THE DANISH

INGOLF-EXPEDITION.

VOL. I.

PUBLISHED AT THE COST OF THE GOVERNMENT

BY

THE DIRECTION OF THE ZOOLOGICAL MUSEUM OF THE UNIVERSITY.

COPENHAGEN.

H. HAGERUP.

PRINTED BY BIANCO LUNO A/S.

1899–1900.

Contents of Vol. I.

THE DANISH INGOLF-EXPEDITION

Vols. I-VI: 1899-1953

Complete sets, in a reprinted edition, will be sold by the Greenwood Press, Inc. 211 East 43rd Street, New York, N.Y. 10017, U.S.A.
Single parts are sold by the Zoological Museum, Universitetsparken 15, 2100 Copenhagen Ø., Denmark.

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H. M. S. INGOLF

THE DANISH INGOLF-EXPEDITION.

VOLUME I.

1.

REPORT OF THE VOYAGE

BY

C. F. WANDEL.

WITH 1 PLATE.

2.

HYDROGRAPHY

BY

MARTIN KNUDSEN.

WITH 34 PLATES.

TRANSLATED BY BALTHAZAR PETERSEN.

COPENHAGEN.
BIANCO LUNO (F. DREYER) PRINTER TO THE COURT.
1899.

The cruiser *Ingolf* in *Godthaab* harbour.

REPORT OF THE VOYAGE.

According to the Financial Law of 1894—95, a sum of 30,000 Kroner was voted on the budget of the Ministry of Public Instruction for preliminary arrangements for a Danish scientific deep-sea expedition by the cruiser *Ingolf* for exploration of the Arctic seas around Iceland and Greenland, zoological collections being the principal object of the expedition.

The expedition was to be made in two voyages of 4 months each, respectively in 1895 and 1896.

On the 12th of April 1894, I received a communication from the Ministry of Public Instruction to undertake the necessary arrangements for the expedition together with professor *Lütken*, and on the 16th of the same month, I received another communication from the Ministry of Naval Affairs to inform me that I was appointed captain of the cruiser *Ingolf* and Leader of the expedition.

The Ministry of Naval Affairs placed the cruiser *Ingolf* at disposal with officers and crew for the above purpose.

Further on negotiations were entered into with the Naval Dockyard, and from these resulted that the principal alterations and fittings that had to be performed were as follows: Building of a deck-house aft with 3 cabins, a large one for the zoologists of the expedition, and two smaller ones, one of which for the physicist and the other for the botanist; fitting of a steam-winch with appertaining reel for the steel-wirerope; a reel for the thermometer-line; a trawl-boom with appurtenances, trawl and dredges as well as weights for soundings. The Ministry of Naval Affairs was not in favour of any alterations being made in the accommodation and fittings below deck, nor were any alterations in this respect necessary.

Furthermore, during the course of the year, all necessary appliances for deep-sea work were procured, and at the acquirement of these articles, the last American Atlantic expeditions[1]) served as a model, while the appliances for collecting of Plankton were copied from those that had been used on the German *Plankton-Expedition*, and in accordance with the experiences made on this expedition, the only one where these investigations hitherto had been carried out after a regular plan.

It was left to the Zoological Museum to supply the expedition with spirits, glasses, and other similar articles for preparation and conservation of the collected material.

The following gentlemen were destined to take part in the expedition: Commander *A. F. M. Evers*, Lieutenants *H. F. Kiær* and *H. O. Ravn*, Mr. *A. C. Otzen* as chief engineer, Mr. *W. Thulstrup* as surgeon, and the following naturalists: Mr. *Ostenfeld-Hansen* as botanist, Mr. *M. Knudsen* M. A., as physicist, Mr. *H. Hansen*, D. P. and Mr. *Hector Jungersen*, D. P., as well as Mr. *W. Lundbeck* M. A., as zoologists.

According to the instructions I received as Cpt. of the cruiser *Ingolf*, and by which it was specially pointed out that the principal object of the expedition was to be zoological work and collections, the following were the objects the expedition had to carry out:

1. Soundings with determination of temperature, collecting of samples of water and bottom, determination of the rate and direction of the current at the surface and, if possible, in the depths.

2. Zoological work. Collecting of marine animals, and preliminary examinations, preparation and conservation of same. The collection was not only intended to comprise what was living on and at the bottom of the sea, but also what could be found in intermediate depths and at the surface, for which purpose the expedition had been furnished with suitable apparatuses.

3. Botanical work. Collecting of specimens of the vegetable kingdom, and preparation and conservation of these articles for further examination.

4. Exploring of Fjords. Stays in the Icelandic fjords should be used for examination and surveying of these latter with special regard to the condition of the bottom. (Flora & Fauna). The same applies to the Greenland fjords, provided there be any occasion to visit these latter.

5. Investigations regarding Fishing. Collection of all data — specially at Iceland — concerning fishing, soundings and collection of bottom material in the shallow sea around Iceland to as large an extent as circumstances would permit.

6. Meteorological observations. Barometer and thermometer observations, likewise observations concerning the direction and force of the wind, amount of clouds, precipitation, etc., determination of the temperature and specific gravity of the sea at the surface, the presence of ice, etc.

7. Magnetic observations. Determination of the variation on shore, when the local circumstances would permit this, as well as at sea.

8. Occasional observations to which circumstances might give rise, such as hydrographical work, observations of the ice, sailing directions as well as collections on shore.

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[1]) *Charles D. Sigsbee:* Deep-Sea Sounding and Dredging, Washington 1880. — *Alexander Agassiz:* Three cruises of the United States Coast and Geodetic Survey Steamer *Blake*, London 1888.

It was left to myself to decide the plan that was to be followed, after I had made myself acquainted with the condition of the ice at the place; I only got orders — on account of the work «*Fauna Grønlandica*» that was being prepared — to finish the investigation of the waters to the westward of *Cape Farewell* in 1895, and upon the whole to work with the object in view of bringing the work — on the whole of the territory intended to be examined — to an end in the course of two voyages of 4 months each.

On the 2d of May, the vessel was commissioned. The crew consisted of 70 hands all told, and when everything was in order and on board, the ship put out from the Naval Dockyard the same day to try her engines. After the third and fourth of May had been used for adjustment of the compasses, and a temporary trial had been made of the instruments and apparatuses on board, the cruiser left on the morning of the 5th for the Færoe-Islands, at which place she arrived on the 9th.

From the Færoe-Islands the course was shaped for *Seydis-Fjord* on the eastcoast of Iceland. During the passage a series of stations were taken as prescribed by the plan. All apparatuses and installations were tried, and everything worked upon the whole in a satisfactory manner, so that only a few modifications were considered necessary.

From *Seydis-Fjord* it was originally intended to proceed to the seas to the northward of Iceland, but the intelligence that reached us at the said fjord concerning the ice, was upon the whole discouraging to such a degree, that I made up my mind to spend the time before the cruiser's departure to Greenland in explorations in the *Denmark-Strait*.

The cruiser left *Seydis-Fjord* on the afternoon of the 15th of May, and sailed in fine weather along the eastern coast of Iceland, sounding and trawling. On the night between the 16th and 17th sounding and trawling were performed south of Iceland in 600 fathoms of water in latitude 63° 13′ N. and longitude 15° 41′ W., but a quickly freshening westerly wind which soon increased to a gale, hardly allowed the completion of the work.

Fighting against bad weather, which prevented all work, the cruiser reached *Cape Reykjanæs* in the forenoon of the 19th, and from this spot a regular line was taken towards the eastcoast of Greenland at the latitude of *Angmagsalik*, the place, where, according to experience, the eastern Greenland ice has the least extent. The edge of the ice was reached on the 23d, but we did not succeed in approaching the coast nearer than 60 miles, and the *Ingolf* reached only the edge of the Arctic current which is running south along the east coast of Greenland. We just succeeded in completing the line under an increasing north easterly breeze, which afterwards increased to a gale till the 28th, preventing all work; on the following day the cruiser arrived at *Dyre-Fjord*.

At this place we coaled ship, completed different kinds of ship's work and overhauled the engines. The bottom of the fjord was examined, and after celebration of the Whitsuntide holidays the cruiser sailed again on the 4th of June into the *Denmark-Strait* for exploration, for which, however, the weather often threw obstacles in the way. On the 7th of June the cruiser called at *Isafjord* to take in coals, which had been discharged there for her, stood again into the *Denmark-Strait*, called at *Ønundar-Fjord* and *Dyre-Fjord*, and arrived at *Reykjavik* on the 12th of June. During her stay here, the naturalists made an expedition into the country.

While in *Ønundar-Fjord* the expedition received the sad tidings that the vessel carrying to

Greenland a great deal of the coals for the expedition had been lost. Notwithstanding the fact that «the Royal Greenland Company» had done all in its power to make up for this misfortune, it had, however, a very impeditive effect on the mobility of the cruiser during the remaining part of the voyage, for which, on account of the difficult means of conveyance, the supply of coals already beforehand was small enough.

On the 15th of June the cruiser left for the *Davis-Strait*, and after a very favourable passage with good scientific results arrived in *Godthaab* on the 26th of June.

After we had coaled ship and completed different kinds of ship's work, the cruiser proceeded again on the 30th of June on a northwesterly course into the *Davis-Strait*, taking soundings and trawlings etc. on the bank along the coast till we fell in with the western ice which was lying very easterly this year. The course was then altered to East towards *Sukkertoppen*, at which place it was intended to call, but on account of continual stiff breeze and fog, this plan had to be abandoned; the cruiser steered again into the Strait for explorations and arrived at *Holstensborg* on the 7th of July. The cruiser was retained at this place one day on account of its assistance being required in consequence of illegal fishing by American fishing-vessels, and, when this case was settled, the cruiser sailed again into the Strait and towards the western ice, which again proved to be lying very easterly. On the 12th of July in a thick fog, the course was shaped NE. to try to get to the northward by following the edge of the ice, but this latter proved to be lying in an easterly-westerly direction, so that the course made good, in spite of repeated attempts to get through to the northward, proved to be East. Owing to this, it was not long before the cruiser found herself on the «*Store Hellefiskebanke*» with only 18 fathoms of water, which proved that the distance from the coast was not great, but a thick fog prevented us from getting a clear view of the situation.

Hoping that the fog would lift, we brought up for a kedge anchor, but shortly afterwards the ice cet in on the ship from the northward, so that no time was to be lost to proceed to the southward; there was no doubt that all passage to the northward was blocked, which also later shipping intelligence has confirmed, and however much I objected to it, I had to give up all further attempts of getting through to the northward, as being too dangerous under the present condition of the ice, partly on account of the unfitness of the vessel to meet large masses of ice, and partly on account of the insufficiency of our supply of coals. Having called at *Sukkertoppen* and continued our work in the Strait, the cruiser arrived at *Godthaab* on the 19th of July. At this place we coaled and performed some ship's work, while the naturalists availed themselves of the opportunity to make an expedition to the *Ameralik-Fjord*.

Having been detained one day by fog, the cruiser left *Godthaab* on the 26th of July steering to the westward, but after a few hour's sailing we found ourselves in the middle of the field-ice, and it was not till after a great deal of sailing in a northerly direction that we succeeded in getting out of it, whereafter the course was shaped to get out of the Strait; we had fine weather and an excellent result of our work as far as *Cape Farewell*, but from that place the cruiser met with constant stormy weather, greatly decreasing our not very large supply of coals, and making it necessary to run in to *Reykjavik*, a determination which I took but reluctantly, because, by doing so, the outward and homeward course between Iceland and Greenland would be nearly the same line.

After a short stay at *Reykjavik*, I proceeded to sea again on the 8th of August, steered a southerly course till the latitude of the Færoe-Islands when the course was altered to East, and arrived at the said islands after a good passage with a corresponding good result of scientific work. By the bye, I shall only mention that at the last trawling made to the westward of the Færoe-Islands, the only mishap occurred to the material employed for the deep-sea work, as not only the trawl-bag came up entirely rent, but the trawl-frame itself was completely destroyed.

From the Færoe-Islands the course was shaped homewards, and on the 23d the cruiser arrived at *Copenhagen*, where she was paid off on the 31st of August.

It will be seen by the foregoing, that on an average and in consideration of the time of the year, the expedition met with very stormy weather, and that furthermore, it fell in with unusually large masses of ice in the *Davis-Strait* as well as in the *Denmark-Strait*, so that on account of the ice in the *Davis-Strait*, the vessel did not get more northerly than to *Holstensborg*, while, in consequence of the ice in the *Denmark-Strait*, explorations in the Eastern Greenland Arctic current were prevented.

The result of the voyage must for all that be regarded as satisfactory.

As to the fitting out, the result of the voyage had in every respect confirmed that the outfit of the vessel had served the purpose, and that with exeption of making up for what had been used on the voyage in 1895 only a few alterations and procuring of articles of minor importance had to be made for the voyage in 1896.

Still is to be noted, that the expedition was specially visited by a mishap, which may occur with the deep-sea thermometer hitherto employed on similar expeditions, a mishap entirely prevented from taking place on the expedition in 1896, in consequence of an alteration made to the thermometer by one of the members of the expedition, the physicist Mr. *Knudsen*; he had likewise constructed an air-analysing apparatus, by means of which investigations could be made on the spot. Further particulars concerning this subject will be mentioned in the following.

The same officers and naturalists that had been with the expedition in 1895 took part in the expedition in 1896, only with exception of Mr. *Wesenberg-Lund*, having joined the expedition instead of Dr. *Hansen* who retired at his own request.

The vessel was commissioned on the 30th of April, and the cruiser proceeded on the 3d of Mai to the seas SE. and S. of Iceland, where the scientific work commenced; this latter was thereafter continued in a westerly direction till the 62d parallel of latitude as the southern line of demarcation; it was not till the 18th that we succeeded in bringing the work in these waters to an end, as the cruiser almost incessantly on her working field encountered very bad weather, sometimes assuming the character of a gale and preventing all work.

From *Reykjavik*, at which place we called for coaling, the course was laid for the *Snefjelds-jokel*, and from here a line was laid towards the eastcoast of Greenland at *Angmagsalik*, to which we succeeded in coming as near as about 40 miles, when the ship was stopped by ice, and for the second time prevented from making her way into the Arctic current. From this place, it was our intention to take a line of observations in the longitudinal section of the *Denmark-Strait*, but this was prevented by the polar ice, which north of *Angmagsalik* stretched itself in an easterly direction, and reached right in upon the Iceland banks.

Hoping that the situation of the ice might be more favourable later on in the year, I sailed on the 8th of July, after having coaled ship and done several kinds of ship's work at *Dyre-Fjord,* for the East coast of Iceland.

It was not without some difficulty occasioned by ice that I succeeded in passing the north-western part of the island, whereafter the course was laid for *Cape Langanæs,* and, when this was passed, the explorations began at the Eastcoast, and were brought to an end on the 18th of July.

The cruiser left *Eske-Fjord,* where it had coaled, on the said day, and the course was laid for *Jan Mayen*, under the south coast of with we brought up with a stiff northerly breeze in the night between the 22d and 23d of July. The island has no safe anchorage, and vessels are obliged to anchor on the open coast, and in case of a fresh sea-breeze suddenly springing up, they may run the risk of being barred out from communication with the shore for a long time; as according to my instructions, I had no special task to perform in this island, we did not make a longer stay here than necessary for the naturalists to make a short visit ashore.

From *Jan Mayen* the course was laid for *Cape Langanæs,* where the cruiser arrived on the 21st of July, and from this place we steered West to the *Melrakkaslette*, and afterwards in a northerly direction till we reached the polar ice at a distance of 105 miles from Iceland.

The whole of the voyage, after we left *Eske-Fjord,* was favoured with fine weather, and a great number of stations had been obtained with a specially good result.

On the 30th and 31st, the cruiser visited *Øfjord.*

It was hereafter my intention to resume the work north and northwest of the northwestern part of Iceland, but the cruiser found the state of the ice just as unfavourable as it had been on the outward passage; from the *Skagen,* the northeasterly corner of the *Skagestrand-Bay,* we only succeeded in penetrating 40 miles to the northward; more westerly, circumstances were still more unfarourable, as the ice here was lying close to the shore; even along the west coast outside *Isafjord*, the ice was on the 3d of August lying at a distance of only 11 miles from the shore, a circumstance I never have witnessed at this time of the year, during the many years I have been navigating in the Icelandic waters.

From a zoological point of view, it is perhaps of minor importance that the part of the Arctic sea, bordering on the northwestern part of Iceland, has not been examined; on the other hand, I regret it more in so far as hydrography regards, and likewise that we have not succeeded in getting soundings on the fishing banks of the aforesaid part of the Arctic sea.

When the cruiser had taken in the necessary coals for the homeward passage at *Dyre-Fjord,* the course was laid round the south of Iceland, where some completing work was done, and after this, some time was spent in examining the submarine ridge between Iceland and the Færoe-Islands, which gave a good result.

At the Færoe-Islands, the cruiser made a stay of a few days, among other things to take on board the skeleton of a cacholot acquired by the Zoological Museum at Copenhagen. On the 19th of August, the *Ingolf* arrived in the *Sound,* and on the 29th she was paid off; with this the expedition was concluded.

From the foregoing it will be seen, that the years 1895—96 were characteristic by the presence of large masses of the polar ice in the seas visited by the expedition, which, as has been seen, prevented the exploration of the seas northwest of Iceland.

Upon the whole, it must be admitted that the expedition has carried through its object, and that valuable collections and results have been brought home.

THE VESSEL, THE APPARATUSES AND THEIR APPLICATION.

The vessel. The cruiser *Ingolf* is an iron vessel built in the Naval Dockyard in 1876, length 188 feet, beam 27 feet, draught of water 12 feet 10 inches, displacement 996 tons, indicated horse power 670; maximum speed 10.5 knots, supply of coals 155 tons; with the common speed of 8 knots, generally employed on the voyages, the consumption of coals is 0.3 ton pr. hour.

By the aforesaid will be seen that the *Ingolf*, on account of its dimensions, supply of coals, and not very large consumption of coals, was well fit for the expedition; less convenient was it, however, that she was an iron vessel. Certainly it must be admitted, that the object with the expedition was not to make the vessel force her way into the polar ice, but navigation with an iron vessel, near or among polar ice, must be undertaken with greater precaution than with a wooden ship, and time may be lost in consequence of the vessel being obliged to wait or to go out of its way under circumstances, when such a thing would not have been necessary with a wooden vessel, but as it was, the navy had not any suitable wooden wessel at its disposal for the expedition.

The large masses of ice the vessel fell in with on both voyages corroborate but too evidently, I am sorry to say, what has been said above.

As already mentioned, the vessel was during the winter 1894—95 fitted out for the forthcoming expedition. No alterations in so far as regards the accomodation and interior fittings of the vessel were made, with exception of a few precautionary measures with the room intented to hold the large store of spirits. — On the forepart of the deck, and aft of the fore-hatch, was placed a trawl-winch for paying out and heaving in of the trawl-wire; a reel for the winding up of this wire, and another reel for the winding up of the thermometer-line. In the superstructure on the starboard side a dark room was arranged for photographic work.

On the quarter deck a house was built for the naturalists, 26 feet long and 24 feet broad, and divided into two parts by an athwart-ship bulkhead. The foremost part of it was the work-room of the zoologists, and the aftermost part of it was by a longitudinal bulkhead divided into two rooms, one of which was intended for the use of the botanist, and the other for the physicist. The roof of the house was surrounded by a low railing to enable it to be used for the stowage of such articles as could not without great difficulty be stoved below deck, or which were to be placed there for drying.

The Sounding Machine. For soundings was used *Sigsbee*'s machine with a few modifications; a driving belt for inst. was not used, but a messenger chain; and, when soundings were taken, the wheel on which the line was wound up was at liberty to revolve round its shaft, with which it was put in connection by means of a sliding coupling box, when it was wanted to heave in on the line.

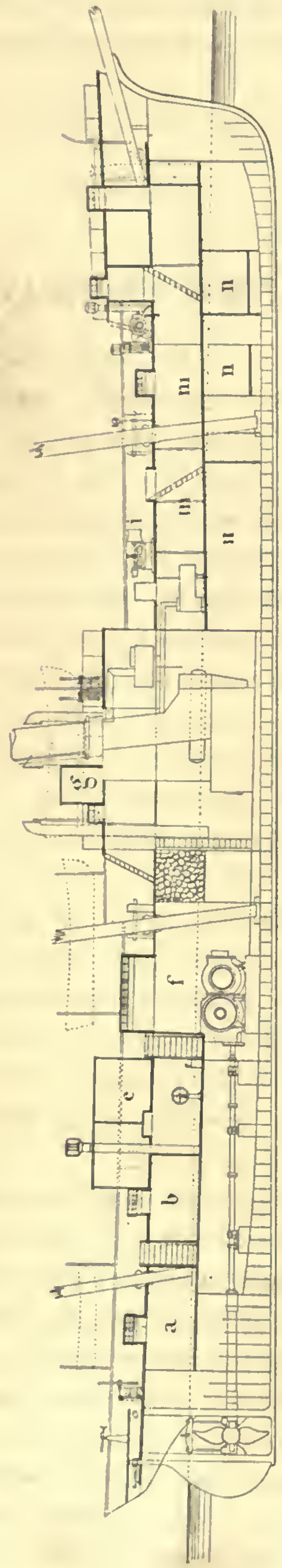


Fig. 1. Longitudinal section of the cruiser *Ingolf*.

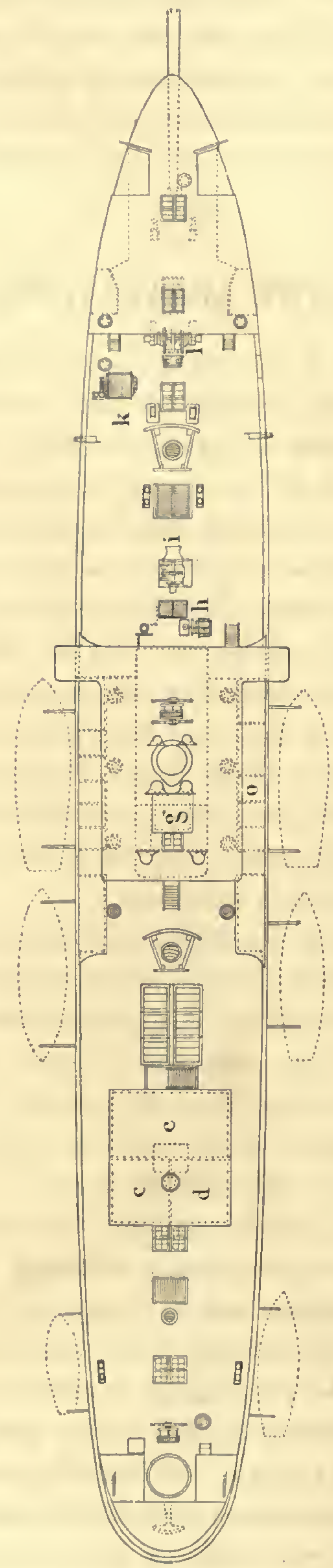


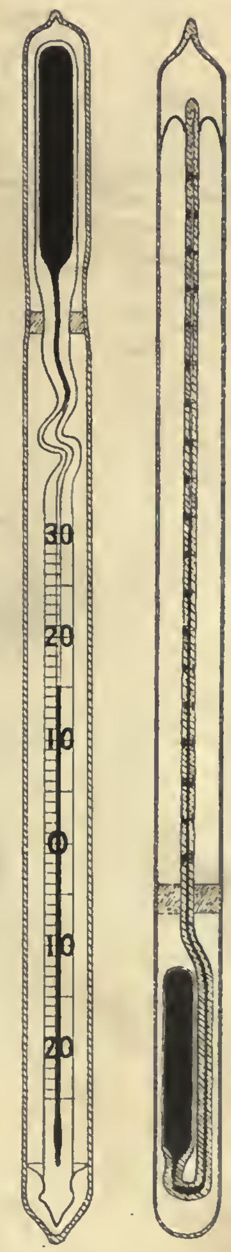
Fig. 2. Deckplan of the cruiser *Ingolf*.

a. Captains' cabin. *b.* Wardroom. *c.* Workroom of the botanist. *d.* Workroom of the physisist. *e.* Workroom of the zoologists. *f.* Engineroom. *g.* Chartroom. *h.* Reel for the thermometer-line. *i.* Trawl-winch. *k.* Reel for the trawl-wire. *l.* Capstan. *m.* Livingplace. *n.* Fore-hold. *o.* Coal-bunkers.

On the wheel were rolled up 4,000 fathoms of line, and this was — when the machine was not in use — stowed away in train-oil in a tank made for this purpose.

The lead-line was bright steel wire of 0.92^{mm} diameter, and with a breaking strain of 170^{kg}; it was delivered by the firm *Felten & Guillaume* in *Mühlheim am Rhein,* in lenghts of about 2,000 fathoms.

Fig. 3.



Negretti & Zambra's therm. *M. Knudsen*'s therm.

The deep-sea thermometer. On the first voyage was used the common *Negretti & Zambra* thermometer placed in *Managhi*'s turning-apparatus. A great defect with this thermometer is, that frequently it cannot be trusted when it has been used for some time. — After it has been turned, the mercury will sometimes during the heaving in make its way out of the reservoir.

We had a sad experience of this on board the *Ingolf* on the first voyage. After a few series had been taken, some of the thermometers commenced to show temperatures, which undoubtedly were wrong, and they had therefore to be re-measured with other instruments, and it was not long before the greater part of our stock of thermometers was unfit for use, as the mercury often filled up the tube of the thermometer entirely, after it had been used. This was a great inconvenience, as in concequence of this, the taking of series was made very troublesome, so that the observations had to be limited as much as possible.

When the aforesaid thermometers were turned in the hand, they always showed the correct temperature, and this was likewise the case with the thermometer attached to the hemp stray-line of the lead-line. This inconvenience did not manifest itself till the thermometer was attached to the thermometer-line. Mr. *Knudsen* proved that by giving the lower end of a thermometer a light push against a hard object, mercury would run down from the reservoir. It must therefore be supposed, that by taking series, the running down of the mercury was due to the vibrations or the jerks which the line is exposed to, when at one moment the vessel is heaved over against the line, and the next moment away from it.

During the preparations for the *Ingolf-Expedition*, it had come to my knowledge that on former expeditions, the aforesaid inconvenience had been noticed to exist with the *Negretti & Zambra* thermometer, and I ordered therefore from the optician Mr. *Chabaud* in Paris three thermometers, of which it was expressly declared, that they did not suffer from the aforesaid defect.

Most unfortunately these thermometers did not come up to what had been promised. On reception of the thermometers in *Copenhagen*, one of them always broke off at the same place when being turned, which probably must have been due to an air-bubble in the mercurial column; as to the two others, it was seen immediately — on their being used — that they could not be relied upon, they were just subject to the very defect, against which we desired to protect ourselves when we bought them.

For the second voyage of the *Ingolf,* Mr. *Knudsen* had constructed a thermometer, which in every respect proved that it could be relied upon; this result had been obtained by placing the reservoir for the mercury on the side of the thermometer-tube instead of in the prolongation of it, furthermore the scale was divided in such a manner that readings of $^1/_{100}°$ could be made with facility.

This thermometer was exclusively used on the second voyage without one single mishap, and must be recommended for application on future deep-sea expeditions, and whenever it is desired to ascertain the exact temperature below the surface of the water[1]).

Water-bottle. A water-bottle was used, to which the one constructed by *Sigsbee* served as a model, but of the following internal dimensions: 10^{cm} in diameter and 17^{cm} in height.

The internal space was decreased by: 1) the valve rod which is $8^1/_2{}^{mm}$ in diameter and 16^{cm} long, 2) a cross-bar through which the valve rod slides, 8^{mm} square and 10^{cm} long, 3) the lower valve which is a little arched and on the middle projects about 3^{mm} into the space.

The capacity of the space was between 1240 and 1250^{ccm}.

The water-bottle was attached to the thermometer-line by jam-nuts.

The thermometer-line employed at the taking of series, and to which thermometers and water-bottles were attached, was a laid galvanized wire-line with a diameter of $4{,}5^{mm}$, a breaking strain of $900—1{,}000^{kg}$, and delivered by the firm *Felten & Guillaume* in *Mülheim am Rhein.*

It was wound in a length of 4,000 fathoms on a reel moved by a two-cylinder engine; the line was marked with coloured bunting sewed on to it every 100 fathoms, the first hundred fathoms were again subdivided into 10 fathoms, the next 100 fathoms into 25 fathoms.

The trawl-wire was a steel wire rope of 10^{mm} diameter with a breaking strain of $5{,}000^{kg}$; it weighed about 30^{kg} per 100 fathoms. We had two lengths of it, each 4,000 fathoms, one of which was wound on a reel moved by a two-cylinder engine, and placed forward on the port side. The wire-rope was delivered by the firm *Felten & Guillaume* in *Mülheim am Rhein.*

This wire as well as the afore-mentioned thermometer-line was made of excellent material.

The trawl that was used, was a copy of the *Sigsbee* trawl, and we had it in two sizes, the large one 10 feet broad, and a smaller one $4^1/_2$ feet broad. A contrivance which proved to be very practical, was the fitting of a number of strings, 6 lines placed on each side of the trawl-bag, with the one end attached to the mouth-leech, and the other to the bottom of the trawl-bag. Even if these strings could not be said to be an absolute protection against rending of the trawl bag on a stony ground, they did at least good service in sparing the bag from chafing, and when damage occurred, they kept the whole mass together, so that the draught was not lost. To the trawl and trawl-frame were always attached 5 or 6 swabs, when it was working.

The dredge was of the type generally used, and with parallel mouth faces, height 4 feet, breadth 3 feet 1 inch. Width at the mouth 1 foot 1 inch.

The swab-rod was an iron-bar 5 feet 6 inches long with a thick circular iron disk, 1 foot 2 inches in diameter at each end to make it go clear of the irregularities of the bottom; the rod had 5 swabs attached to it.

Plankton-apparatuses. The apparatuses used for collection of Plankton, were as aforesaid, with a few modifications, copied from those employed on the German *Plankton-Expedition.*

[1]) The thermometer is delivered by *Negretti & Zambra* in London.

See: «Ergebnisse der Plankton-Expedition der Humboldt-Stiftung. Vol. I. B. Dr. *Victor Hensen*, Methodik der Untersuchungen». 1895. Of these were used:

The large vertical-net. The diameter of the net ring 2 meter, silk-cloth No. 3.

The middle-sized vertical-net. Diameter $1^1/_2$ meter, silk-cloth No. 3.

Plankton-net for quantitative capture. Silk-cloth No. 20.

The small Plankton-net (*Apstein*'s model). Silk-cloth No. 20.

Closing-net (*Hensen*'s improvement of the *v. Petersen & Chun* net). Silk-cloth No. 20.

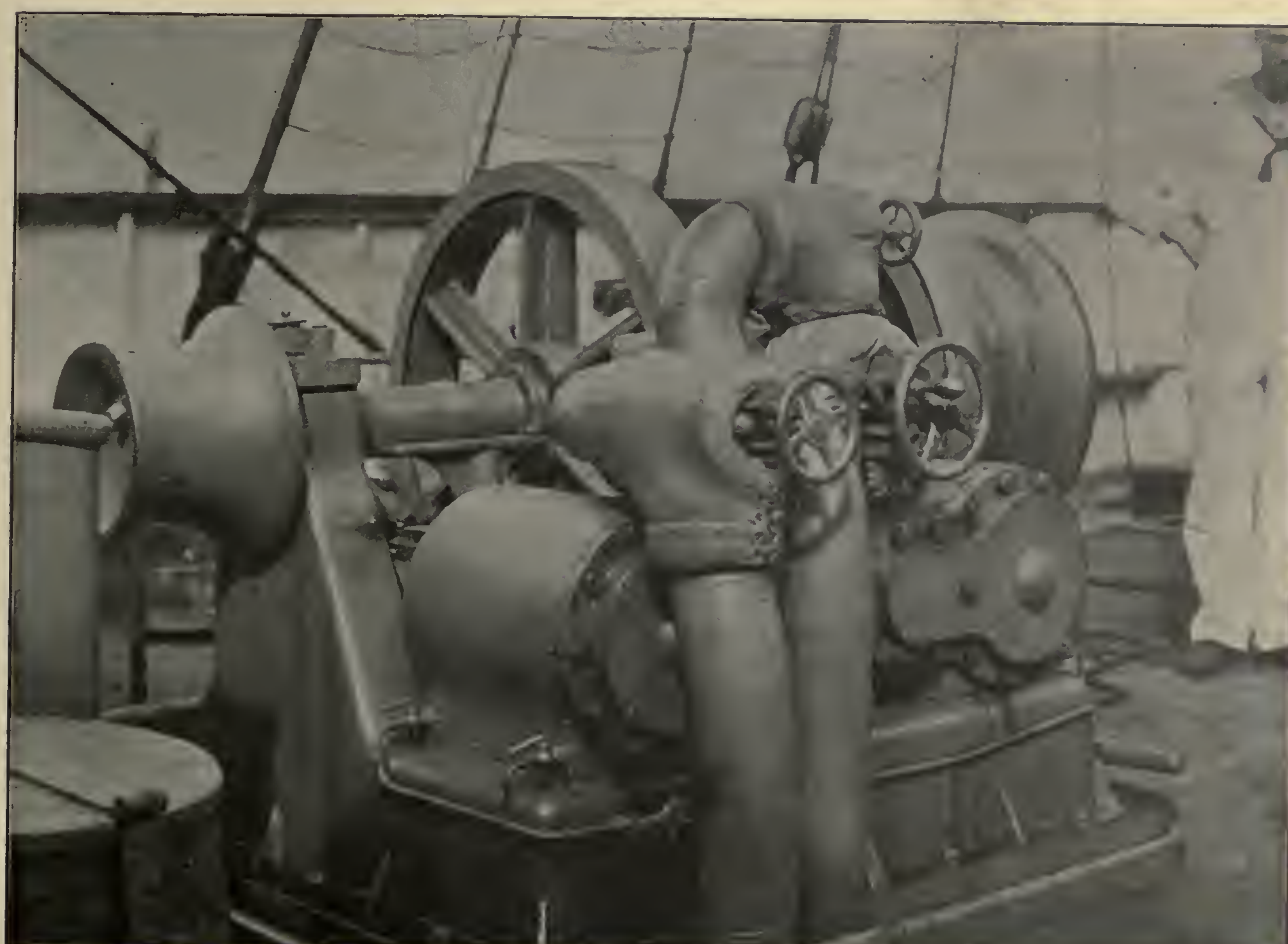


Fig. 4. Trawl-winch.

Cylinder-net for capture when the vessel was going full speed. Silk-cloth No. 19.

Further particulars concerning the application of the apparatuses will be given later on at Plankton-work.

The trawl-winch had 2 cylinders with a diameter of 10 inches, piston stroke 10 inches (the boiler pressure was 65 lbs. pr. square inch). The crank-shaft of the winch worked through gearing a main-shaft, the ends of which were supplied with drums, a small one for warping, and a larger one the diameter of which was 1 fathom, for the trawl-wire. By means of a shifting slide, the turning, direction of the winch could be shifted for heaving in or paying out.

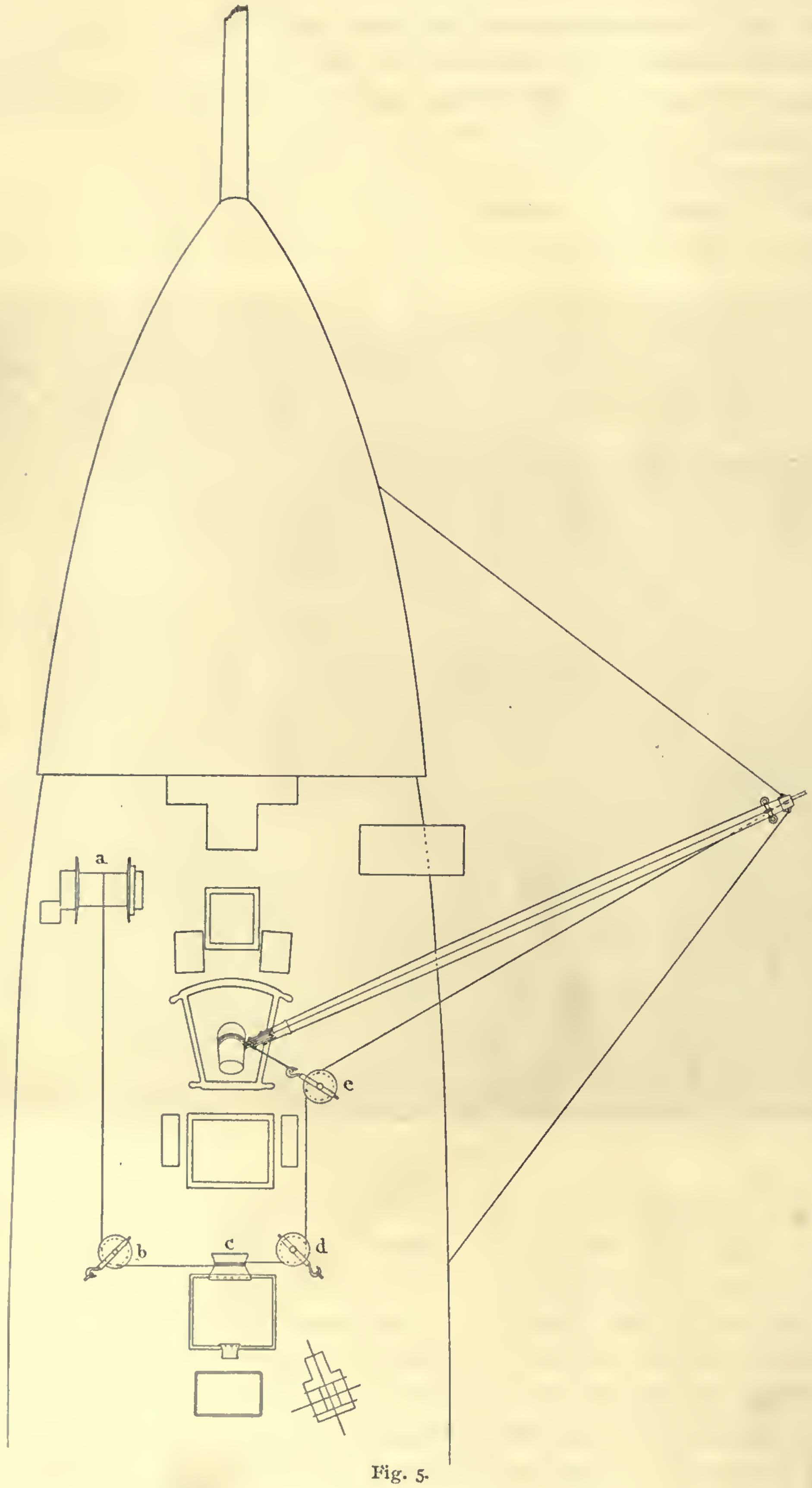


Fig. 5.

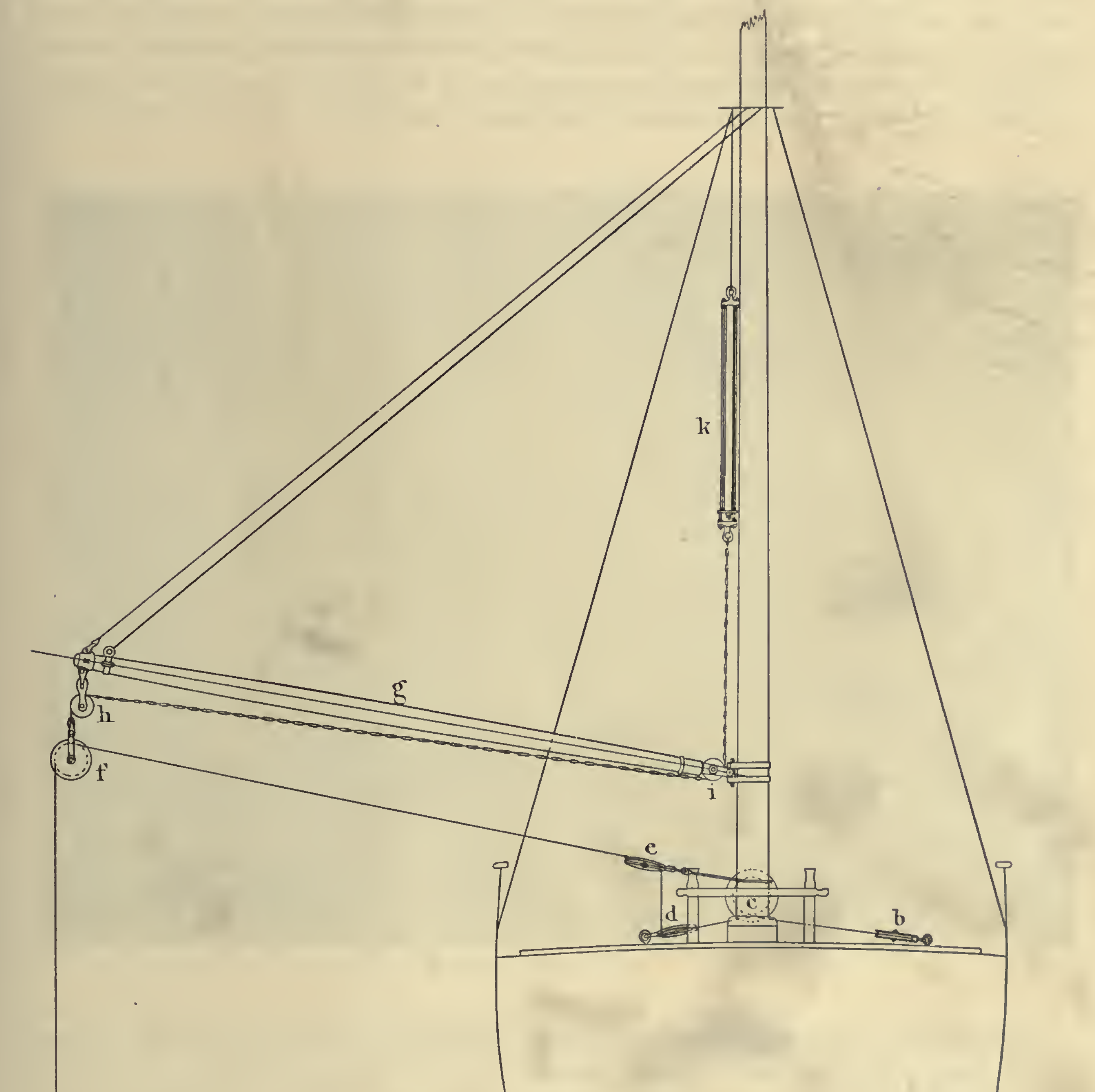


Fig. 6.

Fig. 5—6. *a.* Reel for the trawl-wire. *b.* Block. *c.* Drum of the trawl-winch. *d, e, f.* Blocks. *g.* Trawl-boom. *h.* and *i.* Guiding blocks for the chain. *k.* Accumulator.

Paying out when trawling on very small depths was made without assistance of the steam-engine, the cogwheel of the main-shaft could namely, by means of an apparatus for throwing out of gear, be put out of connection with the cogwheel of the crank-shaft, so that the large drum was at liberty to revolve and the paying out to be regulated by means of a brake-strap acting on the large drum. When trawling on great depths, where the weight of the wire rope that had been paid out was considerable, the paying out was effected by backing the engine.

Fig. 7. Trawl-boom.

By means of a counter worked by the main-shaft, the length of the trawl-wire that had been paid out, could be read, indicated in Danish fathoms.

Soundings were taken with the vessel lying head to wind. At the same time as the depth, the temperature of the water at the bottom was ascertained, and samples of the water at the bottom were taken. To this end a thermometer and a water-bottle were attached to the hemp stray-line of the lead-line.

To take samples of the bottom was used *Baily's* tube, which was generally let down attached to the trawl-frame.

Measurement of series or ascertainment of temperatures in and taking samples of water from intermediate layers was likewise effected with the vessel lying head to wind.

For this purpose was used the aforesaid thermometer line; the end of the line was taken from the reel on which the line was wound and which was placed athwartships before the superstructure, rove through various leading blocks abreast of the drum of the trawl-winch, and thereafter through a block at the lower end of an accumulator on $^1/_4$ part of the fore-yard on the port side and down to the deck,

Fig. 8. The large trawl comes up torn.

Fig. 9. The small trawl.

whereon the reel was braked. A sea-lead of 40 pounds weight was attached to the end of the line, and the thermometer and the water-bottle were put on above the lead. When everything was ready, the line was put over the side, the brake was set free and the line allowed to run out till the mark, at which the next set of instruments were to be attached, was at the rail, when the reel was braked. After the next set of instruments had been attached to the line, we proceeded as before, when again a set of instruments were attached, upon which so much line was allowed to run out that the instruments would come to the intended depth. More than three sets of instruments were never used at a time, that we should not by possible mishaps run the risk of losing a large number of instruments.

The thermometers were allowed 5 minutes to accommodate themselves, which 5 minutes were reckoned from the moment the last thermometer that had been lowered, had arrived at the depth intended for it, or from the moment the running out of the line was stopped.

In the meantime everything had been made ready for heaving in, the thermometer-line was passed round the large drum of the trawl-winch, and the shaft for the reel of the line was brought into gear with its two-cylinder machine. After the aforesaid 5 minutes had elasped, the heaving in was commenced and came to a stop, as soon as a set of instruments was on a level with the rail, whereafter they were detached from the line. Next the temperature was read, and the water-bottle delivered over to the physicist. When all the instruments were on board again, the same proceeding was repeated till observations had been made in all the determined depths.

Trawling. The proceeding is the same whether the apparatus employed be trawl, dredge or swab-rod.

The first of the aforesaid apparatuses was, with a few exceptions, exclusively used on both voyages notwithstanding the unfavourable condition of the bottom, which the expedition nearly always met with, namely large stones spread over the bottom, the presence of which was due to the ice of the present time and that of the past.

The preparations for trawling commenced with reeving the trawl-wire. The end of the wire was taken from the trawl-wire reel (Fig. 5) *a*, and rove through a leading block *b* attached to an eye-bolt in the deck on the port side abreast of the large drum of the trawl-winch *c*; it was thereafter passed round the large drum with 9 turns, rove through a leading block *d* attached to an eye-bolt in the deck on the starboard side abreast of the large drum of the trawl-winch, through a block *e* in a strap round the foremast, through the block (Fig. 6) *f* at the end of the trawl-boom *g*, whereon the thimble at the end of the wire by a shackle with swivel was shackled to a crowfoot on the trawl, dredge or svab-rod.

The trawl-boom *g* whose position was athwart ship when trawling, was used to keep the wire clear of the ship's side; it was a wooden boom, 38 feet long, whose inner end was attached to an iron mounting round the foremast, so as to be moved in a horizontal direction. To steer the boom, a topping lift and two guys, running forward and aft, were attached to the outer end of the boom. The block *f* was attached to the end of a chain which went over a block *h* at the end of the boom, through a sheave-hole at the inner end of the boom, and was then attached to the lower end of an accumulator *k*, hanging in an iron wire strap from the foremast-head. The accumulator was after the American model, and the object of it was by its elasticity to prevent the trawl-wire from being exposed to too sudden jerks by the movements of the vessel; likewise it served by its sudden contraction to notify when the trawl or the apparatus that was used had caught hold of some roughness of the bottom.

When the boom was not used, it was swung in amidships before the foremast, with its outer end resting in a crutch on the forecastle.

When everything was ready for trawling, the vessel was laid head to wind, the head-way was taken off the vessel, and the trawl was lowered down vertically by veering out the wire by means of the trawl-winch with a velocity of 100 fath. in 6 or 7 minuttes, a speed which experience showed could not be exceeded, when it was to be avoided to have kinks on the wire in consequence of its sinking faster than the trawl.

When the trawl approached the bottom, the vessel went a speed of 0.2—1.0 knot, while the paying out was continued till the necessary length of the wire was out. The rule followed by the paying out was, that up to depths of 1,200 fathoms, $1^1/_2$ time the depth was paid out, and for depths over 1,200 fathoms the depth and a surplus of 600 fathoms.

The trawl now followed the bottom, but now and then the vessel had to stop or go back, when a sudden contraction of the accumulator showed that the trawl had caught the bottom.

The trawl was dragged 20—30 minutes, whereon the heaving in by means of the trawl-winch commenced with a velocity of 100 fathoms in 6 minutes till the trawl had slipped the bottom, when the velocity was increased to 100 fathoms in 5 minutes.

As soon as the trawl had reached the surface of the water, the boom was lifted by means of the boom-lift to facilitate the shipping of the trawl. When the trawling was finished, the different appliances were used for collection of Plankton, whereafter the boom was steadied to drag the cylinder-net, wind and weather permitting, and the course was laid for the next station.

DEPTHS.

Depths. As to these, the chart is to be referred to (table I); in this is put down all the stations with the corresponding depths and other soundings. The curves are drawn with graphic interpolation, which is made on vertical sections through the stations.

The depths of the Arctic seas, such as represented on the chart in the 18th volume of «The Norwegian North-Atlantic Expedition 1876—78», have not — even if the curves of soundings in the seas northeast and east of *Iceland* and in the vicinity of *Jan Mayen* may have been somewhat modified as they hitherto have been drawn on the basis of defective data — been subject to any alterations of importance in consequence of the soundings undertaken by the *Ingolf-Expedition.*

On the other hand, it has been a different thing with the seas south and southwest of Iceland, of which a proper knowledge of the depths was nearly entirely wanting, and of which curves have now been drawn in accordance with the soundings taken.

The great Atlantic Deep approaches closely to the southcoast of Iceland, which, as will be seen, already was signified on the aforesaid chart, but of greater interest are the conditions southwest of Iceland.

As will be seen by the chart (table I), a submarine ridge is extending from *Cape Reykjanæs* in a southwesterly direction, the existence of which had not been substantiated until the voyage in 1896. Before I speak of the ridge, I shall premise a few historical remarks.

When *Frobisher* in 1578 returned from his third voyage to find The Northwest-Passage, one of his vessels called the *Emanuel,* was separated from his squadron under Greenland, but afterwards arrived safely in England. The *Emanuel,* which belonged to *Bridgewater* in *Somersetshire,* was one of those vessels, which at that time went by the name of *Busse* — small strong built vessels with two or three masts and measuring 50—70 tons. The said vessel is therefore by many authors called the *Busse of Bridgewater.* The captain of the *Emanuel* reported that he had discovered a large island southeast of *Frisland*, and that for three days he had sailed along its coast; the country seemed to be very fertile and for a great deal covered with wood, and on all charts from that time appeared an island called *Busse Island* differing, however, a little in position, but upon an average in latitude 58° N. and longitude 30° W.

In 1609 *Henry Hudson* tried on his well known third voyage to find the island, but without success, and later investigations had no better result, but since that time appeared in all charts and up to the present century in latitude 58° N. and longitude 30° W. a place called: *versonken Land van Buss*, the meaning with this sentence being to indicate that the island has disappeared on account of an earthquake. Opinion is at variance with respect to what *Busse's Island* has been; some persons suppose that it has been a large iceberg, and others that it really has been an island, only situated at another place than indicated, and finally some have been of opinion that it has been a mere chimera or a sailor's yarn pure and simple.

Versonken Land van Buss disappeared successively in modern charts, but the Greenland traders continued to believe in it, and gave the place a wide berth when they had to pass it, and later on this belief got further nourishment when H. B. M. ship *Bulldog* took a line of soundings for a projected telegraph-cable, and in latitude 59°38′ N. and longitude 29°35′ W. found 726 fathoms, while to the eastward and westward of this place soundings shoved 1,200 fathoms. Similar circumstances were found more southerly when H. B. M. ship *Valorous* on its homeward passage from Greenland, where it had been with coals for *Nare*'s expedition, found 670 fathoms in latitude 56°0′ N. and longitude 34°35′ W. This bank was the residue of *Busse's Island,* so said everybody who believed that it had existed.

Furthermore I shall mention that it is surmised that vessels being in the aforesaid track have noticed earthquakes. The story runs, however, and is a historical fact, that not further back than the 1st of September 1885, the brig *Tjalfe,* belonging to «the Royal Greenland Company», passed the place and noticed an earthquake. — The mate of the brig was walking on deck in conversation with one of the passengers and observed 3 shakings of the ship, each of them lasting 1 or 2 seconds; one of the crew jumped up on the rail and looked over the side to see if the vessel had struck against some floating timber, and the captain came up and asked if they had been rolling casks on the deck. A cast of the lead was taken, but no bottom was found. The earthquake took place at 10.45 a. m. The course steered was E. by N. magnetic with a speed of 2.6 knots. The vessels position at noon by observation was latitude 58°16′ N. and longitude 32°30′ W.

In the paper «*Norsk Sjøfartstidende*» was written on the 25th of November 1895 as follows:

«Thursday the 24th of October at 8.15 a. m. on the voyage from *Miramichi* to this place, when the vessel was in latitude 52°23′ N. and longitude 32°28′ W., breeze decreasing and moderate sea, we noticed suddenly a shaking movement in the vessel, as if it had been dragged along a stony ground. After about 30 seconds had elapsed, the shaking became so violent that all objects on board, loose and fixed, vibrated. It could plainly be seen on the rigging, which vibrated in such a manner, as if the vessel was striking the ground. This lasted about one minute, and afterwards everything was as quiet as before. I am led to believe that it has been a volcanic eruption at the bottom, but it is rather strange that it could be felt with such violence on the surface of the sea, as the depth on the spot was between 15 and 1600 fathoms.

Londonderry in November 1895. *P. G. Pedersen,*
master of the bark *Duisburg.* Christiania.»

As will be seen, this earthquake took place several degrees more southerly than the foregoing one, but in the same longitude.

So much is certain, however, that the aforesaid 2 soundings by English vessels proved the presence of a submarine plateau; as the zoologists of the expedition were of opinion that it might be of special interest to examine animal life on this spot, I set the course for it. From the soundings, which we commenced at once, it was clear, however, that we were on a very narrow ridge, pointing in the direction of the supposed submarine plateau. The sounding was continued as far as the 60th degree of latitude north, constantly with the same result, and by this was proved that the plateau in question was only the continuation of this ridge. It proceeds from *Cape Reykjanæs*, the south-western point of the peninsula, on which is seen everywhere the effect of the subterranean fire; hot springs, solfataras and mud-volcanos are found everywhere, and it is probably in case of these valves not being sufficient, that such catastrophes take place, of which we have got an example by the one that caused so much damage to Iceland in 1896.

The ridge called *Reykjanæs-Ryg* must be of volcanic origin, and it will be seen by the aforesaid reports from ships, that the volcanic forces also here are in constant activity. The ridge, seen from a geological point of view, is of later origin; it has formed itself after the glacial period; this inference may be drawn from the fact, that the trawl — at all the trawlings made on the said ridge — did not meet with a single stone; not one mask in the trawl was broken, while, on the other hand, both to the eastward and westward of the ridge, the bottom was strown with stones, by which the trawl was torn asunder. The proof of the existence of this ridge will still more corroborate the conception that *Busse Island* has existed and disappeared by volcanic eruptions.[1])

The soundings taken in the *Denmark-Strait* and the *Davis-Strait* have not altered anything in our knowledge of the depths in these seas.

Soundings were taken as soon as the vessel was inside the 100 fathom curve, as well at Greenland as at Iceland. The vessel was supplied with 2 sounding-machines (*William Thomson's*) with which — in case of the depth not being too large — soundings may be taken, even if the vessel be going at the rate of 12—14 knots. With a speed of 8 knots, the normal speed for the *Ingolf*, soundings could be taken with facility in 120 fathoms of water. Instead of *Thomson's* tubes the *Rung* Bathometer was used.

In the *Davis-Strait* valuable soundings were taken to determine the position of the banks lying along the westcoast, of which it is of great importance to have a correct knowledge when making the land.

[1]) In the 1st volume page 164—202 of the account of the *Danish Arctic Expeditions in 1605—1620*, published by the *Hakluyt Society* in 1897, is given a detailed information of the question *Busse Island*.

In the Icelandic waters there is still a great deal to be done with respect to surveying of the flats, and soundings were taken whenever there was an opportunity to do so, and we succeeded in gathering a considerable amount of material of interest for navigation as well as for fishing.

The whole of the work mentioned here, has been delivered to the Hydrographic Office to be laid down in the charts of the respective seas.

CURRENT-BOTTLES.

Current-bottles were thrown overboard on the 2d voyage of the expedition in 1896 in that tract of the sea, from which I supposed the drifting of these bottles would offer the greatest interest, namely on the route from *Langanæs* to *Jan Mayen.* As will be seen by the following table, 20 bottles were thrown overboard.

Nbr	Date	Hour.	Latitude North	Longitude West	Found
1	19/7	9^{20} a. m.	66° 19′	13° 46′	
2	19/7	Noon	66° 17′	13° 01′	17/1 98 Sor-Arno, 14 miles SV. of Bodo, westcoast of Norway
3	19/7	3^{00} p. m.	66° 16′	12° 09′	
4	19/7	5^{00} p. m.	66° 32′	11° 47′	4/1 97 Kongshavn at Østero, Færoe-Islands.
5	20/7	12^{20} a. m.	66° 48′	11° 17′	26/3 97 Bud in Romsdalen, westcoast of Norway.
6	20/7	2^{30} a. m.	66° 58′	10° 39′	
7	20/7	4^{30} a. m.	67° 09′	10° 00′	
8	20/7	6^{35} a. m.	67° 17′	9° 20′	10/10 96 Langesand at Stromo, Færoe-Islands.
9	20/7	2^{40} p. m.	67° 16′	8° 30′	
10	20/7	4^{35} p. m.	67° 30′	7° 55′	
11	20/7	6^{38} p. m.	67° 41′	7° 23′	
12	20/7	8^{42} p. m.	67° 55′	6° 50′	28/1 98 Tanahorn in Finmarken, northcoast of Norway.
13	21/7	7^{20} a. m.	68° 12′	6° 44′	
14	21/7	10^{00} a. m.	68° 30′	6° 44′	
15	21/7	12^{30} a. m.	68° 49′.5	6° 44′	29/11 97 Laxe-Fjord, northcoast of Norway.
16	21/7	3^{30} p. m.	69° 10′.5	6° 44′	19/1 98 Røst on Lofoten, westcoast of Norway.
17	21/7	7^{10} p. m.	69° 31′	6° 06′	21/6 97 Vopna-Fjord, eastcoast of Iceland.
18	22/7	7^{00} a. m.	69° 58′	7° 06′	21/1 98 Blixvær, 9 miles west of Bodo, westcoast of Norway.
19	22/7	12^{30} p. m.	70° 25′	7° 11′	
20	22/7	5^{00} p. m.	70° 44′	7° 41′	3/12 96 Skoruvik at Langanæs, northcoast of Iceland.

The bottles employed for this purpose were common soda-water bottles, which were corked after the note, of which the following is a copy, had been put into them.

The bottles were laid down in small wooden boxes to prevent them from being broken when they stranded on a rocky coast, and the empty space between the sides of the boxes and the bottles were filled with melted pitch, whereafter the box, to make it attract the greatest possible attention, was painted red with a white cross on the four long sides of it. The weight of the box and its contents was adjusted in such a manner that it would keep afloat on the surface of the freshest water it might fall in with, even if the wood be a little water-soaked.

At the printing of this report, 10 of the bottles thrown overboard have been found. From the table will be seen, that upon the whole, the drifting of the bottles have corroborated the existence of the rotatory movement of the water in the Northern Sea, such as pointed out by *Mohn*.

Den danske Dybhavsexpedition
med Orlogskrydseren „Ingolf" 1896.

The Danish Scientific Deep-Sea-Expedition
H. M. S. „Ingolf" 1896.

Finderen af denne Seddel anmodes om at sende den til Søkaart-Archivet i Kjøbenhavn, efter at have besvaret nedenstaaende Spørgsmaal.
Finderen vil omgaaende modtage en Postanvisning paa 10 Kroner.

Any person, who may find this paper, is kindly requested to answer the questions below and return the paper to the following address:
«Søkaartarchivet, Copenhagen,
Denmark.»
At the receipt in Copenhagen of the paper a reward of ten Danish Kroner will immediately be forwarded to the finder.

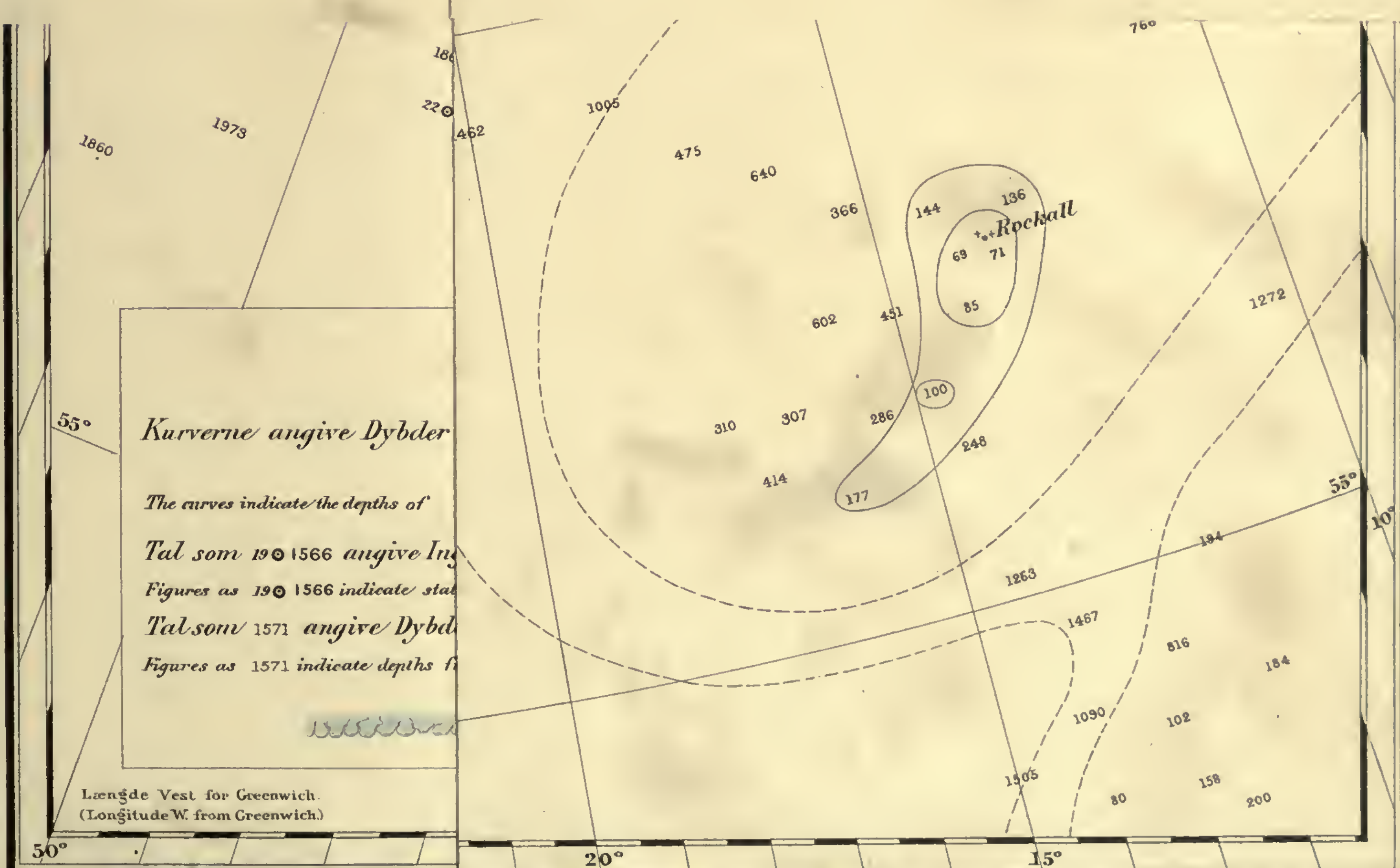
Hvor er Flasken funden?
The locality where found?

Naar er Flasken funden?
When found?

Finderens Navn og Bopæl?
Name and address of finder?

C. F. Wandel,
Captain R. N.

It is to be hoped that still several bottles will turn up, so that the drifting of the bottles may be subject to commentories in a later volume.



Axel E. Aamodt's lith. Etabl. Kjöbenhavn.

II.

HYDROGRAPHY.

BY

MARTIN KNUDSEN.

INTRODUCTION.

The first systematically hydrographical investigations of the Seas round *Iceland* have been made and collected by Admiral *Irminger*, who published the results of these investigations in the magazine «Tidsskrift for Søvæsen» 1861 and 1870. Up to that time, our knowledge of the currents in the vicinity of *Iceland* derived from reports about the drift of the ice, as well as from the narratives of shipmasters, was vague and questionable. The admiral proved that the warm water of the *Atlantic* reaches close up to or nearly close up to the south-coast of *Iceland*, stretching itself along the west-coast, while a cold current from the *Arctic sea* is running along the east-coast of *Greenland* and round *Cape Farewell.*

In 1877 the cruiser *Fylla* made a great deal of investigations in the north-eastern part of the *Denmark-Strait.* The results of these investigations have been published by Cpt. *Hoffmeyer* in the periodical «Geographisk Tidsskrift» second volume, 1878, page 88, and from this will be seen, that the northerly current along the west coast of *Iceland*, the *Irminger-current*, consists of warm Atlantic water from the surface to the bottom. Specially on the basis of observations of temperature from the meteorological station at *Grimsey*, Cpt. *Hoffmeyer* comes to the conclusion that the *Irminger-current* turns round *Cape Nord*, and forms the easterly current along the north coast of *Iceland.*

This was confirmed by the measurings made by the cruiser *Fylla* in June and July 1878. Cpt. *Bardenfleth*, at that time a lieutenant, has published a report of this in the periodical, «Geografisk Tidsskrift» 3d volume, 1879, page 42. Two sections were taken in a northerly direction from the northern coast of *Iceland*, and it appears from these that the temperature up to a distance of about 50 miles from *Cape Nord*, is between 5° and 7°.5, as well at the surface as in the depth, which at this distance from the land only amounts to 158 fathoms (298 metres). The second section from *Mevenklint* showed on an average colder water than the first one from *Cape Nord.* Already at the most southerly station at the mouth of the *Øfjord*, the temperature was at a depth of 44 fathoms (83 metres) 3°, and it was not found to be much higher in the same depth at any of the stations north of this place, while, on the contrary, the surface waters have a temperature of between 5 and 6 degrees. As shall be pointed out afterwards, such a high temperature is by no means a proof of the water being of Atlantic origin, but the fact of the observed temperatures in the depth being subject to a decrease when advancing in a northerly direction, seems to imply the influence of the Atlantic water.

In 1879 when the cruiser *Ingolf* was sailing along the Greenland ice, it was ascertained that *Iceland* and *Greenland* are connected by a submarine ridge, on which the depth is at the most 300 fathoms (565 metres), and that no doubt this ridge debars the ice-cold water at the bottom of the

Arctic Ocean from the basin of the *Atlantic.* An article on this subject by Cpt. *Mourier* is found in the periodical «Geografisk Tidsskrift» 4th volume 1880.

The measurings and determinations of the Norwegian-North-Atlantic-Expedition have partly been made in the region of the sea between *the Faroe islands* and *Iceland* and this latter and *Jan Mayen*, so that the seas round *Iceland* may be considered as a link in the whole of the system of which Mr. *H. Mohn* has written in the report that was published about the expedition, volumeXVIII. *Christiania* 1879.

Cpt. *Wandel* has given a full and detailed description of the currents in the vicinity of *Iceland* in his work «Bemærkninger til Beseilingen af Islands Kyster» 1879. This representation is partly founded on the basis of the aforesaid measurings, as well as on the practical experiences gathered by Cpt. *Wandel*, when, as a lieutenant, he was master of a steamer for three years in the Iceland trade.

Among later investigations are specially noticeable: «Den andra Dicksonska Expedition till Grönland 1883». Mr. *Axel Hamberg* has written about this expedition in «Bihang till K. Svenska Vet.-Akad. Handlingar» volume 9, No. 16—18, and from this will be seen that the East-Greenland-Polar Current, during the whole of its course from latitude 66° N to *Cape Farewell*, is resting on warm water.

As to the currents in the *Davis-Strait*, Admiral *Irminger* has proved in the magazine «Nyt Archiv for Søvæsen, vol. 9th No. 4», especially on account of the drift of the ice, that the East-Greenland-Polar Current rounds *Cape Farewell*, and runs north along the west coast of *Greenland.* Next, the *Davis-Strait* has, in so far as hydrography regards, been subject to the investigations of the numerous arctic explorers that have passed through it, as well as to the researches of the second Dickson-Expedition to *Greenland*, see «Bihang till K. Svenska Vet.-Akad. Handlingar», vol. 9, No. 16. A systematic investigation was commenced by the cruiser *Fylla* in 1884, continued 1886, and completed in 1889. An account of this has been given by Cpt. *C. F. Wandel* in the work «Meddelelser om Grönland» VII, 1891, in which the author at the same time lays before us as full and complete a description of the hydrography of the *Davis-Strait*, as it has been possible to give on the basis of the observations at hand.

Our knowledge of the tract of the sea round *Iceland* and *Greenland* has likewise been increased by the determinations of temperature that have been made for the Meteorological Institute by shipmasters in the Iceland and Greenland trade, as well as by observations at the meteorological stations, and by reports of the drift of the ice.

As to the further details of the system of currents, different theories of importance have been set forth on the basis of the observations at hand, thus by *Irminger* in the magazine, «Tidsskrift for Søvæsen» 1861 and 1870, by Professor *Colding* in his work: «Strømforholdet i almindelige Ledninger og i Havet» 1870, and finally by *Petermann* in «Geographische Mittheilungen» 1870.

The hydrographical observations and determinations due to the Ingolf-Expedition in 1895—1896, have upon the whole confirmed the general conception of the course and nature of the currents in the region of the sea that has been explored. If the attention should be directed to any new established facts, it must certainly be the division of the *Irminger* Current in a westerly and an easterly branch north-west of *Iceland*, and the extent and magnitude of the East-*Iceland*-Polar Current.

THE INVESTIGATIONS, AND HOW THEY WERE PERFORMED.

When I had the honour of being appointed to undertake the physical investigations on board the cruiser *Ingolf* during its voyages in 1895 and 1896, I was totally unacquainted with hydrographical work, and the knowledge I had occasion to acquire of hydrographical literature before our departure in 1895, was but a trifle. It is therefore to Cpt. *Wandel* that we are indebted for what has been done, who decided the character of the observations that were to be made, and who always was ready to assist me by word and deed during my work in the service of the expedition.

OBSERVATIONS OF TEMPERATURE.

During the first voyage in 1895, my work on board was confined to observations of temperature, determinations of the specific gravity and the amount of chlorine of sea-water, and to take samples of water in bottles and exhausted glass-balloons. During the voyage of the second year, the gases held in the sea-water were analysed immediately, in consequence of which it was not considered necessary to take samples of the last-mentioned description. For the determination of temperatures in the depth, we used the turning thermometers mentioned on page 8, but on account of the zero-point-variation proving to be rather considerable, and specially on the thermometers employed on the first voyage, the zero-point was determined whenever there was an occasion to do so. For this object, clean snow fetched from the mountains was used. To convince myself of the snow being sufficiently clean, I made it subject to a trial with a solution of silver nitrate. This trial proved to be sufficient, as no difference could be observed between the melting point of snow that did not give a distinct sediment when a solution of silver nitrate was applied to it, and ice formed of distilled water. As a rule no more than a fortnight elapsed between two zero-point corrections. In spite of the thermometers used on the second voyage being made of normal glass, and in consequence of this not giving so large zero-point variations, a correction became necessary for all that now and then, as the alterations were much larger than in a common thermometer made of the same kind of glass. Before the departure these thermometers were tried for pressure. In want of another apparatus, I had a cast iron tube with a solid piston made for this purpose. After the tube had been filled with molasses and the thermometer put in, the piston was forced into the tube by means of a hydraulic press, kindly placed at our disposal by Mr. *Nielsen*, cand. polyt. and director of the Government Laboratory for the examination of cement. The hydraulic pressure the thermometer had been subject to, was then calculated by using the magnitude of the force and the diameter of the piston as arguments. Thus all the thermometers were proved at a pressure of 500 atmospheres.

On the first voyage, a thermometer supplied by the Meteorological Institute was used for the determination of the temperature of the surface waters, but as it appeared that this thermometer only allowed a very inexact determination of the temperature, it was only used at 12 p. m. and 4 a. m., while I measured the other temperatures myself with a thermometer that had the scale etched on the thermometer-tube, and the degrees divided into tenths. On the second voyage, measuring was only performed with a thermometer of the last-named type, which was placed in a case of brass to prevent it from being broken by the frequent use of it.

As the same water of which the temperature was measured was used afterwards for the determination of the specific gravity and the amount of chlorine, provision had to be made to prevent the salinity of the water from being subject to any alteration during the measuring of the temperature. That such a thing might occur, was to be feared in case of the thermometer not being properly wiped off after each single measuring. If for inst. the water was allowed to evaporate from the surface of the thermometer, a layer of salt would be deposited on this latter, which, during the use of the same thermometer for the examination of another body of water, would have the effect of altering the salinity of this latter. To avoid this inconvenience the thermometer was, when not used, placed in a glass with sea-water, which was frequently renewed, and by the closing of the glass with a cork, the water was prevented from evaporating too quickly. At the beginning canvas buckets were used for the hauling up of the water, but being afraid af salt being lodged in the pores of the canvas of buckets of this kind, and that it might not be properly removed when the buckets were washed out, I had them replaced by metal buckets, in which all deep furrows were filled with melted tin. The water was always hauled up in front of the machine, and after the measuring poured into bottles, which had been properly cleaned beforehand. We had 30 such bottles for temporary conservation of the water, all fitted with properly ground glass-stoppers. In this manner the samples of water were deposited in my laboratory to enable them to adopt the temperature of the room, before the titration and the determination of the specific gravity was to take place.

DETERMINATION OF THE SPECIFIC GRAVITY.

The determination of the specific gravity was made with glass-areometers (from *Steger* in *Kiel*), of which the expedition had three large sets, but with exception of the few measurings that took place in the *North-Sea*, all the measurings during both years were made with one and the same areometer. At determinations of the specific gravity by Pycnometer, the areometers were adjusted before the departure of the vessel, which also was the case, when the voyages were completed, with the areometer that had been used. The glass in which the determination took place, was hung up after the Cardano system in the laboratory. The temperature appertaining to the areometer-readings was determined by two thermometers divided into tenths of degrees. Like the areometer, the same two thermometers were used during all the measurings. The bulb of one of them was placed right under the surface of the water, and that of the other near the bottom to enable me to be on the safe side against too great inequalities in the temperature of the water. During the first voyage, determination of the specific gravity was made with all the samples of which the amount of chlorine likewise had been determined, while, on the other hand, it was not made in 1896 with those samples from the depth that were brought home. The measurings with the areometer were attended with a great deal of difficulty, on account of the vibration caused by the engines and the propeller of the vessel, so that these measurings have only been effected to serve as a guard against great titrational errors, as the salinity was determined by the specific gravity, by multiplying the cipher obtained by reduction after *Krümmel's* table («Ueber den Gebrauch des Aräometers an Bord» pag. 13) by 1310. The determinations of the salinity obtained in this manner, cannot, in so far as correctness is concerned, be compared to those obtained by the chlorine-titrations, and they have not for this reason been put down in the tables.

DETERMINATION OF THE CHLORINE.

Owing to the great development of oceanographic investigations of late years, the determination of chlorine has become a matter of the greatest importance, and titration of the chlorine has therefore been made with almost all the samples of water of which the temperature was determined.

Notwithstanding the fact that a titration of chlorine in itself is a very easy matter, we must, in consequence of the many determinations, which are to be executed with the greatest exactness, have a regular method of working. Concerning this latter and the fitting up of my laboratory, I have obtained many valuable hints from Dr. *H. Topsøe*, who always assisted me by word and deed, when I was at a loss how to act.

To determine the quantity of chlorine, I used the system of volume titration: precipitation with a solution of silver-nitrate, and the application of chromate of potash as index. As the vessel on the voyages had on board weighed off quantities of silver-nitrate in crystals placed in hermetically sealed glass-tubes, as well as distilled water in balloons, the solution of silver-nitrate could take place on board ship. The contents of one glass-tube were dissolved in 1 litre of water, and solutions of this kind would then be nearly of equal strength. This latter was determined exactly by titration of sea-water, the quantity of halogens of which was ascertained exactly beforehand, and found to be suitable when a solution of 35$^{\text{c.cm.}}$ of silver-nitrate was required to neutralise the halogens in 25$^{\text{c.cm.}}$ of ocean-water. Frequently and at least three times during the use of 1 litre of the solution, the strength was determined, and besides many samples of water were taken home for further testings after the expedition had come to an end.

The titration was then effected as follows: 25$^{\text{c.cm.}}$ of sea-water were measured off by a pipette and emptied into a common tumbler, in which the precipitation was to take place. Next the solution of silver-nitrate was added from a calibrated burette (supplied with a glass-cock), on which tenths of cubic centimetres were marked, so that hundredths might be determined by means of a float. As the strength of the solution is kept about the same, the reading of samples by titration of sea-water of which the quantities of halogens differ but little, will be nearly at the same place in the burette, so that eventual caliber-errors in this latter will be of no consequence, in so far as the relative quantity is concerned.

Notwithstanding the fact that the vibrations occasioned by the engine and the propeller of the vessel rendered the reading rather difficult, and that the temperature in the laboratory varied considerably, it will be seen by the curves representing the salinity, plate IV—XIX, that the titrations have given serviceable results. As the determination of the amount of chlorine was effected by direct comparison with the standard-water, and provision always was made to see that the water-samples had the same temperature as that of the room, and likewise as that of the used standard-water and the solution of the nitrate of silver, a change in the temperature of the laboratory could not have any influence of importance. At all titrations on both voyages the same burette was used, which, in accordance with the Cardano system of suspension — used at the determination of the specific gravity — was fitted on to a steel-bar attached to the table and ceiling.

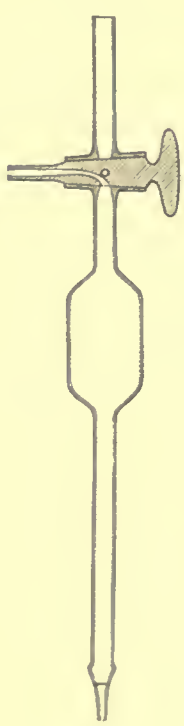


Fig. 10.

The samples of water brought home by the Ingolf, were deposited in bottles closed with parafined corks. This parafination proved, however, to be objectionable, as the parafine might give trouble at the analysis. Thus small particles of parafine may find their way into the pipette during the titration, and even if they be so small that they would expel no appreciable volume of sea-water, it may happen that they attach to the glass, and retain a considerable amount of water round them, when the pipette is emptied, so that this latter had to be rinced with distilled water every time a quantity of water was measured off for titration. At the determination of the strength of the solution of the silver-nitrate, the same method of course has to be used, and in this manner a great number of samples have been titrated after the ship arrived home, and principally samples that had not been titrated an board, but also — to be on the safe side — such as had been titrated on the voyage.

For the measuring of the sea-water, I had constructed a pipette, in which, as seen by fig. 10, a cock is fitted at the uppermost tube. Looking at the figure, it can easily be understood that the adjustment to the mark in the uppermost tube may be avoided, as the water, when it is measured off for titration, is sucked up above the cock, which is shut and opened for the second perforation, when the water is to run out. Instead of a tail-cock, a cock with two oblique perforations may be used. I found that this pipette (made by *Franz Müller* in *Bonn*) worked properly and conveniently. For those revisions of the determinations which were to be executed at home, I found it advisable to use a system of titration, by which the errors only would be small in comparison with those occasioned by titration on board. I employed therefore *Volhard*'s system, namely:

addition of a solution of silver-nitrate in excess and determination of the excess by titration with a very diluted solution of sulphocyanate of ammonium, and the employment of ammonia iron-alum as index. What I wished to obtain by this, was an easy and exact determination of the ratio between the quantities of halogen in two samples of water. The analysis was executed in such a manner, that 10 cubic centimetres of sea-water were placed in a small retort, supplied with a glass-cover ground for the purpose, when the whole was weighed; previously the weight of the retort, as well as that of a little pure nitric acid, which had been poured into it; was ascertained. Next the solution of silver-nitrate, of such a strength that it corresponded to a similar volume of Atlantic sea-water, was added. This process was effected by filling the solution into a *Mariotte's* bottle, the drain-pipe of which was connected with a glass-tube (terminating in a point) by means of a piece of india rubber tube supplied with a cock.

If we open the cock, the solution will run out, and the air will bubble up from the lowermost part of the glass-tube, which goes through the cork in the neck of the bottle. Every time that a bubble of air is ascending, a certain volume of the liquid has made its way out, which is ascertained by weighing. As in consequence of this, I knew how many bubbles of air there were to ascend, and how many drops there still were to be added to neutralise a certain quantity of halogen, and knowing approximatively the quantity of halogen in the water that was to be examined, it became possible for me only to add a very small excess of the solution. The retort and its contents was then weighed again. After this, the retort was heated a little, while at the same time it was shaken, and then placed a few minutes under a cover of black pasteboard to protect its contents against the effects of the light. After the lapse of some minutes, the halogen-silver had settled, and the supernatant liquor was decanted off into a beaker. Next the halogen-silver was shaken during the heating together with distilled water containing a little nitric acid, and deposited as before, on which the liquor was decanted off into the beaker. In this manner the halogen-silver was washed out three times, which proved to be sufficient, as further washing-out did not give any nitrate of silver. The liquor decanted off from the halogen-silver, was now titrated by sulphocyanate of ammonium, applied to it from a burette. The strength of this solution was found to be so, that 1 cubic centimetre of same corresponded to 0.10157 grms of the solution of silver.

Following this method, it proved that the added excess of the solution of silver-nitrate on an average amounted to 0.25 grms, and never exceeded 0.7 grms. Making the excess so small, we run of course the risk of getting a deficit instead of the desired excess of the solution. During the course of 60 analyses, this has only been the case four times, and every time it occurred, the process was repeated with a new sample of water. It appeared from the repeated titrations, executed at different times, that the inaccuracy in the indication of the salinity in pro mille for inst. of 35.24, did not exceed 0.006; consequently the system of titration employed had the desired exactness. By the adoption of this mode of determination, errors, originating from differences of temperature, only manifest themselves in the result as a factor of the frequently mentioned excess of silver-nitrate, so that they may be regarded as being of no consequence at all, and as the greatest weight was attached to have all the analyses made in quite the same manner, it must be considered as an established fact that the mutual deviations of the repetitions may be regarded as due only to differences in the judgement of the colour-reaction, and as this latter, in this case, is much more distinct than the one produced by common titration with chromate of potash as index, it can easily be understood that by this mode of procedure a far greater exactness may be attained, such as shown by the experiment. Being of importance that not only the relative amount of chlorine should be determined, but also that we get a statement which may be compared with the determinations of other hydrographers, I ashed Professor *Pettersson* in Stockholm for a sample of water of which the amount of chlorine was stated. Professor *Pettersson* was kind enough to send me a sample of this kind, the amount of chlorine of which was determined by weight analysis. I have by means of the last mentioned mode of titration made a comparison between this sample and the one, in proportion to which the determinations of chlorine were made an board, so that all the measurings refer to the water sample analysed by Professor *Pettersson.*

ANALYSIS OF THE NITROGEN & OXYGEN CONTAINED IN SEA-WATER.

The well known hydrographical mode of investigation, which has developed itself of late years, and by which great results have been attained, specially by Professor *Otto Pettersson*'s researches, has principally served as a model for the hydrographical investigations made by the Ingolf Expedition. Owing to this, it was quite natural that preliminary arrangements were made for the execution of gas analyses. Doctor *Rørdam* put me up to Professor *Petterson*'s method, and showed me the way in which the analyses could be executed in accordance with this, and he directed likewise my attention to such other analyses, as it might be of interest to have made. In consequence of this, the vessel carried with it on the voyages a great deal of hermetically sealed glass-balloons, from which the air had been expelled by means of mercury, and which were delivered ready made from the glass-works. In 1895 water samples were deposited in balloons of this kind, and the gas analyses were undertaken when the ship had arrived home, and in April I received a report from «the Commission for the Exploration of the Danish seas, which report was made out by Doctor Rordam. On page 105—107, Doctor *Rørdam* gives an account of some of the gas-analyses executed by him, and he writes on this subject as follows: Seen from an analytical point of view, no objection can be made against the correctness of the analyses, and there is every reason to believe that they give as true a statement as practically possible, so that they really indicate the quantities of gases that were present in the water-samples at the time they were analysed. On the other hand, it is a question whether these quantities of gases are the same as those contained in situ in the sea. The greatly varying percentage of oxygen seems to imply that internal transitions have taken place in the samples between the oxygen of the sea-water and the organical, partly organized elements of the water. As according to this, Doctor *Rørdam* had directed the attention to the fact of its being possible that internal transitions might take place in the samples during the storing of same, I considered it necessary to make the analyses on board, and I had therefore an apparatus made, which is described in the following. All the analyses in 1896 were made by this apparatus.

The gas-analysis-apparatus is represented skeleton like on plate II. The principal parts of it are the boiling-flask *A* and the analysis-burettes *B*. The method used for the analysis was in short as follows: The air is expelled from the boiling-flask *A* by means of mercury, and it is filled with a certain volume of sea-water, which is boiled out. The gas extracted by this process, is driven into the burette B_1, where it is measured over water, and from there it is led into the burette B_2, where the carbonic acid is absorbed; finally the remaining gases are transferred to B_3, where the oxygen is absorbed. When this boiling out has taken place, a quantity of sulphuric acid is added to the water in the boiling-flask, and the gases remaining in the water are by repeated boilings extracted from it, and likewise transferred to the burettes, where they are measured.

A is a cylindrical glass-reservoir of 200 to $250^{c\ cm}$ capacity, formed into the shape of *a* tube at the top and at the bottom. The lowermost of the tubes has a diameter of 6^{mm}, and at a is a mark that is etched on it, below which a cock is fitted. It carries a bent down service-pipe with the cock H_5, and this pipe is again by means of an India-rubber tube connected with a glass tube *G* 20^{cm} long and 4^{mm} wide. On the upper tube, the diameter of which is 10^{mm}, is likewise etched a mark at *b*. The space between the two marks, the service-pipe not included, is fixed once for all by weighing off the quantity of distilled water that can be held between them. The lowermost tube is by a strong India-rubber tube through the cock H_6 in communication with a large mercury-reservoir, the contents of mercury of which shall be sufficient to fill the boiling-flask A as well as the condenser *C*. The mercury-reservoir is a cylindrical wooden coop covered with a lid of wood, and the lower part of it is lengthened downwards into the shape of a narrow tube, to which the India-rubber tube from the boiling-flask may be attached. The boiling-flask A is warmed in an air-bath to prevent it from being heated too suddenly. It is surrounded by a brass tube, the bottom and lid of which likewise are made of brass. In the middle of the lid is an orifice, through which the upper glass tube from A proceeds packed with asbestos. The bottom plate is screwed on to the brass cylinder, and like the lid it is separated from the boiling-flask *A* by a plate of asbestos. In the middle of the bottom, a hole is pierced, in which a small brass tube — encircling the lower glass tube which proceeds from *A*, and separated from this tube by asbestos — is soldered on by silver. This brass tube which goes down nearly to the service-pipe, as well as the bottom-plate, are cut longitudinally into two parts of equal size. As the two halves of the brass tube are to be kept closely together round the asbestos-packing, a larger and thinner brass tube, cut open at the one side to enable it to be led past the service- pipe, is fitted round the first mentioned brass tube. At the foot it is supplied with a collar of brass, by which the boiling-flask and its jacket are attached to a wooden stand.

The condenser *C*, of a capacity of 80 cubic centimetres, is at its upper and lower end contracted into the shape of a tube. The lower tube is similar in dimensions to the upper tube that proceeds from *A*, and it communicates with this tube by a short rubber tube, in which the two tubes nearly meet. The upper tube has only a diameter of 2^{mm}, and it is supplied with the threeway cock *H*, which, like H_5, must be ground with the greatest accuracy. The upper tube of the threeway cock is at the top enlarged into the shape of a funnel T_1 the sidetube *K* communicates with the burette B_1. The glass reservoir *C* is enclosed in a water-bath consisting of a short wide glass tube, the bottom-ends of which are faced by grinding and closed with India-rubber sheets, through which the two tubes of the receiver pass, which is likewise the case with an induction pipe at the bottom and an eduction pipe at the top. The whole is kept together by two discs of brass, placed respectively on top of the uppermost and below the nethermost India-rubber sheet. Four long screws are fitted between the above-mentioned discs outside the glass cylinder. By means of an India-rubber tube the cooling-water is admitted into the cylinder from a bottle, which is placed in a higher position, and the tubulure of which is at its bottom; through the eduction pipe it flows into another bottle, which is placed on the table, on to which the whole apparatus is secured.

The burettes used for analysis are three glass tubes B_1, B_2 and B_3, about 40^{cm} long, and not so wide at the top as below, the diameter at the lower end being 11^{mm}, while at the upper end it is only 7^{mm}. The upper part is divided into twentieths of cubic centimetres and the nethermost in tenths. The zero-point is marked at the place where the burette and the capillary tube, in which it terminates at the top, meet, and this mark is found exactly by filling the burette and the said capillary tube with water, and allowing air to ascend through this latter; the zero-point will then be exactly at that place where the upper meniscus of an air-bubble appears. The burettes B_1 and B_2 terminate both at their lower ends in a narrow glass tube, which can be closed by means of a small India-rubber tube with a jam-cock. Close above the narrow part, a side-tube of a small diameter is fitted, which communicates relatively with the two water reservoirs L_1 and L_2 by means of a long India-rubber hose. On the other hand, the hose leading to the reservoir L_3 is fitted on the narrow tube in which B_3 terminates. The burettes B_2 and B_3 are at the top, like B_1, continued in the shape of capillary-tubes, but these latter are, in so far as regards the burettes B_2 and B_3, supplied with the cocks H_4 and H_3, and adopt at the top the shape of the funnels T_2 and T_3.

Each of these three burettes is surrounded by a water-bath, consisting of a glass-tube 30^{mm} wide, at the lowermost aperture of which the burettes are inserted through India-rubber stoppers. To facilitate the insertion, the burettes are cut a little above the place, where the uppermost of the lower side tubes is coming out; after the insertion, the two pieces of the burettes are connected again by means of small India-rubber tubes. The water-bath tubes surround also the nethermost part of the capillary tubes, in which the burettes are continued at the top, and they are at that place closed with India-rubber sheets to keep the water-bath clean. Thermometers are inserted into the bath through these sheets.

The tubes proceeding from the threeway cock H, as well as all other connecting tubes are regarded as capillary tubes; they are all substantial glass tubes with a bore of 2^{mm}. The side tube from the threeway-cock is by means of an India-rubber tube connected with the one branch of a ⊤ tube, the lower branch of which is led to the upper capillary tube of the burette B_1 by means of an India-rubber hose. On the third branch of the ⊤ tube, is fitted a small tube, into which the tube K_1 with the cock H_1 is fitted. Between K_1 and the burette B_2 is another little tube, which is attached to a side tube proceeding from B_2, a little above the second side-tube, and by which B_2 is put in connection with L_2. In a similar manner, the capillary tube K_2 with the cock H_2 connects the burettes B_2 and B_3.

As the air-analysis-apparatus has to be used, even when the ship is in a seaway, it becomes a matter of course that everything must be properly secured, in consequence of which the whole apparatus is screwed on to a wooden stand. The table together with the stand, must be sufficiently high to allow that there is at least one normal height of barometer from the mark a — of which has been spoken before — to the level of the mercury in the mercury-reservoir, when this latter is lowered down as far as the floor. The mercury-receiver can be placed in a wooding casing, in which it fits exactly. This casing, and the wooden stand by which the apparatus is supported, are screwed on to the table, on which the whole is placed. A spirit-lamp, shaped like a circular box, is used for the heating of the boiling-flask. In the box is an incision to enable it to be put round the brass tube, which is fitted below on the brass-capsule that is surrounding the boiling-flask. The small-water receivers L_1, L_2 and L_3, of a capacity of 70 cubic-centimetres each, are hung up on a board in fork-shaped springs, from which they can easily be taken out and put into place again. A vertical screen of metal, screwed on to the wooden stand, is fitted between the boiling-flask and the burettes, and a horizontal screen of asbestos between the boiling-flask and the cooling-water receiver, the former to prevent the burettes from being warmed by radiation from the lamp and the air-bath casing, the latter that warm air shan't make its way up round the cooling-water receiver and heat it. Finally a metal screen is fitted between the funnels T_2 and T_3 to prevent pyrogallic acid from flowing into T_2, when it is poured into T_3.

When the apparatus is to be used for analysis, water is filled into the bottle which is in connection with the cooling-water receiver round C, as well as into the water baths round the burettes; into the water receivers L_1, L_2 and L_3, and into the burettes with their connecting tubes K_1 and K_2, on which all the cocks are closed. The threeway cock H shall always be in such a position as shown in the figure when it is closed.

The threeway cock H shall be in such a position that there is a passage from C to T_1, and H_6 is opened. The mercury-receiver is lifted, so that the mercury fills A and C and goes up into T_1. H is shut. If then the mercury-receiver is lowered, the mercury will sink and leave a vacuum in A and C.

The glass tube G is now put down into the water-bottle. H_5 is opened a sufficiently long time to allow G and the side tube to run full of water, which drives the air in these two tubes into A and C. If H_5 be shut again, H_6 must be opened. The mercury will then rise, and nearly fill the whole space up to H. If H is opened and the mercury-receiver lifted, the air will be expelled through T_1. Next C and A are emptied again by sinking the mercury-receiver.

The mercury is adjusted to the mark a, H_6 is closed, and H_5 opened. The sea-water is now allowed to run in, until it reaches the mark b, on which H_5 is closed. To enable the experimentalist to observe the rising of the water towards b, two small windows, closed with plates of mica and diametrically opposite to one another, have been fitted at the upper part of the metal casing round the boiling-flask. As the space between a and b has been measured beforehand, the volume of the water that has been sucked in will be known at once.

H_6 is opened a little, so that the mercury rises slowly till it is on a level with the bottom of A. This precaution must be observed, as, otherwise, the glass would easily break when afterwards cold mercury made its way into the boiling-flask. The lamp which has two burners, one on each side of the brass tube that surrounds the lowermost tube of the boiling-flask A, may now be lighted, and the boiling out begins.

When the lamp has been lighted 20—25 minutes, it is put out. H_6 is opened. The mercury rises in A driving the water before it, and this again the boiled-out gases. The mercury-receiver is now raised to such a height that the air gets under a higher pressure than that of the atmosphere. H is opened with communication between C and B_1. The air that has been boiled out is driven further on through K into B_1, sea-water is allowed to follow and fill the tube K down to the zero-point for the divisions on B_1. H is closed. The mercury-receiver is sunk till the surface of the mercury is on a level with the bottom af A. H_6 is closed, and the mercury-receiver is put into its place.

Some sulphuric acid is poured into T_1, and part of it is admitted into the boiling-flask by opening the threeway cock H in a suitable manner. The lamp is lighted. A new boiling-out begins, and as long as it is taking place, water is allowed to run into the cooling-water receiver now and then to keep the pressure and the temperature low in the boiling-flask.

At the same time, the gases transferred to B_1 are measured. L_1 is sunk, so that the gases in the burette are subject to the pressure of the atmosphere. The volume of the gases contained in the burette B_1 are read together with the temperature of the water-bath and the height of barometer. L_1 is hung up its place, L_2 is sunk, and H_1 is opened. The air will now through K_1 flow into B_2, followed by water from B_1. This water may, after its being used for a while, contain salt water and sulphuric acid, which, however, will not have any injurious effect during the analysis. The air bubbles up through the water in B_2 to the zero-point for the divisions. H_1 is closed. Potash is poured into T_2. H_4 is opened. Potash flows into B_2 and absorbs the carbonic acid.

The boiling-out with sulphuric acid will likewise last 20—25 minutes, on which the lamp is put out again. The gases that have been boiled out are driven into B_1 and measured there, and farther on to B_2, where the carbonic acid is absorbed. It will be seen then, that nearly all the oxygen and the nitrogen has been expelled at the first boiling, so that the oxidation of the mercury during the boiling with sulphuric acid may be left out of consideration entirely (*Otto Pettersson* och *Gustaf Ekman*: «Grunddragen af Skageracks och Kattegats Hydrografi» pag. 17, Anm. 3). Direct trials with repeated boiling without sulphuric acid led to the same result.

A third and fourth boiling-out was effected to have all the carbonic acid expelled from the sea-water, and the last time, the remaining quantity of this acid was as a rule so small that it could hardly be measured.

The gases remaining after the absorption of the carbonic acid are now collected in B_2, where their volume is measured. The temperature of the water-bath is read. By the sinking of L_3 and the opening of H_2, the gases get into B_3. H_2 is closed. Pyrogallic acid and a solution of potassium hydrate is prepared in T_3, which is effected by the introduction of pyrogallic acid into the funnel by means of a tea-spoon and pouring potash over it. When H_3 is opened, the pyrogallic acid & solution of hydrate is running into the burette B_3 and absorbs the oxygen. For the sake of the reading, rincing with a little clean water is advisable. The gas remaining in B_3 after the absorption of the oxygen, is regarded as nitrogen. Its volume and temperature is determined. The height of barometer is considered as constant during the whole of the analysis.

Every time that gas is led from one of the burettes to another, it is accompanied by a little liquid. Thus a mixture of distilled water, salt water and sulphuric acid makes its way from B_1 into B_2, and diluted potash from B_2 to B_3, which beforehand contains pyrogallic acid & a solution of potassium hydrate. As soon as the gas is transferred from one burette into the next one, the former is ready to receive another quantity for absorption and measuring. At the same time a constant renewal of the water in the burettes is taking place from the water-receiver L_1; but on account of the water being nearly saturated with air during the whole of its passage, the quantity of air that is lost by absorption at improper places, will not be great in so far as the quantity of oxygen and nitrogen is concerned. On the other hand, the absorption of the carbonic acid in the burette B_1 may be the cause of some inaccuracy, but I preferred this to any further complication of the apparatus, as I did not consider the determination of the absolute quantity of carbonic acid to be of much consequence.

Being of opinion that a generation of hydrogen was necessary, when the carbonic acid was to be boiled out completely, I carried out this object by placing a piece of zinc in the mercury. The acid that was added produced then a generation of hydrogen. It was not, however, always convenient to be obliged to take regard to this generation of hydrogen, and, moreover, it would make the determination of the nitrogen unreliable. Owing to this, I made up my mind to avoid it entirely by removing the zinc, as I had come to the conclusion that this little modification was to be preferred, even if it should be at the sacrifice of the exactness of the determination of the carbonic acid.

It is to be observed, however, that the quantity of heat imparted to the boiling-flask is very great, and that the cooling of C is very energetic, in consequence of which the ebullition becomes specially violent towards the completion, even attended with shocks, but this is a matter of no consequence at all.

The burettes were divided with great exactness, but they were calibrated for all that after the determination of the zero-point had taken place with great exactness; by this every single reading can be subject to correction. Each single reading of volume has, by means of this correction, been reduced to a pressure of 0° and 760^{mm}, and the dryness according to the table on page 30—32 in the *Landolt* & *Börnstein* «tables». The application of this table makes it a condition that the height of barometer should be measured with a mercury barometer, but it can easily be seen that the error occasioned by the exclusive use of aneroid barometers, which are those I have used, is hardly perceptible.

That the mercury can be removed, which possibly might get into the burettes B_1 and B_2, these latter are at the nethermost part closed with a little tube and a jam-cock. This precautionary step facilitates also the cleaning of the apparatus, but, according to what has been said above, a purification of this kind is very seldom necessary, for the mercury is for a time collected in the glass tubes in which the burettes terminate below, and it cannot run into the hoses that connect the burettes with the water-receivers L. We have thus, when the water-surface in L is kept on a level with the surface in the burette, with sufficient exactness the pressure of the atmosphere on the quantity of air that is to be measured.

The apparatus can be used with as great an exactness, and nearly with as great a facility when the ship is rolling, as when it is in a smooth sea. The only inconvenience occasioned by the rolling of the vessel, is, to pour sulphuric acid into T_1 and potash into T_2 and T_3.

As soon as the water bottle, after its being hauled up, had been taken into the laboratory, it was properly secured between some wooden stanchions in the table, and the water was, in such a manner as has been described, sucked into the apparatus and made subject to boiling and analysis, so that the water could not be warmed to any perceptible degree, or give up any of the gas contained in it, before the examination of the sample took place. A few times the analysis could not be made before half an hour after the sample had been hauled up. The water then remained in the water-bottle, which was placed on the deck to prevent it from being warmed.

The determinations of temperature and salinity as well as the analysis of gases mentioned in the foregoing, have all been made on board, and of the gentlemen who assisted me in this work, I have the pleasure of directing the attention to the following. On the first voyage in 1895, Mr. *Sigurd Wandel*, painter, took part in the expedition as draughtsman and assisted me in many ways, specially with my work at the stations. On the next voyage in 1896, my work was increased with the execution of the analyses of the gases, and the titrations were therefore principally executed by Mr. *A. Blad*, assistant surgeon on board the Ingolf. From the following will be seen that no exertion has been spared to execute this comprehensive work with the greatest punctuality and accuracy.

When I commenced my researches concerning the relations between the plankton of the surface waters and the amount of oxygen held in these waters, Mr. *Liebmann*, undergraduate, and the draughtsman of the expedition on the second voyage, was entrusted with the collection of Plankton and the temporary examination of same, but shortly after the voyage had commenced, he was relieved by the botanist of the expedition Mr. *Ostenfeld-Hansen*, M. A., together with whom I made some of the investigations described in the following.

The greater part of the chemical analyses mentioned in this work, and which have been executed after the expedition had come home, were made by Mr. *Julius Petersen*, cand. polyt. and assistant at the chemical laboratory of the Polytecnical Academy. Mr. *Jørg. Jørgensen*, teacher, and Mr. *Absalon Larsen*, M. A., have assisted me with the construction of the charts and tables.

Finally I render my best thanks to the gentlemen who assisted me in the execution of the work which I could not manage myself, what by want of time and knowledge of all the branches of the cases concerned.

TABLES.

All the observations concerning the surface waters are noted in the table, see page 40. From this will be seen that, measuring of temperature and salinity has been made every fourth hour and at all the stations. At many places every second hour, sometimes even every quarter of an hour. The hour is indicated according to mean-time on board ship. The geographical longitude is reckoned from the meridian of Greenwich. The appellations used for the weather, are:

0: clear	F: fog
1: lightly clouded	R: rain
2: half clouded	S: snow
3: clouded	H: hail
4: grey, overcast	M: thick with rain
Hz: misty	

The force of the wind is indicated after Beauforts scale (0—12), with the addition that 3 b means stiff breeze [so that the gallant sails can just be carried]. The height of barometer was read on an aneroid barometer. The temperature of the air was found by means of a thermometer, supplied with a scale of paper divided into whole degrees. Any high degree of confidence could hardly be reposed in this thermometer. All the indications are according to Celsius scale of temperature. As to the determination of the temperature, amount of chlorine, and salinity of the water, reference is made to the foregoing.

In the table of measurings made at stations, is noted the depth from which the water sample is fetched, indicated in Danish fathoms & metres. The number representing the depth, is underlined when the sample is taken from the bottom. As to the temperature of the water, the corrected value is put down. At *Ekman*'s researches (Kgl. Svenska Vetenskaps Akademiens handlingar ny följd, Bd. 9, förra del) is noted, according to Professor *Wachcrbarth*'s calculation, how water of different salinity expands by heating. From this can be deduced the specific gravity of sea-water of the temperature $t°$ when the salinity is S, or the amount of chlorine Cl.

This specific gravity is called $s\left(\frac{t}{4}\right)$, and means the gravity of sea-water with the temperature $t°$ in proportion to distilled water at 4°. The quantity $s\left(\frac{t}{4}\right)$, I have calculated and represented graphically, specially because the variation of this quantity with the depth, frequently will give a good idea of the exactness with which temperature and salinity has been determined. Still is to be observed, that $s\left(\frac{t}{4}\right)$ is not the specific gravity of the sea-water in situ, as to obtain this, the pressure must be taken into consideration, that is to way, $s\left(\frac{t}{4}\right)$ must be multiplied by $1 + mx$, where x means the depth, and m a positive number, dependent on the temperature, pressure and salinity of the water at the place concerned. Provided this calculation be made, we shall obtain — if we use a scale like the one applied at the graphic representation of $s\left(\frac{t}{4}\right)$ — a very bold curve, for which there would not be room on the paper, and a smaller scale for the ordinates would entirely efface the peculiarities found. And as, morover, the curves that are drawn for $s\left(\frac{t}{4}\right)$ give a good illustration of the manner in which the specific gravity is varying with the depth, I considered it right to calculate and repres-

Table of log *a*.

$s\left(\frac{t}{4}\right) = 1 + a \cdot Cl$; *Cl* means the amount of chlorine ‰. $s\left(\frac{t}{4}\right)$ means the sp. gravity at $t°$ in proport to dist. Water at 4°.

Temp.	17‰ Chlor	Diff.	18‰ Chlor	Diff.	19‰ Chlor	Diff.	20‰ Chlor	Temp.	17‰ Chlor	Diff.	18‰ Chlor	Diff.	19‰ Chlor	Diff.	20‰ Chlor
	0· ÷3		0· ÷3		0· ÷3		0· ÷3		0· ÷3		0· ÷3		0· ÷3		0· ÷3
÷2·0	16333	26	16359	26	16385	25	16410	4·0	15768	1	15769	1	15770	1	15771
÷1·9	16331	25	16356	25	16381	24	16405	4·1	15752	1	15753	1	15754	1	15755
÷1·8	16329	24	16353	24	16377	23	16400	4·2	15736	1	15737	1	15738	1	15739
÷1·7	16327	23	16350	23	16373	22	16395	4·3	15719	1	15720	1	15721	1	15722
÷1·6	16324	23	16347	22	16369	21	16390	4·4	15702	1	15703	2	15705	1	15706
÷1·5	16322	21	16343	22	16365	20	16385	4·5	15684	2	15686	2	15688	2	15690
÷1·4	16319	20	16339	21	16360	19	16379	4·6	15666	3	15669	2	15671	2	15673
÷1·3	16316	19	16335	20	16355	19	16374	4·7	15649	3	15652	2	15654	2	15656
÷1·2	16312	19	16331	19	16350	18	16368	4·8	15631	3	15634	2	15636	2	15638
÷1·1	16309	18	16327	18	16345	16	16361	4·9	15613	3	15616	2	15618	2	15620
÷1·0	16305	17	16322	17	16339	16	16355	5·0	15594	3	15597	3	15600	2	15602
÷0·9	16300	17	16317	16	16333	15	16348	5·1	15575	4	15579	4	15583	2	15585
÷0·8	16295	16	16311	15	16326	15	16341	5·2	15556	4	15560	4	15564	2	15566
÷0·7	16290	15	16305	15	16320	13	16333	5·3	15537	5	15542	4	15546	2	15548
÷0·6	16285	14	16299	14	16313	13	16326	5·4	15518	5	15523	4	15527	3	15530
÷0·5	16280	13	16293	13	16306	12	16318	5·5	15499	5	15504	4	15508	3	15511
÷0·4	16274	12	16286	12	16298	12	16310	5·6	15479	5	15484	5	15489	3	15492
÷0·3	16268	11	16279	12	16291	11	16302	5·7	15459	5	15464	5	15469	4	15473
÷0·2	16262	10	16272	11	16283	10	16293	5·8	15440	5	15445	5	15450	4	15454
÷0·1	16256	9	16265	10	16275	10	16285	5·9	15420	5	15425	5	15430	4	15434
0·0	16249	9	16258	9	16267	9	16276	6·0	15400	5	15405	5	15410	5	15415
0·1	16241	9	16250	8	16258	9	16267	6·1	15379	6	15385	5	15390	6	15396
0·2	16233	8	16241	9	16250	8	16258	6·2	15358	6	15364	6	15370	6	15376
0·3	16225	8	16233	8	16241	7	16248	6·3	15337	6	15343	7	15350	6	15356
0·4	16217	7	16224	7	16231	7	16238	6·4	15316	6	15322	8	15330	7	15337
0·5	16208	7	16215	7	16222	6	16228	6·5	15294	7	15301	8	15309	8	15317
0·6	16199	7	16206	6	16212	6	16218	6·6	15272	8	15280	8	15288	8	15296
0·7	16190	6	16196	7	16203	5	16208	6·7	15250	9	15259	8	15267	9	15276
0·8	16181	6	16187	6	16193	5	16198	6·8	15228	9	15237	9	15246	9	15255
0·9	16172	5	16177	6	16183	4	16187	6·9	15206	9	15215	9	15224	10	15234
1·0	16163	4	16167	5	16172	4	16176	7·0	15183	10	15193	10	15203	10	15213
1·1	16153	4	16157	4	16161	4	16165	7·1	15160	11	15171	10	15181	11	15192
1·2	16142	4	16146	4	16150	4	16154	7·2	15137	11	15148	12	15160	11	15171
1·3	16132	3	16135	4	16139	3	16142	7·3	15114	12	15126	12	15138	12	15150
1·4	16121	3	16124	4	16128	3	16131	7·4	15090	13	15103	13	15116	13	15129
1·5	16110	3	16113	3	16116	3	16119	7·5	15066	14	15080	13	15093	14	15107
1·6	16098	3	16101	3	16104	3	16107	7·6	15042	15	15057	14	15071	14	15085
1·7	16087	2	16089	3	16092	3	16095	7·7	15018	15	15033	15	15048	15	15063
1·8	16075	2	16077	3	16080	2	16082	7·8	14994	16	15010	15	15025	16	15041
1·9	16063	2	16065	3	16068	2	16070	7·9	14970	16	14986	16	15002	17	15019
2·0	16051	2	16053	2	16055	2	16057	8·0	14945	17	14962	17	14979	17	14996
2·1	16039	2	16041	2	16043	1	16044	8·1	14920	18	14938	18	14956	17	14973
2·2	16026	2	16028	2	16030	2	16032	8·2	14895	18	14913	19	14932	19	14951
2·3	16014	1	16015	2	16017	2	16019	8·3	14869	20	14889	19	14908	20	14928
2·4	16001	2	16003	1	16004	2	16006	8·4	14844	20	14864	20	14884	20	14904
2·5	15988	2	15990	1	15991	1	15992	8·5	14818	21	14839	21	14860	21	14881
2·6	15975	1	15976	2	15978	0	15978	8·6	14792	22	14814	22	14836	21	14857
2·7	15961	2	15963	1	15964	1	15965	8·7	14766	22	14788	24	14812	21	14833
2·8	15948	1	15949	1	15950	1	15951	8·8	14739	24	14763	24	14787	22	14809
2·9	15934	1	15935	1	15936	1	15936	8·9	14713	24	14737	25	14762	23	14785
3·0	15920	1	15921	1	15922	0	15922	9·0	14686	25	14711	25	14736	25	14761
3·1	15906	1	15907	1	15908	0	15908	9·1	14658	26	14684	26	14710	26	14736
3·2	15891	1	15892	1	15893	0	15893	9·2	14631	27	14658	27	14685	27	14712
3·3	15876	1	15877	1	15878	0	15878	9·3	14603	28	14631	28	14659	28	14687
3·4	15861	1	15862	1	15863	0	15863	9·4	14574	29	14603	29	14632	29	14661
3·5	15846	1	15847	1	15848	0	15848	9·5	14546	30	14576	39	14606	30	14636
3·6	15831	1	15832	1	15833	0	15833	9·6	14517	31	14548	31	14579	31	14610
3·7	15816	1	15817	1	15818	0	15818	9·7	14489	31	14520	33	14553	32	14585
3·8	15800	1	15801	1	15802	0	15802	9·8	14460	32	14492	34	14526	33	14559
3·9	15784	1	15785	1	15786	0	15786	9·9	14430	34	14464	34	14498	34	14532

ent this theoretical quantity. As $s\left(\frac{t}{4}\right) = 1 + aCl$; $s\left(\frac{t}{4}\right)$ can be found from log a and log Cl °/₀₀. Log a can be found in the table on the other side, and log Cl°/₀₀, is known from the titrations.

The table referring to log a, is computed for the two arguments: temperature and amount of chlorine, and such that log a is found for every tenth of a degree from — 2° + 10°, as well as for the amounts of chlorine 17, 18, 19 and 20°/₀₀. The calculation of the table has been made on the basis of the above-mentioned results from *Ekman*'s investigations on the expansion of the different water-samples by heating. Still is to be observed that only two of these samples have been used as a basis for the calculation, namely B and D, as they seem to be about similar in composition, while that of C deviates considerably from them. The amount of chlorine is stated to be: in B 14.254°/₀₀, in D 19.374°/₀₀, while the specific gravity $s\left(\frac{0}{0}\right)$ is: for B 1.02084, for D 1.02831. Furthermore the volume of the two water-samples can be found at all whole degrees (according to the mercury thermometer), as the volume at 0° degree is considered as equal to 1.

By means of these tables, I have computed the table for the two water samples, as mentioned above, as we have $s\left(\frac{0}{4}\right) = s\left(\frac{0}{0}\right) / V\left(\frac{0}{4}\right)$, in which $V\left(\frac{0}{4}\right)$ represents the volume of distilled water at 0°, divided by the volume of the same weight of distilled water at 4°. This quantity is according to *Landolt* and *Börnstein*'s tables page 39 considered to be 1.000127. We get then $s\left(\frac{t}{4}\right) = s\left(\frac{0}{4}\right) / v\left(\frac{t}{0}\right)$ where v means the same for sea-water as V for distilled water.

$s\left(\frac{0}{4}\right)$ is a constant quantity for each water-sample. From the 7-ciphered log of this is subtracted log $v\left(\frac{t}{0}\right)$ for all whole degrees. The numbers corresponding to the difference of logarithms were then $s\left(\frac{t}{4}\right)$, written with 6 decimales. As according to the above we have the equation, $a = \left(s\left(\frac{t}{4}\right) - 1\right) / Cl$, we find thus log a for the two water-samples at all whole degrees. Log a is for the same water-sample such a function of the temperature, that the second difference is very nearly constant. If the temperature be the same, log a will grow with the amount of chlorine, but the addition is very small, and has a minimum between 3° and 4°, where, for 1 °/₀₀ of chlorine it is only 0 or 1 on the fifth decimal.

From the table which applies to the water-samples B and D, log a is found for water with the amounts of chlorine 17, 18, 19 and 20°/₀₀ by simple linear interpolation at every whole degree.

In this table is now interpolated to log a for every 0°.1 according to the formula: $f(a + x) = fa + x\Delta' + x(x - 1)/1.2\ \Delta''$, as Δ' and Δ'' respectively mean the first and second difference. Higher differences are as aforesaid zero. This table is used, because the function log a, as it will be seen, only varies very little with the amount of chlorine, for which reason only the stated amounts of chlorine are needed as arguments to use the table with facility. It will furthermore be seen from the computation of the table, that *Ekman*'s observations have been used with the greatest exactness they could give, so that we certainly may regard all possible errors in $s\left(\frac{t}{4}\right)$ as arising from inexactness in the determinations of temperature and chlorine made on board.

We might of course do as Dr. *G. Schott* has done, (Wissenschaftliche Ergebnisse einer Forschungsreise zur See; Petermanns Mittheilungen XXIII Ergänzunsgband, 1892—93, pag. 18) and make a table about the correction that is to be applied to $s\left(\frac{17.5}{17.5}\right)$ to get $s\left(\frac{t}{4}\right)$, but when the amount of chlorine is stated, and not $s\left(\frac{17.5}{17.5}\right)$, then we should first be obliged to determine this quantity, which, of course, would make the calculation much more difficult. In the last column in the tables of the stations are tabulated the numbers of the plates, on which the observations are represented.

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokke-slet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction of the wind)*	Vind: Styrke *(force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1895												
Maj *(May)* 5	0 p. m.		56° 52′ N.	11° 47′ E.	0	N.	2	779·0	29°	10°0	16·38	9·05
	4 p. m.		57° 25′	11° 20′	0	NNE.	2	778·6	13°	11°0	17·74	9·80
	8 p. m.		57° 47′	10° 31′	0	N.	2	778·8	11°	7°5	31·01	17·14
6	0 a. m.		57° 49′	9° 20′	0	NW.	2	779·6	10°	9°5	33·73	18·65
	4 a. m.		57° 49′	8° 18′	0		0	779·8	10°	8°0	33·17	18·34
	8 a. m.		57° 52′	6° 56′	0	N.	1	781·1	12°	10°0	23·53	13·01
	0 p. m.		58° 21′	5° 45′	0		0	782·0	15°	10°0	25·84	14·28
	4 p. m.		58° 42′	4° 52′	0		0	782·0	18°	10°0	31·42	17·37
	8 p. m.		59° 06′	3° 56′	0		0	781·2	11°	11°5	31·43	17·38
7	0 a. m.		59° 28′	2° 57′	0		0	781·1	9°	9°0	34·91	19·30
	4 a. m.		59° 52′	2° 02′	0	S.	1	780·3	8°	8°0	35·10	19·40
	do.		—	—	—	—		—	—	8°0	35·05	19·37
	do.		—	—	—	—		—	—	8°0	35·05	19·37
	8 a. m.		60° 15′	1° 01′	0	SW.	1	780·3	11°	10°0	35·35	19·54
	0 p. m.		60° 41′ 5″	0° 04′ W.	0	SW.	1	780·8	13°	9°0	35·29	19·51
	4 p. m.		61° 01′	0° 50′	0	S. by E.	2	779·1	14°	9°0	35·34	19·54
	8 p. m.		61° 12′	2° 01′	0	S. by E.	2	778·0	12°	9°0	35·47	19·61
8	0 a. m.		61° 24′	3° 10′	0	SSW.	2	777·1	11°	9°0	35·54	19·65
	4 a. m.		61° 35′ 5″	4° 25′	0	SSW.	1	775·5	10°	9°0	35·39	19·56
	8 a. m.		61° 47′	5° 38′	0	SSW.	3	773·1	11°	8°0	35·55	19·65
	0 p. m.		62° 03′	6° 40′	0	NW.	1	772·3	12°	9°5	35·46	19·60
	4 p. m.		61° 50′	6° 43′	0	S.	4	770·0	12°	8°0	35·49	19·62
11	8 a. m.		61° 39′	6° 55′	3	N.byW.	2	765·7	9°		35·22	19·47
	5.45 p. m.	1	62° 30′	8° 21′						9°0	35·32	19·52
12	5 a. m.	2	63° 04′	9° 22′						8°5	35·36	19·55 *
	0 p. m.		63° 12′	9° 48′	3	S.	2	767·2	12°	9°0	35·39	19·56
	5 p. m.	3	63° 35′	10° 24′						7°5	35·38	19·56
13	0 a. m.		63° 56′	10° 54′	R.	SSW.	1	765·8	12°	9°5	35·18	19·45
	3 a. m.	4	64° 07′	11° 12′	R.					7°7	35·30	19·51
	2 p. m.	5	64° 40′	12° 09′	3					5°5	35·04	19·37
	4 p. m.		64° 52′	12° 13′	F.	SW.	3 b	763·7	7°	4°5	34·78	19·23
	6 p. m.		65° 03′	12° 29′	F.					2°5	34·85	19·26
	8 p. m.		65° 12′	12° 37′	F.	WSW.	3	762·0	6°	2°5	34·85	19·26
	11.30 p. m.		65° 19′	13° 02′						2°5	34·76	19·22
16	0 a. m.		65° 10′	12° 56	0		0	771·0	2°	0°9	34·62	19·14
	4 a. m.		64° 37′	12° 52	0		0	770·6	2°	1°0	34·97	19·33
	8 a. m.		64° 11′	13° 33′	4		0	770·9	7°	5°5	35·37	19·55
	0.30 p. m.	6	63° 43′	14° 34′						8°3	35·23	19·47
	4 p. m.		63° 29′	15° 01′	3	WNW.	2	768·0	10°	8°0	35·31	19·52
	6.30 p. m.	7	63° 13′	15° 41′						8°7	35·41	19·57
17	8 a. m.		63° 00′	16° 00′	1	WNW.	4	761·7	10°	9°0	35·32	19·52
	0 p. m.		62° 44′	16° 39′	1	WNW.	5	760·7	11°	8°5	35·41	19·57
18	0 a. m.		62° 27′	16° 57′	0	NW.	5	761·9	9°	8°5	35·35	19·54
	8 a. m.		62° 20′	17° 31′	3	N.byW.	4	767·2	9°	8°0	35·33	19·53
	4 p. m.		62° 52′ 5″	18° 02′	0	N.	4	771·3	10°	8°0	35·24	19·48

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction of the wind)*	Styrke *(force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1895												
Maj *(May)* 18	8 p. m.		63° 03′ N.	19° 08′ W.	0	NE. by E.	3	771·8	8°	7°9	35·40	19·57
19	0 a. m.		63° 12′	20° 17′	0	NW. by N.	1	772·8	6°	8°0	35·39	19·56
	4 a. m.		63° 28′	21° 23′	3	E.	1	772·3	6°	7°5	35·40	19·57
	8 a. m.		63° 43′	22° 26′	4	SW. by W.	1	771·6	10°	8°0	35·14	19·43
	0 p. m.		63° 51′	23° 37′ 5″	Hz.	SW. by S.	3 b	769·5	9°	8°0	35·35	19·54
	4 p. m.	8	63° 56′	24° 40′	4	SW.	2	768·1	10°	8°5	35·31	19·52 *
	8 p. m.		64° 01′	25° 25′	4	SW.	3	766·3	9°	7°2	35·30	19·51
20	0 a. m.		64° 05′	26° 27′	R.	SW. by W.	3	765·8	8°	7°8	35·17	19·44
	4 a. m.	9	64° 18′	27° 00′	3	WSW.	3 b	764·0	8°	7°9	35·41	19·57 *
	8 a. m.		64° 18′	27° 00′	3	WSW.	3 b	763·1	9°	6°7	35·34	19·54
	0 p. m.		64° 25′	28° 15′	R.	WSW.	4	760·5	9°	7°2	35·09	19·40
	4 p. m.		64° 24′	29° 00′	R.	SW.	3 b	760·0	10°	7°5	35·19	19·45
	5 p. m.	10	64° 24′	28° 50′						7°9	35·13	19·42
21	4 a. m.		64° 27′	29° 55′	3	SW. by S.	1	761·0	8°	6°3	35·25	19·48
	8 a. m.		64° 33′ 7″	31° 12′	4	SW.	1	762·2	10°	7°2	35·12	19·41
	1.30 p. m.	11	64° 34′	31° 12′						8°2	35·17	19·44
22	0 a. m.		64° 32′	31° 30′	3	SE. by E.	1	763·5	8°	8°0	35·53	19·64
	4 a. m.	12	64° 38′	32° 37′	0		0	763·0	8°	7°0	35·31	19·52
	5.30 p. m.	13	64° 47′	34° 33′						6°8	35·06	19·38
	8 p. m.		64° 46′	34° 50′	R.	NE.	3 b	759·2	5°	4°0	34·47	19·05
	9 p. m.	14	64° 45′	35° 05′						4°0	34·39	19·01
23	4 a. m.		64° 37′	34° 56′	R.	NE. by E.	6	755·6	4°	2°9	34·29	18·96
	0 p. m.		64° 22′	34° 35′	R.	NE. by E.	7	755·9	4°	4°4	34·63	19·14
	4 p. m.		64° 17′	34° 28′	4	NE.	7	757·1	5°	4°9	34·74	19·20
	8 p. m.		64° 11′	34° 20′	4	NE.	8	757·7	5°	6°2	35·28	19·50
24	0 a. m.		64° 06′	34° 12′	4	NE.	8	758·1	5°	4°9	35·31	19·52
	0 p. m.		63° 50′	33° 50′	R.	NE.	8	759·8	7°	6°4	35·23	19·48
25	0 p. m.		63° 19′	33° 06′	3	NE. by E.	4	754·5	10°	7°4	35·20	19·46
26	0 p. m.		63° 05′	32° 36′	R.	NNE.	5	752·0	10°	8°4	35·31	19·52
	8 p. m.		62° 58′	32° 11′	4	NE.	3	751·8	9°	7°6	35·14	19·43
27	0 a. m.		63° 02′	31° 55′	4	ENE.	2	754·5	9°	7°9	35·06	19·38
	4 a. m.		63° 15′	31° 28′	3	E. by N.	2	757·0	9°	7°4	35·17	19·44
	8 a. m.		63° 28′	31° 02′	3	ENE.	2	760·0	11°	7°8	35·17	19·44
	0 p. m.		63° 47′	30° 21′	3	NE.	2	761·0	14°	8°9	35·09	19·40
	4 p. m.		64° 00′	29° 50′	3	NE.	3	761·3	16°	9°4	35·10	19·40
	8 p. m.		64° 13′	29° 10′	3	NNE.	3 b	760·1	9°	8°9	35·23	19·47
28	0 a. m.		64° 15′	28° 35′	4	NNE.	3 b	758·8	8°	8°0		
	4 a. m.		64° 21′	27° 46′	R.	NNE.	3	758·2	8°	8°0	35·27	19·50
	8 a. m.		64° 26′	27° 05′	4	NE.	2	757·8	11°	7°9	35·39	19·56
	0 p. m.		64° 40′	26° 40′	4	NE.	2	756·2	9°	8°9	35·17	19·44
	4 p. m.		65° 00′	26° 00′	3	NE.	2	755·0	9°	7°6	35·06	19·38
	8 p. m.		65° 25′	25° 12′	4	NE.	2	752·7	6°	6°7	35·09	19·40
29	0 a. m.		65° 44′	24° 26′	4	NE. by N.	3 b	750·9	5°	6°5	34·68	19·17
	4 a. m.		Dyre-Fjords Munding *(the mouth of Dyre-Fjord)*		4	NE. by N.	3b	749·0	6°	6°8	34·12	18·86

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction of the wind)*	Vind: Styrke *(force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1895												
Juni *(June)* 4	8 a. m.		Dyre-Fjords Munding *(the mouth of Dyre-Fjord)*		4		0	759·5	12°	7°2	34·25	18·93
	0 p. m.		66° 06′ N.	24° 40′ 5″ W.	4	SSW.	2	760·0	13°	8°2	35·13	19·42
	4 p. m.	15	66° 18′	25° 59′	4	SSW.	2	759·1	10°	6°1	34·80	19·24
5	0 a. m.		66° 04′	26° 15′	4	SSE.	1	758·3	7°	3°4	34·30	18·96
	4 a. m.		65° 50′	26° 39′	4	SE.	3	753·8	8°	7°3	35·08	19·39
	8 a. m.	16	65° 43′	26° 58′	R.	SE. by E.	4	751·0	9°	7°9	34·99	19·34
	8 a. m.		65° 43′	26° 58′	—	—		—	—	7°5	35·08	19·39
	0 p. m.		65° 38′	27° 06′	4 (R.)	SE. by E.	3	748·5	9°	8°3	35·18	19·45
	4 p. m.		65° 34′	26° 42′	R.	SSE.	4	746·8	9°	8°8	35.08	19·39
	8 p. m.		65° 40′	25° 37′	3	S.	3	750·1	9°	8°1	35·22	19·47
6	0 a. m.		65° 50′	24° 24′	R.	SSE.	4	753·7	8°	7°5	34·91	19·30
15	8 a. m.		64° 11′	22° 05′	3		0	769·2	11°	10°8	34·31	18·97
	0 p. m.		64° 04′	23° 09′	4	S. by E.	2	768·4	14°	10°5	34·69	19.18
	2 p. m.		63° 56′	23° 35′							35·22	19·47
	4 p. m.		63° 48′ 5″	24° 01′	4	SSE.	3	766·8	11°	9°5	35·27	19·50
	6 p. m.		63° 41′	24° 26′							35·39	19·56
	8 p. m.		63° 33′	24° 52′	F.	S. by E.	3	766·7	11°	9°2	35·29	19·51
	10 p. m.		63° 26′	25° 16′	F.	SSE.					35·36	19·55
16	0 a. m.		63° 17′	25° 43′	M.	SSW.	1	767·6	11°	9°5	35·26	19·49
	2 a. m.		63° 09′	26° 09′							35·34	19·54
	4 a. m.		63° 01′	26° 35′	4	SW.	1	767·9	9°	9°2	35·20	19·46
	5·20 a. m.	17	62° 49′	26° 55′						9°1	35·26	19·49
	6 a. m.		62° 49′	26° 55′							35·27	19·50
	0 p. m.		62° 44′	27° 10′	3		0	769·0	12°	10°5	35·35	19·54
	2 p. m.		62° 36′	27° 23′							35·24	19·48
	4 p. m.		62° 27′	27° 36′	4		0	768·4	13°	10°7	35·26	19·49
	6 p. m.		62° 20′	28° 06′							35·22	19·47
	8 p. m.		62° 13′	28° 37′	4		0	768·1	12°	9°7	35·24	19·48
	10 p. m.		62° 04′	29° 07′							35·14	19·43
17	0 a. m.		61° 55′	29° 34′	F.	SSE.	1	767·8	12°	9°9	35·14	19·38
	2 a. m.		61° 49′	29° 52′							35·16	19·44
	4 a. m.		61° 40′	30° 20′	3	S.	1	767·0	12°	10°3	35·17	19·44
	5 a. m.	18	61° 44	30° 29′						10°0	35·05	19·38 *
	8 p. m.		62° 35′	30° 42′	F.	SE.	1	767·0	12°	9°5	35·21	19·46
	10 p. m.		61° 25′	31° 10′							35·17	19·44
18	0 a. m.		61° 16′	31° 35′	F.	SSE	1	767·0	11°	10°7	35·21	19·46
	2 a. m.		61° 07′	32° 02′							35·11	19·41
	4 a. m.		60° 58′	32° 28′	F.	SE.	1	766·6	11°	9°2	35·24	19·48
	6 a. m.		60° 49′	32° 54′							35·21	19·46
	8 a. m.		60° 40′	33° 20′	3	SE.	1	767·1	11°	8°7	35·14	19·43
	10 a. m.		60° 35′	33° 45′						8°3	35·14	19·43
	1 p. m.	19	60° 29′	34° 14′						9°0	35·16	19·44
19	0 a. m.		60° 17′	34° 38′	4	S. by E.	2	769·0	11°	8°2	35·14	19·43
	2 a. m.		60° 07′	35° 05′							35·09	19·40

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction*	Vind: Styrke *force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1895												
Juni *(June)* 19	4 a. m.		59° 58′ N.	35° 31′ W.	4	E.	2	769·2	12°	7°9	35·12	19·41
	6 a. m.		59° 49′	35° 58′							35·10	19·40
	8 a. m.		59° 40′	36° 24′	4	E.	2	769·5	11°	7°8	35·10	19.40
	10 a. m.		59° 36′	36° 50′						8°0	35·12	19·41
	0 p. m.		59° 32′	37° 15′	4	E. by N.	2	769·7	13°	8°1	35·14	19·43
	2 p. m.		59° 22′	37° 42′						6°8	35·00	19·35
	4 p. m.		59° 13′	38° 10′	4	E.	1	770·2	13°	6°5	35·03	19·36
	6 p. m.		50° 04′	38° 35′						6°4	35·06	19·38
	8 p. m.		58° 55′	38° 59′	3	E. by N.	1	770·6	10°	6°35	34·99	19·34
	10 p. m.		58° 46′	39° 22′						6°3	34·97	19·33
20	0 a. m.		58° 38′	39° 45′	4	E.	1	770·9	10°	6°2	34·97	19·33
	2 a. m.		58° 29′	40° 09′							34·96	19·33
	4 a. m.		58° 21′	40° 33′	4		0	770·3	9°	6°1	34·94	19.31
	5 a. m.	20	58° 20′	40° 48′						6°1	34·96	19·33
	2 p. m.		58° 16′	40° 40′						8°1	34·96	19·33
	4 p. m.		58° 07′	41° 23′	0		0	772·7	13°	8°15	34·92	19.30
	6 p. m.		58° 03′	41° 56′							34·87	19·28
	8 p. m.		58° 00′	42° 28′	0		0	772·4	11°	7°9	34·89	19·29
21	0 a. m.		58° 00′	43° 28′	0		0	772·5	8°	6°3	34·79	19·23
	2 a. m.		58° 00′	44° 02′							34·83	19·25
	4 a. m.		58° 00′	44° 35′	0		0	772·5	9°	5°7	34·81	19·24
	5 a. m.	21	58° 01′	44° 45′						6°1	34·79	19·23
	8 p. m.		58° 01′	45° 50′	3	NW. by W.	2	772·6	9°	6°8	34·72	19·19
22	0 a. m.		58° 01′	46° 50′	3	NW.	2	772·5	8°	6°5	34·72	19·19
	4 a. m.		58° 01′	47° 25′	F.	NW.	2	771·8	7°	5°9	34·76	19·21
	8 a. m.		58° 06′	48° 08′	F.	NW.	2	771·3	8°	5°5	34·71	19·19
	10 a. m.	22	58° 10′	48° 25′						5°35	34·78	19·23
	8 p. m.		58° 13′	48° 38′	4	NW.	3 b	770·2	5°	5°3	34·65	19·15
23	0 a. m.		58° 26′	49° 24′	4	NW.	3	769·5	5°	5°1	34·63	19·14
	4 a. m.		58° 38′	50° 15′	4	NW. by N.	3 b	769·5	5°	4°7	34·67	19·17
	8 a. m.		58° 49′	51° 00′	3	NW. by N.	3 b	769·9	7°	5°5	34·63	19·14
	0 p. m.		58° 53′	52° 02′	0	NW. by N.	3 b	770·1	7°	5°5	34·62	19·14
	4 p. m.		59° 06′	52° 51′	0	NNW.	3	772·8	8°	5°45	34·74	19·20
	8 p. m.		59° 19′	53° 38′	0	N.	2	772·9	6°	5°55	34·71	19·19
24	0 a. m.		59° 32′ 5″	54° 40′	1	N.	2	772·4	6°	4°9	34·44	19·04
	4 a. m.		59° 42′	55° 35′	1	N.	1	771·1	7°	5°3	34·19	18·90
	8 a. m.		60° 14′	55° 57′	0	E.	1	770·5	8°	5°26	34·28	18·95
	0 p. m.	23	60° 43′	56° 00′	0	ESE.	1	770·0	8°	5°4	34·08	18·84
	4 p. m.		61° 08′	56° 00′	0	SE.	1	769·6	11°	6°2	34·00	18·80
	8 p. m.		61° 40′	56° 00′	3	SE.	1	768.9	7°	5°35	34·06	18·83
25	0 a. m.		62° 13′	56° 00′	3	SSE.	1	767·9	6°	5°1	33·95	18·77
	4 a. m.		62° 47′	56° 00′	4	SSE.	1	767·9	6°	3°8	33·84	18·71
	9 a. m.	24	63° 06′	56° 00′						4°2	33·35	18·44
	4 p. m.		63° 12′	55° 35′	F.	SW. by S.	1	768·0	8°	4°8	33·83	18·70
	8 p. m.		63° 22′	54° 55′	F.	SW. by S.	1	767·9	6°	3°15	33·23	18·37

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction of the wind)*	Vind: Styrke *(force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1895												
Juni 25 *(June)*	8.15 p. m.		63° 22′ 30″ N.	54° 53′ 08″ W.						3°7		
	8.30 p. m.		63° 23′	54° 51′ 15″						3°7		
	9 p. m.		63° 24′	54° 47′ 30″						3°2		
	9.30 p. m.		63° 25′	54° 43′ 45″						3°0		
	10 p. m.		63° 26′	54° 40′						3°3	33·39	18·46
	10.30 p. m.		63° 27′	54° 36′ 15″						3°7		
	11 p. m.		63° 28′	54° 32′ 30″						3°1		
	11.30 p. m.		63° 29′	54° 28′ 45″						3°0		
26	0 a. m.	25	63° 30′	54° 25′	F.	SW.	2	767·8	8°	2°9	32·97	18·23*
	8 a. m.		63° 34′ 5″	54° 05′	F.	S.	1	768·2	5°	2°1	32·75	18·10
	8.30 a. m.		63° 37′	53° 56′						2°6		
	9 a. m.		63° 38′	53° 52′						3°6		
	0 p. m.		63° 51′ 3″	53° 03′	F.		0	769·0	11°	2°9	32·52	17·97
	0.40 p. m.		63° 52′ 2″	52° 58′						3°0	32·90	18·19
	1 p. m.	26	63° 57′	52° 41′						2°9	32·90	18·19
27	0 a. m.		3 Kml. SV. for Godthaab *(3 miles SW. of Godthaab)*		3		0	766·0	6°	1°9	33·26	18.39
30	6 a. m.		Godthaab Havn *(the harbour of Godthaab)*								33·30	18·41
	8 a. m.		8 Kml. SV. for Godthaab *(8 miles SW. of Godthaab)*		3		0	761·9	10°	3°7	33·27	18·39
	10 a. m.		64° 12′	52° 51′						3°0	33·09	18·29
	0 p. m.		64° 13′ 8″	53° 19′	0		0	760·0	12°	4°3	32·87	18·17
	2 p. m.		64° 24	53° 49′						3°7	33·22	18·36
	4 p. m.		64° 29′	54° 04′	F.	E.	1	758·8	13°	3°85	33·13	18·31
	6 p. m.		64° 35′	54° 18′						4°1	33·06	18·28
	8 p. m.		64° 38′	54° 26′	F.		0	757·9	6°	4°0	32·86	18·16
	10 p. m.		64° 45′	54° 46′						3°5	33·11	18·30
Juli 1 *(July)*	0 a. m.	27	64° 54′	55° 10′	F.	N.	2	756·7	5°	3°9	33·01	18·25
	6 a. m.		64° 58′	55° 09′						3°35		
	8 a. m.		65° 00′	55° 09′	F.	NNE.	3	757·0	5°	2°9		
	10 a. m.		65° 03′	55° 11′						2°8		
	0 p. m.		65° 06′	55° 14′	F.	N.	2	756·4	5°	2°7	33·49	18·51
	4 p. m.		65° 12′	55° 35′	F.	SE.	2	756·1	11°	2°7	33·35	18·44
	8 p. m.	28	65° 14′	55° 42′	F.	SE.	2	755·0	5°	1°15	32·91	18·19
2	0 a. m.		65° 15′	55° 28′	F.	SSE.	3b	754·6	4°	0°8	33·03	18·26
	4 a. m.		65° 15′	55° 09′	3	SSE.	3b	754·9	4°	2°0	33·44	18·49
	8 a. m.		65° 15′	54° 45′	3	SSE.	4	755·4	5°	2°7	33·34	18·43
	10 a. m.		65° 17′	54° 30′						2°7	33·48	18·51
	0 p. m.		65° 38′ 6″	54° 06′	3	SSE.	4	755·8	5°	2°4	35·37	19·55
	2 p. m.		65° 34′	53° 43′						2°6	33·44	18·49
	4 p. m.		65° 31′	53° 25′	F.	SSE.	3b	755·0	5°	2°5	33·55	18·55
	4.30 p. m.		65° 28′	53° 25′							33·32	18·42
4	0 p. m.		65° 06′	53° 27′	F.		0	745·5	9°		33·95	18·77
	5.30 p. m.		65° 19′	53° 19′						4°35	33·36	18·44
5	10 a. m.		65° 21′	53° 31′						3°5		

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction of the wind)*	Vind: Styrke *(force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1895												
Juli *(July)* 5	0 p. m.		65° 25′ N.	53° 53′ W.	4	NW.	1	748·1	6°	3°3	33·33	18·42
	3 p. m.	29	65° 34′	54° 31′						3°5	33·65	18·60*
	8 p. m.		65° 42′	54° 40′	F.	NW. by N.	2	748·1	3°		33·56	18·55
	10 p. m.		65° 45′	54° 43′							33·65	18·60
6	4 a. m.		65° 55′	54° 56′	F.	NW. by N.	3	748·0	2°	2°1	33·54	18·54
	8 a. m.		66° 01′	54° 55′	F.	NNW.	4	747·6	2°		33·65	18·60
	0 p. m.		66° 04′	54° 50′	F.	NNW.	2	747·9	1°		33·61	18·58
	4 p. m.		66° 05′	54° 45′	4 (F.)	NNW.	1	747·8	1°	2°6	33·43	18·48
	6 p. m.		66° 15′	54° 45′						1°95	33·63	18·59
	8 p. m.		66° 28′	54° 44′	F.	NNW.	1	749·1	1°	2°05	33·52	18·53
7	11 a. m.		25 Kml. V. for Holstensborg *(25 miles W. of Holstensborg)*								33·38	18·45
	0 p. m.		66° 44′	54° 00′	4	SSW.	1	753·1	9°	2°3	33·19	18·35
	1.25 p. m.		66° 50′	53° 54′						2°15	33·21	18·36
	2 p. m.		66° 53′ 5″	53° 51′						2°75	32·82	18·14
	2.45 p. m.		mellem Kællingehætten og Amerdlok *(between Kællingehætten and Amerdlok)*							3°45	32·89	18·18
10	Ankerpl. *(anchorage)*									6°0		
	8 a. m.		66° 47′	53° 57′	4		0	757·5	4°	3°2	32·83	18·15
	2 p. m.		66° 50′	54° 28′						1°7		
	7.30 p. m.	30	66° 50′	54° 28′						1°6	33·28	18·40
11	8 a. m.	31	66° 35′	55° 54′	0	N.	3	749·1	5°	2°6	33·36	18·44
	0 p. m.		66° 35′	56° 32′	0	N.	3	749·9	4°	2°8	32·90	18·19
	1 p. m.	32	66° 35′	56° 38′						2°6	33·04	18·26
	8 p. m.		66° 46′	56° 10′	F.	NW.	4	748·6	0°	2°4	33·64	18·60
	10 p. m.		66° 54′	55° 50′						2°1		
12	0 a. m.		66° 59′	55° 36′	F.	NW. by N.	2	749·8	0°	2°2	33·78	18·67
	4 a. m.		67° 16′	55° 36′	F.	NW. by N.	1	751·0	0°	1°6	33·85	18·71
	8 a. m.		67° 38′	55° 36′	F.		0	753·5	0°	2°3	33·75	18·66
	10 a. m.		67° 51′	55° 36′						2°7		
	11.30 a. m.		67° 59′	55° 35′						1°9	33·44	18·48
	1.40 p. m.	33	67° 57′	55° 30′						2°5	33·56	18·55*
	4 p. m.		68° 00′	55° 23′	F.	SSW.	1	757·8	3°	2°3	33·38	18·45
	10 p. m.		67° 56′	55° 23′						2°3		
13	0 a. m.		67° 44′	55° 30′	3	S.	3	761·9	3°	2°4	33·58	18·56
	4 a. m.		67° 17′	55° 30′	4 (F.)	S. by E.	3	763·7	4°	1°5	33·83	18·70
	8 a. m.		66° 55′	55° 04′	4 (F.)	S. by E.	3	765·2	4°	1°8	33·72	18·64
	0 p. m.		66° 35′	55° 09′	4	SE. by S.	3	765·8	5°	2°7	33·46	18·50
	2 p. m.		66° 31′	55° 27′						2°5		
	4 p. m.		66° 28′	55° 43′	3	SSE.	4	766·0	5°	2°5	33·61	18·58
	6 p. m.		66° 22′	55° 35′						2°55		
	8 p. m.		66° 12′	55° 21′	3	S.	2	766·2	4°	2°45	33·58	18·56
14	0 a. m.		65° 52′	55° 05′	3	SSE.	1	766·2	4°	2°6	33·40	18·46
	4 a. m.		65° 42′	55° 05′	F.	SSW.	1	765·4	2°	3°3	33·33	18·42

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*				Vand *(water)*		
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. Styrke *(direction, force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1895											
Juli *(July)* 14	8 a. m.		65° 32′ N.	55° 05′ W.	F.	0	765·8	3°	4°3	33·21	18·36
	0 p. m.		65° 16′ 5″	54° 39′	0 (F.)	0	764·9	5°	6°1	33·24	18·37
	4 p. m.		Kin of Sal retv. N. 32 E. (10 Kml. Afstand) *(10 miles distance)*		3	0	765·7	9°	5°7	31·94	17·66
	5 p. m.		65° 18′5	53° 00′					5°3	28·89	15·97
	5·15 p. m.		65° 19′0	52° 57′					6°2	25·43	14·06
	5·30 p. m.		65° 19′0	52° 55′					6°1	26·19	14·48
	5·45 p. m.		65° 20′0	52° 53′4					6°5	24·53	13·56
	6·15 p. m.		65° 22′0	52° 51′					3°8	23·96	13·24
	6·30 p. m.		65° 23′0	52° 50′					3°7	23·93	13·23
	6·45 p. m.		65° 24′0	52° 51′					6°7	18·59	10·28
	7 p. m.		65° 24′5	52° 53′					3°6	18·64	10·31
18	6·30 a. m.		65° 24′0	52° 52′					6°2	23·18	12·81
	6·45 a. m.		65° 23′0	52° 50′					5°5	27·73	15·33
	7 a. m.		65° 21′5	52° 51′					5°2	27·50	15·20
	7·15 a. m.		65° 20′	52° 52′					5°1	28·88	15.96
	7·30 a. m.		65° 19′0	52° 56′					4°7	29·13	16·14
	7·45 a. m.		65° 18′5	53° 00′					3°85	33·11	18·30
	8 a. m.		65° 18′	53° 03′	4	SW. 2	763·9	7°	3°7	33·05	18·27
	9 a. m.		65° 18′	53° 21′					3°7		
	10 a. m.		65° 19′	53° 39′					4°7	33·25	18·38
	0 p. m.		65° 19′	54° 05′	F.	0	764·2	10°	5°4	33·21	18·36
	3 p. m.	34	65° 17′	54° 17′					5°1	32·97	18·23
	6 p. m.	35	65° 16′	55° 05′					4°4	32·76	18·11
19	0 a. m.		65° 06′	54° 41′	F.	SE. 1	764·5	8°	3°2	32·77	18·12
	4 a. m.		64° 50′ 5″	54° 04′	1 (F.)	0	764·5	7°	4°2	32·88	18·17
	8 a. m.		64° 34′	53° 29′	0	0	765·2	12°	6°0	33·06	18·28
	0 p. m.		64° 19′	52° 55′	0	N. 1	765·2	10°	5°5	32·47	17·95
	2 p. m.		64° 08′	52° 32′					6°0	32·08	17·73
	3 p. m.		64° 04′	52° 09′					5°7	31·45	17·39
	3·30 p. m.		64° 06′	51° 58′					7°6	28·75	15·89
	4 p. m.		64° 08′	51° 51′	1	N. 1	763·2	12°	8°1	27·52	15·21
	4·30 p. m.		64° 10′	51° 45′					6°5	30·68	16·96
26	4 p. m.		tværs af Kangek *(abreast of Kangek)*		F.	0	763·4	13°	3°7	32·17	17·78
	8 p. m.		63° 57′	52° 37′	F.	WNW. 1	764·0	6°	6°5	32·35	17·88
27	0 a. m.		63° 48′	52° 53′	F.	NW. 1	764·0	5°	7°6	31·88	17·62
	4 a. m.		63° 35′	53° 23′	4 (F.)	NW. 2	764·3	5°	5°3	32·22	17·81
	8 a. m.		63° 47′	53° 41′	F.	NNW. 2	765·1	5°	3°2	31·77	17·56
	0 p. m.		64° 00′	54° 53′	4	NW. 2	764·6	6°	6°0	32·93	18·20
	4 p. m.		63° 29′	55° 15′	3	N. 3	764·5	9°	6°2	33·07	18·28
	8 p. m.		62° 58′	55° 35′	4	NNW. 1	764·2	8°	7°9	33·70	18·63
28	0 a. m.		62° 28′	55° 55′	4	N. 1	763·6	8°	8°2	34·04	18·82
	4 a. m.		61° 59′	56° 00′	4	NNW. 1	763·6	8°	8°9	33·71	18·63

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number af the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction of the wind)*	Vind: Styrke *(force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1895												
Juli *(July)* 28	5 a. m.	36	61° 50′ N.	56° 21′ W.						8°5	33·56	18·55
	4 p. m.		61° 24′	55° 50′	4	NW.	2	763·5	10°	9°1	33·79	18·68
	8 p. m.		60° 58′	55° 15′	4	NW.	1	764·0	8°	9°2	33·52	18·53
29	0 a. m.		60° 31′	54° 40′	3		0	763·8	9°	8°5	33·63	18·59
	4 a. m.		60° 05′	54° 05′	4		0	763·4	10°	9°2	33·57	18·55
	6 a. m.	37	60° 17′	54° 05′						9°7	33·80	18·69 *
	4 p. m.		60° 05′	53° 25′	4		0	763·1	13°	10°6	34·13	18·87
	8 p. m.		59° 48′	52° 36′	4	N.	1	762·1	10°	9°6	34·09	18·85
30	0 a. m.		59° 30′	51° 50′	4		0	760·5	9°	9°6	34·02	18·81
	4 a. m.		59° 12′	51° 02′	4	N.	1	759·4	9°	10°2	34·58	19·12
	5 a. m.	38	59° 12′	51° 05′						10°0	34·47	19·05
	4 p. m.		58° 55′	50° 22′	4	NW. by N.	3	756·4	10°	10°0	34·32	18·97
	8 p. m.		58° 35′	49° 32′	4	NW.	3 b	755·2	12°	9°8	34·62	19·14
31	0 a. m.		58° 15′	48° 43′	4	WNW.	3	755·0	12°	9°8	34·49	19·07
	4 a. m.		58° 00′	47° 45′	4	NW. by W.	5	755·2	9°	8°7	34·63	19·14
	8 a. m.		57° 54′	46° 40′	4	WNW.	5	754·6	13°	8°8	34·56	19·11
	0 p. m.		57° 37′	46° 45′	4	WNW.	5	755·0	13°	8°8	34·69	19·17
	4 p. m.		57° 37′	45° 38′	4	WNW.	5	755·6	13°	8°8	34·64	19·15
	8 p. m.		57° 37′	44° 34′	4	WNW.	5	755·8	11°	8°7	34·69	19·18
August *(August)* 1	0 a. m.		57° 37′	43° 28′	4	NW.	5	755·6	11°	9°2	34·71	19·19
	4 a. m.		57° 37′	42° 31′	0	WNW.	5	755·2	12°	9°0	34·74	19·20
	8 a. m.		57° 50′	41° 37′	0	WNW.	7	754·4	10°	8°7	34·60	19·13
	0 p. m.		57° 44′	41° 10′	0	W.	8	752·5	15°	9°0	34·76	19·21
2	0 p. m.		58° 18′	40° 52′	4	WNW.	4	754·1	7°	8°6	34·88	19·28
	4 p. m.		58° 28′	40° 21′	3	NW.	3 b	755·2	8°	8°5	34·73	19·20
	8 p. m.		58° 46′	39° 10′	4	NW.	3 b	756·4	9°	8°6	34·92	19·30
3	0 a. m.		59° 03′	38° 25′	4	W.	3	758·0	9°	8°3	34·75	19·21
	4 a. m.		59° 20′	37° 40′	4	WNW.	3	758·0	8°	9°5	34·71	19·19
	8 a. m.		59° 37′	36° 55′	4	WSW.	2	758·6	11°	9°9	34·92	19·31
	0 p. m.		59° 38′ 5	35° 55′	3	WNW.	2	759·6	14°	9°7	34·94	19·32
	4 p. m.		59° 56′	35° 11′	4	WNW.	2	759·9	11°	10°2	34·80	19·24
	8 p. m.		60° 13′	34° 25′	4	WNW.	1	759·9	11°	10°5	35·03	19·36
4	0 a. m.		60° 30′	33° 41′	3	N.	1	760·0	11°	10°7	35·00	19·35
	4 a. m.		60° 46′	32° 57′	3	N.	1	759·3	12°	10°8	35·02	19·36
	8 a. m.		61° 02′	32° 15′	1	NNE.	3	758·8	14°	11°0	34·91	19·30
	0 p. m.		61° 09′	31° 55′	1	NE. by N.	3	758·8	14°	11°1	35·02	19·36
	4 p. m.		61° 23′	31° 28′	3	N. by E.	3	759·0	11°	11°0	35·04	19·37
	8 p. m.		61° 40′	30° 31′	4	N. by E.	3 b	756·2	10°	10°8	35·10	19·40
5	0 a. m.		61° 57′	29° 52′	4 (R.)	N. by W.	3	756·0	10°	10°3	35·09	19·39
	4 a. m.		62° 14′	29° 10′	4 (R.)	NNW.	3	755·0	9°	11°0	34·96	19·33
	8 a. m.		62° 28′	28° 30′	4	NW.	3	754·8	10°	11°2	35·13	19·42
	0 p. m.		62° 47′	27° 49′	4	NW.	3 b	754·0	11°	11°7	35·05	19·37
	4 p. m.		63° 03′	27° 07′	4	N. by W.	3 b	753·6	10°	11°3	35·08	19·39
	8 p. m.		63° 21′	26° 21′	4	NW.	3	753·4	11°	11°8	35·13	19·42

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction of the wind)*	Vind: Styrke *(force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1895												
August 6 *(August)*	0 a. m.		63° 40′ N.	25° 34′ W.	4	NW.	1	753·0	11°	12°0	35·18	19·45
	4 a. m.		64° 01′	24° 50′	R.	E.	1	754·0	12°	11°3	35·13	19·42
	8 a. m.		63° 48′	23° 51′	0		0	754·0	11°	12°3	34·86	19·27
	0 p. m.		Skagi retv. S. 60 E. 7 Kml. Afst. *(7 miles distance)*		3	NE.	2	754·2	16°	11°8	34·11	18·86
	4 p. m.		Reykjavik Ankerplads *(anchorage)*		R.	SE.	1	754·1	14°	14°3	33·60	18·57
8	8 a. m.		Keilir retv. S. 24 E. Utskolar ÷ retv. S. 52 W.		3	SE.	1	758·3	14°	12°3	33·33	18·42
	0 p. m.		63° 51′	23° 50′	3	SE.	1	760·6	16°	12°3	34·00	18·79
	4 p. m.		63° 31′ 5″	22° 30′	1	E.	2	762·0	17°		35·20	19·46
	4.30 p. m.		63° 28′	22° 30′						13°3	35·21	19·46
	8 p. m.		63° 04′	22° 30′	3	E.	2	762·8	15°	13°6	35·36	19·55
9	0 a. m.		62° 35′	22° 30′	3	E.	2	763·9	14°	13°3	35·31	19·52
	4 a. m.		62° 05′	22° 30′	3	E. by N.	2	763·2	13°	13°0	35·34	19·54
	5 a. m.	39	62° 00′	22° 38′						13°0	35·38	19·56*
	0 p. m.		62° 00′	22° 05′	0	N.	3	761·6	14°	13°1	35·33	19·53
	2.40 p. m.	40	62° 00′	21° 36′						13°5	35·30	19·51
	8 p. m.		62° 00′	21° 12′	R.	NE. by E.	1	758·0	17°	14°3	35·31	19·52
10	0 a. m.		62° 00′	20° 12′	4	NE.	2	757·1	14°	13°2	35·35	19·54
	4 a. m.		62° 00′	19° 22′	3	NE.	3	755·5	14°	13°3	35·26	19·49
	8 a. m.		61° 59′	19° 00′	4	NE.	4	754·0	12°	12°7	35·34	19·54
	8 p. m.		61° 47′	18° 59′	R.	E.	2	754·3	14°		35·36	19·55
	11 p. m.		61° 47′	18° 54′							35·41	19·57
11	8 p. m.		61° 19′	18° 32′	3	ENE.	2	757·5	14°	12°9	35·35	19·54
12	0 a. m.		61° 23′	18° 04′	3	NE.	2	757·5	13°	12°9	35·36	19·55
	4 a. m.		61° 29′	17° 34′	4	NE. by N.	2	758·4	13°	12°8	35·45	19·60
	6 a. m.	41	61° 39′	17° 10′						12°9	35·35	19·54*
	4 p. m.		61° 39′	16° 15	4 (R.)	NE. by N.	3b	756·5	12°	12°8	35·37	19·55
	8 p. m.		61° 39′	15° 36′	4	NE.	4	754·9	12°	12°8	35·40	19·57
13	0 a. m.		61° 36′	15° 05′	4 (R.)	NE.	3	755·3	13°		35·42	19·58
	4 a. m.		61° 34′	14° 37′	4 (R.)	NE.	3b	755·0	13°		35·42	19·58
	8 a. m.		61° 34′	14° 12′	4 (R.)	NNE.	3b	755·0	12°	12°7	35·39	19·56
	4 p. m.		61° 34′	13° 19′	4	NE. by N.	4	755·2	13°	12°5	35·35	19·54
	8 p. m.		61° 29′	12° 16′	4	NE. by E.	2	756·6	14°	12°8	35·34	19·54
14	0 a. m.		61° 34′	11° 39′	3	ENE.	1	758·9	14°	13°0	35·40	19·57
	4 a. m.		61° 39′	10° 51′	4	ENE.	2	760·5	13°		35·42	19·58
	6 a. m.	42	61° 41′	10° 17′						12°5	35·41	19·57
	3 p. m.	44	61° 42′	9° 36′						11°9		
	8 p. m.		61° 42′	8° 55′	4		0	766·2	14°	12°4	35·29	19·51
15	0 a. m.		61° 42′	7° 50′	4		0	767·8	13°	10°1	35·34	19·54
	8 a. m.		61° 42′	7° 29′	Hz.		0	769·0	14°	10°4		
	0 p. m.		Ørnenypen retv. V. 25 Kml. *(25 miles)*		Hz.		0	769·5	15°	11°1	35·31	19·52
18	4 p. m.		Thorshavn Havn *(the Harbour of Thorshavn)*		Hz.		0	760·8	15°	10°5	35·31	19·52

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction of the wind)*	Vind: Styrke *(force of the wind)*	Bar.	Temp.	Temp.	Salt °/₀₀ *(salinity °/₀₀)*	Klor °/₀₀ *(chlorine °/₀₀)*
1895												
August *(August)* 18	8 p. m.	44	61° 51′ N.	6° 13′ W.	F.	S.	2	760·3	13°	11°3	35·29	19·51
19	0 a. m.		61° 42′	5° 11′	4 (F.)	S.	2	759·9	14°	10°8	35·35	19·54
	4 a. m.		61° 31′	4° 02′	3	S.	2	758·7	15°	13°6	35·29	19·51
	8 a. m.		61° 20′	2° 52′	3	SSW.	2	759·2	15°	13°9	35·35	19·54
	0 p. m.		61° 14′	2° 29′	1	SSW.	3b	759·7	17°	14°2	35·49	19.62
	4 p. m.		Muckle Flugga Fyr *(light)* S.55W. 10 Kml. *(10 miles)*		3	S.	3b	761·0	16°	14°6	35·36	19·55
	8 p. m.		60° 36′	0° 19′ E.	3	S.	2	761·5	15°	14°2	35·40	19·57
20	0 a. m.		60° 14′	1° 09′	3	S.	2	762·3	16°	15°4	35·33	19·53
	4 a. m.		59° 51′	2° 00′	3	(SW.)	0	762·5	16°	14°0	33·49	18·51
	8 a. m.		59° 27′	2° 33′	3	SW.	2	763·0	18°	15°5	32·49	17·96
	0 p. m.		59° 04′	3° 40′	3	SW.	2	764·4	17°	15°5	32·22	17·81
	4 p. m.		58° 38′	4° 33′	0	SW.	3	765·2	18°	16°8	29·21	16·15
	8 p. m.		58° 12′	5° 04′	0	SW.	2	765·8	17°	17°2	27·02	14·94
21	0 a. m.		57° 48′	5° 55′	0	SW.	2	765·8	16°	15°8	28·68	15·86
	4 a. m.		Lindesnæs Fyr *(light)* N.4W. 12 Kml. *(12 miles)*		1	WNW.	2	765·9	16°	16°1	29·90	16·53
1896 Maj *(May)* 3	8 p. m.		Skagen Fyr *(light)* N.64W. Skagen Fyrskib *(light-ship)* N.41W.		0	NNW.	2	772·0	11°	8°4	20·83	11·51
4	0 a. m.		57° 49′	9° 52′	0	NNW.	2	772·4	9°	8°5	27·92	15·43
	4 a. m.		57° 50′	8° 52′ 5″	0	NW.	2	772·0	8°	7°9	27·88	15·41
	8 a. m.		Ryvingen Fyr *(light)* NW.7 Kml. *(7 miles)*		0	NW.	2	772·0	10°	7°8	28·04	15·50
	0 p. m.		57° 54′	6° 27′	0	NW.	3	771·2	9°	7°2	31·19	17·24
	4 p. m.		58° 12′	5° 46′	0	NW.	3b	769·8	11°	6°9	31·79	17·58
	8 p. m.		58° 30′	5° 01′	0	NW.	2	769·8	8°	6°2	33·02	18·25
5	0 a. m.		58° 51′	4° 11′	0	NW.	1	770·2	8°	7°0	32·25	17·83
	4 a. m.		59° 13′	3° 19′	1	NW.	1	769·9	9°	7°3	33·59	18·57
	8 a. m.		59° 34′	2° 28′	4	NW.	1	770·1	11°	8°3	35·42	19·58
	0 p. m.		59° 48′ 6″	1° 28′	1	W.	1	770·5	12°	8°4	35·48	19·61
	4 p. m.		60° 10′	0° 48′	4 (F.)	W.	1	770·0	12°	9°8	35·62	19·69
	8 p. m.		60° 29′	0° 21′	4	W.	1	769·2	11°	9°0	35·54	19·64
6	0 a. m.		60° 57′	0° 09′	F.		0	769·8	10°	9°2	35·62	19·69
	4 a. m.		61° 24′	0° 00′	4	WNW.	1	770·0	10°	9°4	35·66	19·71
	8 a. m.		61° 25′	1° 07′ W.	4	WNW.	2	771·0	12°	9°2	35·63	19·70
	0 p. m.		61° 24′	2° 38′	F.	WSW.	2	772·1	11°	8°4	35·50	19.62
	4 p. m.		61° 27′	3° 40′	0 (F.)	WSW.	3	772·0	12°	8°9	35·58	19·67
	8 p. m.		61° 36′	4° 49′	0	WSW.	2	772·8	12°	8°2	35·52	19.63
7	0 a. m.		61° 38′	5° 39′	4 (F.)	W.	2	773·3	10°	7°8	35·46	19·60
	4 a. m.		61° 35′	6° 53′	3	W.	1	774·0	10°	7°4	35.43	19·59
10	0 p. m.		61° 17′	6° 18′	F.		0	769·0	14°	9°2	35·50	19·62
	4 p. m.		61° 04′	7° 03′	F.		0	768·4	13°	10°2	35·52	19·64
	8 p. m.		61° 09′	7° 52′	F.		0	768·0	9°	9°4	35·48	19·61
11	0 a. m.		61° 18′	8° 33′	F.		0	768·8	8°	9°2	35·41	19·57
	4 a. m.		61° 24′	9° 08′	F.		0	769·1	8°	8°9	35·40	19·57

Tid (time)			Sted (position)		Luft (atmosphere)					Vand (water)		
Dato (date)	Klokkeslet (hour)	Stations-Nr. (number of the station)	Bredde (latitude)	Længde Grw. (longitude)	Vejr (weather)	Vind: Retn. (direction of the wind)	Styrke (force of the wind)	Bar.	Temp.	Temp.	Salt ‰ (salinity ‰)	Klor ‰ (chlorine ‰)
1896												
Maj (May) 11	8 a. m.	45	61° 32′ N.	9° 43′ W.	4		0	770·8	8°	9°1	35·37	19·55
	0 p. m.		61° 32′	9° 56′	4	W. by S.	1	770·8	10°	9°4		
	4 p. m.		61° 32′	11° 03′	4	W. by S.	1	771·4	11°	9°15	35·44	19·59
	6 p. m.	46	61° 32′	11° 36′				773·0		9°05	35·39	19·57
12	0 a. m.		61° 32′	12° 12′	4	W. by S.	2	773·1	11°	9°6	35·40	19·57
	4 a. m.		61° 32′	13° 21′	4	W. by S.	2	773·0	11°	9°6	35·43	19·59
	10.30 a. m.	47	61° 32′	13° 40′				771·5		10°5	35·38	19·56*
	0 p. m.		61° 24′ 5″	14° 24′	1	SW.	3	771·5	11°	9°8	35·40	19·57
	5 p. m.	48	61° 32′	15° 11′				768·0		9°6	35·34	19·54
13	0 a. m.		61° 47′	15° 11′	4	WSW.	3	767·3	10°	9°9	35·43	19·59
	4 a. m.		62° 12′	15° 11′	3	SW.	2	765·5	10°	9°5	35·42	19·58
	5 a. m.	49	62° 07′	15° 07′				762·8		9°28	35·31	19·52
	4 p. m.		62° 34′	15° 07′	4 (Hz.)	SW.	3	760·0	11°	9°4	35·38	19·56
	5.45 p. m.	50	62° 43′	15° 07′						9°65	35·35	19·54*
14	0 a. m.		62° 50′	15° 07′	4	W. by N.	5	758·8	8°	8°9	35·33	19·53
	4 a. m.		63° 06′	15° 07′	3	W. by N.	7	757·4	7°	8°1	35·35	19·54
	10.30 p. m.		64° 13′	15° 06′							35·02	19·36
15	0 a. m.		64° 10′	15° 03′	0		0	761·2	13°	8°2	34·86	19·27
	8 a. m.		64° 16′	14° 45′	3	ENE.	2	763·0	8°	4°1	34·80	19·24
	0 p. m.	51	64° 15′	14° 22′	4	SW.	3	763·5	9°	7°63	35·10	19·40
	5 p. m.	52	63° 57′	13° 32′				761·8		8°29	35·33	19·53
16	0 a. m.		63° 50′	13° 44′	F.	SW.	3	761·5	9°	8°9	35·31	19·52
	4 a. m.		63° 38′	14° 05′	F.	SSW.	3 b	761·5	10°	8°5	35·29	19·51
	8 a. m.		63° 28′	14° 25′	4 (R.)	SW.	2	761·5	10°	8°5	35·34	19·53
	2 p. m.	53	63° 15′	15° 07′						8°8	35·26	19·49
17	0 a. m.		63° 06′	14° 54′	3	WSW.	6	757·5	8°	10°0	35·34	19·53
	8 a. m.		62° 55′	14° 43′	3 (R.)	W.	6	762·5	9°	9°5	35·41	19·58
	3 p. m.	54	63° 08′	15° 40′						8°97	35·38	19·56
18	8 p. m.		63° 15′	15° 41′	3	W.	4	755·4	7°	8°6	35·31	19·52
19	8 a. m.		63° 33′	15° 09′	3	W.	4	754·0	10°	8°3	35·25	19·49
	0 p. m.	55	63° 33′	15° 02′	1	NW.	1	756·4	12°	8°43	35·32	19·52
	4 p. m.		63° 42′	15° 09′	0	E.	1	760·3	8°		35·27	19·50
	6 p. m.	56	64° 00′	15° 09′						8°24	35·30	19·51*
	8 p. m.		63° 59′	15° 03′	R.	ENE.	2	761·8	4°	8°0	35·29	19·51
20	0 a. m.		63° 49′	14° 10′	1	S. by E.	1	764·5	6°	7°4	35·28	19·50
	4 a. m.		63° 40′	13° 15′	3		0	765·5	5°	8°4	35·42	19·62
	6 a. m.	57	63° 37′	13° 02′						8°2	35·45	19·59
	0 p. m.		64° 03′	12° 35′	3	S. by E.	2	765·7	9°	8°63	35·42	19·58
	3 p. m.	58	64° 25′	12° 09′						1°24	34·24	18·93
	8 p. m.		64° 48′	11° 30′	3	S.	1	760·0	3°	1°0	34·15	18·88
	10 p. m.	59	65° 00′	11° 16′				756·0		1°65	34·30	18·96*
21	4 a. m.		65° 00′	11° 37′	F.	SW. by S.	3 b	754·2	3°	0°7	34·06	18·83
	8 a. m.	60	65° 09′	12° 27′	F.		0	753·0	5°	1°7	34·36	19·00
	0 p. m.	61	65° 03′	13° 06′	0		0	754·5	11°	2°4	34·41	19·02
26	9.15 a. m.		64° 56′	13° 20′						1°7		

Tid (*time*)			Sted (*position*)		Luft (*atmosphere*)					Vand (*water*)		
Dato (*date*)	Klokkeslet (*hour*)	Stations-Nr. (*number of the station*)	Bredde (*latitude*)	Længde Grw. (*longitude*)	Vejr (*weather*)	Vind: Retn. (*direction of the wind*)	Vind: Styrke (*force of the wind*)	Bar.	Temp.	Temp.	Salt ‰ (*salinity ‰*)	Klor ‰ (*chlorine ‰*)
1896												
Maj (*May*) 26	9.45 a. m.		64° 47′ 5″ N.	13° 18′ W.						1°5	34·31	18·97
	10.15 a.m.		64° 44′	13° 19′						1°6		
	10.45 a.m.		64° 40′ 5″	13° 19′						1°45	34·28	18·95
	11.15 a.m.		64° 37′	13° 20′						1°72		
	11.45 a.m.		64° 33′ 5″	13° 20′						2°35	34·59	19·12
	0.15 p. m.		64° 30′	13° 20′						3°14		
	0.45 p. m.		64° 26′ 7″	13° 20′						5°36	35·06	19·38
	1.15 p. m.		64° 23′ 4″	13° 20′						5°31		
	1.45 p. m.		64° 20′ 1″	13° 20′						4°5		
	2.15 p. m.		64° 16′ 9″	13° 20′						4°95		
	2.45 p. m.		64° 13′ 7″	13° 20′						4°4	35·03	19·36
	3.15 p. m.		64° 11′	13° 20′						4°06		
	3.45 p. m.		64° 08′ 5″	13° 20′						3°84		
	4.15 p. m.		64° 06′	13° 21′						3°35		
	4.45 p. m.		64° 03′ 5″	13° 21′						2°4	34·58	19·12
	5.15 p. m.		64° 01′	13° 21′						6°3		
	5.45 p. m.		63° 58′ 5″	13° 26′ 4″						6°79		
	6.15 p. m.		63° 57′ 7″	13° 31′ 9″						7°32		
	6.45 p. m.		63° 56′ 9″	13° 37′ 4″						7°57		
	7.15 p. m.		63° 56′ 1″	13° 42′ 8″						7°8	35·23	19·49
	7.45 p. m.		63° 57′ 5″	13° 50′						7°8		
	10 p. m.		63° 54′	14° 06′						8°0		
27	0 a. m.		63° 53′	14° 03′	M.	SW. by S.	5	765·3	9°	7°9	35·30	19·51
	2 a. m.		63° 50′	14° 01′						8°1		
	4 a. m.		63° 48′	13° 58′	3 (R.)	WSW.	4	766·0	9°	8°1	35·43	19·58
	6 a. m.		63° 45′	13° 55′						8°15		
	8 a. m.		63° 42′	13° 53′	3	WSW.	5	766·8	8°	8°25		
	10 a. m.		63° 41′	13° 46′						8°38		
28	0 p. m.		63° 16′	13° 26′	4	W.	3 b	765·6	12°	8°8	35·43	19·58
29	4 a. m.		63° 46′	14° 52′	0	W.	2	762·1	11°	8°2	35·33	19·53
	0 p. m.		63° 39′ 5″	15° 29′	3	ESE.	3 b	767·0	9°	8°3	35·44	19·59
	4 p. m.		63° 33′	15° 59′	0		0	765·5	10°	8°8	35·30	19·51
	8 p. m.		63° 28′	16° 43′	4	W.	3	764·5	10°	8°5	35·30	19·51
31	8 a. m.		63° 15′	16° 34′	3	NE.	4	757·6	6°	8°4	35·39	19·56
	0 p. m.		63° 18′ 5″	17° 19′	4	NE.	5	760·5	6°	7°9	35·31	19·52
	4 p. m.		63° 15′	18° 20′	4	ENE.	3	763·2	5°	7°7	35·32	19·53
	8 p. m.		63° 19′	19° 01′	3	NNE.	3 b	764·8	4°	7°5	35·15	19·43
	9.30 p. m.	62	63° 18′	19° 12′				764·8		7°29	34·76	19·21
Juni (*June*) 1	0 a. m.		63° 08′	19° 07′	0	ENE.	3 b	766·5	3°	7°9	35·30	19·51
	4 a. m.		62° 47′	18° 59′	0	ENE.	2	766·5	4°	8°2	35·37	19·55
	5 a. m.	63	62° 40′	19° 05′						8°35	35·32	19·53
	0 p. m.		62° 26′	19° 02′	0	NE. by N.	3	768·8	5°	8°3	35·35	19·54
	3 p. m.	64	62° 06′	19° 00′						8°7	35·35	19·54
2	0.15 a. m.	65	61° 33′	19° 00′				770·9		8°57	35·40	19·57
	8 a. m.		61° 33′	19° 13′	H. S.	NE.	3	771·5	7°	8°7	35·37	19·55

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction, force, of the wind)*	Vind: Styrke	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1896												
Juni *(June)* 2	0 p. m.		61° 39′ N.	20° 20′ W.	1	NNW.	1	772·8	8°	9°3	35·48	19·61
	2.15 p. m.	66	61° 33′	20° 43′						9°1	35·35	19·54
3	0 a. m.		61° 33′	21° 41′	4	W.	1	771·2	7°	8°6	35·36	19·55
	3.30 a. m.	67	61°′ 30	22° 30′				769·9		8°49	35·29	19·51
	1 p. m.	68	62° 06′	22° 30′				768·8		8°82	35·33	19·64*
	8 p. m.		62° 23′	22° 23′	4	NNW.	1	768·8	7°	8°3	35·26	19·49
	10 p. m.	69	62° 40′	22° 17′						8°3	35·29	19·51
4	8.50 a. m.	70	63° 09′	22° 05′						7°78	35·27	19·50
	11 a. m.		63° 22′ 2″	22° 03′ 3″						7°82		
	11.30 a. m.		63° 25′	22° 03′ 3″						7°82	35·33	19·53
	0 p. m.		63° 29′ 3″	22° 03′ 3′	1	ESE.	3 b	770·5	10°	7°88		
	0.30 p. m.		63° 32′ 2″	22° 03′ 3″						7°9	35·02	19·36
	1 p. m.		63° 37′ 2″	22° 03′ 3″						7°91		
	1.30 p. m.		63° 40′ 5″	22° 03′ 3″						7°91	34·80	19·24
	2 p. m.		63° 45′ 4″	22° 03′ 3″						7°89	34·23	18·92
	2.30 p. m.	71	63° 46′	22° 03′				770·8		7°98	34·12	18·86
	4 p. m.		63° 46′	22° 22′	3	ESE.	3	770·8	10°	7°9	34·21	18·91
	8 p. m.		64° 03′	22° 57′	1	ESE.	2	772·0	8°	7°5	35·12	19·42
8	0 p. m.		63° 46′	22° 46′	3	E.	2	765·5	13°	8°0	33·81	18·69
	4 p. m.		63° 19′	22° 57′	4	SSE.	1	764·7	9°	8°4	35·39	19·56
	5 p. m.	72	63° 12′	23° 04′				764·3		8°32	35·30	19·51
	8 p. m.	73	62° 58′	23° 28′	4	SSE.	1	764·0	8°	7°87	35·36	19·55
9	4 a. m.		62° 31′	24° 20′	4	E.	3	763·0	8°	8°3	35·32	19·52
	5.30 a. m.	74	62° 17′	24° 36′				763·3		8°3	35·39	19·56
	0 p. m.		62° 11′	25° 05′	3	NE.	3 b	762·7	8°	8°6	35·32	19·52
11	0 p. m.		61° 27′	25° 40′	1	NE.	2	754·7	11°	8°7	35·39	19·57
	3.30 p. m.	75	61° 28′	26° 25′				753·5		8°65	35·20	19·46
12	8 a. m.		61° 26′	26° 12′	4	N. by W.	3 b	755·2	9°	8°6	35·36	19·54
	0 p. m.		61° 02′	26° 47′	3	N.	3	757·5	11°	8°9	35·32	19·53
	2 p. m.	76	60° 50′	26° 50′				758·2		8°9	35·40	19·57
	8 p. m.		60° 26′	26° 55′	4	NNW.	2	759.0	8°	9°3	35·32	19·53
13	0 a. m.	77	60° 10′	26° 59′	3	NW.	2	759·3	8°	9°42	35·27	19·50
	4 a. m.		60° 30′	27° 45′	3	WNW.	3	758·5	7°	9°0	35·39	19·56
	5 a. m.	78	60° 37′	27° 52′				759·3		9°22	35·33	19·53*
	0 p. m.		60° 46′	28° 16′	3	SSW.	2	759·5	9°	8°8	35·12	19·41
	2 p. m.	79	60° 52′	28° 58′						9°28	35·21	19·46
	7 p. m.	80	61° 02′	29° 32′				758·4		8°53	35·26	19·49*
14	0 a. m.		61° 07′	29° 14′	1		0	758·4	7°	8°5	35·22	19·47
	4 a. m.		61° 22′	28° 07′	0	SW.	1	758·6	7°	9°1	35·16	19·44
	8 a. m.		61° 37′	27° 00′	3	E.	1	759·0	11°	8°5	35·26	19·49
	9 a. m.	81	61° 44′	27° 00′						8°4	35·23	19·48
	0 p. m.		61° 48′ 3″	27° 11′	1	SE.	1	759·4	12°	8°8	35·23	19·48
	2 p. m.	82	61° 55′	27° 28′						9°23	35·22	19·47
	4 p. m.		62° 09′	27° 58′	3	E.	1	758·9	11°	8°9	35·30	19·51
	8 p. m.	83	62° 25′	28° 30′	4	E. by N.	3	756·5	9°	9°23	35·14	19·43

Tid (time)			Sted (position)		Luft (atmosphere)					Vand (water)		
Dato (date)	Klokkeslet (hour)	Stations-Nr. (number of the station)	Bredde (latitude)	Længde Grw. (longitude)	Vejr (weather)	Vind: Retn. (direction of the wind)	Vind: Styrke (force of the wind)	Bar.	Temp.	Temp.	Salt ‰ (salinity ‰)	Klor ‰ (chlorine ‰)
1896												
Juni 15	0 a. m.		62° 27′ N.	28° 05′ W.	3	ENE.	3	755·1	8°	8°6	35·25	19·49
(June)	4 a. m.		62° 30′	27° 06′	R.	ENE.	4	753·0	7°	8°4	35·21	19·46
	8 a. m.		62° 33′	26° 38′	4	ENE.	4	752·0	9°	9°0	35·19	19·45
	0 p. m.		62° 35′	26° 09′	4 (R.)	NE.	5	749·5	8°	8°3	35·22	19·47
16	5.35 a. m.	84	62° 58′	25° 24′				737·7		8°17	35·28	19·50
	0 p. m.		62° 42′ 3″	25° 55′	3	ENE.	2	740·7	11°	8°3	35·24	19·48
17	4 p. m.		63° 40′	25° 28′	4	SE.	3	744·0	10°	8°3	35·19	19·45
18	4 a. m.		64° 10′	22° 50′	3		0	747·9	9°	8°5	33·32	18·42
23	11 a. m.	86	65° 03′ 6″	23° 47′ 6″						8°55	34·40	19·02
	10.15 p. m.	88	64° 58′	24° 25′						8°5	35·24	19·48
24	0 a. m.		64° 56′ 3″	25° 41′	R.	SSE.	3b	759·2	9°	8°1	35·03	19·36
	4 a. m.		64° 45′	26° 06′	4	SSE.	2	758·4	8°	8°0	35·22	19·47
	7.40 a. m.	89	64° 45′	27° 20′				760·0		8°05	35·25	19·49*
	0 p. m.		64° 42′ 5″	28° 00′	1	E.	3	761·4	12°	8°4	35·23	19·47
	3.25 p. m.	90	64° 45′	29° 06′				760·7		8°52	35·27	19·50
25	0 a. m.		64° 44′	30° 39′	4	E.	2	759·5	9°	7°6	35·16	19·44
	1 a. m.	91	64° 44′	31° 00′				756·5		8°33	35·24	19·48*
	8 a. m.		64° 44′	30° 39′	R.	E.	3	756·0	8°	7°7		
	10 a. m.		64° 44′	31° 11′						7°45		
	0 p. m.		64° 44′	31° 58′	M.	ENE.	3b	755·2	12°	7°48		
	3 p. m.	92	64° 44′	32° 52′						7°23	35·16	19·44
26	0 a. m.		64° 44′	34° 00′	4	SW.	3	753·0	6°	6°9	35·20	19·46
	0.30 a. m.		64° 44′	34° 09′						6°8		
	1 a. m.		64° 44′	34° 18′						5°9		
	1.30 a. m.		64° 44′	34° 27′						5°9		
	4 a. m.		64° 26′	35° 08′	3	SSE.	2	752·5	6°	6°0		
	5 a. m.	93	64° 24′	35° 14′						6°05	35·13	19·42
	6.35 a. m.		64° 31′	35° 18′						5°8		
	8 a. m.		64° 34′	35° 26′	3	NE.	2	752·5	3°	0°3	33·49	18·51
	9 a. m.		64° 38′	35° 37′						1°5		
	9.30 a. m.		64° 41′	35° 44′						3°1		
	10 a. m.		64° 44′	35° 51′						2°5		
	10.30 a. m.		64° 47′	35° 58′						3°2		
	11 a. m.		64° 50′	36° 05′						0°8		
	11.30 a. m.		64° 53′	36° 12′						3°3		
	0 p. m.		64° 55′ 6″	36° 19′	1		0	752·9	4°	2°4		
	0.30 p. m.	94	64° 56′	36° 19′				751·8		2°54	33·92	18·75*
	3 p. m.		64° 54′	36° 15′						3°9	34·15	18·88
	3.30 p. m.		64° 50′	36° 06′						2°1	33·83	18·70
	4 p. m.		64° 47′	35° 57′	3	S.	2	751·9	4°	4°0	34·24	18·93
	4.30 p. m.		64° 47′	35° 46′						1°2	33·62	18·59
	5 p. m.		64° 47′	35° 35′						3°1	34·27	18·94
	5.30 p. m.		64° 47′	35° 25′						1°0	33·30	18·41
	5.45 p. m.		64° 47′	35° 20′						0°05		
	6 p. m.		64° 47′	35° 14′						1°2	33·70	18·63

Tid (time)			Sted (position)		Luft (atmosphere)					Vand (water)		
Dato (date)	Klokkeslet (hour)	Stations-Nr. (number of the station)	Bredde (latitude)	Længde Grw. (longitude)	Vejr (weather)	Vind: Retn. (direction of the wind)	Vind: Styrke (force of the wind)	Bar.	Temp.	Temp.	Salt ‰ (salinity ‰)	Klor ‰ (chlorine ‰)
1896												
Juni (June) 26	6.30 p. m.		64° 47′ N.	35° 04′ W.						5°3	34·75	19·21
	7 p. m.		64° 47′	34° 53′						5°5		
	7.30 p. m.		64° 47′	34° 42′						3°8	34·30	18·96
	8 p. m.		64° 47′	34° 32′	1	S.	1	751·8	4°	4°7		
	8.30 p. m.		64° 47′	34° 22′						5°2		
	9 p. m.		64° 47′	34° 12′						7°0	35·26	19·49
	9.30 p. m.		64° 47′	34° 02′						6°8		
	10 p. m.		64° 47′	33° 52′						6°6		
	10.30 p. m.	[1]	64° 47′	33° 42′						6°6	35·14	19·43
27	0 a. m.		64° 53′	33° 12′	4 (R.)	SW.	1	751·5	6°	6°9	35·24	19·48
	4 a. m.		65° 04′	31° 54′	4	SW.	3	750·8	7°	6°6	35·10	19·40
	8 a. m.		65° 12′	30° 57′	4 (R.)	WSW.	3	750·6	9°	8°1	35·24	19·48
	0.30 p. m.	95	65° 14′	30° 39′				751·3		7°82	35·24	19·48
	8 p. m.		65° 25′	29° 57′	3	SW.	2	753·6	7°	6°7	35·20	19·46
	9.30 p. m.		65° 24′	29° 30′						0°1		
	10.45 p. m.	96	65° 24′	29° 00′				755·8		7°94	35·30	19·51 *
28	7.45 a. m.	97	65° 28′	27° 39′				758·8		8°1	35·35	19·54
	0 p. m.		65° 30′ 8″	27° 22′	3	W.	1	759·4	8°	8°1	35·34	19·53
	3.25 p. m.	98	65° 38′	26° 27′				760·0		8°2	35·37	19·55
	8 p. m.		65° 45′	25° 34′ 5″	4		0	760·2	6°	7°8	35·27	19·50
29	0 a. m.		66° 01′	24° 07′	4		0	760·4	6°	7°5	34·74	19·20
Juli (July) 7	2.30 p. m.	99	66° 13′	25° 53′						8°15	35·25	19·49
	8 p. m.		66° 16′ 5″	24° 19′ 4″	3	E. by N.	2	753.8	10°	8°3	35·17	19·44
8	8 a. m.		Cap Nord S. 0.4 Kml. Afst. (0.4 miles distance)		4	NE.	2	754·6	8°	7°9	34·59	19·12
	0 p. m.		66° 27′ 5″	21° 01′	4	E. by N.	2	753·8	7°	3°1	31·68	17·51
	4 p. m.		66° 27′ 5″	19° 51′	0	NE.	2	753·6	8°	4°8	32·36	17·89
	8 p. m.		66° 25′ 5″	18° 41′	R.		0	753·3	9°	7°1	33·12	18·31
9	0 a. m.		66° 32′	17° 19′	3	W.	1	755·8	8°	8°1	32·86	18·16
	4 a. m.		66° 37′	15° 41′	1	S.	1	754·8	7°	5°8	33·11	18·30
	7.30 a. m.		66° 28′	14° 29′						5°0		
	8 a. m.		66° 27′	14° 21′	1		0	756·5	9°	3°3	33·68	18·62
	8.30 a. m.		66° 25′	14° 12′						4°1		
	9 a. m.	100	66° 23′	14° 02′				756·3		4°8	33·35	18·43
	11 a. m.		66° 23′	13° 47′						4°7		
	0 p. m.		66° 23′	13° 24′	0	SE.	1	758·3	11°	5°0		
	3.30 p. m.	101	66° 23′	12° 05′				758·9		5°5	33·26	18·39
	8 p. m.		66° 23′	11° 52′	0		0	760.5	12°	5°7		
	9 p. m.		66° 23′	11° 30′						4°8		
	10 p. m.		66° 23′	11° 08′						4°1		
	11 p. m.		66° 23′	10° 47′						4°5		
10	0 a. m.		66° 23′	10° 30′	F.		0	758·2	5°	4°5		
	0.20 a. m.	102	66° 23′	10° 26′				759·5		4°5	32·82	18·14
	6 a. m.		66° 23′	10° 15′						5°0		
	7 a. m.		66° 23′	10° 01′						5°2		

[1]) Efter 10.30 maaltes Temp. paa hver Side af Istaagegrænsen: — 0°3 + 3°2 (20 Min.'s Mellemrum).
(After 10.30 the temperature was measured on each side of the limit of the icefog — 0°3 + 3°2 (with an interval of 20 minutes).)

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction of the wind)*	Vind: Styrke *(force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1896												
Juli *(July)* 10	8 a. m.		66° 23′ N.	9° 53′ W.	F.	(NW.)	0	759·9	5°	4°5	33·20	18·35
	9 a. m.		66° 23′	9° 40′						5°8		
	10 a. m.		66° 23′	9° 26′						6°0		
	11 a. m.		66° 23′	9° 13′						5°7		
	0 p. m.		66° 23′	9° 02′ 5″	F.	NW.	2	761·9	6°	5°9	33·79	18·68
	0.45 p. m.	103	66° 23′	8° 52′				761·1		6°0	33·63	18·59
	5 p. m.		66° 23′	8° 46′						5°8		
	6 p. m.		66° 23′	8° 32′						5°8		
	7 p. m.		66° 23′	8° 17′						5°9		
	8 p. m.		66° 23′	8° 02′	F.	NW.	1	762·4	4°	5°5		
	9 p. m.		66° 23′	7° 47′						5°4		
	10 p. m.		66° 23′	7° 33′						5°6		
	10.30 p. m.	104	66° 23′	7° 25′				764·0		6°3	34·17	18·89*
11	6 a. m.		66° 21′	7° 25′						6°2		
	7 a. m.		66° 18′	7° 25′						5°6		
	8 a. m.		66° 12′	7° 25′	F.	S.	1	764·4	10°	5°7	33·84	18·71
	9 a. m.		66° 07′ 5″	7° 25′						5°8		
	10 a. m.		66° 02′ 3″	7° 25′						5°8		
	11 a. m.		65° 58′ 1″	7° 25′						5°4		
	0 p. m.		65° 35′ 5″	7° 25′	F.	SSE.	2	765·5	10°	5°6	33·80	18·68
	1 p. m.		65° 48′	7° 25′						6°3		
	2 p. m.	105	65° 34′	7° 31′						5°8	34·07	18·83
	7 p. m.		65° 42′	7° 40′						6°0		
	8 p. m.		65° 42′	8° 02′	3	SE.	3	761·6	7°	5°8	33·81	18·69
	9 p. m.		65° 42′	8° 22′						5°6		
	10 p. m.		65° 42′	8° 37′						5°9		
	10.40 p. m.	106	65° 34′	8° 54′				754·3		6°0	34·27	18·94
12	2 p. m.		65° 27′	8° 40′						6°2		
	3 p. m.		65° 28′	9° 00′						6°5		
	4 p. m.		65° 29′	9° 19′	3	S.	3	755·4	9°	6°4		
	5 p. m.		65° 30	9° 39′						6°7		
	6 p. m.		65° 31′	10° 01′						6°5		
	7 p. m.		65° 32′	10° 23′						6°4		
	7.16 p. m.	107	65° 33′	10° 28′				753·3		6°1	33·63	18·59
13	0 a. m.		65° 32′	10° 53′	4	S.	3	753·6	7°	5°9	33·39	18·46
	1 a. m.		65° 31′	11° 13′						6°3		
	2 a. m.		65° 30′	11° 35′						5°3		
	3 a. m.	108	65° 30′	12° 00′						5°9	33·36	18·44
	4 a. m.		65° 29′	12° 08′	3	SSE.	4	751·7	7°	5°9		
	5 a. m.		65° 28′ 8″	12° 30′						4°3		
	8 a. m.		65° 28′	13° 11′	F.	S.	2	751·2	6°	3°2		
	0 p. m.		65° 25′	13° 15′	F.	SSE.	3	746·3	7°	2°2		
18	8 a. m.		tværs af Vodlavig *(abreast of)*	1 Kml. Land *(1 mile of shore)*	4	E.	1	756·0	5°	1°3		
	9.30 a. m.		paa *(on)* Reydar Fjord							2°7		

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*				Vand *(water)*		
Dato *(date)*	Klokke-slet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. Styrke *(direction, force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1896											
Juli *(July)* 18	10.30 a. m.		65° 24′ N.	13° 20′ W.					3°0		
	11.15 a. m.	109	65° 29′	13° 25′					4°8	33·25	18·38
	0 p. m.		65° 32′	13° 28′	4	SSE. 3 b	753·0	9°	5°8		
	1 p. m.		65° 41′	13° 39′					6°0		
	2 p. m.		65° 48′	13° 48′					6°4		
	3 p. m.		65° 56′	13° 57′					6°1		
	4 p. m.		66° 04′	14° 06′	R.	SE. by S. 3 b	749·0	6°	4°9	33·55	18·55
	5 p. m.		66° 12′	14° 16′					5°1		
19	7 a. m.		66° 24′	14° 30′					6°0		
	8 a. m.		66° 22′ 3″	14° 16′	3	SW. 1	736·7	10°	5°8	33·64	18·59
	9 a. m.		66° 20′	13° 57′					5°9		
	10 a. m.		66° 18′ 5″	13° 38′					5°5		
	11 a. m.		66° 16′ 5″	13° 20′					6°0		
	0 p. m.		66° 17′	13° 01′	1	SW. 1	737·6	12°	6°1	33·55	18·55
	1 p. m.		66° 15′	12° 42′					6°1		
	2 p. m.		66° 13′	12° 25′					5°8		
	3 p. m.		66° 16′	12° 09′					6°0		
	4 p. m.		66° 24′	11° 55′	1	S. 2	737·6	14°	5°9	33·32	18·42
	5 p. m.		66° 32′	11° 47′					5°8		
	6 p. m.		66° 40′	11° 39′					5°0		
	6.30 p. m.	110	66° 44′	11° 33′			737·5		5°3	33·26	18·39
20	0 a. m.		66° 46′	11° 22′	3	WNW. 1	739·5	5°	5°1		
	1 a. m.		66° 51′	11° 05′					4°9		
	2 a. m.		66° 56′	10° 47′					5°3		
	3 a. m.		67° 01′	10° 30′					5°2		
	4 a. m.		67° 06′	10° 11′	4	SW. 2	741·1	5°	5°4	33·28	18·40
	5 a. m.		67° 11′	9° 50′					5°2		
	6 a. m.		67° 15′	9° 30′					5°0		
	7 a. m.		67° 21′	9° 15′					5°1		
	8 a. m.	111	67° 14′	8° 48′	4	SW. 2	742·8	8°	5°1	33·13	18·31
	2 p. m.		67° 13′	8° 39′					5°0		
	3 p. m.		67° 20′	8° 22′					5°3		
	4 p. m.		67° 26′	8° 05′	4	SSW. 3	746·0	6°	6°1	33·66	18·61
	5 p. m.		67° 32′	7° 49′					5°8		
	6 p. m.		67° 38′	7° 33′					5°7		
	7 p. m.		67° 45′	7° 14′					5°9		
	8 p. m.		67° 51′	7° 00′	4	SSW. 3	747·2	5°	5°6	33·83	18·70
	9.20 p. m.	112	67° 57′	6° 44′			746·8		5°6	34·00	18·79
21	4 a. m.		67° 59′	6° 44′	F.	SSW. 1	747·3	6°	5°5		
	4.15 a. m.		68° 00′	6° 44′					5°4		
	4.30 a. m.		68° 01′	6° 44′					5°5		
	4.45 a. m.		68° 02′	6° 44′					5°5		
	5 a. m.		68° 03′	6° 44′					5°4		
	5.15 a. m.		68° 04′	6° 44′					5°6		
	5.30 a. m.		68° 05′	6° 44′					5°5		

Tid (*time*)			Sted (*position*)		Luft (*atmosphere*)					Vand (*water*)		
Dato (*date*)	Klokkeslet (*hour*)	Stations-Nr. (*number of the station*)	Bredde (*latitude*)	Længde Grw. (*longitude*)	Vejr (*weather*)	Vind: Retn. (*direction of the wind*)	Vind: Styrke (*force of the wind*)	Bar.	Temp.	Temp.	Salt ‰ (*salinity* ‰)	Klor ‰ (*chlorine* ‰)
1896 Juli (*July*) 21	5.45 a. m.		68° 06' N.	6° 44' W.						5°3		
	6 a. m.		68° 07'	6° 44'						5°4		
	6.15 a. m.		68° 08'	6° 44'						5°3		
	6.30 a. m.		68° 08' 7	6° 44'						5°3		
	6.45 a. m.		68° 09' 3	6° 44'						5°2		
	7 a. m.		68° 10' 5	6° 44'						5°3		
	7.15 a. m.		68° 11' 6	6° 44'						5°4		
	7.30 a. m.		68° 12' 8	6° 44'						5°3		
	7.45 a. m.		68° 14'	6° 44'						5°2		
	8 a. m.		68° 15' 4	6° 44'	R.	SE.	1	747·5	8°	5°3	34·52	19·08
	8.30 a. m.		68° 16' 8	6° 44'						5°3		
	8.30 a. m.		68° 18' 2	6° 44'						5°3		
	8.45 a. m.		68° 19' 7	6° 44'						5°2		
	9 a. m.		68° 21' 2	6° 44'						5°4		
	9.15 a. m.		68° 23' 4	6° 44'						5°5		
	10 a. m.		68° 30'	6° 44'						5°5		
	11 a. m.		68° 36' 2	6° 44'						5°3		
	0 p. m.		68° 44'	6° 44'	R.	NE.	1	746·5	8°	5°3	34·52	19·08
	1 p. m.		68° 51' 2	6° 44'						5°3		
	2 p. m.		68° 59'	6° 44'						5°2		
	3 p. m.		69° 06'	6° 44'						5°3		
	4 p. m.		69° 15'	6° 44'	R.	NNE.	2	745·8	8°	5°3	34·42	19·03
	5 p. m.		69° 21' 5	6° 44'						4°5		
	6 p. m.		69° 27'	6° 44'						4°8		
	7 p. m.	113	69° 31'	7° 06'				745·4		4°9	34·22	18·92
22	3 a. m.		69° 37'	7° 06'						4°7		
	4 a. m.		69° 42'	7° 06'	4	NNW.	3	748·8	4°	4°6	34·33	18·97
	5 a. m.		69° 47' 3	7° 06'						4°9		
	6 a. m.		69° 53'	7° 06'						4°4		
	7 a. m.		69° 58' 5	7° 06'						3°7		
	7.30 a. m.		70° 01' 5	7° 06'						3°6		
	8 a. m.		70° 04' 5	7° 06'	4	NNW.	3	749·2	5°	3°5	34·29	18·96
	9 a. m.		70° 06'	7° 06'						3°2		
	10 a. m.		70° 12'	7° 06'						2°9		
	11 a. m.		70° 18'	7° 06'						3°8		
	0 p. m.		70° 23'	7° 06'	4	NNW.	3	750·0	5°	3°8	34·34	18·98
	1 p. m.		70° 28'	7° 14'						2°9		
	2 p. m.		70° 32'	7° 20'						2°9		
	3 p. m.		70° 36'	7° 29'						3°1		
	3.15 p. m.	114	70° 36'	7° 29'				751·3		3°2	34·12	18·86
	4 p. m.		70° 39'	7° 33'	4	N.	3b	751·5	6°	3°1		
	5 p. m.		70° 44'	7° 41'						3°1		
	6 p. m.		70° 49' 5	7° 50'						2°8		
	7 p. m.		5 Kml. (*miles*) SE. for (*of*) Jan Mayen							2°9		
	8 p. m.		2 Kml. (*miles*) SE. for (*of*) Jan Mayen		4	NNW.	3	753·3	5°	2°6	34·13	18·86

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokke-slet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction of the wind)*	Styrke *(force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1896												
Juli *(July)* 23	8 a. m.	115	70° 50′ N.	8° 29′ W.	3	NNW.	3 b	754·0	4°	2°3	34·12	18·86
	10 a. m.		70° 42′	8° 29′						2°9		
	11 a. m.		70° 33′	8° 29′						3°0		
	0 p. m.		70° 23′	8° 29′	4	NNW.	1	756·3	10°	3°2	34·10	18·85
	1 p. m.		70° 14′	8° 29′						3°4		
	2 p. m.	116	70° 05′	8° 26′				751·3		4°0	34·11	18·86
	5 p. m.		70° 02′	8° 26′						3°9		
	6 p. m.		69° 53′	8° 26′						4°1		
	7 p. m.		69° 44′	8° 26′						4°2		
	8 p. m.		69° 35′	8° 26′	4	N.	2	757·9	4°	4°8	34·13	18·87
	9 p. m.		69° 27′	8° 26′						4°3		
	10 p. m.		69° 18′	8° 26′						3°9		
	10.40 p. m.	117	69° 13′	8° 23′				757·4		4°1	33·87	18·72
24	5 a. m.		69° 04′	8° 23′						4°1		
	6 a. m.		68° 55′	8° 23′						4°2		
	7 a. m.		68° 46′	8° 23′						4°3		
	8 a. m.		68° 37′	8° 23′	4		0	759·4	5°	4°7	34·06	18·83
	9 a. m.		68° 28′	8° 23′						4°8		
	10 a. m.		68° 20′	8° 23′						5°1		
	10.15 a. m.	118	68° 27′	8° 20′				759·4		4°9	33·79	18·68*
	6 p. m.		68° 20′	8° 48′						5°1		
	7 p. m.		68° 14′	9° 07′						5°3		
	8 p. m.		68° 09′	9° 22′	4		0	762·9	5°	5°2	33·88	18·73
	9 p. m.		68° 04′	9° 42′						5°3		
	10 p. m.		67° 58′	10° 00′						5°3		
	11 p. m.	119	67° 53′	10° 19′				761·7		5°0	33·38	18·45
25	5 a. m.		67° 46′	10° 40′						5°2		
	6 a. m.		67° 40′	11° 00′						5°0		
	7 a. m.		67° 35′	11° 20′						4°7		
	8 a. m.		67° 30′	11° 40′	4	(E.)	0	765·4	5°	4°5	33·30	18·41
	9 a. m.		67° 30′	11° 34′						4°8		
	9.30 a. m.	120	67° 29′	11° 32′				764·4		5°1	33·35	18·44
	3 p. m.		67° 26′	11° 42′						5°0		
	4 p. m.		67° 21′	12° 02′	4		0	765·5	10°	5°1	33·37	18·45
	5 p. m.		67° 16′	12° 20′						4°4		
	6 p. m.		67° 11′	12° 31′						4°6		
	7 p. m.		67° 06′	12° 52′						4°6		
	8 p. m.		67° 00′	13° 07′	4	E.	2	765·4	6°	4°4		
	8.15 p. m.	121	66° 59′	13° 11′				765·0		4°8	33·59	18·57
26	1 a. m.		66° 54′	13° 35′						4°5		
	2 a. m.		66° 50′	13° 57′						5°3		
	3 a. m.		66° 47′	14° 13′						5°6		
	4 a. m.		66° 44′	14° 34′	4	ENE.	2	762·6	5°	5°5		
	5 a. m.	122	66° 42′	14° 44′				762·0		6°0	33·57	18·56
	8 a. m.		66° 33′	15° 33′	3	SE.	3	762·8	7°	6°7	33·61	18·58

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction of the wind)*	Vind: Styrke *(force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1896												
Juli *(July)* 28	11.45 a. m.	123	66° 52′ N.	15° 40′ W.				753·5		5°8	33·46	18·50
	1 p. m.		66° 57′	15° 40′						5°5		
	2 p. m.		67° 04′	15° 40′						3°2		
	3 p. m.		67° 11′	15° 40′						3°3		
	4 p. m.		67° 20′	15° 40′	R.		0	754·9	5°	3°9		
	5 p. m.		67° 28′	15° 40′						3°7		
	6 p. m.		67° 36′	15° 40′						3°7		
	6.30 p. m.	124	67° 40′	15° 40′				753·5		3°6	32·53	17·98
	10 p. m.		67° 41′ 5	15° 40′						3°6		
	11 p. m.		67° 50′	15° 40′						3°5		
29	0 a. m.		67° 58′	15° 40′	4	N.	1	755·2	4°	3°2	33·19	18·35
	1 a. m.		68° 06′	15° 40′						3°1		
	2 a. m.	125	68° 08′	16° 02′				754·8		2°1	33·21	18·36
	7 a. m.		68° 10′	16° 02′						2°3		
	8 a. m.		68° 02′	16° 02′	4	WNW.	4	758·3	2°	3°1		
	9 a. m.		67° 54′	16° 02′						3°2		
	10 a. m.		67° 41′	16° 02′						3°1	33·17	18·34
	11 a. m.		67° 33′	16° 02′						3°5		
	0 p. m.		67° 25′	15° 55′	1	WSW.	3	760·3	5°	3°5		
	1 p. m.	126	67° 19′	15° 52′				760·0		3°8	33·28	18·40
	3 p. m.		67° 15′	15° 59′						4°2		
	4 p. m.		67° 08′ 5	16° 09′	3	SW.	2	761·0	9°	3°9	33·37	18·45
	5 p. m.		67° 01′ 5	16° 21′						3°0	33·37	18·45
	6 p. m.		66° 55′	16° 25′						4°8	33·72	18·64
	7 p. m.		66° 50′	16° 32′						4°9		
	8 p. m.		66° 44′	16° 42′	3	SW.	1	762·8	8°	5°4	33·69	18·62
	9 p. m.		66° 39′	17° 00′						5°6		
	10 p. m.		66° 34′	17° 09′						5°1	33·31	18·41
	11 p. m.		66° 29′	17° 26′						5°2		
30	0 a. m.		66° 25′	17° 47′	1	SSW.	2	762·8	7°	5°4	33·26	18·39
	1 a. m.		66° 22′	18° 04′						6°8		
	3 a. m.		66° 17′	18° 24′						6°6	33·31	18·41
August 1	2 p. m.		66° 17′	18° 39′						7°2		
(August)	4 p. m.		66° 17′	19° 04′	3	W. by S.	3 b	760·5	12°	7°5	34·00	18·79
	8 p. m.		66° 08′	19° 53′	R.	SW.	3 b	760·7	10°	6°8	33·89	18·73
2	0.45 p. m.	127	66° 33′	20° 05′				763·0		6°5	33·41	18·47
	2 p. m.		66° 41′	20° 05′						6°0		
	4 p. m.	128	66° 50′	20° 02′	0		0	763·3	9°	5°1	33·08	18·29*
	5 p. m.		66° 50′	20° 05′						5°4		
	6 p. m.		66° 50′	20° 26′						5°2		
	7 p. m.		66° 50′	20° 49′						5°1		
	8 p. m.		66° 49′	21° 11′	0		0	767·2	9°	5°2	33·75	18·66
	9.20 p. m.		66° 43′	21° 35′						6°4		
3	4 a. m.		66° 28′	21° 42′	0		0	765·3	8°	7°2	34·16	18·89
	10 a. m.	129	66° 35′	23° 47′				764·0		6°9	34·17	18·89

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*		
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction, force of the wind)*	Styrke	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*
1896												
August *(August)* 3	0 p. m.		66° 28'3 N.	23° 48'5 W.	0	S.	2	764·5	11°	7°0		
7	8 a. m.		64° 57'	24° 22'	4	SW.	2	766·8	9°	10°5	34·70	19·18
	0 p. m.		64° 28'	23° 56'	4	SW.	2	767·8	10°	10°5	35·30	19·51
	4 p. m.		64° 00'	23° 05'	4	SW.	2	770·1	10°	10°9	34·60	19·13
	8 p. m.		63° 36'	22° 20'	4	SW.	1	770·9	10°	10°6	35·12	19·41
8	0 a. m.		63° 13'	21° 13'	4	SW.	2	771·1	10°	10°2	34·13	18·86
	2 a. m.	130	63° 00'	20° 40'						11°3	33·96	18·77
	4 a. m.		63° 00'	20° 10'	4	W.	1	770·9	11°	10°9	34·86	19·27
	7.30 a. m.	131	63° 00'	19° 09'						11°1	35·09	19·40
	0 p. m.		63° 00'	18° 02'	F.	W.	3	769·9	16°	11°9	35·15	19·43
	3 p. m.	132	63° 00'	17° 04'						11°8	35·08	19·39
	8 p. m.		63° 02'	16° 01'	F.	W.	1	768·9	14°	11°7	35·27	19·50
9	8 a. m.		63° 10'	13° 00'	4 (F.)	WSW.	1	768·0	13°	11°4	35·40	19·57
	0 p. m.		63° 12'	11° 51'	R.	S.	1	767·7	12°	11°4	35·38	19·56
	1.30 p. m.	133	63° 14'	11° 24'				763·0		10°8	35·23	19·47
	4 p. m.		63° 06'	11° 12'	R.	SSW.	2	765·6	11°	10°5	35·11	19·41
	8 p. m.		62° 39'	10° 32'	F.	SSW.	3	765·0	12°	11°6	35·22	19·47
	8.45 p. m.	134	62° 34'	10° 26'						11°6	35·36	19·55*
10	0.30 a. m.	135	62° 48'	9° 48'						9°3	34·54	19·09
	3.45 a. m.	136	63° 01'	9° 11'						11°3	35·44	19·59
	8 a. m.	137	63° 14'	8° 31'	F.	W.	1	763·3	12°	10°3	34·88	19·28
	11.30 a. m.	138	63° 26'	7° 56'						11°1	35·05	19·38
	4.45 p. m.	139	63° 36'	7° 30'						9°2	34·09	18·84
11	3.30 a. m.	140	63° 29'	6° 57'						8°8	34·15	18·88
	9 a. m.	141	63° 22'	6° 58'						9°5	34·20	18·91
	2 p. m.	142	63° 07'	7° 05'						11°1	35·19	19·46
	3.30 p. m.	143	62° 58'	7° 09'						10°9	35·19	19·46
	6.30 p. m.	144	62° 49'	7° 12'						10°7	34·87	19·28
16	9 a. m.		61° 29'	6° 11'						10°8	35·59	19·68
	0 p. m.		61° 18'	5° 22'	3	NNE.	1	764·9	12°	11°1	35·49	19·62
	4 p. m.		61° 12'	4° 04'	4	N.	1	764·7	10°	11°4	35·53	19·64
	8 p. m.		61° 05'	2° 58'	4	N.	1	764·1	10°	11°5	35·47	19·61
17	0 a. m.		61° 00'	1° 52'	4	N.	1	763·6	10°	12°2	35·62	19·69
	4 a. m.		60° 58'	0° 35'	3	NW.	1	762·8	10°	11°2	35·59	19·68
	8 a. m.		60° 38'	0° 00'	3	NE.	1	762·8	12°	12°5	35·54	19·65
	0 p. m.		60° 18'	0° 51' E.	1	N.	3	763·2	14°	13°4	34·90	19·29
	4 p. m.		59° 53'	1° 44'	3	NE.	2	762·8	15°	13°3	34·63	19·14
	8 p. m.		59° 29'	2° 38'	1		0	761·2	12°	13°3	34·33	18·98
18	0 a. m.		59° 05'	3° 29'	3	S.	2	760·5	11°	13°2	32·99	18·23
	4 a. m.		58° 39'	4° 24'	3	S. by E.	3	760·7	13°	14°4	31·22	17·26
	8 a. m.		58° 15'	5° 13'	3	SSE.	2	761·5	16°	16°1	29·38	16·24
	0 p. m.		57° 59'	5° 56'	3	SSE.	2	762·8	17°	15°8	31·09	17·18
	4 p. m.		57° 46'	6° 55'	3	S.	2	763·1	17°	16°4	31·13	17·21
	8 p. m.		57° 47'	7° 56'	3	SE.	1	763·0	15°	16°5	30·20	16·70

Tid *(time)*			Sted *(position)*		Luft *(atmosphere)*					Vand *(water)*			
Dato *(date)*	Klokkeslet *(hour)*	Stations-Nr. *(number of the station)*	Bredde *(latitude)*	Længde Grw. *(longitude)*	Vejr *(weather)*	Vind: Retn. *(direction of the wind)*	Vind: Styrke *(force of the wind)*	Bar.	Temp.	Temp.	Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*	
1896													
August 19 *(August)*	0 a. m.	144	57° 49′ N.	9° 02′ E.	0	SE.	1	762·6	15°	15°9	31·53	17·43	
	4 a. m.		57° 51′	10° 20′	3	E.	1	762·5	15°	15°7	32·82	18·14	
Juli 17 *(July)*	10 a. m.		64° 56′ 5	13° 38′ W.						4°7			
	10.30 a. m.		64° 52′ 8	13° 33′						2°8	34·10	18·85	
	11.30 a. m.		64° 45′ 5	13° 17′ 3						3°7	34·23	18·92	
	0.30 p. m.		64° 38′	13° 01′						4°0	34·16	18·88	
	1.30 p. m.		64° 31′	12° 45′ 5						4°2	34·19	18·90	
	2.30 p. m.		64° 24′	12° 29′						5°0	34·20	18·90	
	3.30 p. m.		64° 16′ 5	12° 13′						9°1	34·67	19·16	
	4.30 p. m.		64° 09′	11° 56′ 5						10°1	35·22	19·47	
	5.30 p. m.		64° 01′ 7	11° 41′						9°9	35·11	19·41	
	6.30 p. m.		63° 55′	11° 25′ 5						9°8	35·00	19·35	
	7.30 p. m.		63° 47′ 2	11° 09′						9°3	34·78	19·23	
	8.30 p. m.		63° 40′	10° 54′						8°5	34·75	19·21	
	9.30 p. m.		63° 33′	10° 39′						8°6	34·85	19·26	
	10.30 p. m.		63° 26′	10° 24′						9°1	34·81	19·24	1)
	11.30 p. m.		63° 18′	10° 08′						10°3	34·74	19·20	
18	0.30 a. m.		63° 11′ 7	9° 52′						10°4	35·24	19·48	
	1.30 a. m.		63° 04′	9° 36′						10°0	35·14	19·42	
	2.30 a. m.		62° 57′	9° 20′ 5						10°0	35·11	19·41	
	3.30 a. m.		62° 49′ 4	9° 05′						10°0	35·06	19·38	
	4.30 a. m.		62° 45′ 7	8° 42′ 5						10°8	35·30	19·51	
	5.30 a. m.		62° 38′ 5	8° 26′						10°8	35·25	19·49	
	6.30 a. m.		62° 31′ 2	8° 11′						10°7	35·31	19·52	
	7.30 a. m.		62° 24′	8° 00′						10°7	35·32	19·52	
	8.30 a. m.		62° 16′ 3	7° 52′ 7						9°5	35·30	19·51	
	9.30 a. m.		62° 12′ 2	7° 46′ 5						9°3	35·28	19·50	
	10.30 a. m.		62° 06′ 8	7° 35′ 4						9°4	35·30	19·51	

1) Maalinger foretagne fra Krydseren «Hejmdal». *(observations made from the cruiser «Heimdal».)*

Tid (time)		Sta-tions-Nr. (number of the station)	Sted (position)		Dybde (depth)		Vandets Temp. (the temp. of the water)	Vand (water)			Indgaa i Tavle (Is found in the plate)
Dato (date)	Klokkeslet (hour)		Bredde (latitude)	Længde Grw. (longitude)	Fv. (Danish fathoms)	M. (metre)		Salt ‰ (salinity ‰)	Klor ‰ (chlorine ‰)	$s\left(\frac{t}{4}\right)$	
1895											
Maj (May) 11	5.45 p. m.	1	62° 30′ N.	8° 21′ W.	0	0	9°0	35·32	19·52	27·42	XXVIII
					50	94	7°4	35·31	19·52	27·65	
					132	249	7°2				
12	5 a. m.	2	63° 04′	9° 22′	0	0	8°5	35·36	19·55*	27·53	XXVIII
					25	47	7°4	35·42	19·58	27·74	
					100	188	7°3	35·45	19·60	27·77	
					262	494	5°3				
	5 p. m.	3	63° 35′	10° 24′	0	0	7°5	35·38	19·56	27·69	XXVIII
					100	188	3°8	35·23	19·47	28·02	
					200	377	3°5	35·07	19·39	27·92	
					272	512	0°5	34·96	19·33	28·08	
13	3 a. m.	4	64° 07′	11° 12′	0	0	7°7	35·30	19·51	27·60	XXVIII
					100	188	6°7	35·41	19·57	27·82	
					237	446	2°5	34·38	19·28	27·86	
	2 p. m.	5	64° 40′	12° 09′	0	0	5°5	35·04	19·37	27·68	
					155	291	ikke afbr. (not disconnected)	34·94	19·31		
16	0.30 p. m.	6	63° 43′	14° 34′	0	0	8°3	35·23	19·47	27·46	
					90	170	7°0	35·42	19·58	27·79	
	6.30 p. m.	7	63° 13′	15° 41′	0	0	8°7	35·41	19·57	27·54	
					100	188	7°3	35·39	19·56	27·73	
					200	377	knust (broken)	35·32	19·52		
					400	753	7°4	35·38	19·56	27·71	
					600	1130	4°5	35·24	19·48	27·96	
19	4 p. m.	8	63° 56′	24° 40′	0	0	8°5	35·31	19·52*	27·49	XXII, XXIV
					136	256	6°0	35·35	19·54	27·87	
20	4 a. m.	9	64° 18′	27° 00′	0	0	7°9	35·41	19·57*	27·66	XXII, XXIV
					100	188	6°2	35·14	19·42	27·67	
					295	555	5°8	35·24	19·48	27·80	
	5 p. m.	10	64° 24′	28° 50′	0	0	7°9	35·13	19·42	27·44	IX, XXIV
					100	188	6°6	35·12	19·41	27·61	
					200	377	6°3	35·09	19·40	27·62	
					400	753	6°0	35·04	19·37	27·62	
					788	1484	3°5	34·90	19·29	27·79	
21	1.30 p. m.	11	64° 34′	31° 12′	0	0	8°2	35·17	19·44	27·42	X, XXIV
					100	188	6°2	35·25	19·49	27·76	
					200	377	5°6				
					300	565	5°2	35·00	19·35	27·69	
					500	942	5°6	35·02	19·36	27·65	
					1300	2448	1°6	34·96	19·33	28·00	

Tid *(time)*		Stations-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(is found in the plate)*
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*	$s\left(\frac{t}{4}\right)$	
1895											
Maj *(May)* 22	4 a. m.	12	64° 38′ N.	32° 37′ W.	0	0	7°0	35·31	19·52	27·70	X, XXIV
					100	188	6°1				
					200	377	6°3	35·30	19·51	27·79	
					300	565	5°5	35·20	19·46	27·81	
					300	565	ikke afbr. *(not disconnected)*				
					500	942	3°7	35·19	19·46*	28·00	
					<u>1040</u>	<u>1958</u>	0°3	35·05	19·38	28·26	
	5.30 p. m.	13	64° 47′	34° 33′	0	0	6°8	35·06	19·38	27·53	X, XXIII, XXIV
					100	188	6°0	35·23	19·48	27·77	
					300	565	6°0				
					<u>622</u>	<u>1172</u>	3°0	35·24	19·48	28·10	
	9 p. m.	14	64° 45′	35° 05′	0	0	4°0	34·39	19·01	27·33	XXIII, XXIV
					<u>176</u>	<u>331</u>	4°4				
Juni *(June)* 4	4 p. m.	15	66° 18′	25° 59′	0	0	6°1	34·80	19·24	27·42	
					<u>330</u>	<u>621</u>	—0°75	34·99	19·34	28·17	
5	8 a. m.	16	65° 43′	26° 58′	0		7°9	34·99	19·34	27·33	
					<u>250</u>	<u>471</u>	6°1	35·31	19·52	27·82	
16	5.20 a. m.	17	62° 49′	26° 55′	0	0	9°1	35·26	19·49	27·36	IX, XXII, XXIX
					50	94	7°2				
					100	188	7°1	35·33	19·53	27·71	
					200	377	7°1	35·23	19·47	27·62	
					300	565	7°2	35·32	19·53	27·69	
					<u>745</u>	<u>1403</u>	3°4	35·17	19·44	28·02	
17	5 a. m.	18	61° 44′	30° 29′	0	0	10°0	35·05	19·38*	27·05	IX, XXII, XXIX
					50	94	7°2	35·13	19·42	27·54	
					100	188	7°3	35·32	19·53	27·67	
					200	377	6°5	35·14	19·43	27·64	
					300	565	6°6	35·29	19·51	27·74	
					500	942	ikke afbr. *(not disconnected)*	35·13	19·42		
					600	1130	4°0	35·11	19·41*	27·91	
					<u>1135</u>	<u>2137</u>	3°0	35·07	19·39	27·97	
18	1 p. m.	19	60° 29′	34° 14′	0	0	9°0	35·16	19·44	27·29	IX, XXII, XXIX
					50	94	6°4	35·21	19·46	27·71	
					100	188	6°4	35·19	19·45	27·69	
					200	377	6°4	35·12	19·42	27·64	
					300	565	4°5	35·04	19·37	27·79	
					400	753	4°0	35·04	19·37	27·85	
					600	1130		34·78	19·23		
					<u>1566</u>	<u>2947</u>	2°4	35·09	19·40	28·04	

Tid *(time)*		Stations-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*	$s\left(\frac{t}{4}\right)$	
1895											
Juni *(June)* 20	5 a. m.	20	58° 20′ N.	40° 48′ W.	0	0	6°1	34·96	19·33	27·55	XVII, XXIX
					30	57	5°1				
					50	94	4°6	34·96	19·33	27·72	
					100	188	5°0	34·96	19·33	27·68	
					200	377	3°9	34·94	19·32	27·78	
					300	565	3°2	35·04	19·37	27·93	
					500	942	3°2	34·95	19·32	27·85	
					800	1506	ikke afbr. *(not disconnected)*				
					1695	3192	1°5	34·97	19·33	28·02	
21	5 a. m.	21	58° 01′	44° 45′	0	0	6°1	34·79	19·23	27·41	XVII, XXIX
					20	38	ikke afbr. *(not disconnected)*				
					20	38	4°5	34·82	19·25	27·62	
					50	94	ikke afbr. *(not disconnected)*				
					50	94	4°6	34·73	19·20	27·54	
					100	188	4°3	34·90	19·29	27·71	
					200	377	3°3	34·94	19·31	27·84	
					300	565	3°2	34·91	19·30	27·83	
					500	942	ikke afbr. *(not disconnected)*	34·92	19·31		
					500	942	ikke afbr. *(not disconnected)*				
					800	1506	3°0	34·98	19·33	27·90	
					900	1695	2°9	34·94	19·31	27·87	
					1330	2505	2°4	34·72	19·19	27·75	
22	10 a. m.	22	58° 10′	48° 25′	0	0	5°35	34·78	19·23	27·49	XVIII, XXIX
					50	94	ikke afbr. *(not disconnected)*				
					50	94	3°6	34·95	19·32	27·82	
					100	188	0°8	34·79	19·23	27·92	
					150	282	3°3				
					200	377	3°1	34·95	19·32	27·87	
					300	565	ikke afbr. *(not disconnected)*	34·92	19·30		
					400	753	3°4	34·88	19·28	27·78	
					600	1130	2°8	34·79	19·23	27·77	
					1845	3474	1°4	34·96	19·33	28·02	
24	0 p. m.	23	60° 43′	56° 00′	Kun Planktonundersøgelser *(Only investigations of the plankton)*						
25	9 a. m.	24	63° 06′	56° 00′	0	0	4°2	33·35	18·44	26·49	XIX
					10	19	2°7	33·78	18·67	26·97	
					20	38	2°0	33·89	18·73	27·11	
					50	94	2°6	33·67	18·61	26·89	

Tid *(time)*		Stations-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*	$s\left(\frac{t}{4}\right)$	
1895											
Juni *(June)* 25	9 a. m.	24	63° 06′ N.	56° 00′ W.	100	188	4°0	34·82	19·25	27·68	
					200	377	3°9	35·01	19·35	27·83	
					300	565	ikke afbr. *(not disconnected)*				
					300	565	3°9	35·28	19·50	28·05	
					500	942	3°4	34·95	19·32	27·84	
					900	1695	3°0	34·93	19·31	27·86	
					1199	2258	2°4	35·04	19·37	28·00	
26	0 a. m.	25	63° 30′	54° 25	0	0	2°9	32·97	18·23*	26·30	XIX
					10	19	2°4	33·12	18·31	26·47	
					20	38	1°3	33·53	18·53	26·87	
					30	57	ikke afbr. *(not disconnected)*	33·41	18·47		
					50	94	2°3	33·84	18·71	27·05	
					100	188	3°8	34·58	19·12	27·51	
					200	377	4°4	33·21	18·36	26·36 [1]	
					400	753	3°8	34·70	19·18	27·60	
					582	1096	3°3	34·88	19·28	27·79	
	1 p. m.	26	63° 57′	52° 41′	0	0	2°9	32·90	18·19	26·25	
					10	19	1°9	32·89	18·18	26·32	
					20	38	1°4	32·05	18·21	26·40	
					34	64	0°6	33·09	18·29	26·57	
Juli *(July)* 1	0 a. m.	27	64° 54′	55° 10′	0	0	3°9	33·01	18·25	26·25	
					393	740	3°8				
	8 p. m.	28	65° 14′	55° 42′	0	0	1°15	32·91	18·19	26·39	XIX
					10	19	0°2	33·04	18·26	26·55	
					20	38	0°4	33·47	18·50	26·88	
					30	57	— 1°1	33·42	18·47	26·91	
					50	94	1°2	34·00	18·79	27·26	
					100	188	3°3	34·58	19·12	27·55	
					200	377	4°3	34·43	19·03	27·33	
					420	791	3°5	34·71	19·19	27·64	
5	3 p. m.	29	65° 34′	54° 31′	0	0	3°5	33·65	18·60*	26·79	
					10	19	2°2				
					20	38	1°9				
					30	57	0°6				
					40	75	0°4				
					50	94	— 2°7				
					50	94	+ 0°2				
					68	128	+ 0°2	33·43	18·48	26·86	

[1]) To Titreringer. *(Two titrations.)*

Tid *(time)*		Sta-tions-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt °/₀₀ *(salinity °/₀₀)*	Klor °/₀₀ *(chlorine °/₀₀)*	$s\left(\frac{t}{4}\right)$	
1895											
Juli *(July)* 10	7.30 p. m.	30	66° 50′ N.	54° 28′ W.	0	0	1°6	33·28	18·40	26·65	
					10	19	1°1	33·44	18·49	26·82	
					22	41	1°05	33·30	18·41	26·70	
11	8 a. m.	31	66° 35′	55° 54′	0	0	2°6	33·36	18·44	26·65	
					10	19	2°0	33·35	18·44	26·68	
					20	38	1°5	33·36	18·44	26·72	
					30	57	1°3	33·52	18·53	26·87	
					50	94	0°2	33·36	18·44	26·81	
					88	166	1°6	33·59	18·57	26·90	
	1 p. m.	32	66° 35′	56° 38′	0	0	2°6	33·04	18·26	26·38	XIX
					20	38	—0°6	33·28	18·40	26·78	
					30	57	—0°4	33·43	18·48	26·89	
					50	94	—0°9	33·56	18·55	27·01	
					100	188	—0°5	34·10	18·85	27·44	
					150	282	3°3	34·67	19·17	27·63	
					318	599	3°9	34·68	19·17	27·58	
12	1.40 p. m.	33	67° 57′	55° 30′	0	0	2°5	33·56	18·55*	26·81	
					10	19	1°5	33.63	18·59	26·94	
					20	38	1°1	33·84	18·71	27·14	
					35	66	0°8	33·60	18·58	26·97	
18	3 p. m.	34	65° 17′	54° 17′	0	0	5°1	32·97	18·23	26·09	
					10	19	3°3	33·04	18·27	26·33	
					20	38	0°9	33·27	18·39	26·69	
					30	57	0°5	33·36	18·44	26·79	
					40	75	0°3	33·59	18·57	26·99	
					50	94	0°3				
					55	104	ikke afbr. *(not disconnected)*	32·91	18·19		
	6 p. m.	35	65° 16′	55° 05′	0	0	4°4	32·76	18·11*	26·00	
					10	19	3°2	32·91	18·19	26·23	
					20	38	3°2	33·07	18·28	26·36	
					30	57	3°1	33·28	18·40	26·53	
					50	94	0°5	33·47	18·50	26·88	
					100	188	1°9	33·46	18·49	26·77	
					150	282	1°8	34·81	19·24	27·87	
					362	682	3°6				
28	5 a. m.	36	61° 50′	56° 21′	0	0	8°5	33·56	18·55	26·11	XIX, XXIX
					10	19	5°7	33·64	18·60	26·55	
					20	38	2°6	33·77	18·67	26·97	
					30	57	2°8	34·47	19·05	27·51	
					50	94	3°4	34,99	19·34	27·87	

Tid *(time)*		Stations-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt °/₀₀ *(salinity °/₀₀)*	Klor °/₀₀ *(chlorine °/₀₀)*	$s\left(\frac{t}{4}\right)$	
1896											
Juli 28 *(July)*	5 a. m.	36	61° 50′ N.	56° 21′ W.	100	188	4°1	34·93	19·31	27·75	
					150	282	4°1	35·03	19·36	27·83	
					200	377	4°1	34·98	19·34	27·80	
					300	565	3°7	34·98	19·34	27·83	
					600	1130	3°7	34·83	19·26*	27·72	
					1435	2702	1°5	34·93	19·31	27·99	
29	6 a. m.	37	60° 17′	54° 05′	0	0	9°7	33·80	18·69*	26·12	XVIII, XXIX
					10	19	5°4	33·80	18·68	26·71	
					20	38	ikke afbr. *(not disconnected)*				
					20	38	3°4	33·78	18·67	26·91	
					30	57	3°5	34·56	19·10	27·51	
					50	94	ikke afbr. *(not disconnected)*				
					50	94		34·69	19·18		
					100	188	4°5	34·90	19·29	27·68	
					150	282	4°3	35·02	19·36	27·80	
					200	377	4°1	34·92	19·30	27·74	
					300	565	3°5	34·85	19·26	27·75	
					600	1130	3°0				
					1715	3229	1°4	34·63	19·14	27·75	
30	5 a. m.	38	59° 12′	51° 05	0	0	10°0	34·47	19·05	26·59	XXIX
					1870	3521	1°3	34·60	19·13	27·73	
August 9 *(August)*	5 a. m.	39	62° 00′	22° 38′	0	0	13°0	35·38	19·56*	26·75	XXI
					50	94	8°3	35·20	19·46	27·44	
					100	188	3°6				
					100	188	8°0	35·37	19·55	27·61	
					200	377	7°4	35·32	19·52	27·66	
					400	753	6°5	35·22	19·47	27·70	
					865	1628	2°9	34·99	19·34	27·92	
	2.40 p. m.	40	62° 00′	21° 36′	0	0	13°5	35·30	19·51	26·60	
					845	1591	3°3	34·95	19·32	27·85	
12	6 a. m.	41	61° 39′	17° 10′	0	0	12°9	35·35	19·54*	26·64	XX
					1245	2345	2°0	35·06	19·38	28·05	
14	6 a. m.	42	61° 41′	10° 17′	0	0	12°5	35·41	19·57	26·87	
					625	1177	0°4	34·95	19·32	28·08	
	0 p. m.	43	61° 42′	10° 11′	645	1214	0°05				
	3 p. m.	44	61° 42′	9° 36′	0	0	11°9				
					545	1026	4°8	35·22	19·47*	27·91	

Tid (*time*)		Sta-tions-Nr. (*number of the station*)	Sted (*position*)		Dybde (*depth*)		Vandets Temp. (*the temp. of the water*)	Vand (*water*)			Indgaa i Tavle (*Is found in the plate*)
Dato (*date*)	Klokkeslet (*hour*)		Bredde (*latitude*)	Længde Grw. (*longitude*)	Fv. (*Danish fathoms*)	M. (*metre*)		Salt ‰ (*salinity* ‰)	Klor ‰ (*chlorine* ‰)	$s\left(\frac{t}{4}\right)$	
1896 Maj (*May*) 11	8 a. m.	45	61° 32′ N.	9° 43′ W.	0	0	9°1	35·37	19·55	27·44	IV, XX
					10	19	9°1	35·34	19·54	27·42	
					30	57	8°3	35·36	19·54	27·56	
					50	94	8°3	35·35	19·54	27·55	
					100	188	8°2	35·33	19·53	27·55	
					200	377	8°0	35·28	19·50	27·54	
					400	753	7°8	35·34	19·54	27·62	
					643	1211	4°2	35·19	19·45	27·95	
	6 p. m.	46	61° 32′	11° 36′	0	0	9°05	35·39	19·57	27·46	IV, XX, XXVII
					100	188	8°3	35·37	19·55	27·57	
					300	565	8°0	35·35	19·54	27·59	
					400	753	8°1	35·36	19·54	27·59	
					720	1356	2°4	35·08	19·39	28·04	
12	10.30 a. m.	47	61° 32′	13° 40′	0	0	10°5	35·38	19·56*	27·21	IV, XX
					100	188	8°4	35·38	19·56	27·56	
					200	377	8°3	35·39	19·56	27·58	
					300	565	8°2	35·29	19·51	27·52	
					400	753	7°5	35·36	19·54	27·67	
					500	942	7°1	35·39	19·57	27·76	
					700	1318	5°2				
					950	1789	3°2	35·01	19·36	27·91	
	5 p. m.	48	61° 32′	15° 11′	0	0	9°6	35·34	19·54	27·34	IX, XX, XXI
					200	377	8°1	35·30	19·51	27·54	
					400	753	7°7	35·27	19·50	27·58	
					600	1130	6°1	35·14	19·42	27·68	
					1150	2165	3°2	35·10	19·40	27·98	
13	5 a. m.	49	62° 07′	15° 07′	0	0	9°28	35·31	19·52	27·36	VI, XXI
					100	188	8°2	35·26	19·49	27·50	
					200	377	8°1	35·34	19·54	27·57	
					300	565	7°7	35·37	19·55	27·65	
					400	753	7°3	35·34	19·54	27·69	
					500	942	6°2	35·21	19·46	27·73	
					700	1318	4°4	35·17	19·44	27·91	
					1030	1940	3°4	35·34	19·54	28·15	
					1120	2109	2°9				
	5.45 p. m.	50	62° 43	15° 07′	0	0	9°65	35·35	19·54*	27·33	VI, XXI
					200	377	8°1	35·33	19·53	27·57	
					400	753	7°7	35·33	19·53	27·63	
					600	1130		35·17	19·44		
					1020	1921	3°1	35·06	19·38	27·95	
15	0 p. m.	51	64° 15′	14° 22′	0	0	7°63	35·10	19.40	27·45	XXVIII
					10	19	7°6				
					30	57	9°2				
					68	128	7°3	35·17	19·44	27·56	

Tid *(time)*		Stations-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt °/₀₀ *(salinity °/₀₀)*	Klor °/₀₀ *(chlorine °/₀₀)*	$s\left(\frac{t}{4}\right)$	
1896											
Maj 15 *(May)*	5 p. m.	52	63° 57′ N.	13° 32′ W.	0	0	8°29	35·33	19·53	27·53	XVI, XXVIII
					30	57	8°3	35·31	19·52	27·52	
					50	94	8°0				
					100	188	7°8	35·44	19·59	27·69	
					200	377	7°3	35·39	19·56	27·72	
					300	565	8°0	35·27	19·50	27·53	
					420	791	7°9	34·91	19·30	27·26	
16	2 p. m	53	63° 15′	15° 07′	0	0	8°8	35·26	19·49*	27·41	VI, XXI
					20	38	8°7	35·27	19·50	27·43	
					50	94	8°7	35·30	19·52	27·45	
					100	188	8°0	35·31	19·52	27·57	
					200	377	8°0	35·41	19·57	27·64	
					400	753	7°8	35·33	19·53	27·61	
					600	1130	6°1	35·18	19·45	27·72	
					795	1497	3°1	35·10	19·40	27·99	
17	3 p. m.	54	63° 08′	15° 40′	0	0	8°97	35·38	19·56	27·47	
					691	1301	3°9	35·27	19·49	28·04	
19	0 p. m.	55	63° 33′	15° 02′	0	0	8°43	35·32	19·52	27·51	VI, XXI
					10	19	8°3	35·32	19·52	27·53	
					20	38	8°2	35·31	19·52	27·53	
					30	57	8°7	35·33	19·53	27·48	
					50	94	8°3	35·30	19·51	27·51	
					100	188	7°9	35·33	19·53	27·60	
					150	282	7°8	35·28	19·50	27·57	
					200	377	7°8	35·30	19·51	27·58	
					250	471	7°8	35·26	19·49	27·56	
					316	595	5°9	35·11	19·41	27·69	
	6 p. m.	56	64° 00′	15° 09′	0	0	8°24	35·30	19·51*	27·52	XXI
					10	19	8°6	35·28	19·50	27·45	
					20	38	8°1	35·32	19·52	27·56	
					30	57	7°9	35·29	19·51	27·56	
					40	75	7°8	35·36	19·55	27·63	
					68	128	7°6	35·35	19·54	27·65	
20	6 a. m.	57	63° 37′	13° 02′	0	0	8°2	35·45	19·59	27·64	XXVIII
					350	659	3°4	35·12	19·42	27·98	
	3 p. m.	58	64° 25′	12° 09′	0	0	1°24	34·24	18·93	27·45	XXVIII
					211	397	0°8	35·32	19·52	28·35	
	10 p. m.	59	65° 00′	11° 16′	0	0	1°65	34·30	18·96*	27·46	XVI, XXVIII
					10	19	—0°2	34·25	18·93*	27·54	

Tid *(time)*		Sta-tions-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*	$s\left(\frac{t}{4}\right)$	
1896											
Maj *(May)* 20	10 p. m.	59	65° 00′ N.	11° 16′ W.	20	38	— 1°1	34·29	18·95*	27·62	
					30	57	— 1°7	34·32	18·97*	27·66	
					50	94	— 0°9	34·76	19·22*	27·99	
					75	141	+ 0°7	34·96	19·33*	28·07	
					100	188	0°6	34·39	19·01*	27·61	
					150	282	0°4				
					200	377	— 0°2	35·11	19·41*	28·24	
					310	584	— 0°1	35·13	19·42*	28·25	
21	8 a. m.	60	65° 09′	12° 27′	0	0	1°7	34·36	19·00	27·51	
					10	19	1°0	34·60	19·13	27·75	
					20	38	2°1	34·37	19·00	27·49	
					30	57	0°5	34·71	19·19	27·88	
					50	94	1°7	34·77	19·22	27·85	
					75	141	0°7	34·93	19·31	28·04	
					124	234	0°9	34·98	19·34	28·07	
	0 p. m.	61	65° 03′	13° 06′	0	0	2°4	34·41	19·02	27·50	XXVIII
					10	19	2°5	34·39	19·01	27·47	
					20	38	0°6	34·40	19·02	27·62	
					30	57	6°9	34·51	19·07		
					55	104	0°4	34·57	19·11	27·77	
31	9.30 p. m.	62	63° 18′	19° 12′	0	0	7°29	34·76	19·21	27·23	XXI
					30	57	7°9	34·85	19·27	27·22	
					40	75	7°8	35·38	19·56	27·64	
					72	136	7°9	35·33	19·53	27·60	
Juni *(June)* 1	5 a. m.	63	62° 40′	19° 05′	0	0	8°35	35·32	19·53	27·52	VI, XXI
					10	19	8°6	35·52	19·63	27·64	
					30	57	8°7	35·35	19·54	27·49	
					50	94	8°5	35·37	19·55	27·54	
					100	188	8°1				
					300	565	7°4	35·31	19·52	27·65	
					600	1130	4°9	35·11	19·41	27·81	
					800	1506	4°0	35·15	19·43	27·94	
	3 p. m.	64	62° 06′	19° 00′	0	0	8°7	35·35	19·54	27·49	VII, XXI
					20	38	8°9	35·36	19·55	27·47	
					50	94	8°6	35·36	19·55	27·52	
					100	188	8°5	35·36	19·55	27·53	
					200	377	7°3	35·38	19·56	27·71	
					400	753	7°3	35·32	19·52	27·67	
					600	1130	5°2	35·14	19·42	27·79	
					1041	1960	3°1				

Tid (*time*)		Stations-Nr.	Sted (*position*)		Dybde (*depth*)		Vandets Temp.	Vand (*water*)			Indgaa i Tavle
Dato (*date*)	Klokkeslet (*hour*)	(*number of the station*)	Bredde (*latitude*)	Længde Grw. (*longitude*)	Fv. (*Danish fathoms*)	M. (*metre*)	(*the temp. of the water*)	Salt °/oo (*salinity °/oo*)	Klor °/oo (*chlorine °/oo*)	$s\left(\frac{t}{4}\right)$	(*Is found in the plate*)
1896											
Juni (*June*) 2	0.15 a. m.	65	61° 33′ N.	19° 00′ W.	0	0	8°57	35·40	19·57	27·55	V, XX, XXI
					20	38	8°8	35·38	19·56	27·50	
					50	94	8°8	35·44	19·59	27·55	
					100	188	8°3	35·40	19·57	27·59	
					200	377	7°8	35·40	19·57	27·67	
					400	753	7°2	35·34	19·54	27·70	
					600	1130	5°3	35·26	19·49	27·88	
					1089	2051	3°0	35·27	19·50	28·13	
	2.15 p. m.	66	61° 33′	20° 43′	0	0	9°1	35·35	19·54	27·43	V, XX
					50	94	8°4	35·36	19·55	27·54	
					100	188	8°2	35·36	19·55	27·57	
					200	377	7°9	35·36	19·55	27·62	
					400	753	6°8	35·27	19·50	27·70	
					600	1130	5°1	35·17	19·44	27·83	
					900	1695	3°7	35·40	19·57	28·17	
					1128	2124	3°3	35·24	19·48	28·08	
3	3.30 a. m.	67	61° 30′	22° 30′	0	0	8°49	35·29	19·51	27·48	V, XX, XXI
					20	38	8°4				
					50	94	8°5	35·34	19·53	27·51	
					100	188	8°0	35·33	19·53	27·58	
					200	377	7°7	35·30	19·52	27·60	
					400	753	7°2	35·20	19·46	27·59	
					600	1130	5°2	35·09	19·40	27·76	
					975	1836	3°0	35·18	19·45	28·06	
	1 p. m.	68	62° 06′	22° 30′	0	0	8°82	35·33	19·64*	27·46	VII, XXI
					20	38	8°5	35·37	19·55	27·53	
					50	94	8°5	35·34	19·53	27·51	
					100	188	8°1	35·36	19·54	27·59	
					200	377	7°8	35·25	19·49	27·55	
					400	753		35·21	19·46		
					600	1130	5°1	35·33	19·53	27·96	
					843	1588	3°4	35·08	19·39	27·94	
	10 p. m.	69	62° 40′	22° 17′	0	0	8°3	35·29	19·51	27·50	VII, XXI
					10	19	8°4	35·28	19·50	27·48	
					30	57	8°4	35·28	19·50	27·48	
					50	94	7°7	35·25	19·49	27·56	
					100	188	7°4	35·24	19·48	27·59	
					200	377	7°2	35·29	19·51	27·66	
					400	753	5°8	35·21	19·47	27·78	
					589	1109	3°9	35·11	19·41	27·92	

Tid *(time)*		Stations-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*	$S\left(\frac{t}{4}\right)$	
1896											
Juni *(June)* 4	8.50 a. m.	70	63° 09′ N.	22° 05′ W.	0	0	7°78	35·27	19·50	27·56	VII, XXI
					10	19	7°7	35·24	19·48	27·55	
					30	57	7°6	35·22	19·47	27·55	
					50	94	7°5	35·26	19·49	27·60	
					100	188	7°3	35·27	19·50	27·63	
					134	253	7°0	35·30	19·51	27·70	
	2.30 p. m.	71	63° 46′	22° 03′	0	0	7°98	34·12	18·86	26·63	XXI
					10	19	7°8	34·59	19·12	27·03	
					30	57	7°2	35·22	19·47*	27·60	
					42	79	6°7	35·26	19·49	27·71	
8	5 p. m.	72	63° 12′	23° 04′	0	0	8°32	35·30	19·51	27·51	VIII, XXI
					10	19	8°1	35·31	19·52	27·55	
					30	57	7°8	35·34	19·54	27·62	
					50	94	7°7	35·35	19·54	27·64	
					100	188	7°5	35·34	19·54*	27·66	
					197	371	6°7	35·32	19·53	27·75	
	8 p. m.	73	62° 58′	23° 28′	0	0	7°87	35·36	19·55	27·56	VII, XXI
					10	19	8°1	35·31	19·52	27·55	
					30	57	7°6	35·33	19·53	27·64	
					50	94	7°7	35·33	19·53	27·62	
					100	188	7°3	35·33	19·53	27·68	
					200	377	7°2	35·32	19·52	27·68	
					300	565		35·29	19·51		
					486	915	5°5	35·18	19·45	27·80	
9	5.30 a. m.	74	62° 17′	24° 39′	0	0	8°3	35·39	19·56	27·58	VII, XXI
					30	57	8°2	35·31	19·52	27·53	
					50	94	8°4	35·31	19·52	27·51	
					100	188	7°6	35·35	19·54	27·66	
					200	377	7°2	35·33	19·53	27·70	
					300	565	6°8	35·31	19·52	27·73	
					400	753	6°3	35·30	19·51	27·78	
					695	1308	4°2	35·18	19·44	27·94	
11	3.30 p. m.	75	61° 28′	26° 25′	0	0	8°65	35·20	19·46	27·37	V, XX, XXI
					20	38	8°4	35·36	19·55	27·54	
					50	94	7°9	35·34	19·54	27·60	
					100	188	8°2	35·34	19·54	27·56	
					200	377	7°2	35·27	19·50	27·64	
					400	753	6°1	35·20	19·46	27·73	
					600	1130	4°3	35·28	19·50	28·01	
					780	1469	4°3	35·13	19·42	27·89	
12	2 p. m.	76	60° 50′	26° 50′	0	0	8°9	35·40	19·57	27·49	
					800	1517	4°1	35·19	19·45	27·96	

Tid *(time)*		Sta-tions-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokke-slet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt °/oo *(salinity °/oo)*	Klor °/oo *(chlorine °/oo)*	$s\left(\frac{t}{4}\right)$	
1896											
Juni 13 *(June)*	0 a. m.	77	60° 10′ N.	26° 59′ W.	0	0	9°42	35·27	19·50	27·32	VIII, XXII
					20	38	9°3	35·35	19·54	27·39	
					50	94	8°7	35·31	19·52	27·46	
					100	188	8°2	35·33	19·53	27·55	
					200	377	7°5	35·29	19·51	27·62	
					400	753	7°7	35·23	19·47	27·54	
					600	1130	5°0	35·16	19·44	27·84	
					951	1791	3°6	35·20	19·46	28·06	
	5 a. m.	78	60° 37′	27° 52′	0	0	9°22	35·33	19·53*	27·40	VIII, XXI, XXII
					20	38	9°1	35·27	19·50	27·36	
					50	94	8°6	35·28	19·50	27·45	
					100	188	8°7	35·37	19·55	27·51	
					200	377	8°0	35·38	19·56	27·62	
					400	753	6°8	35·36	19·55	27·77	
					600	1130	4°5	35·12	19·42	27·87	
					799	1505	4°5	35·33	19·53	28·03	
	2 p. m.	79	60° 52′	28° 58′	0	0	9°28	35·21	19·46	27·29	VIII, XXII
					20	38	9°1	35·22	19·47	27·32	
					50	94	7°5	35·09	19·40	27·47	
					100	188	7°6	35·09	19·40	27·45	
					200	377	7°1	35·16	19·43	27·57	
					400	753	5°9	35·07	19·38	27·65	
					600	1130	4°5	34·97	19·33	27·74	
					653	1230	4°4	35·11	19·41	27·87	
	7 p. m.	80	61° 02′	29° 32′	0	0	8°53	35·26	19·49*	27·45	VIII, XXII
					20	38	7°5	35·20	19·46	27·55	
					50	94	7°3	35·18	19·45	27·56	
					100	188	7°1	35·20	19·46	27·61	
					200	377	7°0	35·19	19·45	27·61	
					400	753	7°0	35·06	19·38	27·50	
					600	1130	4°5	35·08	19·39	27·83	
					935	1760	4°0	35·14	19·43	27·93	
14	9 a. m.	81	61° 44′	27° 00′	0	0	8°4	35·23	19·48	27·44	
					485	913	6°1	35·13	19·42	27·68	
	2 p. m.	82	61° 55′	27° 28′	0	0	9°23	35·22	19·47	27·31	
					824	1552	4°1	35·00	19·35	27·81	
	8 p. m.	83	62° 25′	28° 30′	0	0	9°23	35·14	19·43	27·25	XXII, XXIV, XXIX
					912	1718	3°5	34·94	19·32	27·82	
16	5.35 a. m.	84	62° 58′	25° 24′	0	0	8°17	35·28	19·50	27·51	
					633	1192	4°8	35·06	19·38	27·78	

Tid (*time*)		Stations-Nr. (*number of the station*)	Sted (*position*)		Dybde (*depth*)		Vandets Temp. (*the temp. of the water*)	Vand (*water*)			Indgaa i Tavle (*Is found in the plate*)
Dato (*date*)	Klokkeslet (*hour*)		Bredde (*latitude*)	Længde Grw. (*longitude*)	Fv. (*Danish fathams*)	M. (*metre*)		Salt °/oo (*salinity* °/oo)	Klor °/oo (*chlorine* °/oo)	$s\left(\frac{t}{4}\right)$	
1896											
Juni 23 (*June*)	11 a. m.	86	65° 03′ 6 N.	23° 47′ 6 W.	0	0	8°55	34·40	19·02	26·76	XXIII
	10.15 p. m.	88	64° 58′	24° 25′	0	0	8°5	35·24	19·48	27·43	XXIII
					10	19	8°4	35·08	19·39	27·33	
					30	57	6°7	35·15	19·43	27·62	
					50	94	6°8	35·23	19·48	27·67	
					70	132	6°8	35·24	19·48	27·67	
					76	143	6°9				
24	7.40 a. m.	89	64° 45	27° 20	0	0	8°05	35·25	19·49*	27·51	XII, XXII, XXIII
					10	19	7°9	35·26	19·49	27·54	
					30	57	7°9	35·25	19·48	27·53	
					50	94	6°9	35·23	19·47	27·65	
					100	188	6°7	35·21	19·46	27·67	
					200	377	6°3	35·24	19·48	27·74	
					290	546	6°2				
					310	584					
	3.25 p. m.	90	64° 45′	29° 06′	0	0	8°52	35·27	19·50	27·46	XII, XXIII, XXIV
					20	38	8°3	35·21	19·46	27·44	
					50	94	8°1	35·20	19·46	27·47	
					100	188	7°8	35·20	19·46	27·51	
					200	377	6°5	35·20	19·46	27·68	
					300	565	6°3	35·20	19·46	27·71	
					400	753	5°5	35·10	19·40	27·73	
					568	1070	4°4	35·05	19·38	27·82	
25	1 a. m.	91	64° 44′	31° 00	0	0	8°33	35·24	19·48*	27·47	XI, XXIII
					20	38	7°3	35·24	19·48	27·61	
					50	94	6°9	35·30	19·51	27·71	
					100	188	6°4	35·22	19·47	27·71	
					200	377	5°9	35·14	19·42	27·71	
					300	565	5°4	35·13	19·42	27·77	
					400	753	4°6	35·10	19·40	27·84	
					600	1130	3°8	35·01	19·35	27·84	
					800	1506	3°6	35·02	19·36	27·88	
					1000	1883	3°5	35·04	19·37	27·90	
					1236	2328	3°1	35·01	19·36	27·92	
	3 p. m.	92	64° 44′	32° 52′	0	0	7°23	35·16	19·44	27·56	X, XXIII
					20	38	7°0	35·18	19·45	27·60	
					50	94	7°1	35·21	19·46	27·61	
					100	188	6°9	35·11	19·41	27·56	
					200	377	5°4	35·21	19·46	27·83	
					400	753	4°6	35·01	19·35	27·76	
					600	1130	2°6	35·01	19·35	27·96	
					976	1838	1°4	34·94	19·31	28·00	

Tid *(time)*		Sta-tions-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokke-slet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathams)*	M. *(metre)*		Salt °/oo *(salinity °/oo)*	Klor °/oo *(chlorine °/oo)*	$s\left(\frac{t}{4}\right)$	
1896											
Juni 26 *(June)*	5 a. m.	93	64° 24′ N.	35° 14′ W.	0	0	6°05	35·13	19·42	27·68	XI
					20	38	5°9	35·17	19·44	27·73	
					50	94	6°1	35·24	19·48	27·77	
					100	188	6°7	35·23	19·47	27·68	
					200	377	6°1	35·24	19·48	27·77	
					400	753	4°3	35·11	19·41	27·87	
					600	1130	3°4	35·15	19·43	28·00	
					767	1444	1°5	35·10	19·40	28·12	
	0.30 p. m.	94	64° 56′	36° 19′	0	0	2°54	33·92	18·75*	27·06	XI, XXIII
					10	19	2°1	34·03	18·81	27·22	
					20	38	2°5	34·00	18·79	27·16	
					30	57	2°3	34·31	18·97	27·43	
					50	94	2°1	34·47	19·06	27·57	
					75	141	3°9	34·85	19·26	27·71	
					100	188	2°5	35·00	19·35	27·96	
					204	385	4°1	35·00	19·35*	27·81	
27	0.30 p. m.	95	65° 14′	30° 39′	0	0	7°82	35·24	19·48	27·53	XI, XXIII
					20	38	7°5	35·16	19·44	27·52	
					50	94	7°2	35·29	19·51	27·66	
					100	188	7°1	35·30	19·51	27·68	
					200	377	6°7	35·30	19·51	27·73	
					400	753	6°1	35·27	19·50	27·79	
					600	1130	4°5	35·14	19·42	27·88	
					752	1416	2°1	35·10	19·40	28·07	
	10.45 p. m.	96	65° 24′	29° 00′	0	0	7°94	35·30	19·51*	27·57	XI, XXIII, XXIV
					20	38	8°0	35·28	19·50	27·54	
					50	94	7°1	35·33	19·53	27·71	
					100	188	6°6	35·30	19·52	27·75	
					200	377	6°3	35·23	19·48	27·74	
					400	753	5°0	35·23	19·48	27·90	
					600	1130	4°4	35·15	19·43	27·90	
					735	1384	1°2	35·11	19·41	28·15	
28	7.45 a. m.	97	65° 28′	27° 39′	0	0	8°1	35·35	19·54	27·58	XII, XXII, XXIII
					20	38	8°2	35·33	19·53	27·55	
					50	94	7°4	35·33	19·53	27·66	
					100	188	7°1	35·37	19·55	27·74	
					200	377	6°6	35·33	19·53	27·77	
					300	565	6°1	35·29	19·51	27·80	
					400	753	5°8	35·27	19·50	27·83	
					450	847	5°5	35·19	19·46	27·81	
	3.25 p. m.	98	65° 38′	26° 27′	0	0	8°2	35·37	19·55	27·58	XII, XXIII, XXIV
					20	38	7°6	35·32	19·53	27·63	

Tid *(time)*		Stations-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*	$s\left(\frac{t}{4}\right)$	
1896											
Juni 28 *(June)*	3.25 p. m.	98	65° 38′ N.	26° 27′ W.	50	94	6°7	35·36	19·55	27·78	
					75	141	6°4	35·32	19·53	27·79	
					138	260	5°9	35·36	19·55	27·88	
Juli 7 *(July)*	2.30 p. m.	99	66° 13′	25° 53′	0	0	8°15	35·25	19·49	27·49	XII, XXIV
					20	38	8°0	35·29	19·51	27·55	
					50	94	6°7	35·33	19·53	27·76	
					100	188	6°2	35·37	19·55	27·86	
					187	352	6°1	35·37	19·55	27·87	
9	9 a. m.	100	66° 23′	14° 02′	0	0	4°8	33·35	18·43	26·42	XXV
					10	19	3°2	33·37	18·45	26·60	
					20	38	0°6	33·42	18·47	26·83	
					59	111	0°4	33·59	18·57	26·99	
	3.30 p. m.	101	66° 23′	12° 05′	0	0	5°5	33·26	18·39*	26·28	XIII, XXV
					10	19	5°2	33·36	18·44	26·39	
					20	38	—0°5	34·33	18·98	27·63	
					30	57	0°1	34·41	19·02	27·66	
					40	75	1°2	33·44	18·48	26·81 [1]	
					50	94	1°7	34·81	19·24	27·87	
					100	188	2°0	33·60	18·57	26·88 [1]	
					200	377	0°7	35·06	19·38	28·15	
					300	565	0°0	35·06	19·38	28·19	
					400	753	—0°3				
					537	1011	—0°7	34·98	19·34	28·16	
10	0.20 a. m.	102	66° 23′	10° 26′	0	0	4°5	32·82	18·14	26·03	XIII, XXV, XXVII
					10	19	2°4	32·80	18·13	26·21	
					20	38	—1°3	33·48	18·51	26·97	
					30	57	—1°4	33·45	18·49	26·94	
					40	75	—1°5	34·43	19·03	27·74	
					50	94	0°7	34·85	19·26	27·98	
					100	188	0°7				
					200	377	0°2	35·04	19·37	28·16	
					400	753	—0°5	35·07	19·38	28·22	
					600	1130	—0°5	35·05	19·37	28·21	
					750	1412	—0°9	34·89	19·29	28·10	
	0.45 p. m.	103	66° 23′	8° 52′	0	0	6°0	33·63	18·59	26·51	XIV, XXV XXVII
					20	38	1°4	33·66	18·61	26·97	
					50	94	—1°4	33·69	18·62	27·14	
					100	188	0°5	33·69	18·62	27·06	
					200	377	0°0	35·03	19·36	28·16	
					300	565	—0°1	34·96	19·33	28·12	
					400	753	—0°2	35·03	19·36	28·17	
					579	1090	—0°6				

[1] To Titreringer. *(Two titrations.)*

Tid *(time)*		Sta-tions-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(langitude)*	Fv. *(Danish fathams)*	M. *(metre)*		Salt ‰ *(salinity ‰)*	Klor ‰ *(chlorine ‰)*	$s\left(\frac{t}{4}\right)$	
1896											
Juli *(July)* 10	10.30 p. m.	104	66° 23′ N.	7° 25′ W.	0	0	6°3	34·17	18·89	26·90	XIV, XXV, XXVI
					20	38	1°3	34·38	19·00	27·56	
					30	57	0°3	34·20	18·91	27·48	
					75	141	0°4	34·46	19·05	27·68	
					100	188	0°8	34·59	19·12	27·76	
					200	377	0°2	35·09	19·40	28·20	
					300	565	—0°2	35·01	19·35*	28·16	
					500	942	—0°8	35·02	19·36	28·19	
					700	1318	—0°9	34·98	19·34	28·17	
					900	1695	—0°9	34·97	19·33	28·16	
					957	1802	—1°1	34·96	19·32	28·16	
11	2 p. m.	105	65° 34′	7° 31′	0	0	5°8	34·07	18·83	26·88	XIV, XXV, XXVI
					20	38	—0°7	33·99	18·79	27·36	
					50	94	0°5	34·92	19·31	28·05	
					100	188	1°1	34·92	19·30	28·01	
					200	377	—0°3	35·01	19·35	28·17	
					400	753	—0°8	35·05	19·37	28·22	
					600	1130	—1°0	35·04	19·37	28·22	
					762	1435	—0°8	34·94	19·31	28·13	
	10.40 p. m.	106	65° 34′	8° 54′	0	0	6°0	34·27	18·94	27·01	XIV, XXV, XXVII
					20	38	1°8	34·28	18·95	27·44	
					30	57	—0°6	34·51	19·08	27·78	
					50	94	—0°3	34·25	18·93	27·55	
					100	188	0°0	34·95	19·32	28·10	
					200	377	—0°7	34·94	19·32	28·13	
					300	565	—0°3	35·00	19·35	28·16	
					447	842	—0°6	34·96	19·32	28·14	
12	7.16 p. m.	107	65° 33′	10° 28′	0	0	6°1	33·63	18·59	26·50	XIV, XXV, XXVII
					20	38	—0°1	34·08	18·84	27·40	
					30	57	—1°1	33·66	18·61	27·10	
					50	94	0°0	34·69	19·18	27·89	
					100	188	0°6	35·01	19·36	28·12	
					200	377	0°2	35·01	19·36	28·14	
					300	565	—0°3	34·94	19·31	28·11	
					492	927	—0°3	34·93	19·31	28·10	
13	3 a. m.	108	65° 30′	12° 00′	0	0	5°9	33·36	18·44	26·31	XXV
					20	38	0°7	33·33	18·43	26·76	
					30	57	0°2	33·61	18·58	27·01	
					50	94	0°8	34·46	19·05	27·66	
					97	183	1°1	34·58	19·11	27·73	

Tid *(time)*		Sta-tions-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokke-slet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt °/∞ *(salinity °/∞)*	Klor °/∞ *(chlorine °/∞)*	$s\left(\frac{t}{4}\right)$	
1896											
Juli 18 *(July)*	11.15 a. m.	109	65° 29′ N.	13° 25′ W.	0	0	4°8	33·25	18·38	26·34	XXV
					10	19	3°5	33·61	18·58	26·76	
					20	38	0°4	34·08	18·84	27·38	
					38	72	1°5	34·16	18·88	27·37	
19	6.30 p. m.	110	66° 44′	11° 33′	0	0	5°3	33·26	18·39	26·30	XIV, XXVIII
					10	19	4°4	33·46	18·49	26·55	
					20	38	—1°5	33·44	18·49	26·94	
					30	57	—1°6	34·50	19·07	27·80	
					50	94	—0°8	34·59	19·12	27·85	
					100	188	0°7	35·09	19·40	28·17	
					200	377	0°3	35·14	19·42	28·23	
					400	753	—0°3	35·10	19·40	28·24	
					600	1130	—0°6	35·05	19·37	28·21	
					781	1471	—0°8				
20	8 a. m.	111	67° 14′	8° 48′	0	0	5°1	33·13	18·31	26·22	XVI, XXVII
					10	19	4°2	33·21	18·36	26·38	
					30	57	—1°4	34·62	19·14	27·90	
					40	75	—1°6	33·13	18·31	26·69	
					50	94	—1°4	34·77	19·22	28·02	
					75	141	—0°1	34·78	19·23	27·97	
					100	188	0°6	35·06	19·38	28·15	
					200	377	0°3	35·09	19·40	28·19	
					400	753		35·08	19·39		
					600	1130	—0°7	35·11	19·41	28·27	
					860	1619	—0°9	35·09	19·40	28·25	
	9.20 p. m.	112	67° 57′	6° 44′	0	0	5°6	34·00	18·79	26·85	XV, XXVI
					30	57	3°2	35·09	19·40	27·97	
					50	94	2°3	35·14	19·42	28·09	
					75	141	2°2	34·00	18·79	27·18	
					100	188	2°3	35·21	19·46	28·14	
					200	377	0°9	35·17	19·44	28·22	
					400	753	—0°3	35·18	19·44	28·30	
					600	1130	—0°7	35·20	19·46	28·33	
					1267	2386	—1°1	35·05	19·38	28·23	
21	7 p. m.	113	69° 31′	7° 06′	0	0	4°9	34·22	18·92	27·11	XV, XXVI
					30	57	1°6	34·21	18·91	27·40	
					50	94	0°5	35·00	19·35	28·11	
					100	188	1°4	35·12	19·41	28·14	
					200	377	0°7	35·05	19·37*	28·14	
					400	753	—0°5	35·14	19·43	28·28	
					800	1506	—1°0	35·15	19·43	28·31	
					1309	2465	—1°0	mudret *(muddy)*			

Tid (*time*)		Stations-Nr. (*number of the station*)	Sted (*position*)		Dybde (*depth*)		Vandets Temp. (*the temp. of the water*)	Vand (*water*)			Indgaa i Tavle (*Is found in the plate*)
Dato (*date*)	Klokkeslet (*hour*)		Bredde (*latitude*)	Længde Grw. (*longitude*)	Fv. (*Danish fathoms*)	M. (*metre*)		Salt ‰ (*salinity* ‰)	Klor ‰ (*chlorine* ‰)	$S\left(\frac{t}{4}\right)$	
1896											
Juli 22 (*July*)	3.15 p. m.	114	70° 36′ N.	7° 29′ W.	0	0	3°2	34·12	18·86	27·19	XXVI
					773	1456	— 1°0	34·63	19·14	27·88	
23	8 a. m.	115	70° 50′	8° 29′	0	0	2°3	34·12	18·86	27·27	XXVII
					86	162	0°1	34·93	19·31	28·08	
	2 p. m.	116	70° 05′	8° 26′	0	0	4°0	34·11	18·86	27·11	XV, XXVII
					20	38	0°0	34·52	19·08	27·75	
					30	57		34·30	18·96		
					40	75	— 0°1	34·82	19·25	28·00	
					50	94	0°3	34·89	19·29	28·04	
					100	188	0°5	35·01	19·35	28·12	
					200	377	0°1	35·00	19·35	28·13	
					371	699	— 0°4				
	10.40 p. m.	117	69° 13′	8° 23′	0	0	4°1	33·87	18·72	26·91	XV, XXVII
					30	57	— 0°7	34·77	19·22	27·99	
					50	94	— 0°6	34·00	18·79	27·36	
					100	188	— 0°7	35·04	19·37	28·21	
					200	377	0°0	35·00	19·35	28·14	
					400	753	— 0°6	35·07	19·39	28·23	
					600	1130	— 0°9	35·10	19·40	28·27	
					1003	1889	— 1°0	35·00	19·35	28·19	
24	10.15 a. m.	118	68° 27′	8° 20′	0	0	4°9	33·79	18·68	26·76	XIII, XXV XXVII
					20	38	0°6	33·85	18·71	27·18	
					30	57	— 0°3	34·75	19·21	27·96	
					50	94	0°4	34·81	19·24	27·96	
					100	188	0°9	35·01	19·35	28·09	
					200	377	0°2	35·01	19·35	28·14	
					300	565	— 0°2	35·08	19·39	28·21	
					400	753	— 0°6	35·00	19·35	28·17	
					500	942	— 0°9	35·02	19·36*	28·20	
					600	1130	— 0°9	35·03	19·36*	28·21	
					700	1318	— 0°9	35·01	19·35	28·19	
					800	1506	— 0°9	34·98	19·34	28·17	
					900	1695	— 1°0	34·99	19·34	28·18	
					1060	1996	— 1°0	35·00	19·35	28·19	
	11 p. m.	119	67° 53′	10° 19′	0	0	5°0	33·38	18·45	26·42	XXV, XXVII
					1010	1902	— 1°0	34·60	19·13	27·86	
25	9.30 a. m.	120	67° 29′	11° 32′	0	0	5°1	33·35	18·44	26·40	XIII, XXV XXVIII
					30	57	— 0°5	34·69	19·17	27·91	
					50	94	— 0°7	33·34	18·43	26·83	
					100	188	+ 0°8	35·18	19·45	28·24	
					200	377	+ 0°1	35·13	19·42	28·24	

Tid *(time)*		Stations-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(is found in the plate)*
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt °/₀₀ *(salinity °/₀₀)*	Klor °/₀₀ *(chlorine °/₀₀)*	$s\left(\frac{t}{4}\right)$	
1896											
Juli 25 *(July)*	9.30 a. m.	120	27° 29′ N.	11° 32′ W.	400	753	−0°5	35·16	19·43	28·29	
					600	1130	−0°8	35·17	19·44	28·31	
					885	1666	−1°0	34·95	19·32	28·15	
	8.15 p. m.	121	66° 59′	13° 11′	0	0	4°8	33·59	18·57	26·61	XIII, XXV
					20	38	−0°3	33·42	18·47	26·88	
					50	94	−0°9	33·62	18·58	27·06	
					75	141	+2°0	34·86	19·27	27·89	
					100	188	+0°4	35·04	19·37	28·15	
					200	377	+0°2	35·18	19·44	28·27	
					400	753	−0°5	35·22	19·47	28·34	
					529	996	−0°7	35·14	19·43	28·29	
26	5 a. m.	122	66° 42′	14° 44′	0	0	6°0	33·57	18·56	26·46	XXIV, XXV
					10	19	5°6	33·67	18·61	26·58	
					20	38	0°1	34·24	18·93	27·52	
					50	94		34·70	19·18		
					115	216	1°8	34·83	19·25	27·88	
28	11.45 a. m.	123	66° 52′	15° 40′	0	0	5°8	33·46	18·50	26·40	XXIV
					30	57	3°0	33·89	18·74	27·03	
					50	94	3°5	33·65	18·60	26·79	
					100	188	3°1	34·04	18·81	27·14	
					145	273	2°0	34·84	19·26	27·88	
	6.30 p. m.	124	67° 40′	15° 40′	0	0	3°6	32·53	17·98	25·89	XII, XXIV
					20	38	−0°8	34·46	19·06	27·76	
					30	57	0°3	33·26	18·39	26·72	
					50	94	0°8	34·82	19·25	27·95	
					100	188	0°9	34·99	19·34	28·08	
					200	377	0°6	35·14	19·42	28·21	
					400	753	−0°5	35·08	19·39	28·23	
					495	932	−0°6	34·95	19·32	28·13	
29	2 a. m.	125	68° 08′	16° 02′	0	0	2°1	33·21	18·36	26·56	XII, XXIV
					30	57	−1°2	34·49	19·07	27·78	
					50	94	0°2	34·75	19·21	27·94	
					100	188	0°8	34·50	19·07	27·69	
					200	377	0°4	34·97	19·34	28·10	
					400	753	−0°3	34·95	19·32	28·12	
					600	1130	−0°4	34·95	19·32	28·12	
					729	1373	−0°8	34·94	19·32	28·14	
	1 p. m.	126	67° 19′	15° 52′	0	0	3°8	33·28	18·40	26·47	XXIV
					293	552	−0°5	34·36	19·00	27·65	

Tid *(time)*		Stations-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt ⁰/₀₀ *(salinity ⁰/₀₀)*	Klor ⁰/₀₀ *(chlorine ⁰/₀₀)*	$s\left(\frac{t}{4}\right)$	
1896											
August 2 *(August)*	0.45 p. m.	127	66° 33′ N.	20° 05′ W.	0	0	6°5	33·41	18·47	26·27	
					44	83	5°6	35·07	19·39	27·70	
	4 p. m.	128	66° 50′	20° 02′	0	0	5°1	33·08	18·29*	26·18	XXIV
					30	57	3°9	34·74	19·21	27·62	
					50	94	4°7	35·01	19·35*	27·75	
					100	188	3°3	34·11	18·85*	27·18	
					194	366	0°6	35·06	19·38	28·15	
3	10 a. m.	129	66° 35′	23° 47′	0	0	6°9	34·17	18·89	26·82	XXIV
					20	38	7°1	34·41	19·02	26·98	
					30	57	6°7	35·02	19·36	27·51	
					50	94	6°6				
					117	220	6°5	35·16	19·43	27·65	
8	2 a. m.	130	63° 00′	20° 40′	0	0	11°3	33·96	18·77	25·97	
					338	636	6°6	35·36	19·55	27·80	
	7.30 a. m.	131	63° 00′	19° 09′	0	0	11°1	35·09	19·40	26·89	XXI
					698	1314	4°7	35·25	19·49	27·95	
	3 p. m.	132	63° 00′	17° 04′	0	0	11°8	35·08	19·39	26·75	
					747	1407	4°6	35·26	19·49	27·96	
9	1.30 p. m.	133	63° 14′	11° 24′	0	0	10°8	35·23	19·47	27·05	XVI, XXVIII
					20	38		35·14	19·42		
					30	57	8°6	35·16	19·44	27·36	
					40	75	7°6	35·17	19·44	27·51	
					50	94	6°9	35·33	19·53	27·73	
					100	188	8°0	35·42	19·58	27·65	
					200	377	4°4	35·13	19·42	27·88	
					230	433	2°2	35·11	19·41	28·07	
	8.45 p. m.	134	62° 34′	10° 26′	0	0	11°6	35·36	19·55*	27·00	XVI, XXVIII
					50	94	8°4	35·42	19·58	27·59	
					100	188	8°2	35·40	19·57	27·61	
					200	377	7°9	35·40	19·57	27·65	
					299	563	4°1	35·43	19·58	28·15	
10	0.30 a. m.	135	62° 48′	9° 48′	0	0	9°3	34·54	19·09	26·76	XXVIII
					270	508	0°4	34·98	19·34	28·10	
	3.45 a. m.	136	63° 01′	9° 11′	0	0	11°3	35·44	19·59	27·12	XVI, XXVIII
					50	94	8°8	35·35	19·54	27·47	
					100	188	8°4	35·37	19·55	27·55	
					200	377	7°6	35·28	19·50	27·60	
					256	482	4°8	35·15	19·43	27·85	

Tid *(time)*		Stations-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Vandets Temp. *(the temp. of the water)*	Vand *(water)*			Indgaa i Tavle *(Is found in the plate)*
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*		Salt °/₀₀ *(salinity °/₀₀)*	Klor °/₀₀ *(chlorine °/₀₀)*	$S\left(\frac{t}{4}\right)$	
1896											
August 10 *(August)*	8 a. m.	137	65° 14′ N.	8° 31′ W.	0	0	10°3	34·88	19·28	26·87	XVI, XXVIII
					50	94	8°4	35·30	19·51	27·50	
					100	188	7°6	35·30	19·51	27·61	
					200	377	1°1	35·07	19·38	28·12	
					297	559	— 0°6	35·08	19·39	28·23	
	11.30 a. m.	138	63° 26′	7° 56′	0	0	11°1	35·05	19·38	26·86	XVI, XXVI, XXVIII
					200	377	3°9	35·12	19·41	27·92	
					300	565	0°0	35·13	19·42	28·25	
					400	753	— 0°4	35·03	19·37	28·19	
					471	887	— 0°6	35·22	19·47	28·35	
	4.45 p. m.	139	63° 36′	7° 30′	0	0	9°2	34·09	18·84	26·42	XXVIII
					702	1322	— 0°6	35·01	19·35	28·18	
11	3.30 a. m.	140	63° 29′	6° 57′	0	0	8°8	34·15	18·88	26·54	
					780	1469	— 0°9	34·83	19·25	28·04	
	9 a. m.	141	63° 22′	6° 58′	0	0	9°5	34·20	18·91	26·46	
					679	1279	— 0°6				
	2 p. m.	142	63° 07	7° 05′	0	0	11°1	35·19	19·46	26·97	
					587	1105	— 0°6	35·00	19·35	28·17	
	3.30 p. m.	143	62° 58′	7° 09′	0	0	10°9	35·19	19·46	27·01	
					388	731	— 0°4	34·95	19·32	28·12	
	6.30 p. m.	144	62° 49′	7° 12′	0	0	10°7	34·87	19·28	26·79	
					276	519	1°6	34·94	19·32	27·99	

It may perhaps be considered as superfluous to indicate the °/₀₀ of chlorine, when the salinity S in proportion to this appears in the tables. If for all that I have done so, it is only because I consider it as a question of time, when another system than the present one will be adopted for the indication of the salinity of sea-water.

The determination of S, the sum of the quantities of salts (expressed in grms) existing in 1 kilo. of sea-water, is a rather complicated matter requiring a great deal of analyses, which again may lead to as many causes of error. Furthermore the direct determination of S by the drying of a quantity of sea-water, the weight of which has been measured, and the heating and weighing of the salts, does not always give results to be entirely relied upon, as transitions and decompositions are taking place during the process of drying and heating, so that correction of determinations and calculations has to be made, new causes of errors.

Being attended with a great deal of trouble to make an analysis of this kind, it is generally customary — instead of the aforesaid method — to determine the surplus of the specific gravity of the sea-water above 1 or its amount of chlorine (grms per kilo of sea-water), and by means of this to find S by multiplication with the so-called coefficients of specific-gravity and chlorine. Many naturalists have tried to determine these coefficients, and found values deviating so much from one another, that the use of any of them, in so far as ocean-water is concerned, would easily give values for S which differ 0·06 ‰ from each other, and thus have the effect of making it impossible to make a direct comparison between the results of the different expeditions. Nearly all the observers have as a basis for the calculation used the determination of the amount of chlorine executed by volumetric titration with a solution of silver-nitrate and chromate of potassium as index, as this way of determination gives the greatest exactness in proportion to the work required.

The question is now: What is obtained by going from the amount of chlorine to the total amount of salt, and what is upon the whole the intention with the determination of chlorine and salinity?

The latter question may be answered this way that it is desired to find a number, by which each water-sample is characterised. The amount of chlorine must, however, be able to do this as well as the total quantity of salt computed by the amount of chlorine. If we set down the quantity of salt as the principal feature of a water-sample, we shall only attain to bring about an incongruity between different series of observations, as it may be disputed which coefficient is to be used, and in case of a direct determination of the total quantity of salt, we shall run a still greater risk, as the probable error arising from this, will be at least as great as the one resulting from a determination of chlorine by volumetric titration, and far greater than the error appearing in a determination of chlorine by weight-titration. It seems as if the experimentalists *(Ekman, Forsberg)* have come to the conclusion that the coefficient of chlorine is increasing with a decreasing quantity of salt. But this will be entirely trifling in proportion to the variation of the salinity, from which follows that the coefficients will not, when used in this manner, contribute to characterise a given sample of water in proportion to others.

It will be quite different, if for a single sample of water we consider the amount of chlorine as the principal feature, in which case the determination of the coefficient of chlorine will be able to give a new characterising cipher for the water-sample. It is evident that the coefficient of chlorine of a water-sample does not alter, even if the sample be mixed with pure water, and when it is found that water of little saltness has a great coefficient of chlorine, this is very likely not to be understood otherwise than that the generation of such water is due to the mixture of salt water with a little coefficient of chlorine, with fresh water with a great coefficient, such as it is the case on the coasts and in the seas where the influence of water from the rivers can be traced. Whether anywhere in nature there is a mixture between sea-water and pure water, must be considered as doubtful; still this must to a certain degree be the case under rain-fall and melting of icebergs, and at such places we may then expect a normal coefficient (the one which applies to ocean-water).

As, however, the uncertain determination of the total quantity of salt, is inseparable from the determination of a coefficient of chlorine, it may be considered as doubtful how far this determination is worth the trouble attending it. One would think that by other proceedings it might be possible to have stated for certain, and with greater exactness, whether a trifling salinity of the sea-water is due to the mixture of sea-water with fresh water from the rivers, or with water produced by the melting of the glacier-ice.

According to the investigations of Professor *Pettersson,* the proportion between the amount of sulphuric acid and the amount of chlorine in sea-ice differs considerably, but still it is to be observed that this proportion is greater than the corresponding one in sea-water. In some samples, it is even so great that the coefficient of chlorine, as a necessity, must be greater in these samples than in the ocean-water, and the consequence of this is, that where such ice is melting, we shall have a mixture with a great coefficient of chlorine, as in water from the coasts.

Owing to the fact of the coefficient of chlorine being such a compound quantity, it seems to me for that reason to be unfit to give distinctive results, even if in some directions it elucidates some characteristic features of the water. And when S is reduced by determination of the different constituents, why then conceal in the coefficient of chlorine all the characterising elements formed by the majority of these separate constituents.

In the tables of the analyses of gases are entered the time and the place of every single sample of water. The appellations are the same as those used in the table of the stations. Furthermore the temperature and salinity of the water as well as the pressure of air in mm. of mercury pressure are entered. Under N will be found in the first column the values of a, a meaning the amount of nitrogen reduced to cubic centimetres at 0° and a pressure of 760 mm., which one litre of water — of the same salinity and temperature as the sample that has been examined — contains in a dissolved state when it is saturated with atmospheric air under a dry pressure of 760 mm.; these values are taken from *Hamberg's* tables *(Bihang til Kgl. Svenska Vet.-Akad. Handlingar.* Bd. 10 Nr. 13 pag. 22). In the second column is entered under the appellation b, the amount of nitrogen reduced to 0° and a pressure of 760 mm., which is necessary to saturate water — of the the same salinity and temperature as the examined sample — under the pressure of air for the time being. In the third column, under c, is entered the quantity of nitrogen determined by the analysis, which

Tid *(time)*		Stations-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Temp.	Salt ‰ *(salinity ‰)*	Bar.	N_2				
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*				Mættet *(saturated)* 760 mm. (a)	Mættet *(saturated)* Bar. (b)	Observ. Mængde *(quantity by observation)* (c)	$c-a$	c
1896 Maj 11 *(May)*	6 p. m.	46	61° 32′ N.	11° 36′ W.	0	0	9°05	35·39	773·0	12·24	12·45	12·64	0·40	
					400	753	8°1	35·36	772·9	12·48				
					720	1356	2°4	35·08	772·4	14·07		14·55	0·48	
12	10.43 a. m.	47	61° 32′	13° 40′	0	0	10°5	35·38	771·5	11·92	12·10	12·45	0·53	
	7.30 a. m.				400	753	7°5	35·36	772·0	12·63		12·71	0·08	
	5.40 a. m.				950	1789	3°2	35·01	772·6	13·83		13·90	0·07	
	9.7 a. m.	48	61° 32′	15° 11′	0	0	9°6	35·34	768·0	12·12	12·25	12·37	0·25	
	7.15 p. m.				400	753	7°7	35·27	769·5	12·57		12·59	0.02	
	4.48 p. m.				1150	2164	3°2	35·10	770·1	13·82		14·02	0·20	
13	10.30 a. m.	49	62° 07′	15° 07′	0	0	9°28	35·31	762·8	12·20	12·25	12·60	0·40	
	9.10 a. m.				400	753	7°3	35·34	764·0	12·67		12·77	0·10	
	6.40 a. m.				1030	1940	3°4	35·34	764·0	13·74		12·43	— 1·31	
15	7.30 p. m.	52	63° 57′	13° 32′	0	0	8°29	35·33	761·8	12·43	12·46	12·97	0·54	
	5.50 p. m.				420	791	7°9	34·91	762·0	12·57		14·55	1·98	

indicates the amount of nitrogen in cubic centimetres — reduced to 0° and a pressure of 760 mm. — that is contained in one litre of sea-water. In the fourth and fifth columns are the two differences *c—a* and *c—b*. Next is entered the temperature of absorption determined by the observed amount of nitrogen according to *Hamberg's* table, and the difference is noted between the observed temperature and the temperature of absorption found in this manner.

Under O_2 is entered in the first column, the observed amount of oxygen — reduced to 0° and 760 mm. — which is contained in one litre of sea-water. In the second colume, *e* means the value adopted by the quantity $\frac{100\ O_2}{N_2 + O_2}$ when sea-water is saturated with asmospheric air under the temperature for the time being. The values that are entered, have been determined by interpolation in *Dittmar's* table *(Report on the scientific results of the voyage of H.M.S. Challenger,* Physics & Chemistry, volume 1 page 224). In the third colum, *f* means the value of $\frac{100\ O_2}{N_2 + O_2}$ computed by means of the observed amount of oxygen and nitrogen. Finally in the fourth column, the difference *f—e* is noted.

Under CO_2 is entered in the first column, the amount of carbonic acid found, which, expressed in cubic centimetres and reduced to 0° and 760 mm. is contained in 1 litre of sea-water; in the second column, under *A*, is entered the alkalinity, expressed by indicating the number of cubic centimetres of carbonic acid required to combine the quantity of alkali which is contained in 1 liter of sea-water in the form of neutral salts.

In the column for the quantity and nature of the Plankton, A. means animal Plankton, V. vegetable Plankton, Pk. peridineer containing chromatophores, Pn. peridineer not containing chromatophores. The cipher before the species of the plankton indicates the proportion of quantity in such a manner, that 1 means that the respective species of plankton only appeared singly in the examined sample; 2 that it appeared rather frequently; 3 generally, and 4 that it was present in so large a quantity as to characterise the sample. These indications of quantity are all relative, and it is only in a few cases that by a remark anything has been said about the absolute quantity, such as for inst., abundantly, exceedingly scarce, etc.

Diff.	O_2				CO_2		Planktonets Mængde og Art *(the quantity and nature of the plankton)*	Anmærkning *(note)*
	O_2	Mættet *(saturated)* $\frac{100\ O_2}{N_2+O_2}$ (e)	Observ. *(by Observ.)* $\frac{100\ O_2}{N_2+O_2}$ (f)	*f—e*	CO_2	*A*		
1°6	7·19	34·2	36·3	2·1	40·1	27·1	4 V. rigeligt *(abundant)*	
					43·7	28·3		
1°5	6·15	34·4	29·7	— 4·7	45·5	26·8		
2°3	6·64	34·1	34·8	0·7	41·8	26·9	4 V. + 1 A.	
0°3	5·41	34·2	29·9	— 4·3	44·2	28·1		
0°2	6·02	34·3	30·2	— 4·1	43·3	27·0		
1°1	6·82	34·1	35·5	1·4	41·5	26·4	4 V.	
0°0	5·40	34·2	30·0	— 4·2	44·5	27·3		
0°7	5·97	34·3	29·9	— 4·4	69·5	29·4		uklart *(not clear)*
1°7	6·77	34·2	35·0	0·8	42.1	26·8	4 V. + 1 A.	
0°4	4·94	34·2	27·9	— 6·3		28·2		
— 4°9	6·05	34·1	32·7	— 1·4	42·6	28·0		
2°1	6·43	34·2	33·1	— 1·1	40·4	26·7	4 V. + 2 A.	
7°0	6·36	34·4	30·4	— 4·0	44·2			

Tid *(time)*		Stations-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Temp.	Salt °/∞ *(salinity °/₀₀)*	Bar.	N_2			
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*				Mættet *(saturated)* 760 mm. (a)	Mættet *(saturated)* Bar. (b)	Observ. Mængde *(quantity, by observation)* (c)	c—a
1896													
Maj *(May)* 19	0 p. m.	55	63° 33′ N.	15° 02′ W.	0	0	8°43	35·32	756·4	12·40	12·34	12·81	0·41
	9.45 a. m.				316	595	5°9	35·11	754·0	13·06		13·52	0·46
20	11.55 p. m.	59	65° 00′	11° 16′	0	0	1°65	34·30	756·0	14·37	14·29	14·88	0·51
	10.13 p. m.				310	584	—0°1	35·13	758·2	14·87		14·85	— 0·02
21	9.15 a. m.	60	65° 09′	12° 27′	0	0	1°7	34·36	753·0	14·36	14·23	14·97	0·61
	8.20 a. m.				124	234	0°9	34·98	753·0	14·52		14·68	0·16
	0.5 p. m.	61	65° 03′	13° 06′	55	104	0°4	34·57	754·5	14·76		13·61	— 1·15
31	9.45 p. m.	62	63° 18′	19° 12′	0	0	7°29	34·76	764·8	12·72	12·80	12·83	0·11
	10.56 p. m.				72	136	7°9	35·33	764·8	12·53		12·96	0·43
Juni *(June)* 2	3.46 a. m.	65	61° 33′	19° 00′	0	0	8°57	35·40	770·9	12·36	12·54	12·32	— 0·04
	2.30 a. m.				400	753	7°2	35·34	770·5	12·70		12·52	— 0·18
	1.5 a. m.				1089	2051	3°0	35·27	770·2	13·87		13·37	— 0·50
3	6 a. m.	67	61° 30′	22° 30′	0	0	8°49	35·29	769·9	12·39	12·55	12·54	0·15
	9 a. m.				0	0			769·6			12·71	
	4.27 a. m.				600	1130	5°2	35·09	770·1	13·25		13·13	— 0·12
	3.37 a. m.				975	1836	3°0	35·18	770·2	13·88		21·83	7·95
	6 p. m.	68	62° 06′	22° 30′	0	0	8°82	35·33	768·8	12·31	12·45	12·48	0·17
	3.10 p. m.				600	1130	5°1	35·33	769·0	13·26		12·95	— 0·31
	1.15 p. m.				843	1588	3°4	35·08	769·0	13·76		13·39	— 0·37
		Til Kontrol: en Analyse af Luften i Laboratoriet *(For control: an analysis of the atmosphere in the laboratory)*							769·6			16·67	
4	3.35 p. m.	71	63° 46′	22° 03′	0	0	7°98	34·12	770·8	12·60	12·78	12·76	0·16
	2.50 p. m.				40	75	6°7	35·26	770·8	12·84		12·78	— 0·06
8	6.20 p. m.	72	63° 12	23° 04′	4	0	8°32	35·30	764·3	12·44	12·51	12·54	0·10
	5.30 p. m.				197	371	6°7	35·32	764·3	12·83		12·83	0·00
9	9.18 a. m.	74	62° 17′	24° 36′	0	0	8°3	35·39	763·3	12·43	12·48	12·52	0·09
11	5.55 p. m.	75	61° 28′	26° 25′	0	0	8°65	35·20	753·5	12·34	12·23	12·39	0·05
	4.10 p. m.				780	1469	4°3	35·13	753·5	13·51		13·89	0·38
12	2 p. m.	76	60° 50′	26° 50′	0	0	8°9	35·40	758·2	12·28	12·25	12·43	0·15
13	8.45 a. m.	78	60° 37′	27° 52′	0	0	9°22	35·33	759·3	12·21	12·20	12·23	0·02
	6.35 a. m.				600	1130	4°5	35·12	759·1	13·45		13·41	— 0·04
	5.45 a. m.				799	1505	4°5	35·33	758·7	13·43		12·82	— 0·61

Diff.	O_2: O_2	O_2: Mættet (saturated) $\frac{100\,O_2}{N_2+O_2}$ (e)	O_2: Observ. (by Observ.) $\frac{100\,O_2}{N_2+O_2}$ (f)	O_2: $f—e$	CO_2: CO_2	CO_2: A	Planktonets Mængde og Art (the quantity and nature of the plankton)	Anmærkning (note)
1°6	6·77	34·2	34·6	0·4	43·4	26·9	4 V. + 2 A. + 3 Pk. + 3 Pn.	
1°6	6·07	34·3	30·5	— 3·8	46·6	27·4		
1°6	7·75	34·4	34·2	— 0·2	43·0	26·1	4 A.	
— 0°1	6·30	34·4	29·8	— 4·6		29·9		mudret *(muddy*
1°9	7·71	34·4	34·0	— 0·4	42·6	25·9	4 V.	
0°4	7·10	34·4	32·6	— 1·8		28·9	overordentlig sparsomt *(very small quantity)*	mudret *(muddy)*
— 3°7	7·88	34·3	36·7	2·4	44·6	26·0		
0°4	6·30	34·2	32·9	— 1·3	43·1	27·2	2 V. + 4 A.	
1°7	5·62	34·2	30·2	— 4·0	40·2	27·5		opbevaret i Kulden paa Dækket i 2 Timer i Vandh. *(kept in the cold on the deck for two hours in the water-bottle)*
— 0°1	6·39	34·1	34·2	0·1	42·9	27·2		
— 0°7	5·31	34·2	29·8	— 4·4	43·9	27·7		
— 1°7	5·69	34·3	29·9	— 4·4	45·4	29·9		
0°6	3·94	34·2	23·9	— 10·3	44·0	27·2		
	4·91		27·9					
— 0°4	3·56	34·2	21·3	— 12·9	46·6	27·2		
	7·89		26·5			31·6		mudret *(muddy)*
0°7	6·04	34·1	32·6	— 1·5	42·9	27·2	3 V. + 4 A.	
— 1°1	4·97	34·2	27·7	— 6·5	43·8	27·6		
— 1°3	5·95	34·3	30·8	— 3·5	43·1	26·5		
	4·40		20·9		0·11			
0°6	7·48	34·2	37·0	2·8		25·8	4 V.	
— 0°2	5·55	34·2	30·3	— 3·9		26·8	meget rigeligt *(very abundant)*	
0°4	6·29	34·2	33·4	— 0·8	42·1	26·9		
0°0	5·64	34·2	30·5	— 3·7		26·2		
0°4	6·43	34·2	33·9	— 0·3	41·4		4 A.	
0°2	6·35	34·1	33·9	— 0·2	39·6		2 V. + 4 A.	
1°3	5·70	34·3	29·1	— 5·2				mudret *(muddy)*
0°6	6·17	34·1	33·2	— 0·9	42·7			
0°1	6·24	34·1	33·8	— 0·3	39·7	26·0		
— 0°1	5·42	34·3	28·8	— 5·5	40·9	29·4		
— 2°2	3·77	34·2	22·7	— 11·5		26·6		mudret *(muddy)*

Tid *(time)* Dato *(date)*	Tid *(time)* Klokke-slet *(hour)*	Sta-tions-Nr. *(number of the station)*	Sted *(position)* Bredde *(latitude)*	Sted *(position)* Længde Grw. *(longitude)*	Dybde *(depth)* Fv. *(Danish fathoms)*	Dybde *(depth)* M. *(metre)*	Temp.	Salt °/oo *(salinity °/oo)*	Bar.	N_2 Mættet *(saturated)* 760 mm. (a)	N_2 Mættet *(saturated)* Bar. (b)	N_2 Observ. Mængde *(quantity by observation)* (c)	N_2 $c—a$	N_2 c
1896														
Juni *(June)* 13	10.25 p. m.	80	61° 02′ N.	29° 32′ W.	o	o	8°53	35·26	758·4	12·39	12·36	12·37	— 0·02	
	8 p. m.				600	1130	4°5	35·08	758.4	13·45		13·31	— 0·14	
	7 p. m.				935	1760	4°0	35·14	758·4	13·59		22·66	9·07	
16	8.35 a. m.	84	62° 58′	25° 24′	o	o	8°17	35·28	737·7	12·46	12·09	12·35	— 0·11	
20	3.35 a. m.	Reykjavik Ankerplads *(anchorage)*			o	o			757·9			12·57		
	7.27 a. m.				o	o			758·8			12·14		
	11.5 a. m.								759·9			11·13		
	12.35 p. m.								759·9			10·89		
23	9.23 a. m.	Ved *(by)* Snefjældsjoklen							757·9			14·58		
	10.10 a. m.								757·9			12·34		
24	10.25 a. m.	89	64° 45′	27° 20′	o	o	8°05	35·25	760·0	12·49	12·49	12·46	— 0·03	—
	9 a. m.				30	57	7°9	35·25	760·0	12·54		12·66	0·12	
	8.5 a. m.				310	584	8°4	35·27	760·0	12·41		12·81	0·40	
	3.25 p. m.	90	64° 45′	29° 06′	o	o	8°52	35·27	760·7	12·39	12·40	12·38	— 0·01	—
25	8.17 a. m.	91	64° 44′	31° 00′	o	o	8°33	35·24	756·5	12·44		15·83	3·39	
	1.55 a. m.				1236	2328	3°1	35.01	758·3	13·86		14·11	0·25	
	10.10 a. m.				o	o	7°5		756·1			12·78		
26	3.47 p. m.	94	64° 56′	36° 19′	o	o	2°54	33·92	751·8	14·15	14·00	14·04	— 0·11	
	2.42 p. m.				30	57	2°3	34·31	752·3	14·18		13·30	— 0·88	
	0.15 p. m.				204	385	4°1	35·00	752·6	13·57		13·39	— 0·18	
27	0.30 p. m.	95	65° 14′	30° 39′	o	o	7°82	35·24	751·3	12·56	12·42	13·00	0·44	
	1.5 p. m.	96	65° 24′	29° 00′	o	o	7°94	35·30	755·8	12·54	12·47	12·48	— 0·06	
	11.20 p. m.				735	1384	1°2	35·11	754·3	14·45		18·98	4·53	
28	10.20 a. m.	97	65° 28′	27° 39′	o	o	8°1	35·35	758·8	12·48	12·46	12·36	— 0·12	
	8.15 a. m.				450	847	5°5	35·19	758·3	13·16		12·83	— 0·33	
	3.25 p. m.	98	65° 38′	26° 27′	o	o	8°2	35.37	760·0	12·45	12·45	12·70	0·25	
	0.40	I *(in)* Dyrefjord — efter Rensning *(after cleaning)*							742·3			12·34		
	1.05	Elvvand fra Dyrefj.s Vandfyldningst. *(Water from a river at the watering-place of Dyrefjord)*							748·2			17·37		
	2.15	Havvand i Dyrefjord *(Sea-water in)*							747·0			12·61		
Juli *(July)* 7	2.30 p. m.	99	66° 13′	25° 53′	187	352	6°1	35·37	749·0	12·98		12·82	— 0·16	
9	9.20 a. m.	100	66° 23′	14° 02′	o	o	4°8	33·35	756·3	13·50	13·43	14·34	0·84	
	10.15 p. m.				20	38	0°6	33·42	756·3	14·81		14·74	— 0·07	

Diff.	O_2				CO_2		Planktonets Mængde og Art) *(the quantity and nature of the plankton)*	Anmærkning *(note)*
	O_2	Mættet *(saturated)* $\frac{100\ O_2}{N_2+O_2}$ (e)	Observ. *(by Observ.)* $\frac{100\ O_2}{N_2+O_2}$ (f)	$f-e$	CO_2	A		
—0°1	6·71	34·1	35·2	1·1	39·0	26·1	4 V. rigeligt *(abundant)*	
—0°5	5·54	34·2	29·4	—4·8	41·4	26·8		
	8·86		28·1			30·0		mudret *(muddy)*
—0°5	6·33	34·1	33·9	—0·2	38·1		4 A. + 4 Pk.	
	6·78		35·0		39·4			
	6·47		34·8		39·3			
	5·56		33·3		43·5			
	5·62		34·0		43·5			
	7·09		32·7				4 V. + 3 A. + 3 Pk.	
	6·34		33·9					
—0°1	6·41	34·1	34·0	—0·1	42·4	25·5	4 V. + 1 A. + 1 Pk.	
0°5	6·20	34·2	32·9	—1·3	42·7	26·0		
1°6	5·98	34·2	31·8	—2·4		30·7		uklart *(not clear)*
0°0	6·49	34·1	34·4	0·3	41·5		4 V. + 1 A. ringe Kvantitet *(small quantity)*	
	7·24	34·2	31·4	—2·8	44·2	28·5	4 V. + 3 A. + 2 Pk.	
0°8	6·12	34·3	30·3	—4·0	44·1	26·2		
	6·38	34·2	33·3	—0·9				
—0°3	7·27	34·3	34·1	—0·2	40·7	28·2	4 V.	
—3°0	6·56	34·2	33·0	—1·2	42·4	26·7		
—0°6	6·05	34·3	31·1	—3·2	45·3	26·5		
1°7	6·51	34·2	33·4	—0·8	43·2		4 V. + 2 Pk. + 4 Copepod faces	
—0°2	6·50	34·1	34·2	0·1	40·3	27·8	2 V. + 4 A.	
	7·54	34·4	28·4	—6·0	43·0	27·1		
—0°5	6·37	34·1	34·0	—0·1	42·3		2 V. + 3 A. + 1 Pk.	
—1°2	6.21	34·2	32·6	—1·6	43·5			c. 0·2 ccm. af Luften undsluppen *(about 0.2 ccm. of the gas escaped)*
1°0	7·26	34·2	36·4	2·2	41·4		4 V. rigeligt *(abundant)*	
	4·47		26·6		35·0			
	8·09		31·8		2·1			
	5·27		29·5		33·7			
—0°6	6·92	34·2	35·1	0·9	39·4			
2°8	7·86	34·3	35·4	1·1	37·8		4 V. meget ringe Kvantitet *(very small quantity)*	
—0°2	7·49	34·4	33·7	—0·7	39·0			

Tid *(time)*		Stations-Nr. *(number of the station)*	Sted *(position)*		Dybde *(depth)*		Temp.	Salt °/oo *(salinity °/oo)*	Bar.	N_2			
Dato *(date)*	Klokkeslet *(hour)*		Bredde *(latitude)*	Længde Grw. *(longitude)*	Fv. *(Danish fathoms)*	M. *(metre)*				Mættet *(saturated)* 760 mm. (a)	Mættet *(saturated)* Bar. (b)	Observ. Mængde *(quantity by observation)* (c)	c — a
1896													
Juli *(July)* 9	5.55 p. m.	101	66° 23′ N.	12° 05′ W.	0	0	5°5	33·26	758·9	13·33	13·31	14·26	0·93
	6.32 p. m.				30	57	0°1	34·41	759·3	14·88		14·79	— 0·09
	5.15 p. m.				100	188	2°0	33·60	758·8	14·33		16·69	2·36
	4 p. m.				537	1011	—0°7	34·98	758·8	15·09		14·88	— 0·21
10	2.47 a. m.	102	66° 23′	10° 26′	0	0	4°5	32·82	759·5	13·65	13·64	14·39	0·74
	1.45 a. m.				20	38	—1°3	33·48	759·5	15·45		15·52	0·07
	1.5 a. m.				750	1412	—0°9	34·89	759·5	15·17		14·54	— 0·63
	2.24 p. m.	103	66° 23′	8° 52′	0	0	6°0	33·63	761·1	13·16	13·18	13·95	0·79
	1.15 p. m.				579	1090	—0°6		761·1			15·12	
	3.40 p. m.	104	66° 23′	7° 25′	0	0	6°3	34·17	764·0	13·03	13·10	13·82	0·79
	1.18 p. m.				20	38	1°3	34·38	763·4	14·48		14·70	0·22
	2.30 p. m.				30	57	0°3	34·20	763·4	14·83		14·62	— 0·21
	0.25 p. m.				300	565	—0°2	35·01	763·4	14·92		15·03	0·11
	11.10 a. m.				957	1802	—1°1	34·96	763·4	15·23		15·17	— 0·06
11	0.40 p. m.	106	65° 34′	8° 54′	0	0	6°0	34·27	754·3	13·10	13·00	14·05	0·95
	11.15 a. m.				447	842	—0°6	34·96	757·0	15·05		15·53	0·48
12	7.16 p. m.	107	65° 33′	10° 28′	0	0	6°1	33·63	753·3	13·13	13·01	14·09	0·96
19	6.45 p. m.	110	66° 44′	11° 33′	0	0	5°3	33·26	737·5	13·39	12·99	13·83	0·44
	8.10 p. m.				30	57	—1°6	34·50	738·5	15·46		15·24	— 0·22
20	8.47 a. m.	111	67° 14′	8° 48′	0	0	5°1	33·13	742·8	13·45	13·15	14·06	0·61
	1.30 p. m.				40	75	—1°6	33·13	744·5	15·60		15·11	— 0·49
	9.50 a. m.				100	188	0°6	35·06	742·8	14·65		14·77	0·12
	9.30 p. m.	112	67° 57′	6° 44′	0	0	5°6	34·00	746·8	13·24	13·01	13·87	0·63
	11.25 p. m.				100	188	2°3	35·21	746·8	14·09		14·51	0·42
	10.23 p. m.				1267	2386	—1°1	35·05	746·8	15·23		15·57	0·34
21	7.10 p. m.	113	69° 31′	7° 06′	0	0	4°9	34·22	745·4	13·42	13·16	13·90	0·48
	8.10 p. m.				200	377	0°7	35·05	745·4	14·62		14·61	— 0·01
22	3.15 p. m.	114	70° 36′	7° 29′	0	0	3°2	34·12	751·3	13·91	13·75	14·57	0·66
23	2 p. m.	116	70° 05′	8° 26′	0	0	4°0	34·11	751·3	13·68	13·52	14·53	0·85
	10.40 p. m.	117	69° 13′	8° 23′	0	0	4°1	33·87	757·4	13·67	13·62	14·32	0·65
24	11 a. m.	118	68° 27′	8° 20′	0	0	4°9	33·79	759·4	13·46	13·45	14·04	0·58
	1.1 p. m.				50	94	0°4	34·81	759·9	14·74		15·94	1·20
	0 p. m.				600	1130	—0°9	35·03	759·4	15·16		15·40	0·24
	11 p. m.	119	67° 53′	10° 19′	0	0	5°0	33·38	761·7	13·46	13·49	14·10	0·64

Diff.	O_2	Mættet (saturated) $\frac{100\, O_2}{N_2 + O_2}$ (e)	Observ. (by Observ.) $\frac{100\, O_2}{N_2 + O_2}$ (f)	$f - e$	CO_2	A	Planktonets Mængde og Art (the quantity and nature of the plankton)	Anmærkning (note)
	O_2				CO_2			
3°2	7·26	34·3	33·7	— 0·6	39·8	24·9	4 V.	
— 0°3	7·30	34·4	33·0	— 1·4	41·5	25·0		
	8·82	34·3	34·6	0·3	43·2	26·8		Vandet opbevaret 2 Tim. i den lufttomme Udkogningsbeholder *(the water kept for two hours in the evacuated boiler)*
— 0°6	7·03	34·4	32·1	— 2·3	42·7	26·1		
2°4	7·97	34·3	35·6	1·3	38·2		4 V.	
0°2	8·64	34·4	35·8	1·4	39·2			
— 1°9	6·61	34·4	31·3	— 3·1				mudret *(muddy)*
2°8	7·59	34·3	35·2	0·9	40·1		4 V. + 2 A. + 1 Pk.	
(0°2)	7·09	34·4	31·9	— 2·5	40·9			
2°8	7·54	34·3	35·3	1·0	41·3	25·7	4 V. + 2 A. + 1 Pk.	
0°7	7·94	34·4	35·1	0·7	42·1	26·2		
— 0°6	7·59	34·4	34·2	— 0·2	40·5	26·1		
0°3	7·10	34·4	32·1	— 2·3	41·3	29·0		
— 0°2	7·30	34·4	32·5	— 1·9	39·1	26·2		
3°3	7·94	34·3	36·1	1·8	40·1		4 V. + 3 Pk. + 3 Pn.	
1°3	6·91	34·5	30·8	— 3·7	43·0			
3°3	7·77	34·3	35·5	1·2	40·1			
1°6	7·47	34·3	35·1	0·8	37·6			
— 0°6	7·67	34·4	33·5	— 0·9	39·4			
2°1	7·46	34·3	34·7	0·4	37·7		4 V. + 2 A. + 2 Pk. + 2 Pn.	
— 1°4	7·99	34·4	34·6	0·2	39·7			
0°4	7·08	34·4	32·4	— 2·0	42·7			
2°2	7·51	34·3	35·1	0·8	40·3		antagelig som St. 111 *(probably like)*	
1°3	7·13	34·4	32·9	— 1·5	43·7			
1°0	7·19	34·4	31·6	— 2·8	43·7			
1°7	7·99	34·3	36·5	2·2	40·1	25·9	antagelig som St. 114 *(probably like)*	
0°0	7·19	34·4	33·0	— 1·4	39·5	26·0		
2°1	8·12	34·4	35·8	1·4	40·5		4 V. + 2 A.	
2°8	7·81	34·4	35·0	0·6	41·0			
2°1	7·90	34·3	35·6	1·3	39·9			
2°0	7·71	34·3	35·4	1·1	39·1	25·5	4 V. + 2 A.	
	7·43	34·4	31·8	— 2·6	43·0	25·6		
0°7	7·10	34·5	31·6	— 2·9	44·0	25·7		
2°2	7·81	34·3	35·6	1·3	37·7		antagelig som St. 118 *(probably like)*	

Tid (*time*)		Stations-Nr. (*number of the station*)	Sted (*position*)		Dybde (*depth*)		Temp.	Salt °/oo (*salinity* °/oo)	Bar.	N_2			
Dato (*date*)	Klokkeslet (*hour*)		Bredde (*latitude*)	Længde Grw. (*longitude*)	Fv. (*Danish fathoms*)	M. (*metre*)				Mættet (*saturated*) 760 mm. (a)	Mættet (*saturated*) Bar. (b)	Observ. Mængde (*quantity by observation*) (c)	c—a
1896													
Juli (*July*) 25	9.30 a. m.	120	67° 29′ N.	11° 32′ W.	0	0	5°1	33·35	764·4	13·43	13·51	14·12	0·69
	8.15 p. m.	121	66° 59′	13° 11′	0	0	4°8	33·59	765·0	13·50	13·59	13·80	0·30
26	5 a. m.	122	66° 42′	14° 44′	0	0	6°0	33·57	762·0	13·16	13·19	13·81	0·65
28	11.45 a. m.	123	66° 52′	15° 40′	0	0	5°8	33·46	753·5	13·23	13·12	13·78	0·55
	6.30 p. m.	124	67° 40′	15° 40′	0	0	3°6	32·53	753·5	13·94	13·85	14·37	0·43
29	2 a. m.	125	68° 08′	16° 02′	0	0	2°1	33·21	754·8	14·34	14·24	14·89	0·55
	1 p. m.	126	67° 19′	15° 52′	0	0	3°8	33·28	760·0	13·81	13·81	14·34	0·53
August (*August*) 2	0.45 p. m.	127	66° 33′	20° 05′	0	0	6°5	33·41	763·0	13·05	13·10	13·82	0·77
	3.20 p. m.	128	66° 50′	20° 02′	0	0	5°1	33·08	763·3				
	4.20 p. m.				100	188	3°3	34·11	763·3			16·91	
3	10.10 a. m.	129	66° 35′	23° 47′	0	0	6°9	34·17	764·0	12·88	12·95	13·48	0·60
	0.25 p. m.				50	94	6°6	(35·10)	764·0	12·87		13·34	0·47
9	1.30 p. m.	133	63° 14′	11° 24′	0	0	10°8	35·23	763·0	11·86	11·91	12·51	0·65
	8.45 p. m.	134	62° 34′	10° 26′	299	563	4°1	35·43	762·0			13·49	
10	3.45 a. m.	136	63° 01′	9° 11′	256	482	4°8	35·15	760·0			13·67	
	11.30 a. m.	138	63° 26′	7° 56′	400	753	−0°4	35·03	759·0			14·97	

A systematic examination of the quantity of carbonic acid contained in sea-water, and the absorbed amount of oxygen and nitrogen, was commenced during the *Pommerania Expedition* in 1872. *Jacobsen* boiled out the water-samples on board and analysed the collected gases when the expedition had come home. Through these analyses, he came to the conclusion that the absorbed quantity of air is not dependent on the pressure to which the water containing the gases is subject in the sea.

In the same manner as *Jacobsen*, *Dittmar* and *Buchanan*, after the *Challenger Expedition*, as well as *Tornøe*, after the *Norwegian North-Ocean-Expedition*, made their analyses of the gases contained in sea-water. Dr. *H.. Tornøe* maintained that the temperature of absorption of the water at the time when last it left the surface, could be ascertained by means of the quantity of nitrogen it contained. By the quantity of oxygen that is required to enable the ratio between oxygen and nitrogen to have the same value as it assumes by saturation with atmospheric air, we should be able to estimate the extent of the reducing effect the water has been subject to since the absorption.

Since the Norwegian North-Ocean-Expedition many analyses have been made of the gases contained in the sea-water, and specially by Professor *O. Pettersson*, who introduced a new method of working by depositing the water samples in glass-balloons void of air, the boiling and the analysis being effected after the expedition had arrived home. By this proceeding the boiling can be made with far greater care than by *Jacobsen's* method, but the greatest advantage by *Pettersson's* method is,

Diff.	O_2				CO_2		Planktonets Mængde og Art *(the quantity and nature of the plankton)*	Anmærkning *(note)*
	O_2	Mættet *(saturated)* $\frac{100\,O_2}{N_2+O_2}$ (e)	Observ. *(by Observ.)* $\frac{100\,O_2}{N_2+O_2}$ (f)	$f-e$	CO_2	A		
2°3	8·24	34·3	36·9	2·6	38·7		4 V. meget rigeligt *(very abundant)*	
1°1	7·79	34·3	36·1	1·8	35·8			
2°3	7·45	34·3	35·0	0·7	38·2			
2°0	7·54	34·3	35·4	1·1	38·8			
1°4	7·90	34·3	35·5	1·2	34·1			
1°7	8·31	34·4	35·8	1·4	39·5		4 A. ringe Kvantitet *(small quantity)*	
1°7	8·00	34·3	35·8	1·5	40·5		4 V. + 1 A. + 1 Pk. + 1 Pn.	
2°8	7·50	34·3	35·2	0·9	39·3		2 A. + 4 Pk.	
					39·2	25·1		
	9·46	34·3	35·9	1·6	42·5	26·5		
2°2	6·79	34·3	33·5	— 0·8	39·7	25·0		
1°7	6·81		33·8		40·9	26·7		
2°8	7·04	34·2	36·0	1·8	41·8		4 A. + 1 Pk. ringe Kvantitet *(small quantity)*	
—0°2	6·43	34·3	32·3	— 2·0	45·8	27·8		
1°1	6·65	34·3	32·7	— 1·6	44·9	27·5		
0°0	7·03	34·4	32·0	— 2·4	44·6	26·3		

that we can easily, and quickly, take out a lot of samples for gas-analysis as soon as the water has come up with the water bottle, and thus have made as many analyses as desired.

Pettersson's method has afterwards been used at nearly all determinations of the gases contained in the water, but on account of Doctor *Rørdam* being in doubt whether these determinations could be relied upon, I did not employ the said method in 1896. As the irregularities in the distribution of the amount of oxygen, on which Dr. *Rørdam* founded his doubt, may be attributed to other causes than the consumption of the oxygen during the storing of the sample, I resolved to deposit water for some time in glass-balloons void of air and remaining from the voyage in 1895, while another sample of the same water was analysed at once. To perform the analysis of the samples brought home in glass-balloons, I was obliged to have the boiling-flask of the gas-analysis-apparatus made larger, as the capacity of a balloon was a little more than 300 cubic centimetres. The balloon was connected with the boiling-flask almost in the same manner as in Professor *Pettersson's* apparatus. As soon as the air was expelled from the boiling-flask, the point projecting into the tube that connects the balloon with the flask was broken off. The other point was led down into mercury, and broken off under the surface of the mercury. The mercury was then sucked up into the balloon, driving the water before it into the boiling-flask, in which boiling out and analysis were effected in the usual manner. The volume of the water was determined by weighing of the balloon before and after it was emptied.

There is hardly any reason to believe that the amount of nitrogen has changed to any appreciable degree during the storing, and as the differences found in the amount of nitrogen are between 0·14 and 0·60, and thus by far exceed the unavoidable observational errors, there can be no doubt but that the cause of this larger quantity of nitrogen must be due to gases contained in the tubes, before the water got in there. To effect a proper examination of this, the quantity of air in 5 of the remaining tubes, which had been pumped out, was measured, and the result of this examination proved that the quantities of air in the tubes would have the volumes 0·48, 0·26, 0·29, 0·51 and 0·48 cubic centimetres at a temperature and pressure of 0° and 760^{mm} (the volume of each tube supposed to be 1 litre). It was impossible to avoid the inconvenience of the tubes being delivered with so much air contained in them, as one single tube, at a trial made before the expedition commenced, proved to be evacuated of air.

By the foregoing ciphers will be seen, that the apparent increase of the quantity of nitrogen very well may be attributed to the fact of the tubes not having been properly pumped out, and if now — after the expedition has arrived home — the amount of nitrogen in the analysis is corrected in such a manner that it becomes equal to that found on board, the amount of oxygen must also be corrected with $^1/_4$ of the correction applied to the amount of nitrogen, the atmosphere being supposed to contain 1 part of oxygen for every 4 parts of nitrogen, and we shall therefore obtain the following quantities for the consumption of oxygen during the storing.

Number of the station	Depth		O_2 consumed	Species & quantity of the Plankton
	Fathoms	Metres		
71	0	0	0·89	4 V., very abundantly
	0	0	0·86	
111	0	0	0·46	4 V. + 2 A. + 2 Pk. + 2 Pn.
	0	0	0·54	
	100	188	0·14	
138	400	753	0·13	

Station Nr. 71, which shows such a large consumption of oxygen, was one of those at which the greatest quantity of Plankton was acquired, and it will be seen that where the quantity of Plankton is limited to a trifle, there is a corresponding small consumption of oxygen during the storing, so that the method of preserving the water in glass-balloons affords sufficient exactness, when the question is about water from great depths[1]).

All the hydrographic results acquired by gas-analyses, have nearly all been obtained by the exclusive application of the two aforesaid theorems, namely, that in the case of the quantity of nitrogen, the temperature of the water, when last it left the surface, can be determined in a water-sample from the depth by means of the quantity of nitrogen held in it; and in so far as regards the analyses of oxygen, that the quantity of this element as the water

[1]) To avoid the influence of the Plankton, Prof. *Pettersson* has, such as it will appear from: *Upplysningar til de hydrografiske kartor og apparater m. m., som udställas under n:o 2399 i Fiskérihallen (Sommeren 1897)*, with success employed the method of covering the tubes internally with a layer of sublimate, which has the effect of killing all organisms.

requires to make it fully saturated, must be regarded as a measure for the estimation of the reducing effect the water has been subject to, since the last time it left the surface.

As it appeared to me, that these theorems had been used without any clear understanding of the correctness of the results gained by them, I have, as will be seen from the table, made a great deal of experiments to determine the quantity of gases held in surface-water.

In case of the two theorems being fully correct, they will require that surface-water should contain exactly the quantity of nitrogen and oxygen required to saturate it. This is, as will be seen from the table, not quite correct, and in consequence of this, we may expect to make as great errors by the application of the theorems on water from the depth, as when applied to surface-water. The theorems must therefore be modified, but as it is such simple physical causes, to which, at least in so far as regards the quantity of nitrogen, these modifications are due, we shall by these causes have new means to ascertain the anterior state of the water.

Several determinations of alkalinity and sulphuric acid, as well as a few determinations of lime and magnesia, have been made with the water-samples brought home from the voyage in 1895. The alkalinity determinations for 1895 have — like similar determinations for 1896 — been made with water-samples deposited in glass-bottles, so that the exactness of these determinations cannot be much relied upon; most unfortunately it came to my knowledge too late that sea-water, when subject to storing, had such an influence on glass, that it could dissolve perceptible quantities of the alkali of this latter, which makes the alkalinity determinations unreliable. Notwithstanding this fact, the relative values may still be worth taking into consideration, and in the following table the alkalinity is put down expressed by cubic centimetres of carbonic acid per litre.

Aar *(year)*	Stations-Nr. *(number of the station)*	Dybde *(depth)* Fv. *(Danish fathoms)*	Dybde *(depth)* M. *(metre)*	Temp.	Salt ‰ *(salinity ‰)*	Alkalinitet *(Alkalinity)*	SO_3 ‰	CaO ‰	MgO ‰
1895	2	0	0	8°5	35·36	28·5	2·307		
		25	47	7°4	35·42	28·0	2·297		
		100	188	7°3	35·45	26·8	2·310		
	3	0	0	7°5	35·38	27·6	2·306	0·559	1·958
		100	188	3°8	35·23	27·2	2·281	0·531	1·938
		200	377	3°5	35·07	26·0	2·273		
		272	512	0°5	34·96		2·279	0·561	2·119
	4	0	0	7°7	35·30	27·0	2·297		
		100	188	6°7	35·41	28·4	2·298		
	5	0	0	5°5	35·04	27·2	2·286		
		155	291	ikke afbr. *(not disconnected)*	34·94	26·8	2·263		
	6	0	0	8°3	35·23	28·3	2·301		
		90	170	7°0	35·42	27·5	2·284		

Aar *(year)*	Stations-Nr. *(number of the station)*	Dybde *(depth)* Fv. *(Danish fathoms)*	M. *(metre)*	Temp.	Salt ‰ *(salinity ‰)*	Alkalinitet *(Alkalinity)*	SO_3 ‰	CaO ‰	MgO ‰
1895	7	0	0	8°7	35·41	28·0	2·315		
		400	753	7°4	35·38	28·0	2·299		
		600	1130	4°5	35·24	26·5	2·308		
	8	0	0	8°5	35·31	26·7	2·308		
		136	256	6°0	35·35	28·9	2·319		
	9	0	0	7°9	35·41	28·1	2·318		
		295	555	5°8	35·24	26·5	2·312		
	10	0	0	7°9	35·13	27·3	2·312		
		400	753	6°0	35·04	26·5	2·300		
		788	1484	3°5	34·90	27·5	2·310		
	11	0	0	8°2	35·17	28·8	2·310	0·544	2·050
		500	942	5°6	35·02	26·5	2·298	0·562	2·126
		1300	2448	1°6	34·96		2·291	0·507	2·096
	12	0	0	7°0	35·31	27·7	2·316		
		500	942	3°7	35·19	26·1	2·262		
		1040	1958	0°3	35·05	26·9	2·273		
	13	0	0	6°8	35·06	26·1	2·282		
		622	1172	3°0	35·24	26·6	2·296		
	17	0	0	9°1	35·26	26·8	2·298		
		300	565	7°2	35·32	25·6	2.305		
		745	1403	3°4	35·17	27·1	2·277		
	18	0	0	10°0	35·05	28·0	2·299		
		600	1130	4°0	35·11	27·2	2·297		
		1135	2137	3°0	35·07	26·9	2·287		
	19	0	0	9°0	35·16	26·9	2·284		
		600	1130		34·78	26·7	2·275		
		1566	2947	2°4	35·09	26·4	2·289		
	20	0	0	6°1	34·96	26·2	2·287		
		1695	3192	1°5	34·97	26·5	2·279		
	21	0	0	6°1	34·79	27·6	2·282		
		500	942	ikke afbr. *(not disconnected)*	34·92	26·5	2·288		
		1330	2505	2°4	34·72	26·9	2·286		
	22	0	0	5°35	34·78	27·7	2·285	0·495	2·270
		600	1130	2°8	34·79	28·1	2·291	0·529	1·668
		1845	3474	1°4	34·96		2·284	0·553	1·725
	24	0	0	4°2	33·35		2·175	0·524	1·756
		500	942	3°4	34·95		2·267	0·545	1·918
		1199	2258	2°4	35·04		2·304	0·543	1·992

Aar (*year*)	Stations-Nr. (*number of the station*)	Dybde (*depth*)		Temp.	Salt °/₀₀ (*salinity* °/₀₀)	Alkalinitet (*Alkalinity*)	SO_3 °/₀₀	CaO °/₀₀	MgO °/₀₀
		Fv. (*Danish fathoms*)	M. (*metre*)						
1895	25	0	0	2°9	32·97	25·9	2.151		
		582	1096	3°3	34·88	26·6	2·290		
	26	0	0	2°9	32·90	25·5	2·123		
		34	64	0°6	33·09	26·7	2·143		
	27	0	0	3°9	33·01	25·2	2·138		
	28	0	0	1°15	32·91	26·5	2·136		
		420	791	3°5	34·71	27·7	2·269		
	29	0	0	3°5	33·65	26·9	2·174		
		68	128	0°2	33·43	27·4	2·190		
	30	0	0	1°6	33·28	26·1	2·202		
		22	41	1°05	33·30	27·3	2·200		
	31	0	0	2°6	33·36	25·9	2·201		
		88	166	1°6	33·59	26·3	2·218		
	32	0	0	2°6	33·04	25·4	2·186		
		150	282	3°3	34·67	25·7	2·268		
		318	599	3°9	34·68	25·6	2·282		
	33	0	0	2°5	33·56	27·1	2·200		
		35	66	0°8	33·60	26·5	2·187		
	34	0	0	5°1	32·97	26·6	2·169		
		50	94	0°3		25·5	2·174		
	35	0	0	4°4	32·76	26·3	2·264		
	36	0	0	8°5	33·56	25·8	2·187		
		600	1130	3°7	34·83	26·2	2·270		
		1435	2702	1°5	34·93	25·6	2·281		
	37	0	0	9°7	33·80	26·1	2·206		
		1715	3229	1°4	34·63	25·8	2·271		
	38	0	0	10°0	34·47	26·1	2·253		
		1870	3521	1°3	34·60	26·7	2·262		
	39	0	0	13°0	35·38	25·8	2·311		
		400	753	6°5	35·22	26·4	2·303		
		865	1628	2°9	34·99	26·3	2·282		
	40	0	0	13°5	35·30	26·2	2·316		
		845	1591	3°3	34·95	27·6	2·283		
	41	0	0	12°9	35·35	27·3	2·318		
		1245	2345	2°0	35·06	27·7	2·288		
	42	0	0	12°5	35·41	26·7	2·319		
		625	1177	0°4	34·95	26·8	2·289		
	44	545	1026	4°8	35·22	27·3	2·296		

Aar *(year)*	Stations-Nr. *(number of the station)*	Dybde *(depth)*		Temp.	Salt °/∞ *(salinity °/∞)*	Alkalinitet *(Alkalinity)*	SO_3 °/∞	CaO °/∞	MgO °/∞
		Fv. *(Danish fathoms)*	M. *(metre)*						
1896	45	0	0	9°1	35·37	27·9			
		10	19	9°1	35·34	28·0			
		30	57	8°3	35·36	30·9			
		50	94	8°3	35·35	29·9			
		100	188	8°2	35·33	31·1			
		300				31·8			
		400	753	7°8	35·34	28·7			
		643	1211	4°2	35·19	29·1			
	46	0	0	9°05	35·39	27·1			
		100	188	8°3	35·37	27·0			
		300	565	8°0	35·35	28·2			
		400	753	8°1	35·36	28·3			
		720	1356	2°4	35·08	26·8			
	47	0	0	10°5	35·38	26·9			
		100	188	8°4	35·38	27·5			
		200	377	8°3	35·39	28·5			
		300	565	8°2	35·29	27·6			
		400	753	7°5	35·36	28·1			
		500	942	7°1	35·39	27·6			
		950	1789	3°2	35·01	27·0			
	48	0	0	9°6	35·34	26·4			
		400	753	7°7	35·27	27·3			
		1150	2165	3°2	35·10	29·4			
	49	0	0	9°28	35·31	26·8			
		400	753	7°3	35·34	28·2			
		1030	1940	3°4	35·34	28·0			
	52	0	0	8°29	35·33	26·7			
	55	0	0	8°43	35·32	26·9			
		316	595	5°9	35·11	27·4			
	59	0	0	1°65	34·30	26·1			
		310	584	—0°1	35·13	29·9			
	60	0	0	1°7	34·36	25·9			
		124	234	0°9	34·98	28·9			
	61	0	0	2°4	34·41	25·9			
		55	104	0°4	34·57	26·0			
	62	0	0	7°29	34·76	27·2			
		72	136	7°9	35·33	27·5			

Aar (year)	Stations-Nr. (number of the station)	Dybde (depth) Fv. (Danish fathoms)	M. (metre)	Temp.	Salt °/₀₀ (salinity °/₀₀)	Alkalinitet (Alkalinity)	SO_3 °/₀₀	CaO °/₀₀	MgO °/₀₀
1896	65	0	0	8°57	35·40	27·2			
		50	94	8°8	35·44	27·8			
		100	188	8°3	35·40	27·3			
		400	753	7°2	35·34	27·7			
		1089	2051	3°0	35·27	29·9			
	67	0	0	8°49	35·29	27·2			
		600	1130	5°2	35·09	27·2			
		975	1836	3°0	35·18	31·6			
	68	0	0	8°82	35·33	27·2			
		200	377	7°8	35·25	26·9			
		600	1130	5°1	35·33	27·6			
		843	1588	3°4	35·08	26·5			
	71	0	0	7°98	34·12	25·8			
		42	79	6°7	35·26	26·8			
	72	0	0	8°32	35·30	26·9			
		197	371	6°7	35·32	26·2			
	78	0	0	9°22	35·33	26·0			
		600	1130	4°5	35·12	29·4			
		799	1505	4°5	35·33	26·6			
	80	0	0	8°53	35·26	26·1			
		600	1130	4°5	35·08	26·8			
		935	1760	4°0	35·14	30·0			
	89	0	0	8°05	35·25	25·5			
		30	57	7°9	35·25	26·0			
		310	584			30·7			
	91	0	0	8°33	35·24	28·5			
		1236	2328	3°1	35·01	26·2			
	94	0	0	2°54	33·92	28·2			
		30	57	2°3	34·31	26·7			
		204	385	4°1	35·00	26·5			
	96	0	0	7°94	35·30	27·8			
		735	1384	1°2	35·11	27·1			
	101	0	0	5°5	33·26	24·9	2·133		
		10	19	5°2	33·36		2·137		
		20	38	—0°5	34·33		2·190		
		30	57	0°1	34·41	25·0	2·207		
		40	75	1°2	33·44		2·141		
		50	94	1°7	34·81		2·230		
		100	88	2°0	33·60	26·8	2·154		

Aar (year)	Stations-Nr. (number of the station)	Dybde (depth) Fv. (Danish fathoms)	M. (metre)	Temp.	Salt °/oo (salinity °/oo)	Alkalinitet (Alkalinity)	SO_3 °/oo	CaO °/oo	MgO °/oo
1896	101	200	377	0°7	35·06		2·241		
		300	565	0°0	35·06		2·253		
		537	1011	— 0°7	34·98	26·1	2·241		
	104	0	0	6°3	34·17	25·7			
		20	38	1°3	34·38	26·2			
		30	57	0°3	34·20	26·1			
		300	565	— 0°2	35·01	29·0			
		957	1802	— 1°1	34·96	26·2			
	113	0	0	4°9	34·22	25·9			
		200	377	0°7	35·05	26·0			
	118	0	0	4°9	33·79	25·5	2·173		
		20	38	0°6	33·85		2·161		
		30	57	— 0°3	34·75		2·221		
		50	94	0°4	34·81	25·6	2·232		
		100	188	0°9	35·01		2·247		
		200	377	0°2	35·01		2·247		
		300	565	— 0°2	35·08		2·240		
		400	753	— 0°6	35·00		2·247		
		500	942	— 0°9	35·02		2·242		
		600	1130	— 0°9	35·03	25·7	2·246		
		700	1318	— 0°9	35·01		2·244		
		800	1506	— 0°9	34·98		2·243		
		900	1695	— 1°0	34·99		2·244		
		1060	1996	— 1°0	35·00		2·239		
	128	0	0	5°1	33·08	25·1			
		100	188	3°3	34·11	26·5			
	129	0	0	6°9	34·17	25·0			
		50	94	6°6		26·7			
	134	299	563	4°1	35·43	27·8			
	136	256	482	4°8	35·15	27·5			
	138	400	753	— 0°4	35·03	26·3			

DISCUSSION REGARDING THE MEASURINGS.

TEMPERATURE & SALINITY CURVES.

On the plates IV—XIX, the depth, as the independent variable co-ordinate, is taken as abscisse, 1 centimeter corresponding to 100 fathoms (188 metres). The depths 100 fathoms, 200, 300 etc. are indicated by the nethermost horizontal line of the co-ordinate system, while the corresponding depths in metres are marked at the uppermost one. The temperatures are represented as ordinates, with a little blue circle, and the salinity as ordinate with a red circle; $s\left(\frac{t}{4}\right)$ (see page 36) as ordinate with a black circle. The temperatures are put down in blue ciphers on the horizontal lines, the salinity in pro mille directly above, and $s\left(\frac{t}{4}\right)$ directly below the appertaining horizontal lines. The units of temperature, the salinity, and $s\left(\frac{t}{4}\right)$ are represented by as long a line as it has been possible to obtain, when everything should be included and the co-ordinale system be of suitable dimensions. The number of the station and its position *(Greenwich)* is indicated at every system of co-ordinates.

A matter of special importance at the drawing of the curves, is the position of the points. That the curve cannot with strict accuracy be drawn through the points laid down, is justified by the fact of errors being attached to the results, caused by uncertainty in the indication of the depth, as well as by incorrectness in the determinations of the temperature & salinity. I have tried to draw as simple and nice a curve as possible by application of the general rules for the graphic interpolation. Temperature-curves of this kind were drawn on board for the sake of the measurings, so that it was possible to obtain one observation more than the usual ones when specially desired. If for all that observations are wanted at many places for the exact determination of the course of the curve, this may be accounted for by the fact of the zoological and botanical investigations already having taken their beginning, so there was no occasion for any more hydrographic measurings which, as is known, require a great deal of work and time.

The sections are indicated by Roman numerals, and laid down in the chart — plate III — as black lines. It can be seen from the chart that the sections on plate XX—XXVIII contain stations nearly lying in straight lines; owing to this, only the latitude and longitude of the two outermost stations have been put down, while the numbers of the stations are indicated for those places of investigation which have got station-number. In one of the sections, plate XXVII, a station is put down from the Norwegian-North-Ocean-Expedition; otherwise all the measurings are those of the Ingolf-Expedition. The stations are put down in the sections with an interval, which is $^3/_2$ of what it is in the chart. This applies to all sections with exception of section plate XXIX, which has been constructed on a smaller scale, the interval between the stations being only half of that shown in the chart. Temperature & salinity have been indicated at every determination for the sake of perspicuity, except at such places, where the determinations are so close to one another that there is no room for the ciphers. Thus between 0 (0) and 100 fathoms (188 m.) is only noted salinity and temperature at 50 fathoms (94 m), even if there be more determinations. Among the curves drawn, the blue are isotherms, the red ones isohalines drawn according to the interpolation curves on the plates IV—XIX, and the signification of a curve is, as a rule, marked on it. The 0° isotherms are drawn with a thicker blue line than the other isotherms. In so far as regards those isotherms and isohalines that have been drawn, this principally depended on whether they offered any interest and could be drawn with tolerable exactness. The depths are, in the same manner as under the curves, indicated in Danish fathoms and metres. 100 fathoms (188 metres) is represented by a centimeter.

TEMPERATURE AND SALINITY IN THE DEPTH.

The ideal we should try to attain by hydrographic investigations, is to be able to give an account of what the condition of a certain area of the sea is at any time. By means of such a voyage as the Ingolf expedition, we can certainly acquire ample information of the state of the sea at many places and at different periods, and by this our knowledge of it has no doubt been greatly increased, as we may take it for granted that in the course of time the condition of the sea has been subject only to changes of such little importance, that they need not to be taken into consideration. Still it is to be observed, that this assumption only can find application on the great depths. As, however, it is necessary for us to have a basis to work on, we choose, as we know of no better, this assumption as the most simple.

To be able to account for the state of the water at a certain place, we must be capable of stating its chemical & physical properties as well as its motion. We have chosen temperature, and the amounts of chlorine, nitrogen, and oxygen (and perhaps flora and fauna) as representatives for the chemical and physical properties as the variations of these qualities are best fit for determinations, and at any rate partly may be attributed to simple and well known causes.

The motion of the water has upon the whole not been measured directly anywhere, and even if such a thing had been the case, we could not from the motion which the water had at the moment of observation, draw any reliable conclusion concerning the resultant motion for any great length of time. It is specially this which offers interest, and we must therefore to the best of our ability draw conclusions on the basis of the observed chemical and physical properties.

If we look at the curves on the plates IV—XIX, it will be seen at once that they nearly all may be ranged under one of the two principal types. One is characterised by the fact of its temperature being rather high (in comparison with the other), and that it is principally decreasing with the depth. The salinity does not vary much, and it is above 35.00, as a rule decreasing with the depth. $s\left(\frac{t}{4}\right)$ increases gradually with the depth, and varies but little from place to place at the same depth. Water in possession of these properties, will in the following be called Atlantic-Ocean-Water; as it is so with the temperature and salinity of the water in the Atlantic, and in the seas that have been explored, we shall hardly meet with water in possession of the aforesaid properties, but that it is found in or originates from the Atlantic.

The second of the two aforesaid principal types distinguishes itself by its throughout low temperature, as well as by a minimum of temperature in or near the surface, and below this minimum of temperature a maximum of temperature, from which the temperature is decreasing gradually towards the bottom. The salinity is throughout lower than in the first of these principal types, and it is specially low at the surface. In general there is a maximum of salinity near the surface, underneath this a minimum, and finally a maximum lying still farther down. $s\left(\frac{t}{4}\right)$ is near the surface greatly increasing with the depth (still it is to be observed that the curve sometimes is bent downwards); in greater depths $s\left(\frac{t}{4}\right)$ grows more slowly, but it will as a rule be greater than in Atlantic-Ocean-Water at a corresponding depth. When the depth is great, $s\left(\frac{t}{4}\right)$ will generally decrease in the lowermost strata. It should be remembered, however, that $s\left(\frac{t}{4}\right)$ does not mean the specific gravity of the sea-water in situ, as the specific gravity — with a few exceptions in the ice-water at the surface — is increasing when the depth is getting larger.

By the foregoing will be seen, that in so far as the North Atlantic is concerned, temperature as well as salinity varies with the depth. If not the water was in a constant motion, these differences would gradually disappear, and this motion must, on the basis of the aforesaid assumption, take place in such a manner that it is just able to maintain the state of matters for the time being. Owing to this, an upper stratum of warm and salt water must therefore be added, and it is a well known fact that this is the case with the whole of the Atlantic draught that is coming from the southward. Water in possession of the last named properties, must therefore be added to the upper strata to maintain the lower temperature and smaller degree of salinity. The simplest manner in which this addition could be effected, would be that the water during the winter time adopted a lower temperature, and, on account of the more abundant rain-fall, a smaller degree of salinity, so that, on account of the cooling, its specific gravity would be increased, and thus make it sink to the bottom. It will be seen, however, by further reflection, that the addition cannot take place in this manner in the whole of the north eastern part of the Atlantic, for, while in this part of the Atlantic, the minimum of the temperature of the surface water hardly goes below 6°, the temperature of the water at a depth of more than 600 fathom (1130 m.) will as a rule be below 6°, and in the larger depths even come down to 2°. The cold water at the bottom cannot therefore be surface-water cooled on the spot, but it must have been added by horizontal currents in the depth.

It is quite a different thing with the seas north of the Faröe-Iceland- and Greenland ridge, in which we have a cold fresh layer of water on top of a warmer and salter one. As the formation of ice in the Polar-seas prevents the fresh water — that is making its way to these seas from rivers as well as in the shape of rain and snowfall — from being mixed with the salt water below, the Polar-currents at the surface lead constantly fresh water to the regions situated more southerly. The lower stratum, which is salter and warmer, receives an addition of water from the Atlantic. In case of such a transmission of water from warmer sections of the sea not taking place, the aforesaid lower stratum would successively be as cold and get as small a salinity as the upper stratum, which, during its constant motion to the southward, gradually would carry away with it its heat as well as its salt. It will be seen that the temperature of the lower stratum is positive as far as to a depth of 200 (377) to 300 fathoms (565 m.), and from there is decreasing gradually towards the bottom, where it can go down as far as about —1°. Nothwithstanding the fact that the salinity as a rule is a little lower at the bottom, it varies but little in the lower stratum. We have therefore every reason to believe that the whole of this mighty lower stratum everywhere is due to the same origin, and originates from Ocean-water which has been cooled in the northern latitudes and made its way in under the lighter, cold, and fresh upper stratum. The parts of the Ocean-water, which are subject to the greatest cooling, will have the greatest specific gravity, and in consequence of this make their way quite down to the bottom, where they constitute the lowermost and coldest layers. As furthermore there is every reason to believe that an ample downpour is the consequence of a great cooling of the surface of the sea, it can easily be accounted for, that in consequence of this, the salinity in the lowermost and coldest strata, as a rule, is a little smaller than in the more elevated and warmer strata.

Speaking about Polar-water, we must distinguish between two different kinds, the upper stratum and the lower stratum; the upper stratum whose distinctive feature is due to the formation and melting of ice, and the lower stratum which hardly can have been in contact with or under the direct influence of the ice. There is still a third layer between these two strata, which, as a transitional link between the two others, has a temperature and a salinity which is increasing rapidly with the depth, and evidently has been formed by reciprocity of action between the two other layers, that is to say, by the conduction of heat and diffusion of salt, and perhaps by a process of mixture, when the physical state of matters allowed it. Where no process of mixture is going on, the exchange between the two layers of water must take place very slowly; it can also be seen from the curve of temperature, that frequently the intermediate layer is not very thick.

The above mentioned qualities, which characterise the water in each of the two principal types, are such reliable and simple marks of distinction, that we never can make a mistake, when at a station the question is to determine whether the water is to be reckoned as belonging to one or the other of the two main types. On the other hand. the differences within each of the two principal types will often be a mere trifle, so that we are frequently at a loss to decide, whether the differences we have before us are real differences in the temperature and salinity of the water, or whether they are due to observational errors.

SECTION I.

In an east and westerly direction south of Iceland.

The salinity from all the determinations that are represented in the sections I, II. III and IV, does not vary much. It is to be observed, however, that in section number I an observational error will have the effect of being able to alter the nature of the isohaline 35·25 entirely. It seems, however, to be evident that there is a rise towards the westward. It appears distinctly from section I, and specially from the curves appertaining thereto, that the salinity is least at the bottom and remarkably small in station 46 and 47, where the temperature likewise is low.

The temperature at the stations 45 and 46 decreases rapidly at the bottom, and the bottom-temperature at station 46 even goes down as far as 2°4, that is to say, lower than in the deepest stations in section I, notwithstanding the fact that the depth in section 46 only is 720 fathoms (1356 metres). We see thus that the bottom-water at the eastern stations in section I has a low temperature and but little salinity, and this applies likewise specially to station 42 with a temperature of 0°4 and a salinity of 34.95, as well as to station 43 with a temperature of 0°1. That all the eastern stations south of the Faröe-Iceland ridge have such a low temperature and such a small salinity at the bottom, can only be accounted for in this way, that water has been running over the ridge in a southerly direction. There is, as we know, water in possession of the aforesaid properties north of the ridge. This layer of cold and not very salt bottom-water, which thus has passed over the ridge, is undoubtedly not very thick. What has led to this supposition is, that the stations 44—45. which are close to the stations 42—43, certainly show a low temperature and salinity at the bottom, but by no means so small values for these quantities as the stations 42—43, and this assumption is corroborated if we look at section XXIII. The circumstances are perhaps so, that but a small quantity of the bottom-water can make its way over the ridge from the North, on account of the very small differences of pressure, and that only a small part of it preserves its distinctive features in the recesses of the bottom near the ridge.

Taking apart these special circumstances at the bottom, the isotherms in section I follow a nearly parallel course, specially in so far as regards the deep strata. The specific gravity is nearly constant in a plan parallel with the surface, so that the whole of this body of water remains in a very stationary state. The isotherm 8° goes deepest towards the east, so that the thickest warm stratum of water, with its small specific gravity, is found on top of the coldest bottom-water with the greatest specific gravity. Thus the strata of water would try to settle, if no other causes exercised any influence, and the currents that exist independent of small local differences of pressure, must therefore be of such a nature that this equilibrium is not disturbed; the thickest warm stratum of water must therefore constantly be found at the eastern stations, and this can be effected thereby, that the water at this place is running with a greater velocity to the northward from warmer areas of the sea than is the case farther to the westward, and likewise thereby that the surface-layer is running from west to east. Both things may perhaps be the case. The isotherms 5°. 6° and 7° rise somewhat at station 75. The water is thus colder here in equally deep strata, which likewise will be seen to be the case in a still higher degree, the farther we advance to the westward.

SECTION II.

In a southerly direction from Horne Fjord in Iceland.

It will be seen from the curves of temperature appertaining to this section, that a large stratum of water throughout has a nearly constant temperature of 8°, and it appears from the curves of salinity that this stratum of water has a rather high salinity. The temperatures at the bottom are higher at the stations situated to the westward than at the rest of them, specially in comparison with the northern ones, so that this section shows exactly the same qualities as the eastern stations appertaining to section I; here is a thick warm stratum of water resting on a layer at the bottom of low temperature and salinity. The origin of the water must therefore also be supposed to be the same. The layer at the bottom must be influenced by water making its way across the Faröe-Iceland ridge.

SECTION III.

From the Westman Islands and southward.

Here we find again a stratum with a nearly constant temperature of 8°, but in this section its thickness is smaller than in section II. The curves of temperature and salinity at the two stations 64 and 65 are about congruent.

SECTION IV.

From Cape Reykjanæs and southward.

The state of matters is about the same as in section III, but the isohaline 35·25 is here lying a little higher.

SECTION V.

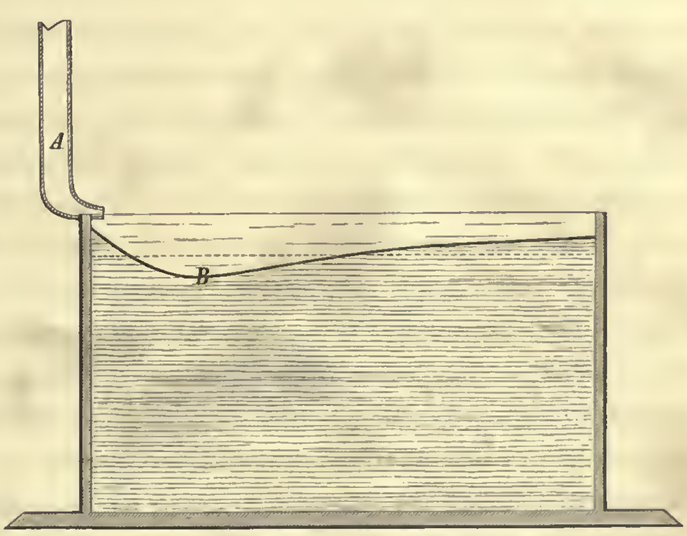
From Cape Reykjanæs in a south-westerly direction.

The isohaline 35·25 is lying still deeper than in section IV. The stratum with a constant temperature has but a very small thickness, but for all that it may be traced.

If we now compare these different sections that have been laid down south of Iceland, the fact that specially attracts our attention is that the different stations resemble one another in a high degree. In a hydrographical point of view, the whole of this part of the Atlantic offers a specially high degree of homogeneousness, so that the differences we have found must be regarded as mere trifles in comparison with this peculiar homogeneousness. It will be seen that the sections II, III, IV, V have this in common, that isotherms and isohalines in the depth are rising towards the coast of *Iceland*, nearly following the ascent of the bottom towards the main land. This cannot be the direct effect of the water from the rivers, for the influence of this latter does not manifest itself in the surface water at any great distance from the shore, it cannot at all for inst. be traced at station 56. At a depth of 40 fathoms (75 metres), the salinity remains unaltered nearly close in to the coast, so that at the aforesaid depth, the influence of the water from the rivers cannot be traced directly. The stations 62 and 71 show for the surface respectively the salinities 34·76 and 34·12; but at a depth of 40 fathoms (75 metres), we meet already again with the normal value applying to *the Atlantic.*

The ascent of the isotherms and the isohalines towards the shore, cannot therefore, in so far as regards the deeper strata, be the direct consequence of the influence of the water from the rivers. It must be accounted for in this way, that the water in the depth has a component of motion in a northerly direction, which is larger than the corresponding component in the case of the surface strata. Such a state can arise thereby, that the water coming from the rivers in *Iceland,* produces a current of reaction in the depth against its own direction. If we only take into consideration the relative motion of the water in a northerly and southerly direction, the case will be, that in the depth we shall have a current running north towards the coast, while at the surface there will be a current setting south, a state of matters which will give rise to an eddy with an approximatively horizontal axis, so that the water at the bottom gets an upgoing motion near the coast, while the water at some distance from this latter has a downward going motion. Even if in reality no eddy is formed, the forces that act on the single particles of water are of such a nature, that they would cause an eddy to appear, if the specific gravity of the water was the same in all depths, that is to say, that the particles of water near the bottom at the coast are acted upon by a power working upwards, while the particles of water, at some distance from the land, are subject to the action of a power that is working downwards. These powers manifest themselves by a rising of isotherms and isohalines along the bottom towards the coast, and by a descent farther away from this latter. Owing to the vague determination of the position of the isohalines, it will in this case be advisable only to take the isotherms into consideration. We see that there is really such a descent in these latter in the sections II, III, IV, V.

It is a matter of course that a correct representation of the currents in the sea, cannot be given by an experiment in a laboratory, but as it seems to me that the following is a good elucidation of the subject, I shall say a few words about it. A vessel 14 centimetres long and 0·8 centimetres broad, with parallel glass-plates as lateral surfaces, is filled with water. By means of a pipette, a strong, and in consequence of this heavy solution of chloride of calcium, is brought down to the bottom in so large a quantity, that this solution, which is coloured by permanganate of potassium, reaches to about 1 centimeter from the upper edge of the vessel. The boundary-plane between the solution and the pure water will remain distinctly visible for a long time, so that a little deviation from the horizontal plan can be seen immediately. A slow and uniform flush of water is through the tube A (see the illustration) made to run along the surface. It will be seen then that the boundary-plane adopts the shape of the curve B, which is drawn on the figure, when the motion in the vessel has become stationary. The curve appears in this shape, as in 1 minute 5·4 cubic centimetres of water have run out of the tube, the eduction orifice of which has a diameter



of 0·2 centimetres. The water was running out over the edges of the vessel no matter where. Motes in the water proved by their motion that there was a real eddy-like formation with a horizontal axis above the place where the boundary-plane was in its lowest position. In the experiment the boundary-plane between the solution of the chloride of calcium and the pure water is a visible isohaline, and it has, as may be seen, the same shape as the isotherms in the afore-mentioned sections. With a more rapid outflow of the water, the deepest place of the boundary-plane B is advancing farther from the orifice of eduction.

In consequence of the Atlantic water taking a sideward motion when it comes up under *Iceland,* rather complicated motions may be the result, and the form which is found for isotherms and isohalines may possibly be due to other causes than those mentioned here. But for all that we can hardly make the assumption that the said depression in the isotherms can be caused by thermical effects only.

SECTION VI.

From station 8 (abreast of Faxe Bay in a south-westerly direction).

From the south-western point of *Iceland,* a submarine ridge is extending in a south-westerly direction. Respectively on the southern and northern side of this latter, the two sections V and VI are lying. Looking at these sections, it will appear that the ridge stands as a partition between water of different properties. North of the ridge, the water at the bottom has at the same depth a lower temperature and less salinity than that south of the ridge. This latter is thus a natural line of demarcation between *the Denmark Strait* and the *Atlantic.*

It is not, however, only in the case of the bottom-water that this submarine ridge, which in connection with the Iceland & Greenland ridge encloses a whole basin in the *Denmark Strait,* becomes a boundary. Also the higher strata on each side of the ridge show differences, though less distinctive than those found for water from the sides of the Faröe-Iceland ridge. While thus the isotherms in section VI approach the surface more and more, successively as we advance in a south-westerly direction, the contrary will be the case with the isotherms in section V, that is to say, only in the outermost part of the section (from station 74 to station 78). The nearer we come to *Iceland,* the smaller will be the difference between the 2 sections.

This can naturally be accounted for thereby, that the water in the *Irminger Current* along the westcoast of *Iceland* passes right across the two sections near the coast, and by this makes up for the differences. Farther to the south-westward, the motion must have another direction than the perpendicular one on the ridge. For a current running in this direction, would also here tend to effect an adjustment of the differences on the two sides of the ridge; the observations prove now that such an equalization does not take place. There is in consequence of this every reason to believe that the motion goes in the same direction as the ridge, that is to say towards *Iceland.* Very likely it is caused thereby, that the current setting north in the western part of the Atlantic, is turning off in a north-easterly direction when it falls in with the eastern Greenland Polar Current, at the same time carrying with it part of the water of the Polar Current. At the southwest coast of *Iceland,* the Atlantic Current is divided into two currents: one that runs to the eastward, and another that runs North and forms the *Irminger Current.* The water brought down from the Polar Current keeps itself continually on the northern & western side of the Atlantic-water, so that it is not removed from the *Denmark Strait*, and does not come in contact with the coasts of *Iceland.*

There is every reason to believe that it really be so, when we look at the isotherms in section VI which are rising to the south-westward, and we likewise take into consideration that the salinity is increasing in the same direction. When there has been spoken about currents in this part of the *Atlantic* proper (south of the ridge), this is to be understood so, that the whole body of water is moving in a northerly and north-easterly direction with very little velocity. It is not until the current is confined to less width that the velocity is increased, such as it is the case with the *Irminger Current* and *the Gulf Stream* in the *Northern Sea.*

The assumption that the *Irminger Current* draws water with it on its northern and western side from the Polar Current, furthermore accounts for the remarkable distribution of the salinity in section VI. Even on the basis of the observations in this section alone, the isohaline 35.25 could certainly have been drawn otherwise, but if we compare this section with section VIII, the form that has been chosen will most likely be the right one. As the *Atlantic*, at the depths referred to here, has a salinity that is greater than 35·25, the isohaline 35·25 may be regarded as the boundary of the Atlantic water, here accordingly of the *Irminger Current.* We see thus that the *Irminger Current* sends two strata of water into the «basin-water», the one stratum over the other, or, if we like to explain it this way, the «basin-water» sends strata of water into *the Irminger Current.* The «basin-water» must therefore be defined here as water of less salinity than 35·25, the origin of which may be supposed to be the effect of the Polar-water on the Atlantic-water.

SECTION VII.

Abreast of Reykjanæs ridge

It can be seen distinctly in this section how the salinity is decreasing from the south-eastward to the north-westward. Those tongues or layers which the *Irminger Current* sends into the basin-water, and the existence of which was shown by section VI, can be traced again here in section VII. The fact is that maxima of salinity appear in the stations 79 and 80. These maxima cannot be identified on the drawing as they do not attain the value 35·25, but that they exist, must still more lead us to believe in the correctness of the aforesaid assumption.

The bottom-curve shows the ridge distinctly, and we see that the isotherms in the depth partly follow the shape of the bottom-curve, that is to say, that they have a bend upwards just above the ridge. This may be accounted for by the fact of the water in the depth flowing towards the ridge, so that, on coming into contact with this latter, it has the effect of causing a motion in an upward direction, which forces the isotherms upwards.

The whole system of currents at the ridge is, however, so complicated, that it would be next to impossible to give a proper and simple explanation of all the peculiarities that have been found by means of the investigations, as the number of these has been too limited to do such a thing. Thus we must leave unanswered why there is such a high temperature (4°5), and so large a salinity (35·33) at the bottom in section 78, or why the salinity close to the bottom in section 79 is so small (34·97);

that the last of these statements is not due to observational errors can best be seen thereby, that the corresponding minima apply to station 78 as well as to station 80.

In stations 83, 82, 81 and 75 which are lying in a row perpendicular on the ridge, we have the following temperatures and salinities at the bottom.

Number of station	Temperature	Salt ‰
83	3°5	34·94
82	4°1	35·00
81	6°0	35·13
75	4°3	35·13

The bottom water accordingly is also here warmer and salter south than north of the ridge.

Still it is not likely to be supposed that this ridge, nor the Faröe & Iceland ridge, should form such a complete boundary between the Atlantic-water and the basin-water that it could not be passed. That water at any rate is coming over the ridge from the southward, and even in considerable quantities, appears from the fact of the temperature at the bottom, just north of the ridge, being considerably higher than to the northward and westward in the basin.

SECTION VIII.

Northerly and southerly direction in Denmark-Strait.

In the middle part of this section, the main body of the water has less salinity than 35·25. It is thus here (in station 9 and 89) that the basin water comes nearest to the coast of Iceland, or the *Irminger Current* has in its northernmost part at this place the smallest breadth. Furthermore it is worth notice to see how the basin-water at a depth of 200 fathoms (377 metres) is making its way like a wedge into the Atlantic-water.

SECTION IX.

West of section VIII in a northerly and southerly direction in the Denmark Strait.

While a great part of the water in section VIII, if looked upon in its entirety, had a salinity that exceeded 35·25, this can only be said to be the case with a very small part of the water in section IX, and the places where so high a salinity is found, are either lying in the most northerly or southerly part, which likevise applies to Section VIII.

The salinity in the lowermost stratum is low, less than 35·00. The expedition has almost nowhere found so low a salinity in the Atlantic south of the ridge extending from the southwest point of *Iceland,* or south of Iceland and the Iceland-Faröe ridge, and this circumstance seems to imply that the basin-water in *the Denmark Strait* is specially characterised by a reciprocity of action between the water of the two currents: *the Irminger Current* and *the East Greenland Polarcurrent.*

It appears from the two sections VIII and IX, that in the same manner as a submarine ridge extends from *Reykjanæs,* another submarine ridge extends in a westerly direction from the peninsula on which *the Snefjeldsjökel* is lying, so that the highest points of the ridge are found between station 9 and 89 and close to station 90. Section IX shows that the temperature at the bottom is considerably lower north than south of the last-named ridge, while the same circumstance does not apply to the salinity.

In station 96 situated north of the ridge, the temperature at the bottom 735 fathoms (1384 metres) is 1°2, at a depth of 600 fathoms (1130 metres) 4°4. This great difference of temperature is the consequence of the *Irminger Current* not coming in contact with the bottom, after it has passed the ridge. As the cold bottom-water at station 96, proportionally is in possession of a rather high salinity (35·11), it becomes very heavy. It may be supposed that there is a recess at the bottom of the sea at this place, in which once cold heavy water has accumulated, and in which it remains whithout being frequently renewed.

SECTION X.

From station 8 (off Faxe bay) towards Angmagsalik.

The isohaline 35·25 goes from the surface down to the bottom. Leaving apart the coast-water, which is lying within the said isohaline, the water of the greatest salinity is found in the eastern part of the *Denmark Strait,* the cause of which is, that the rotation of the earth has the effect of forcing *the Irminger Current* over in the direction of *Iceland.*

When on the basis of the observed temperatures and salinities, we try to draw any conclusions in the following concerning the motion of the water, we shall consider the isohaline 35·25 as the boundary of the *Irminger Current.* It is a matter of course that we cannot with certainty regard an isohaline as the boundary of a current, and by no means such a special and arbitrarily chosen one as the 35·25 isohaline. If for all that the choice has fallen on this one, then it is only due to the accidental position of the sections; if these had been lying more northerly or southerly, it might perhaps have been to greater advantage to choose another isohaline, and by which very likely the same result had been attained. When thus an isohaline (or isotherm) is used as a line of demarcation for a current, this only means that the real line of demarcation is tolerably parallel with the respective isohaline (or isotherm), so that this line does not indicate the breadth of the current. We cannot say for inst., on the basis of the measurings in section X, that the breadth of the *Irminger Current* is equal to the distance between Iceland and station 9.

In the middle part of section X, the salinity from the surface to the bottom is less than 35·25. West of this and separated from Greenland by the well known *East Greenland Polarcurrent*, water is to be found whose salinity exceeds 35·25. Only two measurings, namely from station 12 at the surface, and at a depth of 200 fathoms (377 metres) give this result, and we might perhaps be disposed not to believe in this unexpected state of matters, if not other measurings from the same part of the sea exactly had led to the same result. Thus the salinity at station 12 at a depth af 300 fathoms (565 metres) is 35·20, and at 500 fathoms (942 metres) 35·19; at station 13 at a depth of 100 fathoms (188 metres) 35·23, and at the bottom 35·24.

The isohaline 35·25 cannot be drawn with exactness in the western part of the section, on account of the observations being too few. But that it is to be there, may be taken for granted; so that whether it is to be drawn as in the section, right down to the bottom, or in another way, is rather indifferent. The same applies, but in a far greater measure, to the 35·00 isohaline. The principal thing is, however, that upon the whole these isohalines exist, for the position of them proves that the water of the least salinity appears in the middle of the section.

It is only in a small degree that the isotherms follow the isohalines. The measurings at station 11—12 showed, however, that station 12, at a depth of 200 fathoms (377) and 300 fathoms (565 metre), has a higher temperature than station 11; from this the inference may be drawn that the temperature as well as the salinity is growing in a westerly direction.

It has to be mentioned here that all the stations in section X are from measurings in 1895, while the measurings from both years, 1895 and 1896, will be found in the next section.

SECTION XI.

From the Snefjeldsjökel to the westward towards Angmagsalik.

This section shows in the main points the same state of matters as section X. The isohaline 35·25 goes from surface to bottom round station 89. As this station is situated more westerly than station 9, and as, according to what is stated above, we use 35·25 isohalines as the boundary of the *Irminger Current*, then it will be seen that this current gets a greater breadth, or, to use another terme: that the *Irminger Current* is increasing in breadth to the northward; 35·25 isohalines are again to be found in the western part of this section; here it is, however, drawn on the basis of the same station as in section X, namely station 13. The salinity at station 92 attains nowhere 35·25, but at some depths it is so high that there is every reason to believe in the existence of such a curve; thus it is at a depth of 50 fathoms (94) and 200 fathoms (377 metres) 35·21. Exactly as in section X, the lowest degree of salinity, from the surface to the bottom, is found in the middle of section XI; still it is to be observed that the part of the section whose salinity is less than 35·00, is seen to be considerably smaller in extent than in section X.

SECTION XII.

From station 98 (off the north-western part of Iceland) to station 92.

The isohaline 35·25 stretches still more westerly than in section XI, even past station 95. There is no reason to believe that *the Irminger Current* should have grown to such a breadth, and I have therefore tried to account for the aforesaid state of matters by quite a different view.

The greater part of the water in section XII shows, as already mentioned, a high degree of salinity up to station 92 and it has a corresponding high temperature. This warm and salt water is no doubt in connection with the warm and salt water in which stations 12, 13 and 93 are lying. (From the table will be seen that station 93 has a salinity of more than 35·25 from a depth of 50 fathoms (94) up to 400 fathoms (753 metres), and a corresponding high temperature. We may therefore take it for granted that water from the Atlantic is running along the *East Greenland-Polar Current* across the *Denmark-Strait* in section XII. What is left now, is only to decide in what direction this motion of the water is taking place.

The Atlantic water must, when it comes into contact with the Polar-water, be cooled successively, and obtain a smaller degree of salinity. Owing to this, it must be taken for granted that the current is setting in the same direction as that, in which temperature and salinity are decreasing.

The determinations are, however, too few to have horizontal isohalines drawn that could be relied upon, and thus have the limits of the currents determined. We cannot therefore say for certain whether a station is situated near the limit of the current, or at a distance from it, nor can it be decided, whether a low temperature or salinity observed at a station, is due to a certain direction af the current, or to the position of the station in so far as regards the lateral boundaries of the current.

There are, however, conclusive reasons, by which it can be established as a fact that the current with Atlantic water is a branch proceeding from the *Irminger Current* in a westerly direction, so that section XII is situated in this branch; first it follows the *East Greenland Polar Current* in a westerly, and then in a southerly direction.

As these reasons we shall point out: 1) A current on the eastern side of the land runs generally on the northern hemisphere in a southerly direction. 2) It can hardly be supposed that a small current would be able to run in a northerly direction beside such a rapidly running southerly current as the *East Greenland Polar Current.* And as the most important reason 3) the presence of the basin-water, that is to say, the cold and less salt water in sections X and XI in the middle of the *Denmark Strait.*

A condition which cannot be left aside, if the basin-water is to keep its characteristical properties, its small degree of salinity, and its low temperature, is that there should be a constant addition of water in possession of the said properties, which addition only can be supplied by the Polar Current or water influenced by this latter. If now the Atlantic Current in the western part of the *Denmark Strait* was a current setting North, running along the Polar Current first in a northerly, and then in an easterly direction to join the northern part of the *Irminger Current* afterwards, then it would, during the whole of its course, have a high temperature. For if this be the case during its course in an easterly direction, which is proved by the determinations, then it must also be the case when it is setting in a northerly direction; it cannot of course have been subject to heating, as it is constantly surrounded by water of a lower temperature: Polar-water on one side, and basin-water, on the other. Under such circumstances, the basin-water would be completely excluded from the addition of colder water, and it would successively be obliged to adopt the same qualities as the Atlantic-water, by which it is surrounded on all sides. If, on the contrary, we make the assumption that the aforesaid Atlantic Current is moving in a southerly direction, then it will, as during the whole of its course it has been subject to the influence of the Polar Current, gradually get a lower temperature and a smaller degree of salinity. The basin-water can then be renewed through this current,

We must therefore consider it as an established fact that the current — as a westerly branch of the *Irminger Current* — first goes in a westerly, and then in a southerly direction along the Polar Current. It will then be seen that the whole system partly is forming a kind of rotation, which, as a well known fact, is the form generally adopted by currents in the sea.

According to what has been said in the foregoing, we have thus here in *the Denmark Strait* a reciprocity of action between two currents, the Atlantic draught coming from the southward, and the *East Greenland Polar Current* coming from north-east. As the part of the Atlantic Current that is running to the northward along the westcoast of *Iceland* — which current is called the *Irminger Current* — at the Iceland-Greenland ridge meets the Polar-water, the rapidity of the motion of this latter is so great that it is able to alter the direction of the *Irminger Current,* as well as to carry with it part of the water of this current. The eastern part of the *Irminger Current* is by the rotation of the earth forced to make its way along the *northern coast of Iceland,* while the western part of the same current, which is setting with less rapidity than the Polar Current, turns to the westward.

As the Polar Current, west of the north-western coast of *Iceland* makes a part of the *Irminger Current* run along with it in a westerly direction, it is forced to the westward itself, and off *Angmagsalik* it has but a very small breadth, which of course makes it run with greater rapidity. This place is also one of the most accessible parts of the eastern coast of *Greenland*, which already was pointed out by Cpt. *Wandel* in 1883 (see: Meddelelser om Gronland, 6. Hefte pag. 30).

It is not till close to the east coast of *Greenland* that the Polar Current is able to make the western branch of the *Irminger Current* adopt a southerly direction, and we may therefore be justified in making the assumption that the two currents are running together along the eastcoast of *Greenland*, so that the Atlantic-water from the *Irminger Current* is to be found below and east of the ice-water. I have already pointed out before that the salt and warm water from the *Irminger Current* appears east of the Polar-water. That it also is to be found below, can be seen from the bottom temperatures at the stations 14 and 94, which respectively are 4°4 and 4°1, for temperatures of this height have not been observed north of the Iceland and Greenland ridge in those regions from which the Polar Current proceeds. This warm under-layer is thus due to the western branch of the *Irminger Current;* it may be supposed that it follows part of the Polar Current in its further course round the southern point of *Greenland*, and thus is led away from the basin of the *Denmark Strait.*

Southeast of the southern point of *Greenland,* the Polar-water and the water from the *Irminger Current* which is found on the eastern side of the Polar-current — and on which no doubt the effects of this current can be traced — meet with the Atlantic-draught from the southward. Part of the fresh cold water makes therefore a turn, and runs North again along the western side of the *Irminger Current*, so that it participates in the rotation in the basin of the *Denmark Strait.*

With this theory as a basis, the nature of the water at all the places of observation in the *Denmark Strait* can easily be accounted for. As the Atlantic-water which is lying below the Polar Current, leaves the basin of the *Denmark Strait*, a new supply of water must be added to the basin, and this, which easily can be seen, is made through the western part of the *Irminger Current.* Owing to this, there is reason to believe that only a small part of the water from the Polar Current remains in the basin, which current has the effect of reducing the salinity and temperature of the Atlantic-water, and as the said current constantly has warm Atlantic-water directly under and east of itself, it can easily be accounted for that so large masses of ice are melted in these tracts of the sea.

According to what has been represented here, those powers, or the two powers to which the rotation in the *Denmark Strait* is due, originate from the kinetic energy in the *East Greenland Polar Current* and the *Irminger Current.* Those bodies of water in the basin of the *Denmark Strait* which are most distant from the acting powers, will thus, as a matter of course, be those least acted upon, so that the velocity of the bodies of water must decrease considerably from the outward towards the axis of rotation. According to this, a very slow motion will take place in the middle part of the *Denmark Strait.* and we find therefore here in the depth rather large differences of temperature in equally large depths, and very little similarity between isotherms and isohalines, as these curves are not subject to alteration in an equal degree, in consequence of the vicinity of the Polar Current.

Owing to the above explanation, and according to what has been stated here, we might have spared all the determinations made in 1895. The fact of section X fitting so completely into the system, in spite of this section only containing determinations from 1895, implies that the state of matters described here also existed in 1895, and we are therefore led to believe that it is always existing in the *Denmark Strait.*

SECTION XIII.

Along the northwest and northcoast of Iceland.

The stations 98, 99 and 129 in this section, in connection with the stations 15 and 16, constitute the only row of stations which the expedition has athwart of the Iceland-Greenland ridge. While the stations 89 and 99 still throughout hold a salinity of more than 35·25, station 129 shows a far smaller degree of salinity. The two first stations appertain to the *Irminger Current.* If station 129 is lying in the same current, the nature of the current must have been subject to a great alteration in the tract of the sea from station 99 to station 129. It might be supposed for inst. that station 129 was situated in the coast-water, and that in consequence of this it had such a small degree of salinity. If, however, we compare the two stations 129 and 88, with respect to their position in proportion to the main land, we come to the conclusion, that if station 88 is lying outside the coast-water, which is testified by the measurings, the same must be the case with station 129. Nor can it be supposed that the *Irminger Current* should have so small a breadth northwest of *Iceland,* that it is running between the land and the said station.

There is then only one conclusion to come to, and this is, that the salinity of the *Irminger-current* during its course along the northwest coast of *Iceland* must be subject to a rapid decrease through the influence of the Polar-water. That such a rapid alteration should be possible, can only be accounted for by the fact of the current not being very strong at this place, and that it only moves with very little velocity. The branch of the *Irminger Current* running to the westward, is upon the whole much more extensive than the one setting to the eastward. Circumstances were so at the beginning of August 1896. It is likely to be supposed that the extent of the *Irminger Current* itself, as well as that of its two branches, change periodically in the course of the year, in consequence of the strength with which the Polar Current is manifesting itself.

The stations 16 and 15 were taken in 1895, and a little farther from the land than the stations 98 and 99. From the table will be seen that while the two stations, 16 and 15, show ice-water at the surface, the salinities at the bottom are very different, respectively 35·31 and 34·99. From this will be seen, that at the beginning of June, at which period the stations 16 and 15 have been taken, the eastern branch of the *Irminger Current* was still smaller than in August 1896, the time of observation for the stations 89 and 99. Even if this branch of the *Irminger Current* being of little extent, the determinations prove distinctly that it exists, and show to what extent the Atlantic-water is led over the Iceland-Greenland ridge from the southward.

That the *East Greenland Polar Current* is bringing water from the northward over the ridge is a well known fact, and as this current is a surface current, such a thing must take place in or near the surface. Several determinations imply, however, that water in the depth, even if it be in the vicinity of *Iceland*, also can pass over the ridge from the northward. This can be seen by the temperatures at the bottom at the stations 96 and 95, which are respectively 1°2 and 2°1. Such low temperatures cannot be supposed to be due to such a thing as Atlantic-water — cooled in the western part of the *Denmark Strait* — being led to these stations by the rotation, for in that case we should be able to find at least as low temperatures more southerly in the *Denmark Strait,* which is not the case. That the temperature at the bottom rises so quickly to the southward, must therefore be regarded as sufficient to prove that the cold bottom-water, found in a small quantity south of the Iceland-Greenland ridge, has made its way over the ridge from the northward.

The salinity at station 128 is at several depths less than 35·00. Only at the bottom, and at a depth of 50 fathoms (94 metres), a salt stratum of water is making its way from the westward into the less salt layer of water. At station 127 (it is not in section XIII) which is a little more southerly than station 128, the salinity at the bottom at a depth of 44 fathoms (83 metres) is seen to be 35·07. By this it becomes an established fact, that even if the branch of the *Irminger Current,* which runs in an easterly direction, being of very little breadth and strength, it cannot be denied that it exists, for how should we otherwise be able to account for the salinity that is increasing towards the land.

That the salt water west of the stations 127—128 sends a layer of water in an easterly direction into the more fresh water at a depth of 40—50 fathoms (75—94 metres), must no doubt be a regular consequence of the differences of specific gravity. It is, as we know, warm and salt Atlantic-water, and cold Polar-water of less salinity that meet one another here, and on account of this, the boundary surface between these two species of water will not be able to maintain its position as a vertical plane, for the specific gravity of the Atlantic-water exceeds that of the ice-water which forms the upper layer of the Polar-water, and it is less heavy than the cold and rather salt stratum, which is the lowermost layer of the Polar Current. Owing to this, the Atlantic-water will make its way in between the two strata of the Polar-water, while one of these two is floating above, and the other below the Atlantic-water. As the difference of specific gravity is greater for Atlantic-water and ice-water than it is for the Atlantic-water and the under-layer of the Polar-water, the cold and fresh ice-water will flow farther over the Atlantic-water, than the under-layer of the Polar-water will flow in under the Atlantic-water. The isohaline 35·00 in section XIII just implies that this is the case in so far as this section is concerned.

This way of reasoning may be applied everywhere where two kinds of water — with a different vertical distribution of the specific gravity — meet, still it is to be observed that this only can be the case, when the whole body of water is subject to motion, all these little regulating currents left apart. If there was a constant current, either at the surface or in the depth, the state of things would be otherwise, the isohalines would have to adopt other forms. As now the isohaline 35·00 has the expected form here, we must come to the conclusion that all the parts of the water move as a body, so that there is no special current, neither at the surface nor in the depth, lengthways of section XIII. On the other hand, there is nothing in the foregoing to prove that there should not be currents perpendicular on the direction of the section. It can easily be seen, however, that such a regular current towards and from the land, neither will be able to arise or to be maintained.

According to this, the eastern branch of the *Irminger Current* must be a bottom-going current, that is to say, a current in which the water has almost the same motion from surface to bottom. It is not long in losing its characteristic feature, as the Polar-water, which it is drawing with it, gathers round about it. It is in the nature of things that an Atlantic Current which is getting into Polar-water, sooner looses its characteristical marks, than a Polar-current would do when it is falling in with Atlantic-water; the *East Greenland Polar Current* serves as a good example of this. The fact is that the Polar-water will flow on top of the warmer and salter Atlantic-water, and on account of the different specific gravity of these two strata, they will but slowly and not without difficulty be mixed together. An Atlantic current will, on the contrary, when falling in with Polar-water, be surrounded by this on all sides, and easily get mixed with the not much heavier under-layer of the Polar-water.

The stations 123 and 122, situated far to the eastward in section XIII, show still lower salinities than station 128, which serves as a new proof of how rapidly the eastern-going branch of the *Irminger Current* is weakened. From the temperatures at station 123, the maximum-temperature of which is 3°5 below the surface, we might be tempted to conclude that the said current for all that still shows an appreciable influence so far to the eastward, for so high a maximum temperature has nowhere been found in Polar-water. The salinity is, however, remarkably small, at a depth of 100 fathoms (188 M.) only 34·04, that is to say, less than at a corresponding depth farther East and North. The high temperatures cannot therefore be directly attributed to the influence of the *Irminger Current*, but it is more likely to be supposed that they are due to vertical currents.

SECTION XIV.

From station 123 and northward.

In this section, station 123 is again remarkable by its high temperatures in connection with a small degree of salinity. Water in possession of these qualities, appears otherwise only as the uppermost stratum in the ice-water, and it is produced when the fresh surface-layer is heated by the sun in the summer time. It is therefore likely to be supposed that such surface-water is flowing in the direction of station 123, and that it is sinking down at this station. As, however, the afflux neither can take place from the westward or the eastward, as the surface-water on both of these sides has a higher salinity and specific gravity than the water at station 123, it must come from south or north. It might be supposed, however, that it came from the southward, that is to say from the land. The small degree of salinity and specific gravity would in that case have to be attributed to the influence of water from the rivers. Station 123 is lying, however, at a distance of about 24 miles from the land, so there is but little probability of the correctness of such an assumption. Besides there are other reasons, which give countenance to the notion that the afflux is coming from the northward.

Section XIV shows that salinity and specific gravity of the surface-water is decreasing to the northward, and in consequence of this, the surface-water must try to move in a southerly direction. As furthermore the Polar Current between *Greenland* and *Jan Mayen* is running in a southerly direction, spreading itself into two branches, one of which runs along the east-coast of *Greenland*, and the other along the eastcoast of *Iceland*, it is a matter of course, that the water which is lying between the two branches, will be obliged to move in the same direction, that is to say, towards the north-coast of *Iceland*. If thus we take it for granted that section XIV is lying in or near the boundary between the two Polar-currents, then we can account for the state of matters existing.

The east-going branch of the *Irminger Current,* the extent of which is so small, looses nearly entirely its influence as far to the eastward as this section is laid down, and there are no currents here that would be able to stop the aforesaid south-going motion of the surface water of the Polar Current. It will then continue to run in this direction till it is close to the coast of *Iceland*, where its course is converted into a motion towards the bottom and the sides. Even if a regular current does not appear in all of the three said directions, the powers to the effects of which the bodies of water are exposed, will still be of such a nature that they will produce currents like the aforesaid, in the case of no other powers acting on the water than those due to the kinetic energy in the surface water coming from the north. When on the coast of *Iceland,* this water has altered its direction of motion, the west-going part of it will meet the *Irminger Current* and partly stop and make this current deviate from its original direction, while, on its own part, it will be weakened and effaced. Another part of it will make its way towards the bottom, and so far, that the power by which it is driven downwards will be like the hydrostratic resistance that arises when water of little specific gravity gets down to large depths. The third part, which according to the theory should continue its way in an easterly direction, will very likely also do this, and join the *East Icelandic Polar Current.* With this assumption as a basis, the existence of the fresh and relatively warm water in station 123 can easily be accounted for.

At station 126, the salinity is decreasing to 34·36 at the bottom, at a depth of 293 fathoms (552 M.); this bottom-water must of necessity have come from the surface. The form of the isotherms 1° and 0°8 in section XIV is accounted for in the same manner as the form of the isohaline 35·00 in section XIII. The surface water in station 123 and 126 is driven downwards on account of the vicinity of the coast, and made heavier by the still existing but not very appreciable influence of the *Irminger Current,* that finally is working itself in among the two layers of which the Polar-water generally consists. At station 124 is an extensive stratum of water with a salinity above 35·00. This stratum is considerably smaller at station 125. This is very likely only the effect of the *Irminger Current.* As the ice-water — which the Polar Current conveys in a southerly direction at the surface — passes over water which the *Irminger Current* has moved to the northward of *Iceland,* this last-mentioned water is driven away from the coast. Finally the cold layer of ice-water which is characteristic to the Polar-water, can be seen in the northern part of section XIV.

SECTION XV.

From station 122 in a north-easterly direction.

This section is throughout one of the most typical sections of the Polar-water. The salinity is very small at the surface. The 35·00 isohaline is met with at a depth of 100 fathoms (188 metres), somewhat deeper in the western than in the eastern part of the section. At a depth of about 300 fathoms (565 metres) the salinity attains its greatest value, and decreases from this depth towards the bottom, so that it becomes less than 35·00 at very large depths. As this falling off towards the depth is taking place exceedingly slowly, it will be impossible to indicate the lowermost 35·00 isohaline with exactness.

In the upper stratum of water (the ice-water) is found a smaller stratum with a temperature lower than 0°. The 0° isotherm is a closed curve on the figure, which shows that the ice-water loses its characteristical properties towards both ends of the section. To make it disappear entirely, would be required that the salinity should exceed 35·00; and this is, as it can be seen, far from being the case.

At the stations 122 and 121, which are lying nearest the coast, the maximum temperatures are higher than at the stations lying more easterly, a similar distribution being the case at station 123 in section XIV. It may therefore be supposed that the ice-water — after it has altered its direction of motion near the northern coast of *Iceland* — without meeting any obstruction is flowing the to the eastward, and afterwards to the southward along the coast of *Iceland*. This discloses itself in section XV by the bent 1° and 2° isotherms in connection with the deep lying 35·00 isohaline in the western part of the section. In the line *c*, formed by intersection between the sections XV and XVIII, the temperatures and the salinities are fixed by the points of intersection between the line *c* and respectively isotherms and isohalines in section XVIII.

The isotherms in the under-layer, by which is understood here the whole body of water lying below the uppermost 35·00 isohaline, have a tolerably parallel course. They bend a little towards *c*; thus it can also be traced in the under-layer that *c* is lying nearer the warmer and salter water which is found in the eastern part of the basin of the *Northern Sea*. Furthermore it can be seen, that in the under-layer, the western part of the section has a higher degree of salinity than the eastern one. It may be supposed that this is due to the *Irminger Current*, which, as we know, disclosed itself by an almost closed 35·00 isohaline. Thus the effects of the *Irminger Current*, though they be weak, can still be traced as far to the eastward as in section XV.

SECTION XVI.

From Cape Langanæs in an easterly direction.

This section is, upon the whole, similar to section XV. The uppermost 35·00 isohaline is here lying a little deeper than in the former section, and thus the layer of ice-water has a greater thickness. The uppermost 0° isotherm is again here a closed curve, from which appears that the ends of the section approach the limits of the ice-water. Station 101 has in comparison with the more easterly lying stations in the section a high maximum temperature combined with a very small degree of salinity. In station 103 where the ice-water layer is thickest, the lowermost isotherms 0°0 and 0°5 go highest; we have thus here the lowest temperature.

SECTION XVII.

From station 109 in an easterly direction.

The isohaline 35·00 is drawn in reference to very unreliable data, so that we cannot draw any conclusions from its form, but only from its existence and position, which shows that we have again here ice-water with an under-layer in the same manner as before. The uppermost 0° isotherm is a curve open to the eastward, so that the section is too short to enable us to come to a conclusion concerning the extension of ice-water to the eastward. It is evident, however, from other reasons that station 105 cannot be far from the eastern limit of the ice-water. The lower 0° isotherm is namely at the highest in station 106, and from there it is sinking rapidly to the eastward. The increasing thickness to the eastward of the stratum of water whose temperature is above 0°, is most likely due to the presence of the warm water of the eastern part of the *Northern Sea*. In the western part of section XVII, a stratum is found in the deep with a very small degree of salinity and a proportionally high temperature, and similar to the layer in the former section.

The sections XIV, XV, XVI and XVII have in so far as regards position one feature that is common to all of them, and this is, that they all extend in a north-easterly and easterly direction from the eastcoast of *Iceland*, and that they are all lying completely in Polar-water. This can be seen by the fact of the uppermost stratum of water, the upper layer, having a smaller salinity in the sections than 35·00, and for the greater part a very low temperature.

From the curves, plates XII—XVI, will be seen that the temperature at the surface, as a rule, is 4—6°. It is decreasing slowly until it reaches a depth of 10—20 fathoms (19—38 metres), from which depth it goes down rapidly, most frequently below 0°, to the freezing-point of the sea-water, and reaches its minimum value at a depth varying between 20 and 50 fathoms (38 and 94 metres). From this depth the temperature rises, sometimes rapidly and sometimes slowly, till it attains its maximum value, which is not equally great, and can be found at different depths, most frequently between 50 and 100 fathoms (94 and 188 metres). The stratum of water in which the temperature is increasing, may be regarded as a layer of transition between the upper and the under-layer.

Owing to the fact of the observations being rather incomplete, it is attended with more difficulty to lay down general rules concerning the variation of the salinity in the upper-layer. The common feature, however, seems to be that the salinity is smallest, though much varying, at the surface. It changes but little at the upper 10—20 fathoms (19—38 metres), and grows very rapidly till a depth of about 30 fathoms (57 metres), where it attains its maximum value between 34·50 and 34·90. From this maximum, the salinity goes down to a minimum, and rises again to a maximum value, which is the largest value of the salinity at all station-determinations, most frequently larger than 35·00. The stratum of water, in which the degree of salinity changes from its minimum point in the deep to its maximum-point, is the layer of transition. Still it is to be observed that the maximum-point often is somewhat below this layer, consequently in the under-layer.

Matters are very simple in the under-layer, as the temperature is decreasing towards the bottom, first rapidly, and afterwards, specially in large depths, very slowly. Even at the largest depths, it is seldom getting below — 1°, a temperature which is higher than that af the coldest ice-water. The salinity in the under-layer varies but slightly. It will often be difficult, even impossible, to indicate the position of the aforesaid maximum-point. It seems to be a rule that the salinity is slightly decreasing towards the bottom.

The typical distribution of the strata of water, each with its special properties, which has been pointed out above, is found for all the stations in sections XIV, XV, XVI and XVII, including the special circumstances that manifest themselves at the coasts, and it is specially characteristic for the Polar-water, by which is to be understood here, not only the water (the upper-layer) at the surface of which freezing of water or melting of ice has taken place or takes place, but also the under-layer. The stratum of water which here is called the upper-layer, has therefore often in the foregoing been called the ice-water.

The Polar-water east and north of *Iceland,* forms a Polar Current (see *C. Ryder* and *K. Rørdam*: Hydrografiske Undersogelser udførte paa den østgrønlandske Expedition 1891—92. «Meddelelser om Grønland» XVII, page 205). The larger Polar Current, the breadth of which reaches from the east-coast of *Greenland* to the other side of *Jan Mayen*, divides itself as already mentioned into two smaller branches, one of which forming the *East Greenland Polar Current*, while the other one runs south along the east-coast of *Iceland,* and therefore with full justice may be called the *East Icelandic Polar Current.*

This *East Icelandic Polar Current* must flow athwart of the sections XV, XVI and XVII. It has already been pointed out before, when speaking about the different sections separately, that they reach about as far as to the eastern limit of the found ice-water, which just is constituting the said current. Thus it will be seen that it has a very large extent, expanding itself more than 160 miles east of *Iceland*, and carrying with it such large masses of ice-water, that this latter has exercised its influence up to depths of more than 100 fathoms (188 metres). The velocity of the current cannot be directly found by the measurings, but these show at any rate that the velocity of the current is great enough to impart to these seas all the properties peculiar to a Polar Current. By means of current-bottles that have been thrown overboard, we have got an idea of the movement of the surface-water, but still we dare not from this draw any conclusion concerning the velocity of the whole of the ice-water layer. According to the drift of the ice, we may be led to believe that the velocity of the *East Icelandic Polar Current* cannot by far be so large as that of the *East Greenland Polar Current.*

Like all other Polar Currents, this one has a very cold and fresh upper-layer, which evidently has such a low temperature and slight salinity, because a great deal of ice has been melted in it. The ice-water produced by this, will try to cool and make the under-layer less salt, and thus be the cause of the formation of the transitional layer. During the summer time the ice-water is heated, but the rays of the sun do not get far down in the water, before they are, as it were, completely absorbed, so that it is only a very thin surface-layer which is heated directly by the rays of the sun. This heating has, moreover, the effect of reducing the specific gravity of the ice-water, which involves great difficulties with respect to a process of mixture between the surface-water and the water below this latter. At any rate, a mixture must take place, as water from 0 to 10 fathoms (0—19 M.) only alters its temperature and salinity slightly, and as we can take it for granted that the rays of heat do not make their way so far down, before they, get almost completely absorbed.

The motion of the waves caused by a moderate breeze, will hardly produce any mixture. It is therefore likely to be supposed that the mixture takes place when it is blowing a gale of wind. If this assumption be correct, we must expect to find a high temperature at the surface when it has been fine weather for some time, while, on the other hand, a gale of wind must have the effect of reducing the temperature at the surface considerably, as, in that case, the warmest surface layer, perhaps not 1 fathom (2 M.) thick, will be mixed with colder water from a depth of 10 fathoms (19 M.). The process of mixture must be most energetic near the surface, and it will therefore have the effect of making the temperature near the surface vary slowly. It will appear afterwards, that these possibilities agree with the reality. If, on the contrary, the heat should be transmitted downwards by conduction only, the variation of temperature near the source of heat — this is synonymous with the surface — would grow rapidly, and afterwards decrease towards the depth.

It will be seen from the curves of temperature that there is a turning-point on the first down-going part of the curves. The depth at which this turning-point appears, we must therefore regard as the limit, above which the heat, upon the whole, is transmitted downwards by processes of mixture in the water, while below this limit it is principally transmitted downwards by conduction. We have thus by the position of the turning-point, a kind of mark that shows at how great a depth the beating of the waves can have a disturbing effect on the stratification of the bodies of water.

The assumption that the sections XV, XVI and XVII are situated in a Polar Current, running southerly along the east-coast of *Iceland,* is fully accounted for by all the peculiarities found in these sections. The Polar Current carries with it in a southerly direction the warm but not very salt water which is found on the eastern side of the north coast of *Iceland,* and the presence of this water makes itself known thereby, that in all three sections, it forces the isohaline 34·00 down close to the coast, and, that in the depth and close to the land, there is found 1° nay even 2° isotherms, which are not to be found again at a great distance from the main land.

This warm water is pressing itself in among the regular under and upper-layer, and as it is warmer than these two layers, and, moreover, enclosed by them, it will be cooled successively, and the more so, the longer it has been in contact with the cold stratum of water. Owing to this, it must be supposed that its temperature is decreasing to the southward, which just proves to be the case. The maximum-temperature caused by this water in the deep close inshore, is sinking from station 123 [3°5 at a depth of 50 fathoms (94 M.)] through the stations 121 [2°0 at a depth of 75 fathoms (141 M.)] and 101 [2°0 at a depth of 100 fathoms (188 M.)] to station 108 [1°1 af the bottom, depth 97 fathoms (183 M)].

It will likewise be seen from these ciphers that the depth of the maximum temperature is growing. Owing to the rotation of the earth, the south-going ice-water will be driven in against the east coast of *Iceland,* that is to say, in over the aforesaid water with the slightly appreciable salinity and relatively high temperature, and the consequence will then be that the more we advance in a southerly direction, the more the maximum temperature will be pressed towards the bottom. This water cannot in consequence of its little degree of salinity be reckoned as belonging to the underlayer, no more so than on account of its high temperature, it can be considered as a part of the upper-layer.

The water of the *Irminger Current* must on the contrary be considered as a component of the underlayer. It has been mentioned on page 117 that this current can be traced in section XIV and XV. Even in section XVI, its influence can be traced on the salinities in the under-layer; we see thus that there are salinities at stations 101 and 102 as high as 35·04—35·07, while the highest salinity at station 103 is 35·03. No observations of this kind tending to prove a difference of the salinity in the under-layer between the western and middle parts of the section, are to be found in section XVII. Owing to this, we may take it for granted that the before mentioned high degree of salinity of the under-layer in the western parts of section XV and XVI cannot be due to a northerly current in the under layer along the east-coast of Scotland, nor can itbe attributed to currents from the salt water in the *North Ocean* making their way into the under-layer, as we should not, if such a thing was the case, be able to account for the low degree of salinity at stations 118 and 103. Hence there is the possibility of supposing that the high degree of salinity of the under-layer in the western part of the aforesaid section may be ascribed to the branch of the *Irminger Current* that is flowing in an easterly direction north of *Iceland.* It has been mentioned before how this branch is driven away from the coast at the eastern coast of *Iceland.* Furthermore we have seen how it is spreading in the underlayer in a southerly and easterly direction north-east of *Iceland,* gradually losing its character entirely.

Considering the *East Greenland Polar Current* as a surface-current flowing on top of the warmer and salter water of the *Irminger Current,* which it is dragging with it to the southward — but very likely with a velocity inferior to its own — thus we may now likewise consider the *East-Icelandic-Polar Current* in the same light. The warm under layer of this latter is in its western part due to the effects of the eastern branch of the *Irminger Current,* at any rate it gets its character from this current, while, on the contrary, the warm under-layer of the eastern part is due to the effects of the *Gulf Stream.*

SECTION XVIII.

From Jan Mayen in a southerly direction.

This section goes through the most easterly stations of the expedition. According to this we should here have a longitudinal section through the eastern part of the Polar Current and its continuation in the *East Icelandic Polar Current.* The section is not, however, remarkable by any characteristical features in so far as the current is concerned. The fact is that many of the stations are lying in the near vicinity of its eastern line of demarcation. It is only at the stations 104 and 105 that we meet with negative temperatures in the ice-water. We see also how the 1° isotherms are penetrating underneath the cold ice-water, the usual phenomenon, that the salt and warm water on account of the distribution of the specific gravity is flowing in between the upper and under-layer of the Polar Current.

We have seen that the *Irminger Current* is sending its water quite into the Polar Current, and that the character of the western under-layer of this latter is due to this circumstance. The fact of the salinities and temperatures in the western part of the under-layer being subject to a decrease when advancing in a southerly direction, proves that this layer follows the motion of the East Icelandic Current, at least in so far as the direction is concerned. The existence of the under-layer cannot be considered as originating from the south, that is to say, from Atlantic water flowing in a northerly direction, as on the assumption of the existence of the cold upper-layer, the temperatures and salinities of an under-layer moving in this direction would be gradually increasing to the southward. Even the fact that, upon the whole, there is such a decline in salinity and temperature, proves at the same time that the under-layer has been subject to the influence of the ice-water for a considerable time, so that the velocity of its motion must be very small. Reference is made to all stations in section XVII, station 103 in section XVI.

That it really must be the cold and fresh ice-water, which is the cause of a decline in the temperature and salinity of the under-layer or its upper part — even to a considerable depth — can be seen from section XVIII. Where the coldest upper-layer is to be found, the 0° and — 0°5 isotherms attain their greatest height, while at station 112, where the ice-water is less prominent, these isotherms sink to their lowest position. From station 105, where the ice-water assumes a very prominent character, the isotherms sink gradually towards station 138 which is near the Faröe-Iceland ridge, and thus in the vicinity of Atlantic-water. We cannot consider it as absolutely granted that the isotherms between the two last stations really run as laid down in the chart, but the position of the terminal points is given together with the observations, and this is what it depends upon in this case. It is still more difficult to decide anything with certainty regarding the course of the isohalines, or, upon the whole, to give a description of the transitional amalgamation between the *East Icelandic Polar Current* and the Atlantic-water, as we are wanting a sufficient number of determinations to this purpose.

The reason why the under-layer of the Polar Current is moving in a southerly direction together with the Polar Current itself, is probably due to the internal friction in the water. The motion of the Polar-water proper, or I should prefer to say, of the surface-layer, is due to the effects of the wind and the unequal distribution of the pressure; this motion is then on account of the friction imparted to the layers underneath, provided that these latter are not acted upon by special powers that are sufficiently strong to give them a direction that is independent of the aforesaid circumstances. The coefficient of friction is as we know, in so far as water is concerned, a very small quantity, so that the moving power with which the upper-layer, during its travel in a southerly direction, is acting on the strata of water that are in a deeper position, must be exceedingly small. Not even the surface waters in the *Kattegat*, which are flowing in a northerly direction with considerable velocity on account of the afflux from the *Baltic*, are able to carry the salt under-layer away with them, and gradually take its place. Owing to this, we are led to believe that the extent of the under-layer of the Polar Current north and east of *Iceland*, on which the influence of the ice-water may be traced, is not determined by the extent of the ice-water at a certain moment, but more likely by the average-value of the extent of this latter during the different seasons of the year; perhaps through several years.

At station 112, the maximum temperature of the under-layer is high; at the same place the minimum temperature of the ice-water is not very prominent. These circumstances seem to imply that station 112 must be in the vicinity of the eastern boundary line of the ice-water, and nearer than any other station. In addition to the low temperature, we meet with the little degree of salinity that is characteristic of the ice-water, and which manifests itself so openly at the surface, that even if we only take the circumstances at the surface into consideration, we may come to the conclusion that the Polar Current in the vicinity of station 112 has its greatest extent in an easterly direction.

Hence it can be seen that the extent of the surface and the under-layer of the Polar Current is not the same. The deeper the strata of water are lying, the less they will be effected by the motion of the upper-layer. If we get down to a greater depth than 600—700 fathoms (1130—1318 metres), the temperatures as well as the salinities will nearly be the same everywhere in the horizontal stratum concerned. It appears from the measurings and investigations of the Norwegian-North-Ocean-Expedition that this, as it were, applies to the whole of the basin of the *North Ocean*.

SECTION XIX.

From Jan Mayen in a southerly direction (west of section XVIII).

If we compare this section with the forcgoing one, it cannot escape our attention that the two sections in their principal features have the same character. That section XIX is situated nearer the axis of the Polar-current, manifests itself by the fact of a cold layer of water near the surface, everywhere with a temperature that is below 0°, is stretching itself through the whole of the section. The 35·00 isohaline approaches the surface a little more in section XVIII than in section XIX.

At station 118 the ice-water has the least thickness, and on an average the highest temperature; at the same station we find the highest maximum temperature for the under-layer. These circumstances prove that station 118 is the one of all the stations in section XIX that is nearest to the eastern boundary of the Polar Current. This is in good conformity with the fact of this station being the one of all the stations of the section that is in the nearest vicinity of station 112, at which the ice-water almost had disappeared.

The shape of the 0° isotherms in the under-layer is about the same in both sections. In section XVIII it comes to its lowest position a little north of station 112, while its lowest point in section XIX is a little more southerly, that is to say a little north of station 111. This circumstance seems also to be indicative of the proximity of the boundary of the Polar Current, and, according to what has been explained in the foregoing, not that of the ice-water at a given moment, but the average-position of this line of demarcation during a length of time.

SECTION XX.

From station 119 in a southerly direction to station 48 of the Norwegian-North-Ocean-Expedition.

It is obvious that the layer of ice-water does not go so far as to the Norwegian station 48, when judging by the determinations of temperature that have been made at this station. This may probably be accounted for in this manner, that the extent of the layer in a southerly direction has not been so great at the time when the determinations were made at the Norwegian station, as it was at the time when the *Ingolf-Expedition* made its observations. The 0° isotherm in the under-layer is rising in a southerly direction, just as in the southern part of the two foregoing sections.

SECTION XXI.

In a southerly direction from station 120.

Looking at the chart, it can be seen that the ice-water is stretching as far as south of station 59, where it has a considerable thickness and very low temperatures. The values of salinity and temperature in the two series *f* and *g* are determined by interpolation in the two sections XVI and XVII. It appears that the ice-water in these two lines is a thinner layer, in which there are not to be found so low temperatures as at the stations 59 and 110; at station 120 the layer is contracted again. That the layer is varying in thickness at different places, can again be accounted for here by the fact of *f* and *g* being near the western boundary of the Polar Current proper, as, between the Polar Current and the coast of *Iceland*, we meet with the not very salt but fairly warm water mentioned on page 117. This water is, as has been said above, by the Polar Current led to the southward, and it is different from the upper-layer of this current by its high temperature and a little higher salinity.

The 0° isotherm in the under-layer has in this section its lowest point much more southerly than in sections XVIII and XIX, namely between *f* and *g*. The depth for this lowest point of the isotherm is nearly in all cases about 300 fathoms (565 M.). From its minimum point, the isotherm is rising in a southerly direction, until it attains its maximum point in the proximity of station 59. From this station it inclines downwards again towards the Faröe-Iceland ridge.

Atlantic-water and Polar-water meet between the stations 59 and 4, and I am led to believe that the two species of water become merged into one another. The observations in this section are, however, too few to give us a true picture of the boundary-plane, in consequence of which the isotherms from the warm Atlantic-water, which are reaching to the northward of station 4, have been drawn rather arbitrarily.

The sections XVIII, XIX, XX and XXI have it in common with one another that they are lying in the longitudinal direction of the *East Icelandic Polar Current.* The 0° isotherms in the under-layer have all a minimum point in each of the sections, that is to say, a point at which the isotherm removes to the greatest distance from the surface, in order to rise again in a southerly direction. This state of matters may be accounted for by the fact of the minimum-point lying at the boundaries of the current.

Another assumption may, however, be made to account for this. It will be seen by a look at the chart, that the 0° isotherm is going upwards just where the bottom-curve is rising, and in consequence of this, it is not unlikely to suppose that there is a co-incidence between these two circumstances. Taking for granted that the under-layer of the Polar Current is moving in a southerly direction, there may be a possibility of an upward going motion taking place in the water, when it is forced to slide upwards on the sloping bottom. This would of course have the effect of producing a rising to the southward of the 0° isotherm, but the consequence of such a motion would be, however, that the ice-water also was lifted upwards, and on account of this made to flow out at the sides, by which it only would come to consist of a thinner layer. It can be seen from section XXI, station 59, that this it not the case. The ice-water has just at this station, such as shown by the 35·00 isohaline, its greatest thickness. It cannot therefore be the motion of the water in the under-layer, or regular vertical currents that give the 0° isotherm its characteristical shape; it is, on the contrary, determined by the position of the section in the current, and there is no reason to suppose that there should be any regular vertical currents here.

All the stations of the expedition that are lying north and east of *Iceland* are, as it appears from the foregoing, situated in the Polar Current, and we have pointed out above what is the influence of this latter on the water that is lying underneath it, the under-layer. As this latter, throughout, has the same salinity, it must, in order to be in equilibrium, have higher and higher temperatures from the bottom towards it uppermost boundary plane. As the ice-water that is lying on top of the under-layer is cooling this latter from above, a maximum of temperature will be brought about, and the higher the temperature of the uppermost part of the under-layer has been, and the less the cooling influence of the ice-water has manifested itself, the higher the aforesaid maximum of temperature will be.

We have therefore in the greatness of the maximum temperature a measure for the influence of the combination of these two powers. The longer the ice-water has been in contact with the under-layer, the deeper the cooling influence of the ice-water may be traced, and the deeper the maximum temperature will come to lie. In concequence of this, the depth at which the maximum temperature is to be found, will be a measure for the time during which the under-layer has been acted upon, or, if we like to call it so, a measure for the rapidity with which the under-layer is renewed.

This measure, however, is not very correct. In case of the ice-water expanding sidewards, the maximum point will at the same time rise towards the surface. It would be far better to use the distance between the position of the minimum point and that of the maximum point as a measure. To obtain only a tolerably exact determination of the position of these two points, requires, however, a far greater number of observations at a station, than it has been possible to get, and it can be seen from the temperatures, plates XII—XIX, that where the position of the maximum point has been approximatively correctly determined, it is as a rule impossible to determine the place of the minimum point and vice versa.

In the chart, table XXX, above the maximum temperature and its depth, is therefore besides the maximum temperature, which is marked in blue ciphers, likewise — in black ciphers to the right, and below the number of the station — noted the distance from the surface to the place of the maximum temperatures, expressed in Danish fathoms. According to this, the signification of the blue and that of the black curves can easily be understood. These curves show that the maximum temperature attains its smallest value in a belt that is stretching along the east-coast of *Iceland* in a southerly direction in longitude 9° W. of G. about 120 miles east of *Iceland*. According to this, the influence of the *East Icelandic Polar Current* is greatest in this belt, what by the intensity of its action, and the time during which the under-layer has been exposed to its cooling influence.

The stations 128 and 123, at which the state of matters is different, have been mentioned on page 115. It might perhaps have been expected that the depth of the maximum temperature should be extremely small near the confines of the current, but it can be seen that this is not the case in any notable degree, see for inst. stations 104, 112 and 113. It is therefore likely to be supposed that at these stations the under-layer has been in contact with the ice-water for a very long time.

SECTION XXII.

From station 1 (near the Faröe islands) in a north-westerly direction.

The many isotherms as well as isohalines that are going from the surface to the bottom, show that the south-eastern part of this section is situated in Atlantic-water, while the north-western part has got its character from the Polar-water.

The whole section is lying on the Faröe-Iceland ridge, at which we must look for the boundary between Atlantic-water and Polar-water. The determinations that have been made do not show us any trace of the existence of the Ice-water near the surface, which, however, cannot be taken as a proof, as the number of the observations was very limited. On the other hand we do not only see the under-layer but also the manner in which it passes into the Atlantic-water. Looking at the form of the isotherms and the isohalines, it cannot escape our attention that Atlantic-water from the western part of the section is spreading over the under-layer, while this latter, from the eastern part of the section, is making its way in underneath the Atlantic-water, a distribution which is a consequence of the circumstances relating to the specific gravity.

SECTION XXIII.

Abreast of the Faröe-Iceland ridge.

This section shows the transition between Atlantic-water and Polar-water. It will be seen that the isotherms are rising considerably from south towards north, and that the 35·25 isohaline goes from the surface down to the bottom close to the top of the ridge. That the transition from one species of water to the other must take place very abruptly, appears from the fact of the isotherms lying close to one another.

The Faröe-Iceland ridge is thus the boundary between Atlantic-water and Polar-water, and not only between the strata of water which are actually debarred from one another by the ridge itself, but also in so far as regards the strata that are lying in a higher position. When it is said here that the ridge forms a boundary between the two different species of water, this is to be understood so, that there is water — on each side of this ridge — which is in possession of specially characteristic qualities, and that water is not flowing across the ridge in so large quantities that it is able to efface the boundary between the two species of water, or remove it in any appreciable degree, or make its form subject to any alteration of importance.

It has been said on page 105 that water is flowing across the ridge from north to south. The same appears from this section, as the isotherms for the lowest temperatures in the Atlantic are stretching along the bottom and down the south western side of the ridge. The body of the cold, and in consequence of this heavy Polar-water, which is making its way in underneath the water of the *Atlantic*, is, however, so small, that it is only in the proximity of the ridge that the presence of it can be proved with certainty; farther west it can be traced, as, in consequence of the influence of the *Atlantic*, its distinctive features have nearly been effaced; that is to say: its low temperature and little degree of salinity.

It appears from the salinity at the surface in section XXIII, that ice-water is found at the stations 135, 137 and 139. At station 136, the salinity is specially high, and at station 138 medium, from which can be seen that the confines for the extent of the ice-water must have a very irregular form. It appears likewise from this, that the ice-water is stretching a great distance to the southward towards the *Faröe Islands*.

SECTION XXIV.

From station 1 in a west north-westerly direction.

Station 1 is in common with the two sections XXII and XXIV, which are situated in such a manner that they form a little angle with one anoher, section XXIV south of section XXII. They are both lying along the Faröe-Iceland ridge, but while the western part of section XXII is stretching into the Polar-water, the same does not apply to section XXIV.

On the other hand, the isotherms that are crowded together at the bottom, as well as the nethermost 35·25 isohaline, prove that nearly the whole of the layer at the bottom in this section is consisting of North Ocean Water. On top of this is a layer with a salinity that is higher than 35·25, a layer constituting the greater part of the water in section XXIV, and which must be due to Atlantic-water. Finally we find at stations 133 and 135 a stratum of ice-water, which certainly does not offer any marked features, but this is perhaps on account of observations being wanting from stations 135. It can be seen then from what has been said, how in this section Atlantic-water is forcing itself in among the upper and under-layer of the Polar-water; the same applies to section XIII, where the 35·25 isohaline in the shape of an arc makes its way in between the same two strata of water.

The three last sections XXII, XXIII and XXIV cross the boundary between the water of the Atlantic and water from the *East Icelandic Polar Current*. This boundary must be a surface of a very complicated shape. Isotherms and Isohalines are in each section drawn independently of the two others, which, though it cannot be considered as quite correct, has been done to facilitate the view. We find in section XXIV, which is lying south of section XXII, a layer of ice-water at the surface, the existence of which could scarcely be accounted for, if it was not likewise to be found in XXII. This latter does not, however, show us anything by which the origin of the ice-water can be traced, and I have therefore entirely omitted to put down ice-water in section XXII. With respect to this must be observed that section XXII is constructed according to observations made, partly in 1895 and partly in 1896. This is at least, in so far as the upper-layer is concerned, not justifiable, as we must take it for granted that the extent of the ice-water alters during the different seasons and from one year to the other. Nor could such a proceeding be considered as right in so far as regards the deeper situated layers, as Atlantic-water is here getting mixed with Polar-water; furthermore we cannot consider it as an established fact that the currents in the depth should be the same at different times.

Although, on account of the few observations, the sections do not give us minute information about the actual state of matters above this ridge, we may for all that through section XXI be able to form an idea of the further course of the western part of the *East Icelandic Polar Current*. In this section the isohaline 35·00 is seen to incline downwards at station 59, nearly down to the 0° isotherm, which at the same place has a considerable inclination upwards .This shows that the under-layer does not begin here before at a great depth, and that it has a lower temperature here than farther north. Owing to this, this under-layer cannot be due to Atlantic-water flowing in a northerly direction, for if such a thing being the case, the temperature of the under-layer would be decreasing instead of increasing to the northward. We must therefore constantly maintain what has been pointed out many times before, that the under-layer originates from or gets its character from the easterly running branch of the *Irminger Current*. The state of matters in section XXI furnish a new proof of the correctness of this assumption.

The deep curve of the 35·00 isohaline at station 59, can, as shown below, be accounted for by the fact of the upper-layer or ice-water in the *East Icelandic Polar Current* flowing with a greater velocity at this place than the under-layer. If we make the assumption that currents in the sea, upon the whole, are due to powers acting on the surface, such a ratio as the above mentioned, between the velocity of the under-layer and that of the upper-layer, must inevitably arise in consequence of the exceedingly small internal friction in the water, of which has been spoken on page 125.

As the southerly flowing surface-layer of the Polar Current meets the Atlantic-water that is moving in an easterly or north-easterly direction, the motion of the surface-layer is stopped in its original direction, and it will try to move towards the bottom and towards the south-east and east. Of these two motions, the one towards the bottom will cease, when the power that is resulting from the kinetic energy in the upper-layer, has become equal to the hydrostatic counteracting power that arises when water of little specific gravity is brought down to large depths. The result will be, however, that a thick layer of ice-water will accumulate at the top on account of the upper-layer coming in contact with the Atlantic-water.

That the state of matters must be such as represented here, where two currents are meeting one another, or where a current is flowing towards the main land, is a conclusion we have come to by reasoning. We can easily prove the correctness of this assumption by a new experiment, which is performed in the following manner.

The bottom of a large glass vessel is covered with a liquid which is heavier than water, for inst. with a coloured solution of salt or — still better — bisulphide of carbon. The vessel is filled with water, and a stream of water is led into it through a glass-tube, the lower end of which, at a place a little above the under-layer (the liquid on the bottom of the vessel), is bent to give the stream a horizontal direction.

At the place where the stream meets the side of the glass, a depression will appear in the under-layer, and large enough to be seen, even if the water be flowing very slowly. If we make two similar currents in the vessel, and make them run against one another, a similar depression will arise in the under-layer at the place, where the said currents meet, and this will be the case whether the two currents are flowing straight against one another or their directions are forming an angle less than 180°. In the last case, it will be seen that the two currents unite into one single current, and that in the under-layer — close behind the depression that has been formed in this latter, and in the direction in which the aforesaid united current is flowing — a little elevation will arise, the greatest height of which above the original boundary plane between the liquids, will be smaller than the greatest depth of the depression under the same plane. If the two currents are flowing straight against one another, the depression will adopt the shape of a spherical segment; and in case of the courses of the currents forming an angle with one another, less than 180°, the form of the depression will be elongated, and with its greatest length in that direction in which the united currents are flowing.

As now in section XXI, at station 59, we have found a corresponding depression in the under-layer of the Polar Current, or rather in the 35·00 isohaline, this must of course be indicative of our having two currents here meeting one another; in consequence of which the ice-water in section XXI cannot be stagnant, but water which is moving in a southerly direction, that is to say a current. The isohaline 35·00 in the sections XVIII and XIX is likewise sinking to the southward, and judging by this, the ice-water should also in these sections move in a southerly direction. In short, according to the aforesaid experiment, we must be led to believe that the whole layer of ice-water, east of *Iceland*, is flowing to the southward with a velocity that is greater than that of the under-layer. In the meantime it is not proved by this that the ice-water is moving in a southerly direction, as the depression in the under-layer, or the sinking of the isohaline may be due to other circumstances than those, on the basis of which the above-named trial is made.

If it really be so, that the whole body of ice-water, east of *Iceland*, is moving in a southerly direction until it falls in with the Atlantic Current, then it must be considered as a fact that it constitutes the western part of the rotation in the *North Ocean* of which Professor *Mohn* has written in his work: «Nordhavets Dybder, Temperatur og Strømninger», Christiania 1887, and the ice-water must therefore first be turned off in an easterly direction by the Atlantic Current to be carried to the northward by the *Gulf Stream* afterwards. Provided that this assumption be correct, we must expect to find Polar-water in a closer proximity to the coast of *Norway* than we hitherto have supposed to find it.

But it may also be supposed that the system of currents in these seas is quite a different one. We know as a fact that the part of the Polar Current that is nearest to the coast of *Iceland*, really moves in a southerly direction. This has already been pointed out by Cpt. *Wandel* in his work: «Bemærkninger til Beseilingen af Islands Kyster» 1879, page 12. It may then be that this part of the Polar Current when it encounters the Atlantic Current is turned off, first in an easterly, and afterwards in a northerly direction, by which it is made to form the easternmost part of the ice-water east of *Iceland*. In this case, we have a rotation again. But the centre of rotation is now removed into the ice-water itself, so that this latter virtually is limited to the extent in which it was found by the *Ingolf-expedition*.

Whether the whole of the body of ice-water observed by the *Ingolf-expedition*, is moving to the southward, or whether it is forming a rotation of its own, I cannot judge of with certainty on the basis of the determinations of temperature and salinity at hand. Another circumstance is speaking in favour of the first-named conception.

During the voyage of the *Ingolf* from *Iceland* to *Jan Mayen* in 1896, a route was followed through the stations 110, 111, 112, 113 and 114. On this voyage 20 current-bottles were thrown overboard, and of these latter 10 have been found now at the places indicated on page 20 and 21. As the bottles and their boxes, according to what is said on page 20, only were visible a little above the surface of the water. there is every reason to believe that, upon the whole, they must have followed the motion of the surface-water, as it would be next to impossible that the wind under such circumstances could have carried the bottles long distances, without their being accompanied at the same time by the water in which they were originally floating.

Bottle Nr. 8, thrown out west of station 111, was found about $2^1/_2$ months after at the *Faröe islands.* The drift of this bottle agrees with the supposition of the Polar Current going south. Bottle

Nr. 5 was thrown out east of station 110, and found 8 months after at «*Romsdalen*» on the western coast of *Norway.* Bottle Nr. 15 thrown out about midway between the stations 112 and 113, and found in *Finmark* 16 months after. If now it must be supposed that the surface water can move away from the *East Icelandic Polar Current*, and get close to the coast of *Norway*, it is, according to my opinion, very likely that a great part of the layer of the ice-water is following it, and specially the part of it that by heating has attained so high a temperature that it is able to flow on top of the salter surface-layer of the *Northern-Sea.* It is difficult, on the basis of the circumstances before us, to say for certain whether the above-named connection between the western and the eastern part of the *Northern-Sea* is taking place at all times of the year, but it is not very likely, for it is a well known fact that the *Atlantic* is sending a current, the *Gulf Stream*, along the western coast of *Norway,* and according to this, it must be supposed that under general circumstances the Polar-water from the *East Icelandic Polar Current* will keep to the westward of the *Gulf Stream,* until it is driven in over the warm current by strong westerly winds.

That the surface-layer can move a long distance, independent of the ice-water to which it originally belongs, has been mentioned before. This state of matters will furthermore be able to account for the fact of the bottles Nr. 17 and Nr. 20, which were thrown out far to the northward, having landed in *Iceland.* For taking it for granted — which for the rest is a well known fact — that the supply from the northward to the *East Icelandic Polar Current* is weakened in the summer time, and that the ice-water at this time of the year by preference is flowing in a south-westerly direction towards the *East Greenland Polar Current*, we shall be able to understand why the two bottles in question have been cast up on the shores of *Iceland.*

According to what has been said on page 118, a current with comparatively warm water of little salinity is flowing between the regular *East Icelandic Polar Current* and the east-coast of *Iceland*. At the south-eastern corner of *Iceland,* this current must trend off in a south-easterly direction together with the Polar Current. It can namely be seen from section II that the warm and salt Atlantic-water is stretching close in to *Horne-Fjord* without any layer that is in possession of the aforesaid qualities between itself and the coast. According to this, the main body of the southerly fresh-water-current does not continue its course along the southern coast of *Iceland,* but is forced into a south-easterly direction by the Atlantic-water.

The duty of this current will therefore to all appearances be to form a kind of transitional link between the Atlantic-water and the regular ice-water, a stratum of water with pretty high temperatures, but with a salinity that is but a little higher than the salinity of the ice-water. Such water must have a very small specific gravity, and in consequence of this, it will try to expand at the surface, where it will be moving to and fro according to the prevailing direction of the wind, but still in such a manner that it gets a resulting motion, first in an easterly and afterwards in a northerly direction. The fact is that a motion of this kind will be brought about by the resultant of the directions of the wind in these quarters and, moreover, the *Gulf Stream* will contribute to give the water in question a northerly direction, when it has reached this current.

SECTION XXV.

From Iceland in a curve round the southern point of Greenland.

This section deviates from the other sections by reason of its horizontal extent being drawn on a scale which is $^1/_2$ of the scale of the chart on plate III, while that of the other sections is $^3/_2$ of that scale, and furthermore thereby that it is not approximatively lying in a plane — which is the case with the other sections — but in a curved surface south of *Cape Farewell.*

The eastern part of the section is also to be found in section VI, and it has already been described there. In section XXV we meet with the curved 35·25 isohalines again, which show how the water is ranging itself in layers at the boundary between the basin of the *Atlantic* and that of the *Denmark Strait.* The 35·00 isohaline is stretching from the surface to the bottom in the shape of an S, and west of this isohaline, the salinity is nearly everywhere lower than 35·00.

It will be seen from the bottom-curve that the section goes across a submarine ridge, situated between the stations 20 and 21, and probably a continuation of *Cape Farewell*, in a southerly direction. It will be noticed that the temperature at the bottom is lower west than east of the ridge, and the same applies to all the salinities. There are, however, a few exceptions to this rule. Station 20 for inst. on the eastern side of the ridge, has a low temperature, while station 22 on the western side of the ridge has a high salinity. Here we meet with a phenomenon, which is exactly the same as the one that applies to the state of matters round all the submarine ridges which have been subject to investigation by the expedition, and this is, that even if such a ridge is forming a boundary between water of different qualities, it will never for all that form an insurmountable barrier; water will always pass across the ridge in both directions.

When speaking about the sections X, XI and XII, we called the water in the middle part of the *Denmark Strait* that had a smaller salinity than 35·25 basin-water. We must therefore, judging by the salinity in section XXV, come to the conclusion that this section, from station 18 to station 21, is lying in the basin-water. The basin of the *Denmark Strait* has, as we know, a natural boundary to the westward in *Greenland* and the ridge that probably is proceeding from *Cape Farewell* in a southerly direction. We shall find that the observations represented in section XXV, agree very well with the theory I have put forth on page 114 concerning the currents in the *Denmark Strait.*

Is has been pointed out how the basin-water arose: The western branch of the *Irminger Current* is by the *East Greenland Polar Current* turned to the southward, and during its course along this latter it is getting cooled, while at the same time its salinity is decreased, so that the part of it, which by the Atlantic-water is forced to run east, afterwards north, and made to take part in the rotation in the *Denmark Strait*, exactly has the same qualities as the basin-water.

As the water, while it is moving in an easterly and northerly direction at the side of the *Irminger Current* constantly is under the influence of the Atlantic-water, we must be led to believe that its temperature and salinity is growing from west to east. Looking at section XXV, it will be seen that this conclusion is exactly in conformity with the actual state of matters, in so far as the said tract of the sea is concerned.

At the stations 20, 21 og 22 the influence of the *East Greenland Polar Current* is manifesting itself by the fact of minima of temperature and salinity being found near the surface at these stations. Also at the stations 38, 37 and 36 ice-water is found at the surface, which is proved by the low salinities. The two stations 36 and 37 are lying at a greater distance from the coast of *Greenland* than the rest of the stations, which accounts for the higher degree of temperature and salinity.

The under-layer in the *Davis Strait* is to all appearances water from the western part of the *Atlantic*, and that this water has got so low temperatures is most likely due to the influence of the *Labrador Current*. As the bottom temperatures in the *Davis Strait* are lower than those in the basin of the *Denmark Strait*, it is not very likely that the under-layer in the *Davis Strait* receives any supply of importance from the basin-water.

We know, however, that the *East Greenland Polar Current* flows round *Cape Farewell*, and runs north into the *Davis Strait*, and we may no doubt make the assumption that the part of the *Irminger Current* which is forming the under-layer of the *Polar Current*, is carried along by the *East Greenland Polar Current*. This water is therefore to all appearances cooled to such a degree that it is able to contribute to the formation of the under-layer in the *Davis Strait*.

As to hydrography, in so far as the *Davis Strait* is concerned, the observations and determinations of the *Ingolf expedition* are too few, and confined to so small a part of the Strait, that they do not add anything new to what is already known in this respect. All the observations and determinations are fully in harmony with the view of the currents, which Cpt. *C. F. Wandel* has advanced in «Meddelelser om Grønland» VII, 1891, and they must therefore rather be regarded as a supplement to the observations and determinations made by the cruiser *Fylla* in 1884, 1886 and 1889 than otherwise.

Only one point of importance appears from the observations of the *Ingolf expedition* in the *Davis Strait*, and this is, that temperature and salinity in the depth is not subject to alteration in any appreciable degree from one year to the other. This fact, to which Cpt. *Wandel* already has directed the attention (l. c. page 58) is further elucidated by examples in the table of determinations on the other side.

It must be admitted that the places where the investigations and researches were made, do not fully coincide, but the difference that has been found between the observations for the depth in 1889 and 1895 is not greater than that it may be considered as due to shifting of place and observational errors. Owing to this, we may then take it for granted that temperature and salinity in the depth cannot have altered much during the years that have elapsed between the observations. If this be the case in a strait like the *Davis Strait*, where three different deep-sea-currents are flowing side by side in a proportionally small tract of the sea, in so far as breadth regards, how much the more likely will it not be to suppose that this in a still higher degree applies to the deeper layers of the open sea.

Depth		*Fylla*		*Ingolf*	
		Temperature	Salt °/₀₀	Temperature	Salt °/₀₀
Fathoms	Metres	Series 76: Lat. N. 65° 36′ Long. W. 56° 24′		Station 28: Lat. N. 65° 14′ Long. W. 55° 42′	
0	0	0°5	32·00	1°2	32·91
10	19	1°8	33·26	0°2	33·04
20	38			0°4	33·47
30	57	— 0°2	33·82	— 1°1	33·42
50	94	— 0°8	33·97	1°2	34·00
100	188	2°8	34·59	3°3	34·58
200	377	4°2	35·05	4°3	34·43
300	565	3°9	35·06		
349	657	3°8			
420	791			3°5	34·71
		Series 79: Lat. N. 66° 49′ Long. W. 56° 28′		Station 32: Lat. N. 66° 35′ Long. W. 56° 38′	
0	0	0°0	31·76	2°6	33·04
10	19	1°8	33·48		
20	38	1°0		— 0°6	33·28
30	57	0°7		— 0°4	33·43
50	94	— 1°1	34·06	— 0°9	33·56
100	188	— 0°9		— 0°5	34·10
150	282	3°8	34·88	3°3	34·67
200	377	4°0	35·08		
235	442	4°4			
318	599			3°9	34·68

The ice-water of the Polar Current owes, as we know, its characteristical features to water frozen to ice and to ice converted into water. It is a well known fact that the sea-ice often is driven in a southerly direction along the east-coast of *Iceland,* and by this circumstance proves in what direction the Polar Current is flowing in these regions of the sea. According to the annual publication from the Meteorological Institute, «Meteorologisk Aarbog for 1896, 3 volume», it can be seen in the charts, representing the conditions of the ice in the seas east of *Greenland* and in the *Davis Strait,* that in May 1896, the ice in the latitude of *Cape Langanæs* has driven as far to the eastward as 7° longitude west of Greenwich, that is to say almost to the very place, where, according to the observations made by the *Ingolf expedition,* we may expect to find the boundary between Polar-water and North-Ocean-water. Part of the ice is melted in this tract of the sea, but the rest of it has driven away and left the ice-water behind, in which a great deal of the observations of the *Ingolf expedition* have been made.

The salinity curves for the stations in the ice-water have, in so far as this layer of water is concerned, been drawn over entirely insufficient data, as it can be seen from the determinations that the isohalines of the ice-water have a very complicated form. Still it seems to be a rule that there is a layer near the surface of the cold ice-water — most frequently at a depth of 20—30 fathoms (38—57 metres) — with a pretty high degree of salinity, but its origin cannot be due to Atlantic water, as it has not a corresponding high temperature. Owing to this, it would be an absurd idea to suppose that the Atlantic-water which is cooled in northern latitudes, should penetrate into the ice-water itself, when as we know, it is making its way underneath this latter and forming the under-layer of it.

The presence of the salt and cold water in the ice-water can more easily be accounted for, if we make the assumption that the high degree of salinity is due to salt, which is eliminated when sea-water is freezing to ice. The lower surface of the ice is always very rough on account of the frequent screwings of the ice, and in the cavities of this rugged surface, water will accumulate successively as the freezing and the elimination of salt is taking place, and this water will be in possession of the qualities: a high degree of salinity and low temperatures. This water is to all appearances led along with the ice, adhering to it in the cavities of its rough lower surface, and getting its place underneath the stratum of water that is formed when the ice is melting, while underneath another layer will be found, originating from former melting of ice.

The correctness of this supposition may be corroborated by examination of the ratio between the amounts of chlorine and sulphuric acid found in the sea-water. Professor *Pettersson* writes on the basis of his analyses (»Vega-Expeditionens vetenskapliga Iakttagelser» Bd. II, Stockholm 1883, or «On the properties of water and ice by *Otto Pettersson*», page 305), that the ice is getting richer in sulphates by freezing, while the eliminated brine is getting richer in chlorine», and that this elimination is continued even after the freezing. If the above assumptions are correct we may expect to find a minimum of the ratio $\frac{SO_3}{Cl}$ in the cold salt layer of water, and it will be seen from the following table that this is the case at a depth of 20 fathoms (38 metres), in so far as two of the stations 101 and 118 are concerned.

The cold and salt stratum of water which is lying inside the ice-water, is in general heavier than the ice-water lying below it. Consequently the equilibrium is unsteady, and the salt water must try to move downwards towards the under-layer. According to this, it seems to be justifiable to come to the conclusion that when the salt water-layer is found in the ice-water, it cannot have been long time ago that the salt water must have been subject to freezing.

The observations are, as already said, too few to enable us to prove the presence of this layer of water in all cases, but it seems to be least prominent at the southernmost stations in the ice-water. This agrees very well with the fact of a long time having elapsed since the water at these stations was subject to freezing in northern latitudes. It ought to be noticed that the cold and salt stratum of water is found to be as much expanded at the eastern as at the western stations in the ice-water. This state of matters can hardly be put in connection with a rotation in the ice-water itself, so that the western part of this latter was moving in a southerly direction in order to be turned off in a northerly direction a little more to the eastward; for if this be the case, we might expect to find the salt water-layer less prominent in the most easterly stations of the ice-water. The uniform distribution of the salt layer of water in the whole of the layer of ice-water,

Number of station	Depth fathoms Danish	Depth Metres	SO_3 I	SO_3 II	SO_3 III	SO_3 mean value	Chlorine ‰	$100 \frac{SO_3}{Cl}$
101	0	0	2·133	2·132	2·135	2·133	18·39	11·60
	10	19	2·133	2·138	2·139	2·137	18·44	11·59
	20	38	2·190	2·188	2·191	2·190	18·98	11·54
	30	57	2·207	2·208	2·205	2·207	19·02	11·60
	40	75	2·142	2·144	2·138	2·141	18·48	11·58
	50	94	2·226	2·233	2·232	2·230	19·24	11·59
	100	188	2·158	2·150	2·155	2·154	18·57	11·60
	200	377	2·243	2·242	2·239	2·241	19·38	11·56
	300	565	2·255	2·252	2·252	2·253	19·38	11·62
	537	1011	2·242	2·239	2·242	2·241	19·34	11·59
118	0	0	2·176	2·167	2·176	2·173	18·68	11·63
	20	38	2·160	2·160	2·164	2·161	18·71	11·55
	30	57	2·219	2·218	2·225	2·221	19·21	11·56
	50	94	2·231	2·234	2·230	2·232	19·24	11·60
	100	188	2·247	2·244	2·249	2·247	19·35	11·61
	200	377	2·250	2·243	2·248	2·247	19·35	11·61
	300	565	2·235	2·244	2·241	2·240	19·39	11·61
	400	753	2·249	2·244		2·247	19·35	11·61
	500	942	2·244	2·240		2·242	19·36	11·58
	600	1130	2·248	2·244		2·246	19·36	11·60
	700	1318	2·244	2·244		2·244	19·35	11·59
	800	1506	2·243	2·242		2·243	19·34	11·60
	900	1695	2·241	2·247		2·244	19·34	11·60
	1060	1996	2·242	2·235		2·239	19·35	11·57

implies that this latter is moving as a body in a southerly direction and constituting the *East Icelandic Polar Current.* Still it is to be observed that what has been said here, does not claim to be a perfect proof of the correctness of this conception, as the curves of salinity are not determined with any great exactness.

If the salt Atlantic-water could freeze when it is cooled in northern latitudes, the result of this process would be that — in consequence of this formation of ice — salt water would be formed, which had a still higher degree of salinity than that of the Atlantic. The extremely saliferous water would on account of its high specific gravity sink to the bottom, and it is perhaps in this manner that the deepest lying strata of the under-layer have been formed.

According to the theory set forth by Professor *Pettersson* (l. c. or «Grunddagen af Skageracks och Kattegats Hydrografi» af *Otto Pettersson* og *Gustaf Ekman* page 121), the freezing point of water is found at that temperature, at which the water has its greatest density, provided the salinity be 23—24 ‰. As to water of a higher degree of salinity, the temperature of the maximum density is lower than that of the freezing-point. According to this, water of this kind should not be able to freeze by cooling from above, before the whole body of water had got the temperature of the freezing-point.

To try at least whether it might be possible by a quick cooling to produce a layer of ice on water of a salinity of 35 ‰, before the whole body of water had been cooled to its freezing point, I made some experiments for this purpose in the laboratory. A large glass-vessel was filled with sea-water of a salinity of 35 ‰, and above this a cup of metal containing a freezing mixture (snow and salt) was suspended, and in such a manner that the bottom of the cup was just in contact with the water in the vessel. It appeared then that ice commenced to be deposited on the bottom of the cup, when the temperature at the bottom of the vessel had come down to 0°.

There are, however, in so far as this experiment is concerned, other conditions at hand for the formation of ice than when it takes place in the sea. The bottom of the metal cup is constantly in contact with the water in the vessel. I repeated therefore the experiment several times, but with the modification that there was a little distance between the surface of the water and the bottom of the cup with the freezing mixture. These experiments did not, however, give the results I desired. The water was constantly cooled below the freezing point before the freezing commenced, and if a piece of ice was not put in the water, the formation of ice commenced as a rule at the bottom. Even if a small piece of ice was placed in the surface of the water, it was for all that cooled below the freezing point at the bottom, and the formation of ice then manifested itself thereby that long crystal needles or leaves from the piece of ice were shooting down through the water from the piece of ice at the surface. When these ice-crystals had attained a certain size, they broke off and made their way to the surface, where they were floating and became the starting points for new formations of ice.

From this will be seen that the experiment does not show anything in the line of whether formation of ice can take place in the ocean-water, as long as the whole body of water has not been cooled down to its freezing-point. Even if such formation of ice be possible, it is for all that likely to be supposed that the main body of the Polar-ice has been formed by freezing of water of very little salinity, for water of a very small degree of salinity would, as we know, keep itself on the surface when cooled to a temperature near the freezing-point.

It has been stated on page 105 that the specific gravity of the water in the Atlantic varies but very little in the same horizontal layer. The specific gravity of the basin-water in the *Denmark Strait* is greater than that of the *Atlantic*, but still the difference must be regarded as small. It is not till the transition from Atlantic-water to Polar-water takes place that differences of importance appear, not only with respect to the magnitude of the specific gravity at equally large depths, but also in so far as the distribution of the specific gravity at each single station is concerned.

We shall now compare the distribution of the specific gravity for a station in Atlantic-water with the distribution of the specific gravity for a station in the *East Icelandic Polar Current*, and for the sake of simplicity we will avail ourselves of the values for $s\left(\frac{t}{4}\right)$. The following will then manifest itself: In the Atlantic $s\left(\frac{t}{4}\right)$ is growing gradually from surface to bottom. In the Polar-water $s\left(\frac{t}{4}\right)$ is very small in the upper-layer, but larger in the under-layer than it was found to be anywhere else in the Atlantic. In the ice-water proper $s\left(\frac{t}{4}\right)$ appears at the surface — where the water in general is greatly heated — as a rule to be smaller than $s\left(\frac{t}{4}\right)$ for the surface-water of the Atlantic. Owing to this, there will be a possibility of the heated surface-layer of the ice-water being able to flow out over the Atlantic-water. If, however, the Atlantic-water has the temperature a^b 8°, $s\left(\frac{t}{4}\right)$ will be a^h 1·0275, and while the surface-layer of the ice-water in general has $s\left(\frac{t}{4}\right)$ smaller than 1·0275, the cold layer of the ice-water will often have $s\left(\frac{t}{4}\right)$ larger than this value. We see thus that the difference of specific gravity between Atlantic-water and ice-water will not with any great power try to mix the two species of water together or produce currents of the coldest ice-water.

That notwithstanding this fact currents must exist, which try to neutralize the difference between Atlantic-water and ice-water, called forth by differences of the specific gravity, can be seen by the $s\left(\frac{t}{4}\right)$ curves appertaining to the stations in section XXIII. Station 46: the $s\left(\frac{t}{4}\right)$ curve is rising a little from 0 to 100 fathoms (188 M.), and remains thereafter constant with the value 1·0276 until a depth of at least 400 fathoms (753 M.). The stations 134 and 136: the $s\left(\frac{t}{4}\right)$ curves at the two stations are nearly equal, and have in the main the same form as the $s\left(\frac{t}{4}\right)$ curve at station 46; the value of $s\left(\frac{t}{4}\right)$ in the horizontal piece of the curve is the same as that applying to the same piece at station 46, but at these stations it only remains constant until a depth of hardly 200 fathoms (377 M.). Station 137: At this station there is no tract through a certain depth where $s\left(\frac{t}{4}\right)$ remains constant; the curve has only a turning-point at the place, where $s\left(\frac{t}{4}\right)$ has the same value 1·0276 as this quantity had at the constant pieces of the curves at the stations 46, 134 and 136. We see therefore that the different forms gradually merge into one another at the line of demarcation between Atlantic-water and North-Ocean-water, and it must therefore be supposed that there are local currents at this boundary with the object of neutralizing the differences of specific gravity for equally large depths in the two species of water.

TEMPERATURE AND SALINITY AT THE BOTTOM.

It will be seen from plate XXXI of the chart representing the temperature and salinity at the bottom, that the drawn isotherms and isohalines have nearly the same course, and without any appreciable difference follow the bottom-curves. In the mean time it is entirely out of the question that there can be a complete similarity between the course of the two said curves and that of the bottom-curves; if this should be the case, isotherms and isohalines would have to be horizontal planes, which, according to the plates XX—XXIX, is far from being the case. The chart shows that the 3° and 4° isotherms are running parallel with the ridge extending from the south-western extremity of *Iceland*, and that a 3° isotherm is enclosing the deepest of the basin of the *Denmark Strait*, which likewise applies to the 35.10 isohaline.

Nearly all the isotherms are coming into close proximity of one another northwest of *Iceland*, a circumstance which appears from the observations at station 15 and 99, which are close to each other. Station 15: temperature at the bottom — 0°8, depth 330 fathoms (621 metres). Station 99: temperature at the bottom 6°1, depth 187 fathoms (352 metres). It is perhaps the great difference of depth that is the cause of the great difference of temperature between the two stations, but it must not be left out of consideration that the determinations for station 15 were made in 1895, while those for station 99 were made in the following year; for there is a possibility of the temperature at this place, even in the depth, having been subject to a considerable change during the course of a year. Or, what is more likely, it may be supposed that station 15 is lying in a recess at the bottom of the sea, in which very cold water has accumulated; what is in favour of this supposition is that so low a temperature at so small a depth, has not been found at any other place in the under-layer as at this station.

It is seen that the 0° isotherm is stretching round the northern part of *Iceland*, and then in a south-easterly direction along the Faröe-Iceland ridge, north of which it constantly remains. In about 10° longitude west of Greenwich, a tongue of water with a temperature that is less than 2°, and a salinity below 35·00, is expanding over the ridge in a southerly direction. A very broad belt that is stretching over the ridge, has a lower temperature than 3°, and a salinity below 35·10, the same state of matters as mentioned under the sections page 104. The series of stations south of Greenland does not give any good determination of the 2° isotherm, which, like the isotherms in the *Denmark Strait* only gives a rough sketch of the continued course of the curve.

TEMPERATURE AND SALINITY AT THE SURFACE.

It will be seen from the table of determinations at the surface, page 40—61, that the salinity of the sea-water, south and southwest of *Iceland*, only varies very little, and that the variations which appear, do not show any regularity in so far as regards the position of the place of observation. Temperatures taken at short intervals in the same tract of the sea, are nearly equally large, whether the observations were made at the beginning, or at the completion of the voyages. Nor do the almost inappreciable deviations, in so far as the temperature is concerned, show any regular dependence of the place of observation. Owing to this, there is every reason to believe that the variations in temperature and salinity which cannot be attributed to observational errors, must be due to causes pertaining to meteorology.

It will be seen that where we have determinations south and south-west of *Iceland* at one place during the two years 1895 and 1896, the difference of salinity has been so trifling that it can scarcely be attributed to other causes than those to which the irregular variations are due in so far as regards the position of the place of observation. At such places where the ice-water west, north and east of *Iceland* manifests its presence by the slight salinity from 32·00 to 35·00, we meet also with irregular variations in so far as the distribution of the salinity is concerned, which variations, moreover, are much greater than those we meet with in the *Atlantic*. It is not difficult to find the cause of this, as the ice at the time that it is melting, does not form a single connected sheet, but is broken into large hummocks, often floating about at a great distance from one another. Owing to this, it is very likely that the water has a very small degree of salinity at those places where such a hummock of ice just has been subject to melting.

If we consider the 35·00 isohaline as a line of demarcation between Atlantic-water and Polar-water, it will be seen that at the north-west coast of *Iceland*, this line is lying at a greater distance from the land in 1896 than in 1895, and in so far as the last year is concerned at a distance of 30 miles from the coast, while due west of *Iceland*, it has remained unaltered from one year to the other. (The chart on plate III). In 1895 the observations north-west and west of *Iceland* were made at the beginning of June, while, on the other hand, in 1896 they were made a month later at the same places. According to this, it seems to appear that the *Irminger Current*, when looked upon as a surface-current, most frequently does not flow round *Cape North* at all. According to the statements given by Cpt. *Wandel* in his work «Bemærkninger til Besejlingen af Islands Kyster», the northern coast of *Iceland* is on an average within a period of 10 years blocked up with large masses of ice during 7 of these ten years, and it is of course entirely out of the question that there can be a warm surface-current where the surface is consisting of ice.

The isohalines 33·50 and 34·00 in the region of the sea *Iceland—Jan Mayen* proceed from *Iceland*, first in an easterly and afterwards in a north-easterly direction, until in 67° 30′ L. N. they change this latter into a north-westerly one. Owing to this, the surface-layer of the Polar-current had in this latitude its greatest extent from the east to the west at the end of July 1896. It will be seen when comparing this statement with what is said on page 122, that these two statements concerning the breadth of the Polar-current do not agree at all. Formerly we have found that at this place the Polar-current had its smallest extent to the eastward. This discrepancy proves, however, only that the heated surface-layer of the ice-water can have a motion, which, to a certain degree, is independent of that of the main body of the ice-water. The surface-layer has namely a very slight specific gravity, so that in consequence of this, it will be apt to spread over large areas, which in reality it is also doing. And it is just this part of the sea-water that can be directly acted upon by the wind, in consequence of which it is led away from the actual Polar-current, the characteristically distinctive mark of which is the cold ice-water under the here mentioned heated surface-layer.

On the route south of *Greenland* in 1895, the cold fresh water did not on the voyage out stretch so far to the eastward as it did on the voyage home. The isohaline 35·00 has from the 20th of June to the 3d of August moved from 39° L. W. to 34° L. W., which very likely means that the Polar-current during the said period has moved a similar distance to the south-eastward, or that it has grown so much in breadth. West of these confines, we do not, through any of the determinations that have been made, find a higher salinity than 35·05; it has everywhere been subject to a reduction on account of the melting of ice that is taking place in the *Davis Strait* and south and east of *Greenland*. As usual in the ice-water, the salinity varies also here quite irregularly, but it appears distinctly that it is decreasing in the *Davis Strait* the more we advance to the northward. North of about 62° L. N., the salinity in this strait sinks as a rule below 34·00, but in return it is nearly everywhere above 33·50, when not, of course, the determinations have been made between hummocks of ice or close to the land.

It will be seen from the chart of the stations, plate III, that the routes followed during the voyage to and from *Godthaab*, and south of *Greenland*, nearly coincide. The determinations of salinity which have heen made at nearly the same places, at the interval of a month, vary but little. From the beginning of the voyage in June till the voyage home in August, the salinities have on an average decreased with 0·15 ‰, while the temperature of the water at the same time increased with 3°3, which last circumstance is due to the influence of the heat of summer. Considering the physical conditions south of *Greenland* in their entirety, it will appear that the ice-water has a greater extent in the month of August than in the month of June.

We shall now cast a glance on the seas east of *Iceland*. The chart XXXII with the determinations of salinity and temperature that are laid down in it, contains all the surface-observations of the *Ingolf-Expedition* for both years 1895—1896 in the region of the sea the chart is comprising, as well as a series of observations taken on the route *Iceland* and the *Faröe Islands*, and made by the cruiser *Heimdal* during the 17th and 18th of July 1896.

The southernmost part of the isohaline 33·00 is stretching as far as 66° 30′ L. N. and 10°—11° L. W. of Greenwich, a little more southerly we meet with the 33·50 isohaline, and still further south, in 65° 20′ Lat. N., the 34·00 isohaline. It will be observed that from 33·00 the salinity is only increasing slowly to the southward in the western seas, while it is increasing rapidly in the eastern ones. Following the series of observations in a south south-easterly direction from *Langenæs*, it will be noticed that the salinity is decreasing as far to the southward as 65° 20′ Lat. N., which probably must be due to the influence of the fresh-water current that, as already said, is flowing south along the east-coast of *Iceland*.

From the southernmost part of the 34·00 curve, the salinity remains for a long time constant in a southerly direction, till suddenly it comes up to the salinity of the Atlantic-water. This abrupt transition can plainly be seen from the line 17th—18th July 96 and the line 26th May 96. These transitions are accompanied by considerable variations of temperature, characterising the surface-water east of *Iceland* as ice-water that is brought hither by a Polar-current, a conception which is backed up by all the observations that have been made.

While the Atlantic-water has an almost constant temperature of between 8° and 9° during the month of May, the temperature of the ice-water is varying between 0° and 5° from one place to another. The very irregular variations that appear, may, as has been said before, be accounted for by the fact of the ice being broken into hummocks when melting. Owing to this, we may expect, when in the month of May we are coming from the *Atlantic* into the *East Icelandic Polar Current*, to meet with a pretty high change of temperature from at the least 8° (in the Atlantic) to at the highest 4° (in the Polar-current). In the course of the summer, the Atlantic-water and that of the Polar-current is heated, the latter most in consequence of its having the lowest temperature. Thus the difference of temperature between the two species of water will in the course of the summer be less and less, which likewise applies to the variations of temperature in the southernmost part of the Polar-current itself, but for all that the difference of temperature between Atlantic-water and Polar-water will never be perfectly effaced. While in the month of August the Atlantic-water has a temperature of more than 11°, that of the ice-water is always below 10°. In consequence of this, it is possible on the basis of the temperature alone, to distinguish between Atlantic-water and water from the Polar-current.

Combining the determinations of temperature of the expedition with similar determinations made the whole year round between the *Faröe Islands* and *Iceland*, it will be possible to draw approximatively a line of demarcation between the two species of water in these seas. The last named of these observations were made by Danish vessels, and entered into meteorological journals made exclusively for the use of the *Meteorological Institute*. The institute has in its annual publication, Meteorologisk Aarbog 1892» Tredie Del pag. XII and «Meteorologisk Aarbog 1895» Tredie Del pag. 5, given an account of these determinations. The mean values of the observations of temperature can be found in the tables of these yearly publications. The manager of the Meteorological Institute Mr. *Adam Paulsen* has been kind enough to place the said journals at my disposal, and I have selected those observations that are lying within 61°—68° Lat. N. and 5°—15° L. W. of G., as it appears that the aforesaid boundary line between the two species of water, always is met with inside this region of the sea, provided of course that it be possible to fix such a line of demarcation.

Of about 650 observations for 1896, those that are pertaining to one and the same month, have been laid down in the same chart, and a line has been drawn through those points, at which a quick transition from the surface temperature of the Atlantic to lower temperatures has manifested itself. This line is then regarded as the line of demarcation between Atlantic-water and ice-water. Taking the different circumstances into consideration, it is a matter of course that the observations during the winter months only have been very few, and as the observations have not, upon the whole, been carried out on a regular plan, in so far as we may desire to avail ourselves of them for the aforesaid purpose, it can often be attended with difficulty, and it is sometimes even entirely impossible to fix the boundary line between the two species of water with tolerable exactnes.

In the chart on plate XXXIII where the boundary line is drawn for each of the months April, May, June, July, August, and October, only so great a part of the line has been laid down that the parts which have been drawn with complete exactness show the direction of the motion of the boundary line together with the approximate extent of the deviation the line has been subject to. It can be seen by this chart that the boundary line in the course of a short time can alter its form considerably, specially from April to June and from June to July. In consequence of this, we cannot fix a line of demarcation that applies to a whole month, but we must have the determinations by which this line is represented, made at more frequent intervals of time than a month or months, if we want to give a true and faithful illustration of the continued change the boundary line must be subject to.

In the chart I have therefore as far as possible drawn the extreme positions of the boundary, so that the line of demarcation drawn for April, in reality is the northernmost position of this line in April. The boundary line for June has been drawn on the basis of the situation from the 2d to the 5th of June, while this line, if we had availed ourselves of observations from the 20th of June, ought to have been laid as far northerly as for the month af July. Hence the figure will give us a representation of the amplitude of the deviations the boundary line has been subject to. I take it for granted that it must afford the greatest interest to know the extreme positions, and specially the southernmost ones.

The deviations the boundary line has been subject to, cannot be called great, and in a south-westerly—north-easterly direction they will take place within a range of scarcely 100 miles, but sometimes they occur in a very short time, and the question will then arise whether we shall be able to find a variation that is characteristic for a certain time of the year or a certain month, or whether the whole system of oscillations only is due to the effects of the wind. To answer this question in a satisfactory manner, we must know the oscillations that have occurred through a longer series of years. It seems to be the case, however, that the line of demarcation between the Atlantic-water and the Polar-water is lying more northerly in the spring than in the autumn.

The fact of the boundary between the cold ice-water and the Atlantic-water not being subject to any change of importance during the course of the year, shows that the resultant of the powers that are trying to dislocate this line of demarcation, on an average only is very small, either because the water on both sides of this line is at rest, or because the momenta have equally large components in opposite directions perpendicular on the boundary line.

The arrows on the charts of the boundary lines indicate the force and direction of the wind, such as it is noted in the meteorological journals that it principally has been just before the period for which the boundary line has been drawn. Looking at these arrows, we can form an idea of the important part the wind is playing, when the question is about the removal of the boundary line. A prominent south-west wind has the effect of forcing the boundary line towards north-east, while by a north-eastwind it is forced towards south-west. The distance the boundary-line is removed, depends as a matter of course on the force of the wind, as well as on the length of time during which it has been blowing in one and the same direction. The direction of the wind during the month of August was changeable to such a degree, that according to the entries in the journals in this respect, it was quite impossible for me to decide how the arrows should be placed. But the other curves indicate the dependence between the place of the boundary and the wind with so great exactness, that we can determine at once, when looking at the shape of the August-curve, how the resultant of the winds that are prevailing in August, ought to be drawn. We have only a small piece of the October-curve, far to the south-westward, which is due to strong north-easterly gales.

If we take the average temperature for each month of the observations taken in the region of the sea between 65°—67° Lat. N. as well as those that have been taken between 65° Lat. N. and the boundary, we get:

	April	May	June	July
65°—67° Lat. N.		2°23	4°28	6°16
Boundary — 65° Lat. N. .	1°28	1°99	3°05	4°56

It is a peculiar fact that during the months May, June, and July we meet with lower temperatures in the water between the boundary and 65° Lat. N. than between 65° and 66° Lat. N. At times the temperature at the boundary goes down as far as 1°—3°. This may be due to the stormy seas round the boundary, as the heated surface-water when it is blowing a gale of wind, is mixed with water from larger depths. This proves also that the water must be moving in a southerly direction, for in the case of this motion taking place in a northerly direction, we might expect to find the highest temperatures to the southward.

Through the foregoing reflections, we thus come to the conclusion that the ice-water east of *Iceland* is forming a Polar-current. On account of its extent, and its being in the vicinity of *Europe*, this Polar-current must have a great and decisive influence on the climate of *Northern Europe*, and in consequence of its specially biological conditions be of great importance for the fauna of the seas of *Northern Europe*.

THE QUANTITY OF NITROGEN ABSORBED IN THE SURFACE-WATER.

c—a is on the chart, plate XXXIV, placed uppermost on the right side of the small circle that indicates the place of the station; *c—b* is placed on the right side of the nethermost part of the circle, while the number of the station is found on the left side of this circle; *e* means the amount of nitrogen found, expressed in c.cm. per litre of sea-water; *a* is the amount of nitrogen, which, according to *Hamberg*, the water should contain to be saturated under a pressure of 760^{mm} and at the temperature and salinity for the time being; *b* the amount of nitrogen which the water would contain, if it had been saturated at the found height of barometer, temperature of water, and salinity. *c—a* and *c—b* are thus two expressions for the supersaturation of the water with nitrogen.

Casting a glance on the ciphers marked on the chart, our attention will at once be attracted by the fact of large areas of the surface of the sea being supersaturated with nitrogen, even to a pretty high degree. It will be seen that this is specially the case with the stations that are lying in the Arctic-sea water north-east and east of *Iceland*, and it must furthermore be pointed out with respect to these stations, that in the uppermost strata of water there has been a very quick falling of temperature with the depth. Thus the supersaturation at the stations 106 and 107 is $1{\cdot}00^{ccm}$, but at the same time it will readily be perceived that while the temperature at the surface is about 6°, it is already at a depth of 20 fathoms (57 metres) coming down to 0°6 and — 1°1. This supersaturation with nitrogen proves that the warm surface-layer north and east of *Iceland* is due to a hasty heating of the surface of the sea by the atmosphere and the sun, which likewise is implied by the low degree of salinity. The inference might of course also be drawn that the existence of the warm surface-layer was due to the afflux of warm water from warmer tracts of the sea; but however likely such an assumption might be, it is entirely out of the question here, as in that case, the supersaturation could not be accounted for.

The blue cipher in the chart shows how much the temperature is higher at the surface than at a depth of 20 or 30 fathoms (38 or 57 metres). Where this cipher is high, or, what here must be considered as synonimous with it, where a quick heating has taken place, we shall also meet with an ample supersaturation. As it can be seen, the difference between the surface temperature and that at a depth of 20—30 fathoms (38—57 metres) is here put down as a measure for the heating. It must be admitted thas this mode of proceeding is not quite correct, for the exact measure can only be ascertained by observing the temperature of the same water at different times, but as I had not at my disposal a series of observations of this kind, I had no other choice than having recourse to the aforesaid measure, which under all circumstances has to be used with discretion.

As to the greater part of the stations, it appears that a low surface-temperature is attended with a great supersaturation with nitrogen, in consequence of which, it would not be unlikely to suppose that such a supersaturation was a feature characteristic to a cold stratum of water. That this assumption cannot be upheld, and that it is not the temperature itself or the nature of the water, but, on the contrary, the variation of temperature that has the dominant influence here, manifests itself sufficiently by the observations made at the stations 59 and 60. The temperatures are very low (1°7, 1°7), but the supersaturation only amounts to 0·6 and 0·6^{ccm} respectively, nor has the heating, according to the chart, been specially great at these stations. (For station 59 it is 2°8. At station 60 20 fathoms (38 metres), a temperature of 2°1 is put down, which, however, may be due to observational errors). It is not unlikely that this is indicative of a melting of ice having taken place recently, and this agrees very well with the fact of the observations at the stations having been taken in the month of May, and that the water had such a low temperature. That the above-mentioned assumption cannot hold good, appears even more distinctly, if we cast a glance at the observations at station 94, where the surface-temperature is 2°5, the heating 0°0, and the supersaturation abt. 0·00^{ccm}. Finally we shall come to the same conclusion, if we look at the observations at station 133, which has a high surface-temperature, namely 10°8, the heating 2°2, and the supersaturation abt. 0·60^{ccm}.

I shall direct the attention to another circumstance, which may be the cause of supersaturation. Supposing for inst. that 1 litre of sea-water with a temperature of —2°, and a salinity of 30°/₀₀, was mixed with another litre of sea-water that had a temperature of 12° and a salinity of 35 °/₀₀, and that both species of water, before the process of mixture took place, were saturated with nitrogen, the result of this operation would be that the mixture approximatively would get a temperature of 5° and a salinity of 32·5 °/₀₀, and, according to the observations of *Hamberg*, nearly contain a quantity of air (16·07 + 11·62): 2 = 13·845^{ccm} per litre. According to *Hamberg*, the mixture shall contain only 13·535^{ccm} to be saturated, so that according to this, it will be supersaturated with 0·31^{ccm}. We dare not, however, take it for granted that a process of mixture will take place in the sea, between water with so great differences of temperature as assumed in the example, and the supersaturation caused by the mixture will therefore hardly exceed about 20^{ccm}.

We may therefore, in so far as the surface-water is concerned, set up the thesis: That the supersaturation of the water with nitrogen is due to a heating, and that the extent of the supersaturation is dependent on the rapidity with which the heating is taking place.

If furthermore we take it for granted that a rapid heating has the effect of causing a great supersaturation, we may through this be able to judge of the influence the height of barometer has on the gases contained in the water, and that such an influence really is exercising its power, we may beforehand consider as a fact. The question is then whether it can be left out of consideration or not. That is to say: can a specially high or low height of barometer remain unaltered over the same water during a space of time that cannot be left out of consideration when comparing it with the time during which the water is heated to about 2° or 3°? It can be seen, namely, that the difference between the temperature measured and the temperature of absorption can rise to that height. By the temperature of absorption is understood the temperature the water is required to have at a pressure of 760^{mm} to be saturated with the amount of nitrogen it is found to contain.

To answer the question before us, we must have ascertained by which of the two quantities $(c—a)$ and $(c—b)$ the most homogeneous results can be attained. Looking at the table, it will be seen that $(c—a)$ shows, on an average, a more reliable dependence on the heating than $c—b$. Station 110 is apparently an exception to this, as for a heating of 6°8 we have $c—a = 0{\cdot}44^{ccm}$, $c—b = 0{\cdot}84^{ccm}$, while station 101 for a heating of 6°0 gives $c—a = 0{\cdot}93^{ccm}$, $c—b = 0.95^{ccm}$. It can be seen here at once, however, that the measure used for heating proves to be inappropriate, as the two stations have nearly the same surface-temperature, notwithstanding the observations at station 110 being taken 10 days later than those at station 101. Station 121 where the observations again have been taken 19 days later than those at station 110, has for a heating of 5°1 $c—a = 0{\cdot}30$, $c—b = 0{\cdot}21$. Consequently station 110 does not refute the aforesaid assumption, but, on the other hand, it does not prove anything at all, for the state of matters found at the stations 101, 110 and 121, could very well be due to a continued minimum of the barometer-height at these places between the moments of time, at which the observations at the stations 101, 110 and 121 were taken. The other stations where the observations have been taken under a conspicuous high or low height of barometer, are lying in too isolated positions to allow us to draw any reliable conclusions concerning the aforesaid assumption, but, as has been said before, $c—a$ seems, upon the whole, to be regulated by the heating with greater precision than $c—b$.

The consequence of this is that we must be justified in not having regard to the pressure of air during the absorption, when by means of the gases contained in the water we are going to determine the temperature at which the absorption has taken place. Such a determination is, as it will be seen, anything but reliable, as surface-water may contain up to 1^{ccm} of nitrogen more per litre than it ought to do according to the law of absorption, so that on account of this, the calculation may be subject to an error of 3°. Hence the temperatures found in this manner, do not with any high degree of exactness represent the temperature of the water when it left the surface.

The following two circumstances may be the cause of water ceasing to be surface-water. It will either on account of cooling obtain a higher specific gravity than the stratum of water below it, and in consequence of this have a motion towards the depth, or, as another possibility, it is not excluded that a layer of less specific gravity could be flowing and spreading itself on top of it.

In the first case, it may be expected that the water is not saturated with nitrogen when it leaves the surface. The fact is that there is every reason to believe, that as the water is supersaturated during the heating, it will not, when subject to cooling, be saturated with the said gas. If now such water is not subject to heating on its way to the depth, it will for all that constantly remain in an unsaturated state, and we cannot therefore from an observed slight incomplete saturation draw the conclusion that the water has been subject to cooling, while, on the contrary, a supersaturation proves with certainty that the water has been subject to heating after it left the surface.

If, on the other hand, the second assumption being the case, that is to say, if we suppose that a cold fresh layer of water is flowing and expanding over warm and salt water, such a thing will have the effect of producing an unstable equilibrium at the boundary-plane; the two strata of water will then be mixed together, and part of the mixture will sink on account of its higher specific gravity. This mixture may, as has been pointed out before, be supersatured with nitrogen, but it does not follow absolutely that such a thing is the case, as we cannot consider it for certain that the two strata of water that are to be mixed together, should be saturated with nitrogen, before the process of mixture is taking place. The lower surface of the uppermost layer of water must of course consist of water that has sunk down in consequence of cooling, while, on the other hand, we cannot know anything about the state of matters at the surface of the lower stratum of water.

It will be seen, when looking at the chart, that all the water west of 17° Long. W., with exception of station 129, is very near the point of saturation, while the water east of this longitude is supersaturated with nitrogen. This proves that the water south-east of *Iceland* is subject to heating during the first half of the month of May, while, on the contrary, such a heating does not take place in the seas south-west of *Iceland* during the first half of June. That a heating may be traced at the beginning of May in the first-named part of the seas that have been subject to investigations, is not unlikely, but that a similar thing should not be the case at the beginning of June with the seas that are situated more westerly, seems at the first glance to be rather strange, as the heat of the sun is constantly increasing at this time of the year. The last-named circumstance can only be accounted for by the fact of the water southwest of *Iceland* coming from more southerly or warmer regions of the sea, nor does the chart in the annual publication from the Meteorological Institute «Meteorologisk Aarbog for 1896», 3d part, say anything to the contrary. It must be admitted that the considerable supersaturation at the stations 46—55 may be indicative of a southerly motion during the month of May in the region of the sea south-east of Iceland, but it appears from the chart on plate XXXIII that such a motion is hardly appreciable, and the supersaturation must therefore be due to the increasing heat of the sun.

In the northern part of the *Denmark Strait*, the state of matters is in a hydrographical point of view similar to what we meet with in the tract of the sea south-west of *Iceland*, which furthermore serves as a proof of the correctness of the general conception concerning the currents west of *Iceland.* At the first glance station 95 seems to make an exception to this, but it can be seen by the salinity (35·24, stations 96 and 97 have respectively the salinities 35·30 and 35·35,) and the heating (0·3, for the stations 96 and 97 this latter is relatively — 0·1 and — 0·1,) that the influence of the ice-water can be traced at this station. Station 94 holds an exceptional position, as it is lying entirely in the ice-water on the shores of *Greenland*, or, if we prefer to call it so, in the *East Greenland Polar Current.*

The stations east, north-east, and north of *Iceland* are all remarkable by the great supersaturation, which is inseparable from the great heating of the ice-water. At station 112, the supersaturation seems to be unusually great in proportion to the heating.

Instead of reducing to 760^{mm}, we might in this case, in so far as the surface-water is concerned, reduce to the average height of barometer (the quantity *a*); but by the adoption of this method, the values would only be subject to so small a difference that it would be of no consequence at all, and it is for the same reason that no regard has been taken to the moisture of the air at the calculation of *b*.

The objection may perhaps be made that it is not appropriate to have recourse to foreign observations — such as *Hamberg*'s — at the indication of the quantity of nitrogen which the water contains when it is saturated, for it is a matter of course that there is a possibility of systematical errors occurring, when comparing ciphers due to different observers that have used different instruments. But to this I shall confine myself to say that even if the numerical values be made a little larger or smaller, such a thing will not have any influence on the conclusions set forth in the foregoing.

It will be seen from what has been said in this chapter, that the rapidity with which the heating of the surface-water has taken place, can be ascertained, if we know the supersaturation the said water has been subject to, and in case of our having many observations, we have likewise a means to explain from what quarters the water at the different places has its origin, provided that the whole does not form a regular uniform system.

THE AMOUNT OF NITROGEN AT THE BOTTOM.

In the chart, plate XXXV, the amount of nitrogen is noted immediately on the right hand side of the places where the stations are noted, uppermost to the right the temperature of the water, and nethermost on the same side the temperature of absorption. Across each of the places marking the stations, an arrow is drawn, which is pointing in the direction the current is supposed to have run on the basis of these observations concerning supersaturation and incomplete saturation. The extent of these qualities is approximately indicated by the length of the arrow. The stippled arrows show in the same manner the direction of the current at a depth of 400 or 600 fathoms (753 or 1130 metres); which direction, in all the cases that have been subject to investigation, is seen to coincide with the direction of the current at the bottom.

As already mentioned in the chapter on the determination of the amount of nitrogen in the surface-water, we cannot take it for absolutely granted that water in the depths, which has come from surface-layers in cold regions of the sea, should be supersaturated with nitrogen. If such water, on the contrary, proves to be supersaturated, it must probably be due to its having been subject to heating while it was making its way from the surface to the depth. It is not likely to be supposed that water should leave the surface while it is subject to heating, and in consequence of this supersaturated.

By the putrefaction of organisms, the amount of nitrogen may be increased, and a supersaturation be brought about. It is to be supposed that this has been the case at the stations 67 and 80, which show such an extraordinarily large amount of nitrogen. The water samples contained mud from the bottom, and must therefore belong to the very lowermost strata, where the greater part of organisms is to be found. Other muddy samples, such as at the stations 45, 48, 75, 78 and 89 did not deviate from the usual type of samples, but it is a matter of course that these samples could not be supposed to be samples on which full reliance could be placed. As to the seas that have been subject to investigation, we will take our stand on the basis of the assumption, that a supersaturation in the depth means that the water has come from surface-layers in the colder regions of the sea.

Furthermore it will be seen from what has been explained, that a slight incomplete saturation in the depth is not absolutely dependent on a cooling of the water, after it left the surface, for there is every reason to believe that the water, already when it leaves the surface, is subject to cooling, and in consequence of this incompletely saturated, a circumstance which we must not forget to take into consideration, when we are going to draw conclusions on the basis of an incomplete saturation in the depth.

Station 134 has incompletely saturated water, but we cannot, as already said, on account of this consider it as a fact that the water has come from a warmer region of the sea, that is to say, from the southward. The high degree of salinity that is found in the water at this station, implies, however, that the conclusion regarding a current that is setting north, may be right in this case. At the rest of the stations, south-east of *Iceland*, there is supersaturation everywhere, that is to say, the current is setting south. (That the observations at station 49 show that there is such an exceedingly small amount of nitrogen at the bottom, is probably due to observational errors). According to this, I am led to believe that the current at the bottom is flowing across the Färoe-Iceland ridge in a southerly direction in the proximity of the *Färoe-Islands* and *Iceland*, but in a northerly direction on the middle of the ridge.

South and south-west of *Iceland*, the water has in general been found to be incompletely saturated; exceptions to this are the stations 75 and 62. At station 75 the sample was muddy, and the arrow pointing south is therefore not to be considered as being of much consequence at this place.

West and north-west of *Iceland*, the observations at stations 99, 97 and 94 show an incomplete saturation of the water, which, in so far as station 99 and 97 are concerned, is quite in harmony with the fact of the water coming from the southward, that is to say, from warmer regions of the sea, while on the other hand, according to what has been said on page 111, the afflux of warm water to station 94 is taking place from the north-east. The observations at station 89 show that the water was supersaturated, but the samples muddy. At station 96 the amount of nitrogen found is so great, that I think it must due to observational errors. The observations at station 91, prove that the water was supersaturated, which perhaps may be ascribed to cold water having made its way to the bottom through the water (which on this spot is comparatively stagnant), and which water must be regarded as a kind of centre for the rotation in the *Denmark Strait*. The fact is that the *Irminger Current* is setting north along the west-coast of *Iceland*, and then it is sending a branch to the westward towards the *East Greenland Polar Current*, making its way underneath this latter. (The observations at station 94 situated in this tract of the sea, show an incomplete saturation of the water). Another branch of the above current runs north round *Iceland*, and may be traced at station 101, at which place the observations show that the water likewise is incompletely saturated. At stations 102 and 103 the water has nearly attained the point of saturation. The observations at station 104 show incomplete saturation, which very likely may be ascribed to an afflux of water from the eastward. The water at station 113 has just attained the point of saturation.

Passing in review all these observations, the inference may be drawn that in the tract of the sea, from 15°—20° Long. W., a line of demarcation may be drawn between the bottom water that has come across the Färoe-Iceland ridge in a southerly direction, and the rest of the bottom water farther to the westward in the *Atlantic*, which latter therefore must be supposed to originate from some other sources, and furthermore that the results gained through the analyses of nitrogen, are not at any point in contradiction to the conclusions already drawn, but even supplement and corroborate these latter.

ON THE OTHER DETERMINATIONS OF NITROGEN.

At station 71, the difference between the actual temperature and the temperature of absorption is found to be 0°6 at the surface, — 0°2 at a depth of 40 fathoms (75 metres), that is to say, there is a supersaturation at the surface, and an incomplete saturation at the indicated depth. This confirms the correctness of the assumption that the water is coming from the southward, consequently from warmer to colder regions of the sea, and the cooling of the water that is due to this circumstance, has the effect of making it incompletely saturated. At the surface the increasing heat of the summer may however, give rise to a slight supersaturation. At station 89 there is a slight supersaturation at a depth of 30 fathoms (57 metres); this is probably due to heating from the surface, as it can be seen from the curve that the temperature, below the aforesaid depth, suddenly goes down 1°. The observations at station 94 show throughout incomplete saturation, and specially at a depth of 30 fathoms (57 metres), which very likely may be attributed to a great cooling from above, originating from the cold ice-water.

At station 101, we find at a depth of 30 fathoms (57 metres) incomplete saturation. It is obvious when looking at the curve of temperature, that at this place the temperature is rising with the depth, a circumstance which is due to the fact of the warm water that is coming from the westward from the *Irminger Current* having been cooled by the ice-water that is lying above it. On the other hand, a great supersaturation is prevailing at a depth of 100 fathoms (188 metres). There is every reason to believe that this is due to observational errors, but on account of the amount of oxygen being great too, we cannot take it for granted that this is the case. But now it is seen, however, that the degree of salinity is specially low (33·60), and the temperature rather high, which is a state of matters that will have the effect of producing an unstable equilibrium. This is a sign of the ice-water having made its way downwards and got mixed with the warm water below from the *Irminger Current*. Provided that this assumption be correct, the supersaturation cannot be accounted for. As according to this, the observations we have before us are at variance, I think it is not unlikely to be supposed that the water bottle also has fetched up water from a smaller depth than 100 fathoms (188 metres). At station 102, there is an inappreciable supersaturation at a depth of 20 fathoms (38 metres). It will be seen that this spot is located on the first downward bent branch of the temperature-curve; the water at the said depth has consequently been subject to heating, which, as we know, has the effect of producing a supersaturation. It is for the same reason that we meet with a supersaturation at station 104 at a depth of 20 fathoms (38 metres), while, on the contrary, the incomplete saturation at the same station, and at a depth of 30 fathoms (57 metres), must originate in water from this depth belonging to the lower stratum of water, the upper part of which has been cooled by the ice-water that is lying on top of it. It is for the same reason that at station 110 we meet with an incomplete saturation at a depth of 30 fathoms (57 metres); the same applies to station 111 at a depth of 40 fathoms (75 metres). When the observations at station 112, at a depth of 100 fathoms (188 metres), show a supersaturation, the cause of this state of matters is perhaps due to the whole of the stratum of water below the ice-water originating in Atlantic-water. The observations at station 118, at a depth of 50 fathoms (94 metres), show that the water contains such a quantity of nitrogen that the analysis scarcely can be supposed to be correct; furthermore the extraordinarily low percentage of oxygen seems to be indicative of atmospheric air having exerted its influence on the determination.

Looking at all the temperatures of absorption determined in the seas south and west of *Iceland* through the analysis of nitrogen, it will be noticed that the temperature of absorption for water varies but little at a depth between 40 (75) and 500 fathoms (942 metres), and remains between 6°2 and 7°9. Stations 72, 89, 97, and 99, at which the depth does not exceed 500 fathoms (942), have all a temperature of absorption at the bottom of 6°7 or 6°8. The cause of this can quite naturally be accounted for by the fact of the surface-water having been subject to cooling during the course of the winter, in consequence of which it is sinking down till it reaches the bottom, or a colder and on account of this heavier layer of water. It is a matter of course that the water which is sinking to the greatest depth, must be that which has been subject to the greatest cooling, and the temperature of absorption for this water indicates thus approximatively the minimum temperature of the year for the place where the water left the surface. According to what has been stated, the temperature of absorption for the said stations is 6°7 or 6°8, and this temperature should then according to what has been explained above be the minimum temperature of the here described — or more southerly — seas.

Supposing a surface to be laid through all the bodies of water that have a temperature of absorption of 6°7, it is evident that this surface must form the nethermost boundary of the vertical circulation of water that arises in consequence of the changes of temperature the whole year round. The following table has been made to facilitate the view of the position of this boundary surface.

Number of Station.	Depth		Temperature of Absorption
	fathoms	M.	
47	400	753	7°2
48	400	753	7°7
49	400	753	6°9
65	400	753	7°9
67	600	1130	5°6
68	600	1130	6°2
78	600	1130	4°6
80	600	1130	5°0

From this will be seen that the boundary surface, at the stations 47, 48, 49, and 65, is lying at a greater depth than 400 fathoms (753 M.), at the stations 67, 68, 78, and 80, at a less depth than 600 fathoms (1130 M.). It has been mentioned before that the temperature-curves for these stations south of *Iceland*, continue their course nearly horizontally, until they attain a certain depth, and the farther the stations are situated to the eastward, the greater this depth will be. It is therefore likely to be supposed that the boundary surface is to be found at the depth where the temperature begins to decrease rapidly, so that the whole of the large stratum of water with an approximately constant temperature, has got this constant temperature on account of the vertical circulation that takes place during the winter time. If the whole of the layer really be formed in this manner, we find at the same time a natural explanation of its great thickness to the westward by the fact of water constantly making its way from west to east in the surface-layer. To account for it by the supposition of the cold during the winter time having the effect of cooling larger bodies of water at the eastern than at the western stations is an impossibility.

Station 78 has at the bottom a temperature of absorption of 6°7; at 600 fathoms (1130 M.) it is 4°6. At this station the salinity is also higher at the bottom than in the said depth, and it appears that the values for salinity, and the temperature of absorption at the bottom, are exactly the same as at a small depth — less than 400 fathoms (753 M.). From this the inference might be drawn, that part of the surface-layer with the constant temperature had made its way down to the bottom through the colder stratum of water. According to my opinion, it is more likely to be supposed that the water bottle has fetched up water from a smaller depth and not from the bottom.

THE AMOUNT OF OXYGEN ABSORBED IN SEA-WATER.

In the table of the gas-analyses, the quantity of oxygen is noted with the designations stated on p. 85. The values used for the quantity $\frac{100\ O_2}{N_2+O_2}$ when the water is saturated with atmospheric air, has been taken from *Dittmar*'s determinations, but it is only the values for the positive temperatures that can be found in *Dittmar*'s table, so I was obliged to deduce the values for the negative ones by extrapolation. The values computed for $\frac{100\ O_2}{N_2+O_2}$ through the observations made by me, are noted under f in the next column. Under $f-e$ is found the difference between the last and the first-named quantity. According to this, $f-e$ may, as it were, be regarded as an expression for the supersaturation of the water with oxygen. That $f-e$ is positive, signifies therefore that there has been a generation of oxygen in the water after the absorption took place, while just the reverse is the case when $f-e$ is negative, namely that there has been a consumption of oxygen.

It will be seen that there has been a constant consumption of oxygen in the depth, while, on the other hand, it has been observed frequently that there was a supersaturation with oxygen in and near the surface. This state of matters was already observed during the *Challenger-Expedition* and the *Norwegian North Atlantic-Expedition*. Thus *Dittmar* writes (l. c., page 188): «What puzzled me very much at first, was the not unfrequent occurrence in our table of negative oxygen deficits.

It is difficult to see, how sea water can contain more oxygen per litre than is demanded by the law of gas-absorption. I tried to account for the apparent anomaly in a variety of ways, and at last was led to suspect that it may be the result of observational errors.» *Tornöe* writes (The Norwegian North-Atlantic-Expedition 1876—78 Chemistry pag. 19): «Now, assuming the results of these experiments to furnish a normal standard, the relative large proportion of oxygen as compared with the total amount of air present in the surface-water of the northern tracts of the sea investigated, will be found to arise from supersaturation with oxygen, and not, as might be supposed, from imperfect saturation with nitrogen, seeing that the proportion of oxygen exceeded that computed from these experiments by as much as, or even more than, 0·5 cc; for a difference so considerable does not admit of being ascribed to errors of observation. On the basis of these facts, the proportion of oxygen in surface-water is shown to depend not only on pressure and temperature, but, probably, also on the effect of one or more causes as yet unknown.»

Seeing that my analyses of the surface-water gave similar inexplicable results as those pointed out by *Tornöe*, that is to say, supersaturation with oxygen, and as there was good reason to suppose that the variation of the percentage of oxygen was due to the plankton contained in the water, I asked Mr. *Ostenfeld*, M. A., and botanist of the expedition, to undertake researches of plankton at the same places where I made the gas-analyses. In compliance with this request, Mr. *Ostenfeld* made this kind of preliminary investigations on board, and the list of «the species and quantity of the plankton» which is inserted in the table of the gas-analyses, I had the pleasure of receiving from Mr. *Ostenfeld*. At many places the quantity of the plankton was determined by measuring the volume of the same to as great an exactness as possible, but in consequence of a final investigation of the plankton not having been carried out as yet, no attempt will be made here to set up any universal theory regarding the relation of the different organisms to the oxygen dissolved in the water.

It appears from the table that a specially marked vegetable plankton has caused a supersaturation with oxygen, and to such an extent that where the quantity of vegetable plankton has been specially great, we shall always be pretty sure of meeting with a corresponding great supersaturation with oxygen, which is manifesting itself here by a great positive value for $f—e$. Reference is made to the stations 46, 71, 80, 98, 120.

We cannot, on the other hand, because there has been a great supersaturation, expect to find a great quantity of vegetable plankton. That nothing has been noted under station 48 regarding the quantity of plankton, is probably a sign of its not having been extraordinarily great. Under station 100 is certainly noted for a supersaturation $f—e = 1·1$ that the plankton has been of an entirely vegetable nature, but the quantity has been almost inappreciable. Under station 125 with $f—e = 1·4$ is noted that the plankton was of an entirely animal nature, and only of a very small quantity; the same applies to station 133, where $f—e$ is equal to 1·8.

That a great quantity of vegetable Plankton has the effect of producing a supersaturation with oxygen, is of course not to be wondered at, as the plants that contain chlorophyll or kindred pigments may assimilate carbonic acid when exposed to the light, and in consequence of this disengage the oxygen causing the supersaturation. As will be seen afterwards and proved by experiments, the respiratory process of the plants is in this case a matter of quite a subordinate importance.

It is obvions, however, that a daily period, in so far as the quantity of oxygen is concerned, is manifesting itself at those places where plants are found. This can be accounted for as follows. We collect the values for $f-c$, from such places where the plankton principally is of a vegetable nature, into two groups, the one containing the analyses made between 12 p. m. (midnight) and 12 a. m. (noon), the second the values for the analyses made between 12 a. m. and 12 p. m. We then get the result that the mean for $f-c$ of the analyses made between midnight and noon will be 0·83, and that of those made between noon and midnight 0·98, and, furthermore, that the ratio between these two values is 1·18. In both cases the mean value for $f-c$ is expressed by a positive number, which shows that the entire result of respiration and assimilation with carbonic acid, is a generation of oxygen, which must be supposed to be the consequence of a consumption of carbonic acid. The fact of the analyses made between noon and midnight giving a greater mean for $f-c$ than those made between midnight and noon, is indicative of the quantity of oxygen having a daily period with maximum between noon and midnight, and minimum between midnight and noon. The phase of the period is supposed to be 6 hours behind that of the illuminative power, so that the cipher indicating the quantity of oxygen passes the mean value at 12 o'clock (noon) and at 12 o'clock (midnight), at which hours the illuminative power has its maximum and its minimum. In the case of the higher plants, the difference of phases between the maximum of the illuminative power and the maximum of the quantity of oxygen is very nearly 6 hours, and a similar ratio applies most likely to the lower plants also.

If a similar calculation be made for the stations that are lying north of 66° Lat. N., we shall have the a. m. mean-value for $f-c$ to be 1·21, the p. m. mean-value 1·37. The ratio between the said values will be 1·13. According to this, it seems as if the period caused by the illuminative power in the generation of oxygen of the plants also is felt here, where, however, it is nearly as light at night as it is in the daytime. The ratio between the mean values for $f-c$ has become less, as it is here 1·13 against 1·18 in the first-named calculation. That the night has become shorter and lighter, has thus the effect of the aforesaid ratio approaching more to 1, that is to say, the quantity of oxygen that is disengaged during the night, approaches to be equal to the one eliminated during the day-time, in so far as the northern seas are concerned.

In consequence of the investigations having been made at different places, and in water with plankton that is widely different in so far as quantity and quality is concerned, it is, as a matter of course, quite impossible to draw any conclusion with certainty regarding the question about the course of the daily period, but the results acquired by the formation of the aforesaid mean, furnish us with an answer, which still perhaps may be of some value.

That the mean for $f-c$ is larger in the northern seas than in the southern ones, shows that the organisms we meet with in the northern seas produce more oxygen than those we meet with in the southern seas, not to be forgotten, in the month of July — how the state of matters is at other times of the year, it is difficult to have any opinion about on the basis of the investigations before us.

We cannot as said already expect with certitude that there should be a great deal of vegetable plankton, because we have met with plenty of oxygen. This is a natural consequence of the fact that a long time can elapse from the moment that the surface-water is supersaturated with atmospheric air, until again it assumes its normal saturation. We have seen from the foregoing that this state of matters, in so far as the nitrogen is concerned, is of great importance, and there is no reason to suppose that there should be any material difference in the behaviour of the oxygen than in that of the nitrogen, when the question is about giving up the atmospheric air absorbed by the water, or, more properly spoken, the air which the water contains in surplus according to the law of absorption.

We are therefore fully justisfied in expecting that $f—c$ is determined, not only by the plankton found in the water at the moment of investigation, but also by the plankton that has been in the water for some time before the investigation took place. The longer the time that has elapsed since the plankton disappeared, or was replaced by new plankton, the less the influence of it will be. If then for inst. we find a certain value for $f—c$, but not the plankton corresponding to this value, we may draw the conclusion that such plankton has been at this place shortly before, that is to say, within a space of time, which, on the basis of the experiences gathered from the determinations of nitrogen, we may estimate to be at the most a few (3—4) weeks.

To form an idea of the generation of oxygen that is the result of the assimilation of carbonic acid and respiration of vital diatoms, as well as of the consumption of oxygen that is due to the respiration alone, I made up my mind to make the following experiment on board, at which the botanist of the expedition Mr. *Ostenfeld,* M. A. assisted me with great willingness.

At a place where there was plenty of diatom plankton, the fishing was carried on with a small horizontal net made of mill-gauze Nr. 20. The plankton that was fished up, was filtered through another net with so large openings that the diatoms just could make their way through it, by which process they were separated from all larger, specially animal organisms. The diatoms that had got through, were now percolated through a very tight net, and those that had come through this net were deposited in 100^{ccm} of sea-water in a measuring glass, care being taken, that the depositing was complete. Half of the contents of the measuring-glass was poured into a bottle holding 1 litre, which was filled immediately with sea-water and corked, but a very fine opening was left at the cork to avoid an increase or a diminishing of the pressure inside the bottle. This latter was made of perfectly bright and transparent glass. The other half of the contents of the measuring bottle was, under observance of the same measures, placed in a similar bottle, entirely wrapped up in tin-foil. Two similar bottles, the one with, and the other without tin-foil, were filled with the same kind of water as that filled on the two first bottles, but still without diatoms. All four bottles were placed in a basket and submerged into the sea, close below the surface. Here the bottles were turned several times, and after they had remained in the water some time, they were hauled up and analysed immediately afterwards. To prevent diatoms from getting into the air-analysis-apparatus, the end of the suction-tube was covered with a piece of silk network, similar to that used for the filtration and the fishing-net. The weather was cloudy, and the sun was shining brightly now and then during the whole of the time the experiment was made. The results of the analyses, after the indicated periods had elapsed, were as follows:

	Time elapsed between the preparation and the analyses	ccm. CO_2 per Litre	ccm. N_2 per Litre	ccm. O_2 per Litre	$\frac{100\ O_2}{N_2 + O_2}$
I. bottle without diatoms, without tin-foil . . .	$^1/_2$ hour	41·4	12·57	6·60	34·4
II. — with — — — . . .	2 hours 20 m.	32·2	12·12	17·60	59·2
III. — — — with — . . .	4 hours	42·6	12·00	4·19	25·9
IV. — without — — — . . .	6 hours		12·34	6·53	34·6
Diatoms generate in the dark	4 hours	1·2		— 2·38	
— — — light	2 hours 20 m.	— 9·2		+ 11·03	

In consequence of analysis IV only being a repetition of analysis I, we might expect to find the same amount of nitrogen. The great difference in the quantities of nitrogen (0·23^{ccm}) which has appeared in the results of the two analyses, is perhaps due to observational errors, and I am therefore led to be believe that it has been caused by the decantations. The difference in the quantities of oxygen, in so far as these two analyses are concerned, is a mere trifle in comparison with the alterations that took place at the two other experiments.

It will be seen that the difference in the quantity of oxygen in both cases (diatoms in the dark and diatoms exposed to the light), is greater than the difference in the quantity of carbonic-acid. Nearly the whole of the large volume of oxygen found at analysis II, had remained in a dissolved state in the water, and only a few bubbles of air, which could not amount to many hundreds of cubic-centimetres, were disengaged on the faces of the bottle, but in consequence of this, the amount of oxygen stated is even too small. The number of diatoms used for this experiment, must be supposed to have been about 300 times as large in the bottles as the number of diatoms in the same volume of water in the sea. This statement is, however, in a high degree unreliable, as it is impossible to know how great an error is made, when we consider it as given that the volume of water that is passing through the net is equal to the product of the opening of the net, and the distance the net is carried through the water.

The experiment shows, however, that it would be entirely wrong to ignore the influence of the living plankton on the quantity of oxygen in the sea, nay not even on that at the surface, and the volume of oxygen absorbed by the plants at their respiration is very small in comparison with the quantity that is eliminated when they are exposed to the light.

If we look at the stations in the table of the gas-analyses at which animal plankton has been specially predominant, we find, as a rule, that a negative value for $f—c$ corresponds to such a large quantity of animal plankton, that is to say, an incomplete saturation. This is for inst. the case at stations 59, 62, 68, 74, 75, and 97. Stations 96, 125, 133 make an exception to this rule. As to station 96, we cannot draw any reliable conclusions from the observations made there, as *f—e* only is 0·1 against the plankton-indication 2 V. + 4 A. We have now stations 125 and 133 left, at which *f—e* relatively is 1·4 and 1·8, the plankton-indication of which is respectively 4 A. and 4 A. + 4 Pk., both with the remark: small quantity. This state of matters may be accounted for by the fact of its being specially vegetable plankton that has been predominant at these stations, shortly before the analyses took place.

The mean-value of *f—e* for all the stations where animal plankton has been predominant, is equal to — 0·75, which, as will be seen, is a negative quantity. The cause of this mean not having a larger negative value is evident, when we take into consideration that animal plankton would hardly be able to exist for a length of time at a place, if there was not at the same time vegetable plankton, from which, at any rate, some of the animals could get their nourishment. It is a matter of course, therefore, that even if we find pure animal plankton at a station, there must shortly before that time have been vegetable plankton. We cannot, therefore, because we meet with exclusively animal plankton at a place consider it as absolutely granted that an incomplete saturation of the water is existing at that place.

In accordance with the experiment concerning the influence of the diatoms on the gases held in sea-water, I made another experiment with the copepoda to examine how great an influence they exercised. The copepoda were caught in a large vertical-net, and filtered through a net of wide mesh, on which they were deposited in a litre-bottle filled with sea-water. After they had been left 3 hours and 17 minutes in the said bottle, the water with the copepoda was analysed. The result of this analysis, stated in the table below in proportion to the volume of gases contained in the water before it was poured on the copepoda, was as follows:

	ccm. CO_2 per Litre	ccm. N_2 per Litre	ccm. O_2 per Litre	$\frac{100\,O_2}{N_2 + O_2}$
V. Bottle with copepoda	44·3	12·36	2·79	18·4
VI. — without —	40·6	12·29	6·70	35·4
Copepoda consume	— 3·7		3·91	

The number of copepoda used for this experiment was about 2000 times larger than the amount of these in the same volume of water in the sea. Still it is to be observed that this indication, like the one concerning the experiment with diatoms, is to be regarded as rather unreliable. It will be seen that at the same time as the quantity of oxygen has been considerable decreased by the stay of the copepoda in the water, the amount of carbonic acid has increased, but not in the same ratio, as the quantity of oxygen has been subject to the greatest alteration.

According to these experiments, it must be considered as an established fact that the quantity and nature of the plankton has a great influence on the amount of oxygen contained in sea-water. If for all that we have met with quantities of oxygen — at several places — which could not be ranged under the above mentioned system, the cause of this apparent discrepancy must of course be accounted for by the fact of the plankton being subject to changes in so far as quantity and quality is concerned, at certain places and in a given body of water, which alterations may take place frequently and in a short time. A change of this kind may for inst. be caused by the plankton, or only part of it leaving the surface, even if it only be for a short time, and in case of our leaving out of consideration the changes that might take place at the surface on account of the motion of the plankton in the water, a real change in the nature of the plankton is not improbable, as the plankton that is present in an abundant quantity dies, and is replaced by other plankton, which then in its turn becomes predominant in respect of quantity and quality.

THE REST OF THE ANALYSES.

Notwithstanding the fact that we cannot attach any importance at all to the absolute indications at the determinations of the carbonic acid in consequence of the method employed at the analyses, we may for all that suppose the relative determinations to be tolerably reliable, as all of the analyses are made in the same manner, and errors at repeated analyses never amount to $^2/_{10}$ of a cubic centimetre.

If we divide all the values for the amount of carbonic acid in the surface-water into two groups, according to the sign for $f—e$, by which in the one group we get the amount of carbonic acid in water with oxygen in excess, and in the other the amount of carbonic acid in water with an oxygen-deficit, and we take the mean of the values in each of these two groups, we shall have for $f—e$ positive, $CO_2 = 39{\cdot}8$, for f—e negative $CO_2 = 41{\cdot}7$. We see by this that there is observed a smaller quantity of carbonic acid at those places where we have found oxygen in excess, than at the places where an oxygen-deficit is manifesting itself. We know, according to what has been explained in the foregoing, that the plankton has an influence on the quantity of carbonic acid, and we see, moreover, that even if other causes exercise their influence on the result, they are not for all that sufficiently active to conceal the influence of the plankton.

We may perhaps even be quite justified in making the assumption that the organisms in the sea are those factors that have the greatest influence in so far as regards the quantity of carbonic acid existing. On the basis of this conclusion the irregular distribution of the carbonic acid can easily be understood, as the quantity of carbonic acid at a certain place, is not only dependent on the plankton that is present at the moment of observation, but also on that which has been present before in the same water. Taking into consideration at the same time, how quickly the quantity and nature of the plankton is changing, and that at two places lying close to one another, and which we should think would have the same conditions for organic life, the plankton can be of quite a different nature, then the variations in the quantity of carbonic acid, apparently in opposition to the laws of nature, can easily be accounted for.

There is, therefore, at the single observations of plankton very little possibility of finding a slight quantity of carbonic acid where we meet with vegetable plankton, and a great quantity of carbonic acid where the plankton is of an animal nature. It is only, as has been stated above, by taking the mean of many observations that such a state of matters is manifesting itself.

That we better can form an idea of the quantity of oxygen at the single observation of plankton, is, because we have here a fixed normal value for the absorbed quantity, provided that organisms were not existing in the water. A constant generation of oxygen will then at any moment of time have the effect of producing a supersaturation of oxygen, while a constant consumption of oxygen will be the cause of incomplete saturation. If these agencies cease to act, generation of oxygen and consumption of the same, the water will when some time has elapsed—though it be not a very short time — through the effects of the atmosphere, obtain the normal quantity of oxygen which it should have according to the law of absorption.

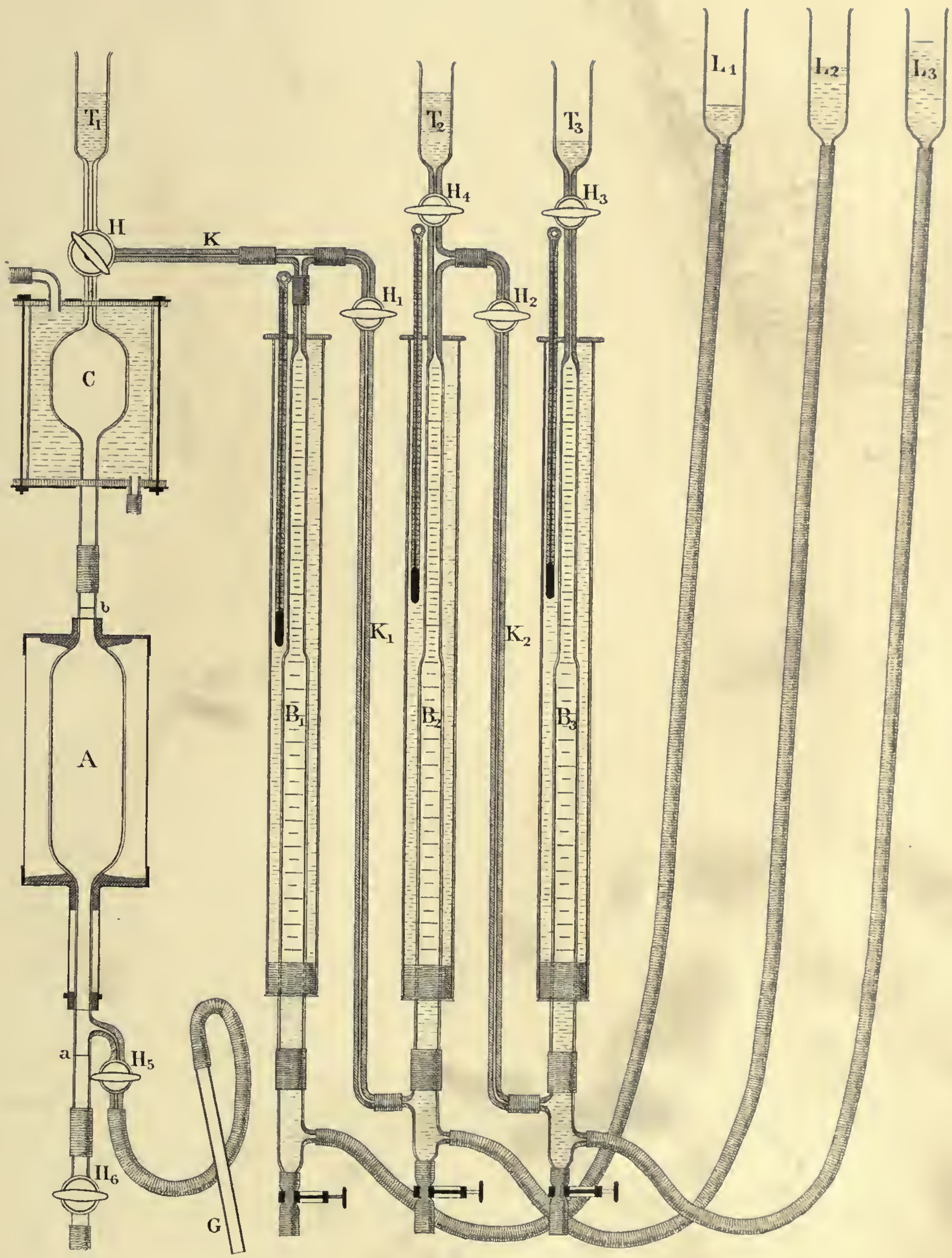
With exception of the determinations of sulphuric acid mentioned on page 133, I have not succeeded in finding that the determinations of the quantity of sulphuric acid which is held in the water at different places, is regulated by any special law. It seems to appear from the determinations of sulphuric acid on page 95—100 that the ratio between sulphuric acid and chlorine is a quantity that varies so little — even in water with very different qualities — that we cannot by the methods of analysis generally used, obtain determinations of so great exactness that reliable results can be gained in so far as the variations of the aforesaid ratio are concerned. Still it is to be noticed that this is only said in respect of ocean-water.

Owing to the influence of the glass on the alkalinity, I dare not embark on a discussion regarding the results obtained through the determinations of alkalinity. As, however, there may be a possibility of the determinations being of some consequence, they have been embodied in the table on page 95—100.

PLANKTON.

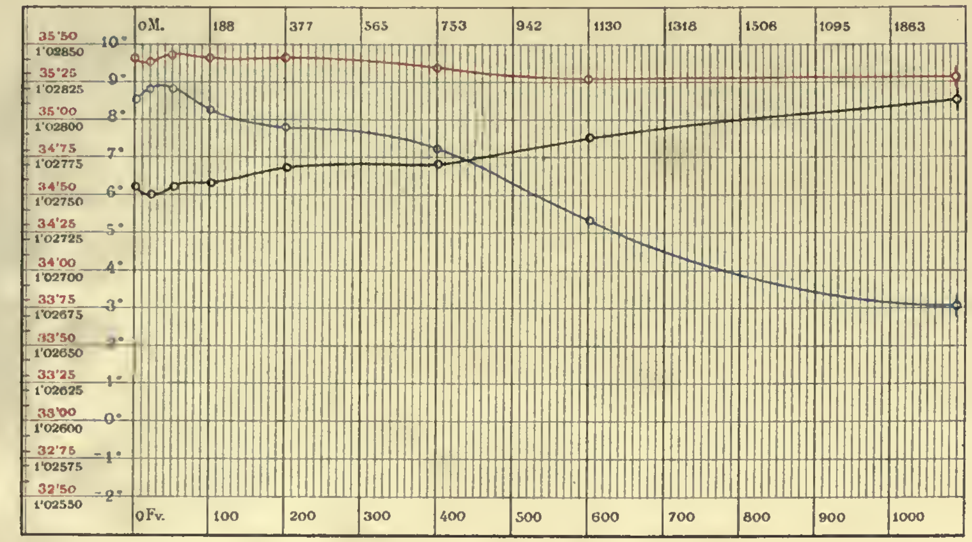
In recent hydrographic investigations the plankton-determinations have become a matter of extraordinary importance. In consequence of this a great deal of samples of plankton have been taken on the Ingolf Expedition, but they have not as yet been subject to a final investigation, and I have therefore not been able in the foregoing to have recourse to this important expedient.

Sent in in the month of January 1898.



Axel E Aamodt, Copenhagen

65 61° 33' N. Lat. 19° 00' W. Long.



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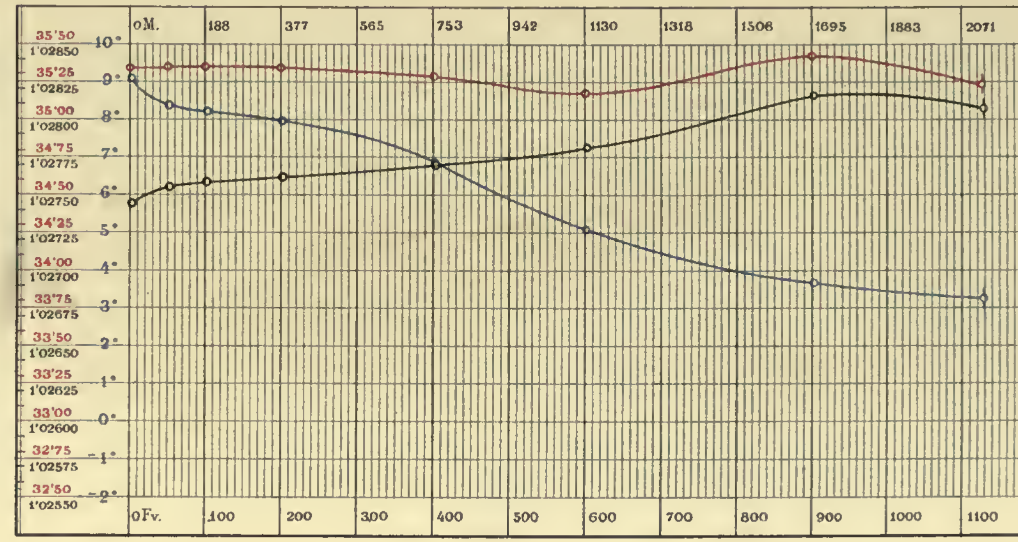

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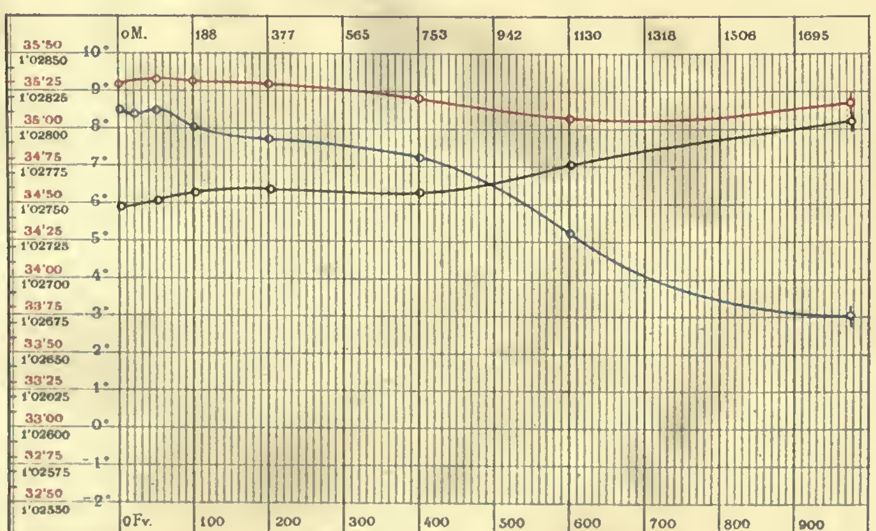

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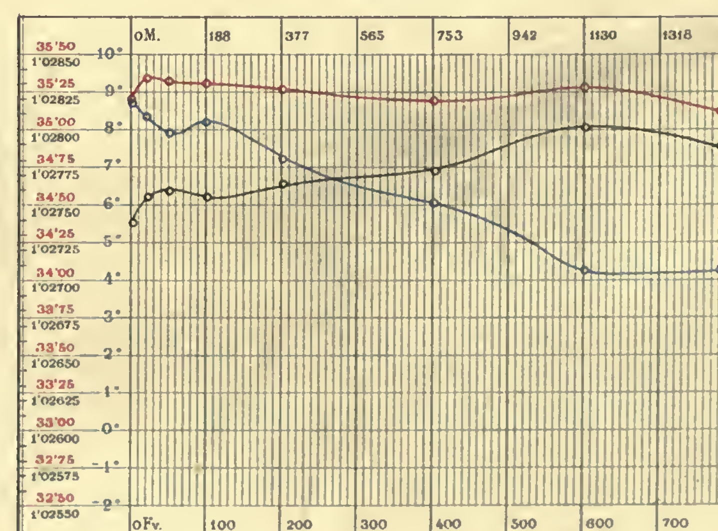

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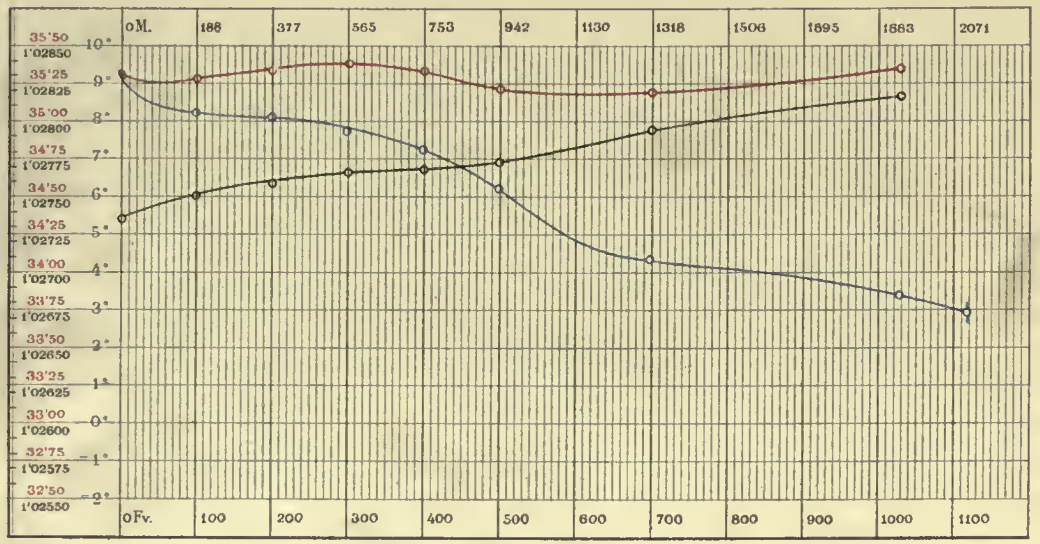

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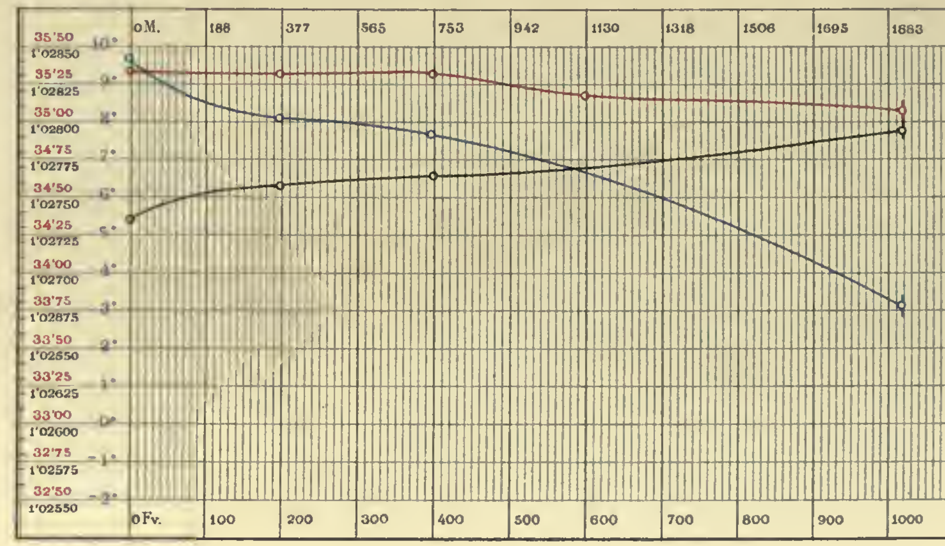

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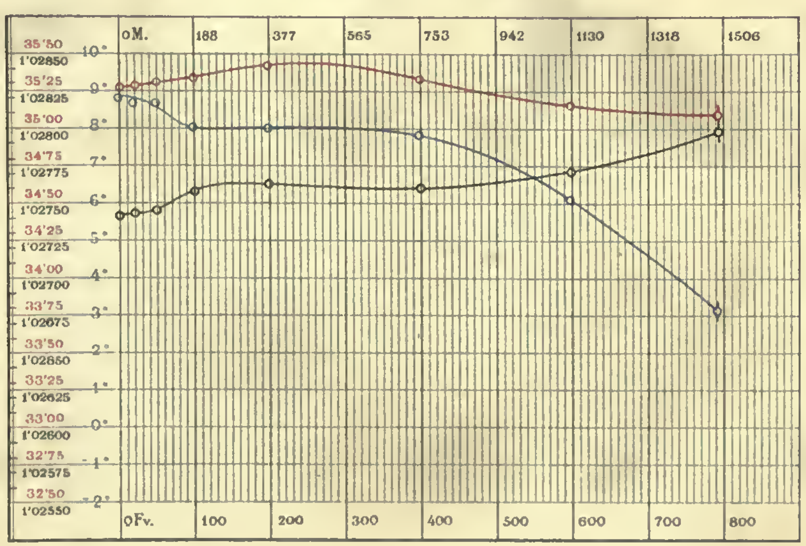

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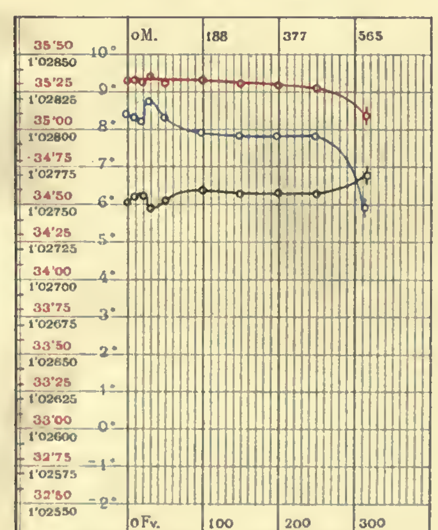
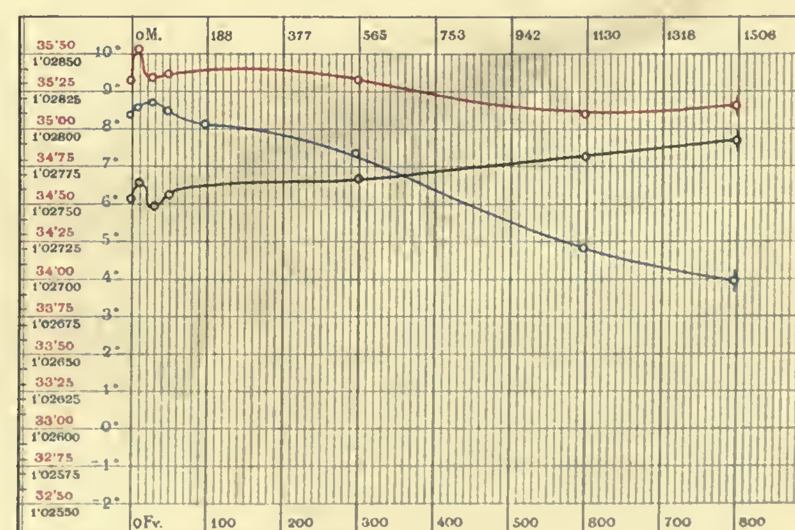


63 62° 40' N. Lat. 19° 05' W. Long.



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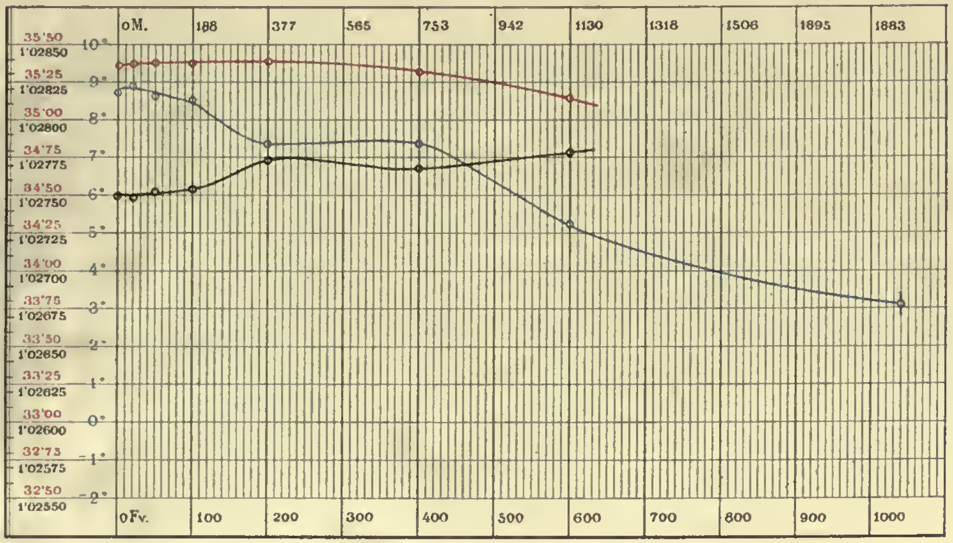

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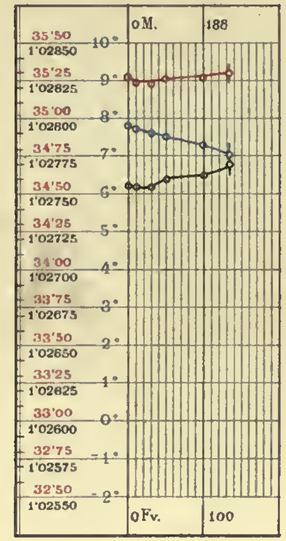

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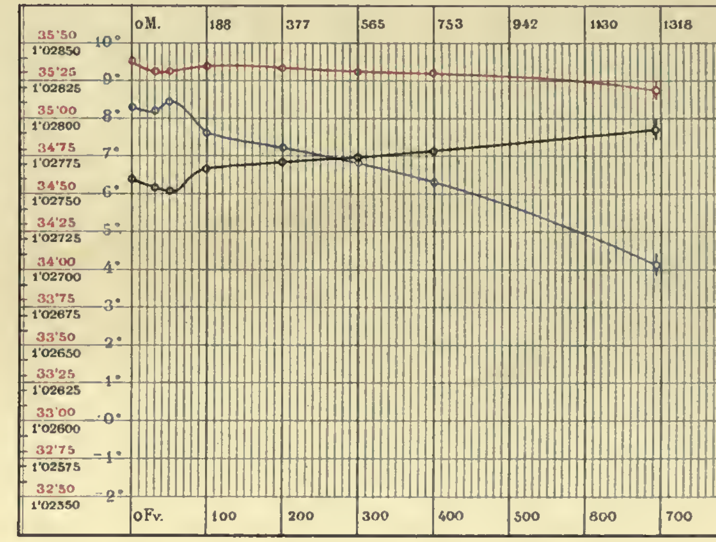

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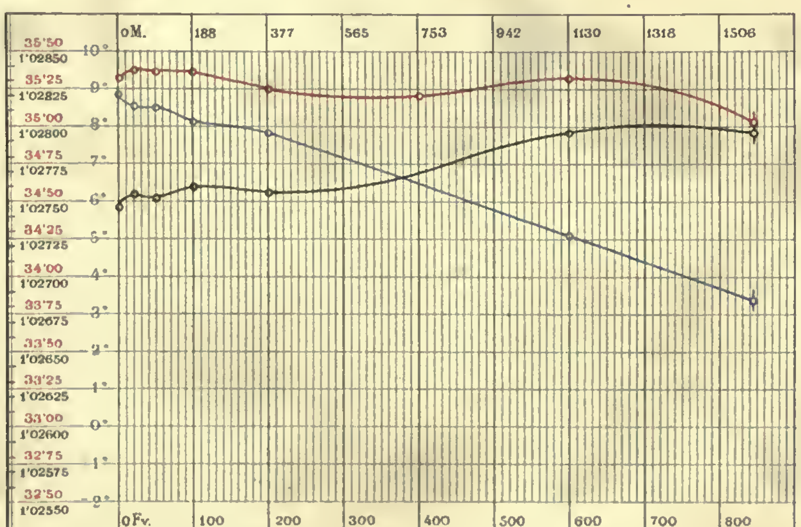

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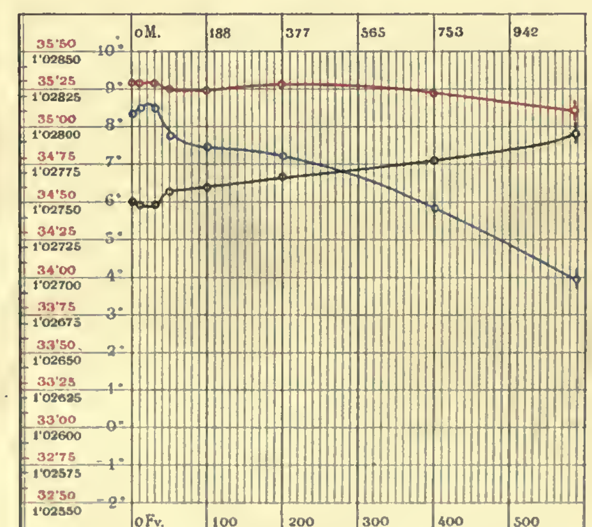

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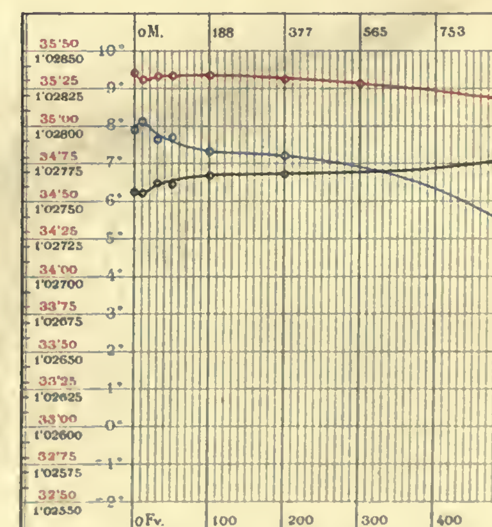

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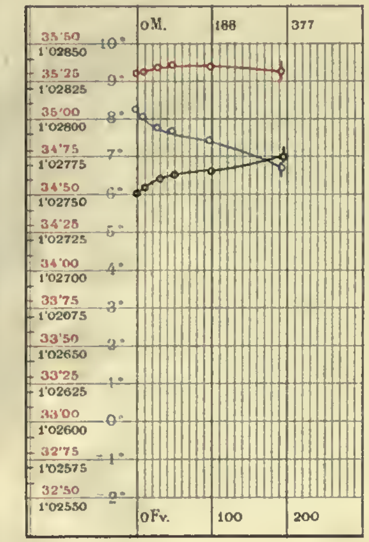

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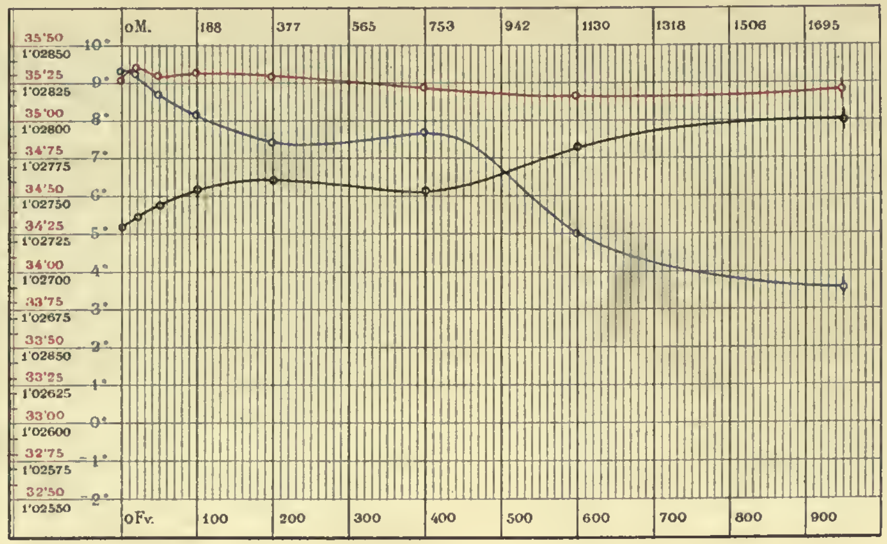

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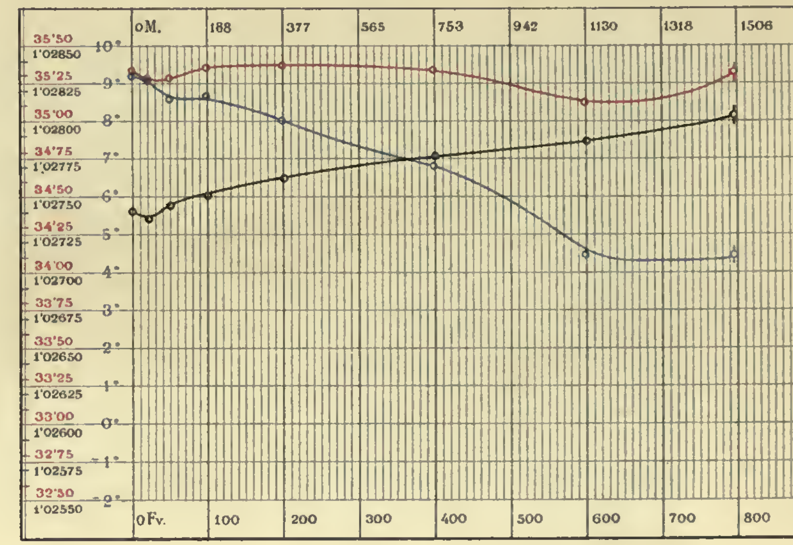

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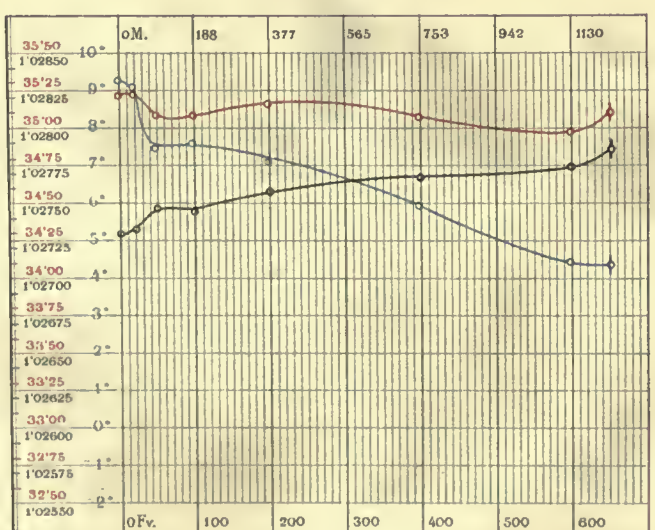

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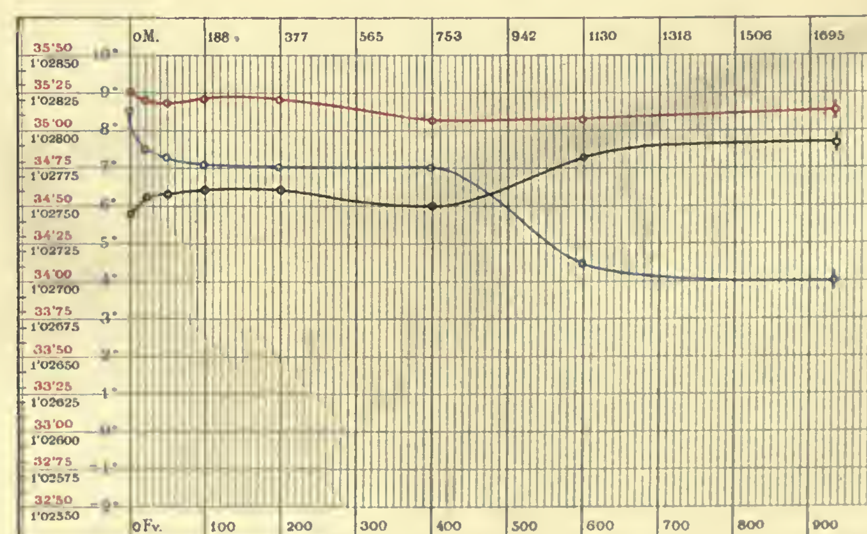

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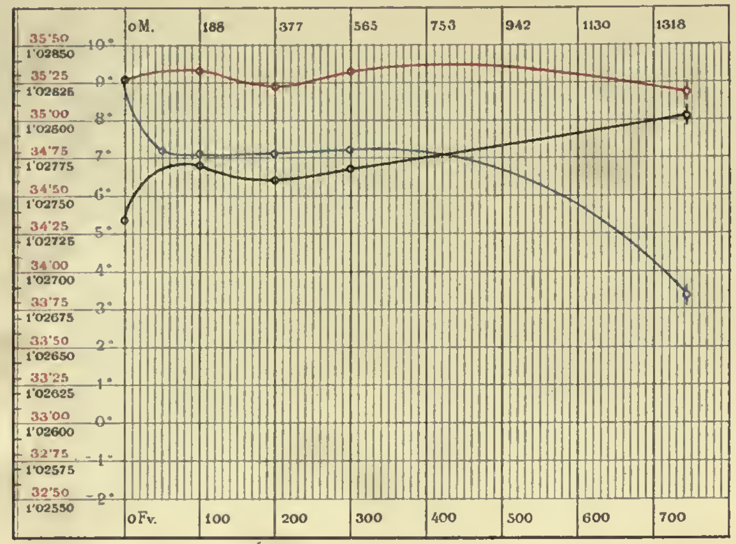

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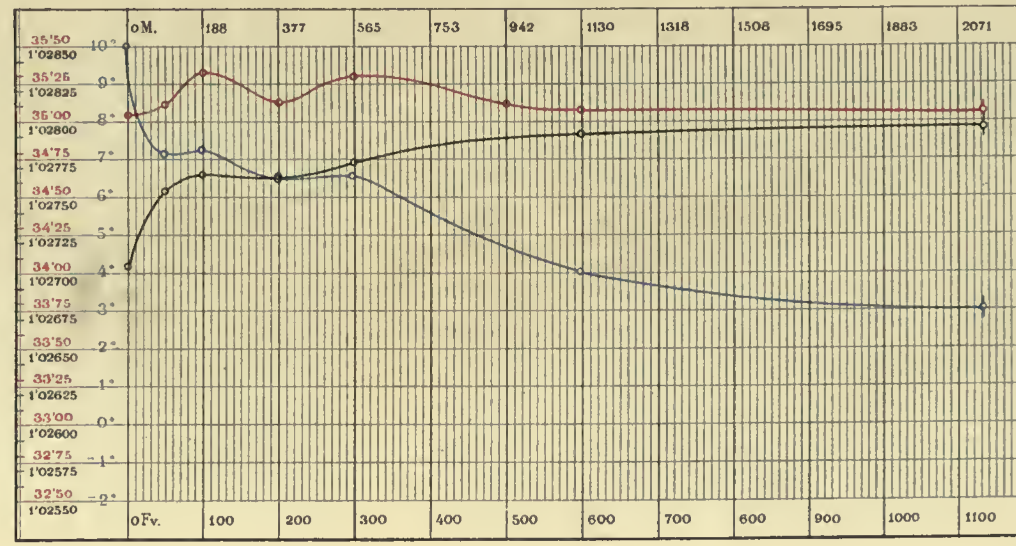

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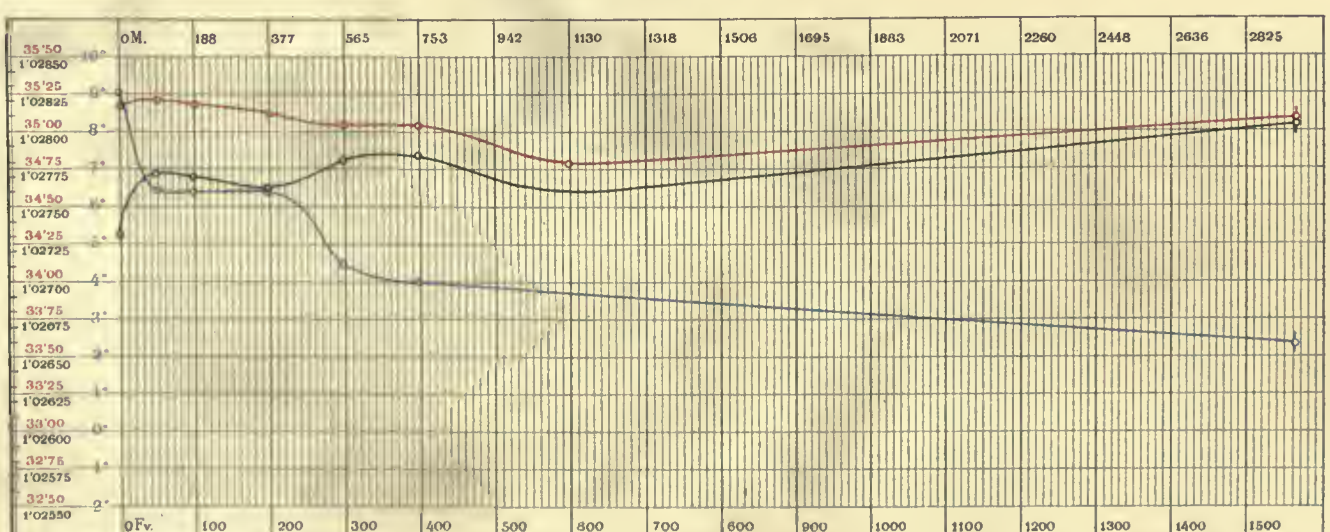

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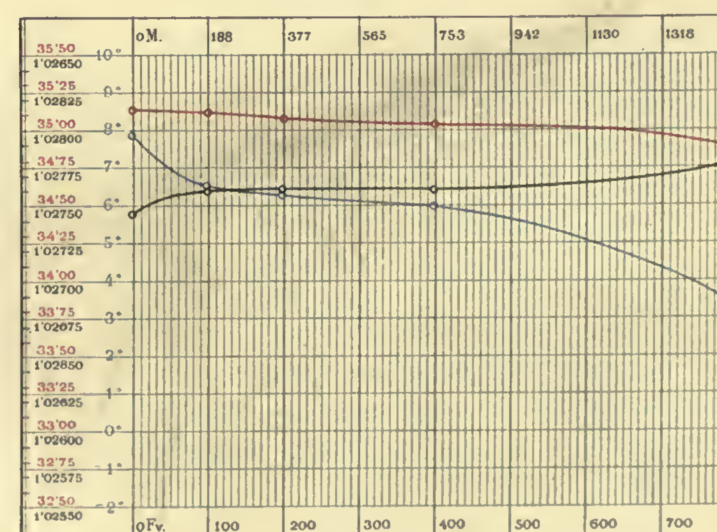

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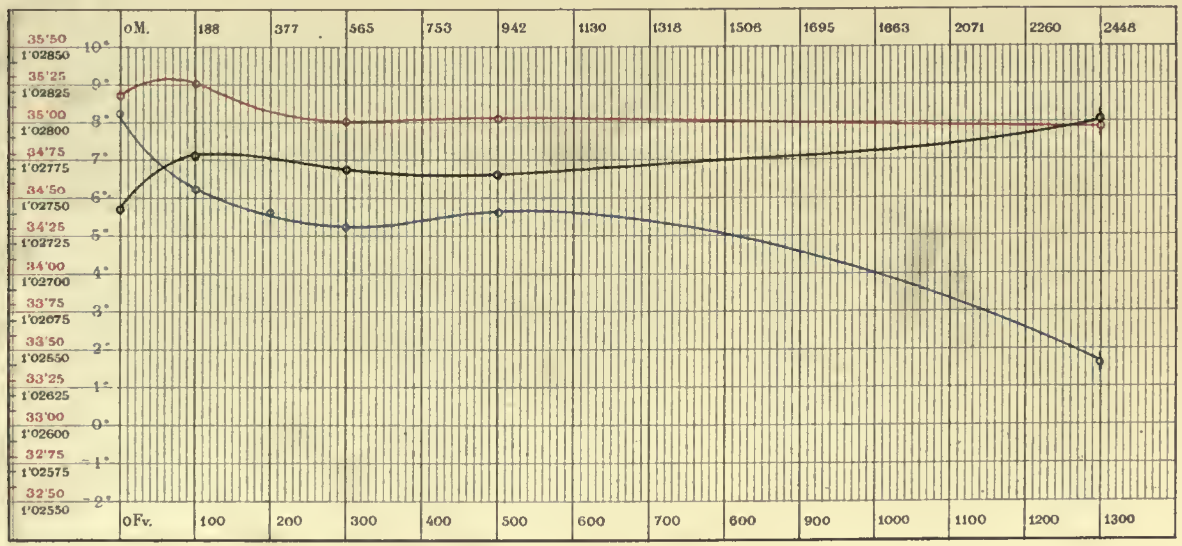

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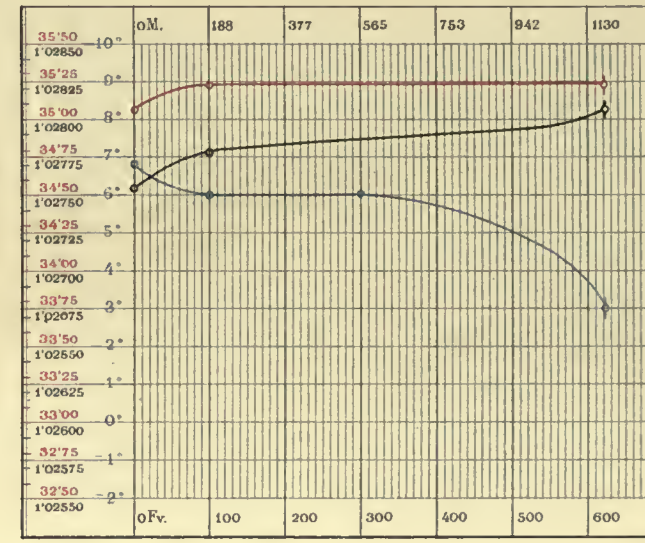

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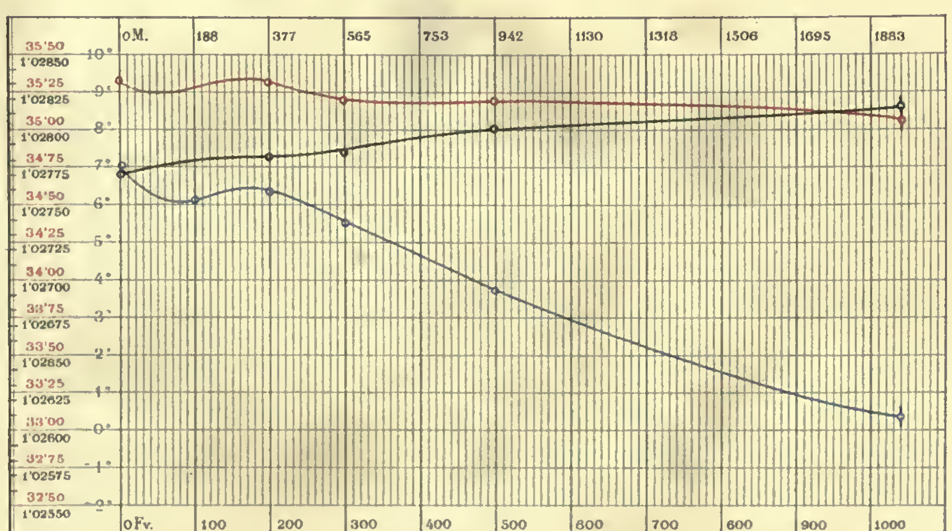

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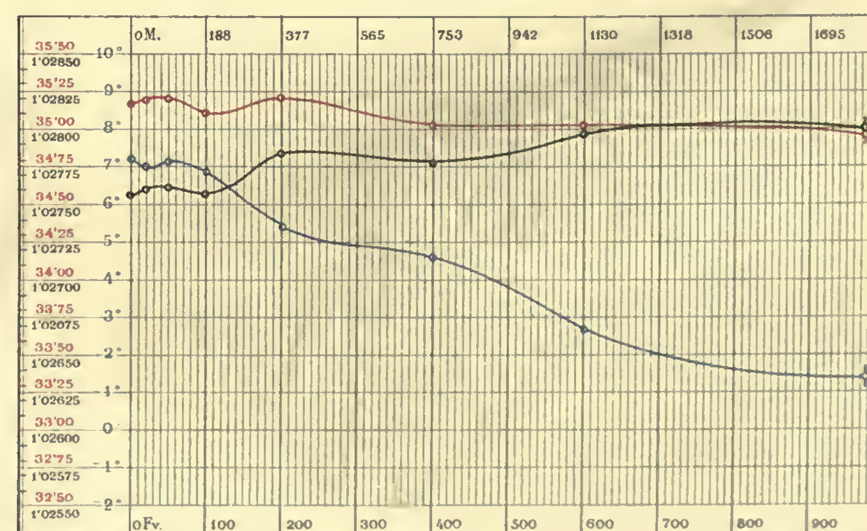

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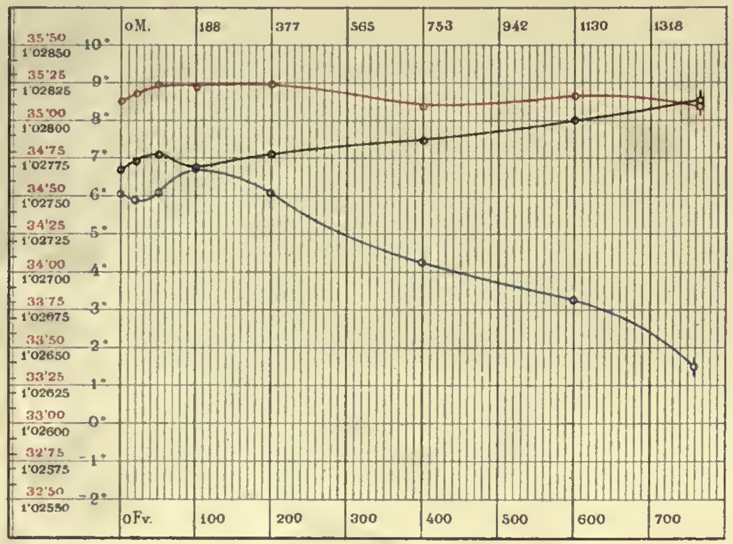

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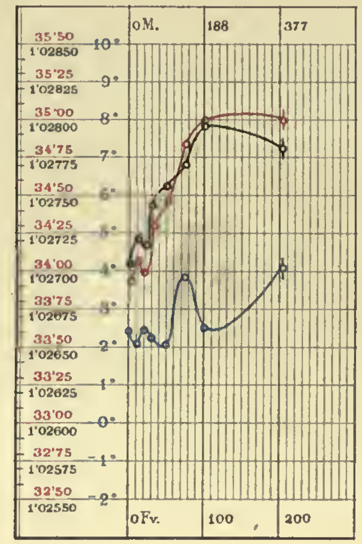

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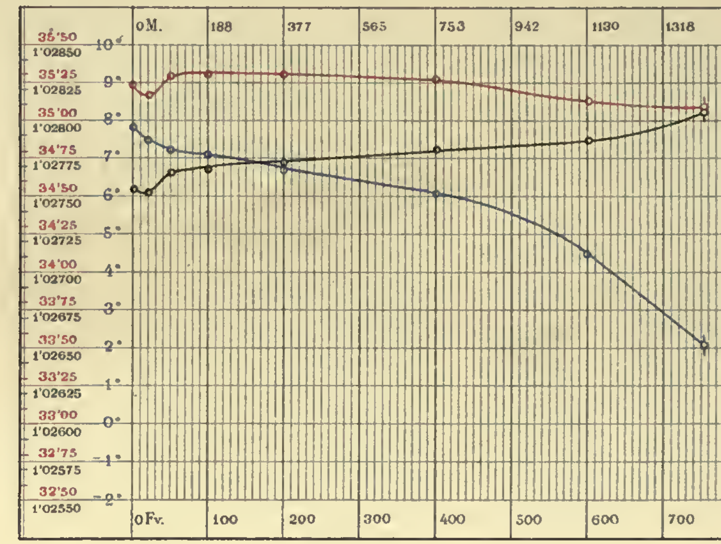

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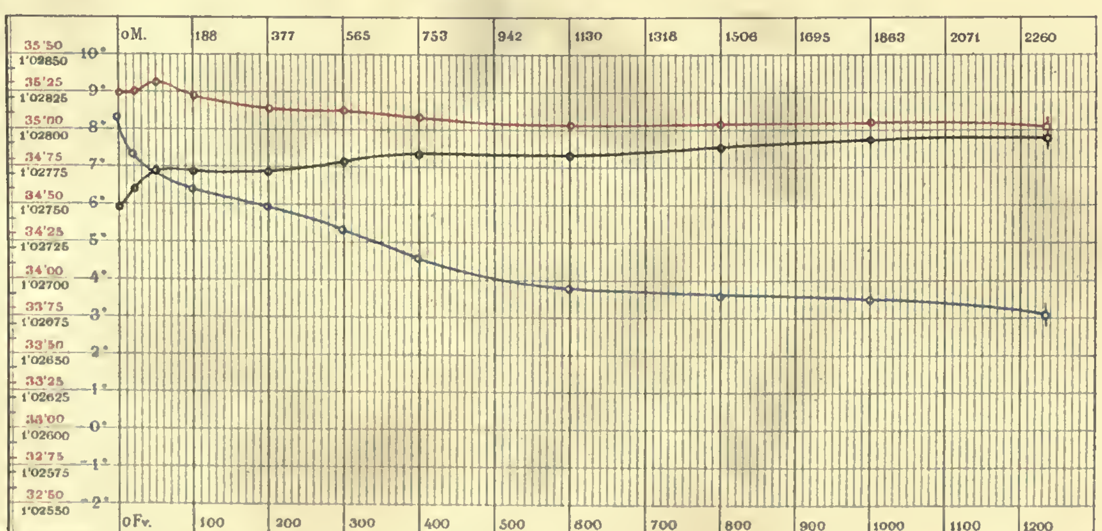

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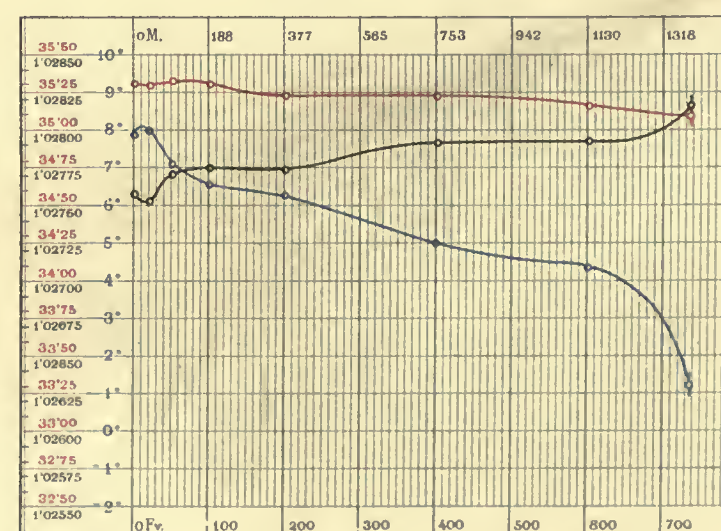

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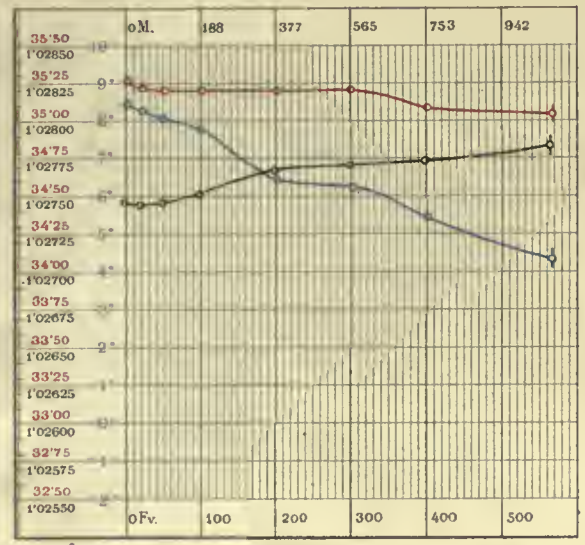

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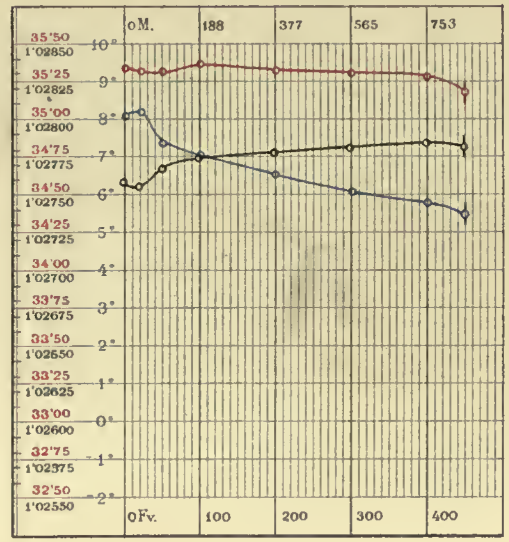

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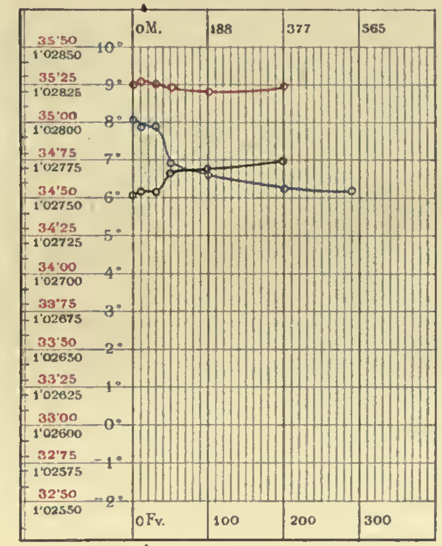

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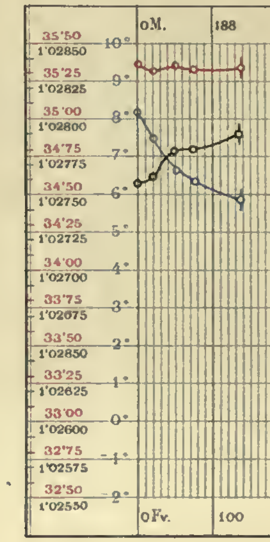

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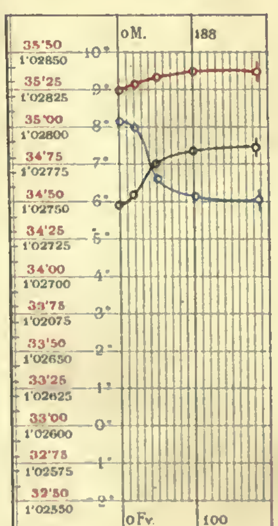

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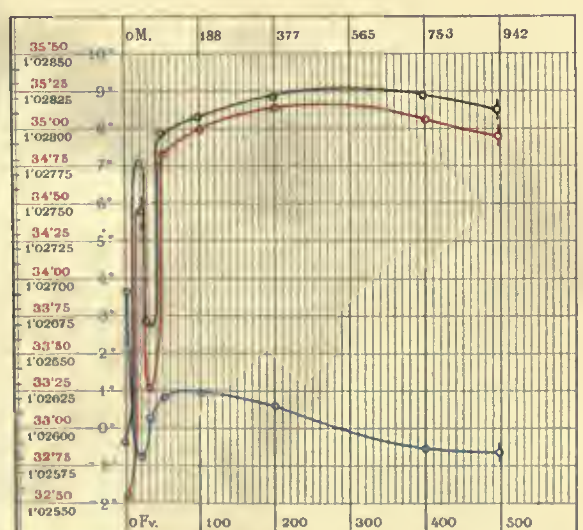

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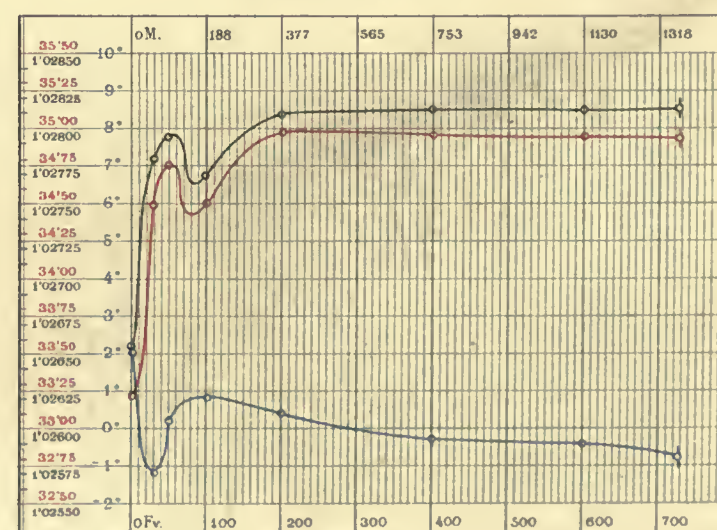

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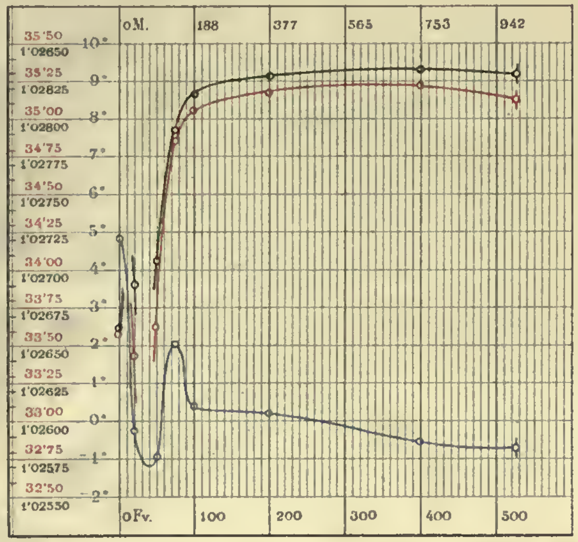

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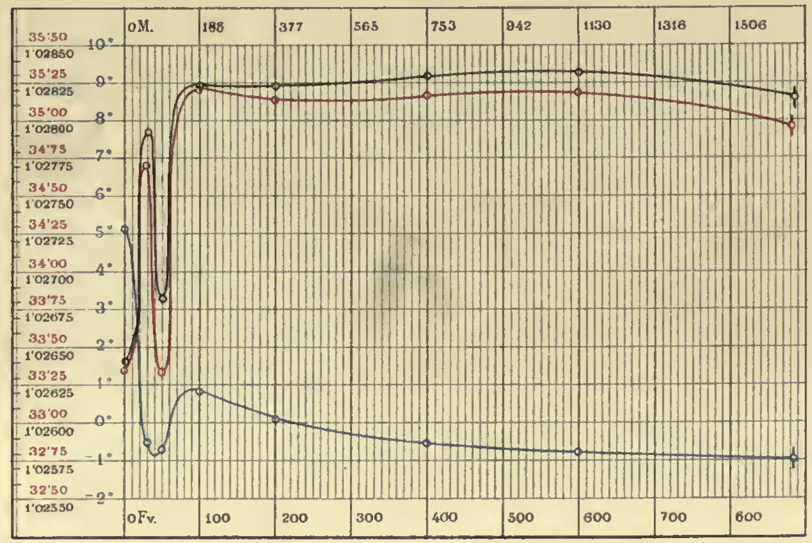

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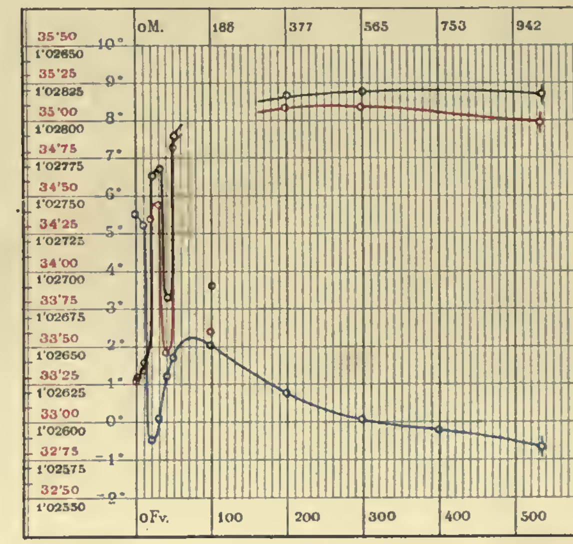

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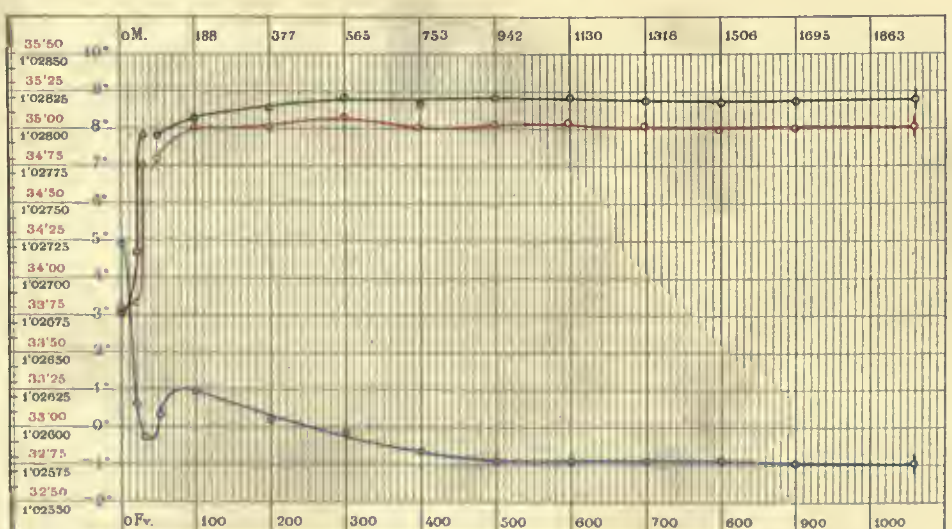

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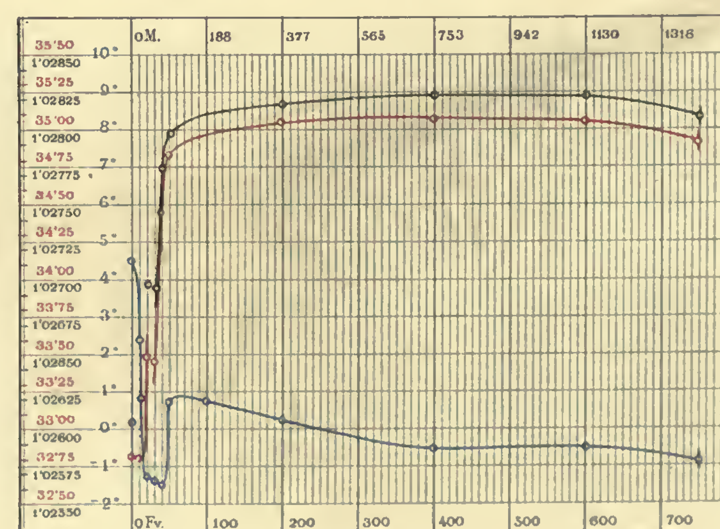

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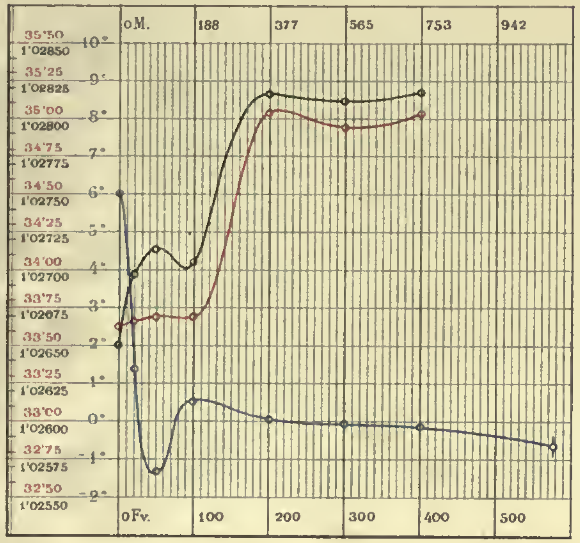

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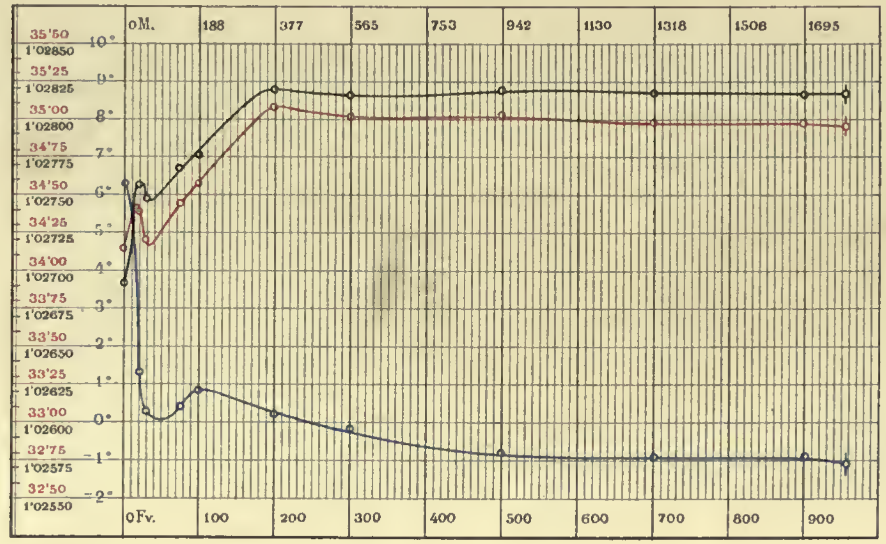

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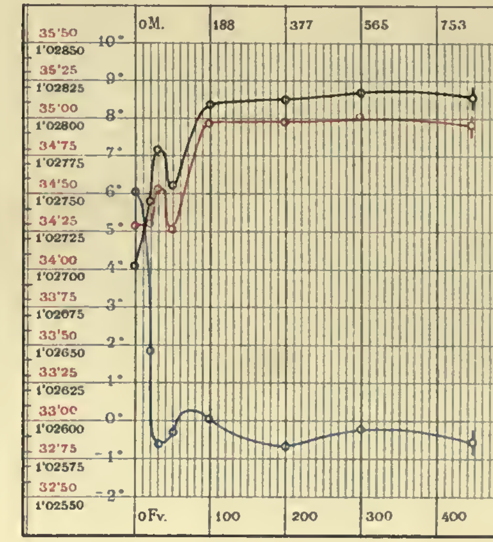

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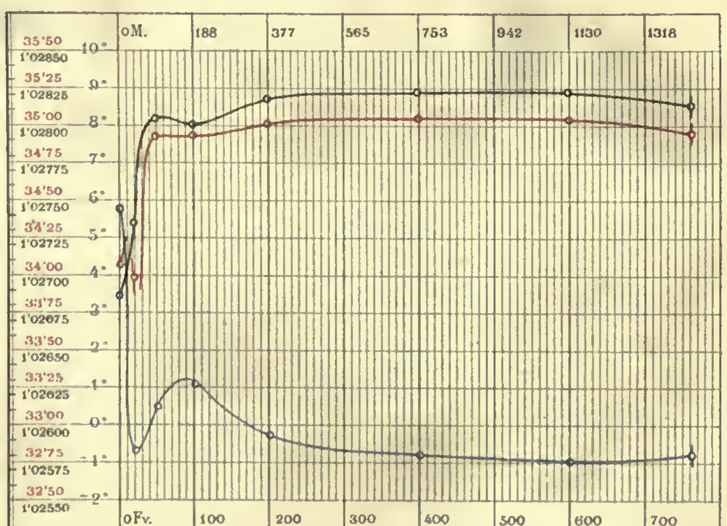

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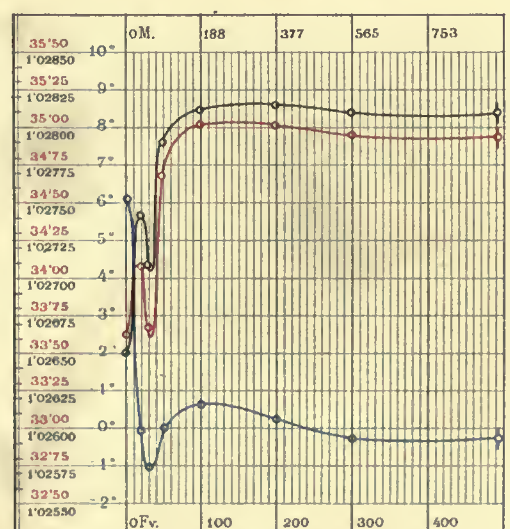

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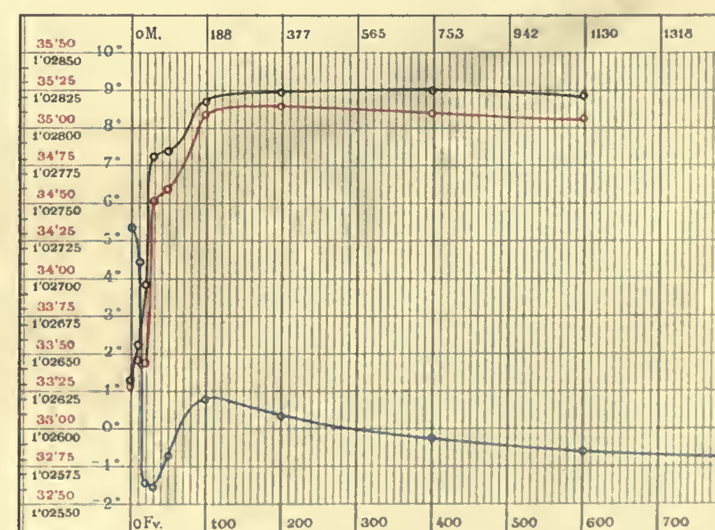

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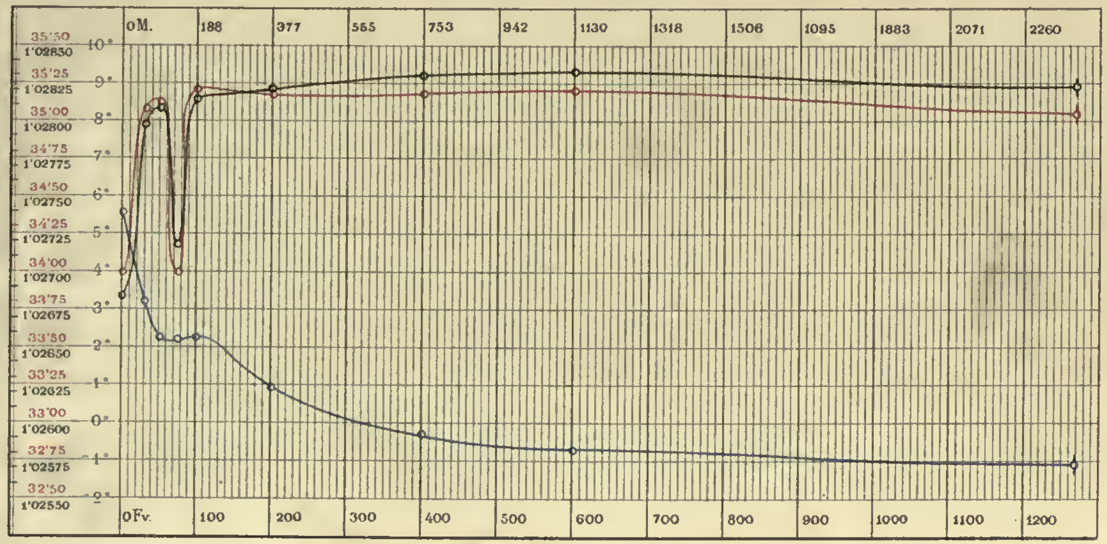

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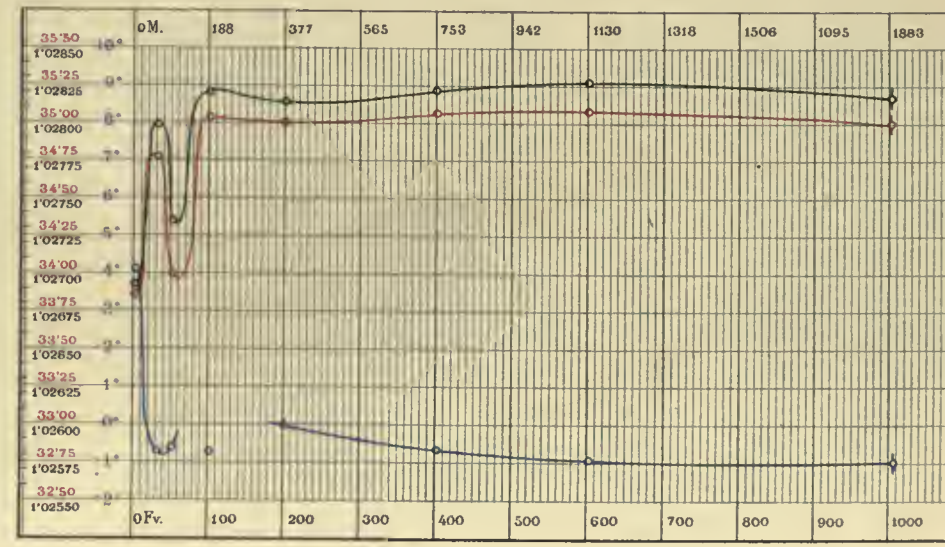

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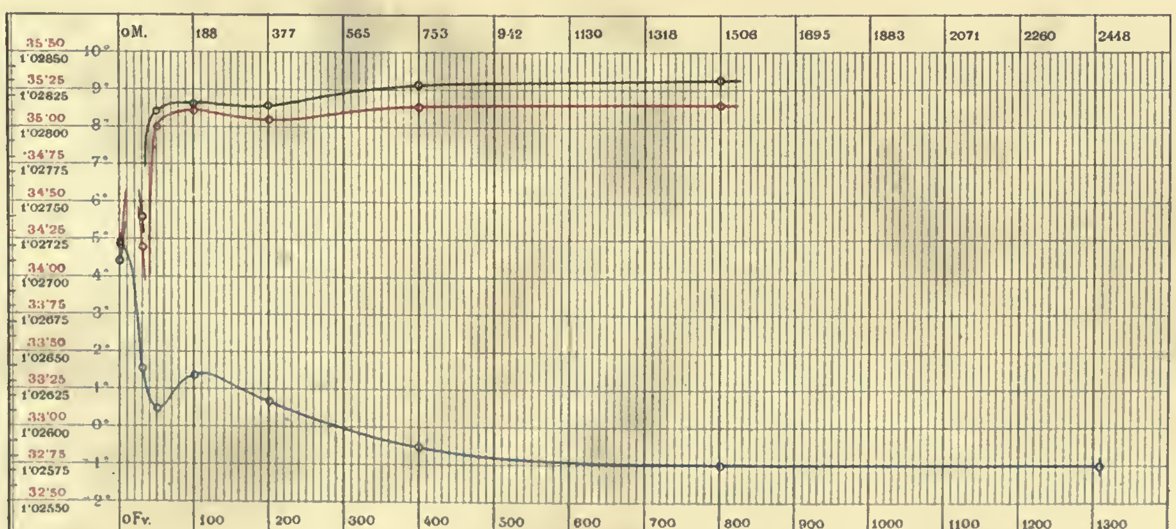

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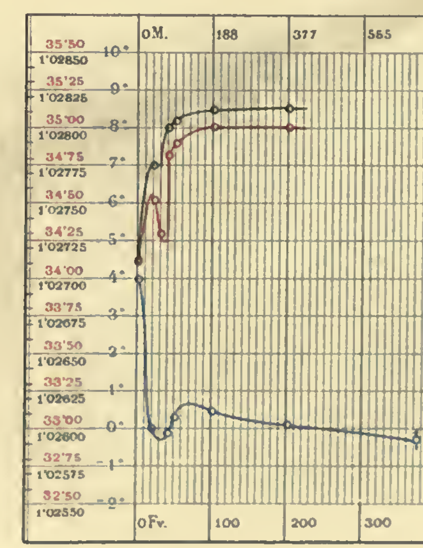

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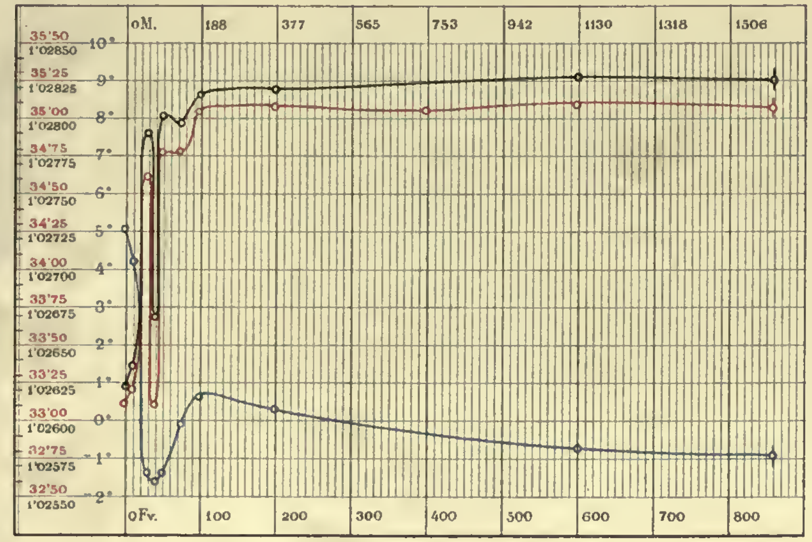

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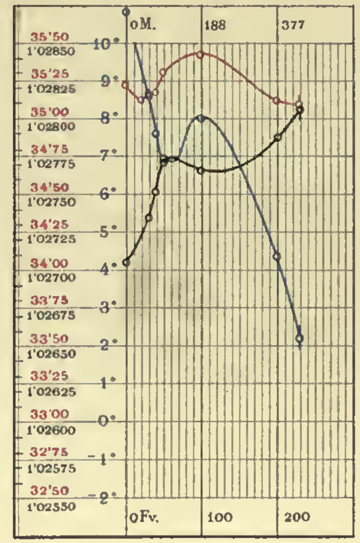

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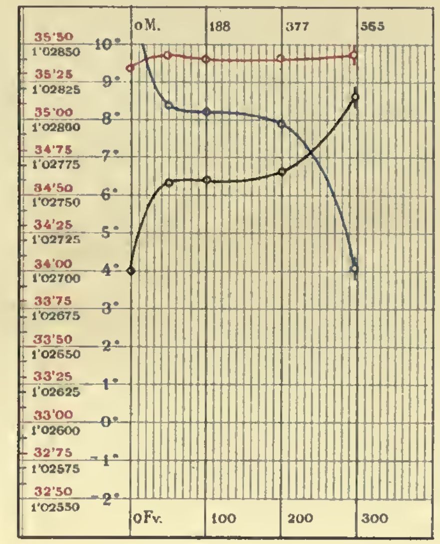

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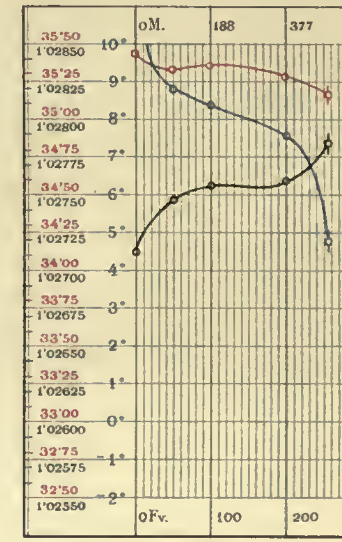

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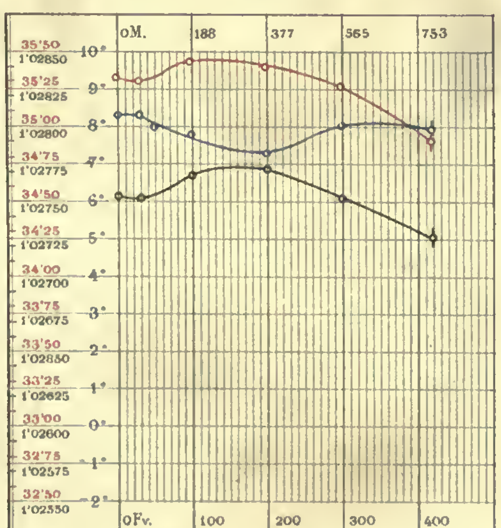

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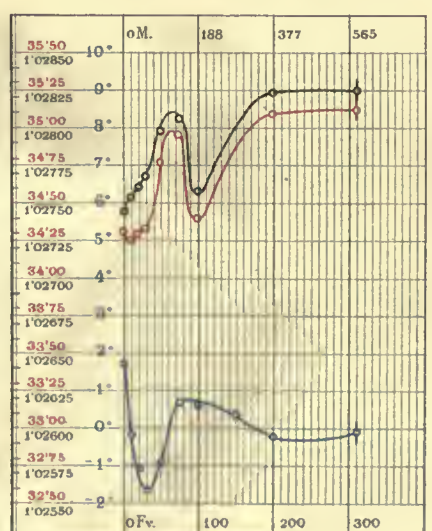

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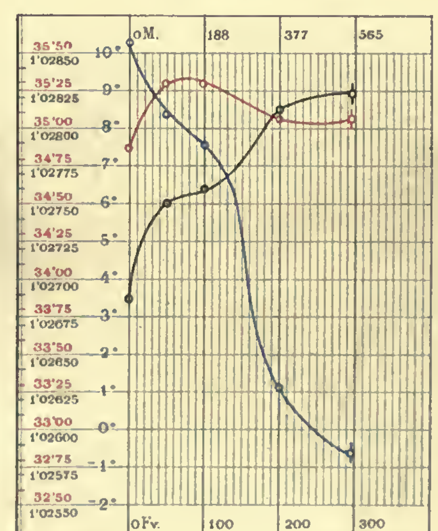

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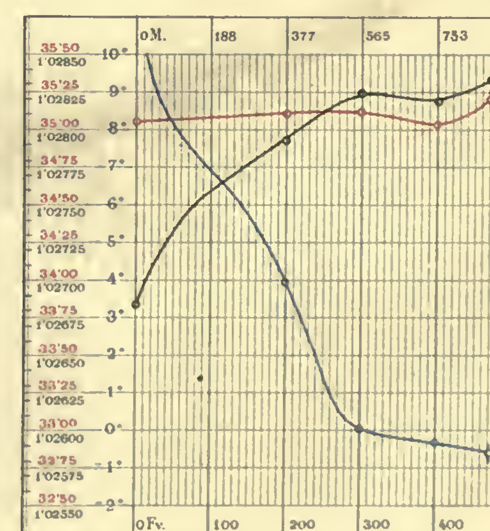
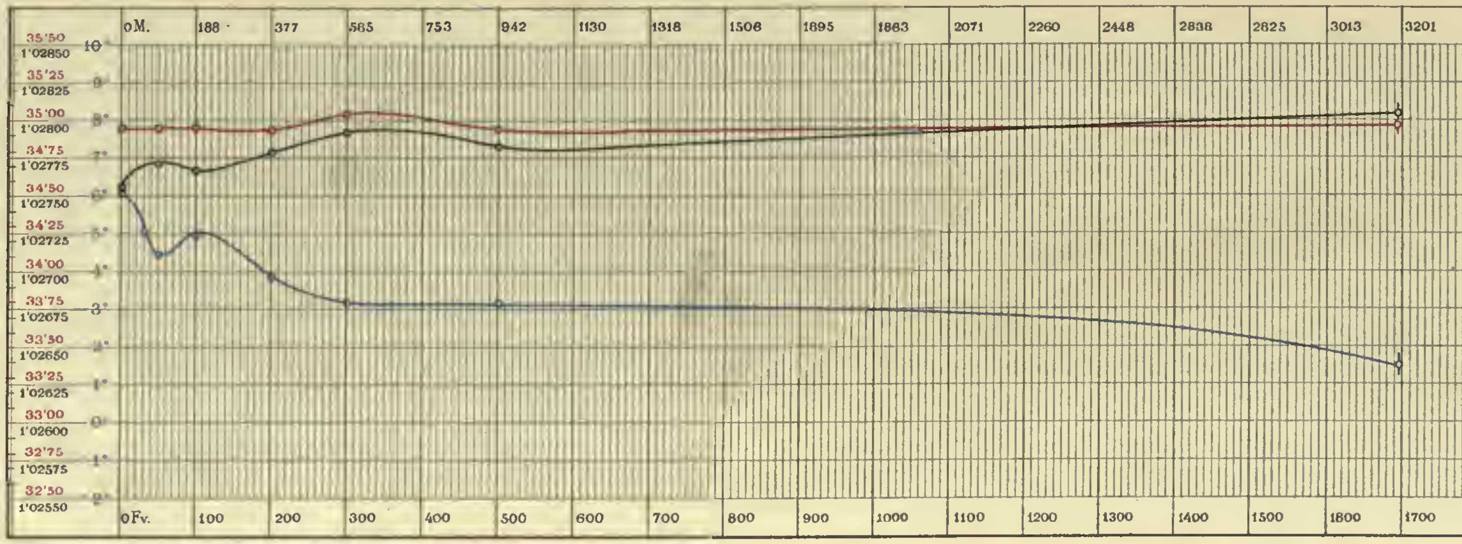
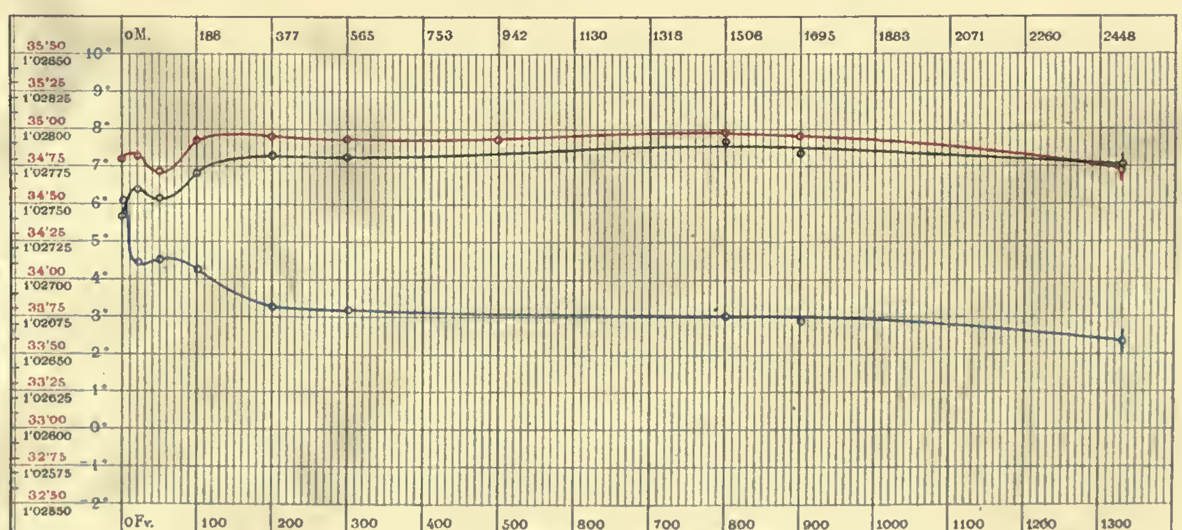


Axel E. Aamodt Kjøbenhavn

20 58° 20′ N. Lat. 40° 48′ W. Long.

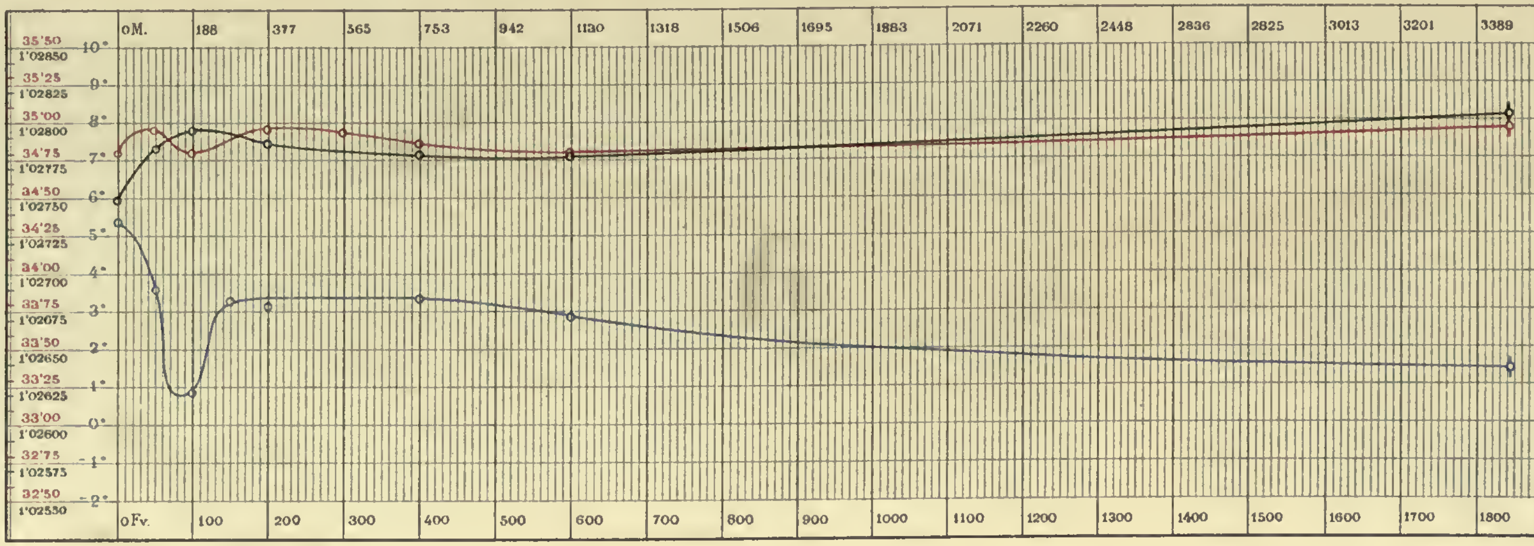


21 58° 01′ N. Lat. 44° 45′ W. Long.



Axel E Aamodt, Kjøbenhavn

22 58° 10' N. Lat. 48° 25' W. Long.



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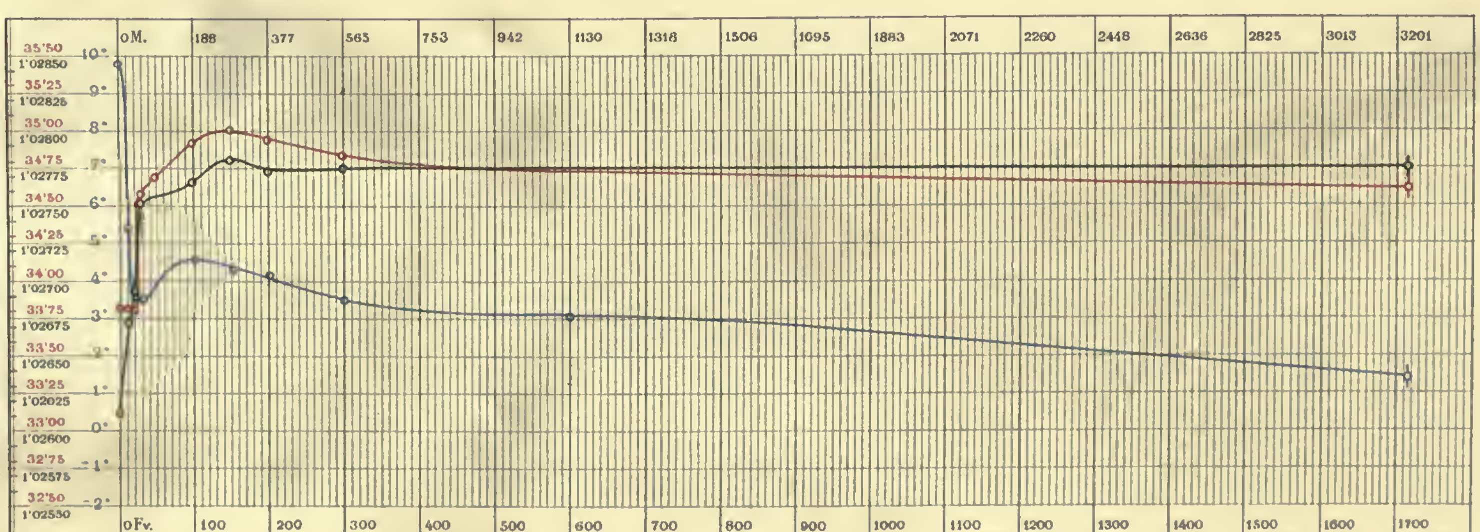

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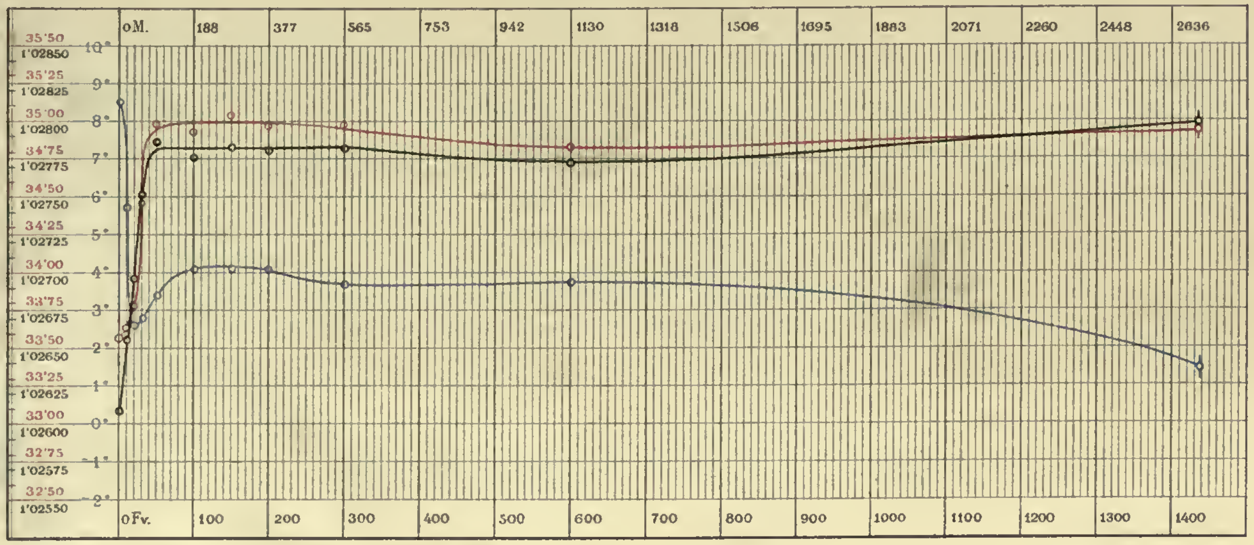
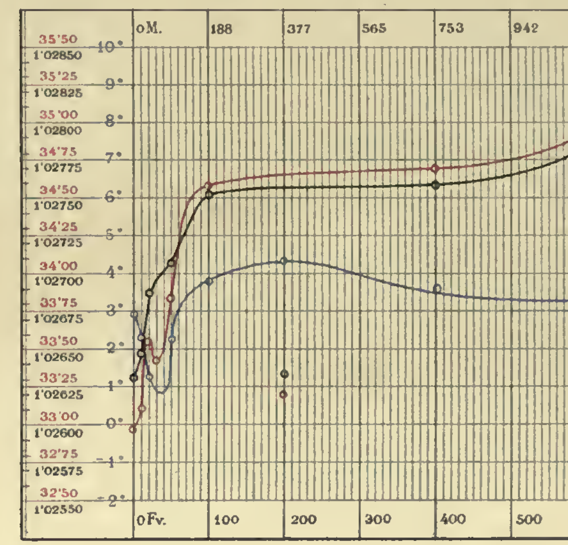
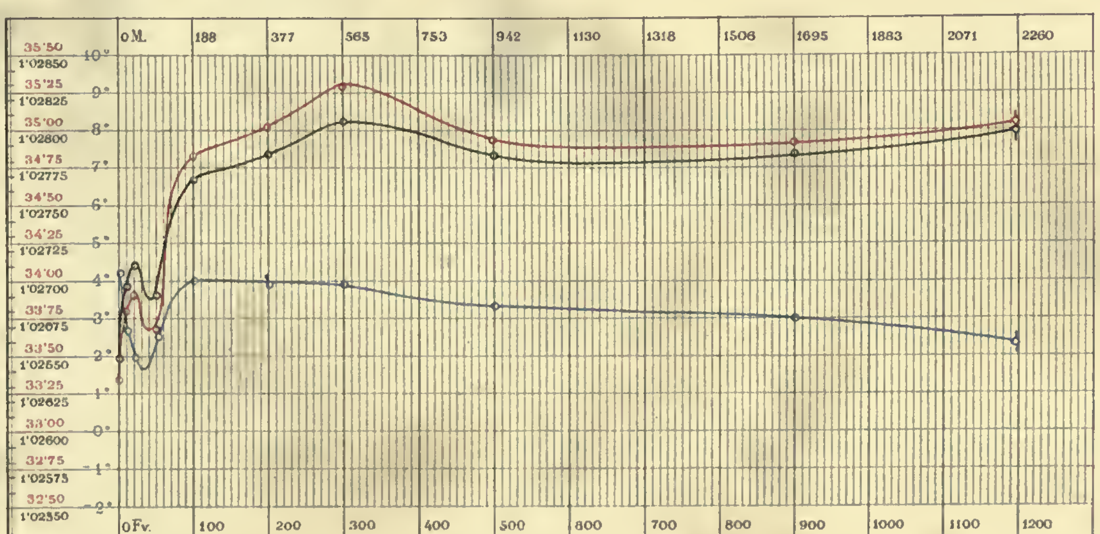


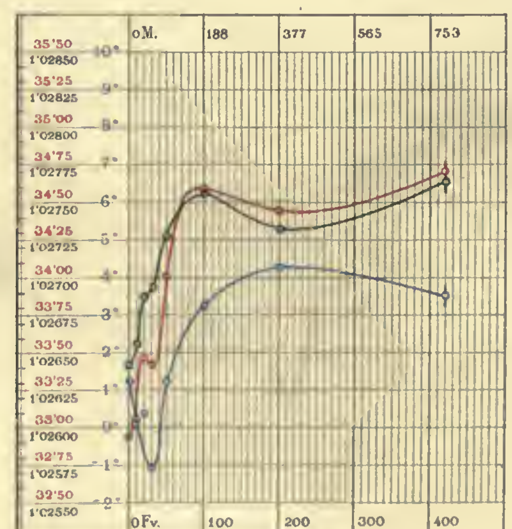
25 63° 30' N. Lat. 54° 25' W. Long.



24 63° 06' N. Lat. 56° 00' W. Long.



28 65° 14' N. Lat. 55° 42' W. Long.



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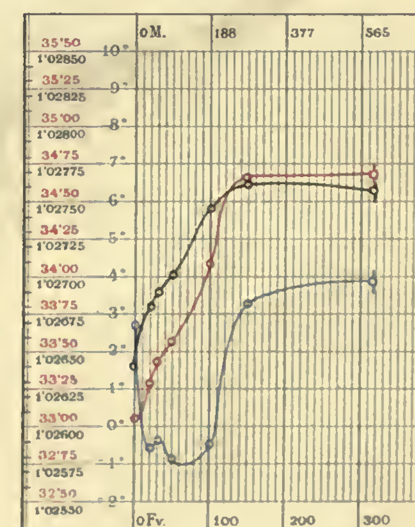
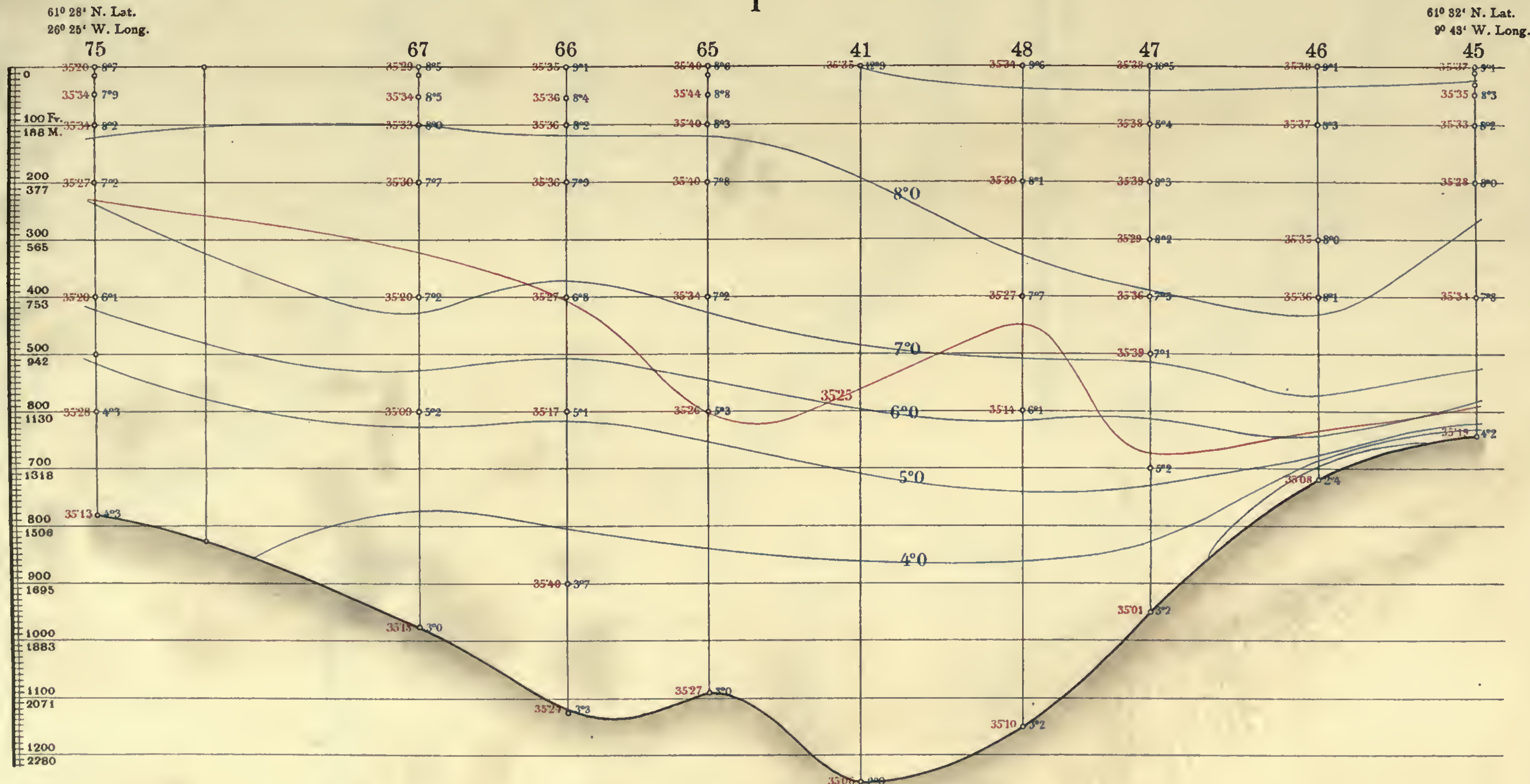
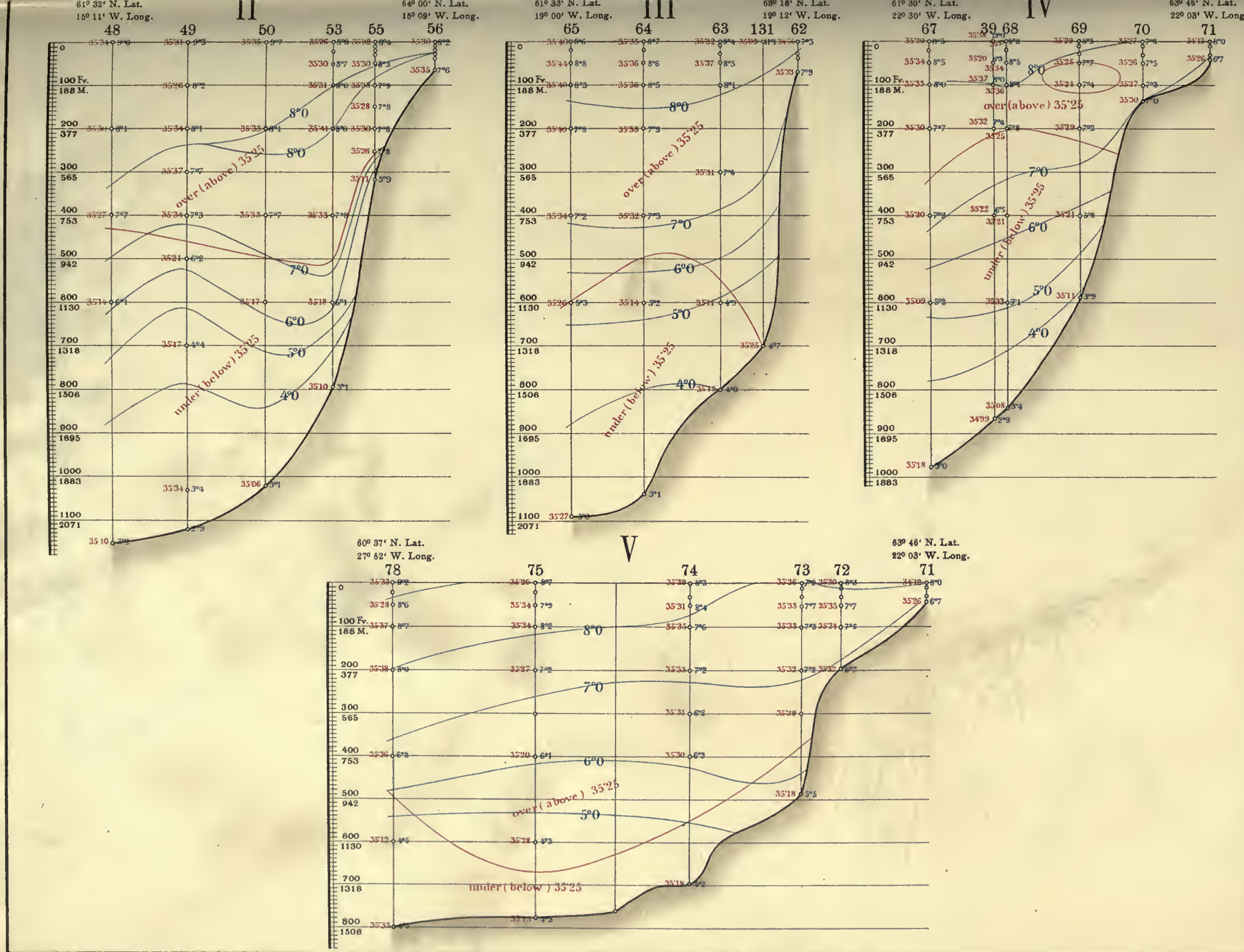
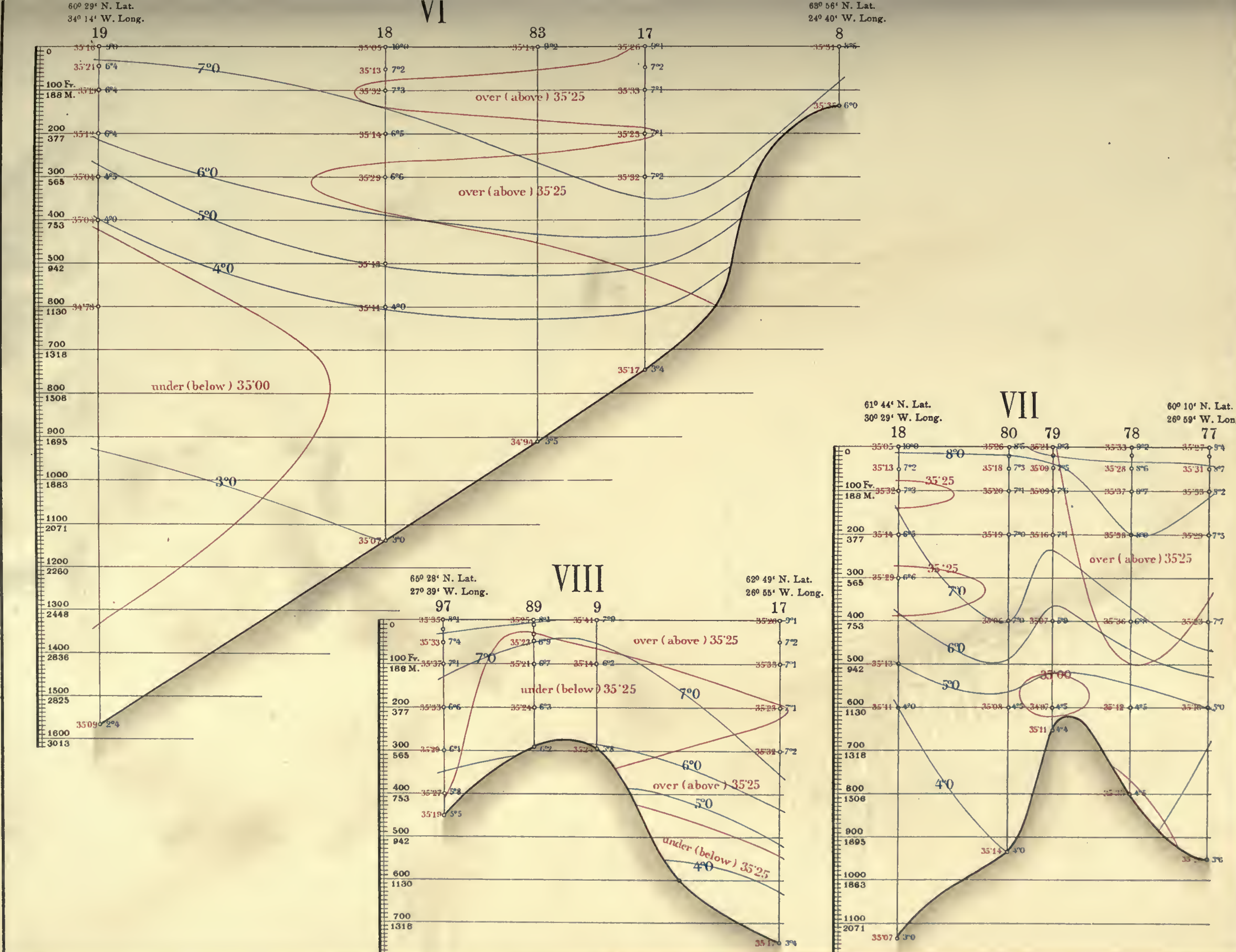


I

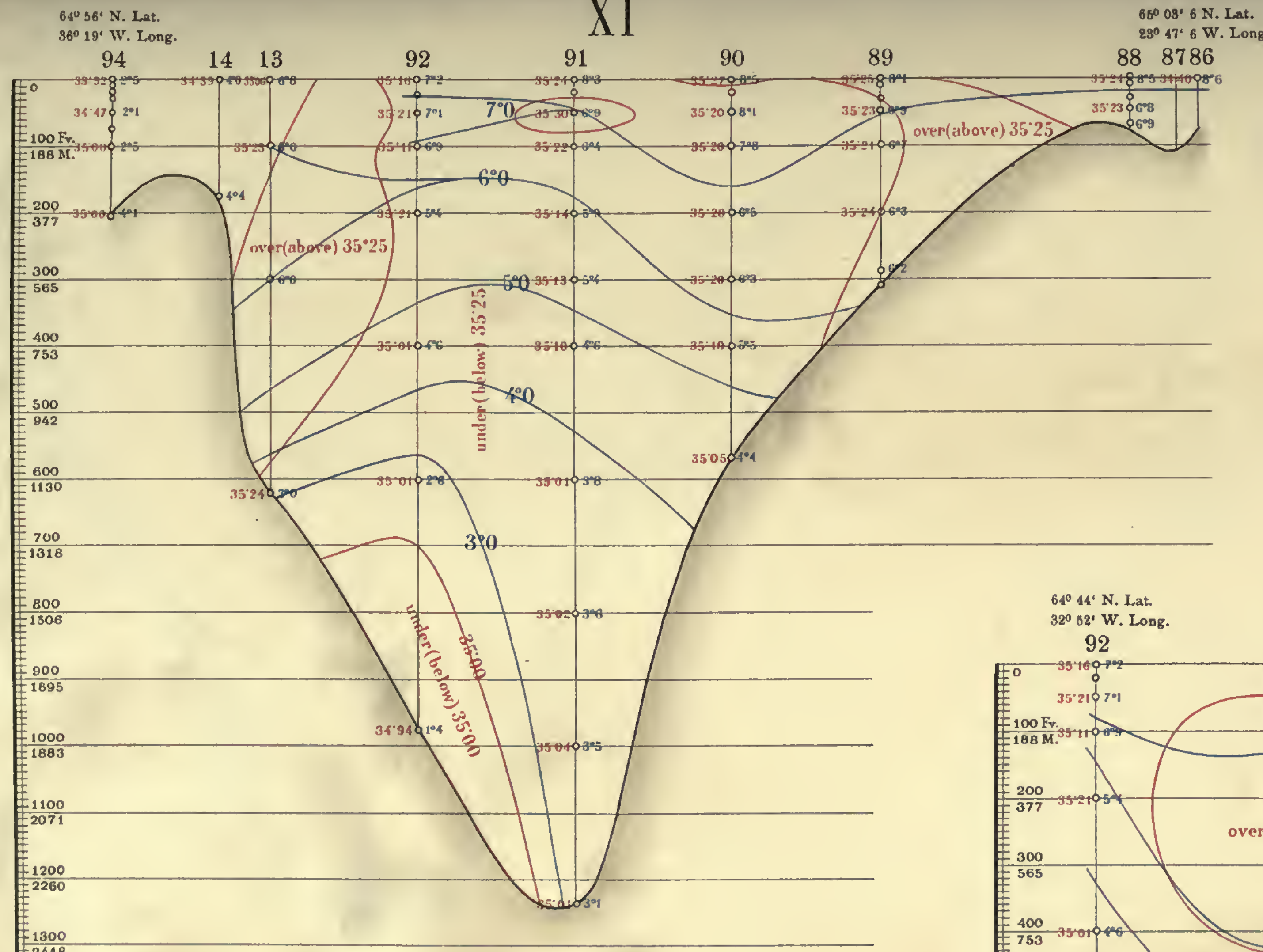

61° 28' N. Lat.
26° 25' W. Long.
61° 32' N. Lat.
9° 43' W. Long.
75
67
66
65
41
48
47
46
45
0
100 Fv.
188 M.
200
377
300
565
400
753
500
942
600
1130
700
1318
800
1506
900
1695
1000
1883
1100
2071
1200
2280
8°0
7°0
6°0
5°0
4°0
35·25



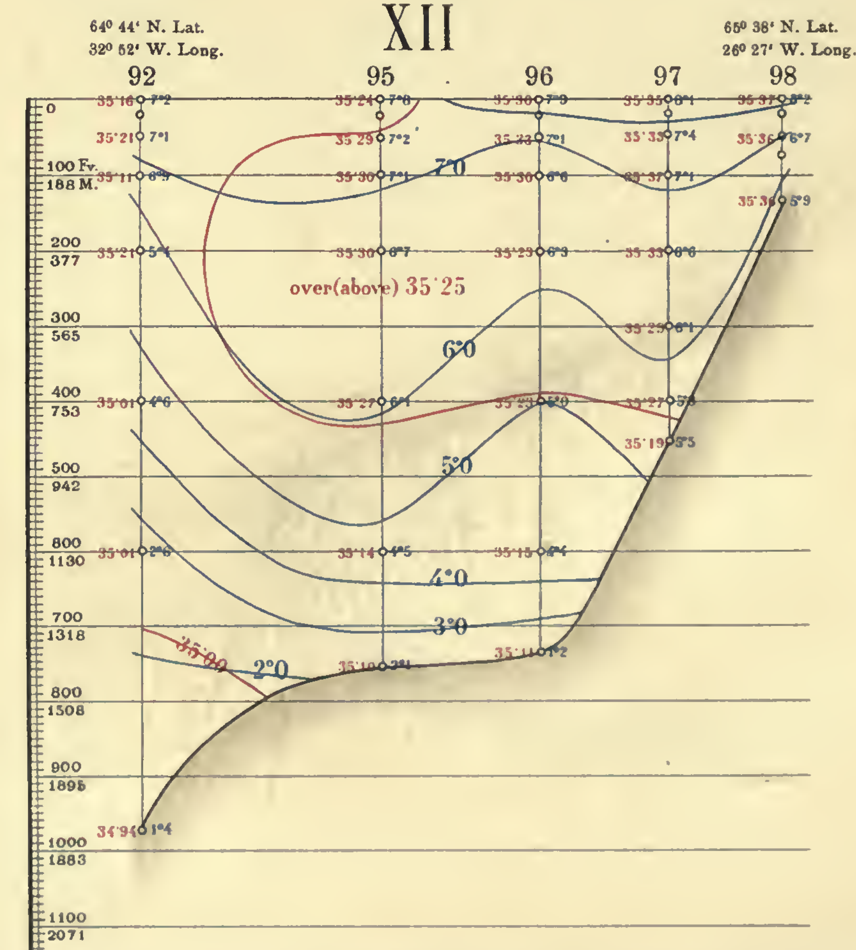
II
61° 32' N. Lat.
15° 11' W. Long.
64° 00' N. Lat.
15° 09' W. Long.
48
49
50
53
55
56
III
61° 33' N. Lat.
19° 00' W. Long.
68° 18' N. Lat.
19° 12' W. Long.
65
64
63
131
62
IV
61° 30' N. Lat.
22° 30' W. Long.
63° 46' N. Lat.
22° 03' W. Long.
67
39
68
69
70
71
V
60° 37' N. Lat.
27° 52' W. Long.
63° 46' N. Lat.
22° 03' W. Long.
78
75
74
73
72
71
100 Fv.
188 M.
over (above) 35·25
under (below) 35·25
8°0
7°0
6°0
5°0
4°0

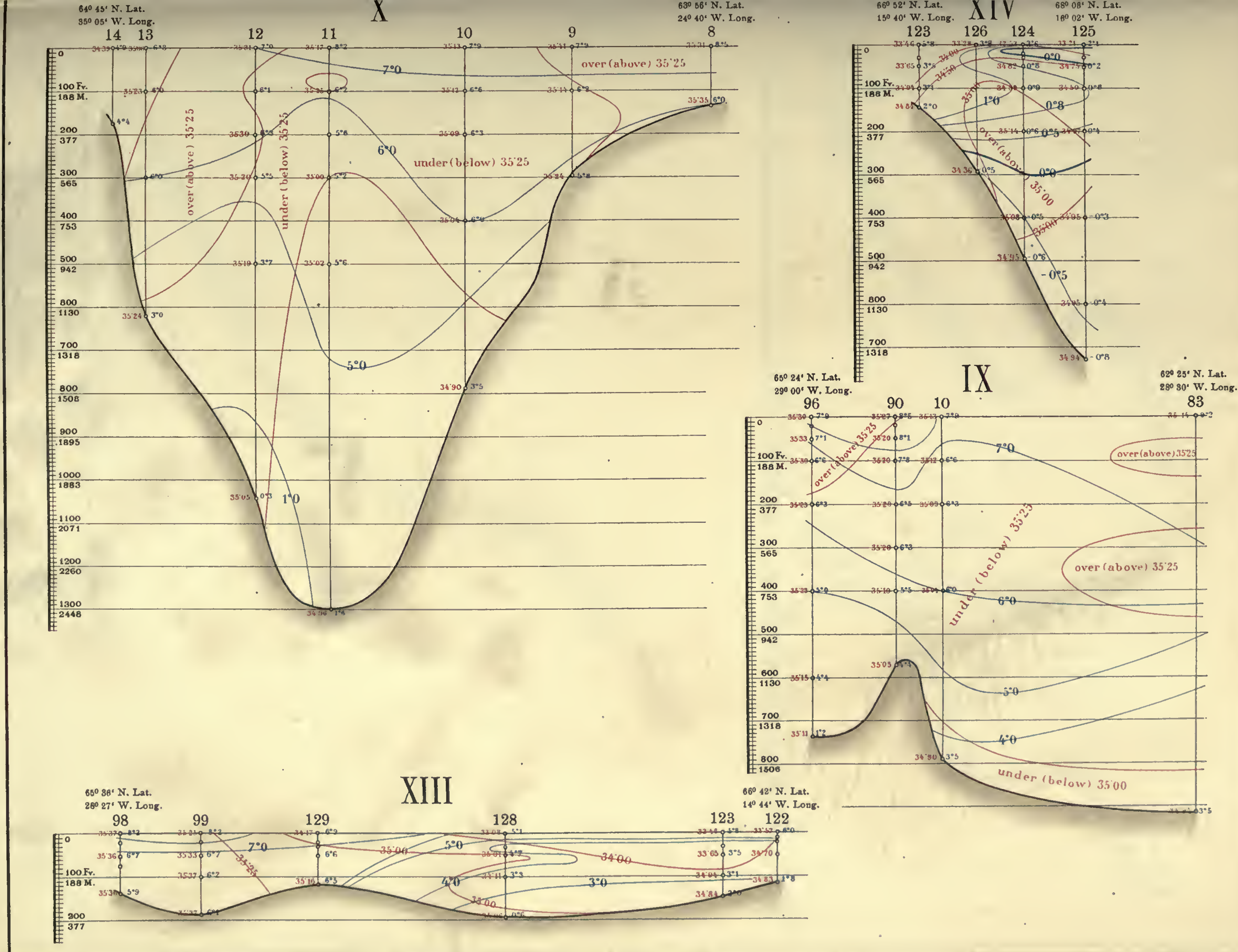

VI
60° 29' N. Lat.
34° 14' W. Long.
63° 56' N. Lat.
24° 40' W. Long.
19
18
83
17
8
over (above) 35'25
over (above) 35'25
under (below) 35'00
7°0
6°0
5°0
4°0
3°0
VII
61° 44' N. Lat.
30° 29' W. Long.
60° 10' N. Lat.
26° 59' W. Long.
18
80
79
78
77
35'25
35'25
over (above) 35'25
35'00
8°0
7°0
6°0
5°0
4°0
VIII
65° 28' N. Lat.
27° 39' W. Long.
62° 49' N. Lat.
26° 55' W. Long.
97
89
9
17
over (above) 35'25
under (below) 35'25
over (above) 35'25
under (below) 35'25
7°0
6°0
5°0
4°0
100 Fv.
188 M.

XI

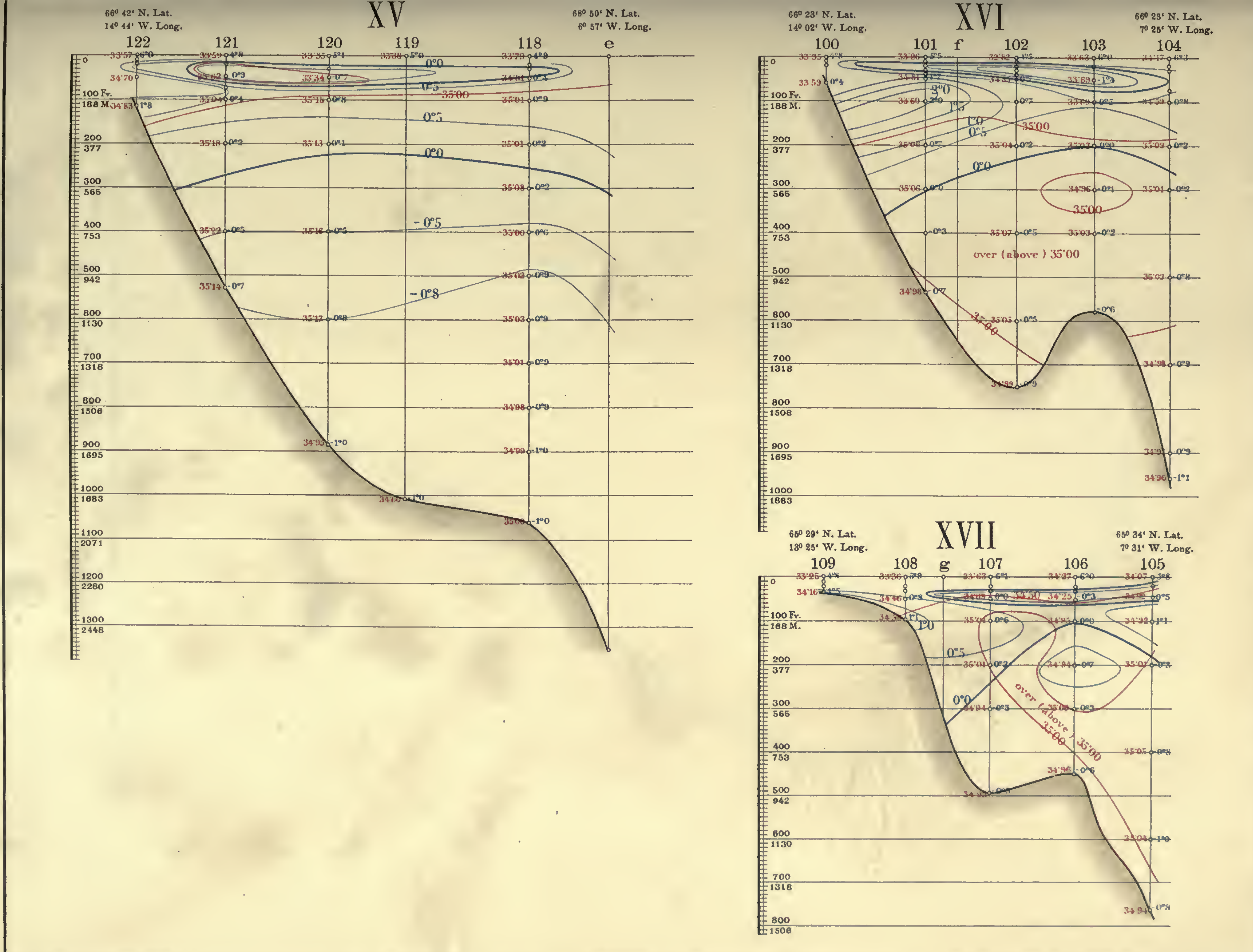

64° 56' N. Lat.
36° 19' W. Long.
65° 08' 6 N. Lat.
23° 47' 6 W. Long.
94
14
13
92
91
90
89
88
87
86
100 Fv.
188 M.
over(above) 35·25
under (below) 35·25
under (below) 35·00
35·00
7°0
6°0
5°0
4°0
3°0

XII


64° 44' N. Lat.
32° 52' W. Long.
65° 38' N. Lat.
26° 27' W. Long.
92
95
96
97
98
100 Fv.
188 M.
over(above) 35·25
35·00
7°0
6°0
5°0
4°0
3°0
2°0

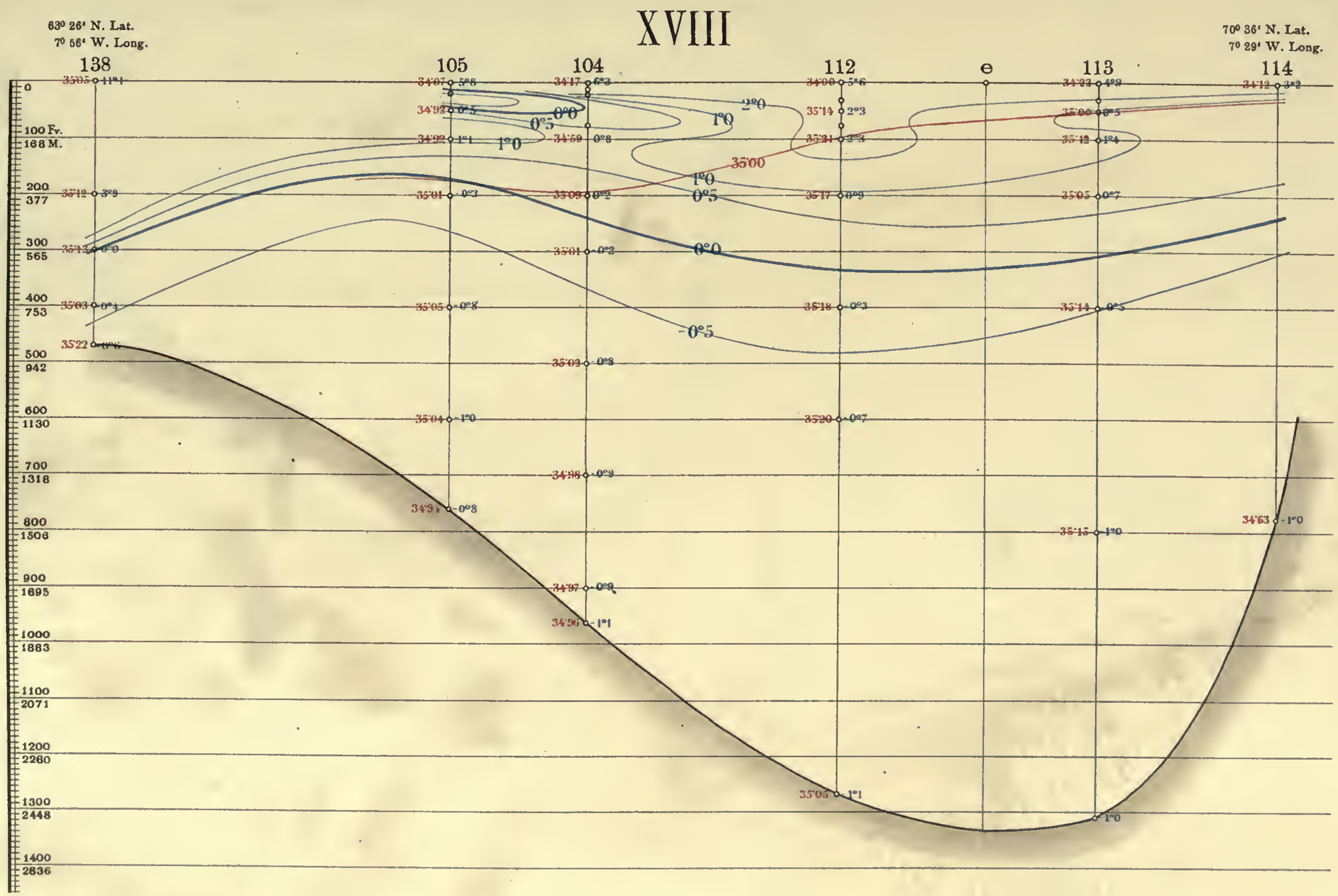


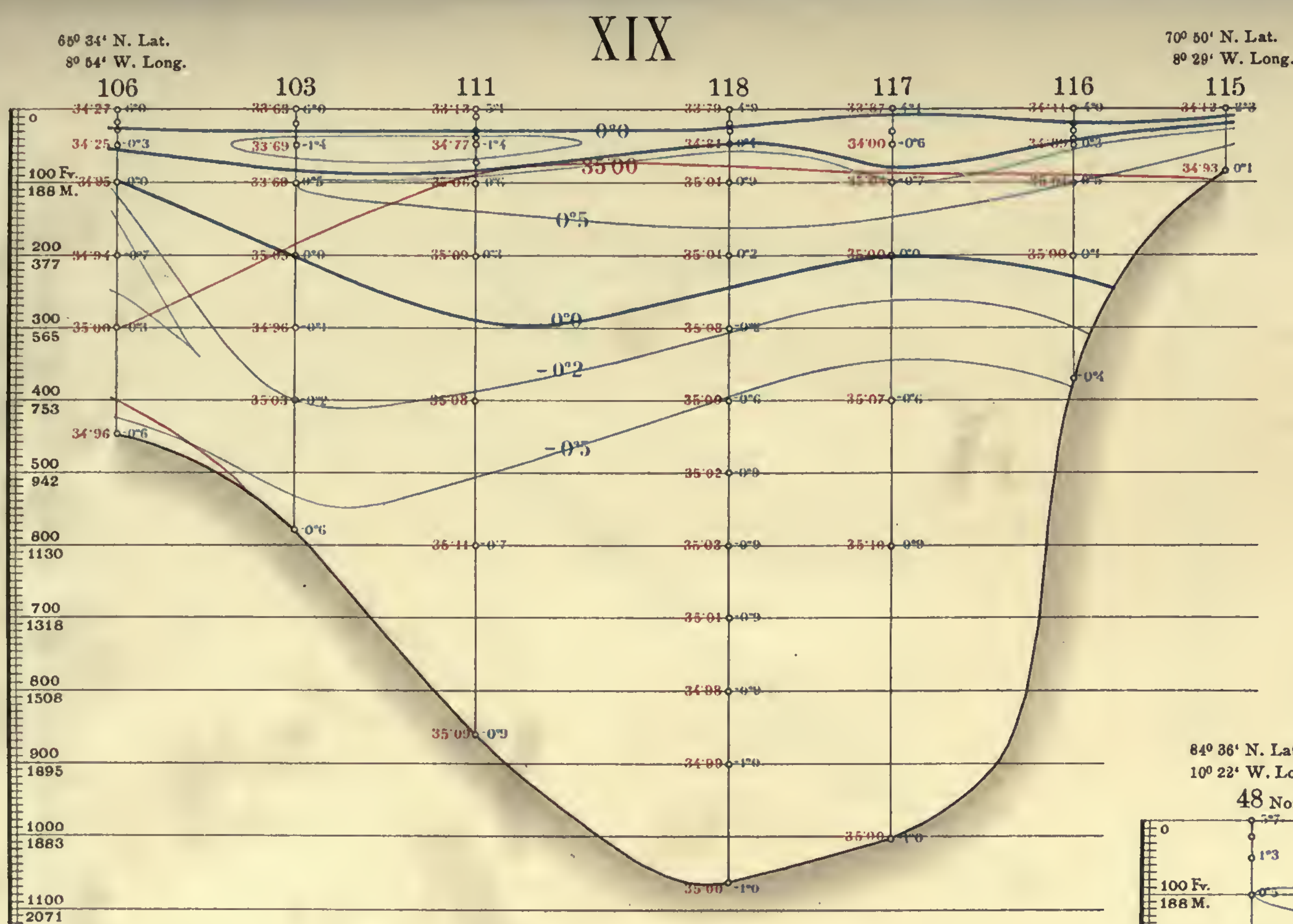
X
64° 45' N. Lat. 35° 05' W. Long.
63° 56' N. Lat. 24° 40' W. Long.
over (above) 35·25
under (below) 35·25
XIV
66° 52' N. Lat. 15° 40' W. Long.
68° 08' N. Lat. 16° 02' W. Long.
IX
65° 24' N. Lat. 29° 00' W. Long.
62° 25' N. Lat. 28° 30' W. Long.
under (below) 35·00
XIII
65° 36' N. Lat. 26° 27' W. Long.
66° 42' N. Lat. 14° 44' W. Long.

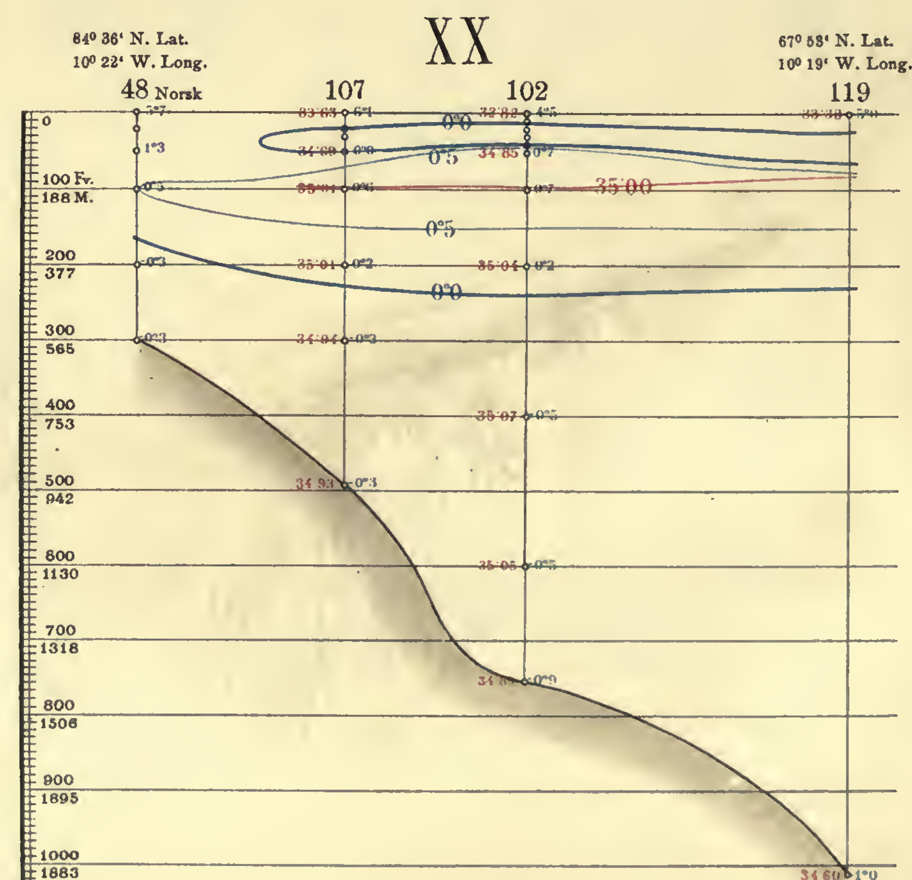


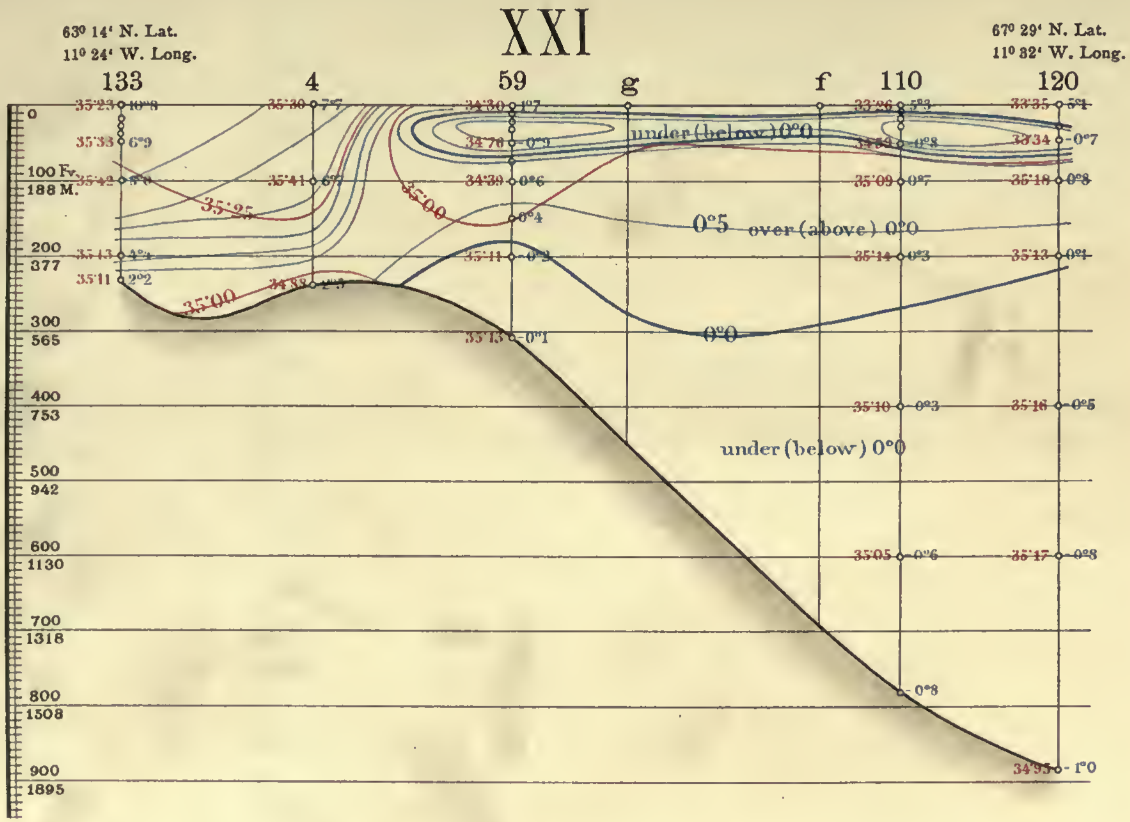
AXEL E AAMODT, KJØBENHAVN

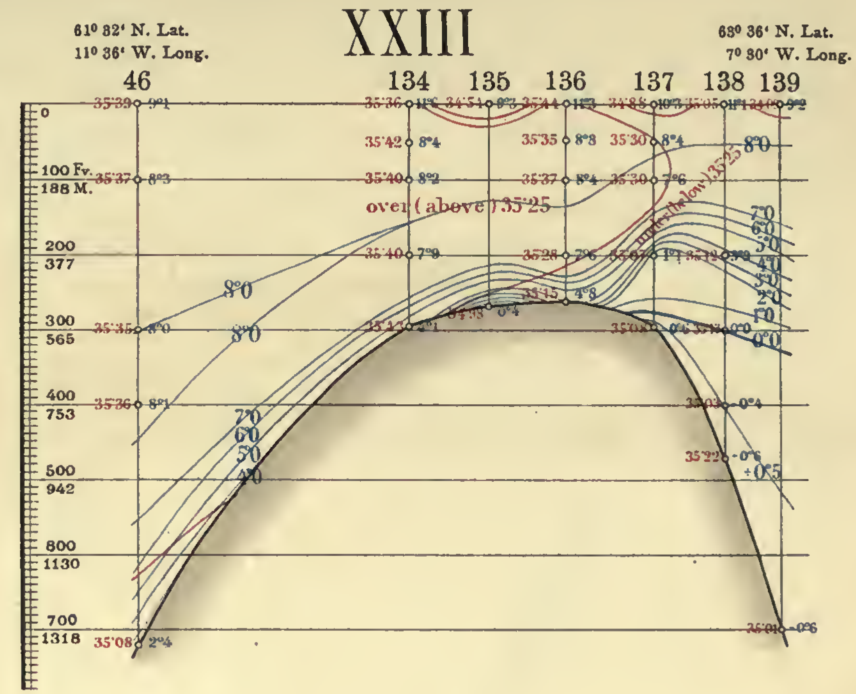
XVIII

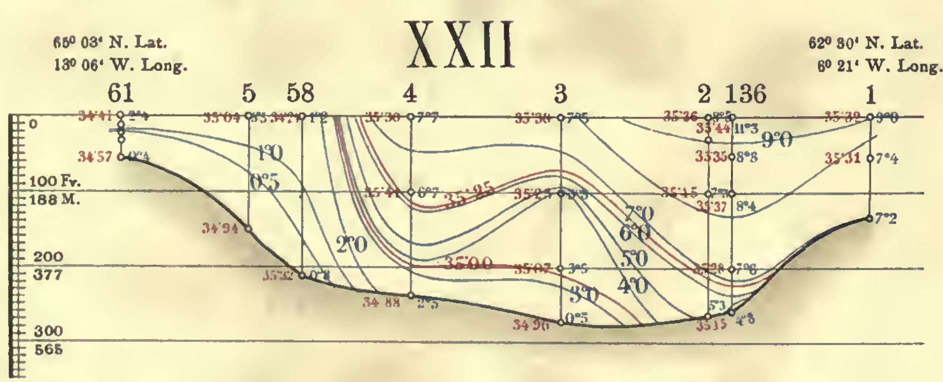

63° 26' N. Lat.
7° 56' W. Long.
70° 36' N. Lat.
7° 29' W. Long.
138
105
104
112
e
113
114
0
100 Fv.
168 M.
200
377
300
565
400
753
500
942
600
1130
700
1318
800
1506
900
1695
1000
1883
1100
2071
1200
2260
1300
2448
1400
2836
2°0
1°0
0°5
0°0
-0°5
35·00

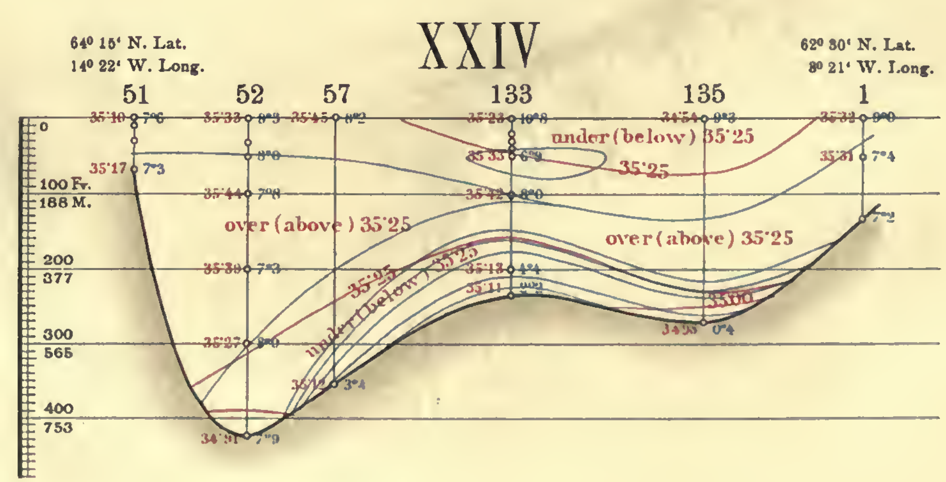

XIX
65° 34' N. Lat.
8° 54' W. Long.
70° 50' N. Lat.
8° 29' W. Long.
106
103
111
118
117
116
115
0
100 Fv.
188 M.
200
377
300
565
400
753
500
942
600
1130
700
1318
800
1508
900
1895
1000
1883
1100
2071
0°0
35·00
0°5
-0°2
-0°5


XX
64° 36' N. Lat.
10° 22' W. Long.
67° 53' N. Lat.
10° 19' W. Long.
48 Norsk
107
102
119
0
100 Fv.
188 M.
200
377
300
565
400
753
500
942
600
1130
700
1318
800
1506
900
1895
1000
1883
0°0
0°5
35·00

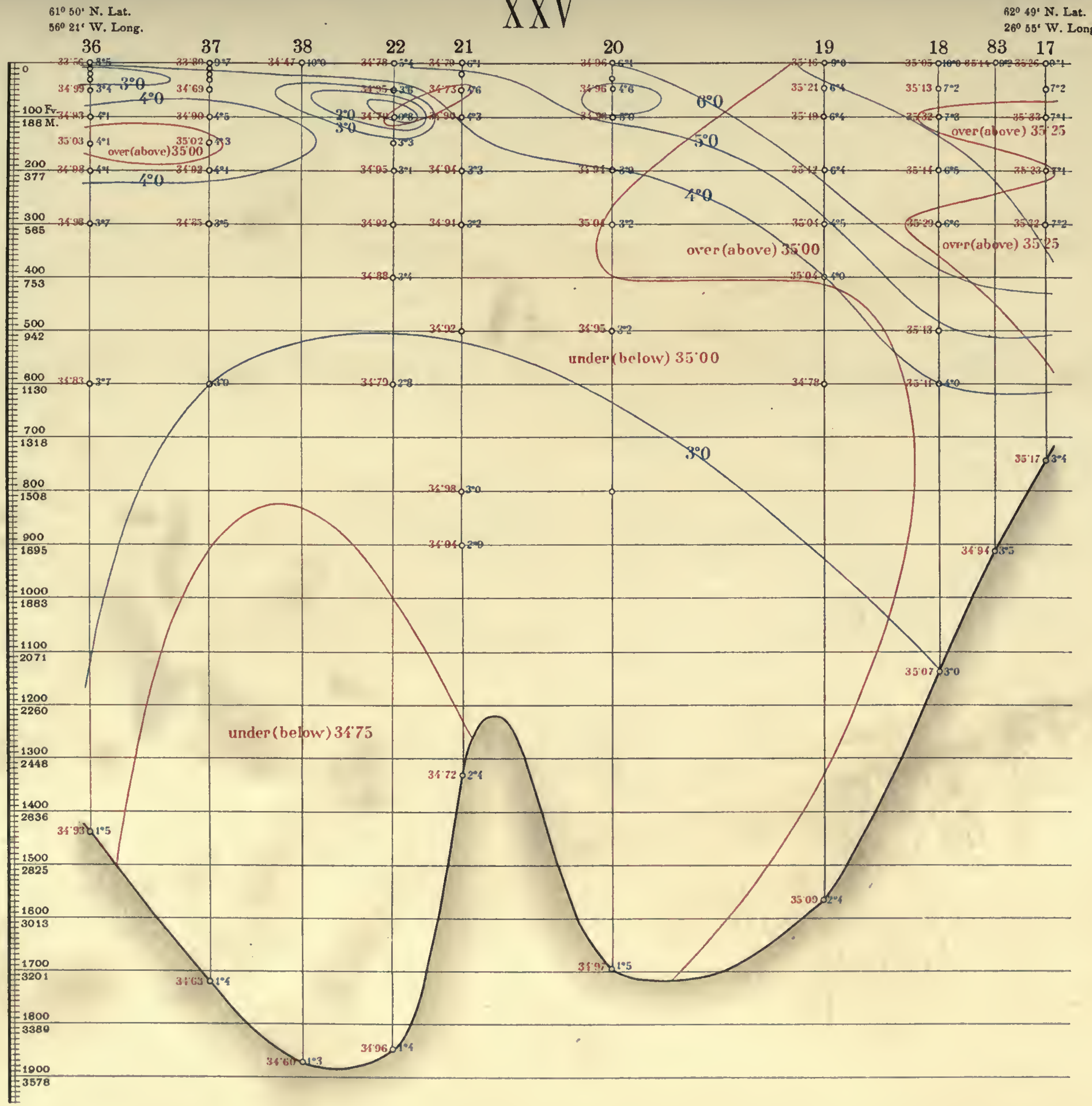

XXI
63° 14' N. Lat.
11° 24' W. Long.
67° 29' N. Lat.
11° 32' W. Long.
133
4
59
g
f
110
120
under (below) 0°0
over (above) 0°0
0°5
35°25
35°00
0°0
under (below) 0°0
100 Fv.
188 M.
200
377
300
565
400
753
500
942
600
1130
700
1318
800
1508
900
1895


XXIII
61° 32' N. Lat.
11° 36' W. Long.
63° 36' N. Lat.
7° 30' W. Long.
46
134
135
136
137
138
139
over (above) 35°25
under (below) 35°25
8°0
7°0
6°0
5°0
4°0
3°0
2°0
1°0
0°0
+0°5
100 Fv.
188 M.
200
377
300
565
400
753
500
942
600
1130
700
1318

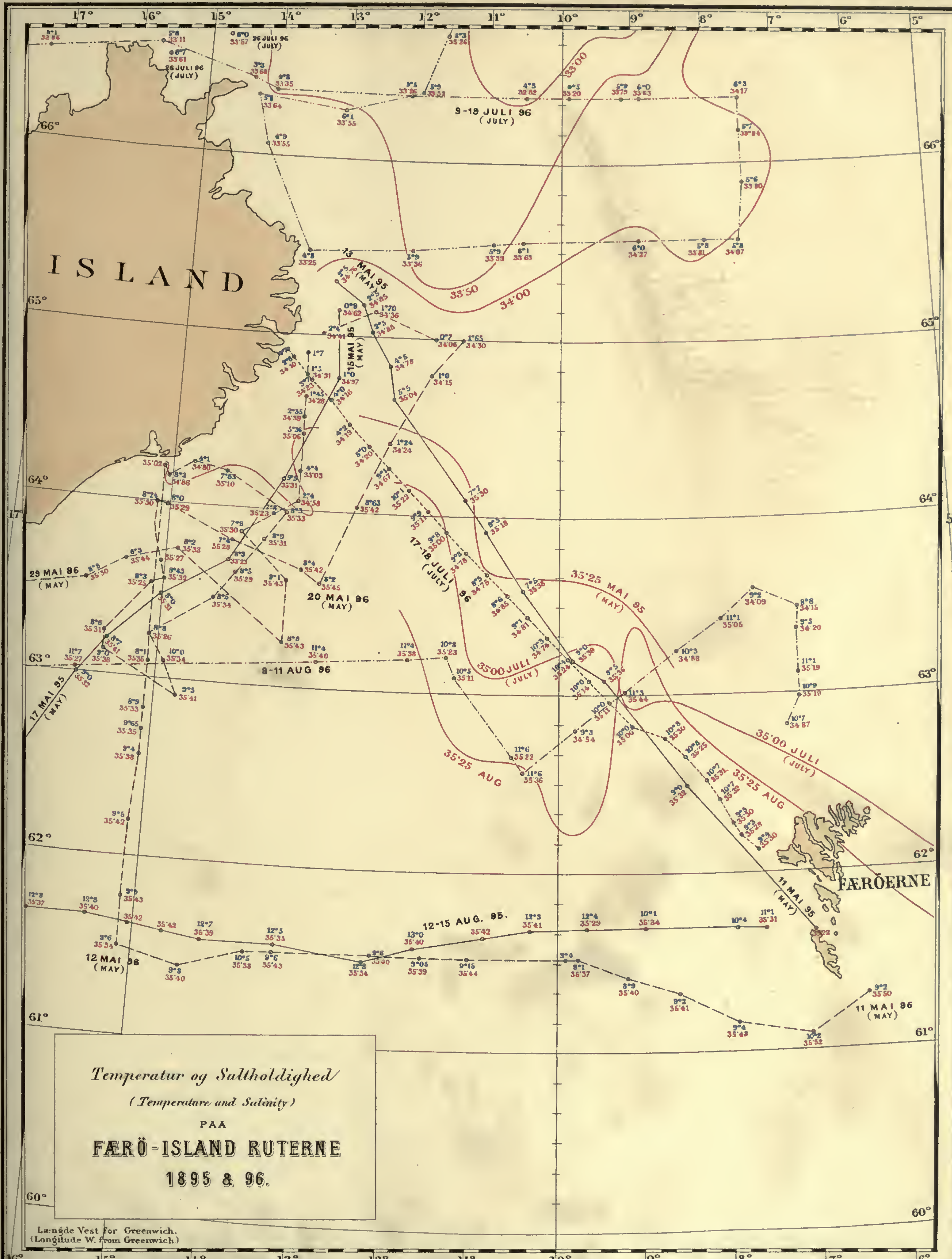

XXII
65° 03' N. Lat.
13° 06' W. Long.
62° 30' N. Lat.
6° 21' W. Long.
61
5
58
4
3
2
136
1
1°0
0°5
2°0
35°25
35°00
7°0
6°0
5°0
4°0
3°0
9°0
100 Fv.
188 M.
200
377
300
565


XXIV
64° 15' N. Lat.
14° 22' W. Long.
62° 30' N. Lat.
8° 21' W. Long.
51
52
57
133
135
1
under (below) 35°25
35°25
over (above) 35°25
under (below) 35°25
35°25
35°00
100 Fv.
188 M.
200
377
300
565
400
753

XXV

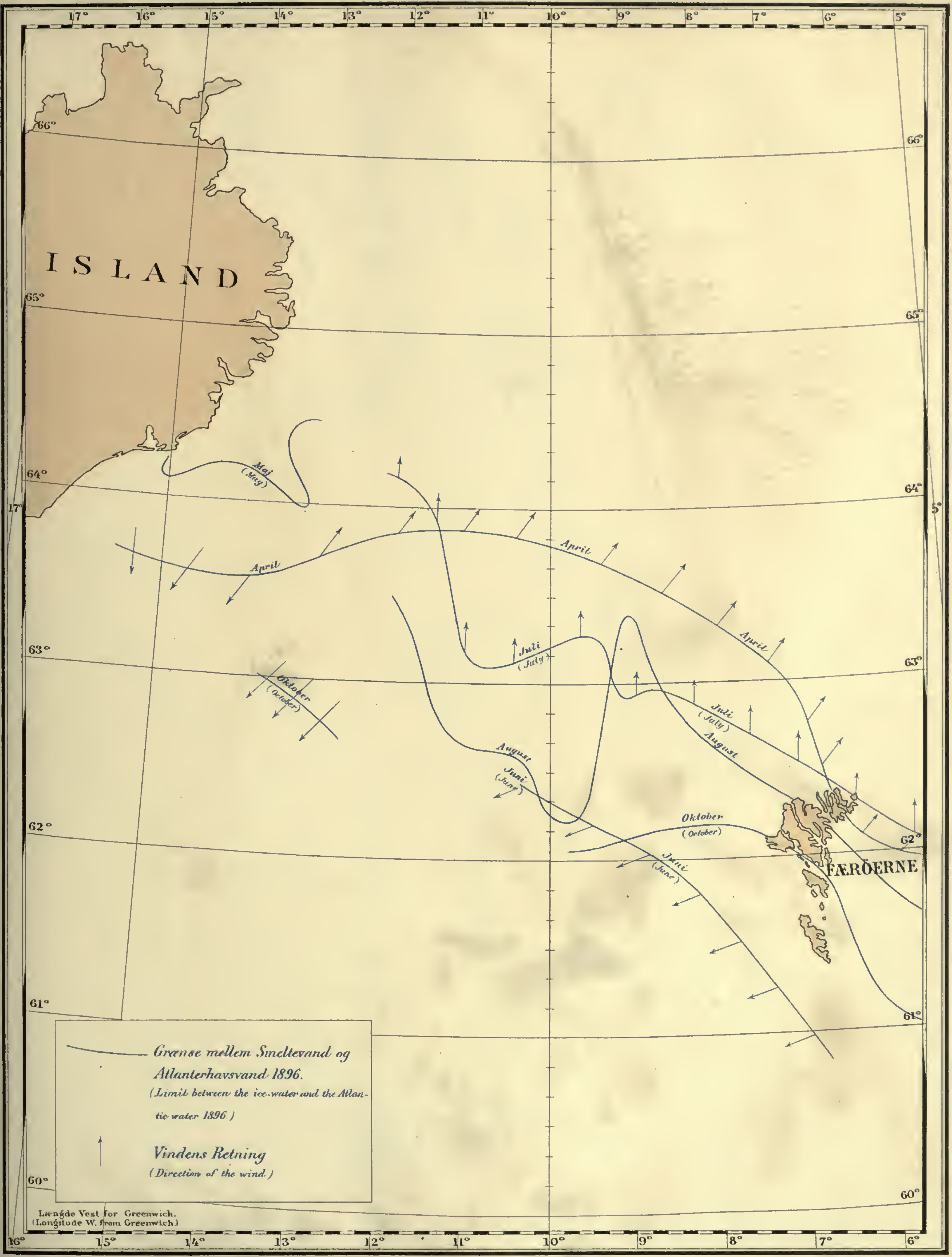

61° 50' N. Lat.
56° 21' W. Long.
62° 49' N. Lat.
26° 55' W. Long.
36
37
38
22
21
20
19
18
83
17
0
100 Fv.
188 M.
200
377
300
565
400
753
500
942
600
1130
700
1318
800
1508
900
1695
1000
1883
1100
2071
1200
2260
1300
2448
1400
2636
1500
2825
1600
3013
1700
3201
1800
3389
1900
3578
over(above)35'00
over (above) 35'00
over(above) 35'25
under (below) 35'00
under (below) 34'75
3°0
4°0
5°0
6°0


Maximumstemperatur
(The maximum temperature)
Maximumstemperaturens Dybde
(the depth of the maximum temperature)
GRÖNLAND
DANMARKS-
STRÆDE
ISLAND
Jan Mayen
Scoresby Sund
Angmagsalik
Isefjord
Dyrefjord
C. Nord
Öfjord
Langanæs
Seydisfjord
Eskifjord
Reykjavik
Reykjanæs
FÆRÖERNE
100Fv.
0°8
2°0
Længde Vest for Greenwich.
(Longitude W. from Greenwich.)

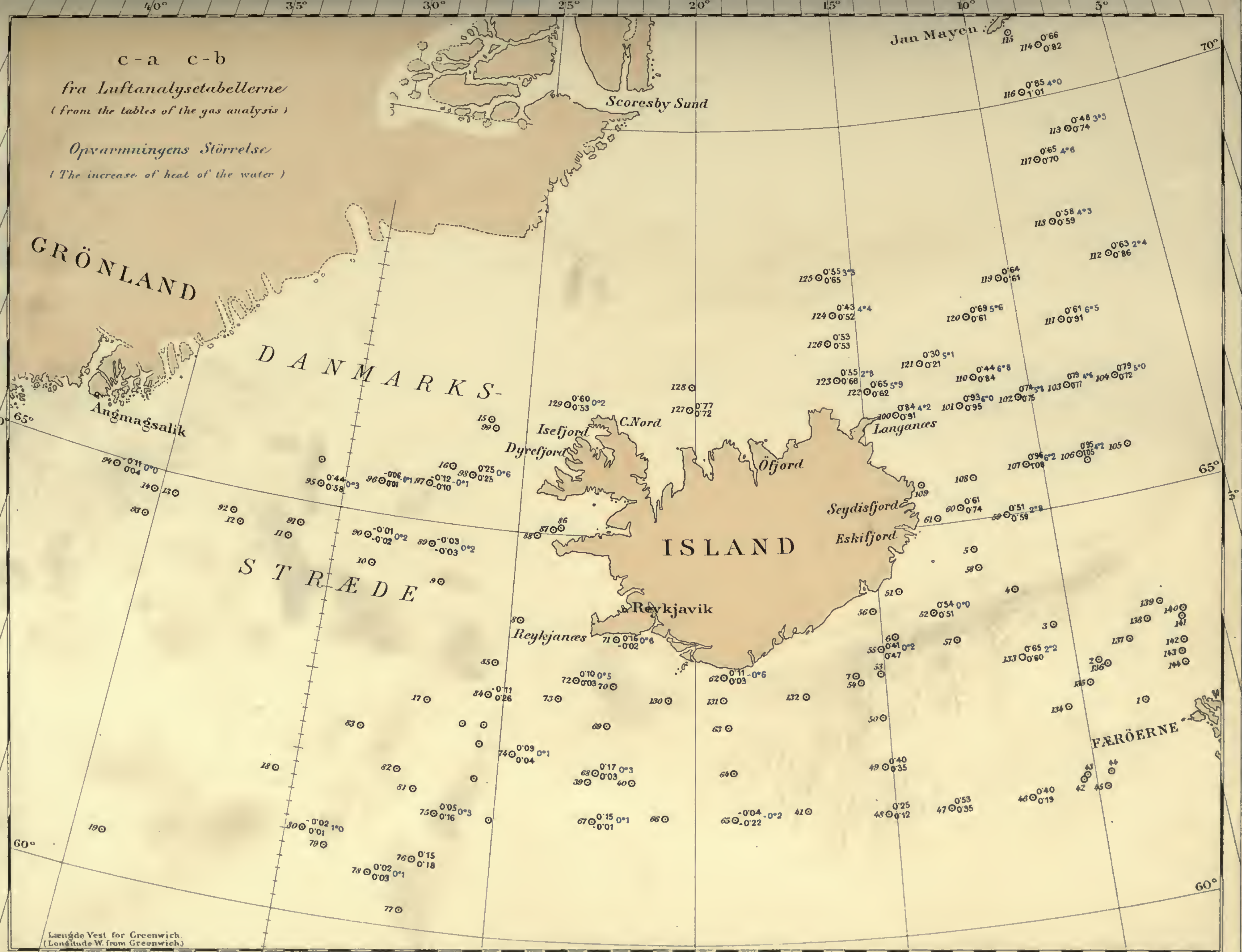


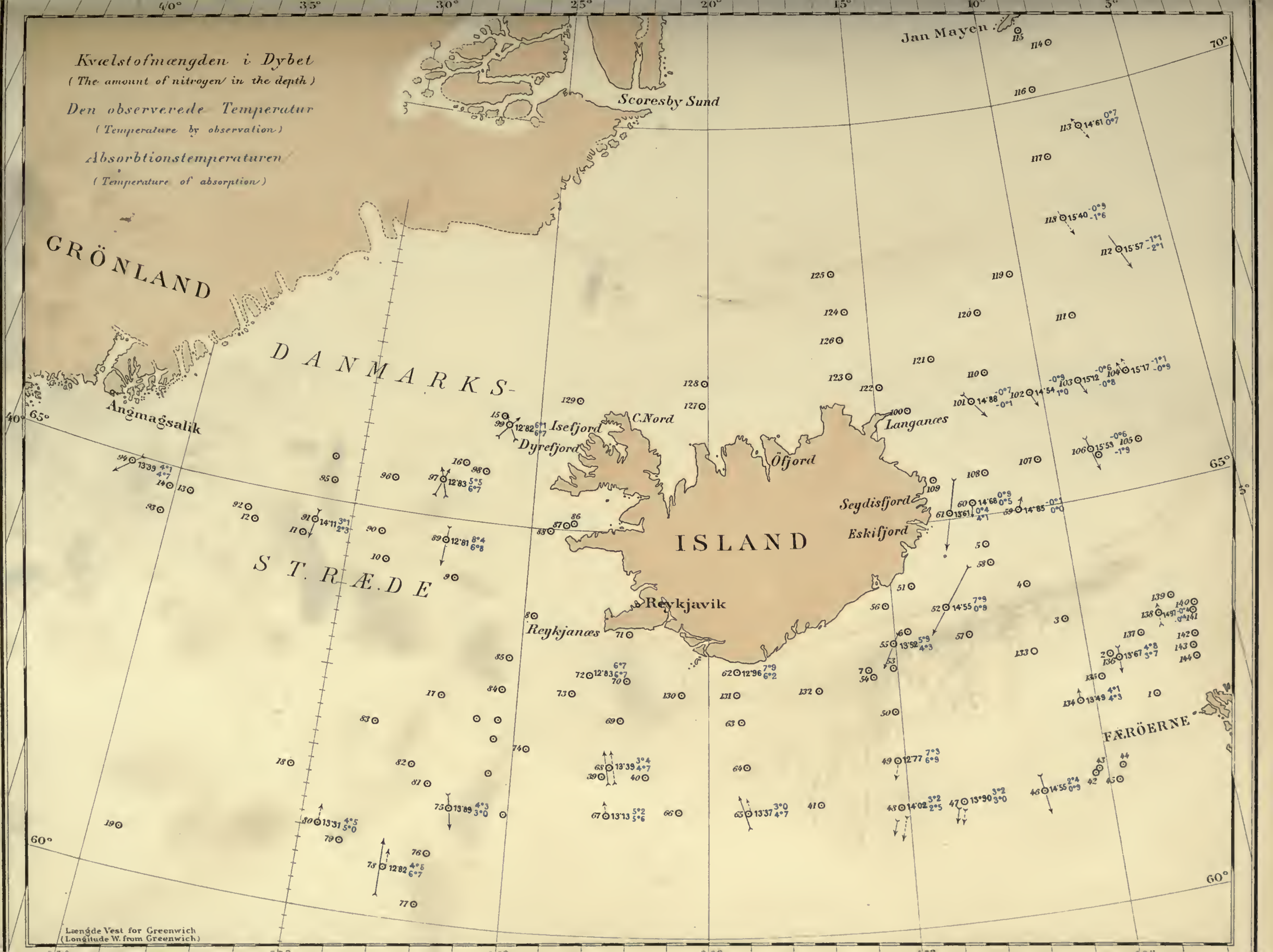
Temperatur og Saltholdighed
(Temperature and Salinity)
PAA
FÆRÖ-ISLAND RUTERNE
1895 & 96.

Axel E. Aamodt, Kjøbenhavn.



Axel E. Aamodt, Kjøbenhavn


c-a c-b
fra Luftanalysetabellerne
(from the tables of the gas analysis)
Opvarmningens Störrelse
(The increase of heat of the water)
GRÖNLAND
DANMARKS-
STRÆDE
ISLAND
Jan Mayen
Scoresby Sund
Angmagsalik
Isefjord
Dyrefjord
C.Nord
Öfjord
Langanæs
Seydisfjord
Eskifjord
Reykjavik
Reykjanæs
FÆRÖERNE
Længde Vest for Greenwich
(Longitude W. from Greenwich)


Kvælstofmængden i Dybet
(The amount of nitrogen in the depth)
Den observerede Temperatur
(Temperature by observation)
Absorbtionstemperaturen
(Temperature of absorption)
GRÖNLAND
DANMARKS-STRÆDE
ISLAND
FÆRÖERNE
Jan Mayen
Scoresby Sund
Angmagsalik
Isefjord
Dyrefjord
C.Nord
Öfjord
Langanæs
Seydisfjord
Eskifjord
Reykjavik
Reykjanæs
Længde Vest for Greenwich
(Longitude W. from Greenwich)

THE DANISH

INGOLF-EXPEDITION.

VOL. I, PART II.

CONTENTS:

PUBLISHED AT THE COST OF THE GOVERNMENT

BY

THE DIRECTION OF THE ZOOLOGICAL MUSEUM OF THE UNIVERSITY.

COPENHAGEN.

H. HAGERUP.

BIANCO LUNO (F. DREYER), PRINTER TO THE COURT.

1900.

THE DANISH INGOLF-EXPEDITION.

FIRST VOLUME.

3.

THE DEPOSITS OF THE SEA-BOTTOM.

BY

O. B. BOEGGILD.

WITH 7 CHARTS AND A LIST OF THE STATIONS.

COPENHAGEN.
BIANCO LUNO (F. DREYER), PRINTER TO THE COURT.
1900.

The Deposits of the Sea-Bottom.

By

O. B. Bøggild.

Of all the branches of geological science scarcely any has hitherto been subjected to so little systematic treatment as the science of the deposits of the sea-bottom. Most of the literature treating of this subject, consists of more or less dispersed observations; most frequently the work has been confined to a description of the new animals found on the sea-bottom, and the deposits proper have been subjected to no thorough petrographic and mineralogical examination. This branch of the science, moreover, has had only little material for examination; for although in earlier times a sufficient number of specimens from more shallow water near the coast have been examined, it is only lately that specimens of the deposits in the deeper parts of the sea have been brought up in so great a number, that it has been possible to form a clearer notion of their nature. Another impediment for the systematic examination of these deposits has been the tinge of mysticism by which they have been surrounded; much working-power has been wasted in theoretic speculations on the many new and remarkable phenomena shown by the deep-sea deposits, and for those speculations the treatment of the less conspicuous, more general ingredients of the specimens, from which may be drawn inferences of greater value to geology, has partly been slighted. Of late, however, considerable changes have taken place in this respect; the material of several of the larger deep-sea expeditions has been in many respects completely and exhaustively examined, while by other expeditions only small attention has been paid to the deep-sea deposits. Two works, above all, have been of excellent use by my examinations: the report of the Norwegian North-Atlantic expedition, part IX, Chemistry, by Ludvig Schmelck, which report has in particular yielded material for comparison, as it gives a thorough treatment of a locality, immediately bordering on that of the present expedition; and next the report of the deep-sea deposits of the Challenger expedition, by F. Renard and John Murray, which latter work gives a quite overwhelming mass of material from the whole earth, which material, however, cannot easily be used, as it has only partly been worked into more general results, what would also require a task almost more than human.

As the subject of my examinations I have had a collection of 91 tub-specimens, taken during the two voyages of the Ingolf-expedition in the summers of 1895 and 1896. These specimens have the great advantage that they are most frequently quite unaltered during the hauling-up, so that we get an exact notion of the ratio between the different constituents of the specimen. On the other hand, this kind of specimens has the drawback, that larger stones cannot be taken in them; as a compensation I have had at my disposal some material consisting of larger and smaller stones taken in the trawl or the dredge; the number of these stones, however, has not been nearly so great as desirable or necessary, if I was to draw more general inferences with regard to their distribution.

As to the working up I have followed a plan somewhat different from that of my predecessors; while they have mostly regarded each single class of deposits as a rather separate group, and described alle their qualities jointly, I have taken another view; in my opinion each bottom-specimen is a mechanic compound of many different elements, deposited on the locality in question in a mutually rather accidental ratio of multitude. The charts showing the different distribution, will show this distribution to be regulated by quite different laws, and accordingly it is not to be collected under one head, but to be specified as much as possible. I have tried to show the distribution, and, if possible, to point out the laws by which it is regulated, for each single mineral and organic ingredient, as well as for each single size of grain, and for still more particulars of the specimens. If I have not everywhere succeded so well, as it might be desired, it is, I hope, to be ascribed partly to the insufficiency of the material as to the showing of the effect of each of the great many factors that together are the condition of the distribution, and the particulars of many of which are comparatively little known, partly also to the comparatively great want of predecessors in the method, the consequence of which has been that to begin with I was uncertain as to most of the phenomena which only gradually during the proceeding of the work have become clear to me. In the present report there will be missed, perhaps, the mentioning of many of the curious phenomena commonly thought to be found in the deeper parts of the sea-bottom, especially with regard to the new-formation of minerals; I, however, have found no trace of such formations, excepting, perhaps, the coccoliths; the tract of the sea, treated of here, has upon the whole many disadvantages in this respect. On account of the land being everywhere rather close at hand, the deposition of terrigenous material takes place so quickly, that the ingredients taken in the sounding-tube presumably everywhere are so lately deposited, that no perceptible new-formations have taken place. I have not been able to find any means whatever for making out how quickly the deposition takes place; but from the fact that submarine rocks constantly can exist, especially between the Faröe Islands and Iceland, and between this latter island and Greenland, may be drawn the inference, that the deposition is rather slow. To be sure many thousand years have passed since these regions were sunk below the surface, and even if we suppose that originally very high perpendicular rocks were found, the result will not be perceptibly altered by this supposition, as we shall have to suppose, that at the bottom of such high rocks material will be deposited on a far greater scale than farther out.

In conclusion I have to pay my best thanks to Professor, Dr. phil. N. V. Ussing for his kind assistance by the examination of the mineral material, and for the readiness with which he has placed the rooms and apparatus of the mineralogical museum at my disposal during my work.

Section I.

On the General Qualities of the Bottom-Specimens, their Colour, Consistency, etc., as well as their Classification.

See the charts on pl. 1 and 2.

Before entering upon the examination of the particular ingredients of the specimens, I must give an account of their macroscopic qualities and their classification, that is, to which of the different bottom-species each single specimen is to be referred. As the percentage of carbonate of lime must necessarily be known to be able to decide the last question, and as, moreover, it is closely connected with the colour and the other qualities, I have been obliged to include this examination in the present section. In the following table all the details belonging hither, have been enumerated; the signification given by me to the particular expressions used, is explained afterwards.

[…] the specimen	Depth in Danish fathoms	Percentage of $CaCO_3$	Designation	When wet		When dry		Colour of the residue when wet	Additional observations
				Colour	Consistency	Colour	Consistency		
[illegible]	262	2·85	Gray deep-sea clay	yellowish gray	sandy-clayey	light yellowish	rather coherent	yellowish gray	
[illegible]	272	3·64	Gray deep-sea clay	dark yellowish gray	sandy-clayey	yellowish gray	slightly coherent	dark yellowish gray	
[illegible]	237	2·12	Gray deep-sea clay	dark yellowish blue	sandy-clayey	light bluish gray	slightly coherent	dark grayish blue	contained some stones.
[illegible]	90		Sand	brownish gray	coarsely sandy	. . . .	. . . .	. . . .	cont. some calcareous pebbles.
[illegible]	600	4·52	Brown deep-sea clay	brown	sandy-clayey	light gray brown	slightly coherent	dark brownish gray	
[illegible]	136	11·93	Transition clay	brown-gray	sandy-clayey	whitish gray	rather coherent	grayish black	
[illegible]	295	4·17	Brown deep-sea clay	yellowish brown	gritty clayey	light yellowish brown-gray	very coherent	dark brown-gray	
[illegible]	788	55·36	Globigerina clay	very light brown-gray	clayey-sandy	whitish brown-gray	rather coherent	brown	
[illegible]	1300		Globigerina clay	light gray-yellow	clayey	. . . .	. . . .	. . . .	contained a few larger stones.
[illegible]	1040	5·83	Transition clay	brown-gray	clayey	light brown-gray	very coherent	dark brown	
[illegible]	622	9·71	Transition clay	brown-gray	clayey	light brown-gray	rather coherent	dark brown	contained numerous stones.
[illegible]	745	66·02	Globigerina clay	light brownish gray	clayey	grayish white	rather coherent	dark gray	
[illegible]	1135	71·43	Globigerina clay	light brownish gray	finely clayey	grayish white	very coherent	brownish black	
[illegible]	1566	39·28	Globigerina clay	light brownish gray	coarsely clayey	grayish white	very coherent	dark brown-gray	
[illegible]	1695	34·13	Globigerina clay	gray-brown	finely sandy-clayey	light gray-brown	rather coherent	dark brown-gray	
[illegible]	1330	15·74	Transition clay	gray-brown	coarsely sandy-clayey	light gray-brown	very coherent	dark brown-gray	

Number of the specimen	Depth in Danish fathoms	Percentage of $CaCO_3$	Designation	When wet		When dry		Colour of the residue when wet	Additional observations
				Colour	Consistency	Colour	Consistency		
22	1345	36·73	Globigerina-clay	light gray-brown	finely clayey	whitish gray-brown	highly coherent	black brown	
24	1199	2·46	Gray deep-sea clay	light brownish gray	finely clayey	whitish gray	very coherent	brownish gray	
25	582	0·26	Gray deep-sea clay	light bluish gray	finely clayey	light bluish gray	very coherent	light bluish gray	
27	393	0·27	Gray deep-sea clay	brownish gray	coarsely sandy-clayey	light brownish gray	slightly coherent	gray	
28	420	0·44	Gray deep-sea clay	yellowish gray	finely sandy-clayey	light gray	rather coherent	gray	
29	68	0·35	Sand	yellowish gray	coarsely sandy	gray	incoherent	yellowish gray	
31	88		Sand	greenish brown-gray	large-grained sandy				
32	318	0·41	Gray deep-sea clay	greenish gray	sandy-clayey	light gray	very coherent	gray	
33	35	0·11	Sand	black gray	large-grained sandy	gray	incoherent	black gray	smelled of hydrosul-phuric acid
34	55		Sand	gray	sandy, slightly clayey	light gray	almost incoherent	gray	
36	1435	15·70	Transition clay	light grayish brown	very finely clayey	whitish brown	very coherent	grayish brown	
37	1715	23·55	Transition clay	light brown-gray	finely sandy-clayey	whitish brown	very coherent	brown-gray	
38	1870	35·23	Globigerina clay	light brown-gray	finely clayey	whitish brown	very coherent	grayish brown	
39	865	19·29	Transition clay	brownish gray	finely sandy-clayey	light gray-brown	rather coherent	dark brownish gray	
40	845	19·67	Transition clay	brownish gray	sandy-clayey	whitish gray	very coherent	dark brownish gray	
41	1245	29·71	Globigerina clay	light brownish gray	finely clayey	whitish gray	very coherent	gray	
45	643	47·02	Globigerina clay	light brown-gray	coarsely sandy-clayey	light brown-gray	rather coherent	dark brownish gray	numerous sponge spicules.
46	720	12·18	Transition clay	brown-gray	finely clayey-sandy	light gray	very coherent	dark brown	
47	950	40·71	Globigerina clay	light gray-brown	coarsely clayey-sandy	whitish brown-gray	slightly coherent	brownish black	
48	1150	54·72	Globigerina clay	light gray	coarsely sandy-clayey	white-gray	slightly coherent	grayish black	
50	1020	16·56	Transition clay	dark brown-gray	coarsely sandy-clayey	brownish gray	slightly coherent	brown-black	
54	691	7·65	Transition clay	gray-brown	coarsely clayey-sandy	light gray-brown	rather coherent	dark brown	The specim very hetero genous.
58	211	2·95	Gray deep-sea clay	dark blue-gray	finely clayey	light gray	rather coherent	dark blue-gray	
59	310	0·68	Gray deep-sea clay	dark gray	finely clayey-sandy	light gray	very coherent	dark gray	
63	800	14·95	Transition clay	gray	finely clayey	light yellowish brown	very coherent	dark gray	
64	1041	5·33	Brown deep-sea clay	yellowish brown	finely clayey-sandy	light brown	very coherent	dark yellowish brown	
65	1089	9·70	Transition clay	brown	finely clayey-sandy	light bluish gray	highly coherent	dark brown	
66	1128	19·45	Transition clay	dark bluish gray	finely clayey	light brown	rather coherent	dark gray	
67	975	23·31	Transition clay	brown gray	finely clayey-sandy	light bluish gray	rather coherent	dark brown	
68	843	20·92	Transition clay	dark gray	finely clayey-sandy	light brown gray	very coherent	dark gray	
69	589	25·46	Transition clay	brown gray	clayey-sandy	light gray	rather coherent	dark brown	
73	486	20·45	Transition clay	brown gray	coarsely clayey-sandy	light brown-gray	rather coherent	dark brown	
74	695	23·62	Transition clay	light brown	clayey-sandy	light brown	slightly coherent	brown	
75	780	35·85	Globigerina clay	light brown	clayey-sandy	white-brown	rather coherent	brown	
76	806	34·84	Globigerina clay	light brown	clayey-sandy	light brown	rather coherent	brown	
77	951	30·00	Globigerina clay	rather light brown	finely clayey	light brown	very coherent	dark brown	
78	799	43·79	Globigerina clay	light brown	rich clayey	whitish brown	rather coherent	dark brown	a great number of sponge spic.
80	935	62·22	Globigerina clay	very light brown	rich clayey	brownish white	very coherent	brown	
81	485		Globigerina clay	. . . .	. . . .	. . . .	. . . .	. . . .	not unalter
83	912		Globigerina clay	light brown	. . . .	. . . .	. . . .	. . . .	only a smal quantity; a few stones
85	170	19·09	Transition clay	brownish gray	very coarsely clayey-sandy	light gray	slightly coherent	dark brown-gray	

Number of the specimen	Depth in Danish fathoms	Percentage of $CaCO_3$	Designation	When wet		When dry		Colour of the residue when wet	Additional observations
				Colour	Consistency	Colour	Consistency		
89	310		Transition clay	brownish	. . . .	. . . .	. . . .	. , ...	not in the original condition.
90	568	57·00	Globigerina clay	light gray-brown	clayey-sandy	brownish white	rather coherent	black-brown	numerous sponge spicules.
91	1236	26·09	Transition clay	light gray-brown	very coarsely clayey-sandy	light gray-brown	very slightly coherent	dark brown	numerous stones.
92	976	6·72	Transition clay	gray	sandy-clayey	light gray	rather coherent	dark gray	a great many stones.
94	204		. . . .	light brown	. . . .	. . . .	. . . .	. . . .	consisted of pieces of shells and grains of sand; not original.
98	138		. . . .	dark brown	. . . .	. . . .	. . . .	. . . .	consisted of Foraminifera and grains of sand; not original.
01	537	0·48	Gray deep-sea clay	dark bluish gray	very finely clayey	bluish gray	highly coherent	dark bluish gray	
02	750	15·91	Transition clay	grayish brown	finely clayey	light brown	very coherent	dark brown	
03	579	14·01	Transition clay	light brownish gray	very finely clayey	very light brownish gray	highly coherent	dark brown-gray	
04	957	54·04	Globigerina clay	light brown	clayey-sandy	white-brown	rather coherent	brown-black	
05	762	48·30	Globigerina clay	brownish	clayey-sandy	light brown	rather coherent	brown-black	
06	447	21·80	Transition clay	light gray	finely clayey	light gray	very coherent	dark gray	
07	492	2·21	Gray deep-sea clay	bluish gray	richly clayey	light bluish gray	very coherent	bluish gray	
0	781	8·75	Transition clay	brownish	clayey-sandy	light brownish	rather coherent	black-brown	
1	860	36·63	Globigerina clay	grayish brown	clayey	light grayish brown	very coherent	brown-black	
2	1267	46·32	Globigerina clay	light brown	sandy-clayey	very light brown	highly coherent	brown	af few larger stones.
3	1309	31·29	Globigerina clay	light gray-brown	sandy-clayey	light gray-brown	highly coherent	gray brown	
5	86	0·14	Black clay	grayish black	sandy-clayey	gray	rather coherent	grayish black	some stones.
6	371	9·60	Transition clay	dark brown-gray	sandy-clayey	light brown-gray	rather coherent	dark brown-gray	
7	1003	61·34	Globigerina clay	light brown-gray	sandy-clayey	brownish white	slightly coherent	brown-black	
8	1060	43·67	Globigerina clay	light brown-gray	sandy-clayey	brownish white	very coherent	brown-black	
9	1010	55·81	Globigerina clay	light brown-gray	sandy-clayey	white brown	rather coherent	brown-black	
0	885	28·59	Transition clay	brownish	sandy-clayey	light brown	highly coherent	brown-black	
4	495	0·72	Gray deep-sea clay	dark bluish gray	very richly clayey	light bluish gray	highly coherent	dark bluish gray	
5	729	10·31	Transition clay	brown	richly clayey	light brown	very coherent	brown	
6	293	0·26	Gray deep-sea clay	dark gray	sandy-clayey	light gray	very coherent	dark gray	
7	44		Gravel	. . . .	. . . .	. . . .	. . . .	. . . .	almost exclusively stones with fragments of shells.
8	194	5·22	Gray deep-sea clay	dark bluish gray	richly clayey	light bluish gray	very coherent	dark gray	
9	117	48·27	Transition clay	brownish gray	sandy-clayey	light brownish gray	slightly coherent	brownish black	
8	471	5·48	Gray deep-sea clay	dark gray	richly clayey	light gray	very coherent	black-gray	
9	702	7·24	Transition clay	bluish gray	richly clayey	light gray	highly coherent	dark gray	
0	780	9·59	Transition clay	gray	richly clayey	light gray	very coherent	dark gray	
1	679	4·70	Gray deep-sea clay	gray	clayey-sandy	light gray	rather coherent	dark gray	
3	388	6·14	Gray deep-sea clay	gray	sandy, slightly clayey	light gray	slightly coherent	gray	

The whole number of specimens examined by me, amounts to 91. Two of these, nos 94 and 98, I have not been able to class positively; both consisted of larger grains of sand and pieces of shells, and have probably been washed during the hauling up, which has also partly been the case with a few of the other specimens; these I have not thought fit for determination with regard to their contents of carbonic acid, and the classification of them is therefore less reliable. Of the 89 specimens 7 have by me been referred to shallow-water deposits, of which one must be characterized as gravel, viz. no. 127 at the northern coast of Iceland, and 5 as sand, viz. one specimen no. 6 at the southern coast of Iceland and four specimens at the western coast of Greenland, while one (near the coast of Jan Mayen) has been called Black clay. The remaining 82 specimens are all deep-sea deposits, of which 18 have been characterized as Gray deep-sea clay, 28 as Globigerina clay, while 33 specimens form a transition between those classes, and therefore have been named Transition clay. Three specimens finally have been classified as Brown deep-sea clay on account of their peculiarly strong brown colour; they are upon the whole nearly related to the Transition clay. In using these appellations I have chiefly followed Schmelck in his Account of the Norwegian North-Atlantic Expedition, where he uses the following names: Grey Clays and Brown Clay, the latter again comprising two classes, viz. Transition Clay and Biloculina Clay. By this classification regard has only been paid to the colour, which is chiefly dependent on the degree of oxidation of the iron. But as this quality, at least as far as the specimens examined by me are concerned, scarcely can be said to be specially characteristic, specimens of a gray colour for inst. occurring side by side by specimens of a more brownish colour without any possibility of adducing certain rules of the distribution of these colours, I have laid particular stress on the amount of carbonic acid, and have placed the limit between the Gray clay and the Transition clay at 5—10 per ct. $CaCO_3$, and between the Transition clay and the Globigerina clay at ca. 30 per ct. $CaCO_3$. The appellation of Biloculina Clay of Schmelck I have not found expedient to use, as it seems to be rather accidental what genus of the larger Foraminifera is to be found most abundantly in the deposits; South of Iceland the genus Biloculina occurs only to a very small degree in the specimens; and even between Iceland and Jan Mayen, where it is found in greatest numbers, it plays no prominent part; of the six specimens of Globigerina clay found in this part of the sea, only the two easternmost (nos 112 and 113) contain greater numbers of Biloculina while the rest on an average contains one for every gram of the specimen. In putting the limit of the Globigerina clay at ca. 30 per ct. $CaCO_3$ I have followed Murray, who in the account of the Challenger Expedition divides the marine deposits into the following classes: I. Littoral Deposits, II. Shallow-water Deposits, stretching from low-water mark to a depth of 100 fathoms, and III. Deep-sea Deposits, which are again divided into Terrigenous Deposits and Pelagic Deposits. To the Terrigenous Deposits are referred: Blue Mud, Red Mud, Green Mud, Volcanic Mud, and Coral Mud; to the Pelagic Deposits: Pteropod Ooze, Globigerina Ooze, Diatom Ooze, Radiolarian Ooze, and Red Clay. I have, as Murray, placed the limit between the deep-sea deposits and the shallow-water deposits at the depth of 100 fathoms, as all the specimens from lesser depths, with the single exception of no. 115, consist of sand or gravel, while all specimens from larger depths consist of clay. Murray's appellation of Blue Mud corresponds to what I have named Gray deep-sea clay; the blue tone of colour was only found in part of the specimens while the rest were either pure gray or brownish gray. The appellation of Volcanic Mud I have seen no cause of keeping distinct from the Gray deep-sea clay, as both are quite identical as to their macroscopic qualities, and can only be distinguished by a closer examination of their mineral ingredients. On the other hand I have thought proper to keep the name of Transition clay, though in itself it is not very characteristic; Murray classifies the specimens in question as Blue Mud; but as the colour is brown-gray or brown and more light than in the Gray deep-sea clay, I think the Transition clay sufficiently distinguished from the Gray deep-sea clay to form a separate type in the system.

Concerning the colour of the specimens it has to be remarked that the appellation will of course be to a certain degree dependent on a subjective judgment. I have tried to make it as simple and uniform as possible by only using terms formed by a combination of the single colours, so that for inst. the term brown-gray or gray-brown means a colour midway between what is generally termed pure brown or pure gray, grayish brown means a brown colour with a grayish shade etc. As to the lighter and darker shade it must of course also be a matter of subjective judgment which colour is to be called for inst. gray without any additional remarks of its being light or dark; I have used the following scale: white, grayish white, white-gray, very light gray, light gray and gray, and in the same manner with the dark shades. For completeness I have also noted the colour of the specimen when dry, although it is almost the same as that of the wet specimen, only one or more shades lighter. Further I have added the colour of the residue after the dissolution of the carbonate of lime in hydrochloric acid; the residue of the specimens, which only contain a little lime, is, of course, of the same colour as the specimen itself, while in the specimens with much lime the colour of the residue is considerably darker while the tone of colour itself is unaltered. The colour of the bottom specimens is almost exclusively dependent on the colour of the clay, and this, as has been shown by Schmelck, arises from the different degree of oxidation of the iron; the lighter or darker shade is in proportion to the number of Foraminifera; that the mineral contents play only a small part, may be seen from the fact that the samples taken near the coasts of Iceland and Greenland do not differ from each other to any appreciable degree with regard to colour, although the sandy ingredients at the coasts of Greenland consist of common light arenaceous quartz, while at Iceland they chiefly consist of brown volcanic substance.

As to the consistency of the samples I have used the expression sandy-clayey or clayey-sandy, when by rubbing a small quantity between my fingers I could perceive the presence of a great deal of sand, while I have used the appellation clayey, when sand was only to bo perceived to a slight degree, and richly or finely clayey, when sandy ingredients were not felt at all. The appellation plastic could not, in my opinion, be used of any of the samples. Some of the bottom specimens consist of completely unsorted material, containing all sizes from small stones to the finest clay, and thus they resemble very much the till. Of organogen ingredients that may have a perceptible influence on the macroscopic quality of the specimen, the spicules are to be mentioned: in most samples of the Globigerina clay they are found in a perceptible quantity, but only in a few to so large a degree as to give the sample a particular entangled consistency; this is the case with no. 45, west of the Faröe Islands, and most particularly with no. 78 southwesth of Iceland, this latter specimen being the one containing the largest quantity of organic ingredients, though it does not, according to its locality, hold any peculiar position among the other samples. To be complete I have everywhere noted the consistency of the specimen when dry by its different degree of coherence; even where the specimen is denoted as highly coherent, it is more easily broken than most of the quaternary or older sorts of clay; this, however, cannot be supposed to be caused exclusively by a less content of clay, but may also be due to the fact that the recent sorts of clay have not, as the older ones, been compressed in the lapse of time, but are taken up in a completely loose condition.

After having thus accounted for the different macroscopic qualities of the specimens I shall now proceed to mention the different classes more particularly. Concerning the deposits of the shallow water not much has to be said: they surround the land as a narrow border above the 100 fathom curve, and consist almost exclusively of terrigenous ingredients, mostly from the nearest coasts; as no calcareous rocks are found in the territory surveyed by the Ingolf expedition, it follows from this fact that the percentage of carbonate of lime must be very small in these deposits; in three of the specimens where this percentage was measured, it varied from 0·11 to 0·35; in the other four specimens that were not at hand in sufficient quantity for a measuring of the carbonic acid, it has probably not been greater. The four specimens taken immediately at the west coast of Greenland, consist of common grayish arenaceous quartz, rather coarse, almost without finer particles, but also with rather few firm ingredients larger than 0·5^{mm}. The sample taken close to Jan Mayen consisted of uncommonly dark clay with numerous sandy and stony ingredients; it seems rather unaccountable how the deposit here close to the land can consist of clay, as this on so shallow water generally does not precipitate unless it be in bays or inland seas where the water is neither put in motion by currents nor by the dashing of the waves; but according to Schmelck, who has examined numerous samples in close vicinity of the island, clay is found in very shallow water, even to 20 fathoms (station 222 b). Very remarkable is also the dark colour, by which the deposits round Jan Mayen are distinguished; none of the specimens round Iceland and the Faröe Islands are approximately so dark, although it would seem that they were formed of about the same material; as, however, the colour is essentially dependent on the clayey ingredients of the specimen, a chemical analysis of these ingredients will perhaps be able to give some information in this respect.

The Gray Deep-sea Clay surrounds all land as a more or less narrow border outside of the shallow-water deposits; it stretches likewise as a rather broad belt between Iceland and the Faröe Islands, coinciding rather exactly with the ridge, found there; on the contrary it is not likely to be found on the ridge between Iceland and Greenland. Above it begins at the 100 fathoms curve; below it stretches in the different places to very different depths; as a rule it does not pass beyond 500 fathoms; but sometimes it stretches much farther; the largest depth in which it is found, is 1199 fathoms, west of Greenland, a depth in which mostly Globigerina clay is met with. The same sample (no. 24) is also the one in which the Gray deep-sea clay is found in the largest distance from land, viz. ca. 220 km. Probably the whole sea bottom north of 63° Lat. N. between Greenland and Baffin-Land opposite, consists of Gray deep-sea clay; at about 62° the Transition clay begins to appear, and along the southern part of the western coast of Greenland, as also round the south point, only a comparatively narrow belt of Gray deep-sea clay is found, as the Transition clay and Globigerina clay here is found rather close to the land. Nothing can with certainty be said of the distribution of the

Gray deep-sea clay along the eastern coast of Greenland; probably it is found in a belt, 100—150 km. broad. We have no specimens of this sort of clay along the south and west coast of Iceland; it must be supposed to stretch in a distance of 40—70 km. round the outermost parts of the land.

North of Iceland the distribution is greater; but it abounds especially to the east of the island where it covers a great area, gradually decreasing in breadth towards the Faröe Islands. West of these islands it is only little found, as the Globigerina clay is already met at station 25, ca. 130 km. from the land; the condition of the sea-bottom south and east of the Faröe Islands cannot be ascertained; perhaps the Gray deep-sea clay is stretching without interruption to Norway and the Shetland Islands, while, according to Murray, a strip of Globigerina clay stretches from the open Atlantic to the northwest of Iceland and Scotland, where it ceases about at the Orkney Islands. Round Jan Mayen the Gray deep-sea clay is not much found; according to Schmelck the Biloculina clay reaches very close to the island on the north, while the specimen 116 of the Ingolf Expedition, from a distance of about 80 km. south of the island, consists of Transition clay.

The Gray deep-sea clay may be characterized as a generally rather rich and clean variety of clay of a grayish colour; when dry it is light gray, most frequently very coherent; on more shallow water, closer to the coast, it is commonly much mixed with sand, also often with stony material. The colour is now somewhat lighter, now somewhat darker, sometimes with a slightly bluish tint, but as often slightly brownish or yellowish. After Schmelck the gray colour arises from the degree of oxidation of the iron, the ratio between the sesquioxide and the protoxide of iron being in the gray clay on an average as $1^1/_2:1$, while in the brown sorts of clay the same ratio is as $3:1$; in the gray clay the iron is accordingly present in its more original condition, while it becomes more and more oxidized, as we get farther from the land. The amount of carbonate of lime in the Gray deep-sea clay is rather small, the terrigenous ingredients being completely void of lime; it varies from 0·26 to 6·14, and generally it is of course largest at the border of the transition clay. After Schmelck the amount of carbonate of lime rises in some places to more than 20 per ct.; but as these highly lime-charged specimens are also mentioned as being of a brown-gray colour, I do not understand why they are referred to this category, and no inference can thus be drawn from these numbers.

The Transition Clay covers the sea-bottom as a more or less broad belt between the Gray deep-sea clay inwardly and the Globigerina clay outwardly. On an average it begins at a depth of about 500 faths, and reaches to a depth of about 1000 faths; but from this there are innumerable exceptions on account of the different localities. On the west coast of Greenland the Transition clay begins at about 62° Lat. N.; from this place it stretches as a broad belt round the southern point up along the east coast. In this part of the sea it is found to a very large depth, reaching at station 37 to 1715 faths, the largest depth but two upon the whole measured during the Ingolf Expedition. The Challenger Expedition, however, has taken Blue Mud, which also includes the Transition clay, on far greater depths, in a few places even on 2800 faths; but such cases must be considered as quite exceptional. South of Iceland the Transition clay is widely spread, and sends out, as it were, a low tongue into the Atlantic, which does not, however, coincide with the ridge stretching from Iceland to the southwest, but is situated to the east of this ridge. On both sides of the ridge between Iceland and the Faröe Islands the Transition clay stretches as a rather narrow belt; round Jan Mayen it is only little found. At the northwestern coast of Iceland is found the before mentioned specimen no. 129 which is remarkable by its containing almost 50 per ct. of carbonate of lime although taken at a small depth, 117 faths, and only ca. 40 km. from the land; great part of this carbonate of lime, to be sure, is found in the shape of fragments of shells and the like; but as numerous Foraminifera are also found in the specimen, I have thought that it ought to be referred to the Transition clay. Unfortunately this station is exceedingly isolated, and it might of course be of great interest to know the condition of the sea-bottom from this place towards Greenland, and whether the Transition clay or possibly even the Gray deep-sea clay stretches across the Denmark Strait. On the route followed by the Ingolf Expedition from Iceland towards Greenland, i. e. on 65° Lat. N., the Globigerina clay is found midway; but as this route is directly to the south of the submarine ridge, it is probable that the Globigerina clay does not stretch much farther north.

The Transition clay is generally gray-brown; sometimes it has a more pure, brown colour; but on the other hand it may also be completely gray, specially the specimens situated closest to the territory of the Gray deep-sea clay. As to consistency the Transition clay is sometimes richly clayey, sometimes rather sandy, which latter quality may have its rise partly from mineral ingredients, partly from the larger Globigerinæ and other Foraminifera. The amount of carbonate of lime varies from 5·23 to 28·59 per ct., and of course increases more and more, as we get farther from the territory of the Gray deep-sea clay, and proceed to larger depths.

The Brown Deep-sea Clay found in three places inside the territory of the Transition clay ought, perhaps, to be incorporated with this; it is distinguished by its especially powerful brown or yellow brown colour, while the colour of the Transition clay is more grayish brown; the amount of carbonic acid is always very small, about 5 per ct., although two of the specimens were taken far from land, and in the middle of the territory of the Transition clay. Otherwise the Brown deep-sea clay presents no matter of special interest; it was only found south and southwest of Iceland.

The Globigerina Clay covers, in the tract of the sea navigated by the Ingolf Expedition, everywhere the parts of the sea-bottom that are deepest and farthest off from the land. According to Challenger the Red deep-sea clay, found in the very deepest parts of the sea-bottom, is not met with in the northern part of the Atlantic north of 40° Lat. N., and only on depths of far more than 2000 faths; but the specimen taken on the greatest depth by the Ingolf Expedition, is from 1870 faths. Generally the Globigerina clay does not begin till a depth of 1000 faths; but several exceptions are found from this rule, especially on the ridge stretching from Iceland towards the southwest into the Atlantic; here it is even found on so small a depth as 485 faths. It is never found near the coast; at the south point of Greenland it is met with at a distance of about 140 km. from the Land; and it reaches about as near to the east coast of Greenland and to the coasts of Iceland, as well to the west as to the south and north. It stretches more close to the smaller islands; southwest of the Faröe Islands it is only about 150 km. from the land, and south of Jan Mayen it is found at about the same distance. As a comparison it may be observed that at the western coast of Norway and Spitzbergen the Globigerina clay is in some places met with up to a distance of about 80 km. from the land, and north of Jan Mayen even at a distance of only 30 km.; in the tropic seas it is often met with at a distance of less than 80 km. from the coasts of the continents, and as a common rule it may be said that the Globigerina clay is found farther from the land, the farther we proceed into the arctic regions, whether the cause is that the Foraminifera have not so good conditions of life in the colder seas, and consequently fall to the bottom in smaller quantity, or that the deposition of terrigenous ingredients is larger here on account of the icebergs that are able, to a far higher degree than anything else, to carry clay, sand, and stones far out on the sea, and deposit these ingredients there.

The Globigerina clay is rather different, now very finely and purely clayey, now more sandy to the touch, sometimes also rather coarsely sandy; this fact is exclusively due to the size of the Globigerinæ, as mineral particles upon the whole play a very inconspicuous part, and the other Foraminifera also generally are found in rather small numbers. In the specimens of Globigerina clay, southeast of Iceland, that have been designated as coarsely sandy-clayey, a greater number of Globigerinæ has been found measuring more than 0·5^{mm} in diameter, while such otherwise are rather rare in the specimens; the specimens having a sandy-clayey consistency, contain Globigerinæ only a little smaller than 0·5^{mm}, while the Globigerinæ of the finer specimens measure about 0·1—0·3^{mm} in diameter. The colour of the Globigerina clay is almost always light brown, sometimes with a slight grayish tint, in a few cases light gray; when dry it is very light, sometimes almost quite white with a brownish tint, generally not so coherent as the Transition clay. As the light colour arises from the contents of Globigerinæ and ooze of lime, the colour of the residue is always much darker than that of the specimen, being generally brown or dark brown.

The amount of carbonate of lime in the Globigerina clay varies from 29·71 per ct. to 71·43 per ct. in the specimen no 18 southwest of Iceland; the carbonate of lime of the 25 specimens averages 46·06 per ct.; if we calculate the average amount of carbonate of lime with regard to the different depths we get:

13	specimens	from 500—1000	faths	with an average of	47·06	per ct. of $CaCO_3$
9	—	- 1000—1500	—	—	47·77	— —
3	—	- 1500—2000	—	—	36·81	— —

and thus it would seem, as if the amount of carbonic acid decreased with greather depth, but the cause is only that the specimens have their origin from very different places presenting highly different conditions for the deposits; a large portion of the specimens taken on the smallest depths, is from the before mentioned ridge southwest of Iceland where the circumstances are highly favourable for the formation of deposits with great contents of lime, while the specimens from the very greatest depths are found near the south point of Greenland, where the circumstances must produce the contrary effect; within the same territory the amount of carbonic acid will almost always be seen to increase with the depth, when this latter is not large; but if the question be of deeper water than has been sounded by this expedition, the amount of carbonic acid will be seen to decrease again by increasing depth; this fact may be seen from the following table taken from the account of the Challenger expedition; here was found in

3	specimens	under 500	faths	87·07	per ct. $CaCO_3$
2	—	from 500 to 1000	—	68·47	— —
13	—	— 1000 - 1500	—	63·69	— —
35	—	— 1500 - 2000	—	72·66	— —
49	—	— 2000 - 2500	—	61·74	— —
16	—	over 2500	—	49·58	— —

According to this table it seems, as if the maximum is found between the depths of 1500 and 2000 faths, that is to say, just at the largest depths reached by the Ingolf Expedition; the large percentages, given from the smaller depths, must be taken to have originated in casual circumstances; Murray, it is true, draws himself from these large percentages the inference that the amount of carbonic acid generally decreases with increasing depth, and adds moreover that this fact would be more strikingly exhibited, if only the circumstances of each single region were taken into consideration. It seems, however, to be evident that if we had a continuous series of specimens from a single region, we should find, that the Globigerina clay, which always towards the land begins with 30 per ct. $CaCO_3$, would, as to the carbonate of lime, increase quite evenly to the greatest percentage it should reach in the place in question, and then decrease as evenly, until by and by it merged into the Red deep-sea clay, in which the carbonate of lime is often completely wanting.

If a comparison be made between the percentages of carbonate of lime from the two expeditions, it will be seen that on corresponding depths it is considerably larger in the specimens of the Challenger Expedition. From this may be drawn the conclusion that in the colder seas the circumstances are not so favourable for the formation of lime-charged Globigerina clay as in the warmer seas, the same result we also arrived at by considering the distance from land, in which the Globigerina clay was found; what these circumstances are will be examined later.

The relation between tbe Globigerina clay and the common chalk has often before been discussed [1]), and there is no special cause for treating this question here. The forms of Globigerina clay brought home by the present expedition, are rather different from the chalk as to their amount of lime, and accordingly other conditions must have been predominant by the formation of this latter. If we go to the warmer seas we shall find, according to Murray, that the largest amount of carbonate of lime found in Globigerina clay, is 96·80 per ct., near Ascension, while the chalk often contains upwards of 99 per ct. of carbonate of lime. The difference, to be sure, is not so large, if we consider that the chalk contains strata of flint that must have been formed by silica originating by the dissolution of siliceous organisms originally evenly distributed throughout the whole mass; but if we regard the number of mineral grains we shall find a far greater difference between the two rocks. The least amount of sandy ingredients I have found in Globigerina clay, is 0·86 per ct. in the specimen no 80; and even in the most lime-charged specimens from the Challenger-Expedition 1 per ct. of mineral grain is noted. But according to Hume the amount of minerals in the chalk may decrease to 0·0026 per ct., i. e. about a 400 times smaller quantity than in the Globigerina clay. This fact is still more remarkable considering the nature of the minerals in both sorts of deposits. In the chalk the most prominent mineral is the quartz, while this mineral is only little conspicuous in the specimens of Globigerina clay taken farthest from land in the oceans, in which specimens the chief part of the sandy ingredients consists of lapilli, pumice, volcanic glass, felspar, augite, olivine a. s. o. Nearer to the land, on the contrary, the quartz is generally prominent in the Globigerina clay. Accordingly we may, in analogy with this, make the conclusion that the chalk must have been formed rather close to the land, but, to be sure, under circumstances found nowhere at the present time.

[1]) C. Wyville Thomson: The Depths of the Sea. London 1873.
W. F. Hume: Researches on the upper cretaceous zones of the south of England. London 1893.

The small amount of minerals must be caused either by an uncommonly small transport of solid ingredients from the continents into the surrounding seas, a fact that can only be supposed to have been caused by the climate being at the same time as well warm and dry to prevent the formation of larger rivers as specially calm, that the beating of the waves might not erode at the shores and the currents carry the material into the sea. Or else the deposition of Foraminifera and the still smaller calcareous organisms must have been uncommonly abundant in that time, wich may perhaps also be supposed to be a consequence of a specially warm and calm climate. As especially the Foraminifera living on the sea-bottom, play a proportionally prominent part in the chalk, while in the Globigerina clay they are only found in small numbers in proportion to the Globigerina, the circumstances on the sea-bottom may be supposed to have been especially favourable to the Foraminifera and the other calcareous organisms, possibly also on account of higher temperatures. The depth on which the chalk has been deposited, can, on account of the land being so near, scarcely be supposed to have been so great as that on which the Globigerina clay is formed; neither is it likely that in so many places of the earth as where the chalk now is found, so enormous upheavals should have taken place, as would have to be supposed, if the chalk had originally been deposited on the depth of 1—3000 faths where the Globigerina clay is now found.

Having thus given an account of the distribution of the different sorts of deep-sea deposits in the territory navigated by the Ingolf Expedition, and of the most prominent facts regarding their nature, it may perhaps be thought appropriate here to try to account for some of the factors that have been cooperating in the deposition of these sediments, and have been the conditions of their distribution on the sea-bottom. On account of the large number of these concurrent factors it is, however, only possible in a comparatively small degree to account for the influence of each among them. In most instances the collection of specimens I have had at my disposal, has not given sufficient information so as to enable me to account for the facts that moreover in the territory explored by the Ingolf Expedition are especially intricate; from certain regions of the territory specimens are wanting exactly on places where they are most missed for the explanation of some phenomenon, while in other places only a single specimen has been taken, from which it will not do to draw more general conclusions, as the casual irregularities that may take place, are sometimes rather large; two specimens taken close to each other, will often show very essential differences in one or more directions, so that only a comparison with more adjacent specimens has made it possible to decide for each single case, what was the rule, and what the exception.

What I intend to examine in the present section, is the amount of lime, this quality being, as before mentioned, the most essential and most characteristic of the species of the specimen. The quantity of carbonate of lime in a specimen is chiefly dependent on two large groups of factors viz. partly such as cause a greater or smaller supply and distribution of material from the land, and partly such as may influence the deposition of greater or smaller numbers of organisms with calcareous shells. As to the supply from land, it will be immediately evident that the extent of the country must largely influence the mass of material carried away from it; by regarding the chart, plate II, it will also be seen that the curves are gathered especially closely round Jan Mayen and the Faröe

Islands, less closely round Iceland, and that they are found in the greatets distance round Greenland; the causes of this are sufficiently manifest, viz. in the first place, that in the small islands a smaller portion of land will correspond to a certain extent of coast, the supply of material from inland consequently be smaller, and the erosion of the coast will be almost the only operative factor; in the second place the material carried away from a certain stretch of coast of a smaller island, will be spread over a far greater area of the sea-bottom than that coming from the larger islands, and therefore it will naturally decrease more quickly in thickness. The same phenomenon, of course, may also assert itself by the form of the single lands; thus it is by no means improbable that the circumstance of the curves being closer together round the south point of Greenland than farther up, must be accounted for in a similar way.

If we now more closely examine the means by which material may be transported from land into the sea, they will be seen to consist in the three following: 1) the erosion and transport by the running water; 2) the erosion of the coast; 3) the breaking down of the glaciers, and the subsequent transport of the material by icebergs. Other ways of transport cannot here be taken into consideration; for even if volcanic eruptions in connection with the wind, or the latter factor alone, may carry some material into the sea, this material will scarcely in any case be any greater part of the whole mass, and thus it will be of no consequence with regard to the percentage of carbonate of lime. The action of the running water is very unequally distributed within the territory treated of here; while rather large rivers laden with large masses of sediments, are emptying on the northern and southern coasts of Iceland, there are in Greenland only some small streams, and in the Faröe Islands and Jan Mayen they are quite inconsiderable. The effect of the rivers may perhaps be traced at the eastern part of the north coast of Iceland where the amount of carbonate of lime in the specimens is especially inconsiderable, and perhaps also at the southwest coast of Iceland, where the curves in a single place are lying specially far from the land; in the last case, however, other factors must also be acting. The erosion of the coast, on the other hand, acts more equally everywhere, and of course most strongly at the western coasts of the lands; this, however, will not easily occasion a greater deposition of material outside of these coasts, as the currents and the winds will chiefly transport it to the east. Thus the erosion of the coast can upon the whole not be proved to be a factor by the distribution of the deposits, unless the rocks on the shore should consist of essentially other minerals than the inland which is scarcely the case in any of the regions treated of here. As to the transport with ice finally, it of course plays the most prominent part on the coasts of Greenland; large numbers of icebergs, partly laden with masses of sand, clay, and stones, are constantly carried out into the sea. In what manner this material is distributed on the sea bottom, is dependent on more factors, especially the currents and the temperature; it may be supposed, I think, that the melting icebergs are the cause of the exceedingly small amount of carbonate of lime in the deposits on the west coast of Greenland north of 63° Lat. N. On the east coast the masses of ice are far larger; but on account of their melting to a smaller degree it is to be supposed that the deposit on the sea-bottom is smaller than on the northern part of the west coast, and consequently the amount of carbonic acid in the few stations taken here, is larger than to the west. Upon the whole there will always be found that difference between the material carried along by the ice, and that coming with running water or eroded at the coast, that the former will not to so high a degree as the latter be precipitated near the place where it comes into the sea, but will be spread over larger areas. The two means of transport will also be quite unequally acted upon by the different sorts of agencies; while the material washed out in the water, is only driven by the currents, to begin with by the surface currents, later by the deeper ones, the icebergs will be acted upon boths by the winds and the surface currents, and when the material from them has got into the water, and sunk down in it, it will likewise be carried away by the deeper currents. All these facts may give rise to a very complicated state of distribution, from which it is very difficult to account for the single factors, and an attempt to point out the effects of the directions of winds and currents in the territory of the Ingolf Expedition will scarcely lead to any result, as these very directions are here complicated and not fully known; in a later section I shall find an opportunity for returning to these circumstances.

We shall now have to examine the effects of the two most important factors with regard to the distribution of the deposits, that is to say, the distance from the land and the depth; of these factors the former no doubt plays the greater part, and it is altogether remarkable, how the material from land spreads everywhere in the sea in all directions, even in the teeth of the currents and the prevalent directions of the wind. If we look at the course of the curves on plate II for instance, we shall see that in a locality southwest of Iceland comparatively small amounts of carbonate of lime are found, the curves forming rather large bends into the Atlantic; this fact, as will be shown in a later section, has its origin from Icelandic material, a specially large mass of which has accordingly been carried into that direction. This, as has been mentioned before, may perhaps be connected with the large streams that are found in this region, but as far as we know, the Gulf-stream reaches close to the southwest coast of Iceland, and thus it seems quite incomprehensible how the material is able to spread so far down in this direction; the same is found north of Iceland; here also the material has spread in the opposite direction of the predominant current, almost quite to Jan Mayen. That the depth is not of so much importance with regard to the distribution may be seen very clearly to the southwest of Iceland; as the Ingolf Expedition itself has essentially been instrumental in making clear, a submarine ridge is here found stretching from Iceland in a straight line towards the southwest far into the Atlantic, where by degrees it disappears; how prominent this ridge must be on the bottom of the sea may be imagined by considering the three stations 75, 81, and 82, lying in a straight line across the ridge, so that the distance between the outer ones is only ca. 120 km., and yet the specimen 81 is lying about 300 faths higher than the two others; that is to say, a difference in depth of 1800 feet on a distance of 120 km. Now it might be expected that the curves designating the amount of carbonic acid, would follow this ridge tolerably close; but in reality on the ridge itself, especially on the western slope of it, particularly large percentages of carbonate of lime are found, while on the eastern slope and east of the ridge the percentages are much smaller; thus the curves designating the amount of carbonate of lime make bends situated beside the ridge, a fact, of which for the present I am quite unable to give any explanation. Round the south point of Greenland very large depths are found; when the stations 20—22, and 38 show no larger amounts of carbonate of lime the reason must be the proximity of the land. The depth may, however, in other places exercise an important influence, as is especially the case on the ridge between the Faröe Islands and Iceland, where the bottom is covered with a Gray deep-sea clay very poor in lime though according to the position we should expect to find Transition clay or Globigerina clay; in what manner the ridge is able to get such an influence is not quite clear; as the specimens found on it, are as rich in clay as most of the others, the circumstances must also be favourable to the deposition of the finer calcareous organisms; but perhaps the circumstance may here be of some importance that the currents running along both the northern and southern coast of Iceland, meet here, and run together eastward towards the Faröe Islands, so that the material from Iceland gets a specially good opportunity for spreading in this direction; possibly a factor may also here be of some importance, which we have not hitherto taken into consideration, viz. the circumstance that firm rocks on the bottom may produce part of the loose material found in the bottom-specimens. We must especially expect this circumstance to be of importance on a ridge like the mentioned, which is not everywhere covered with loose soil, but partly consists of firm rocks that may even be rather rugged.

According to Delesse submarine rocks are almost always found outside a rocky coast, and they may by erosion and disintegration give rise to the formation of loose layers in the hollows between them. Delesse likewise mentions the fact that on the edge between Iceland and the Faröe Islands numerous such rocks are found even to a depth of 600 metres. Whether such firm rocks may be subject to any breaking down on the bottom of the sea is a question that cannot be directly examined; it may be taken for granted, that the bursting caused by the frost, cannot assert itself no more than the influence of the roots of plants, and also the mechanic erosion must be of small importance, the sea water being almost quite free of firm ingredients, and the moving being on deeper water rather slight. Thus the only agent able to corrode the rocks, is the disintegration; as the sea-water always contains some carbonic acid, there is a possibility of the feldspars being transformed into kaoline, and also of the disintegration of the other silicates; as the rock is never homogenous, some parts will decay, while others remain more or less unchanged, and thus the rock will be transformed partly to clay, partly to sand or gravel with all sizes of grains. Now as the currents are rather weak on the ridge, and the beating of the waves has no influence so far down, the formed material must be distributed in such a manner that the coarser parts remain on the spot itself, or, if this be elevated in proportion to the surroundings, are only carried a little way off, while the finer parts, and especially the clayey particles, may partly be carried to a greater distance before precipitating; perhaps they may also be redeposited several times, if the currents at times get another direction than the common one, there being then no shelter on the same places as before. The result of it all will be the formation of deposits of rather different habits; some will be tolerably pure clay, while others will be shaped as boulder-clay and contain every possible size of grains. As the latter habit is predominant in the specimens taken on the ridge, it may be taken as a sign of the ridge consisting of rather rugged, firm rock; in a later section, in which the mineralogical nature of the specimens will be examined more closely, it will be shown that some of the coarser ingredients show signs of having been produced in the immediate vicinity of the specimen, while others must be taken to have been brought sometimes even from a very great distance, which can scarcely have taken place by other means than the ice.

In the other localities the nature of the bottom-specimens does not so decidedly suggest the presence of submarine rocks. Near the coasts this presence will not be so easily pointed out, as the coarser ingredients of the specimens may as well have been derived from the land. From the ridge between Iceland and Greenland, unfortunately, no specimens have been obtained; it would otherwise have been of great interest, if by such we should have been able to show where the border is found between the Greenlandic and Icelandic rocks. The before mentioned ridge stretching from Iceland towards the southwest, is likely to be completely covered by sediment; if this was not the case larger quantities of mineral ingredients would surely have been obtained, and the specimens would not be so rich in carbonic acid, as they are seen to be. From this may again be drawn the conclusion that a comparatively large period of time must have elapsed, since the ridge was above the surface, if upon the whole it ever was so. On account of this comparatively complete covering with loose layers, nothing can be said of the petrographic nature of the ridge.

Those factors produced in the foregoing, may be regarded as the factors being of most importance with regard to the transportation of mineral material from the land, or eventually from the sea-bottom, and the depositing of it on other places of the bottom. The description will, I think, have conveyed the impression, that the different factors may in many ways counteract each other, and that, in most cases, it will be difficult, if not quite impossible, to state how much each factor has contributed to give the specimen in question its precise character. But the case is even more difficult, when we come to regard the fact that the above named factors are not the only ones that are of importance as to the deciding of the amount of carbonic acid in the specimen, and through that of the species of this specimen; one circumstance more has to be taken into consideration, viz. the larger or smaller number of calcareous organisms deposited on the place in question, and here again a number of different circumstances are of importance, as, besides the depth, also the temperature and the salinity, as well in the surface as at the bottom, and moreover the dashing of the waves, the currents, and perhaps still more. As the conditions of life of the Foraminifera and the still smaller calcareous organisms are scarcely so well known that it is possible to clear up the single facts, I shall not here discuss this question more particularly; perhaps in a later section I may find an opportunity of entering upon some details regarding it. Here I shall only add that the same circumstances that are favourable to the growth and deposition of the calcareous organisms, will as a rule also be favourable to the siliceous organisms, by which fact the case becomes still more complicated, the amount of lime not being so large, as otherwise was to be expected.

Section II.

The Percentages of the different Sizes of Grains in the Specimens.

See the charts, pls. III and IV.

Having commented on the amount of carbonic acid, the consistency, and the colour of the specimens, and the results of these factors with regard to the classification and the distribution on the the sea-bottom, I shall now pass to the washing and the results obtained by it. That the quantitative determination of the different sizes of grains may be justified, will be shown by the fact that the distribution of these grains is subject to a certain conformity to law, which conformity I shall try to show more particularly in the following.

The manner of proceeding with the washing is the one most commonly used. The specimen is first dried several hours at 100°, then it is weighed and passed through a sieve the meshes of which had a size of 0·5^{mm}; the coarser part contains as well calcareous shells as mineral ingredients. The greater part of the shells are picked off with a pair of tweezers, whereupon the rest is dissolved in hydrochloric acid; and the minerals left are now dried and weighed. The ingredients not measuring 0·5^{mm} are washed out with cold, diluted hydrochloric acid; the residue is placed in a tall goblet for some hours; when all the ingredients have precipitated, the clear fluid over them is poured off, that the washing shall not take place in water containing too much hydrochloric acid and chloride of calcium, in which the ingredients will precipitate considerably quicker than in pure water. The percentage of the carbonate of lime, which is measured beforehand, is calculated with regard to weight, and from this is got the weight of the ingredients insoluble in hydrochloric acid; and by subtraction is got the weight of the particles smaller than 0·5^{mm}. Upon this the specimen is washed in a Schone's washing apparatus with a rate of motion calculated in such a way as to wash out rounded grains of quartz with a diameter smaller than 0·02^{mm}, while the larger grains are retained; although grains of other minerals and of irregular forms precipitate in the water with rates of motion that may deviate somewhat from that of the quartz, and although thus by the mentioned rate of motion of the washing many grains over 0·02^{mm} may get away, while some smaller may be left, it has not been possible to pay any regard to this; in the following the two parts produced by the washing, will be designated as the ingredients over and under 0·02^{mm}, and the same will be the case at the other borders. The ingredients over 0·02^{mm} are dried at 100° and weighed; then the weight of the ingredients under 0·02^{mm} is got by subtraction, while the coarser particles are washed once more and thereby divided into the ingredients over and under 0·05^{mm}. Altogether each specimen is divided into five parts, viz. 1) Carbonate of lime, 2) Ingredients over 0·5^{mm}, 3) 0·5—0·05^{mm}, 4) 0·05—0·02^{mm}, and 5) The ingredients under 0·02^{mm}.

By this manner of proceeding we get the groups upon the whole best adapted for the examination. The ingredients over 0·5^{mm} are upon the whole too great to be examined by the microscope, but fit for an examination by the magnifying glass; they contain no other siliceous organisms than sponge spicules. The ingredients between 0·5^{mm} and 0·05^{mm} contain the minerals in the size best adapted for microscopical examination; besides the sponge spicules are found of organisms only a single form of Radiolaria. The ingredients from 0·05—0·02^{mm} show the advantage that they contain almost all the siliceous organisms within so small a space as possible whereby the examination of them is made much easier. The minerals show nothing of special interest, being the same as those of the preceding part. The ingredients under 0·02^{mm} contain all the clay, besides small mineral grains of no interest, and finally fragments of sponge spicules, Radiolaria, and Diatoms, as well as whole individuals of a few smaller forms of Diatoms. With regard to the parts containing lime, it is also especially fortunate that the border has been placed at 0·5^{mm}; all higher animal groups are found between the coarser ingredients, coccoliths and the like between the finer; and the Foraminifera, that are of far the greater importance, are divided into two groups, and these, as will be shown in a later section, are essentially different with regard to their distribution.

In the following table showing the results of the washing I have, for the sake of the survey, taken each bottom-specimen for itself; otherwise I have followed the numerical order.

Table showing the amount of carbonate of lime, and the different sizes of grains in the bottom-specimens.

I. Shallow-water deposits (sand and clay).

Number of the specimen	Depht in fathoms	$CaCO_3$	Over 0·5^{mm}	0·5—0·05^{mm}	0·05—0·02^{mm}	Under 0·02^{mm}
29	68	0·35	1·77	93·30	1·15	3·42
33	35	0·11	0·64	93·51	0·91	4·83
34	55	0·17	2·95	71·40	5·61	19·87
115	86	0·14	5·55	13·75	13·29	67·27

II. Gray deep-sea clay.

Number of the specimen	Depth in fathoms	$CaCO_3$	Over 0·5^{mm}	0·5—0·05^{mm}	0·05—0·02^{mm}	Under 0·02^{mm}
3	272	3·64	18·08	37·99	14·94	25·34
4	237	2·12	14·19	56·00	3·61	24·06
24	1199	2·46	0·02	17·45	17·38	62·68
25	582	0·26	0·36	37·16	14·68	47·52
28	420	0·44	0·17	60·16	9·80	29·43
32	318	0·41	1·15	34·15	19·48	44·84
58	211	2·95	0·05	16·75	18·63	61·63
59	310	0·68	0·01	29·49	24·26	45·55
101	537	0·48	0·04	12·42	12·68	74·39
107	492	2·21	0	15·17	4·37	78·25
124	495	0·72	0·05	15·09	11·18	72·96
126	263	0·26	0·05	33·29	10·89	55·51
128	194	5·22	0·11	12·40	2·96	79·32
138	471	5·48	0·23	19·28	4·19	70·82
141	679	4·70	0·76	28·01	9·49	57·04
143	388	6·14	31·38	47·97	1·72	12·74

III. Transition clay (incl. of Brown deep sea-clay).

Number of the specimen	Depth in fathoms	Ca CO_3	Over 0·5mm	0·5—0·05mm	0·05—0·02mm	Under 0·02mm
8	136	11·93	0·10	19·36	23·90	44·71
12	1040	5·83	2·10	6·87	9·66	75·52
13	622	9·71	23·57	20·38	25·03	21·31
21	1330	15·74	4·24	41·25	3·88	34·89
36	1435	15·70	0	2·96	8·81	72·53
37	1715	23·55	0	18·78	11·42	46·25
39	865	19·29	0	2·22	6·15	72·34
40	845	19·67	0	1·89	4·77	73·68
46	720	12·18	7·74	7·64	15·35	57·09
54	691	7·65	14·26	28·53	8·24	41·30
63	800	14·94	0·01	14·17	12·04	58·84
64	1041	5·33	0·08	41·16	19·23	34·20
65	1089	9·70	2·78	23·20	6·98	57·34
66	1128	19·45	0·08	6·67	12·48	61·30
67	975	23·31	0·02	2·80	4·51	69·36
68	843	20·92	0	1·69	6·03	71·37
69	589	25·46	0·10	6·96	5·00	62·48
73	486	20·45	1·33	25·07	6·56	46·59
74	695	23·62	0·22	4·70	5·50	65·96
85	170	19·09	12·26	36·92	2·64	29·09
91	1236	26·09	9·00	28·21	8·43	28·27
92	976	6·72	27·39	25·77	8·59	31·53
102	570	15·91	0·03	12·40	8·00	63·65
103	579	14·01	0	5·47	7·23	73·29
106	447	21·80	0	11·30	5·40	61·49
110	781	8·75	0·02	14·31	9·32	67·62
116	371	9·60	4·14	26·26	6·74	53·26
120	885	28·59	0·37	5·83	6·81	58·40
125	729	10·31	0·04	4·29	3·37	82·00
129	194	48·27	0·04	25·22	2·39	24·07
139	702	7·24	0·02	0·80	0·56	91·39
140	780	9·59	0·05	0·89	0·30	89·16

IV. Globigerina clay.

Number of the specimen	Depth in fathoms	Ca CO_3	Over 0·5mm	0·5—0·05mm	0·05—0·02mm	Under 0·02mm
10	788	55·36	3·82	9·51	4·20	27·11
17	745	66·02	0·33	4·43	0·41	28·81
18	1135	71·43	0·25	4·69	1·47	22·16
19	1566	39·28	5·84	12·91	2·28	39·69
20	1695	34·13	0	17·71	13·73	34·42
22	1345	36·73	0	1·33	4·27	57·67
38	1870	35·23	0	0·88	15·19	48·70
41	1245	29·71	0	4·13	7·61	58·55
45	643	47·02	1·84	12·85	4·73	33·55

Number of the specimen	Depth in fathoms	Ca CO_3	Over 0·5mm	0·5–0·05mm	0·05—0·02mm	Under 0·02mm
47	950	40·71	1·31	26·36	6·16	25·46
48	1150	54·72	0·01	18·81	7·37	19·09
75	780	35·85	0·08	2·59	5·89	55·60
76	806	34·84	0·07	4·51	2·50	58·07
77	951	30·00	0·03	1·52	3·39	65·05
78	799	43·79	0·47	2·21	2·07	51·47
80	935	62·22	0·01	0·86	0·54	36·37
90	568	57·00	6·75	9·35	2·35	24·55
104	957	54·04	0·13	8·28	5·53	32·02
105	762	48·30	1·18	7·19	6·05	37·27
111	860	36·63	0·01	4·09	3·56	55·70
112	1267	46·32	0·02	1·36	3·13	49·17
113	1309	31·29	0·02	2·92	3·15	62·62
117	1003	61·34	0·09	1·61	1·08	35·87
118	1060	43·67	0·02	0·42	0·52	55·37
119	1010	55·81	0·08	1·52	2·45	40·15

In the first group the instances are too few to deduce more common results from them; of the three last groups we get the following average:

	Ca CO_3	Over 0·5mm	0·5—0·05mm	0·05—0·02mm	Under 0·02mm
Gray deep-sea clay	2·38	4·17	29·55	11·27	52·63
Transition clay	16·58	3·44	14·81	8·29	56·88
Globigerina clay	46·05	0·90	6·49	4·38	42·18

Of this last table it will be seen how the coarser ingredients of the specimen, as was to be expected, decrease very much when we get farther from the land, while on the contrary the ingredients under 0·02mm keep at about the same percentage in all three species of deposits; this is caused by the fact, that these finest ingredients at the same time decrease in proportion to the carbonate of lime, and increase in proportion to the other mineral ingredients, which two influences tolerably well counterbalance each other. If we calculate the percentages of the different sizes of grains without regard to the carbonate of lime we get the following numbers:

	Over 0·5mm	0·5—0·05mm	0·05—0·02mm	Under 0·02mm
Gray deep-sea clay	4·27	30·27	11·54	53·92
Transition clay	4·12	17·75	9·94	68·19
Globigerina clay	1·66	12·05	8·12	78·17

From this is seen how the coarser ingredients in the two first columns decrease with more than half the amount from the Gray deep-sea clay to the Globigerina clay, while the ingredients from 0·05—0·02mm only decrease very slightly, and the finest particles increase very much. Of all the mineral particles, carried out into the sea, the coarsest accordingly, as was to be expected, precipitate proportionally quickly, while the finest are carried farthest away; if we had specimens from a still greater distance from the land, these specimens would probably come up very close to 100 per ct.

If we, however, examine the circumstances more in detail, a number of irregularities will appear; these irregularities are most conspicuous in the percentages of the coarsest ingredients over 0.5^{mm}, in which numbers an exceedingly great variation is seen. While the average numbers with regard to the three species of deposits were 4.17, 3.44 and 0.90, we find that more than half of all the specimens have percentages under 0.1, while about two thirds have under 1. Thus it is seen that the high average numbers arise from a comparatively small number of specimens, which are, however, tolerably equally divided between the three species of deposits. Of the 24 specimens having more than 1 per ct., two are found at Jan Mayen, three at the west coast of Greenland, south of Cape Farewell, two at the southwest coast of Iceland, and only three, the specimens 19, 65 and 105, are, without any apparent reason, found far out in the Atlantic. All the others are found on or immediately south of the submarine ridge between the Faröe Islands and Iceland, and just south of the ridge between Iceland and Greenland, and thus it is an obvious conclusion that this coarser material for the greater part is derived from these ridges themselves. On the ridge between Iceland and the Faröe Islands we find the very characteristic fact that the specimens on the ridge and immediately south of it have the very great percentages, while the specimens immediately north of it have only very small amounts, which fact is seen by far most plainly in the eastern part, where the specimen 143 on a depth of 388 faths has a percentage of 31.38, the absolutely largest percentage found in any of the specimens, while the specimens 138 and 141 a little farther north on depths of 471 and 679 faths, have 0.23 and 0.76 per ct., and the specimens 139 and 140, situated immediately north of the two preceding, on depths of 702 and 780 faths, only have the percentages 0.02 and 0.05. From these facts we should seem to be justified in drawing the conclusion that currents are passing over the ridge, chiefly from north to south; that currents are likely to pass in the same direction over the ridge between Iceland and Greenland would also seem to be a lawful conclusion on account of the large mass of coarse material found on the route south of this ridge; here, however, specimens farther north for comparison are wanting.

As the presence of the coarser material may almost always be sufficiently accounted for by the proximity of the coast or one of the mentioned ridges, there is thus no reason to suppose that the ice-bergs have been of any considerable importance with regard to the deposition of this material. On the contrary, in places where at times many icebergs are found, as in the tract north of Iceland and west of Greenland at the 65^{th} degree of latitude, very small masses of coarser material are seen in the specimens, as will appear from pl. III; the northern coast of Iceland is even the place where the curves are closest to the land in the whole territory. From this we may be almost justified in concluding that ice-bergs can not generally produce till-like deposits, as has been supposed in earlier times, a supposition scarcely quite given up in our time. On the other hand, the icebergs may, of course, have contributed some part of the coarser material found in the different specimens; but when a survey of the map shows the specimens south of Iceland outside of the region of the ice-bergs to contain the same masses as those between Iceland and Jan Mayen, we shall necessarily arrive at the opinion that the drift of the ice is upon the whole of very small importance; in what manner then the ingredients over 0.5^{mm} can be carried to that distance from the coast in which they are found, becomes thus a very difficult question to solve. As they precipitate with a rather great rate of motion, so that for inst. a grain of a diameter of 1^{mm} will sink about 100 faths in half an hour, it is difficult to suppose that they can be transported by means of the currents so far out in the sea, as they really are found. In a later section where the mineralogical nature of these ingredients will be examined, I shall have a better opportunity of entering upon the details of these questions, as it has also to be taken into consideration, from which land these minerals may be thought to have been procured, as also that the transporting effect may be different for the different ingredients.

On the chart showing the distribution of the coarser ingredients two curves have been drawn, one for 1 per ct., and one for 0·1 per ct.; they will be seen to be very close together, there being upon the whole comparatively few specimens between these two values. To draw more curves can not easily be done, as neither the higher numbers especially found on the two ridges, nor the lower ones are distributed with any recognizable regularity; the before mentioned specimens, 65 and 105, are to be treated as exceptions, and can not be given any influence on the direction of the curves; whether this is also to be the case with specimen 19, is not easily decided, this specimen being rather isolated from the others; it seems, however, to be most correct to class it with the two others.

A closer examination of the ingredients of the next size of grain, $0.5—0.05^{mm}$ will show, that generally they are found most abundantly nearest to the land, what was also to be expected; although some deviations from this rule are found, the distribution is upon the whole rather regular; the largest amount of sandy ingredients are found in the specimens 29 and 33 at the west coast of Greenland, which specimens have 93·30 and 95·51 per ct., and consequently may be designated as very pure and homogenous sand; the smallest percentages are found in the specimens 38 west of Greenland with 0·88 per ct., 80 southwest of Iceland with 0·86 per ct., 139 and 140 north of the Faröe Islands with 0·80 and 0·89 per ct., and finally 118 between Iceland and Jan Mayen with 0·42 per ct., which last specimen thus is the one poorest in the larger mineral ingredients. It is otherwise impossible in detail to account for the causes of the irregularities that appear in the distribution of these ingredients, as they are too closely connected as well with the nearest larger as with the nearest smaller particles to be kept separate.

This latter remark may to a still higher degree be applied to the next size of grain, the particles between 0.05^{mm} and 0.02^{mm}. The percentages in which these are found in the specimens, do not vary so much, as the case is with some of the other sizes; generally the amount decreases from 10—20 per ct. closer to the land to less than 5 per ct. farthest out, but the decreasing is not so regular as in the preceding size. The largest amount is found in no. 13, viz. 25·03 per ct., the smallest amounts in the same specimens as before noted, the very smallest amount in specimen 140 with only 0·30 per ct. As the two sizes, 0·05—0·05 and 0·05—0·02, are upon the whole distributed according to about the same laws, I have in the map, pl. IV, noted the aggregate amounts of both sizes, that is to say the particles between 0·5 and 0.02^{mm}; accordingly this chart will upon the whole give an idea of the distribution of all the sandy particles. It will here be seen that the curves lie the closer to the land, the smaller this land is, as was also to be expected; further that the ridges between the Faröe Islands and Iceland, and between this latter island and Greenland produce the same effect here, as the case was with the coarsest size, that is to say, very great percentages, which fact then may also here be taken to be caused by the submarine rocks supplying part of the material, even if a larger part than before may in this case be transported from the land; nor has on the other hand the ridge southwest of Iceland any influence here, the curves crossing it without any appreciable alteration.

As to the finest particles under 0·02^{mm} hardly a single rule concerning their distribution can be made out. As has been seen before, they are on an average present in about the same amount in the three species of deep-sea deposits, even if they decrease a little in the Globigerina clay. This circumstance is, of course, dependent on the fact that the coarser ingredients in the specimens decrease from the land outward, while, at the same time, the calcareous organisms increase, which two opposite influences upon the whole counterbalance each other. The percentage may, for the rest, be rather varying in the single specimens, but, as has been said before, without any special regularity; the largest amount (91·39 per ct.) is found in specimen 139 north of the Faröe Islands, which specimen, as before noted, is uncommonly poor in sandy particles, while the percentage of lime at the same time is small; if calcareous organisms are not deposited here in essentially smaller masses than at other places, an uncommonly large mass of clayey substance and fine mineral particles must be deposited here, and it is not easy to see, from where these particles should originate, unless the ridge should have produced at least great part of them. The smallest percentage in the deep-sea specimens proper, is found in no. 143 with 12·74 per ct.; it is situated immediately south of the preceding one, and the small amount here is of course dependent on the deposition of especially large masses of the coarser particles, so that the specimen upon the whole gets a highly sandy consistency.

Section III.

The Mineralogical Nature of the Bottom-Specimens.

See the charts on plates 5—7.

The object of the present section is to show the nature of the mineral ingredients of the specimens, and, as far as possible, refer the rocks and minerals to their place of origin. This latter can, of course, only be made partly, even if the territory explored by the Ingolf expedition, shows rather great advantages in this respect. Scarcely anywhere will be found a more marked difference with regard to petrography than that existing between Iceland, the Faröe Islands, and Jan Mayen on one side, and Greenland, Scandinavia, and perhaps land farther to the north on the other side, and from these sources the bottom-specimens have received all their mineral material, with the only exception of the few ingredients that may have come from the sea-bottom. But it has been quite impossible to refer the different rocks to particular localities within these territories, and especially on account of the fact that the coarsest ingredients of the specimens very seldom reach any considerable size; by far the greatest number are smaller than 2^{mm} in diameter, and only a few pieces have surpassed the size of a pea. Consequently it will in most cases be impossible to refer the ingredients to a particular rock, and still more impossible to refer this rock to a particular locality; very often each grain is made up of only one single mineral, and even if it be an aggregate of more minerals, it will generally, on account of its smallness, not be able to show the structure characteristic of the rock in question, with sufficient distinctness. To this is to be added that the rocks in each of the two mentioned groups of lands are rather homogenous. From Greenland and Scandinavia the ingredients are almost exclusively of gneiss and granite, and, far the most predominant, of quartz, and those ingredients cannot be referred to any particular locality inside this large territory; the rocks and minerals from the Faröe Islands are, in the condition in which they are found in the bottom-specimens, scarcely to be distinguished from the Icelandic ones, whereas part of these latter will not be found in the Faröe Islands. The ingredients from Jan Mayen may easily be distinguished from those from Iceland, but they are only found in close vicinity of the island.

In the following the mineral ingredients of the two larger sizes of grains will be examined, while the finer particles will only be treated briefly, they being partly rather difficult to distinguish, and partly of about the same nature as the coarser ones. The ingredients over $0{\cdot}5^{mm}$ are generally directly recognizable, and it has only in a few cases been necessary to subject them to a closer microscopic examination; the ingredients between $0{\cdot}5$—$0{\cdot}05^{mm}$, on the other hand, have chiefly been examined by means of a microscope. On account of the different methods of examination, I have thought it most correct to treat each of the sizes of grains separately, and the more, as they, on account of the different circumstances in which they are found and their partly different origin, give results that are not in every respect identical.

I. The Ingredients over 0·5^{mm}.

Station 2. Between Iceland and the Faröe Islands; Gray deep-sea clay; the percentage undetermined. Chiefly numerous angular pieces of one and the same light gray rock; probably volcanic tufa with grains of feldspar and small black grains; further 5 small rounded pieces of black or dark brown basalt; 2 small rounded grains of quartz.

Station 3. Between Iceland and the Faröe Islands; Gray deep-sea clay; 18·08 per ct. The grains all rather rounded; more than half of their number black or dark gray basalt, compact or fine-grained; of volcanic ingredients were found small quantities as: light gray tufa?, black glass, pumice, a single grain of olivine; of not volcanic ingredients: a rock consisting of quartz, feldspar, muscovite, and garnet (probably gneiss); another rock with quartz, feldspar, and biotite (gneiss or granite); further a few grains of quartz, orthoclase, and a pyroxene mineral.

Station 4. Between Iceland and the Faröe Islands; Gray deep-sea clay; 14·19 per ct. The pieces rather much rounded, chiefly basalt as in the preceding specimen; besides were found of volcanic ingredients: light gray tufa?, a single grain of olivine; of other ingredients pieces of gneiss or granite, a single piece of granulite or quartz-porphyry, a single piece of gray mica-schist, further grains of quartz and feldspar.

Station 6. The southeast coast of Iceland; Sand; the percentage undetermined. Almost exclusively rounded pieces of differently coloured basaltic rocks; a few pieces of light gray tufa, a few grains of quartz.

Station 7. The southeast coast of Iceland; Brown deep-sea clay; 0·95 per ct. By far the larger part basalt; a little rounded or almost quite angular pieces of black basalt, partly coated with a red-brown crust made by disintegration; the structure sometimes more glassy and vesicular. Further were found some pieces of light pumice and gray tufa; one single piece of slate.

Station 8. The southwest coast of Iceland; Transition clay; 0·10 per ct. A couple of larger and several smaller pieces of the same rock, a black pumice, vesicular and glassy.

Station 9. Between Iceland and Greenland; Brown deep-sea clay; the percentage undetermined. Half-rounded pieces of basalt, sometimes passing into pumice; a few other grains could not be referred to any particular rock.

Station 10. Between Iceland and Greenland; Globigerina clay; 3·82 per ct. Chiefly almost angular pieces of pumice, black or gray; besides also pieces of brown or gray tufa, black, compact basalt; one single colourless grain of feldspar.

Station 11. Between Iceland and Greenland; Globigerina clay; the percentage undetermined, very large. One single, especially large piece (10^{mm}) consisted of reddish white zeolites, forming the stuffing of a cavity with dark brown crust. Another rather large piece consisted of a soft greenish gray rock; further were found several, only little marked pieces of basalt, pumice, and tufa.

Station 12. Between Iceland and Greenland; Transition clay; 2·10 per ct. Chiefly black pumice; further gray tufa containing numerous black grains of volcanic glass; finally a few pieces of black, compact basalt.

Station 13. Between Iceland and Greenland, nearer to the latter; Transition clay; 23·57 per ct. Chiefly volcanic material. The larger grains rather angular, consisting of a red-brown, rather peculiar variety of basalt with glassy inclosings and brown grains of feldspar; in section it was seen to be built as typic basalt, with numerous grains of augite, feldspar, and magnetite lying in a glassy matter. The smaller grains were more or less rounded, and contained of volcanic ingredients black or dark gray basalt, a few pieces of black and gray pumice and gray tufa. Of not volcanic material were found a few pieces of quartzite, dark, micaceous sandstone, grayish and yellowish, loose quartz sandstone, a few grains of feldspar and quartz.

Station 17. Southwest of Iceland; Globigerina clay; 0·33 per ct. Almost angular pieces, chiefly of black basalt and pumice with all degrees of transition; one single red-brown piece of pumice. Of not volcanic material was found a piece of granite or gneiss, much larger than any of the other pieces; further a piece of sandstone, and a grain of quartz.

Station 18. Southwest of Iceland; Globigerina clay; 0·25 per ct. Almost half of the material volcanic, black pumice and gray tufa. Otherwise grains of quartz; one piece of quartzite.

Station 19. Southwest of Iceland; Globigerina clay; 5·84 per ct. About two thirds volcanic material, of which must be noted: several pieces of the same light gray tufa; several pieces of the same characteristic black, porous basalt; a few pieces of black, compact basalt, basaltic pumice, light pumice, and olivine. Of the not volcanic ingredients I note: numerous grains of quartz; a few grains of feldspar and hornblende, a few pieces of sandstone, one single piece of granite or gneiss.

Station 21. South of Greenland; Transition clay; 4·24 per ct. Chiefly not volcanic, but numerous grains of quartz; further pieces of gneiss, clay-slate, a large piece of sandstone, biotite, muscovite, and feldspar. About one fourth volcanic, consisting of compact and porous basalt, tufa, a few pieces of glassy basalt and obsidian.

Station 24. West of Greenland; Gray deep-sea clay; 0·02 per ct.; two grains of quartz.

Station 25. West of Greenland; Gray deep-sea clay; 0·36 per ct. Very small, partly rounded grains of quartz formed the chief mass; besides some grains of a very fine-grained or compact grayish rock; single grains of feldspar and biotite.

Station 27. West of Greenland; Gray deep-sea clay; the percentage undetermined, not very large. Far the greater part grains of quartz, partly rounded; besides biotite, feldspar, and some pieces of a similar grayish fine-grained rock as in the preceding specimen.

Station 28. West of Greenland; Gray deep-sea clay; 0·17 per ct. Far the greater part grains of quartz; besides feldspar, magnetite, and a piece of the same rock as in the preceding specimens.

Station 29. West of Greenland; Sand; 1·77 per ct. Far the greater part grains of quartz; besides the same gray rock as in the preceding specimens; the larger pieces found here, seemed to indicate a granulite-like rock; further some pieces of a black rock, possibly basalt; a few grains of feldspar.

Station 32. West of Greenland; Gray deep-sea clay; 1·15 per ct. Chiefly grains of quartz; further were found some pieces of clay-slate, phyllite, biotite-schist, sandstone, and gneiss; a few grains of feldspar.

Station 33. West of Greenland; Sand; 0·64 per ct. About six seventh of the specimen grains of quartz; the rest feldspar, perhaps a single piece of gneiss; some few indeterminable gray grains.

Station 34. West of Greenland; Sand; 2·95 per ct. Far the greater part grains of quartz; further feldspar, biotite, muscovite-schist, pieces of gneiss or granite; several indeterminable pieces.

Station 45. West of the Faröe Islands; Globigerina clay; 1·84 per ct. Chiefly not volcanic, being mostly grains of quartz; besides feldspar, a single piece of sandstone; of volcanic material was found black, compact or more or less porous basalt.

Station 46. West of the Faröe Islands, southeast of Iceland; Transition clay; 7·64 per ct. The grains rather rounded, reddish brown on the surface. Far the greater part not volcanic; in the first instance an immense mass of grains of quartz; next sandstones some of which of a very peculiar nature, consisting besides grains of quartz of a compound of brown, white, and black grains; further mica-schist, clay-slate, and rocks of a gneiss- or granulite-like nature; finally grains of orthoclase, plagioclase, and biotite; of volcanic material was found a number of pieces of basalt, some of them more porous.

Station 47. Southeast of Iceland; Globigerina clay; 1·31 per ct. The larger pieces almost angular. Far the greater part not volcanic material, especially a large mass of quartz; besides grayish sandstone, biotite, muscovite, and feldspar. Of volcanic material was found compact basalt, black, vesicular glass, tufa; further augite and magnetite.

Station 48. Southeast of Iceland; Globigerina clay; 0·01 per ct. Chiefly not volcanic; of 12 small grains 6 were quartz, 2 feldspar with a dark mineral; of volcanic material were found 2 grains of black, compact basalt, 1 of porous basalt, 1 of magnetite.

Station 50. Southeast of Iceland; Transition clay; the percentage undetermined, rather small. Almost exclusively volcanic material, that is to say basalt, partly compact, partly glassy, porous; several pieces that were not to be defined, on account of their smallness. One single grain of quartz.

Station 54. Southeast of Iceland; Transition clay; 14·26 per ct. Most of the grains rounded, disintegrated on the surface, sometimes with a brownish crust. The large number of grains almost exclusively of volcanic material viz. primarily a black or dark gray, fine-grained basalt forming all the larger pieces; further compact basalt; black, porous, volcanic glass, brownish feldspar, obsidian, tufa. Of other ingredients were found some grains of quartz.

Station 58. East of Iceland; Gray deep-sea clay; 0·05 per ct. All the grains very small, chiefly compact, grayish or black basalt; further black, porous glass. Of not volcanic material a number of grains of quartz were found.

Station 59. East of Iceland; Gray deep-sea clay; 0·01 per ct. Only few and very small grains, chiefly basalt; black, volcanic glass and tufa; a few grains of quartz and feldspar.

Station 63. South of Iceland; Transition clay; 0·01 per ct. Of the 11 very small grains 7 consisted of a porous, black lava, 3 of a tufa-like rock; 1 grain of quartz.

Station 64. South of Iceland; Brown deep-sea clay; 0·08 per ct. The rather numerous, very small grains almost exclusively quartz; a few grains of feldspar; of volcanic material a few pieces of tufa, one single grain of basalt.

Station 65. South of Iceland; Transition clay; 2·78 per ct. Consisted of a comparatively very large piece of black, compact basalt, disintegrated on the surface with a reddish crust. The rest very small, and not numerous grains. More than half of it not volcanic, viz. some grains of quartz, a single grain of feldspar, a piece of gneiss (?) consisting of quartz, feldspar, and a dark mineral. Among the small grains was found of volcanic material basalt, black, porous glass, gray tufa.

Station 66. South of Iceland; Transition clay; 0·08 per ct. The very small grains consisted chiefly of quartz; a few grains of feldspar; of volcanic material a few pieces of black, compact basalt, porous basalt, grayish tufa.

Station 67. Southwest of Iceland; Transition clay; 0·02 per ct. 28 small grains, 17 of which were quartz, 8 black, compact basalt, 3 gray tufa.

Station 68. Southwest of Iceland; Transition clay; 0·00 per ct. A grain of quartz, and a piece of black, porous basalt.

Station 69. Southwest of Iceland; Transition clay; 0·10 per ct. Chiefly volcanic material, especially pieces of light gray pumice forming the largest pieces, some black, porous basalt, a few pieces of gray, volcanic tufa; of not volcanic material was found some quartz; a few grains of feldspar.

Station 73. Southwest of Iceland; Transition clay; 1·33 per ct. Almost exclusively volcanic material, especially large masses of a grayish pumice forming all the largest pieces (up to 8^{mm}), and the greater part of the smaller ones; under the microscope it was seen to be basaltic; further a great number of pieces of black pumice, connected with the preceding mineral by gradual transition, and this again passed gradually into more or less porous basalt; quite compact basalt, however, was scarcely found; besides a mass of volcanic tufa; a few crystals of olivine and grains of augite. Of not volcanic material were found a few grains of quartz and orthoclase.

Station 74. Southwest of Iceland; Transition clay; 0·22 per ct. Chiefly volcanic material, viz. gray or brownish gray pumice, black, shining pumice, and gray tufa; a smaller quantity of black, compact basalt; of not volcanic material only a few grains of quartz.

Station 75. Southwest of Iceland; Globigerina clay; 0·08 per ct. A little more than half of the material volcanic, viz. black pumice, gray, volcanic tufa, gray and brown pumice; a smaller quantity of orthoclase and light mica.

Station 76. Southwest of Iceland; Globigerina clay; 0·07 per ct. About half of the material volcanic; black, porous basalt and gray, volcanic tufa; otherwise quartz and a smaller quantity of feldspar and muscovite.

Station 77. Southwest of Iceland; Globigerina clay; 0·07 per ct. About half of the material volcanic, especially black, porous basalt, and gray, volcanic tufa; the rest quartz and a single piece of feldspar.

Station 78. Southwest of Iceland; Globigerina clay; 0·47 per ct. Almost exclusively consisting of sponge spicules; the quantity of minerals very small; about half of the minerals volcanic, viz. black, compact basalt, and black, porous basalt; the rest quartz.

Station 80. Southwest of Iceland; Globigerina clay; 0·01 per ct. Chiefly not volcanic, that is to say, of 12 grains were 8 quartz, 1 biotite; 3 gray tufa (?).

Station 81. Southwest of Iceland; Globigerina clay; the percentage undetermined, very small; only two small grains, one quartz, the other black, porous basalt.

Station 83. Southwest of Iceland; Globigerina clay; the percentage undetermined, but very large, 3 stones being found, larger than in any other specimen, weighing nearly 10 grams; they were rounded, and coated with a red-brown crust. They consisted of: 1) fine-grained, dark gray basalt with numerous pores and cavities, and with small grains of feldspar; 2) a gray, very fine-grained, rather loose rock, mostly consisting of quartz (most likely sandstone); 3) gray granite or gneiss, with very different sizes of grains, consisting of gray quartz and orthoclase, as also biotite.

Station 85. Southwest of Iceland; Transition clay; 12·26 per ct. The grains partly rounded, coated with a rather thick, red-brown crust, which very much impeded the examination. The larger pieces, over 2^{mm} in diameter, were absolutely exclusively volcanic, viz. 50 pieces of a red-brown, fine-grained rock, probably altered basalt; 28 pieces of black, compact or fine-grained basalt, 7 of gray pumice, 6 of dark gray, porous basalt, 5 of black pumice, 5 of gray basalt, 4 of brown-gray vesicular glass or pumice, 3 of black, volcanic glass, palagonite, 1 of gray, volcanic tufa. In the exceedingly numerous smaller particles the same ingredients were by far the most prominent; besides was found of volcanic material: olivine and plagioclase; of not volcanic material: a few grains of quartz; a single table of muscovite.

Station 89. Between Iceland and Greenland, nearer to Iceland; Transition clay; the percentage undetermined, rather large. Far the greater part volcanic material; chiefly gray grains, probably tufa; further black, vesicular glass; colourless, vesicular glass, black and red-brown basalt; a smaller quantity of gray pumice and plagioclase. Of not volcanic material was only found a small quantity of quartz.

Station 90. Between Iceland and Greenland; a little nearer to Iceland; Globigerina clay; 6·75 per ct. The larger ingredients half-rounded, almost exclusively volcanic, out of 55 grains was only one of quartz, and one of orthoclase; of the other 53 pieces 15 were compact or fine-grained, black basalt, 11 a red-brown, fine-grained rock, probably disintegrated basalt, 9 black-gray, porous basalt, 5 gray pumice, 5 black glass or palagonite, 3 brown-gray, vesicular glass, 2 gray, fine-grained basalt, 2 gray tufa, and 1 black, vesicular glass. Among the smaller pieces (under 2^{mm}) the same ingredients were found, chiefly in the same ratio; a little more quartz was however found; further was found clear, colourless, volcanic glass, more or less vesicular, a few grains of olivine, and red garnet.

Station 91. Between Iceland and Greenland, a little nearer to Greenland: Transition clay: 9·00 per ct.

The larger pieces rather angular, far the greater part of volcanic material, viz. 47 grains of 52, distributed in the following way: 11 grains of a red-brown, loose rock, probably disintegrated basalt, 9 of black, porous basalt, 8 of gray pumice, 7 of vesicular, black glass, 5 of black, compact basalt, 3 of black glass or palagonite, 2 of plagioclase, 1 of gray, compact basalt, one crystal of augite. The five pieces of not volcanic material were: 3 pieces of crystalline schist, gneiss, mica-schist, and quartzite, 2 grains of quartz. Among the innumerable smaller grains the quartz was present in a comparatively somewhat larger quantity, otherwise the ingredients were found in about the same ratio of quantity; further was found colourless glass, olivine and biotite.

Station 92. Between Iceland and Greenland, nearer to the latter; Transition clay; 27·39 per ct. In this specimen that is situated not very far from the preceding one, the not volcanic material is suddenly found to be predominant, so that among the grains over 2^{mm}, besides 6 that could not be determined, 121 out of 141 were not volcanic. These ingredients were: 67 grains of fine-grained granite or gneiss, 35 of sandstone, 10 grains of quartz, 3 of a hälleflinte-like rock, 2 of orthoclase, 2 of black, and one of gray clay-slate, one of black siliceous slate. The volcanic ingredients consisted of 10 grains of black, porous basalt, 5 of red-brown, fine-grained, disintegrated basalt, 2 of colourless feldspar, probably plagioclase, 2 of gray tufa, and one grain of gray pumice. Among the smaller grains the same ingredients were found in about the same ratio, quartz, however, in a larger quantity, as also gray tufa; further were found olivine, colourless, volcanic glass, red garnet, augite, epidote, magnetite, biotite.

Station 94. Close to the east coast of Greenland; unnamed, as the specimen was taken up in an almost washed out condition, so that all the finer ingredients were wanting. On the same account the percentage is not determined, but is not especially large. Completely made up of very small grains, far the greater part quartz, besides a single black clay-slate; of volcanic material black, compact basalt, black vesicular basalt, colourless volcanic glass.

Station 98. Near the west coast of Iceland. Unnamed on the same account as the preceding one, and the percentage not determined, not especially large. Completely made up of very small grains, almost exclusively of volcanic origin; the greater part was colourless, vesicular glass; besides some compact, gray grains, possibly tufa, some pieces of black vesicular glass. Of not volcanic material a few grains of quartz were found.

Station 101. Northeast of Iceland; Gray deep-sea clay; 0·04 per ct. Very small grains, chiefly of volcanic origin, viz. colourless, vesicular glass, black, vesicular glass, and black, compact or fine-grained basalt. Further were found some grains of quartz.

Station 102. Northeast of Iceland; Transition clay; 0·03 per ct. Of 9 grains 8 were volcanic, viz. black, vesicular glass, and black, compact basalt; one grain of quartz.

Station 104. Northeast of Iceland; Globigerina clay; 0·13 per ct. Almost half of the material volcanic, viz. black, compact basalt, black, vesicular glass, one single grain of olivine; the rest mostly grains of quartz; a single grain of feldspar.

Station 105. East of Iceland; Globigerina clay; 1·18 per ct. Far the greater part not volcanic, viz pieces of the same gray clay-slate; further some grains of quartz, a single grain of feldspar; a piece of loose sandstone; a larger piece of white-gray limestone, the only one in all the specimens. Of volcanic material was found a piece of brown-gray tufa(?).

Station 106. East of Iceland; Transition clay; 0·00 per ct. 3 very small grains, of which two were of black, porous basalt, the third one a grain of quartz.

Station 110. Northeast of Iceland; Transition clay; 0.02 per ct. Very small grains, as far as they could be recognized, exclusively black, compact basalt.

Station 111. Northeast of Iceland; Globigerina clay; 0·01 per ct., exclusively black, compact basalt.

Station 112 Northeast of Iceland, south of Jan Mayen; Globigerina clay; 0.02 per ct.; one single piece of black, compact basalt. Besides the weighed part of the specimen were found two larger stones, weighing together about 7 grs. They were black, fine-grained basalt, and yellow-gray, very fine pumice.

Station 113. South of Jan Mayen; Globigerina clay; 0·02 per ct. Black, fine-grained basalt, and greenish olivine.

Station 115. Immediately at the south coast of Jan Mayen; deposit of more shallow water, clay; 5·55 per ct. Almost exclusively basalt of a peculiar type; apparently it was fine-grained, but under the microscope it was seen to consist of a brown, glassy mass with very numerous, small vesicles; sometimes these were more inconspicuous, sometimes small grains were found, in some instances in so great numbers that the glass almost disappeared. Further were found larger quantities of olivine and augite; a very small quantity of red basalt and colourless glass. Of not volcanic material a very small quantity of quartz was found.

Station 116. South of Jan Mayen; Transition clay; 4·14 per ct. Rather angular grains; a little more than half of them volcanic, chiefly basalt of the same type as in the preceding specimen; some olivine; further augite and plagioclase. Of not volcanic material far the greater part was quartz; further feldspar, biotite, red garnet, sandstone.

Station 117. Between Iceland and Jan Mayen, a little nearer to Jan Mayen; Globigerina clay; 0·02 per ct. 10 very small grains, of which 7 were black, porous basalt; one black, compact basalt; one olivine, and one quartz.

Station 118. Between Iceland and Jan Mayen, a little nearer to Jan Mayen; Globigerina clay; 0·02 per ct. 10 very small grains, of which 7 were black, porous basalt; one black, compact basalt; one olivine, and one quartz.

Station 119. Between Iceland and Jan Mayen, a little nearer to Iceland; Globigerina clay; 0.08 per ct. Of 11 pieces 8 were black, compact or somewhat porous basalt; two were brownish pumice, one quartz.

Station 120. Between Iceland and Jan Mayen, nearer to Iceland; Transition clay; 0·37 per ct. One piece, much larger than the others, consisted of reddish basalt; the smaller grains were almost exclusively volcanic; black and red, compact basalt; olivine; colourless, vesicular glass; black, vesicular glass; brown glass. Of not volcanic material only a few grains of quartz were found.

Station 124. North of Iceland; Gray deep-sea clay; 0·05 per ct. Very small grains, almost exclusively of volcanic nature, viz. black, compact basalt, olivine, black, vesicular glass, light pumice; red, porous basalt. Further a few grains of quartz.

Station 125. North of Iceland; Transition clay; 0·04 per ct. Almost exclusively volcanic; the chief mass was black, more or less porous basalt, besides olivine, augite, colourless or slightly brown, vesicular glass, black, vesicular glass. Further a few grains of quartz.

Station 126. North of Iceland; Gray deep-sea clay; 0·05 per ct. Almost exclusively volcanic, chiefly black, vesicular glass; further black, compact basalt, colourless, vesicular glass and gray tufa. A few grains of quartz.

Station 127. North of Iceland; deposit from more shallow water; gravel. The percentage not determined, very large, ca. 90. Among the largest grains, over 5^{mm} in diameter, the volcanic ingredients were so completely predominant, that among 145 grains only one was not volcanic, it being quartz; the others were of a rather homogeneous nature; 97 were gray-black, fine-grained or compact basalt, 50 black, fine-grained or compact basalt, 11 gray-green, fine-grained or compact basalt, 2 black, vesicular glass, 2 light gray basalt. All the pieces were rounded, and coated with a dark crust; in a few of the grains of basalt were found grains of feldspar, augite or olivine; very few of them had cavities or amygdaloids. Among the smaller grains the same ingredients were found, the quartz, however, being somewhat more prominent; a few amygdaloids of chalcedony were seen.

Station 128. North of Iceland; Gray deep-sea clay; 0·11 per ct. Chiefly volcanic, viz. 9 grains of black basalt, one of red basalt, 3 grains of quartz.

Station 129. Northwest of Iceland, Transition clay; 0·04 per ct. The only things found were some small plates of colourless glass.

Station 138. North of the Faröe Islands; Gray deep-sea clay; 0·23 per ct. Chiefly not volcanic, viz. quartz and some feldspar; about one fourth volcanic, consisting of black, shining, volcanic glass, black, compact basalt, plagioclase, and colourless glass.

Station 139. North of the Faröe Islands; Transition clay; 0·02 per ct. 12 small grains, viz. 11 grains of quartz, and one of black basalt.

Station 140. North of the Faröe Islands; Transition clay; 0·05 per ct. 5 pieces of black basalt.

Station 141. North of the Faröe Islands; Gray deep-sea clay; 0·76 per ct. Far the greater part not volcanic, being quartz, feldspar, and dark mica; of volcanic material: black or gray basalt, black, volcanic glass, olivine.

Station 143. North of the Faröe Islands; Gray deep-sea clay; 31·38 per ct. Of the larger grains, over 2^{mm}, not a single one was of volcanic origin; they consisted of: 17 pieces of a compact or fine-grained rock, rich in quartz, granulite, hälleflinte, or quartzite, of gray, black-gray, or red-gray colour; 4 pieces of black or black-gray clay-slate, 4 of gray or red-gray, rather hard sandstone, 3 of quartz + red feldspar (granite or gneiss), 2 of opaque, grayish quartz, one of loose sandstone, one of phyllite, one of clear, colourless quartz. In the smaller grains the same ingredients were found; but here the quartz was most prominent of all. Further was found: red garnet, biotite, and muscovite, and of volcanic material gray pumice, black, shining, vesicular glass, olivine and augite.

Having thus accounted for the rocks and mineral ingredients of the single specimens, it will be necessary for the general view to say a few words of the distribution of each of these ingredients, before passing to more general reflections on the distribution. Of the volcanic material is to be named primarily:

Basalt, which occurs widely distributed in the specimens in many varieties: the most common form is a black or black-gray, compact or very fine-grained basalt forming the chief portion of Iceland and the Faröe Islands, and found in almost all the specimens from the vicinity of these islands, being often the chief ingredient of the specimens, and sometimes the only ingredient of the coarser particles. Of the 79 specimens in which ingredients over a diameter of $0{\cdot}5^{mm}$ are found, the compact basalt is found in 53, and in 18 specimens it is more than half of all the ingredients; these latter specimens are almost all found in close vicinity of Iceland, where the terrigenous material has not been mixed up with material from other places; besides, especially large masses of basalt are found between Iceland and Jan Mayen; accordingly the circumstances must be especially favourable for transport from Iceland in that direction. A single specimen, no. 140, north of the Faröe Islands, occupies a peculiar position, containing, contrary to the neighbouring specimens that are rich in quartz, nothing but 5 pieces of black basalt; but these may well be supposed to have arisen from one single piece that more or less casually may have been carried to this place, while the circumstances have otherwise been of such a nature as not to allow coarser material to be deposited in the said place. Among the specimens from Greenland, small, dubious pieces of basalt have been observed from a single station, no. 29; they may be supposed to have originated from the Greenland basaltic region farther north. In the basalt small grains have often been observed of feldspar, olivine, augite; more rarely small cavities are found filled with some white mineral, either chalcedony or zeolites. Sometimes the basalt assumes a more brownish or reddish colour; it is often, like several of the other ingredients, covered on the surface by a dark, red-brown crust, which crust may either be formed by disintegration or else by the surrounding water having contained dissolved iron, and deposited it on the grains as ferric oxide; that this process has taken place in many cases, may be seen from the fact that also the grains of quartz and other grains that cannot decay, are often covered with a similar brownish crust. Sometimes the basalt has been totally disintegrated, and has passed into a rather loose, brownish rock, chiefly observed in the specimens between Iceland and Greenland. Very commonly the basalt is found to be quite filled with small cavities; the designation of porous basalt has been used, when the elementary matter is compact, while the rock has been put down as vesicular glass or pumice, when the elementary matter is glassy. The porous basalt has been observed in 20 specimens, situated to all sides of Iceland, mostly, perhaps, to the southeast; in three of these specimens it forms the chief portion of the ingredients, viz. no. 80, southwest of Iceland, no. 106, east of Iceland, and no. 125, north of Iceland; thus it would seem, as if this rock and the compact basalt may arise from all sides of the island indiscriminately.

Volcanic glass and pumice. The two sorts of volcanic glass that may be found in these deposits, are only with difficulty to be distinguished from each other: the common form, the basaltic glass or the palagonite, is as a rule intransparent to the naked eye, even in small splinters, while the microscopic grains are commonly of a strong brown colour. The acidic glass or the obsidian, on the other hand, is most commonly transparent with a gray or brown colour in small splinters, while under the microscope it is most often colourless; sometimes the obsidian is as strongly coloured as the palagonite, and then it is hardly to be distinguished from this latter. In the vesicular or pumice-like varieties, the two sorts are as difficult to make out; black or dark brown pumice will probably always be basaltic, as also a brown variety; the gray pumice, on the contrary, may as well be acidic as basic; sometimes gray varieties of pumice are found passing evenly into the black ones; one and the same piece of pumice may even have both colours, and is thus to be regarded as basic, while the most lightly coloured and lightest varieties must be richer in silica. The categories of pumice and vesicular glass will, of course, pass into each other; the latter designation has been used, when the glassy mass appeared to have the predominance of the vesicles. The black palagonite without vesicles is found in 8 of the specimens situated as well to the east as to the west of Iceland, a single one, no. 21, south of Cape Farewell; as it is to be supposed that all varieties of volcanic glass have their origin from Iceland (or Jan Mayen), we must assume that a very long transport has taken place. Obsidian has, with rather great certainty, been found in two specimens, nos. 21 and 54, the former south of Cape Farewell, the latter southwest of Iceland. Black, vesicular glass is one of the most common volcanic ingredients; it is found in 20 specimens situated on all sides of Iceland; in 6 specimens all situated between Iceland and Jan Mayen, it is the chief ingredient; in the specimens nearest to the latter island, a special variety of the rock is found, which, as before mentioned, is distinguished under the microscope by the very numerous, very small vesicles; this form has been found in very large quantities in the specimens 115 and 116, in a smaller quantity in specimen 117. Colourless, vesicular glass is almost always found in small curved plates that may be rather similar to muscovite; the vesicles are often strongly prolonged in one and the same direction; this fact has been observed in 12 specimens, distributed round Iceland with the exception of the south side, as also towards Jan Mayen and north of the Faröe Islands; in two specimens it forms the chief constituent, viz. no. 98, west of Iceland, and no. 129, northwest of this island. This latter specimen, which, as before mentioned, forms a natural exception to the rule of the quantity of carbonic acid being dependent on the distance from land, it containing about 50 per ct. of carbonate of lime, although it is closer to the coast of Iceland than any other specimen, forms a fully as remarkable exception with regard to the quantity of coarser ingredients; although situated at a distance of but about 40 kms. from the land it contains only a few small leaves of colourless glass, while we had so much the more reason to expect larger masses of minerals, as the locality in question is frequently passed by icebergs; thus this specimen may be regarded as one of the best proofs of the fact, that the icebergs do not commonly to any essential degree contribute to the deposition of material on the sea-bottom. Besides black and colourless vesicular glass, there has in a couple of specimens been found a few pieces of a brown-gray, vesicular glass, both specimens being west of Iceland. Of pumice the black variety has been found in 13 specimens, almost exclusively southwest of Iceland; in 4 of these specimens it forms the chief mass of the ingredients. Red-brown pumice has been found in a single specimen, no. 17, southwest of Iceland. Common gray pumice has been found rather commonly; it is upon the whole met with in 15 specimens, situated on all sides of Iceland; in three of these it forms the chief mass, viz. nos. 69, 73, and 74, all situated closely southwest of Iceland. This distribution can only be accounted for in the way that large masses of pumice must be sent forth from this side of the island, probably through the large rivers emptying out there. As at least some forms of pumice are lighter than the water, they will thus more easily than the other ingredients be carried off from land; but the smaller pieces must comparatively quickly be so much soaked with water, that they go to the bottom, while large pieces may be found everywhere floating on the sea.

Feldspar may also partly be counted among the volcanic ingredients, as far as the labradorite forms a chief constituent of the basalt, and is found in it as grains. It is, however, not easy to distinguish it from orthoclase, unless it be by microscopic examination, and as the feldspar is only found in subordinate quantities in the specimens, I have not thought it necessary to point out this distinction in detail, so much the less as plagioclase may also be a constituent of granite and gneiss and many other rocks; the single pieces, in which it has been possible to discern a twinning striation, have been classed as plagioclase, while the others have commonly merely been called feldspar, and then the colour has been given as a farther character.

Olivine is an absolutely volcanic ingredient being found as grains in the basalt; it is always easily distinguished in the larger grains; in a few instances it has been found bordered by crystalline surfaces of the common form. Olivine has been met with in 16 specimens, almost always in small quantities; it is chiefly found in the specimens near Jan Mayen; but it never forms any essential part of the specimens.

Augite is chiefly volcanic forming a chief part of the basalt; it may, however, also be found in other crystalline rocks, but in smaller quantity; it is found in about the same specimens as the olivine, that is to say, on all sides of Iceland, and at Jan Mayen; but it is not so much spread, and is found in far smaller quantities. The reason of this is, that the augite, as also the feldspar, is almost exclusively found in microscopically small grains in the basalt, while the olivine forms larger grains. From this again arises the peculiar circumstance that while the latter mineral far surpasses the others, and especially the augite, in quantity in the coarser ingredients, it is only, as will be seen hereafter, found to a small degree in the finer ones, whereas the augite here is found in immense masses, and also the feldspar is rather frequent.

Magnetite is certainly chiefly volcanic, but is, however, also often found in most other rocks; therefore it is one of the least characteristic of the ingredients; it has only been met with in three specimens, one at the west coast of Greenland, and two southeast of Iceland, and only one single grain in each specimen.

Zeolites have been found sometimes as stuffing of small cavities in the basalt, but on account of the smallness it has not been possible to determine the species, which would, however, also be of small importance, as the different zeolites are found everywhere in Iceland and the Faröe Islands; in a single specimen, no. 11, between Iceland and Greenland a larger cavity was found stuffed with a fine-grained rock, probably some zeolite; it is likely to have come from the ridge itself.

Chalcedony has also been found as stuffing of small cavities; a single one of these was found isolated in specimen 127 north of Iceland.

Volcanic tufa is a rather common ingredient in the specimens; commonly it is only very little characteristic, and resembles very much gray clay; but in the larger pieces are often seen small grains of black volcanic rocks that are found in it. It has, with more or less certainty, been pointed out in 36 specimens situated on all sides of Iceland, mostly to the southwest; of two of these specimens it formed the chief ingredient, viz. in no. 2, between the Faröe Islands and Iceland, and in no. 89, west of Iceland.

Of the not volcanic ingredients has especially to be mentioned:

Quartz, the most widely distributed of all the minerals in the specimens, forms the chief constituent of most of the not volcanic specimens, and the only not volcanic ingredient in a great number of volcanic specimens. Most frequently it is clear and colourless, also often brownish, yellowish, or reddish, often more or less opaque; crystalline surfaces have not yet been found. The quartz has altogether been met with in 69 out of the 79 specimens; the only specimens absolutely free of quartz, were: no. 7, at the southeast coast of Iceland, nos. 8—12, west of Iceland, and nos. 110—113, between Iceland and Jan Mayen; it forms the chief constituent of 23 specimens, partly of all the specimens close to Greenland, partly of a great many specimens surrounding Iceland on all sides, but generally at a rather large distance, and partly of the specimens from a region north of the Faröe Islands. In many of these localities the large mass of quartz might seem strange; if we regard, for instance, a large series of specimens, nos. 45—48, and nos. 65—67, situated about 200 kms. south of Iceland, it seems rather remarkable that already here the Icelandic ingredients should be so strongly eclipsed by the quartz, the nearest native land of which, Greenland, is at a distance of up to 1200 kms. from these specimens. But the fact is still more remarkable when we take into consideration that this series of specimens is situated across the territory of the Gulf-stream, and thus it would be most likely to expect the circumstances to be as infavourable as possible for a transport from the north or the northeast. As it is impossible to suppose that the Gulf-stream should have carried material across the Atlantic, there would seem to be chiefly two possibilities left: either that the quartz has its origin from ice-bergs that have strayed from the north into this region, and have been melted by the influence of the Gulf-stream, or else that the ice-bergs about at the south point of Greenland have come into the territory of the Gulfstream, and have been melted, whereupon the quartz has been transported towards the northeast. This question cannot be decided, unless an examination is made of specimens situated to the south of those mentioned here. As the distribution of the quartz coincides so closely with that of the other not volcanic minerals and rocks, it will be better to treat these matters together in a later section.

Feldspar, as has been mentioned, may be of volcanic origin; in most instances, however, it is found as red orthoclase together with the quartz, but always in small quantity. It has altogether been found in 35 specimens, partly alone, partly as an ingredient of crystalline rocks together with quartz and other minerals. The feldspar does not in any of these specimens form an especially large percentage. As to the distribution nothing more can be given than the fact of its being absent in most of the strongly volcanic specimens. Crystalline surfaces have never been observed, always cleavage planes.

Hornblende has often been found as an ingredient of crystalline rocks, single only one piece in specimen no. 19, east of the south point of Greenland.

Garnet in loose grains has only been found in three specimens: no. 90, between Greenland and Iceland, no. 116, south of Jan Mayen, and no. 143, north of the Faröe Islands, at all three places as red garnet, probably almandine; the origin of the garnet is probably to be sought in Greenland, and the fact that this mineral has not been found in the specimens nearest to Greenland, may be regarded as a mere casualty; among the finer ingredients it is found in especially large amounts in some Greenland specimens.

Biotite has been found in 12 specimens without any especially characteristic distribution, as well of volcanic as of not volcanic habitus. It is only found in single leaves, and plays only a minor part, as is also the case with the

Muscovite that has been observed in 6 specimens, most of them south or southwest of Iceland, a single one north of the Faröe Island.

Granite and Gneiss, as the other crystalline rocks, are only with difficulty to be distinguished in so small pieces as those mostly found. To this category I have referred any grained compound of quartz and feldspar commonly together with some dark mineral, either hornblende or biotite, or sometimes muscovite and garnet. Such rocks have been observed in 14 specimens, of which three from the west coast of Greenland, one south of Cape Farewell, three southwest of Iceland; of these latter has to be noted a very large piece of gray granite or gneiss (of a diameter of 3^{cm}) in no. 83, while in the other specimens only a few small fragments were found. Further were found a few pieces of granite or gneiss in two specimens south and southeast of Greenland, in three specimens between Iceland and the Faröe-Islands, and in two specimens between the Faröe Islands and Greenland, in one of which latter, no. 92, numerous pieces were found of a very fine-grained dark gray variety, more prominent than the other ingredients of the specimen. From this rock an even transition is found to

Fine-grained or compact rocks of quartz, which cannot be more exactly determined on account of the small pieces in which they occur; they may be partly quartz-porphyry or kindred rocks, and partly granulite or hälleflinte. Such rocks have been found in several of the Greenland specimens, and in a couple of specimens near the Faröe Islands. In one specimen, no. 143, north of the Faröe Islands, they form the prominent part of the material; here the rock gets more or less resemblance to quartzite or sandstone, and all the pieces are, perhaps, better taken to be quartzite, even if the presence of larger grains of quartz and feldspar seems to imply that also eruptive rocks must be found in the neighbourhood.

Quartzite has otherwise only been found in three specimens between Iceland and Greenland, and southwest of Iceland, and plays no prominent part in any of them.

Sandstone has been found in 13 specimens distributed over the whole area without any especially characteristic distribution, often only in a few rather small pieces; of a few specimens it forms, however, a greater part, as of no. 13, where a comparatively very large piece is found, which can hardly be supposed to have been carried there in any other way than by means of the ice, as must also be the case with the granite of the same specimen. In the two specimens from the east coast of Greenland, nos. 13 and 92, a rather large number of grains of sandstone is found which is likely to have its origin from the place itself, as also the fine-grained rocks of the same specimens that are rich in quartz; sandstone to a rather large amount is also found in specimen no. 143 north of the Faröe Islands together with other fine-grained rocks.

Mica-schist is, of course, only with difficulty to be distinguished with certainty in very small pieces from pieces of gneiss, granite, and the like rocks containing much mica; muscovite-schist has been noted in four specimens, as well near Greenland as southeast of Iceland; the dark variety has only been observed in specimen 32, west of Greenland. Both parts have only been found in a few pieces, and are only of small interest.

Clay mica-schist has been observed in a couple of specimen, one, no. 32, at the west coast of Greenland, the other, no. 143, north of the Faröe Islands; as the preceding rock it is only of small interest.

Clay-slate has been found in 9 specimens, mostly near Greenland, and only in small amount: an exception from this rule is formed by specimen no. 105, east of Iceland, in which the chief part of the ingredients is formed by a grayish clay-slate; if it has not its origin from the sea-bottom itself, it can hardly have been transported there in any other way than by icebergs either from Greenland or Spitzbergen, and the single small pieces must originally have been coherent, and only later have crumbled to pieces.

Lime-stone has only been found in one single piece in specimen no. 105, east of Iceland, a light gray, compact variety the origin of which could not at all be determined.

This account of the single minerals and rocks will have shown that, with a few exceptions, especially one fact is of more interest with regard to the distribution, and that is, how far the volcanic ingredients from Iceland, the Faröe Islands, and Jan Mayen have spread on the sea-bottom, and in what manner, when we pass farther out, they are thinned more and more, and mingled with quartz-material, till at last they completely disappear in this. To elucidate this fact I have, on the chart, pl. V, given the different mass of volcanic material found in the specimens by different colours; the darkest colour designates the localities exclusively containing volcanic ingredients, or in which the grains of quartz and other kindred minerals and rocks form only a very small part of the specimen; the next shade designates the localities that are chiefly volcanic, but in which are also found some other ingredients; the limits of this region represent about 90 per ct. of volcanic material inwardly, and 65 per ct. outwardly. The next shade of colour denotes the area in which both kinds of material are present in about the same quantity; the volcanic material is here found in an amount of about 35—65 per ct. In the next area the volcanic ingredients are only found in an amount of ca. 10—35 per ct.; in this region, therefore, the volcanic material is not at all prominent. Outside this area either no volcanic material is found at all, or, at all events, it is found in so small quantities as to be of no importance with regard to the composition of the specimen. By regarding the chart it will be seen that all the volcanic material belongs to Iceland, the Faröe Islands, and Jan Mayen; round the two latter localities it reaches only a small way into the sea; from Iceland, on the contrary, it spreads far away to all sides, and upon the whole in a rather characteristic way. Towards the north and northwest are not many specimens; yet the few, found there, indicate that the volcanic ingredients do not reach very far upward, but that Iceland and Greenland here exert about the same influence on the composition of the bottom-specimens, each from its own side. When we pass to the north east of Iceland we find, that the volcanic material is widely spread in this direction, and that it is the Icelandic material may be inferred, primarily from the nature of the material, and next also from the fact that the volcanic ingredients of the specimens decrease towards Jan Mayen, and is not again found in any large quantity until specimen no. 115, lying close to that island. That the volcanic ingredients spreading from Iceland to the northeast, cannot have their origin from the sea-bottom itself, may be seen from the regularity with which they are found in the specimens. The amount of coarser material decreases rather evenly, the more we withdraw from Iceland, and it is upon the whole rather small in the region treated of here. If, on the other hand, submarine rocks also contribute some material, this is always seen to be very irregularly distributed, partly, when a larger area is concerned, consisting of very heterogeneous material, partly appearing in very large quantities, which are, however, always much varying from one specimen to the other, according to the circumstances in which the specimen has been taken, whether from a rugged bottom, or close to such a place, where large accumulations are made of the material set free by the disintegration of the rocks or ortherwise, or the specimen has been taken from a comparatively level bottom farther away from projecting rocks. In what way the material of the region in question has been transported from Iceland so far into the sea, is not easily explained; the most likely explanation would seem to be that it has been carried there by the ice, which may have been either coast-ice, or ice from the rivers; but against this supposition tells the fact that the currents prevailing on the locality in question, pass from the north to the south, and thus this transport would seem to be very much hindered; the floating ice, as is well known, is, however, not absolutely dependent on the currents, but may be supposed to be acted on by the wind also, and this is presumably chiefly southwest in these regions.

Immediately east of Iceland the volcanic material ceases rather quickly; but on the ridge towards the Faröe Islands it again reaches rather far. Here, however, it does not seem to have come from Iceland; on account of the large quantity of coarser material, especially in the specimens nos. 2, 3, and 4, it is to be supposed that at least the larger part has its origin from the ridge itself. The fact is that we can find no possible reason whatever why the material from Iceland should be deposited in very small quantities on the deeper water, while deposited in so enormous masses on the two ridges reaching from Iceland to the Faröe Islands and Greenland. The same reason must, at all events, be appliable also to the ridge running from Iceland to the southwest, but here are found exactly the same small quantities of the coarser material on the ridge as on both sides of it. The difference between the deposited quantities of coarser ingredients may be so large, that for inst. in specimen no. 143 north of the Faröe Islands is found 1500 times as much as in no. 139 situated about 80 kms. north of the preceding one. Such a difference would be absolutely incomprehensible, if we do not suppose that this coarser material has its origin from the sea-bottom itself. But a consequence of this supposition will again be, that from the nature of this material we may get a notion of the outline of the petrography of the sea-bottom. It will then be seen that that part of the ridge, which is closest to Iceland, consists of volcanic material of about the same nature as that of Iceland itself, that is to say, chiefly black basalt, some volcanic tufa etc. These rocks spread over almost the two thirds of the length of the ridge towards the Faröe Islands. But closest to these islands, at least on the northern side of the ridge, a quite different sort of rocks is found; the specimen no. 143, especially, that is so very rich in coarser ingredients, has none of these volcanic rocks but on the contrary large masses of fine-grained rocks rich in quartz. In this part the ridge must consequently be taken to consist of older formations, partly crystalline rocks as granite and gneiss, and partly quartzite or sandstone. Also in the part of the ridge closest to Iceland, some regions of similar rocks are likely to be found, or else it will be rather difficult to comprehend, how they should have fonnd their way into specimen no. 4, in which some of them are found, although most of the specimen is volcanic. The amount, however, is too small to allow our drawing definite conclusions to that effect.

South of Iceland the volcanic ingredients decrease more rapidly than in any other direction; as has been mentioned before, a larger series of specimens is found here, containing no great amount of volcanic material, but on the contrary rather large quantities of quartz, the presence of which seems rather difficult to explain. Towards the southwest the volcanic ingredients spread farther out again, so that in specimen no. 19, west of Cape Farewell, they are present in as large quantities as the not volcanic, and in specimen no. 21, directly south of Cape Farewell, they are still found in appreciable quantities in the largest distance, to which the material is upon the whole removed from Iceland. Here we shall also necessarily have to think of the ice as an acting factor. The East-Greenland current must be supposed casually to carry with it some material from the northern coast of Iceland; but it seems nevertheless remarkable that this material does not disappear so completely in the large mass of Greenland material, as to be only with difficulty distinguished in the specimens. At least it will be as improbable to suppose submarine rocks in this deep part of the sea-bottom that is covered by so regular and fine deposits, as the case is here.

If we next proceed to the specimens situated between Iceland and Greenland, we shall find the circumstances quite analogous to those existing on the ridge between the Faröe Islands and Iceland. Here we also find irregular deposits the nature of which is suddenly changed from one specimen to the next, and which contain a large abundance of coarse material. Though the specimens here are not situated on the ridge itself they are found immediately south of it, and it is to be supposed that it is able to assert its influence by giving material for the specimens. By an examination of this material it will be seen that the volcanic part of it reaches far to the west, about two thirds of the distance towards Greenland. So far, then, the ridge is built of entirely Icelandic material, the common black basalt, however, not being so predominant, as is usually the case, but partly replaced by a red-brown, loose, disintegrated basalt, and by black or gray pumice; in specimen no. 11 this latter is still predominating over the other ingredients; but in specimen no. 92, distant only about 20 kms. from the last mentioned one, the ingredients are chiefly not volcanic, that is to say, partly quartzite or sandstone, and partly fine-grained rocks as granulite and the like; here, then, we are in a region, in which the older formations are interrupted by a few eruptive regions, and such a region is found once more farther to the west, at specimen no. 13 situated ca. 80 kms. west of the preceding one, and only 150 kms. from the nearest coast of Greenland, while it is more than 450 kms. distant of Iceland. Here are found numerous pieces of the before mentioned basalt which does not resemble any of the more common Icelandic rocks, and the presence of which in several rather angular pieces on the same place seems to imply that it must have been broken off from a rock in the neighbourhood consisting of this sort. But this, evidently, is the very outermost volcanic region to the west; in specimen no. 94, lying still closer to Greenland, only a few pieces of volcanic material of different nature are found, the predominant ingredient being quartz, the greater part of which has probably come directly from Greenland.

In this connection might still remain a mentioning of the few ingredients of more or less certain basaltic origin that are found in some of the northernmost specimens at the west coast of Greenland, and probably have their origin from the region of basalt farther north; but partly they are too insignificant to draw further conclusions from, and partly the connection with more northerly specimens is wanting, so that from these ingredients no laws can be deduced with regard to the distribution of this basalt.

Appendix to I.

In connection with the preceding section there still remains the description of a collection of larger and smaller stones that are for the greater part too large to have been taken in the sounding tube, but are taken in the trawl or the dredge. The reason why I have not treated them in the preceding section, is partly that this material did not come into my possession, till the whole account had been written, so that the addition would have caused much rewriting. Further the material treated of here, has been very unequally represented at the different stations, the number of stones taken in each place being dependent not only on the number in which they are found on the bottom, but also on the extent to which the different instruments have been used, and the effect they have had; in the case that an especially large number of stones is found in a locality, it may easily happen, for inst. that the trawl is torn, and brings up none of them; while, on the other hand, the fact that the trawl is torn, is no evidence of any special large amount of stones, as one large stone may be the cause of that.

As the stones examined in this section, are almost all larger than the ingredients of the preceding one, this fact is of itself a sufficient reason for treating them in a particular section. The distribution of these two parts, as it will be seen, is rather different. While the ingredients not much larger than $0{\cdot}5^{mm}$ may have been carried to their place by the currents, if they are not found in too large a distance from land, this is not the case with stones over 1^{cm} in diameter; they cannot well be thought to have been transported to their place in any other way than by means of ice, whether it be glacial ice, river-ice, or sea-ice, and thus they may give important informations as to the ice-drift in each individual place. And we may be justified in taking it for granted that the stones have been transported under circumstances not essentially different from the present ones; it is especially very improbable that some of the stones should have been transported by the ice during the glacial period; were this the case, the deposition of loose ingredients on the sea-bottom must be exceedingly slight, far slighter, than we have otherwise reason to suppose, if it had not yet been able to cover these stones. If such stones were yet to be found, they would have to be sought far from the land, in places where the deposition of material is now comparatively small.

Station 2. 12 stones of sizes from $0{\cdot}7^{cm}$ to 3^{cm}, all half-rounded; most of them volcanic, viz. 4 black, fine-grained basalt, two gray, fine-grained basalt, one brown basalt; further one red granite, 3 gray, fine-grained granite, one gray, fine-grained gneiss. The not volcanic ingredients, however, are far more prominent here than among the finer ingredients in the specimen.

Station 3. One very large block, 44^{cm} in diameter, the largest of all taken home; the surface subangular, rather rough. The nature was common, red, middle-grained granite, with gray quartz, red orthoclase, and black biotite.

Station 4. One half-rounded, large block of a diameter of 32^{cm}, the surface rather smooth. It consisted of brown-gray, fine-grained basalt with small grains of feldspar; the outer part to a thickness of ca. 1^{cm} disintegrated, of a lighter brown colour. According to the journal many large stones of basalt are noted from this station.

Station 6. 15 stones, up to 10^{cm}, all half-rounded, one somewhat ice-striated; 14 were black or dark gray, fine-grained basalt, a few of these with reddish stripes, one volcanic tufa, dark gray, compact, with numerous grains of basalt.

Station 9. 18 smaller stones, up to 2^{cm}, half-rounded; 12 were black basalt, 5 brown, more or less disintegrated and loose basalt, and one dark gray, volcanic tufa.

Station 10. 87 stones from 2^{cm} to 10^{cm}, of which 80 were volcanic, viz. 41 black or dark gray, more or less fine-grained basalt, 8 gray basalt, 3 reddish, vesicular lava, 11 brown, disintegrated basalt, 2 obsidian, 3 black pumice, one light lava, perhaps liparite, and 11 brownish, volcanic tufa with grains of basalt, obsidian, and pumice. The rest was: 3 pieces of granite, 3 of gneiss, and one sandstone. Many of the pieces, especially the not volcanic ones, were much rounded, while most of the volcanic ones were more or less angular; these latter, perhaps, have their origin from the sea-bottom itself, which accordingly must here be purely volcanic, as was also seen by an examination of the bottom-specimens themselves.

Station 11. According to the journal some stones were found here of which two were granite, the rest basalt.

Station 18. A very copious and varying collection of stones, 66 in all, up to 12^{cm} in diameter; most of them were subangular, a few more irregularly shaped; some were distinctly ice-striated, a single one with so regular streaks, that it looks as having formed the surface of a firm rock. Only 15 of the stones were volcanic, viz. 6 black or dark gray basalt, 7 brown or brown-gray volcanic tufa, and two black pumice. Of the rest 14 pieces were granite, one porphyry, 12 crystalline schists, 17 sandstone, 3 clay-slate, two lime-stone, and one concretion. Of the granites 4 were fine-grained gray, 8 fine-grained red, two red, middle-grained, one of them with strongly blue quartz, 5 gray, middle-grained, one large-grained hornblende-granite, and one beautiful red graphic granite. The quartz-phorphyry was light red with small, angular grains of quartz. The stones of gneiss were as varying as the granites, there were: 4 red gneiss, 5 gray gneiss, and further one granulite, and two dark mica-schist. Of the sandstones 7 were common quartz-sandstone, white or white-gray, more or less fine-grained; one light red, and two more strongly red sandstone, one darker gray, 3 quartzite, two brown sandstone with mica, and one gray lime-sandstone, rich in mica. Of the clay-slates one was a common, gray one, the two others were red, rather hard, and rich in quartz with a very irregular fracture. Further were found one white limestone without fossils, and one grayish limestone with some glittering fish-scales, and other indeterminable remnants of fishes. Upon the whole it will be seen that no special type of rock is found predominant over the others in this specimen; thus it is not very probable that any of the stones have their origin from rocks on the sea-bottom; but they may all be taken to have been carried there by ice, which must naturally have come in especially large quantity from East-Greenland, or perhaps from other, still more northerly polar lands, while the Icelandic influence in this direction is only small, contrary to what is the case with the smaller ingredients of the specimen, in which the volcanic elements are almost as conspicuous as the not volcanic.

Station 20. According to the journal numerous stones were found here of the size of a walnut, mostly granite; a couple were basalt, that is to say upon the whole the same ratio, as shown by the other ingredients of the specimen.

Station 24. A few small fragments of granite (according to the journal).

Station 25. According to the journal was found a large block of granite or gneiss; many smaller blocks of granite.

Station 27. 7 smaller stones, up to 5^{cm}, almost quite angular, five of them rather fine-grained, gray or red, gneiss or granite, one feldspar, and one black basalt, which latter has probably been carried with the ice from the region of the isle of Disco.

Station 46. According to the journal numerous stones, the chief part of which was basalt; some were granite, a few pieces were mica-schist. This result does not coincide very well with that, got from the smaller ingredients that are, for far the greater part, not volcanic; sandstones and fine-grained granite and gneiss, and perhaps also other rocks may, however, have been classed as basalt, if, as is often the case, they have been coated with a black crust. If, on the other hand, the statement be correct, the reason may be taken to be that the ice from Greenland and the polar regions reaches so far to the south, while the basalt found must necessarily have been deposited by coast-ice from Iceland. The few stones brought home, indicate, however, that the volcanic element is only little conspicuous; there were 11 stones of sizes up to 10^{cm}, subangular, and partly ice-striated; only two of them were volcanic, viz. one dark gray basalt, and one brownish tufa with well developed crystals of augite. Of the rest 4 were fine-grained, gray gneiss, one common red granite, two gray, impure sandstone, one quartzite, and one phyllite.

Station 50. According to the journal black grains of basalt.

Station 52. One piece of dark gray basalt, ca 3^{cm}.

Station 54. One piece of granite of a diameter of ca. 14^{cm}, subangular with a rather rough surface. The nature peculiar; quite unicolorous, gray grains of quartz and feldspar without any dark mineral, but with irregular, angular inclosings of some dark rock, probably basalt.

Station 64. Some clods of clay, up to 12^{cm}; very irregularly shaped, pierced by deep holes, probably made by animals. The colour brownish. These clods resembled much the deposit on the place in question, and must accordingly have been formed by a hardening of this deposit, though it is impossible to say anything of the way in which this should have taken place. The consistency of the clods is for the rest very loose, and not much different from that of the clay itself; but still they present themselves as outwardly well limited bodies. According to the journal a single piece of basalt was also found at this station.

Station 65. 4 stones, up to 10^{cm}, subangular, slightly ice-striated; of these one was black, compact basalt, one dark gray basalt with cavities and amygdaloids; one gray biotite-gneiss, and one of a rock, which, as far as discernible, consisted exclusively of white-gray plagioclase in rather large grains with distinct twinning striation. Further one rather large stone (24^{cm}), consisting of black basalt or dolerite with a few cavities filled with stilbite.

Station 81. 6 stones, up to 5^{cm}, rather irregular and angular. One was volcanic tufa, one red, large-grained granite, one gray, vere fine-grained granite, one gray sandstone, one brown sandstone with mica, and one gray-black clay-slate with mica. This compound is most peculiar seeing that the specimen is situated so close to the southwest coast of Iceland. The great predominance of sandstone and slate is also extraordinary, and scarcely to be accounted for, if we do not set it down as having originated from the sea-bottom itself; if this be the case we should here have the only instance of rocks from the ridge southwest of Iceland.

Station 83. 6 stones, up to 7^{cm}, most of them almost angular; only one volcanic, viz. highly vesicular, pumice-like lava; one fine-grained granite, one white, compact limestone; one quartzite, one hornstone, and one loose, gray sandstone. The compound was very much like that in station 81, and the same conclusions will hold good for this specimen as for the preceding one.

Station 85. 53 smaller, and 6 larger stones; the smaller ones, up to 1^{cm}, all basalt except two pieces of tufa; the larger ones, up to 6^{cm}, also basalt with one piece of volcanic tufa; they were subangular, partly ice-striated. This station, thus, is situated so close to Iceland, that the Greenland ice never, or only as a rare exception, reaches so far; the sea-bottom here must also be supposed to consist exclusively of basalt.

Station 89. One stone of a size of 8^{cm} consisting of black-gray basalt.

Station 97. One piece of black basalt, $1{\cdot}5^{cm}$.

Station 98. A hundred small stones, up to 5^{cm}, some angular, some half-rounded. 80 of them were black basalt, 10 gray basalt, 7 brown, disintegrated basalt, two vesicular lava, and one obsidian.

Station 105. One red quartz-porphyry, with small grains of quartz, of a diameter of 2^{cm}, rounded.

Station 115. One gray basalt with grains of olivine, rounded and rolled, of a diameter of 10^{cm}.

Station 125. One gray, hornstone-like rock with small grains of pyrite; the size 5^{cm}, the form quite irregular, almost angular.

Station 127. From this locality, close to the north coast of Iceland, an immense mass of stones was brought home, which were all rolled to an uncommonly high degree. All those examined by me, consist of basalt.

Station 143. One piece of vesicular black basalt, of a diameter of $1{\cdot}5^{cm}$.

As a common rule it can be said that the results which we get from the stony ingredients of the specimens, essentially correspond with those got from the other parts; the few exceptions have already been noted under the different stations, and they commonly tend to show that the Greenland material is more predominant in proportion to that from Iceland, than is the case in the finer ingredients. This again is accounted for by the fact that while the stones cannot well be supposed to have been transported in any other way than by ice, the direct transport by water, on the other hand, plays a very great part with regard to the sandy and clayey ingredients of the specimens. Most of the material from Greenland is now carried into the sea frozen up in the ice, while this is only to a smaller degree the case with that from Iceland. The consequence of this upon the whole will be that the material from Greenland will not be sorted to so high a degree with regard to the size of the grains, as that from Iceland; thus of the former as well the stones as the finer ingredients may be carried to a large distance, while this, with regard to the Icelandic material, is only the case with the comparatively small part that is transported by the ice, while all the rest is sorted in such a way, that the stones are deposited immediately at the land, while the sand and the clay is carried out the farther, the finer it is.

A rather curious phenomenon has still to be mentioned here, that is to say, the ferruginous and manganic crust with which the stones of the sea-bottom are covered. With the basaltic stones this circumstance is not very conspicuous; but by all the light-coloured rocks we see that the side rising above the clay, is more or less dark-coloured, often quite black, while the side turned downward has the natural colour of the rock, or is only of a slightly darker shade. The colour of the coating is otherwise somewhat changing; the upper side may be brown, red-brown, dark brown, dark violet, or black; the lower side light brown, or light yellow-brown, if upon the whole it be coloured. From one and the same station all the stones are coloured in the same way, thus for inst. at station no. 18 where the phenomenon is most prominent, all the upper surfaces are black, and all the lower ones absolutely colourless, while brown shades are found in the transition between both. The coating is easily disolved in diluted hydrochloric acid to a yellow solution containing iron and manganese, which substances are often on deeper water disengaged to a large amount by the sea-water. The few pieces of limestone found in the specimens, have no such coating, from which fact, however, cannot be drawn the conclusion that such a disengagement cannot take place on limestone.

Whether such a disengagement of iron and manganese also takes place on the surface of the clay itself, is not easily decided; it would seem that it might as well take place there as on the stones; but the ingredients of the clay, on the other hand, show no trace of such a thing, which would also impart a very dark colour to the clay, while in reality it is very often almost white. Perhaps the Foraminifera cannot get the coating; but at all events the grains of sand may be supposed to be able to be thus incrusted. In this case there are two possibilities: either the surface of the clay is really coated with the dark layer, which is again decomposed when covered by other layers; or else the fauna on the sea-bottom will keep the surface of the clay so much in motion, that a quiet deposition is impossible; at all events there is found no dark layer on the mineral ingredients in the Globigerina clay itself or in the other bottom-species. That such a layer shields from disintegration may be seen from a piece of gneiss that is quite crumbled away on the lower side, while the upper surface is considerably firmer. I cannot, however, decide, whether this disintegration has taken place on the sea-bottom, or after the stone has been taken up.

II. The Ingredients $0{\cdot}5$—$0{\cdot}05^{mm}$.

We have now to examine more closely the size of grains next to that treated in the preceding section, and which contains the sandy ingredients of the specimens properly so called. In some respects they give a better result than the ingredients before mentioned, especially as they are found in a quantity sufficient for examination in all the specimens, while many of those contained only very small quantities of coarser ingredients or none at all. On the other hand the particles of this size give as good as no informations of the rocks directly, but only of the minerals contained in them; but nevertheless we are fortunately able to distinguish between almost all the volcanic ingredients and the not volcanic. The chief reason, however, to treat this size of grain in a separate chapter is that by its distribution essentially other laws have been ruling than by the distribution of the coarser sizes. While by these latter we must most frequently seek the origin from so adjacent regions as possible, especially often from the sea-bottom itself, and, where this factor is not sufficient, from the floating ice, these circumstances play no particularly prominent part with regard to the finer ingredients, where we must pay essential regard to the currents in order to explain the distribution. This distribution proves also here to be much more regular than by the sizes before mentioned; the two ridges especially are of very small importance here.

By the treating of the sandy ingredients the microscopic examination must, of course, yield the chief assistance. First, however, I note the larger or smaller fineness of the sand as well as its colour which is rather varying. Next a smaller specimen is treated with a common magnet, by which the magnetic ingredients are extracted and valued to an approximate percentage; this percentage might, of course, be much more exact by a precise weighing and treating with an electromagnet in water or spirits; but I do not think the result would be sufficiently great to make up for the time it would take, so much the less, as the laws of distribution cannot be put down with any great exactness, especially because the quantity of magnetic material must be taken to be comparatively casual. The next step is to examine by the magnifying glass the presence of certain more conspicuous ingredients that might easily be absent in the microscopic preparation, that is to say, besides siliceous organisms as sponge spicules and Radiolaria that are not to be treated in this section, especially dark mica and muscovite, and the fine leaves of colourless, volcanic glass that may often be quite like muscovite, and then have to be distinguished from this by their single refraction. Then a preparation of the sand is made in Canada balsam, and for the sake of homogeneousness the finer ingredients are selected by rolling the sand on a piece of paper, when the coarser sand will always be the foremost portion. By this method we may perhaps get a somewhat different ratio between the particular constituents than what we should get from the sand as a whole; but in the first place it may be said that the coarser grains are not easily distinguished by microscope, as they will easily, especially if the question be of fine-grained rocks, prove intransparent, while the finer grains more frequently contain the particular minerals; and next it will be very difficult to make a preparation with different sizes among each other, as the larger grains must make the preparation very thick, up to $^1/_2$ mm, and then the finer grains will be placed in more layers one upon the other, so that they cannot be examined at all. The chief reason, however, is that the larger grains must be supposed to be of almost the same nature as the before mentioned particles over 0·5 mm, and thus an examination of them would in all essentials be a repetition. On the other hand it will not do neither to lay the principal stress on the still smaller particles under 0·05 mm, as they are only with too much difficulty to be distinguished on account of their smallness, by which we are especially prevented from seeing whether they belong to a more or less double refracting mineral, as also the colour is much slighter. When the preparation is finished a hundred grains are counted off from each of two different fields of view from opposite sides without any selection whatever of the ingredients. The reason of two countings being made is that the ingredients may perhaps have been washed out from each other by floating in the melted Canada balsam. By the enumeration the grains are separated into the three categories: intransparent, single refracting, and double refracting, besides the organisms that are not included in the calculation of the percentage. The single refracting ingredients may either be brownish, intransparent grains, the species of which are not to be determined, or a glasslike substance, mostly brown, but also of several other colours or quite colourless; the garnet is also to be included here; whether other single refracting minerals, as for inst. spinel, are also found, cannot be determined; it may be supposed beforehand that they play only a very small part beside the garnet, and so they may at once be incorporated with this. The double refracting ingredients are separated in the opaque that cannot be more particularly determined, and the clear and transparent ones, and of these latter as many as possible are determined and counted; the rest will commonly be made up of quartz and feldspar, which two minerals most frequently cannot be distinguished from each other. Finally a search is made in the part of the preparation that is not enumerated, to ascertain whether here should perhaps be found single grains of other minerals than those included in the calculation of the percentage.

In the first of the following tables is first noted the nature and colour of the sand, and next the contents of magnetic material, mica, and colourless, volcanic glass; the presence of the two latter parts is denoted by a +. Then the percentages of the different sorts of ingredients, obtained by the enumeration from the preparation are noted, except the double refracting minerals that are, for the sake of the space, put off to the second table. The presence of the ingredients is besides denoted by a +, when they are not found in the mentioned part of the specimen.

Table I showing the Nature of the Sandy Ingredients.

Number of the specimen	The nature of the sand with regard to the size of the grains	The colour of the sand	The percentage of magnetic ingredients	Contents of: Volcanic glass	Contents of: Biotite	Contents of: Muscovite	Percentage of: Intranspar. grains	Percentage of: Brown, opaque grains	volcanic glass: brown	volcanic glass: yellow	volcanic glass: green	volcanic glass: red	volcanic glass: colourl.	garnet: red	garnet: violet	garnet: brownish	double refracting grains: opaque	double refracting grains: clear
2	coarse	brownish	35				5	44	1		2	1					27	20
3	rather coarse	dark gray	70		+		25	30	29·5		0·5			0·5			7·5	7
4	coarse	dark green-gray	45				25	38·5	15·5			1					8·5	11·5
6	rather coarse	dark brown	50	+			17·5	31	45								12	4·5
7	rather fine	grayish	75		+	+	24·5	28·5	3		0·5	+		0·5			12	31
8	fine	grayish	25			+	27	42·5	25·5								1·5	3·5
9	coarse	dark brown	40				18	40·5	13·5			1		0·5			8	18·5
10	coarse	gray	25	+ +			11·5	17·5	1·5	0·5	0·5	0·5	1·5				11·5	55
11	rather coarse	brown	15	+	+	+	10·5	38	2	1	0·5	+	1·5				17	29·5
12	coarse	brown-gray	30	+ +	+		15	25	4·5				4·5				15	36
13	very coarse	brown-gray	35	+		+	13	33·5	0·5		0·5		0·5				11	37
17	rather coarse	grayish	15	+ +			11·5	24	1				8·5	1	1		16	34
18	rather fine	light gray	10	+		+	5	18	+				2				17	58
19	rather coarse	gray	10	+	+		3·5	33	+		0·5		2		+		22	49
20	very fine	light gray	5	+		+	2	4					1·5		+	+	19	73·5
21	coarse	brown-gray	10		+	+	9·5	9·5	+					1	1·5		20	58·5
22	rather fine	light gray	25			+	2	14·5	0·5		+				0·5		6·5	76
24	fine	white-gray	3			+	1·5	5	+		0·5		1		1		4·5	86·5
25	rather fine	grayish	8		+	+	2	3·5	+				1·5		1		8·5	83·5
27	very coarse	grayish	5		+	+	2	6					1		0·5		9	81·5
28	rather fine	light gray	2		+	+	2·5	7·5			+		+		1·5		7	81·5
29	coarse	greenish gray	3		+	+	4·5	0·5						3	1·5		9·5	81
31	coarse	brownish	2		+		4	2·5						3·5	2·5	1·5	11·5	74·5
32	rather coarse	greenish gray	4		+		1·5	1·5					0·5	0·5	4		4	88
33	coarse	light greenish gray	1				3	1					1·5	3·5	13·5		3	74·5
34	coarse	grayish	2		+		1	4						+	0·5		3	91·5
36	very fine	light gray	20		+	+	1·5	4·5							+		5	89
37	fine	gray	8		+ +	+ +	4	1·5						0·5	+		4	90
38	rather fine	gray	30		+	+	0·5	5·5						0·5			4·5	89
39	rather fine	dark brown-gray	40				10	35	41			0·5	1	+			5	7·5
40	rather fine	dark brown	70				3·5	30	56			+	2				1·5	7·5
41	rather fine	dark brown	80		+		11	30·5	23·5			+	1				3	31·5
45	rather fine	brown-gray	20			+	6·5	21·5	0·5		0·5						5·5	65·5
46	rather coarse	brown-gray	20				6·5	15·5	+				1·5				5	71·5
47	rather fine	brownish gray	15			+	24	7·5	0·5				0·5	+			5	62·5
48	fine	dark gray	30		+	+	17·5	9	4·5		+		1				2·5	65·5
50	rather coarse	black-brown	60				19·5	16	15	+	+		1				6	42·5
54	rather coarse	dark brown-gray	70				16	33·5	8				1				19·5	22
58	fine	dark gray	85				16	47·5	28				+				3	5·5
59	fine	dark gray	70	+ +			26·5	34	17·5	0·5			1·5				9	11
63	fine	grayish black	65			+	13·5	25·5	43·5				1				3·5	13
64	rather fine	brownish	85			+	12·5	28	4·5			+	1				17	37
65	rather fine	brown-gray	85				9	38	27			+	1	0·5	+		4	20·5
66	fine	dark gray	90				12·5	25·5	34·5				2				6	19·5
67	rather fine	brown-gray	95				9·5	53·5	26				0·5	0·5			1·5	8·5

Number of the specimen	The nature of the sand with regard to the size of the grains	The colour of the sand	The percentage of magnetic ingredients	Contents of: Volcanic glass	Contents of: Biotite	Contents of: Muscovite	Percentage of: Intranspar. grains	Percentage of: Brown, opaque grains	Volcanic glass: brown	Volcanic glass: yellow	Volcanic glass: green	Volcanic glass: red	Volcanic glass: colourl.	Garnet: red	Garnet: violet	Garnet: brownish	Double refracting grains: opaque	Double refracting grains: clear
68	rather fine	dark brownish gray	90				8·5	37	42·5			+					3	9
69	rather coarse	gray-brown	80				17	39	34			+	+				3	7
73	coarse	dark brown	50	+			4·5	38	47·5			+					3·5	6·5
74	rather fine	light gray-brown	85				7	59·5	16·5				0·5				7	9·5
75	rather coarse	light gray	70		+		6	32	2·5				1·5	+			18	50
76	rather fine	brown-gray	70			+	11	22·5	2·5				0·5				18	48
77	rather fine	brown-gray	90				7·5	35	7·5				1·5	0·5			20·5	27·5
78	coarse	white	90				2	61·5	7					+			6	23·5
80	rather fine	gray	15		+	+ +	2	8·5	0·5					+			12	77
81	rather coarse	gray-brown	10		+	+	2·5	11	0·5						0·5		18·5	67
83	rather coarse	gray	15		+	+	5	10					+	+			16	69
85	rather coarse	dark brown	40	+			7	49	19			+					19·5	5·5
89	rather coarse	dark brown	30				13·5	46·5	10				3				16·5	10·5
90	rather coarse	dark gray-brown	25	+ +			6	23	9				1·5				20	40·5
91	rather coarse	gray-brown	50	+ +			14	28	1·5						0·5		22	35
92	coarse	dark gray-brown	50	+			4	17·5						0·5			21	57
94	coarse	light gray	5				3	3						5·5	4		25·5	59
98	rather coarse	dark brown-gray	65	+ +			10·5	42	2								23·5	22
101	fine	dark gray	65				6·5	38	32·5				0·5				9	12·5
102	fine	dark brown	50				8	45·5	35	0·5							6·5	4·5
103	fine	brown-gray	80				9·5	38·5	43				0·5				3·5	5
104	rather fine	dark brown-gray	50	+ +			16·5	32	16·5			+	1·5				14	19·5
105	rather fine	dark brown-gray	25	+ +			26	31	22·5			+	0·5	+			7·5	12·5
106	rather fine	dark brown-gray	50	+ +			11	34·5	27·5			+	7·5				7	12·5
107	rather fine	dark gray	70	+ +			18	34	36			+	2				3·5	6·5
110	rather iine	dark brown-gray	50				13·5	36·5	33·5			0·5					7	9
111	fine	brown-gray	85	+			12	19	4			0·5	1	+			26	37·5
112	fine	dark gray	75				4	36·5	+	+		0·5	1				19·5	38·5
113	fine	dark gray	70			+	6·5	28·5	0·5	1		+					25·5	38
115	rather coarse	brownish black	25				4	17	57			+					11	11
116	rather coarse	brown-gray	10	+ +			8	5·5	1		0·5	+	1	+			27·5	56·5
117	rather coarse	brown-gray	30	+ +			5	18	1·5			+	1				31	43·5
118	rather coarse	dark gray	30	+ +			13	29·5	2·5			0·5	1				13·5	40
119	rather fine	hrown	55			+	15	30	24·5				1	1			11	17·5
120	fine	gray-brown	85	+ +			22·5	40	25				0·5				7	5
124	fine	gray	75			+	17·5	37	18·5			+					12	15
125	rather fine	dark gray	45	+			28·5	21	6								19	25·5
126	fine	gray	70	+			15·5	26·5	28·5		0·5	+	0·5				11·5	17
127	very coarse	black	90				20·5	30	8	1		1	1·5				25·5	12·5
128	rather fine	dark brown	60			+	16	12	3				0·5				28	40·5
129	rather fine	dark gray	50	+			11	13	1	+	+						31·5	43·5
138	coarse	dark gray	30	+			27·5	19·5	7			+					17	29
139	rather fine	black-gray	50	+			29	22	19				1				10·5	18·5
140	fine	dark gray	75	+			23	28	16·5	+			4·5				10·5	17·5
141	fine	brown-gray	35	+ +			15	17·5	6			0·5					26	35
143	coarse	gray-brown	15				22	19	4·5			0·5					19	35

In the next table is noted the nature of the double refracting, clear grains; as many minerals, as can be recognized, are enumerated and calculated in per ct. There is everywhere a remnant left almost exclusively consisting of quartz and feldspar, especially of the former mineral. The minerals not found in the enumerated part of the specimen, are also here marked with a +.

Table II showing the Nature of the Sandy Ingredients.

Number of the specimen	Augite	Hyper-sthene	Horn-blende	Epidote	Olivine	Zircon	Rutile	Tourma-line	Plagi-oclase	Micro-cline	Quartz + Ortho-clase etc.	Total
2	2		0·5		+				0·5		17	20
3	1·5				+				+		5·5	7
4	3		0·5		0·5				0·5		7	11·5
6	0·5										4	4·5
7	13		+		+				1·5		30·5	4·5
8	2·5										1	3·5
9	5·5		1·5	+	0·5	0·5	+		3		7·5	18·5
10	3		+		+	+			1	0·5	50·5	55
11	3		1								25·5	29·5
12	2·5				+		+		1·5	1	31	36
13	6	+	0·5		0·5	0·5	+	+	0·5	0·5	28·5	37
17	+		1·5						0·5		32	34
18	2·5		1·5		0·5	0·5	0·5	+	0·5		52	58
19	1		+					+	+		48	49
20	6		3·5		+	+		0·5	1	1	61·5	73·5
21	7·5	0·5	4·5		+			+	+		46	58·5
22	5·5	+	3·5	+			+		1	+	66	76
24	3·5	+	6·5	+				0·5	3	+	73	86·5
25	3	1	8		1				+		70·5	83·5
27	3		5·5	+					+	+	73	81·5
28	6		9	2				+	1·5	0·5	62·5	81·5
29	6·5		13·5	2·5				+	2	0·5	56	81
31	3		15	1				0·5	1		54·5	74·5
32	1·5	0·5	7·5	0·5				+	3·5	+	74·5	88
33	2		8·5	2·5	1				3		57·5	74·5
34	3		6·5	1	0·5	0·5			2	0·5	77·5	91·5
36	1·5		5			0·5			2	+	80	89
37	0·5		5·5		0·5				4·5		79	90
38	0·5		3·5			0·5			6·5	1·5	74·5	89
39	2·5		+						+	+	5	7·5
40	2								+		5·5	7·5
41	10·5		+						3		18	31·5
45	18		0·5						1		46	65·5
46	20		0·5						4·5		46·5	71·5
44	30		0·5		+				1·5		30·5	62·5
48	20·5		+						4·5	+	40·5	65·5
50	11·5		+						1·5		29·5	42·5
54	8·5		+						1·5		12	22

Number of the specimen	Augite	Hyper-sthene	Horn-blende	Epidote	Olivine	Zircon	Rutile	Tourma-line	Plagi-oclase	Micro-cline	Quartz + Ortho-clase etc.	Total
58	1·5								0·5		3·5	5·5
59	1·5								0·5		9	11
63	6		0·5						0·5		6	13
64	15·5		0·5		+				2	+	19	37
65	7		+						1		12·5	20·5
66	11		+						+		8·5	19·5
67	2·5		+						+		6	8·5
68	1					+			2		6	9
69	1·5		+						1		4·5	7
73	3										3·5	6·5
74	3·5		+						+		6	9·5
75	1							0·5	1		47·5	50
76	1·5		+		0·5				0·5		45·5	48
77	5		1			+			+		21·5	27·5
78	0·5		1				+				22	23·5
80	6·5		1·5		+			+	1		68	77
81	1·5		2·5			+			1·5	1	60·5	67
83	1·5		1						1·5	1·5	63·5	69
85	1·5		0·5		+				+		3·5	5·5
89	3·5		+								7	10·5
90	4		0·5		0·5				0·5		35	40·5
91	11				0·5				3		20·5	35
92	20·5		1						2·5		33	57
94	5·5	0·5	4	1	1	0·5		0·5	4	0·5	41·5	59
98	3·5		1		2				1		14·5	7·5
101	4·5		+						0·5		7·5	12·5
102	1·5		+		+						3	4·5
103	2				+				+		3	5
104	3·5		1·5						0·5		14	19·5
105	3·5		0·5		+				+		8·5	12·5
106	1		0·5						0·5		10·5	12·5
107	2										4·5	6·5
110	3·5		+						+		5·5	9
111	28		+						4		5·5	37·5
112	10·5		0·5						1		26·5	38·5
113	14·5		0·5		+				2		21	38
115	4		+		2·5				+		4·5	11
116	2		1·5		0·5				0·5		61	65·5
117	3·5		0·5		+				0·5	0·5	38·5	43·5
118	10·5		0·5		1				0·5	0·5	27	40
119	3		0·5						0·5		13·5	17·5
120	4								+		1	5
124	3		+						0·5	+	11·5	15
125	3		+						1·5		21	25·5
126	8								+		9	17
127	6		1		0·5				0·5		4·5	12·5
128	32		+						2	+	6·5	40·5

Number of the specimen	Augite	Hyper-sthene	Horn-blende	Epidote	Olivine	Zircon	Rutile	Tourma-line	Plagi-oclase	Micro-cline	Quartz + Ortho-clase etc.	Total
129	31		0·5		1·5				2		8·5	43·5
138	15				1				2·5		9·5	29
139	7		+		+				+		11·5	18·5
140	8		0·5						1·5		7·5	17·5
141	15·5		0·5		+				1		18	35
143	17		+		+				0·5		17·5	35

With regard to the certainty of the determinations of the minerals it has to be noted that the qualities of the minerals do not always appear distinctly in so small sizes of grain as those treated of here, and so it often happens that a grain may resemble one mineral about as much as another, and then it will be a matter of judgment where to refer it. It is also very difficult to draw the limits between the different chief categories, in which the grains were divided; for the present I shall only point it out to be a frequent occurrence, that one part of a grain is not of the same nature as the other; one half part may for inst. be clear, crystalline, double refracting, while the other half is intransparent; in such cases the grain is referred to the category, that seems to be the larger part of it. Now if the grain consists of an aggregate of several clear, crystalline, and intransparent individuals the case is still more difficult; if none of the ingredients be decidedly predominant, the grain has to be referred to one of the categories of opaque grains, and as by double refracting, opaque grains I only mean such as show extinction in one direction, and thus belong to one individual, I have always placed such a grain under the very comprehensive category of brown, opaque, single refracting grains, the brown colour being almost always predominant in such cases. Of course we cannot, in itself, be justified in referring an aggregate of double refracting individuals to single refracting bodies, but on a contrary supposition we should have to make a new rubric, which would be rather difficult to keep apart from all the others, and under which only comparatively few cases would fall, and this would scarcely be practical.

As to the colour of the sand it is principally dependent on the amount of quartz; where this mineral is predominant the sand will get the light, brownish gray colour commonly known from arenaceous quartz; if, on the other hand, the volcanic particles be present in the larger amount, the colour will generally be considerably darker; if it approaches the black, this is owing to a considerable amount of basalt or basaltic glass, while volcanic tufa always imparts to the sand a very homogeneous, gray or gray-brown colour; this will also be the case, if there be clay in the specimen so hard, that it has not been washed out. A strongly brown or red-brown colour may either be owing to basalt that is disintegrated on the surface, or to quartz coated with limonite, or it may, what is often the case, be owing to Foraminifera that have, at least partly, been transformed into limonite, so that they have not been soluble in diluted hydrochloric acid. A greenish shade in the arenaceous quartz has its origin from a thin coating on the particular grains of some unknown substance, perhaps some compound of protoxide of iron.

The size of grains in the sand is of course closely connected with the amount of the coarser ingredients in the whole specimen; where they are found in greater numbers, the coarser grains will also be predominant in the sand, and it will chiefly get sizes rising towards $0{\cdot}5^{mm}$; if, on the other hand, the coarser ingredients be wanting, or if they be only found to a small amount, the sand will be fine, which latter case thus will be predominant in the deeper regions far from land.

The percentage of the magnetic ingredients is closely connected with the more or less volcanic nature of the sand, the larger part of the volcanic ingredients being attracted by the magnet, while this only applies to a very small part of the other ingredients. Most of the intransparent particles are attracted, as also almost all basalt and tufa, but not the basaltic glass, nor of course the glass rich in silica. Of the minerals the most ferruginous varieties of augite and hornblende are magnetic, but only to a small degree. What especially reduces the value of the determination of the magnetic ingredients is the circumstance that most of the coherent clay that may be found in the sand, is also attracted by the magnet, and the amount of this clay is not dependent on the nature of the sand according to its locality, but is quite casual.

The intransparent ingredients may consist of grains of magnetite or perhaps pyrite; but this, I think, is only the case with the smaller part of the ingredients. The greater part I take to be made up of compact, very ferruginous basalt, which in the size of grain in question proves absolutely intransparent; finally may also some of the volcanic tufa and the transformed Foraminifera fall under this category. The intransparent grains pass evenly into the brown, opaque grains; to this latter category I have referred the grains, when only a single corner of them was transparent. The percentage of the intransparent grains is on an average upwards of ten in the volcanic regions; it is largest between Iceland and the Faröe Islands, where it rises commonly over 20, up to 29 in no. 139. The smallest amounts are found in the purely Greenland specimens, the very smallest one in no. 38 with 0·5 per ct.; in these specimens I suppose all the intransparent grains to be made up of magnetite. For the rest no great regularity is found in the distribution of these grains, and therefore I shall not here enter upon a closer examination of this distribution.

The brown, opaque grains form the most comprehensive class of the ingredients, most of the basalt, tufa, and hardened clay, besides more impure, volcanic glass, and part of the transformed Foraminifera falling under this heading. On account of this heterogenousness the distribution is, of course, very irregular; the amount is largest in the most volcanic districts, up to 61·5 per ct. in no. 78; smallest in the Greenland regions, with 0·5 per ct. in no. 29; the largest amount is here surely made up of conglomerated clay. The category passes very evenly and gradually into the next one, the brown glass, so that the classification in many instances is rather difficult.

Contrary to the two preceding categories that of the brown, volcanic glass is a very uncompounded one, even if it be not distinctly bordered on one side from the brown, opaque grains, on the other from the colourless glass or the other, differently-coloured sorts of glass. Consequently the distribution is rather regular, and put down in the chart, pl. 6. In viewing this chart we shall immediately perceive at great difference between it and the charts, giving the distribution of all the volcanic ingredients. While in the latter as well Iceland as the Faröe Island and Jan Mayen are centres of distribution, and everywhere give volcanic material, the distribution here takes only place from Jan Mayen and Iceland, and from the different parts of the latter island to a very unequal degree. Certain regions produce large percentages, while others only yield little or perhaps nothing at all; the latter regions are especially gathered in two districts, a smaller one on the southeast coast, and a larger one round the large northwestern peninsula, while the southwestern and the whole eastern part of the island yield large quantities that spread rather evenly outward, and disappear more and more towards the outer borders; while the ridge between Iceland and the Faröe Islands seems to be of no importance, that between Iceland and Greenland occasions a somewhat larger percentage than the surroundings, chiefly, I suppose, on accout of the earlier mentioned masses of pumice originating from the ridge. The influence to be traced here, is, however, minimally small in comparison with what is the case with regard to the coarser sizes. The distribution appears also to be rather great southwest of Iceland, though it is not easy to account for this fact. The nature of the brown glass is somewhat different on the different localities; sometimes it is quite without vesicles, and then the grains are irregularly angular; sometimes it is filled with very small vesicles; more frequently, however, these vesicles are in size equal to or larger than the grain itself, so that this is limited by inverted circle planes. Sometimes the vesicles are distinctly lengthened in a certain direction, they may also become linear, twisted in different directions; this latter, however, is not so frequent here as in the colourless glass. Small crystals are often found as grains in the brown glass; but on account of their smallness they cannot be determined.

The red, yellow, and green volcanic glasses may be interpreted as subordinate varieties of the brown glass, with which they are also connected by transitions, and they have the same distribution; they are all only found in very small quantities in the specimens, only rarely rising to one per ct. The yellow glass has been found in 10 specimens divided all round Iceland; the green glass has been found in 16 specimens, of which some, strange to tell, are situated at the west coast of Greenland, where otherwise volcanic ingredients are not found. Perhaps the grains referred to this category, are not at all volcanic glass, but chlorite or a similar mineral; chlorite especially, which is always very slightly double refracting, and in certain varieties even wants double refraction completely, will in a grain-preparation scarcely in any way be distinguishable from green, volcanic glass. The red or red-brown glass is the most widely spread of the three varieties; it is found in 33 specimens, exclusively in such, in which brown glass is also found; it is met with in especially large quantity in the specimens northeast of Iceland, and between Iceland and Jan Mayen; in the specimens closest to the latter island, it may perhaps have its origin from this island.

The colourless glass is also connected with the brown glass by some transitions in the colour; far the greater part, however, is rather different from it. That the colour is completely wanting makes this glass rather difficult to be distinguished in the preparations, especially as it contains no trace of any double refracting substance, so that it cannot at all be seen in polarised light. The refraction is about the same as that of the Canada balsam, only slightly smaller, while for the brown glass it is a little greater, which we may observe by putting on a strong objective, and then raising and lowering the tube a little; at the edge of each transparent grain we shall then see a whitish shadow, and if this passes in over the edge when the tube is lowered, the grain is more slightly refracting than the Canada balsam, while it is stronger if the opposite case takes place. At grains that have exactly the same refraction as the Canada balsam, we shall see no shadow; this is the case with a few of the brown grains that may perhaps be supposed to consist of a very dark obsidian, while the majority consists of basaltic glass. The colourless glass differs also from the brown glass by the form of the grains, as it consists either of very thin and flat leaves, or else is strongly produced in one direction so as to be filamentous; this latter form approaches somewhat to that before mentioned in the brown glass with lengthened air vesicles. The colourless glass has been met with altogether in 67 specimens, distributed over the whole territory; as it originates from the pumice that may float about everywhere, we may expect to find it in all specimens from all parts of the earth, though on most places only in small quantities. At the west coast of Greenland it is found in several specimens; but south and southwest of Greenland it is wanting; in most of the other specimens it is found with a few dispersed exceptions; in some, more limited regions, it is found in larger quantity, viz. in some specimens west of Iceland, a series of specimens between Iceland and Jan Mayen, a very little territory north of the Faröe Islands, and a series of specimens east of Iceland; this latter territory is remarkable by almost exclusively containing the filamentous form, otherwise not very conspicuous, while the other territories contain the glass in thin, micalike leaves. The causes of this distribution are not easily explained; whether they have to be sought in particular volcanic eruptions and showers of ashes or in an abundant transport into the sea in these territories, is very dubious; it is upon the whole almost always impossible to decide, how great a part the showers of ashes play with regard to the deposits of the sea-bottom. The fact is that volcanic ashes may contain as well intransparent as brown, opaque grains, and brown and colourless glass, so that they will most likely disappear entirely between the other ingredients. The different territories for larger quantities of the colourless glass never reach quite to the land, what is at all events easily accounted for by the fact that the pumice is not to the same degree as the other ingredients deposited upon a larger scale closer to the land than farther out in the sea, and consequently it will in the former place easily disappear between the other ingredients.

The garnet is very conspicuous in the preparations, partly on account of its comparatively great refraction that is about equal to that of the augite, partly by the colour, after which it may be divided into three sorts, red garnet or almandine, dark, violet garnet or melanite, and brownish garnet or cinnamon stone. It is found in the specimens as an absolute Greenland material; but on account of its imperishableness it may like the quartz be widely distributed, though, of course, in far smaller quantity. Thus the almandine has been found in 17 specimens very far from Greenland, spread over the whole territory. At the coasts of Greenland it has been found in larger quantity in no. 94 on the east coast, and in several of the specimens on the west coast, in especially large quantity in some of the northernmost ones, while it is quite wanting or rather scarce in the southern ones. The melanite is found in especially large quantity in the northernmost of all the specimens on the west coast of Greenland, no. 53 with 13·5 per ct., in rather large quantity in the two more southern specimens, nos. 32, and 31; for the rest it is found evenly distributed in all the specimens from the west and south coast of Greenland. On the east coast it is found in larger quantity in no. 94, viz. 4 per ct.; when we get farther out it is not nearly so widely spread as the almandine, it has only been found in 5 specimens, all west and southwest of Iceland, and only in small quantities, partly only in a single piece. The cinnamon stone has only been found in two specimens, viz. in no. 51 at the northern part of the west coast of Greenland, where it is found in 1·5 per ct., and a single piece in no. 21 south of Greenland.

The double refracting grains are of course found in the largest quantity in the not volcanic specimens; but as many of them are also of volcanic origin, as a whole they give no clear idea of the distribution. The same applies also to the class that has been called the opaque double refracting grains; they may belong to every possible mineral, and the border between them and the clear ones is of course very indeterminate, as a mineral grain may well contain smaller inclosings of something without having to be put down as opaque; as, however, I have everywhere put the limit at the same point, I think that the division may have practical validity.

The most important one of the double refracting minerals is the quartz, but as it is not always to be distinguished from the feldspar, I have joined these two minerals together with a few other indeterminable ones, the quantity of which, however, is always small compared with that of the quartz, to one class. Between the feldspars the plagioclases and the microcline may generally be distinguished from the quartz by means of the twinning striation; sometimes, however, they may be turned in such a way as not to show this; these two minerals are, however, always enumerated separately. It is very difficult to distinguish between the different sorts of plagioclase in grain-preparations; for this purpose may be used either the refraction or the directions of extinction. By the refraction is to be noted that the refraction of the albite is slighter than that of the Canada balsam, while the anorthite and most of the mixed forms have a stronger refraction; but as we may take it for granted that the albite will be very rare in the specimens, and as the measuring of the refraction would necessitate the putting in of a stronger ocular for each grain, I have not thought it worth the while to waste time on such a determination in each single case, so much the less, as we have no absolute warrant that the Canada balsam has always the same index of refraction. The angle of extinction can only in a very few cases be of practical use for the distinguishing between the plagioclases rich in lime, and those rich in soda, and it can at most only be used to distinguish those richest in lime. If we see a grain in such a direction, that the twinning striation is seen plainly and distinctly, that is to say, in a direction $\neq$ (010), we may draw the conclusion that, if the angle of the extinction with the striation be more than 30°, we have a pure anorthite; if it be more than 20°, we have either bytownite or anorthite, and if it be over 5°, the mineral is either labradorite, bytownite or anorthite; if, on the other hand, it be smaller than 5°, we cannot infer that it is one more rich in soda, as the others may well be turned in such a way, that the angle is smaller than the mentioned numbers. The orthoclase may as a rule also be distinguished from the quartz by its being less refracting than the Canada balsam, while the quartz is more refracting; but from the reasons set forth above, I have not made this examination, so much the less, as the plagioclases richer in lime without visible twinning striation cannot in this way be distinguished from the quartz. In a few cases the feldspar makes itself distinctly known by being bordered by cleavage planes or by being provided with interpositions arranged after right lines; but as this refers only to part of the grains of feldspar, I have put no stress on these instances. On the other hand, feldspar and quartz, taken as a whole, are easily distinguished from almost all the other minerals found in the specimens, on account of their slight refraction, which makes them appear very indistinctly bordered from the Canada balsam while the others are generally sharply distinguished, and further on account of the slighter double refraction, which is, however, not so sure as the preceding criterion, as it is to a high degree dependent on the thickness of the grain, and its crystallographic position with regard to the axis of the microscope.

If we subject the distribution of the quartz and feldspar together to a closer examination, we shall see that in a rather broad belt round Iceland the quantity is under 10 per ct.; then it rises quickly with the distance from this island, and reaches as well southwest of Iceland as towards Jan Mayen up towards 70 per ct. The largest masses, however, are found at the west coast of Greenland where the percentage is as a rule between 70 and 80, sometimes even more. Twinning striated plagioclase has been found in almost all the specimens, the largest amount on an average in the Greenland ones, largest in no. 36 with 6·5 per ct.

It may, perhaps, also be supposed that the plagioclase forms a greater percentage of the Greenland rocks than of the Icelandic ones, although the basalt contains this mineral as its chief ingredient; but most frequently it is found in the basalt in so small grains, that they do not fall under the size of grains treated of here, unless it be together with the other minerals of the basalt; on the other hand the plagioclase is found, although as a subordinate ingredient, still in no very small quantity, in most of the Greenland rocks, and almost everywhere in rather large grains. As to the microcline, it is not so widely spread as the plagioclase; altogether it has been found in 23 specimens, everywhere in small quantities, but evidently also most commonly in the Greenland specimens.

Among the other double refracting minerals, the augite is by far the most conspicuous; it is rather easily distinguished from most of the other minerals except the olivine; as, however, both of these two minerals are chiefly of volcanic origin, a confounding of their identity will be of no great consequence. Their colour is almost the same; the augite is commonly of a peculiar brown-gray, slightly violet colour; more rarely the green form is met with in the specimens; this form, however, is easily distinguished from hornblende by its almost complete want of pleochroism. When the augite is prismatic, what is more rarely the case, it is very easily distinguished from olivine and hornblende by its large angle of extinction; but most frequently the grains, on account of the slight cleavage, are rounded without any conspicous longitudinal direction, and in such cases the refraction has to be taken into consideration; the refraction of augite is a little larger than that of olivine; but the difference is too small to be used as a characteristic; on the other hand the olivine has a considerably larger double refraction, viz. 0·033 against 0·023, and by this it may often be distinguished though with some uncertainty. The olivine is commonly almost colourless, sometimes with a slight green tint; nevertheless the colour is no reliable character. The augite is found in the largest quantity in several of the Icelandic specimens; but the percentage is, for the rest, rather deviating from place to place without any special regularity. It is found in especially large quantity in the specimens north of Iceland, where it rises to the absolutely largest percentage, 32%, in specimen 128. It is likewise found in large quantity in the specimens between Iceland and Jan Mayen, while east of Iceland it is less conspicuous. North of the Faröe Islands much augite is found; but on the ridge between these islands and Iceland very little of this mineral is met with. Southeast of Iceland it is found in large quantities, but in the large number of specimens southwest of Iceland it is quite minimal. Between Iceland and Greenland the quantity is very irregular, as is also the case with the specimens from this region in all other respects; in the two adjacent specimens, nos. 12 and 92, the percentage leaps from 20·5 to 3. In the Greenland specimens the augite is found in comparatively small quantities, varying from 0·5 to 7·5 per ct. without any recognizable regularity in the distribution.

Among the rhombic pyroxenes the hypersthene is easily distinguished and conspicuous; it forms prismatic grains with very strong pleochroism, green when viewed longitudinally, and brownish or yellowish red when viewed transversally. As in enstatite and bronzite, the refraction is about like that of augite, while the double refraction is far slighter, also a very characteristic fact. The hypersthene has been found in several of the Greenland specimens, but always in small quantity; on the other hand the enstatite and the bronzite that are only little characteristic, more or less colourless, have not been found. The triclinic pyroxenes, aegirine and akmite, on account of their small angle of extinction, can only with great difficulty be distinguished from hornblende, having the same colour and pleochroism as this mineral, nor have they been noticed; moreover there is only a very slight possibility for their being found in the specimens at all.

The common hornblende is one of the minerals most easily distinguished; it is almost always found in prismatic grains with distinctly marked pleochroism, longitudinally bluish green, transversally yellowish green in different shades. It has been found in almost all the specimens; in the volcanic specimens in very small quantity; in the Greenland ones, on the contrary, it is very common, especially in the northernmost specimens, where, in no. 31, it rises to 15 per ct. It is probable that wherever it is found in the volcanic specimens, it must, as is the case with the quartz and the garnet, have been spread from Greenland or perhaps from Scandinavia. In a few of the volcanic specimens the basaltic hornblende was found, dark reddish brown when viewed longitudinally, yellowish brown transversally; it is likely to have originated from Iceland. Other amphiboles have not been observed in the specimens, whether the case be, that they, as the tremolite, are not so easily distinguished, or they have been very rare.

Epidote is most frequently seen in prismatic grains with a rather strong refraction and a very strong double refraction; the extinction is parallel to the longitudinal direction of the prisms. The pleochroism is somewhat varying, being less characteristic than it is when seen in a section of the mineral, because the colour of the rays swinging after the axis b, the longitudinal direction of the prisms, is lying between the colours of rays swinging perpendicularly on this axis. When viewed longitudinally the grains commonly appear yellowish green, while, when viewed transversally, they may show all shades from a strong green to light yellowish; the epidote may, however, be more or less colourless, and in such cases it is not easily distinguished from olivine, as its stronger refraction and double refraction are not always sufficient characteristics. Epidote has only been found in the Greenland specimens, and only in small quantities, up to 2·5 per ct., it appears also to be most widely spread in the northern specimens.

As before mentioned, olivine is not always easily distinguished from augite and epidote. It has been found distributed in the volcanic specimens, but always only in small quantities; the greatest quantity is found in no. 115, close at Jan Mayen, where 2·5 per ct. of olivine is found; it has also been met with in a few Greenland specimens.

Tourmaline is very characteristic by its strong absorption of light; it is almost always found in prismatic form. Longitudinally the colour is rather varying; but transversally the rays are almost completely absorbed, so that the colour is almost black. The refraction and double refraction are not very conspicuous, they are both a little slighter than in hornblende. The tourmaline has been met with in most Greenland specimens, but always only in small quantities, never surpassing 0·5 per ct. Further it has been found in two specimens, nos. 80 and 75, southwest of Iceland, but also here it may easily have come from Greenland.

Zircon is distinguished by its large refraction and double refraction, both somewhat stronger than in all the above named minerals; it is almost colourless, and no pleochroism is to be seen, and by its absence it is easily distinguished from epidote, which is most like it with regard to the refraction. Zircon has been found in 12 specimens mostly situated near Greenland or between Greenland and Iceland; it has always only been observed in quite few grains.

Rutile is easily distinguished by its very strong refraction and double refraction, both much stronger than in zircon. The colour is very strong, reddish or brownish; contrary to what is the case in the tourmaline, the absorption of the extraordinary ray is the stronger, so that the crystals, if lengthened, appear darker longitudinally. Rutile has been found as well in single grains as in small needles in grains of quartz; it has only been met with in 6 specimens near Greenland, or west or southwest of Iceland, and always only in a few pieces.

To get a general survey of the distribution of the minerals, I have in the chart, pl. 7, stated, as far as possible, the ratio between the volcanic ingredients and the not volcanic ones. This statement, however, has rather great difficulties, as the different categories cannot always with certainty be referred to one or the other of the two principal groups. The intransparent grains that have proved themselves chiefly volcanic, have been referred to these ingredients. The brown, opaque grains, on the other hand, have not been counted with, although consisting of chiefly volcanic material, because in part of the specimens they also contain much coherent clay which would somewhat disturb the final result. All the glassy ingredients have, of course, been counted as absolutely volcanic, and this, among the double refracting minerals, is also the case with augite and olivine, although these minerals may also be found in smaller quantities in the Greenland specimens. To the not volcanic ingredients have been counted garnet, quartz, and feldspar, although the latter mineral is also often of volcanic origin; further all the other double refracting minerals that are enumerated in the table, with the exception of augite and olivine; the opaque, double refracting grains have not been counted to any of the groups, as they appear in about the same quantity in all the specimens. In the chart three curves have been drawn, one showing the limit of the specimens in which the number of the ratio is over 10, that is to say, where the volcanic ingredients amount to more than 90 per ct. of all the ingredients; another curve for the number of ratio 1, corresponding to 50 per ct., and a third curve for the number of ratio 0·1, corresponding to about 10 per ct. of volcanic ingredients. It will be seen that the two first curves surround Iceland, the Faröe Islands, and Jan Mayen, in a rather regular way on all sides, although with a pretty well marked greater distance from Iceland on the southeast. This is a natural consequence of the fact that an immense mass of material rich in quartz is sent forth from Greenland, which material completely outweighs the Icelandic ingredients in the

Denmark Strait, so that here the curves approach Iceland, while on the other sides of this island the quartz has to be carried hither from greater distances, and therefore cannot get such a preponderance over the volcanic ingredients. A comparison with the chart showing the distribution of the coarser material, pl. V, will show that this material is much more irregularly distributed than that treated of here. It will be especially conspicuous that the volcanic ingredients among the coarser sizes of grains extended far in tongues towards Greenland, the Faröe Islands, and Jan Mayen, while with regard to the finer ingredients no trace is found of any especial distribution in any of these three directions. This fact must have its origin in the distribution taking place according to different laws in either case; with regard to the coarser material the distribution of the volcanic material out on the two ridges between Iceland and Greenland, and Iceland and the Faröe Islands had to be accounted for by the supposition, that most of this material had been derived from the ridges themselves, what appeared, partly from the large mass of coarser ingredients, partly from the irregular distribution of these ingredients. As to the distribution towards Jan Mayen, on the other hand, the coarser ingredients were here found to a far smaller amount, and without great irregularities of distribution, so that we had to seek another cause of the volcanic nature of these ingredients; this cause might possibly be the distribution with coast-ice and river-ice from Iceland; but on account of my ignorance of the ice in these regions I am not able to value the correctness of this supposition. With regard to the finer ingredients, on the other hand, these more local causes play a rather small part. It is here to be supposed that most of the distribution takes place by means of the currents of material, either eroded from the coast or carried hither by the rivers. It is impossible here to trace the effects of the single currents; on the contrary it would appear, as has been pointed out before, that the material has a power of spreading in directions against the commonly adopted directions of the currents. It would beforehand seem to be almost impossible that for inst. the Icelandic material should be able to spread so far to the south, as it really does, contrary to the direction of the Gulf stream; but now it appears on the contrary that as well the finer as the coarser ingredients reach rather far in this direction; thus we find regions where volcanic and not volcanic material is found to the same amount, situated more than 400 kms. south and southwest of Iceland. Thus the currents cannot be taken to have an especially regular course, but we must suppose them to be, at certain times and on certain localities and depths, interrupted by currents that may have a contrary course. The fact cannot be accounted for by supposing that, to speak only of one region, so small quantities of material are deposited there, that they might possibly have been carried there by quite casual or exceptional circumstances. Some countenance might also be given to this notion by the circumstance, before pointed out, that it also seems to be very difficult to explain by any reasonable cause the presence of the large mass of material, rich in quartz, south of Iceland. But on the other hand it would be unreasonable to suppose that the two sorts of ingredients could be found so regularly mingled with each other, as they really are in this region, if they were only carried hither by more or less casual and extraordinary circumstances; the fact that we are always able to draw a conclusion as to the composition of any specimen whatever by regarding the surrounding specimens, tends decidedly to show that certain regularly acting factors must exist carrying both kinds of material to the specimen in question. That we are not able to calculate these factors must chiefly be owing to our want of knowledge of the individual currents; that no small quantities of both kinds of material are transported to the regions south of Iceland, may however with certainty be inferred from the comparatively small amount of carbonic acid in the specimens from these regions; if only small amounts of mineral ingredients were deposited, the Foraminifera and the other calcareous organisms would be of comparatively far greater importance in the specimens. One thing is common for the chart on pl. 7 and that on pl. 5, that is the great distribution of a to be sure rather small amount of volcanic material, which is shown in both charts to the south of cape Farewell. This circumstance, I think, is only to be accounted for by the East-Greenland current, which has an opportunity of receiving some ingredients, partly directly from the northwest coast of Iceland, and partly from a larger afflux, branching off from the Gulf Stream and touching the southwest coast of Iceland, whereupon it unites with the preceding one.

III. The Ingredients under $0{\cdot}05^{mm}$.

Apart from the organic ingredients, the finer particles of the specimens, which we now have to examine, are of no special interest, beyond what has already been pointed out, and therefore I shall only mention them quite briefly.

As to the particles $0{\cdot}05^{mm}$—$0{\cdot}02^{mm}$ in the first place, their smallness, as before stated, does not allow any exact mineralogical determination; they may, sure enough, be referred to the same groups as the larger ingredients, but not with the same degree of exactness. According to a valuation made for each single specimen, they contain the ingredients in about the same ratio of quantity as the preceding size of grains; the quartz is, perhaps, altogether a little more conspicuous, but, as it will be remembered, it was also in the preceding size found in greater quantity than in the coarsest ingredients. For the rest the most expedient treatment of the particles in question is to let them flow out on a plate with a small quantity of water; the lighter particles will then be the foremost ones, while the heavier will remain behind, both parts, however, of course connected by every possible transition. If we now make a preparation of the very foremost particles, and one of the very hindmost ones, those preparations will appear as different as possible. The lighter parts of the specimen will be seen to contain all the siliceous organisms, further the brown, opaque grains, if they consist of tufa or conglomerated clay, all the colourless glass, and part of the brown glass, that is to say, the more vesicular and highly indented grains; on the other hand, if the washing has been made with sufficient caution, not a single double refracting grain will be found; the heavier part, on the contrary, contains all these, as well as all the intransparent grains, further the brown, opaque grains, if they consist of firm rocks, as basalt, and the more compact grains of brown glass. By this division an excellent survey is got of the presence of siliceous organisms and the colourless glass, and with regard to this latter it is seen that the distribution is the same as that, mentioned before with regard to the larger ingredients with the very characteristically distributed four regions where the colourless glass is found in uncommonly great quantities. The colour is somewhat different in the two parts, into which the particles 0·05—0·02^{mm} may be divided. The lighter ingredients are commonly of a brown or brown-gray colour, while the heavier ones are black-gray.

The finest ingredients, under 0·02^{mm}, are of very small interest; they consist of clay and small, indeterminable grains of minerals; besides they often contain Diatoms and pieces of Radiolaria and sponge spicules. The colour is that of the specimen itself, it being determined by the clayey ingredients.

Section IV.

The Organic Ingredients of the Bottom-Specimens.

In the preceding sections we have only paid regard to the mineral ingredients, and have tried to get a clear view of their distribution; but the examination of the bottom-specimens is not finished; the organisms make so prominent an element in most of them, that they require a special examination. Of course the question cannot here be of a determination of the individual genera or species; that would require the labour of many specialists; the essential thing will here be to point out the part played by the individual groups with regard to the constitution of the specimens, and to find, if possible, a connection between the locality and other circumstances of the specimen on one hand, and the leading features with regard to its organic contents on the other. Most frequently the part of the organisms found in the specimens, is their shells or skeletal parts of lime or silica; the organic substance has almost always completely disappeared; nor have ingredients of horn or bone been found with the exception, perhaps, of a single jaw of an Annelid. In some of the specimens, on the other hand, sand-tubes are found belonging to some of the larger Foraminifera. The only specimens, in which organic substance has been found, are the three northernmost ones at the western coast of Greenland, nos. 31—33; here are found pieces of Algæ, partly larger fucaceæ, partly smaller, tubular ones, and partly microscopic threads of Algæ. The tubular Algæ were in a curious manner intervowen with grains of sand and sponge spicules placed transversally to the longitudinal direction of the tube.

The distribution of the organic ingredients must be essentially another than that of the minerals, and at the same time more implicated. While the mineral ingredients of each single specimen may, as a rule, be pointed out to have been transported from a certain, larger or smaller, territory, a corresponding supposition will in no way hold good with regard to the organisms; those found in an individual specimen, may have lived on the same locality, and have sunk to the place, but they may also have lived in every possible, though not too large, distance from the specimen, and in every possible direction, and have been transported by currents, as to the nature of which it is impossible to come to any conclusion. A closer zoological and botanical examination will perhaps give some elucidation with regard to this; if we shall be able to point out species living in some limited region of the surface of the sea, we shall also be able to draw inferences with regard to the currents from the distribution of those species in the bottom-specimens; such inferences, however, will never be very reliable, if they are not founded on examinations from a greater series of years, as at least many organisms are very differently distributed from one year to another. With regard to the organisms living on the bottom of the sea, the question, of course, will be less intricate; there is no reason to suppose that they can be carried far by the current; if upon the whole such a transport takes place, it must be where the water is less deep, and the movement so strong, that finer particles cannot be deposited, and this is not the case with any of the deep-sea deposits of the expedition. Among the factors that are of importance with regard to the deposition of the organisms, are of course principally to be named the temperature, salinity, and depth; it is, however, almost impossible to distinguish these factors from each other in the individual cases. The mass of organic material as a whole cannot be taken as a measure to show, whether larger or smaller masses of organisms are deposited on the locality in question; the fact is that this mass is principally dependent on the mass of mineral material; as this latter is deposited most abundantly closest to the land, but farther out only to a considerable smaller degree, the consequence is, that the organisms will make a continually larger percentage of the deposit, the farther we go from the land; but from this we can draw no conclusion at all with regard to the absolute quantity in which they are deposited, which quantity can scarcely be measured by any means whatever. Another matter is whether some conclusions may be drawn from the ratio of the individual organisms in the specimens.

I. *The Foraminifera.*

Among all the organisms, the Foraminifera, I think, play the most important part on account of the immense masses in which they are found in the specimens. The Coccoliths, to be sure, are present in a many times larger number, but on account of their smallness they are not of so great importance. As a rule the Foraminifera may be supposed to be far more than half of the carbonate of lime in the specimens; great part of the rest consists of amorphous lime-ooze with numerous Coccoliths and Coccospheres. The higher organisms with calcareous shells are only found in small numbers at a greater distance from land, whereas they are more numerous near land, and in some cases, perhaps, may form the greater part of the small percentage of carbonate of lime found in the Gray deep-sea clay. For practical reasons the Foraminifera have been classed in two divisions according to their being larger or smaller than 0·5^{mm}. In the first class, which is found in the part of the specimen that has been sifted, most frequently together with proportionally very small masses of mineral material, each individual is examined by means of the magnifying glass, and classified into the different groups; the smaller ones are found by placing some of the sifted substance under a microscope. If small Foraminifera be very scarce in the specimen, it may happen that none are seen in the part under the microscope; but then it is also proved that they are only found in minimally small numbers in the bottom-specimen in question, and I have not thought it necessary to search for the single individuals by the special methods for the isolating of Foraminifera, as by the present examination the essential thing is to point out what is of most importance in the specimens. The two classes of Foraminifera are seen to differ very much from each other; while the smaller ones are almost exclusively of the genus Globigerina, this genus is only exceptionally found among the larger ones, where other genera, different in the different specimens, are most conspicuous.

a. Foraminifera under 0·5^{mm} were found in the specimens as shown by the following table:

Station 2; 2·85 per ct. $CaCO_3$; one Globigerina.

Station 3; 3·64 per ct. $CaCO_3$; a few Globigerinæ.

Station 4; 2·12 per ct. $CaCO_3$; no Foraminifera.

Station 6; the percentage underdetermined, very small; no Foraminifera.

Station 7; 4·52 per ct. $CaCO_3$; some Globigerinæ; one rotaliform Foraminifer.

Station 8; 11·93 per ct. $CaCO_3$; for the greater part Globigerinæ; a few rotaliform Foraminifera and Lagenæ.

Station 9; 4·17 per ct. $CaCO_3$; one Globigerina.

Station 10; 55·36 per ct. $CaCO_3$; far the greater part Globigerinæ; a few rotaliform Foraminifera and Lagenæ.

Station 11; the percentage undetermined, great. Chiefly Globigerinæ; a few rotaliform Foraminifera.

Station 12; 5·83 per ct. $CaCO_3$; a few Globigerinæ.

Station 13; 9·71 per ct. $CaCO_3$; far the greater part Globigerinæ; a few Lagenæ and rotaliform Foraminifera.

Station 17; 66·02 per ct. $CaCO_3$; almost exclusively Globigerinæ; some rotaliform Foraminifera and Textulariæ; one Miliolina.

Station 18; 71·43 per ct. $CaCO_3$; almost exclusively Globigerinæ; a few rotaliform Foraminifera.

Station 19; 39·28 per ct. $CaCO_3$; almost exclusively Globigerinæ; some Orbulinæ; one Textularia, and one rotaliform Foraminifer.

Station 20; 34·13 per ct. $CaCO_3$; almost exclusively Globigerinæ; one Orbulina, and one rotaliform Foraminifer.

Station 21; 15·74 per ct. $CaCO_3$; almost exclusively Globigerinæ, most of them very large; one rotaliform Foraminifer.

Station 22; 36·74 per ct. $CaCO_3$; almost exclusively Globigerinæ; one Orbulina, one rotaliform Foraminifer, and one Textularia.

Station 24; 2·46 per ct. $CaCO_3$; one Globigerina, and one Textularia.

Station 25; 0·26 per ct. $CaCO_3$; no Foraminifera.

Station 27; 0·27 per ct. $CaCO_3$; no Foraminifera.

Station 28; 0·44 per ct. $CaCO_3$; no Foraminifera.

Station 29; 0·35 per ct. $CaCO_3$; no Foraminifera.

Station 31; the percentage undetermined, very small; no Foraminifera.

Station 32; 0·41 per ct. $CaCO_3$; no Foraminifera.

Station 33; 0·11 per ct. $CaCO_3$; one Globigerina.

Station 34; the percentage undetermined, very small; one Globigerina.

Station 36; 15·70 per ct. $CaCO_3$; chiefly Globigerinæ; a few Textulariæ and rotaliform Foraminifera.

Station 37; 23·55 per ct. $CaCO_3$; almost exclusively Globigerinæ; a few rotaliform Foraminifera; one Lagena.

Station 38; 35·23 per ct. $CaCO_3$; almost exclusively Globigerinæ; a few Textulariæ and rotaliform Foraminifera.

Station 39; 19·29 per ct. $CaCO_3$; almost exclusively Globigerinæ; one Miliolina, and one rotaliform Foraminifer.

Station 40; 19·67 per ct. $CaCO_3$; almost exclusively Globigerinæ; a few rotaliform Foraminifera.

Station 41; 29·71 per ct. $CaCO_3$; far the greater part Globigerinæ; some Miliolinæ; one rotaliform Foraminifer.

Station 45; 47·02 per ct. $CaCO_3$; almost exclusively Globigerinæ; some rotaliform Foraminifera; one Textularia, and one Lagena.

Station 46; 12·16 per ct. $CaCO_3$; far the greater part Globigerinæ; a few rotaliform Foraminifera and Textulariæ.

Station 47; 40·71 per ct. $CaCO_3$; far the greater part Globigerinæ; some rotaliform Foraminifera; one Textularia.

Station 48; 54·72 per ct. $CaCO_3$; almost exclusively Globigerinæ; some rotaliform Foraminifera; one Miliolina, and one Lagena.

Station 50; 16·56 per ct. $CaCO_3$; far the greater part Globigerinæ; a few Textulariæ and rotaliform Foraminifera.

Station 54; 7·65 per ct. $CaCO_3$; far the greater part Globigerinæ; one rotaliform Foraminifer.

Station 58; 2·95 per ct. $CaCO_3$; one Globigerina.

Station 59; 0·68 per ct. $CaCO_3$; no Foraminifera.

Station 63; 14·95 per ct. $CaCO_3$; far the greater part Globigerinæ; a few Textulariæ and rotaliform Foraminifera.

Station 64; 5·33 per ct. $CaCO_3$; the greater part Globigerinæ, almost all rather large and very opaque, dark brown; besides a great deal of Miliolinæ; a few rotaliform Foraminifera.

Station 65; 9·70 per ct. $CaCO_3$; almost exclusively Globigerinæ, as in the preceding specimen large and opaque; one Miliolina, and one rotaliform Foraminifer.

Station 66; 19·45 per ct. $CaCO_3$; the greater part Globigerinæ; besides a greater number of Textulariæ of an especially long and slender form; a few rotaliform Foraminifera.

Station 67; 23·31 per ct. $CaCO_3$; exclusively Globigerinæ, most of them rather large.

Station 68; 20·92 per ct. $CaCO_3$; almost exclusively Globigerinæ; one Miliolina, and one rotaliform Foraminifer.

Station 69; 25·46 per ct. $CaCO_3$; almost exclusively Globigerinæ, most of them rather large and opaque; one rotaliform Foraminifer.

Station 73; 20·45 per ct. $CaCO_3$; almost exclusively Globigerinæ, most of them large; one Textularia, and one rotaliform Foraminifer; a few genera unknown by me.

Station 74; 23·62 per ct. $CaCO_3$; almost exclusively Globigerinæ; a few rotaliform Foraminifera.

Station 75; 35·85 per ct. $CaCO_3$; almost exclusively Globigerinæ; one Miliolina, and one Textularia.

Station 76; 34·84 per ct. $CaCO_3$; almost exclusively Globigerinæ; one Lagena, and one Textularia.

Station 77; 30·00 per ct. $CaCO_3$; almost exclusively Globigerinæ; one Lagena.

Station 78; 43·79 per ct. $CaCO_3$; almost exclusively Globigerinæ; one rotaliform Foraminifer.

Station 80; 62·22 per ct. $CaCO_3$; almost exclusively Globigerinæ; one rotaliform Foraminifer.

Station 81; the percentage not determined, large; exclusively Globigerinæ, as well whole as in fragments.

Station 83; the percentage not determined, large; almost exclusively Globigerinæ, partly broken; a few rotaliform Foraminifera.

Station 85; 19·09 per ct. $CaCO_3$; the greater part Globigerinæ, very dark and opaque; some Textulariæ and rotaliform Foraminifera.

Station 89; the percentage not determined, rather large; almost exclusively Globigerinæ, very opaque; a few Textulariæ; one rotaliform Foraminifer.

Station 90; 57·00 per ct. $CaCO_3$; almost exclusively Globigerinæ; a few Miliolinæ and rotaliform Foraminifera.

Station 91; 26·09 per ct. $CaCO_3$; almost exclusively Globigerinæ; one rotaliform Foraminifer.

Station 92; 6·72 per ct. $CaCO_3$; almost exclusively Globigerinæ; one rotaliform Foraminifer.

Station 94; the percentage not determined, rather small; the greater part rotaliform Foraminifera; many Globigerinæ.

Station 98; the percentage not determined, rather large; almost exclusively Globigerinæ; a few Textulariæ, Biloculinæ, Miliolinæ, Spiroloculinæ, and rotaliform Foraminifera.

Station 101; 0·48 per ct. $CaCO_3$; no Foraminifera.

Station 102; 15·91 per ct. $CaCO_3$; the greater part Globigerinæ; many Textulariæ, rotaliform and other Foraminifera.

Station 103; 14·01 per ct. $CaCO_3$; an almost equal number of Globigerinæ and rotaliform Foraminifera; a few Lagenæ.

Station 104; 54·04 per ct. $CaCO_3$; almost exclusively Globigerinæ; a few rotaliform Foraminifera, Lagenæ, and Miliolinæ.

Station 105; 48·30 per ct. $CaCO_3$; almost exclusively Globigerinæ; a few Lagenæ and rotaliform Foraminifera.

Station 106; 21·80 per ct. $CaCO_3$; more than the half Globigerinæ; the greater part of the rest rotaliform Foraminifera; a few Textulariæ and Lagenæ.

Station 107; 2·21 per ct. $CaCO_3$; more than the half rotaliform Foraminifera, the rest Globigerinæ; one Lagena.

Station 110; 8·75 per ct. $CaCO_3$; chiefly Globigerinæ; some rotaliform Foraminifera; a few Lagenæ and Miliolinæ.

Station 111; 36·63 per ct. $CaCO_3$; almost exclusively Globigerinæ; a few Lagenæ and rotaliform Foraminifera.

Station 112; 46·32 per ct. $CaCO_3$; far the greater part Globigerinæ; some rotaliform Foraminifera; a few Lagenæ, Miliolinæ, and Nonioninæ.

Station 113; 31·29 per ct. $CaCO_3$; chiefly Globigerinæ; many rotaliform Forminifera; some Lagenæ and Miliolinæ.

Station 115; 0·14 per ct. $CaCO_3$; an almost equal number of Globigerinæ and rotaliform Foraminifera; a few Lagenæ.

Station 116; 9·60 per ct. $CaCO_3$; somewhat more than the half Globigerinæ; most of the rest rotaliform Foraminfera; many Lagenæ; one Textularia, and one Reophax.

Station 117; 61·34 per ct. $CaCO_3$; far the greater part Globigerinæ; many rotaliform Foraminifera; some Lagenæ and Miliolinæ.

Station 118; 43·67 per ct. $CaCO_3$; far the greater part Globigerinæ; some rotaliform Foraminifera; a few Lagenæ and Miliolinæ.

Station 119; 55·81 per ct. $CaCO_3$; far the greater part Globigerinæ; a few rotaliform Foraminifera, Miliolinæ, and Lagenæ.

Station 120; 28·59 per ct. $CaCO_3$; almost exclusively Globigerinæ; a few rotaliform Foraminifera; one Miliolina, and one Lagena.

Station 124; 0·72 per ct. $CaCO_3$; exclusively Globigerinæ.

Station 125; 10·31 per ct. $CaCO_3$; exclusively Globigerinæ.

Station 126; 0·26 per ct. $CaCO_3$; exclusively Globigerinæ.

Station 127; the percentage not determined, rather small; chiefly rotaliform Foraminifera; some Globigerinæ, Nonioninæ, Textulariæ, Lagenæ, and several other forms.

Station 128; 5·22 per ct. $CaCO_3$; a few Globigerinæ and rotaliform Foraminifera.

Station 129; 48·27 per ct. $CaCO_3$; far the greater part rotaliform Foraminifera; a few Globigerinæ.

Station 138; 5·48 per ct. $CaCO_3$; about an equal quantity of Globigerinæ and rotaliform Foraminifera.

Station 139; 7·24 per ct. $CaCO_3$; chiefly rotaliform Foraminifera; many Globigerinæ; one Lagena.

Station 140; 9·59 per ct. $CaCO_3$; chiefly Globigerinæ; some rotaliform Foraminifera.

Station 141; 4·70 per ct. $CaCO_3$; more than the half rotaliform Foraminifera; many Globigerinæ and Nonioninæ; a few Lagenæ and other forms.

Station 143; 6·14 per ct. $CaCO_3$; far the greater part Globigerinæ; one Miliolina, one Biloculina, and one rotaliform Foraminifer.

As is shown by the table it is only in a smaller number of specimens, that is to say such as only contain very small quantities of carbonate of lime, that no Foraminifera have been found; in some of those specimens we shall be justified in supposing them to be quite wanting; in the others they must be found in only very small quantity. In far the greater number of the specimens the genus Globigerina is absolutely predominant over the other forms; in most instances 50—100 Globigerinæ may he counted, before other Foraminifera are met with; especially in the specimens with the highest percentage of carbonate of lime, this genus is particularly predominant over the others, and accordingly the appellation of Globigerina clay is quite suitable in all these cases; in the Transition clay and the Gray deep-sea clay, on the other hand, some of the other genera may, in some instances, make out the predominant portion of the Foraminifera. The Globigerinæ of the different specimens are only little deviating from each other; almost all of them belong, I think, to the same species, or, at any rate, to very nearly related species; most of them are rather small, commonly 0·2—0·3^{mm}. In most cases, however, some of them rise to nearly 0·5^{mm}, and in some specimens most or almost all of them are of that size; in this case they are also mostly very dark and opaque, and, when viewed in incident light, brownish; they are saturated with limonite, which is often found in so large a quantity, that, when the lime has been resolved in diluted hydrochloric acid, it often completely gives the form of the Foraminifer; sometimes, perhaps, no lime is left at all. Such highly ferruginous Foraminifera are especially found in a few specimens between Iceland and Greenland, and in a few south of Iceland; larger not ferruginous Foraminifera are chiefly found south and southwest of Iceland, and, when found in great numbers, they impart to the specimen a rather peculiar, whitish, gritty appearance.

Of the other forms of Foraminifera the rotaliform especially play the most conspicuous part. In most specimens they occupy the place next to the Globigerinæ, and in a few they are found in the same quantity as, or even in larger quantity than, these. This, for instance, is the case with some specimens at the northern coast of Iceland, with a few specimens at Jan Mayen, as also with a few ones east of Iceland and north of the Faröe Islands, and finally with the single specimen at the east coast of Greenland. These specimens do not appear to any special degree to form separate regions, as they are situated among the others without any recognizable order; the only thing that may be given as a common rule, is that all the specimens south and southwest of Iceland and along the south and west coast of Greenland have an absolutely predominant quantity of Globigerinæ; thus it would seem that we shall have to pass to the north of the ridge between the Faroë Islands and Island in order to find the Globigerinæ less predominant. The other Foraminifera are of very small interest in this connection; they are most frequently found in a few specimens between the Globigerinæ, and it appears to be more or less casually, which of them are found in the individual specimen. As an exception from this rule it must be pointed out that the genus Nonionina is especially conspicuous in a couple of specimens, north of the Faröe Islands where it is found in almost the same quantity as the rotaliform Foraminifera and the Globigerinæ; and further also that the genus Miliolina in a single specimen, no. 64, and Textularia in specimen no. 66, both of them south of Iceland, are met with in an extraordinary great quantity, almost as great as that of the Globigerinæ. The zoological examination of the Foraminifera will, of course, trench on the same questions with far greater exactness, and accordingly there is no reason for dwelling further on them here.

b. The Foraminifera over 0·5^{mm}. In the following table I have noted the types of these found in the specimens, and in order to give a notion of their importance for the composition of the bottom-specimen in question, I have at each station noted the weight of the portion of the specimen, of which these Foraminifera were taken.

Stations 2—9; no Foraminifera.

Station 10; 9·5 gram. 1 Cristellaria, and 1 Biloculina.

Station 11; ca. 2 gram. About 10 Biloculinæ.

Station 12; 11·0 gram. About 10 Biloculinæ.

Station 13; 28·6 gram. No Foraminifera.

Station 17; 18·2 gram. A few Biloculinæ.

Station 18; 18·7 gram. About 10 Biloculinæ.

Station 19; 21·9 gram. About 15 Biloculinæ.

Station 20; 16·4 gram. 1 Biloculina.

Station 21; 32·9 gram. One of each of the following genera: Truncatulina, Miliolina, Pulvinulina, Gaudryina, Textularia.

Station 22; 16·4 gram. 1 Biloculina.

Station 24; 19·0 gram. No Foraminifera.

Station 25; 22·5 gram. No Foraminifera.

Station 27; ca. 2 gram. Numerous sand-tubes of a length of up to 2cm, probably of the genus Hyperammina.

Station 28; 25·0 gram. No Foraminifera.

Station 29; 14·8 gram. 1 rotaliform Foraminifer.

Station 31; ca. 3 gram. A few Hyperamminæ.

Station 32; 13·1 gram. 2 Hyperamminæ.

Stations 33—41; no Foraminifera.

Station 45; 9·6 gram. Numerous Globigerinæ; 2 Biloculinæ.

Station 46; 31·6 gram. A great many, upwards of 100, of the genus Rupertia; numerous Globigerinæ, about 10 Biloculinæ; a few individuals of the genera Nonionina, Textularia, Miliolina, a. o.

Station 47; 33·0 gram. Numerous Globigerinæ; one Rupertia, and one Nonionina.

Station 48; 25·9 gram. No Foraminifera.

Station 50; ca. 4 gram. A few Globigerinæ.

Station 54; 22·2 gram. A few Rupertiæ; 1 Biloculina.

Stations 58—68; no Foraminifera.

Station 69; 20·6 gram. A few fragments of Biloculinæ.

Station 73; 25·7 gram. A very great many (many thousands) of Globigerinæ; a few Biloculinæ, Cristellariæ, a. o.

Station 74; 19·9 gram. A few Globigerinæ; 2 rotaliform Foraminifera; 1 Biloculina.

Station 75; 23·7 gram. Numerous Globigerinæ.

Station 76; 36·4 gram. Some Globigerinæ.

Station 77; 8·5 gram. 1 Biloculina, and 1 rotaliform Foraminifer.

Station 78; 22·2 gram. Numerous Globigerinæ; about 30 Biloculinæ; 2 Cristellariæ.

Station 80; 21·8 gram. A few Globigerinæ.

Station 81; ca. 4 gram. Numerous Globigerinæ.

Station 83; ca. 15 gram. No Foraminifera.

Station 85; 41·5 gram. A very great number of Textulariæ; numerous Truncatulinæ and other rotaliform Foraminifera; a few individuals of the genera Biloculina, Nonionina, Miliolina, and Globigerina.

Station 89; ca. 2 gram. Some Globigerinæ and Textulariæ; a few Nonioninæ and rotaliform Foraminifera; one Biloculina.

Station 90; 36·7 gram. Numerous Globigerinæ; some Biloculinæ and Miliolinæ; a few rotaliform Foraminifera and Haplophragmia; one Textularia, and one Cyclammina.

Station 91; 38·2 gram. Numerous Globigerinæ; some individuals of the genera Biloculina, Cristellaria, Miliolina, and some rotaliform Foraminifera. One Rupertia.

Station 92; 51·9 gram. Numerous Rupertiæ and Truncatulinæ; some other rotaliform Foraminifera; a few Globigerinæ and Miliolinæ; one Biloculina.

Station 94; ca. 3 gram. Numerous rotaliform Foraminifera; some Nonioninæ and Biloculinæ; a few Miliolinæ, Globigerinæ, Textulariæ, Spirillinæ, a. o.

Station 98; ca. 3 gram. A great many Globigerinæ; a few rotaliform Foraminifera, and a few Textulariæ, Biloculinæ, Miliolinæ, and Spiroloculinæ.

Station 101; 13·5 gram. A few rotaliform Foraminifera; one Nonionina, and one Globigerina.

Station 102; 14·9 gram. A very great number of Haplophragmia; many Truncatulinæ; some nodosarine Foraminifera, 8 Miliolinæ, 4 Biloculinæ.

Station 103; 8·2 gram. No Foraminifera.

Station 104; 23·1 gram. A very great number (several thousands) of Truncatulinæ; some Haplophragmia and Biloculinæ (about 30), a few nodosarine Foraminifera.

Station 105; 16·8 gram. A great many Haplophragmia; some Truncatulinæ; a few nodosarine Foraminifera, 1 Biloculina.

Station 106; 27·8 gram. A few Haplophragmia and Truncatulinæ.

Station 107; 29·1 gram. 4 Haplophragmia, 4 Truncatulinæ.

Station 110; 9·4 gram. A great many Haplophragmia; some Truncatulinæ; 2 Biloculinæ.

Station 111; 31·0 gram. Very many Haplophragmia; some Truncatulinæ; a few nodosarine Foraminifera; one Biloculina.

Station 112; 29·5 gram. Very many Haplophragmia, Biloculinæ, and Truncatulinæ; a few Miliolinæ and nodosarine Foraminifera.

Station 113; 44·3 gram. A very great number of Truncatulinæ; many Biloculinæ and Haplophragmia; a few Miliolinæ and nodosarine Foraminifera.

Station 115; 84·5 gram. Some Truncatulinæ; a few other rotaliform Foraminifera; a few Miliolinæ; 1 Biloculina, and 1 Textularia.

Station 116; 18·8 gram. A few Haplophragmia, Truncatulinæ, and other rotaliform Foraminifera; 1 Biloculina, and 1 Textularia.

Station 117; 25·7 gram. The most foraminiferous of all the specimens. An immense number of Truncatulinæ; many Haplophragmia; about 20 Biloculinæ; a few nodosarine Foraminifera.

Station 118; 29·3 gram. A very great many Truncatulinæ; many Haplophragmia; about 30 Biloculinæ; one nodosarine Foraminifer.

Station 119; 33·7 gram. An immense mass of Truncatulinæ; many Haplophragmia; about 50 Biloculinæ; a few nodosarine Foraminifera.

Station 120; 32·9 gram. Some Truncatulinæ; a few Haplophragmia and nodosarine Foraminifera.

Station 124; 23·0 gram. 3 Truncatulinæ; 1 Haplophragmium.

Station 125; 28·9 gram. Some Haplophragmia, 5 Truncatulinæ.

Station 126; 19·7 gram. 2 rotaliform Foraminifera.

Station 127: ca. 50 gram. A very great number of rotaliform Foraminifera; 1 Miliolinæ.

Station 128; 13·0 gram. 2 rotaliform Foraminifera; 1 Haplophragmium.

Station 129; 18·3 gram. Many rotaliform Foraminifera. 1 Miliolina, and 1 Textularia.

Station 138; 31·2 gram. 10 rotaliform Foraminifera; 1 nodosarine Foraminifer, and 1 Miliolina.

Station 139; 36·3 gram. About 20 Haplophragmia.

Station 140; 15·9 gram. 5 Haplophragmia; 1 rotaliform Foraminifer.

Station 141; 37·0 gram. Some Haplophragmia; a few Miliolinæ, Truncatulinæ and other rotaliform Foraminifera; 1 nodosarine Foraminifer.

Station 143; 16·0 gram. 1 Miliolina, 1 Biloculina, and 1 rotaliform Foraminifer.

As is shown by the table, the larger Foraminifera show a far greater variety, and are found in the specimens with far greater irregularity than the smaller ones. This is caused, partly by the fact that rather large territories are found where they are wanting completely or in part, as for instance south of Iceland and at the west coast of Greenland, while on the other hand they are specially numerous between Iceland and Jan Mayen; partly also the cause is that the predominant forms are very different in the different localities, while the smaller Foraminifera almost exclusively were Globigerinæ. The forms of this genus being more than 0·5^{mm} in diameter, are in the specimens almost exclusively found in two localities, but found in these in great quantity, while in these places the other large Foraminifera are either quite wanting or only found in subordinate quantities. One of these localities is situated southeast of Iceland, the other and larger one southwest of Iceland and between Iceland and Greenland. The genus most widely distributed of all the larger Foraminifera, is Biloculina, and even if it is almost always only found in small numbers, it is nevertheless sometimes so conspicuous in the specimens on account of its size and clean white colour, that Schmelck has designated these specimens as Biloculina clay, while, as before mentioned, I have not thought it necessary to abandon the common name of Globigerina clay on account of some more Biloculinæ than usually being found in the specimen. Besides it is only in the specimens 112 and 113 between Iceland and Jan Mayen that this genus occurs in larger number than 1 or 2 individuals in each gram of the specimen, and where accordingly it may have any influence on the appearance of the bottom species. Upon the whole it is most numerous between Iceland and Jan Mayen, as also between Iceland and Greenland and southwest of Iceland, where in several specimens it is the only genus of larger Foraminifera. The nearly related genus Miliolina is found distributed on about the same territories and besides north of the Faröe Islands, but in all these places only in small numbers.

Among the other genera of Foraminifera the rotaliform ones have first to be noticed, and of these especially the genus Truncatulina, which may easily be distinguished from the others, and is sometimes found in very great quantities. With the exception of a couple of specimens between Iceland and Greenland it is only found in a couple of specimens north of Iceland, and especially in the open sea between this island and Jan Mayen it is often met with in quantities of more than one hundred individuals in each gram of the specimen; nearer the land it is found in considerably smaller numbers, and it disappears almost completely, whether we move to the west along the northern coast of Iceland or to the south towards the Faröe Islands. As it is rather insignificant, it has nowhere any influence on the general appearance of the specimen, which, to be sure, also holds good with regard to all the other genera, excepting Globigerina and Biloculina. I have not been able to refer the other rotaliform Foraminifera to any genera; contrary to the Truncatulina they seem to occur in the greatest numbers nearer the land. Thus they are found on the whole territory between Iceland and Greenland, but they are most numerous in the specimens no. 85, near the southwest coast of Iceland, and no. 94, at the east coast of Greenland. They are found in the greatest quantities at the western part of the north coast of Iceland, where almost no other Foraminifera are met with, while, on the other hand, they are wanting in all the specimens between Iceland and Jan Mayen, where the Truncatulinæ were found in so very great numbers, excepting close at the coasts of the two islands, where they occur in some quantity. A few of them are also found north of the Faröe Islands, while, with very few exceptions, they are wanting in the whole southern territory. The genus Nonionina has been found in a few specimens on all sides of Iceland, but always only in small quantities.

The distribution of the genus Haplophragmium is especially characteristic, it being, with the exception of one individual between Iceland and Greenland, only found in the territory north of Iceland and the Faröe Islands, but there, in return, in very great numbers; it has almost the same distribution as the Truncatulinæ, what is also the case with the nodosarine Foraminifera, which are found in numerous specimens in this territory, but always only in small numbers. The genus Cristellaria has only been found in a few individuals between Iceland and Greenland, and southwest of Iceland; the genus Textularia partly in the same territory, but in some of the specimens in greater numbers; thus in the specimens no. 85 and no. 89, west of Iceland, it is found far more numerous than any of the other Foraminifera. The genus Rupertia has a rather peculiar distribution in two separate regions; thus it is found in three specimens southeast of Iceland, where, especially in no. 46, it occurs in far greater quantity than any of the other genera; further in two specimens between Iceland and Greenland, where in one of them, no. 62, it is also predominant. Finally the sandtube-Foraminifera of the genus Hyperammina have to be mentioned; they have only been found in three specimens at the west coast of Greenland, where, with a single exception, no one of the other Foraminifera has been found. The minerals found in the tubes, are the same as those found in the specimens, that is to say, almost exclusively quartz; as the nature of the minerals is rather identical over this whole territory, we have no means of deciding, whether these Foraminifera may have been formed on the same place where they are now found, or perhaps may have been subject to some kind of transport, which latter supposition, however, would beforehand seem rather improbable.

II. *Other calcareous Organisms.*

The higher animals with calcareous shells are not by far so conspicuous in the specimens as the Foraminifera, but are nevertheless sometimes met with in not quite inconsiderable quantities. Sometimes only quite indeterminable fragments of shells are found; most frequently, however, it is possible to recognize the fragments; the shells are more rarely found whole, and then they are always of small individuals or species. In the following table I note the animal forms whose calcareous shells have been found in the specimens, but without any attempt at determining genera or species.

Stations 2—4; no calcareous shells.

Station 6; a few fragments of Lamellibranch shells and Echini spines.

Station 7; no calcareous shells.

Station 8; a few fragments of Lamellibranch shells.

Stations 9—12; no calcareous shells.

Station 13; particulary copious; contained Bryozoa of several different forms; further Serpula tubes, Gasteropods, Lamellibranchs, Corals, and Echini spines and fragments of Echini shells.

Station 17; a few fragments of Lamellibranch shells.

Stations 18—20; no calcareous shells.

Station 21; several species of Gasteropod shells and lids of such; a few fragments of Lamellibranch shells.

Stations 22—28; no calcareous shells.

Station 29: one fragment of a Bryozoon; a few Echini spines; a few fragments of Lamellibranch shells.

Stations 31—32; no calcareous shells.

Station 33; a few fragments of Lamellibranch shells; a fragment of a balanoid shell.

Stations 34—41; no calcareous shells.

Station 42; a fragment of an Echinus shell.

Station 45; a few small fragments of Lamellibranch shells; a few Echini spines; a colony of Bryozoa.

Station 46; a few Lamellibranchs, Echini spines, Bryozoa, and small Pteropods.

Stations 47—50; no calcareous organisms.

Station 54; a few small fragments of Echini spines.

Station 58; a few small Lamellibranch shells.

Stations 59—64; no calcareous shells.

Station 65; some small tubes of worms on some of the stones.

Stations 66—69; no calcareous shells.

Stations 73; a few small fragments of Echini spines and Lamellibranch shells.

Stations 74—77; no calcareous organisms.

Station 78; a few Echini spines.

Station 80; no calcareous shells.

Station 81; some fragments of Gasteropods, Lamellibranchs, and Echini spines; a few small Pteropods.

Station 83; no calcareous shells.

Station 85; a few Echini spines and fragments of Gasteropod and Lamellibranch shells.

Station 89; a few small Pteropods.

Station 90; a great many small Pteropods; a great many small Lamellibranchs and fragments of larger ones; a few fragments of Echini spines and Bryozoa.

Station 91; a few fragments of Lamellibranchs, and a few small, entire Lamellibranchs and Pteropods.

Station 92; an immense mass of small Pteropods; some Serpula tubes and fragments of larger Lamellibranchs and Gasteropods; some Echini spines and fragments of Bryozoa; a few fragments of Sertulariæ; in this specimen was further found a tooth of a fish.

Station 94; many small Pteropods and fragments of Bryozoa; a few Lamellibranchs, Gasteropods, and fragments of Echini spines and Echini shells; a few covers of Gasteropod shells.

Station 98; some small Pteropods; a few fragments of Echini spines.

Station 101; a few small fragments of Gasteropod and Lamellibranch shells.

Station 102; a couple of small Pteropods.

Stations 103—110; no calcareous shells.

Station 111; many indeterminable crust-like bodies; the surface irregular and rough; by dissolution in acid a loose membrane remained, inclosing small grains of sand of the same nature as the other grains in the specimen.

Station 112; a few Echini spines.

Station 113; a few Echini spines and fragments of Lamellibranch shells.

Station 115; some very thin fragments of Lamellibranch shells.

Station 116; some fragments of Echini spines and Echini shells.

Station 117; a few Echini spines.

Stations 118—126; no calcareous shells.

Station 127; a very great number of rather indeterminable fragments; a few entire Lamellibranchs, Bryozoa, small Ophiurida and Echini spines.

Station 128; a few fragments of Lamellibranch shells and Bryozoa.

Station 129; a great many fragments of Lamellibranchs, Echini spines, a. o.; a few small Lamellibranchs.

Stations 138—141; no calcareous shells.

Station 143; one fragment of coral.

When we look at the above list, it will first of all be conspicuous how small a part calcareous shells of the higher organisms upon the whole play in the bottom specimens; by a comparison with the older rocks we shall get the result that the quantity of fossils found in those, will as a rule be larger than these insignificant fragments commonly forming the greater part of the contents. If, besides this, we remember that most of the material enumerated in the table, is of so small dimensions that it would scarcely be noticed if found in clay-slate or lime-stone, the contrast is still more striking. In earlier geological periods, to be sure, several rocks may be found, extremely poor in fossils, but they are to be regarded as exceptions. In the same way we may be justified in supposing that in most other regions of the oceans somewhat more of the mentioned ingredients of the specimens may be found, and that the region navigated by the Ingolf-expedition is to be regarded as one, in which comparatively very small quantities of Mollusc shells and the like are deposited. If we regard all the 28 specimens of Globigerina clay as a whole, we shall find that in the 27 of them weighing together about 600 gram, no other entire shells are met with than a couple of Pteropods; only in one of the whole number, no. 90, between Greenland and Iceland, some larger Gasteropods and Lamellibranchs are found. This region is altogether remarkable by the quantity, sometimes very large, of small Pteropods. Outside of this region they are not found, and it is a very remarkable fact that they are only found in the specimens taken on the second cruise of the expedition, during the summer of 1896, while they are wanting in the specimens from the preceding year, although these latter were taken in close vicinity of the former.

By a closer examination of the distribution of the calcareous organisms in the specimens, we shall find that all the specimens, in which those organisms are found in the largest quantities, have been taken near the coasts; with the exception of the above named Gasteropods, all the other animals with calcareous shells are thus seen to be living in many times larger numbers close to land than in the open sea. Especially when we consider the fact that the deposition of the mineral material from the land is much larger near the land than farther out, the difference between the quantities, in which the calcareous organisms are deposited in the two places, will be extremely great. Otherwise the different coasts are different in this respect. At the western part of the north coast of Iceland the largest quantity of calcareous shells in the whole territory is found. In the specimens from this locality, nos. 127, and 129, the shells are to a very high degree found in fragments, most frequently quite undistinguishable, unless a section was made of each fragment and subjected to a closer microscopic examination. The subdivision of the shells in these specimens has even gone so far, that the fragments are found in great numbers in the microscopic grains, which is only the case to a very small degree in the other specimens. The reason why the shells are thus broken, must be sought in the strong surf that is found on all the coasts of the territory navigated by the expedition. It would also seem that the few shells found farther out, are far less broken than those closer to the coasts; especially the very fine and fragile Pteropods mentioned above, which are found in so great numbers between Iceland and Greenland, are almost all completely entire. In all the specimens from the west coast of Greenland uncommonly few shells are found, whether the reason of this be that the animals are living there in smaller quantities than on the other coasts, or the sedimentation of mineral material is taking place with greater force, or perhaps both causes are acting jointly, both of them perhaps being caused by the great quantity of ice in these regions. In the latter case, however, it would be rather remarkable that the same circumstances are not found on the east coast of Greenland where the ice is probably found in still greater quantity. At Jan Mayen comparatively few calcareous shells are found in the specimens; but this may be accounted for by the fact that the tract of coast is here very small, when compared with the area, over which the shells are spread.

III. *Siliceous Organisms.*

The skeletal parts of siliceous organisms, viz. Sponges, Radiolaria, and Diatoms, found in the specimens, are far less conspicuous than the Foraminifera and the other calcareous organisms, although the Sponge spicules may at times be rather conspicuous. The three groups being upon the whole distributed according to the same laws, they are enumerated together in the following table.

Station 2; a few Sponge spicules; in the sand preparation was found a spherulitic body, showing between Nicholls placed crosswise a black cross with coloured rings; this body, perhaps, belonged to a Radiolarian.

Station 3; a few Sponge spicules; one oblong Diatom.

Station 4; a few Sponge spicules; a few circular Diatoms, and one oblong one.

Station 6; a few Sponge spicules; one attached form of Diatoms.

Station 7; a few Sponge spicules and circular Diatoms.

Station 8; some Sponge spicules; a few circular and oblong Diatoms.

Station 9; a few Sponge spicules; one circular Diatom; a few larger Radiolaria.

Station 10; a great number of Sponge spicules; many circular Diatoms; a few Radiolaria, as well larger as microscopic ones.

Station 11; some Sponge spicules; some circular Diatoms; a few larger Radiolaria.

Station 12[1]); a great number of Sponge spicules; a few Radiolaria, as well microscopic as visible to the naked eye; a great many circular and oblong Diatoms.

Station 13; no siliceous organisms.

Station 17; numerous Sponge spicules; a few larger Radiolaria; a few circular Diatoms.

Station 18; a few Sponge spicules, microscopic Radiolaria, and circular Diatoms.

Station 19; a few Sponge spicules, larger Radiolaria, and circular Diatoms.

Station 20; a few Sponge spicules, microscopic Radiolaria, and circular Diatoms.

Station 21; numerous Sponge spicules, among which one larger, coherent net; a few Radiolaria, and circular Diatoms.

Station 22; a great number of Sponge spicules; some miscroscopic Radiolaria, and a few larger ones; some circular Diatoms.

Station 24; a few Sponge spicules; a few Diatoms, and larger and smaller Radiolaria.

Station 25; a few Sponge spicules, and smaller Radiolaria; very few Diatoms.

Station 27; a few Sponge spicules; very few larger Radiolaria, and circular Diatoms.

Station 28; a few Sponge spicules; very few larger and smaller Radiolaria; a few Diatoms.

Station 29; very few Sponge spicules.

Station 31; very few Sponge spicules.

Station 32; some Sponge spicules; a few Diatoms.

Station 33; a few Sponge spicules; very few Radiolaria; a few circular Diatoms.

Station 34; a few Sponge spicules; one circular Diatom; very few Radiolaria.

Station 36; some Sponge spicules; a few Diatoms.

Station 37; some Sponge spicules; one circular Diatom.

Station 38; some Sponge spicules; one Diatom, and one Radiolarian.

Station 39; a few Sponge spicules, and Diatoms; a few Radiolaria.

Station 40; some Sponge spicules; a few Diatoms and Radiolaria.

Station 41; a few Sponge spicules and Diatoms; a few Radiolaria, as well microscopic individuals as larger forms.

Station 45; a great many Sponge spicules; one Radiolarian.

Station 46; very few Sponge spicules.

Station 47; a few Sponge spicules and circular Diatoms; a few oblong Diatoms.

[1]) This specimen and several of the following ones (13, 31, 42, 54, 64, 77, 81, 83, 85, 89, 92, 94, 98, 115, 127, 128 and 129) have not, as I had before supposed, been taken with the Baillie tube, but with the dredge or the trawl. Consequently the quantitative ratio between the organisms and the inorganic ingredients may have been somewhat disturbed, whereas the different minerals may be taken to be present in their original mutual ratio of quantity.

Station 48; many Sponge spicules; very many Radiolaria, partly larger forms, partly miscroscopic ones, the latter found in an abundance of forms; a few circular and attached Diatoms.

Station 50; a few Sponge spicules, microscopic and larger Radiolaria, and circular and attached Diatoms.

Station 54; a few Sponge spicules; some larger Radiolaria.

Station 58; some Sponge spicules.

Station 59; some Sponge spicules; a few Radiolaria, and circular and attached Diatoms.

Station 63; some Sponge spicules, and circular Diatoms; a few larger and smaller Radiolaria.

Station 64; some Sponge spicules, and circular Diatoms; one Radiolarian.

Station 65; some Sponge spicules; one Radiolarian.

Station 66; numerous individuals of all three groups; the Radiolaria were present in many and beautiful forms.

Station 67; some Sponge spicules; a few Radiolaria, and circular Diatoms.

Station 68; numerous Sponge spicules; very few Diatoms; some Radiolaria.

Station 69; some Sponge spicules; many Radiolaria; a few circular, oblong, and attached Diatoms.

Station 73; some Radiolaria, and Sponge spicules.

Station 74; many Sponge spicules, and Radiolaria in many forms; a few circular and attached Diatoms.

Station 75; some Sponge spicules, and Radiolaria; a few Diatoms.

Station 76; numerous Sponge spicules, and some Radiolaria; one circular Diatom.

Station 77; some Sponge spicules; a few Radiolaria, and circular Diatoms.

Station 78; the specimen containing the greatest number of siliceous organisms; an immense number of Sponge spicules and Radiolaria, in the sandy ingredients far surpassing the mineral particles in number; the Radiolaria otherwise of not very different forms; only a few Diatoms were found.

Station 80; many Sponge spicules, and larger and smaller Radiolaria of several different forms; one circular Diatom.

Station 81; some Sponge spicules; a few Radiolaria; a few circular Diatoms.

Station 83; numerous Sponge spicules, and Diatoms; a few Radiolaria.

Station 85; some Sponge spicules, and Radiolaria; a few Diatoms.

Station 89; some Sponge spicules, and larger Radiolaria; a few Diatoms.

Station 90; a very great number of Sponge spicules, especially among the coarser particles present in larger quantity than in any other specimen; many larger and smaller Radiolaria of different forms; many Diatoms.

Station 91; a few Sponge spicules; very few Radiolaria, and Diatoms.

Station 92; very few Sponge spicules, and Radiolaria.

Station 94; some Sponge spicules, and larger Radiolaria.

Station 98; some Sponge spicules; one Radiolarian, and one Diatom.

Station 101; some Sponge spicules; a few Radiolaria, and Diatoms; the latter as well circular, as oblong and attached

Station 102; a few Sponge spicules, and Radiolaria; some circular Diatoms.

Station 103; af few Sponge spicules, Radiolaria, and circular and attached Diatoms.

Station 104; some Sponge spicules, and circular Diatoms, a few oblong Diatoms.

Station 105; some Sponge spicules, and circular Diatoms, a few oblong Diatoms; very few Radiolaria.

Station 106; a few Sponge spicules, and circular and attached Diatoms; one Radiolarian.

Station 107; a few Sponge spicules, and circular and attached Diatoms.

Station 110; some Sponge spicules, and circular and attached Diatoms; a few Radiolaria.

Station 111; a few Sponge spicules, and circular Diatoms.

Station 112; a few Sponge spicules.

Station 113; some Sponge spicules; a few Radiolaria, and circular Diatoms.

Station 115; very few Sponge, spicules and Diatoms.

Station 116; some Sponge spicules; a few Radiolaria and Diatoms.

Station 117; some Sponge spicules; a few Radiolaria; very few Diatoms.

Station 119; some Sponge spicules and Diatoms; a few larger and smaller Radiolaria.

Station 120; a few Sponge spicules; very few Radiolaria and Diatoms.

Station 124; a few Sponge spicules.

Station 125; very few Sponge spicules.

Station 126; some Sponge spicules; a few Diatoms.

Station 127; no siliceous organisms.

Station 128; numerous Sponge spicules; a few circular and attached Diatoms.

Station 129; numerous Sponge spicules; a few Radiolaria.

Station 138; numerous Sponge spicules; a few Radiolaria and Diatoms.

Station 139; numerous Sponge spicules; some Diatoms; a few larger Radiolaria.

Station 140; a few Sponge spicules; very few Diatoms; one single Radiolarian.

Station 141; some Sponge spicules; a few Radiolaria; very few Diatoms.

Station 143; some Sponge spicules; a few Radiolaria and Diatoms.

The siliceous organisms of the specimens are rather unequally divided in the different sizes of grains. In all the specimens where Sponge spicules have been found, they have occurred among the smallest particles, under $0{\cdot}05^{mm}$; in more than half the cases they are also found among the particles $0{\cdot}5$—$0{\cdot}05^{mm}$, and in about half the specimens besides they are found in the coarsest part of the specimen, the particles over $0{\cdot}5^{mm}$. It is, of course, more or less casual, whether a Sponge spicule will pass through the sieve; if the sifting be continued for a sufficiently long time, almost all of them may pass, with the exception of the branched ones, and those united to larger nets. The Radiolaria have chiefly been found among the particles $0{\cdot}05$—$0{\cdot}02^{mm}$; in the finer part they almost only occur as fragments, and among the ingredients $0{\cdot}5$—$0{\cdot}05^{mm}$ almost only one single form is found, which is, on the other hand, of very frequent occurrence in the specimens, and may be seen in the sand as small, snow-white grains with the naked eye or with a magnifying glass; under the microscope it is seen to be oblong, flattened, with an impression in one side; it is very often met with in the sand preparations. The Diatoms, on the contrary, are chiefly found in the finest specimens, under 0·02^{mm}, and only a few larger forms are met with among the particles 0·05–0·02^{mm}. With regard to the forms of these organisms, I, of course, cannot have much to say, as I do not know the individual genera and species. All the siliceous organisms are single-refracting, and consist of hydrous silica; a few Radiolaria may however be found with spheroid double-refraction, and consist accordingly of quartz or chalcedony. The Sponge spicules appear generally as quite smooth, straight bodies with almost parallel sides, and generally with a hollow in the middle; the refraction is for these organisms, as also for the other siliceous organisms, somewhat slighter than that of the Canada balsam, and thus they are rather conspicuous in the balsam. The larger Sponge spicules are often regularly ramified, commonly with three branches from each point of division; sometimes they take the form of an anchor or of other regular figures. The Sponge spicules are more rarely granulated on the surface, and it is still more rare to find them of a sinuous form. The Radiolaria are generally globular with a very different size of meshes and equipment of radiating rays; in a few specimens other forms are found in larger quantity, partly south and southwest of Iceland, partly between Iceland and Greenland. Far the greater part of the Diatoms are circular, belonging to the genus Coscinodiscus or nearly allied forms; different oblong forms and attached Diatoms are however found here and there in all the specimens; other types are far more rarely met with.

The siliceous organisms have been found in all the specimens only excepting two; and in these two specimens they might perhaps also be found by a closer examination. The Sponge spicules are most widely distributed, and have been found in almost all the specimens in larger numbers than the Diatoms and the Radiolaria; they are also the only ingredients that may sometimes be of essential importance with regard to the appearance of the specimen, as they bristle out on all sides when the specimen is broken. This is especially the case with station 78, southwest of Iceland, and station 90, between Iceland and Greenland, to a smaller degree with stations 45 and 48, southeast of Iceland; it seems, however, to be quite a casual phenomenon, as neighbouring specimens do not contain any specially large quantities of Sponge spicules. The Radiolaria and the Diatoms are found in the specimens in quantities, being in a fixed proportion to that of the Sponge spicules; if there be few of the latter, only a few individuals of the former will generally be found. Which of the two groups is of most importance is not easily decided; as a rule more Radiolaria than Diatoms are found in the region south of Iceland, and on the ridge between this island the Faröe Island, while to the north the case is the reverse. Upon the whole it may be taken as a rule that the siliceous organisms are found in greater quantity farther off from the land, while near the land they are quite minimal in the specimens; but whether this be owing to the fact that they live in smaller numbers near the land, or to the supply of mineral material being here far greater, is as impossible to decide with regard to these, as it was with regard to the other groups of animals. I have not been able to discover fresh-water Diatoms in the specimens, neither would the pointing out of such be of special interest, as we know beforehand that the specimens get large supplies of terrigenous material, unless it might also be decided whence they had come, and such a determination would require a more thorough knowledge of the Diatoms than I am possessed of.

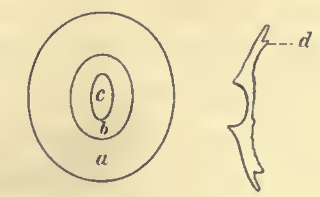
Section V.

The Coccoliths.

We have now to regard the peculiar beings, found in almost all the specimens, and in some of them in quite an overwhelming multitude, that is to say, the Coccoliths and the Coccospheres. They play a very important part in the composition of the bottom-specimens, but it is still very doubtful, to which of the three kingdoms they are to be referred. From the year 1836, when they were discovered by Ehrenberg, and down to the present day, they have been made the subject of many different interpretations. By Ehrenberg himself they were called Morpholiths, as he has set forth in detail in his Microgeologie, 1854, and later 1872[1]), and he took them to be a purely inorganic formation; he only knew them from the older geological formations, and supposed them to be transformed from Foraminifera. Many other investigators, as Huxley and Haeckel classed those beings with the organic nature, and took them to be parts of the mysterious being, the Bathybius, which was said to be the most primitive of all organisms, but which is now regarded as a purely inorganic formation. Huxley distinguishes between two forms, the Discoliths and the Cyatholiths, the former being one single disk, the latter composed of two such almost of the form of a shirt-stud with two flat disks. Haeckel figures the Coccoliths in a way often repeated in later text-books, and therefore needing a more detailed mentioning; hė divides the Coccoliths into 5 parts arranged concentrically round each other; farthest in a central grain, round this a marrow sphere, next a marrow ring, then a grain ring, and finally an outer ring. Of these five divisions the first and the last are only optical phenomena; they are, at all events, not found in the Coccoliths I have examined, the structure of which will be described later. C. W. Gümbel[2]) (1870) decidedly maintains the organic nature of Bathybius and the Coccoliths, but he adds that it is doubtful whether Bathybius is to be regarded as an independent being; he describes peculiar phenomena of colours shown by the Coccoliths by various adjustments of the objective; these phenomena I have not been able to find. Wyville Thomson (1874) pointed out that the Coccoliths belonged to the same class as the Coccospheres, which latter will be mentioned more in detail hereafter, and which were by him referred to the one-celled Algæ. Contrary to this opinion Gümbel, in his Geologie von Bayern, 1888, maintains that the Coccoliths are purely inorganic formations, which he classes with the disk-shaped grains found in the urine of horses; he describes and draws the Coccoliths as common spherulites with a regular, vertical cross in polarised light, which phenomenon is also mentioned in later works and essays where the Coccoliths are men-

[1]) Abh. d. Akad. d. Wissens. zu Berlin, 1872, p. 361.
[2]) Vorl. Mitth. ueber Tiefseeschlamm; Neues Jahrb. f. Min. 1870, p. 753.

tioned. By this time, also, more light begins to be thrown over the origin of the Coccoliths, when the discovery is made by Harting, that from an albuminous solution of carbonic ammonia bodies resembling Coccoliths may be precipitated by chloride of calcium, and when, in 1889, it is pointed out by Steinmann[1]) that such a precipitation may be made with albumen alone and chloride of calcium or sulphuric lime, and when he from this fact draws the further conclusion that the calcareous shells of all marine animals are made by such a process, while the animals that have no such shells, still in the skin get formed numerous calcareous grains, which are removed by the moulting of the skin. In the Paleontology by Steinmann and Döderlein, 1890, it is decidedly maintained that organic action has been cooperating to the formation of the Coccoliths, and that consequently all marine lime stones are to be regarded as fossils. Murray, in the report of the Challenger-Expedition, 1891, still maintains that the Coccospheres must be taken to be Algæ. He denies their existence in the arctic regions, a supposition, which, as will be shown in the following, does not hold good with regard to the territory treated of here. By Murray and several other authors the Coccoliths are often drawn with a transverse partition through the central part; unfortunately I have not succeeded in discovering such a partition.

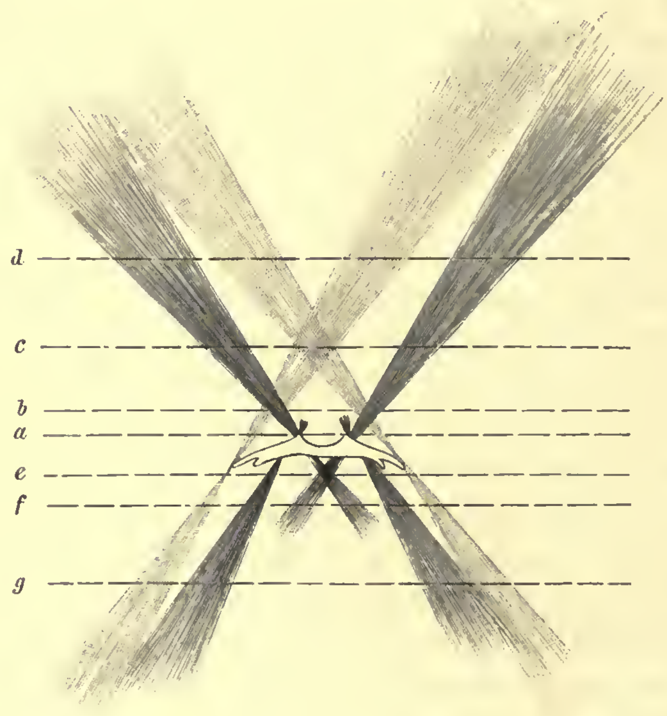


The Coccoliths are small, disk-shaped bodies; they are elliptical when seen from the flat side; their size and the form of the ellipse is almost exactly the same in all of them; on an average the major axis measures 11 μ, the minor axis 9 μ. On the outside an everywhere equally broad plate is found, which may be taken to correspond to the grain ring + outer ring of Haeckel; as I am not, however, quite sure of the correctness of this supposition, I shall prefer to call this plate the marginal plate, *a*. Inside of this plate we find an elliptic ring perhaps identical with the marrow ring of Haeckel; it may perhaps, be most properly designated the central ring, *b*, and is in every respect the most interesting and most characteristic part of the Coccolith; its outer circumference is generally $5^1/_2 \mu$ for the major axis, $3^1/_2 \mu$ for the minor one. The thickness of the central ring is a little more than 1 μ while that of the marginal plate is about 3 μ. Innermost is found an elliptic sphere of dimensions about $1^1/_4 \mu$ by $2^3/_4 \mu$ probably corresponding to the central grain + the marrow sphere; I shall call it the central sphere, *c*. In an optic transverse section the Coccolith appears as a curved disk, a consequence of its original position on the outside of the Coccosphere. The central sphere appears as a very marked hollow on the outside, while the central ring is formed by the thick margin of this hollow; on the inside the surface of the Coccolith is rather irregular, as it is torn from the Coccosphere; the outer part of the marginal plate, however, has evidently not been firmly united with the Coccosphere, as we find in most cases in the middle of the inside of the marginal plate, a distinctly projecting part, *d*, which seems to be the spot where the surface of the Coccosphere has been broken off from the Coccolith. This same part may be observed on a Coccolith seen from the flat, inner side where sometimes a very faint elliptic line may be distinguished inside of the outer margin and parallel to this; this line, however, cannot well

[1]) S. Steinmann; Ueber Schalen- und Kalksteinbildung. Berichte der naturf. Gesellschaft zu Freiburg i B.; IV Bd., 1889.

be drawn on the diagram without being too marked, what is also the case with some very fine radiating lines, sometimes found on the marginal plate.

We shall get the best idea of the refraction of the Coccolith by observing the light shadows which are seen when the tube is moved up and down, and which here give very characteristic figures. The common rule is that at the boundary between two media of different refraction a whitish shadow will be formed over the medium with the stronger refraction, if the field of view be above the object, while it will be seen over the medium with the slighter refraction, if the field of view be under the object. By moving the tube up and down we shall, when looking at a Coccolith, get a system of luminous rings, which may be elucidated by the following figure.



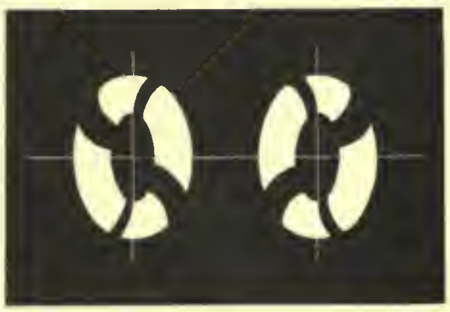
The Coccolith is seen in a transverse section, and the rays likewise are imagined transverse sections of the ringformed systems seen by different adjustments. If the field of view is immediately over the Coccolith (line *a*) a strongly luminous, elliptic ring will be seen over the central ring, and another, much fainter ring outside of this, almost at the outer edge of the marginal plate. If the tube is lifted they will approach more and more, until at *b* they will pass into one ring; farther up the two rings will pass through each other, and the formerly outer one will soon gather to a very faint and vague spot, still, however, to be distinguished from the luminous ring round it (transverse section *c*); the shadows, of course, become more and more faint, and cover larger areas, the farther they go from the starting-point. The highest figure we get, is a very faint circle of light (line *d*); the rays from the middle of *c* now have passed through each other and joined the outer circle. If the tube is lowered below the preparation, the first thing seen (line *e*) will be a very faintly luminous ring, inside of this a more luminous one, and inmost a very strongly luminous line formed by the rays of the central ring, which are all thrown towards the middle; that we get a line and not a point is the consequence of the elliptic form of the central ring; it is likely to be this line that is found in many figures as a central grain, but perhaps also other forms of Coccoliths may be found really provided with such a central grain. If the tube is lowered farther down (to *f*) the two outer circles will almost unite into one, while the inner line will form a more indefinite, circular spot in the middle; still farther down (at *g*) this spot has disappeared, and only one, indistinct circle is seen.

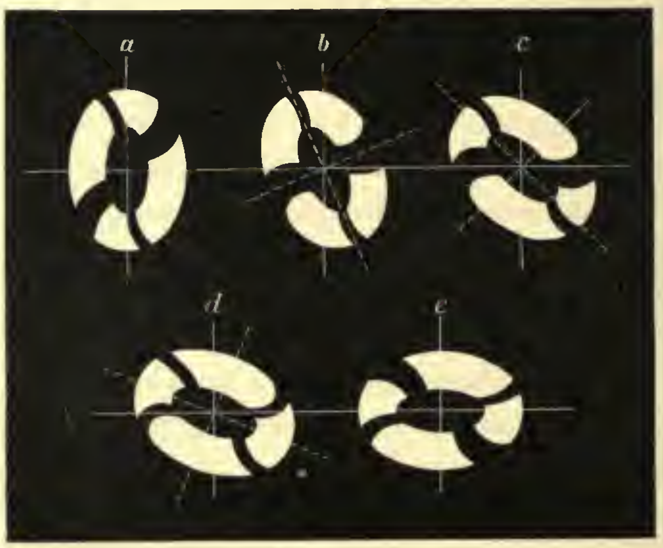
These pictures of rays are seen most distinctly, when the Coccolith is placed in water; in Canada balsam they are developed in the same way, but to a far slighter degree. It is of no consequence which side of the Coccolith is turned up; but if, on the other hand, it was placed in a fluid with larger refraction than calcite, the whole figure would be inverted. In consequence of the above stated rule with regard to the refraction we may judge from this system of shades that the central ring is much more strongly refracting than the inner and outer part of the Coccolith; if the whole body is composed of calcite the difference in refraction must arise from the thickness of the place in question. It is not to be seen whether the central sphere or the marginal plate is the more refracting; but we may come to the conclusion that no more strongly refracting central grain is found in the middle, as such a one would produce a white shade in the middle of the field of view, at line *a*. If an outer ring were found, it must form a shade in the same field of view outside the outer ring; but there is no trace of such a shade. By this examination we consequently get the result that the Coccoliths, or at least those examined by me, consist only of the above mentioned three parts: the central sphere, the central ring, and the marginal plate.

The Coccospheres, as far as discernible, are globular bodies of on average diameter of 20 μ, on the surface closely set with Coccoliths partly overlapping each other with their margins, partly leaving corners uncovered between them. On an average ten Coccoliths may be placed on each Coccosphere. When treated with diluted hydrochloric acid, an irregular, very insignificant mass of albuminoid matter is left, which has kept no trace of the form of the Coccosphere; this form, therefore, must be preserved, either by the Coccoliths' being united with their edges, or rather by a system of radiating calcareous bars in the middle; such bars, however, cannot be observed directly, the Coccoliths being an absolute hindrance to the transparency of the Coccosphere; in a few instances it is possible, by means of Nicholls placed crosswise, to see a faint, but rather regular black cross, showing that the Coccosphere must be of a spherulitic structure; generally, however, the double refraction of the Coccoliths themselves prevents us from seeing this phenomenon.

In polarised light between crossed Nicholls the Coccoliths show peculiar phenomena. The marginal plate and the central sphere appear dark, and must consequently be composed of a peculiar, single refracting form of carbonate of lime; but the central sphere shows a black cross, which is not, as has else been mentioned, vertical, but oblique to different sides. The two annexed figures show a Coccolith, seen in polarised light; to the right it is seen from the upper side, that is, the side looking away from the Coccosphere, to the left from the under side. The figures are symmetrical, both of them show a thinner, vertical beam, and a thicker transverse beam, the latter running obliquely upwards to the right, when the Coccolith is seen from the upper side, to the left, when it is seen from the under side; in the former case the branches are somewhat spirally twisted to the left, in the latter case to the right. If we now turn the table with the preparation we shall, when the Coccolith is seen from the upper side, observe the following alterations in the cross, when the turning takes place to the left.

It will be seen that the branches of the cross continue to be spirally twisted to the same side, but alter their mutual position and thickness. When the turning has grown to somewhat more than 20°, we get the position *b*, where the branches of the cross are almost at a right angle and in the direction of the axes of the Coccolith, the short branch being still much thicker than the other one. In the next position, at *c*, where the turning has reached 45°, the thin branch still almost covers the major axis, while the thick branch has got an oblique direction, contrary to the first position. If the

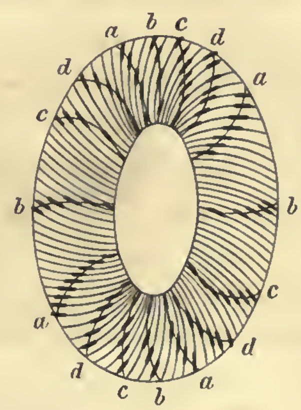




turning is continued still 20°, to *d*, both branches will be of equal thickness, and be situated almost symmetrically to the major axis; the hitherto thicker branch will be the one most spirally twisted. Finally, when the Coccolith has got to the horizontal position (*e*) the hitherto thinner branch has become thick and transverse, we have exactly the same figure as that of the starting point, and by a further turning we shall get the same series of figures, in all four times for each whole turning. If the Coccolith is seen from the inner side, we may, by a turning to the right, get the same figures in positions symmetrical to those of the preceding ones.

To understand how these phenomena arise, we must suppose the central ring to be built of threads of calcite or another modification of calcium carbonate, chiefly situated in radiating directions, but arranged, however, in a rather peculiar way. In each of the positions drawn in the preceding figure, the threads of calcite must be parallel to the direction of the thread-cross in the places where the black cross is situated. If we now draw the middle lines of the branches of the cross in the four positions on a joint figure, and indicate the directions that the threads of calcite are to have where they intersect the 16 lines thus produced, we may by means of these directions construct the position of the threads, as it has been done in the figure below.

The letters *a*, *b*, *c*, and *d* indicate the positions of the corresponding crosses in the preceding figure. It will be seen that the central ring is built of a system of threads of calcite, somewhat spirally twisted to the right, while the black crosses are twisted to the left. On the sides of the ring the direction of the threads changes only little, and consequently the branches of the cross are here very thick, while, on the contrary, the directions at the ends of the ring change quickly, and the cross becomes here much thinner, but is, in return, more definitely bordered. Those same systems of black crosses would also arise, if the threads had everywhere directions at right angles to those drawn here, that is to say, if they formed spirals twisted to the left, and situated about tangentially; but the shiftings of colour, when a gypsum plate is interposed, show this latter possibility to be excluded. To get an idea of the position of the threads in other dimensions, I have tried to get a picture of a Coccolith seen from the edge in polarised light; but here the impression is highly confused, as several parts of the rings are seen over each other extinguishing the light at different times. We may draw the conclusion that the threads are not all arranged in one plane, as the Coccolith is not dark in any position whatever, but is light almost to the same degree during the whole turning. Also the marginal plate appears illuminated in all positions, which, however, can only be explained by its receiving a reflection of light from the central ring, as we cannot imagine any position of threads of calcite, by which the marginal plate can appear thus illuminated, while it is dark in all positions, when viewed from the flat side.



For the sake of comparison I have also examined some specimens of common chalk, and in this are found numerous genuine Coccoliths, although of a somewhat different structure from the present ones. The common chalk I have examined, was taken from a boring that takes place at the Grondal bridge near Copenhagen; the Coccoliths appear here in different depths as oblong, disk-shaped bodies of about the same size as the above mentioned ones, but wanting the marginal plate, so that consequently the central ring and the central sphere are much larger than in those. The central ring is comparatively thin, but shows otherwise the same phenomena in polarised light as those we have described. The central sphere, on the contrary, is not single refracting, but consists of a granulary aggregate of small crystals of calcite extinguishing the light in different directions. If these Coccoliths have originally had marginal plates, they must accordingly have had the double size of the present ones; but this, I think, cannot be taken for granted. Besides these Coccoliths may also, in the species of chalk I have examined, be found common, globular, spherulitic bodies, which I do not take to be genuine Coccoliths, though they have earlier been described as such; they are, however, only found in small numbers. If we would draw into the examination other species of calcareous stones from the earlier geological periods, we should no doubt be able to get a clear view of the way in which the Coccoliths in the process of time are transformed; it would, however, lead too far from the object of the present account, and such an examination would, moreover, be rather extensive.

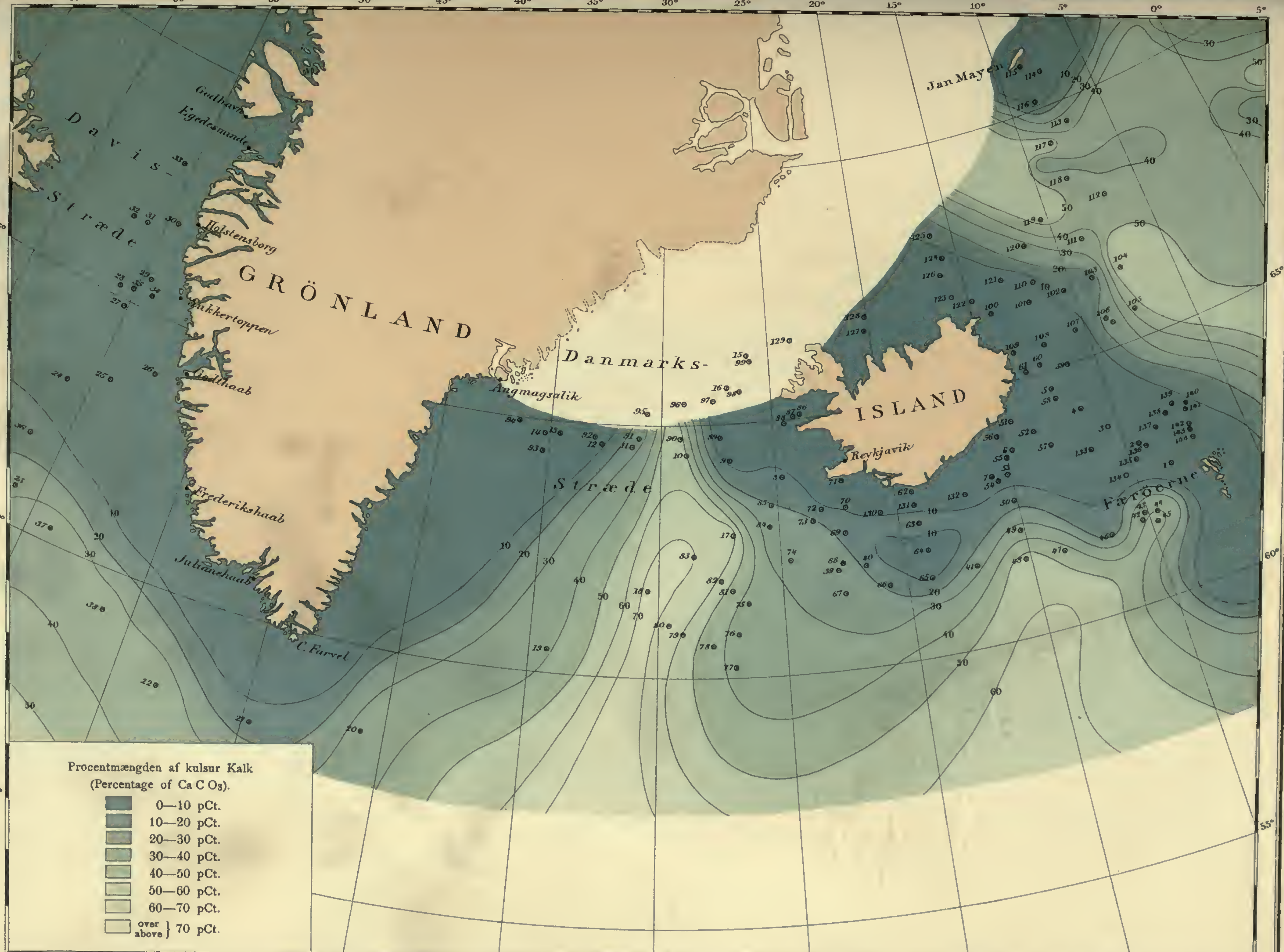
With regard to the possibility of producing the Coccoliths by artificial means, I have made som trials in the way indicated by Steinmann. By precipitating albumen with calcium chloride or calcium sulphate a precipitate is got consisting of small, globular bodies of an exceedingly regular, spherulitic structure; I have, however, not been able to form genuine Coccoliths in this way. On the contrary I have by precipitation of calcium chloride with ammonium carbonate without the presence of albumen got a copious sediment consisting of almost globular grains of calcium carbonate, some of which were made up of one single crystal, while others formed irregular spherulites of a rather coarse structure; after having been left alone for some time genuine Coccoliths have also been produced of a close resemblance to those from the chalk with regard to size, the want of a marginal plate etc. Further examinations with different compounds, circumstances of concentration and temperature etc. may perhaps give some elucidation with regard to the conditions of the forming of the Coccoliths in nature, but such examinations would also carry us too far in this direction.

The Coccoliths may accordingly be formed by purely inorganic means; probably they may also be produced by albumen and calcium salts; but this has not yet been proved by the experiments I have made in this direction. Whether the Coccoliths in nature are made by organic action or not, cannot for the present be decided; their form indicates that they have all been placed on Coccospheres; but whether these represent a living being, or are only to be regarded as a dead lump of slime, must be left for the present, until either a nucleus is discovered in them with its characteristic reactions, or, on the other hand, a Coccosphere is produced by chemical means; here is a wide range for future examinations.

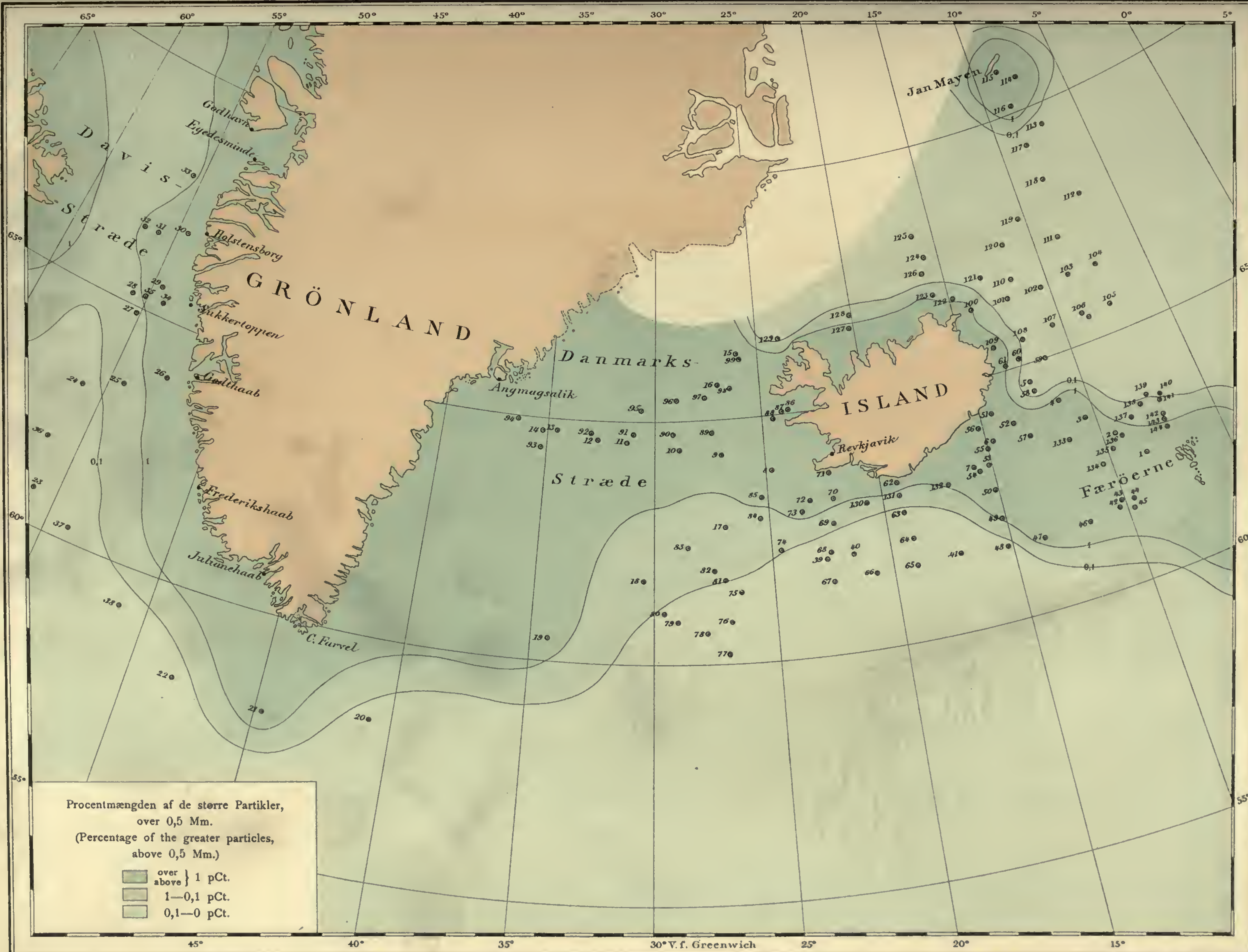
The Coccoliths are found in very great numbers through the whole territory of the Ingolf expedition. I have not, to be sure, searched for them in all the specimens; but where it has been done, the number of them has appeared to be in a proper ratio to the whole mass of carbonate of lime, of which they also form a very important part. They never, however, make up the whole of the calcareous mud; an equally large part of this is made up of very small gritty calcareous bodies of indefinite form, which, I think, are not well adapted for a closer examination. In all places where Coccoliths are found, Coccospheres are also found, although in far smaller numbers; on an average only one Coccosphere is found for each 50 Coccoliths. Rabdospheres and Rabdoliths have not been found in these deposits, and, according to Murray, they are only found in the warmer seas. When, on the other hand, the same author states that the Coccoliths should be wanting in the arctic seas, then this statement has to be positively denied with regard to the region treated of here; they are found in equally large numbers north and south of Iceland; the only deposits in which they have not been met with, are a few specimens near the coasts with exceedingly small quantities of carbonate of lime; by a closer examination they might probably also be found here.

The most important geological features of the bottom-specimens may now, I think, be sufficiently elucidated; other examinations might, perhaps, still be made, and might give further information; but the want of predecessors in the method I have followed, must be my excuse. I have not found it necessary to make chemical analyses, partly because they are of rather long duration, and partly because they cannot give much new information; as each specimen is composed of a great many different ingredients that are deposited on the bottom of the sea to a certain degree independent of each other, specimens with very different contents may get almost the same chemical composition, and in such a case an analysis would only be of little value, even if its results in themselves may claim a greater exactness than that of a mineralogical examination. And so I end this account in the hope of not having omitted anything that might to any essential degree elucidate the facts belonging to this subject.


GRÖNLAND
ISLAND
Jan Mayen
Færöerne
Davis Stræde
Danmarks-Stræde
Godhavn
Egedesminde
Holstensborg
Sukkertoppen
Godthaab
Frederikshaab
Julianehaab
C. Farvel
Angmagsalik
Reykjavik
30° V f. Greenwich
Aflejringernes Udbredelse (Distribution of the Deposits).
Lavere Vands Aflejringer (Shallow-Water Deposits).
Graat Dybhavsler (Grey Deep-Sea Clay).
Overgangsler (Transition Clay).
Globigerinaler (Globigerina Ooze).
AXEL E AAMODTS LITH. ETABL. KJØBENHAVN



AXEL E AAMODTS LITH ETABL KJØBENHAVN


Jan Mayen
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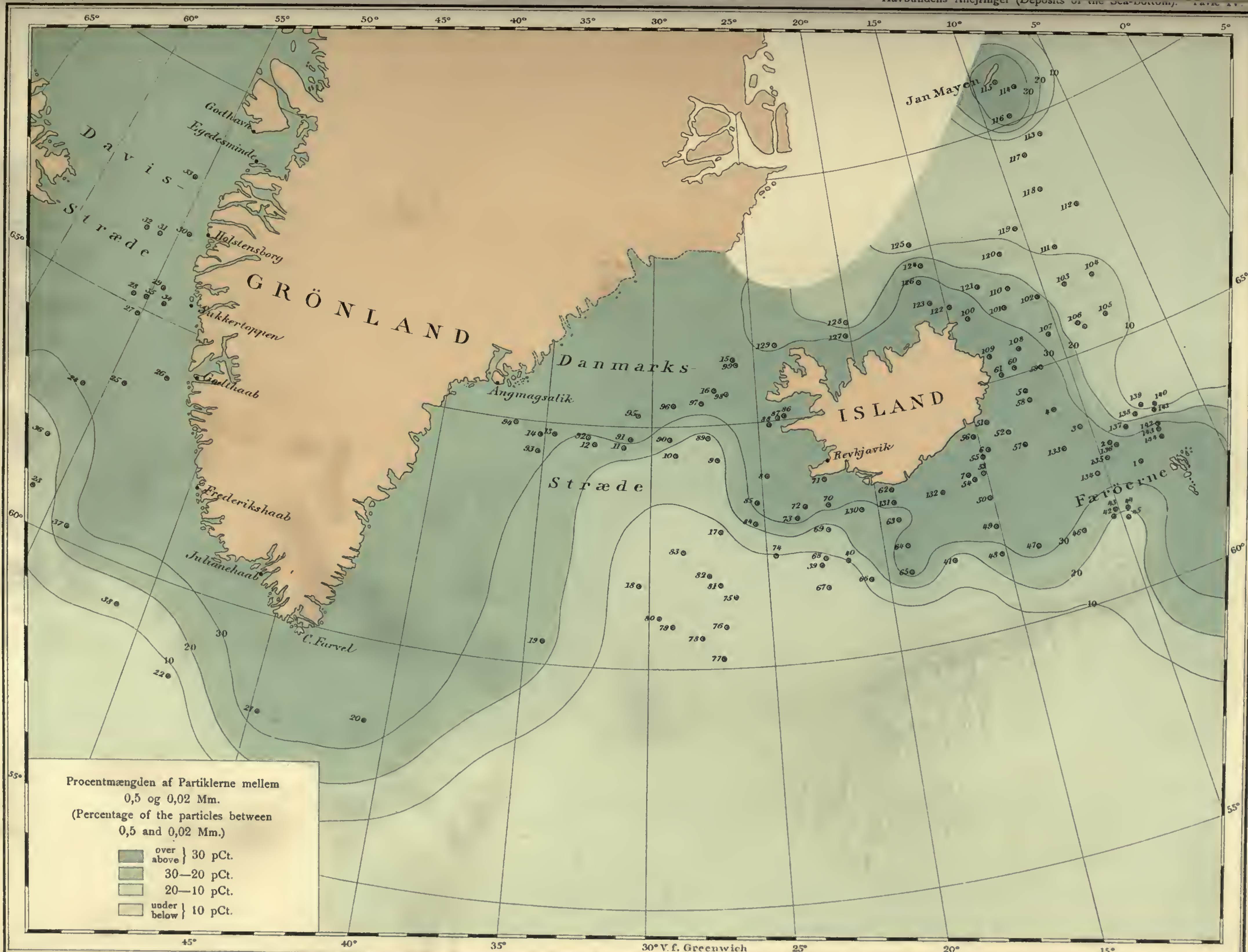
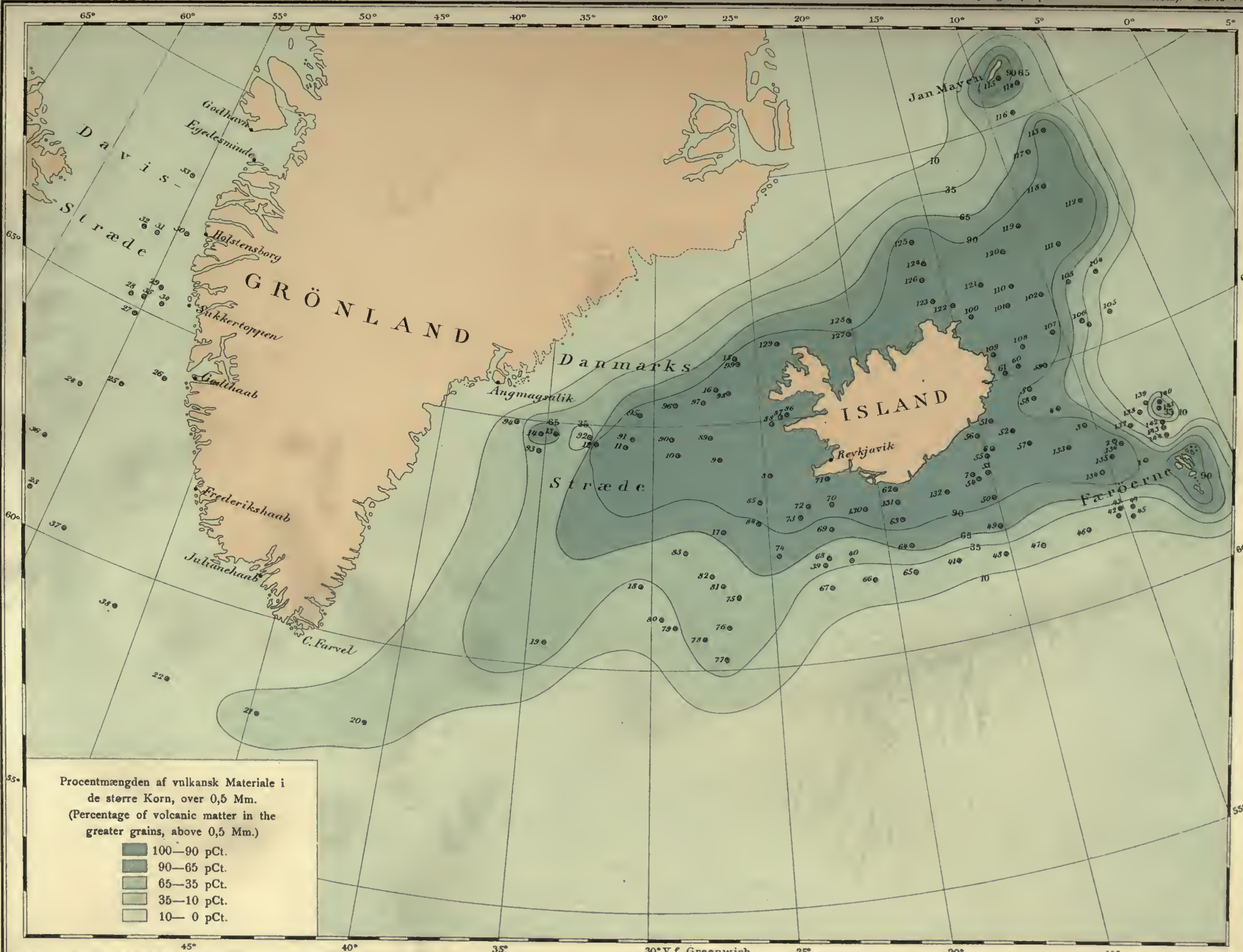
Sukkertoppen
Godthaab
Frederikshaab
Julianehaab
C. Farvel
Angmagsalik
Danmarks-Stræde
ISLAND
Reykjavik
Færöerne
30° V. f. Greenwich
Procentmængden af de større Partikler, over 0,5 Mm.
(Percentage of the greater particles, above 0,5 Mm.)
over / above } 1 pCt.
1—0,1 pCt.
0,1—0 pCt.


Davis Stræde
Godhavn
Egedesminde
Holstensborg
GRÖNLAND
Sukkertoppen
Godthaab
Frederikshaab
Julianehaab
C. Farvel
Danmarks Stræde
Angmagsalik
ISLAND
Reykjavik
Jan Mayen
Færöerne
30° V. f. Greenwich
Procentmængden af Partiklerne mellem 0,5 og 0,02 Mm.
(Percentage of the particles between 0,5 and 0,02 Mm.)
over / above } 30 pCt.
30—20 pCt.
20—10 pCt.
under / below } 10 pCt.
AXEL I. AAMODTS LITH. ETABL. KJØBENHAVN



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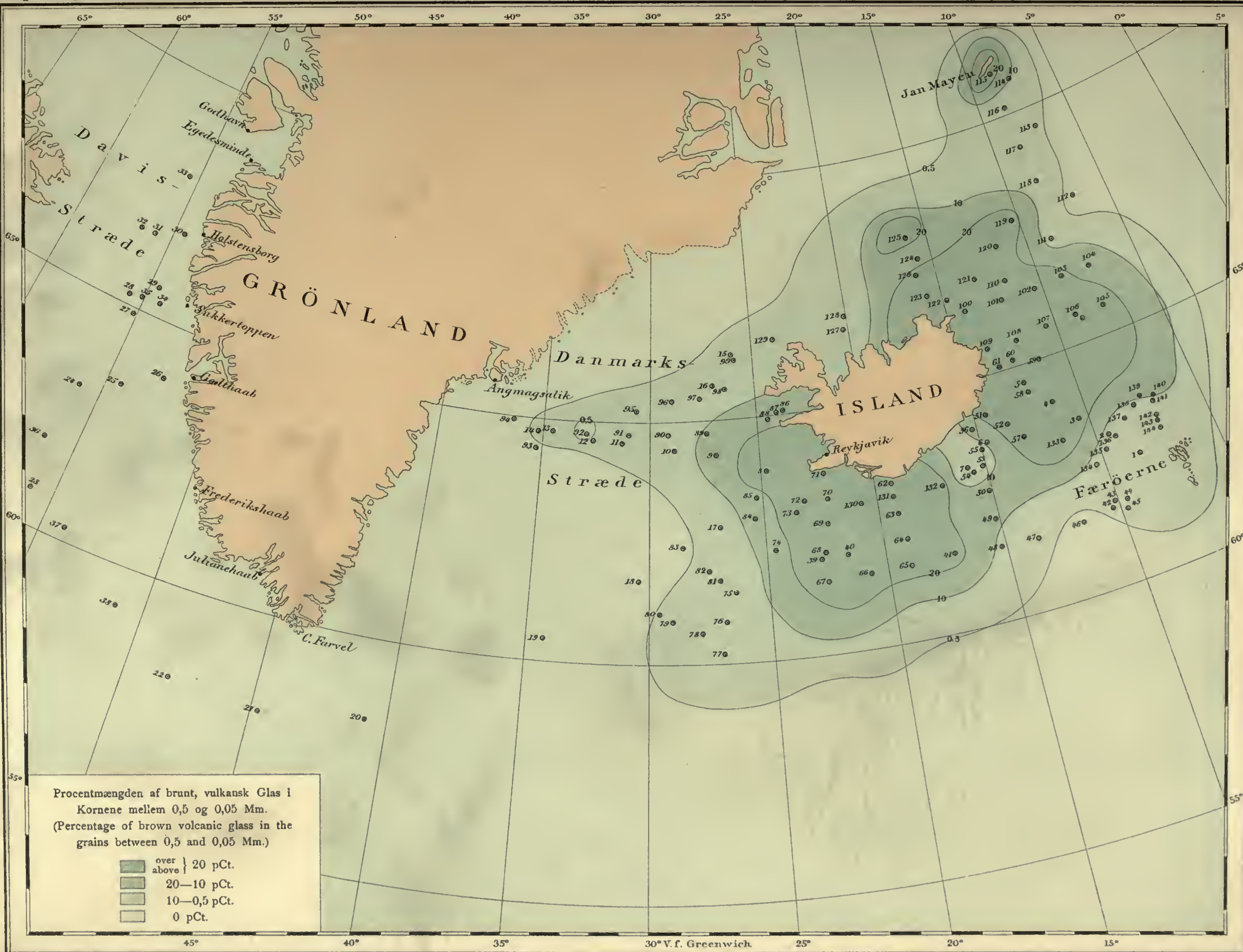

AXEL E AAMODTS LITH. ETABL. KJØBENHAVN


Davis-Stræde
GRÖNLAND
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Frederikshaab
Julianehaab
C. Farvel
Angmagsalik
Reykjavik
30° V. f. Greenwich
Procentmængden af samlet vulkansk Materiale i Kornene mellem 0,5 og 0,05 Mm.
(Percentage of total volcanic matter in the grains between 0,5 and 0,05 Mm.)
100—90 pCt.
90—50 pCt.
50—10 pCt.
10— 0 pCt.

THE INGOLF-EXPEDITION

1895—1896.

THE LOCALITIES, DEPTHS, AND BOTTOMTEMPERATURES OF THE STATIONS.

Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.	Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.	Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.
1	62° 30′	8° 21′	132	7°2	24	63° 06′	56° 00′	1199	2°4	45	61° 32′	9° 43′	643	4°17
2	63° 04′	9° 22′	262	5°3	25	63° 30′	54° 25′	582	3°3	46	61° 32′	11° 36′	720	2°40
3	63° 35′	10° 24′	272	0°5		63° 51′	53° 03′	136		47	61° 32′	13° 40′	950	3°23
4	64° 07′	11° 12′	237	2°5	26	63° 57′	52° 41′	34	0°6	48	61° 32′	15° 11′	1150	3°17
5	64° 40′	12° 09′	155			64° 37′	54° 24′	109		49	62° 07′	15° 07′	1120	2°91
6	63° 43′	14° 34′	90	7°0	27	64° 54′	55° 10′	393	3°8	50	62° 43′	15° 07′	1020	3°13
7	63° 13′	15° 41′	600	4°5	28	65° 14′	55° 42′	420	305	51	64° 15′	14° 22′	68	7°32
8	63° 56′	24° 40′	136	6°0	29	65° 34′	54° 31′	68	0°2	52	63° 57′	13° 32′	420	7°87
9	64° 18′	27° 00′	295	5°8	30	66° 50′	54° 28′	22	1°05	53	63° 15′	15° 07′	795	3°08
10	64° 24′	28° 50′	788	3°5	31	66° 35′	55° 54′	88	1°6	54	63° 08′	15° 40′	691	3°9
11	64° 34′	31° 12′	1300	1°6	32	66° 35′	56° 38′	318	3°9	55	63° 33′	15° 02′	316	5°9
12	64° 38′	32° 37′	1040	0°3	33	67° 57′	55° 30′	35	0°8	56	64° 00′	15° 09′	68	7°57
13	64° 47′	34° 33′	622	3°0	34	65° 17′	54° 17′	55		57	63° 37′	13° 02′	350	3°4
14	64° 45′	35° 05′	176	4°4	35	65° 16′	55° 05′	362	3°6	58	64° 25′	12° 09′	211	0°8
15	66° 18′	25° 59′	330	—0°75	36	61° 50′	56° 21′	1435	1°5	59	65° 00′	11° 16′	310	—0°1
16	65° 43′	26° 58′	250	6°1	37	60° 17′	54° 05′	1715	1°4	60	65° 09′	12° 27′	124	0°9
17	62° 49′	26° 55′	745	3°4	38	59° 12′	51° 05′	1870	1°3	61	65° 03′	13° 06′	55	0°4
18	61° 44′	30° 29′	1135	3°0	39	62° 00′	22° 38′	865	2°9	62	63° 18′	19° 12′	72	7°92
19	60° 29′	34° 14′	1566	2°4	40	62° 00′	21° 36′	845	3°3	63	62° 40′	19° 05′	800	4°0
20	58° 20′	40° 48′	1695	1°5	41	61° 39′	17° 10′	1245	2°0	64	62° 06′	19° 00′	1041	3°1
21	58° 01′	44° 45′	1330	2°4	42	61° 41′	10° 17′	625	0°4	65	61° 33′	19° 00′	1089	3°0
22	58° 10′	48° 25′	1845	1°4	43	61° 42′	10° 11′	645	0°05	66	61° 33′	20° 43′	1128	3°3
23	60° 43′	56° 00′	Only the Plankton-Net used		44	61° 42′	9° 36′	545	4°8	67	61° 30′	22° 30′	975	3°0

Station Nr.	Long. W.	Lat. N.	Depth in Danish fathoms	Bottom-temp.	Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.	Station Nr.	Lat. N.	Long. W.	Depth in Danish fathoms	Bottom-temp.
68	62° 06′	22° 30′	843	3°4	92	64° 44′	32° 52′	976	1°4	118	68° 27′	8° 20′	1060	—1°0
69	62° 40′	22° 17′	589	3°9	93	64° 24′	35° 14′	767	1°46	119	67° 53′	10° 19′	1010	—1°0
70	63° 09′	22° 05′	134	7°0	94	64° 56′	36° 19′	204	4°1	120	67° 29′	11° 32′	885	—1°0
71	63° 46′	22° 03′	46			65° 31′	30° 45′	213		121	66° 59′	13° 11′	529	—0°7
72	63° 12′	23° 04′	197	6°7	95	65° 14′	30° 39′	752	2°1	122	66° 42′	14° 44′	115	1°8
73	62° 58′	23° 28′	486	5°5	96	65° 24′	29° 00′	735	1°2	123	66° 52′	15° 40′	145	2°0
74	62° 17′	24° 36′	695	4°2	97	65° 28′	27° 39′	450	5°5	124	67° 40′	15° 40′	495	—0°6
	61° 57′	25° 35′	761		98	65° 38′	26° 27′	138	5°9	125	68° 08′	16° 02′	729	—0°8
	61° 28′	25° 06′	829		99	66° 13′	25° 53′	187	6°1	126	67° 19′	15° 52′	293	—0°5
75	61° 28′	26° 25′	780	4°3	100	66° 23′	14° 02′	59	0°4	127	66° 33′	20° 05′	44	5°6
76	60° 50′	26° 50′	806	4°1	101	66° 23′	12° 05′	537	—0°7	128	66° 50′	20° 02′	194	0°6
77	60° 10′	26° 59′	951	3°6	102	66° 23′	10° 26′	750	—0°9	129	66° 35′	23° 47′	117	6°5
78	60° 37′	27° 52′	799	4°5	103	66° 23′	8° 52′	579	—0°6	130	63° 00′	20° 40′	338	6°55
79	60° 52′	28° 58′	653	4°4	104	66° 23′	7° 25′	957	—1°1	131	63° 00′	19° 09′	698	4°7
80	61° 02′	29° 32′	935	4°0	105	65° 34′	7° 31′	762	—0°8	132	63° 00′	17° 04′	747	4°6
81	61° 44′	27° 00′	485	6°1	106	65° 34′	8° 54′	447	—0°6	133	63° 14′	11° 24′	230	2°2
82	61° 55′	27° 28′	824	4°1		65° 29′	8° 40′	466		134	62° 34′	10° 26′	299	4°1
83	62° 25′	28° 30′	912	3°5	107	65° 33′	10° 28′	492	—0°3	135	62° 48′	9° 48′	270	0°4
	62° 36′	26° 01′	472		108	65° 30′	12° 00′	97	1°1	136	63° 01′	9° 11′	256	4°8
	62° 36′	25° 30′	401		109	65° 29′	13° 25′	38	1°5	137	63° 14′	8° 31′	297	—0°6
84	62° 58′	25° 24′	633	4°8	110	66° 44′	11° 33′	781	—0°8	138	63° 26′	7° 56′	471	—0°6
85	63° 21′	25° 21′	170		111	67° 14′	8° 48′	860	—0°9	139	63° 36′	7° 30′	702	—0°6
86	65° 03′6	23° 47′6	76		112	67° 57′	6° 44′	1267	—1°1	140	63° 29′	6° 57′	780	—0°9
87	65° 02′3	23° 56′2	110		113	69° 31′	7° 06′	1309	—1°0	141	63° 22′	6° 58′	679	—0°6
88	64° 58′	24° 25′	76	6°9	114	70° 36′	7° 29′	773	—1°0	142	63° 07′	7° 05′	587	—0°6
89	64° 45′	27° 20′	310	8°4	115	70° 50′	8° 29′	86	0°1	143	62° 58′	7° 09′	388	—0°4
90	64° 45′	29° 06′	568	4°4	116	70° 05′	8° 26′	371	—0°4	144	62° 49′	7° 12′	276	1°6
91	64° 44′	31° 00′	1236	3°1	117	69° 13′	8° 23′	1003	—1°0					

THE DANISH INGOLF-EXPEDITION.

VOLUME I.

4.

CURRENT-BOTTLES.

BY

C. F. WANDEL.

WITH 1 PLATE.

COPENHAGEN.

BIANCO LUNO (F. DREYER), PRINTER TO THE COURT.

1899.

In «The Ingolf-Expedition», first Volume no. 1, Pages 18—20, under the Article «Current-bottles» an account will be found of the throwing overboard of current-bottles, the place of throwing, description of the bottles and the landing-place of those bottles, which had been found, when the Article was printed.

Since that time 4 bottles more have been found and there is not much probability, that others will appear, so we may suppose, that the time to analyze the obtained result has come. There is the more reason to believe this, as the bottles already found have diverged very little in their course and the appearance of more bottles will hardly have any influence on the result. The following table indicates the course of the bottles found.

Specification

of

the places where the current-bottles were thrown and the landing-places of those hitherto found.

Nr.	Date	Time	Lat. N.	Long. W.	Found
1	19/7 96	9²⁰ AM.	66° 19′	13° 46′	October 1898. Mikkel-Vig, Skage-Sund, 32 miles North of Tromsø. Northern coast of Norway.
2	19/7 -	NOON	66° 17′	13° 01′	17/1 98 Sor-Arnø, 14 miles SW. of Bodø, Western coast of Norway.
3	19/7 -	3 PM.	66° 16′	12° 09′	
4	19/7 -	5 —	66° 32′	11° 47′	4/1 97 Kongshavn on Østerø, Færoe-Islands.
5	20/7 -	12²⁰ AM.	66° 48′	11° 17′	26/3 97 Bud, Romsdal, Western coast of Norway.
6	20/7 -	2³⁰ —	66° 58′	10° 39′	16/6 98 Mokka-Fjord, Murman-coast, Russia.
7	20/7 -	4³⁰ —	67° 09′	10° 00′	
8	20/7 -	6³⁵ —	67° 17′	9° 20′	10/10 96 Laugesand on Stromø, Færoe-Islands.
9	20/7 -	2⁴⁰ PM.	67° 16′	8° 30′	10/6 97 Makur, East-Finmarken, Northern coast af Norway. [1]).
10	20/7 -	4³⁵ —	67° 30′	7° 55′	
11	20/7 -	6³⁸ —	67° 41′	7° 23′	
12	20/7 -	8⁴² —	67° 55′	6° 50′	28/1 98 Tanahorn, Finmarken, Northern coast of Norway.
13	21/7 -	7²⁰ AM.	68° 12′	6° 44′	
14	21/7 -	10 —	68° 30′	6° 44′	17/8 97 Renø, Bustad-Sund, Northern coast of Norway.
15	21/7 -	12³⁰ —	68° 49′.5	6° 44′	29/11 97 Laxe-Fjord, Northern coast of Norway.
16	21/7 -	3³⁰ PM.	69° 10′.5	6° 44′	19/1 98 Rost, Lofoten, Western coast of Norway.
17	21/7 -	7¹⁰ —	69° 31′	6° 06′	21/6 97 Vopna-Fjord, Eastern coast of Iceland.
18	22/7 -	7 AM.	69° 58′	7° 06′	21/1 98 Blixvær, 9 miles West of Bodø, Northern coast of Norway.
19	22/7 -	12³⁰ PM.	70° 25′	7° 11′	
20	22/7 -	5 —	70° 44′	8° 41′	3/12 96 Skoruvik on Langanæs, Northern coast of Iceland.

The object of throwing current-bottles is to discover the direction and force of the current between the spots of their throwing and landing. Their course can only be stated exactly, if the

[1]) Nr. 9 does not appear on Table 1, as information concerning it was received during the printing.

landings take place evenly scattered on the routes of the bottles. In stating the exact speed the length of time elapsed, after the landing of the bottles, must be taken into consideration.

Circumstances have not favored the experiments, which have been made. The bottles could only reach land at three places, namely on Iceland, the Færoe-Islands and the coast of Norway, and these coasts are so thinly populated, that a bottle may lie long before it is found.

All the bottles have undoubtedly drifted with the East-Icelandic Polar-current; some have landed on the Færoe-Islands, while the greater part has reached the Western coast of Norway. With our knowledge of the East-Icelandic Polar-current, the passage of the bottles to the Færoe-Islands can be drawn with approximate exactness; we can only imagine their directions between the Færoe-Islands and Norway. Along the Western coast of Norway the bottles follow the current running northwards, and from the date, when the relatively first bottles were found, we can ascertain the slowest speed they can have had and thereby also judge of the speed of the current.

The bottles — 20 in number — were thrown during the period from the 19th to the 22nd of July 1896 on «Ingolf»s voyage from Langanæs to Jan Mayen. The places, from where the bottles were thrown, are shown on the attached chart with ° and a figure, which indicates the number of the bottle. The place, where the respective bottle has been found is indicated by a x with corresponding number and date. The curves indicate the routes, which the bottles are supposed to have taken.

According to our knowledge of the direction of the currents at Iceland and especially on account of what has been stated on this matter in the section «Hydrography» of this report, page 117 and following, there cannot be any doubt, that the movement of all the bottles has in the beginning been towards the South, following the East-Icelandic Polar-current and then towards the East, following this current in the direction of the Færoe-Islands; it is not very likely, that they have passed very much to the South of these islands, as they must have been stopped here by the Gulfstream-water going North-East and we cannot suppose either, that they have gone very much to the North of the islands, judging from the direction taken by bottle no. 8.

The routes of the bottles must be supposed to converge somewhat towards the Færoe-Islands.

Those of the bottles, which have drifted as southerly as the Færoe-Islands and have not been found there, have passed outside of or between the Færoe-Islands and have finally landed on the Western coast of Norway.

When the bottles have first come into the neighbourhood of the Færoe-Islands, they will be drawn into the whirlpool, which runs round these islands and is due to the action of the local tide. Their courses might then cross each other, for the arrival of a bottle one hour sooner or later within the whirlpool may cause it to take a very different direction.

It is not possible to state (and it might be due to mere chance), how many times a bottle might drift round or pass between the islands, if it does not land, but there cannot be any doubt, that the courses of the bottles have crossed each other, while they have been in the neighbourhood of the Færoe-Islands and that the bottles have left the Færoe-Islands in a very different order to that, in which they arrived.

If we now take into consideration the drifting of the different bottles separately, then we shall see, that bottle no. 20, which was thrown near Jan Mayen, was found about $4^1/_2$ months later at Langanæs; this bottle must therefore have drifted with a speed of at least 2,4 miles in 24 hours and there is reason to believe, that the speed has been even greater judging by bottle no. 8. The last mentioned bottle was found on the Færoe-Islands about $2^1/_2$ months after it had been thrown and it has accordingly travelled with a speed of at least 4,0 miles during 24 hours, from which it may be concluded, that the speed of the surface-water of the East-Icelandic current is at least as great. The two current-bottles no. 20 and no. 8 and especially the latter have been found so soon after they were thrown, that it may be concluded, that they have not made any circuit worth speaking of in passing between their throwing- and landing-places. The same may be supposed as regards bottle no. 5, which was found at Bergen about 8 months after it had been thrown. If it be supposed, that this bottle has travelled southwards to the Færoe-Islands and then to Bergen, its average speed will have been at least 2,9 miles during 24 hours. If it be supposed in the same way, that bottle no. 15 has travelled as shown on the chart, its average speed will have been at least 3,3 miles during 24 hours and the average speed of bottle no. 12 has been about the same.

As regards the other bottles, which have been found much more to the North and much later, it may be supposed, that they have been found long after landing or after having reached their place of landing, where local currents have kept them drifting about; it cannot be supposed, that they have travelled once round the North-Atlantic, before they have reached the Western coast of Norway, as this would mean a rotation-speed, which is quite out of the question.

Some of the routes of the bottles West of the Færoe-Islands cross each other; all the bottles having been thrown in the same kind of water, i. e. in the East-Icelandic Polar-current and with so short intervals, that it could hardly be supposed, that two bottle-routes would cross each other in the open sea, such crossings could only take place near the shore and could only be occasioned by the circumstance, that one bottle lands, while the other remains distant from the coast, or that one of the bottles is caught by a special coast-current, while the other does not reach so far, or finally, that one bottle is kept near the coast for some time, while the current, which runs along the coast, changes its direction. These remarks apply to the routes taken by bottles no. 17, 18 and 20.

If it be supposed, that the drifting of the bottles has been approximately as indicated in the chart, we shall find, that the water of the East-Icelandic Polar-current between 65° and 70° Northern latitude has moved in a southwesterly direction towards the North-Eastern coast of Iceland. A movement in such a direction will cause a diminuation of the Polar-current-area between Iceland and Jan Mayen as Gulfstream-water must follow from the East and North-East. It is generally known, that the Polar-currents usually diminish during the summer and have their smallest extent at the beginning of the autumn and we learn accordingly from the drifting of the bottles, that this increase of the Gulfstream and decrease of the Polar-current owe their existence to the fact, that the surface-water in the East-Icelandic Polar-current moves towards the South-West, and with the surface-water goes probably partly the whole icewater stratum. As it has been pointed out in «Hydrography», page 122, it cannot be expected, that the understratum of the Polar-current, which at its Eastern side consists of Gulfstream-water, participates in this movement of the icewater to any marked extent. While the whole bulk of icewater in this way alters its extent from one season to the other, the very uppermost part of the icewater, the real surface-stratum, which during the summer is considerably warmed up, as is shown on page 137, can move quite independent of that icewater, to which it originally belongs. Such movements can be caused by the wind and can perhaps also have assisted to carry the surface-water with the bottles towards the South-West. When the bottles nos 1—12 were thrown the wind was light, chiefly coming from the South-West, when bottles nos 13—16 were thrown, the wind turned through the South-East to the North, but was continuously very light. The bottles nos 17—20 were thrown, when the wind was northnorthwesterly of strength 3 (Beaufort). During «Ingolf»s return-voyage from Jan Mayen to Iceland the wind was all the time very light. It is therefore not to be supposed, that the wind can have had any particular influence on the drifting of the bottles. Very little is known about the mean direction of the wind in these waters. It appears however from the meteorological observations, that the wind at the Northern coast of Iceland is on an average easterly during the months of July and August. If it may be concluded, that the direction of the wind is usually the same in the Ocean North of Iceland, then the wind will also have contributed to carry the current-bottles inwards towards the North-Eastern coast of Iceland. We must suppose, that the bottles deviate towards the South-East about on 65° Northern latitude and follow the Polar-current towards the Færoe-Islands.

The bottles have now arrived at the line of contact between the Gulfstream and the Polar-current. We do not know the further course of the last mentioned, whether it runs round a circle in the Western North-Ocean or whether its circular course has even a greater diameter. In the summer of 1896 it could be traced North of the Færoe-Islands and there is hardly any doubt, that it enters the Eastern part of the North-Ocean. The question now to be decided is whether the bottles can be carried from the Polar-current into the Gulfstream.

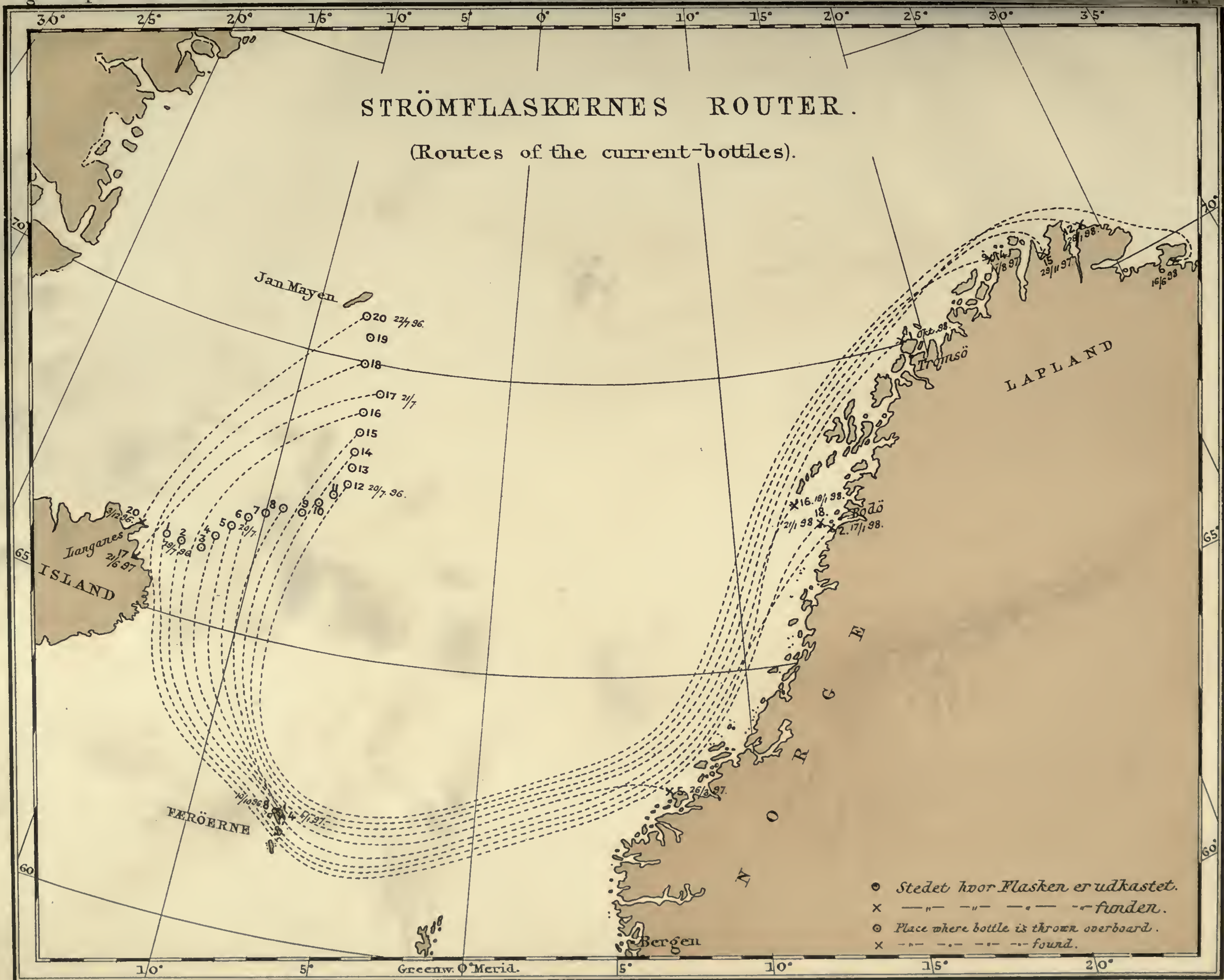
The specific gravity of the bottles was only very little less than that of the water, and as a bottle in this way only offers a very little surface for the action of the wind, it can hardly be supposed, that the wind has driven the bottle with a speed worth considering; in accordance herewith it must be supposed, that the wind cannot change the course of the bottle, causing it to go from the Polar-current into the Gulfstream. On the other hand, if it be supposed, that the water, in which the bottle is thrown, sinks down under other water strata, the bottle will not follow the water stratum, to which it belongs, but will pass into the water stratum, which is uppermost. This however can not take place in the present case. The water, in which the bottles were thrown contained 32—33 ‰ salt. While this water runs southwards, it is in contact with the cold and somewhat salter bulk of the icewater and thereby its contents of salt are somewhat increased. Its temperature also increases, the summerheat from the air having more effect than the cold water below. When the bottles have arrived in the neighbourhood of the Atlantic-water, they will then be in icewater, which is a little, but not much, colder than the Atlantic-water. The quantity of salt in this icewater has been somewhat increased by its coming into contact with the salter icewater underneath, and possibly also by its being mixed with Atlantic-water. The specific gravity of the surface-water cannot surpass the specific gravity of the Atlantic-water by any of these processes; the surface stratum of the icewater accordingly can not sink under the Atlantic-water and consequently the bottles cannot in this way pass into the Gulfstream.

The bottles thus being unable to pass the line of contact between the Polar-current and the Gulfstream, we must suppose, that surface-water from the Polar-current can pass over the water of the

Gulfstream from the Færoe-Islands to Norway. We must suppose, that this is a fact, caused by the frequent southwesterly winds, but at the same time it seems strange, that this has not been proved long ago or at least hitherto fully proved. Still it must be remembered, that the temperature has always been used for deciding in former times between Polar-water and Atlantic-water, but as regards surface-water this way of deciding is unreliable, the Polar-current-water far down South having in the autumn and the first part of the winter almost as high a temperature as the Gulfstream-water.

It must be reserved for future hydrographical observations to state more exact details with regard to this, as it would be most interesting to have light thrown upon these matters (which are most important in the interest of the fishing), especially as regards the presence of the Polar-water in the Skager Rack.

The result of the drifting of the bottles thrown has accordingly confirmed the supposition, which existed concerning the rotation movement in the Northern Ocean, and has given an idea as to the speed of the same.


STRÖMFLASKERNES ROUTER.
(Routes of the current-bottles).
Jan Mayen
ISLAND
Langanes
FÆRÖERNE
LAPLAND
NORGE
Tromsö
Bodö
Bergen
Greenw. 0° Merid.
Stedet hvor Flasken er udkastet.
— " — — " — — " — funden.
Place where bottle is thrown overboard.
— " — — " — — " — found.