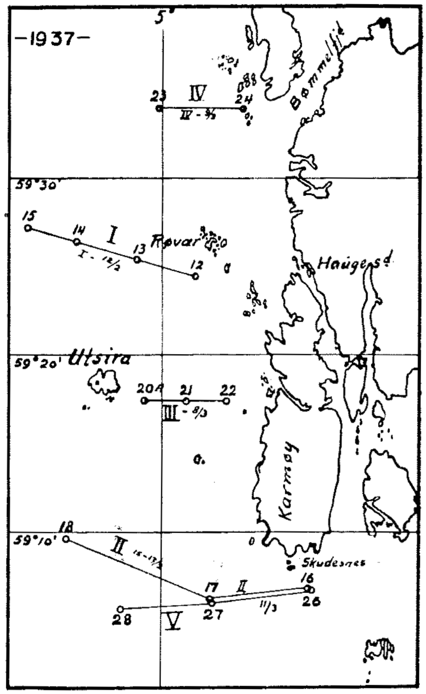

Fig. 39. Locality of the sections from the spring herring area in February and March 1937.

Table 14. *Salinity, temperature,* σ_t *and stability of the water off Røvær before and after the front has passed, and off Egersund after.*

Depth	Off Røvær. 12 II 1937 59 23.9 N.; 05 03.4_8E.				Off Røvær. 10 III 1937 59 24.6 N.; 05 34.0 E.				Off Egersund. 26 II 1937 58 23.6 N.; 05 49.5 E.			
	t°C	S ‰	σ_t	$\frac{\Delta\alpha'}{\Delta Z}\cdot 10^{-7}$	t°C	S ‰	σ_t	$\frac{\Delta\alpha'}{\Delta Z}\cdot 10^{-7}$	t°C	S ‰	σ_t	$\frac{\Delta\alpha'}{\Delta Z}\cdot 10^{-7}$
0	4.61	33.41	26.48	—20	1.26	28.83	23.11	300	0.20	26.65	21.41	70
10	4.63	33.38	26.46	40	1.53	29.23	23.42	373	0.31	26.74	21.48	1180
25	4.15	33.40	26.52	24	2.42	30.05	24.01	748	1.99	29.15	23.33	1256
50	4.27	33.50	26.59	24	4.06	32.72	25.98	152	4.96	33.65	26.63	52
75	4.89	33.66	26.65	—13	4.41	33.24	26.37	233	5.42	33.90	26.77	72
90	5.03	33.66	26.63		5.12	33.81	26.74		—	—	—	
100									5.67	34.20	26.98	

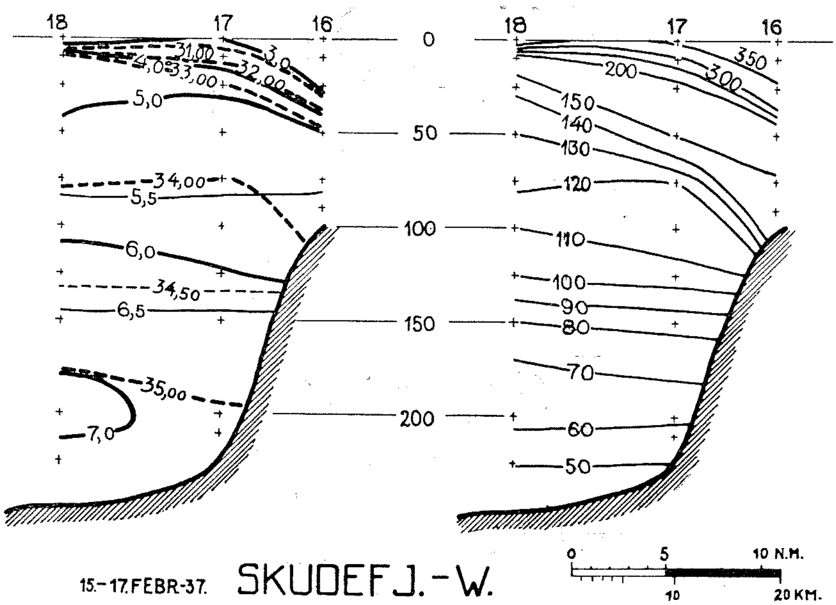

Fig. 40. Isotherms (solid lines) and isohalines (broken lines) to the left and isosteres expressed as anomalies in specific volume, $\triangle \alpha$, multiplied with 10^5 to the right. February 15—17th 1937. All depths are in meters.

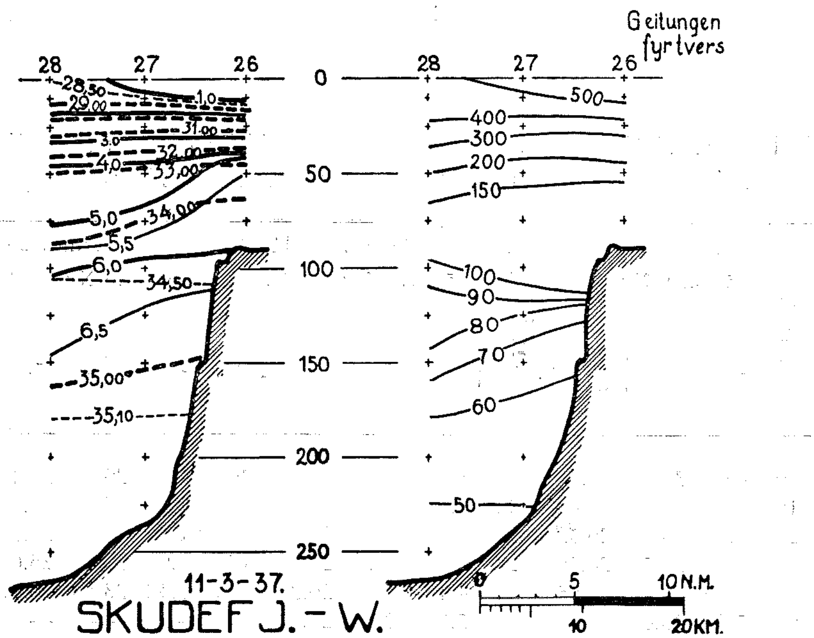

Fig. 41. Isotherms (solid lines) and isohalines (broken lines) to the left, and $10^5 \triangle \alpha$ to the right. March 11th 1937.

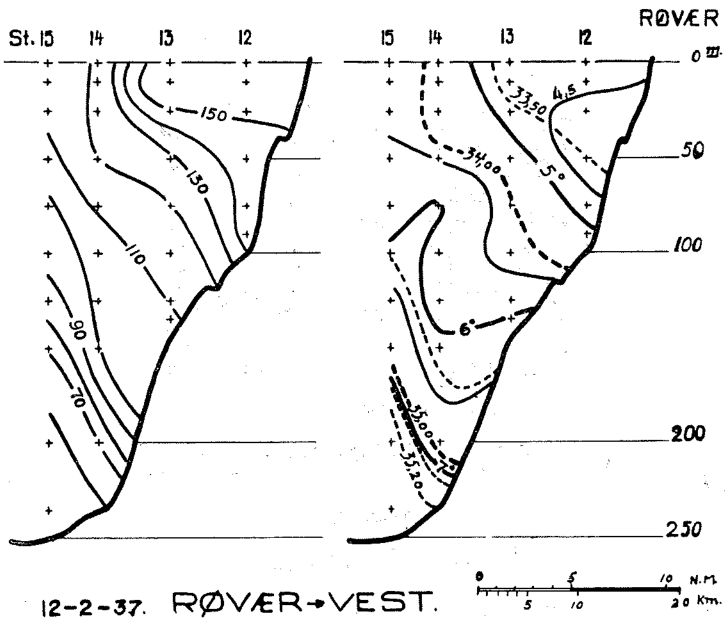

Fig. 42. Temperature- and salinity section to the right and $10^5 \triangle \alpha$ to the left. February 12th 1937.

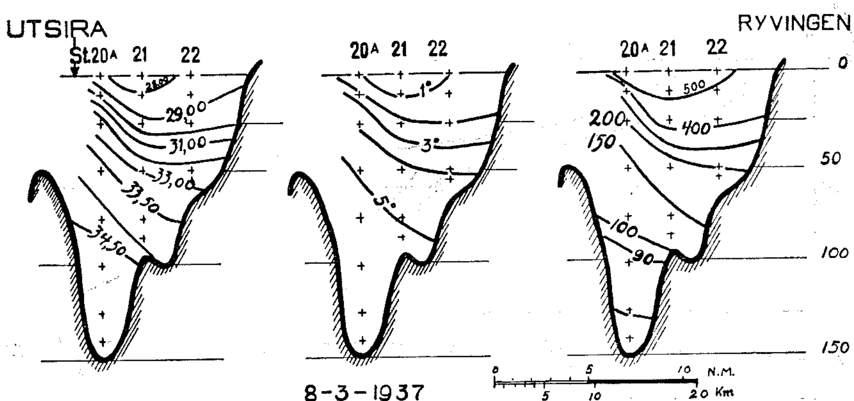

Fig. 43. Sections of salinity, temperature and $10^5 \triangle \alpha$. March 8th 1937.

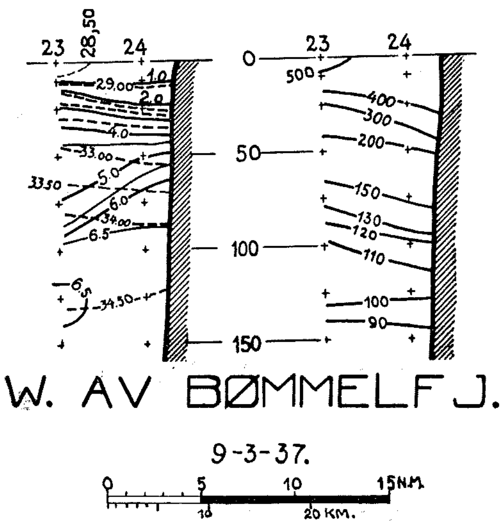

Fig. 44. Sections of salinity and temperature to the left and of specific volume anomalies. 10^5 to the right. March 9th 1937.

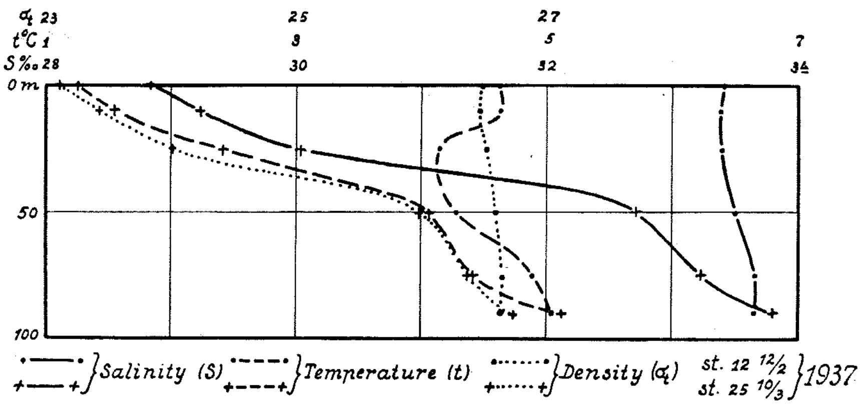

Fig. 45. Curves showing the great difference in S $^0/_{00}$, t° C and σ_t at Røvær on February 12th (stat. 12) and March 10th (stat. 25), 1937.

underlying water can be reckoned at about 40 metres, and in the other section at 25—40 metres, the greatest thickness being nearest land.

The sections cannot supply us with any information as to how far out from the coast this type of water reaches, as on March 8th — 11th, it was present in the entire length of the sections. But here we may make use of other observation material.

e) *The Sea-Thermograms.*

It will be evident that the type of Baltic water here discussed is characterized not only by its low salinity, but also by its low temperature. This gives us some hope that we may be able to follow its movements in considerably more detail with the help of the regular, continuous temperature registrations than we can when using only material generally obtained at greater intervals, and at certain places only.

The time of year also is favourable for such studies as the temperature is then lowest in the upper layers of water. Thus, if in any area especially cold water is found to be present, one knows that it does not come from the depths — but from the surface. The conveyance of water by the wind will therefore not deceive us. Further, as previously stated, we have the salinity and density also to support us.

As will be seen from fig. 46 a radical fall in temperature took place off Ferder between January 20th and February 1st, reaching as it did then a minimum. It remained at about — 1° C throughout the month of February. Further, it will be seen that there are similar conditions present to the westward and northward, but that the great fall of temperature and the minimum are met with later and later the farther west and north we go. Thus, at Lindesnes the temperature fell rapidly from February 8th to 13th, and at Jæren there is but a slight fall after February 20th. Along Sletta, near Haugesund, we can reckon the fall there as taking place about February 26th, and in the Korsfjord south of Bergen at a time between February 19th and March 5th. In the Sognesjø the temperature reached its minimum on March 5th, and in the waters at Stadt it was between March 9th and 19th that this occurred.

Now, this provides no legitimate proof that it is the movement of the cold water front which is responsible for the fall of temperature and for the minimum taking place later and later as we go farther west and north. As previously mentioned, the minimum temperature will, on account of stability conditions, generally take place earlier along the coast of the Skagerack than on the west and north coast of Norway. Good evidence going to prove that it really is the cold water front which

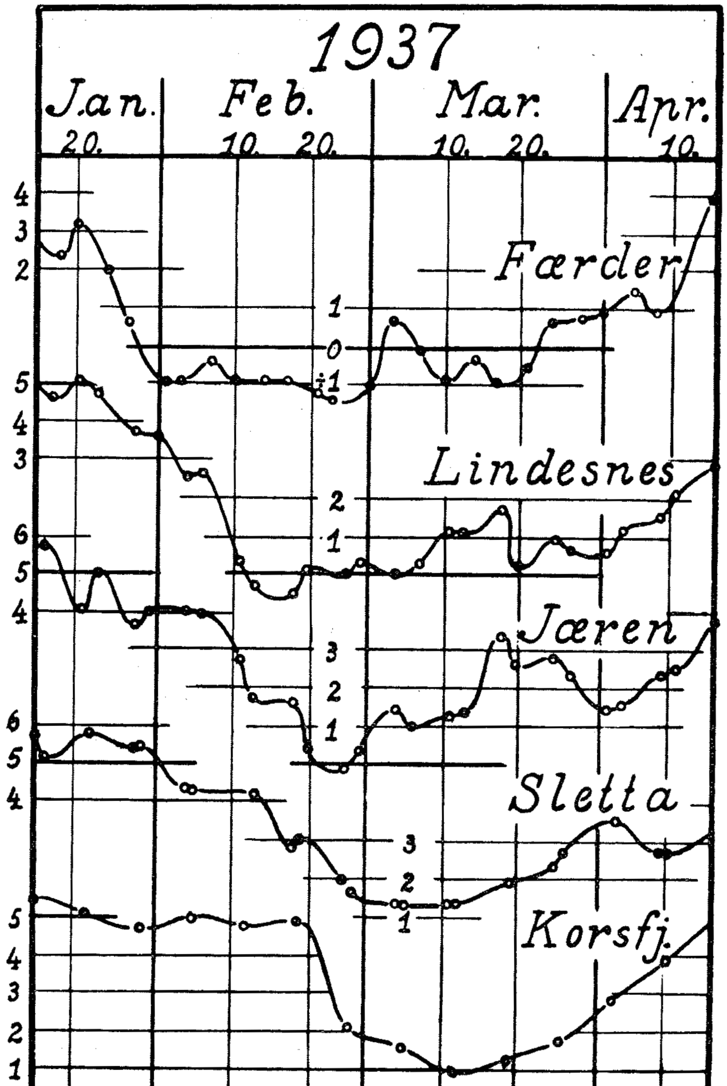

Fig. 46. Temperatures plotted day by day from the sea-thermograms at different places along the coast between Oslo and Bergen from January 15th—April 15th 1937.

Table 15. *The speed of movement of the cold water front.*

Area	Date 1937	Distance naut. miles	Time 24 hrs.	Naut. miles per 24 hrs.	cm per sec.
Ferder—Lillesand	30. I— 7. II	82	8	10.3	22.1
Lillesand—2'NE Songvår light	7.—11. II	23.5	3.9	6.0	12.9
2'NE Songvår light- Lindesnes	11.—13. II	26	2.84	9.2	19.7
Lindesnes—Ogna, Jæren	13.—18. II	56	4.64	12.1	25.9
Ogna—Jærens Rev	18.—20. II	18	1.74	10.3	22.4
Jærens Rev—Alden, Askvold	20. II— 9. III	159	16.9	9.4	20.1
Alden—Rundø, Møre ..	9.—19. III	76	10.5	7.2	15.4
Ferder—Rundø	30. I—19. III	440.5	48.52	9.1	19.4

is responsible, is that the time of the great fall in temperature at the several places, agrees with that which was registered for the movement of the water front when the distribution of salinity and density were taken into consideration.

We obtain better proof of the movement of this front along the coast by studying the continuous registrations for each voyage. Thus, on February 7th, the thermograms taken from Bergen to Oslo present a distinct fall abreast of Lillesand (fig. 47). To the east the temperature was found to be evenly low, after remaining relatively high along the entire stretch westward and northward. This must be interpreted as meaning that the cold water front reached abreast of Lillesand on February 7th, at about 3.15 a. m. (3 a. m.—3.23 a. m.). The greater part of the rise has taken place between 3.08 a. m. and 3.23 a. m., over an area corresponding to 3 nautical miles. Here then there is an area of mixed water, where the more typical Baltic water has, through turbulence, got mixed with the coast water that was present previously. On the next voyage, February 9th — 12th (Oslo—Bergen), it was found that the front had shifted 23.5 nautical miles to the south-west, to 2 n. m. NE of Songvår light on February 11th. Thereafter it shifts westwards on each voyage. On February 13th it lies between Ryvingen and Lindesnes. At this place the front is not so sharp as it is farther west. At Jæren it is near Ogna on February 18th, at 0.15 p. m., and by Jærens Rev on February 20th, at 5.30 a. m. On February 26th it is 5.5 n. m. north of the southern end of the Karmøy, and on March 9th, at 3.30 a. m. it puts in an appearance in the fairway leading to Yttre

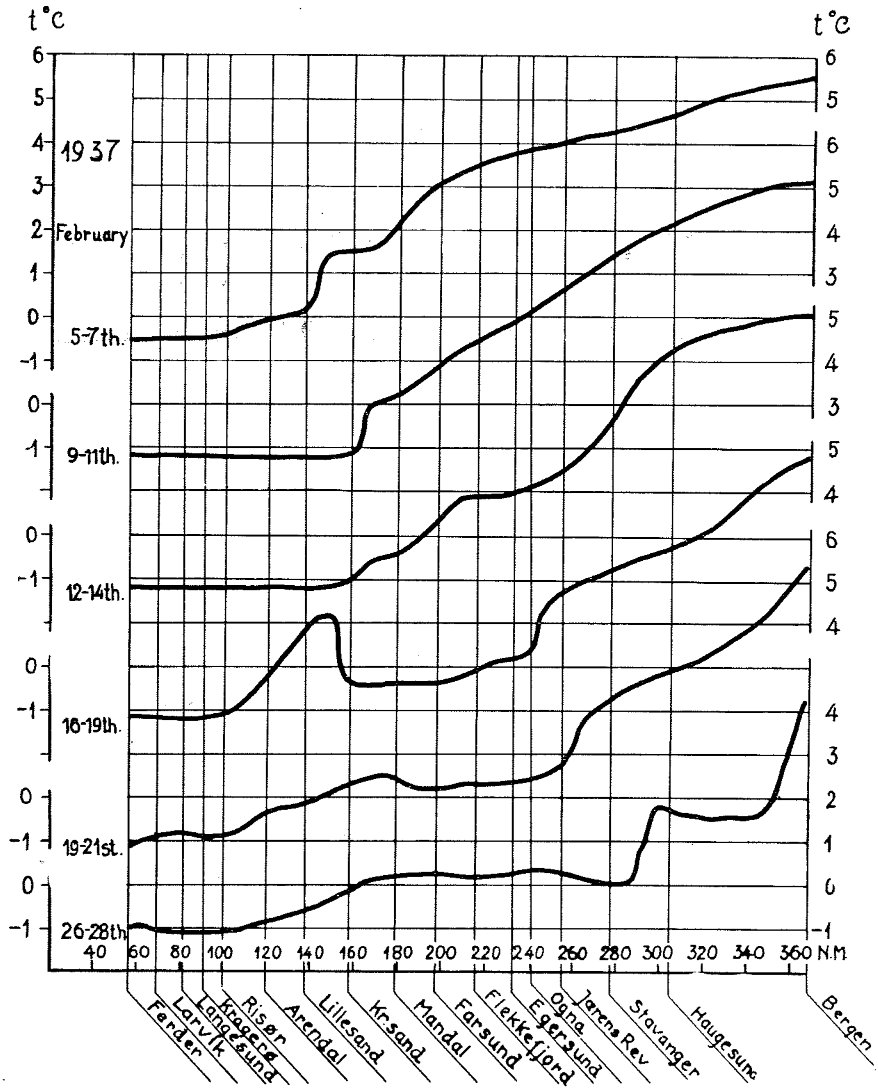

Fig. 47. The temperatures between Ferder light and Bergen as shown by the sea-thermograms from February 5th—28th 1937. The scale of distance in nautical miles (N. M.).

Sogn (Alden). More northerly it is difficult to follow the movements of the front by the aid of the thermograms. On March 19th, however, it appears that it is found at Møre, abreast of the Rundø. Farther north its traces cannot be followed.

From Lillesand to Møre (the Rundø) then, the water has flowed at an average velocity of 9.1 nautical miles per day.

3. CURRENT VELOCITY.

Summarising the results obtained regarding the movements of the water front by the help of the oceanographic sections, the observations at the permanent oceanographic station, the sea water samples supplied by the regular coasting steamers and the continuous temperature registrations taken on board these vessels (table 16), it will be seen that there is full agreement between the several methods of investigation. Further, it will be seen that although the aid of the ordinary sections which are at hand from the research vessels suffice only to reveal the passage of the water front for the nearest 24 days (Karmøy and Utsira), one can, by the aid of the observations taken at the permanent oceanographic station (the Sognesjø) determine it for the nearest 14 days, and by the aid of water samples collected on board the coasting vessels it can be determined for the nearest 10 days. Further, it can be taken for granted that on one and the same day it must lie within a certain area, thus, on March 5th it lay between the Sognesjø and Stadt, distance 78 nautical miles. Further, by help of the continuous temperature registrations we can determine the position of the water front at several places on the coast with an exactness of less than one hour.

In addition to this, the permanent oceanographic station supplies us with information as to the thickness of the Baltic type of water at various times, and some of the sections also present the thickness of it. The temperature registrations taken on board the foreign going vessels supply us with its extent east-west.

On the basis of the material here discussed, the average speed of movement of the cold water front has been computed and entered in table 15, for the several coastal areas between Ferder and Møre. It will be observed that it lies between 13 and 26 cm per sec., average 19.4 cm/sec., or 9.1 nautical miles per day.

The speed of the current is greatest off Jæren, attaining 22.4—25.9 cm/sec.; it then falls of in a northerly and easterly direction to 12.9 cm/sec. at the stretch between Lillesand and Songvår, and 15.4 cm/sec. between Alden and Rundø.

To compare the speed of these currents with earlier, direct current

Table 16. *Survey over the movements of the cold water front along the coast in February and March 1937 by means of different research methodes.*

The front	Oceanographic sections		Observations on fixed oceanographic stations		Water samples taken onboard trading vessels		Sea thermograms	
	reached		reached		reached		reached	
	after	before	after	before	after	before	date	hrs.
Ferder							Febr. 1.	
Lillesand, off							» 7.	3.15 a. m.
2' NE Songvaar light ..							» 11.	0.50 a. m.
Lindesnes							» 13.	9.00 p. m.
Egersund, off		Febr. 26.						
Jæren, Ogna							» 18.	0.15 p. m.
Jæren, Obrestad						Febr. 20.		6.30 a. m.
Jærens Rev							» 20.	6.00 a. m.
Karmøy, the south end..	Febr. 15.	March 11.						
12' south of Haugesund..							» 26.	9.45 p. m.
Utsira	» 12.	» 8.						
Bømmelhuk		» 9.						
Korsfjorden					Febr. 19.	March 5.		
Sognesjøen..............			Febr. 20.	March 6.	» 23.	» 5.		
Alden							March 9.	3.30 a. m.
Stad					March 5.			
Rundø, tvers							» 19.	3.25 p. m.

measurements is no easy matter, since these on the parts of the coast in question have only been ascertained in summer time, and then only at certain places. Direct current measurements in the coastal current, for instance, will usually present higher values than the average velocity between two places situated at some distance from each other, as the water particles will surely not pass along the shortest line between them.

With regard to the Baltic current along the south coast of Norway, Prof. H. MOHN, 1887 (18) says: »This current, which, according to our map flows toward the south-west, west and north-west from the mouth of the Oslo Fjord to Lister and farther still, with a velocity of 10 nautical miles in 24 hours (0.22 m per sec.) is well known to mariners. Beating, with reefed sails, against a head wind from the south west, they can advance in a few days from Ferder to Oxø, Lindesnes and Lister.«

This statement with regard to the average velocity agrees very well with the values obtained which in the table along the same stretch, presents 9.2 nautical miles per day.

On September 25th, 1939, a person fell overboard from the S/S »Trio« in the neighbourhood of Risør and was lost. 27 days later the body was found drifting in the sea abrest of Hernar, 24 nautical miles NW of Bergen. As the distance between Risør and Hernar is 281 nautical miles, the body drifted at an average speed of 10.4 nautical miles per day (22.4 cm/sec.). From the table it can be arrived that the cold water front along this stretch has had an average velocity of 9.5 nautical miles per day (20.4 cm/sec.).

Between the northern part of Jæren and the Karmøy, the observations indicated that the front had moved more slowly northwards than it had done to the southward and northward of it. This accords with the fact that in water very close to the coast there easily arise swirls in the upper layers in this area (9). To judge by two crossings of the water front when the thermograph presented such slight oscillation (perhaps on account of eddies) that they were not entered in the tables, the speed northwards, in the area in question, was 4 — 5 nautical miles per day, with a correspondingly greater average speed between the Karmøy and Alden.

It is obvious that this type of water, which was very cold and of small salt content, also would penetrate into the fjords on the west coast and remain there for a longer time than out on the coast. In June and July it seemed to be found in a depth of 20—30 meters in the fjords of Hordaland and Rogaland according to material of observations collected on a cruise under the leadership of Mr. PAUL BJERKAN.

4. THE EXTENT EAST—WEST OF THE BALTIC WATER OFF THE WEST COAST.

The sea thermograms supplied by the S/S »Jupiter« and S/S »Ariadne«, trading between Stavanger—Newcastle, and Stavanger—Rotterdam and back respectively, show that the belt of typically cold water was relatively narrow off Jæren when it reached that place, but then it gradually increased in width. Thus, on February 20th the width was only 7.5 nautical miles off Orre, reckoned from land. The following day the width was 12 nautical miles, and on February 25th it was 22.5 nautical miles.

The thermograms prove that the line of demarcation between this water and the more westerly lying warmer water is very distinct, this being especially the case on February 20th. On a stretch of water that the vessel covers in less than 10 mins. (5.06 p. m. — 5.15 p. m. G. M. T.) about 7.5 n. m. to the south of Orre, the temperature rises from 0.65° C to 4.65° C. On the return voyage from Rotterdam, February 25th — 26th, it is seen that the demarcation line is situated farther from land, about 22 n. m., and is not so sharply defined. In the course of half an hour the temperature had fallen from 5.3° C. to 1.85° C., then it fell further to 0.2° C. up under the Ekerøy one hour and a half later at 1 a. m. (fig. 48).

Where a distinctly defined demarcation line is concerned, the wind undoubtedly plays an important part. In the first mentioned instance the wind was towards land i. e. a westerly breeze — but in the second case the breeze was south-east.

The effect of the wind on the surface water in the first case, was to produce a component directed towards land. Thereby the light Baltic water was pressed more forcibly towards the coast. The considerably heavier, salter and warmer type of water will not be noticed as offshoots in among the inner-lying surface water, but owing to its greater density it will submerge under it. Thereby, the line of demarcation between the 2 types of water becomes sharp and clear as represented by the uppermost diagram. If, on the other hand, the effect of the wind is to produce a component directed away from land, there will as a rule, be offshoots (of relatively slight thickness) of the lighter water above the heavier. The great variations displayed by the thermogram lowest down on the figure, between 57° 25' N. and 57° 55' N. may be interpreted in this manner.

Farther north the width of the coast water belt widens. Thus, west-north-west of Feie the border line joins the water of the Atlantic,

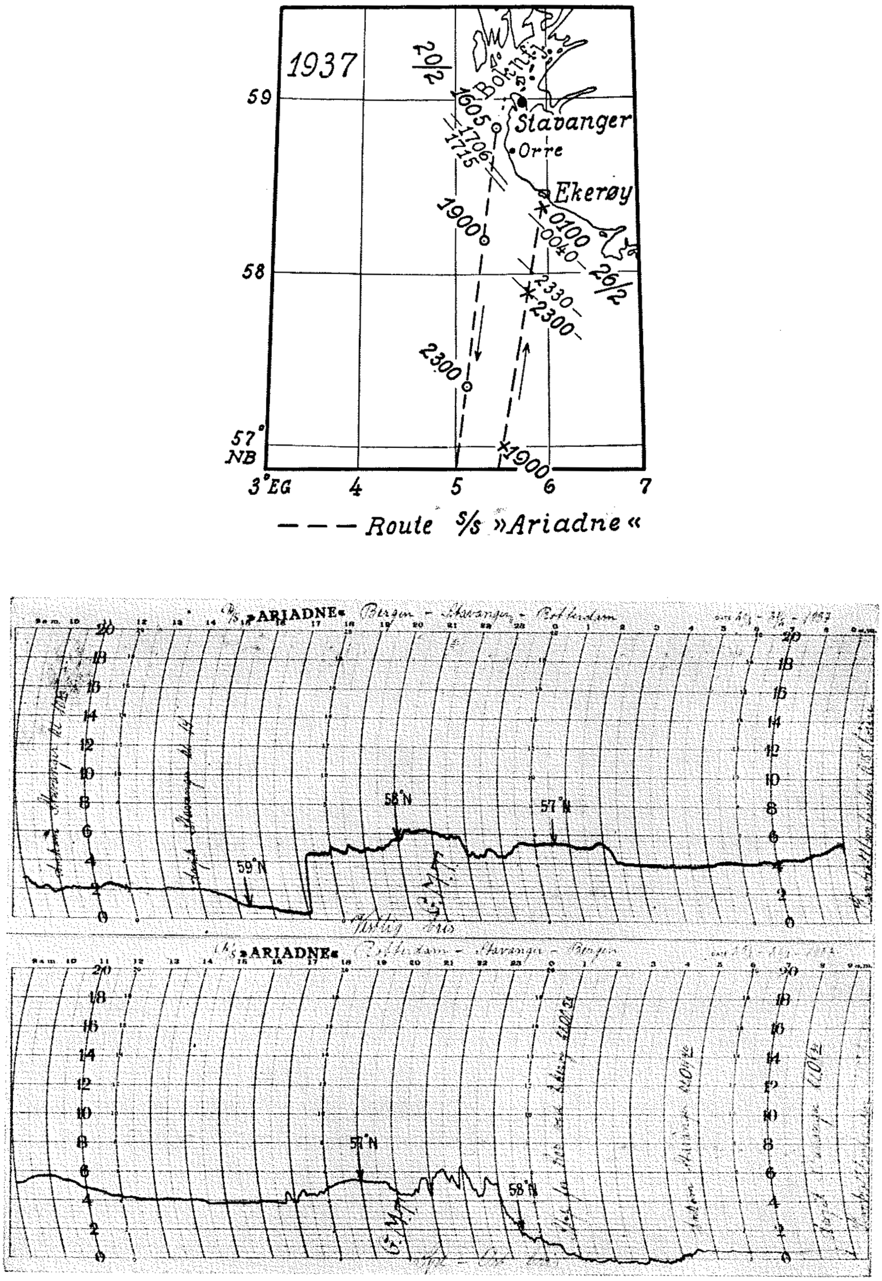

Fig. 48. Sea-thermograms taken off Jæren on February 20th—21st and 25th—26th 1937 showing the line of demarcation between the cold Baltic water and the more westerly lying warmer water. See also the corresponding chart of position.

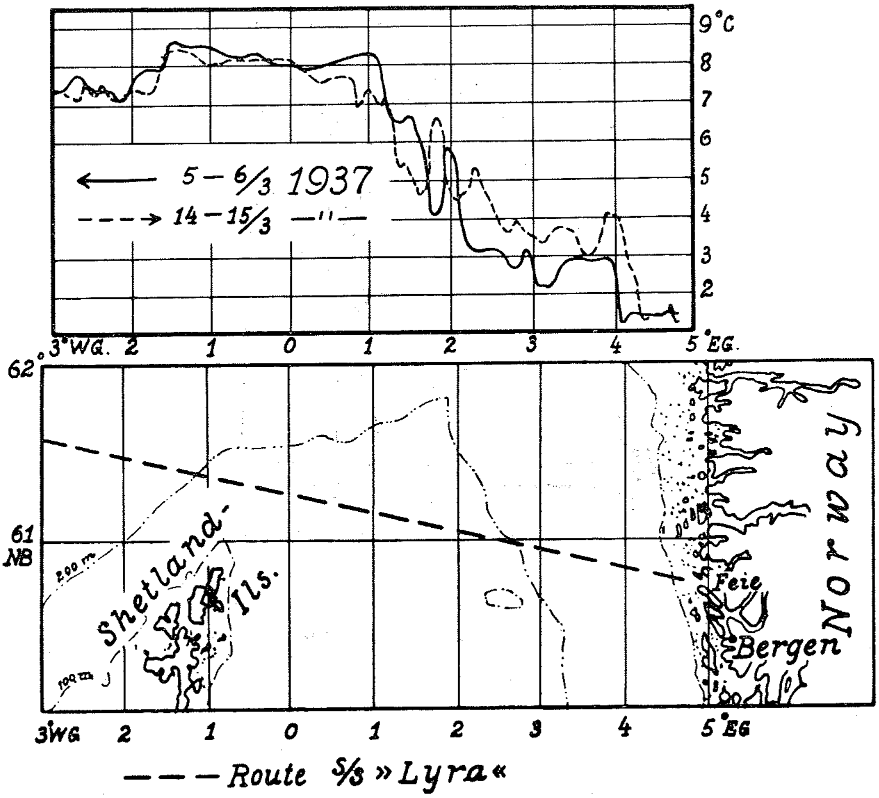

Fig. 49. Temperature curves taken from the thermograms obtained on board the S/S »Lyra« March 1937. The route of the ship is seen on the lower part of the figure.

in 1° 15' E. long. according to the thermograph registrations taken on board the S/S »Lyra«, March 6th and 15th (fig. 49).[1])

It can also be seen that the Baltic water makes itself conspicuous in a belt, 20—25 nautical miles wide, from the Norwegian coast to about 4° E. long. The temperature there is only about 1½° C.

The border line between the Atlantic water and the coast water proved to vary fairly considerably during the same season in this area. On the next 2 voyages the border line was at about the same place on March 19th and 29th, but in the beginning of April the width of the belt decreased. On April 2nd the border lay in about 2° E. long. and on April

[1]) The curves are taken from a diagram which was kindly placed at our disposal by Capt. NELLEMOSE, General Secretary of the Bureau du Conseil International, Copenhagen. They result from remodelling the thermogram material, obtained on board the S/S »Lyra« by the Fisheries Directorate. The parts of the curves, 4°—5° E. Long. we have plotted directly from the thermograms.

12th in 3° E. long. The following day (April 13th) the Fisheries Directorate took an oceanographic section at 21 stations from Feie to the northern point of the Shetland Islands. The salinity proved that the border lay in 3° 02' E. long. Contemporarily with the registrations of temperature on board the S/S »Lyra«, sea water samples are taken four times every year, every hour, between Feie and Iceland. Then it proves that there is full agreement between the thermogram and the water samples where the location of the border line is in question. We can therefore take it for granted that the thermograms decide the border line as stated above, except at the change of the seasons, the spring and late autumn when the two types of water possess approximately the same temperature in this area.

As mentioned on page 82 enormous masses of coast-water were driven away from the west coast by the south easterly storms in the latter half of January 1937, and were replaced by Atlantic water.

There is no material to hand which allows us to follow these masses of water on their further movements and to discover how long they could retain their character as coast water before getting thoroughly mixed with the Atlantic water. The sea thermograph material obtained from the Iceland voyages will only supply us with insufficient evidence, there having been in January 1937, such negligible differences between the temperature of the two types of water. But that great masses of water originating close inshore may be found isolated far out at sea off the west coast having definitely retained their original character is proved by fig. 50 which presents a clear picture of this fact. It presents i. a. the distribution of salinity and temperature in a section at 27 stations between the Feistein light, Jæren and Burra, Orkney, taken on September 25th — 27th, 1935, by the Fisheries Directorate. The crosses indicate the observation spots.

Over the western part of the Norwegian Channel and a part of the North Sea plateau, 3°—4½° E. long., there is in the uppermost 20 metres water of very low salinity, as low as 30.50 $^0/_{00}$. The Water nearer the coast of Norway is however considerably more saline — at the innermost station 33.19 $^0/_{00}$. From its character this must be water of partly Baltic origin which is present there far out at sea. As will be seen from the figure, this influences the distribution of currents in the section, at its eastern part this mass of water has a southerly setting current (dashed lines) but in its western part there is a stronger and northerly setting current (unbroken lines). With the help of the sections which were taken at approximately the same time to the north and south, the supposition of eddies being present is confirmed.

Over the slope between stations 126—128, it will be seen that the

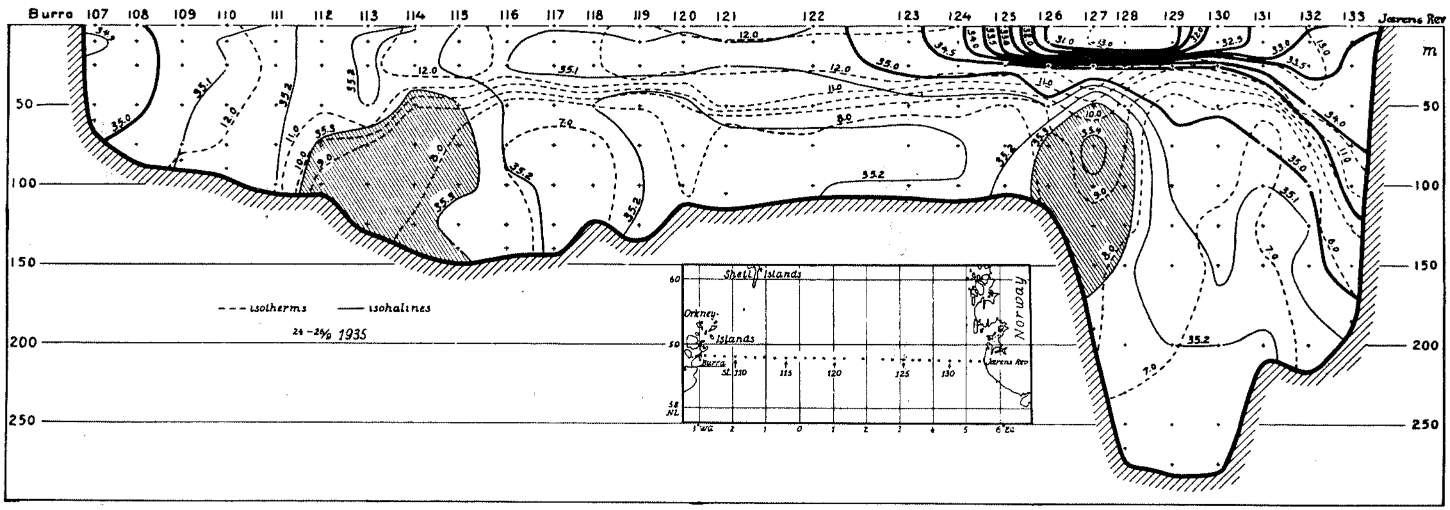

Fig. 50 a. Section, temperature and salinity, between Jærens rev and Burra, Orkney, taken on September 25th—27th, 1935. Areas with salinities > 35,30 ‰ are hatched.

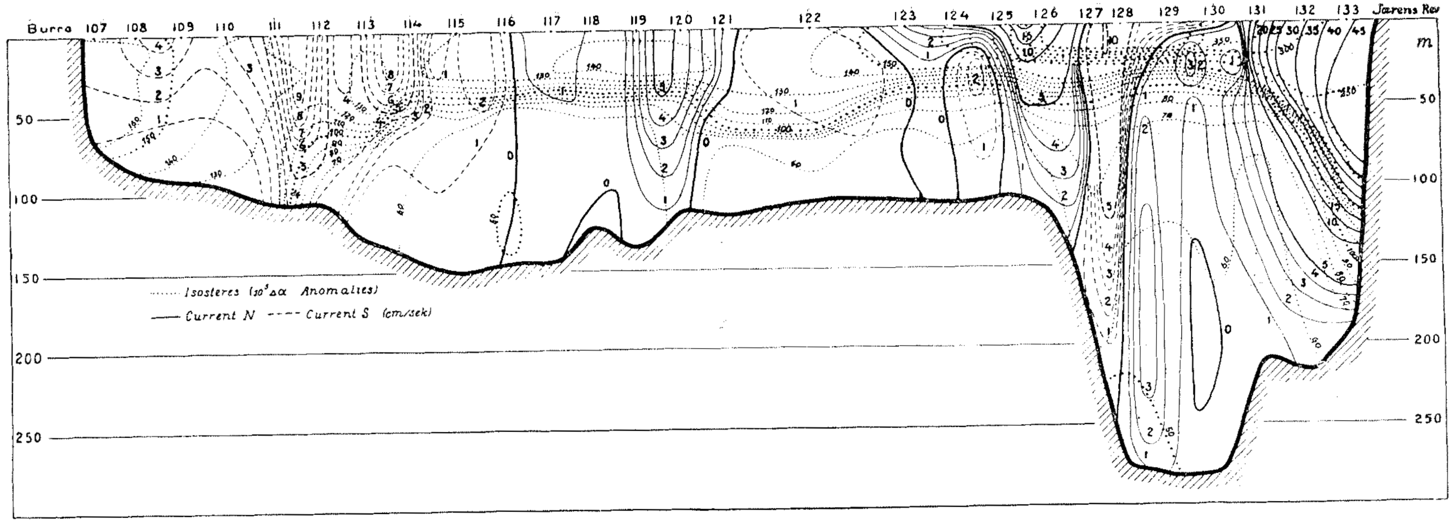

Fig. 50 b. Section showing the vertical distribution of the current velocity. The dotted curves are isosteres expressed as anomalies of specific volume .10^5. Solid lines current components to the north and broken lines current components to the south in cm pr. sec.

salinity as well as temperature, from a depth of 40 metres to the bottom, is higher than those on either side, and at 75 metres depth at station 127, the highest salinity in the whole section is met with, viz. 35.42 $^0/_{00}$. This is a branch of the Atlantic current which flows southward along the western edge of the deep basin of the Norwegian Channel, see also current diagram. It will also be noted that from station 116 and westwards the current sets southwards in the entire column of water, a fact that is known generally. In the central part of the section the current is very weak. Otherwise the figures speak for themselves.

The dotted curves (fig. 48 b) are isosters expressed as anomalies of specific volume.

When calculating the current the specific vol. anomaly (10^5) in situ has been worked out for the standard isobar surfaces for all stations (compression taken into consideration), and the dynamic depths expressed as anomalies in ten thousandth parts of a dynamic metre have been calculated, reckoned from the surface to the same isobar surfaces. By anomalies in specific vol. and dynamic depth are understood the difference between the actual values in situ, and the values that would have been found if the temperature had been 0° C. and the salinity 35 $^0/_{00}$ at all depths.

The observed values for temperature and salinity of the depth of Z metres have also been employed for that depth where the pressure is Z decibars.

Otherwise BJERKNES' theorem of circulation combined with a method by FRIDTJOF NANSEN (HELLAND-HANSEN 1934, (13)) has been employed. The last-mentioned method was recommended, when calculating currents in such cases as where the bottom is uneven, in this case the Norwegian Channel — North Sea plateau. Friction and tidal currents have not been taken into account. An easier and simpler method of calculating the current devised by W. WERENSKIOLD 1935, (24) gives practically the same result.

IX. The Effect of the Cold Water Front on the Herring Fishery.

As we have now succeeded in following the movements of an individual mass of water for a distance of several hundred kilometres along the coast in the months of February and the beginning of March, and as this type of water was abnormally cold and poorly saline into the bargain, there is good reason to wonder whether it had any influence on the fishing, and if so, whether such influence can be proved beyond doubt.

Already at an early date, GUSTAV EKMAN and OTTO PETTERSON 1891 (19) proved that the herring fishery along the Bohusläns coast takes place in the bank waters which possess a salinity of from 32—33 $^0/_{00}$. Further, they pointed out that provided the poorly saline, winter-cooled, cold Baltic water gets washed in along the bottom, thereby displacing the warmer bank water, then the herring draw away, and fishing consequently ceases.

Later on, JOHAN HJORT 1896, (16) and S. RUNNSTRØM 1932, (20) made similar observations with regard to the spring herring fishery on the west coast of Norway. On this point, HJORT says inter alia:

»In cold — often calm — winters when the Baltic current flows along the coast and we find a thick layer of cold water covering the shallow spawning places, we see the shoals of Herrings stop far out on the outer margin of the shallows and spawn on their stretches of shell-sand. *The Baltic current and the fresher layers appear therefore, to drive the shoals of fish away from the land.*«

During the winter of 1931 when the hydrographic situation was unfavourable for the spring herring fishery because there appeared great masses of cold and slightly saline water near the coast, RUNNSTRØM proved that the quantity of herring making for the usual spawning grounds was barely half as great as the following year when the hydrographic situation was favourable, and that the spawning along the coast of Norway took place in considerably deeper water, and farther away from land in 1931 than was usual. Further, RUNNSTRØM maintained that despite there being nothing to indicate that the mass of adult herrings differed in the 2 years, the quantity landed, was only half as great in 1931 as it was in 1932.

Further, Runnstrøm rights (20): »In some years when the hydrographic conditions are unfavourable we may suggest that only a part of the herring masses come to the usual spawning grounds while a great part are to be found farther out at sea, for instance on the banks west of the Norwegian Channel. In this connection it is of great interest that the Scottish research ship in April 1931 recorded great masses of herring roe on the Vikingbank.«

This is in good agreement with the statement of Paul Bjerkan in 1917[1]) — »From the above discussion I think the herring (Norwegian) might very likely spawn on the western side of the Norwegian Channel in the spring, perhaps somewhat later than on the coast of Norway. — The intensity of the spring spawning on the western banks is likely to vary much according to the annual variations of the hydrographic conditions.«

In confoımity with the above there can exist no doubt but that the oceanographic situation, during the herring fishery, is of great economic importance.

It appears from Inspector Ola Brynjelsen's report on the herring fishery in 1937, between Stadt and Lindesnes, (3) that on the shallows in the Egersund district good net catches were made in the week prior to February 20th, but from that day the fishing fell off daily until the 26th, when it suddenly ceased altogether.

As before stated the cold water front had reached to Ogna, at Jæren on February 18th, at about midday, registered at a depth of 3.5 metres; since the distance from this place to Egersund is only about 7 nautical miles, the front must, in keeping with the speed of the current, have passed off Egersund the day before. This was three days before the fishing began to fall off. The thickness of the cold water, however, plays an important part, and we must assume that matters have developed here in about the same way as shown by the observations at the permanent station on the Sognesjø, viz., that the thickness was slight to begin with, but increased as time went on, corresponding to a somewhat greater current velocity at the surface than deeper down.

As just stated the fishing fell off greatly up to the 26th, ceasing altogether just after that date. On this day an oceanographic station in 2.7 nautical miles S 30° W of Egerøy light showed that the thickness of the cold water was about 40 metres. If we now bear in mind that fishing took place with nets on the bottom, at a depth of 38—45

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[1]) Paul Bjerkan: Age, Maturity and Quality of the North Sea Herrings. Rep. on Norwegian Fishery and Marine Invest. Vol. III, No. 1. Bergen 1917.

metres, it is clear that there is good agreement between the time that the cold water flowed in along the bottom of the banks, and the time that the herring drew away and fishing ceased.

O. BRYNJELSEN says in his before mentioned report that findings of herring roe in deep water of 70—80 metres during the succeeding coal (Gadus virens, L.) fishery is indicative of the fact that spawning has been continued in deeper water after the herring had withdrawn from the shoals where bar-nets were employed. To judge by this the herring have withdrawn out from land, and then down into the eastern slope of the Norwegian Channel.

Northward also, there is agreement between the passage of the front and the cessation of fishing. The front along the surface, passed off Haugesund at about midnight on February 27th. And in the first days of March the fishing in that district ceased abruptly.

As soon as the material from the permanent oceanographic stations and the coasting steamers is received at the department of the Directorate of Fisheries, it is taken in hand and prepared. Thereby the present writer at an early stage, became aware of the extraordinary oceanographic conditions that existed on the south coast during the winter of 1937. Dr. S. RUNNSTRØM, who then conducted the herring research, and Inspector BRYNJELSEN were both of the opinion that it must have been the extraordinarily cold water that was responsible for the fishing ceasing so abruptly at several places.

CONCLUSION.

The two, relatively new methods adapted in oceanographic research — the permanent oceanographic stations in deep water and the registration of sea temperature on board coasting steamers and liners, prove effectively that they add to, and supplement the material collected on the cruises of the research ships most valuable. Further, by the help of these methods we have succeeded in solving important problems which would otherwise have been insoluable by only using the material obtained from the cruises.

An example has been described above as to how the distribution of air pressure well in advance, can influence the herring fishery along the west coast. From the results here arrived at we shall when next a similar meteorological situation arises under comparable conditions of temperature, be prepared to expect certain consequences. We shall know reasonably far in advance when the (cold) Baltic water front will reach the several parts of the south and west coasts. We shall then be able to take our measures when it concerns the fishing. For a closer study of the movements of the water front, we shall then be able to apply the most suitable methods of investigation in ample time, and along the best localities, and also to examine nearer what effect different sorts of wind may have on the front after it has reached the Norwegian Coast.

By maintaining two permanent oceanographic stations in the spring herring fishery district, one off Egersund and one off Bømlo, we will together with the oceanographic observations taken by the Flødevigen Hatchery near Arendal, the permanent station on the Sognesjø, and the temperature registrations taken on the line steamers, have at our disposal material that will allow of our being able to follow the movements of the front fairly well, and also decide the thickness of the penetrating watermass. A few oceanographic sections from the coast and seawards will also be valuable. When then all this auxiliary matter is established and tested, we shall be able to inform the fishermen as to how the situation lies, how it seems to develop, and what consequences it will have on the fishing. The fishermen will not then have to waste their time in fishing on banks where the cold water has already penetrated, but to seek deeper water, either along the slope of the Norwegian Channel, or at suitable places in the fjords where the depth is great enough, or that fishing be carried out in shallower water (to the north) where the front has not yet passed.

Such a network of observations as here mentioned will be capable of supplying valuable oceanographic information of other kinds also.

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Table 17. The sea temperature at a depth of about 4 meters read from the thermograms.

OSLO-FJORDEN OFF NESODDEN

1935

Date	t°C
5. April	2.9
6. »	3.9
12. »	4.6
13. »	4.5
19. »	5.1
20. »	5.3
26. »	9.1
27. »	8.7
4. May	9.4
10. »	10.6
11. »	10.1
17. »	9.5
18. »	10.3
24. »	13.2
25. »	12.6
31. »	12.1
1. June	12.6
7. »	12.8
8. »	13.0
14. »	13.2
16. »	13.6
22. »	16.4
24. »	19.6
30. »	20.4
2. July	20.0
8. »	19.3
10. »	20.2
16. »	22.0
18. »	21.4
24. »	20.4

Date	t°C
25. July	20.2
1. Aug.	18.8
3. »	18.1
9. »	19.6
11. »	19.0
17. »	18.6
19 »	18.7
25. »	18.6
27. »	18.2
2. Sept.	16.7
4. »	16.7
10. »	15.1
12. »	14.8
18. »	14.0
20. »	13.6
26. »	11.8
28. »	11.2
5. Oct.	10.9
11. »	9.6
12. »	8.8
30. »	6.4
31. »	6.3
7. Nov.	6.7
13. »	6.0
14. »	5.8
21. »	5.6
27. »	4.2
28. »	4.0
4. Dec.	3.8
5. »	3.8
11. »	3.3
12. »	2.0
18. »	5.2
19. »	5.2
25. »	6.0
27. »	4.0

1936

Date	t°C
2. Jan.	3.0
3. »	3.0
9. »	2.5
10. »	2.8
16. »	1.5
17. »	1.4
23. »	— 0.5
24. »	— 0.5
31. »	2.7
6. Feb.	0.0
7. »	0.0
13. »	6.4
14. »	0.2
20. »	6.0
21. »	2.2
27. »	2.4
28. »	5.4
5. March	4.3
6. »	5.2
12. »	2.8
13. »	3.0
19. »	3.3
20. »	3.5
26. »	4.4
27. »	4.5
2. April	4.8
4. »	4.7
9. »	4.8
10. »	4.7
16. »	5.2
17. »	5.4
23. »	6.6
26. »	5.6
7. May	9.6

Date	t°C
8. May	10.0
14. »	15.6
15. »	14.7
21. »	14.4
22. »	12.8
28. »	11.4
29. »	13.0
4. June	13.0
5. »	13.2
11. »	16.8
12. »	17.0
17. »	17.4
19. »	19.0
25. »	22.0
27. »	20.4
3. July	21.8
4. »	21.0
5. »	21.4
11. »	21.2
12. »	21.0
13. »	21.0
19. »	21.0
21. »	20.6
27. »	19.6
29. »	20.2
4. Aug.	19.9
6. »	20.0
12. »	20.8
14. »	20.6
20. »	20.5
22. »	19.8
28. »	19.4
30. »	19.0
5. Sept.	12.2
7. »	13.5
13. »	13.7

Date	t°C	Date	t°C	Date	t°C	Date	t°C
15. Sept.	14.0	7. March	0.7	19. Sept.	14.3	15. March	1.7
21. »	14.3	9. »	0.3	21. »	13.7	16. »	2.4
23. »	13.6	15. »	2.5	27. »	12.9	21. »	3.8
29. »	11.3	17. »	1.9	29. »	12.5	23. »	4.1
2. Oct.	10.2	22. »	3.0	5. Oct.	12.1	28. »	4.1
9. »	8.6	23. »	2.9	7. »	11.5	30. »	4.2
15. »	8.0	28. »	6.3	13. »	9.9	4. Apr.	3.4
16. »	8.2	31. »	5.3	15. »	9.7	7. »	3.9
22. »	8.0	4. Apr.	5.0	21. »	9.5	11. »	5.4
23. »	7.1	6. »	5.6	23. »	9.4	13. »	4.9
29. »	6.5	13. »	5.3	29. »	9.4	18. »	4.4
30. »	7.0	2. May	12.6	31. »	9.5	20. »	4.2
5. Nov.	6.6	4. »	12.7	6. Nov.	8.1	25. »	8.0
6. »	6.2	9. »	10.9	8. »	7.7	27. »	8.3
12. »	6.5	11. »	11.4	14. »	6.6	2. May	7.2
13. »	6.2	16. »	12.2	16. »	5.5	5. «	9.5
19. »	4.8	18. »	12.1	22. »	5.4	9. »	7.4
20. »	5.2	23. »	14.3	24. »	4.1	11. »	7.6
26. »	5.4	25. »	13.1	30. »	3.9	16. »	10.2
27. »	4.6	30. »	14.0	2. Dec.	6.3	18. »	9.4
3. Dec.	3.7	1. June	13.1	8. »	3.8	23. »	10.6
5. »	4.2	7. »	14.6	10. »	3.6	25. »	10.6
10. »	3.1	9. »	15.7	16. »	5.0	30. »	11.7
11. »	3.2	15. »	17.2	18. »	5.5	1 June	11.3
18. »	3.1	17. »	16.9	25. »	2.1	6. »	13.7
19. »	3.7	23. »	16.0	29. »	0.5	8. »	13.4
24. »	2.9	25. »	16.5	1938		13. »	15.3
29. »	3.0	1. July	16.8			14. »	15.0
1937		3. »	17.8	3. Jan.	—0.4	20. »	16.8
		9. »	22.2	5. »	0.5	22. »	16.0
4. Jan.	2.7	11. »	20.8	10. »	2.8	28. »	16.0
5. »	2.6	17. »	21.2	12. »	2.4	30. »	15.3
10. »	2.8	18. »	21.2	17. »	0.7	6. July	16.8
12. »	1.9	19. »	20.6	19. »	0.9	8. »	17.0
18. »	1.4	25. »	21.5	24. »	1.0	14. »	17.1
19. »	1.3	27. »	20.7	26. »	1.4	16. »	17.6
24. »	1.1	2. Aug.	19.8	31. »	1.1	22. »	21.2
26. »	1.4	4. »	18.0	2. Febr.	0.9	24. »	20.4
1. Febr.	0.8	10. »	19.3	7. »	1.4	30. »	19.5
2. »	0.0	12. »	18.0	9. »	1.3	1. Aug.	19.7
7. »	—0.4	18. »	18.4	14. »	0.2	7. »	22.0
9. »	0.2	20. »	18.3	16. »	0.1	9. »	22.0
14. »	—0.6	26. »	19.7	21. »	0.0	15. »	22.0
16. »	—0.4	28. »	19.7	23. »	0.0	17. »	20.5
21. »	—0.6	3. Sept.	18.5	1. March	0.2	23. »	19.5
23. »	0.3	5. »	17.8	2. »	0.7	25. »	18.8
28. »	2.3	11. »	16.0	7. »	1.1	31. »	19.0
2. March	1.9	13. »	15.3	9. »	0.8	2. Sept.	18.3

Date	t°C
8. Sept.	17.7
10. »	17.0
16. »	14.7
18. »	14.3
24. »	14.9
26. »	14.7

FERDER

1935

Date	t°C
5. Apr.	2.1
6. »	3.7
12. »	4.1
14. »	3.7
19. »	4.5
21. »	4.5
26. »	7.7
28. »	7.6
4. May	8.6
5. »	7.4
10. »	9.8
12. »	9.5
17. »	8.0
19. »	8.4
24. »	10.6
26. »	11.3
31. »	12.8
2. June	11.8
7. »	12.4
9. »	12.5
14. »	12.9
17. »	12.1
22. »	16.8
25. »	17.5
30. »	18.5
3. July	19.0
8. »	17.2
11. »	18.2
16. »	21.2
19. »	20.1
24. »	20.3
26. »	17.5
1. Aug.	17.3
3. »	16.8
9. »	18.6
11. »	17.8
17. »	18.0
19. Aug.	17.7
25. »	18.3
28. »	17.7
2. Sept.	16.7
5. »	16.3
10. »	15.7
13. »	14.5
18. »	14.3
21. »	13.3
26. »	12.5
29. »	12.3
4. Oct.	12.4
6. »	11.9
11. »	10.4
13. »	11.5
30. »	9.0
1. Nov.	10.7
6. »	8.5
8. »	7.8
13. »	7.7
15. »	7.8
20. »	6.1
22. »	5.7
27. »	6.6
29. »	5.2
4. Dec.	5.0
6. »	4.3
11. »	3.6
13. »	1.9
18. »	3.0
20. »	2.8
25. »	1.6
28. »	1.9

1936

Date	t°C
2. Jan.	2.7
4. »	2.1
9. »	2.3
11. »	3.1
16. »	1.4
18. »	1.4
23. »	1.6
25. »	1.0
31. »	2.5
1. Febr.	2.7
6. »	0.7
8. »	2.3
13. Febr.	0.7
15. »	1.1
20. »	1.9
22. »	1.2
27. »	0.2
29. »	0.0
5. March	—0.3
7. »	—0.1
12. »	0.0
14. »	—0.1
19. »	1.7
21. »	0.7
26. »	2.1
28. »	2.0
2. Apr.	3.8
4. »	3.2
9. »	3.6
11. »	3.4
16. »	3.1
18. »	2.9
23. »	7.2
25. »	4.9
7. May	9.8
9. »	9.0
14. »	15.7
16. »	12.7
21. »	12.5
23. »	11.8
28. »	12.3
30. »	11.7
4. June	12.4
6. »	13.0
11. »	17.2
13. »	16.4
17. »	17.4
20. »	17.4
25. »	[20.2]
28. »	19.4
3. July	20.7
5. »	19.0
11. »	20.9
14. »	20.0
19. »	19.7
22. »	18.3
27. »	18.7
30. »	18.4
4. Aug.	18.8
7. »	17.7
12. Aug.	19.3
15. »	19.9
20. »	19.8
23. »	18.3
28. »	18.7
31. »	17.4
5. Sept.	15.3
8. »	15.3
13. »	14.8
16. »	14.6
21. »	14.9
24. »	14.5
29. »	12.7
3. Oct.	12.0
9. »	10.8
10. »	10.1
15. »	9.0
17. »	9.5
22. »	8.8
24. »	8.6
29. »	9.1
31. »	9.0
5. Nov.	9.1
7. »	8.9
12. »	7.9
14. »	7.6
19. »	6.2
21. »	9.1
26. »	9.1
28. »	5.4
3. Dec.	5.2
5. »	6.9
10. »	7.0
12. »	6.2
18. »	5.0
19. »	6.1
24. »	5.7
30. »	4.4

1937

Date	t°C
4. Jan.	5.2
6. »	5.6
10. »	4.6
12. »	3.8
18. »	2.4
20. »	3.2
24. »	2.0

Date		t°C
27.	Jan.	0.6
1.	Febr.	—0.9
3.	»	—0.9
7.	»	—0.4
10.	»	—0.9
14.	»	—0.9
17.	»	—0.9
21.	»	—1.2
23.	»	—1.4
28.	»	—1.1
3.	March	0.7
7.	»	—0.1
10.	»	—0.8
14.	»	—0.3
17.	»	—0.9
21.	»	—0.5
24.	»	0.7
28.	»	0.8
31.	»	1.0
4.	Apr.	1.5
7.	»	1.0
14.	»	3.9
2.	May	9.7
5.	»	10.9
9.	»	10.8
12.	»	10.1
16.	»	10.7
19.	»	11.2
23.	»	13.2
26.	»	12.7
30.	»	13.3
2.	June	13.4
7.	»	13.8
10.	»	14.5
15.	»	14.7
18.	»	15.5
23.	»	15.9
26.	»	16.2
1.	July	16.1
4.	»	16.3
9.	»	20.1
12.	»	19.0
17.	»	20.0
20.	»	20.0
25.	»	20.1
28.	»	19.9
2.	Aug.	21.2
5.	»	21.0

Date		t°C
10.	Aug.	19.0
13.	»	20.0
18.	»	19.8
21.	»	19.2
26.	»	20.9
29.	»	20.4
3.	Sept.	18.6
6.	»	17.7
11.	»	16.6
14.	»	15.0
19.	»	14.8
22.	»	14.1
27.	»	13.7
30.	»	13.5
5.	Oct.	12.5
8.	»	11.8
13.	»	10.2
16.	»	13.0
21.	»	11.9
24.	»	11.0
29.	»	10.9
1.	Nov.	10.9
6.	»	9.7
9.	»	8.7
14.	»	8.3
17.	»	6.8
22.	»	6.7
25.	»	6.1
30.	»	5.6
3.	Dec.	5.0
8.	»	2.9
11.	»	2.5
16.	»	1.5
19.	»	1.6
24.	»	1.4
30.	»	0.3

1938

3.	Jan.	—0.3
6.	»	—0.6
10.	»	0.6
13.	»	0.0
17.	»	2.1
20.	»	1.9
24.	»	2.2
27.	»	2.0
31.	»	2.2

Date		t°C
3.	Febr.	2.7
7.	»	3.6
10.	»	3.5
14.	»	1.4
17.	»	1.0
21.	»	1.5
24.	»	0.9
28.	»	2.6
3.	March	2.4
7.	»	2.6
10.	»	2.2
15.	»	3.7
17.	»	4.5
21.	»	5.1
24.	»	4.8
28.	»	5.2
31.	»	5.1
4.	Apr.	4.7
7.	»	4.7
11.	»	5.7
14.	»	5.8
18.	»	6.0
21.	»	5.7
25.	»	7.5
28.	»	7.8
2.	May	8.2
5.	»	8.2
9.	»	7.7
12.	»	6.6
16.	»	9.4
19.	»	8.9
23.	»	10.4
26.	»	9.4
30.	»	11.5
2.	June	10.7
6.	»	13.3
9.	»	12.2
13.	»	14.5
15.	»	11.0
20.	»	14.3
23.	»	13.7
28.	»	14.6
1.	July	14.7
6.	»	15.3
9.	»	15.1
14.	»	16.6
17.	»	16.9
22.	»	20.7

Date		t°C
25.	July	20.7
30.	»	19.3
2.	Aug.	18.0
7.	»	21.7
10.	»	22.0
15.	»	22.0
18.	»	18.9
23.	»	18.3
26.	»	17.4
31.	»	17.6
2.	Sept.	17.0
8.	»	15.9
11.	»	15.9
16.	»	14.3
19.	»	14.9
24.	»	14.9
27.	»	14.6

ARENDAL

1935

5.	Apr.	2.2
7.	»	2.6
12.	»	3.9
14.	»	4.3
19.	»	4.0
21.	»	4.6
26.	»	6.9
28.	»	7.0
3.	May	7.0
5.	»	8.6
10.	»	7.8
12.	»	9.3
17.	»	8.3
19.	»	9.2
24.	»	9.8
26.	»	11.0
31.	»	11.6
2.	June	12.0
7.	»	11.8
9.	»	5.8
14.	»	10.0
17.	»	9.4
22.	»	13.6

Date	t°C
25. June	16.0
30. »	13.2
3. July	14.1
8. »	14.8
11. »	14.9
16. »	17.6
19. »	15.2
24. »	16.4
27. »	16.3
1. Aug.	15.7
4. »	16.4
9. »	15.2
12. »	14.2
17. »	16.8
20. »	17.8
25. »	17.8
28. »	17.3
2. Sept.	16.1
5. »	16.3
10. »	15.0
13. »	14.7
18. »	13.4
21. »	13.6
26. »	12.6
29. »	13.0
4. Oct.	12.0
6. »	12.6
11. »	11.6
13. »	12.6
30. »	9.6
1. Nov.	10.8
6. »	9.3
8. »	8.6
13. »	7.8
15. »	8.6
20. »	6.1
22. »	6.1
27. »	7.3
29. »	5.9
4. Dec.	5.0
6. »	5.0
11. »	3.4
13. »	2.6
18. »	3.0
20. »	4.3
25. »	2.0
28. »	3.0

Date	t°C
1936	
2. Jan.	2.8
4. »	3.3
9. »	2.6
11. »	6.6
16. »	3.4
18. »	1.9
23. »	3.8
25. »	3.8
30. »	1.8
1. Febr.	2.2
6. »	1.8
8. »	3.4
13. »	1.5
15. »	1.0
20. »	1.4
22. »	0.8
27. »	1.0
29. »	0.8
5. March	—0.1
7. »	0.1
12. »	0.2
14. »	0.2
19. »	1.0
21. »	0.9
26. »	1.4
28. »	2.2
2. Apr.	2.8
4. »	3.2
9. »	2.8
11. »	3.8
16. »	3.4
18. »	2.7
23. »	3.8
25. »	5.0
7. May	7.4
9. »	9.6
14. »	11.0
16. »	12.6
21. »	11.6
23. »	12.0
28. »	12.0
30. »	12.4
4. June	7.8
6. »	12.6
11. »	14.2
13. »	15.7

Date	t°C
17. June	12.4
20. »	17.0
25. »	18.5
28. »	19.4
3. July	19.0
7. »	14.4
11. »	18.8
14. »	20.1
19. »	18.5
22. »	16.1
27. »	17.6
30. »	18.0
4. Aug.	17.6
7. »	18.0
12. »	17.8
15. »	19.1
20. »	17.0
23. »	17.8
28. »	17.4
31. »	16.8
5. Sept.	15.8
8. »	15.2
13. »	14.8
16. »	15.6
21. »	15.0
24. »	15.0
29. »	13.4
3. Oct.	13.0
8. »	11.4
10. »	10.4
15. »	10.6
17. »	10.6
22. »	10.0
24. »	10.3
29. »	9.8
31. »	10.0
5. Nov.	9.4
7. »	10.1
12. »	8.3
14. »	8.0
19. »	6.8
21. »	9.9
26. »	5.8
28. »	6.2
3. Dec.	6.8
5. »	4.9
10. »	6.5
12. »	7.5

Date	t°C
17. Dec.	7.6
19. »	7.3
24. »	6.2
30. »	5.7
1937	
3. Jan.	6.6
6. »	6.7
10. »	5.2
13. »	4.2
17. »	4.3
20. »	3.4
24. »	3.1
27. »	2.3
31. »	1.0
3. Febr.	0.8
7. »	—0.1
10. »	—1.0
14. »	—1.0
17. »	0.4
21. »	0.0
24. »	—0.6
28. »	—0.9
3. March	—0.9
7. »	—0.4
10. »	—0.7
14. »	—1.3
17. »	—0.8
21. »	—0.7
24. »	—0.3
28. »	—0.3
31. »	1.2
4. Apr.	0.5
7. »	2.1
11. »	2.6
14. »	2.9
2. May	6.0
5. »	8.6
9. »	9.2
12. »	9.8
16. »	9.3
19. »	10.6
23. »	10.6
26. »	12.1
30. »	11.8
2. June	6.4
7. »	11.8

Date	t°C	Date	t°C	Date	t°C	Date	t°C
10. June	12.2	19. Dec.	2.3	2. June	10.6	20. May	8.0
15. »	14.7	24. »	1.5	6. »	11.9	23. »	9.4
18. »	15.8	30. »	0.4	9. »	13.5	27. »	10.4
23. »	14.8			13. »	12.6	30. »	10.0
26. »	13.0	1938		15. »	14.1	3. June	9.0
1. July	11.2	3. Jan.	—0.1	20. »	14.0	6. »	5.5
4. »	16.3	6. »	—0.4	23. »	10.3	10. »	6.4
9. »	15.2	10. »	0.0	28. »	11.4	13. »	10.9
12. »	18.8	13. »	0.1	1. July	12.4	18. »	9.0
17. »	17.9	17. »	3.3	6. »	13.9	21. »	12.5
20. »	19.1	20. »	2.0	9. »	14.2	26. »	16.7
25. »	17.7	24. »	4.2	13. »	14.8	29. »	9.0
28. »	19.8	27. »	3.8	17. »	16.3	4. July	10.2
2. Aug.	19.0	31. »	4.4	22. »	17.6	7. »	9.0
5. »	20.6	3. Feb.	4.7	25. »	19.7	12. »	11.0
10. »	15.8	7. »	4.9	30. »	16.0	15. »	8.8
13. »	19.8	10. »	4.6	2. Aug.	18.4	19. »	11.4
18. »	19.8	14. »	2.7	7. »	18.9	23. »	11.6
21. »	19.1	17. »	2.5	10. »	22.0	27. »	11.4
26. »	19.8	21. »	3.6	15. »	21.0	31. »	16.4
29. »	20.2	24. »	1.5	18. »	18.7	4. Aug.	13.6
3. Sept.	15.6	28. »	2.2	23. »	15.9	8. »	14.3
6. »	14,4	3. March	4.6	26. »	17.0	13. »	12.1
11. »	15,4	7. »	3.8	31. »	16.8	16. »	12.5
14 »	15,0	10. »	4.9	3. Sept.	17.3	21. »	14.8
19. »	14.7	14. »	5.0	8. »	15.5	24. »	17.3
22. »	14.6	17. »	5.2	11. »	16.2	29. »	16.0
26. »	13.9	21. »	5.1	16. »	14.1	1. Sept.	16.2
30. »	13.8	24. »	5.8	19. »	14.8	6. »	15.6
5. Oct.	13.2	28. »	5.0	24. »	14.1	9. »	15.2
8. »	12.3	31. »	6.0	27. »	15.1	14. »	14.8
13. »	11.5	4. Apr.	5.1			17. »	14.1
16. »	13.4	7. »	5.9	LINDESNES		22. »	12.6
21. »	12.9	11. »	5.4			25. »	13.0
24. »	11.5	14. »	6.5	1935		30. »	12.9
29. »	11.0	17. »	5.3	4. April	2.8	7. Oct.	12.4
1. Nov.	11.2	21. »	6.3	8. »	2.5	10. »	12.8
6. »	10.6	25. »	6.9	11. »	3.5	14. »	12.3
9. »	9.8	28. »	6.8	15. »	4.0	30. »	10.3
14. »	10.0	2. May	7.5	18. »	4.3	2. Nov.	11.2
17. »	7.6	5. »	8.8	22. »	4.7	5. »	10.3
22. »	7.9	9. »	6.8	25. »	5.8	9. »	9.7
25. »	6.4	12. »	6.7	29. »	5.7	12. »	9.0
30. »	6.4	16. »	8.7	2. May	5.9	16. »	8.9
3. Dec.	5.4	19. »	9.6	6. »	6.5	19. »	8.0
8. »	5.1	23. »	9.6	9. »	6.0	23. »	7.1
11. »	4.0	26. »	8.5	13. »	6.1	26. »	8.1
16. »	2.5	30. »	11.2	16. »	8.1	30. »	8.7

Date	t°C
3. Dec.	6.5
7. »	7.8
10. »	5.0
14. »	3.8
17. »	3.8
21. »	4.4
24. »	3.2
29. »	3.2
1936	
1. Jan.	3.6
5. »	3.3
9. »	3.7
12. »	7.9
15. »	7.3
19. »	1.7
22. »	2.8
26. »	2.1
29. »	3.1
2. Febr.	2.9
5. »	2.1
9. »	4.0
12. »	3.7
16. »	2.0
19. »	1.6
22. »	1.0
26. »	2.1
1. March	2.4
4. »	2.4
8. »	3.6
11. »	1.1
15. »	0.4
18. »	2.1
22. »	2.2
25. »	2.2
29. »	2.3
1. April	4.0
5. »	3.7
8. »	4.0
12. »	3.8
15. »	3.6
19. »	3.6
22. »	5.6
26. »	4.8
6. May	6.8
10. »	7.6
13. »	10.4
17. »	10.7

Date	t°C
20. May	10.0
24. »	11.2
27. »	11.8
31. »	9.4
3. June	8.8
7. »	9.9
10. »	7.1
14. »	14.3
16. »	11.4
21. »	13.0
24. »	18.3
29. »	17.6
2. July	19.2
7. »	10.3
10. »	18.4
15. »	18.6
18. »	18.3
23. »	16.0
26. »	17.3
31. »	15.0
3. Aug.	17.2
8. »	17.1
11. »	17.7
16. »	18.2
19. »	17.4
24. »	16.2
27. »	16.1
1. Sept.	11.7
4. »	16.2
9. »	15.6
12. »	14.9
17. »	15.1
20. »	15.3
25. »	14.6
28. »	13.5
4. Oct.	12.6
7. »	11.8
11. »	11.4
14. »	11.2
18. »	7.0
21. »	10.8
25. »	10.4
28. »	10.0
1. Nov.	10.0
4. »	10.0
8. »	9.8
11. »	9.5
15. »	8.5

Date	t°C
18. Nov.	7.6
22. »	9.0
25. »	7.2
29. »	7.1
2. Dec.	9.5
6. »	8.7
9. »	6.8
13. »	7.2
17. »	7.8
20. »	8.0
23. »	7.4
31. »	6.5
1937	
2. Jan.	6.8
7. »	6.3
9. »	6.2
14. »	5.2
17. »	4.6
21. »	5.0
23. »	4.7
28. »	3.7
31. »	3.6
4. Febr.	2.6
6. »	2.7
11. »	0.3
13. »	—0.3
18. »	—0.5
20. »	0.1
25. »	0.0
27. »	0.3
4. March	0.0
6. »	0.3
11. »	1.1
13. »	1.1
18. »	1.7
20. »	0.2
25. »	0.9
27. »	0.7
1. Apr.	0.6
3. »	1.2
8. »	1.6
10. »	2.2
15. »	2.9
1. May	5.3
6. »	8.5
8. »	9.6

Date	t°C
13. May	9.7
15. »	9.3
20. »	9.4
22. »	10.3
27. »	12.1
29. »	7.2
3. June	4.7
6. »	11.5
11. »	12.7
14. »	14.0
19. »	14.4
22. »	15.0
27. »	10.1
30. »	9.4
5. July	14.8
8. »	11.4
13. »	14.3
16. »	14.7
21. »	17.7
24. »	17.4
29. »	18.6
1. Aug.	20.3
6. »	20.6
9. »	15.3
14. »	19.1
17. »	19.5
22. »	18.9
25. »	18.5
30. »	17.7
2. Sept.	17.1
7. »	14.1
10. »	10.6
15. »	14.7
18. »	14.6
23. »	14.3
25. »	13.9
1. Oct.	13.7
4. »	13.4
9. »	13.2
12. »	12.7
17. »	12.4
20. »	13.0
25. »	12.2
28. »	11.1
2. Nov.	11.1
5. »	10.5
10. »	9.9
13. »	8.5

Date	t°C
18. Nov.	7.8
21. »	7.6
26. »	8.7
29. »	8.0
4. Dec.	5.7
7. »	5.7
12. »	5.7
15. »	5.7
20. »	3.7
23. »	3.6
31. »	0.8

1 9 3 8

Date	t°C
2. Jan.	0.6
7. »	2.9
9. »	1.9
14. »	1.0
16. »	3.3
21. »	3.4
23. »	4.3
28. »	6.0
30. »	5.9
4. Febr.	5.0
6. »	5.4
11. »	4.9
13. »	4.4
18. »	3.4
20. »	2.9
25. »	3.4
27. »	2.4
4. March	5.2
6. »	6.0
11. »	5.9
13. »	5.5
18. »	5.3
20. »	5.5
25. »	5.2
27. »	5.3
1. Apr.	5.5
3. »	5.8
8. »	6.0
10. »	5.9
15. »	6.6
17. »	6.0
22. »	6.0
24. »	6.9
29. »	6.5
1. May	7.4
6. »	7.7
8. »	6.5
13. »	6.6
15. »	8.1
20. »	8.2
22. »	9.5
27. »	9.4
29. »	10.0
3. June	10.1
5. »	11.6
10. »	12.0
12. »	9.2
16. »	8.2
19. »	11.7
24. »	8.7
27. »	8.7
2. July	12.7
5. »	12.8
10. »	13.3
13. »	14.1
18. »	15.9
21. »	14.7
26. »	16.0
29. »	16.8
3. Aug.	14.8
6. »	18.7
11. »	20.3
14. »	21.3
19. »	13.5
22. »	13.4
27. »	16.8
30. »	16.7
4. Sept.	16.3
7. »	16.2
11. »	15.5
15. »	11.3
20. »	14.8
23. »	14.7
28. »	14.8

JÆREN.

1 9 3 5

Date	t°C
4. April	3.6
8. »	2.6
11. »	2.8
15. April	4.8
18. »	3.6
22. »	4.7
25. »	4.9
29. »	5.2
2. May	5.5
6. »	7.8
9. »	5.9
13. »	6.3
16. »	7.2
20. »	8.0
23. »	8.9
27. »	10.2
30. »	8.0
3. June	8.4
6. »	6.7
10. »	8.7
13. »	9.8
18. »	10.4
21. »	10.6
26. »	14.5
29. »	12.7
4. July	12.6
7. »	6.2
12. »	9.9
15. »	11.8
20. »	12.2
22. »	11.1
28. »	13.2
30. »	6.2
5. Aug.	13.8
8. »	11.9
13. »	14.1
15. »	10.7
21. »	15.5
24. »	16.0
29. »	16.3
1. Sept.	15.7
6. »	15.6
9. »	14.4
14. »	14.6
17. »	14.4
22. »	12.4
25. »	12.1
30. »	12.4
2. Oct.	12.3
7. »	12.6
10. »	12.2
14. Oct.	12.0
29. »	10.4
2. Nov.	10.0
5. »	8.7
9. »	9.0
12. »	9.6
16. »	9.3
19. »	8.9
23. »	7.7
26. »	7.6
30. »	7.4
3. Dec.	7.3
7. »	5.6
10. »	5.2
14. »	4.5
17. »	5.2
21. »	4.7
24. »	3.9
29. »	4.4

1 9 3 6

Date	t°C
1. Jan.	5.6
5. »	4.7
8. »	4.0
12. »	5.1
15. »	7.2
19. »	4.8
22. »	3.4
26. »	2.7
29. »	3.1
2. Feb.	4.4
5. »	5.6
9. »	2.8
12. »	3.2
16. »	3.0
19. »	3.1
22. »	2.4
26. »	3.0
1. March	3.6
4. »	2.4
8. »	2.4
11. »	3.0
15. »	2.2
18. »	2.8
22. »	3.6
25. »	3.0
29. »	3.6

Date	t°C
1. April	3.5
5. »	5.5
8. »	6.1
12. »	6.4
15. »	3.8
19. »	4.4
22. »	5.6
26. »	5.2
6. May	7.0
10. »	8.1
13. »	9.2
17. »	9.6
20. »	9.6
24. »	10.8
27. »	9.8
31. »	6.9
3. June	8.9
7. »	10.6
10. »	7.4
14. »	9.6
16. »	11.6
21. »	14.5
24. »	17.4
29. »	8.0
2. July	17.7
7. »	19.3
10. »	18.6
15. »	18.3
17. »	16.3
23. »	17.8
26. »	17.4
31. »	16.3
3. Aug.	16.6
8. »	16.3
11. »	16.8
16. »	18.0
19. »	17.6
24. »	15.7
27. »	13.0
1. Sept.	9.2
4. »	9.4
9. »	15.8
12. »	15.3
17. »	15.6
20. »	15.1
25. »	14.4
28. »	13.4
4. Oct.	12.6

Date	t°C
7. Oct.	12.0
11. »	11.9
14. »	7.0
18. »	7.1
21. »	7.0
25. »	10.5
28. »	10.0
1. Nov.	10.1
4. »	9.6
8. »	9.8
11. »	9.4
15. »	8.8
18. »	8.4
22. »	8.2
25. »	8.0
29. »	7.9
2. Dec.	7.1
6. »	8.4
9. »	8.5
13. »	7.0
16. »	7.3
21. »	7.8
23. »	7.5
31. »	7.1

1937

Date	t°C
2. Jan.	6.5
7. »	6.5
9. »	5.7
14. »	5.4
16. »	5.7
21. »	4.0
23. »	5.0
28. »	3.6
30. »	4.0
4. Febr.	4.0
6. »	3.9
11. »	2.7
13. »	1.7
18. »	1.6
20. »	0.4
25. »	—0.1
27. »	0.4
4. March	1.4
6. »	1.0
11. »	1.2
13. »	1.3

Date	t°C
18. March	3.4
20. »	2.6
25. »	2.8
27. »	2.4
1. Apr.	1.5
3. »	1.6
8. »	2.4
10. »	2.5
15. »	3.8
1. May	5.1
6. »	7.1
8. »	7.3
13. »	9.1
15. »	8.6
20. »	9.2
22. »	9.3
27. »	10.8
29. »	5.8
3. June	7.2
6. »	8.5
11. »	13.7
14. »	14.6
19. »	12.8
22. »	13.0
27. »	12.6
30. »	11.7
5. July	13.9
8. »	14.2
13. »	9.1
16. »	14.0
21. »	15.8
24. »	17.5
29. »	14.6
1. Aug.	15.0
6. »	21.0
9. »	19.6
14. »	18.6
17. »	19.2
22. »	19.1
25. »	18.7
30. »	15.0
2. Sept.	15.9
7. »	15.8
10. »	10.6
15. »	14.6
18. »	14.1
23. »	13.8
25. »	13.2

Date	t°C
1. Oct.	13.6
4. »	13.3
9. »	13.1
12. «	11.5
17. »	12.0
20. »	11.5
25. »	12.1
28. »	11.6
2. Nov.	11.2
5. »	10.9
10. »	10.3
13. »	9.7
18. »	8.0
21. »	8.7
26. »	7.7
29. »	8.3
4. Dec.	6.9
7. »	6.1
12. »	5.3
15. »	5.7
20. »	6.1
23. »	5.3
31. »	5.0

1938

Date	t°C
2. Jan.	4.2
7. »	3.1
9. »	2.4
14. »	2.3
16. »	2.8
21. »	4.4
23. »	4.3
28. »	4.3
30. »	5.2
4. Febr.	5.2
6. »	5.4
11. »	5.3
13. »	6.0
18. »	4.4
20. »	4.5
25. »	4.5
27. »	3.9
4. March	4.9
6. »	5.0
11. »	4.9
13. »	5.8
18. »	5.8

Date	t°C	Date	t°C	Date	t°C	Date	t°C
20. March	5.6	23. Sept.	14.1	7. Sept.	14.9	3. March	3.9
25. »	5.9	28. »	14.9	8. »	12.7	8. »	3.9
27. »	5.2			14. »	13.3	10. »	3.6
1. Apr.	5.5			16. »	13.3	15. »	4.0
3. »	5.5	SLETTA		23. »	13.3	17. »	4.5
8. »	6.7			24. »	12.7	23. »	4.9
10. »	6.2	1935		30. »	12.1	25. »	5.2
15. »	6.5	3. Apr.	5.0	2. Oct.	11.9	29. »	4.6
17. »	6.6	8. »	4.0	7. »	12.2	31. »	4.5
22. »	6.5	10. »	3.6	9. »	12.2	5. Apr.	5.0
24. »	6.1	15. »	3.9	2. Nov.	9.8	7. »	5.1
29. »	6.8	17. »	3.9	4. »	9.7	12. »	5.8
1. May	6.7	22. »	4.5	9. »	9.1	14. »	6.0
6. »	7.3	24. »	5.0	11. »	8.2	19. »	4.2
8. »	6.4	29. »	5.1	16. »	9.0	21. »	4.8
13. »	7.1	1. May	5.2	18. »	9.0	5. May	7.1
15. »	7.0	6. »	5.9	23. »	8.1	10. »	7.6
20. »	7.6	8. »	6.3	25. »	7.9	12. »	8.4
22. »	8.4	13. »	5.9	30. »	7.4	17. »	9.0
27. »	9.2	15. »	6.4	2. Dec.	7.7	19. »	9.8
29. »	9.1	20. »	6.7	7. »	7.7	24. »	8.5
3. June	10.0	22. »	7.6	9. »	5.7	26. »	10.4
5. «	10.0	28. »	7.4	14. »	5.0	31. »	8.0
10. »	12.6	29. »	7.7	16. »	5.5	2. June	10.5
12. »	11.4	3. June	7.7	21. »	5.0	7. »	9.0
16. »	7.8	5. »	7.4	23. »	4.3	9. »	9.0
19. »	8.1	10. »	9.0	29. »	5.3	14. »	9.9
24. »	10.1	12. »	9.2	31. »	5.8	15. »	11.0
27. »	9.4	18. »	10.2			21. »	12.0
2. July	11.1	20. »	10.7			23. »	13.3
5. »	11.8	26. »	12.8	1936		29. »	10.8
18. »	14.3	28. »	13.2	5. Jan.	5.6	1. July	12.4
21. »	14.6	4. July	13.2	7. »	4.9	7. »	18.6
26. »	15.7	6. »	12.8	12. »	5.0	9. »	18.0
29. »	16.5	12. »	10.6	14. »	6.1	15. »	17.2
3. Aug.	15.2	14. »	13.8	19. »	6.0	17. »	17.4
6. »	17.9	20. »	10.2	21. »	5.4	23. »	17.3
11. »	20.5	22. »	12.0	26. »	4.0	25. »	17.5
14. »	19.2	28. »	12.1	28. »	4.3	31. »	16.1
19. »	17.4	30. »	7.7	2. Febr.	4.0	2. Aug.	17.2
22. »	14.4	5. Aug.	10.9	4. »	4.0	8. »	13.8
27. »	13.4	7. »	14.8	9. »	4.3	10. »	15.6
30. »	15.9	14. »	12.2	11. »	4.5	16. »	16.7
4. Sept.	15.2	15. »	11.7	16. »	4.3	18. »	17.3
7. »	15.2	21. »	14.0	18. »	4.1	24. »	16.3
12. »	15.5	23. »	14.8	23. »	3.9	26. »	15.8
15. »	9.1	29. »	15.3	25. »	4.2	1. Sept.	12.3
20. »	13.6	31. »	15.3	2. March	3.8	3. »	12.5

Date	t°C
9. Sept.	15.3
11. »	15.3
17. »	15.0
19. »	14.8
26. »	13.9
27. »	13.2
4. Oct.	11.2
6. »	11.2
11. »	12.0
13. »	11.3
19. »	9.4
20. »	9.2
26. »	9.4
27. »	9.5
1. Nov.	9.7
3. »	9.4
8. »	9.3
10. »	9.5
16. »	8.0
17. »	8.3
22. »	8.1
24. »	8.4
29. »	7.5
1. Dec.	8.1
7. »	7.9
8. »	7.5
14. »	7.8
15. »	7.6
21. »	7.1
22. »	7.4
31. »	6.9
1937	
1. Jan.	7.1
7. »	6.6
8. »	6.5
15. »	5.7
16. »	5.1
22. »	5.7
28. »	5.4
29. »	5.4
4. Febr.	4.3
5. »	4.3
12. »	4.2
18. »	2.8
19. »	3.0
25. »	1.9
26. Febr,	1.6
4. March	1.3
5. »	1.3
11. »	1.3
12. »	1.3
19. »	1.9
25. »	2.3
26. »	2.7
2. Apr.	3.5
8. »	2.7
9. »	2.7
7. May	7.4
13. »	8.5
14. »	8.2
20. »	8.6
21. »	9.0
28. »	10.1
3. June	9.0
5. »	9.1
11. »	9.8
13. »	10.4
19. »	12.6
21. »	12.6
27. »	12.9
29. »	12.7
5. July	12.7
7. »	13.1
13. »	12.2
15. »	14.3
21. »	14.8
23. »	15.1
29. »	14.5
31. »	14.8
6. Aug.	15.8
8. »	16.4
14. »	16.2
16. »	17.2
22. »	18.1
24. «	17.7
30. »	16.7
1. Sept.	15.9
8. »	15.9
9. »	15.0
15. »	12.6
17. »	13.0
23. »	12.1
24. »	12.7
1. Oct.	13.5
3. Oct.	13.5
9. »	13.1
11. »	12.7
18. »	11.7
19. »	11.6
25. »	11.1
27. »	11.7
2. Nov.	11.3
4. »	11.3
10. »	10.0
12. »	9.3
18. »	7.7
20. »	8.0
27. »	7.4
28. »	7.3
4. Dec.	6.2
6. »	6.5
12. »	6.0
14. »	5.8
20. »	5.6
22. »	5.4
31. »	6.0
1938	
1. Jan.	5.7
7. »	5.2
9. »	5.9
15. »	3.4
22. »	4.1
28. »	4.3
29. »	4.6
4. Febr.	4.9
5. »	5.4
11. »	4.4
12. »	5.0
18. »	4.9
19. »	5.0
25. »	5.4
26. »	4.6
4. March	5.4
5. »	5.5
11. »	5.8
12. »	5.9
18. »	6.2
19. »	6.2
25. March	6.1
26. »	6.0
2. Apr.	6.1
8. »	5.9
9. »	6.2
15. »	6.6
16. »	6.7
22. »	6.7
29. »	7.2
30. »	7.2
6. May	6.9
7. »	7.0
13. »	6.6
14. »	6.7
20. »	7.5
21. »	8.3
27. »	8.6
28. »	8.9
3. June	9.8
4. »	9.6
10. »	10.8
11. »	10.8
16. »	9.8
18. »	12.7
24. »	10,4
26. »	10.5
2. July	11.2
4. »	11.2
10. »	12.5
12. »	12.7
18. »	13.4
20. »	13.8
26. »	14.7
28. »	15.0
3. Aug.	15.0
5. »	16.0
11. »	18.3
13. »	18.5
19. »	16.5
21. »	16.6
27. »	13.8
29. »	13.6
4. Sept.	12.4
6. »	12.9
12. »	14.2
14. »	13.4
20. »	12.6

Date	t°C
22. Sept.	12.8
28. »	14.4

KORS-FJORDEN

1 9 3 5

Date	t°C
3. April	4.2
9. »	4.4
10. »	4.5
16. »	4.7
17. »	4.8
23. »	4.8
24. »	5.0
30. »	5.6
1. May	6.0
7. »	6.8
8. »	6.8
14. »	6.2
15. »	6.4
21. »	7.2
22. »	7.7
28. »	8.5
29. »	10.0
4. June	8.0
5. »	10.6
11. »	9.6
12. »	10.4
19. »	10.0
20. »	10.6
27. »	14.8
28. »	14.6
5. July	12.8
6. »	14.0
13. »	16.0
14. »	17.0
20. »	15.8
22. »	15.0
28. »	14.0
30. »	13.6
6. Aug.	13.3
7. »	13.4
14. »	13.0
15. »	13.8
22. »	15.2
23. »	14.8
30. »	14.9
31. Aug.	15.1
7. Sept.	14.4
8. »	14.7
15. »	13.8
16. »	13.5
23. »	12.8
24. »	12.9
1. Oct.	12.5
2. »	12.4
8. »	11.6
9. »	11.4
3. Nov.	11.4
4. »	10.8
10. »	8.4
11. »	8.1
17. »	8.1
18. »	8.0
24. »	6.8
25. »	7.2
1. Dec.	8.4
2. »	8.0
8. »	7.0
9. »	7.2
15. »	6.0
22. »	4.4
23. »	4.3
30. »	5.2
31. »	5.3

1 9 3 6

Date	t°C
6. Jan.	4.7
7. »	4.2
13. »	5.2
14. »	6.3
20. »	5.5
21. »	5.2
27. »	4.6
28. »	5.2
3. Febr.	5.0
4. »	5.2
10. »	4.6
11. »	4.6
17. »	4.4
18. »	4.6
24. »	4.2
25. »	4.2
2. March	4.2
3. »	4.4
9. March	4.4
10. »	4.3
16. »	3.8
17. »	4.7
23. »	5.2
24. »	5.2
30. »	5.6
31. »	5.5
6. April	5.2
7. »	5.3
13. »	5.6
14. »	6.4
20. »	5.6
21. »	5.7
5. May	7.8
11. »	10.4
12. »	8.8
18. »	10.0
19. »	10.9
25. »	11.2
26. »	11.4
1. June	9.6
2. »	10.8
8. »	9.7
9. »	10.6
15. »	10.6
22. »	12.4
23. »	15.2
30. »	17.4
1. July	17.5
7. »	16.8
9. »	16.3
16. »	16.0
17. »	17.0
24. »	17.6
25. »	17.6
1. Aug.	17.2
2. »	17.7
9. »	16.6
10. »	16.6
17... »	17.0
18. »	17.1
24. »	15.9
26. »	16.2
2. Sept.	11.5
3. »	15.0
10. »	14.5
11. »	14.8
18. Sept.	14.8
19. »	15.4
26. »	13.4
27. »	13.4
5. Oct.	12.7
6. »	12.7
13. »	12.1
19. »	9.8
20. »	10.1
26. »	10.1
27. »	10.0
2. Nov.	9.6
3. »	9.5
9. »	8.8
10. »	8.0
16. »	8.6
17. »	7.6
23. »	7.6
24. »	6.8
30. »	7.7
1. Dec.	7.8
7. »	7.0
8. »	7.6
14. »	7.5
15. »	7.2
22. »	7.3
31. »	7.2

1 9 3 7

Date	t°C
1. Jan.	7.3
8. »	4.3
15. »	5.5
22. »	5.0
29. »	4.6
5. Febr.	4.9
12. »	4.7
19. »	4.8
26. »	2.0
5. March	1.5
12. »	0.9
19. »	1.2
26. »	1.7
2. Apr.	2.8
9. »	3.8
7. May	9.0
14. »	10.8
21. »	9.7

Date	t°C
28. May	9.9
4. June	10.5
5. »	11.3
12. »	11.5
13. »	13.0
20. »	12.8
21. »	13.2
28. »	11.3
29. »	12.1
6. July	13.9
7. »	14.6
14. »	14.4
15. »	14.2
22. »	16.1
23. »	16.3
30. »	17.0
31. »	17.6
7. Aug.	17.8
8. »	16.5
15. »	17.6
16. »	18.6
23. »	18.4
24. »	18.4
31. »	16.9
1. Sept.	16.9
8. »	15.7
9. »	15.6
16. »	13.7
17. »	13.9
24. »	12.6
2. Oct.	12.2
3. »	12.4
10. »	12.0
11. »	11.4
18. »	11.6
19. »	12.0
26. »	11.1
27. »	11.1
3. Nov.	10.5
4. »	10.7
11. »	9.0
12. »	9.8
19. »	7.4
20. »	7.4
27. »	7.3
28. »	7.0
5. Dec.	6.6
6. »	5.7

Date	t°C
13. Dec.	5.6
14. »	5.6
21. »	5.6
22. »	5.3
1938	
1. Jan.	5.0
8. »	5.4
15. »	5.7
22. »	5.4
29. »	5.1
5. Febr.	5.3
12. »	4.4
19. »	3.6
26. »	4.7
5. March	5.0
12. »	4.8
19. »	5.6
26. »	5.6
2. Apr.	5.7
9. »	5.3
16. »	6.9
23. »	6.4
30. »	8.2
7. May	7.3
14. »	6.7
21. »	9.5
28. »	9.3
4. June	10.6
11. »	10.7
17. »	10.4
18. »	11.8
25. »	11.6
26. »	11.1
3. July	11.7
4. »	12.1
10. »	13.2
12. »	13.3
19. »	13.1
20. »	13.9
27. »	15.4
28. »	16.3
4. Aug.	15.7
5. »	17.4
12. »	20.0
13. »	21.0
20. »	15.9

Date	t°C
21. Aug.	15.8
28. »	14.6
29. »	15.2
5. Sept.	13.6
6. »	14.7
13. »	12.7
14. »	13.0
21. »	12.5
22. »	13.3
29. »	13.3
SOGNESJØEN	
1935	
7. May	7.9
17. »	7.3
21. »	7.5
31. »	7.0
3. June	9.0
14. »	10.4
17. »	10.4
28. »	12.8
1. July	15.9
12. »	16.0
15. »	15.8
26. »	14.5
29. »	13.5
9. Aug.	14.0
12. »	13.5
23. »	16.2
26. »	14.8
6. Sept.	14.8
9. »	14.3
21. »	12.8
24. »	13.1
8. Oct.	12.1
18. »	11.6
21. »	10.8
1. Nov.	10.3
4. »	9.7
15. »	9.7
18. »	9.6
29. »	8.9
2. Dec.	8.4
13. »	6.9
16. »	7.0
27. »	6.0
30. »	6.1

Date	t°C
1936	
11. Jan.	5.6
13. »	5.7
24. »	5.3
27. »	5.2
7. Feb.	4.8
10. »	4.4
22. »	3.6
23. March	4.0
3. April	4.2
6. »	4.1
17. »	5.0
20. »	5.2
1. May	6.4
4. »	7.0
16. »	9.6
18. »	10.0
29. »	8.0
1. June	8.8
12. »	10.4
15. »	11.0
27. »	11.6
30. »	11.0
10. July	15.8
13. »	17.0
24. »	16.6
27. »	16.6
7. Aug.	16.2
10. »	15.7
21. »	15.9
24. »	15.6
4. Sept.	14.5
7. »	13.6
18. »	13.6
21. »	13.5
2. Oct.	12.1
5. »	11.3
16. »	10.1
19. »	9.7
30. »	9.7
3. Nov.	9.0
13. »	7.3
17. »	7.4
27. »	7.2
1. Dec.	7.4
12. »	6.7
15. »	6.2

Date	t°C
25. Dec.	6.5
29. »	6.3
1937	
9. Jan.	5.1
12. »	5.4
22. »	5.8
26. »	5.2
5. Febr.	4.9
9. »	4.4
19. »	3.7
23. »	3.2
5. March	2.3
9. »	2.5
20. »	2.3
6. Apr.	2.3
16. »	3.8
20. »	3.8
30. »	4.2
4. May	4.5
15. »	6.4
1. June	9.6
11. »	10.5
15. »	11.6
25. »	9.8
29. »	10.5
10. July	12.0
13. »	11.9
23. »	15.9
27. »	15.7
6. Aug.	15.9
10. »	14.0
21. »	16.9
24. »	17.2
4. Sept.	15.9
7. »	15.5
17. »	12.5
21. »	12.2
1. Oct.	11.4
5. »	11.2
16. »	11.5
19. »	11.5
29. »	9.9
1. Nov.	10.2
12. »	9.2
16. »	8.9

Date	t°C
27. Nov.	7.6
29. »	7.3
11. Dec.	6.0
14. »	5.8
24. »	5.3
28. »	5.2
1938	
7. Jan.	4.9
10. »	4.8
21. »	5.1
25. »	4.9
5. Febr.	5.0
8. »	5.4
19. »	4.7
22. »	4.6
5. March	5.1
8. »	4.8
18. »	5.4
22. »	5.6
1. Apr.	5.3
9. »	5.4
19. »	5.6
23. »	5.5
3. May	7.6
6. »	6.9
17. »	7.5
21. »	8.6
31. »	10.4
4. June	10.7
14. »	10.1
18. »	10.8
29. »	11.5
2. July	10.9
12. »	13.8
16. »	12.3
26. »	15.2
30. »	15.2
9. Aug.	18.3
13. »	19.3
23. »	14.7
27. »	15.3
6. Sept.	14.3
10. »	12.8
20. »	11.5
24. »	12.7

Date	t°C
STADT	
1935	
7. May	6.8
17. »	6.3
21. »	6.4
31. »	7.8
4. June	7.8
14. »	9.2
18. »	9.3
28. »	11.4
2. July	13.2
12. »	14.2
16. »	14.5
26. »	13.3
30. »	12.9
9. Aug.	13.7
13. »	13.2
23. »	16.2
27. »	14.3
6. Sept.	14.1
10. »	13.3
20. »	13.2
24. »	13.3
8. Oct.	11.7
18. »	11.2
22. »	10.8
1. Nov.	10.2
5. »	9.0
15. »	8.7
19. »	8.6
29. »	8.6
3. Dec.	8.3
13. »	7.6
17. »	7.0
27. »	6.5
31. »	6.5
1936	
10. Jan.	5.8
14. »	5.8
24. »	4.9
28. »	4.3
7. Feb.	4.3
11. »	4.4
21. »	3.2
24. March	3.2

Date	t°C
3. April	3.8
6. »	3.8
16. »	5.6
20. »	5.6
1. May	8.0
5. »	8.0
15. »	10.0
19. »	11.0
29. »	7.9
2. June	7.8
12. »	10.3
16. »	10.4
26. »	12.0
30. »	12.0
10. July	13.4
14. »	14.6
24. »	14.6
28. »	16.0
7. Aug.	15.4
11. »	15.0
21. »	15.9
25. »	15.2
4. Sept.	15.0
8. »	13.2
18. »	13.8
21. »	13.3
2. Oct.	12.4
6. »	11.0
16. »	10.0
20. »	8.8
30. »	9.2
3. Nov.	7.9
13. »	8.2
17. »	8.0
27. »	7.8
1. Dec.	7.2
11. »	6.6
15. »	6.1
25. »	6.6
29. »	6.9
1937	
8. Jan.	5.1
12. »	5.4
22. »	4.5
26. »	4.5
5. Febr.	4.3

Date	t°C
9. Febr.	4.4
19. »	3.6
23. »	3.6
5. March	3.5
9. »	3.5
19. »	2.5
23. »	2.5
2. Apr.	2.4
6. »	2.5
16. »	3.4
22. »	4.5
30. »	3.9
4. May	4.3
14. »	6.2
1. June	9.3
11. »	10.3
15. »	11.4
25. »	10.7
29. »	10.2
9. July	12.1
13. »	11.7
23. »	14.3
27. »	13.2
6. Aug.	13.0
10. »	13.5
20. »	15.7
24. »	16.4
3. Sept.	15.7
7. »	15.2
17. »	12.9
21. »	12.1
1. Oct.	11.2
5. »	11.3
15. »	11.1
19. »	11.3
29. »	10.1
2. Nov.	10.5
12. »	9.5
16. »	8.6
26. »	8.0
30. »	7.3
10. Dec.	5.8
14. »	5.2
24. »	5.7
28. »	5.2

Date	t°C
1938	
7. Jan.	5.0
11. »	4.5
21. »	4.9
25. »	5.1
4. Febr.	5.2
8. »	5.2
18. »	4.8
22. »	4.6
4. March	5.1
8. »	5.0
18. »	5.2
22. »	5.2
1. Apr.	5.3
9. »	5.5
19. »	5.8
23. »	5.7
3. May	7.2
7. »	6.8
17. »	6.5
21. »	7.0
31. »	9.0
4. June	9.8
14. »	9.9
18. »	10.4
28. »	11.2
2. July	11.3
12. »	12.7
16. »	12.9
26. »	15.0
30. »	14.6
9. Aug.	17.6
13. »	19.1
23. »	15.4
27. »	15.1
6. Sept.	13.9
10. »	13.4
20. »	11.5
24. »	11.9
BREI-SUNDET	
1935	
7. May	6.8
17. »	6.4
21. »	8.0

Date	t°C
31. May	8.1
4. June	7.7
14. »	10.3
18. »	9.3
28. »	14.1
2. July	14.0
12. »	14.4
16. »	14.1
26. »	13.5
30. »	13.0
9. Aug.	14.1
13. »	13.2
23. »	16.1
27. »	14.9
6. Sept.	14.7
10. »	13.2
20. »	13.0
24. »	12.7
9. Oct.	11.8
19. »	10.8
22. »	10.7
1. Nov.	9.6
5. »	9.0
15. »	9.2
19. »	8.7
29. »	8.5
3. Dec.	7.6
13. »	7.5
17. »	7.3
27. »	6.9
31. »	6.3
1936	
10. Jan.	6.1
14. »	5.9
24. »	5.3
28. »	5.0
7. Febr.	4.5
11. »	4.7
21. »	3.6
24. March	3.2
3. Apr.	3.3
7. »	3.4
17. »	4.6
21. »	4.8
1. May	7.2
5. »	7.9

Date	t°C
15. May	12.4
19. »	11.3
29. »	9.0
2. June	8.0
12. »	11.4
16. »	11.7
26. »	12.7
30. »	11.8
10. July	14.2
14. »	14.4
24. »	14.6
28. »	15.5
7. Aug.	15.2
11. »	15.0
21. »	15.9
25. »	15.3
4. Sept.	13.0
8. »	13.9
18. »	14.2
22. »	13.7
2. Oct.	12.6
6. »	10.9
16. »	9.8
20. »	8.7
30. »	8.8
3. Nov.	8.5
13. »	8.2
17. »	7.2
27. »	7.4
1. Dec.	6.8
11. »	6.4
15. »	5.8
25. »	6.1
29. »	6.1
1937	
8. Jan.	4.9
12. »	5.3
22. »	5.4
26. »	5.0
5. Febr.	4.3
9. »	4.7
19. »	3.6
23. »	3.8
5. March	3.7
9. »	3.4
19. »	3.3
23. »	2.7

Date	t°C
2. Apr.	2.3
6. »	3.2
16. »	4.1
20. »	4.6
30. »	4.1
4. May	4.6
14. »	6.2
7. Sept.	14.9
17. »	12.9
21. »	12.3
1. Oct.	10.8
5. »	11.1
15. »	10.7
19. »	10.4
29. »	10.2
2. Nov.	9.9
12. »	9.7
16. »	8.5
26. »	7.8
30. »	7.2
10. Dec.	5.4
14. »	5.7
24. »	5.1
28. »	5.0

1938

Date	t°C
7. Jan.	4.8
11. »	4.4
21. »	4.7
25. »	4.4
4. Febr.	4.8
8. »	5.1
18. »	4.6
22. »	4.0
4. March	5.2
8. »	5.0
18. »	5.3
22. »	5.3
1. Apr.	5.3
9. »	5.0
19. »	4.9
23. »	5.5
3. May	7.0
7. »	6.4
17. »	6.8
21. »	7.4
31. »	9.7

Date	t°C
4. June	10.6
14. »	10.2
18. »	11.2
28. »	11.9
2. July	11.6
12. »	13.8
16. »	14.1
26. »	15.4
30. »	15.3
9. Aug.	17.6
13. »	19.0
23. »	15.2
27. »	15.6
6. Sept.	14.6
10. »	13.3
20. »	12.1
24. »	12.4

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1935

Date	t°C
7. May	7.0
17. »	6.2
21. »	7.2
31. »	6.8
4. June	7.6
14. »	9.2
18. »	9.8
28. »	11.6
2. July	12.0
12. »	13.6
16. »	14.3
26. »	12.8
30. »	13.0
9. Aug.	13.3
13. »	13.3
23. »	14.8
27. »	15.0
6. Sept.	13.2
10. »	13.2
20. »	13.2
24. »	12.5
4. Oct.	11.8
8. »	11.5
18. »	10.8
22. »	10.2
1. Nov.	9.1

Date	t°C
5. Nov.	8.7
15. »	8.4
19. »	8.4
29. »	7.7
3. Dec.	7.6
13. »	7.4
17. »	6.8
27. »	6.0
31. »	6.4

1936

Date	t°C
10. Jan.	5.7
14. »	5.8
24. »	5.2
28. »	5.2
7. Feb.	4.5
11. »	4.8
21. »	3.4
24. March	3.8
3. April	3.6
7. »	3.4
17. »	3.7
21. »	4.0
1. May	6.4
5. »	8.2
15. »	9.6
19. »	10.8
29. »	8.2
2. June	8.6
12. »	10.2
16. »	11.6
26. »	12.4
30. »	10.7
10. July	12.4
14. »	14.6
24. »	11.6
28. »	14.7
7. Aug.»	14.6
11. »	14.8
21. »	15.9
25. »	15.0
4. Sept.	14.0
8. »	13.8
18. »	13.8
22. »	13.6
2. Oct.	11.6
6. »	11.0

Date	t°C
16. Oct.	9.6
20. »	8.8
30. »	8.7
3. Nov.	8.5
13. »	7.4
17. »	7.0
27. »	6.8
1. Dec.	6.9
11. »	6.2
15. »	6.8
25. »	6.2
29. »	6.5

1937

Date	t°C
8. Jan.	5.5
12. »	4.9
22. »	4.3
26. »	4.1
5. Febr.	3.9
9. »	3.7
19. »	3.4
23. »	3.4
5. March	3.6
9. »	3.6
19. »	3.4
23. »	3.5
2. Apr.	3.2
6. »	3.8
16. »	3.5
20. »	4.2
30. »	4.2
4. May	5.4
14. »	5.5
1. June	9.7
11. »	9.0
15. »	11.0
25. »	10.8
29. »	10.6
9. July	11.5
13. »	12.6
23. »	14.2
27. »	13.3
6. Aug.	12.2
10. »	13.7
20. »	14.5
24. »	15.6
3. Sept.	15.0

Date	t°C
7. Sept.	14.6
17. »	12.6
21. »	11.6
1. Oct.	10.6
5. »	11.3
15. »	10.5
19. »	10.4
29. »	9.8
2. Nov.	10.0
12. »	9.1
16. »	8.3
26. »	7.7
30. »	7.0
10. Dec.	5.1
14. »	5.1
24. »	5.3
29. »	5.3
1938	
7. Jan.	5.0
11. »	5.0
21. »	4.3
25. »	5.6
4. Febr.	4.6
8. »	5.0
18. »	4.8
22. »	4.6
4. March	4.9
8. »	5.1
18. »	5.0
22. »	5.3
1. Apr.	5.0
10. »	4.9
19. »	4.9
23. »	5.7
3. May	6.1
7. »	6.4
17. »	6.3
21. »	7.1
31. »	9.2
4. June	9.4
14. »	9.6
18. »	10.3
28. »	10.2
2. July	11.9
12. »	12.9
16. »	14.3
26. July	14.3
30. »	14.9
9. Aug.	17.7
13. »	18.1
23. »	14.6
27. »	15.3
6. Sept.	13.3
10. »	13.4
20. »	11.0
24. »	12.6
SMØLA	
1935	
8. May	6.8
16. »	6.0
22. »	7.0
30. »	7.2
4. June	7.7
13. »	9.4
19. »	8.6
27. »	12.0
3. July	11.8
11. »	12.6
16. »	14.2
25. »	12.4
30. »	12.6
8. Aug.	13.4
14. »	12.8
22. »	15.8
27. »	13.4
5. Sept.	13.3
11. »	12.6
19. »	12.8
24. »	12.0
4. Oct.	11.8
9. »	11.6
17. »	10.8
22. »	10.2
1. Nov.	9.2
5. »	9.2
15. »	8.8
19. »	8.8
28. »	8.5
3 Des.	7.9
12. Dec.	7.3
17. »	6.8
27. »	6.5
1936	
1. Jan.	6.5
9. »	6.0
15. »	6.0
23. »	5.7
28. »	5.4
6. Feb.	4.6
12. »	4.6
20. »	3.6
25. March	3.2
3. April	3.6
7. »	3.5
16. »	3.8
21. »	4.9
30. »	6.6
6. May	8.2
15. »	10.4
20. »	8.0
28. »	8.4
2. June	8.7
11. »	10.2
16. »	12.0
25. »	11.6
30. »	11.4
9. July	12.4
15. »	14.6
23. »	13.4
28. »	13.0
6. Aug.	13.8
11. »	14.4
20. »	15.3
25. »	14.6
3. Sept.	14.1
8. »	13.0
17. »	13.8
22. »	13.4
1. Oct.	11.6
6. »	10.4
15. »	9.2
20. »	8.6
29. »	8.4
3. Nov.	8.4
12. »	7.6
17. Nov.	7.0
26. »	6.6
2. Dec.	6.7
11. »	5.8
16. »	6.0
24. »	6.4
30. »	6.4
1937	
8. Jan.	5.3
12. »	5.2
21. »	5.0
27. »	4.6
4. Febr.	4.1
10. »	4.1
18. »	3.8
24. »	3.8
4. March	4.0
10. »	3.9
18. »	3.6
24. »	3.6
1. Apr.	3.5
7. »	4.3
15. »	3.9
21. »	4.4
29. »	4.5
5. May	5.1
13. »	6.0
1. June	8.8
10. »	9.6
16. »	10.7
24. »	11.3
29. »	10.3
8. July	11.7
13. »	12.5
22. »	14.2
27. »	13.9
5. Aug.	13.4
10. »	12.8
20. »	14.5
24. »	14.7
3. Sept.	14.1
7. »	14.0
16. »	12.8
21. »	11.9
30. »	10.8
5. Oct.	11.2

Date	t°C
14. Oct.	10.5
20. »	10.4
29. »	9.6
2. Nov.	9.7
11. »	9.1
16. »	8.2
26. »	7.3
30. »	6.7
9 Dec.	5.7
14. »	5.0
23. »	5.5
29. »	5.7

1938

Date	t°C
6. Jan.	5.5
12. »	3.9
20. »	4.9
25. »	5.0
3. Febr.	4.8
8. »	5.0
17. »	4.9
22. »	4.6
3. March	5.1
8. »	5.1
17. »	5.1
22. »	5.2
31. »	5.0
10. Apr.	5.0
18. »	4.8
23. »	5.2
2. May	6.4
8. »	5.9
16. »	6.3
21. »	7.0
30. »	8.8
4. June	9.1
13. »	9.5
18. »	9.1
27. »	10.1
2. July	11.7
11. »	13.7
16. »	13.9
25. »	15.5
30. »	14.5
8. Aug.	17.0

Date	t°C
13. Aug.	17.6
22. »	14.5
27. »	14.9
5. Sept.	14.0
10. »	13.3
19. »	11.8
24. »	12.5

TRONDHEIMS FJORDEN (off Rissa)

1935

Date	t°C
8. May	6.6
17. »	6.2
22. »	8.0
30. »	9.5
5. June	8.9
13. »	10.3
19. »	9.8
27. »	13.1
3. July	16.1
11. »	12.6
17. »	15.5
25. »	12.9
31. »	11.7
8. Aug.	12.4
14. »	13.0
22. »	16.1
28. »	14.3
5. Sept.	11.8
11. »	11.6
19. »	11.3
25. »	10.1
3. Oct.	9.8
9. »	9.5
17. »	10.2
23. »	8.5
31. »	6.6
6. Nov.	7.5
14. »	7.0
20. »	6.9
28. »	7.4
4. Dec.	6.6
12. »	6.1
18. »	5.9
26. »	5.7

1936

Date	t°C
1. Jan.	5.2
9. »	5.1
15. »	5.7
23. »	4.7
29. »	4.5
6. Feb.	4.3
12. »	4.6
20. »	3.4
25. March	3.8
2. April	4.6
8. »	3.7
16. »	3.2
22. »	3.8
30. »	7.2
6. May	7.6
14. »	11.2
20. »	8.7
28. »	6.9
3. June	9.4
11. »	10.4
17. »	13.2
25. »	10.0
1. July	13.8
9. »	13.9
15. »	15.7
23. »	14.6
29. »	12.8
6. Aug.	11.8
12. »	13.9
20. »	14.2
26. »	13.9
3. Sept.	13.4
9. »	11.6
17. »	12.2
23. »	12.5
1. Oct.	10.9
7. »	9.3
15. »	8.8
21. »	7.7
29. »	7.6
4. Nov.	7.6
12. »	6.0
18. »	5.0
26. »	5.7
2. Dec.	6.0
10. »	4.5
16. Dec.	5.5
24. »	5.9
30. »	5.1

1937

Date	t°C
7. Jan.	4.5
13. »	4.6
21. »	5.1
27. »	3.8
4. Febr.	3.4
10. »	3.8
18. »	3.6
24. »	3.4
4. March	4.0
10. »	3.5
19. »	4.0
24. »	4.5
1. Apr.	4.7
7. »	4.5
15. »	5.4
21. »	5.8
29. »	6.1
5. May	7.2
13. »	6.4
2. June	9.5
10. »	11.0
16. »	10.7
24. »	13.5
30. »	10.6
8. July	11.9
14. »	11.4
22. »	14.9
28. »	15.3
5. Aug.	14.5
11. »	16.0
19. »	16.0
25. »	13.0
2. Sept.	12.5
8. »	12.7
16. »	11.4
22. »	10.9
30. »	10.1
6. Oct.	10.8
14. »	9.8
20. »	9.3
28. »	9.2
3. Nov.	8.6

Date	t°C
11. Nov.	8.1
17. »	7.7
25. »	7.0
1. Dec.	6.6
9. »	4.5
15. »	3.5
23. »	4.5
29. »	4.9

1 9 3 8

Date	t°C
6. Jan.	5.5
12. »	3.4
20. »	4.3
26. »	5.2
3. Febr.	4.4
9. »	5.1
17. »	4.9
23. »	5.0
3. March	4.3
9. »	4.8
17. »	4.9
23. »	4.7
31. »	4.7
10. Apr.	4.4
18. »	4.6
24. »	4.9
2. May	5.5
8. »	5.5
16. »	7.9
22. »	8.5
30. »	10.2
5. June	11.9
13. »	9.3
19. »	9.9
27. »	11.5
3. July	12.4
11. »	14.7
17. »	15.5
25. »	15.5
31. »	14.7
8. Aug.	16.4
14. »	17.3
22. »	13.5
28. »	14.8
5. Sept.	14.0
11. »	13.5
19. »	10.4
25. »	11.5

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1 9 3 6

Date	t°C
8. May	6.6
16. »	6.3
22. »	7.0
30. »	7.3
5. June	8.0
13. »	9.8
19. »	9.2
27. »	11.8
3. July	10.7
11. »	11.4
17. »	14.0
25. »	12.2
31. »	12.0
8. Aug.	12.3
14. »	12.6
22 »	13.6
28. »	13.4
3. Sept.	11.8
11. »	11.0
19. »	11.2
25. »	10.7
3. Oct.	10.0
9. »	10.2
17. »	10.0
23. »	9.7
31. »	8.0
6. Nov.	7.8
14. »	7.6
20. »	7.2
28. »	6.8
4. Dec.	7.3
12. »	6.5
18. »	6.4
26. »	5.6

1 9 3 6

Date	t°C
1. Jan.	5.6
9. »	4.8
15. »	4.9
23. »	5.2
29. »	5.0
6. Feb.	4.8
12. »	4.7

Date	t°C
20. Feb.	3.4
25. March	3.6
2. April	3.8
8. »	3.2
16. »	3.2
22. »	4.4
30. »	6.0
6. May	6.7
14. »	9.7
20. »	10.2
28. »	8.0
3. June	9.8
11. »	9.4
17. »	12.4
25. »	13.0
1. July	9.6
9. »	12.4
15. »	14.7
23. »	11.4
29. »	12.8
6. Aug.	12.6
12. »	13.8
20. »	14.4
26. »	13.6
3. Sept.	13.4
9. »	12.4
17. »	12.2
23. »	12.0
1. Oct.	10.8
7. »	10.3
15. »	8.3
21. »	8.4
29. »	7.8
4. Nov.	7.6
12. »	6.8
18. »	5.8
26. »	6.6
2. Dec.	6.5
10. »	5.8
16. »	5.8
24. »	6.2
30. »	6.0

1 9 3 7

Date	t°C
7. Jan.	5.3
13. »	5.3
21. »	4.8

Date	t°C
27. Jan.	4.6
4. Febr.	3.7
10. »	3.3
18. »	3.0
24. »	3.6
4. March	3.1
10. »	3.5
18. »	3.2
24. »	2.5
1. Apr.	4.3
7. »	4.5
21. »	4.1
29. »	5.8
5. May	5.3
13. »	6.0
2. June	8.6
10. »	9.6
16. »	9.4
24. »	12.0
30. »	10.8
8. July	11.8
14. »	11.5
22. »	13.4
28. »	14.0
5. Aug.	13.4
11. »	13.0
19. »	14.3
25. »	15.4
2. Sept.	12.5
8. »	12.6
16. »	11.9
22. »	11.3
30. »	10.3
6. Oct.	10.7
14. »	9.8
20. »	9.5
28. »	9.2
3. Nov.	9.1
11. »	8.6
17. »	7.6
25. »	6.8
1. Dec.	6.2
9. »	5.6
15. »	4.3
23. »	4.4
29. »	5.6

Date	t°C
1938	
6. Jan.	5.7
12. »	4.6
20. »	4.3
26. »	5.3
3. Febr.	4.9
9. »	5.1
17. »	5.0
23. »	5.1
3. March	4.8
9. »	4.7
17. »	5.3
23. »	5.4
31. »	4.8
10. Apr.	4.8
18. »	5.0
24. »	5.6
2. May	6.5
8. »	5.7
16. »	6.5
22. »	8.0
30. »	7.6
5. June	9.6
13. »	11.0
19. »	11.0
27. »	9.8
3. July	11.8
11. »	12.8
17. »	13.6
25. »	14.3
31. »	13.3
8. Aug.	14.5
14. »	15.1
22. »	13.8
28. »	14.0
5. Sept.	13.3
11. »	13.0
19. »	10.9
25. »	11.3

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Date	t°C
1935	
8. May	6.3
16. »	6.3
22. »	6.5
29. »	7.5
5. June	9.0
12. »	8.3
19. »	9.5
26. »	11.8
3. July	10.0
10. »	12.1
17. »	12.8
24. »	12.8
31. »	12.4
7. Aug.	12.5
14. »	12.6
21. »	14.6
28. »	14.4
4. Sept.	12.9
11. »	11.1
18. »	13.1
25. »	12.0
2. Oct.	11.3
9. »	10.9
16. »	10.8
23. »	9.9
30. »	9.2
6. Nov.	8.8
14. »	8.2
20. »	8.7
28. »	7.6
4. Dec.	7.9
12. »	7.3
18. »	6.6
26. »	6.4
1936	
1. Jan.	6.5
8. »	5.8
15. »	5.7
22. »	5.8
29. »	5.4
5. Feb.	5.0
12. »	5.4
19. »	4.8
25. March	4.0
1. April	4.0
8. »	3.6
15. »	3.6
22. »	4.8
29. »	6.2
6. May	7.0
13. May	9.4
20. »	8.0
27. »	8.5
3. June	9.4
10. »	10.8
17. »	12.0
24. »	13.8
1. July	12.2
8. »	11.8
15. »	14.5
22. »	13.3
29. »	13.2
5. Aug.	13.2
12. »	14.4
19. »	14.4
26. »	14.0
2. Sept.	14.0
9. »	12.4
16. »	12.4
23. »	12.6
30. »	11.4
7. Oct.	10.3
14. »	9.0
21. »	9.0
28. »	8.6
4. Nov.	8.3
11. »	7.2
18. »	6.6
25. »	7.0
2. Dec.	6.2
10. »	6.6
16. »	6.2
24. »	6.3
30. »	6.6
1937	
7. Jan.	5.1
13. »	5.5
21. »	4.7
27. »	4.2
4. Febr.	4.0
10. »	3.8
18. »	3.2
24. »	3.2
4. March	3.3
10. »	3.2
17. »	3.2
24. »	2.9
31. March	3.2
7. Apr.	4.5
14. »	4.4
21. »	4.5
28. »	4.9
5. May	6.1
13. »	5.6
2. June	7.4
9. »	9.1
16. »	10.1
24. »	11.3
30. »	10.5
8. July	11.9
14. »	13.7
21. »	14.4
28. »	13.5
4. Aug.	14.3
11. »	12.7
18. »	13.8
25. »	15.7
1. Sept.	13.3
8. »	13.3
15. »	12.3
22. »	11.2
29. »	10.6
6. Oct.	11.0
13. »	10.1
20. »	10.0
28. »	10.0
3. Nov.	9.8
10. »	8.7
17. »	7.7
25. »	7.7
1. Dec.	7.4
8. »	6.2
15. »	5.8
23. »	4.9
29. »	4.9
1938	
5. Jan.	5.8
12. »	4.1
19. »	5.0
26. »	5.8
2. Febr.	5.0
9. »	5.9
16. »	5.4
23. »	5.5

Date	t°C
2. March	5.3
9. »	5.4
16. »	5.3
23. »	6.2
30. »	5.0
10. Apr.	5.1
17. »	5.2
24. »	5.6
1. May	6.3
8. »	5.7
15. »	6.2
22. »	7.3
29. »	9.0
5. June	9.5
12. »	11.0
19. »	10.8
26. »	10.9
3. July	10.9
10. »	12.7
17. »	14.5
24. »	15.5
31. »	14.5
7. Aug.	15.6
14. »	16.7
22. »	14.4
28. »	14.6
4. Sept.	14.1
11. »	13.4
18. »	12.3
25. »	12.1

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1935

Date	t°C
9. May	6.2
15. »	5.8
23. »	6.2
29. »	6.4
6. June	7.6
12. »	7.6
20. »	8.6
26. »	10.4
4. July	9.8
10. »	10.4
18. »	12.0
24. »	12.2
1. Aug.	12.2
7. Aug.	12.3
15. »	12.5
21. »	14.0
29. »	13.8
4. Sept.	13.2
12. »	10.8
18. »	10.8
26. »	9.7
2. Oct.	9.8
10. »	9.6
16. »	9.5
24. »	9.3
30. »	8.1
7. Nov.	7.6
13. »	7.6
21. »	7.3
27. »	6.8
5. Dec.	6.3
11. »	6.0
19. »	5.6
25. »	5.3

1936

Date	t°C
2. Jan.	5.0
8. »	4.6
16. »	4.4
22. »	4.2
30. »	4.0
5. Feb.	3.6
13. »	3.6
19. »	2.6
26. March	2.7
9. April	2.6
15. »	2.6
23. »	3.1
29. »	5.2
7. May	5.6
13. »	8.0
21. »	7.9
27. »	8.2
4. June	8.0
10. »	9.6
18. »	10.4
24. »	11.2
2. July	9.5
8. »	11.5
16. July	14.4
22. »	12.4
30. »	12.0
5. Aug.	12.9
13. »	13.1
19. »	14.4
27. »	13.0
2. Sept.	13.0
10. »	12.1
16. »	11.6
24. »	9.5
30. »	10.6
8. Oct.	10.1
14. »	9.6
22. »	8.6
28. »	8.0
5. Nov.	7.6
11. »	7.2
19. »	6.4
25. »	5.9
3. Dec.	5.6
10. »	5.3
17. »	5.3
23. »	5.5
31. »	5.3

1937

Date	t°C
6. Jan.	4.6
14. »	4.7
20. »	4.1
28. »	4.0
3. Febr.	3.8
11. »	3.6
17. »	2.8
25. »	3.0
3. March	3.1
10. »	3.3
17. »	3.0
25. »	2.9
31. »	3.1
8. Apr.	3.2
14. »	3.4
28. »	4.1
6. May	5.0
12. »	6.1
3. June	6.0
9. June	9.0
17. »	8.6
23. »	10.6
1. July	9.9
7. »	12.8
15. »	13.8
21. »	14.9
29. »	13.1
4. Aug.	15.0
12. »	13.0
18. »	13.7
26. »	14.0
1. Sept.	13.1
9. »	11.6
15. »	11.7
23. »	10.8
29. »	10.4
7. Oct.	10.8
13. »	10.3
21. »	9.5
27. »	9.2
4. Nov.	8.7
10. »	8.3
18. »	7.6
24. »	7.4
2. Dec.	6.7
8. »	5.9
16. »	5.8
22. »	4.7
30. »	4.5

1938

Date	t°C
5. Jan.	4.4
13. »	4.0
19. »	3.9
27. »	4.2
2. Febr.	4.6
10. »	4.8
16. »	4.8
24. »	4.3
2. March	4.4
10. »	4.0
16. »	4.2
24. »	4.3
30. »	4.0
11. Apr.	4.1
17. »	4.7
25. »	4.7

Date	t°C
1. May	5.5
9. »	5.0
15. »	5.6
23. »	6.4
29. »	7.8
6. June	8.1
12. »	10.0
20. »	10.7
26. »	10.1
4. July	11.7
10. »	13.1
18. »	14.2
24. »	15.5
1. Aug.	14.1
7. »	14.5
15. »	14.9
21. »	14.7
29. »	14.0
4. Sept.	14.1
12. »	13.2
18. »	12.1
26. »	12.0

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1935

Date	t°C
9. May	5.6
15. »	5.5
23. »	6.0
29. »	6.0
6. June	6.8
12. »	8.2
20. »	6.6
26. »	10.0
4. July	11.0
10. »	10.4
18. »	12.0
24. »	12.0
1. Aug.	11.9
7. »	12.0
15. »	11.4
21. »	13.0
29. »	12.4
4. Sept.	12.2
12. »	10.2
18. »	10.0
26. »	9.0
2. Oct.	8.8
10. »	8.6
16. »	8.6
24. »	7.0
30. »	7.6
7. Nov.	7.4
13. »	7.2
21. »	6.8
27. »	6.6
5. Dec.	6.0
11. »	6.0
19. »	5.6
25. »	5.3

1936

Date	t°C
2. Jan.	5.0
8. »	4.6
16. »	4.1
22. »	4.1
30. »	3.8
5. Febr.	3.6
13. »	3.0
19. »	3.0
26. March	2.2
9. April	2.6
15. »	2.3
23. »	3.6
29. »	4.4
7. May	5.6
13. »	8.0
21. »	8.0
27. »	8.0
4. June	8.2
10. »	9.6
18. »	11.4
24. »	11.3
2. July	10.0
8. »	10.2
16. »	14.6
22. »	14.0
30. »	12.0
5. Aug.	13.4
13. »	12.2
19. »	14.4
27. »	12.2
2. Sept.	12.5
10. »	11.2
16. »	11.6
24. »	10.9
30. »	9.7
8. Oct.	9.0
14. »	9.0
22. »	7.4
28. »	7.4
5. Nov.	7.4
11. »	6.6
19. »	6.3
25. »	6.2
3. Dec.	5.0
9. »	5.3
17. »	5.5
23. »	5.2
31. »	5.2

1937

Date	t°C
6. Jan.	4.2
14. »	4.3
20. »	4.1
28. »	4.1
3. Febr.	3.8
11. »	3.5
17. »	2.9
25. »	2.5
3. March	2.9
11. »	2.7
17. »	2.7
25. »	2.2
31. »	3.2
8. Apr.	2.8
14. »	3.0
22. »	3.8
28. »	4.0
6. May	4.9
12. »	5.6
3. June	5.3
9. »	9.0
17. »	7.7
23. »	11.8
1. July	10.4
7. »	13.6
15. »	13.3
21. »	14.5
29. »	13.9
4. Aug.	13.5
12. »	12.5
18. »	13.2
26. »	13.2
1. Sept.	12.2
9. »	10.9
15. »	10.3
23. »	9.6
29. »	9.5
7. Oct.	9.8
13. »	8.2
21. »	8.9
27. »	8.9
4. Nov.	8.1
10. »	7.2
18. »	6.6
24. »	6.9
2. Dec.	6.1
8. »	5.7
16. »	4.9
22. »	4.8
30. »	4.6

1938

Date	t°C
5. Jan.	4.0
13. »	2.7
19. »	3.6
27. »	4.4
2. Febr.	4.1
10. »	4.3
16. »	4.2
24. »	4.3
2. March	4.2
10. »	3.9
16. »	3.9
24. »	4.6
30. »	4.1
11. Apr.	4.1
17. »	4.2
25. »	4.4
1. May	5.0
9. »	5.7
15. »	5.7
23. »	6.2
29. »	7.0
6. June	7.8
12. »	9.8
20. »	10.3
26. »	10.6

Date	t°C
4. July	10.5
10. »	12.2
18. »	13.8
24. »	15.5
1. Aug.	13.9
7. »	13.0
15. »	14.7
21. »	13.9
29. »	13.0
4. Sept.	13.4
12. »	12.4
18. »	11.5
26. »	11.5

VEST-FJORDEN

1935

Date	t°C
9. May	4.4
15. »	4.2
23. »	5.0
28. »	5.1
6. June	6.4
11. »	7.0
20. »	8.3
25. »	8.4
4. July	9.4
9. »	10.8
18. »	11.4
23. »	11.8
1. Aug.	12.1
6. »	12.3
15. »	11.7
20. »	12.0
29. »	13.8
3. Sept.	12.9
12. »	11.2
17. »	10.5
26. »	9.6
2. Oct.	9.1
10. »	8.4
16. »	8.3
24. »	9.0
30. »	8.6
7. Nov.	8.7
13. »	8.4
21. »	8.0
27. Nov.	7.7
5. Dec.	7.3
11. »	7.0
19. »	6.8
25. »	6.5

1936

Date	t°C
2. Jan.	6.1
7. »	5.8
16. »	5.6
21. »	5.1
30. »	4.3
5. Feb.	4.4
13. »	3.8
19. »	3.6
26. March	1.8
31. »	2.3
9. Apr.	1.6
14. »	1.6
23. »	2.7
28. »	3.4
7. May	6.8
13. »	7.6
21. »	8.0
26. »	5.0
4. June	7.2
9. »	8.2
18. »	9.4
23. »	9.2
2. July	9.4
7. »	10.4
16. »	14.0
21. »	13.8
30. »	12.8
4. Aug.	14.0
13. »	13.2
18. »	13.6
27. »	12.6
1. Sept.	12.4
10. »	11.0
16. »	11.6
24. »	10.8
29. »	11.0
8. Oct.	10.2
14. »	9.4
22. »	8.4
28. »	8.6
5. Nov.	8.0
11. »	7.2
19. »	6.6
24. »	6.5
3. Dec.	6.2
9. »	5.6
17. »	5.9
23. »	5.2
31. »	4.9

1937

Date	t°C
6. Jan.	4.5
14. »	4.6
20. »	4.2
28. »	3.5
3. Febr.	2.9
12. »	2.8
17. »	2.5
25. »	2.3
3. March	2.5
11. »	2.8
17. »	2.6
25. »	1.3
30. »	2.7
8. Apr.	2.9
13. »	3.2
22. »	3.6
28. »	3.8
6. May	4.4
12. »	5.5
3. June	6.7
8. »	7.1
17. »	8.0
23. »	10.3
1. July	9.3
7. »	12.4
15. »	14.2
20. »	14.4
29. »	14.7
4. Aug.	15.7
12. »	11.5
18. »	12.5
26. »	13.6
31. »	12.4
9. Sept.	11.2
15. »	10.8
23. »	10.0
28. »	9.5
7. Oct.	10.0
12. »	9.9
21. »	9.2
27. »	8.9
4. Nov.	8.5
9. »	8.4
18. »	7.3
24. »	7.0
2. Dec.	6.2
7. »	5.8
16. »	4.8
22. »	4.9
30. »	4.9

1938

Date	t°C
4. Jan.	4.8
13. »	3.9
18. »	4.0
27. »	4.1
2. Febr.	3.8
10. »	4.2
15. »	3.8
24. »	3.4
2. March	3.7
10. »	3.3
15. »	3.0
24. »	3.1
29. »	3.7
11. Apr.	3.8
16. »	3.4
25. »	3.9
30. »	4.7
9. May	4.6
14. »	5.5
23. »	5.0
28. »	6.6
6. June	9.0
11. »	9.5
20. »	10.3
25. »	10.6
4. July	11.5
9. »	13.1
18. »	13.3
23. »	16.6
1. Aug.	13.3
6. »	12.2
15. »	13.7

Date	t°C
21. Aug.	13.3
29. »	13.2
3. Sept.	13.9
12. »	12.6
17. »	11.4
26. »	11.7

VÅGS-
FJORDEN

1935

Date	t°C
10. May	4.0
14. »	4.3
24. »	4.7
28. »	4.6
7. June	6.2
11. »	7.0
21. »	7.4
25. »	8.2
5. July	9.4
9. »	9.2
19. »	11.2
23. »	11.2
2. Aug.	11.0
6. »	11.4
16. »	10.2
20. »	11.4
30. »	12.7
3. Sept.	11.8
13. »	9.4
17. »	9.3
27. »	8.3
1. Oct.	8.2
11. »	8.0
15. »	7.9
25. »	7.2
29. »	7.1
8. Nov.	6.8
12. »	6.6
22. »	6.3
26. »	6.2
6. Dec.	6.0
10. »	5.7
20. »	5.5
24. »	5.2

Date	t°C
1936	
3. Jan.	4.8
7. »	4.8
17. »	4.2
21. »	4.1
31. »	3.6
4. Feb.	3.6
14. »	3.2
18. »	3.1
27. March	1.5
31. »	1.2
10. April	1.0
14. »	1.0
24. »	2.2
28. »	2.7
8. May	7.4
12. »	9.2
22. »	7.9
26. »	6.2
5. June	7.0
9. »	7.8
19. »	8.2
23. »	7.8
3. July	8.8
7. »	9.8
17. »	12.8
21. »	13.6
31. »	12.6
4. Aug.	13.2
14. »	12.2
18. »	12.0
28. »	11.7
1. Sept.	11.5
11. »	9.8
15. »	10.4
25. »	9.6
29. »	9.1
9. Oct.	8.3
13. »	8.2
23. »	7.2
27. »	7.2
6. Nov.	7.3
10. »	6.6
20. »	6.9
24. »	6.3
4. Dec.	5.9
8. »	5.5

Date	t°C
18. Dec.	5.5
22. »	5.2
1937	
1. Jan.	4.6
5. »	4.2
15. »	4.3
19. »	3.7
29. »	3.6
2. Febr.	3.0
16. »	1.6
26. »	2.3
2. March	2.8
12. »	3.0
16. »	2.5
26. »	2.1
30. »	2.5
9. Apr.	2.4
13. »	3.6
23. »	4.0
27. »	3.8
7. May	4.7
11. »	5.6
4. June	6.3
8. »	7.3
18. »	8.6
22. »	9.7
2. July	9.6
6. »	11.2
16. »	14.6
20. »	14.5
30. »	13.6
3. Aug.	14.2
13. »	12.9
17. »	13.1
27. »	13.4
31. »	12.4
10. Sept.	11.7
14. »	11.5
24. »	10.0
28. »	10.0
8. Oct.	10.1
12. »	9.8
22. »	8.8
26. »	8.7
5. Nov.	8.1
9. »	8.0

Date	t°C
19. Nov.	6.6
23. »	6.3
3. Dec.	5.7
7. »	5.4
17. »	5.2
21. »	4.9
31. »	4.9
1938	
4. Jan.	4.6
14. »	4.1
18. »	3.8
28. »	3.8
1. Febr.	4.0
11. »	3.8
15. »	3.8
25. »	3.4
1. March	3.2
11. »	2.3
15. »	3.3
25. »	3.1
29. »	2.7
12. Apr.	2.6
16. »	3.1
26. »	3.3
30. »	4.0
10. May	4.6
14. »	4.8
24. »	5.5
28. »	5.3
7. June	8.8
11. »	11.1
21. »	11.8
25. »	11.5
5. July	10.9
9. »	12.2
19. »	13.8
23. »	15.1
2. Aug.	12.6
6. »	11.9
16. »	12.9
20. »	13.0
30. »	12.6
3. Sept.	12.9
13. »	11.5
17. »	11.0
27. »	10.9

Date	t°C
MALANGEN	
1935	
10. May	4.0
14. »	4.2
24. »	4.6
28. »	4.5
7. June	6.0
11. »	6.2
21. »	7.2
25. »	6.2
5. July	8.0
9. »	7.2
19. »	10.0
23. »	10.0
2. Aug.	10.6
6. »	10.0
16. »	9.6
20. »	9.4
30. »	11.2
3. Sept.	9.0
13. »	8.6
17. »	8.0
27. »	7.6
1. Oct.	7.3
11. »	7.1
15. »	7.2
25. »	6.6
29. »	6.7
8. Nov.	6.6
12. »	5.8
22. »	5.6
26. »	5.6
6. Dec.	5.6
10. »	5.2
20. »	5.2
24. »	4.0
1936	
3. Jan.	4.0
7. »	4.8
17. »	3.6
21. »	3.8
31. »	3.2
4. Feb.	3.2
14. »	2.8
18. »	2.6
27. March	1.2

Date	t°C
31. March	0.1
10. April	0.3
14. »	0.4
24. »	2.5
28. »	2.6
8. May	5.0
12. »	7.0
22. »	5.8
26. »	5.2
5. June	6.6
9. »	5.8
19. »	6.6
23. »	8.0
3. July	8.0
7. »	8.4
17. »	7.4
21. »	9.7
31. »	10.2
4. Aug.	11.8
14. »	9.6
18. »	11.1
28. »	10.6
1. Sept	11.0
11. »	9.0
15. »	9.2
25. »	8.4
29. »	7.8
9. Oct.	7.8
13. »	7.8
23. »	6.3
27. »	7.0
6. Nov.	6.8
10. »	6.6
20. »	6.5
24. »	6.2
4. Dec.	5.9
8. »	5.1
18. »	5.2
22. »	4.9
1937	
1. Jan.	4.5
5. »	4.1
15. »	3.6
19. »	3.5
29. »	3.5
2. Febr.	3.3

Date	t°C
16. Febr.	1.9
26. »	2.4
1. March	2.5
12. »	2.2
16. »	2.9
26. »	1.7
30. »	2.2
10. Apr.	2.4
23. »	4.0
27. »	3.4
11. May	4.0
4. June	6.5
8. »	7.1
18. »	7.3
22. »	8.5
2. July	8.3
6. »	9.8
16. »	10.6
20. »	11.0
30. »	11.9
3. Aug.	10.7
13. »	11.9
17. »	10.5
27. »	12.0
31. »	11.6
10. Sept.	10.8
14. »	10.3
24. »	10.2
28. »	9.0
8. Oct.	9.0
12. »	7.8
22. »	8.1
26. »	8.2
5. Nov.	7.3
9. »	7.2
19. »	6.0
23. »	6.1
3. Dec.	5.4
7. »	5.3
17. »	4.9
21. »	4.5
31. »	3.8
1938	
4. Jan.	3.6
14. »	3.8
18. »	3.1
28. »	3.3

Date	t°C
1. Febr.	3.5
11. »	3.1
15. »	3.5
25. »	2.6
1. March	2.7
11. »	2.6
15. »	3.3
25. »	2.9
29. »	2.3
12. Apr.	3.0
16. »	3.1
26. »	3.4
30. »	3.6
10. May	4.1
14. »	4.4
24. »	5.1
28. »	5.2
7. June	9.7
11. »	9.8
21. »	9.8
25. »	9.8
5. July	10.0
9. »	10.6
19. »	12.5
23. »	11.7
2. Aug.	10.8
6. »	11.0
16. »	12.5
20. »	11.8
30. »	11.5
3. Sept.	10.9
13. »	11.5
17. »	10.1
27. »	10.1
LOPPHAVET	
1935	
10. May	3.6
13. »	3.6
24. »	4.4
27. »	4.6
7. June	5.6
10. »	5.3
21. »	6.3
24. »	6.4

Date	t°C
5. July	6.9
8. »	6.8
19. »	9.4
22. »	11.6
2. Aug.	10.4
5. »	10.4
16. »	10.2
19. »	10.4
30. »	11.0
2. Sept.	10.4
13. »	8.7
16. »	8.6
27. »	7.8
30. »	7.7
11. Oct.	6.8
14. »	6.8
25. »	6.3
28. »	6.0
8. Nov.	5.9
11. »	6.5
22. »	5.8
25. »	6.2
6. Dec.	5.6
9. »	6.0
20. »	5.6
23. »	5.1

1936

3. Jan.	4.7
6. »	5.2
17. »	4.0
20. »	3.8
31. »	4.2
3. Feb.	4.3
14. »	3.2
17. »	3.0
27. March	1.7
30. »	1.8
10. April	1.6
13. »	1.8
24. »	2.6
27. »	2.9
9. May	3.4
11. »	4.0
22. »	4.9
25. »	4.5
5. June	5.9

Date	t°C
8. June	6.4
19. »	7.2
22. »	7.2
3. July	8.0
6. »	8.6
17. »	8.2
20. »	10.6
31. »	10.2
3. Aug.	10.6
14. »	11.2
17. »	10.9
28. »	10.6
31. »	10.7
11. Sept.	8.8
14. »	9.1
25. »	8.6
28. »	8.6
9. Oct.	8.0
12. »	7.3
23. »	6.2
26. »	6.6
6. Nov.	7.0
9. »	6.3
20. »	6.1
23. »	6.0
4. Dec.	5.6
7. »	5.1
19. »	5.3
21. »	5.1

1937

1. Jan.	4.6
4. »	4.2
15. »	3.6
18. »	3.7
29. »	3.5
1. Febr.	3.3
12. »	1.7
15. »	1.8
26. »	1.9
1. March	2.1
13. »	2.2
15. »	1.5
27. »	2.0
29. »	1.3
10. Apr.	2.3
24. »	2.5

Date	t°C
26. Apr.	3.0
8. May	3.0
10. »	3.1
4. June	5.5
7. »	5.7
18. »	6.3
21. »	8.9
2. July	8.4
5. »	10.1
16. »	11.1
19. »	11.7
30. »	11.2
2. Aug.	11.1
13. »	9.8
16. »	10.2
27. »	11.0
30. »	10.6
10. Sept.	10.9
13. »	9.5
24. »	8.4
27. »	8.6
8. Oct.	8.8
11. »	8.6
22. »	7.9
25. »	7.9
5. Nov.	7.2
8. »	7.2
20. »	6.1
22. »	6.1
4. Dec.	5.6
6. »	5.1
18. »	4.8
20. »	4.4
31. »	4.2

1938

3. Jan.	4.6
14. »	3.8
17. »	3.8
29. »	3.4
31. »	3.7
11. Febr.	3.7
14. »	3.7
25. »	3.5
28. »	3.4
11. March	3.0
14. »	3.0

Date	t°C
26. »	2.6
28. »	2.3
12. Apr	2.9
15. »	2.9
26. »	3.3
29. »	3.4
10. May	3.9
13. »	4.0
24. »	4.5
27. »	4.6
7. June	8.3
10. »	9.0
21. »	10.2
24. »	11.0
5. July	11.0
8. »	10.1
19. »	12.3
22. »	12.7
2. Aug.	11.5
5. »	11.0
16. »	11.1
19. »	11.4
30. »	11.8
2. Sept.	11.7
13. »	10.6
16. »	10.0
27. »	9.9
30. »	10.1

REVSBOTN

1935

11. May	3.6
13. »	4.0
25. »	4.4
27. »	4.1
8. June	5.1
10. »	5.0
22. »	6.0
24. »	5.5
6. July	6.0
8. »	5.9
20. »	7.1
22. »	7.4
3. Aug.	9.6
5. »	9.0
17. »	9.1

Date	t°C
19. Aug.	9.0
31. »	9.6
2. Sept.	9.2
14. »	7.9
16. »	7.4
28. »	7.4
30. »	7.3
12. Oct.	6.8
14. »	6.9
26. »	6.4
28. »	6.2
9. Nov.	6.1
11. »	6.3
23. »	6.0
25. »	6.0
7. Dec.	5.6
9. »	5.6
21. »	5.3
23. »	5.3

1936

Date	t°C
4. Jan.	4.9
6. »	5.0
18. »	4.4
20. »	4.3
1. Feb.	3.9
3. »	4.0
15. »	3.5
17. »	3.5
28. March	2.4
30. »	2.8
11. April	2.0
13. »	2.0
25. »	3.2
27. »	3.5
9. May	3.4
11. »	3.8
23. »	4.4
25. »	4.4
6. June	4.6
8. »	4.9
20. »	5.4
22. »	5.6
4. July	6.4
6. »	5.8
18. »	7.4
20. »	7.8
1. Aug.	9.0
3. »	9.5
15. »	9.5
17. »	9.4
29. »	9.1
31. »	9.6
12. Sept.	7.9
14. »	8.2
26. »	8.3
28. »	8.4
10. Oct.	7.3
12. »	7.4
24. »	6.8
26. »	6.7
7. Nov.	7.2
9. »	6.3
21. »	6.6
23. »	6.2
5. Dec.	5.6
7. »	5.6
19. »	5.6

1937

Date	t°C
2. Jan.	4.9
4. »	4.5
16. »	4.3
18. »	4.2
30. »	3.9
1. Febr.	3.8
13. »	2.1
15. »	2.2
27. »	2.1
1. March	1.8
13. »	1.2
27. »	2.1
29. »	1.7
10. Apr.	2.1
12. »	2.2
24. »	2.6
26. »	2.6
8. May	3.0
10. »	3.2
5. June	4.2
7. »	4.5
19. »	5.4
21. »	6.6
3. July	6.5
5. July	9.0
17. »	8.2
19. »	9.4
31. »	9.0
2. Aug.	8.6
14. »	8.5
16. »	8.9
28. »	9.5
30. »	8.7
11. Sept.	8.7
13. »	8.4
25. »	8.0
27. »	8.0
9. Oct.	8.2
11. »	8.2
23. »	7.7
25. »	7.7
6. Nov.	7.1
8. »	7.2
20. »	6.4
23. »	6.2
4. Dec.	5.6
6. »	5.5
18. »	5.1
20. »	4.9
31. »	4.7

1938

Date	t°C
3. Jan.	4.6
15. »	4.3
17. »	4.1
29. »	4.0
31. »	3.9
12. Febr.	4.4
14. »	4.3
26. »	4.0
28. »	3.9
12. March	3.9
14. »	3.9
26. »	3.4
28. »	3.4
13. Apr.	3.5
15. »	3.7
27. »	3.6
29. »	3.7
11. May	4.1
13. »	3.9
25. May	4.5
27. »	4.2
8. June	6.2
10. »	6,7
22. »	7.0
24. »	7.5
6. July	7.8
8. »	8.6
20. »	9.7
22. »	10.8
3. Aug.	9.8
5. »	9.9
17. »	9.6
19. »	10.6
31. »	10.1
2. Sept.	10.2
14. »	9.9
16. »	9.9
28. »	9.9
30. »	9.5

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1935

Date	t°C
11. May	3.6
13. »	3.3
25. »	4.3
27. »	4.3
8. June	4.9
10. »	4.8
22. »	4.6
23. »	5.6
6. July	5.8
7. »	5.7
20. »	9.1
21. »	7.0
3. Aug.	7.6
5. »	9.2
17. »	8.4
18. »	8.3
31. »	9.7
1. Sept.	9.0
14. »	7.8
15. »	7.7
28. »	7.2
30. »	7.0
12. Oct.	6.5

Date	t°C
14. Oct.	6.6
26. »	5.6
28. »	5.2
9. Nov.	5.6
11. »	5.4
23. »	6.0
25. »	5.7
7. Dec.	5.0
9. »	5.1
21. »	4.7
23. »	4.6

1936

Date	t°C
4. Jan.	4.7
18. »	4.4
19. »	4.1
1. Feb.	3.6
2. »	3.4
15. »	3.8
17. »	3.6
28. March	1.8
30. »	2.4
11. April	1.8
12. »	2.0
25. »	3.4
26. »	3.2
10. May	4.1
11. »	4.1
23. »	4.5
24. »	4.4
6. June	5.0
8. »	4.8
20. »	6.0
22. »	5.4
4. July	7.0
6. »	6.0
18. »	8.1
20. »	7.2
1. Aug.	8.4
3. »	9.6
15. »	9.8
17. »	9.9
29. »	9.8
31. »	9.4
12. Sept.	8.1
14. »	8.4
26. »	8.0
28. »	7.8

Date	t°C
10. Oct.	7.2
12. »	7.0
24. »	6.6
26. »	6.6
7. Nov.	6.0
8. »	6.0
21. »	5.8
22. »	5.7
5. Dec.	5.3
7. »	5.3
19. »	5.3
21. »	5.0

1937

Date	t°C
2. Jan.	4.8
4. »	4.3
16. »	4.2
18. »	3.8
30. »	4.0
31. »	3.7
13. Febr.	2.2
15. »	1.9
27. »	1.9
28. »	2.0
13. March	1.9
15. »	1.7
27. »	2.2
29. »	2.0
10. Apr.	1.9
11. »	1.9
24. »	2.7
26. »	2.7
8. May	3.3
10. »	3.0
5. June	4.5
6. »	4.5
19. »	6.9
20. »	8.3
3. July	7.7
5. »	9.2
17. »	11.4
19. »	10.4
31. »	8.9
1. Aug.	9.5
14. »	10.0
15. »	10.1

Date	t°C
28. Aug.	9.4
29. »	10.0
11. Sept.	8.4
12. »	8.0
25. »	7.7
26. »	7.6
9. Oct.	7.9
11. »	7.9
23. »	7.6
25. »	7.1
6. Nov.	6.8
7. »	6.6
20. »	6.3
21. »	6.1
4. Dec.	5.8
5. »	5.4
18. »	5.0
19. »	4.7

1938

Date	t°C
1. Jan.	4.6
2. »	4.9
15. »	3.7
17. »	3.7
29. »	3.9
31. »	3.9
12. Febr.	4.3
14. »	4.3
26. »	4.0
27. »	4.0
12. March	4.1
14. »	3.9
26. »	3.3
28. »	3.3
13. Apr.	2.5
15. »	2.7
27. »	3.3
28. »	3.4
11. May	3.3
13. »	3.3
25. »	3.8
26. »	4.1
8. June	6.3
9. »	6.6
22. »	5.8
23. »	6.2
6. July	7.0

Date	t°C
8. July	7.8
20. »	11.0
21. »	11.0
3. Aug.	10.1
4. »	11.2
17. »	10.0
19. »	9.6
31. »	10.0
1. Sept.	10.5
14. »	9.8
16. »	9.4
28. »	9.3
29. »	9.3

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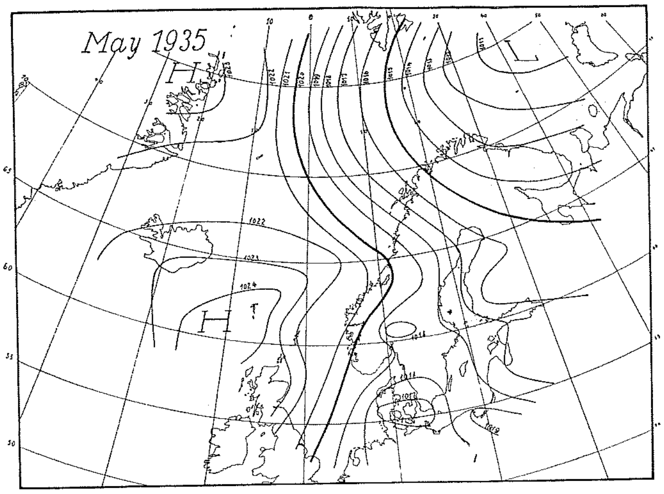
1935

Date	t°C
12. May	3.1
26. »	3.7
8. June	5.0
9. »	5.2
23. »	6.5
6. July	6.0
7. »	6.0
21. »	7.2
4. Aug.	7.2
5. »	7.6
17. »	8.2
18. »	8.1
31. »	8.5
1. Sept.	8.4
14. »	8.0
15. »	8.1
28. »	7.2
29. »	7.0
13. Oct.	6.8
26. »	5.9
27. »	5.6
10. Nov.	5.3
24. »	4.9
7. Dec.	4.7
8. »	4.4
22. »	4.8
23. »	4.9

Date	t°C
1936	
4. Jan.	4.0
5. »	3.7
18. »	3.9
19. »	3.9
1. Feb.	3.0
2. »	3.5
16. »	2.6
28. March	1.2
30. »	0.8
11. April	0.8
12. »	1.4
25. »	2.5
26. »	2.8
10. May	3.7
23. »	4.6
24. »	4.5
7. June	5.0
21. »	5.5
5. July	6.2
19. »	7.2
2. Aug.	8.3
16. »	8.7
29. »	9.4
30. »	9.4
13. Sept.	8.0
26. »	7.6
27. »	7.6
10. Oct.	6.8
11. »	6.8
24. »	5.7
25. »	6.5
7. Nov.	5.2
8. »	5.6
21. »	6.1
22. »	5.4
6. Dec.	5.2
20. »	5.0
1937	
2. Jan.	4.4
3. »	4.0
16. »	3.9
17. »	3.6
30. »	3.5
31. »	3.4
14. Febr.	2.0
28. Febr.	2.0
14. March	1.0
28. »	2.0
10. Apr.	1.8
11. »	1.9
24. »	2.3
25. »	2.3
9. May	2.8
5. June	4.5
6. »	4.8
20. »	6.6
4. July	7.8
18. »	7.8
1. Aug.	8.4
15. »	9.7
28. »	10.0
29. »	9.8
11. Sept.	8.6
12. »	8.7
25. »	7.5
26. »	7.4
9. Oct.	7.4
10. »	7.4
23. »	7.1
24. »	7.0
7. Nov.	6.3
20. »	5.3
21. »	5.5
4. Dec.	5.0
5. »	5.1
18. »	3.8
19. »	3.8
1938	
1. Jan.	4.1
2. »	3.8
16. »	3.5
30. »	3.3
12. Febr.	3.8
13. »	3.8
26. »	3.8
27. »	3.4
12. March	3.2
13. »	2.9
27. »	3.0
13. Apr.	2.4
14. »	2.5
27. Apr.	3.3
28. »	3.1
11. May	3.6
12. »	3.6
25. »	4.3
26. »	4.0
9. June	5.6
22. »	7.0
23. »	7.2
6. July	7.7
7. »	7.6
20. »	9.0
21. »	9.8
3. Aug.	9.7
4. »	9.7
17. »	9.5
18. »	9.5
31. »	9.9
1. Sept.	10.0
14. »	10.0
15. »	9.9
28. »	9.2
29. »	9.2
VARANGER-FJORDEN	
1935	
12. May	3.0
26. »	3.6
9. June	6.1
23. »	8.0
7. July	6.0
21. »	8.7
4. Aug.	10.8
18. »	8.8
1. Sept.	9.8
15. »	8.2
29. »	7.3
13. Oct.	7.0
27. »	6.0
10. Nov.	5.2
24. »	4.5
8. Dec.	4.0
22. »	3.2
1936	
5. Jan.	3.5
19. »	2.8
2. Feb.	2.4
16. »	2.3
29. March	0.8
12. April	1.2
26. »	2.5
10. May	4.6
24. »	4.7
7. June	5.7
21. »	9.4
5. July	7.0
19. »	8.2
2. Aug.	10.0
16. »	10.6
30. »	9.4
13. Sept.	8.5
27. »	7.7
11. Oct.	7.0
25. »	6.8
8. Nov.	5.6
22. »	5.3
6. Dec.	4.9
20. »	4.7
1937	
3. Jan.	4.0
17. »	3.6
31. »	3.4
14. Febr.	1.6
28. »	1.8
14. March	1.2
28. »	0.8
11. Apr.	0.9
25. »	1.6
9. May	2.8
6. June	4.2
20. »	9.0
4. July	8.2
18. »	11.9
1. Aug.	13.5
15. »	12.7
29. »	12.0
12. Sept.	9.4
26. »	7.8

Date	t°C	Date	t°C	Date	t°C	Date	t°C
10. Oct.	7.4	1938		27. March	2.4	7. July	10.7
24. »	7.0	2. Jan.	3.9	14. Apr.	2.4	21. »	13.9
7. Nov.	6.3	16. »	3.2	28. »	2.4	4. Aug.	8.4
21. »	5.7	30. »	2.9	12. May	2.9	18. »	9.9
5. Dec.	5.2	13. Febr.	3.1	26. »	4.1	1. Sept.	11.3
19. »	4.4	27. »	3.1	9. June	8.1	15. »	10.3
		13. March	2.6	23. »	8.5	29. »	9.2


May 1935
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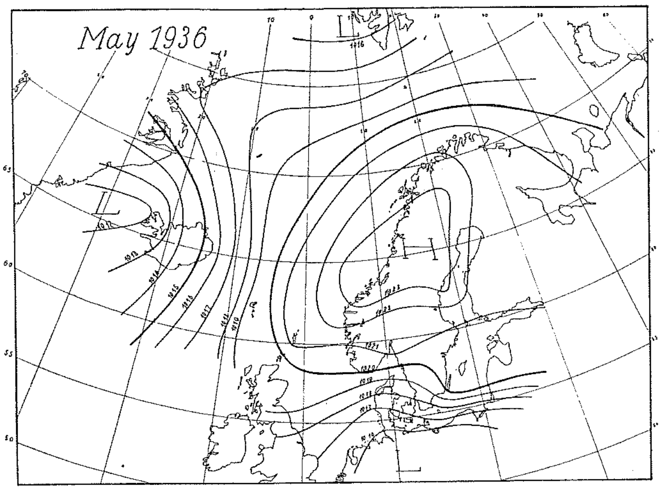
May 1936
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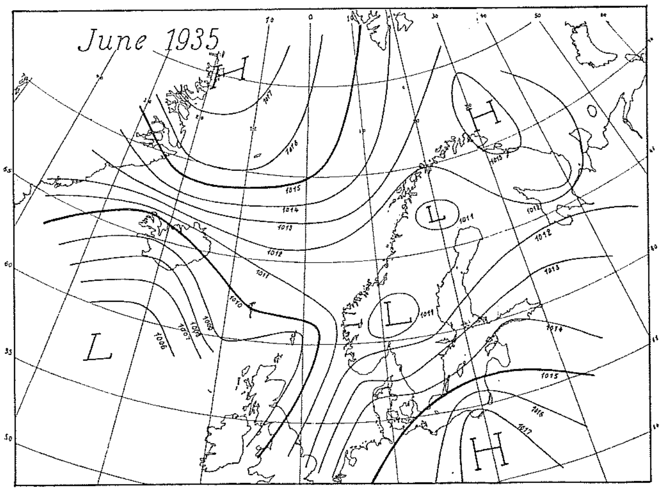
June 1935
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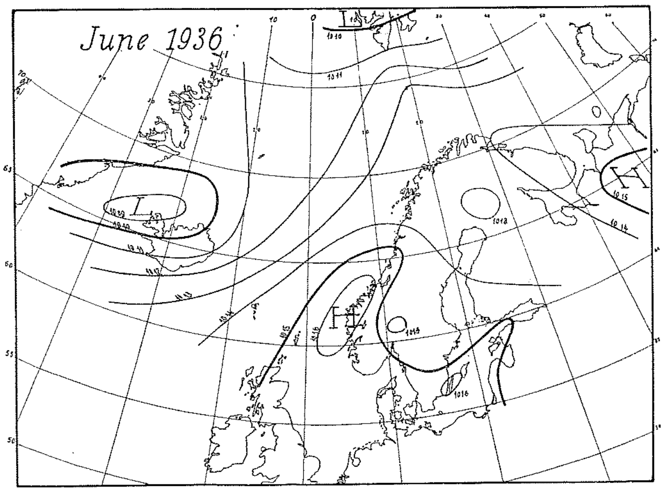
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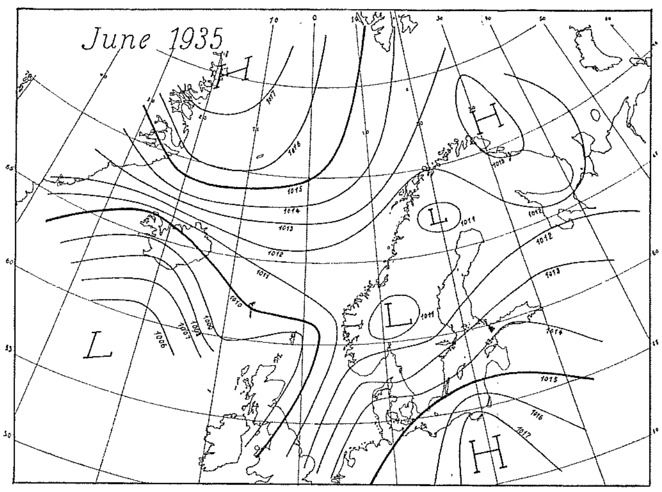
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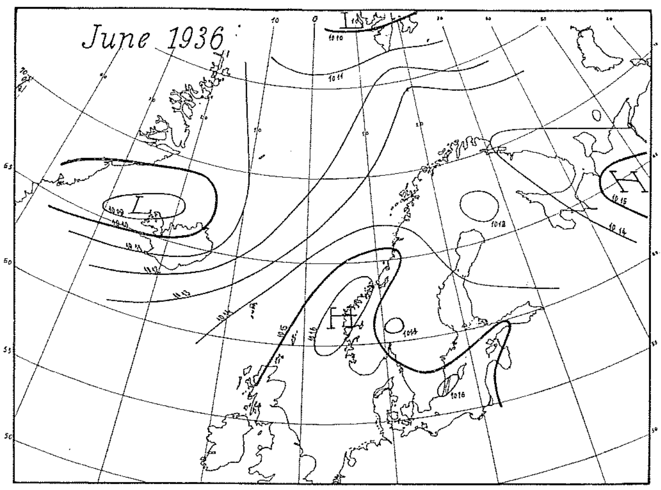
June 1936
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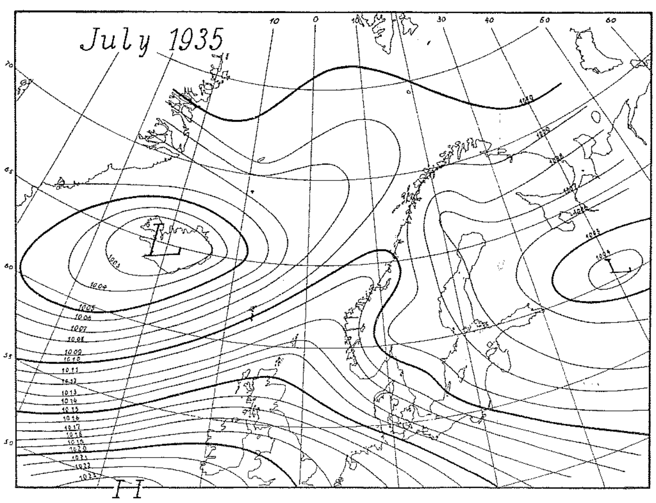
July 1935
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L
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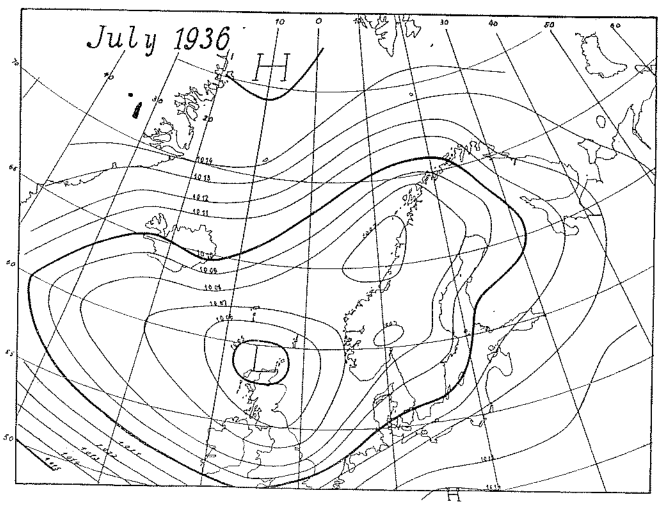
July 1936
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