DEN NORSKE NORDHAVS-EXPEDITION

1876—1878.

CHEMI.

I. OM LUFTEN I SØVANDET.
II. OM KULSYREN I SØVANDET.
III. OM SALTHOLDIGHEDEN AF VANDET I DET NORSKE NORDHAV.

AF

HERCULES TORNØE.

MED 3 TRÆSNIT OG 3 KARTER.

CHRISTIANIA.
GRØNDAHL & SØNS BOGTRYKKERI.
1880.

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THE NORWEGIAN NORTH-ATLANTIC EXPEDITION

1876—1878.

CHEMISTRY.

I. ON THE AIR IN SEA-WATER.
II. ON THE CARBONIC ACID IN SEA-WATER.
III. ON THE AMOUNT OF SALT IN THE WATER OF THE NORWEGIAN SEA.

BY

HERCULES TORNØE.

WITH 3 WOODCUTS AND 3 MAPS.

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I. Om Luften i Søvandet.

Allerede i lange Aarrækker har der fra Tid til anden af forskjellige Chemikere været foretaget Experimenter i den Hensigt at studere Forholdene ved den atmosphæriske Lufts Absorbtion af de Vædsker, hvormed den i Naturen kommer i Berøring, men det er dog først i de seneste Aar, at dette Spørgsmaal har været gjort til Gjenstand for mere omfattende Undersøgelser, hvad angaar Søvandet i de aabne Have. Rigtignok foreligger der ogsaa fra ældre Tider enkelte Opgaver over Sammensætning og Mængden af den i Søvandet opløste Luft, men disse ere for det Meste bundne til nogle ganske faa Puncter af Kysterne, og der, hvor Forsøgene ogsaa omfatte Vandprøver fra det aabne Hav, er der ofte saameget at indvende mod Materialets Indsamling og Opbevaring, at man, selv om Intet maatte være at udsætte paa Methoderne til dets Undersøgelse, ikke kunde sætte disse i Klasse med de med vore Tiders fuldkomnere Hjælpemidler udførte Observationer.

Naar saaledes vort Kjendskab til Fordelingen af Luften i Verdenshavene specielt for de store Dybs Vedkommende lige til de seneste Aar maa siges at have været meget mangelfuldt, da maa Grunden hertil søges i de mange Vanskeligheder, som man allevegne møder, naar man vil undersøge disse Spørgsmaal. Hvor det gjælder at bestemme Sammensætningen af den atmosphæriske Luft, giver Luftens Letbevægelighed Ret til af Undersøgelser udførte paa faa Puncter at slutte til den hele Atmosphære, hvad der imidlertid ikke er Anledning til for Søvandets Vedkommende. Der fordrer Havenes langt ringere Bevægelighed et større Antal Observationer, idet der her maa stilles meget strengere Fordringer til den geografiske Udbredning. Enten maatte altsaa Vandprøver hjemføres fra fjerne Farvande, saaledes at de ved en længere Tids Henstand udsatte for allehaande fremmed Indvirkning kunde blive aldeles ubrugbare, eller Analytikeren maatte, udsat for alle de Ulemper, som et Skibs Bevægelser medfører for videnskabelige Undersøgelser, forsøge bedst muligt at udføre sine Observationer ombord. Men selv naar der hos mange Chemikere fra ældre Tider kan have været Interesse for ved Undersøgel-

I. On the Air in Sea-Water.

Experiments have long since been instituted, from time to time, by divers chemists, with the object of investigating the absorption of atmospheric air by the fluids with which in the course of nature it comes in contact; but not till of late years has this phenomenon been made the subject of exhaustive treatment in its relation to ocean-water. True, there do exist comparatively early statements respecting the amount and composition of the air present in sea-water, but the great majority of such are confined to a very few coastal localities; and when, as was sometimes the case, the samples of sea-water examined had been drawn from the open sea, the mode of collecting and preserving them was frequently so open to objection that, even assuming the methods adopted for their examination to have been in every respect trustworthy, these early experiments will not bear comparison with those of modern date, performed with the far superior apparatus since devised.

Our knowledge therefore, till but a few years since, of the distribution of air in ocean-water, must be said to have continued very imperfect; and the reason is found in the numerous difficulties everywhere encountered when proceeding to investigate so intricate a subject. From the great mobility of the atmosphere, experiments in a few localities only will suffice to determine the general composition of air; but with sea-water the case is different. Water being far less fluid than air, many observations are obviously needed, since the greatest importance must be attached to geographical position. Hence, samples of sea-water had to be brought home from distant regions, and in that case, by being allowed to stand over for a comparatively long period, left exposed to all manner of disturbing influences; or the observations were taken on board, and experiments performed to the best of the analyst's ability, in spite of the numerous drawbacks entailed by the motion of the vessel. But, though many of the earlier chemists would, when at sea, no doubt have felt an interest in contributing to solve the problem of the distribution of air in the water of the ocean, they almost inva-

ser paa Reiser at give Bidrag til Løsningen af Spørgsmaalet om Fordelingen af Luften i Havet, da har Anledningen dertil næsten bestandig manglet. Først ved de i de senere Tider hyppigt udsendte Expeditioner, hvormed der har været givet Chemikere Anledning til at medfølge, har det været muligt mere detailleret at studere disse Ting. Ved disse Expeditioner har Formaalet udelukkende været videnskabelig Undersøgelse af Havet, og der har derfor med Hensyn paa Udrustningen altid været lagt megen Vind paa ved hensigtsmæssige Foranstaltninger og omhyggelige Forberedelser at fremme dette Formaal saa meget som muligt, og det er derfor klart, at disse Expeditioner maa have den største Betydning for den chemiske Undersøgelse af Havene specielt, hvor Talen er om saadanne Observationer, der ligesom Bestemmelser af Gasarterne ikke taale Opsættelse, men nødvendigvis maa udføres øieblikkelig efter at Vandprøven er øst. Saaledes maa aabenbart de under disse Omstændigheder udførte Observationer faa størst Vægt, hvor det dreier sig om at skaffe Oplysninger om Gasarterne i Søvandet, udenat det dog derfor vil findes paa urette Plads her at give en kort Oversigt ogsaa over de herover udførte ældre Undersøgelser.

De tidligste Undersøgelser, der mig bekjendt ere gjorte over Luften i Søvandet, udførtes i 1838 af Frémy[1] paa nogle Vandprøver, der over et Aar forud vare bleven optagne paa den franske Expedition med 'La Bonite' i 1836 og 37. Vandprøverne bestode dels af Overfladevand, dels af Vand fra forskjellige Dyb indtil 450 franske Favne og vare optagne med et af Biot opfundet Apparat.[2]

Ved Analysen af den udkogte Gas absorberede Frémy Kulsyren med Kalilud og Surstoffet med Phosphor. Resultaterne ansaaes allerede af Frémy selv for upaalidelige og de staa saa bestemt i Strid med alle nyere Angivelser, at man med temmelig stor Sikkerhed kan antage, at det lange Tidsrum mellem Vandprøvernes Øsning og deres Undersøgelse har gjort dem fuldstændig ubrugbare.

I 1843 udførte Morren[3] nogle Undersøgelser af Overfladevandet ved Saint-Malo nærmest i den Hensigt at paavise Sollysets Indflydelse paa den relative Sammensætning af den af Vandet absorberede Luft. Han kom i den Henseende til det Resultat, at Surstofmængden fandtes størst og Kulsyremængden mindst ved klart Sollys, hvorimod omvendt Surstofmængden fandtes mindst og Kulsyremængden størst ved mørkt overskyet Veir. Vandprøverne undersøgtes ikke paa Stedet, men sendtes til Rennes, hvor de af Morren udkogtes i Kolber paa 4.5 Litre. Den udkogte Gas lededes gjennem Kautschukledning over i en Flaske, hvori Gasarterne opsamledes over Vand. Ved Analysen af Gasen anvendte han til Absorbtion af Kulsyren Kalilud og for-

[1] Compt. rend. 6 — 616.
[2] Pogg. Ann. 37 — 416.
[3] Ann. Chim. Phys. [3] — 12 — 5.

riably lacked the means. Not till chemists had been sent out on the numerous Expeditions dispatched of late years to all quarters of the globe, was it possible to study this subject in detail. The sole object of such Expeditions having been the scientific investigation of the ocean, they were naturally fitted out with the greatest possible care, being furnished with the latest and most improved apparatus, and every necessary aid and appliance. It is obvious, therefore, that these Expeditions must largely contribute to our chemical knowledge of the ocean, more particularly with regard to observations which, like the determination of gaseous bodies, will not brook delay, but must be taken immediately the sample of water has been drawn. Hence, very great weight should be attached to observations instituted under such circumstances, viz. those that relate to the determination of gaseous bodies in sea-water. It will not, however, be out of place, briefly to notice some of the earlier observations undertaken with that object in view.

The earliest experiments, so far as I am aware, relating to the air in sea-water, were instituted in 1838, by Frémy,[1] with samples of water drawn more than a year before on the French Expedition with the 'Bonite,' in 1836 and 1837. These samples of water consisted partly of surface-water, partly of water from various depths, the greatest being 450 French fathoms; and were collected with an apparatus devised by Biot.[2]

When analysing the gas driven off, the carbonic acid was absorbed in a lye of potash, the oxygen being consumed with phosphorus. But Frémy himself did not regard as trustworthy the results of this process; and they have proved so decidedly at variance with those of all later observations, that his samples of water, owing to the length of time for which they had been preserved previous to examination, had no doubt become utterly worthless for experimental purposes.

In 1843, Morren[3] instituted a series of experiments with surface-water, near St. Malo, chiefly with the object of determining the influence of solar light on the composition of the air absorbed by sea-water. He found the proportion of oxygen to be greatest, and that of carbonic acid least, in bright weather; whereas the proportion of oxygen was least, and that of carbonic acid greatest, with a dark, cloudy sky. The samples of water were not examined on the spot, but taken to Rennes, and there boiled by Morren, in matrasses containing 4.5 litre. The gas driven off during the process was conducted through a caoutschouc tube into a phial, and there collected over water. When analysing the gas, Morren used a lye of

[1] Compt. rend. 6, p. 616.
[2] Pogg. Ann. 37, p. 416.
[3] Ann. Chim. Phys. [3], 12, p. 5.

brændte Surstofgasen med overskydende Vandstof. Han brugte ogsaa her som Spærrevædske Vand, som paa Forhaand var mættet med Luft, og det kan saaledes ikke forundre, at de Resultater, han erholdt, vise temmelig betydelige Afvigelser. Surstofmængden varierer saaledes fra 39.5 til 31.0 og udgjør i Middel 34.7 % af den samlede Surstof-Kvælstofmængde, medens denne varierer mellem 20.0 og 30.5 og i Middel udgjør 24.5 CC. pr. Litre af det udkogte Vand. Som man heraf ser, svarer den midlere Surstofprocent meget nøie med det af Bunsen senere for destilleret Vand opstillede Tal, hvorimod de Tal, Morren opfører som Udtryk for den samlede Surstof-Kvælstofmængde, ingen nøiagtig fixeret Betydning have, da han intetsteds angiver den Barometerstand og Temperatur, hvortil han har reduceret sine Gasvolumina.

Nogle Aar senere i 1846 gjenoptog Lewy[1] Morrens Undersøgelser paa nogle Vandprøver, som han øste ved Langrune i Nordost for Saint-Malo, og anvendte for at kunne sammenligne sine Resultater med Morrens nøiagtig den af ham beskrevne Arbeidsmethode. Hans Resultater vise ogsaa, naar man tager Hensyn til, at Vandprøverne alle skrive sig fra samme Sted, ikke ubetydelige om end meget mindre Afvigelser, som han ligesom Morren tilskriver Sollysets Indflydelse. Surstofmængden varier hos ham fra 35.4 til 32.4 og udgjør i Middel 33.6 % af den samlede Surstof-Kvælstofmængde, som gjennemsnitlig beløber sig til 17.3 CC. pr. Litre og ikke overskrider Grændserne 18.9 og 16.3. Heller ikke Lewy har nærmere fixeret Betydningen af de opførte Gasvolumina. Der har forresten i hans Tabel indsneget sig meningsforvirrende Regnefeil, som har givet Anledning til, at han er bleven misforstaaet.

I 1851 har endvidere A. Hayes[2] offentliggjort nogle Udtalelser om Fordelingen af Luften i Søvandet dog uden at vedføie sine Originalobservationer. Ifølge ham findes i Vand fra større Dyb altid en betragtelig mindre Mængde Surstof end i Overfladevandet, en Regel, som overalt holdt stik saavel i den hede som tempererede Zone, naar undtages i Golfstrømmen, hvor den stærke Bevægelse i Vandet kunde antages at forstyrre den almindelige Ligevægt. Han fandt ogsaa efter Storme en betydelig større Surstofmængde i Overfladevandet.

I 1855 udførte M. F. Pisani[3] nogle Undersøgelser af Saltene i Overfladevandet ved Bujuk-Déré og bestemte samtidig de i Vandet indeholdte Gasarter. Resultaterne findes sammenstillede i nedenstaaende Tabel, hvor Volumet er reduceret til 0^0 og 766^{mm} Tryk og udtrykt som CC. pr. Litre Vand.

[1] Ann. Chim. Phys. [3] — 17. Ann. Chem. Pharm. 58 — 326.
[2] Sillim. Amer. Journ. [2] — 11 — 241.
[3] Compt. rend. 41 — 532.

potash for absorbing the carbonic acid, and consumed the oxygen with a surplus of hydrogen. Here, too, the confining fluid was water, previously saturated with air; and hence it is not surprising, that the results obtained should have been found to vary considerably. Thus, for instance, the amount of oxygen varies between 39.5 and and 31.0 per cent, the mean proportion being 34.7 of the total amount of oxygen and nitrogen; while the latter ranges from 20.0 to 30.5, giving a mean proportion of 24.5cc per litre. The mean percentage of oxygen agrees, therefore, very closely with the proportion afterwards found by Bunsen for distilled water; whereas no definite importance can be attached to Morren's figures representing the total amount of oxygen and nitrogen, since that observer does not anywhere state to what temperature and atmospheric pressure he had reduced the volume of the gas.

Some years after, in 1846, Lewy[1] repeated Morren's experiments, with samples of water drawn at Langrune, north-east of Saint-Malo, adopting, the better to compare his results with those of Morren, precisely the same mode of operation. The results obtained by this chemist, seeing that the samples of water were all of them from the same locality, vary, too, considerably, though by no means to the same extent, — which he, in common with Morren, ascribes to the influence of solar light. The amount of oxygen ranges from 35.4 to 32.4—33.6 per cent, being the mean proportion of the total amount of oxygen and nitrogen, which averages 17.3cc per litre, having in no case passed the limits 18.9 and 16.3. Lewy, too, omits to give the factors determining the volume of the gas. Moreover, divers perplexing errors have slipped into his Table; and hence he has been misunderstood by some.

In 1851, A. Hayes[2] published a paper on the distribution of air in sea-water, without however embodying his original observations. According to the observations of that chemist, the amount of oxygen in water drawn from great depths is always appreciably less than that in surface-water, a rule which holds good for all seas both of the torrid and the temperate zones, with the exception of the Gulf Stream, where the strong current may be supposed to exert a disturbing influence. After a heavy gale of wind, too, the proportion of oxygen in the surface-water was found to be much greater.

In 1855, M. F. Pisani[3] instituted a series of observations near Bujuk-Déré on the salts in surface-water, and also determined the gaseous bodies it contained. His results are given in the following Table, the volume being reduced to a temperature of 0^0 and a pressure of 760^{mm}, expressed in cubic centimetres per litre.

[1] Ann. Chim. Phys. [3], 17; Ann. Chem. Pharm. 58, p. 326.
[2] Sillim. Amer. Journ. [2], 11, p. 241.
[3] Compt. rend. 41, p. 532.

$O + N$ pr. Litre		16.0	16.2
$O + N = 100$	O %	31.4	33.2
	N %	68.5	66.8

I Aaret 1869 udgik fra England Porcupineexpeditionen, hvor der for første Gang foruden de øvrige videnskabelige Arbeider ogsaa foresloges udført mere omfattende chemiske Undersøgelser. Man besluttede her at benytte den udmærkede Anledning til ved talrige Forsøg saavel med Overfladevand som Vand fra større Dyb at skaffe sig Oplysning om de Fluctuationer, som optræde saavel i de absolute som relative Mængder af de i Søvandet opløste Gasarter. Forat undgaa de Feil, som nødvendigvis maatte indsnige sig, naar de til Gasanalyser bestemte Vandprøver opbevaredes i længere Tid før Undersøgelsen, bestemte man sig her for den Udvei at foretage Gasanalyserne ombord. Til Optagelse af de fra større Dyb stammende Vandprøver benyttedes en meget simpel Vandhenter bestaaende af en hul Metalcylinder med letbevægelige opadslaaende Keglеventiler, et Apparat, hvis Paalidelighed senere Undersøgelser giver Anledning til at betvivle. Udkogningen og Opsamlingen af Gasarterne foretoges i alt Væsentligt som ved de tidligere beskrevne Forsøg, og anvendtes under Analysen til Absorbtion af Kulsyre og Surstof Kalihydrat og pyrogallussur Kali. Det siger sig selv, at de paa denne Maade erholdte Resultater maatte være behæftede med meget betydelige Observationsfeil, hvad der ogsaa tydeligst vises af de store Afvigelser mellem de af forskjellige Observatorer efter denne Fremgangsmaade udførte Bestemmelser. Som Udtryk for Sammensætningen af den af Overfladevandet udkogte Luft fandt nemlig de tre Chemikere, som paa de tre Togter, hvori denne Expedition deltes, efter hinanden udførte de chemiske Arbeider, følgende Tal:[1]

W. L. Carpenter . . . . 31.6 % *O* mod 68.4 % *N*.
Hunter . . . . . 36.4 - *O* - 63.6 - *N*.
P. Herbert Carpenter . . . 30.5 - *O* - 69.5 - *N*.

Dette er kun de af de enkelte Observationer udledede Middelværdier, men, som man ser, er allerede Afvigelserne mellem disse overmaade store, medens de enkelte Bestemmelser, som ikke findes opførte, varierer mellem langt videre Grændser. Saaledes opføres som Ydergrændser for Variationerne af Surstofmængden i Overfladevandet Maximum 45.3 og Minimum 14.0 % af den samlede Gasmængde, Kulsyren iberegnet.

Porcupineexpeditionens Chemikere ansaa selv sine Resultater upaalidelige, dog mindre paa Grund af Mangler ved Arbeidsmethoderne, end fordi den af dem benyttede Vandhenter tillod Undvigelsen af den Luft, som de mente kunde udvikle sig, naar Vandet fra de større Dyb naaede op til det ved Overfladen herskende mindre Tryk. De tog forresten sin Tilflugt ogsaa til andre Midler for at forklare

[1] Proc. Roy. Soc. 18 — 397.

$O + N$ pr. Litre		16.0	16.2
$O + N = 100$	O p.ct.	31.4	33.2
	N p.ct.	68.5	66.8

In the year 1869, the 'Porcupine' Expedition was dispatched by the British Government, and it was now proposed, for the first time, to institute a series of chemical experiments on a more comprehensive scale than any hitherto performed. By taking advantage of this excellent opportunity to examine numerous samples of sea-water, both from the surface and from great depths, the fluctuations that occur alike in the absolute and the relative amounts of gaseous bodies in ocean-water might be effectively investigated. In order to guard against the error that must necessarily arise when the samples of water are preserved for any length of time previous to examination, it was resolved to undertake all analyses of gas on board. For obtaining samples of water from great depths, a very simple instrument was used, consisting of a hollow metal cylinder, furnished with conical-shaped valves, opening above, an apparatus the trustworthiness of which subsequent experiments have shown reason to doubt. The gas was boiled out and collected by a process essentially similar to that adopted for the experiments previously described, the carbonic acid and the oxygen having been absorbed by hydrate of potash and pyrogallic acid. As a matter of course, very considerable errors of observation would attach to results obtained by this method, the best proof of which lies in the extent to which the determinations of different observers performed by this mode of operation are found to vary. For instance, the three chemists who successively accompanied the Expedition on the three voyages into which it was divided, express the composition of the air boiled out of surface-water by the following figures:[1] —

W. L. Carpenter . . . 31.6 p.ct. *O* and 68.4 p.ct. *N*.
Hunter . . . . . 36.4 - *O* - 63.6 - *N*.
P. Herbert Carpenter . 30.5 - *O* - 69.5 - *N*.

These amounts, however, are the mean values deduced from the several observations, and yet they vary exceedingly; the individual determinations, which are not given, must obviously have ranged between far wider limits. Thus, the extreme limits between which the amount of oxygen was found to vary in surface-water, is stated to have been 45.3 (maximum) and 14.0 (minimum) per cent of the total amount of gas, including the carbonic acid.

The chemists who accompained the 'Porcupine' Expedition did not even themselves regard the results obtained as trustworthy, less however on the ground of possible defects in the modes of operation, than because the the apparatus used for collecting the water admits of the escape of air which, in their opinion, may be liberated on water drawn from great depths reaching the surface, where the atmos-

[1] Proc. Roy. Soc. 18, p. 397.

de observerede store Afvigelser, saaledes tilskreves stærke Bevægelser af Havoverfladen enten ved Storme eller paa anden Maade den Evne at forøge Surstofmængden og forringe Kulsyremængden, ligesom rigt Dyreliv ogsaa tilskreves en meget stor Indflydelse paa Sammensætningen af den i Søvandet opløste Luft.

I 1871 udgik atter igjen denne Gang fra Tyskland en Expedition til Undersøgelse af Østersøen, hvormed som Chemiker fulgte Dr. O. Jacobsen. Med Resultaterne af de fra de tidligere Expeditioner hidrørende Gasbestemmelser for Øie besluttede han sig hverken for den ene eller den anden af de ved Bonite eller Porcupineexpeditionen anvendte Fremgangsmaader men slog ind paa en Middelvei, den eneste, som i dette Tilfælde kunde føre til paalidelige Resultater.

Han delte Undersøgelserne i to Dele og udførte den uopsættelige Del af dem nemlig Gasarternes Udkogning strax, medens han, indseende Umuligheden af at udføre tilfredsstillende Gasanalyser ombord paa et Fartøi i aaben Sø, opsatte deres nærmere Undersøgelse til Hjemkomsten. Desværre gav Mangelen af en til Optagelse af Dybvandsprøver egnet paalidelig Vandhenter Anledning til, at det 1ste Aars Udbytte af denne Expedition for Gasanalysernes Vedkommende reducerede sig til blot og bart Indsamling af den Erfaring, som senere skulde komme til Anvendelse ved det Aaret efter foretagne Togt i Nordsøen. Manglerne ved den paa Porcupineexpeditionen benyttede Vandhenter havde nemlig bevæget Jacobsen til ogsaa til Øsning af de for Gasanalyser bestemte Vandprøver at benytte en Vandhenter, der nedsænkedes fyldt med Luft. Naar nu Apparatet i Dybet aabnedes, absorberedes under det der herskende store Tryk momentant en Del af den nedbragte atmosphæriske Luft, hvorved de paa disse Vandprøver udførte Gasanalyser bleve saa upaalidelige, at der ikke engang værdigedes dem en Offentliggjørelse.

De paa Østersøtogtet i 1871 indhøstede Erfaringer, muliggjorde det imidlertid for Jacobsen ved en omhyggelig Forberedelse til den i 1872 foretagne Expedition i Nordsøen at overvinde eller omgaa de Vanskeligheder, som havde bevirket Manglerne ved de paa Porcupineexpeditionen foretagne Undersøgelser, og det lykkedes ham denne Gang som Resultat af sine Arbeider at offentliggjøre en Afhandling,[1] som giver en Række af vore Tiders Fordringer strengt tilfredsstillende Oplysninger om Luften i Søvandet. Til Optagelse af de til Gasanalyser bestemte Vandprøver fra Dybet tjente paa Nordsøtogtet et af Dr. H. A. Meyer angivet Apparat[2] bestaaende af en tung Metalcylinder, som ved Udløsning i det bestemte Dyb faldt ned over to vel islebne koniske Ventiler, og derved afspærrede det mellem disse

[1] Ann. Chem. Pharm. 167 — 1; Jahresbericht der Commission zur wissenschaftlichen Untersuchung der deutschen Meere in Kiel, 1872—73 — 43.

[2] Jahresbericht der Commission zur wissenschaftlichen Untersuchung der deutschen Meere in Kiel 1872—73 — 5.

pheric pressure is less. But they had recourse to other means whereby to explain the great differences observed, ascribing to the state of violent agitation into which the surface of the ocean is thrown by heavy storms, or to some other adequate cause, the ability of increasing the proportion of oxygen and diminishing that of carbonic acid; an abundance of animal life, too, was believed to exert very great influence on the composition of the air absorbed in sea-water.

In 1871, an Expedition was despatched from Germany for the investigation of the Baltic, Dr. O. Jacobsen accompanying it as chemist. Warned by the unsatisfactory results of former gas-analyses, he resolved to adopt neither of the methods resorted to on the 'Bonite' and 'Porcupine' Expeditions, but rather to take a middle course, which indeed held out the only prospect of success.

Accordingly, he divided his observations. Experiments admitting of no delay, such as boiling off the gas, were performed at once, whereas all analyses of gas, impossible as it is found to operate satisfactorily on board a vessel in the open sea, were deferred till his return home. Unfortunately, the want of a trustworthy apparatus for collecting samples of water from great depths, confined the results obtained on the first voyage of the Expedition, as regards analyses of gas, to the mere acquisition of experience, which, however, there was ample opportunity of applying on the cruise undertaken the following year in the North Sea. The defective construction of the instrument employed for collecting water on the 'Porcupine' Expedition had induced Jacobsen to make use of an apparatus which, even when drawing water for gas-analyses, was sunk full of air. Now, on opening this apparatus at the required depth, some portion of the air it contains will, by reason of the great pressure, be momentarily absorbed; and hence all analyses of gas with such samples of water proved to that extent defective as to be not even deemed worthy of publication.

Meanwhile, taking advantage of the experience acquired in 1871 on the cruise in the Baltic, Dr. Jacobsen succeeded, after careful preparation to meet the requirements of the Expedition undertaken in 1872 to the North Sea, in surmounting or evading the difficulties experienced on the 'Porcupine' Expedition, and was enabled, as the result of his labours, to publish a treatise[1] on the air present in sea-water recording a series of eminently satisfactory results. For collecting samples of water wherewith to undertake analyses of gas in water from the bottom, or from great depths, an apparatus, described by Dr. H. A. Meyer, was made use of on the cruise in the North Sea.[2] It consists of a heavy metal cylinder, which, at the required depth, will drop down on two accurately fitted conical valves, cutting off all com-

[1] Ann. Chem. Pharm. 167, p. 1; Jahresbericht der Commission zur wissenschaftlichen Untersuchung der deutschen Meere in Kiel, 1872—73, p. 43.

[2] Jahresbericht der Commission zur wissenschaftlichen Untersuchung der deutschen Meere in Kiel, 1872—73, p. 5.

beliggende Vandlag. Udløsningen foregik enten ved Apparatets Anslag mod Bunden eller i intermediære Dyb ved et langs Linen nedsænket Lod.

Ved Uddrivelsen af de i Vandet indeholdte Gasarter anvendte Jacobsen Bunsens Princip, idet Vandet kogtes i

munication with the outside water. The detachment was effected either by the instrument striking the bottom, or, at intermediate depths, by running a weight down the line.

For expelling the gas contained in the water, Jacobsen made choice of Bunsen's method, boiling the water in

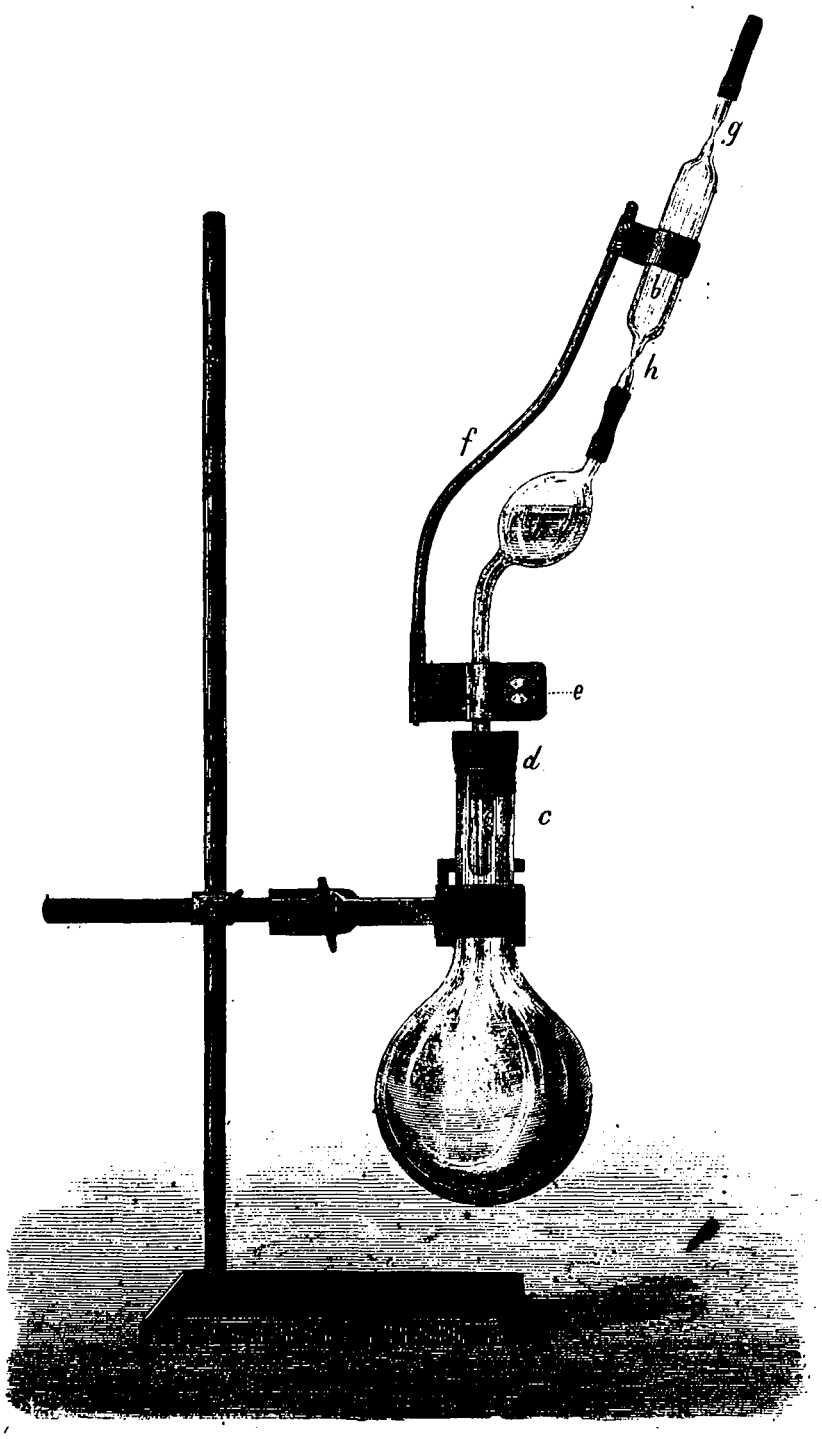

Fig. 1.

et ved Vanddamp frembragt Vacuum, og construerede i Forbindelse med Dr. H. Behrens i dette Øiemed et Apparat, som i Simpelhed og Paalidelighed Intet lader tilbage at ønske. Apparatet, som findes afbildet i Figur 1, har af Jacobsen faaet følgende Beskrivelse:

a vacuum created by steam; and to meet the requirements of this process, he devised, with the assistance of Dr. H. Behrens, an apparatus which in trustworthiness and simplicity of construction leaves nothing to be desired. This apparatus, of which a drawing is given in Fig. 1, Dr. Jacobsen has described as follows: —

"Die Siedekugel *a* läuft in ihrem unteren Theil in ein starkwandiges, genau cylindrisches Glasrohr aus, welches unten zugeschmolzen, aber bei *c* mit einer seitlichen Oeffnung versehen ist. Je nachdem diese Oeffnung bis unter den Kautschukpfropfen *d* hinabgedrückt oder bis in seine Durchbohrung heraufgezogen wird, ist die Siedekugel mit dem Innern des Wasserkolbens in Verbindung oder gegen dasselbe abgeschlossen. Das Glasrohr muss sich in der glatten Durchbohrung des Kautschukpfropfens mit Reibung auf- und niederbewegen, diese Reibung darf aber nicht so stark sein, wie die zwischen dem Pfropfen und dem cylindrischen Kolbenhals. Ist einmal ein fehlerfreier Pfropfen aus vulkanisirtem Kautschuk den Glastheilen des Apparates auf das Sorgfältigste angepasst, so kan diese Ventilvorrichtung unbegrenzt lange benuzt werden, ohne von ihrer völligen Zuverlässigkeit einzubüssen.

Das Gassammelrohr *b* ist durch ein kurzes Kautschukröhrchen mit der Siedekugel verbunden und zwischen die federnden Arme des messingenen Halters *f* eingeklemmt. Das untere Ende dieses Halters trägt eine weit stärkere Klammer, deren Korkfütterung durch die starche Schraube *e* sehr fest um das Rohr der Siedekugel gepresst wird, so dass man, am unteren Theil des Halters anfassend, Siedekugel und Sammelrohr in dem Kautschukpfropfen auf- und niederschieben und damit die Oeffnung *c* beliebig verlegen kann.

Der Rauminhalt der Siedekugel beträgt etwas mehr als das Doppelte von dem Volumen, um welches sich die auszukochende Wassermenge beim Erwärmen auf 100° ausdehnt.

Bei der Benutzung des Apparates füllt man zunächst die schon im Pfropfen steckende und in den Halter eingeklemmte Siedekugel zur Hälfte mit Wasser und schiebt den Pfropfen über die seitliche Oeffnung. Man füllt nun die Kochflasche durch ein bis auf ihren Boden reichendes Gummirohr direct aus dem Schöpfapparat bis zum Ueberlaufen mit dem auszukochenden Wasser und setzt, nachdem die Oeffnung *c* bis eben unter den Kautschukpfropfen verschoben ist, diesen sehr fest in den Hals der Kochflasche ein. Zieht man nun die Siedekugel bis zur Herstellung des Verschlusses in die Höhe, so entsteht dadurch in der Kochflasche ein kleines Vacuum, in welches sofort Gasbläschen aus dem Wasser aufsteigen. Es wird dadurch Raum geschafft für die Ausdehnung, welche das oft sehr kalte Wasser schon in den ersten Augenblicken durch die höhere Temperatur der umgebenden Luft erfährt, Man fügt nun das Sammelrohr an, über dessen beide Enden vorher kurze Gummiröhren gezogen sind, stelt die Kochflasche in ein Wasserbad, erhitzt das Wasser in der Siedekugel durch eine darunter angebrachte Weingeistflamme und erhält es im Sieden, bis man der vollständigen Austreibung der Luft aus dem Sammelrohr gewiss sein kann. In dem Augenblick, in welchem man mit der rechten Hand die Flamme entfernt, kneift man mit der linken das Ende des oberen Gummirohrs zu, verschliesst es darauf durch Hineinstecken der abgerundeten Spitze eines passenden Glasstäbchens und schmilzt sofort bei *g* ab.

"Die Siedekugel *a* läuft in ihrem unteren Theil in ein starkwandiges, genau cylindrisches Glasrohr aus, welches unten zugeschmolzen, aber bei *c* mit einer seitlichen Oeffnung versehen ist. Je nachdem diese Oeffnung bis unter den Kautschukpfropfen *d* hinabgedrückt oder bis in seine Durchbohrung heraufgezogen wird, ist die Siedekugel mit dem Innern des Wasserkolbens in Verbindung oder gegen dasselbe abgeschlossen. Das Glasrohr muss sich in der glatten Durchbohrung des Kautschukpfropfens mit Reibung auf- und niederbewegen, diese Reibung darf aber nicht so stark sein, wie die zwischen dem Pfropfen und dem cylindrischen Kolbenhals. Ist einmal ein fehlerfreier Pfropfen aus vulkanisirtem Kautschuk den Glastheilen des Apparates auf das Sorgfältigste angepasst, so kan diese Ventilvorrichtung unbegrenzt lange benutzt werden, ohne von ihrer völligen Zuverlässigkeit einzubüssen.

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Bei der Benutzung des Apparates füllt man zunächst die schon im Pfropfen steckende und in den Halter eingeklemmte Siedekugel zur Hälfte mit Wasser und schiebt den Pfropfen über die seitliche Oeffnung. Man füllt nun die Kochflasche durch ein bis auf ihren Boden reichendes Gummirohr direct aus dem Schöpfapparat bis zum Ueberlaufen mit dem auszukochenden Wasser und setzt, nachdem die Oeffnung *c* bis eben unter den Kautschukpfropfen verschoben ist, diesen sehr fest in den Hals der Kochflasche ein. Zieht man nun die Siedekugel bis zur Herstellung des Verschlusses in die Höhe, so entsteht dadurch in der Kochflasche ein kleines Vacuum, in welches sofort Gasbläschen aus dem Wasser aufsteigen. Es wird dadurch Raum geschafft für die Ausdehnung, welche das oft sehr kalte Wasser schon in den ersten Augenblicken durch die höhere Temperatur der umgebenden Luft erfährt. Man fügt nun das Sammelrohr an, über dessen beide Enden vorher kurze Gummiröhren gezogen sind, stellt die Kochflasche in ein Wasserbad, erhitzt das Wasser in der Siedekugel durch eine darunter angebrachte Weingeistflamme und erhält es im Sieden, bis man der vollständigen Austreibung der Luft aus dem Sammelrohr gewiss sein kann. In dem Augenblick, in welchem man mit der rechten Hand die Flamme entfernt, kneift man mit der linken das Ende des oberen Gummirohrs zu, verschliesst es darauf durch Hineinstecken der abgerundeten Spitze eines passenden Glasstäbchens und schmilzt sofort bei *g* ab.

Nachdem nun die Oeffnung *c* bis eben unter den Pfropfen hinabgeschoben ist, wird das Wasserbad erwärmt und der Inhalt des Kolbens in heftigem Sieden erhalten. Nach einiger Zeit hat sich im oberen Theil des Kolbenhalses ein freier Raum gebildet, in welchen die Dampfblasen mit Geräusch hineinschlagen. Man bringt durch Entfernen der Wärmequelle oder durch kurzes Heraushеben des Apparates aus dem Wasserbade das Wasser aus der Siedekugel in den Kolben zurück und wiederholt dieses Erwärmen und theilweise Abkühlen des Kolbenhalses noch zweimal, wodurch binnen verhältnissmässig kurzer Zeit eine sehr vollständige Austreibung der Luft bewirkt wird.

Es ist sehr leicht, schliesslich das Wasser bis zur vollständigen Anfüllung der Siedekugel steigen zu lassen, worauf man durch Aufziehen derselben den Verschluss herstellt und das Sammelrohr nun auch bei *h* abschmilzt.

Das Sammeln der Gase mittelst dieses Apparates machte auch bei ziemlich stark bewegter See keine Schwierigkeit.

Gewöhnlich wurden 900 CC Wasser zur Auskochung verwendet."

Ved Hjælp af dette Apparat indsmeltede Jacobsen paa Nordsøtogtet 73 Luftprøver, som efter Hjemkomsten analyseredes efter Bunsens Methode, idet Kulsyren fjernedes med Kali og Surstoffet bestemtes ved Forbrænding med overskydende Vandstof. Han sammenstiller sine Resultater i en Tabel, hvor han i Modsætning til de tidligere Forfattere betragter den kulsyrefrie Luft og Kulsyren hver for sig,[1] saaledes beregnes Surstof og Kvælstofmængderne som Procenter af den kulsyrefrie Luft, der opføres som CC pr. Litre udkogt Vand reduceret til 0° og 760^{mm} Tryk. Ifølge denne Tabel hersker der en ganske mærkelig gjennemført Ensartethed i Sammensætningen af den Luft, der er uddrevet af de Vandprøver, som have befundet sig under samme physikalske Forholde, saaledes ligger Surstofprocenten i alle de 24 Luftprøver, som stamme fra Overfladevandet, tiltrods for at de skrive sig fra meget forskjellige Localiteter, mellem de meget snævre Grændser af 34.14 og 33.64, og naar denne Overensstemmelse ikke i samme Udstrækning er fundet at gaa igjen i de dybere Lag, da har dette sin Forklaring i en ujevn Circulation. Naar Surstofmængden overalt i Dybet er funden lig eller noget mindre end i Overfladen, da kan det vel ikke være tvivlsomt, at dette skriver sig fra Surstoffets Forbrug til Oxydation af de i Søvandet forekommende organiske Plante- og Dyrerester samt til Sødyrenes Aandeproces, saaledes som det af Jacobsen udtales med følgende Ord: "Der Zusammenhang dieses Unterschiedes ist leicht zu deuten. In dem schwereren Wasser, welches ohne erhebliche Beimischung aus höhe-

[1] Naar jeg her overalt har anvendt denne Jacobsens Fremstillingsmaade og ifølge denne omregnet de ældre Forfatteres Opgaver, hvor Gasmængderne overalt ere fremstillede som Procenter af den samlede Surstof-Kvælstof-Kulsyremængde, da vil Grunden hertil fremgaa af min senere Afhandling "Om Kulsyren i Søvandet."

Nachdem nun die Oeffnung *c* bis eben unter den Pfropfen hinabgeschoben ist, wird das Wasserbad erwärmt und der Einhalt des Kolbens in heftigem Sieden erhalten. Nach einiger Zeit hat sich im oberen Theil des Kolbenhalses ein freier Raum gebildet, in welchen die Dampfblasen mit Geräusch hineinschlagen. Man bringt durch Entfernen der Wärmequelle oder durch kurzes Heraushеben des Apparates aus dem Wasserbade das Wasser aus der Siedekugel in den Kolben zurück und wiederholt dieses Erwärmen und theilweise Abkühlen des Kolbenhalses noch zweimal, wodurch binnen verhältnissmässig kurzer Zeit eine sehr vollständige Austreibung der Luft bewirkt wird.

Es ist sehr leicht, schliesslich das Wasser bis zur vollständigen Anfüllung der Siedekugel steigen zu lassen, worauf man durch Aufziehen derselben den Verschluss herstellt und das Sammelrohr nun auch bei *h* abschmilzt.

Das Sammeln der Gase mittelst dieses Apparates machte auch bei ziemlich stark bewegter See keine Schwierigkeit.

Gewöhnlich wurden 900 CC. Wasser zur Auskochung verwendet."

With this apparatus Jacobsen collected on the cruise in the North Sea 73 samples of air, which, after the return of the Expedition, were analysed by Bunsen's method, potash being used for absorbing the carbonic acid, and the oxygen consumed with a surplus of hydrogen. His results are set forth in a Table, where, reversing the custom of earlier authors, he refers separately to the carbonic acid and the air free from that body;[1] thus, for instance, the respective amounts of oxygen and nitrogen will be found computed as percentages of the air free from carbonic acid, which is given in cc. per litre of the water examined, reduced to a temperature of 0° and a pressure of 760^{mm}. According to this Table, a truly remarkable uniformity prevails in the composition of the air expelled from samples of sea-water which have been exposed to the same physical influences; thus, for instance, the percentage of oxygen in the 24 samples of air derived from surface-water, was found, notwithstanding the collection of the latter in widely different localities, to range between the exceedingly narrow limits of 34.14 and 33.64; and though equal agreement does not extend to the deeper-lying strata, this may be accounted for by irregularity of circulation. That the amount of oxygen at the bottom, or in great depths, should invariably prove equal to, or somewhat less than, that at the surface, is a phenomenon the cause of which must unquestionably be ascribed to the consumption of that gas in the oxidation of organic remains, and for the support of the res-

[1] The reason that induced me to adopt exclusively Jacobsen's mode of representation, and by the standard of that process to recompute the results of earlier observers, who invariably give the proportions of the gases determined as percentages of the total amount of oxygen, nitrogen, and carbonic acid, will appear in my next Memoir on the carbonic acid present in sea-water.

ren Schichten sehr lange in der Tiefe verweilt, wird ohne genügenden Ersatz fortwährend Sauerstoff verbraucht zur Oxydation der im Wasser und besonders am Meeresgrunde vorhandenen oxydirbaren Stoffe, — in wahrscheinlich weit untergeordnetem Grade auch durch die Athmung der Thiere."

Men de herved foranlédigede Afvigelser ere ikke meget store, idet Surstofprocenten, bortseet fra nogle faa Undtagelser, ligger indesluttet mellem 30 og 34, saaledes at den som Regel aftager med Dybet.

Jacobsens Observationer, der vare udførte under de mest forskjelligartede Omstændigheder, vise ogsaa paa det Bestemteste, at de tidligere gjorte Antagelser, om at Sollyset og Stormene eller i det Hele taget de meteorologiske Forholde skulde spille nogen fremtrædende Rolle ligeoverfor den relative Sammensætning af Overfladevandsluften, vare fuldstændig ubegrundede, i ethvert Fald vise de store Overensstemmelser, at disse Factorers Indflydelse maatte være meget ringe.

Med Hensyn paa den absolute Mængde af den Luft, der indeholdes i de fra forskjellige Dyb optagne Vandprøver, da viser den sig at tiltage med Dybet, noget der imidlertid let lader sig forklare ved Temperaturens Aftagen med Dybet, uden at det er fornødent at tage sin Tilflugt til de store Tryk. Der blev ogsaa paa Pomeraniaexpeditionen for at bevise Urigtigheden af den tidligere paa flere Steder udtalte Formodning, om at Luftgehalten i de store Dyb skulde staa i Forhold til det der herskende større Tryk, foretaget specielle Experimenter med en af Dr. Behrens og Jacobsen construeret Vandhenter af Kautschuk. Denne sammenklemtes først mest muligt, hvorpaa den sidste Rest Luft uddreves af den ved Hjælp af Kviksølv, og nedsænkedes derefter fuldstændig lufttom og lufttæt igjenlukket. Først i Dybet ved Apparatets Anslag mod Bund aabnedes det, udspændtes og fyldtes med Vand, hvorpaa det atter lufttæt igjenlukket og fyldt med Vand ankom til Overfladen. Det viste sig altid, at de med dette Apparat optagne Vandprøver ikke indeholdt mere Luft, end de ved Vandprøvens Temperatur kunde holde opløst under almindeligt Atmosphæretryk. At dette maatte være saa, kunde man allerede være berettiget til at slutte af nogle Forsøg, som Aimé[1] i 1843 udførte. Han anvendte et i den ene Ende aabent Glasrør, som nedsænkedes fyldt med Kviksølv og i det bestemte Dyb vendtes omkring, hvorved Kviksølvet i Glasrøret delvis erstattedes af Vand paa en saadan Maade, at dette afspærredes af Kviksølvet, der optoges af en nedenunder anbragt passende Beholder. Som Resultat af de med dette Apparat udførte Forsøg udtalte Aimé den Sats, at den Mængde Luft, som indeholdtes i en bestemt Mængde Søvand, i alle Dyb var meget nær den samme.

[1] Ann. Chim. Phys. [3] — 7 — 497. Pogg. Ann. 30 — 412.

piratory process in marine animals, as stated by Dr. Jacobsen in the following words: — "Der Zusammenhang dieses Unterschiedes ist leicht zu deuten. In dem schwereren Wasser, welches ohne erhebliche Beimischung aus höheren Schichten sehr lange in der Tiefe verweilt, wird ohne genügenden Ersatz fortwährend Sauerstoff verbraucht zur Oxydation der im Wasser und besonders am Meeresgrunde vorhandenen oxydirbaren Stoffe, — in wahrscheinlich weit untergeordnetem Grade auch durch die Athmung der Thiere."

But the differences thus occasioned are not very great, since the percentage of oxygen, with but few exceptions, ranges from 30 to 34, as a rule diminishing with the depth.

Moreover, Jacobsen's observations, instituted under circumstances the most diverse, furnish incontestible proof, that the views of earlier authors, according to which the effect of solar light and storms, or indeed meteorological influence generally, was assumed to play an important part in modifying the composition of the air in surface-water, were wholly unfounded; nay, the extent to which the results based on that hypothesis are found to vary, will of itself show the comparative insignificance of such factors.

As regards the absolute amount of air contained in samples of water collected from different strata, this is found to increase with the depth, — a fact sufficiently obvious from the temperature diminishing as the depth increases, without needing to seek an explanation in the greater pressure. And with the object of showing that the proportion of air present in sea-water at great depths, is not, as assumed by some, to any appreciable extent dependent on the greater pressure prevailing there, a special series of experiments was instituted on the 'Pomerania' Expedition, with an apparatus for collecting water constructed of caoutschouc by Drs. Behrens and Jacobsen. This instrument was first pressed flat, and then sunk, after the air still remaining in it had been expelled by means of mercury, perfectly air-tight. On its striking the bottom, it opened and filled with water, after which it again closed, and was then brought up to the surface, air-tight as before. The samples of water collected in this apparatus were never found to contain more air than would be absorbed, with the same temperature, at the surface. That such must be the case, there was indeed reason to infer from the experiments instituted by Aimé[1] in 1843. Aimé made use of a glass tube, which, open at the upper extremity, was sunk full of mercury, and at the required depth inverted, causing part of the mercury in the tube to be replaced by water, in such manner that the mercury, flowing into a receiver of proper size and shape, prevented its escape. As the result of the experiments performed with this instrument, Aimé ventured to assume, that the proportion of air contained in a given quantity of sea-water, is at all depths very nearly the same.

[1] Ann. Chim. Phys. [3], 7, p. 497; Pogg. Ann. 30, p. 412.

I Aaret 1873 udgik atter fra England en Expedition, Challengerexpeditionen, som i et Tidsrum af 3 Aar skulde undersøge baade de æquatoriale og antarktiske Farvande. Med denne Expedition fulgte som Chemiker J. Y. Buchanan, som besluttede sig til at anvende de paa Pomeraniaexpeditionen benyttede Methoder og Apparater saa godt som uden Modifikationer. Resultaterne af hans Undersøgelser ere, saavidt jeg ved, endnu ikke offentliggjorte i sine Enkeltheder, medens der dog er gjort nogle foreløbige Meddelelser, hvorefter man vil kunne danne sig et Begreb om de Slutninger, hvortil hans Observationer ville føre.

Han finder[1], at Surstofmængden i Overfladevandet varierer mellem 33 og 35 % af den samlede Surstof-Kvælstofmængde, saaledes at den største Mængde er fundet (baade relativt og absolut) i Vandprøver øste i Nærheden af den sydlige Polarcirkel og den mindste i Pasatvindegnene. Hvad angaar de under Overfladen liggende Lag, da har han observeret det mærkelige Factum, at Surstofprocenten aftager nedover indtil et Dyb af 300 Favne, hvor den opnaar et Minimum for atter igjen at stige, saaledes som det fremgaar af følgende Tabel.

Dybde i engelske Favne.	0	25	50	100	200	300	400	800	Derover.
$O + N = 100$ O %	33.7	33.4	32.2	30.2	33.4	11.4	15.5	22.6	23.5

Om den absolute Mængde af de af hans Vandprøver udkogte Gasarter findes paa dette Sted Intet, hvorimod der senere er bleven offentliggjort følgende Tabel[2].

Dybde i Fod.	CC. O per Litre.	Midlere Temperatur i °C. t.	CC. N per Litre N_1.	CC. N per Litre destill. Vand ved Temperat. t. Bunsen N_2.	$N_2 - N_1$
600	4.24	14.°6	11.26	11.75	0.49
1200	3.59	13. 0	11.71	11.92	0.21
1800	1.67	6. 9	13.00	13.45	0.45
2400	2.41	5. 1	13.10	14.00	0.90
4800	4.06	2. 5	13.82	15.00	1.14
derover.	—	1. 5	14.37	15.40	1.03

Hermed er i Korthed gjengivet det Vigtigste af de til Dato fremkomne Bidrag til Løsningen af Spørgsmaalet om Luften i Søvandet.

I Vaaren 1876, da man i Norge var beskjæftiget med Udrustningen af den Expedition, som var besluttet udsendt for i Sommermaanederne af Aarene 1876—77 og 78 at

[1] The Voyage of the 'Challenger.' The 'Atlantic.' 2 — 366.
[2] Ber. Berl. chem. Ges. 11 — 410.

In the year 1873, another Expedition was dispatched, from England, with H. M. S. 'Challenger,' its object being the investigation, during a period of 3 years, both of the Equatorial and the Antarctic Seas. As chemist to this Expedition, had been secured the services of J. Y. Buchanan, who resolved to adopt the methods and apparatus employed on the 'Pomerania' Expedition, almost without modification. The results of his labours are not yet, I believe, published in detail; preliminary papers have, however, appeared, from which we can form some general idea of his results.

Buchanan found[1] the proportion of oxygen in surface-water to vary between 33 and 35 per cent of the total amount of oxygen and nitrogen; it was greatest (both relatively and absolutely) in the samples of water drawn near the Antarctic Circle, and smallest in those collected within the region of the trade winds. As regards the proportion of oxygen in water below the surface, he observed the very remarkable fact, that it generally diminishes down to a depth of 300 fathoms, where a minimum is reached, and then begins to increase, as shown by the following Table.

Depth in English Fathoms.	0	25	50	100	200	300	400	800	Greater Dpths.
$O + N = 100$ O p. ct.	33.7	33.4	32.2	30.2	33.4	11.4	15.5	22.6	23.5

With respect to the absolute amounts of the gases boiled out of the different samples of water, nothing is stated in the work alluded to, but the following Table[2] has since appeared.

Depth in Feet.	CC. O per Litre	Mean Temperature in C. t.	CC. N per Litre N_1.	CC. N per Litre distilled Water, at Temp. t. Bunsen N_2.	$N_2 - N_1$
600	4.24	14.°6	11.26	11.75	0.49
1200	3.59	13. 0	11.71	11.92	0.21
1800	1.67	6. 9	13.00	13.45	0.45
2400	2.41	5. 1	13.10	14.00	0.90
4800	4.06	2. 5	13.82	15.00	1.14
Greater Depths.	—	1. 5	14.37	15.40	1.03

A brief account has now been given of what had previously been accomplished as regards the solution of the problem presented by the air in sea-water.

In the spring of 1876, when fitting out the Norwegian Expedition, which had for its object the investigation, during the summer months of 1876, 1877, and 1878, of

[1] The Voyage of the 'Challenger.' The 'Atlantic,' 2, p. 366.
[2] Ber. Berl. chem. Ges. 11, p. 410.

undersøge det mellem Norge, Færøerne, Island, Jan Mayen og Spitsbergen beliggende Hav, vare heller ikke de paa den engelske Challengerexpedition udførte Observationer offentliggjorte, saaat de Data, der den Gang forelaa, i Righoldighed paa ingen Maade kunde sammenlignes med dem, som nu staa til Raadighed. Især var det med Hensyn paa den geografiske Udbredning, at Observationerne ikke kunde give synderlg omfattende Oplysninger, idet det eneste Hav, som endnu var grundigt undersøgt, nemlig Nordsøen, baade med Hensyn paa Dybde og øvrige physikalske Forholde afveg i høi Grad fra det store Verdenshav, forsaavidt man kjendte det. Da der først var fattet Beslutning, om at der ogsaa paa den norske Nordhavsexpedition skulde udføres chemiske Undersøgelser af samme Art som paa de tidligere Expeditioner, maatte det derfor for Hr. S. Svendsen, hvem disse Arbeider oprindelig vare overdragne, fremstille sig som en meget vigtig, ja man kan sige, som den vigtigste Opgave at tilveiebringe de fornødne Oplysninger om Gasarterne i Søvandet, hvad angaar den Del af Verdenshavet, som Norge havde paataget sig at gjøre til Gjenstand for videnskabelig Undersøgelse. Med Hensyn paa de Midler, der skulde benyttes til Løsningen af denne Opgave, da kunde Valget af disse ikke falde vanskeligt, da de af Dr. Jacobsen benyttede Methoder og Apparater strax maatte udpege sig som de hensigtsmæssigste fremfor Alt, hvad der for Resten stod til Raadighed, selv om ikke Hensynet til Resultaternes Sammenlignelighed havde gjort deres Anvendelse ønskelig. Svendsen besluttede derfor uden Modificationer at optage de paa Pomeraniaexpeditionen benyttede Arbeidsmetlioder, og var det i Henseende til Expeditionens Udrustring et stort Held, at Professor Dr. Jacobsen velvilligen tilbød sig at anskaffe de til de chemiske Undersøgelser fornødne Apparater.

Det var dog ikke alle de ved Pomeraniaexpeditionen benyttede Apparater, som ogsaa kom til Anvendelse paa den norske Nordhavsexpedition, idet man der besluttede at anvende en af Capitain Wille construeret Vandhenter, som især i en Henseende maatte være at foretrække for den af Dr. H. A. Meyer angivne. Paa denne maatte nemlig, naar den skulde optage Vandprøver fra intermediære Dyb, Cylinderen udløses ved et langs Linen nedsænket Lod, som aldeles udelukkede Muligheden af paa Linen samtidig at have anbragt Thermometre eller deslige, saaledes som det uden mindste Ulempe kan forenes med Brugen af Willes Vandhenter.

Willes Vandhenter, som findes afbildet i Fig. 2, er af Opfinderen bleven beskrevet paa følgende Maade:

"Vandprøven indesluttes i dette Instrument i et for Pladsens Skyld spiralformig bøiet Rør, der under Nedfiringen i Vandet holdes aabent i begge Ender, saaledes at Vandet frit kan strømme igjennem; men naar Instrumentet ophales et kort Stykke, lukkes Enderne af Røret med to Ventiler, hvorved det da i Røret staaende Vand afstænges og kan bringes op.

the sea lying between Norway, the Feröe Islands, Iceland, Jan Mayen, and Spitzbergen, the results of the observations instituted on the 'Challenger' Expedition had not yet been made public; and hence the data then obtained were few compared to those of which we are now in possession. It was more particularly with respect to geographical distribution, that the information former observations could supply had proved but meagre, inasmuch as the only sea thoroughly investigated, viz the German Ocean, was found to differ widely in regard to depth and other physical conditions from the Atlantic and Pacific, so far at least as our knowledge of both may be said to extend. The resolution once formed, of instituting on the Norwegian North-Atlantic Expedition a series of chemical experiments similar to those performed on former Expeditions, Mr. S. Svendsen, the gentleman on whom the execution of this task was to have devolved, could not but regard as an important, nay the most important, part of his labours, accurate determinations of the gases present in that tract of the Atlantic Ocean which the Norwegian Expedition was to make the subject of scientific investigation. Respecting the means whereby to solve this problem, no difficulty could be experienced in making a choice, since Dr. Jacobsen's methods and apparatus must at once suggest themselves as by far the best, even apart from the consideration, that, for the better comparing of his results with those obtained, their adoption was desirable. Svendsen, therefore, decided in favour of the process — without modification — resorted to on the 'Pomerania' Expedition; and it was a fortunate concurrence, that Professor Jacobsen should kindly volunteer his assistance in procuring the various apparatus necessary for the chemical experiments.

All the apparatus made use of on the 'Pomerania' Expedition, were not, however, adopted on the Norwegian North-Atlantic Expedition; the instrument, for instance, employed to collect water, which, particularly in one respect, must be held preferable to that described by Dr. H. A. Meyer, had been constructed by Captain C. Wille R. N. When drawing water from intermediate depths, the cylinder in the latter is detached by running a weight down the line, which precludes the possibilty of having a thermometer, or any other instrument, attached to it, an advantage which may, without the slightest drawback, be combined with Wille's apparatus.

Wille's instrument for collecting water, of which Fig. 2 is a represention, has been described by the inventor as follows: —

"The samples of water drawn with this instrument are, to save space, brought up in a spiral tube, which, when sunk through the water, is kept open at both ends, to admit of the free passage of the fluid; but, on the instrument, at the required depth, being hauled in a few fathoms, the ends of the tube are closed by means of two valves, and the water it contains, thus prevented from escaping, may be brought to the surface.

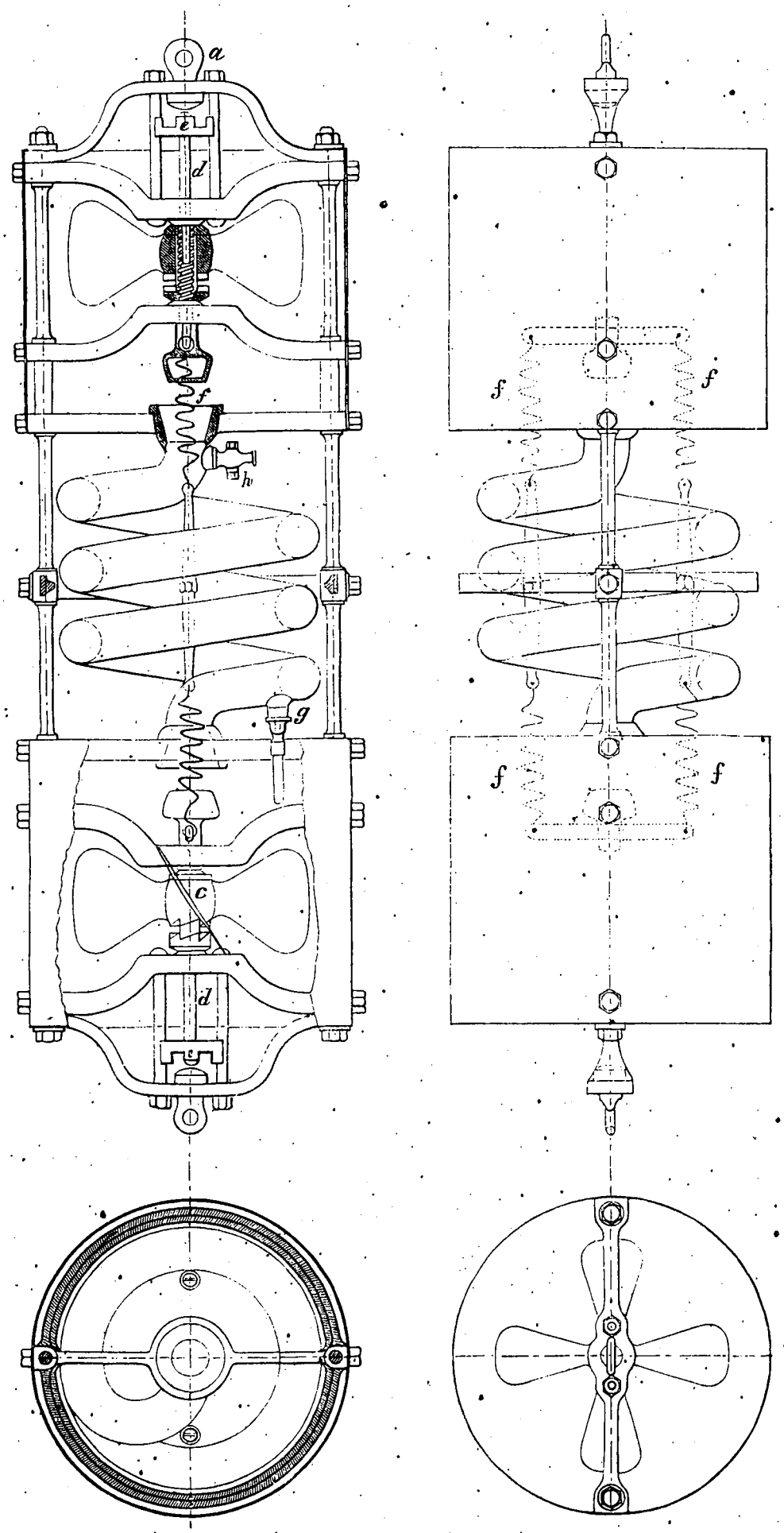

Fig. 2.
$^1/_8$ af naturlig Størrelse.
(One-eighth of the Actual Size.)

Tegningen fremstiller Instrumentet klar til Nedfiring; Tampen af Lodlinen hexes i øverste Øiebolt (*a*) og Loddet i den nedre (*b*). Under Nedfiringen løfter Vandtrykket Propellerne op, saa at Taggerne i Underkant af Propelbosset (*c*) kommer klar af Taggerne i Muffen, gjennem hvilken Ventilstangen (*d*) gaar, og om de ikke kommer ganske klare, sker Propellens Omdreining *med* Skraaplanerne, saa at Muffen og Ventilstangen bliver staaende stille. Naar Instrumentet derimod under Ophalingen bevæges opad, driver Vandtrykket Propellerne ned, de dreies rundt den anden Vei og tager Mufferne med sig. Ventilstængerne, der ikke kan dreie sig rundt, men styres af Tværstykkerne (*e*), skrues da, tilligemed de med Kautschuk overtrukne Ventiler, mod Ventilsæderne i Enderne af Røret, og naar de ere næsten lukkede, glipper den sidste Skruegjænge paa Ventilstangen ud af Skruegjængerne i Muffen, og Spiralfjædrene (*f*) klappe da Ventilerne i, medens Propellerne og Mufferne gaa løse rundt om den glatte Del af Ventilstængerne, og frembyder saaledes meget liden Modstand under Resten af Indhivningen. Instrumentet lukker sig efter omtrent 7 Favnes (13 Meters) Indhaling. Ringen om Midten og Skjærmerne rundt Propellerne beskytte Instrumentet, saaledes at det uden Skade kan ligge paa Bunden.

For at konstatere, om der var Overskud af Luft i de nedre Vandlag, blev der over Svikhullet paaskruet et gjennemboret Laag (*g*), der ved Hjælp af et Stykke Gummislange forenedes til et i den ene Ende lukket Glasrør. Naar Vandet under Nedfiringen strømmede ind i Vandrøret, løb det ogsaa ned i Glasrøret, af hvilket Luften saaledes blev udjaget. Naar Instrumentet kom ombord, endevendtes det, saa at Kranen kom ned og Glasrøret op. Man bevægede nu Vandhenteren lidt frem og tilbage med den øvre Ende, og hvis der havde været Overskud af Luft, maatte denne have arbeidet sig op og vist sig i Toppen af Glasrøret, men dette viste sig stadig fuldt lige til Tops, og blev derfor i den sidste Tid ikke paasat."

Instrumentet kan tømmes gjennem Tappekranen (*h*) og leverer en Vandprøve paa circa 5 Litre.

Udførelsen af de chemiske Arbeider ombord paa den norske Nordhavsexpedition overtoges altsaa først i Følge den oprindelige Plan af Hr. Svendsen, som gjorde Togtet i 1876 med, men blev senere, da denne af Helbredshensyn bad sig fritaget, overdraget Forfatteren, der saaledes har udført de paa de to sidste Togter gjorte Observationer delvis med Assistance af Hr. L. Schmelck, som sidste Sommer medfulgte Expeditionen, og som for Tiden er beskjæftiget med Bearbeidelsen af en anden Del af det paa Expeditionens Togter til chemisk Undersøgelse indsamlede Materiale.

The figure shows the instrument ready for sinking. The end of the sounding-line is made fast to the upper eyebolt (*a*), and the lead to the lower (*b*). On the downward passage, the pressure of the water lifts up the propellers, enabling the cogs in the under surface of the base of the latter (*c*) to get clear of the cogs in the bush, through which passes the rod of the valve (*d*); and if not quite clear, the propeller revolves *with* the inclined planes, the bush and the rod of the valve remaining stationary as before. On the other hand, when the instrument, on being hauled in, is given an upward motion, the pressure of the water forces down the propellers, which then revolve in the opposite direction, carrying along with them the bushes. The rods of the valves, which cannot revolve, being kept in position by transverse pieces (*e*), are, together with the valves covered with caoutschouc, screwed against the ends of the tube. Now, when the latter are almost closed, the last twist of the screw on the rod of the valve slips out of the corresponding twist of the screw on the bush, and the spiral springs (*f*) instantly press down the valves, the propellers and the bushes revolving independently round the smooth portion of the rods, thus presenting but little resistance to the water during the remainder of the upward passage. The instrument closes on being hauled in about 7 fathoms (13 metres). The ring round the middle, and the shields protecting the propellers, prevent the instrument from sustaining injury on its striking the bottom.

With a view to ascertain whether the proportion of air were really greater in the lower strata, a perforated cover (*g*) was screwed over the spigot-hole, and connected by means of a piece of caoutschouc hose with a glass tube, open at one end. Now, when the water on the downward passage flowed into the spiral tube, it also descended into the glass tube, expelling the air. So soon as the instrument came on board, it was inverted, the stop-cock therefore pointing down, and the glass tube up. The upper end of the apparatus being now moved a little backwards and forwards, the surplus of air, if any had been present, must obviously have forced its way upwards, and have appeared, in the form of bubbles, at the top of the tube, which, however, was invariably found to be quite full, and therefore not attached to the apparatus when the fact would no longer admit of doubt."

The stopcock (*h*) serves to empty the instrument, which will hold about 5 litres of water.

The chemical work to be done on board was, as stated above, originally undertaken by Mr. S. Svendsen, who went out on the first cruise, in 1876; but, his health failing, Mr. Svendsen was succeeded by the author, who had therefore to take the observations instituted in 1877 and 1878, partly with the assistance of Mr. L. Schmelck, that gentleman having accompanied the Expedition on the last cruise. (Mr. Schmelck is now engaged in working up other materials collected on the Expedition for chemical investigation).

Da jeg Vaaren 1877 blev opfordret til at overtage disse Arbeider, var der kun givet mig faa Dages Varsel, saaat jeg havde de største Vanskeligheder med at faa udført selv de aller nødtørftigste Forberedelser, og naar det alligevel lykkedes at faa Alt tilfredsstillende ordnet før Afreisen, da skyldes dette udelukkende den Beredvillighed, hvormed Hr. Professor Waage bistod mig blandt Andet ogsaa med Indredningen af det chemiske Laboratorium ombord.

Det paa Expeditionens første Togt i 1876 fremherskende ualmindeligt stormfulde Veir gjorde det i høi Grad vanskeligt ja næsten ugjørligt at udføre de chemiske Observationer ombord, og det Udbytte, som af Svendsen hjembragtes fra første Togt, indskrænkede sig derfor i denne Branche til 17 Luftprøver, hvoraf desuden 3 ved Uheld senere gik tabt. Det rolige Veir, som de to sidste Aar begunstigede Expeditionens Arbeider, tillod mig derimod paa de Togter, hvormed der var givet mig Anledning til at medfølge, at indsmelte et større Antal, idet der for disse Aars Vedkommende erholdtes 80 Luftbestemmelser af de hjembragte Luftprøver, hvoraf 9 vare indsmeltede af Hr. Schmelck. Naar Udbyttet ikke er blevet større, da har dette sin Grund i, at talrige Observationer gik tabt nogle faa ved Uheld under Analysen men de fleste ved Uheld under Indsmeltningen. Saaledes var der til Brug paa sidste Togt fra Küchler & Söhne i Ilmenau sendt mig nogle Luftopsamlingsrør, hvoraf over 75 % tiltrods for den omhyggeligste Behandling sprang enten under Indsmeltningen eller efter samme. Luftprøverne ere alle analyserede ved det af Franckland og Ward[1] angivne Gasanalyseapparat, saaledes at Kulsyren er fjernet med Kalilud og Surstoffet bestemt ved Forbrænding med Vandstof. De 14 førstnævnte Prøver ere analyserede af Hr. Svendsen de øvrige 80 af Forfatteren. De erholdte Resultater findes sammenstillede i Tabel I, hvortil kan bemærkes følgende: De i Tabellen opførte Temperaturangivelser ere mig meddelte af Professor Mohn. Ved Angivelse af de Dybder, hvorfra Vandprøverne ere hentede, er ikke taget Hensyn til, at Vandhenteren først lukker sig efter circa 7 Favnes Indhivning. Ved de med * betegnede 10 Nummere var der i de til Luftprøvernes Opbevarelse benyttede Glasrør smaa Feil, uden at jeg dog har fundet mig foranlediget til at tillægge disse mindre Vægt end de Øvrige, da man vel ikke kan tænke sig Muligheden af en Lækage, uden at den, naar Glasrørene i flere Maaneder opbevaredes under en Trykdifferents mellem det ydre og indre Gastryk af circa 300 til 400^{mm}, maatte have øvet en mærkbar Virkning paa den indesluttede Lufts Sammensætning. Jeg kan saa meget trøstigere tage dem med i Beregningerne, hvor det gjælder at opstille de almindelige Slutninger, som de ikke i synderlig Grad ville bidrage til at forrykke Udseendet af de endelige Resultater. Alle Gasvolumina findes i Tabellen udtrykte i CC. per Litre udkogt Søvand reduceret til 0° og 760^{mm} Barometerstand.

[1] Chem. Soc. Journ. 22—313. 1869.

When, in the spring of 1877, I was requested to undertake these labours, I had but a few days' notice, and experienced, therefore, very great difficulty in making even the most necessary preparations; nor would it indeed have been possible to get everything satisfactorily arranged in so short a time but for the readiness with which Professor Waage came forward to assist me; for instance, in fitting up the chemical laboratory on board.

The exceptionally heavy weather on the first cruise in 1876, rendered it in the highest degree difficult, nay well nigh impracticable, to perform the necessary experiments on board; and hence the chemical work done by Svendsen on the first voyage was, with regard to gas-determinations, confined to collecting 17 samples of air, 3 of which however were subsequently lost. On the two last cruises of the Expedition the weather proved much more favourable, and I succeeded in obtaining a larger number of samples (9 of them collected by Mr. Schmelck), with which, when brought home, 80 air-determinations were performed. A more satisfactory result would, however, have been obtained but for the loss of numerous samples, some few from accident when analysing the gass, but the great majority by reason of the difficulty experienced in sealing. Thus, for instance, on the last voyage 75 per cent of the glass tubes for collecting air, procured from Küchler & Sohne in Ilmenau, notwithstanding the greatest care cracked either during the sealing-process or after its completion. The samples of air were all of them analysed in the apparatus described by Franckland and Ward,[1] the carbonic acid having been absorbed in a lye of potash and the oxygen determined by consuming it with hydrogen. The first 14 samples were analysed by Mr. Svendsen, the remaining 80 by myself. The results obtained will be found in Table I. The temperatures in the Table were given by Professor Mohn. When stating the depths from which the samples of water were drawn, regard has not been had to the fact, that the instrument used for collecting them does not close till it has been hauled in about 7 fathoms. The asterisk marking 10 of the determinations signifies that the glass tubes used for preserving these samples of air had small defects. To these determinations, however, I have not attached less weight than to the others; for it is impossible to conceive that a leakage, after the glass tubes had been exposed for months together to a difference of pressure amounting to 300^{mm}—400^{mm}, viz. that existing between the air inside and the atmosphere without, should not have had an appreciable effect on the composition of the air they contained. Moreover, I hesitate the less to include them as factors when seeking to arrive at general conclusions, since they cannot to any considerable extent disturb the character of the final results. The volumes are given in cubic centimetres per litre of the sea-water examined, reduced to a temperature of 0° and a pressure of 760^{mm}.

[1] Chem. Soc. Journ. 22, p. 313; 1869.

Tabel I.

No.	Stat. No.	Nordlig Bredde. (*North Latitude.*)	Længde fra Greenwich. (*Longitude from Greenwich.*)	Dybde hvorfra Prøven hentet. (*Depth from which the Samples were collected.*) Engelske Favne. (*English Fathoms.*)	Meter. (*Metres.*)	$O+N$ CC. per Litre.	N CC. per Litre.	$\frac{O+N}{=100}$ O % (*O per cent.*)	Temperatur. Celsius.	Anmærkninger. (*Remarks.*)
1		Husö		0	0	17.4	11.3	35.1	10.5	
2	14	62° 4′	2° 44′.5 E.	226	413	20.1	13.8	31.1	6.1	
3	32	63 10	4 51.3	430	786	19.0	13.0	31.7	—0.6	
4	33	63 5	3 0	0	0	18.9	12.4	34.4	11.8	
5	33	63 5	3 0	525	960	17.3	11.7	32.6	—1.1	
6	35	63 7	1 26 W.	0	0	17.0	11.1	35.0	10.4	
7	35	63 7	1 26	721	1319	18.4	12.4	32.6	—0.9	
8	37	62 28.3	2 29	309	565	18.5	12.4	32.8	0.1	
9	37	62 28.3	2 29	690	1262	18.3	12.3	32.7	—1.1	
10	40	63 22.5	5 29	0	0	17.1	11.1	35.2	9.7	
11	40	63 22.5	5 29	515	942	20.5	13.9	32.4	—0.4	
12	51	65 53	7 18	515	942	20.6	13.9	32.3	—0.6	
13	51	65 53	7 18	1163	2127	20.9	14.1	32.7	—1.1	
14	52	65 47.5	3 7	1861	3403	—	—	32.2	—1.2	
15	95	60 42	4 13.7 E.	175	320	—	—	32.4	5.8	
16	96	66 8.5	3 0	805	1472	—	—	32.3	—1.1	
17	125	67 52.5	5 12	700	1280	20.5	13.7	33.0	—1.1	
18	125	67 52.5	5 12	700	1280	20.0	13.3	33.6	—1.1	
19	152	67 18	12 46	125	229	—	—	31.0	4.1	
20	162	68 23	10 20	795	1454	20.6	13.9	32.6	—1.2	
21	162	68 23	10 20	795	1454	19.4	12.9	33.7	—1.2	Udkogt efter nogen Tids Henstand. (Boiled after the lapse of a short interval.)
22	171	69 18	14 29	642	1174	19.6	13.0	33.5	—1.0	
23	179	69 32	11 10	1607	2939	—	—	32.1	—1.2	
24	183	69 59.5	6 15	0	0	20.2	12.9	36.1	8.6	
25	183	69 59.5	6 15	0	0	—	—	36.1	8.6	
26	184	70 4	9 50	1547	2829	21.5	14.6	32.0	—1.3	
27	184	70 4	9 50	600	1097	20.7	14.1	32.1	0.0	
28	189	69 41	15 42	0	0	18.4	12.0	35.0	9.6	
29	189	69 41	15 42	860	1573	21.5	14.6	32.0	—1.1	
30	200	71 25	15 40.5	620	1134	19.9	12.8	35.8	—1.0	Udkogt efter 5—6 Timers Henstand. (Boiled after the lapse of 5 or 6 hours.)
31		Indløbet til Malangenfjord. (Entrance to the Malangen Fjord.)		0	0	—	—	35.5	8.5?	
32	213	70° 23′	2° 30′	0	0	18.6	12.1	34.9	8.2	
33	213	70 23	2 30	1760	3219	19.6	12.9	34.0	—1.2	
34	213	70 23	2 30	1760	3219	—	—	33.8	—1.2	
35	215	70 53	2 0 W.	0	0	—	—	34.8	8.0	
36	215	70 53	2 0	700	1280	20.1	13.6	22.4	—0.6	
37	215	70 53	2 0	1665	3045	19.2	12.9	32.8	—1.2	
38	226	70 59	7 51	0	0	—	—	33.7	3.0	
39	226	70 59	7 51	340	622	—	—	32.7	—0.6	
40	—	69 20	11 18	0	0	20.7	13.3	35.8	4.3	
41	—	69 20	11 18	0	0	—	—	35.4	4.3	
42	243	68 32.5	6 26	0	0	20.0	13.1	34.7	7.8	
43	243	68 32.5	6 26	600	1097	22.1	15.0	32.2	—0.8	
44	243	68 32.5	6 26	1385	2533	22.6	15.3	32.5	—1.3	
45	247	68 5.5	2 24 E.	0	0	19.3	—	—	9.4	
46	247	68 5.5	2 24	500	914	—	—	32.3	—0.4	
47	249	68 12	6 35	1063	1944	21.4	14.5	32.3	—1.3	
48	252	Sundenfor Skraaven. (South of Skraaven.)		0	0	18.2	11.9	34.7	14.0?	
49	253	Skjærstadfjord. (The Skjerstad Fjord.)		263	481	20.9	13.8	34.2	3.2	
50	254	67° 27′	13° 25′	0	0	18.2	11.9	34.8	10.0	
51	254	67 27	13 25	70	128	21.3	14.2	33.2	4.8	
52	254	67 27	13 25	140	256	19.5	13.2	32.4	5.8	
53	264	70 56	35 37	0	0	20.6	13.3	35.5	5.2	
54	264	70 56	35 37	86	157	20.7	13.8	33.1	1.9	
55	275	74 8	31 12	0	0	20.5	13.3	34.9	2.9	
56	275	74 8	31 12	147	269	21.9	14.6	33.4	—0.4	
57	278	74 1.5	22 27	0	0	20.4	13.3	35.0	4.2	
58	278	74 1.5	22 27	230	421	20.7	13.8	33.3	0.9	

No.	Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich.)		Dybde hvorfra Prøven hentet. (Depth from which the Samples were collected.) Engelske Favne. (English Fathoms.)	Meter. (Metres.)	$O + N$ CC. per Litre.	N CC. per Litre.	$O + N = 100$ O % (O per cent.)	Temperatur. Celsius.	Anmærkninger. (Remarks.)
59	283	73° 47′.5	14° 21′		0	0	19.8	12.8	35.4	7.2	
60	283	73 47.5	14 21		0	0	19.5	12.6	35.3	7.2	
61	286	72 57	14 32		0	0	20.6	13.2	35.8	7.2	
62	286	72 57	14 32		447	817	21.8	14.8	31.9	—0.8	
63*	293	71 .7	21 11		95	174	19.6	13.0	33.5	5.1	
64	295	71.59	11 40		0	0	20.2	12.8	36.7	7.0	
65	295	71 55	11 30		600	1097	21.4	14.6	31.7	—0.8	
66	295	71 59	11 40		1110	2030	21.5	14.6	32.1	—1.3	
67	296	72 15.5	8 9		100	183	20.4	13.4	34.2	3.1	
68	297	72 36.5	5 12		1280	2341	21.3	13.8	35.1	—1.4	
69*	301	74 1	1 20	W.	0	0	21.9	14.1	35.6	2.2	
70*	303	75 12	3 2	E.	150	274	22.0	14.7	33.1	—1.1	
71*	304	75 3	4 51		300	549	21.7	14.7	32.2	—0.8	
72	304	75 3	4 51		1735	3173	21.6	14.6	32.2	—1.5	
73*	321	74 56.5	19 30		0	0	23.8	15.4	35.2	0.5	
74	321	74 56.5	19 30		25	46	23.7	15.3	35.4	0.2	
75	323	72 53.5	21 51		0	0	19.3	12.3	36.5	7.8	
76	323	72 53.5	21 51		0	0	—	—	35.8	7.8	
77	332	75 56	11 36		1149	2101	21.9	14.8	32.2	—1.5	
78	332	75 56	11 36		1149	2101	22.0	15.0	31.8	—1.5	
79	335	76 16.5	14 39		0	0	20.8	13.3	36.2	5.4	
80	335	76 16.5	14 39		179	327	21.0	14.0	33.1	1.0	
81	339	76 30	15 39		37	68	21.6	14.2	34.1	0.9	
82	342	76 33	13 18		0	0	21.8	14.1	35.3	6.2	
83	342	76 33	13 18		523	956	20.8	13.8	33,8	—1.0	
84	345	76 42.5	10 9		300	549	20.9	13.7	34.4	1.0	
85	345	76 42.5	10 9		300	549	21.5	14.2	33.9	1.0	
86	347	76 40.5	7 47		0	0	20.9	13.4	35.7	4.4	
87	347	76 40.5	7 47		1429	2613	21.4	13.9	35.1	—1.3	
88*	349	76 30	2 57		1487	2719	21.7	14.6	32.5	—1.5	
89	350	76 26	0 29	W.	300	549	21.9	14.7	32.7	—1.1	
90	350	76 26	0 29		1686	3083	22.9	15.3	33.3	—1.5	
91*	352	77 56	3 29	E.	300	549	21.9	14.8	32.5	—0.8	
92*	352	77 56	3 29		1686	3083	22.4	15.1	32.8	—1.5	
93*	359	78 2	9 25		0	0	—	—	35.7	4.3	
94*	362	79 59	5 40		0	0	20 3	13.0	35.8	5.2	

Vandprøverne ere overalt, hvor det Modsatte ikke udtrykkelig er anført, udkogte strax efter deres Optagelse.

Som man ser, ligner denne Tabel overmaade meget den af Dr. Jacobsen opstillede, hvad man ogsaa paa Forhaand kunde vente, da de undersøgte Districter fuldstændig gaa over i hinanden, og naar Differentserne mellem de af Hr. Svendsen og mig opførte Tal ere noget større, da kommer dette ligefrem af det af os bearbeidede Felts større Udstrækning og deraf følgende større Uensartethed i de physikalske Forholde.

Hvad der er mest iøinefaldende, er det paafaldende Phænomen, at der med Hensyn paa den relative Sammensætning af den i Overfladevandet indeholdte Luft paa den norske Nordhavsexpedition er fundet betydeligt større Surstofgehalt end af Dr. Jacobsen for Nordsøen opstillet, saaledes er Surstofprocenten i Overfladen i Nordsøen bestemt til i Middel 33.93 % af den samlede Luftmængde, medens den for det af den norske Expedition i 1876 og 77 undersøgte Strøg søndenfor den 70de Breddegrad, beløber sig

The samples of water were all, except when the reverse is stated, boiled immediately on being drawn.

As will be seen, this Table agrees very closely with that prepared by Dr. Jacobsen, which was indeed to be expected, since the tracts investigated coalesce; and the somewhat greater differences exhibited by Mr. Svendsen's and my own figures arise simply from the region explored by the Expedition having been more extensive, involving greater dissimilarity in the physical conditions.

With regard to the relative composition of the air in surface-water, the proportion of oxygen was, strange to say, on the Norwegian North-Atlantic Expedition found to be considerably greater than that given by Dr. Jacobsen for the North Sea. The mean proportion of oxygen in the surface-water of the North Sea he determined to be 33.93 per cent of the total amount of air, whereas the mean proportion for the tract of the North-Atlantic stretching south of the 70th parallel of latitude, that investigated by the

til i Middel 34.96 og for det i 1878 undersøgte mellem 70de og 80de Breddegrad beliggende Strøg til 35.64 %. Fuldstændigt tilsvarende er det af Buchanan fundet at være paa den sydlige Halvkugle, idet Surstofprocenten i Overfladen der varierer fra omkring 33 i Æqvatoregnene til ca. 35 omkring den sydlige Polarcirkel.

Dette lod med temmelig stor Bestemthed formode, at de for destilleret Vand gjældende, af Bunsen opstillede, Absorbtionscoefficienter ikke skulde være gyldige for Søvand, idet det, naar Overfladevandsluftens Sammensætning fandtes at variere med Bredden, maatte være det Naturligste at skrive disse Variationer paa Temperaturforandringerne. Det vil imidlertid ikke føre til noget rimeligt Resultat, om man vil betragte Temperaturen som den Variable og af de her foreliggende Observationer forsøge at udlede en Lov for Absorbtionscoefficienternes Variationer med Temperaturen. Man vil da finde, at de enkelte Observationer staa ikke ubetydeligt i Strid med hinanden, idet der for Surstofmængdernes Vedkommende overalt optræder meget større Afvigelser, end man kan antage begrundede i Observationsfeil. Det kunde dog ikke synes tilraadeligt at lade det bero hermed og forsøge at discutere de foreliggende Observationer uden nøiere Kjendskab til Absorbtionscoefficienternes Afhængighed af Temperaturen, og jeg besluttede derfor at bestemme saavel Sammensætning som Mængde af den i Søvandet ved forskjellige Temperaturer opløste Luft.

Først gjordes en Del Forsøg, hvorved Søvandet i et Bad af constant Temperatur søgtes mættet ved flere Timers Gjennemledning af Luft, (saaledes som Bunsen har gaaet frem ved sine Bestemmelser[1]), hvorefter den opløste Luft uddreves og analyseredes paa den før beskrevne Maade. De paa denne Maade mættede Vandprøver afgave bestandig Luftmængder, som uden Hensyn til den Temperatur, hvorved Vandet var mættet, viste nogenlunde nær den samme Sammensætning (med 34.9 % Surstof mod 65.1 % Kvælstof), medens de ofte temmelig stærkt afvigende Tal, som udtrykte de absolute Mængder af opløste Gaser, tydeligt viste, at der paa denne Maade ikke var opnaaet fuldstændig Mætning.

Professor Waage foreslog mig derfor at gjentage disse Forsøg med nogen Variation i den Maade, hvorpaa Mætningen iværksattes, og har jeg som Følge deraf ved de senere Forsøg benyttet følgende Fremgangsmaade. En passende Portion Søvand af nogenlunde høi Egenvægt rystedes med Luft i en rummelig Kolbe i et Tidsrum fra 1 til 2 Timer under stadig Vexlen af den i Kolben værende Luft og hensattes derpaa i nogle Timer ganske rolig, idet Temperaturen saavel under Rystningen som senere holdtes fuldstændig constant. Forat overbevise mig om, at jeg har opnaaet fuldstændig Mætning, har jeg nærmet mig Mæt-

[1] Bunsen, Gasom. Methoden — 165.

Norwegian Expedition in 1876 and 1877, amounts to 34.96, and for that lying between the 70th and 80th parallels of latitude, to 35.64 per cent. Buchanan observed precisely the same phenomenon in the southern hemisphere, the proportion of oxygen varying from about 33 per cent in the Equatorial Seas to about 35 per cent in the vicinity of the Antarctic Circle.

Reasoning on these data, there were strong grounds to assume, that the coefficients of absorption given by Bunsen for distilled water could not apply to sea-water; for, the composition of the air in surface-water having been found to vary with the latitude, the most probable cause of this phenomenon would seem to be temperature. Meanwhile, we shall not arrive at a satisfactory result by regarding temperature as the variable factor, and by seeking from the observations here set forth to discover a law according to which the coefficients of absorption vary with the temperature. The individual observations would in that case be found to clash, inasmuch as the variation with regard to oxygen is invariably greater than can be assumed to arise from errors of observation. However, it did not seem advisable to leave the question as it stood, and proceed to the discussion of the results without having further investigated the relation of the coefficients of absorption to the temperature; and I resolved, therefore, on determining alike the composition and the amount of the air absorbed by sea-water at different temperatures.

A series of experiments were first instituted with a view to saturate sea-water with air, viz. by placing it in a bath of constant temperature, and for the space of several hours uninterruptedly conducting through it a current of air, — the mode of operation adopted by Bunsen for his determinations,[1] — after which the air absorbed in the water was driven off, and analysed by the process previously described. The samples of water saturated in this manner invariably yielded quantities of air which, irrespective of the temperature at which the water had been saturated, were found to be very nearly uniform in composition, viz. 34.9 per cent oxygen and 65.1 per cent nitrogen, whereas the figures, often widely divergent, expressing the absolute quantities of the gaseous bodies absorbed, gave sufficient proof that by this method complete saturation had not been attained.

At Professor Waage's suggestion, I repeated these experiments, varying slightly the means by which saturation was sought to be effected, and have since adopted the following mode of operation. A quantity of sea-water, of considerable specific gravity, is shaken, along with air, in a roomy matrass for one or two hours, the air in the matrass being frequently renewed, and then left perfectly still for a few hours, at the precise temperature preserved during its continual agitation. To be quite sure that I have really succeeded in saturating the water, I approach the point of saturation as it were from opposite directions:

[1] Bunsen, Gasom. Methoden, p. 165.

ningspunctet fra begge Sider, idet jeg paa den ene Side har behandlet Vand, som paa Forhaand var utilstrækkeligt mættet med Luft ved vedkommende Temperatur, og paa den anden Side først har mættet Vandet ved en betydelig lavere Temperatur for derefter, som ovenfor beskrevet, at ryste det med Luft ved den Temperatur, hvorved det ønskedes mættet. Den Barometerstand, hvorved Vandprøverne ere mættede, er altid bleven observeret, og ere de uddrevne Gasmængder reducerede til Mætning ved 760^{mm}, idet de absorberede Volumina ere satte proportionale med Trykket. Resultaterne ere sammenstillede i nedenstaaende Tabel, hvor Gasmængderne ere udtrykte som CC. pr. Litre udkogt Vand reduceret til 0° og 760^{mm} Tryk. De med fede Typer trykkede Tal hidrøre fra de Vandprøver, der i Forveien have været mættede med Luft ved en lavere Temperatur. Ved de med Klammer sammenføiede Tal ere begge Luftprøver udkogte af samme Vandprøve.

0° C.		5° C.		10° C.		15° C.	
O	*N*	*O*	*N*	*O*	*N*	*O*	*N*
7.76	14.36	6.83	13.20	6.31	12.14	5.60	10.79
7.85	14.56	6.90	13.30	**6.30**	**12.06**	5.79	11.20
7.71	14.31	**6.97**	**13.16**	**6.25**	**12.04**	**5.70**	**11.04**
—	—	**7.01**	**13.20**	—	—	—	—

Som Middelværdier erholder man heraf:

°C.	0	5	10	15
O	7.77	6.93	6.29	5.70
N	14.41	13.22	12.08	11.01
$O + N = 100$ O %	35.03	34.39	34.24	34.11

Til yderligere Control paa Rigtigheden af denne Tabel hensattes en Vandprøve i uproppet Kolbe ved 0° i 7 Døgn, hvorpaa den deri opløste Luft udkogtes og analyseredes, og viste den uddrevne Gas sig at være omtrentlig af samme Sammensætning som ovenfor angivet nemlig 35.18 % *O* mod 64.82 % *N*. Af den samlede Luftmængde erholdtes her ingen Maaling, da desværre en liden Blære under Overfyldningen i Evdiometret gik tabt, den resterende Del maalte 21.71 CC. Som man af denne Tabel vil kunne se, er den Kvælstofmængde, som 1 Litre Søvand absorberer af den atmosphæriske Luft, ligetil proportional med Temperaturen og lader sig udtrykt i CC. meget nøie fremstille ved Formelen

$$N = 14.4 - 0.23\,t,$$

hvoraf man istedetfor de

observerede Værdier .	14.41	13.22	12.08	11.01
kan beregne	14.40	13.25	12.10	10.95.

Hvad angaar den absorberede Surstofmængde, da er Forholdet ikke længere saa simpelt, idet den Curve, der betegner Variationen med Temperaturen, ikke længere er en ret men en svagt krummet Linie, som paa Strøget fra 0 til 10°, hvorom der her nærmest er Tale, lader sig udtrykke ved Formelen

on the one hand, operating with water that has been imperfectly saturated at a given temperature, and on the other, saturating that water at a much lower temperature; and not till then proceeding to shake it along with air at the temperature for which saturation is sought to be attained. The atmospheric pressure at which the samples of water were saturated, was always noted down, and the quantity of gas driven off reduced to the point of saturation at 760^{mm}, the volumes absorbed being put proportional with the pressure. The results are set forth in the following Table, the amounts of gas being expressed in cubic centimetres per litre of the water examined, reduced to a temperature of 0° and a pressure of 760^{mm}. The figures printed in thick type refer to samples of water previously saturated with air at a lower temperature; those in brackets are determinations performed with the same sample of water.

0° C.		5° C.		10° C.		15° C.	
O	*N*	*O*	*N*	*O*	*N*	*O*	*N*
7.76	14.36	6.83	13.20	6.31	12.14	5.60	10.79
7.85	14.56	6.90	13.30	**6.30**	**12.06**	5.79	11.20
7.71	14.31	**6.97**	**13.16**	**6.25**	**12.04**	**5.70**	**11.04**
—	—	**7.01**	**13.20**	—	—	—	—

The mean proportions are accordingly: —

C.	0°	5°	10°	15°
O	7.77	6.93	6.29	5.70
N	14.41	13.22	12.08	11.01
$O + N = 100$ *O* p.ct.	35.03	34.39	34.24	34.11

With the object of testing still further the accuracy of this Table, a sample of water was allowed to stand over in an open matrass at a temperature of 0° for the space of 7 days, when the air absorbed by it was boiled out and analysed; but the composition of the gas driven off proved to be almost the same as that specified above, viz. 35.18 per cent oxygen and 64.82 per cent nitrogen. Of the total amount of air no measurement was obtained, a small bubble of gas having unfortunately escaped when transferring the air into the eudiometer; the remaining portion measured 21.71^{cc}. As appears from this Table, the quantity of nitrogen absorbed from the atmosphere by 1 litre of sea-water is strictly proportional to the temperature, and may be very accurately expressed in cubic centimetres by the formula —

$$N = 14.4 - 0.23\,t,$$

which, in place of

the values observed,	14.41	13.22	12.08	11.01
gives	14.40	13.25	12.10	10.95

With regard to the amount of oxygen absorbed, the proportion is less easily expressed, since the curve indicating the variation with the temperature will no longer be a straight, but a slightly curved line, which, from 0° to 10°, the interval most important here, may be expressed by the formula —

$$O = 7.79 - 0.2\,t + 0.005\,t^2,$$

som istedetfor de observerede Værdier	7.77	6.93	6.29
giver	7.79	6.92	6.29

Men Hensyn paa den relative Sammensætning af den absorberede Luft, da er den ikke, saaledes som af Bunsen for destilleret Vand fundet, uafhængig af Temperaturen men varierer med denne, saaledes at Surstofprocenten paa Strøget fra 0° til 15° forandrer sig med en hel Procent.

Betragter man Resultaterne af disse Forsøg som Norm, viser det sig, at den relativt til den samlede Luftmængde meget høie Surstofgehalt, som er observeret i Overfladen i den nordlige Halvdel af det undersøgte Hav, i Virkeligheden skriver sig fra en Overmætning med Surstof og ikke, som man ogsaa kunde tænkt, fra en mangelfuld Mætning med Kvælstof, idet der mærkeligt nok her findes en Surstofgehalt, der meget hyppigt overskrider den af disse Forsøg beregnede med 0.5 CC. og derover. Det vil sige, der optræder saa store Afvigelser, at de paa ingen Maade kunne tilskrives Observationsfeil, og det viser sig saaledes, at Surstofgehalten i Overfladen ikke alene afhænger af Tryk og Temperatur, men rimeligvis ogsaa maa paavirkes af en eller flere andre ubekjendte Aarsager.

Naar det gjælder nærmere at studere Surstofmængdens Variation med Dybden, falder det bekvemmest at udtrykke den som Procenter af den samlede Luftmængde, da den absolute Luftmængde varierer i meget stærkere Grad med Temperaturen end Luftens relative Sammensætning, og man vil saaledes ved at benytte denne Udtryksmaade opnaa at gjøre sig i betydeligt større Udstrækning uafhængig af Temperaturens Indflydelse.

Ordner man de paa denne Maade udtrykte Tal efter Dybden, viser det sig, at der med Hensyn paa Surstofprocentens Størrelse i de forskjellige Dyb existerer en temmelig udpræget Lovmæssighed, som nærmere kan karakteriseres af nedenstaaende Tabel, der er uddraget af samtlige Observationer, naar undtages de to, hvor Udkogningen ikke foretoges strax men først efter nogen Tids Henstand.

Dybdeintervaller.		Antal Observationer.	Midlere Dybde.		Midlere Surstofprocent.
Engelske Favne.	Meter.		Engelske Favne.	Meter.	
0	0	28	0	0	35.31
0—100	0—183	6	69	126	33.93
100—300	183—549	14	210	384	32.84
300—600	549—1097	16	420	768	32.50
600—1000	1097—1829	11	684	1251	32.58
1000—1400	1829—2560	6	1192	2180	32.78
1400—1760	2560—3219	10	1646	3010	32.89

De enkelte Observationers Afvigelser fra den ved denne Tabel bestemte Regel ere i Betragtning af det undersøgte Felts store Udstrækning hverken mange eller synderlig store, idet kun 10, No. 2, 19, 38, 49, 64, 68, 83,

$$O = 7.79 - 0.2\,t + 0.005\,t^2,$$

giving	7.79	6.92	6.29
in place of the values observed.	7.77	6.93	6.29

Hence, the relative composition of the air absorbed is not, as Bunsen found to be the case with distilled water, independent of temperature, but varies with that factor, the percentage of oxygen, for instance, differing as much as 1 per cent between 0° and 15°.

Now, assuming the results of these experiments to furnish a normal standard, the relatively 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.

When investigating the degree in which the proportion of oxygen varies with the depth, it will be most convenient to express the difference as a percentage of the total amount of air, the absolute amount of air varying to a much greater extent with the temperature than does its relative composition; besides, with this mode of expression considerably less regard need be had to the influence of temperature.

If the figures representing the results thus expressed are arranged according to depth, the proportion of oxygen present in the different strata will be found to exhibit very considerable uniformity, as appears from the following Table, based as it is on the whole series of determinations, with the exception of two, the water with which the latter were performed not having been boiled at once, but allowed to stand over for some time previous to examination.

Intervals of Depth.		Number of Observations.	Mean Depth.		Mean Percentage of Oxygen.
English Fathoms.	Metres.		English Fathoms.	Metres.	
0	0	28	0	0	35.31
0—100	0—183	6	69	126	33.93
100—300	183—549	14	210	384	32.84
300—600	549—1097	16	420	768	32.50
600—1000	1097—1829	11	684	1251	32.58
1000—1400	1829—2560	6	1192	2180	32.78
1400—1760	2650—3219	10	1646	3010	32.89

Considering the great extent of the region investigated, the deviation of the individual observations from the standard given in this Table is neither frequent nor considerable, 10 only, viz. Nos. 2, 19, 38, 49, 64, 68, 83, 84,

84, 85 og 87, fjerne sig om mere end 1 Procent fra det almindelige Resultat, medens man af samtlige Observationer kan bestemme en enkelt Observations sandsynlige Afvigelse fra den efter denne Tabel optrukne Curve til ± 0.52 %, en Afvigelse saa liden, at en ikke ringe Del af den kan skrives paa Observationsfeil.

De største Uoverensstemmelser optræde talrigst i et Dyb fra 300—600 Favne (549—1097 Meter) men findes ogsaa enkeltvis i større Dyb.

Fra Bunden hidrører i de større Dyb kun to Luftprøver med væsentlig for høi Surstofprocent nemlig No. 68 og 87, optagne fra to Puncter, som mærkeligt nok begge ligge paa en Linie paralel med og tæt ved Grændsen mellem den nordover strygende varme Strøm og den sydover forbi Jan Mayen gaaende Polarstrøm. Bortser man imidlertid fra disse de væsentligste Uoverensstemmelser, som bidrage til at give Curven et om end meget svagt Minimum i 300—400 Favnes (549—732 Meters) Dyb, vil man i Korthed kunne udtale Regelen for Surstofprocentens Aftagen med Dybet saaledes: Surstofprocenten er i Overfladen gjennemsnitlig 35.3 og aftager derpaa først hurtigt senere langsommere til henimod 32.5 i 300 Favnes (549 Meters) Dyb, hvorfra den med stigende Dyb holder sig paa det Nærmeste constant. Det kan bemærkes, at af de her undersøgte Vandprøver 40 ere øste lige ved Havbunden. Man vil imidlertid forgjæves bestræbe sig for at opdage nogen Forskjellighed i Egenskaber mellem disse og de fra ligestore intermediære Dyb optagne.

Hvor det gjælder at studere Variationerne af den absolute Luftmængde, maa det synes naturligt som Maal for denne at benytte den opløste Kvælstof, idet den observerede Luftmængde paa Grund af det vedvarende Forbrug af Surstof i de dybere liggende Lag bestandig kan forudsættes at være mere eller mindre forskjellig fra den Mængde, som vilde absorberes i Overfladen under directe Paavirkning af Atmosphæren. Kvælstofmængden kan derimod paa Grund af denne Gasarts stærkt udprægede Indifferentisme ligeoverfor andre Legemer uden synderlig Feil antages uafhængig af locale Tilfældigheder.

Anvendes saaledes Kvælstofmængden som Maal for den i Søvandet opløste Luft, viser der sig i Fordelingen ogsaa her en udpræget Lovmæssighed, naar undtages, at der i de af Svendsen paa det første Togt udførte Observationer overalt er fundet en mindre Kvælstofmængde, end man efter alle øvrige foreliggende Observationer skulde vente. Bortser man imidlertid fra disse paa første Togt udførte 14 Observationer, vil man se, at alle de Øvrige paa faa Undtagelser nær meget vel stemme overens med de Tal, man kan beregne efter den ved de ovenciterede Forsøg bestemte Formel

$$N = 14.4 - 0.23\,t.$$

85, and 87 exhibiting a difference of more than 1 per cent as compared with the general result, whereas the probable deviation of a single observation from the curve drawn according to this Table may be computed at ± 0.52 per cent, a deviation so small as to arise, probably, in no slight degree from errors of observation.

The greatest discrepancies refer chiefly to a depth of 300—600 fathoms (549—1097 metres); now and again, however, they were met with in water obtained from greater depths.

In only two of the samples of air expelled from bottom-water drawn where the depth was great, did the percentage of oxygen prove much too high, viz. in Nos. 68 and 87, the samples of water yielding them having been obtained from two spots which, strange to say, are in a line running parallel and in close proximity to the boundary between the warm current flowing north and the cold Arctic current flowing south past the Island of Jan Mayen. Now, if we exclude from these differences the chief of those that contribute towards giving the curve a very slight but appreciable minimum at a depth of from 300 to 400 fathoms (540—732 metres), the rule according to which the proportion of oxygen is found to diminish with the depth may be expressed as follows: — The proportion of oxygen, which at the surface is 35.3 per cent, begins at once and continues to diminish, at first rapidly and afterwards at a slower rate, till it has reached 32.5 per cent, at the depth of 300 fathoms (549 metres), from whence it keeps almost constant. I will not omit to observe, that of the samples of water examined 40 had been drawn from the bottom; is was, however, impossible to detect any difference in composition between these and the samples obtained from equal intermediate depths.

When investigating the variation in the absolute amount of air, it will obviously be advisable to make use of the nitrogen absorbed, since the quantity of air observed in the deeper strata may, by reason of the steady consumption of oxygen, be assumed to differ more or less from that which would be absorbed at the surface under the direct influence of the atmosphere, whereas nitrogen, from the very slight affinity evinced by that gas for other bodies, may, without involving appreciable error, be regarded as proof against the accidents of locality.

If, therefore, the amount of nitrogen be adopted as the standard of measurement for the air absorbed in seawater, a marked uniformity will here, too, be found to characterise the distribution, as determined by the observations described, with the exception however of Svendsen's, on the first voyage, by which the amount of nitrogen was found to be less than all subsequently instituted observations gave reason to expect. Excluding, then, the 14 observations from the first voyage, all of the others, with but few exceptions, agree closely with the figures which may be found by the formula stated above —

$$N = 14.4 - 0.23\,t,$$

Man faar nemlig af Observationerne følgende Middelværdier:

Dybdeintervaller.		Middeltemp. °C.	Midlere Kvælstofmængde observeret	Kvælstofmængde beregnet.	Differents.
Engelske Favne.	Meter.				
0	0	6.4	13.07	12.93	—0.14
0—100	0—183	2.7	13.98	13.78	—0.20
100—300	183—549	1.0	14.15	14.17	0.02
300—600	549—1097	—0.6	14.54	14.54	0.00
600—1000	1097—1829	—0.8	14.04	14.58	0.54
1000—1760	1829—3219	—1.4	14.38	14.72	0.34

Naar den midlere Kvælstofmængde her i de dybere Lag er funden noget lavere end man skulde vente, da har dette sin Grund i, at der ved de 5 Observationer No. 17, 22, 33, 36 og 37, alle hidrørende fra Vandprøver fra det i 1877 undersøgte Strøg, er fundet en ca. 1.5 CC. lavere Gehalt, end de ved sin Temperatur vilde kunne optage ved almindeligt Atmosphæretryk. Forresten vil efter alle de øvrige Observationer at dømme ogsaa i de større Dyb Kvælstofmængden findes at stemme overens med den af Formelen beregnede.

En lignende Sammenligning[1] er af Buchanan gjort mellem de af ham for de sydlige Have fundne Tal og de af Bunsen for destilleret Vand opstillede. Der optræder ved denne Sammenligning især ved de lavere Temperaturer ikke ubetydelige Differentser paa lige op til over 1 CC. pr. Litre, men disse vil ved Sammenligning med de efter Forfatterens Formel beregnede Tal saa godt som bortfalde, idet man faar:

Dybde i Fod.	Midlere Temperatur. °C.	Kvælstofmængde efter Buchanan.	Kvælstofmængde efter Formelen.	Differents.
600	14.6	11.26	11.04	—0.22
1200	13.0	11.71	11.41	—0.30
1800	6.9	13.00	12.81	—0.19
2400	5.1	13.10	13.23	0.13
4800	2.5	13.82	13.82	0.00
derover	1.5	14.37	14.05	—0.32

Det fremgaar heraf, at Kvælstofmængden, saaledes som det allerede af Dr. Jacobsen og Andre er antaget, ikke i mindste Maade retter sig efter de i de store Dyb herskende Tryk men kun afhænger af Temperaturen. Den eneste rimelige Fortolkning udelukker Muligheden for, at Tryk- og Temperaturdifferentser i de under Overfladen

[1] Ber. Berl. chem. Ges. — 11 — 410.

as will be seen from the following Table showing the mean values.

Intervals of Depth.		Mean Temp. °C.	Mean Amount of Nitr. observed.	Amount of Nitrogen computed.	Difference.
English Fathoms.	Metres.				
0	0	6.4	13.07	12.93	—0.14
0—100	0—183	2.7	13.98	13.78	—0.20
100—300	183—549	1.0	14.15	14.17	0 02
300—600	549—1097	—0.6	14.54	14.54	0.00
600—1000	1097—1829	—0.8	14.04	14.58	0.54
1000—1760	1829—3219	—1.4	14.38	14.72	0.34

The mean quantity of nitrogen in the deeper strata proved, accordingly, somewhat lower than there was reason to expect; but this arose from the proportion determined by 5 of the observations, viz. Nos. 17, 22, 33, 36, and 37 — all of them referring to samples of water obtained from the tract of ocean investigated in 1877 — having been about 1.5^{cc} less than could be absorbed at the same temperature under ordinary atmospheric pressure. For the rest, judging from all the other observations, the proportion of nitrogen observed, even at greater depths, will be found to agree with that computed by the formula.

A similar comparison[1] was instituted by Buchanan between his results for the water of the Southern Seas and the figures found by Bunsen for distilled water. The differences resulting from this comparison, more especially for a low temperature, are considerable, the greatest reaching 1^{cc} per litre; but, on comparing them with the figures given by the author's formula, they will be found almost to vanish, as appears from the following Table.

Depth in Feet.	Mean Temperature. °C.	Amount of Nitrogen accord. to Buchanan.	Amount of Nitrogen comp. by the Formula.	Difference.
600	14.6	11.26	11.04	—0.22
1200	13.0	11.71	11.41	—0.30
1800	6.9	13.00	12.81	—0.19
2400	5.1	13.10	13.23	0.13
4800	2.5	13.82	13.82	0.00
Greater Depths.	1.5	14.37	14.05	—0.32

Hence the amount of nitrogen, as previously assumed by Dr. Jacobsen and others, can in no wise be affected by the increase of pressure at great depths, but must obviously be dependent on temperature alone. The results of these observations exclude, therefore, the possibility of differences in temperature and pressure at depths below

[1] Ber. Berl. chem. Ges. 11, p. 410.

liggende Lag skulde kunne bidføre en anden Fordeling af Luften end den, der allerede existerer fra den Tid, da Vandet sidste Gang befandt sig i Overfladen udsat for fri Paavirkning af Atmosphæren. Luften vil saaledes kun gjennem Vandets Circulation kunne naa ned i Dybet, og nogen Udjevning af Luftmængderne vil der kun kunne ske gjennem Blanding af de forskjelligartede Vandmængder, en Blanding, som under Forudsætning af at der ikke ogsaa foregaar Opvarmning eller Afkjøling, ikke vil kunne forrykke det rette Forhold mellem Temperatur og Kvælstofmængde, da Kvælstofmængdens Variation med Temperaturen fremstilles ved en ret Linie.

Man vil altsaa, dersom disse Forudsætninger holde Stik, ved en Kvælstofbestemmelse i de dybere liggende Vandlag kunne om end meget raat bestemme, om disse have været Gjenstand for en væsentlig Opvarmning eller Afkjøling, siden de sidst befandt sig i Overfladen, forudsat at man kan negligere Virkningerne af Atmosphæretrykkets Forandringer og andre mulige Tilfældigheder, som under Absorbtionen i Overfladen vil kunne gjøre sin Indflydelse gjældende.

Grupperer man de her offentliggjorte Observationer efter Vandprøvernes Temperatur, viser det sig, at Kvælstofmængden meget nøie svarer til den efter denne Temperatur af Formelen beregnede, det vil sige, Vandprøvernes Temperatur skulde ikke i væsentlig Grad have forandret sig, siden de sidst befandt sig i Overfladen. Man faar nemlig:

Temperatur-interval.	Midlere Temperatur.	Midlere Kvælstof-mængde.	Beregnet Kvælstof-mængde.	Differents.
under 0°	—1°.1	14.32	14.65	0.33
0—3	1.2	14.19	14.12	—0.07
3—6	4.6	13.38	13.34	—0.04
6—9	7.5	12.90	12.67	—0.13
over 9	11.2	11.93	11.82	—0.11

At Overensstemmelsen for Temperaturerne under 0° ikke er saa fuldstændig som ellers, skyldes ogsaa her de ovenfor nævnte 5 Observationer alle udførte paa Togtet i 1877. Beregner man derimod den midlere Temperatur og Kvælstofmængde for dette Interval af de paa sidste Aars Togt gjorte Observationer, erholder man til Middeltemperaturen —1.2 Kvælstofmængden 14.59 CC. altsaa kun 0.09 CC. mindre end beregnet.

Benyttes paa samme Maade de af Dr. Jacobsen offentligjorte Observationer til et Overslag over Kvælstofmængden i Nordsøen, erholder man med runde Tal:

the surface causing a distribution of the air different to that which existed when the water was last at the surface, in direct contact with the atmosphere. Hence the air cannot penetrate to such depths save by the circulation of the water, and an adjustment of the amounts of air can be effected solely by the mixing of the water different in composition, which will not, however, unless we assume a simultaneous increase or decrease of heat, disturb the true relation between the temperature and the amount of nitrogen, since the variation of the latter with the temperature is expressed by a right line.

If, then, these assumptions are found to hold good, it will be possible, when computing the proportion of nitrogen in the lower strata of the water, to determine — very roughly indeed — whether the latter have experienced any increase or decrease of heat since they were last at the surface, provided we can ignore the effect of change in the atmospheric pressure and of other accidental circumstances, which, during the process of absorption, may have made their influence felt.

On grouping together according to the temperature of the samples of water examined, the observations published in this Memoir, the proportion of nitrogen will be found to agree very closely with that computed by the formula, showing, as appears from the following Table, that the temperature could have varied but little since the water had been last at the surface.

Intervals of Temperature.	Mean Temperature.	Mean Amount of Nitrogen.	Computed Amount of Nitrogen.	Difference.
below 0°	—1°.1	14.32	14.65	0.33
0—3	1.2	14.19	14.12	—0.07
3—6	4.6	13.38	13.34	—0.04
6—9	7.5	12.90	12.67	—0.13
above 9	11.2	11.93	11.82	—0.11

For the temperatures under 0° the agreement is indeed not so close; but here, too, the cause may be traced to the aforesaid 5 observations from the voyage in 1877. If, however, we compute the mean temperature and the amount of nitrogen for that interval by the results of the observations instituted on the last voyage, the mean temperature will be —1.2 and the amount of nitrogen 14.59 cc, or only 0.09 cc less than that computed by the formula.

A similar computation with the observations published by Dr. Jacobsen for estimating the amount of nitrogen in the water of the North Sea, will give, in round numbers, the following results: —

Temperatur-interval.	Midlere Temperatur.	Midlere Kvælstof-mængde.	Beregnet Kvælstof-mængde.	Differents.
under 10°	6°.5.	13.2	12.9	—0.3
10—15	12 .1	12.0	11.6	—0.4
15—20	16 .9	11.0	10.5[1]	—0.5

Her findes altsaa overalt en Kvælstofgehalt svarende til en noget lavere Temperatur end den observerede og det i stærkest Grad for de høiere Temperaturer, eller da Temperaturen aftager med Dybden, for de øverst liggende Vandlag. Naar man erindrer, at Jacobsens Observationer ere udførte i Eftersommeren og for det Meste paa Vandprøver fra saa smaa Dyb, at Luft- og Vandtemperaturens aarlige Variation kan tænkes at have gjort sig gjældende, vil dette ikke være saa vanskeligt at forklare gjennem Vandets Opvarmning i Sommermaanederne, medens Kvælstofmængden maa antages at rette sig efter en Temperatur mindst lige saa lav som den aarlige Middeltemperatur.

At lignende Phænomener ikke ogsaa ere observerede i de øvre Lag af det af den norske Nordhavsexpedition undersøgte Hav, har sin simple Forklaringsgrund deri, at Lufttemperaturen der selv om Sommeren ikke er høiere end Overfladetemperaturen hellere omvendt.

[1] Den for Intervallet fra 0 til 15° udledede Formel er her forudsat at gjælde ogsaa fra 15 til 20°.

Intervals of Temperature.	Mean Temperature.	Mean Amount of Nitrogen.	Computed Amount of Nitrogen.	Difference.
below 10°	6°.5	13.2	12.9	—0.3
10—15	12 .1	12.0	11.6	—0.4
15—20	16 .9	11.0	10.5[1]	—0.5

The proportion of nitrogen in this Table corresponds accordingly to a somewhat lower temperature than that observed, especially for the higher temperatures, or rather, since the temperature diminishes with the depth, for the upper strata of the water. If, however, we bear in mind that Jacobsen's observations were instituted at the latter end of summer, and the majority with samples of water obtained from such trifling depths that the annual variation in the temperature of air and water probably exerted some influence, this will not be difficult to account for, by reason of the heat stored in the water during the summer months, whereas the amount of nitrogen must be regulated by a temperature at least as low as the mean annual temperature.

That similar phenomena were not observed in the upper strata of the water throughout the tract of ocean investigated on the Norwegian North-Atlantic Expedition, arises simply from the fact, that the temperature of the air in those regions does not even in summer exceed that of the water at the surface, nay the reverse is rather the case.

[1] The formula deduced for the interval from 0° to 15° is here assumed to be correct for that extending from 15° to 20°.

II. Om Kulsyren i Søvandet.

Af alle de Chemikere, som før den tyske Pomerania-expedition i 1872 anstillede Undersøgelser over Luften i Søvandet, blev der foruden Bestemmelser af Surstof-Kvælstofmængden ogsaa samtidig udført Maalinger af den under Udkogningen uddrevne Kulsyre, og de Qvantiteter, man paa denne Maade fandt, bleve ogsaa bestandig opførte blandt Resultaterne som den samlede Mængde Kulsyre, der var opløst i Søvandet enten fri som Gasart eller bunden til Carbonater som sure Salte. De Resultater, som ad denne Vei erholdtes, vise imidlertid bestandig overmaade store Uoverensstemmelser ikke alene mellem de forskjellige Forfattere men ogsaa mellem de enkelte Observationer hos en og samme Experimentator, hvor man dog maatte have antaget, at en større Ensartethed i Forsøgenes Udførelse skulde have udjevnet Differentserne.

Som Exempel paa, hvor vidt Uoverensstemmelserne i de ældre Opgaver strække sig, kan anføres Følgende:

I en Liter Overfladevand fandt

Frémy	2.2 til 2.8	CC.	Kulsyre	[1].
Morren	1.6 „ 3.9	—	—	[2].
Lewy	2.4 „ 3.9	—	—	[3].
Pisani	6.0 „ 8.1	—	—	[4].
Hunter	0.8 „ 5.9	—	—	[5].

Desuden fandtes efter en noget anden Fremgangsmaade af

Bischof	39.0	CC.	[6].
Vogel	55.6 til 116.3	—	[7].

Ved alle disse ældre Undersøgelser, hvor der ved Udkogningerne var anvendt fuldt Atmosphæretryk, og hvor

[1] Compt. rend. 6—616.
[2] Ann. Chim. Phys. [3] — 12 — 5.
[3] Ann. — — [3] — 17. Ann. Chem. Pharm. 58 — 328.
[4] Compt. rend. 41 — 532.
[5] Jahresbericht 1869 — 1279.
[6] Chem. Geologie 1 Aufl. 2 — 1130.
[7] Schweigg. Journ. 8 — 351.

II. On the Carbonic Acid in Sea-water.

The several chemists who, previous to the German 'Pomerania' Expedition (1872), had instituted observations on the air present in sea-water, when measuring the amount of the oxygen and nitrogen also collected the carbonic acid driven off during the process of boiling; and the quantities determined were invariably set down among the results as the total amount of carbonic acid actually existing in the water, either free as gas or contained, to a less extent, also in bicarbonates. The results thus attained vary however to a remarkable extent, and not only as between the different experimentalists individually, — the like is also the case with the observations of one and the same person, although greater uniformity in the mode of operation should apparently have tended to eliminate error.

The following Table will show the wide difference prevailing between the formulæ of early authors.

Amount of Carbonic Acid in 1 Litre of Surface-water.

Frémy	2.2 to 2.8	CC.		[1].
Morren	1.6 „ 3.9	—		[2].
Lewy	2.4 „ 3.9	—		[3].
Pisani	6.0 „ 8.1	—		[4].
Hunter	0.8 „ 5.9	—		[5].

The proportion as found by a somewhat different process was as follows —

Bischof	39.0	CC.	[6].
Vogel	55.6 to 116.3	—	[7].

Hence, it appears that the quantity of carbonic acid given off under these early experiments, for which the boil-

[1] Compt. rend. 6, p. 616.
[2] Ann. Chim. Phys. [3] 12, p. 5.
[3] — — — [3] 17. Ann. Chem. Pharm. 58, p. 328.
[4] Compt. rend. 41, p. 532.
[5] Liebigs Jahrbericht 1869, p. 1279.
[6] Chem. Geologie 1 Aufl. 2, p. 1130.
[7] Schweigg. Journ. 8, p. 351.

derfor Temperaturen steg over 100°, undveg altsaa altid vel maalelige og ofte endog temmelig betydelige Mængder Kulsyre.

Ved de paa Pomeraniaexpeditionen i 1871 udførte Luftbestemmelser [1], hvor den tidligere beskrevne Methode med Gasarternes Udkogning under et ved Vanddamp frembragt Vacuum anvendtes, sænkedes imidlertid Temperaturen ikke ubetydeligt, og det viste sig da, at man ved denne Temperatur temmelig ofte kun fik næsten umaalelig smaa Qvantiteter Kulsyre uddrevet sammen med den øvrige Luft, medens de tidligere Uoverensstemmelser mellem flere med samme Vandprøve gjentagne Udkogninger ogsaa her gik igjen.

Jacobsen fandt sig derfor ved dette mærkelige Phænomen foranlediget til nærmere at andersøge Kulsyrens Absorbtionsforhold ligeoverfor Søvand.

Gjennem de Forsøg, som han i denne Anledning anstillede, viste det sig da, at man ad andre Veie kunde paavise aldeles uventet store Qvantiteter Kulsyre i det samme Vand, hvoraf man ved en i flere Timer fortsat Udkogning efter Bunsens Methode kun kunde erholde meget smaa Mængder. Afdestilleredes nemlig Søvandet i en kulsyrefri Luftstrøm uden Luftfortynding i en Retorte, undveg der den hele Tid Kulsyre, lige indtil den hele Mængde Vædske var afdestilleret, saaledes at man først ved rigelig Udskillelse af Salte kunde være fuldstændig sikker paa at have erholdt det samlede Udbytte af Kulsyre uddrevet.

Der lod sig under Udkogningen ikke paavise noget Punct, hvor man kunde tale om en Grændse mellem fri og surt bunden Kulsyre.

Paa denne Maade uddrev nu Jacobsen ved fuldstændig Afdestillation af $^1/_4$ Litre Søvand i en kulsyrefri Luftstrøm den hele Mængde Kulsyre og opsamlede den efter Pettenkoffers Princip i en afmaalt Mængde titreret Barytvand, som efter endt Operation retitreredes med Oxalsyre, og beregnedes efter disse den samlede Kulsyremængde, som for ufortyndet Nordsøvand opgives til omkring 100 Mgr. per Litre.

Samtidig bestemtes ogsaa i Residuet fra Inddampning af circa 10 Litre af det samme Vand den i de neutrale Carbonater indeholdte Kulsyre til i Middel kun omkring 10 Mgr. per Litre.

Ifølge disse Observationer kunde altsaa kun en meget liden Brøkdel af den ved Destillationen uddrevne Kulsyre betragtes som surt bunden, og Jacobsen imødegaar derfor i sin Afhandling bestemt den af Vierthaler [2] gjorte Antagelse, at al den ved Kogning af Søvandet uddrevne Kulsyre skulde være surt bunden. Han anser sig endvidere aldeles sikker for under Inddampningen ikke at have erholdt decomponeret nogen Del af de i Søvandet indeholdte neutrale Carbonater, idet han udtrykkelig siger: "Die ganze Menge der nicht

[1] Ann. Chem. Pharm. 167 — 1.
[2] Wien. Acad. Ber. [2] — 56 — 479.

ing-process was conducted with full atmospheric pressure, or at a temperature of more than 100° C., invariably proved appreciable, nay sometimes rather large.

When performing the air-determinations [1] on the 'Pomerania' Expedition in 1871 (by the method, previously described, of boiling out the gaseous elements in a vacuum created by steam), the temperature kept considerably lower, and the quantity of carbonic acid expelled with the other atmospheric elements at a comparatively low temperature was often immeasurably small; moreover, the variable character of the results, alluded to above, on repeating the boiling-process with the same sample of water again asserted itself.

Struck by this remarkable phenomenon, Jacobsen determined to investigate anew the absorptive capacity of sea-water in relation to carbonic acid.

The experiments of that chemist undertaken with the above object in view afforded conclusive proof of the fact, that large quantities of carbonic acid were still present in water from which a very small amount only could be expelled after several hours' protracted boiling by Bunsen's method. On distilling in a retort sea-water exposed to a current of air free from carbonic acid, but not rarified, carbonic acid is found to escape so long as any portion of the fluid remains undistilled, an abundance of solid deposit however being the only indication that all or nearly all the carbonic acid present in the water has been driven off.

During the process of boiling no particular moment could be determined marking the escape of the carbonic acid present as gas and of that which has combined with carbonates to form bicarbonates.

In this manner, by distillation in a current of air free from carbonic acid, Jacobsen succeeded in expelling the whole amount of carbonic acid contained in $^1/_4$ litre of sea-water, and collected it, by Pettenkoffer's method, in a given quantity of titrated baryta water of known strength, which, on the operation being terminated, he retitrated with oxalic acid, computing accordingly the total amount of carbonic acid driven off in the process. Undiluted North Sea water contains according to Jacobsen's results about 100^{mgr} per litre.

The amount of carbonic acid contained by the neutral carbonates in the residuary deposit from the evaporation of 10 litres of the same water, was also calculated, and found to average only about 10^{mgr} per litre.

According to these observations, a very small proportion only of the carbonic acid driven off by distillation could have been present in bicarbonates; and hence Jacobsen emphatically opposes Vierthaler's assumption, [2] that the carbonic acid boiled out of sea-water occurs in that form. Moreover, he feels quite sure that no portion of the neutral carbonates in the water examined was decomposed during the process of boiling. "Die ganze Menge," he says, "der nicht mit Basen zu neutralen Salzen verbun-

[1] Ann. Chem. Pharm. 167, p. 1.
[2] Wien. Acad. Ber. [2] 56, p. 479.

mit Basen zu neutralen Salzen verbundenen Kohlensäure erhält man aus dem Meerwasser, wenn dieses unter Durchleiten eines Stromes kohlensäurefreier Luft bis zur reichlichen Abscheidung von Chlornatrium verkocht wird."

Det maatte saaledes fremstille sig som et høist mærkeligt Phænomen, at den Kulsyre, som dog maatte tænkes opløst i Søvandet paa en eller anden Maade som fri Gasart, ikke skulde lade sig uddrive ved Udkogning efter Bunsens Methode, og at den endogsaa ved Udkogning under fuldt Atmosphæretryk og i en kulsyrefri Luftstrøm skulde undvige saa langsomt, at man først ved Concentration til omkring $^1/_{10}$ af det oprindelige Volum erholdt den sidste Rest uddrevet

Forat kunne forklare disse Mærkeligheder tillægger Jacobsen Søvandet en eiendommelig Evne til med megen Kraft at kunne tilbageholde sin Kulsyre, en Mening, som han efter nærmere at have fremført sine Grunde mod den af Vierthaler gjorte Antagelse udtrykker med følgende Ord: "Wie man aber auch eine Deutung der starken Absorptionswirkung des Meerwassers auf die atmosphärische Kohlensäure versuchen möge, jedenfalls kann man die Kohlensäure nicht in demselben Sinne, wie Sauerstoff und Stickstoff, als absorbirtes freies Gas darin annehmen. Man mag einstweilen von einem eigenthümlichen Zustande der Bindung sprechen, bei welchem die Kohlensäure selbst durch stundenlanges Kochen nur sehr unvollständig ausgestrieben wird. Das Vorhandensein ungeheuerer Mengen Kohlensäure im Meerwasser, in einem solchen Zustande, wo sie der Athmungsluft der Seethiere nicht ohne Weiteres zugezählt werden kann, ohne andererseits der Vegetation des Meeres unzugänglich zu sein, ist jedenfalls für das maritime Thier- und Pflanzenleben von höchster Bedeutung."

Jacobsen antager nærmest at maatte henlægge denne eiendommelige Absorbtionsevne hos Søvandet til den deri opløste Chlormagnesium og henviser i saa Henseende til Egenskaber hos en Chlormagnesiumopløsning, der indeholder en i Kulsyre opløst Mængde kulsur Kalk. En saadan Opløsning kan ifølge ham henstaa i ugevis ja endog koges uden at blakkes, først ved meget langt fortsat Concentration udskiller der sig ren kulsur Magnesia.

Denne Jacobsens Anskuelsesmaade blev senere saa godt som uforandret optagen af den engelske Challenger-expeditions Chemiker, J. Y. Buchanan, som udførte en Række Forsøg[1] for nærmere at bestemme, hvilket eller hvilke af Saltene i Søvandet der skulde være i Besiddelse af denne Evne saaledes at kunne tilbageholde Kulsyren. Han kom i den Henseende til det paafaldende Resultat, at de fleste Salte, som han undersøgte, i mere eller mindre Grad skulde være i Besiddelse af denne Egenskab dog mest Sulfaterne, saaledes at denne Søvandets stærke Absorbtionsevne ligeoverfor Kulsyren af ham henlagdes fra Chlormagnesium til Sulfaterne. Ved de af ham udførte

[1] Proc. Royal Soc. 22 — 192 og 483.

denen Kohlensäure erhält man aus dem Meerwasser, wenn dieses unter Durchleiten eines Stromes kohlensäurefreier Luft bis zur reichlichen Abscheidung von Chlornatrium verkocht wird."

Hence it could not but strike the experimentalist as a remarkable phenomenon, that the carbonic acid, which in some way or other must have been held absorbed by the sea-water in a free gaseous form, should not admit of being boiled out by Bunsen's method, and that even when the boiling-process was conducted with full atmospheric pressure in a current of air free from carbonic acid, it should escape so slowly, that concentration to the extent of about one-tenth of the original volume proved necessary to obtain it all.

To account for this perplexing phenomenon, Jacobsen ascribed to sea-water a peculiar property of retaining its carbonic acid, an assumption which, after setting forth more at large the grounds that led him to oppose Vierthaler's hypothesis, he enounces in the following terms: — "Wie man aber auch eine Deutung der starken Absorptionswirkung des Meerwassers auf die atmosphärische Kohlensäure versuchen möge, jedenfalls kann man die Kohlensäure nicht in demselben Sinne, wie Sauerstoff und Stickstoff, als absorbirtes freies Gas darin annehmen. Man mag einstweilen von einem eigenthümlichen Zustande der Bindung sprechen, bei welchem die Kohlensäure selbst durch stundenlanges Kochen nur sehr unvollständig ausgestrieben wird. Das Vorhandensein ungeheuerer Mengen Kohlensäure im Meerwasser, in einem solchen Zustande, wo sie der Athmungsluft der Seethiere nicht ohne Weiteres zugezählt werden kann, ohne andererseits der Vegetation des Meeres unzugänglich zu sein, ist jedenfalls für das maritime Thier- und Pflanzenleben von höchster Bedeutung."

Jacobsen is of opinion, that this peculair absorptive power must be derived from the chloride of magnesia present in sea-water, and draws attention to certain properties possessed by a solution of chloride of magnesia containing carbonate of lime dissolved in carbonic acid. A solution of this kind may, according to his statement, be left exposed for weeks together, may be boiled even, without becoming turbid; nor can it be made to part with pure carbonate of magnesia till after protracted concentration.

Jacobsen's hypothesis was subsequently adopted, almost without modification, by J. Y. Buchanan, chemist to the 'Challenger' Expedition, who instituted a series of experiments[1] with a view to determine which of the salts present in sea-water had this property of retaining carbonic acid. He arrived at the surprising conclusion, that most of the salts examined were in some degree distinguished by this property, chiefly however the sulphates; and the remarkable power possessed by sea-water of retaining carbonic acid he transferred accordingly from chloride of magnesia to the sulphates. Hence, when performing carbonic acid determinations he always precipitated the sulphuric

[1] Proc. Royal Soc. 22, pp. 192 and 483.

Kulsyrebestemmelser pleiede han derfor altid før Operationens Begyndelse at udfælde Svovlsyren med concentreret Chlorbariumopløsning, forat Kulsyren lettere skulde undvige, men anvendte forresten den af Dr. Jacobsen angivne Methode, hvorved han har bestemt Kulsyren i Søvandet i de sydlige Have til i Middel 43.26 Mgr. per Litre[1].

Da jeg Vaaren 1877 opfordredes til at gaa ud som Chemiker paa den norske Nordhavsexpeditions 2det Togt, var der kun levnet mig nogle faa Dage til Forberedelser, og det følger derfor af sig selv, at jeg ikke paa nogen Maade dengang kunde have befattet mig med vidtløftigere Forundersøgelser, og jeg maatte saaledes uden selv at kunne prøve optage de tidligere Methoder uforandrede. Paa Togtet i 1877 anvendtes derfor den af Dr. Jacobsen angivne Methode, og bestemtes efter denne gjennem en Række omhyggelig udførte Observationer Kulsyregehalten i det da undersøgte Hav til omkring 100 Mgr. per Litre. Der viste sig imidlertid ved Gjentagelse af samme Observation bestandig Uoverensstemmelser, som ofte vare ikke ubetydelige og engang endog løb op til hele 12 Mgr. per Litre.

Dels herved dels ved andre Omstændigheder vaktes min Mistanke om Tilforladeligheden af den af Dr. Jacobsen i Forslag bragte Methode.

Det syntes mig paa Forhaand overmaade urimeligt, at der hos Søvandet skulde findes en saadan mærkelig Evne til rent mekanisk at tilbageholde den ene Gasart, medens den ingensomhelst Virkning skulde udøve paa de Andre. Heller ikke var der nogensinde gjort noget Forsøg paa at sætte dette Phænomen i Forbindelse med bekjendte chemiske Egenskaber hos nogen af de i Søvandet indeholdte Stoffe.

Ved et Tilfælde kom jeg en Dag til at forsøge Søvandets Reaktion paa Lakmus og Rosolsyre og fandt til min sore Forundring, at det reagerede bestemt og tydeligt alkalisk, hvad jeg siden har bragt i Erfaring, at allerede v. Bibra[2] og senere E. Guignet og A. Telles[3] har observeret.

Efter mine Forsøg viser to ligestore Prøver af en efter Gottliebs[4] Fremgangmaade frisk tilberedt Lakmusopløsning, hvoraf den Ene tilsættes en tilstrækkelig Mængde Søvand og den Anden et ligestort Volum rent destilleret Vand, ikke ubetydelige Farvedifferentser. Ligeledes antager en med meget fortyndet Oxalsyre svagt udsyret passende Portion rent Vand, hvori paa Forhaand er opløst en Draabe Rosolsyre, ved Tilsætning af Søvand strax den bekjendte rødlig-violette Farve.

Paa denne Maade undersøgtes paa Expeditionens sidste Togt, hvor der var fuld Anledning til at erholde Vandprøverne ganske friske, et meget stort Antal af disse og uden Undtagelse med det samme ovenbeskrevne Resultat.

[1] Ber. Berl. chem. Ges. 11 — 410.
[2] Ann Chem. Pharm. 77 — 90.
[3] Compt. rend. 83 — 919.
[4] Journ. für pract. Chem. 107 — 488.

acid, before commencing the operation, by adding to the water a saturated solution of chloride of barium, in order to facilitate the liberation of the carbonic acid, but, with this exception, adopted the method devised by Dr. Jacobsen, and determined the mean amount of carbonic acid present in the water of the Southern Seas to be 43.26^{mgr} per litre.[1]

When invited, in the spring of 1877, to go out as chemist to the Norwegian North-Atlantic Expedition, on the second cruise, I had but a few days in which to make the necessary preparations, and consequently no time being left me for preliminary experiments, I was compelled to adopt unchanged the earlier methods, without testing the accuracy of their results. On the cruise in 1877, I therefore applied Dr. Jacobsen's method, and determined by a series of careful observations the amount of carbonic acid present in the water of the tract then investigated to be about 100^{mgr} per litre. But, on repeating the operation with the same sample of water, the results were always found to vary, and frequently indeed considerably; nay, on one occasion the difference amounted to as much as 12^{mgr} per litre.

Partly for this reason, and partly from other circumstances, I was led to question the trustworthiness of Jacobsen's method.

Now it struck me at once as highly improbable that sea-water should possess so remarkable a power of retaining mechanically one gas, and yet, in this respect, exert no influence whatever on others. Nor had any attempt been made to connect this phenomenon with known chemical properties distinguishing the substances contained in sea-water.

Quite accidentally, I was one day led to investigate the effect of sea-water as a reagent on litmus and rosolic acid, and found its reaction, to my great surprise, distinctly alkaline, which, indeed, as I subsequently learnt, had been already observed, first by von Bibra[2] and later by E. Guignet and A. Telles.[3]

According to my experiments, two equal measures of a solution of litmus, freshly prepared by Gottlieb's method,[4] one of which has added to it a sufficient quantity of sea-water and the other an equal volume of pure distilled water, exhibit considerable difference in colour. Moreover, a proportionate mixture of highly dilute oxalic acid and pure water, the latter having been previously treated with a drop of rosolic acid, will, on the addition of sea-water, immediately assume the well known reddish-violet hue.

In this manner were examined on the last cruise of the Expedition, which afforded excellent opportunities of obtaining the water quite fresh, a very large number of samples, and invariably with the results described above.

[1] Ber. Berl. chem. Ges. 11, p. 410.
[2] Ann. Chem. Pharm. 77, p. 90.
[3] Compt. rend. 83, p. 919.
[4] Journ. für pract. Chem. 107, p. 488.

Dette syntes ogsaa meget vanskeligt at forklare, saafremt det virkelig skulde forholde sig som af Enkelte paastaaet, at der i Søvandet skulde findes et meget stort Overskud af fri Kulsyre ved Siden af en meget liden Qvantitet af sure Carbonater. Det maatte aabenbart synes meget rimeligere at forklare de af Dr. Jacobsen gjorte Observationer derved, at Søvandet under den langvarige Kogning ved en eller anden chemisk Reaction gav Slip paa noget af sin neutralt bundne Kulsyre.

For at komme paa det Rene med, om dette virkelig forholdt sig saa, gik jeg frem paa følgende Maade:

200 CC. Søvand (af sp. Vægt 1.0267 ved 17.°5 C. i Forhold til destilleret Vand af samme Temperatur) afdestilleredes næsten til Tørhed i en kulsyrefri Luftstrøm, og opfangedes den undvigende Kulsyre i 25 CC. af en Barytopløsning, hvoraf 1 CC. svarede til 4.0204 Mgr. Kulsyre. Ved Retitration med Oxalsyre viste det sig, at 19.97 CC. af det anvendte Barytvand var uneutraliseret, hvoraf den undvegne Kulsyre beregnedes til 20.2 Mgr. Residuet paaheldtes nu friskt udkogt Vand, som atter afdestilleredes, hvorved endnu et ubetydeligt Spor af Kulsyre erholdtes. Sluttelig tilsattes circa 0.5 Gr. fuldkommen ren friskt udglødet Soda, hvorpaa det Hele atter fortyndedes med kulsyrefrit Vand til Søvandets oprindelige Volum og saa afdestilleredes i en kulsyrefri Luftstrøm.

Allerede fra det Øieblik af, da Vædsken var kommen i Kog, begyndte strax en saa voldsom Kulsyreudvikling, at det i Forlaget anbragte Barytvand slap store Mængder uabsorberede igjennem, og det viste sig efter endt Operation, at kun 1.3 CC. Barytvand var forblevet uneutraliseret. Heraf beregnes den absorberede Del af den undvegne Kulsyre til 95.3 Mgr., medens desforuden meget betydelige Mængder gik igjennem, idet nemlig Barytvandet i et uformigt Rør, som var anbragt foran Forlaget, fuldstændigt var forbrugt.

Efter Forslag af Professor Waage gjentoges Forsøget med varmt fældt, ved 100° tørret kulsur Kalk, hvoraf det ogsaa lykkedes at uddrive ikke ubetydelige om end meget mindre Mængder Kulsyre, hvorimod der ved et Forsøg med fint pulveriseret Marmor ikke erholdtes noget sikkert Resultat.

Betydningen af disse Observationer kunde ikke være tvivlsom, da det hermed paa det Tydeligste var godtgjort, at den i Søvandet forhaandenværende Saltblanding ved Koghede decomponerede neutrale Carbonater, og dermed ogsaa, at alle de hidindtil gjorte Kulsyrebestemmelser med Hensyn paa sin Hensigt at bestemme den i Søvandet indeholdte frie og surt bundne Kulsyre vare forfeilede. Hvad angaar de før Publicationen af Dr. Jacobsens Afhandling om Luften i Søvandet udførte Kulsyrebestemmelser, da er det en Selvfølge, at de alle uden Undtagelse maatte være i enhver Henseende fuldstændig værdiløse, idet der ved dem intetsteds er kommen til Anvendelse en Afdestillation til Tørhed eller en saa vidtdreven Concentration, at man

This fact would obviously be most difficult of explanation if, as some have affirmed, sea-water does actually contain a very large surplus of free carbonic acid along with an exceedingly small proportion of bicarbonates. A more plausible hypothesis by which to explain Dr. Jacobsen's observations were surely the assumption, that during the protracted process of boiling some of the neutral carbonates present in sea-water had been decomposed.

With the object of ascertaining whether such was really the case, I went to work as follows.

Two hundred c.centim. of sea-water (sp. grav. 1.0267, temp. 17.°5 C., as compared with distilled water of the same temperature) were distilled almost to dryness in a current of air free from carbonic acid, and the carbonic acid collected in 25^{cc} of baryta water, 1^{cc} of which represented 4.0204^{mgr} carbonic acid. On being retitrated with oxalic acid 19.97^{cc} of the baryta water were found not to be saturated, and 20.2^{mgr} carbonic acid had accordingly been driven off. Water freshly boiled was now poured on the residue, and then evaporated, the result yielding a slight trace of carbonic acid; finally, about 0.5^{mgr} purified and freshly heated soda was added, and the whole compound again diluted with water, from which all carbonic acid had been expelled, to the original volume of the sample, and then distilled in a current of air free from carbonic acid.

From the very moment at which the fluid began to boil, so rapid was the liberation of carbonic acid that large quantities passed unabsorbed through the baryta water; and, on the operation being terminated, 1.3^{cc} only of the baryta water had not been neutralised. Hence the absorbed portion of the carbonic acid was calculated at 95.3^{mgr}, exclusive of which a very considerable quantity, as before stated, passed off into the atmosphere, the baryta water, placed in a glass tube (resembling in form the letter *U*) connected with the receiver, being surcharged with the gas.

At Professor Waage's suggestion I repeated the experiment with carbonate of lime, precipitated warm and dried at a temperature of 100° C., and succeeded in expelling carbonic acid in considerable, though not so large, quantities as before, whereas an experiment with finely pulverised marble gave no positive result.

The importance of these observations was not to be questioned, affording as they did conclusive proof that the saline mixture in sea-water, on the temperature being raised to the boiling point, decomposed neutral carbonates, and likewise that all carbonic acid determinations hitherto attempted with the object of measuring the carbonic acid present in sea-water were faulty. As regards the carbonic acid determinations performed previous to the publication of Dr. Jacobsen's Memoir on the presence of air in sea-water, such must as a matter of course be wholly worthless, the method of distillation to dryness having in no case been adopted, or that of concentrating the fluid till further evaporation ceased to expel carbonic acid. The

ikke ved fortsat Inddampning skulde kunne have erholdt et større Udbytte af Kulsyre. De af Dr. Jacobsen og J. Y. Buchanan udførte Observationer kunde derimod ikke saa ligefrem forkastes, idet der jo kunde tænkes Mulighed for, at det ved de af dem benyttede Methoder kunde have lykkedes ved den langvarige Kogning at uddrive ogsaa al neutralbunden Kulsyre, i hvilket Fald de af dem opførte Tal i en anden Henseende kunde faa Betydning nemlig som Udtryk for den samlede Sum af den i Søvandet indeholdte Kulsyre.

Desværre lagde flere Omstændigheder Hindringer i Veien for Afslutningen af mine Forsøg over disse Gjenstande i Vinteren 1877—78, dels var min Tid optaget med andre Arbeider, dels lod min Helbred den største Del af Vinteren adskilligt tilbage at ønske, saaat mine Forsøg ingenlunde havde den ønskelige Fremgang, og jeg blev derfor nødt til at gaa ud ogsaa paa Togtet i 1878 uden nogen paalidelig Methode til Bestemmelse af den i Søvandet indeholdte Kulsyre. Da jeg efter endt Togt om Høsten vendte tilbage, gjenoptog jeg imidlertid atter mine Undersøgelser og bragte dem til Afslutning.

Gjennem en netop da af C. Borchers offentliggjort Afhandling[1] om Bestemmelsen af Kulsyren i naturlige Mineralvande blev jeg gjort opmærksom paa det for Bestemmelse af Kulsyren i Carbonater af Alexander Classen angivne Apparat,[2] som jeg senere i stor Udstrækning har benyttet.

Apparatet i den Form, hvori det her er kommen til Anvendelse, findes sammenstillet i Figur 3.

A er 2 med Natronkalk fyldte uformige Rør, *B* indeholder Barytvand. *C* er en Erlenmeyers Kolbe paa circa 0.5 Litre, der gjennem et ved Bunden udmundende Rør communicerer med *B*, medens et lige under Kautschukproppen udmundende sætter den i Forbindelse med Kjøleleren *D*, hvis indre Del efter Classen bestaar af et 27—30^{mm} vidt Glasrør, hvortil i øvre og nedre Ende er loddet Rør med respective 15 og 7^{mm} Diameter. Forlaget *E* er fuldstændig af samme Construction som det af Jacobsen benyttede og er oventil forsynet med det af P. Wagner[3] foreslaaede med Glaskugler fyldte Rør *F*.

Ved *a*, hvor der findes en Indsnevring, er anbragt en noget større Glaskugle, som temmelig nøie dækker over det nederste snevre Rør. Idet det til Opsamling af Kulsyren anvendte titrerede Barytvand heldes ned gjennem *F*, fjernes Proppen *b*, indtil det Meste af Barytvandet har passeret *a*, men sættes derpaa hurtigt i, saaledes at der over de nederste Glaskugler bliver staaende noget Barytvand til en Høide af omtrent 50^{mm} over *a*. Dersom nu

[1] Journ. für pract. Chem. 125 — 353.
[2] Fresenius Zeitschrift 15 — 288.
[3] Fresenius Zeitschrift 9 — 445,

series of observations instituted by Dr. Jacobsen and J. Y. Buchanan cannot however be wholly rejected, since the protracted boiling characteristic of the method they adopted may possibly have driven off all the carbonic acid contained in the carbonates, in which case their figures would acquire importance as expressive of the total amount of carbonic acid present in the sea-water examined.

Unfortunately, divers untoward circumstances conspired to prevent my terminating in the winter of 1877—78 the series of experiments I had begun with the object of elucidating this intricate subject; my time, for instance, came to be unexpectedly occupied in other ways, and during the greater part of that period I suffered from ill-health. My observations, therefore, not having progressed so favourably as I at first had reason to anticipate, I was again obliged to set out on the Expedition, in 1878, without having fixed on any reliable method for determining the carbonic acid present in sea-water. On my return however to Christiania in the autumn of that year, I recommenced the said experiments, and succeeded in bringing them to a satisfactory termination.

A paper by C. Borchers, which had just appeared,[1] on the determination of carbonic acid in mineral water, drew my attention to the apparatus — of which I have since made frequent use — devised by Alex. Classen[2] for determining carbonic acid in carbonates.

Figure 3 represents this apparatus as constructed for my experiments.

A 2 glass tubes, resembling in form the letter *U*, filled with soda-lime; *B* a vessel for baryta water; *C* an Erlenmeyer flat-bottomed matrass, containing about 0.5 litre, which by means of a tube terminating at the bottom is made to communicate with *B*, a similar tube, issuing immediately beneath the caoutschouc stopper, putting it likewise in communication with the cooler *D*, the inner portion of which, according to Classen, should consist of a glass tube from 27^{mm} to 30^{mm} in diameter, with tubes, measuring respectively 15^{mm} and 7^{mm} in diameter, sealed to its upper and lower extremities. The receiver *E* has precisely the same form as that adopted by Jacobsen, and is furnished above with a glass tube, *F*, filled with glass balls, as suggested by P. Wagner.[3]

At the point *a*, where the tube suddenly narrows, is introduced a somewhat larger glass ball, to fill up, as near as may be, the opening of the lower or slender portion of the tube. When the titrated baryta water, which absorbs the carbonic acid, is being poured down through *F*, the stopper *b* has to be taken out, but must be quickly replaced, before the whole of the fluid has passed *a*, in order that the glass balls to a height of about 50^{mm} above *a*

[1] Journ. für pract. Chem. 125, p. 353.
[2] Fresenius Zeitschrift 15, p. 288.
[3] Fresenius Zeitschrift 9, p. 445.

den nederste Glaskugle slutter godt, vil den gjennem *a* passerende Luft spaltes i en Mængde meget fine Blærer, som ved at stige op mellem de af Barytvand omgivne Glaskugler bliver fuldstændig kulsyrefri. Det uformige Rør *G* indeholder Barytvand, *H* fører til Aspiratoren.

may be immersed in baryta water. Now, assuming the large glass ball to fit well, the air will pass *a* in the form of minute bubbles, which, having to ascend between the glass balls surrounded by baryta water, must part with the whole of its carbonic acid. The tube *G* contains baryta water; *H* leads to the aspirator.

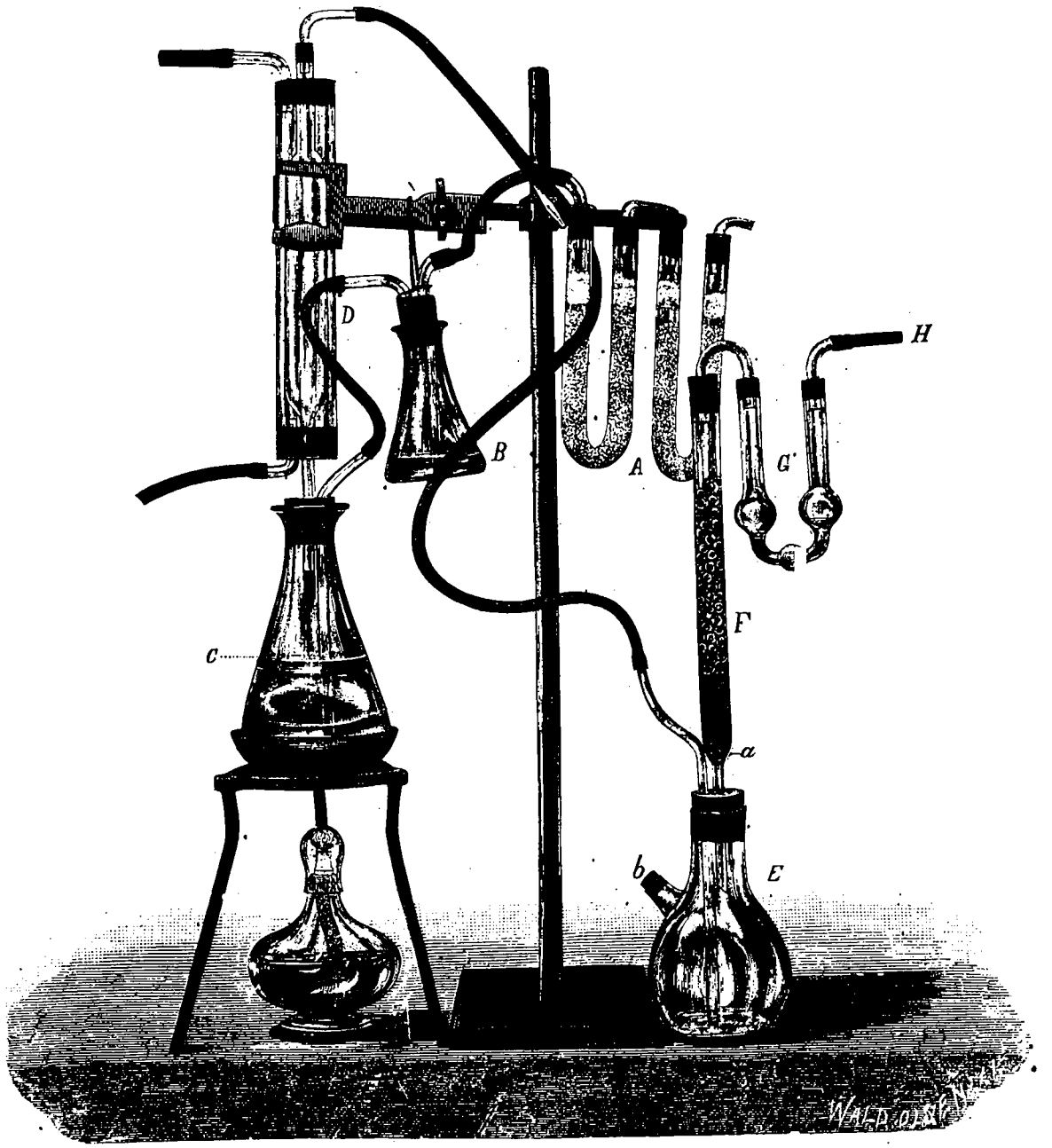

Fig. 3.

Den af Classen foreslaaede Kjøler virker saa udmærket, at man i meget lang Tid kan koge fortyndet Saltsyre i Kolben, uden at det mindste Spor af Chlor kan paavises i Forlaget, forudsat at den gjennemledede Luftstrøm ikke gives for stor Hastighed, hvad der imidlertid heller ikke er fornødent.

The cooler devised by Classen is so excellent, that diluted hydrochloric acid may be boiled in the matrass for a very considerable length of time without a trace of acid being detected in the receiver, provided that too great rapidity be not given to the current of air; this, however, is quite unnecessary.

Naar Søvandet i dette Apparat kogtes med fortyndet Svovlsyre i en kulsyrefri Luftstrøm, undveg Kulsyren meget hurtigt, idet 15 Minutters Kogning fuldstændig strak til for at bringe al Kulsyre over i Forlaget. Søvandets Sulfater viste altsaa i alle Fald ikke ved Tilstedeværelsen af fri Syre de af J. Y. Buchanan observerede Egenskaber. Naar den paa denne Maade uddrevne Kulsyremængde opsamledes og bestemtes, viste den sig altid at stemme nogenlunde med, hvad man efter den af Dr. Jacobsen anvendte Methode kunde erholde uddrevet, idet de optrædende Afvigelser snart vare positive snart negative men i Regelen ikke større, end at de for den største Del maatte kunne tilskrives Observationsfeil. Ved den af Buchanan i Forslag bragte Udfældning af Svovlsyren erholdt jeg derimod bestandig betydelig for lave Resultater, hvorom senere.

For samtidig i en og samme Portion at kunne bestemme baade den neutralbundne og den samlede Mængde Kulsyre, anvendte jeg følgende Fremgangsmaade.

Efterat Apparatet fuldstændig var befriet for kulsyreholdig Luft, anbragtes i Forlaget paa den før beskrevne Maade 25 CC. Barytvand, hvoraf hver CC. svarede til 4,129 Mgr. Kulsyre, hvorefter der i Kolben *C* heldtes 367.7 CC. af det til Undersøgelse bestemte Søvand tilligemed 10 CC. af en Svovlsyre, hvoraf hver CC. svarede til 4.099 Mgr. Kulsyre. Indholdet i Kolben ophededes nu under Gjennemleduing af en meget langsom Luftstrøm til Koghede og holdtes i Kog i nogen Tid. Efter Forløb af henimod 15 Minutter fjernedes atter Varmekilden og Vædsken afkjøledes, idet Luftstrømmen lidt efter lidt gaves en noget større Hastighed, hvorved den endnu ikke absorberede Kulsyre meget hurtigt bragtes over i Forlaget.

Efter endt Operation bragtes de i *F* værende Glaskugler tilligemed det ved Rørets Vægge heftende Barytvand ned i Forlaget *E*, hvorpaa det Hele retitreredes med en Oxalsyre, hvoraf hver CC. svarede til 3.976 Mgr. Kulsyre, idet alkoholisk Curcuma tjente som Index. Ligeledes skylledes den ved de indre Vægge af Kjøleren heftende Vædske ved lidt kulsyrefrit destilleret Vand ned i Kolben, hvori den overskydende Syre neutraliseredes med en Natronlud, hvoraf hver CC. svarede til 2.928 Mgr. CO_2, idet Rosolsyre tjente som Index.

Som Resultat af disse Titreringer erholdtes den samlede Kulsyremængde bestemt til omkring 97 Mgr. og den neutralbundne til gjennemsnitlig henimod 53 Mgr. pr. Litre. De 44 Mgr. Kulsyre, som udgjør Differentsen mellem den samlede Kulsyremængde og den neutralbundne, kan aabenbart ikke forekomme i Søvandet som fri Gasart, men maa forene sig med de allerede færdigdannede Carbonater under Dannelsen af Bicarbonater, og det viser sig altsaa, at de af Dr. Jacobsen gjorte Observationer meget naturligt lade sig forklare derved, at Søvandet ikke indeholder det mindste Spor af fri Kulsyre men hele 53 Mgr. neutralbunden og kun omkring 44 Mgr. surtbunden Kulsyre pr. Litre.

On boiling sea-water along with diluted sulphuric acid, exposed to a current of air free from carbonic acid, in this apparatus, carbonic acid escaped very rapidly, the space of 15 minutes sufficing to collect the whole of it in the receiver. The sulphates in sea-water — at least when free acids were present — did not, accordingly, exhibit the properties ascribed to them by J. Y. Buchanan. On collecting and determining the carbonic acid driven off by this process, the amount was invariably found to agree with that which could be liberated by Dr. Jacobsen's method, the differences observed having been sometimes positive and sometimes negative, but as a rule not greater than would admit of imputing them chiefly to errors of observation. On precipitating the sulphuric acid as suggested by Buchanan, the results obtained were invariably too low; but to this subject I shall afterwards return.

In order to determine both the proportion of carbonic acid forming the neutral carbonates and the whole amount of carbonic acid contained in one and the same sample of sea-water, I adopted the following mode of procedure.

After expelling from the apparatus all air in which carbonic acid was present, 25 ^{cc} of baryta water were introduced, as previously described, into the receiver, each c.centim. representing 4.129 ^{mgr} carbonic acid; 367.7 ^{cc} of the sea-water to be examined were then poured into the matrass (*C*), along with 10 ^{cc} of sulphuric acid, each c.centim. of which represented 4.099 ^{mgr} carbonic acid. The contents of the matrass were now heated, during exposure to a very slow current of air, up to the boiling-point, and kept for some time at that temperature. After the lapse of about 15 minutes, the source of heat was removed and the fluid cooled, the rapidity of the current of air being slightly increased, causing the carbonic acid not yet absorbed to pass off quickly into the receiver.

The operation being terminated, the glass balls in the tube *F*, along with the baryta water adhering to the walls of the tube, were introduced into the receiver *E*, and the whole of its contents retitrated with oxalic acid, each c.centim. of which represented 3.976 ^{mgr} carbonic acid, a solution of alcoholic curcuma serving as the index. The fluid adhering to the walls of the cooler was likewise washed down into the matrass with a little distilled water free from carbonic acid, and the surplus acid neutralised by the addition of soda-lye, each c.centim. of which represented 2.928 ^{mgr} CO_2, rosolic acid serving as the index.

As the result of this titration, the total amount of carbonic acid was found to be about 97 ^{mgr} and the proportion forming neutral carbonates to average about 53 ^{mgr} per litre. Now, the difference, 44 ^{mgr}, cannot occur free as gas, but will unite with the carbonates to form bicarbonates; and hence Dr. Jacobsen's observations could be readily explained on the assumption that sea-water contains no trace even of free carbonic acid, but as much as 53 ^{mgr} per litre of carbonic acid forming carbonates and only about 44 ^{mgr} per litre of carbonic acid forming bicarbonates.

Som man ser, er den her til Bestemmelse af den neutralbundne Kulsyre anvendte Methode i alt væsentligt den samme, som allerede for flere Aar tilbage er beskreven af Dr. Mohr.[1] Forskjellen stikker kun deri, at jeg har anvendt Classens Kjøler og desuden ombyttet Salpetersyren med Svovlsyre. Det syntes mig nemlig ikke tilraadeligt at anvende Salpetersyre ligeoverfor et saa stærkt chlorholdigt Mineralvand som Søvand, hvori der desuden fandtes en vel mærkbar om end temmelig liden Qvantitet oxyderbare Stoffe.

Efter denne Fremgangsmaade har jeg senere ved 78 Observationer bestemt Kulsyren i 64 forskjellige Vandprøver temmelig jevnt fordelte over det af den norske Nordhavexpedition undersøgte Felt. Resultaterne findes sammenstillede i Tabel II.

Først skal i Korthed berøres de Feil, hvormed de i Tabellen opførte Tal kan tænkes beheftede.

Om man vilde antage, at den i Søvandet indeholdte Kiselsyre ikke forekom opløst som fri Syre, men forefandtes bundet til Baser i Form af Silicater, en Antagelse af meget tvivlsom Berettigelse, vilde man aabenbart efter den ovenfor beskrevne Methode faa noget feilagtige Resultater, idet den til Kiselsyre bundne Mængde Baser vilde findes som bunden til Kulsyren. Forat kunne danne mig en Forestilling om, hvorvidt den Feil, som man under denne Forudsætning skulde kunne begaa, nogensinde vil kunne tænkes at faa særlig Betydning, har jeg bestemt Kiselsyremængden i forskjellige af de hjembragte Vandprøver, idet følgende Fremgangsmaade er kommen til Anvendelse. 0.5 Litre Søvand inddampedes med lidt Saltsyre i en Platinaskaal først over fri Ild senere paa Vandbad til Tørhed og tørredes ved 110°—120° C. Saltene udtoges derpaa og pulveriseredes bedst muligt i en vel poleret Agatriveskaal, hvorpaa de atter tørredes ved samme Temperatur, og sluttelig bragtes over i et passende Kar og tilsattes ca. 200 CC. saltsyreholdigt Vand, hvorved al Gips fuldstændigt opløstes. De paa denne Maade udskilte Kiselsyremængder vare altid meget smaa og maatte nærmest blive at betegne som Spor, idet de, hvor jeg forsøgte at veie dem, kun beløb sig til Brøkdele af Mgr. i den anvendte Portion Vand. Dette stemmer paa det Nøieste med, hvad Thorpe og Morton nylig har fundet i det irske Hav,[2] hvorimod de ældre Opgaver giver noget større Tal. Og man vil saaledes se, at der ingensomhelst Rimelighed er for, at den i Søvandet indeholdte Kiselsyremængde skulde bidrage til i mærkelig Grad at gjøre de fundne Resultater upaalidelige.

Naar man skal danne sig en Mening om Nøiagtigheden af disse Observationer, er det imidlertid nødvendigt at tage Hensyn til en anden Omstændighed, som kunde tænkes at have havt sin Indflydelse paa Resultaterne.

[1] Mohr Titrirmethode 3te Aufl. — 524.
[2] Ann. Chem. Pharm. 158 — 122.

As will be seen, the method adopted for the determination of the carbonic acid forming carbonates, was essentially the same as that described by Dr. Mohr[1] several years previously. The only difference lay in my having employed Classen's cooler and made choice of sulphuric acid in preference to nitric. It did not seem advisable to use nitric acid when examining a mineral water so rich in chlorine as is sea-water, and which besides contains a quantity, small indeed but appreciable, of organic matter.

By this process I subsequently determined the carbonic acid in 64 different samples of sea-water, drawn at comparatively regular intervals from the tract of ocean investigated on the Norwegian North-Atlantic Expedition; the number of observations amounted to 78. The results are given in Table II.

I will first say a few words respecting the errors that may possibly affect the accuracy of the figures set down in the Table.

Assuming the silicic acid in sea-water not to occur as a free acid, but combined with bases in the form of silicates, an hypothesis of very doubtful value, the results obtained by the method described above would be obviously to some extent inaccurate, inasmuch as the bases combined with silicic acid must in that case have behaved as if originally combined with carbonic acid. In order to ascertain what importance could possibly be attached to an error arising on such an assumption, I determined the amount of silicic acid in divers of the samples of sea-water brought home with me, adopting for that purpose the following method. Five-tenths of a litre of sea-water mixed with a little hydrochloric acid were evaporated to dryness in a platinum dish, at first over a common fire and then in a water-bath, and dried at a temperature of 110°—120° C. The salts were then taken out and transferred to a well polished agate dish, in which they were finely pulverised, and again dried at the same temperature; finally they were placed in a suitable vessel, and mixed with about 200cc of water containing hydrochloric acid, which thoroughly dissolved all the gypsum. The amounts of silicic acid thus precipitated were invariably very small, indeed but little more than traces; for, on attempting to weigh them, they proved to be but fractions of a milligramme. This result agrees exactly with the observations of Thorpe and Morton on water from the Irish Sea,[2] whereas the figures in earlier statements are somewhat higher. Hence, there is no reason whatever to assume, that the silicic acid present in sea-water should to any considerable extent influence the results obtained.

When judging of the accuracy of these observations, regard must, however, be had to another circumstance that might possibly in some measure affect the results. The water examined did not consist of freshly drawn samples,

[1] Mohr's Titrirmethoden 3te Aufl. p. 524.
[2] Ann. Chem. Pharm. 158, p. 122.

Tabel II.

No.	Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich.)	Dybde hvorfra Prøven hentet. (Depth from which the Samples were collected.) Engelske Favne. (English Fathoms.)	Dybde hvorfra Prøven hentet. Meter. (Metres.)	Temperatur. Celsius.	Neutralbunden Kulsyre. (Carbonic Acid forming Carbonates.) Mgr. per Litre.	Surtbunden Kulsyre. (Carbon. Acid forming Bicarbonates.) Mgr. per Litre.	Anmærkninger. (Remarks.)
1	—	Jæderen.		0	0	?	52.3	41.1	
2	51	65° 53′	7° 18′ W.	1163	2127	—1.1	52.6	46.7	
3	52	65 47.5	3 7	1861	3403	—1.2	52.7	46.9	
4	52	65 47.5	3 7	1861	3403	—1.2	52.9	46.1	
5	53	65 13.5	0 33 E.	1539	2814	—1.3	53.1	43.8	
6	53	65 13.5	0 33	0	0	10.5	54.3	40.4	
7	143	66 58	10 33	189	346	6.2	53.8	43.3	
8	143	66 58	10 33	0	0	8.2	53.4	41.5	
9	183	69 59.5	6 15	1609	2926	—1.2	52.6	44.8	
10	183	69 59.5	6 15	0	0	8.6	53.5	44.8	
11	184	70 4	9 50	1547	2829	—1.3	53.0	45.5	
12	184	70 4	9 50	600	1097	0.0	52.4	44.7	
13	184	70 4	9 50	0	0	7.6	53.8	40.9	
14	187	69 51.5	14 41	1335	2441	—1.1	53.8	43.1	
15	189	69 41	15 42	860	1573	—1.1	53.0	45.5	
16	189	69 41	15 42	860	1573	—1.1	52.7	43.6	
17	189	69 41	15 42	0	0	9.6	54.2	41.8	
18	215	70 53	2 0 W.	0	0	8.0	54.2	41.4	
19	215	70 53	2 0	200	366	2.8	52.6	—	
20	215	70 53	2 0	200	366	2.8	52.6	46.8	
21	217	71 0	5 8	0	0	4.6	52.7	41.3	
22	226	70 59	7 51	340	622	—0.6	54.3	46.4	
23	226	70 59	7 51	340	622	—0.6	54.6	46.0	
24	226	70 59	7 51	340	622	—0.6	54.7	—	
25	226	70 59	7 51	0	0	3.0	52.2	40.7	
26	226	70 59	7 51	0	0	3.0	52.2	41.6	
27	237	70 41	10 10	0	0	3.0	53.4	42 4	
28	237	70 41	10 10	0	0	3.0	54.5	39.7	
29	240	69 2	11 26	0	0	4.2	55.0	44.4	
30	240	69 2	11 26	0	0	4.2	55.4	—	
31	—	68 33	7 25	0	0	6.0	53.0	45.0	
32	—	68 33	7 25	0	0	6.0	53.0	43.9	
33	243	68 32.5	6 26	1385	2533	—1.3	53.7	42.4	
34	245	68 21	2 5	0	0	9.0	53.8	45.2	
35	245	68 21	2 5	0	0	9.0	53.8	44.2	
36	247	68 5.5	2 24 E.	500	914	—0.4	53.9	47.3	
37	247	68 5.5	2 24	0	0	9.4	54.0	47.2	
38	264	70 56	35 37	0	0	5.2	51.8	42.3	
39	264	70 56	35 37	86	157	1.9	52.6	43.2	
40	275	74 8	31 12	0	0	2.9	53.0	45.3	
41	284	73 1	12 58	0	0	6.8	52.6	43.2	
42	295	71 59	11 40	0	0	7.0	52.8	42.4	
43	295	71 55	11 30	100	183	3.2	51.9	42.8	
44	295	71 55	11 30	600	1097	—0.8	52.6	43.7	
45	295	71 59	11 40	1110	2030	—1.3	53.8	43.1	
46	297	72 36.5	5 12	0	0	4.6	52.6	43.7	
47	297	72 36.5	5 12	1280	2341	—1.4	52.1	43.4	
48	298	72 52	1 50.5 W.	1500	2743	—1.5	52.2	42.9	
49	300	73 10	3 22	0	0	1.7	48.6	43.4	Ost lige ved Kanten af Grønlandsisen. (Drawn ip immediate proximity to the Greenland Ice.)
50	300	73 10	3 22	0	0	1.7	48.4	42.0	
51	303	75 12	3 2 E.	0	0	3.3	52.2	47.9	
52	303	75 12	3 2	0	0	3.3	51.8	48.0	
53	303	75 12	3 2	150	274	—1.1	51.8	43.0	
54	304	75 3	4 51	300	549	—0.8	52.2	42.5	
55	304	75 3	4 51	300	549	—0.8	52.3	45.1	
56	304	75 3	4 51	1735	3173	—1.5	52.4	43.9	
57	306	75 0	10 27	1334	2440	—1.3	52.0	40.5	
58	323	72 53.5	21 51	223	408	1.5	53.1	42.1	

No.	Stat. No.	Nordlig Bredde. (*North Latitude.*)	Længde fra Greenwich. (*Longitude from Greenwich.*)	Dybde hvorfra Prøven hentet. (*Depth from which the Samples were collected.*) Engelske Favne. (*English Fathoms.*)	Meter. (*Metres.*)	Temperatur. Celsius.	Neutralbunden Kulsyre. (*Carbonic Acid forming Carbonates.*) Mgr. per Litre.	Surtbunden Kulsyre. (*Carbon. Acid forming Bicarbonates.*) Mgr. per Litre.	Anmærkninger. (*Remarks.*)
59	335	76° 16′.5	14° 39′ E.	0	0	5.4	53.4	42.7	
60	347	76 40.5	7 47	1429	2613	—1.3	52.2	41.6	
61	347	76 40.5	7 47	0	0	4.4	52.6	41.0	
62	349	76 30	2 57	1487	2719	—1.5	51.6	43.5	
63	350	76 26	0 29 W.	0	0	3.0	54.0	47.2	
64	350	76 26	0 29	300	549	—1.1	53.2	45.8	
65	350	76 26	0 29	300	549	—1.1	53.3	46.0	
66	350	76 26	0 29	1686	3083	—1.5	51.9	43.9	
67	351	77 49.5	0 9	0	0	3.3	51.9	42.8	
68	352	77 56	3 29 E.	0	0	3.9	52.3	41.5	
69	352	77 56	3 29	300	549	—0.8	52.6	46.0	
70	355	78 0	8 32	0	0	4.9	52.4	43.2	
71	355	78 0	8 32	948	1734	—1.3	51.8	44.6	
72	361	79 8.5	5 28	0	0	4.2	52.4	42.7	
73	361	79 8.5	5 28	905	1655	—1.2	51.9	46.1	
74	362	79 59	5 40	0	0	5.2	52.6	43.2	
75	362	79 59	5 40	459	839	—1.0	51.8	44.6	
76	363	80 0	8 15	260	475	1.1	52.9	44.0	
77	368	78 43	8 20	315	567	1.6	52.9	42.4	
78	373	78 10	14 26	120	219	0.8	51.4	44.4	

Forsøgene ere nemlig ikke blevne udførte paa Vandprøverne strax efter deres Optagelse men først, efterat de have henstaaet i kortere eller længere Tid. Angaaende Tidsrummet, hvori de enkelte Vandprøver have henstaaet før Bestemmelsen, kan anføres Følgende: No. 1, en Vandprøve, som Hr. Dampskibsfører E. Rostrup viste mig den Velvillie at skaffe mig, har kun henstaaet nogle Dage, de øvrige Prøver have benstaaet, No. 2—6 i ca. $2^1/_4$ Aar, 7—37 i ca. $1^1/_4$ Aar og 38—78 i 2 til 4 Maaneder paa et kjøligt Sted opbevarede paa Flasker, der vare forsynede med vel islebne Glasproppe. Der aabner sig altsaa en Mulighed for, at der ved Oxydation af de i Søvandet værende, aldrig manglende, organiske Bestanddele kunde have dannet sig en mindre Qvantitet Kulsyre paa Bekostning af den opløste Surstofmængde, en Proces, der naturligvis kun har Indflydelse paa den surt bundne Kulsyre, saafremt ikke Oxydationen skulde skride saa vidt frem, at ogsaa Surstoffet i Svovlsyren skulde medgaa til Dannelsen af Kulsyre, i hvilket Fald den dannede Kulsyre maatte træde ind som neutralbunden istedetfor den destruerede Mængde Svovlsyre. En saa vidt fremskreden Oxydation kan imidlertid ikke tænkes mulig, medmindre man til Prop i Flaskerne anvender Kork, da den i Søvandet opløste Surstofgas er meré end tilstrækkelig til at oxydere alle de oprindelig tilstedeværende organiske Bestanddele. Det kan ogsaa bemærkes, at det ikke i nogen af de undersøgte Vandprøver har været muligt at paavise det mindste Spor af Svovlvandstof. For saa nogenlunde at fixere de Mængder Kulsyre, som paa denne Maade skulde kunne dannes, har jeg anmodet min Ven Schmelck, som har været beskjæftiget med Undersøgelse af de faste Bestanddele i Vandet i det af Expeditionen befarede Hav, og som saaledes ogsaa har

having all of it been allowed to stand over for a longer or shorter period. With respect to the interval that had elapsed before commencing the determinations, the following particulars can be given: — No. 1, a sample of seawater which Captain E. Rostrup had the kindness to procure me, did not stand over for more than a few days; of the remaining samples, Nos. 2—6 were preserved for about two years and a quarter, Nos. 7—37 for about one year and a quarter, and Nos. 38—78 from two to four months, all of them in a cool spot, and in bottles furnished with ground glass stoppers. Hence it is just possible that oxidation of the organic matter never absent in seawater may have produced a small quantity of carbonic acid, by reducing the amount of oxygen, a process which of course could only affect the carbonic acid forming bicarbonates, unless indeed oxidation were so far advanced, that the oxygen in the sulphuric acid should also contribute to the formation of carbonic acid, in which case such carbonic acid would reimplace the sulphuric acid decomposed. But this advanced stage of oxidation is clearly impossible unless the bottles are *corked*, since the oxygen in sea-water is more than sufficient to oxidize all organic matter originally present. I can also observe, that in none of the samples of water examined was it possible to detect the slightest trace of sulphuretted hydrogen. With the object of determining approximately what proportion of carbonic acid could result from this process, I requested my friend Mr. Schmelck — whose labours have been chiefly confined to the examination of the solid matter present in the water of the seas explored on the Expedition, and who accordingly instituted a series of experiments to ascertain the amount of organic substances it contained — to furnish

udført en Række Forsøg til Bestemmelse af de organiske Stoffes Mængde, om at meddele mig de fornødne Data. Ifølge ham ere de organiske Stoffes Mængde kun underkastet meget smaa Variationer, og affarver 1 Litre Søvand gjennemsnitlig 3 Mgr. Kamæleon, som under Forudsætning af Reduction til Oxydulsalt kun kan afgive henimod 0.8 Mgr. Surstof, hvoraf det lettelig vil kunne indsees, at den dannede Mængde Kulsyre ikke kan være meget stor, naar Surstofforbruget selv ved en saa energisk Oxydation som ved Anvendelse af Kamæleon er saa lidet. Og hvad der især tyder paa, at den Oxydation, som kan foregaa ved Vandprøvens Henstand under ordinære Forholde, fuldstændig maa kunne negligeres, er den Omstændighed, at Schmelck har fundet Søvandets Evne til at affarve Kamæleon ligestor, hvadenten Vandprøven undersøges frisk eller først efter aarelang Henstand.

At noget af Kulsyren ved den lange Henstand skulde være fordampet, er der heller ingen Rimelighed for, naar man erindrer, at Søvandet er en alkalisk Vædske, som ikke indeholder det mindste Spor af fri Kulsyre, og som med saadan Kraft holder paa sin surt bundne Kulsyre, at den i timevis kan koges i det af Jacobsen angivne Luftudkogningsapparat med det Resultat, at kun en meget liden Brøkdel uddrives. Der er aabenbart større Fare for det Modsatte, nemlig at der skulde kunne absorberes noget af Atmosphærens Kulsyre, men for Undgaaelsen af denne Feilkilde er der sørget ved omhyggelig Opbevaring paa velproppede Flasker.

Resultaterne synes heller ikke at tyde paa, at Henstanden skulde have været til Skade for Vandprøvernes Brugbarhed, idet de alle uden Hensyn til den meget forskjellige Varighed af det Tidsrum, hvori de have henstaaet, vise nogenlunde det samme Resultat, og jeg tror saaledes ikke at tage meget Feil, naar jeg anser de af mig udførte Observationer som i alt Væsentligt ligesaa gode, som om de havde været udførte ombord paa friskt optagne Vandprøver.

Hvad angaar de af selve Methoden og Experimentationen flydende Observationsfeil, da vil de hyppigt udførte Controlbestemmelser kunne give de fornødne Bidrag til Bedømmelsen af deres Størrelse, saaledes er ved 13 Controlbestemmelser for den neutralt bundne Kulsyres Vedkommende den gjennemsnitlige halve Differents mellem 2 paa samme Vandprøve udførte Observationer bestemt til 0.11 Mgr. per Litre (Maximum 0.6) og for den surt bundne Kulsyres Vedkommende til 0.59 Mgr. per Litre (Maximum 1.35). Foruden den variable Feil vil der imidlertid i sidste Tilfælde ogsaa være en constant, idet det ikke lader sig undgaa, at man ved Arbeide i en kulsyreholdig Atmosphære vil erholde noget om end meget lidet for høie Resultater. Naar Feilene ved Bestemmelsen af den surt bundne Kulsyre er funden at være størst, da er Grunden dertil for en stor Del at søge deri, at man ved Retitration med Natronlud, især naar Rosolsyre anvendes som Index, erholder en meget skarp Endereaction, medens dette paa lang Vei ikke i samme Grad er Tilfælde, hvor Baryt re-

me with the necessary data. According to his obserations, the amount of organic matter varies but very slightly, 1 litre of sea-water discolouring on an average 3^{mgr} permanganate of potash; and this quantity, assuming extreme reduction, cannot give off more than about 0.8^{mgr} of oxygen. Hence it is obvious that the amount of carbonic acid cannot be very large, considering the limited consumption of oxygen even with the use of permanganate of potash: But that the oxidation which can ordinarily result from allowing the water to stand over may be altogether ignored, is more particularly indicated by the fact of Schmelck having found the property in sea-water of discolouring permanganate of potash to be invariably the same, whether the samples are freshly drawn or have been preserved for years together.

Nor is there reason to assume, that any portion of the carbonic acid should have escaped by evaporation during the long interval, if we bear in mind that sea-water is an alkaline fluid, which does not contain the smallest trace of free carbonic acid, and which retains that present in bicarbonates with such vigour, that it may be boiled for hours together in the apparatus devised by Jacobsen for boiling out air and not part with more than a mere fraction. Nay, there is obviously danger of the reverse, viz. that some of the carbonic acid present in the atmosphere will be absorbed; but that source of error was effectually avoided by keeping the water in bottles provided with tight-fitting glass stoppers.

Judging, too, from the results, which were very nearly the same for all the samples, irrespective of the difference in the length of the period during which they had been preserved, the interval that had elapsed previous to examination did not appear to have had any injurious effect on the water for experimental purposes; and hence I feel tolerably convinced that my observations in all essential particulars are as reliable as if they had been conducted on board with freshly drawn water.

With respect to the errors of observation involved in the method itself, numerous test-determinations will serve as an approximate standard by which to compute their magnitude; thus, for instance, half the difference between two observations with the same sample of water was found, for the carbonic acid forming carbonates, to be 0.11^{mgr} per litre (maximum 0.6), and for the carbonic acid forming bicarbonates to be 0.59^{mgr} per litre (maximum 1.35). Exclusive of the variable error there will also, in the latter case, be a constant one, inasmuch as the results of experiments performed in an atmosphere containing carbonic acid must necessarily be somewhat, if but a very little, too high. When the error in the determination of the carbonic acid forming bicarbonates is found to be greatest, the reason will be chiefly this, that retitration with soda-lye, more especially if rosolic acid has been selected as the index, gives rise to a very decided terminal reaction, which does not result on the baryta water being titrated with oxalic acid; the reaction is then much less obvious. It must be likewise

titreres med Oxalsyre. Tillige bør det erindres, at de som Udtryk for den surt bundne Kulsyre opførte Tal indeholde Feilene saavel i Bestemmelsen af den neutralt bundne som den samlede Kulsyremængde.

Som man let vil overbevise sig om, vise de i Tabellen opførte Tal især for den neutralt bundne Kulsyres Vedkommende en mærkelig Overensstemmelse, naar nemlig 2 Observationer, begge udførte paa en Vandprøve hentet lige ved Grønlandsisen, undtages, ligger i alle de øvrige 63 Vandprøver den neutralt bundne Kulsyre mellem Grænserne 51.4 og 55.4 Mgr. per Litre, saaledes at den største Differents kun beløber sig til 4 Mgr., hvad der maa siges at være meget lidet i Betragtning af, at disse Tal ere fremkomne ved Undersøgelse af et Hav paa betydeligt over 200 geografiske Mile i Udstrækning saavel i syd og nord som øst og vest. Hvad derimod den surt bundne Kulsyre angaar, da ere de optrædende Differentser betydelig større og beløbe sig i Ydertilfældene til omkring 8 Mgr. pr. Litre.

Jeg har længe bestræbt mig for at opdage nogen Lovmæssighed i disse Variationer, uden at det dog saaledes som for Luftens Vedkommende har lykkes at erholde klare og paalidelige Resultater i saa Henseende og det ligegyldigt, hvadenten man vælger Dybdeforholdene eller den geografiske Beliggenhed til Udgangspunkt for sin Betragtning.

Da saaledes ingen Del af det undersøgte Felt udmærker sig fremfor den anden ved nogen tydelig Forskjellighed i Kulsyregehalt, og da de optrædende Differentser overalt ere smaa, ville de erholdte Resultater naturligst være at benytte til Udledning af Gjennemsnitsværdier, der kunne opføres som Udtryk for Kulsyregehalten i det undersøgte Hav i sin Helhed betragtet. De Gjennemsnitsværdier, som saaledes blive at opstille som Hovedresultater, ere for den neutralt bundne Kulsyres Vedkommende

$$52.78 \pm 0.083 \text{ Mgr. pr. Litre}$$

med en sandsynlig Afvigelse herfra af en enkelt Observation af $\pm$ 0.662 Mgr. pr. Litre
og for den surt bundne Kulsyres Vedkommende

$$43.64 \pm 0.16 \text{ Mgr. pr. Litre}$$

med en sandsynlig Afvigelse herfra af en enkelt Observation af $\pm$ 1.26 Mgr. pr. Litre.

Da det først var bragt paa det Rene, at de af Dr. Jacobsen iagttagne Egenskaber hos Søvandet skrev sig derfra, at den i Søvandet existerende Saltblanding ved Koghede decomponerede neutrale Carbonater, maatte det ogsaa fremstille sig som en meget interessant Opgave at finde den nærmere Forklaring dertil.

Den nærmestliggende Tanke, som i denne Anledning først paatvang sig mig, var den at søge Grunden i Chlormagnesiumens bekjendte Egenskaber. At denne under Kogningen selv ved Tilstedeværelsen af Overskud af Chlornatrium skulde have Tilbøielighed til lidt efter lidt at spalte sig, og at der af den dannede Saltsyre skulde kunne uddrives noget Kulsyre, kunde jo ikke synes umuligt. Der

borne in mind, that the figures representing the carbonic acid forming bicarbonates also include the error in both titrations.

A glance at the Table will show that the figures therein set down, more particularly those representing the carbonic acid forming carbonates, exhibit a remarkable uniformity; save in 2 observations, both with a sample of water drawn in close proximity to the ice off the coast of Greenland, the carbonic acid forming carbonates determined in the remaining 63 samples lies between the limits 51.4^{mgr} and 55.4^{mgr} per litre and the greatest difference amounts therefore to only 4^{mgr}, which must be regarded as very small, considering that the said figures refer to the examination of water from a tract of ocean which, measured both from north to south and from east to west, extends for considerably more than 200 geographical miles. As regards the carbonic acid forming bicarbonates, the differences in the amounts determined are, however, much greater, reaching 8^{mgr} per litre.

I have long had my attention directed to the possible discovery of a law controlling these variations, similar to that which I found to regulate those of air, but have not yet succeeded in obtaining conclusive results; and it is quite immaterial whether depth or geographical position be made the basis of investigation.

The water in no part of the ocean-tract explored being characterised by properties plainly distinguishing it from that of any other, and the differences in the results obtained having invariably proved small, the latter will obviously serve for the computation of average formulæ representing the amount of carbonic acid present in the water of the sea investigated. These average formulæ, set down accordingly as the final results, were found to be —

$$52.78 \pm 0.083^{mgr} \text{ per litre}$$

for the carbonic acid forming carbonates, with a probable error in a single observation of $\pm$ 0.662 per litre; and

$$43.64 \pm 0.16^{mgr} \text{ per litre}$$

for the carbonic acid forming bicarbonates, with a probable error in a single observation of $\pm$ 1.26^{mgr} per litre.

Having now obtained conclusive proof that the properties observed by Dr. Jacobsen in sea-water were the result of the property possessed by the saline compounds present therein of decomposing at the boiling-point neutral carbonates, the next step was to find a satisfactory explanation of the interesting phenomenon.

My first thought in this direction was to seek the cause in the known properties of chloride of magnesia. Assuming this body to have a tendency of gradually decomposing during the process of boiling, carbonic acid might possibly be driven off by the hydrochloric acid formed. Against such an hypothesis, however, various objections may be raised, Dr. Jacobsen and others having shown that sea-

lader sig imidlertid reise Indvendinger mod denne Betragtningsmaade, idet det af Dr. Jacobsen med Flere er paavist, at Søvand lader sig inddampe til Tørhed og Saltene endog tørre ved en Temperatur af 180° C., uden at nogen synderlig Mængde Saltsyre forflygtiger sig, og det er i Virkeligheden heller ikke fornødent at ty til Chlormagnesiumens Dissociation for at finde den rimeligste Forklaringsgrund. Man behøver blot at holde sig til den kulsure Magnesia og dens Egenskaber, saaledes som de ere kjendte af Arbeider udførte af de mest berømte Chemikere.

Ifølge Angivelser af Berzelius,[1] H. Rose,[2] Fritzsche,[3] Nörgaard[4] og L. Joulin[5] er den ved høiere Temperatur dannede kulsure Magnesia altid mere eller mindre basisk, ja ifølge Berzelius og H. Rose er selv de ved Blanding af Magnesiaopløsninger med kulsure Alkalier i Kulden dannede Bundfald mere kulsyrefattige end mættet kulsur Magnesia. Der findes om den kulsure Magnesia et meget stort Antal tildels meget modstridende Angivelser, og der er, eftersom Fremstillingsmaaden er varieret, erholdt meget forskjelligt sammensatte Salte, hvis procentiske Sammensætning ifølge Analyserne stemme meget daarligt overens med den af de opstillede Formler beregnede. Disse Forbindelser ere ogsaa af enkelte Forfattere betragtede som basiske Salte af variabel Sammensætning og ansees af L. Joulin endog for en Blanding af vexlende Mængder Oxyd og Carbonat. Det vilde føre for langt her at gjennemgaa de talrige over dette Emne forfattede Afhandlinger, og jeg skal derfor indskrænke mig til at henvise til Gmelin-Kraut's Handbuch der Chemie 6te Aufl. 2 432, hvor det Væsentligste findes i Uddrag. Det maa dog være mig tilladt at citere nogle Udtalelser af H. Rose, som jeg nylig blev opmærksom paa, Udtalelser, som vise at Videnskaben allerede meget længe har været i Besiddelse af Materiale til Forklaringen af de af Dr. Jacobsen gjorte Observationer. H. Rose siger (Pogg. Ann. [3] — 23 — 417) Følgende:

"Als das Gesetz der einfachen chemischen Proportionen aufgestellt und hinreichend durch Versuche bewiesen worden war, ergab sich die Neutralität zweier sich zersetzender Salzauflösungen als eine ganz natürliche Folge des Gesetzes der bestimmten Verhältnisse, in denen sich alle Körper, also auch Säuren und Basen, mit einander verbinden.

Aber das Gesetz, dass durch Zersetzung zweier neutraler Salze nach ihrer Auflösung in Wasser wiederum zwei neutrale Salze entstehen, ist nicht richtig, wenigstens nicht in der Allgemeinheit, wie es bisher ohne den geringsten Widerspruch angenommen worden ist.

Es ist bemerkenswerth, dass die so ausserordentlich vielen Ausnahmen, die bei diesem Gesetze stattfinden, nicht früher aufgefallen sind, obgleich mehrere derselben schon seit langer Zeit bekannt waren. Nur eine fast einzeln stehende

[1] Berzelius Jahresbericht 17 — 158.
[2] Pogg. Ann. 83 — 435.
[3] Pogg. Ann. 37 — 310.
[4] K. Danske Vid. Selsk. Skrift. [5] — 2 — 54 (1850).
[5] Ann. Chim. Phys. [4] — 30 — 271.

water admits of being evaporated to dryness, and the residue even dried at a temperature of 180° C. without volatilising any considerable quantity of hydrochloric acid. But it is not necessary to seek in the properties of chloride of magnesia the most plausible means of explanation; we need only keep to the carbonate and its properties, as determined by the most renowned Chemists.

According to the statements of Berzelius,[1] H. Rose,[2] Fritzsche,[3] Nörgaard,[4] and L. Joulin,[5] carbonate of magnesia formed at a high temperature invariably contains less carbonic acid than the neutral salt; nay, according to Berzelius and Rose the precipitate resulting from the mixture of carbonate of potash, when cold, with solutions of magnesia, contains less carbonic acid than saturated carbonate of magnesia. For carbonate of magnesia we have a very large number of conflicting statements, and the compounds obtained have been found to vary greatly with the mode of operation, the proportion of their constituents, too, often agreeing but very indifferently with that computed by the formulæ. By some authors these combinations have been regarded as basic salts, varying in their component parts; nay by L. Joulin, as consisting of inconstant mixtures of some oxide and carbonate. I lack space here to notice the numerous memoirs treating of this subject, and shall therefore merely refer the reader to Gmelin-Kraut's 'Handbuch der Chemie' (6te Auflage, 2, p. 432), in which copious extracts from them will be found. I cannot however refrain from quoting certain remarks by H. Rose, on which a short time since I happened to light, — remarks showing science to have been long in possession of materials amply sufficient to explain Dr. Jacobsen's observations. In Pogg. Ann., [3] 23, p. 417, H. Rose observes as follows: —

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Ausnahme erregte vor längerer Zeit ein allgemeines Aufsehen. Als man fand, dass eine Auflösung von gewöhnlichem phosphorsaurem Natron, welche für sich geröthetes Lackmuspapier bläut, mit einer Auflösung von salpetersaurem Silberoxyd, welche das Lackmuspapier unverändert lässt, versetzt, einen Niederschlag von gelbem phosphorsaurem Silberoxyd und eine Flüssigkeit giebt, welche gebläutes Lackmuspapier röthet, konnte diese Erscheinung nicht früher genügend erklärt werden, als bis die interessanten Untersuchungen von Clarke, und die sinnreiche Deutung derselben durch Graham bekannt wurde.

Aber vor weit längerer Zeit schon hatte man Erscheinungen beobachtet, die eben so räthselhaft waren, als der beschriebene Fall. Man hatte schon oft bemerkt, dass aus der Auflösung eines neutralen kohlensauren Alkalis durch Zersetzung vermittelst einer Auflösung eines neutralen Salzes von Magnesia, von Zinkoxyd oder von einem andern ähnlich zusammengesetzten Metalloxyd Kohlensäuregas entwickelt werde, besonders wenn die Fällung des kohlensauren Oxyds in der Wärme geschieht, und eine grosse Reihe von Versuchen, die man besonders in neuerer Zeit angestellt hat, hat ergeben, dass die meisten der kohlensauren unlöslichen Salze, welche man durch Zersetzung neutraler Salzauflösungen erhält, nicht die entsprechende Zusammensetzung des kohlensauren Alkalis haben, das zu ihrer Erzeugung angewandt worden ist. Sie enthalten weniger Kohlensäure, aber obgleich die Untersuchungen oft von sehr bewährten Chemikern angestellt worden sind, so hat man ihre Zusammensetzung sehr wenig übereinstimmend gefunden."

H. Rose har ogsaa ved Forsøg, som han sammesteds beskriver, fundet, at varmt fældt basisk kulsur Magnesia indeholder mindre Kulsyre, naar den efter Fældningen koges nogen Tid, end naar den strax gjøres til Gjenstand for Analyse.

Det kan efter dette ikke være tvivlsomt, at den kulsure Magnesia ved høiere Temperaturer decomponeres og antager meget forskjellige Sammensætninger, eftersom den koges kortere eller længere Tid. Rigtignok er det ikke nogensteds ved de tidligere Forsøg paavist, at man paa denne Maade kan faa Magnesia fuldstændig befriet for Kulsyre, men man maa ogsaa her tage Hensyn til, at man ved de tidligere Forsøg visselig overalt har arbeidet med temmelig store Mængder Bundfald, der naturligvis ikke med samme Lethed som Smaaportioner vil kunne erholdes decomponerede.

Forat paavise, at smaa-Mængder kulsur Magnesia ved Kogning lader sig omvandle til fuldstændig rent Oxyd, gik jeg frem paa følgende Maade. Af fuldstændig ren friskt udglødet Soda afveiedes 0.422 Gr. og opløstes i 100 CC. kulsyrefrit destilleret Vand, ligeledes tilberedtes en 13 % indeholdende Opløsning af almindelig ren svovlsur Magnesia, som i Forveien ved gjentagne Omkrystallisationer var befriet for alle Forurensninger. En Blanding af 15 CC. af Sodaopløsningen med 50 CC. af Bittersaltopløsningen fortyndet med noget over 1/4 Litre friskt udkogt endnu varmt Vand kogtes i en kulsyrefri Luftstrøm i Classens

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Moreover, H. Rose also found, by experiments which he has described in the same paper, that basic carbonate of magnesia, precipitated warm, contains less carbonic acid when boiled for some time after precipitation than when at once subjected to analysis.

From what has been stated above, carbonate of magnesia is evidently decomposed at a high temperature, and enters into a variety of very different combinations according to the duraton of the boiling-process. True, none of the earlier experiments have shown that all the carbonic acid present in magnesia can be expelled by this method; but those experiments were conducted, we must remember, with a comparatively large amount of precipitate, which necessarily proves less easy to decompose than do small quantities.

In order to show that small quantities of carbonate of magnesia may be transformed by boiliug into pure oxide, I went to work as follows. In 100^{cc} of distilled water free from carbonic acid were dissolved 0.422^{gr} of freshly heated carbonate of soda; a solution was likewise prepared containing 13 per cent of ordinary sulphate of magnesia, which by repeated crystallization had been previously freed from all impurities. A mixture consisting of 15^{cc} of the solution of soda and 50^{cc} of a solution of Epsom salts diluted with a little more than 1/4 of a litre of freshly boiled water, still warm, was boiled in Classen's ap-

Apparat i omkring 2 Timer, idet den undvigende Kulsyre som før opfangedes og bestemtes ved titreret Barytvand. I den anvendte Mængde Sodaopløsning var indeholdt 63.3 Mgr. Soda svarende til 26.3 Mgr. Kulsyre, medens der ved to Experimenter paa denne Maade fandtes uddrevet den ene Gang 26.8 og den anden 27.7 Mgr. Ved Forsøgets Gjentagelse med en lidt større Qvantitet paany indveiet Soda fandtes uddrevet 34.1 Mgr. Kulsyre istedetfor beregnet 33.2. Under Kogningen var Opløsningen i Begyndelsen fuldstændig klar, hvorpaa der efter circa $^1/_2$ Times Forløb begyndte at fremkomme et Bundfald af Magnesia, hvori der trods al anvendt Møie ikke lykkedes mig at paavise det mindste Spor af Kulsyre. Den basisk kulsure Magnesia er nemlig ifølge H. Rose og Flere ikke ubetydelig opløselig saavel i Vand som i forskjellige Salte, saaledes at der af smaa Mængder intet Bundfald fremkommer, og det er derfor ikke paafaldende, at Oxydet ved saa fortyndede Opløsninger, som her ere anvendte, ikke udfældes, førend det ved Kogningen er befriet for sin Kulsyre.

Koges Søvand under Concentration, kan man meget let komme til at overse denne Udskillelse af Magnesia, idet denne først indtræder efter nogen Tids Forløb, saaledes at man kan antage Blakningen fremkommen ved Udfældning af Gips i den concentrerede Vædske. Udskillelsen vil ogsaa, naar Inddampningen foregaar i aabent Kar, forsinkes betydeligt, idet Kulsyrens Undvigen foregaar meget langsommere i en kulsyreholdig Atmosphære end i en kulsyrefri Luftstrøm, og det kan derfor ikke forundre, at denne Udfældning af Magnesia af kogende Søvand, saavidt mig bekjendt, ikke tidligere er observeret, naar undtages, at Usiglio[1] i det tørrede Residum har paavist fri Magnesia. Dersom man imidlertid koger Søvand, uden Concentration i en kulsyrefri Atmosphære med omvendt Kjøler, saaledes som det let kan ske ved Classens Apparat, fremtræder Phænomenet meget tydeligt paa samme Maade som ved Kogning af en Blanding af Soda og Bittersalt, idet der efter circa $^1/_2$ Times Kogning begynder at udskille sig et Bundfald bestaaende af ren kulsyre- og kalkfri Magnesia ved Siden af et lidet Spor af Kiselsyre hidrørende fra det benyttede Glaskar. Om man samtidig opfanger og bestemmer den undvigende Kulsyre, viser det sig, at den Villighed, hvormed Kulsyren undviger, ikke saameget afhænger af Concentrationsgraden som af Varigheden af det Tidsrum, hvori Kogningen fortsættes, da ogsaa paa denne Maade circa 2 Timers Kogning strækker til for at skaffe en fuldstændig kulsyrefri Vædske.

Det vil forhaabentlig hermed kunne ansees fuldstændig godtgjort, at Søvandets Evne til ved Kogning at decom-

[1] Journ. für pract. Chem. 46 — 106.

paratus for 2 hours' exposed to a current of air free from carbonic acid, the carbonic acid driven off being collected and determined as before by titrated baryta water. The portion of the solution of carbonate of soda employed contained 63.3^{mgr} of that substance, representing 26.3^{mgr} carbonic acid; and two experiments performed by this method gave respectively 26.8^{mgr} and 27.7^{mgr} as the amount of the latter driven off. On repeating the experiment with a somewhat larger quantity of carbonate of soda, carefully weighed, 34.1^{mgr} were found to have been liberated, whereas the exact proportion would have been 33.2^{mgr}. During the process of boiling, the fluid at first continued perfectly clear; but after the lapse of about half an hour magnesia began to be precipitated, in which with the most delicate tests I failed to detect the smallest trace of carbonic acid. According to H. Rose and other authors basic carbonate of magnesia is to a considerable extent soluble alike in water and in solutions of divers salts, so that small quantities give no precipitate; and hence it is not surprising that with a solution so diluted as that made use of for these experiments, the oxide should not have been precipitated before it had given off all its carbonic acid.

If sea-water be boiled during concentration, this precipitation of magnesia may be easily overlooked, since it does not take place till after the lapse of some time, and the turbidness of the concentrated fluid might therefore be ascribed to the deposit of gypsum. When the water, too, is evaporated in an open dish, the precipitation will be considerably retarded, since the carbonic acid escapes much more slowly in an atmosphere containing carbonic acid than in a current of air from which all carbonic acid has been expelled; and this accounts for the precipitation of magnesia in boiled sea-water, so far as I am aware, not having been previously observed, except at least by Usiglio,[1] who detected the presence of free magnesia in the dried residue. When, however, sea-water is boiled without being concentrated in an atmosphere free from carbonic acid, and with the cooler inverted, which it easily may be with Classen's apparatus, the phenomenon appears with great distinctness, as is the case on boiling a mixture of soda and Epsom salts; for after about half an hour's boiling a precipitate begins to form, consisting of pure magnesia, with no admixture of lime and carbonic acid and a trace only of silicic acid, the latter arising from the glass vessel employed in the operation. If the carbonic acid be simultaneously collected and determined, the readiness with which it escapes is found to depend not so much on the degree of concentration as on the duration of the boiling-process, about 2 hours proving amply sufficient to obtain a fluid free from the smallest trace of carbonic acid.

From what has been stated, there is, we think, conclusive proof, that the property possessed by sea-water of

[1] Journ. für pract Chem. 46, p. 106.

ponere neutrale Carbonater maa blive at tilskrive gradvise Omsætninger mellem de i Søvandet existerende kulsure Salte og Magnesiaforbindelserne, og de af Dr. Jacobsen hos Søvandet iagttagne Egenskaber maa derfor ogsaa i mere eller mindre Grad tilligge alle andre magnesiaholdige Mineralvande, eller naar man lægger Roses ovenciterede Udtalelser til Grund, alle Saltopløsninger, forsaavidt de foruden Alkalier og Jordalkalier tillige indeholder opløselige Salte af nogen af de svagere Baser, som med Kulsyren danner ubestandige Forbindelser. Denne Omstændighed vil saaledes uden videre stemple saa godt som alle de til Bestemmelse af Forholdet mellem den frie og bundne Kulsyre i Mineralvande anvendte talrige Methoder som mere og mindre upaalidelige ligeoverfor magnesiaholdige Mineralvande, idet man ved dem til Bestemmelse af neutralbunden Kulsyre enten anvender Residuet fra Inddampning eller paa anden Maade benytter sig af Kogning, hvor den efter det forhen udviklede vil være utilladelig.

Det vil sluttelig ikke være paa urette Sted kortelig at berøre de Synsmaader, som fra ældre Tider har været gjort gjældende, hvad angaar de i Søvandet indeholdte Carbonater.

Efter de Fremgangsmaader, hvorved disse af ældre Forfattere ere bestemte, kunde de naturligvis kun erholdes udskilte i Form af kulsur Kalk eller, som af enkelte ogsaa fundet, lidt kulsur Magnesia, men deraf følger ingenlunde, at de med Nødvendighed oprindelig skulde forekommet i Søvandet under denne Form, ja dette er saa langt fra sikkert, at jeg meget mere skulde være tilbøielig til at tro, at saa ikke er Tilfælde. Koger man nemlig Søvand i det af Dr. Jacobsen beskrevne Luftudkogningsapparat, undviger der, som allerede før bemærket, meget smaa Qvantiteter Kulsyre, idet man kan fortsætte Kogningen med vexlende Afkjøling en hel Time uden at faa uddrevet mere end en Brøkdel af Milligram pr. Litre. Kogepunctet vil her i Begyndelsen ligge meget lavt, men stiger, efterhaanden som den undvigende Luft og den dannede Vanddamp forøger Trykket, meget hurtigt, saaledes at jeg allerede under den første Halvdel af Operationen har observeret en Temperatur af 89° C. Naar saaledes de i Søvandet indeholdte sure Carbonater vise en saa haardnakket Modstand mod Decomposition, at de i en hel Time skulde saa godt som aldeles uden Virkning kunne udsættes for en Temperatur af omkring 90° C., da synes mig denne Egenskab at passe noget bedre paa surt kulsurt Natron end paa sur kulsur Kalk, og det vilde desuden falde vanskeligt at forklare Søvandets tydelige alkaliske Reaction, medmindre man kunde antage, at Carbonaterne i det Mindste for en ikke ringe Del bestod af Alkalisalte.

Med Hensyn paa Qvantiteten af de i Søvandet forekommende kulsure Salte, da stemme de derover existerende Opgaver meget daarligt overens, de lyde i Regelen paa Spor undertiden endog paa Intet, medens der af enkelte igjen er opført forholdsvis store Mængder. Saaledes finder

decomposing when boiled neutral carbonates, arises from the slow reciprocal action of the carbonates and salts of magnesia it contains, and the properties observed by Dr. Jacobsen in sea-water must therefore to a greater or less extent distinguish all mineral waters containing magnesia compounds, or, according to Rose, in his statements quoted above, all solutions of salts, provided they contain, exclusive of sodium, potassium, lime, barium, and strontium, also soluble salts of some one of the weaker bases, which along with carbonic acid form inconstant combinations. Hence, this circumstance clearly shows, that of the numerous methods devised for determining, in mineral waters, the relative proportion of free carbonic acid and that present in carbonates nearly all are, when magnesia is present, unreliable, since for the determination of the carbonic acid present in carbonates, either the residue from evaporation or some other result of boiling is had recourse to, which has been shown to be inadmissible.

Finally, it will not be out of place to notice the views originally entertained with regard to the carbonates present in sea-water.

By the process according to which the earlier chemists determined these compounds, they could of course obtain them only in the form of carbonate of lime, or, as found by some observers, along with a little carbonate of magnesia; but from this it does not by any means follow that they necessarily occur in that form in sea-water; nay, I am myself inclined to believe that such is not the case. On boiling sea-water in the apparatus described by Dr. Jacobsen, very small quantities only of carbonic acid are found to escape; the fluid may be alternately boiled and cooled for an hour together without liberating more than a fraction of a milligramme per litre. The boiling-point with this method will at first be very low, but, on the pressure being increased by the escape of the air and the formation of steam, rapidly rise; even in the first half of the operation I have observed a temperature of 89° C. The vigorous resistance to decomposition thus exhibited by the bicarbonates in sea-water, which admits of their being exposed almost without effect for an hour together to a temperature of nearly 90° C., would rather seem to indicate bicarbonate of soda than bicarbonate of lime; and besides, the decided alkaline reaction of sea-water would be difficult to explain unless by assuming the carbonates — or a considerable portion of them at least — to consist of carbonate of soda and potash.

With regard to the proportion of carbonates present in sea-water, the results as yet obtained agree but very indifferently; the majority of observers have detected traces only or none whatever, whereas some allege to have found comparatively large quantities, as will be seen from the following Table.

von Bibra[1] Intet,
Robinet og Lefort[2] i det røde Hav Spor,
Pisani[3] ved Bujuk-Déré i Bosporus 0.1569 Gr. pr. Litre,
C. Knauss[4] 0.011 Gr. pr. Litre,
Thorpe og Morton[5] i det irske Hav 0.04754 i 1000 Dele Vand,
Dr. Jacobsen i Nordsøen 0.018—0.028 Gr. pr. Litre,
Vierthaler[6] i Adriaterhavet 0.315 Gr. pr. Litre,
F. Wibel[7] i det joniske Hav Intet
og Buchanan[8] i de sydlige Have enten Intet eller og meget smaa Mængder.

Saa store Forskjelligheder vilde naturligvis være meget paafaldende, i Fald man kunde anse Resultaterne af disse Observationer for aldeles correcte, hvad der imidlertid ikke er muligt, da alle uden Undtagelse ere udførte efter Methoder, som kun for aldeles specielle Sammensætninger af Havvandet kunde føre til nogenlunde rigtige Resultater.

Ved de tidligere i denne Afhandling beskrevne Forsøg er det godtgjort, at Søvandet (under enhver Omstændighed det af Forfatteren undersøgte) ved Kogning i kulsyrefri Luft taber al neutralbunden Kulsyre, og det maa endvidere ved de af v. Bibra og Buchanan udførte Observationer ansees fuldt bevist, at almindeligt Oceanvand ved Inddampning til Tørhed selv i en kulsyreholdig Atmosphære undertiden kan give et fuldstændig kulsyrefrit Residuum, medens det kanske ligesaa ofte ikke vil være Tilfælde, idet der ofte af Buchanan og altid af Jacobsen er fundet Carbonater i Residuet. Hvor den neutralbundne Kulsyre under Inddampningen bortdrives, vil der til Gjengjæld altid udfældes den æqvivalente Mængde Magnesia, som, naar Residuet henstaar i kulsyreholdig Luft før Bestemmelsen, vil kunne gjenoptage en Del Kulsyre, og det er derfor let forklarligt, at man ved Anvendelse af Inddampning vil kunne erholde meget forskjellige Resultater selv i Søvand af fuldstændig identisk Sammensætning.

En til Bestemmelse af Carbonaterne hyppig anvendt Methode er den, hvorefter Søvandet koges i ca. 1 Time under stadig Fornyelse af det fordunstede Vand, hvorefter det udskilte Bundfald frafiltreres og veies, saaledes som Vierthaler og flere har gjort, medens T. E. Thorpe og E. H. Morton af den i Søvandet oprindelig indeholdte Kalkmængde og den i Vædsken efter Frafiltration af det ved Kogningen udskilte Bundfald tilbageværende beregner den kulsure Kalks Mængde.

[1] Ann. Chem. Pharm. 77 — 90.
[2] Compt. rend. 62 — 436.
[3] Compt. rend. 41 — 532.
[4] Petersb. Acad. Bull. 2 — 203 (1860).
[5] Ann. Chem. Pharm. 158 — 122.
[6] Wien. Acad. Ber. [2] — 56 — 479.
[7] Ber. Berl chem. Ges. 6 — 184.
[8] Proc. Roy. Soc. 24 — 604.

Von Bibra:[1] none.
Robinet and Lefort,[2] in the Red Sea: traces.
Pisani,[3] near Bujuk-Déré in the Bosporus: 0.1569^{gr} per litre.
C. Knauss:[4] 0.011^{gr} per litre.
Thorpe and Morton,[5] in the Irish Sea: 0.04754 in 1000 parts of water.
Dr. Jacobsen, in the North Sea: 0.018—0.028^{gr} per litre.
Vierthaler,[6] in the Adriatic Sea: 0.315^{gr} per litre.
F. Wibel,[7] in the Ionian Sea: none.
Buchanan,[8] in the Southern Seas: none at all or traces only.

Differences so considerable would indeed be extraordinary, assuming the results of the observations to be quite correct; this, however, is simply impossible, since they were all without exception obtained by methods none of which, save for sea-water of a particular composition, can lead to results even approximately reliable.

By the experiments previously described in this Memoir, it has been shown that sea-water — at least that examined by the author — can, by boiling in an atmosphere free from carbonic acid, be made to part with all of its carbonic acid that is present in carbonates; and moreover, the observations of v. Bibra and Buchanan have furnished conclusive proof, that ordinary ocean-water when evaporated to dryness even in a atmosphere containing carbonic acid, sometimes gives a residue in which no trace of carbonic acid can be detected, but the reverse will, perhaps, no less frequently prove to be the case, seeing that Buchanan has often, and Jacobsen always, found carbonates present in the residue. When the neutral carbonates are decomposed during the process of evaporation, an equivalent proportion of magnesia will invariably be precipitated, which, on the residue being allowed to stand over previous to determination in an atmosphere containing carbonic acid, may possibly absorb some carbonic acid; and hence, when recourse is had to evaporation, very different results may obviously be obtained even with water identical in composition.

A method frequently adopted for determining the proportion of carbonates, is to boil the sea-water for about an hour, while steadily adding freshwater in place of that evaporated, after which the precipitate is filtered off and weighed, as done by Vierthaler and others; T. E. Thorpe and E. H. Morton calculate the proportion of carbonate of lime by comparing the amount of lime originally present in the water with that contained in the fluid after filtering off the precipitate.

[1] Ann. Chem. Pharm. 77, p. 90.
[2] Comp. rend. 62, p. 436.
[3] Comp. rend. 41, p. 532.
[4] Petersb. Acad. Bull. 2, p. 203 (1860).
[5] Ann. Chem. Pharm. 158, p. 122.
[6] Wien. Acad. Ber. [2] 56, p. 479.
[7] Ber. Berl. chem. Ges. 6, p. 184.
[8] Proc. Roy. Soc. 24, p. 604.

Det er af samme Grund som ovenfor klart, at denne Fremgangsmaade for almindeligt Oceanvands Vedkommende vil føre til aldeles værdiløse Resultater, uden at det dog med Sikkerhed kan paastaaes, at dette i samme Udstrækning skulde være Tilfælde for det af Vierthaler undersøgte Vand, som har en fra almindeligt Søvand meget forskjellig Sammensætning. Efter de talrige og værdifulde Analyser af Søvand, som vi skylde Professor Forchhammer, indeholder Vandet i de store Verdenshave uden synderlig store Variationer i de enkelte Bestanddeles indbyrdes Forhold gjennemsnitlig

Chlor + Brom	1.895 %
Svovlsyre (SO_3)	0.225 -
Magnesia	0.210 -
Kalk	0.056 -

medens Vierthaler i Adriaterhavet har fundet

Chlor + Brom	2.264 %
Svovlsyre	0.262 -
Magnesia	0.237 -
Kalk	0.371 -

Denne uforholdsmæssig store Forøgelse af Kalkmængden uden tilsvarende Forøgelse af Svovlsyremængden vil bidrage til, at det af Vierthaler undersøgte Vand vil have en meget større Tilbøielighed til ved Kogning at udskille kulsur Kalk, hvad der i ikke ringe Grad kan tænkes at forrykke de almindelige Phænomener.

Hvad angaar de af Thorpe og Morton udførte Observationer, da er der i en Henseende en væsentlig Forskjel mellem de af disse Forfattere og de af mig erholdte Resultater. Jeg havde, allerede før jeg blev opmærksom paa den af dem offentliggjorte Afhandling, lagt Mærke til, at der af Søvand ved Kogning i en kulsyrefri Luftstrøm i Classens Apparat udfældtes et Bundfald af Magnesia, indeholdende lidt fra Glasset hidrørende Kiselsyre, men jeg havde aldrig deri kunnet paavise hverken Kulsyre eller Kalk og det, uanseet om Kogningen afbrødes paa et tidligere eller senere Stadium, hvadenten den neutralbundne Kulsyre var helt eller kun delvis bortdrevet. Rigtignok anfører Thorpe og Morton intetsteds udtrykkelig, at de have undersøgt det udskilte Bundfald paa Kalk, men det fremgaar indirecte med stor Bestemthed, af hvad der forresten er bemærket, at saa maa have været Tilfælde.

At Vierthaler kunde faa udfældt kulsur Kalk af et saa abnormt sammensat Søvand som det i Adriaterhavet flydende, kunde ikke vække Forundring, men at det samme fandtes at være Tilfælde med Vandet i det irske Hav, som ved livlige Strømme stadig optager friske Vandmængder fra det store Verdenshav, og som i sin Sammensætning viser sig saa analogt det af den norske Nordhavsexpedition undersøgte, forekom mig meget paafaldende. Jeg har derfor gjentaget Thorpe og Mortons Forsøg aldeles uforandrede paa flere af de fra den norske Expedition hjembragte Vandprøver, men erholdt altid det samme Resultat, at det i det udskilte Bundfald trods al anvendt Møie ikke lykkedes at paavise Spor hverken af Kulsyre eller Kalk. Af det forhen Udviklede vil det fremgaa, at man af de ældre Angi-

For the same reason, as explained above, the said process with ordinary ocean-water will give results absolutely worthless; this cannot however be affirmed with certainty of Vierthaler's observations, the water he examined having been very different in composition from ordinary sea-water. According to the numerous and valuable analyses of sea-water for which we are indebted to Professor Forchhammer, the water of the great oceans, the component parts of which vary but little in their relative proportion, is generally found to contain —

Chlorine + Bromine	1.895 per cent.
Sulphuric Acid (SO_3)	0.225 - —
Magnesia	0.210 - —
Lime	0.056 - —

whereas the water of the Adriatic Sea, according to Vierthaler's observations, contains —

Chlorine + Bromine	2.264 per cent.
Sulphuric Acid	0.262 - —
Magnesia	0.237 - —
Lime	0.371 - —

This disproportionately large amount of lime without a corresponding increase in the amount of sulphuric acid will give the water examined by Vierthaler a tendency, when boiled, to precipitate carbonate of lime, which must to a considerable extent have a disturbing influence on the phenomena.

With regard to the series of observations instituted by Thorpe and Morton, there is, in one respect, an essential difference between their results and mine. Previous to my reading their Memoir, I had become aware of the fact, that, on boiling sea-water exposed to a current of air free from carbonic acid in Classen's apparatus, there results a precipitate of magnesia, containing a little silicic acid, derived from the glass; but I have never succeeded in detecting therein the presence of carbonic acid or lime: the result is precisely the same whether the boiling be interrupted at an early or a late stage of the process, or whether all or part only of the carbonates be decomposed. True, Thorpe and Morton nowhere distinctly state their having examined the precipitate for lime; but from what is observed in other respects, this must obviously have been the case.

That Vierthaler should have succeeded in precipitating carbonate of lime from water so exceptionally composed as is that of the Adriatic Sea, cannot surprise us; but that the same result should have been obtained with water from the Irish Sea, which by reason of rapid currents is continually receiving a large influx of water from the Atlantic Ocean, and which in its composition exhibits so great an analogy with that examined on the Norwegian North-Atlantic Expedition, does, to me, indeed appear strange. I have therefore repeated the experiments instituted by Thorpe and Morton, adopting their method without the slightest modification; but the results obtained were invariably the same: even with the most delicate tests I failed to detect the smallest traces of carbonic acid or

velser Intet med Bestemthed kan slutte om Carbonaternes Mængde i de store Verdenshave. Det synes dog, som om de af Buchanan udførte Bestemmelser af Kulsyren i Atlanterhavet, (hvorved han inddamper efter forudgaaende Tilsætning af Chlorbarium og tilslut med stærk Saltsyre forgjæves har bestræbt sig for at paavise Kulsyre i Residuet), med Sikkerhed skulde fastsætte en øvre Grændse for den tilstedeværende Carbonatmængde, men dette er i Virkeligheden ikke Tilfælde.

Som bekjendt beskytter uopløselige Sulfater Carbonater mod Decomposition endog, naar til Uddrivelse af Kulsyren anvendes saa radicale Midler som concentreret Svovlsyre, saaledes at man endog af den Grund har fundet det fornødent at modificere den af Fresenius og Will angivne Methode til Bestemmelse af Kulsyren i neutrale Carbonater.[1] De af Buchanan foretagne Undersøgelser efter Kulsyre i Residuet kan derfor ikke betragtes som Bevis for, at den ikke skulde have været tilstede, og det fremgaar ogsaa tydeligt af hans egne Udtalelser, at han selv har været af samme Mening.

Forat faa Rede paa, hvorvidt en ved Kogning bevirket Decomposition af de i Søvandet indeholdte neutrale Carbonater foregaar i større Udstrækning ogsaa, naar der i Vædsken findes uopløselige Sulfater, har jeg udført nogle Forsøg efter den af Buchanan foreslaaede Fremgangsmaade. Af nogle Vandprøver, som, udersøgte efter den af mig benyttede Methode, viste sig at indeholde en Sum af surt- og neutralbunden Kulsyre af 96 Mgr. pr. Litre og derover, erholdtes ved Inddampning til Tørhed efter Tilsætning af Chlorbarium uddrevet kun henimod 50 Mgr., ved en enkelt Undtagelse erholdtes engang over 50 Mgr. pr. Litre. Det vil sige, den uddrevne Kulsyremængde var ikke synderlig høiere end den af Buchanan for Vandet i Æqvatoregnene angivne og beløb sig til kun faa Mgr. over, hvad den surtbundne Kulsyre efter pælidelige Observationer skulde beløbe sig til, de endnu i Residuet tilbageværende Carbonater lykkedes det heller ikke mig at paavise.

Spørgsmaalet om Carbonaternes Mængde i de sydlige Have maa derfor endnu betragtes som aabent.

Forhaabentlig resterer endnu en Del af de fra Challengerexpeditionens Togter hjembragte Vandprøver, og man vil i saa Fald ved Undersøgelse af disse kunne give Bidrag til Besvarelsen af disse Spørgsmaal.

Efterat Ovenstaaende var nedskrevet paa Norsk, men førend det endnu var oversat paa Tysk, ankom hertil 2det og 3die Hefte for 1879 af Fresenius' Zeitschrift für anal. Chem., hvori E. Bohlig offentliggjør en Afhandling,[2] hvoraf det sees, at han ved Arbeide med naturlige Mineralvande. har observeret Omsætninger mellem kulsur Kalk og svovl-

[1] Fresenius, Qvant. Analyse, 5te Aufl. 364 bb.
[2] Fresenius' Zeitschrift, 18 — 195.

of lime. From what has been already explained, it is obvious that nothing definite can be inferred from earlier statements respecting the proportion of carbonates in the water of the great oceans. The carbonic acid determinations performed by Buchanan with water from the Atlantic Ocean (he had recourse to evaporation, adding first chloride of barium, and then attempting, unsuccessfully, to detect carbonic acid in the residue by means of strong hydrochloric acid) would appear to fix a limit for the maximum amount of carbonates contained in sea-water; but such is not really the case.

The presence of insoluble sulphates serving, as is known, to protect carbonates against decomposition, even when concentrated sulphuric acid is made use of to expel the carbonic acid, it was necessary for this reason alone to modify the process devised by Fresenius and Will for determining carbonic acid in neutral carbonates.[1] Hence, the experiments performed by Buchanan with a view to detect carbonic acid in the residue, cannot be regarded as affording conclusive proof of its absence; indeed, he himself, as appears from his statements, is clearly of the same opinion.

In order to ascertain whether the decomposition by boiling of the neutral carbonates in sea-water also took place to a considerable extent when insoluble sulphates were present in that fluid, I made a few experiments by Buchanan's process. From several samples of sea-water which, examined by the method I adopted, were found to contain 96^{mgr} of carbonic acid per litre, I succeeded, by evaporation to dryness, after adding a solution of chloride of barium, in liberating about 50^{mgr} only, with a solitary exception, when the amount exceeded 50^{mgr} per litre. The proportion of carbonic acid expelled was accordingly not much greater than that determined by Buchanan in water from the Equatorial Seas, and but a few millegrammes in excess of what the carbonic acid forming bicarbonates, according to trustworthy observations, should have been; of the carbonates said to be still present in the residue, I failed to detect any trace.

The amount of the carbonates contained in the water of the Southern Seas must, therefore, be still regarded as an open question.

It is to be hoped, that some of the samples of water collected on the 'Challenger' Expedition still remain, in which case their examination will serve to throw further light on the subject.

After this Memoir had been written in Norwegian, but previous to its translation into German, the 2nd and 3rd Parts of Fresenius' Zeitschrift für anal. Chemie for 1879 came to hand, in which E. Bohlig has published a paper[2] on transformations, observed by him in mineral waters, resulting from the reciprocal action of carbonate of

[1] Fresenius, Qvant. Analyse, 5te Aufl. 364, bb.
[2] Fresenius' Zeitschrift, 18, p. 195.

sur Magnesia, som fuldstændig svare til, hvad jeg efter de foran beskrevne Observationer har fundet for Søvands Vedkommende. Disse Omsætninger kunne saaledes, idet de ere iagttagne af to af hinanden uafhængigt arbeidende Chemikere, uden videre Begrundelse antages fuldstændig factiske.

Det vil af dette Bohligs Arbeide sees, at han allerede Sommeren 1878 over det samme Thema har publiceret en Afhandling,[1] som jeg ikke tidligere har været opmærksom paa. Den vilde dog ikke havt nogen væsentlig Indflydelse paa mine Undersøgelser, saasom de vigtigste af de Observationer, der har ført mig frem til de samme Resultater, som Bohlig først har beskrevet, allerede vare udførte 3—4 Maaneder, førend hans første Afhandling forelaa trykket.

[1] Fresenius' Zeitschrift, 17 — 301.

lime and sulphate of magnesia, which precisely agree with those I have described as occurring in sea-water. These transformations having accordingly been observed by two chemists working independently of each other, may without further proof be accepted as facts.

From the said paper, it appears that Bohlig published a treatise on the same subject in the summer of 1878,[1] to which my attention had not previously been directed. It would not, however, have materially influenced my experiments, the most important of the observations that led me to the results which Bohlig was the first to describe, having been instituted 3 or 4 months before his first treatise had left the press.

[1] Fresenius' Zeitschrift, 17, p. 301.

III. Om Saltholdigheden af Vandet i det norske Nordhav.

Hvor det gjælder at tilveiebringe Oplysninger om Variationerne af Saltmængderne i Havvandet, kan man til sine Saltbestemmelser benytte flere forskjellige Methoder, som hver især tidligere har fundet udstrakt Anvendelse. Den nærmest liggende af disse bestaar i Vandets Afdampning og derpaa følgende Tørring og Veining af de som Residuum tilbageblivende Salte, en Fremgangsmaade, som rigtignok directe fører til Maalet, men som til Gjengjæld ogsaa fordrer temmelig meget Arbeide. Som mere indirecte men ogsaa ulige mindre besværlige Methoder kan ogsaa anvendes Bestemmelse af Havvandets Chlormængde[1] eller Egenvægt, hvoraf man gjennem passende bestemte Coefficienter kan beregne den samlede Saltmængde, forudsat, at man kan antage et constant indbyrdes Forhold mellem de i Søvandet indeholdte faste Bestanddele. Den første af disse Methoder medfører foruden Besværligheder ved Udførelsen ogsaa den Ulempe, at den ikke lader sig anvende ombord paa et Fartøi i aaben Sø, hvor Skibets Bevægelser forbyder Brugen af Vægt, medens Egenvægtsbestemmelser ved Hjælp af Aræometre og volumetriske Chlorbestemmelser meget letvindt og med temmelig stor Nøiagtighed kan udføres ombord selv i temmelig uroligt Veir.

Hvor man derfor ikke tror sig sikker paa at kunne opbevare Vandprøverne i længere Tidsrum uden derved at risikere, at de undergaa Forandringer, som kunde ytre en skadelig Indflydelse paa Resultaterne af de erholdte Saltbestemmelser og, hvor man som Følge deraf maa lægge Hovedvægten paa en hurtig Undersøgelse af Vandprøverne i frisk Tilstand, bliver man saaledes udelukkende henvist til Brugen af Chlorbestemmelser eller Egenvægtsbestemmelser som Maal for den samlede Saltgehalt.

Paa det første af den norske Expeditions Togter blev af Svendsen, hvem de chemiske Observationer dengang vare

[1] Saavel her som overalt senere forstaaes ved Chlormængde den samlede Chlor- og Brommængde.

III. On the Amount of Salt in the Water of the Norwegian Sea.

When seeking to investigate the degree in which the proportion of salt varies in sea-water, choice may be made for performing the salt-determinations between several methods, each of which has in turn been extensively adopted. The most simple process, is first to evaporate the water, and then dry and weigh the salts left in the residue, a mode of operation which, though leading direct to the desired result, involves considerable labour. Two other methods, not so direct, but far less tedious, consist in determining either the specific gravity of the water or the amount of chlorine[1] it contains, from which, by means of proper coefficients, the total amount of salt may be computed, provided always that a constant proportion can be assumed to exist between the solid constituents of sea-water. The first process is attended, irrespective of the troublesome mode of operation, with another drawback, viz. the impractibility of adopting it on board ship in the open sea, where the motion of the vessel altogether precludes the use of the balance, whereas both specific gravity determinations, with the hydrometer, and volumetric determinations of chlorine, may be performed at sea with the greatest ease, and very considerable accuracy, even in comparatively rough weather.

Hence, when there is reason to fear that the samples of water cannot be preserved for any length of time without exposing them to chemical change, which might exert a disturbing influence on the results; and whenever, accordingly, weight must be chiefly attached to their immediate examination, the only practicable standard of measurement for computing the total amount of salt will be that furnished by determinations of chlorine or of specific gravity.

On the first voyage of the Norwegian Expedition, Svendsen, who then, as previously stated, did the chemical

[1] By "the amount of chlorine," here and elsewhere throughout this Memoir, is understood the total amount of chlorine and bromine.

overdragne, til Undersøgelser over Saltgehalten udelukkende anvendt Egenvægtsbestemmelser, hvorimod jeg paa de to sidste Togter ved Siden af disse ogsaa har udført et større Antal Chlortitreringer for gjennem denne Control at give Resultaterne en større Sikkerhed.

Til Undersøgelser over den i Søvandet indeholdte Chlormængde medhavdes paa de to sidste Togter foruden Sølvopløsning af saadan Styrke, at 1 CC. af denne omtrent svarede til 1 CC. Søvand, ogsaa 2 paa første Togt indsamlede Vandprøver, bestemte til som Normaler at tjene til den nøjagtigere Fastsættelse af Sølvopløsningens Styrke. Disse Normalers Chlormængde i Procenter blev ved omhyggeligt udførte Veiningsanalyser hvert Aar bestemt saavel før Expeditionens Udreise som efter dens Hjemkomst bestandig med meget nær det samme Resultat, hvorhos tillige deres Egenvægter ved Hjælp af Aræometret ombord aflæstes. Til Brug ved alle ombord udførte Chlortitreringer tjente kun to Büretter af lignende Construction og Størrelse, de samme, som af Stipendiat A. Helland anvendtes ved de Bestemmelser af Chlormængderne i Overfladevandet i Atlanterhavet, som denne foretog i Aaret 1875 paa en Reise til Grønland, de bleve af ham den Gang calibrerede ved Hjælp af Kviksølv og befundne særdeles tjenlige for Øiemedet.

Ved Büretternes Brug fyldtes den ene med Sølvopløsning den anden med det til Undersøgelse bestemte Søvand, hvorefter en passende Portion Søvand fra den ene under Omrystning tilsattes Sølvopløsning fra den anden, indtil al Chlor var udfældt, idet chromsurt Kali tjente som Index. Begge Büretters Stand aflæstes nu, og nogle Draaber Søvand tilsattes atter til Affarvning, hvorefter paany fulgte Tilsætning af Sølvopløsning og Aflæsning af Büretternes Stand o. s. v. Gjennem en Række af 4 à 5 paa hinanden følgende lignende Aflæsninger erholdtes paa denne Maade de fornødne Data til Beregning af det Volum Søvand, som i hvert enkelt Tilfælde svarede til 1 CC. Sølvopløsning.

Paa denne Maade sammenlignedes paa den ene Side Søvandsprøverne og paa den anden Side ogsaa fra Tid til anden de medbragte Normaler med Sølvopløsningen, idet der altid sørgedes for, at Vandprøvernes og Opløsningernes Temperatur ikke fjernede sig synderlig meget fra hinanden. Büretterne bleve for at tilveiebringe en bedst mulig Afløbning hyppig rensede med concentreret Svovlsyre.

Af de gjennem disse Observationer erholdte Tal er senere Søvandets Chlormængde beregnet efter følgende Formel

$$p = \frac{K S P}{k s}$$

hvori p betegner den undersøgte Vandprøves Chlormængde i Procenter, k det Antal CC. af samme, der svare til 1 CC. Sølvopløsning og s dens Egenvægt ved 17.°5 C., P Middeltallet mellem de før Udreisen og efter Hjemkomsten i Normalen fundne Chlormængder, K det Antal CC., som af denne svarer til 1 CC. Sølvopløsning og S dens Egen-

work, made exclusive use of specific gravity determinations; but for a considerable number of my own observations, on the last two cruises, I also adopted titration for chlorine as a means of testing the general accuracy of the results.

For estimating the amount of chlorine in sea-water, I took with me, on the two last cruises, besides a solution of silver of such strength that 1 ^{cc} of the fluid about corresponded to 1 ^{cc} of sea-water, also 2 samples of water collected on the first voyage, to serve as a normal standard by which to determine the strength of the solution of silver. Each year, both previous to the departure of the Expedition and after its return, the chlorine in these standard samples was carefully determined by weighing, and the percentage calculated accordingly, their specific gravity too, as shown by the areometer on board, having been likewise noted down. For all chlorine-titrations performed at sea, there were only two burettes in use, similar alike in size and construction, — those used by Mr. Helland for determining the amount of chlorine in the surface-water of the Atlantic on a voyage to Greenland in 1875; he had calibrated them by means of mercury, and they proved excellently adapted for the purpose.

When using the burettes, one was filled with solution of silver and the other with the sea-water selected for examination, after which solution of silver was added to a proper quantity of the sea-water, while shaking the flask in which the titration was performed till all chlorine had been precipitated, chromate of potassium serving as the index. The height of the fluid in both burettes was now read, and a few drops of sea-water added to the mixture, to discolour it, after which solution of silver was again added, and the height of the fluids read as before, &c. After the height had been thus read 4 or 5 times in succession, the necessary data were obtained for computing the volume of sea-water, which in each individual case corresponded to 1 ^{cc} solution of silver.

In this manner, were compared on the one hand the freshly drawn samples of sea-water, and on the other, from time to time, also the standard samples, with the solution of silver, care being taken to keep the samples of water and the solution as near as possible at the same temperature. In order to prevent any portion of the fluid from adhering to the burettes, they were frequently rinsed with concentrated sulphuric acid.

With the figures obtained from these observations, the amount of chlorine in sea-water was afterwards determined by the following formula —

$$p = \frac{K S P}{k s},$$

in which p signifies the percentage of chlorine in the sample of water examined, k the proportion in cubic centimetres representing 1 ^{cc} of the solution of silver, and s the specific gravity of the water at 17°5 C.; P the mean between the amounts of chlorine found in the standard sample before the departure and after the return of the

vægt ved 17° 5 C. Disse Observationer bleve dog selv paa de to sidste Togter ikke anstillede i samme Udstrækning som Egenvægtsbestemmelserne, der ogsaa oprindelig vare bestemte til i første Række at tjene som Maal for den samlede Saltgehalt.

Expeditionen var for Egenvægtsbestemmelser forsynet med flere Sæt Glasaræometre fra Dr. Küchler i Ilmenau, indrettede til at vise Søvandets Egenvægt ved $\frac{17° 5}{17° 5}$[1], saaledes at et Sæt viste Egenvægter fra 1 til 1.007, et andet fra 1.006 til 1.013, et tredie fra 1.012 til 1.019, et fjerde fra 1.018 til 1.025 og et femte fra 1.024 til 1.031. Aræometrene vare inddelte i Delstreger af Værdi 0.0002, medens Afstanden mellem disse Delstreger paa Scalaen beløb sig til meget nær 1.5^{mm}, saaledes at man maatte kunne aflæse uden stor Feil det 5te Decimal. Under Aflæsningen af Vandprøvernes specifiske Vægt anbragtes disse i en i dobbelt Slingrebøile ophængt Glascylinder, hvis indre Diameter beløb sig til omtrent det tredobbelte af Aræometrets Corpus, hvorefter dette omhyggeligt renset og aftørret neddykkedes i Vædsken og tillodes at svømme frit i nogen Tid, indtil det havde antaget Vandets Temperatur. Aflæsningen foretoges nu langs den undre Rand af Vædskens Niveau, idet samtidig Vandets Temperatur iagttoges paa et controlleret Thermometer, inddelt i Delstreger af Værdi 0.°2.

Paa Grund af det af Expeditionen benyttede Dampskibs fortrinlige Egenskaber som Søskib voldte disse Observationer i nogenlunde roligt Veir ingensomhelst Vanskeligheder, selv naar Kursen sattes ret mod Vinden, hvorimod Skibets Duvning i meget haardt Veir altid ytrede sig i mærkbare om end smaa Bevægelser hos Aræometret. Hvor Vandprøverne optoges i saa uroligt Veir, at Bestemmelsen paa Grund deraf kunde medføre forøget Usikkerhed, bleve de altid hensatte nogle Dage, indtil de kunde undersøges under mere gunstige Vilkaar.

Disse saaledes aflæste Egenvægter maa imidlertid i 2 Henseender forbedres, idet man paa den ene Side maa anvende passende Correctioner for at faa de ved meget forskjellige Temperaturer aflæste Egenvægter reducerede til den fælles Normaltemperatur 17.° 5, og paa den anden Side maa befrie dem for Aræometrenes constante Feil.

Hvad for det Første Correctionerne for Temperaturen angaar, da give de af flere Videnskabsmænd udførte Bestemmelser af Søvandets Volumforandring med Temperaturen Midlerne til at beregne disse, idet baade Hubbard[2], L. F.

[1] Naar her som ofte senere bruges Betegningsmaaden Egenvægt ved $\frac{t^0}{T^0}$, da menes dermed Egenvægt ved t^0 i Forhold til destilleret Vand af T^0 som Enhed. Alle Temperaturangivelser i denne Afhandling ere udtrykte i Grader Celsius.

[2] Maury's Sailing Directions 1858, — 1 — 237.

Expedition, K those amounts in cubic centimetres corresponding to 1^{cc} of the solution of silver, and S the specific gravity of the standard sample at 17° 5 C. These observations, however, were not instituted even on the two last voyages to the same extent as those based on determinations of specific gravity, the method by which, as originally agreed upon, the total amount of salt was to be chiefly computed.

For performing specific gravity determinations, the Expedition had been supplied by Dr. Küchler of Ilmenau with divers sets of glass areometers, adapted to show the specific gravity of sea-water at $\frac{17° 5}{17° 5}$[1], one set indicating specific gravities from 1 to 1.007, another from 1.006 to 1.013, a third from 1.012 to 1.019, a fourth from 1.018 to 1.025, and a fifth from 1.024 to 1.031. The areometers were graduated in degrees of 0.0002, the interspaces on the scale measuring however very nearly 1.5^{mm}; and hence you could read off with comparative accuracy to the fifth decimal. When about to read the specific gravity, the samples of water were poured into a glass cylinder suspended in gimbals, the inner diameter of the cylinder being triple that of the areometer, which, carefully wiped and dried, was immersed in the fluid and suffered to float freely for some time till of the same temperature as the water. The specific gravity was now read in the ordinary way, the temperature of the water, as shown by a tested thermometer graduated in fifths of a degree Centigrade, being simultaneously observed.

The steamer selected for the Expedition being an excellent sea-boat, these observations were attended with no difficulty whatever in moderately fair weather, even when steaming dead against the wind; pitching, however, was found to have a distinctly disturbing effect on the areometer, and therefore all samples of water drawn when it was in any way violent, so as to give reason for apprehending greater uncertainty in the determinations if performed at once, were stored for a few days, till the weather had improved.

These readings of specific gravity have, however, a twofold need of correction, arising on the one hand from the very different temperatures at which the specific gravities were read, involving the necessity of their reduction by proper corrections to the normal temperature 17° 5, and on the other, the constant error of the areometer, which has also to be eliminated.

As regards the corrections for temperature, these may be computed by the determinations performed by divers men of science of the extent to which the volume of sea-water varies with the temperature, Hubbard,[2] L. F.

[1] The expression, specific gravity at $\frac{t^0}{T^0}$, signifies specific gravity at t^0, with distilled water of T^0 as the unit of comparison. All statements of temperature in this Memoir are given in degrees Celsius.

[2] Maury's Sailing Directions, 1858, 1, p. 237.

Ekman[1] og Thorpe og Rücker[2] har givet meget fuldstændige Tabeller over Søvandets Volumina ved forskjellige Temperaturer, hvorhos tilligè ogsaa Dr. Karsten[3] har opstillet en Correctionstabel, hvorefter man kan rèducere de ved vilkaarlige Temperaturer aflæste Egenvægter til 17.°5. Sammenstiller man de Correctioner, som efter disse Iagttagelser kunne beregnes, erholder man imidlertid især for de lavere Temperaturer meget daarligt overensstemmende Værdier, idet der kan optræde Differenter, der endog kan overskride 0.0004, mellem de af Ekmann's og Hubbard's Observationer beregnede Correctioner, hersker der den største Overensstemmelse, men ogsaa her gaar Differentserne paa enkelte Puncter op til meget nær 0.0001. I Betragtning af disse tildels temmelig betydelige Uoverensstemmelser mellem de hidtil publicerede Undersøgelser af denne Art kunde det ikke findes ubeføiet endnu engang at gjenoptage Bestemmelserne af Søvandets Volumina ved forskjellige Temperaturer, og jeg besluttede mig derfor til gjennem egne Undersøgelser at forvisse mig om, hvilken af de opstillede Tabeller der bedst svarede til Udvidelsen af det i det norske Nordhav flydende Vand. Dels i dette Øjemed dels for at bestemme de benyttede Aræometres Correctioner og de Constanter, hvormed Chlorprocenterne og Decimalerne i Egenvægten maatte multipliceres for at give Saltmængden, har jeg anstillet Undersøgelser med følgende Vandprøver,

Station.	Bredde.	Længde fra Greenwich.	Dybde Eng. Fvn.	Dybde Meter.
245	68° 21′	2° 5′ V.	0	0
247	68 5.5	2 24 Ø.	500	941
253	Skjærstadfjord.		0	0
254	67° 27′	13° 25′	0	0
284	73 1	12 58	0	0
300	73 10	3 22 V.	0	0
349	76 30	2 57 Ø.	1487	2719
362	79 59	5 40	0	0

hvilke jeg for Kortheds Skyld i den Orden, hvori de her findes opførte, vil betegne med I, II o. s. v. indtil VIII. Til Bestemmelse af Søvandets Udvidelse benyttede jeg et Sprengel's Pyknometer[4], forarbeidet af to Stykker meget tynde Glasrør af et og samme Rør med en indvendig Diameter af omtrent 13 mm. Rørene vare nedentil sammenloddede ved Hjælp af et snævert kort u-formig bøiet Glasrør og oventil paaloddede knæformig bøiede solide Capillarrør med meget fin Aabning. Ved Paalodningen af disse Glasrør blev der saa meget som muligt draget Omsorg for, at kun en liden Del af de videre Rør udsattes for Opvarmning over Blæselampen, forat ikke Apparatet deryed skulde

[1] Kongl. Svenska Vetenskapsak. Handlingar 1870 — 1.
[2] Proc. Roy. Soc., 24 — 159.
[3] Tafeln zur Berechnung der Beobachtungen an den Küstenstationen u. s. w. Kiel 1874.
[4] Pogg. Ann. 150 — 459.

Ekman[1], and Thorpe and Rücker[2] having prepared comprehensive Tables to show the volume of sea-water at different temperatures; Dr. Karsten[3], too, has published a Table of Corrections by which specific gravities read at any temperature may be reduced to 17.°5. Meanwhile, on comparing together the corrections computed from these observations, the values obtained, more especially for low temperatures, are found to agree but very indifferently, the difference in some cases exceeding even 0.0004. The agreement is closest between the corrections computed from Ekman's and Hubbard's observations; but here, too, the difference for some temperatures amounts to very nearly 0.0001. Considering, therefore, the want of uniformity, in some cases very considerable, exhibited by such observations of this kind as had till then been made public, it could not be deemed superfluous to investigate anew by a further series of experiments the variation in volume which sea-water is found to undergo at different temperatures; and hence I determined on ascertaining from the results of my own observations which of the aforesaid Tables corresponded best with the expansion of the water in the Norwegian Sea. Partly with this object in view, and partly in order to determine the corrections for the areometers and the constants by which the percentages of chlorine and the decimals of specific gravity had to be multiplied when computing the amount of salt, I examined the following samples of water: —

Station.	Latitude.	Longitude from Greenw.	Depth Eng. Fath.	Depth Metres.
245	68° 21′	2° 5′ W.	0	0
247	68 5.5	2 24 E.	500	941
253	The Skjærstad Fjord.		0	0
254	67° 27′	13° 25′	0	0
284	73 1	12 58	0	0
300	73 10	3 22 W.	0	0
349	76 30	2 57 E.	1487	2719
362	79 59	5 40	0	0

which I will indicate, for the sake of brevity, by the Roman numbers from I to VIII, and in the order in which they are given here. For determining the expansion of the sea-water, I made use of Sprengel's pycnometer;[4] the instrument was constructed of two pieces of glass tubing, cut off from the same length, with an inner diameter of about 13 mm. These tubes were sealed together at their lower ends by means of a short, narrow glass tube, bent into the form of the letter U, and had strong knee-shaped capillary tubes sealed on to their upper extremities. When sealing on these glass tubes, the greatest care was taken to confine the heat from the glass-blower's lamp to as small a portion

[1] Kongl. Svenska Vetenskapsak. Handlingar 1870, 1.
[2] Proc. Roy. Soc., 24, p. 159.
[3] Tafeln zur Berechnung der Beobachtungen an den Küstenstationen u. s. w. Kiel 1874.
[4] Pogg. Ann. 150, p. 459.

antage en anden Udvidelsescoefficient end den, det anvendte Glasrør oprindelig havde. Pyknometret blev først omkring 4 Maaneder, efterat det var blæst, taget i Brug til de Forsøg, som her skulle beskrives, forat ikke den for alle Glasgjenstande eiendommelige Contraction gjennem de første Maaneder efter deres Blæsning skulde bidrage til i mærkelig Grad at forandre dets Volum under Observationernes Udførelse. Pyknometret benyttedes ved de første Forsøg uden nogen Sikkerhedskugle, men maatte senere, hvor det fyldtes ved lavere Temperaturer, forsynes med en saadan, indrettet til at trækkes ind over det videre Capillarrør. Apparatet uden Sikkerhedskugle vil jeg for Kortheds Skyld betegne som Pyknometer No. 1 og med Sikkerhedskugle som Pyknometer No. 2. Ved Hjælp af disse udførtes følgende Forsøg i den Orden, hvori de her findes opførte.

	Pyknometer med Indhold.	Vægt Gr.	I Luft af sp. Vægt.
1.	Pykn. No. 1 tomt	15.9222	0.001200
2.	— - 1 „	15.9223	0.001200
3.	— - 1 med rent Vand af 17.°5	44.3153	0.001200
4.	— - 1 „ „ „ „ 17.5	44.3156	0.001201
5.	— - 1 „ „ „ „ 17.5	44.3151	0.001201
6.	— - 1 „ III . . . . „ 17.5	44.8097	0.001201
7.	— - 1 „ III . . . . „ 17.5	44.8093	0.001201
8.	— - 1 „ VII . . . . „ 17.5	45.0742	0.001200
9.	— - 1 „ VII . . . . „ 17.5	45.0738	0.001200
10.	— - 2 tomt	18.5665	0.001194
11.	— - 2 med I . . . . af 0.°	47.7869	0.001198
12.	— - 2 „ I . . . . „ 0.	47.7873	0.001198
13.	— - 2 „ I . . . . „ 0.	47.7871	0.001199
14.	— - 2 „ I . . . . „ 17.°5	47.7249	0.001201
15.	— - 2 „ I . . . . „ 17.5	47.7246	0.001201
16.	— - 2 „ I . . . . „ 20.	47.7085	0.001198
17.	— - 2 „ I . . . . „ 20.	47.7087	0.001198
18.	— - 2 „ I . . . . „ 8.	47.7696	0.001200
19.	— - 2 „ I . . . . „ 8.	47.7702	0.001200
20.	— - 2 „ I . . . . „ 4.	47.7810	0.001200
21.	— - 2 „ I . . . . „ 4.	47.7808	0.001200
22.	— - 2 „ I . . . . „ 13.	47.7487	0.001198
23.	— - 2 „ I . . . . „ 13.	47.7484	0.001198
24.	— - 2 med rent Vand „ 0.	46.9773	0.001191
25.	— - 2 „ „ „ „ 0.	46.9776	0.001191
26.	— - 2 tomt	18.5658	0.001191
27.	— - 1 „	15.9216	0.001191
28.	— - 2 „	18.5656	0.001231
29.	— - 1 „	15.9213	0.001231

Til Bestemmelse af Udvidelsescoefficienten af det anvendte Glas forarbeidedes af det samme Glasrør et andet engrenet Pyknometer nedentil tilsmeltet og oventil forsynet med et Capillarrør, idet der ogsaa her sørgedes for Opvarmning af en saa liden Del af Røret som muligt. Ved

as possible of the wider tubes, lest it should give to the apparatus a coefficient of expansion different to that which the glass tubes originally had. The pycnometer was not made use of for the experiments to be described here, till about 4 months after the tubes of which it consisted had been sealed together; for the contraction peculiar to all articles of glass throughout the first few months after they have been blown might otherwise have occasioned an appreciable change in its volume during the progress of the observations. For the first experiments, the pycnometer was used without a receiver, but subsequently, when filled at a lower temperature, one had to be provided, adapted so as to admit of its being drawn over the capillary tube. The apparatus when used *without* a receiver I shall designate for the sake of brevity 'Pycnometer No. 1,' and when used *with* a receiver, 'Pycnometer No. 2.' By means of this instrument the following experiments were performed, in the order in which they are here arranged.

	Pycnometer with Contents.	Weight in Grammes.	In Air with a Sp. Gr. of
1.	Pycn. No. 1 empty	15.9222	0.001200
2.	— - 1 „	15.9223	0.001200
3.	— - 1 with pure water of 17.°5	44.3153	0.001200
4.	— - 1 „ „ „ „ 17.5	44.3156	0.001201
5.	— - 1 „ „ „ „ 17.5	44.3151	0.001201
6.	— - 1 „ III . . . . „ 17.5	44.8097	0.001201
7.	— - 1 „ III . . . . „ 17.5	44.8093	0.001201
8.	— - 1 „ VII . . . . „ 17.5	45.0742	0.001200
9.	— - 1 „ VII . . . . „ 17.5	45.0738	0.001200
10.	— - 2 empty	18.5665	0.001194
11.	— - 2 with I . . . . of 0.°	47.7869	0.001198
12.	— - 2 „ I . . . . „ 0.	47.7873	0.001198
13.	— - 2 „ I . . . . „ 0.	47.7871	0.001199
14.	— - 2 „ I . . . . „ 17.°5	47.7249	0.001201
15.	— - 2 „ I . . . . „ 17.5	47.7246	0.001201
16.	— - 2 „ I . . . . „ 20.	47.7085	0.001198
17.	— - 2 „ I . . . . „ 20.	47.7087	0.001198
18.	— - 2 „ I . . . . „ 8.	47.7696	0.001200
19.	— - 2 „ I . . . . „ 8.	47.7702	0.001200
20.	— - 2 „ I . . . . „ 4.	47.7810	0.001200
21.	— - 2 „ I . . . . „ 4.	47.7808	0.001200
22.	— - 2 „ I . . . . „ 13.	47.7487	0.001198
23.	— - 2 „ I . . . . „ 13.	47.7484	0.001198
24.	— - 2 with pure water „ 0.	46.9773	0.001191
25.	— - 2 „ „ „ „ 0.	46.9776	0.001191
26.	— - 2 empty	18.5658	0.001191
27.	— - 1 —	15.9216	0.001191
28.	— - 2 —	18,5656	0.001231
29.	— - 1 —	15.9213	0.001231

For determining the coefficient of expansion of the glass, a single-branched pycnometer was constructed, of the same length of glass tubing, with the lower opening sealed up and the upper extremity bearing a capillary tube, care being taken, as before, not to heat a greater part of the large tube than

Hjælp af dette Apparat, som ved et Stykke Kautschukrør var forbundet med et lidet Reservoir, bestemt til Optagelse af den ved mulig Opvarmning udskudte Del af Indholdet, bestemtes nu Udvidelsescoefficienten af det anvendte Glasrør med renset Kviksølv, som nogen Tid før Forsøgenes Udførelse under Udkogning paafyldtes Pyknometret. Med dette Apparat, som jeg vil betegne som Pyknometer No. 3, udførtes til den Ende følgende Veininger.

Pyknometer med Indhold.		Vægt Gr.	I Luft af sp. Vægt.
30.	Pykn. No. 3 tomt	10.8654	0.001214
31.	— - 3 „	10.8653	0.001214
32.	— - 3 med Kviksølv af 0°	195.9265	0.001215
33.	— - 3 „ „ „ 0	195.9265	0.001215
34.	— - 3 „ „ „ 20	195.3588	0.001205
35.	— - 3 „ „ „ 20	195.3592	0.001205
36.	— - 3 „ „ „ 15	195.4993	0.001205
37.	— - 3 „ „ „ 0	195.9276	0.001205
38.	— - 3 tomt	10.8650	0.001203
39.	— - 3 med rent Vand af 4°	24.4621	0.001202
40.	— - 3 „ „ „ „ 4	24.4634	0.001190

Alle disse Veininger ere udførte efter Substitutionsmethoden ved Aflæsning af Svingninger paa en Vægt, hvis Følsomhed uden Belastning beløb sig til 1.4 Mgr. pr. Delstreg og for stigende Belastning temmelig jevnt aftog indtil 1.9 Mgr. ved 200 Gr. Belastning. Til disse saavel som alle finere Veininger, som jeg har foretaget i Anledning af disse Arbeider, benyttedes en Platinalodsats fra Deleuil i Paris, hvis Correctioner jeg i Forveien havde bestemt ved flere vel overensstemmende Veininger paa en af P. Bunge forarbeidet fortrinlig Vægt, hvis Følsomhed for de her omhandlede Belastninger beløb sig til omkring 0.14 Mgr. Ved Veiningerne iagttoges altid Temperatur og Barometerstand af Luften i Veieværelset, hvorimod dens Fugtighedsgrad i Mangel af Observation passende ansattes, en Mangel, der ikke har nogen mærkbar Indflydelse paa Forsøgenes Paalidelighed, da selv en saa grov Feil i Ansættelsen af Luftens relative Fugtighed som 25 % under de her omhandlede Forhold kun virker paa det endelige Resultat med en liden Feil i 6te Decimal. Efter disse Data er Luftens specifiske Vægt under Veiningerne paa vanlig Maade beregnet og opført i Tabellen. Pyknometret blev for hver særskilt opført Veining indstillet paany for Temperaturen 0° i finstødt Is og forøvrigt i Vandbad, hvis Temperatur under stadig Omrøring holdtes constant, ligesom det mindst en Gang for hver anden Veining tømtes og fyldtes igjen med det Søvand, hvis Volum skulde bestemmes. Ingen Indstilling toges for god, med mindre det lykkedes i mindst 15 Minutter at holde Temperaturen saa constant, at Thermometret ingensinde viste Variationer af 0.°1 eller derover. Til Brug ved Aflæsning af Vandbadets Temperatur tjente

absolutely unavoidable. With this apparatus, which was connected by a caoutschouc tube with a small receiver for collecting any portion of the contents that, in the event of the instrument becoming warmer might possibly be expelled, the coefficient of expansion of the glass tube was now determined by means of purified mercury, which, shortly before the commencement of the experiment, had, when boiling out the air, been introduced into the pycnometer. With this apparatus, which I will designate 'Pycnometer No. 3,' were performed the following determinations of weight: —

Pycnometer with Contents.		Weight in Grammes.	In Air with a Sp. Gr. of
30.	Pycn. No. 3 empty	10.8654	0.001214
31.	— - 3 „	10.8653	0.001214
32.	— - 3 with mercury of 0°	195.9265	0.001215
33.	— - 3 „ „ „ 0	195.9265	0.001215
34.	— - 3 „ „ „ 20	195.3588	0.001205
35.	— - 3 „ „ „ 20	195.3592	0.001205
36.	— - 3 „ „ „ 15	195.4993	0.001205
37.	— - 3 „ „ „ 0	195.9276	0.001205
38.	— - 3 empty	10.8650	0.001203
39.	— - 3 with pure water „ 4°	24.4621	0.001202
40.	— - 3 „ „ „ „ 4	24.4634	0.001190

These weight-determinations were all performed according to the substitution method, by reading the oscillations of a balance, the sensibility of which, when not loaded, amounted to 1.4^{mgr} for every division of the scale, diminishing, on being loaded with successive weights, at a comparatively uniform rate down to 1.9^{mgr}, when loaded with 200^{gr}. For the above-mentioned as for all accurate weight-determinations involved in these labours, I made use of a set of platina weights procured from Deleuil in Paris, the corrections of which I had previous to starting on the Expedition computed from a series of closely agreeing determinations of weight performed with an excellent balance (made by P. Bunge), its sensibility when loaded to the extent here specified being nearly 0.14^{mgr}. When performing the weight-determinations, the temperature and the atmospheric pressure in the room were always observed, but the relative humidity not having been found by observation had to be roughly estimated, a source of inaccuracy which however can exert no appreciable influence on the trustworthiness of the experiments, seeing that an error of even 25 per cent in the computation of the relative humidity of the atmosphere would affect the final result only by occasioning a very small error in the 6th decimal. From these data, the specific gravity of the air during the process of weighing was computed in the usual manner, and entered in the Table. For each successive determination, the pycnometer was placed in finely crushed ice, to give it the temperature of 0°, and for every other required, in a water-bath, which by constant stirring was kept at an equable temperature; it was emptied,

et Thermometer, inddelt i Delstreger af Værdi 0.°2 med en Længde af 0.68^{mm}., hvis Correctioner bestemtes ved gjentagne Sammenligninger med det herværende meteorologiske Instituts Normalthermometer, som til det Brug velvillig blev mig laant af Institutets Bestyrer, Professor Dr. Mohn.

Af Observationerne 32 til 37 kan først Udvidelsen af det til Pyknometrene benyttede Glasrør beregnes, og man erholder, naar de af Wüllner[1] beregnede Værdier for Kviksølvets Udvidelse lægges til Grund, som Udtryk for Glassets midlere Udvidelsescoefficient mellem 0° og 15° 0.0000267 og mellem 0° og 20° 0.0000274. Man kan desuden ogsaa benytte Observationerne 3, 4 og 5 i Forbindelse med 24 og 25 til Beregning af Glassets Udvidelse og erholder, naar man anvender de af Hällström[2] og Rosetti[3] bestemte Værdier for Vandets Udvidelse, meget vel overensstemmende Tal, som i Middel fastsætte Glassets midlere Udvidelsescoefficient mellem 0° og 17.°5 til 0.0000275. Efterat man heraf har bestemt en passende Værdi for Glassets Udvidelse, hvorved naturligvis de med Kviksølv udførte Bestemmelser fortrinsvis maa komme i Betragtning, kan man nu skride til Udledelsen af de videre Resultater af Forsøgene. Man maa imidlertid her tage Hensyn til, at Observationerne 1, 2, 10, 26, 27, 28 og 29 tydeligt bevise, at Pyknometret under Forsøgene har tabt omkring 0.7 Mgr. i Vægt, hvad der rimeligvis skriver sig fra Opløsning af en Del af Glasset paa de ydre Vægge paa Grund af den stadige Omrøring i Badet. Den herved foraarsagede Usikkerhed kan dog betydelig reduceres, naar man beregner Pyknometrets Vægt til enhver Tid under Forudsætning af, at Vægttabet er proportionalt med Observationernes Antal, idet Usikkerheden da knapt nok vil influere paa 5te Decimal. Under denne Forudsætning har jeg senere beregnet følgende Resultater, idet jeg paa enkelte Steder har tilladt mig smaa Aproximationer, som imidlertid kun kan virke paa de endelige Værdier med en liden Feil i 6te Decimal.

Egenvægt ved $\frac{17.°5}{17.°5}$ af III 1.01739.
$\frac{17.°5}{17.°5}$ af VII 1.02669.
$\frac{17.°5}{17.°5}$ af I 1.02691.
$\frac{0°}{0°}$ af I 1.02845.

[1] Pogg. Ann. 153 — 440.

[2] Disse Værdier ere ogsaa af Ekman benyttede til Bestemmelse af Udvidelsen af det Dilatometer, som denne til sine Forsøg over Søvandets Udvidelse har anvendt.

[3] Ann. Chim. Phys. [4] — 17 — 372.

too, at least once for every other determination, and again filled with the sea-water the volume of which had to be found. These observations were in no case considered satisfactory unless the temperature of the water-bath had been kept comparatively uniform for at least 15 minutes, the greatest variation indicated by the thermometer during that interval never having exceeded 0.°1. For reading the temperature of the water-bath, a thermometer graduated in divisons of 0.°2, measuring each 0.68^{mm}, was made use of, the instrument having been previously corrected by frequent comparison with the standard thermometer of the Norwegian Meteorological Institute, which the Director, Professor H. Mohn, had kindly lent me for that purpose.

Nos. 32—37 are the first of the observations by which the expansion of the glass in the pycnometer may be computed; and, taking the values found by Wüllner[1] for the expansion of mercury as the basis of calculation, the mean coefficient of expansion of the glass between 0° and 15° will be 0.0000267, and between 0° and 20°, 0.0000274. Moreover, Nos. 3, 4, and 5, in conjunction with Nos. 24 and 25, will also serve for determining the expansion of the glass; and, adopting the values computed by Hallström[2] and Rosetti[3] for the expansion of water, very closely agreeing results will be obtained, the figures expressing the average mean coefficient of expansion of the glass between 0° and 17.°5 being 0.0000275. After a proportionate value of the expansion of the glass has been found, for computing which preference should be given to the determinations performed with mercury, we may proceed to deduce the further results of the experiments. Meanwhile, regard must be had to the fact, of which the observations 1, 2, 10, 26, 27, 28, and 29 afford conclusive proof, that the pycnometer had lost about 0.7^{mgr} in weight during the progress of the experiments, some portion of the outer surface of the glass having probably been dissolved, a result of the constant motion of the water surrounding the instrument when in the water-bath. The uncertainty this occasions may however be very considerably reduced by computing the weight of the pycnometer for every experiment on the assumption that the loss of weight is proportional to the number of observations; in that case it will hardly influence the 5th decimal. On the basis of this assumption, I subsequently computed the following results, introducing here and there slight approximations, which, however, can affect the final result only by occasioning a small error in the 6th decimal.

Specific Gravity at $\frac{17.°5}{17.°5}$ of III 1.01739.
$\frac{17.°5}{17.°5}$ of VII 1.02669.
$\frac{17.°5}{17.°5}$ of I 1.02691.
$\frac{0°}{0°}$ of I 1.02845.

[1] Pogg. Ann. 153, p. 440.

[2] These values were also adopted by Ekman for determining the expansion of the dilatometer which he used when investigating the expansion of sea-water.

[3] Ann. Chim. Phys. [4], 17, p. 372.

og som Control paa det benyttede Kviksølvs Renhed dettes Egenvægt ved $\frac{0°}{4°}$ til 13.5963

samt Søvandets Volumina ved forskjellige Temperaturer til

t^0	0	4	8	13	17.5	20
V_t af I	1.000000	1.000308	1.000794	1.001654	1.002605	1.003227

Til Udjevning af den efter disse Observationer optrukne Curve har jeg benyttet de mindste Kvadraters Methode, idet jeg har sat Ligningen for Søvandets Volum ved $t°$ under Formen

$$V_t = 1 + at + bt^2 + ct^3.$$

Betingelsesligningerne blive

$$\begin{aligned}
a + 4\ b + 16\ c - 0.000077 &= 0\\
a + 8\ b + 64\ c - 0.00009925 &= 0\\
a + 13\ b + 169\ c - 0.00012723 &= 0\\
a + 17.5b + 306.25c - 0.000148857 &= 0\\
a + 20\ b + 400\ c - 0.00016135 &= 0
\end{aligned}$$

hvoraf Systemerne

$$\begin{aligned}
5a + 62.5\ b + 955.25c - 0.000613687 &= 0\\
62.5a + 955.25b + 16132.37c - 0.008588 &= 0\\
955.25a + 16132.37b + 286702\ c - 0.1392135 &= 0
\end{aligned}$$

som ved Elimination giver

$$\begin{aligned}
a &= 0.0000527328\\
b &= 0.00000617375\\
c &= -0.000000037516
\end{aligned}$$

eller ved Afrunding

$$V_t = 1 + 0.000052733t + 0.0000061738t^2 - 0.000000003752t^3.$$

Efter denne Formel har jeg beregnet følgende Tabel, hvori Søvandets Volum findes opført for hver hel Grad ogsaa for Temperaturerne under 0°, uagtet Formelens Gyldighed for dette Strøg ikke er støttet ved nogen Observation.

$t°$	V_t	$t°$	V_t	$t°$	V_t
—4	0.99989	5	1.00041	14	1.00185
—3	0.99990	6	1.00053	15	1.00205
—2	0.99992	7	1.00066	16	1.00227
—1	0.99995	8	1.00080	17	1.00250
0	1.00000	9	1.00095	17.5	1.00261
1	1.00006	10	1.00111	18	1.00273
2	1.00013	11	1.00128	19	1.00297
3	1.00021	12	1.00146	20	1.00322
4	1.00031	13	1.00165		

and, as a test of purity, the specific gravity of the mercury at $\frac{0°}{4°}$ was found to be 13.5963, and

the volume of sea-water at different temperatures —

t^0	0	4	8	13	17.5	20
V_t of I	1.000000	1.000308	1.000794	1.001654	1.002605	1.003227

For smoothing the curve laid down from these observations, I adopted the method of the least squares, giving the equation for the volume of the sea-water at $t°$ the form —

$$V_t = 1 + at + bt^2 + ct^3.$$

The conditional equations will be —

$$\begin{aligned}
a + 4\ b + 16\ c - 0.000077 &= 0\\
a + 8\ b + 64\ c - 0.00009925 &= 0\\
a + 13\ b + 169\ c - 0.00012723 &= 0\\
a + 17.5b + 306.25c - 0.000148857 &= 0\\
a + 20\ b + 400\ c - 0.00016135 &= 0
\end{aligned}$$

from which are deduced —

$$\begin{aligned}
5a + 62.5\ b + 955.25c - 0.000613687 &= 0\\
62.5a + 955.25b + 16132.37c - 0.008588 &= 0\\
955.25a + 16132.37b + 286702\ c - 0.1392135 &= 0
\end{aligned}$$

and these equations give by elimination —

$$\begin{aligned}
a &= 0.0000527328\\
b &= 0.00000617375\\
c &= -0.000000037516
\end{aligned}$$

or, rounded off,

$$V_t = 1 + 0.000052733t + 0.0000061738t^2 - 0.000000003752t^3.$$

By means of this formula I determined the results set forth in the following Table, which shows the volume of sea-water, computed for every degree, including temperatures below 0°, although the applicability of the formula to the latter has not been ascertained from observation.

$t°$	V_t	$t°$	V_t	$t°$	V_t
—4	0.99989	5	1.00041	14	1.00185
—3	0.99990	6	1.00053	15	1.00205
—2	0.99992	7	1.00066	16	1.00227
—1	0.99995	8	1.00080	17	1.00250
0	1.00000	9	1.00095	17.5	1.00261
1	1.00006	10	1.00111	18	1.00273
2	1.00013	11	1.00128	19	1.00297
3	1.00021	12	1.00146	20	1.00322
4	1.00031	13	1.00165		

Til Sammenligning hidsættes her de af Ekman fundne Værdier for Volumet af 4 Vandprøver *A*, *B*, *C* og *D* af respective Egenvægter ved $\frac{15°}{15°}$ 1.01603, 1.01982, 1,02306, og 1.02695.

$t°$	V_t af *A*	V_t af *B*	V_t af *C*	V_t af *D*
—5	1.000145	1.000061	0.999983	0.999902
—4	1.000087	1.000020	0.999959	0.999894
—3	1.000044	0.999994	0.999948	0.999904
—2	1.000015	0.999983	0.999953	0.999922
—1	1.000001	0.999985	0.999969	0.999955
0	1.000000	1.000000	1.000000	1.000000
1	1.000019	1.000035	1.000043	1.000062
2	1.000047	1.000083	1.000100	1.000136
3	1.000096	1.000142	1.000168	1.000220
4	1,000154	1.000213	1.000249	1.000315
5	1.000223	1.000296	1.000344	1.000421
6	1.000305	1.000390	1.000450	1.000537
7	1.000399	1.000495	1.000567	1.000664
8	1.000504	1.000612	1.000696	1.000801
9	1.000621	1.000739	1.000836	1.000948
10	1.000749	1.000877	1.000985	1.001104
11	1.000888	1.001026	1.001145	1.001272
12	1.001038	1.001185	1.001315	1.001449
13	1.001199	1.001354	1.001495	1.001635
14	1.001370	1.001533	1.001683	1.001831
15	1.001551	1.001719	1.001880	1.002038
16	1.001742	1.001925	1.002085	1.002250
17	1.001943	1.002134	1.002299	1.002473
18	1.002153	1.002353	1.002520	1.002705
19	1.002373	1.002582	1.002749	1.002946
20	1.002601	1.002819	1.002984	1.003195
21	1.002839	1.003002	1.003227	1.003453
22	1.003085	1.003321	1.003474	1.003719
23	1.003340	1.003588	1.003728	1.003993
24	1.003602	1.003861	1.003988	1.004275
25	1.003875	1.004144	1.004253	1.004565

For den af mig undersøgte Vandprøve I er efter de forhen beskrevne Observationer fundet Egenvægten 1.02691 ved $\frac{17.°5}{17.°5}$ eller 1.02707 reduceret til $\frac{15°}{15°}$, medens Ekman for Vandprøven *D* har fundet Egenvægten 1.02695 ved $\frac{15°}{15°}$, og det fremgaar saaledes, at Undersøgelserne for disse Vandprøvers Vedkommende meget godt kunne gjøres til Gjenstand for Sammenligning. En saadan Sammenligning viser let, at der paa alle Puncter selv for Temperaturerne under 0° existerer en tilfredsstillende Overensstemmelse, idet Differentserne i Regelen ikke overstige 0.00001 og for de høiere Temperaturer, hvor de antage sin største Værdi, kun gaa op til omtrent 0.000025, en Uoverensstemmelse, som, naar Hensyn tages til Forskjellen mellem Vandprøvernes Egenvægter, end yderligere kan reduceres. Med de ovenfor nævnte af andre Chemikere udførte Undersøgelser

For comparison with these figures, are annexed the values found by Ekman for the volume of 4 samples of sea-water, *A*, *B*, *C*, and *D*, their specific gravity at $\frac{15°}{15°}$ being respectively 1.01603, 1.01982, 1.02306, and 1.02695.

$t°$	V_t of *A*	V_t of *B*	V_t of *C*	V_t of *D*
—5	1.000145	1.000061	0.999983	0.999902
—4	1.000087	1.000020	0.999959	0.999894
—3	1.000044	0.999994	0.999948	0.999904
—2	1.000015	0.999983	0.999953	0.999922
—1	1.000001	0.999985	0.999969	0.999955
0	1.000000	1.000000	1.000000	1.000000
1	1.000019	1.000035	1.000043	1.000062
2	1.000047	1.000083	1.000100	1.000136
3	1.000096	1.000142	1.000168	1.000220
4	1.000154	1.000213	1.000249	1.000315
5	1.000223	1.000296	1.000344	1.000421
6	1.000305	1.000390	1.000450	1.000537
7	1.000399	1.000495	1.000567	1.000664
8	1.000504	1.000612	1.000696	1.000801
9	1.000621	1.000739	1.000836	1.000948
10	1.000749	1.000877	1.000985	1.001104
11	1.000888	1.001026	1.001145	1.001272
12	1.001038	1.001185	1.001315	1.001449
13	1.001199	1.001354	1.001495	1.001635
14	1.001370	1.001533	1.001683	1.001831
15	1.001551	1.001719	1.001880	1.002038
16	1.001742	1.001925	1.002085	1.002250
17	1.001943	1.002134	1.002299	1.002473
18	1.002153	1.002353	1.002520	1.002705
19	1.002373	1.002582	1.002749	1.002946
20	1.002601	1.002819	1.002984	1.003195
21	1.002839	1.003062	1.003227	1.003453
22	1.003085	1.003321	1.003474	1.003719
23	1.003340	1.003588	1.003728	1.003993
24	1.003602	1.003861	1.003988	1.004275
25	1.003875	1.004144	1.004253	1.004565

According to the observations previously described the specific gravity of sample I, was, at $\frac{17.°5}{17.°5}$, 1.02691, or, reduced to $\frac{15°}{15°}$, 1.02707, and Ekman found the specific gravity of sample *D* to be 1.02695 at $\frac{15°}{15°}$. Hence the results, so far at least as these samples are concerned, very well admit of being compared; satisfactory agreement exists even for temperatures below 0°, since the difference does not as a rule exceed 0.00001, and for the highest temperatures, at which it is greatest, it amounts to only 0.000025; nay, these figures may be still further reduced by taking into account the specific gravities of the samples. With the results of the above-mentioned observations instituted by other chemists, those here described agree but indifferently. According to the formula deduced by

stemme de her beskrevne Resultater kun maadeligt overens. Ifølge den af Wackerbarth efter Ekmans Observationer beregnede Formel er Temperaturen for Tæthedsmaximum hos Søvand af Egenvægt 1.02707 = — 4.°04, medens Ligningen $\frac{dV}{dt} = 0$ med de af mig fundne Coefficienter giver Temperaturen —4.°45.

Paa Grund af denne gjennemførte Overensstemmelse mellem Ekmans og mine Resultater, har jeg ikke fundet det fornødent at bestemme Udvidelsen af Vandprøver af lavere Egenvægt, men har uden videre anvendt Ekmans Observationer paa de faa Puncter, hvor jeg til Reduction af de paa den norske Nordhavsexpedition aflæste Egenvægter har havt Brug for dem. Ved Hjælp af de ovenfor opførte Værdier for Søvandets Volumina ved forskjellige Temperaturer kan man nu beregne de Correctioner, hvormed de ved vilkaarlige Temperaturer aflæste Egenvægter maa forbedres forat reduceres til $\frac{17.°5}{17.°5}$. Correctionerne, hvori ogsaa indgaar et Led, der afhænger af Aræometrenes Udvidelsescoefficient,[1] findes sammenstillede i nedenstaaende Tabel.

$t°$	Correction	$t°$	Correction
0	—0.00224	12	—0.00104
2	—0.00214	14	—0.00069
4	—0.00201	16	—0.00031
6	—0.00183	18	0.00011
8	—0.00161	20	0.00056
10	—0.00134		

Hvor den Temperatur, hvorved Aflæsningen foretages, ikke fjerner sig meget fra Normaltemperaturen 17.°5, kan disse Correctioner, der strengt taget kun gjælde for Søvand af Egenvægt omkring 1.027, ogsaa uden mærkelig Feil anvendes for Vandprøver af en derfra temmelig forskjellig Egenvægt. Hvor derimod den Temperatur, hvorved Aflæsningen foretages, ligger langt fra 17.°5, ere disse Correctioner kun gyldige for et meget begrændset Interval.

Efterat saaledes de aflæste Egenvægter ved Anbringelse af disse Correctioner ere reducerede til Normaltemperaturen, staar det endnu tilbage at befrie dem for de ved de benyttede Aræometre heftende constante Feil.

Til Aflæsning af saa godt som alle paa Expeditionen bestemte Egenvægter benyttedes kun 3 Aræometre, to paa første Togt og et paa de to sidste. Af de to først nævnte, der af Svendsen før Udreisen vare udvalgte af de øvrige, fordi de havde vist sig at stemme særdeles vel overens, er desværre det ene senere bleven knust, det andet er endnu i Behold og er sammen med det paa sidste Togt benyttede bleven corrigeret af mig.

[1] Som saadan benyttedes 0.000026.

A. Wackerbarth from Ekman's observations, the temperature for the maximum density of sea-water with a specific gravity of 1.02707 is —4.°04, whereas the equation $\frac{dV}{dt} = 0$ gives, with my coefficients, a temperature of —4.°45.

Relying, then, on the close agreement between Ekman's results and my own, I have not determined the expansion in samples of sea-water with a lower specific gravity, but have adopted Ekman's observations, for reducing, when needful, the specific gravities read on the Norwegian North-Atlantic Expedition. By means of the values, tabulated above, for the volume of sea-water at different temperatures, the corrections which serve to reduce specific gravities read at any given temperature to $\frac{17.°5}{17.°5}$ may be computed. These corrections, into which the coefficient of expansion of the areometer[1] enters as a factor, are given in the following Table.

$t°$	Corrections	$t°$	Corrections
0	—0.00224	12	—0.00104
2	—0.00214	14	—0.00069
4	—0.00201	16	—0.00031
6	—0.00183	18	0.00011
8	—0.00161	20	0.00056
10	—0.00134		

When the temperature is not far removed from the normal temperature, 17.°5, these corrections, which, strictly speaking, apply only to sea-water with a specific gravity of about 1.027, may, without involving any appreciable error in the result, be likewise adopted for samples of water whose specific gravity differs considerably from that expressed by the above formula; but when, on the other hand, the temperature at which the specific gravity is read and that of 17.°5 lie far apart, the interval for which these corrections will serve is but very limited.

After reducing by means of these corrections the specific gravities to the normal temperature, there still remains to eliminate the constant error of the areometer.

For reading almost all of the specific gravities determined on the Expedition, only 3 areometers were made use of, two on the first cruise and one on the two last. Of the two former, which, having been found to agree uncommonly well, Mr. Svendsen had selected previous to his departure, one was unfortunately afterwards broken; the other is still in perfect order, and was, together with that made use of on the last voyage, corrected by myself.

[1] That adopted was 0.000026.

Correctionernes Bestemmelse udførtes ved Hjælp af Vandprøverne I og VII, hvis Egenvægter tidligere ere bestemte til 1.02691 og 1.02669 ved $\frac{17.°5}{17.°5}$. For det paa første Togt anvendte Aræometer erholdtes saaledes gjennem 5 Aflæsninger i I Correctionen —0.00023 og gjennem 12 Aflæsninger i VII ligeledes —0.00023. Paa samme Maade bestemtes det andet Aræometers Correctioner ved 5 Aflæsninger i I til —0.00037 og ved 8 Aflæsninger i VII til —0.00038. Under disse Aflæsninger var Vædsken altid bragt til 17.°5 eller en meget nærliggende Temperatur, hvorfra Aflæsningerne efter de forhen gjengivne Correctioner reduceredes til Normaltemperaturen. Gjennem flere Rækker Aflæsninger i Vandprøven I ved forskjellige Temperaturer har jeg tillige forvisset mig om, at den ved Beregning af Correctionstabellen benyttede Udvidelsescoefficient for Aræometrene er passende valgt.

Hermed er givet de fornødne Data til Reduction af de paa den norske Nordhavsexpedition aflæste Egenvægter, og jeg gaar dernæst over til Bestemmelsen af Relationerne mellem Saltgehalten, Chlormængden og Egenvægten.

Til Bestemmelse af Saltmængden har, saavidt jeg ved, tidligere kun været benyttet den simpleste Methode, bestaaende i Afdampning af Vandet og Residuets Tørring ved en passende Temperatur, som af de forskjellige Chemikere er bleven valgt noget forskjelligt fra 150°—180°. Denne Methode har jeg imidlertid af flere Grunde fundet lidet tilfredsstillende, hvad man ogsaa paa Forhaand maatte vente. Efter Graham[1] og andre taber nemlig den svovlsure Magnesia, om hvis Tilstedeværelse i Søvandet der vel ikke kan reises Tvivl, først ved en Temperatur af over 200° sit sidste Molekyl Vand, medens man paa den anden Side allerede ved en Temperatur af betydeligt under 200° maa befrygte en delvis Decomposition af den i Saltene tilstedeværende Chlormagnesium. Efter de Forsøg, som jeg anstillede, viste det sig, at Saltene selv efterat være tørrede ca. 20 Timer i Luftbad ved en Temperatur fra 170°—180° endnu indeholdt ikke ubetydelige Mængder Vand (omkring 15 Mgr. pr. Gr. Salt), medens de tørrede ved lidt lavere Temperatur indeholdt noget mere. Samtidig undersøgtes ogsaa Saltene paa fri Magnesia, hvorved jeg i Strid med ældre Angivelser fandt, at de bestandig selv ved Tørring ved 160° til 170° indeholdt uventet store Qvantiteter, saaat der for hvert Gr. tørret Salt fandtes en Magnesiamængde tilstrækkelig til at neutralisere over 20 Mgr. HCl (ved Tørring ved 180° fandt jeg endog en enkelt Gang 40 Mgr.). Bestemmelsen af den frie Magnesia foretoges ved Saltenes Opløsning i en afmaalt Mængde titreret Svovlsyre og derpaa følgende Retitration med fortyndet Natronlud af bekjendt Styrke. Ved Anvendelse af Rosolsyre som Index erholdtes her en meget skarp Endereaction.

[1] Phil. Mag. J. 6 — 422.

The determination of the corrections was performed with the water of samples I and VII, whose specific gravity at $\frac{17.°5}{17.°5}$ had been found to be respectively 1.02691 and 1.02669. For the areometer used on the first voyage, 5 readings with the water of sample I gave the correction —0.00023, and 12 readings with the water of sample VII likewise —0.00023; in the same manner, the corrections for the other areometer were determined, by 5 readings with the water of sample I, to be —0.00037, and, by 8 readings with the water of sample VII, to be —0.00038. For these readings, the fluid was always brought to 17.°5, or as near that temperature as possible, the readings having in the latter case to be reduced, by means of the corrections given above, to the normal temperature. Several series of readings with the water of sample I, at different temperatures, convinced me that the coefficient of expansion for the areometer which I had computed for preparing the Table of Corrections was practically correct.

Having now specified the data necessary for reducing the specific gravities read on the Norwegian North-Atlantic Expedition, I shall proceed to determine the relation between the specific gravity of sea-water and the amount of salt and chlorine it contains.

For determining the amount of salt, the only method formerly resorted to was, so far as I am aware, the simplest, viz. that of evaporating the water and then drying the residue at a proper temperature, which has been variously fixed by different chemists at from 150° to 180°. This method, however, has proved in several respects defective, as was indeed to be expected. According to Graham[1] and others, sulphate of magnesia, the presence of which in sea-water can hardly admit of doubt, does not part with its last molecule of water till exposed to a temperature of more than 200° whereas, on the other hand, it is highly probable that partial decomposition of the chloride of magnesium contained in the salt takes place considerably below 200°. Even after the salts had been dried for about 20 hours in an air-bath at a temperature of 170°—180°, they were still found to contain, according to my experiments, a considerable quantity of water (about 15^{mgr} salt per gramme); dried at a lower temperature, the amount was somewhat greater. I also tested the salts for free magnesia, and found, in direct opposition to earlier statements, that, even when dried at 160°—170°, they invariably contained a very large amount, the quantity of magnesia to every gramme of dried salt being sufficient to neutralize more than 20^{mgr} HCl (once, when dried at 180°, even 40^{mgr}). For determining the free magnesia, the salts were dissolved in a given quantity of titrated sulphuric acid, and the fluid then retitrated with dilute soda-lye of known strength. With rosolic acid as the index, the final reaction was very decided.

[1] Phil. Mag. J. 6, p. 422.

Forat undgaa de her omtalte Feil, benyttedes til Bestemmelse af Saltmængden i Søvandet følgende Fremgangsmaade.

I en med tætsluttende Laag forsynet tyk, veiet Porcellaindigel indveiedes 30 til 40 Gr. Søvand, som afdunstedes paa Vandbad. Efterat Saltene vare nogenlunde vel tørrede, ophededes Digelen med Laaget paa ca. 5 Minutter over en Bunsens Lampe, afkjøledes og veiedes paany. Derefter bestemtes paa den forud beskrevne Maade den ved Decomposition af Chlormagnesium dannede frie Magnesia, hvorved de til Beregning af den samlede Saltgehalt fornødne Data erholdtes.

I en tidligere Afhandling[1] har jeg paavist, at Carbonaterne i Søvandet ved Kogning omsætter sig til kulsur Magnesia, som ved Inddampning eller under enhver Omstændighed ved Glødning efterlader Magnesia, og man skulde altsaa strengt taget for den saaledes dannede Del af den frie Magnesia beregne en anden Correction end for den ved Decomposition af Chlormagnesium dannede Hovedmængde. Den Feil, man begaar, ved at undlade dette er imidlertid baade meget nær constant og desuden saa liden, at den uden videre kan negligeres, idet den kun bidrager til at formindske den samlede Saltgehalt med omkring 0.0015 %. Det er saaledes fuldstændig tilstrækkeligt til den ved Veiningen fundne Mængde tørret Salt at addere 1.375 Gange den ved Titreringen bestemte Mængde fri Magnesia, for af det saaledes fremkomne Tal at beregne Saltgehalten i Procenter.

Mod denne Methode kan der dog reises Indvendinger, idet det kunde befrygtes, at mindre Qvantiteter Chlornatrium, Chlormagnesium eller Chlorkalium under Glødningen kunde forflygtiges, eller at en Del af den svovlsure Magnesia ved den høie Temperatur kunde decomponeres og give Anledning til Tab af Svovlsyre. Man kan imidlertid let forvisse sig om, at dette ved Anvendelse af en tyk Porcellaindigel med tætsluttende Laag ikke bevirker nogen Feil af mærkbar Indflydelse. Saaledes fandt jeg, at 1.2 Gr. af en passende Blanding af Chlorkalium og Chlornatrium ved $1^1/_4$ Times stærkest mulig Glødning over en Bunsens Lampe i den samme Digel, som jeg benyttede til mine Saltbestemmelser, kun tabte 2 Mgr. i Vægt, det vil sige, Blandingen tabte ved Glødningen ikke fuldt 0.14 Mgr. pr. 5 Minutter. Ligeledes paavistes ved Bestemmelse af Svovlsyre og Magnesia saavel i det benyttede Søvand som i det glødede Residuum, at man selv ved en meget længere fortsat Glødning end den, der udfordres forat skaffe fuldstændig vandfrit Salt, ikke risikerer nogen skadelig Feil foranlediget ved Forflygtigelse af Chlormagnesium eller Decomposition af svovlsur Magnesia.

[1] "Om Kulsyren i Søvandet" Side 40 øverst.

In order to guard against the above-mentioned errors, the following mode of operation was adopted for determining the amount of salt in sea-water.

From 30^{gr} to 40^{gr} of sea-water were introduced into a thick porcelain crucible of known weight, furnished with a tight-fittting cover, and evaporated on a water-bath. So soon as the salt was sufficiently dry, the crucible, with the cover on, was heated for about 5 minutes over one of Bunsen's gas-burners, then cooled and weighed with its contents. The free magnesia liberated by the decomposition of the chloride of magnesium was now determined in the manner previously described, and the last factor necessary for computing the total amount of salt accordingly found.

In a former paper[1] I drew attention to the fact, that the carbonates present in sea-water are transformed during the process of boiling into carbonate of magnesia, which after evaporation, or, at least, on the salt being thoroughly heated, leaves a residue of magnesia; and hence the proportion of free magnesia thus formed would, strictly speaking, seem to involve the need of a correction different from that adopted for the principal amount liberated by the decomposition of the chloride of magnesium. But the error which arises from applying the same correction to both is, on the one hand, very nearly constant, and, on the other, so small as to admit of being safely ignored, seeing that it reduces the total amount of salt only about 0.0015 per cent. It is, therefore, amply sufficient, if to the amount of dried salt found by weighing be added 1.375 times the amount of the free magnesia determined by titration: the figure thus obtained will serve to compute the percentage of salt.

This method certainly is so far open to objection, that small quantities of chloride of sodium, chloride of magnesium, or chloride of potassium may be volatilized during the process of heating, or some portion of the sulphate of magnesia be decomposed at the high temperature, and thus occasion a loss of sulphuric acid. The error, however, arising from this source will not exert any appreciable influence on the result, provided the crucible used for the operation be of thick porcelain, and have a tight-fitting cover. Thus, for instance, I found that 1.2^{gr} of a proportionate mixture of chloride of potassium and chloride of sodium, on being heated for the space of an hour and a quarter over one of Bunsen's gas-burners in the crucible I had used for my salt-determinations, lost only 2^{mgr} in weight, or 0.14^{mgr} every 5 minutes. Moreover, it was manifest on determining the sulphuric acid and magnesia both in the water itself and in the heated residue, that, even in the event of the heating-process being much more protracted than is necessary to obtain salt free from the smallest trace of water, no serious error can result from the volatilization of chloride of magnesium or the decomposition of sulphate of magnesia.

[2] "On the Carbonic Acid in Sea-Water," p. 40.

At Methoden giver indbyrdes vel overensstemmende Resultater, viser de talrige Saltbestemmelser, som udførtes med samme Vandprøver. Saaledes fandtes ved nedenstaaende Forsøg

Proc. Salt i II	3.525 3.517	Proc. Salt i VII	3.514 3.516 3.515
— — - III	2.303 2.299		
— — - IV	3.386 3.385	— — - VIII	3.501 3.507 3.508 3.500
— — - V	3.530 3.533		3.502 3.506
— — - VI	3.276 3.279		3.500 3.501

Resultaterne ere, som man ser, allerede her temmelig vel overensstemmende, men kunde visselig gives en endnu større Nøiagtighed, om man vilde arbeide med noget større Quantiteter Søvand.

For Vandprøverne III og VII er Egenvægten ved $\frac{17.^{\circ}5}{17.^{\circ}5}$ allerede tidligere ved Hjælp af Pyknometer bestemt til respective 1.01739 og 1.02669, for Vandprøverne IV, V, VI og VIII er den funden ved gjentagne Aflæsninger paa et af de corrigerede Aræometre, medens den for Prøven II kun blev bestemt ved en enkelt Aflæsning. Ligeledes bestemtes meget omhyggeligt samtlige Vandprøvers Chlormængder. Heraf kan

$$\text{Chlorcoefficienten} = \frac{\text{Saltmængden}}{\text{Chlormængden}}$$

og

$$\text{Egenvægtscoefficienten} = \frac{\text{Saltmængden}}{\text{Egenvægten} - 1}$$

beregnes, saaledes som det er gjort i nedenstaaende Tabel.

No.	Egenvægt ved $\frac{17.^{\circ}5}{17.^{\circ}5}$	Chlor-mængde %	Salt-mængde %	Egen-vægts-coefficient.	Chlor-coefficient.
II	1.02670	1,947	3.521	131.9	1.808
III	1.01739	1.271	2.301	132.3	1.810
IV	1.02573	1.868	3.386	131.6	1.813
V	1.02676	1.956	3.532	132.0	1.806
VI	1.02488	1.809	3.278	131.8	1.812
VII	1.02669	1.947	3.515	131.7	1.805
VIII	1.02655	1.938	3.503	131.9	1.808

Som det heraf fremgaar, er baade Chlor- og Egenvægtscoefficienterne tiltrods for Saltgehalternes Forskjellighed overalt meget nær constante, saa at Variationerne

That the results obtained by this method must be regarded as agreeing very closely *inter se*, is shown by the numerous salt-determinations performed with the same samples of water.

Per cent. of Salt in II	3.525 3.517	Per cent. of Salt in VII	3.514 3.516 3.515
„ „ - — - III	2.303 2.299		
„ „ - — - IV	3.386 3.385	„ „ - — - VIII	3.501 3.507 3.508 3.500
„ „ - — - V	3.530 3.533		3.502 3.506
„ „ - — - VI	3.276 3.279		3.500 3.501

These figures, it will be seen, differ but little *inter se*, and by increasing the quantity of water greater accuracy could no doubt be attained.

For samples III and VII, the specific gravity at $\frac{17.^{\circ}5}{17.^{\circ}5}$, respectively 1.01739 and 1.02669, had been previously determined by means of the pycnometer; for samples IV, V, VI, and VIII, it was found by repeated readings of one of the corrected areometers, whereas for sample II it was determined by one reading only. The amount of chlorine, too, in each sample was carefully determined. From these data may be computed the

$$\text{Coefficient of Chlorine} = \frac{\text{Amount of Salt}}{\text{Amount of Chlorine}}$$

and the

$$\text{Coefficient of Specific Gravity} = \frac{\text{Amount of Salt}}{\text{Specific Gravity} - 1}$$

as set forth in the following Table.

No.	Spec. Grav. at $\frac{17.^{\circ}5}{17.^{\circ}5}$	Percentage of Chlorine.	Percentage of Salt.	Coefficient of Spec.Grav.	Coefficient of Chlorine.
II	1.02670	1.947	3.521	131.9	1.808
III	1.01739	1.271	2.301	132.3	1.810
IV	1.02573	1.868	3.386	131.6	1.813
V	1.02676	1.956	3.532	132.0	1.806
VI	1.02488	1.809	3.278	131.8	1.812
VII	1.02669	1.947	3.515	131.7	1.805
VIII	1.02655	1.938	3.503	131.9	1.808

It thus appears, that the coefficients both of chlorine and specific gravity, notwithstanding the difference in the percentage of salt, are always very nearly constant;

rimeligst bliver at tilskrive Observationsfeil. Som Chlorcoefficient kan heraf opstilles

$$1.809 \pm 0.00076$$

med en sandsynlig Feil af en enkelt Bestemmelse af $\pm$ 0.002 og som Egenvægtscoefficient

$$131.9 \pm 0.058$$

med en sandsynlig Feil af en enkelt Bestemmelse af $\pm$ 0.15.

Disse Værdier stemme især for Chlorcoefficientens Vedkommende ganske vel overens med tidligere fundne Værdier, saaledes har baade Forchhammer og Ekman i Middel fundet 1.811, medens de af Andre opstillede Egenvægtscoefficienter overalt ere noget mindre end den af mig fundne.

Ved Hjælp af disse Coefficienter har jeg af de paa Expeditionens Togter udførte Chlor- og Egenvægtsbestemmelser beregnet Vandprøvernes Saltgehalt og sammen med Originalobservationerne opført dem i nedenstaaende Tabel.

Egenvægterne ere i Regelen kun aflæste med 4 Decimaler, det 5te er kun opført, hvor det havde en Værdi nær 5, saa at det kunde være Tvivl underkastet, om der ved Afrunding skulde formindskes eller forhøies. I de reducerede Egenvægter findes ligeledes kun opført 4 Decimaler, hvor det uden Tvivl kunde afgjøres, til hvilken Side Afrundingen skulde finde Sted, hvorimod der i modsat Fald ogsaa der er tilføiet et 5te. De med * betegnede Egenvægter ere aflæste paa Aræometre, hvis Correction ikke er bleven bestemt. Til Optagelse af de til Undersøgelse af Saltholdigheden bestemte Vandprøver er foruden det tidligere beskrevne, af Wille construerede, Apparat ogsaa paa grundere Vand ofte benyttet den af Ekman angivne fortrinlige Vandhenter, som imidlertid ifølge den Fremgangsmaade, hvorefter Dyblodninger paa den norske Expedition foretoges, ikke egnede sig til Brug ved større Dyb.

Ved Velvillie af Professor Mohn har jeg faaet opgivet de undersøgte Vandprøvers Temperatur i Havet, hvorved det er bleven muligt ogsaa at tilføie en Rubrik for deres Egenvægter ved denne Temperatur i Forhold til rent Vand af 4°.[1] Af de i Tabellen gjengivne Observationer ere alle indtil No. 149 udførte paa 1ste Togt af Svendsen, alle fra 149 til 225 paa 2det Togt af mig, de øvrige ere udførte paa sidste Togt af Schmelck og mig i Fællesskab, saaledes at det største Antal skyldes Schmelck, der dette Aar medfulgte Expeditionen.

[1] Rent Vand af 4° er ved denne Reduction valgt som Enhed, fordi den allerede tidligere er anvendt af J. Y. Buchanan (Proc. Roy. Soc. 24—597). Ved Beregning af Egenvægternes Værdi ved Havets Temperatur i Forhold til Vand af 4° er Forholdet mellem Volumet af rent Vand ved 4° og 17.°5 sat = 0.998768.

and hence the variation in the results should most probably be ascribed to errors of observation. The coefficient of chlorine may accordingly be taken at —

$$1.809 \pm 0.00076$$

with a probable error in a single determination of $\pm$ 0.002, and the coefficient of specific gravity, at —

$$131.9 \pm 0.058$$

with a probable error in a single determination of $\pm$ 0.15.

These values agree closely, in particular as regards the coefficient of chlorine, with those previously found. Thus, for instance, the mean value found both by Forchhammer and Ekman was 1.811, whereas the coefficient of specific gravity given by former observers is somewhat lower than mine.

By means of these coefficients I have computed from the determinations of chlorine and specific gravity the amount of salt in the samples of water collected on the Expedition, and have set down the observations and their results in the accompanying Table, which calls for a brief explanation.

The specific gravities are as a rule not read to more than 4 decimals, a fifth being added only in the event of its having a value of 5, in which case it is often doubtful whether, when rounding off the figures, there should be increase or diminishment. The reduced specific gravities, too, are expresed with 4 decimals only, wherever it was manifest in which direction the rounding off had to be made; when such is not the case, a fifth has been added. An asterisk at the side of a specific gravity denotes that the latter was determined with an areometer for which no correction had been found. Besides the instrument devised by Wille, of which a description has been given, Ekman's excellent apparatus was likewise made use of, in comparatively shallow localities, for collecting the samples of seawater in which to determine the amount of salt; the mode of sounding practised on the Norwegian North-Atlantic Expedition would not admit of its adoption for greater depths.

Professor Mohn has kindly furnished me with the temperatures of the samples of water *in situ*, which has enabled me to give an aditional column for the specific gravities at those temperatures as compared with pure water of 4°.[1] Of the observations given in the Table, those extending from No. 1 to No. 149 were performed on the first voyage, by Mr. Svendsen; those extending from No. 149 to No. 225, on the second voyage, by myself; the remainder were taken on the last voyage, by Mr. Schmelck and myself conjointly, the greater number, however, by Mr. Schmelck, who that year accompanied the Expedition.

[1] Pure water of 4° was chosen as the unit of reduction, J. Y. Buchanan having previously adopted it as such (Proc. of Roy. Soc. 24, p. 597). When computing the specific gravities at the temperature of the sea, as compared with water of 4°, the ratio existing between the volume of pure water at 4° and 17.°5 was assumed to be 0.998768.

Tab. III.

No.	Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich.)	Dybde hvorfra Prøven hentet. (Depth from which the Samples were collected.) Engelske Favne. (English Fathoms.)	Meter. (Metres.)	Aflæste Egenvægter. (Specific Gravity read.)	Temperatur. (Temperature.) Under Aflæsningen. (When read.)	I Havet. (In Situ.) t^0	Egenvægter. (Specific Gravity.) Ved $\frac{17.^0 5}{17.^0 5}$ At 17.° 5 / 17.° 5	Ved $\frac{t^0}{4^0}$ At $\frac{t^0}{4^0}$	Chlormængde. (Amount of Chlorine.)	Saltmængde. (Amount of Salt measured.) Efter Aræometer. (By the Arcometer.)	Efter Chlormængde. (By the Amount of Chlorine.)
1	—	Esefjord, Sogn.		0	0	1.0151*	14.8	—	1.01465	—	—	1.93	—
2	—	Do.		1	2	1.0234*	13.7	—	1.0227	—	—	2.99	—
3	—	Do.		2	4	1.0237*	12.5	—	1.0228	—	—	3.01	—
4	—	Do.		3	5	1.0241*	13.0	—	1.0233	—	—	3.07	—
5	—	Do.		4	7	1.0242*	13.8	—	1.0235	—	—	3.10	—
6	—	Do.		5	9	1.0240*	17.3	—	1.02395	—	—	3.16	—
7	—	Do.		6	11	1.0245*	17.0	—	1.0244	—	—	3.22	—
8	—	Do.		7	13	1.0249*	20.0	—	1.02545	—	—	3.36	—
9	2	61° 9.′6	6° 31.′9	672	1229	1.0270	16.7	6.7	1.0266	1.0274	—	3.51	—
10	—	Fjærland.		0	0	1.0118*	9.2	—	1.0107	—	—	1.41	—
11	—	Esefjord.		0	0	1.0147*	12.0	—	1.0139	—	—	1.46	—
12	—	Do.		1	2	1.0188*	12.5	—	1.0180	—	—	2.37	—
13	3	61° 5.′2	5° 15.′3 E.	618	1130	1.0280	11.0	6.6	1.0266	1.0274	—	3.51	—
14	—	Husø.		0	0	1.0262	9.7	—	1.0246	—	—	3.24	—
15	—	Do.		0	0	1.0262	9.9	—	1.02465	—	—	3.25	—
16	—	Do.		0	0	1.0262	10.2	—	1.0247	—	—	3.26	—
17	—	Do.		6	11	1.0261	10.7	—	1.02465	—	—	3.25	—
18	—	Do.		6	11	1.0258	15.6	—	1.0252	—	—	3.32	—
19	—	Do.		0	0	1.0262	10.9	—	1.0248	—	—	3.27	—
20	—	61° 25′	3° 41′ E.	0	0	1.0254	16.8	—	1.0250	—	—	3.30	—
21	10	61 41.1	3 18.5	0	0	1.0253	16.2	11.5	1.0248	1.0248	—	3.27	—
22	12	61 53.3	3 0	0	0	1.0270	18.0	11.1	1.0269	1.0270	—	3.55	—
23	14	62 4	2 44.5	0	0	1.0265	19.9	9.9	1.0268	1.0271	—	3.53	—
24	14	62 4	2 44.5	226	413	1.0268	18.6	6.1	1.0268	1.0277	—	3.53	—
25	16	62 23.9	2 17	0	0	1.0275	15.4	10.9	1.02685	1.0270	—	3.54	—
26	17	62 33	2 4	0	0	1.0271	17.5	11.2	1.0269	1.0269	—	3.55	—
27	18	62 44.5	1 48	0	0	1.0270	18.4	11.6	1.0270	1.02695	—	3.56	—
28	—	62 39	2 8	0	0	1.0270	17.9	12.5	1.0269	1.0267	—	3.55	—
29	—	62 29	2 34	0	0	1.0273	16.2	12.5	1.0268	1.0266	—	3.53	—
30	19	62 23.5	2 50	0	0	1.0262	17.5	11.0	1.0260	1.02605	—	3.43	—
31	20	62 16.3	3 8	0	0	1.0256	18.7	11.2	1.0256	1.0257	—	3.38	—
32	21	62 14.7	3 27.5	0	0	1.0251	17.8	13.4	1.02495	1.02455	—	3.29	—
33	22	62 13.2	3 40.5	0	0	1.0254	18.0	12.6	1.0253	1.02505	—	3.34	—
34	—	62 52.5	5 51.5	0	0	1.0252	19.5	12.1	1.0254	1.0253	—	3.35	—
35	—	62 56	6 16	0	0	1.0253	18.4	12.8	1.0253	1.0250	—	3 34	—
36	—	Christiansund.		0	0	1.0255	17.5	—	1.0253	—	—	3.34	—
37	—	63° 10′	6° 30′	0	0	1.0260	16.2	10.0	1.0255	1.0257	—	3.36	—
38	24	63 10	5 57.5	0	0	1.0262	17.5	11.7	1.0260	1.0259	—	3.43	—
39	24	63 10	5 57.5	90	165	1.0262	17.5	6.9	1.0260	1.0267	—	3.43	—
40	—	63 10	5 19	0	0	1.0266	17.2	11.2	1.0263	1.0264	—	3.47	—
41	26	63 10	5 16	0	0	1.0261	17.6	11.8	1.0259	1.0258	—	3.41	—
42	—	63 7.1	5 17	0	0	1.0264	18.6	11.7	1.0264	1.0264	—	3.48	—
43	—	63 10	4 56	0	0	1.0264	17.5	11.6	1.0262	1.0261	—	3.46	—
44	32	63 10	4 51.3	430	786	1.0270	17.0	—0.6	1.0267	1.0281	—	3.52	—
45	—	63 9	3 56	0	0	1.0265	16.2	11.2	1.0260	1.0260	—	3.43	—
46	—	63 6	3 1	0	0	1.0260	15.8	11.8	1.0254	1.02535	—	3.35	—
47	33	63 5	3 0	525	960	1.0279	15.0	—1.1	1.0272	1.0286	—	3.59	—
48	—	63 5	2 57	0	0	1.0271	15.2	11.6	1.0264	1.0264	—	3.48	—
49	—	63 4	2 52	0	0	1.0269	14.6	12.3	1.0261	1.0259	—	3.44	—
50	—	63 3	2 43	0	0	1.0266	17.3	11.9	1.0263	1.0262	—	3.47	—
51	—	63 3	2 10	0	0	1.0275	14.3	12.0	1.02665	1.0265	—	3.52	—
52	—	63 5	1 7	0	0	1.0278	14.7	11.5	1.0270	1.0270	—	3.56	—
53	34	63 5	0 52.5	587	1073	1.0277	15.0	—1.0	1.0270	1.0284	—	3.56	—
54	—	63 3	0 54	0	0	1.0277	14.8	12.0	1.02695	1.0268	—	3.55	—
55	—	62 48	1 51	0	0	1.0273	16.3	11.9	1.0268	1.0267	—	3.53	—
56	—	62 44	2 10	0	0	1.0272	16.1	11.4	1.0267	1.0267	—	3.52	—

No.	Stat. No.	Nordlig Bredde. (*North Latitude.*)	Længde fra Greenwich. (*Longitude from Greenwich.*)	Dybde hvorfra Prøven hentet. (*Depth from which the Samples were collected.*) Engelske Favne. (*English Fathoms.*)	Dybde hvorfra Prøven hentet. Meter. (*Metres.*)	Aflæste Egenvægter. (*Specific Gravity read.*)	Temperatur. (*Temperature.*) Under Aflæsningen. (*When read.*)	Temperatur. I Havet. (*In Situ*) t^0	Egenvægter. Ved $\frac{17.^0 5}{17.^0 5}$ (*At* $\frac{17^0 5}{17^0 5}$)	Egenvægter. Ved $\frac{t^0}{4^0}$ (*At* $\frac{t^0}{4^0}$)	Chlormængde. (*Amount of Chlorine.*)	Saltmængde. (*Amount of Salt measured.*) Efter Areometer. (*By the Areometer.*)	Saltmængde. Efter Chlormængde. (*By the Amount of Chlorine.*)
57	—	62° 37′	2° 37′ E.	0	0	1.0277	13.1	11.5	1.0266	1.0266	—	3.51	—
58	—	62 40.5	1 58	0	0	1.0276	13.7	11.4	1.0266	1.02665	—	3.51	—
59	—	62 45	1 13	0	0	1.0277	14.6	11.4	1.0269	1.0269	—	3.55	—
60	—	63 2	1 12 W.	0	0	1.0275	15.9	11.1	1.02695	1.0270	—	3.55	—
61	—	63 3	1 14	0	0	1.0275	13.4	10.8	1.0265	1.0266	—	3.50	—
62	—	63 4	1 19	0	0	1.0277	13.2	10.8	1.02665	1.1268	—	3.52	—
63	—	63 6	1 24	0	0	1.0279	12.5	10.4	1.0267	1.0269	—	3.52	—
64	—	63 8	1 26	0	0	1.0279	12.9	10.8	1.0268	1.0269	—	3.53	—
65	—	63 12	1 26	0	0	1.0279	12.8	10.4	1.0268	1.0270	—	3.53	—
66	—	63 14	1 27	0	0	1.0278	12.8	10.5	1.0267	1.02685	—	3.52	—
67	—	63 17	1 28	0	0	1.0279	13.3	10.8	1.02685	1.0270	—	3.54	—
68	—	63 18	1 23	0	0	1.0280	11.9	10.8	1.0267	1.02685	—	3.52	—
69	—	63 45	0 57	0	0	1.0277	15.2	10.7	1.0270	1.0272	—	3.56	—
70	—	63 46	1 0	0	0	1.0277	15.2	10.2	1.0270	1.02725	—	3.56	—
71	—	63 26	1 28	0	0	1.0274	16.5	10.8	1.02695	1.0271	—	3.55	—
72	—	63 18	1 38	0	0	1.0275	16.2	10.4	1.0270	1.0272	—	3.56	—
73	—	63 8	1 58	0	0	1.0279	13.8	10.4	1.02695	1.02715	—	3.55	—
74	—	62 58	2 38	0	0	1.0279	14.0	10.2	1.0270	1.0272	—	3.56	—
75	—	62 46	3 34	0	0	1.0277	14.0	9.8	1.0268	1.0271	—	3.53	—
76	—	62 34	4 28	0	0	1.0283	11.9	9.4	1.0270	1.0274	—	3.56	—
77	—	62 20	5 28	0	0	1.0282	12.3	10.0	1.0270	1.02725	—	3.56	—
78	—	62 5	6 22	0	0	1.0278	13.8	10.6	1.02685	1.0270	—	3.54	—
79	—	Thorshavn.		0	0	1.0280	13.4	9.4?	1.0270	1.02735	—	3.56	—
80[1]	—	Do.		0	0	1.0266	10.2	9.4	1.0251	1.0254	—	3.31	—
81	—	Do.		0	0	1.0275	15.8	9.4	1.0269	1.0273	—	3.55	—
82	—	Naalsø Nordpynt. (Northern Extremity of Naalsø.)		0	0	1.0276	15.0	9.4	1.0269	1.02725	—	3.55	—
83	—	Do.		0	0	1.0277	15.0	9.4	1.0270	1.02735	—	3.56	—
84	37	62° 28′.3	2° 29′ W.	309	565	1.0276	15.3	0.1	1.0269	1.0283	—	3.55	—
85	37	62 28.3	2 29	690	1262	1.0276	15.8	—1.1	1.0270	1.0285	—	3.56	—
86	—	62 15	4 32	0	0	1.0274	15.8	9.3	1.0268	1.0272	—	3.53	—
87	—	62 23	3 26	0	0	1.0274	15.5	9.6	1.0268	1.0271	—	3.53	—
88	—	62 28	2 29	0	0	1.0274	15.7	10.4	1.0268	1.0270	—	3.53	—
89	—	62 37	2 52	0	0	1.0275	15.7	10.2	1.0269	1.0271	—	3.55	—
90	—	62 50	3 30	0	0	1.0276	15.3	10.5	1.0269	1.0271	—	3.55	—
91	—	62 57	3 47	0	0	1.0275	14.8	10.3	1.02675	1.0270	—	3.53	—
92	—	63 12	4 39	0	0	1.0274	15.7	9.7	1.0268	1.0271	—	3.53	—
93	—	63 22	5 20	0	0	1.0277	14.0	9.4	1.0268	1.0272	—	3.53	—
94	40	63 22.5	5 29	515	942	1.0277	13.6	—0.4	1.0267	1.0281	—	3.52	—
95	40	63 22.5	5 29	0	0	1.0277	13.8	9.7	1.02675	1.0271	—	3.53	—
96	40	63 22.5	5 29	0	0	1.0277	13.8	9.7	1.02675	1.0271	—	3.53	—
97	40	63 22.5	5 29	0	0	1.0277	15.4	10.3	1.02705	1.0273	—	3.57	—
98	—	Reikjavik.		0	0	1.0272	11.1	9.8	1.0258	1.0261	—	3.40	—
99	—	Midten af Faxebugt. (The Middle of Faxe Bay.)		0	0	1.0267	16.3	10.0?	1.0262	1.0265	—	3.46	—
100	—	63° 49′	22° 52′	0	0	1.0273	14.5	8.8	1.0265	1.0269	—	3.50	—
101	—	63 37	21 58	0	0	1.0274	14.2	9.7	1.0265	1.0268	—	3.50	—
102	—	63 42	22 25	0	0	1.0278	11.7	9.5	1.0265	1.0268	—	3.50	—
103	—	63 25	21 0	0	0	1.0271	15.6	10.0	1.0265	1.02675	—	3.50	—
104	—	63 13	19 54	0	0	1.0273	15.6	10.4	1.0267	1.0269	—	3.52	—
105	—	63 6	18 43	0	0	1.0273	16.8	10.6	1.0269	1.0271	—	3.55	—
106	—	63 7	17 31	0	0	1.0273	15.3	10.2	1.0266	1.02685	—	3.51	—
107	—	63 7	16 20	0	0	1.0273	15.6	11.0	1.0267	1.0268	—	3.52	—
108	—	63 8	15 9	0	0	1.0276	15.2	11.0	1.0269	1.0270	—	3.55	—
109	—	63 8	13 59	0	0	1.0279	13.0	10.7	1.0268	1.02695	—	3.53	—
110	—	63 20	13 22	0	0	1.0272	16.0	10.7	1.02665	1.0268	—	3.52	—
111	45	63 28	12 58	0	0	1.0273	16.9	10.4	1.02695	1.02715	—	3.55	—
112	—	63 38	12 35	0	0	1.0279	13.6	10.0	1.0269	1.0272	—	3.55	—

[1] Stærk Regn. (Heavy Rain.)

No.	Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich.)	Dybde hvorfra Prøven hentet. (Depth from which the Samples were collected.) Engelske Favne. (English Fathoms.)	Meter. (Metres.)	Aflæste Egenvægter. (Specific Gravity read.)	Temperatur. (Temperature.) Under Aflæsningen. (When read.)	I Havet. (In Situ) t^0	Egenvægter. (Specific Gravity.) Ved $\frac{17.^0 5}{17.^0 5}$ At $\frac{17^0 5}{17^0 5}$	Ved $\frac{t^0}{4^0}$ At $\frac{t^0}{4^0}$	Chlormængde. (Amount of Chlorine.)	Saltmængde. (Amount of Salt measured.) Efter Aræometer. (By the Areometer.)	Efter Chlormængde. (By the Amount of Chlorine.)
113	—	63° 57′	11° 52′ W.	0	0	1.0277	13.6	10.2	1.0267	1.0269	—	3.52	—
114	—	64 14	11 12	0	0	1.0277	14.0	9.5	1.0268	1.0271	—	3.53	—
115	48	64 36	10 21.5	0	0	1.0279	11.5	5 3	1.02655	1.0275	—	3.50	—
116	—	64 44	10 4	0	0	1.0270	17 5	7.0	1.0268	1.0275	—	3.53	—
117	—	65 0	9 24	0	0	1.0269	18.0	7.4	1.0268	1.0275	—	3.53	—
118	—	65 21	8 36	0	0	1.0271	16.8	7.8	1.0267	1.0273	—	3.52	—
119	—	65 39	7 53	0	0	1.0271	15.0	7.2	1.0264	1.02705	—	3.48	—
120	51	65 53	7 18	0	0	1.0272	15.0	8.0	1.0265	1.02705	—	3.50	—
121	51	65 53	7 18	515	942	1.0272	16.0	—0.6	1.02665	1.0281	—	3.52	—
122	51	65 53	7 18	1163	2127	1.0272	16.0	—1.1	1.02665	1.0281	—	3.52	—
123	—	65 51	5 36	0	0	1.0269	18.2	8.4	1.0268	1.02735	—	3.53	—
124	—	65 49	4 18	0	0	1.0270	17.6	9.3	1.0268	1.0272	—	3.53	—
125	52	65 47.5	3 7	0	0	1.0270	17.6	9.7	1.0268	1.0271	—	3.53	—
126	52	65 47.5	3 7	515	942	1.0270	17.4	—0.4	1.02675	1.0282	—	3.53	—
127	52	65 47.5	3 7	1861	3403	1.0280	12.0	—1.2	1.0267	1.0282	—	3.52	—
128	—	64 47	4 24 E.	0	0	1.0274	13.9	11.0	1.02645	1.02655	—	3.49	—
129	—	64 47	4 24	0	0	1.0264	19.5	11.0	1.0266	1.0267	—	3.51	—
130	—	64 49	4 46	0	0	1.0263	19.0	10.8	1.0264	1.0265	—	3.48	—
131	—	64 46	5 38	0	0	1.0270	18.0	11.2	1.0269	1.02695	—	3.55	—
132	—	64 42	6 47	0	0	1.0265	19.0	10.6	1.0266	1.0268	—	3.51	—
133	—	64 37	8 0	0	0	1.0265	19.0	10.8	1.0266	1.0267	—	3.51	—
134	—	64 27	8 36	0	0	1.0253	19.2	10.5	1.02545	1.0256	—	3.36	—
135	—	Mellem Sydhund og Revillen. Between Sydhund and Revillen.		0	0	1.0220*	15.8	—	1.0217	—	—	2.86	—
136	63	64° 41.3	9° 0′	0	0	1.0278	13.4	11.6	1.0268	1.02675	—	3.53	—
137	68	64 44.1	8 9	0	0	1.0277	13.0	11.6	1.0266	1.0266	—	3.51	—
138	73	64 46.5	7 28	0	0	1.0276	13.0	11.3	1 0265	1.0265	—	3.50	—
139	—	64 48	6 45	0	0	1.0277	13.0	11.5	1.0266	1.0266	—	3.51	—
140	—	64 48	6 26	0	0	1.0281	12.2	11.6	1.02685	1.0268	—	3.54	—
141	—	64 33	5 31	0	0	1.0278	14.2	11.8	1.0269	1.0269	—	3.55	—
142	—	64 4	5 35	0	0	1.0277	13.8	11.7	1.02675	1.0267	—	3.53	—
143	—	64 2	5 42	0	0	1.0277	13.8	12.0	1.02675	1.0267	—	3.53	—
144	89	64 1	6 7.5	0	0	1.0277	13.8	12.2	1.02675	1.0266	—	3.53	—
145	—	64 0	6 42	0	0	1.0279	12.0	11.4	1.0266	1 02665	—	3.51	—
146	—	63 48	6 42	0	0	1.0268	12.8	12.8	1.0257	1.0264	—	3.39	—
147	—	63 22	6 47	0	0	1.0259	12.8	—	1.0248	—	—	3.27	—
148	—	Stadt.		0	0	1.0250	14.2	—	1.02415	—	—	3.19	—
149	94	59° 8,2	4° 38′	0	0	1.0259	12.0	9.8	1.0245	1.0248	—	3.23	—
150	94	59 8.2	4 38	145	265	1.0263	12.0	5.0	1.0249	1.0258	—	3.28	—
151	95	60 42.5	4 13.7	0	0	1.0254	12.9	9.4	1.0242	1.0245	—	3.18	—
152	95	60 42.5	4 13.7	175	320	1.0278	11.9	5.8	1.0264	1.0272	—	3.48	—
153	—	64 47	2 50	0	0	1.0276	12.7	9.4	1.0263	1 0267	—	3.47	—
154	96	66 8.5	3 0	0	0	1,0278	13.5	8.2	1.0266	1.0272	—	3.51	—
155	96	66 8.5	3 0	805	1472	1.0275	14.9	—1.1	1.0266	1.0280	—	3.51	—
156	97	66 2	4 21	683	1249	1.0284	10.9	—1.1	1.0268	1.0283	—	3.53	—
157	98	65 56	5 21	388	710	1.0278	13.0	—1.0	1.02655	1.0280	—	3.50	—
158	99	65 51.5	6 25	213	390	1.0277	13.5	6.1	1.0265	1.0274	—	3.50	—
159	101	65 36	8 32	0	0	1.0276	12.6	9.4	1.0263	1.02665	—	3.47	—
160	101	65 36	8 32	223	408	1.0283	10.3	6.0	1.0266	1.0275	—	3.51	—
161	104	65 28	9 56	162	296	1.0282	11.4	6.5	1.0267	1.0275	—	3.52	—
162	124	66 41	6 59	0	0	1.02735	14.5	8.4	1.0264	1.0269	—	3.48	—
163	125	67 52.5	5 12	0	0	1.0282	10.1	7.0	1.0265	1.0272	1.957	3.50	3.54
164	125	67 52.5	5 12	700	1280	1.0280	10.4	—1.1	1.02635	1.0278	1.951	3.48	3.53
165	137	67 24	8 58	0	0	1.02745	9.9	8.2	1.0257	1.0263	—	3.39	—
166	137	67 24	8 58	400	732	1.0281	11.7	—1.0	1.0266	1.0281	—	3.51	—
167	143	66 58	10 33	0	0	1.0273	10.7	8.2	1.0257	1.0262	1.899	3.39	3.44
168	143	66 58	10 33	189	346	1.0279	12.0	6.2	1.0265	1.0273	1.956	3.50	3.54

No.	Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich.)	Dybde hvorfra Prøven hentet. (Depth from which the Samples were collected.) Engelske Favne. (English Fathoms.)	Meter. (Metres.)	Aflæste Egenvægter. (Specific Gravity read.)	Temperatur. (Temperature.) Under Aflæsningen. (When read.)	I Havet. (In Situ) t^0	Egenvægter. (Specific Gravity.) Ved $\frac{17.^0 5}{17.^0 5}$ At $\frac{17^0 5}{17^0 5}$	Ved $\frac{t^0}{4^0}$ At $\frac{t^0}{4^0}$	Chlormængde. (Amount of Chlorine.)	Saltmængde. (Amount of Salt measured.) Efter Aræometer. (By the Areometer.)	Efter Chlormængde. (By the Amount of Chlorine.)
169	—	Hopen ved Bodø. (Hopen near Bodø.)		0	0	1.0091*	11.7	—	1.0083	—	—	1.09	—
170	152	67° 18′	12° 46′ E.	0	0	1.0266	14.3	8.2	1.0256	1.0261	—	3.38	—
171	152	67 18	12 46	70	128	1.0270	13.5	4.1	1.02585	1.0269	—	3.41	—
172	152	67 18	12 46	125	229	1.0274	13.5	4.1	1.0262	1.0273	—	3.46	—
173	162	68 23	10 20	795	1454	1.0270	17.2	—1.2	1.0266	1.0280	1.943	3.51	3.51
174	—	Indløbet til Hasselfjord. (Entrance to the Hassel Fjord.)		0	0	1.0269	14.5	8.8	1.0259	1.0264	—	3.41	—
175	171	69° 18′	14° 29′	0	0	1.0272	11.9	9.0	1.0258	1.0262	—	3.40	—
176	171	69 18	14 29	642	1174	1.0282	9.9	—1.0	1.0265	1.0279	—	3.50	—
177	176	69 18	14 32.7	0	0	1.0270	13.3	8.0	1.0258	1.0264	—	3.40	—
178	179	69 32	11 10	0	0	1.0280	10.9	8.8	1.0264	1.0269	1.945	3.48	3.52
179	179	69 32	11 10	1607	2939	1.0282	9 7	—1.2	1.0264	1.0279	1.935	3.48	3.50
180	183	69 59.5	6 15	0	0	1.0279	13.3	8.6	1.0267	1.0272	1.952	3.52	3.53
181	184	70 4	9 50	0	0	1.0280	12.6	7.6	1.0267	1.0273	1.943	3.52	3.51
182	184	70 4	9 50	600	1097	1.0279	12.8	0.0	1.0266	1.0280	1.928	3.51	3.49
183	184	70 4	9 50	1547	2829	1.02765	13.4	—1.3	1.0265	1.0279	1.935	3.50	3.50
184	187	69 51.5	14 41	1335	2441	1.0276	15.2	—1.1	1.02675	1.0282	1.933	3.53	3.50
185	188	69 43	15 29	0	0	1.0278	13.2	9.0	1.0266	1.0270	1.939	3 51	3.51
186	189	69 41	15 42	0	0	1.0275	13.2	9.6	1.0263	1.0266	1.923	3.47	3.48
187	189	69 41	15 42	860	1573	1.0279	12.9	—1.1	1.0266	1.0281	1.931	3.51	3.49
188	200	71 25	15 40.5	0	0	1.0282	9.9	7.8	1.0265	1.0271	—	3.50	—
189	200	71 25	15 40.5	620	1134	1.0285	9.4	—1.0	1.0267	1.0281	1.949	3.52	3.53
190	206	70 45	14 36	0	0	1.0282	9.5	8.2	1.0264	1.0270	1.945	3.48	3.52
191	206	70 45	14 36	700	1280	1.0285	8.7	—0.7	1.0266	1.0280	1.945	3.51	3.52
192	206	70 45	14 36	1248	2282	1.0283	9.2	—1.1	1.0265	1.0279	1.945	3.50	3.52
193	—	Indløbet til Malangenfjord. (Entrance to the Malangen Fjord.		0	0	—	—	—	—	—	1.744	—	3.15
194	212	70° 12.5	17° 41′	0	0	1.0255	21.7	7.2	1.0261	1.02675	1.895	3.44	3.43
195	212	70 12.5	17 41	142	260	1.0272	17.6	5.8	1.02685	1.02775	1.940	3.54	3.51
196	213	70 23	2 30	0	0	1.0277	14.2	8.2	1.0267	1.0272	1.956	3.52	3.54
197	213	70 23	2 30	1760	3219	1.0274	15.5	—1.2	1.0266	1.02805	1.951	3.51	3.53
198	215	70 53	2 0 W.	0	0	1.0276	14.9	8.0	1.0267	2.0273	1.945	3.52	3.52
199	215	70 53	2 0	200	366	1.02755	15.2	2.8	1.0267	1.0279	1.945	3.52	3.52
200	215	70 53	2 0	700	1280	1.0276	14.3	—0.6	1.0266	1.0280	1.935	3.51	3.50
201	215	70 53	2 0	1665	3045	1.0275	14.5	—1.2	1.0265	1.02795	1.939	3.50	3.51
202	217	71 0	5 8.5	0	0	1.0283	6.5	4.6	1.0262	1.0272	—	3.46	—
203	—	Østpynten af Jan Mayen. (Eastern Extremity of Jan Mayen.)		0	0	1.0280	4.0	3.0	1.02565	1.0268	—	3.38	—
204	225	70° 58′	8° 4′	0	0	1.0278	9.2	3.4	1.0260	1.0271	—	3.43	—
205	226	70 59	7 51	0	0	1.0277	10.5	3.0	1.0261	1.0272	1.893	3.44	3.42
206	226	70 59	7 51	340	622	1.0282	9.1	—0.6	1.02635	1.0278	1.936	3.48	3.50
207	—	69 20	11 18	0	0	1.0276	12.8	4.3	1.0263	1.02745	1.925	3.47	3.48
208	—	68 33	7 25	0	0	—	—	6.0	—	—	1.936	—	3.50
209	243	68 32.5	6 26	0	0	1.0280	12.8	7.8	1.0267	1.0273	1.945	3.52	3.52
210	243	68 32.5	6 26	600	1097	1.02715	16.7	—0.8	1.0266	1.0280	1.927	3.51	3.49
211	243	68 32.5	6 26	1385	2533	1.0286	5.7	—1.3	1.0264	1.0278	1.940	3.48	3.51
212	245	68 21	2 5	0	0	1.0280	13.4	9.0	1.0268	1.02725	—	4.53	—
213	247	68 5.5	2 24 E.	0	0	1.0278	13.8	9.4	1.0267	1.0271	1.954	3.52	3.53
214	247	68 5.5	2 24	500	914	1.0278	13.1	—0.4	1.0266	1.0280	1.927	3.51	3.49
215	247	68 5.5	2 24	1120	2048	1.0275	14.5	—1.2	1.0265	1.02795	1.929	3.50	3.49
216	249	68 12	6 35	1063	1944	1.0274	15.4	—1.3	1.0266	1.0280	1.937	3.51	3.50
217	251	68 6.5	9 44	0	0	1.0276	13.9	13.2	1.0265	1.0262	1.927	3.50	3.49
218	252	Sønden for Skraaven. (South of Skraaven.)		0	0	1.0254	19.2	14.0?	1.0254	1.0249	1.820	3.35	3.29
219	253	Skjærstadfjord.		0	0	1.0178*	14.4	13.0	1.0173	1.0168	1.261	2.28	2.28
220	253	Do.		263	481	1.02755	11.2	3.2	1.0260	1.02715	1.887	3.43	3.41
221	254	67° 27′	13° 25′	0	0	1.0266	12.6	10.0	1.0253	1.0255	1.843	3,34	3.33
222	254	67 27	13 25	70	128	1.0278	11.2	4.8	1.02625	1.0272	1.929	3.46	3.49
223	254	67 27	13 25	140	256	1.0281	12.1	5.8	1.0267	1.0276	1.931	3.52	3.49
224	—	Frohavet.		0	0	1.0262	12.0	—	1.0248	—	1.822	3.27	3.29

No.	Stat. No.	Nordlig Bredde. (North Latitude.)		Længde fra Greenwich. (Longitude from Greenwich.)		Dybde hvorfra Prøven hentet. (Depth from which the Samples were collected.) Engelske Favne. (English Fathoms.)	Dybde hvorfra Prøven hentet. (Depth from which the Samples were collected.) Meter. (Metres.)	Aflæste Egenvægter. (Specific Gravity read.)	Temperatur. (Temperature.) Under Aflæsningen. (When read.)	Temperatur. (Temperature.) I Havet. (In Situ) t^0	Egenvægter. (Specific Gravity.) Ved $\frac{17.^0 5}{17.^0 5}$ At 17° 5 / 17° 5	Egenvægter. (Specific Gravity.) Ved $\frac{t^0}{4^0}$ At $\frac{t^0}{4^0}$	Chlormængde. (Amount of Chlorine.)	Saltmængde. (Amount of Salt measured.) Efter Aræometer. (By the Areometer.)	Saltmængde. (Amount of Salt measured.) Efter Chlormængde. (By the Amount of Chlorine.)
225	255	68°	12.'3	15°	40′ E.	0	0	1.0262	14.3	10.7	1.0252	1.0253	—	3.32	—
226	255	68	12.3	15	40	300	549	1.0280	12.9	6.5	1.0267	1.0275	—	3.52	—
227	256	70	8.5	23	4	0	0	—	—	—	—	—	1.118	—	2.02
228	256	70	8.5	23	4	225	411	1.0280	10.9	4.0	1.0264	1.0275	1.930	3.48	3.49
229	258	70	12.6	23	2.5	0	0	1.0276	8.3	11.6	1.0257	1.0256	1.865	3.39	3.37
230	258	70	12.6	23	2.5	230	421	1.0282	6.9	4.0	1 0261	1.0272	1.907	3.44	3.45
231	259	70	48.9	25	59	80	146	1.0286	6.7	4.1	1.02645	1.0275	1.942	3.49	3.51
232	261	70	47.5	28	30	0	0	1.0248	11.9	7.4	1.0234	1.0240	1.713	3.09	3.10
233	261	70	47.5	28	30	127	232	1.0280	10.9	2.8	1.0264	1.0276	1.920	3.48	3.47
234	262	70	36	32	35	0	0	1.0282	8.5	5.6	1.0263	1.0272	1.921	3.47	3.47
235	262	70	36	32	35	148	271	1.0284	8.9	1.9	1.0265	1.0278	1.932	3.50	3.49
236	263	70	44.5	34	14	121	221	1.1286	6.9	1.9	1.0265	1.02775	1.927	3.50	3.49
237	264	70	56	35	37	0	0	1.0279	11.3	5.2	1.0264	1.0273	1.929	3.48	3.49
238	264	70	56	35	37	86	157	1.0281	11.4	1.9	1.0266	1.02785	1.934	3.51	3.50
239	268	71	36.5	36	18	0	0	1.0284	8.7	4.4	1.0265	1.02755	1.925	3.50	2.48
240	268	71	36.5	36	18	130	238	1.0285	8.9	—1.0	1.0266	1.0281	1.938	3.51	1.51
241	270	72	27.5	35	1	0	0	1.0284	9.0	3.6	1.02655	1.0277	1.937	3.50	1.50
242	270	72	27.5	35	1	136	249	1.0286	8.9	0 0	1.0267	1.0281	1.937	3.52	3.50
243	272	73	10.8	33	3	113	207	1.0285	8 9	1.5	1.0266	1.0279	1.937	3.51	3.50
244	273	73	25	31	30	0	0	1.0285	8.7	4.9	1.0266	1.0276	1.938	3.51	3.51
245	273	73	25	31	30	197	360	1.0285	8.5	2.2	1.0266	1.0278	1.943	3.51	3.51
246	275	74	8	31	12	0	0	1.0287	5.9	2.9	1.0265	1.0277	1.935	3.50	3.50
247	275	74	8	31	12	147	269	1.0289	5.5	—0.4	1.02665	1.02805	1.936	3.52	3 50
248	278	74	1.5	22	27	0	0	1.0286	5.9	4.2	1.0264	1.02745	—	3.48	—
249	278	74	1.5	22	27	230	421	1.0287	5.3	0.9	1.0264	1.0278	—	3.48	—
250	280	74	10.5	18	51	0	0	1.0282	9.3	1.2	1.0264	1.0277	—	3.48	—
251	280	74	10.5	18	51	35	64	1.0283	9.4	1.1	1.0265	1.0278	—	3.50	—
252	281	74	3	17	18	0	0	1.0285	8.9	4.6	1.0266	1.02765	1.967	3.51	3.56
253	281	74	3	17	18	115	210	1.0287	8.8	2.2	1.0268	1.0281	1.939	3.53	3.51
254	283	73	47.5	14	21	0	0	1.0282	11.3	7.2	1.0267	1.0274	1.938	3.52	3.51
255	284	73	1	12	58	0	0	1.0283	11.2	6.8	1.02675	1.0275	1.940	3.53	3 51
256	286	72	57	14	32	447	817	1.0284	9.5	—0.8	1.0266	1.02805	—	3.51	—
257	289	72	41.5	20	18	0	0	1.0282	11.1	7.6	1.02665	1.0273	—	3.52	—
258	289	72	41.5	20	18	219	400	1.0282	11.1	2.0	1.02665	1.0279	—	3.52	—
259	291	71	54	21	57	0	0	1.0280	12.0	7.4	1.0266	1.02725	1.936	3.51	3.50
260	291	71	54	21	57	194	355	1.0284	10.5	3.0	1.02675	1.02795	1.944	3.53	3.52
261	293	71	7	21	11	0	0	1.0272	5.0	—	1.02495	—	1.909?	3.29	3.45
262	293	71	7	21	11	95	174	1.0276	5.3	—	1.0254	—	1.943	3.35	3.51
263	294	71	35	15	11	0	0	1.0272	4.9	—	1.02495	—	1.918	3.29	3.47
264	294	71	35	15	11	637	1165	1.0284	7.1	—1.2	1.0263	1.02775	1.934	3.47	3.50
265	295	71	59	11	40	0	0	1.0278	13.5	7.0	1.02665	1.02735	1.942	3.52	3.51
266	295	71	55	11	30	100	183	1.0283	10.1	3.2	1.0266	1.0278	1.942	3.51	3.51
267	295	71	55	11	30	600	1097	1.0281	10.7	—0.8	1.0265	1.0279	1.936	3.50	3.50
268	295	71	59	11	40	1110	2030	1.0278	13.3	—1.3	1.0266	1.02805	1.934	3.51	3.50
269	296	72	15.5	8	9	100	183	1.0286	7.1	3.1	1.0265	1.0277	1.944	3.50	3.52
270	296	72	15.5	8	9	600	1097	1.0287	7.1	—0.5	1.0266	1.0280	1.939	3.51	3.51
271	297	72	36.5	5	12	0	0	1.0284	5.9	4.8	1.0262	1.0272	1.928	3.46	3.49
272	297	72	36.5	5	12	1280	2341	1.0286	5.0	—1.4	1.0263	1.02775	1.926	3.47	3.48
273	298	72	52	1	50.5	0	0	1.0272	15.1	4.0	1.0263	1.0274	1.917	3.47	3.47
274	298	72	52	1	50.5	1500	2743	1.0271	16.8	—1.5	1.0266	1.0280	1.915?	3.51	—
275	299	73	10	2	14 W.	0	0	1.0269	13.7	3.6	1.0258	1.0269	1.888	3.40	3.42
276	300	73	10	3	22	0	0	1.0255	15.2	1.7	1.0247	1.0259	1.810	3.26	3.27
277	301	74	1	1	20	0	0	1.0263	14.3	2.2	1.0253	1.0265	1.837	3.34	3.32
278	302	75	16	0	54	0	0	1.0285	7.9	3.0	1.0265	1.0277	1.920	3.50	3.47
279	303	75	12	3	2 E.	0	0	1.0283	6.5	3.3	1.02615	1.0273	1.914	3.45	3.46
280	303	75	12	3	2	150	274	1.0288	4.4	—1.1	1.02645	1.0279	1.929	3.49	3.49

No.	Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich.)	Dybde hvorfra Prøven hentet. (Depth from which the Samples were collected.)		Aflæste Egenvægter. (Specific Gravity read.)	Temperatur. (Temperature.)		Egenvægter. (Specific Gravity.)		Chlormængde. (Amount of Chlorine.)	Saltmængde. (Amount of Salt measured.)	
				Engelske Favne. (English Fathoms.)	Meter. (Metres.)		Under Aflæsningen. (When read.)	I Havet. (In Situ.) t^0	Ved $\frac{17.^0 5}{17.^0 5}$ At 17.° 5 / 17.° 5	Ved $\frac{t^0}{4^0}$ At t^0 / 4^0		Efter Aræometer. (By the Areometer.)	Efter Chlormængde. (By the Amount of Chlorine.)
281	304	75° 3′	4° 51′ E.	300	549	1.0273	14.9	—0.8	1.0264	1.0278	1.929	3.48	3.49
282	304	75 3	4 51	1735	3173	1.0273	14.5	—1.5	1.0263	1.02775	1.940	3.47	3.51
283	305	75 1.5	7 56	0	0	1.0272	14.8	5.3	1.0263	1.0272	1.947	3.47	3.52
284	306	75 0	10 27	0	0	1.0275	14.1	5.4	1.02645	1.0274	1.929	3.49	3.49
285	306	75 0	10 27	1334	2440	1.0272	14.9	—1.3	1.0263	1.0277	1.920	3.47	3.47
286	310	74 56	13 50	0	0	1.0274	14.7	5.5	1.02645	1.0274	1.936	3.49	3.50
287	310	74 56	13 50	1006	1840	1.0275	13.8	—1.4	1.0264	1.0278	1.932	3.48	3.49
288	316	74 56	16 29	0	0	1.0269	14.7	3.6	1.02595	1.02705	1.903	3.42	3.44
289	316	74 56	16 29	129	236	1.0275	14.6	1.9	1.02655	1.0278	1.930	3.50	3.49
290	321	74 56.5	19 30	25	46	1.0275	9.7	0.2	1.02575	1.0271	—	3.40	—
291	323	72 53.5	21 51	0	0	1.0283	9.7	7.8	1.02655	1.0272	1.947	3.50	3.52
292	323	72 53.5	21 51	223	408	1.0284	8.9	1.5	1.0265	1.0278	1.933	3.50	3.50
293	326	75 31.5	17 50	0	0	1.0276	8.9	4.8	1.02575	1.0267	1.904	3.40	3.44
294	326	75 31.5	17 50	123	225	1.0284	8.7	1.6	1.0265	1.0278	1.930	3.50	3.49
295	328	75 42	15 39	0	0	1.0279	9.9	4.7	1.0262	1.0272	1.908	3.46	3.45
296	328	75 42	15 39	200	366	1.0282	9.8	—1.3	1.02645	1.0279	1.942	3.49	3.51
297	331	75 51	13 5	0	0	—	—	—	—	—	1.935	—	3.50
298	332	75 56	11 36	1149	2101	1.0286	6.3	—1.5	1.0264	1.0279	—	3.48	—
299	334	76 12.5	14 0	0	0	1.0275	13.7	6.0	1.0264	1.0272	1.923	3.48	3.48
300	334	76 12.5	14 0	403	737	1.0277	13.7	1.0	1.0266	1.0279	1.935	3.51	3.50
301	335	76 16.5	14 39	0	0	1.0270	15.5	5.4	1.0262	1.0271	1.914	3.46	3.46
302	335	76 16.5	14 39	179	327	1.0276	13.4	1.0	1.0264	1.0277	1.940	3.48	3.51
303	339	76 30	15 39	0	0	1.0267	12.7	2.6	1 0254	1.0266	1.867	3.35	3.38
304	339	76 30	15 39	37	68	1.0273	13.6	0.9	1.02615	1.0275	1.924	3.45	3.48
305	342	76 33	13 18	0	0	1.0277	12.4	6.2	1.02635	1.0272	1.936	3.48	3.50
306	342	76 33	13 18	523	956	1.0277	12.2	—1.0	1.0263	1.0277	1.933	3.47	3.50
307	344	76 42	11 16	0	0	1.0283	6.2	5.2	1.0261	1.0271	—	3.44	—
308	347	76 40.5	7 47	0	0	1.0277	11.3	4.4	1.0262	1.0272	1.924	3.46	3.48
309	347	76 40.5	7 47	1429	2613	1.0278	11.6	—1.3	1.0263	1.02775	1.935	3.47	3.50
310	349	76 30	2 57	0	0	1.0274	11.2	3.8	1.02585	1.0269	1.898	3.41	3.43
311	349	76 30	2 57	1487	2719	1.0277	11.3	—1.5	1.0262	1.0276	1.946	3.46	3.52
312	350	76 26	0 29 W.	0	0	1.0270	10.9	3.0	1.0254	1.0266	1.872	3.35	3.39
313	350	76 26	0 29	300	549	1.0279	10.9	—1.1	1.0263	1.02775	1.922	3.47	3.48
314	350	76 26	0 29	1686	3083	1.0276	10.8	—1.5	1.0260	1.0274	1.916	3.43	3.47
315	352	77 56	3 29 E.	0	0	1.0272	12.8	3.9	1.0259	1.0270	1.908	3.41	3.45
316	352	77 56	3 29	300	549	1.0274	14.0	—0.8	1.0263	1.02775	1.928	3.47	3.49
317	355	78 0	8 32	0	0	1.0275	10.3	4.9	1.0258	1.0268	1.890	3.40	3.42
318	355	78 0	8 32	948	1734	1.0280	9.9	—1.3	1.0263	1.0277	1.927	3 47	3.49
319	357	78 3	11 18	0	0	1.0261	10 9	5.0	1.02455	1.02545	1.797	3.24	3.25
320	359	78 2	9 25	0	0	1.0280	5.3	4.3	1.02575	1.0268	—	3.40	—
321	359	78 2	9 25	416	761	1.0276	13.7	0.8	1.0265	1.0278	1.925	3.50	3.48
322	361	79 8.5	5 28	0	0	1.0278	11.5	4.2	1.0263	1.02735	1.906	3.47	3.45
323	361	79 8.5	5 28	905	1655	1.0272	12.9	—1.2	1.02595	1.02705	1.928	3.42	3.49
324	362	79 59	5 40	0	0	1.0274	13.0	5.2	1.02615	1.0271	1.917	3.45	3.47
325	362	79 59	5 40	459	839	1.0275	12.8	—1.0	1.0262	1.0276	1.922	3.46	3.48
326	363	80 0	8 15	0	0	1.0276	10.9	4.6	1.0260	1.0270	—	3.43	—
327	363	80 0	8 15	260	475	1.0284	7.7	1.1	1.0264	1.0277	1.945	3.48	3.52
328	—	Ved Norskøerne. (The Norsk Islands.)		0	0	1.0283	4.1	2.7	1.02595	1.0271	—	3.42	—
329	—	Magdalenebay.		0	0	1.0268	12.3	2.2	1.02545	1.0266	—	3.36	—
330	368	78° 43′	8° 20′	0	0	1.0266	13.0	4.6	1.0254	1.02635	—	3.35	—
331	368	78 43	8 20	315	576	1.0286	8.5	1.6	1.0267	1.0280	1.936	3.52	3.50
332	—	78 34	9 22	0	0	1.0262	11.9	4.5	1.0248	1.0258	—	3.27	—
333	372	78 9	14 12	0	0	1.0258	5.0	4.1	1.0236	1.0246	—	3.11	—
334	373	78 10	14 26	0	0	1.0250	12.5	4.0	1.0237	1.0247	—	3.13	—
335	—	Mundingen af Adventbay. (Entrance to Advent Bay.)		0	0	1.0250	5.3	4.7	1.02285	1.0237	—	3.01	—

Af denne Tabel fremgaar det, at Differentserne mellem de ved Hjælp af Egenvægt og Chlormængde beregnede Saltmængder i Regelen ere meget smaa, kun de 3 samtidig udførte Bestemmelser i Vandprøverne No. 261, 262 og 263 danne i saa Henseende en Undtagelse. De store her optrædende Differentser skyldes uden Tvivl en Feil ved Aflæsningen af Egenvægterne, som for disse Vandprøvers Vedkommende ere fundne altfor lave, til at de kunne bringes i Harmoni med andre paa Steder i Nærheden udførte Observationer. Det er saaledes i høi Grad paafaldende for Vandprøven No. 262, optagen fra et Dyb af 95 Favne (174 Meter) i ca. 8 Miles Afstand fra Land, at finde Egenvægten 1.0254, medens man i de indenfor liggende Fjorde, hvor Saltgehalten ellers overalt er mindre end paa Havet, i lignende Dyb finder en meget større Egenvægt. Selv i den indelukkede Skjærstadfjord, hvor Overfladevandet er særdeles fattigt paa Salte, er dog Egenvægten paa Bunden funden at være 1.026, kort sagt, Egenvægter som de i de omtalte Tilfælde observerede staa paa dette Strøg af Kysten fuldstændig uden Sidestykke. Naturligst lade disse Urimeligheder sig forklare ved at antage Egenvægterne aflæste med 0.001 for lavt, da de ved denne Antagelse paa det Nærmeste kan bringes i Overensstemmelse saavel med de i de samme Vandprøver udførte Chlorbestemmelser som med de andre Observationer fra nærliggende Puncter.

Bortser man fra disse 3 nævnte Observationer og af de øvrige beregner den gjennemsnitlige halve Differents mellem to paa samme Vandprøve ved Hjælp af Chlortitrering og Aræometer udførte Saltbestemmelser, resulterer som Udtryk for denne 0.00904, eller man erholder under Forudsætning af, at Feilene i lige høi Grad skyldes Chlor- som Egenvægtsbestemmelserne, for den gjennemsnitlige Feil af en Egenvægtsbestemmelse Værdien 0.000069 og af en Chlorbestemmelse 0.005. Differentserne falde, som man ser, snart til den ene snart til den anden Side, idet det dog maa bemærkes, at Chlormængden gjennemsnitlig giver lidt over 0.008 % høiere Saltgehalt end Egenvægterne, hvad der næsten udelukkende skyldes de nordenfor den 75de Breddegrad udførte Observationer.

Førend jeg nu gaar over til at give en Oversigt over de Resultater, som af disse Observationer lader sig udlede, vil det være nødvendigt parenthetisk at indskyde nogle Bemærkninger om Dybde- og Temperaturforholdene i det norske Hav i sine groveste Træk. Hvad der til den Ende her meddeles, er hovedsagelig hentet fra en af Professor Dr. Mohn forfattet Afhandling, som findes trykt i C. F. Schübelers "Vækstlivet i Norge."

Dybden i det af den norske Expedition undersøgte Hav, forsaavidt det ligger vestenfor en Linie fra Spitsbergen til det nordlige Norge, er i større Afstand fra Land overalt over 1000 Favne (1829 Meter) og gaar i Regelen op til mellem 1500 og 2000 Favne (2743 og 3658 Meter) eller endog derover. Paa Strøget mellem Beeren Eiland og Jan Mayen hæver sig en Ryg, hvor Dybden ikke naar 1500 Favne (2743 Meter), medens der saavel søndenfor

This Table shows the differences in the amount of salt computed from specific gravity and the proportion of chlorine to be, as a rule, exceedingly small, the 3 determinations performed successively with samples Nos. 261, 262, and 263 constituting the sole exception. The great differences observed here must unquestionably arise from erroneous readings of the specific gravity, which, as found for these samples, is much too low when compared with that determined for others obtained from adjacent localities. Thus, for instance, the specific gravity of sample No. 262, drawn at a depth of 95 fathoms (174 metres), about 8 geographical miles from land, is stated to be 1.0254, whereas that determined for the water of the neighbouring fjords, in which the amount of salt at equal depths is invariably less than in the open sea, was much greater. Even for a frith locked in as is the Skjærstadfjord, where the surface-water is remarkably deficient in salts, the specific gravity of bottom-samples was found to be 1.0260; in short, such exceptional specific gravities are without a parallel on this line of coast. The most natural explanation of these incongruities, is afforded by assuming the specific gravity in each case to have been read 0.001 too low; the results could then be made to agree pretty closely both with the chlorine-determinations performed with the same samples of water and with observations taken in adjacent localities.

Now, if we disregard the 3 exceptional observations, and for the others compute the average half-difference between two salt-determinations performed with the same sample of water by means of the areometer and titrating with chlorine, this will be expressed by 0.00904; or, assuming the errors to lie equally in the chlorine and the specific gravity determinations, the mean error of a specific gravity determination is 0.000069, and of a chlorine-determination 0.005. As will be seen, the differences between the 2 right-hand columns of the Table are sometimes positive, sometimes negative; but the amount of salt indicated by the proportion of chlorine exceeds on an average that denoted by the specific gravity by a trifle over 0.008 per cent, which must be referred almost exclusively to the observations taken north of the 75th parallel of latitude.

Before proceeding to review the results deducible from these observations, it will be necessary to interpolate a few general remarks on the depth and temperature of the Norwegian Sea. To this end, I shall merely recapitulate what Professor Mohn has stated on the subject in a Memoir printed in C. F. Schübeler's "Vækstlivet i Norge."

The depth of the Sea investigated by the Norwegian North-Atlantic Expedition was found to be as follows: — Throughout the tract extending west of an imaginary line drawn from Spitzbergen to the northern extremity of Norway, it is never less than 1000 fathoms (1829 metres) some considerable distance from land, and generally ranges from 1500 to 2000 fathoms (2743—3658 metres); nay, in some places it is even greater. Between Beeren Ei-

som nordenfor findes betydelig større Dyb paa indtil over 2000 Favne (3658 Meter). Østhavet, det vil sige Havet østenfor en Linie fra Spitsbergen til det nordlige Norge, er overalt meget grundt, da Dybden der paa faa Steder overskrider 200 Favne (366 Meter).

De talrige udførte Temperaturobservationer vise, at Vandet i den af Expeditionen undersøgte Del af Østhavet med Undtagelse af den østligste og nordligste Strækning holder Varmegrader ligefra Overfladen til Bunden, saaledes som dette ogsaa er Tilfælde med Vandet paa de norske Banker, som paa enkelte Steder strækker sig ud til en ikke ubetydelig Afstand fra Kysten. Helt anderledes er Forholdet i det vestenfor liggende dybere Hav, som med Hensyn paa Temperaturforholdene naturlig kan inddeles i 2 Hovedstrøg, den i den østlige Del nordover gaaende saakaldte Golfstrøm og den i den vestlige Del sydover gaaende østgrønlandske Polarstrøm. Grændsen mellem disse gaar nordenom Island op til Jan Mayen, bøier i en Bue sønden- om og østenom denne og overskrider paa omkring 3° vestlig Længde med nordostlig Retning den 71de Breddegrad. Herfra gaar den mod Øst til henimod 7° østlig Længde og fortsætter derfra i nordlig og lidt vestlig Retning til nordenom den 80de Breddegrad.

I den østenfor denne Grændse beliggende Del af Havet besidder Overfladevandet en forholdsvis høi Temperatur, der endog overskrider Luftens midt om Sommeren, hvorhos ogsaa Vandet i de nærmest under Overfladen beliggende Lag holder Varmegrader, saaledes at 0° først forefindes i et Dyb af omkring 500 Favne (914 Meter), hvorfra Temperaturen jevnt og langsomt synker til omkring —1.°3 ved Havbunden.

I den østgrønlandske Koldvandsstrøm er derimod Temperaturen i selve Overfladen meget lav men om Sommeren i isfrit Vand dog overalt over 0°, medens den allerede fra faa Favnes Dyb og nedover lige til Bunden holder sig under 0°.

Med Hensyn paa Saltgehalten i Overfladevandet henvises til Kartet No. I, hvori findes indtegnet en større Del af de Tal, der fremgaa som Middel af de efter Chlor- og Egenvægtsbestemmelserne beregnede Værdier for Saltmængden. Efter disse Observationer findes ogsaa optrukket Grændserne for 3.55, 3.50, 3.45 og 3.40 % Salt, saaledes som deres Form maa antages at være i Sommermaanederne. Kartet viser, at den i Syd ind i det norske Hav strømmende Varmvandsstrøm fører Vand af temmelig stor Saltgehalt, som i de sydligste Egne paa begge Sider af Færøerne gaar op til 3.55 % eller endog derover. Herfra gaar Strømmen videre i nordostlig Retning med noget lavere Saltgehalt (omkring 3.525 %) indtil henimod Beeren Eiland, hvor den deler sig og sender en Arm mod Øst ind i Østhavet og en anden i nordlig og noget vestlig Retning

land and Jan Mayen there is a vast ridge, and here the depth does not reach 1500 fathoms (2743 metres); but south and north of that ridge it is much greater, in some localities more than 2000 fathoms (3658 metres). Barents' Sea, or the tract of ocean stretching between Novaja Zemlja and an imaginary line drawn from Spitzbergen to the northern extremity of Norway, is everywhere exceedingly shallow, the depth in but few places reaching above 200 fathoms (366 metres).

The extensive series of observations shows that the temperature of the water throughout the part of Barents' Sea investigated by the Expedition, saving the most easterly and northerly tracts, exhibits everywhere a temperature above zero, from the surface to the bottom, as is also the case with the water on the great Norwegian banks, which, in certain localities, extend to a considerable distance from the coast. A very different relation rules in the deep western section, which, as regards temperature, may be divided into two principal tracts, an eastern, with the Gulf Stream, as it is called, flowing north, and a western, with the Arctic current, flowing south, along the shores of East Greenland. The boundary-line between these two currents extends north of Iceland to the island of Jan Mayen, where it makes a bend southward and eastward, crossing, in longitude about 3° W., with a north-easterly direction, the 71st parallel of latitude. From thence it runs east, and, when in longitude about 7° E., takes a northerly and somewhat westerly direction, continuing on past the 80th parallel of latitude.

In the tract of ocean stretching to the east of this boundary, the temperature of the surface-water is comparatively high, exceeding even that of the atmosphere in the middle of summer; the water, too, some distance below the surface exhibits a temperature above zero, the depth at which 0° is reached being about 500 fathoms (914 metres), from which the temperature sinks slowly and gradually to about —1.°3, at the bottom.

In the cold East Greenland current, the temperature at the surface is on the other hand exceedingly low, though in summer above zero where the water is free from ice; 0° however is reached at the depth of a few fathoms.

As regards the amount of salt in the surface-water, the reader is referred to Plate I, in which will be found most of the figures representing the mean values, deduced from the chlorine and specific gravity-determinations, for the proportion of salt. In Pl. I, too, are laid down curves constructed from these results, to show the limits of distribution for the following percentages of salt: 3.55, 3.50, 3.45, and 3.40, as they may be assumed to extend in the summer months. The warm current, flowing from the south into the Norwegian Sea, brings with it, as shown by the Plate, an indraught of water containing a comparatively large amount of salt, the maximum percentage, upwards of 3.55, being reached in the most southerly tracts, along the eastern and western shores of the Feröe Islands. From thence, with a slightly reduced amount of salt (about 3.525), the

forbi Spitsbergens Vestkyst. I den mod Øst gaaende Gren synker Saltgehalten meget langsomt og jevnt, indtil den ved Grændsen af det af Expeditionen undersøgte Felt har naaet 3.50 %, medens den i den nordover flydende Arm meget hurtigt synker til endog under 3.45 % for atter ved Spitsbergens Nordvestkyst at hæve sig til lidt over 3.45 %.

Denne i Vest for Spitsbergen forefundne ringe Saltholdighed i Overfladen er dog sandsynligvis kun eiendommelig for den varmere Aarstid, da der fra Spitsbergens mægtige Is- og Snebræer flyder store Mængder Ferskvand ned i det tilstødende Hav.

Indflydelsen af saadant fra Kysterne udgaaende Ferskvand indskrænker sig dog hovedsagelig kun til meget smaa Dyb, da det saavel af disse som tidligere publicerede Undersøgelser af samme Art fremgaar, at et over saltere Vand flydende ferskere Overfladelag besidder en mærkelig Evne til meget længe at holde sig forholdsvis ublandet, saaledes at den fra Kysterne hidrørende Fortynding i Overfladen ofte kan spores 30 til 40 Mile tilhavs, medens man ved Bunden i Nærheden af Land ja endog i Fjordene kan finde meget saltholdigt Vand. Denne Eiendommelighed træder meget skarpt frem i Observationsrækken No. 1 til 8,[1] da Saltgehalten her fra Overfladen til 1 Favns (2 Meters) Dyb tiltager med over 1 %, medens den siden temmelig jevnt voxer med kun 0.06 % for hver Favns Tilvæxt af Dybden. De paa Spitsbergens Banker tagne Observationer viser da ogsaa ganske rigtigt, at Vandet der paa Bunden i nogen Afstand fra Land besidder en Saltstyrke, som paa sine Steder endog gaar op til over 3.50 %.

Paa begge Sider af den midt efter det norske Hav flydende salte Overfladestrøm synker Saltgehalten paa den ene Side mod den norske Kyst og paa den anden Side mod den østgrønlandske Polarstrøm, en Synkning, som paa Grund af de herskende Strømforholde hverken er jevn eller regelmæssig. Saaledes flyder der fra Nordsøen langs Norges Vestkyst i nordlig Retning en lidet saltholdig Overfladestrøm, som ved den 62de Breddegrad, hvor Kysten bøier nordostover, forlader denne, og fortsætter fremdeles i nordlig Retning, indtil dens Virkninger i omtrent 40 Miles Afstand fra Land efterhaanden taber sig. En mindre udpræget lignende Kyststrøm gaar fra Vestfjorden udover i sydvestlig Retning og naar ligeledes temmelig langt tilhavs, førend dens Indflydelse paa Saltgehalten i Overfladevandet fuldstændig forsvinder. Mellem disse Kyststrømme kaster der sig en smal Arm af det saltere Atlanterhavsvand forholdsvis nær ind under Land, hvor den meget skarpt

[1] Disse Observationer kunne desuden ogsaa tjene som Bevis for Fortrinligheden af den af Ekman angivne Vandhenter, som ved denne Leilighed benyttedes.

current flows in a north-easterly direction, as far north almost as Beeren Eiland, where it divides into two arms, one running east into Barents' Sea, and the other in a north-westerly direction past the west coast of Spitzbergen. In the branch flowing east, the amount of salt diminishes very slowly and gradually down to 3.50 per cent, at the limit of the region explored by the Expedition, whereas in that running north it rapidly sinks even below 3.45 per cent, rising, however, on the north-western coast of Spitzbergen a little above 3.45 per cent.

This low percentage of salt in the surface-water west of Spitzbergen is, however, in all probability the result of summer heat, vast quantities of freshwater pouring down to the sea at that season of the year from the immense glaciers and snow-fields of that group of islands.

The effect of such an influx of fresh water from the coast is, however, mostly confined to a very trifling depth, the result of the observations taken on the Expedition, and of others in connexion with the same subject previously published, being to show, *inter alia*, that freshwater possesses the remarkable property of floating on salt water for some considerable time in a comparatively unmixed state, so that its influence may be frequently traced at a distance of from 30 to 40 geographical miles off shore, whereas the bottom-water close in shore, nay that of friths and estuaries even, often contains a very large proportion of salt. This peculiar feature was strikingly instanced in the series of observations from No. 1 to 8,[1] the amount of salt at the depth of 1 fathom (2 metres) exceeding that at the surface by 1 per cent, whereas the subsequent increase with the depth did not amount to more than 0.06 per cent for every fathom. The observations taken on the banks of Spitzbergen show that the maximum percentage of salt in the bottom-water some distance from land, in certain localities, reaches 3.50.

On either side of the salt surface-current flowing through the medial portion of the Norwegian Sea, the amount of salt diminishes, eastward in the direction of the Norwegian coast and westward in the direction of the Arctic current off East Greenland; but this diminution, owing to the effect of ocean currents, is however anything but regular and gradual. Thus, for instance, a surface-current, with a low percentage of salt, flows from the North Sea in a northerly direction along the west coast of Norway, from which it diverges near the 62nd parallel of latitude, continuing on, still in a northerly direction, till, about 40 geographical miles from land, its influence gradually ceases to be felt. Another coastal current, more limited in extent, flows from the Vestfjord in a south-westerly direction, its influence on the amount of salt in the surface-water being likewise perceptible comparatively far out at sea. Between these coastal currents runs a narrow arm

[1] These observations likewise attest the excellence of Ekman's apparatus for collecting sea-water, which was used on this occasion.

afgrændser sig mod det indenfor flydende meget ferskere Vand. Forøvrigt holder Grændsen for det saltere Overfladevand sig meget langt tilhavs med Undtagelse af, at den ved den 70de Breddegrad paa en ganske kort Strækning kaster sig tæt ind under Kysten.

Denne Fortynding af Overfladevandet, som overalt ytrer sig ved den norske Kyst, er intetsteds ledsaget af nogen væsentlig Forrykkelse af Overfladetemperaturen. Saltgehaltens Formindskelse skyldes her aabenbart det fra Kysterne udstrømmende Flodvand, der om Sommeren besidder en ikke ringe Varmegrad, saaledes at man i den mest fremtrædende Kyststrøm langs Norges Vestkyst endog finder en noget høiere Overfladetemperatur end paa nærliggende Puncter. Ganske anderledes stiller Sagen sig paa den mod den østgrønlanske Polarstrøm vendende Side, hvor Overfladevandet fortyndes ikke ved Flodvand men ved det ved Havisens Smeltning dannede, stærkt afkjølede Ferskvand, og det viser sig derfor, at en Synken i Saltgehalten her bestandig er ledsaget af en tilsvarende Formindskelse af Overfladetemperaturen. Grændsen for det saltere Vand i Overfladen følger derfor paa denne Side ofte Polarstrømmens Grændse, og selv der, hvor den forlader denne, optræder der dog samtidig med Overgangen fra saltere til ferskere Vand altid meget tydelige Variationer i Temperaturen, der gaa i samme Retning som Saltgehaltens. At Overfladetemperaturen synker, naar man enten nærmer sig eller overskrider Grændsen for 3.50 % Salt, vise Observationerne No. 115 til 120 og No. 207 til 209.

I selve Polarstrømmen er Saltgehalten i Overfladen i nogen Afstand fra Grændsen oftest fundet meget lav, kun paa et Sted optræder i saa Henseende en Undtagelse fra den almindelige Regel, idet der omtrent paa den 75de Breddegrad skyder sig en smal Tunge med Vand af høiere Saltstyrke ind over Polarstømmen, uden at der dog derved bevirkes nogen væsentlig Forhøielse af Overfladetemperaturen. En Mærkelighed, som fortjener at omtales, er den, at Professor Dr. G. O. Sars, som paa Expeditionens Togter jevnlig undersøgte Dyrelivet i Overfladen, netop paa dette Punct langt inde i Polarstrømmen har gjenfundet de for det varmere Atlanterhavsvand eiendommelige Dyreformer, der forresten intetsteds ellers ere fundne i den østgrønlandske Koldvandsstrøm.

Med Hensyn paa Saltmængderne i de større Dyb henvises til Kartet No. II, hvori paa samme Maade som ovenfor findes indtegnet Saltgehalten ved Havbunden samt i de intermediære Dyb, forsaavidt Observationerne refererer sig til Puncter saa dybt under Overfladen, at Temperaturen der ligger under 0°. Hvor en Observation hidrører fra et intermediært Dyb, er Tallet i Kartet understrøget.

Naar man bortser fra enkelte i Nærheden af Kysterne og paa grundt Vand optagne Vandprøver, varierer Saltgehalten paa de store Dyb mellem 3.59 og 3.45 %,

of the salt ocean-water of the Atlantic, distant but a few miles from land, its boundary being distinctly marked by the limits of the brackish water flowing along the shore. Except in this region, and a locality bordering the 70th parallel of latitude, where, for a short distance, it runs close to the coast, the boundary of the salt surface-water lies far out at sea.

This dilution of the surface-water on all parts of the Norwegian coast is not anywhere found to exert a material influence on the surface-temperature. The decrease in the amount of salt must be obviously ascribed to the influx of river-water, the temperature of which during the summer months is relatively high, — so high indeed, that the principal coastal current, flowing along the western shores of Norway, has a somewhat higher surface-temperature than that observed in its immediate vicinity. Phenomena the reverse of these prevail in the tract of ocean exposed to the influence of the Arctic, or East Greenland, current. There, the surface-water is not diluted by an influx of river-water, but with freshwater of a low temperature, produced by the melting of drift-ice; and hence a decrease in the percentage of salt is invariably attended with a corresponding reduction of the surface-temperature. The salt surface-water borders, therefore, not infrequently the Arctic current; and even where its boundary diverges from it, the transition from salt to comparatively fresh water is always accompained by a very considerable variation in temperature, proportionate to the variation in the amount of salt. That the surface-temperature becomes gradually lower on approaching the limits of the section in which the proportion of salt is 3.50 per cent, will be seen from the series of observations Nos. 115—120 and Nos. 207—209.

In the Arctic current, some distance from its extreme boundary, the proportion of salt at the surface was found to be very small, except in one locality, near the 75th parallel of latitude, where a narrow strip of salter water flows into the current, without, however, causing an appreciable rise in the surface-temperature. It is a remarkable fact, which must not be passed by unnoticed, that Professor G. O. Sars, naturalist to the Expedition, found here in the surface-water, which he examined from day to day, forms of animal life peculiar to the warm area of the Atlantic water, which he never met with in any other part of the cold East Greenland current.

As regards the amount of salt observed at great depths, the reader is referred to Pl. II, in which, as in Pl. I, will be found the percentage both at the bottom and at intermediate depths, provided the observations were taken with samples of water the temperature of which *in situ* was below 0°. Observations with water from intermediate depths are denoted by underlining the figures expressing their results.

Disregarding a few samples of water collected near the coast and in shallow spots, the proportion of salt, where the depth is great, ranges from 3.59 to 3.45 per

og Differentserne ere saaledes ogsaa her vel paaviselige om end mindre end i Overfladen. For tydeligt at kunne markere disse optrædende Differentser paa en let overskuelig Maade, har jeg benyttet forskjellige Farver. Saaledes ere de Strøg, hvor Saltgehalten beløber sig til 3.50 % eller derunder, betegnede med blaa Farve, de Strøg, hvor Saltgehalten ligger mellem 3.50 og 3.55 %, med rød Farve, medens de Vandmasser, der ifølge Observationerne besidde en Saltmængde af over 3.55 %, ere tegnede med en noget kraftigere rød Farve. I Nærheden af Kysterne er Kartet overalt ufarvet uden Hensyn til, om Vandet der henhører under den ene eller den anden af de tre Hovedgrupper.

Den uregelmæssige Fordeling af Saltgehalten i de større Dyb, som det saaledes tegnede Kart udviser, maa unegtelig betegnes som meget paafaldende. At Saltmængderne paa Bankerne og i den sydlige Del af Østhavet paa det Nærmeste findes at svare til den, som det i Overfladen svømmende varme Atlanterhavsvand besidder, kan ikke synes overraskende. Havet er her meget grundt, og det deri flydende Vand besidder overalt en Temperatur af over 0° og maa saaledes nærmest henføres til den nordover flydende Atlanterhavsstrøm, med hvilken det da ogsaa helt naturligt har Saltgehalt tilfælles. Ligeoverfor de store Dyb maatte man derimod paa Forhaand vente et andet Resultat. Temperaturen ligger her uden Undtagelse under 0° ja paa de fleste Steder endog under —1°, og det kunde derfor synes rimeligst at tilskrive det der flydende Vand polar Oprindelse. Det fremgaar imidlertid med Bestemthed af alle mig bekjendte Undersøgelser over Saltmængderne i de forskjellige Have, at de fra arktiske Egne udgaaende Strømme uden Undtagelse fører Vand af lavere Saltgehalt end de fra de mere tempererede Himmelstrøg udgaaende Varmvandsstrømme, og man skulde derfor i de dybere og koldere Lag af det her undersøgte Hav vente at finde en Vandmasse med adskilligt lavere Saltgehalt end den, der er funden i det i Overfladen og nærmest under den flydende Vand, som aabenbart skriver sig fra varmere Egne. Hvad der virkelig finder Sted er desuagtet dette, at det i de dybere liggende Lag flydende, iskolde Vand paa store Strækninger viser sig at have en Saltgehalt, der temmelig nøie svarer til den, der er funden i den atlantiske Overfladestrøm.

Saavel af denne Grund som ogsaa af andre Grunde, som jeg senere skal fremføre, finder jeg det rimeligt at gjøre den Antagelse, at Vandet paa de større Dyb paa de Steder, som i Kartet findes aflagte med rød Farve, enten udelukkende skriver sig fra varmere Egne eller under enhver Omstændighed er saa opblandet med saadant Vand, at det Hele derved antager en tydelig atlantisk Karakter, medens Vandet i de med blaa Farve betegnede Strækninger mere eller mindre skarpt udpræger sig som hidrørende fra polar Oprindelse.

Hvor det gjælder at besvare Spørgsmaalet om, hvorledes de øvre Lag finder Vei ned til Bunden, da synes dette ikke at kunne besvares paa anden Maade, end at det atlantiske Vand under stadig Afkjøling maa synke gjennem det iskolde og fordrive dette, under enhver Omstændighed; and there too, accordingly, the differences are appreciable, though smaller than at the surface. For the better apprehension of these differences, the sections in which they occur have been differently coloured in the Plate: blue indicates a percentage of 3.50, and under; red, a percentage ranging from 3.50 to 3.55; and a somewhat deeper red, a higher percentage than 3.55. Along the coasts, the Plate is left uncoloured, no matter to which of the three principal groups the water there belongs.

This irregular distribution of the amount of salt at great depths, as shown in the Plate, is certainly a most remarkable phenomenon. That the proportion of salt on the banks and in the southern portion of Barents' Sea should agree pretty closely with that contained in the warm surface-water of the Atlantic, is not indeed surprising: the depth is in both localities comparatively trifling, and the water, having everywhere a temperature above 0°, must be referred to the warm Atlantic current; its percentage of salt is therefore naturally the same as that of the Gulf Stream. For the great depths, on the other hand, there was reason to expect a very different result. Here, the temperature is without exception below 0°, nay in most places below —1°; and hence, as regards the origin of such water, there seems much to urge in favour of an indraught from the Polar Sea. Of the observations undertaken to determine the amount of salt in sea-water, all with which I am acquainted furnish incontestible proof that the water of the currents flowing from the Arctic Ocean has a lower percentage of salt than that of the warm currents flowing from more temperate regions; and the proportion of salt in the deeper and colder strata of the tract of ocean explored by the Expedition was expected, therefore, to prove considerably lower than that observed at the surface or a short distance beneath it, where the water is obviously an influx from warmer climes. But such was not the case, for the amount of salt found in the water of the cold area, where the temperature is below zero, agrees, in some localities, pretty closely with that in the water of the Atlanic surface-current.

This phenomenon, in conjunction with reasons that will afterwards be explained, has led me to assume, that the water met with at great depths in the sections coloured red in the Plate, is either exclusively the result of an influx from warmer regions, or is, at least, so mixed with such water as to have distinctly acquired Atlantic characteristics; whereas the water in the blue-coloured sections would seem to indicate more or less determinately a Polar origin.

As to the question involved in the descent of the upper strata to the bottom, the only way in which this can take place seems to be by the Atlantic surface-water, as it parts with its excess of heat, gradually sinking through the water of the cold area, and displacing it; at all events,

dighed synes det sikkert, at man for det afgrændsede østenfor Jan Mayen beliggende Strøg ikke kan antage nogen anden Vei. Men at den varmere Vandmasse saaledes skulde synke gjennem den koldere, kunde jo ved første Øiekast synes stridende mod vel kjendte Naturlove, da man nærmest maatte tro, at det i Nærheden af Overfladen flydende atlantiske Vand paa Grund af sin høiere Temperatur skulde være specifisk lettere end det ifølge sin lave Temperatur stærkt fortættede Bundvand. Nærmest for at fjerne enhver Tvivl i saa Henseende, er der i den forhen gjengivne Tabel opført en Rubrik for Vandprøvernes Egenvægter ved den i Havet observerede Temperatur i Forhold til rent Vand af 4°. Ved Hjælp af de der beregnede Tal kan man med Lethed studere den specifiske Vægts Variation med Dybden, saaledes som den finder Sted i Havet, bortseet fra den ved Vandets Sammentrykkelighed foraarsagede Fortætning i de større Dyb.

Den Region, som i denne Henseende mest interesserer os, er den, hvori der i Overfladen og nærmest under den findes en bestemt udpræget atlantisk Varmvandsstrøm, en Region, som paa det Nærmeste falder sammen med den søndenfor en Linie fra Island til Beeren Eiland liggende Del af Havet, dog saaledes at det nærmest Norge liggende Parti paa Grund af den fra Kysterne udgaaende Fortynding maa bortskjæres. Grupperer man de i denne Egn tagne Observationer over Saltgehalt og den specifiske Vægt reduceret til Havets Temperatur og en Atmosphæres Tryk efter Dybden, fremgaar som Resultat heraf Følgende.

Dybdeinterval.		Midlere Dybde.		Midlere Saltgehalt %	Midlere Egenvægt ved Havets Temperatur.
Engelske Favne.	Meter.	Engelske Favne.	Meter.		
0	0	0	0	3.526	1.02688
0—300	0—549	167	305	3.514	1.02782
300—600	549—1097	502	918	3.521	1.02812
600—1000	1097—1829	681	1245	3.513	1.02802
1000—1500	1829—2743	1203	2200	3.506	1.02800
under 1500	under 2743	1688	3087	3.507	1.02800

Det i denne Tabel erholdte Tal for Saltgehalten paa Strøget mellem 0 og 300 Favnes (0 og 549 Meters) Dyb er imidlertid uden Tvivl for lavt, da en uforholdsmæssig stor Del af Observationerne i dette Dyb hidrøre fra Østhavet, hvor Saltgehalten overalt er mindre end i de centrale og sydlige Dele af Feltet. De Observationer, som skrive sig fra dette Dyb i større Afstand fra Kysten, tyde hen paa, at Saltgehalten der meget nær svarer til den, der er funden i Overfladen paa de samme Steder. Denne Mislighed ved den geografiske Fordeling af Observationerne fra de mindre Dyb faar derimod ingen væsentlig Indflydelse paa det som Middel af de specifiske Vægter erholdte Tal, da den i de nordligere Egne ved Saltgehaltens Synkning foraarsagede Formindskelse af Egenvægterne paa det Nær-

it is certain that no other plausible explanation can be given of the phenomenon for the region east of Jan Mayen. But, that water of a higher temperature should sink in this manner through water of a lower, appears at first sight to be at variance with well-known physical laws; for the water from the Atlantic current having a higher temperature, one would imagine it to be specifically lighter than the cold and dense bottom-water. With the object of dispelling every doubt that might arise in connexion with this subject, a column has been added to the Table given above for the specific gravity of the samples of water at their temperature *in situ*, as compared with that of pure water of 4°. By means of the figures set down in the column, the variation of the specific gravity with the depth, as it occurs in the sea irrespective of increased density from the compressibility of water at great depths, may be readily investigated.

The tract of ocean which in this respect it will be most desirable to investigate, is that through which flows, on or near the surface, a warm current, setting from the Atlantic, — a tract which nearly coincides with the region stretching south of an imaginary line drawn from Iceland to Beeren Eiland, but from which, owing to the influx of freshwater, must be cut off the section extending along the Norwegian coast. Now, if we group together the observations taken in this part of the North-Atlantic to determine the percentage of salt and the specific gravity reduced to the temperature of the sea and a pressure of one atmosphere, the result will be as follows: —

Intervals of Depth.		Mean Depth.		Mean Amount of Salt per cent.	Mean Sp. Gr. at the Temp. of the Sea.
English Fathoms.	Metres.	English Fathoms.	Metres.		
0	0	0	0	3.526	1.02688
0—300	0—549	167	305	3.514	1.02782
300—600	549—1097	502	918	3.521	1.02812
600—1000	1097—1829	681	1245	3.513	1.02802
1000—1500	1829—2743	1203	2200	3.506	1.02800
below 1500	below 2743	1688	3087	3.507	1.02800

The figures in this Table expressing the amount of salt at depths ranging from 0 to 300 fathoms (0—549 metres) are, however, unquestionably too low, seeing that a disproportionate number of the observations at this depth were taken in Barents' Sea, where the amount of salt is everywhere smaller than in the central and southern sections of the tract investigated. The observations referring to this depth at a considerable distance from land, show that the percentage of salt is very nearly the same as that at the surface. The said defect in the geographical distribution of the observations taken at a comparatively trifling depth, does not however materially affect the correctness of the figures expressing the mean specific gravity; for the fall in specific gravity occasioned in northern regions

meste opveies af den Forøgelse af samme, der skyldes de der herskende lavere Temperaturer.

Det fremgaar altsaa, at Differentserne mellem Saltgehalten i de atlantiske Overfladelag og de paa Bunden hvilende iskolde Vandmasser gjennemsnitlig kun ere meget smaa, om de end paa de Puncter, hvor Vandet i de dybere Lag besidder en overveiende polar Karakter, turde være adskilligt mere fremtrædende. Disse Differentser af henimod 0.02% ere dog mere end tilstrækkelig store til i de nederste mere afkjølede Lag af det atlantiske Vand at fremkalde et, som det vil sees af Tabellen, meget tydeligt om end svagt Maximum af den specifiske Vægt, hvad der nærmest bevirkes derved, at Søvandet ved Afkjøling under 0° nærmer sig sit Tæthedsmaximum og derfor i Nærheden af dette for mindre Temperaturvariationer kun forandrer sit Volum med næsten umærkelig smaa Værdier, saaledes at en selv meget ringe Forøgelse af Saltgehalten under disse Omstændigheder faar en overveiende Indflydelse ligeoverfor en Grads Forandring af Temperaturen.

Det er saaledes saa langt fra Tilfælde, at der i de specifiske Vægter af de forskjellige Vandlag ligger nogen Hindring for Antagelsen af, at det atlantiske Vand skulde synke gjennem det koldere Polarvand, at man tvertom af disse maa slutte, at saa maa være Tilfælde, dersom ikke andre i Havet herskende Strømme virke hemmende paa en saadan Bevægelse. Man tænke sig f. Ex. ved Siden af hinanden i Havet to Vandsøiler af 2000 Favnes (3658 Meters) Dybde, hvori Temperaturens Variation med Dybden for Simpelheds Skyld kan antages at være den samme, hvorimod Saltgehalten i den 1ste helt igjennem sættes til 3.52%, medens den i den 2den paa Strøget fra Overfladen til 500 Favnes (914 Meters) Dyb gives Værdien 3.52% og fra 500 til 2000 (914 til 3658) Værdien 3.50%, saaledes som Forholdet ifølge Observationerne virkelig synes at stille sig paa enkelte Steder i det undersøgte Hav. Det er da umiddelbart indlysende, at en saadan Fordeling af Saltgehalten vil have en Synkning i den 1ste Søile til Følge, saaledes at Vandet i denne vil søge at udbrede sig langs Bunden og fordrive det omliggende specifisk lettere Vand. Den Hastighed, hvormed en saadan Bevægelse foregaar, vil naturligvis rette sig efter Differentsen mellem Trykkene i samme Niveau i begge Søiler, en Differents, som ved Bunden i 2000 Favnes (3658 Meters) Dyb efter Beregning beløber sig til henimod 32^{mm} Kviksølvsøile.

For nærmere at begrunde den forhen fremsatte Hypothese, om at det paa Bunden hvilende iskolde Vand paa de i Kartet med rød Farve betegnede Steder skulde have atlantisk Oprindelse, vil jeg benytte mig af de i en tidligere Afhandling[1] beskrevne Observationer over de i Søvandet indeholdte Kvælstofmængder, hvis Anvendelse i saadant Øiemed allerede paa det Sted løselig er bleven antydet.

Som bekjendt herskede der i ældre Tider den Anskuelse, at de i Søvandet i de større Dyb indeholdte Luftmængder paa Grund af det der herskende Tryk maatte

[1] "Om Luften i Søvandet."

by a decrease in the amount of salt, is almost compensated by the rise resulting from the low temperatures prevailing there.

It appears, therefore, that the differences between the amount of salt in the warm upper strata and that in the cold water at the bottom, are, on an average, exceedingly small, though more striking perhaps in localities where the water of the deeper strata to a very great extent is Polar in origin. These differences — about 0.02 per cent — are, however, as will be seen from the Table, more than sufficient in the deepest and coldest strata of Atlantic water to occasion an appreciable, though a low, maximum of specific gravity, which is explained by the fact, that seawater below 0° has very nearly reached its maximum of density, and the increase in volume then resulting from trifling variations in temperature, is a well nigh inappreciable magnitude: hence, under such circumstances, the influence of a very slight addition to the amount of salt with but one degree's difference in temperature will be exceedingly great.

Such being the case, there is nothing in the specific gravities observed in the different strata of water to disfavour the assumption that the comparatively warm Atlantic water should sink through the cold water of Polar origin; nay, from these specific gravities we may infer its correctness, provided only that such descending motion be not counteracted by the effect of ocean currents. To give an illustration. Let us imagine two columns of water, 2000 fathoms (3658 metres) deep, in both of which, for convenience' sake, the variation in temperature with the depth is assumed to be equal; the amount of salt on the other hand, being put at 3.52 per cent throughout the whole of the first, but in the second, at 3.52 per cent from the surface to a depth of 500 fathoms (914 metres), at 3.50 per cent from 500 to 2000 fathoms (914—3658 metres), — a ratio of distribution actually observed in some localities. This given, it is obvious that such a distribution must cause the water in the first column to sink, and spread itself over the bottom, displacing as it does so the specifically lighter. The rapidity of this downward motion will of course be proportionate with the difference in pressure at the same level in the two columns, a difference which, at the depth of 2000 fathoms (3658 metres), has been computed equal to that of a column of mercury 32^{mm} in height.

With a view to furnish additional confirmation of the hypothesis brought forward above, which assumes the cold bottom-water in the red-coloured sections of the Plate to be of Atlantic origin, I shall have recourse to my observations on the amount of nitrogen in sea-water, published in a former paper,[1] where their application to such a purpose was briefly alluded to.

The opinion formerly entertained, that the quantity of air contained in sea-water at great depths must be exceedingly great, by reason of the immense pressure pre-

[1] "On the Air in Sea-Water."

være uforholdsmæssig store, en Anskuelse, som ved de senere Undersøgelser fuldstændig er bleven modbevist. Rigtignok er det paa den engelske Challengerexpedition iagttaget, at de i den hede Zone fra Havbunden optagne Vandprøver ved at henstaa nogen Tid vise Overmætningsphænomener, men dette vil jo ikke være vanskeligt at forklare, naar man erindrer, at Vandet i de store Dyb selv i Æqvatoregnene er meget nær iskoldt. Det følger nemlig af sig selv, at de til en saa lav Temperatur svarende Luftmængder ikke kunne holdes opløste, naar Vandprøverne ved længere Tids Henstand antager de tropiske Egnes høie Lufttemperatur. Stærkest taler de paa den norske Expedition udførte Luftbestemmelser for, at Tryktilvæxten med Dybden ikke kan have nogen Indflydelse paa Mængden af den i Søvandet opløste Luft. Tager man nemlig Middelet af Dybder, Temperaturer og Kvælstofmængder for alle de fra Puncter under Overfladen stammende Vandprøver, hvori der paa denne Expedition er foretaget Luftbestemmelser, erholder man til et Middeldyb 693 Favne (1267 Meter) en Middeltemperatur — 0.°05 og en midlere Kvælstofgehalt 13.99 CC. per Litre, det vil sige, Vandet i Dybet indeholder gjennemsnitlig næsten 0.5 CC. Kvælstof *mindre,* end det ved sin Temperatur vilde kunne holde opløst under en Atmosphæres Tryk.

Naar man erindrer, at Trykket i Havdybene ikke dreier sig om Atmosphærer men om Hundreder af Atmosphærer; saa maatte man dog vente, at dets Indflydelse (om det havde nogen) vilde give sig tilkjende ved Uregelmæssigheder af paaviselig Størrelse, og man er, da dette ikke i mindste Maade er Tilfældet, berettiget til den Slutning, at Trykket ikke besidder nogen Evne til i mærkbar Grad at ophobe Luftmængderne i de store Dyb. Paa den anden Side maa det fornuftigvis antages, at Vandet i de dybere liggende Lag ikke kan afgive noget af sin Luft, da det jo paa Grund af det der herskende Tryk vil kunne holde opløst overveiende større Mængder end de, der nogensinde ere forefundne.

Den rimeligste Slutning af de senere Tiders Observationer over disse Gjenstande vil saaledes være den, at en Vandprøve, saalænge den befinder sig under Overfladen, uforandret vil beholde den samme Luftmængde eller rigtigere Kvælstofmængde[1], som den havde absorberet, da den sidste Gang befandt sig i Overfladen udsat for Luftens frie Indvirkning.

Nu er den Luftmængde, som Søvandet absorberer af Atmosphæren, hovedsagelig afhængig af Vandets Temperatur, idet Barometerstandens Variationer ligeoverfor større Temperaturdifferentser kun har en underordnet Betydning. Heraf følger, at de Vandmasser, der have absorberet sin Luftmængde under varmere Himmelstrøg, maa være forholdsvis

[1] Den absorberede Surstofmængde er nemlig i nogen Grad afhængig af Dyrelivet og andre Tilfældigheder, saaledes at det her ligesom i den tidligere Afhandling vil være det Rigtigste at anvende Kvælstofmængden som Maal for den samlede Luftmængde.

vailing there, has been wholly refuted by the results of later observations. True, the samples of water obtained at great depths within the tropics on the 'Challenger' Expedition were found to exhibit the phenomena of supersaturation when allowed to stand over some time; this, however, is easily explained, if we call to mind that the water at great depths, even in equatorial regions, has a temperature but little above zero. Hence it naturally follows, that the quantity of air corresponding to so low a temperature cannot be retained on the samples of water having stood over sufficiently long to acquire the high temperature of the atmosphere in tropical climates. The air-determinations performed on the Norwegian Expedition afford the strongest proof of the fact, that the increase of pressure with the depth does not exert any appreciable influence on the proportion of air in sea-water. Now, if we compute the mean depth, temperature, and amount of nitrogen for all the samples of water from below the surface examined for air-determinations, the result will be as follows: mean depth 693 fathoms (1267 metres); mean temperature — 0.°05; mean amount of nitrogen 13.99 cc per litre, which shows that in the depths of the ocean the proportion of nitrogen averages 0.5 cc *less* than could be absorbed by sea-water of the temperature prevailing there with the pressure of one atmosphere.

If we call to mind that the pressure in the depths of the sea is not computed even by tens, but by hundreds of atmospheres, its influence, if any, must surely, one would imagine, occasion irregularities of appreciable magnitude; and we may therefore safely conclude, since no such disturbance can be detected, that pressure does not perceptibly increase the amount of air at great depths. On the other hand, there is every reason to infer, that the water in the lower strata, owing to the immense pressure, cannot part with any of its air, the quantity actually absorbed never being even approximately so great as such a pressure would enable it to retain.

From the latest observations throwing light on this question, we may therefore reasonably infer, that all sea-water below the surface retains undiminished the quantity of air, or rather of nitrogen,[1] which it absorbed when last at the surface, in direct contact with the atmosphere.

Now, the quantity of air absorbed by sea-water is mainly dependent on the temperature of the latter, the rise or fall of the barometer, as compared with considerable differences in temperature, being in this case of but little moment. Hence it follows, that the proportion of air absorbed by sea-water in warm climates is small compared

[1] The amount of oxygen absorbed by sea-water depending to a certain extent on the presence of animal life and other accidental causes, the amount of nitrogen may, with greater precision, be assumed to represent the total amount of air — a standard of measurement adopted in the preceeding Memoir.

lidet luftholdige, medens de, der have absorberet sin Luftmængde i de arktiske Egne, maa indeholde meget større Mængder, og man vil derfor netop i de paa Expeditionen udførte Gasanalyser have et fortrinligt Middel til at controllere den forhen opstillede Hypothese, ifølge hvilken enkelte Regioner af det iskolde Dyb skulde være opfyldt af Vandmasser, der ialfald delvis havde atlantisk Oprindelse.

For at vise Udfaldet af en saadan Control har jeg tegnet Kartet No. III, hvorpaa efter samme Princip som det ved Tegning af Kartet No. II befulgte findes afsat de i Dybet fundne Kvælstofmængder udtrykte i CC. pr. Litre reducerede til 0° og 760^{mm} Tryk, ligesom der ogsaa ved Siden af disse Tal findes opført den Temperatur, hvorved Søvandet absorberer denne Kvælstofmængde, beregnet til nærmeste hel Grad efter den af de tidligere beskrevne Forsøg udledede Formel

$$N = 14.4 - 0.23t.$$

Det siger sig selv, at disse Temperaturer ikke kunne gjøre Fordring paa nogen stor Grad af Nøiagtighed. da en forholdsvis liden Feil i Kvælstofbestemmelsen bevirker en meget stor Feil i den deraf beregnede Temperatur. Der findes saaledes flere Observationer, der give Temperaturen — 4°, en Temperatur, der mig bekjendt ikke er observeret i Havet. Dette vil dog ikke forekomme saa urimeligt, naar man tager Hensyn til, at Søvand af —2° ved 780^{mm} Barometerstand absorberer en Kvælstofmængde, der paa det Nærmeste gaar op til, hvad der i Ydertilfældene er fundet.

Farvelægningen er her foretagen saaledes, at de Strøg, hvor Kvælstofmængden er funden at være 14.4 CC. eller derover, ere betegnede med blaa Farve, de Strøg, hvor Kvælstofmængden ligger mellem 14.4 og 12.5 CC., med en svag rød Farve, medens et mindre Parti, hvor Kvælstofmængden er funden at ligge under 12.5 CC., er betegnet med en noget kraftigere rød Farve. Betydningen af disse Farver bliver ligesom i Kartet No. II den, at de røde Farver bedække de Strækninger, hvor Vandet i mere eller mindre Grad besidder atlantisk Karakter, medens den blaa Farve tilhører de Vandmasser, der have absorberet sin Kvælstofmængde ved en Temperatur af under 0°, og som altsaa nærmest synes at hidrøre fra de arktiske Egne.

Ved at sammenligne Kartene No. II og III vil man strax se, at Farvelægningen i disse i alt Væsentligt viser en særdeles stor Overensstemmelse, som paa mange Puncter endog nærmer sig til Congruents, om man end ved nærmere Betragtning vil finde, at disse Ligheder ikke gaa igjen i alle Detailler, hvad man heller ikke paa nogen Maade kunde vente. Grændserne bliver nemlig paa Kartet No. III paa Grund af Observationernes Faatallighed meget vanskelige at bestemme, ja der findes endog her paa omkring den 65de Breddegrad et større Strøg, hvorom man intet med Bestemthed kan slutte, da der under Analysen tabtes en mindre Del af de Luftprøver, der vare bestemte til at udfylde dette Hul, saaledes at den samlede Luftmængde desværre ikke kunde maales. Desuden ere ogsaa Observationsfeilene baade for Salt- og Kvælstofbestemmelse

with that absorbed in the Arctic regions, wherefore the analyses of gas performed on the Expedition furnish an excellent means of testing the value of the hypothesis according to which certain sections of the cold area are assumed to be made up of water part of which at least would seem to be of Atlantic origin.

To show the result of such a test, I have annexed a third Plate (drawn on the same principle as Pl. II), in which are given the different amounts of nitrogen present in deep water, expressed in c.centim. per litre, reduced to 0° and a pressure of 760^{mm}. Along with these figures will be found, too, the temperature at which sea-water absorbs such an amount of nitrogen, computed, in whole degrees, by means of the formula deduced from the observations previously described, viz: —

$$N = 14.4 - 0.23t.$$

These temperatures cannot of course pretend to any high degree of accuracy, a comparatively small error in a nitrogen-determination involving a very considerable error in the temperature. Thus, for instance, several of the observations indicate — 4°, a temperature which, so far as I am aware, was not anywhere observed in the sea. This, however, will not appear so strange, if regard be had to the fact, that sea-water of — 2°, at a pressure corresponding to 780^{mm}, absorbs an amount of nitrogen which agrees very closely with the highest found on the Expedition.

The sections in this Plate are coloured as follows: those in which the amount of nitrogen was found to equal or to exceed 14.4^{cc}, blue; those in which it ranged from 14.4 to 12.5^{cc}, light red; a somewhat deeper red serves to indicate a small tract in which the amount of nitrogen did not reach 12.5. Moreover, as in Plate II, the red colour indicates water more or less distinguished by Atlantic characteristics; the blue, water in which the nitrogen was absorbed at a temperature below 0°, and which, therefore, would seem to have derived its origin from some part of the Polar Seas.

A comparison of Plates II and III will at once show considerable agreement in the distribution of colour, many of the sections almost coinciding; though, on closer inspection this approach to congruity is not found to characterise all details, which indeed there was no reason to expect. In Pl. III, the limits proved exceedingly difficult to define, owing to the limited number of observations; nay, respecting an extensive tract near the 65th parallel of latitude nothing definite can be inferred, part of several samples of air, the analysis of which would have served to fill up the blank, having been unfortunately lost, and the total amount of air could not, therefore, be measured. Besides, the errors of observation both in the salt and the nitrogen determinations, are so considerable, when compared with the minute differences in amount, that, in some

sernes Vedkommende af saadan Størrelse, at de i Sammenligning med de smaa Differentser, som det her gjælder at paavise, lettelig paa sine Steder kunne gjøre sig gjældende og frembringe Uoverensstemmelser, hvor de i Tilfælde af absolut nøiagtige Observationer ikke vilde findes.

Hvilken Vægt man nu end vil tillægge disse faa Forskjelligheder mellem de to Karter, saa meget er dog sikkert, at de kun optræde som Undtagelser, medens den langt stærkere fremtrædende Regel er Overensstemmelser af saadan Art, at de ikke uden videre kunne tilskrives Tilfældigheder. Der existerer uimodsigeligt en paa mange Puncter næsten til Proportionalitet grændsende lovmæssig Forbindelse mellem Saltgehalten og Kvælstofmængderne, som muligens ikke turde lade sig forklare paa anden Maade end netop gjennem den før omtalte Hypothese, som saaledes maa ansees for at indeholde ialfald en stor Del Sandhed, idet den samtidig bestyrkes af to af hinanden fuldstændig uafhængige, uensartede Observationsrækker, der i alt Væsentligt give det samme Resultat.

Den, som det synes, største Vanskelighed ved denne Hypothese bestaar i at forklare, hvorledes det i de store Dyb flydende atlantiske Vand skulde have antaget en saa lav Temperatur, som det ifølge Observationerne viser sig at besidde. Dette turde dog maaske ikke synes saa urimeligt, naar man betænker, at den varme, søndenfra kommende Atlanterhavsstrøm ved at flyde henover det underliggende meget kolde Vand paa de nærmest til dette grændsende Lag maa blive udsat for en meget stærk Afkjøling nedenfra, og at det først gjennem en saadan Afkjøling til omkring 0° opnaar den høie specifiske Vægt, der er den nødvendige Betingelse for, at det skal kunne synke tilbunds. Det atlantiske Vand har altsaa, allerede førend det begynder at synke, antaget en meget lav Temperatur og vil desforuden under selve Synkningen, idet det da kanske i et meget langt Tidsrum befinder sig paa alle Sider omgivet af polart Vand, end yderligere blive Gjenstand for Afkjøling, førend det naar Bunden. Det fremgaar forøvrigt ogsaa af de endnu ikke offentliggjorte Temperaturobservationer, som jeg desuagtet ved Velvillie af Professor Mohn har faaet Anledning til at gjøre mig bekjendt med, at Temperaturen i de store Dyb paa de med rød Farve betegnede Partier er noget høiere end der, hvor Kartet er farvet blaat, saaledes at i Virkeligheden ogsaa Temperaturforholdene tale for den opstillede Hypothese.

Det vilde dog være paa urette Sted paa dette Stadium at forsøge udredet alle Vanskeligheder, saalænge de paa Expeditionen udførte talrige Temperaturbestemmelser endnu ikke ere forelagte Offentligheden, da man alene ved at tage tilbørligt Hensyn til det hele foreliggende Materiale af Observationer vil kunne vente at faa det bedst mulige Indblik i de mere indviklede Spørgsmaal om Strømforholdene. Det er dog meget sandsynligt, at man senerehen ved at combinere alle Data vil kunne kaste Lys over meget, som nu maa synes dunkelt.

Uheldigvis var det ved Expeditionens Udreise ikke muligt at forudse, at de chemiske Observationer skulde kunne føre til Slutninger af saadan Art som de her paa-

of the computations, they might easily affect the result, and give rise to discrepancies which, with perfectly accurate observations, there would be no fear of.

Whatever weight may be attached to these differences, they must unquestionably be regarded as exceptional; the rule is agreement, and of a character precluding the possibility of ascribing it to chance. Many of the observations prove incontestibly the existence of a definite, well nigh proportional connexion between the amount of salt and that of nitrogen, a connexion difficult, perhaps, to explain without having recourse to the aforesaid hypothesis, which cannot but come near the truth, confirmed as it is by two widely different series of observations, leading, each independently of the other, in all essential points, to the same result.

The greatest apparent difficulty involved in this hypothesis consists in explaining the low temperature of the Atlantic water in the deeper strata. We must, however, bear in mind that the warm Atlantic current, in flowing over the cold water of the lower strata, is necessarily made to part with a very considerable amount of heat; and that the high specific gravity, without which it could not sink to the bottom, involves a temperature of about 0°. Hence, the Atlantic water will have acquired a very low temperature before beginning to sink, and moreover, being surrounded during its downward passage, possibly for a considerable period, by Polar water, give off a further amount of heat ere it reaches the bottom. For the rest, it appears from the independent series of temperature observations, not yet in print, with which Professor Mohn has kindly made me acquainted, that the temperature at great depths in the sections coloured red in the Plate, is somewhat higher than in those coloured blue; and hence the hypothesis adopted here derives additional support from the variation in temperature.

Meanwhile, it would be premature to attempt disposing of all difficulties, till the numerous temperature determinations performed on the Expedition shall have been made public, since to elucidate fully the more intricate questions connected with ocean currents, the whole stock of materials must be dealt with. We may however venture to hope, that, at a later stage of this interesting inquiry, a general combination of data will throw light upon much that is at present involved in obscurity.

Unfortunately, it was not possible to foresee on the departure of the Expedition, that such inferences as those here pointed out would be drawn from the chemical ob

pegede, og det er derfor helt naturligt, naar Undersøgelserne ikke i Henseende til Studiet af tidligere ukjendte Eiendommeligheder ved Havet kunde føre til saa fyldige Resultater, som ønskeligt kunde være. Men om end disse Undersøgelser paa Grund heraf nærmest faa Karakteren af forberedende Arbeider, saa vil det dog, som jeg haaber, indrømmes, at de desuagtet kunne have sine maaske ikke uvigtige Følger, idet de vise, at man gjennem de chemiske Observationer, der tidligere i Sammenligning med Temperatur- og Dybdebestemmelser har spillet en mindre fremtrædende Rolle ved Studiet af Havets Physik, vil kunne skaffe Oplysninger om mærkelige Forholde i Havet, som man ad anden Vei vanskelig skulde falde paa at søge opklarede. Man vil ved Hjælp af de her erholdte Resultater med Lethed i Fremtiden kunne udkaste en detailleret Plan for en fornyet Undersøgelse af det norske Hav, der i mine Øine stiller sig som særdeles ønskelig, da man ved at gjøre et hidindtil ukjendt Hav til Gjenstand for Bearbeidelse vanskelig turde gjøre Regning paa at træffe et, der i Henseende til Studiet af Strømforholdene er saa instructivt som det norske Hav.

Ved saadanne fremtidige Undersøgelser kunne de paa den norske Expedition benyttede Arbeidsmethoder ikke i alle Retninger blive optagne i uforandret Form, og det vil derfor ikke være ubeføiet til Slutning med faa Ord at paapege de Mangler, der klæbe ved disse.

De til Saltbestemmelserne tidligere benyttede Methoder, ifølge hvilke alle herhen hørende Observationer anstilles ombord, bør utvivlsomt for Fremtiden ikke komme til Anvendelse, da man ad den Vei tiltrods for al anvendt Møie ikke vil kunne opnaa den Nøiagtighed, som tiltrænges for med ønskelig Sikkerhed at kunne paavise de i Havet forekommende ofte meget smaa Differentser. Paa den norske Expedition blev denne Fremgangsmaade benyttet, fordi man med ældre Iagttageres Udtalelser for Øie maatte befrygte, at Søvand ikke lod sig opbevare i længere Tidsrum uden at undergaa forskjellige Forandringer, en Frygt, der imidlertid efter min Erfaring kun forsaavidt er begrundet, som man til Opbevaring af Vandet benytter Kar, der ere forsynede med Korkeprop.. Jeg har nemlig undersøgt flere Vandprøver, der have været opbevarede paa denne Maade i omkring 2 Aar og fundet, at de alle uden Undtagelse have undergaaet Forandringer af saadan Art, at man turde være berettiget til at anse dem uskikkede til Egenvægtsbestemmelse, hvorimod jeg hos Vandprøver, der i lignende Tidsrum havde henstaaet paa Flasker forsynede med isleben Glasprop, ikke kunde opdage nogensomhelst Eiendommeligheder, der kunde adskille dem fra friskt øste Vandprøver. Ved denne Opbevaringsmaade risikerer man dog ganske sikkert Fordunstning af en Del af Vandet, og man maa derfor beskytte sig mod denne Feilkilde ved at hjemføre det til Saltbestemmelser bestemte Vand paa tilsmeltede Glasrør.

I de saaledes conserverede Vandprøver vil man senerehen efter Hjemkomsten kunne bestemme Egenvægten ved Sprengels Pyknometer og Chlorgehalten ved Hjælp af Veiningsanalyser med saadan Skarphed, som man ved Arbeide

servations, and hence the results of the work done, embracing as it did the investigation of phenomena unknown before, were naturally less comprehensive than might otherwise have been attained. But, though such labours must to a certain extent, be regarded as preliminary, they will, I trust, prove of considerable importance, showing as they do, that chemical observations, which, as compared with determinations of temperature and depth, previously held quité a subordinate rank among the means employed for studying the physical conditions of the ocean, will serve to throw light upon many remarkable phenomena, that without such data would be extremely difficult to explain. On the basis of the results here set forth, a detailed plan might be easily laid down for the further exploration of the Norwegian Sea, — in my opinion a most desirable undertaking, since of ocean tracts as yet unknown, there are probably few that, in regard to the study of ocean currents, would so well repay investigation as that section of the North-Atlantic.

As several of the methods of investigation practised on the Norwegian Expedition, will not admit of being adopted on future occasions in a wholly unmodified form, it will not be out of place in conclusion briefly to point out their defects.

The methods previously devised for determining the amount of salt in sea-water, by which all observations with this object in view were taken on board, should unquestionably cease to be adopted, since they will not suffice, with the greatest care even, to attain the high degree of accuracy requisite for detecting such minute differences as are frequently found to occur. These defective modes of operation were, however, adopted on the Norwegian Expedition, there being reason to believe from the statements of earlier observers, that sea-water could not be preserved for any length of time without undergoing chemical change, a supposition which, so far as my experience goes, is confirmed only in the event of its being kept in *corked* vessels. I have examined, for instance, various samples of sea-water that had been preserved for about 2 years in corked bottles, and found all without exception to have undergone a change sufficient to render them unfit for specific gravity determinations; whereas, on the other hand, sea-water which had been allowed to stand over for the same space of time in bottles furnished with ground glass stoppers, was not to be distinguished from freshly drawn samples. There is, however, a risk of loss from evaporation, the stoppers being seldom, if ever, tight-fitting; and to guard against this source of error, the water for salt-determinations must be brought home in hermetically sealed glass tubes.

With water thus preserved, the specific gravity may be determined by means of Sprengel's pycnometer, and the amount of chlorine by weighing, on the return of the Expedition, far more accurately than would be possible on

ombord ikke i fjerneste Maade vil kunne gjøre Regning paa at opnaa, hvorhos man tillige vil have den Fordel at kunne benytte directe Saltbestemmelser som Controlmiddel.

Mod de paa Expeditionen udførte Luftbestemmelser vil ikke kunne gjøres nogen væsentlig Indvending, med mindre man skulde anke over, at de benyttede Vandprøver ere optagne ved Hjælp af Apparater, der ikke vare omgivne med slette Varmeledere, saaledes at de ved Ankomsten til Overfladen vilde have havt Anledning til at antage en i Forhold til sin Luftmængde noget for høi Temperatur. Denne Feilkilde kan dog ikke antages at have faaet nogen væsentlig Indflydelse i et Hav som det her undersøgte, hvor kun et meget tyndt Lag nærmest Overfladen besidder en Temperatur af over 5°, især da Vand, der kun er svagt overmættet med Luft, meget langsomt giver Slip paa den overskydende Del.

Det ved Udkogningen benyttede, af Jacobsen beskrevne Apparat er i alt Væsentligt fundet særdeles bekvemt, kun vilde det maaske være hensigtsmæssigt at give Luftopsamlingsrøret en noget forandret Form, hvorved man lettelig vilde undgaa den Vanskelighed, hvormed det nu er forbundet at overfylde Luftmængden i Eudiometret uden Tab.

Ovenstaaende Afhandlinger ere indsendte til Redactionscomiteen for den norske Nordhavsexpeditions Generalberetning, No. I og II i April 1879 og No. III i December samme Aar.

De i disse 3 Afhandlinger beskrevne Observationer ere, forsaavidt de ikke ere udførte ombord, anstillede i Professor Waages Afdeling af Universitetets chemiske Laboratorium i Christiania.

Sluttelig henytter jeg Anledningen til at udtale min Tak til D'Hrr Professorerne Waage og Mohn for den Bistand, de under mit Arbeide med disse Gjenstande paa flere Puncter har ydet mig.

board; moreover, there is the additional advantage of being able to test the results by direct salt-determinations.

As regards the air-determinations performed on the Expedition, their general accuracy can hardly be impugned. True, the apparatus with which the samples of water were collected not having been surrounded by a non-conducting medium, they may possibly in their passage to the surface have assumed a temperature somewhat too high as compared with the amount of air contained in them; but the error arising from this source cannot have exerted any material influence, since the tract of ocean investigated has but a thin stratum of water in which the temperature rises above 5°; besides, water slightly surcharged with air is found to part very slowly with the surplus portion.

The boiling-apparatus devised by Jacobsen proved very convenient; possibly, however, the tube for collecting air might be given a somewhat different form, to obviate the difficulty now experienced in transferring the air to the eudiometer without loss.

These Memoirs were sent in to the Editorial Committee for the Norwegian North-Atlantic Expedition as follows: — Nos. I and II in April 1879 and No. III in December.

The observations set forth in the foregoing Memoirs were, when not taken on board, instituted in Professor Waage's department of the Chemical Laboratory of the University of Christiania.

In conclusion, I must not omit to thank Professors Waage and Mohn for the assistance they kindly rendered me, in certain respects, when engaged on the investigation of the subjects treated of in these papers.

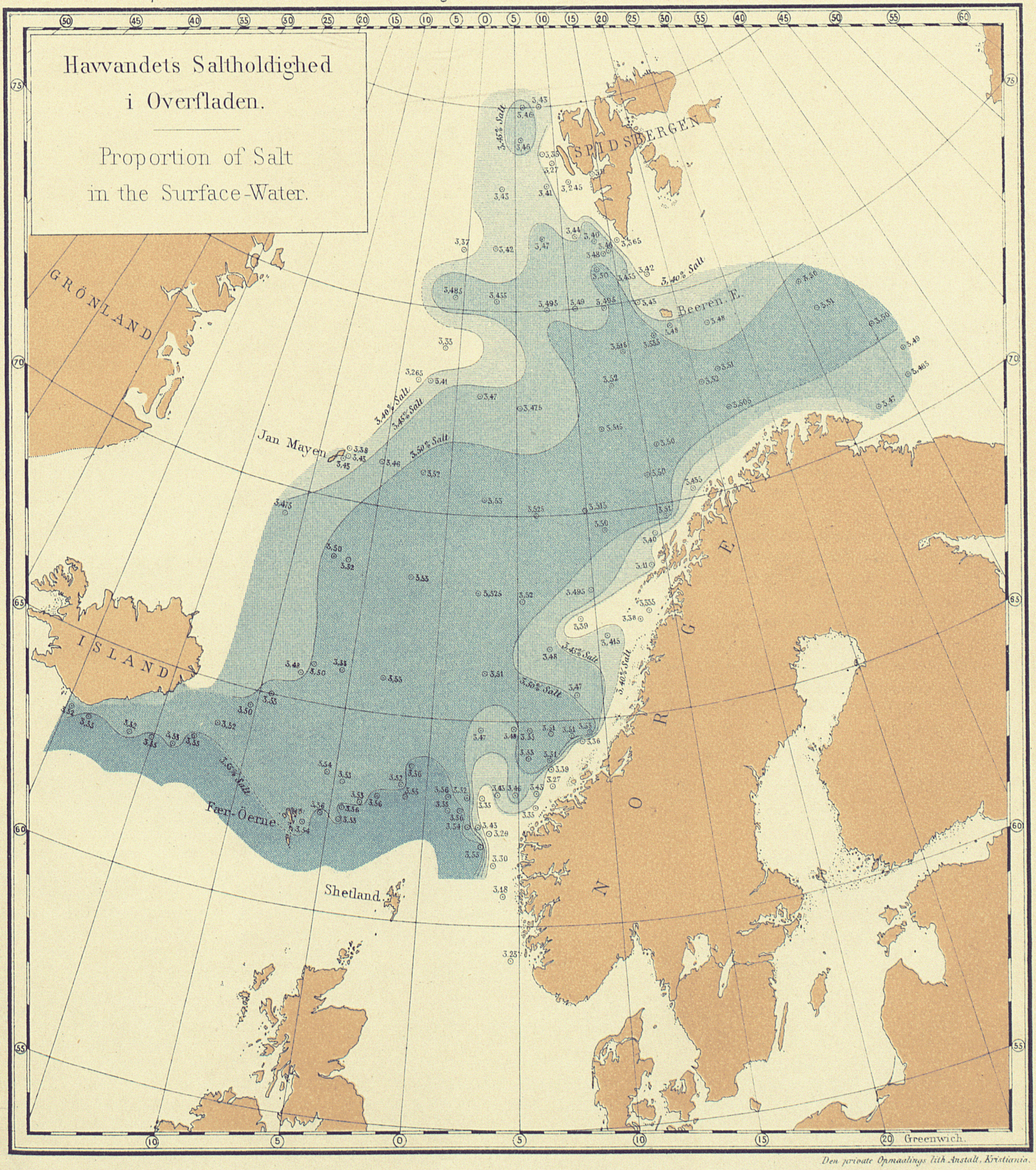
Errata.

Page 3, line 26, from top of page, *for* '35.4 to 32.4 — 33.6 per cent, being' *read* '35.4 to 32.4, 33.6 per cent being.'
— 9, line 20, from top of page, *for* 'the extent to which the results based on that hyppothesis,' etc. *read* 'the slight extent to which Jacobsen's results.' etc.
— 28, line 22, from top of page, *for* 'soda was added, and the whole compound' *read* 'carbonate of soda was added, and the whole mixture.'
— 38, line 3, from foot of page, *for* 'soda' *read* 'carbonate of soda.'
— 39, line 13, from foot of page, *for* 'soda' *read* 'carbonate of soda.'

Translated into English by **John Hazeland.**

Havvandets Saltholdighed i Overfladen.

Proportion of Salt in the Surface-Water.



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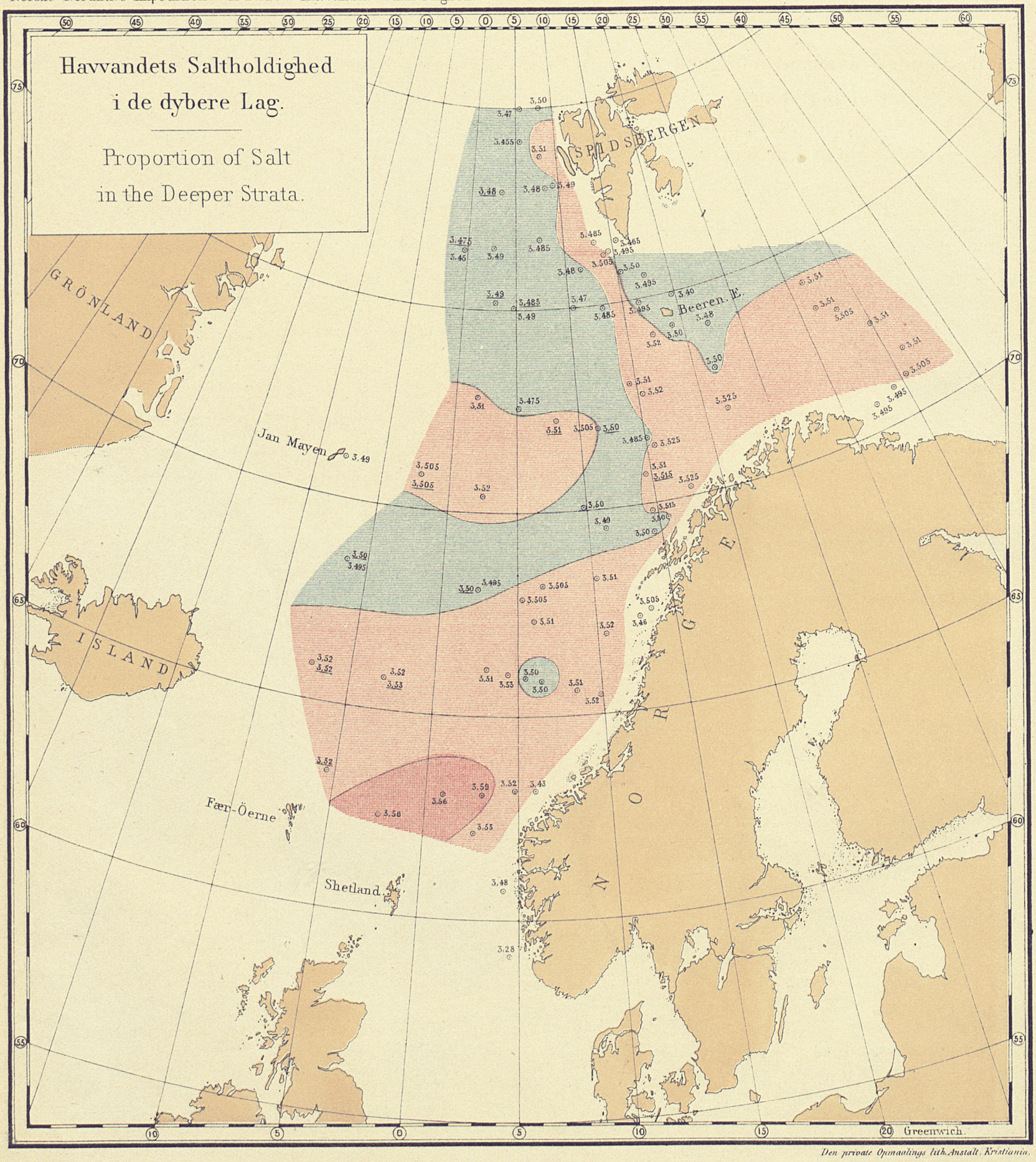
Havvandets Saltholdighed i de dybere Lag.

Proportion of Salt in the Deeper Strata.



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Havvandets Kvælstofholdighed i de dybere Lag.

Proportion of Nitrogen in the Deeper Strata.

SPITSBERGEN

GRÖNLAND

Beeren E.

Jan Mayen

ISLAND

Fær-Öerne

Shetland

NORGE

Greenwich

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DEN NORSKE NORDHAVS-EXPEDITION

1876—1878.

ZOOLOGI.

FISKE,

VED

ROBERT COLLETT.

MED 5 PLANCHER, 3 TRÆSNIT, OG 1 KART.

CHRISTIANIA.

GRØNDAHL & SØNS BOGTRYKKERI.

1880.

THE NORWEGIAN NORTH-ATLANTIC EXPEDITION

1876—1878.

ZOOLOGY.

FISHES,

BY

ROBERT COLLETT.

WITH 5 PLATES, 3 WOODCUTS, AND 1 MAP.

CHRISTIANIA.
PRINTED BY GRØNDAHL & SØN.
1880.

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1881
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I følge Planen for Bearbejdelsen af det videnskabelige Udbytte, der erhvervedes under den norske Nordhavs-Expeditions 3 Togter i Aarene 1876—78, har der i forskjellige Brancher i inden- og udenlandske Tidsskrifter været leveret foreløbige Oversigter, der kortelig have refereret de væsentligste Resultater, enten saaledes, som disse have foreliggét efter Slutningen af hvert enkelt Togt, eller som et samlet Resumé af dem alle.

For de under Expeditionen erhvervede Dybvandsfiskes Vedkommende ere to saadanne foreløbige Oversigter udkomne, begge trykte i „Forhandlinger i Videnskabs-Selskabet i Christiania Aar 1878".[1] Af disse Oversigter, der ikke vare ledsagede af Figurer, udgjør denne General-Beretning en udførligere, og i flere Henseender suppleret og corrigeret Bearbeidelse.

Medens Udbyttet af Evertebraterne allerede under de 2 første Togter, i 1876 og 1877, viste sig at være ganske betydeligt, og frembød Former af den største Interesse, vare de samtidigt indsamlede Fiske forholdsvis faatallige. Dette havde væsentlig sin Grund deri, at de Apparater, der i de nævnte Aar anvendtes til Skrabning eller Optagelse af Bundprøver, ikke vare synderlig tjenlige til disse Dyrs Erhvervelse. Især var dette Tilfældet under det første Togt; Undersøgelserne foregik desuden dette Aar næsten udelukkende paa de store Dybder i den iskolde Area mellem Norge og Island, hvor maaske idetheletaget Fiske-Faunaen er fattigere, end paa flere nordligere Localiteter, hvor Strømningsforholdene bevirke en rigeligere Adgang til Føde, skjønt Bundtemperaturen kan være ligesaa lav. Noget større blev Udbyttet Sommeren 1877, da Undersøgelserne bleve drevne paa det noget grundere Vand, dels paa Bankerne udenfor de norske Kyster, dels i Trakterne af Jan Mayen.

[1] Collett. „Fiske, indsamlede under den norske Nordhavs-Expeditions 2 første Togter, 1876 og 1877". (No. 4, pp. 1—24; foredraget i Mødet den 22de Febr. 1878).

Collett. „Fiske fra Nordhavs-Expeditionens sidste Togt Sommeren 1878". (No. 14, pp. 1—106; foredraget i Mødet d. 13de Dec. 1878).

Pursuant to the resolution for arranging and publishing the fruits of the Norwegian North-Atlantic Expedition, from voyages undertaken in the years 1876, 1877, and 1878, preliminary papers, connected with divers branches of scientific research, have appeared in Norse and foreign journals, giving a summary of the chief results attained, either progressively, as set forth at the termination of each separate voyage, or comprehensively, as a brief *resumé* of them all.

The deep-sea fishes collected on the Expedition form the subject-matter of two such preliminary memoirs, both of which will be found in "Forhandlinger i Videnskabs-Selskabet i Christiania Aar 1878."[1] These synoptical papers — which were not furnished with figures — have been subjected to a careful revision, and, with the aid of additional data, expanded into the present section of the General Report.

For the invertebrate animals, the results even of the two first voyages, in 1876 and 1877, proved very considerable, yielding forms of the greatest interest, whereas the number of fishes obtained was comparatively small. The chief reason of this, however, lay in the fact of the dredging-apparatus then employed not having been well adapted for securing specimens of these animals. Such showed itself the case more particularly on the first voyage; the investigations, too, in 1876 were carried on almost exclusively at great depths, in the cold area between Norway and the shores of Iceland, where the marine fauna is less rich perhaps than in some localities further north, which the effect of ocean currents has secured a more abundant influx of food, though the temperature at the bottom may be equally low. In the summer of 1877 the results were somewhat greater, the Expedition extending its investigations to shallower water, partly on the banks off the Norwegian coast, and partly in the region adjoining Jan Mayen.

[1] Collett. "Fiske, indsamlede under den norske Nordhavs-Expeditions to første Togter, 1876 og 1877." (No. 4, pp. 1—24; read at Meeting held Feb. 22nd 1878.)

Collett. "Fiske fra Nordhavs-Expeditionens sidste Togt Sommeren 1878." (No. 14, pp. 1—106; read at Meeting held Dec. 13th 1878.)

Naar intet Hensyn tages til en Del almindelige Arter, der indsamledes paa ringe Dyb under Opholdet ved de norske Kyster, udgjør Antallet af de erholdte Dybvandsfiske under disse 2 første Aar: i 1876 1 Art (1 Individ), i 1877 10 Arter (17 Individer). Uagtet sin Faatallighed have disse dog indeholdt Former af ikke ubetydelig Interesse. Dette havde ikke alene sin Grund deri, at de tildels stammede fra Dele af Nordhavet, der i ichthyologisk Henseende vare saagodtsom ubekjendte (saaledes Trakterne omkring Jan Mayen); men af de indsamlede Specimina fandtes Arter, der i det Hele vare kun lidet bekjendte, saaledes som Ungerne af *Lycodes esmarkii*, Coll., og af den senere som ny beskrevne *Lycodes frigidus*; fremdeles *Careproctus reinhardi*, Kr. og *Onos septemtrionalis*, (Coll.). Endelig var en enkelt, *Lycodes muraena*, tidligere ubeskreven.

Da det ichthyologiske Udbytte saaledes under de 2 første Togter havde i det Hele været mindre, end' paaregnet, blev der under Udrustningen til det sidste Togt, i 1878, lagt speciel Vægt paa Anskaffelsen af saadanne Apparater, der ikke blot vare skikkede til at ophente de forskjellige Evertebrater fra de største Dybder, men tillige kunde medbringe Dybvandsfiske, som det maatte antages heller ikke her ganske manglede, naar blot Apparaterne vare istand til at opbringe dem. Et Trawlnet af ganske betydelige Dimensioner blev derfor indrettet væsentlig til dette Brug, og ved en sindrig Mechanisme ombord paa Skibet blev Linens Spænding modereret under Skrabningen; men da et Fangeapparat af denne Construction neppe med Fordel kan benyttes, uden hvor Bunden er flad, og bestaar af Ler eller Sand, blev dets Anvendelse i det Hele indskrænket til et mindre Antal Kast, hvor Bundforholdene tillode dette. Var Bunden stenet eller ujevn, blev Trawlnettet ikke benyttet; ikke destomindre kom det flere Gange op sønderflænget eller knækket, naar det tilfældigvis var kommen til at berøre et klippefuldt Strøg af Bunden; ved én Lejlighed tabtes den hele Trawl tilligemed et Par Tusinde Favne Tougværk.

Denne Anvendelse af Trawlnettet paa de dertil egnede Localiteter kronedes med et uventet Held. Neppe nogensinde gik Trawlen ned, uden at medbringe Fiske, undertiden blot enkelte, men oftest flere. Den Dybde, hvori den nedsendtes, var forskjellig, men gik lige ned til mellem 1300 og 1400 Favne. Aldeles uventet var det at finde Slægten *Lycodes*, hvoraf hidtil, som bekjendt, et kun ganske indskrænket Antal Individer ere kjendte, skjønt Slægten er repræsenteret ved forholdsvis ikke faa Arter, udbredt paa de fleste undersøgte Localiteter, hvor Dybden var nogenlunde betydelig; saaledes erholdtes alene af en enkelt Art (*L. frigidus*, n. sp.) ikke mindre end 15 Individer, de fleste fra en Dybde af mellem 600 og 1300 Favne, eller derover, og næsten alene paa Steder, hvor Vandets Temperatur gik ned til under 0°.

Ialt erholdtes denne Gang af Lycoder 25 Individer, tilhørende 6 Arter, hvoraf 3 vare tidligere ubeskrevne, og 1 beskreven under Beretningen om foregaaende Aars Togt.

Exclusive of a few of the commoner forms taken at a trifling depth off the coast of Norway, the number of deep-sea fishes obtained on the two first voyages was 18, comprising 11 species: in 1876, 1 species (1 individual), in 1877, 10 species (17 individuals). But this result, though comparatively meagre, afforded forms of very considerable interest, — a circumstance to be explained not only by the habitat of several among them lying in tracts of the Northern Ocean hitherto unexplored by ichthyologists, certain of the species secured were likewise of rare occurrence, and in themselves but little known; for instance, the young of *Lycodes esmarkii*, Coll., and of *Lycodes frigidus*, since described as a new species; moreover, *Careproctus reinhardi*, Kr., and *Onos septemtrionalis*, (Coll.); finally, *Lycodes muræna*, a species not previously described.

Thus, the ichthyological results from the two first voyages having on the whole proved less satisfactory than anticipated, great importance was attached, when fitting out the Expedition for the final voyage, in 1878, to the possibility of procuring apparatus which should be adapted not only for securing the various species of invertebrate animals there met with, but also for bringing up deep-sea fishes, which there was reason to believe would be found to occur, were suitable apparatus employed for taking them. A trawl-net of very considerable dimensions was therefore constructed, principally with the above object in view, an ingenious piece of mechanism regulating from the deck of the vessel the strain on the line. But fishing-apparatus of this character could not however be employed except for traversing a smooth bottom of clay or sand, and its use was accordingly confined to some few hauls in specially favourable localities. Wheresoever the bottom proved rugged or uneven, recourse was not had to the trawl-net; but notwithstanding the care thus displayed to prevent accidents, it came up several times in a damaged state, with the meshes torn or the boom broken, having chanced to strike against some rocky projection; nay, on one occasion the entire trawl was lost, together with a couple of thousand fathoms of rope.

The use of the trawl-net in localities for which it is adapted met with eminent and unlooked-for success. Fishes were brought up at well nigh every haul, sometimes indeed two or three only, but more frequently a larger number. The net was worked at various depths, the greatest to which it was sunk being close upon 1400 fathoms. It occasioned no little surprise to find the genus *Lycodes*, — of which but a very limited number of individuals are as yet known, notwithstanding this genus is represented comparatively by a good many species, — throughout most of the localities investigated where the depth was considerable; thus, for instance, 15 examples were obtained of a single species (*L. frigidus*, n. sp.), the majority at depths ranging from 600 to upwards of 1300 fathoms, and almost exclusively in spots where the temperature of the water was below zero.

The total number of *Lycodes* specimens was 25, comprising 6 species, 3 of which had not previously been described, and 1 for the first time in the Report of the

Denne Slægt, der endnu hører til de i Musæerne allersparsomst repræsenterede Former af den arctiske Fauna, synes saaledes i Virkeligheden af alle Dybvandsfiske at være blandt de talrigste i Ishavets Dyb paa jevn Lerbund, og maa forekomme her i store Mængder; maaske udgjøre de her Hovednæringen for flere andre Rovfiske (*Somniosus*, *Rajae*, etc.) paa Grund af deres noget træge Væsen, hvilken sidste Egenskab det sandsynligvis væsentlig skyldtes, at de saa ofte erholdtes i Trawlnettet.

Det samlede Udbytte under dette sidste Aars Togt udgjorde ialt 33 Arter, hvoraf 6 vare nye for Videnskaben; af de under de 2 foregaaende Togter erhvervede 11 Arter gjenfandtes de 10, hvoriblandt ogsaa den ny opstillede *Lycodes muraena*. De 6 Arter, der maa ansees som tidligere ubeskrevne, ere *Raja hyperborea*, *Liparis* (*Paraliparis*) *bathybii*, *Lycodes frigidus*, *Lycodes pallidus*, *Lycodes lütkeni*, samt *Rhodichthys regina*, den sidstnævnte tillige repræsenterende en ny Slægt. Ialt har saaledes Expeditionen bragt 7 nye Arter (og 1 ny Slægt) for Dagen, alle udprægede Dybvandsfiske.

Flere af de øvrige Arter vare kun ufuldstændigt kjendte eller beskrevne, hvilket saaledes var Tilfældet med flere af Lycoderne. En Art, *Onos reinhardi*, (Kr.), havde aldrig været tildelt endog den korteste Diagnose eller Beskrivelse, men dens Benævnelse er alene grundet paa en haandskreven Etikette, og dennes Indførelse i en Catalog. Flere vare ikke tidligere paaviste i den europæiske Fauna, men blot fundne, tildels for længere Tid tilbage, og blot i enkelte Exemplarer, ved de grønlandske Kyster. Vil man saaledes udstrække et Lands eller en Landsdels faunistiske Omraade indtil i omkring 100 Kilometers Afstand fra Kysterne, kan der til Spitsbergens Fauna føjes næsten et Dusin Arter, som tidligere ikke have været omtalte fra denne Øgruppe.

Det i 1878 undersøgte Areal omfattede Strækningen mellem Hammerfest og Varangerfjorden i Syd, Havet henimod Novaja Zemlja i Øst og Jan Mayen i Vest, samt i Nord til Spitsbergens Nordvest-Spidse.

Af de fleste Arter har jeg hos et eller flere Individer undersøgt Ventrikelens Indhold, og til Bestemmelsen af de her forefundne Dyrelevninger har jeg havt en beredvillig Hjælp af Prof. G. O. Sars, hvis Navn er den bedste Garanti for Bestemmelsernes Rigtighed. Denne Undersøgelse af Maveindholdet har desuden havt Interesse ikke blot af den Grund, at den har givet Bidrag til vor Kundskab om visse Evertebraters Udbredelse mod Nord, men ogsaa fordi derved er bleven constateret det ret mærkelige Factum, at flere af disse pelagiske Dyreformer, der væsentlig have været anseede for at have sit Tilhold i Overfladen, formaa at trænge ned til de største Dybder, hvorfra Dybvandsfiskene

preceding voyage. Hence this genus, which must still be regarded as one of the Arctic forms most sparingly represented in museums, would appear to be more numerous than any other of the deep-sea fishes inhabiting the depths of the Polar Sea over a smooth clay bottom; and it occurs no doubt in very considerable quantities. There, perhaps, it constitutes the chief food of other predatory fishes (*Somniosus*, *Rajæ*), owing to its somewhat sluggish movements, a circumstance which probably to a great extent accounts for this fish having been so often captured in the trawl-net.

The number of species secured on this voyage, the last undertaken by the Expedition, amounted in all to 33, 6 of which proved new to science. Of the 11 species obtained on the two preceding voyages, 10 were again met with, including the new species *Lycodes muræna*. The 6 species that must be regarded as not previously known are: — *Raja hyperborea*, *Liparis bathybii*, *Lycodes frigidus*, *Lycodes pallidus*, *Lycodes lütkeni* and *Rhodichthys regina*, the last-mentioned also representing a new genus. The Expedition has thus brought to light 7 new species, (and 1 new genus), all of them true forms of deep-sea fishes.

Several of the remaining species were but imperfectly known and described; this, for instance, was the case with divers of the genus *Lycodes*. One species, *Onos reinhardi*, (Kr.), had not even been made the subject of the briefest diagnosis or description; its designation is traceable to a manuscript label, copied into a catalogue. Several had not previously been shown to occur in the European fauna, but merely found, in some cases years ago and as solitary examples, on the coast of Greenland. Hence, if the area inhabited by the fauna of a country or region be assumed to extend to about 100 kilometres from its shores, we may add to the fauna of Spitzbergen nearly a dozen species of fishes not previously mentioned as occurring off that group of islands.

The region investigated in 1878 comprised, southward, the tract between Hammerfest and the Varanger Fjord, eastward and westward, the expanse of ocean stretching towards Novaja Zemlja and Jan Mayen, and northward, that extending to the north-western extremity of Spitzbergen.

In most of the individuals I have examined the contents of the stomach, and in determining the animal remains found there, Professor G. O. Sars, whose name is a sufficient guarantee for accuracy, has kindly favoured me with his valuable assistance. Moreover, an examination of the stomach and its contents has proved of considerable interest, not only by contributing to our knowledge of the distribution of divers invertebrate species in northern latitudes, but also from its having substantiated the very remarkable fact, that several of these pelagic forms of animal life, whose habitat was generally believed to be near the surface, possess the power of descending to the greatest depths

erhvervedes, og de have her vist sig at kunne opnaa en endog betydeligere Størrelse, end de, der ere kjendte fra de øvre Vandlag. Maaske bør alle disse opfattes som væsentligt beboende de dybere Vandlag, men naar visse gunstige Betingelser ere tilstede, formaa de ogsaa at stige op til Overfladen. Til disse Dyreformer hører fremfor alle Amphipoden *Themisto libellula*, Mandt (af Hyperidernes Familie), der i store Mængder forekommer paa de fleste Steder i Ishavet; denne Art udgjorde Hovedbestanddelen af de undersøgte Arters Føde, og manglede neppe ganske hos nogen af dem, skjønt disse kunde tilhøre Arter, der beboede omkring 1000 Favnes Dyb, og paa Grund af sin Legemsbygning med Vished kunde antages ikke at være istand til at hæve sig synderligt fra Bunden. Det samme var Tilfældet med enkelte Calanider, og flere andre pelagiske Crustaceer.

Nedenfor meddeles en Fortegnelse over alle de Stationer, paa hvilke Dybvandsfiske erholdtes, tilligemed det paa hver enkelt Station erholdte Udbytte[1].

1876.

Station 33. Storeggen, 174 Kilom. vestenfor Aalesund, Norge (63° 5′ N. B., 3° 0′ Ø. L. f. Gr.), 30te Juni.
1 *Scopelus mülleri*, (Gmel.), i Overfladen.

1877.

Station 124. Banken udenfor Trænen, Helgeland i Norge, 325 Kilom. V.S.V. for Bodø (66° 41′ N. B., 6° 59′ Ø. L.), 19de Juni. Dybden 350 Favne (640^m). Bundtemperaturen — 0,9° C. Bunden Ler.
1 *Lycodes frigidus*, jun. (beskreves først senere).
1 *Lycodes esmarkii*, Coll.
1 *Lycodes muraena*, n. sp.

Station 164. Banken udenfor Lofoten, Norge, 117 Kilom. vestenfor Røst (68° 21′ N. B., 10° 40′ Ø. L.), 29de Juni. Dybden 457 Favne (836^m). Bundtemperaturen — 0,7° C. Bunden graa Sandler.
1 *Lycodes frigidus*, jun. (beskreves først senere).

Røst, Lofoten (67° 31′ N. B., 12° 12′ Ø. L.), 26de Juni. 50—150 Favne (100—280^m). Bundtemperaturen + 5° C. Bunden Sandbund.
1 *Onos septemtrionalis*, (Coll.).
1 *Glyptocephalus cynoglossus*, (Lin.).

Station 183. Havet nordvest for Lofoten, 354 Kilom. fra Land (69° 59′ N. B., 6° 15′ Ø. L.), 5te Juli. I Overfladen.
4 *Sebastes marinus*, (Lin.), Yngel.

[1] En Del almindelige Former, optagne fra ringe Dyb under Opholdet ved de norske Kyster, ere ikke nærmere omtalte.

in which deep-sea fishes were met with, where they attain even a larger size than those taken in the upper strata of the water. All of these forms should, perhaps, be regarded as occurring chiefly at great depths, but gifted with the faculty of ascending, under certain favourable conditions, to the surface. Among such forms must be ranked above all the Amphipod *Themisto libellula*, Mandt (of the family *Hyperidæ*), which is found in enormous quantities in most parts of the Polar Sea; this animal had constituted the chief food of the species examined, and traces of its presence were probably not altogether wanting in any one of the examples, though belonging even to species that occur at a depth of about 1000 fathoms, and which from their bodily structure may with certainty be assumed not to ascend far from the bottom. Such, too, was the case with the Calanids and other species.

List of stations at which deep-sea fishes were taken, together with a specification of the results for each station.[1]

1876.

Station 33. — Storeggen, 174 kilom. west of Aalesund, Norway (lat. 63° 5′ N., long. 3° 0′ E.), 30th June.
1 *Scopelus mülleri*, (Gmel.); at the surface.

1877.

Station 124. — The bank off Trænen, Helgeland in Norway, 325 kilom. WSW. of Bodø (lat. 66° 41′ N., long. 6° 59′ E.), 19th June; depth 350 fathoms (640^m); temperature at bottom — 0.9° C.; clay bottom.
1 *Lycodes frigidus*, jun. (not described till later).
1 *Lycodes esmarkii*, Coll.
1 *Lycodes muræna*, n. sp.

Station 164. — The bank off the Lofoten Islands, Norway, 117 kilom. west of Røst (lat. 68° 21′ N., long. 10° 40′ E.), 29th June; depth 457 fathoms (836^m); temperature at bottom — 0.7° C.; bottom: grey sablous clay.
1 *Lycodes frigidus*, jun. (not described till later).

Røst, Lofoten Islands (lat. 67° 31′ N., long. 12° 12′ E.), 26th June; depth 50—150 fathoms (100—280^m); temperature at bottom + 5° C.; sandy bottom.
1 *Onos septemtrionalis*, (Coll.).
1 *Glyptocephalus cynoglossus*, (Lin.).

Station 183. — The open sea, north-west of the Lofoten Islands, 354 kilom. from land (lat. 69° 59′ N., long. 6° 15′ E.), 5th July; at the surface.
4 *Sebastes marinus*, (Lin.); fry.

[1] The commoner forms obtained at a trifling depth off the Norwegian coast are not included in this report.

Station 223. Østsiden af Jan Mayen (70° 54′ N. B., 8° 24′ V. L.), 1ste August. Dybden 70 Favne (128ᵐ). Bundtemperaturen — 0,6° C. Bunden sort (vulkansk) Sand og Ler.

1 *Icelus hamatus*, Kr.
1 *Triglops pingelii*, Reinh.

Station 224. Østsiden af Jan Mayen (70° 51′ N. B., 8° 20′ V. L.), 1ste August. Dybden 95 Favne (174ᵐ). Bundtemperaturen — 0,6° C. Bunden sort (vulkansk) Sand og Ler.

1 *Icelus hamatus*, Kr.

Station 237. Sydsiden af Jan Mayen (70° 41′ N. B., 10° 10′ V. L.), 3die August. Dybden 263 Favne (481ᵐ). Bundtemperaturen — 0,3° C. Bunden grovt Grus og Smaastene, især af Lava.

1 *Triglops pingelii*, Reinh.
1 *Careproctus reinhardi*, Kr.
1 *Gymnelis viridis*, (Fabr.).

Station 248. Havet vestenfor Lofoten, 364 Kilom. fra Land (67° 56,5′ N. B., 4° 11′ Ø. L.), 8de August. I Overfladen.

1 *Sebastes marinus*, (Lin.), Yngel.

1878.

Station 261. Tanafjord i Øst-Finmarken (70° 47,5′ N. B., 28° 30′ Ø. L.), 25de Juni. Dybden 127 Favne (232ᵐ). Bundtemperaturen + 2,8° C. Bunden Mudder og Ler.

5 *Raja radiata*, Donov.
2 *Sebastes marinus*, (Lin.).
1 *Glyptocephalus cynoglossus*, (Lin.).
6 *Hippoglossoides platessoides*, (Fabr.).

Station 262. Havet østenfor Vardø, 63 Kilom. fra Land (70° 36′ N. B., 32° 35′ Ø. L.), 27de Juni. Dybden 148 Favne (271ᵐ). Bundtemperaturen + 1,9° C. Bunden Ler.

1 *Centridermichthys uncinatus*, (Reinh.).

Station 275. Havet østenfor Beeren Eiland, 360 Kilom. fra Land (74° 8′ N. B., 31° 12′ Ø. L.), 2den Juli. Dybden 147 Favne (269ᵐ). Bundtemperaturen — 0,4° C. Bunden grønligt Ler.

1 *Sebastes marinus*, (Lin.).
3 *Centridermichthys uncinatus*, (Reinh.).

Station 286. Havet sydvest for Beeren Eiland, 215 Kilom. fra Land (72° 57′ N. B., 14° 32′ Ø. L.), 6te Juli. Dybden 447 Favne (817ᵐ). Bundtemperaturen — 0,8° C. Bunden graagrønt Ler.

18 *Sebastes marinus*, (Lin.), Yngel, i Overfladen.
1 *Platysomatichthys hippoglossoides*, (Wahlb.).

Station 223. — Eastern shore of Jan Mayen (lat. 70° 54′ N., long. 8° 24′ W.), 1st August; depth 70 fathoms (128ᵐ); temperature at bottom — 0.6° C.; bottom: black (volcanic) sand and clay.

1 *Icelus hamatus*, Kr.
1 *Triglops pingelii*, Reinh.

Station 224. — Eastern shore of Jan Mayen (lat. 70° 51′ N., long. 8° 20′ W.), 1st August; depth 95 fathoms (174ᵐ); temperature at bottom — 0.6° C.; bottom: black (volcanic) sand and clay.

1 *Icelus hamatus*, Kr.

Station 237. — Southern shore of Jan Mayen (lat. 70° 41′ N., long. 10° 10′ W.), 3rd August; depth 263 fathoms (481ᵐ); temperature at bottom — 0.3° C.; bottom: coarse sand and shingle, consisting to a great extent of lava.

1 *Triglops pingelii*, Reinh.
1 *Careproctus reinhardi*, Kr.
1 *Gymnelis viridis*, (Fabr.).

Station 248. — The open sea, west of the Lofoten Islands, 364 kilom. from land (lat. 67° 56,5′ N., long 4° 11′ E.), 8th August; at the surface.

1 *Sebastes marinus*, (Lin.); fry-specimen.

1878.

Station 261. — The Tana Fjord, East Finmark (lat. 70° 47,5′ N., long. 28° 30′ E.), 25th June; depth 127 fathoms (232ᵐ); temperature at bottom + 2.8° C.; bottom: mud and clay.

5 *Raja radiata*, Donov.
2 *Sebastes marinus*, (Lin.).
1 *Glyptocephalus cynoglossus*, (Lin.).
6 *Hippoglossoides platessoides*, (Fabr.).

Station 262. — The open sea, east of Vardø, 63 kilom. from land (lat. 70° 36′ N., long. 32° 35′ E.), 27th June; depth 148 fathoms (271ᵐ); temperature at bottom + 1.9° C.; bottom: clay.

1 *Centridermichthys uncinatus*, (Reinh.).

Station 275. — The open sea, east of Beeren Eiland, 360 kilom. from land (lat. 74° 8′, long. 31° 12′ E.), 2nd July; depth 147 fathoms (269ᵐ); temperature at bottom — 0.4° C.; bottom: greenish clay.

1 *Sebastes marinus*, (Lin.).
3 *Centridermichthys uncinatus*, (Reinh.).

Station 286. — The open sea, south-west of Beeren Eiland, 215 kilom. from land (lat. 72° 57′ N., long. 14° 32′ E.), 6th July; depth 447 fathoms (349ᵐ); temperature at bottom — 0.8° C.; bottom: grey-green sand.

18 *Sebastes marinus*, (Lin.), fry; at the surface.
1 *Platysomatichthys hippoglossoides*, (Wahlb.).

Station 290. Havet midt mellem Beeren Eiland og Hammerfest, 216 Kilom. fra Land (72° 27′ N. B., 20° 51′ Ø. L.) 7de Juli. Dybden 191 Favne (349ᵐ). Bundtemperaturen + 3,5° C. Bunden sandholdigt Ler.

4 *Centridermichthys uncinatus*, (Reinh.).
1 *Cottunculus microps*, Coll.

Station 295. Havet vestenfor Hammerfest, 453 Kilom. fra Land (71° 59′ N. B., 11° 40′ Ø. L.), 14de Juli. Dybden 1110 Favne (2030ᵐ). Bundtemperaturen — 1,3° C. Bunden *Biloculina*-Ler.

5 *Lycodes frigidus*, n. sp.
3 *Scopelus mülleri*, (Gmel.).

Station 297. Havet midt mellem Nordcap, Jan Mayen og Spitsbergen, 465 Kilometer fra nærmeste Land (72° 36′ N. B., 5° 12′ Ø. L.), 16de Juli. Dybden 1280 Favne (2341ᵐ). Bundtemperaturen — 1,4° C. Bunden gulbrun *Biloculina*-Ler.

1 *Rhodichthys regina*, n. gen. & sp.

Station 303. Havet vestenfor Beeren Eiland, 450 Kilom. fra Land (75° 12′ N. B., 3° 2′ Ø. L.), 19de Juli. Dybden 1200 Favne (2195ᵐ). Bundtemperaturen — 1,6° C. Bunden brunt Ler.

1 *Lycodes frigidus*, Coll.

Station 312. Havet vestenfor Beeren Eiland, 108 Kilom. fra Land (74° 54′ N. B., 14° 53′ Ø. L.), 22de Juli. Dybden 658 Favne (1203ᵐ). Bundtemperaturen — 1,2° C. Bunden brunt og grønt Ler.

1 *Liparis bathybii*, n. sp.
2 *Careproctus reinhardi*, Kr.
2 *Onos reinhardi*, (Kr.)
1 *Lycodes muraena*, Coll.
5 *Lycodes frigidus*, Coll.

Station 323. Havet midt mellem Nordcap og Beeren Eiland, 180 Kilom. fra Land (72° 53,5′ N. B., 21° 51′ Ø. L.), 30te Juli. Dybden 223 Favne (408ᵐ). Bundtemperaturen + 1,5° C. Bunden brungraat Ler.

1 *Centridermichthys uncinatus*, (Reinh.).
1 *Agonus decagonus*, Schn.
1 *Hippoglossoides platessoides*, (Fabr.).

Station 326. Havet midt mellem Spitsbergen og Beeren Eiland, 105 Kilom. fra Land (75° 31′ N. B., 17° 50′ Ø. L.), 3die August. Dybden 123 Favne (225ᵐ). Bundtemperaturen + 1,6° C. Bunden mørkt Ler.

1 *Raja radiata*, Donov.
2 *Sebastes marinus*, (Lin.).
3 *Centridermichthys uncinatus*, (Reinh.).
6 *Agonus decagonus*, Schn.
1 *Gadus saida*, Lepech.
15 *Hippoglossoides platessoides*, (Fabr.).

Station 290. — The open sea, midway between Beeren Eiland and Hammerfest, 216 kilom. from land (lat. 70° 27′ N., long. 20° 51′ E.), 7th July; depth 191 fathoms (349ᵐ); temperature at bottom + 3.5° C.; bottom: sabulous clay.

4 *Centridermichthys uncinatus*, (Reinh.).
1 *Cottunculus microps*, Coll.

Station 295. — The open sea, west of Hammerfest, 453 kilom. from land (lat. 71° 59′ N., long. 11° 40′ E.), 14th July; depth 1110 fathoms (2030ᵐ); temperature at bottom — 1.3° C.; bottom: *biloculina*-clay.

5 *Lycodes frigidus*, Coll.
3 *Scopelus mülleri*, (Gmel.).

Station 297. — The open sea, midway between the North Cape, Jan Mayen and Spitzbergen, 465 kilom. from land (lat. 72° 36′ N., long. 5° 12′ E.), 16th July; depth 1280 fathoms (2341ᵐ); temperature at bottom — 1.4° C.; bottom: yellowish brown *biloculina*-clay.

1 *Rhodichthys regina*, n. gen. & sp.

Station 303. — The open sea, west of Beeren Eiland, 450 kilom. from land (lat. 75° 12′ N., long. 3° 2′ E.), 19th July; depth 1200 fathoms (2195ᵐ); temperature at bottom — 1.6° C.; bottom: brown clay.

1 *Lycodes frigidus*, Coll.

Station 312. — The open sea, west of Beeren Eiland, 108 kilom. from land (lat. 74° 54′ N., long. 14° 53′ E.), 22nd July; depth 658 fathoms (1203ᵐ); temperature at bottom — 1.2° C.; bottom: brown and green clay.

1 *Liparis bathybii*, n. sp.
2 *Careproctus reinhardi*, Kr.
2 *Onos reinhardi*, (Kr.).
1 *Lycodes muræna*, Coll.
5 *Lycodes frigidus*, Coll.

Station 323. — The open sea, midway between the North Cape and Beeren Eiland, 180 kilom. from land (lat. 72° 53′, 5″ N., long. 31° 51′ E.), 30th July; depth 223 fathoms (408ᵐ); temperature at bottom + 1.5° C.; bottom: brownish grey clay.

1 *Centridermichthys uncinatus*, (Reinh.).
1 *Agonus decagonus*, Schn.
1 *Hippoglossoides platessoides*, (Fabr.).

Station 326. — The open sea, midway between Spitzbergen and Beeren Eiland, 105 kilom. from land (lat. 75° 31′ N., long. 17° 50′ E.), 3rd August; depth 123 fathoms (225ᵐ); temperature at bottom + 1.6° C.; bottom: dark clay.

1 *Raja radiata*, Donov.
2 *Sebastes marinus*, (Lin.).
3 *Centridermichthys uncinatus*, (Reinh.).
6 *Agonus decagonus*, Schn.
1 *Gadus saida*, Lepech.
15 *Hippoglossoides platessoides*, (Fabr.).

Station 338. Udenfor Sydcap, Spitsbergen (76° 22′ N. B., 17° 13′ Ø. L.), 6te August. Dybden 146 Favne (267ᵐ). Bundtemperaturen — 1,1° C. Bunden Stenbund.

1 *Agonus decagonus*, Schn.

Station 353. Havet vestenfor Isfjorden, Vest-Spitsbergen, 230 Kilom. fra Land (77° 59′ N. B., 5° 10′ Ø. L.), 10de August. Dybden 1333 Favne (2438ᵐ). Bundtemperaturen — 1,4° C. Bunden *Biloculina*-Ler og Smaastene.

3 *Lycodes frigidus*, Coll.

Station 362. Havet vestenfor Norsk-Øerne, Nordvest-Spitsbergen, 115 Kilom. fra Land (79° 59′ N. B., 5° 40′ Ø. L.), 14de August. Dybden 459 Favne (839ᵐ). Bundtemperaturen — 1,0° C. Bunden blaagraat Ler.

1 *Raja hyperborea*, n. sp.
2 *Raja radiata*, Donov.
1 *Cottunculus microps*, Coll.
2 *Lycodes esmarkii*, Coll.
1 *Lycodes lütkeni*, n. sp.
1 *Lycodes pallidus*, n. sp.
2 *Lycodes muraena*, Coll.

Station 363. Havet vestenfor Norsk-Øerne, Nordvest-Spitsbergen, 60 Kilom. fra Land (80° 3′ N. B., 8° 28′ Ø. L.), 14de August. Dybden 260 Favne (475ᵐ). Bundtemperaturen + 1,1° C. Bunden Blaaler.

1 *Agonus decagonus*, Schn.
1 *Cottunculus microps*, Coll.
1 *Lycodes frigidus*, Coll.
1 *Lycodes esmarkii*, Coll.
1 *Lycodes pallidus*, Coll.
1 *Lycodes seminudus*, Reinh.

Norsk-Øerne, Nordvest-Spitsbergen (79° 51′ N. B., 11° 45′ Ø. L.), 15de August. Dybden ubetydelig.

1 *Cottus scorpius*, Lin.
3 *Liparis lineatus*, (Lepech.).
1 *Gadus saida*, Lepech.
3 *Gymnelis viridis*, (Fabr.).

Station 366. Magdalenebay, Nord-Spitsbergen (79° 35′ N. B., 11° 17′ Ø. L.), 17de August. Dybden 37—61 Favne (75—112ᵐ). Bundtemperat. fra — 0,2° indtil — 2,1° C. Bunden mørkgraat Ler med løsrevne Alger og Smaasten.

1 *Icelus hamatus*, Kr.
1 *Triglops pingelii*, Reinh.
8 *Gymnacanthus pistilliger*, (Pall.).
1 *Liparis lineatus*, (Lepech.).
1 *Lumpenus maculatus*, (Fries).
4 *Lumpenus medius*, Reinh.
1 *Lumpenus lampetraeformis*, (Walb.).
72 *Gadus saida*, Lepech.

Station 338. — Off the South Cape, Spitzbergen (lat. 76° 22′ N., long. 17° 13′ E.), 6th August; depth 146 fathoms (267ᵐ); temperature at bottom — 1.1° C.; rocky bottom.

1 *Agonus decagonus*, Schn.

Station 353. — The open sea, west of the Isfjord, western coast of Spitzbergen, 230 kilom. from land (lat. 77° 59′ N., long. 5° 10′ E.), 10th August; depth 1333 fathoms (2438ᵐ); temperature at bottom — 1.4° C.; bottom: *biloculina*-clay and shingle.

3 *Lycodes frigidus*, Coll.

Station 362. — The open sea, west of the Norsk Islands, north-western coast of Spitzbergen, 115 kilom. from land (lat. 79° 59′ N., long. 5° 40′ E.), 14th August; depth 459 fathoms (839ᵐ); temperature at bottom — 1.0° C.; bottom: bluish grey clay.

1 *Raja hyperborea*, n. sp.
2 *Raja radiata*, Donov.
1 *Cottunculus microps*, Coll.
2 *Lycodes esmarkii*, Coll.
1 *Lycodes lütkeni*, n. sp.
1 *Lycodes pallidus*, n. sp.
2 *Lycodes muræna*, Coll.

Station 363. — The open sea, west of the Norsk Islands, north-western coast of Spitzbergen, 60 kilom. from land (lat. 80° 3′ N., long. 8° 28′ E.), 14th August; depth 260 fathoms (475ᵐ); temperature at bottom + 1.1° C.; bottom: blue clay.

1 *Agonus decagonus*, Schn.
1 *Cottunculus microps*, Coll.
1 *Lycodes frigidus*, Coll.
1 *Lycodes esmarkii*, Coll.
1 *Lycodes pallidus*, Coll.
1 *Lycodes seminudus*, Reinh.

Norsk Islands, north-western coast of Spitzbergen (lat. 79° 51′ N., long. 11° 45′ E.), 15th August; depth trifling.

1 *Cottus scorpius* (Lin.).
3 *Liparis lineatus*, (Lepech.).
1 *Gadus saida*, Lepech.
3 *Gymnelis viridis*, (Fabr.).

Station 366. — Magdalena Bay, north coast of Spitzbergen (lat. 79° 35′ N., long. 11° 17′ E.), 17th August; depth 37—61 fathoms (75—112ᵐ); temperature at bottom as low as — 2.1° C.; bottom: dark-grey clay and shingle.

1 *Icelus hamatus*, Kr.
1 *Triglops pingelii*, (Reinh.).
8 *Gymnacanthus pistilliger*, (Pall.).
1 *Liparis lineatus*, (Lepech.).
1 *Lumpenus maculatus*, (Fries).
4 *Lumpenus medius*, Reinh.
1 *Lumpenus lampetræformis*, (Walb.).
72 *Gadus saida*, Lepech.

Isfjorden, Vest-Spitsbergen (78° 9′ N. B., 14° 12′ Ø. L.), 19de August. Dybden 129 Favne (236ᵐ). Bundtemperaturen + 1,2° C. Bunden Stenbund.

1 *Eumicrotremus spinosus*, (Müll.).

Station 374. Advent Bay, Isfjorden, Vest-Spitsbergen (78° 16′ N. B., 15° 38′ Ø. L.), 22de August. Dybden 60 Favne (110ᵐ). Bundtemperaturen + 0,7° C. Bunden mørkt Ler.

3 *Lumpenus medius*, Reinh.

Det samlede Antal har saaledes tilhørt følgende 32 Arter:

Rajidae.

Raja hyperborea, n. sp. 1878. *Raja radiata*, Donov. 1808.

Scorpaenidae.

Sebastes marinus, (Lin.) 1766.

Cottidae.

Cottunculus microps, Coll. 1874. *Cottus scorpius*, Lin. 1766. *Gymnacanthus pistilliger*, (Pall.) 1811. *Centridermichthys uncinatus*, (Reinh.) 1833—34. *Icelus hamatus*, Kr. 1844. *Triglops pingelii*, Reinh. 1838.

Agonidae.

Agonus decagonus, Schn. 1801.

Cyclopteridae.

Eumicrotremus spinosus, (Müll.) 1776.

Liparididae.

Liparis lineatus, (Lepech.) 1774. *Liparis bathybii*, n. sp. 1878. *Careproctus reinhardi*, Kr. 1862.

Blenniidae.

Lumpenus medius, Reinh. 1838. *Lumpenus maculatus*, (Fries) 1837. *Lumpenus lampetraeformis*, (Wahlb.) 1792.

Lycodidae.

Lycodes esmarkii, Coll. 1874. *Lycodes frigidus*, n. sp. 1878. *Lycodes lütkeni*, n. sp. 1880. *Lycodes pallidus*, n. sp. 1878. *Lycodes seminudus*, Reinh. 1838. *Lycodes muraena*, n. sp. 1878. *Gymnelis viridis*, (Fabr.) 1780.

Gadidae.

Gadus saida, Lepech. 1774. *Onos reinhardi*, (Kr.) MS. 185?. *Onos septemtrionalis*, (Coll.) 1874.

Pleuronectidae.

Platysomatichthys hippoglossoides, (Wahlb.) 1792. *Hippoglossoides platessoides*, (Fabr.) 1780. *Glyptocephalus cynoglossus*, (Lin.) 1766.

Ophidiidae.

Rhodichthys regina, n. gen. & sp. 1878.

Scopelidae.

Scopelus mülleri, (Gmel.) 1788.

The Isfjord, western coast of Spitzbergen (lat. 78° 9′ N., long. 14° 12′ E.), 19th August; depth 129 fathoms (236ᵐ); temperature at bottom + 1.2° C.; bottom rocky.

1 *Eumicrotremus spinosus*, (Müll.).

Station 374. — Advent Bay, west coast of Spitzbergen (lat. 78° 16′ N., long. 15° 38′ E.), 22nd August; depth 60 fathoms (110ᵐ); temperature at bottom + 0.7° C.; bottom: dark clay.

3 *Lumpenus medius*, Reinh.

The individuals collected on the Expedition comprised accordingly the following species, 32 in number: —

Rajidæ.

Raja hyperborea, n. sp. 1878. *Raja radiata*, Donov. 1808.

Scorpaenidæ.

Sebastes marinus, (Lin.) 1766.

Cottidæ.

Cottunculus microps, Coll. 1874. *Cottus scorpius*, Lin. 1766. *Gymnacanthus pistilliger*, (Pall.) 1811. *Centridermichthys uncinatus*, (Reinh.) 1833—34. *Icelus hamatus*, Kr. 1844. *Triglops pingelii*, Reinh. 1838.

Agonidæ.

Agonus decagonus, Schn. 1801.

Cyclopteridæ.

Eumicrotremus spinosus, (Müll.) 1776.

Liparididæ.

Liparis lineatus, (Lepech.) 1774. *Liparis bathybii*, n. sp. 1878. *Careproctus reinhardi*, Kr. 1862.

Blenniidæ.

Lumpenus medius, Reinh. 1838. *Lumpenus maculatus*, (Fries) 1837. *Lumpenus lampetræformis*, (Wahlb.) 1792.

Lycodidæ.

Lycodes esmarkii, Coll. 1874. *Lycodes frigidus*, n. sp. 1878. *Lycodes lütkeni*, n. sp. 1880. *Lycodes pallidus*, n. sp. 1878. *Lycodes seminudus*, Reinh. 1838. *Lycodes muræna*, n. sp. 1878. *Gymnelis viridis*, (Fabr.) 1780.

Gadidæ.

Gadus saida, Lepech. 1774. *Onos reinhardi*, (Kr.) MS. 185?. *Onos septemtrionalis*, (Coll.) 1874.

Pleuronectidæ.

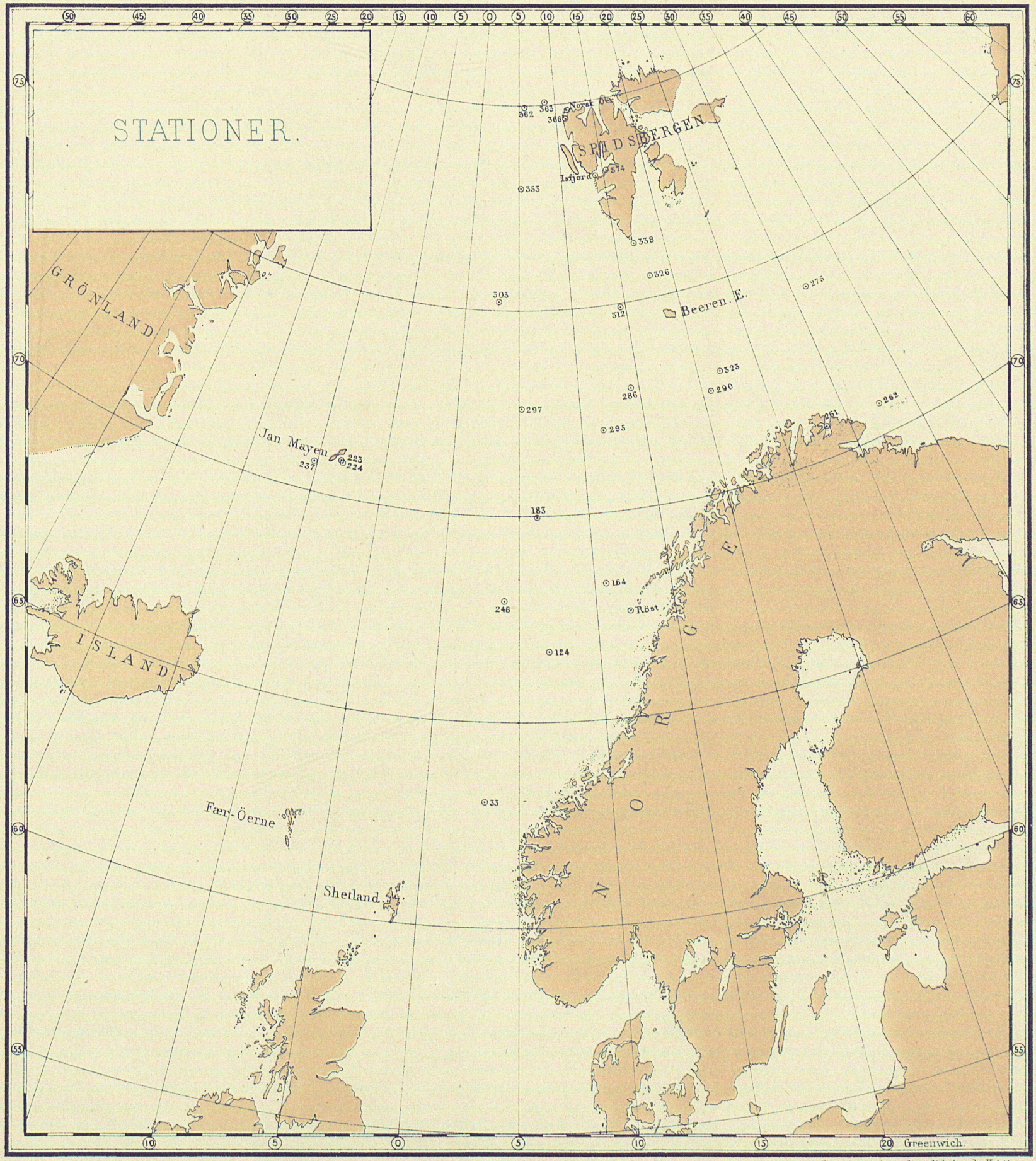
Platysomatichthys hippoglossoides, (Wahlb.) 1792. *Hippoglossoides platessoides*, (Fabr.) 1780. *Glyptocephalus cynoglossus*, (Lin.) 1766.

Ophidiidæ.

Rhodichthys regina, n. gen. & sp. 1878.

Scopelidæ.

Scopelus mülleri, (Gmel.) 1788.



Den private Opmaalings lith. Anstalt. Kristiania.

A. Palaeichthyes.

Subord. Plagiostomata.

Fam. Rajidae.

Gen. Raja, Lin.

Syst. Nat. ed. 12, tom. 1, p. 395 (1766).

1. **Raja hyperborea**, Coll. 1878 (n. sp.).

Pl. I., fig. 1—2.

Raja hyperborea, Coll. Forh. Vid. Selsk. Chra. 1878, No. 14, p. 7.

Diagn. *Snuden tilspidset, af middels Længde; Snudespidsens Afstand fra Øjet udgjør ikke fuldt det dobbelte af Interorbitalrummets Bredde. Legemet noget bredere, end dets Længde fra Snudespidsen til Enden af de accessoriske Generationsorganer. Halen forholdsvis kort, indeholdes 3 Gange i Totallængden. Tænderne (hos Hannen) spidse og slanke, danne i Overkjæven omtrent 36, i Underkjæven 42 Tverrækker. Oversiden er ru, samt beklædt med større Torne; Undersiden er glat. De større Rygtorne ere 6 i Antal; Haletornene, der danne en enkelt Række, ere 17. Mellem de 2 Dorsaler sidder en liden Torn. Farven oventil mørkt graabrun, Undersiden hvid med store, lateralt-symmetriske Felter af Oversidens Farve.*

Localit. fra Nordh.-Exped. Havet vestenfor Nord-Spitsbergen.

	Stat. 362.
Beliggenhed.	115 Kilom. V. Norskøerne, Spitsbergen.
Dybde.	459 Favne (839 m).
Temp. paa Bunden.	— 1,0° C.
Bunden.	Blaagraat Ler.
Datum.	14de August 1878.
Antal Individer.	1 Ind. (en Han).

Udmaalinger.

Totallængde (Han)	518 mm
Legemets Længde til Spidsen af Hjælpegenitalierne	390 -

A. Palæichthyes.

Subord. Plagiostomata.

Fam. Rajidæ.

Gen. Raja, Lin.

Syst. Nat. ed. 12, tom. 1, p. 395 (1766).

1. **Raja hyperborea**, Coll. 1878 (n. sp.).

Pl. I. fig. 1—2.

Raja hyperborea, Coll. Forh. Vid. Selsk. Chra. 1878, No. 14, p. 7.

Diagnosis. — *Snout pointed, of moderate length; distance from end of snout to the orbit not quite double the width of the interorbital space. The transverse diameter of the disk somewhat greater than its length from the snout to the termination of the accessory sexual appendages. The tail comparatively short, one-third of the total length. Teeth (in the male) sharp and slender, about 36 transverse rows in the upper and 42 in the lower jaw. The upper surface rough, and armed with spines; under surface smooth. The larger dorsal spines are 6 in number; the tail is furnished with 17, in a single row; and a small spine occurs between the 2 dorsal fins. The colour of the upper surface is a dark greyish brown, that of the under plain white, with large, laterally-symmetrical brown patches.*

Locality (North Atl. Exped.): — The open sea, west of the northern coast of Spitzbergen.

	Stat. 362.
Exact Locality.	115 Kilom. W. of the Norsk Islands, Spitzbergen.
Depth.	459 Fathoms (839 m).
Temp. at Bottom.	— 1.0° C.
Bottom.	Bluish-grey Clay.
Date.	14th August 1878.
Numb. of Specim.	1 Indiv. (a male).

Measurements.

Total length (male)	518 mm
Length of body to the termination of the accessory sexual appendages	390 -

Største Bredde mellem Pectoralernes Spidse	405 mm
Halens Længde	168 -
Snudespidsen til Øjets Forrand	90 -
Bredden mellem Øjnene	49 -
Snudespidsen til Pectoralens Spidse (Legemets forreste Profil-Linie)	305 -
Pectoralspidsen til Ventralens bagre Spidse (Legemets bagre Profil-Linie)	175 -
Hjælpegenitaliernes Længde	48 -
Snudespidsen til Næseborene	77 -
Afstanden mellem Næseborene	64 -
Bredden af Mundspalten	66 -
Ventralernes Grundlinie	86 -
Ventralernes største Længde	110 -
Halens Bredde ved Roden	26 -
Halens Bredde ved Begyndelsen af 1ste Dorsal	15 -
Halens Højde ved Roden	12 -
Halens Højde ved Begyndelsen af 1ste Dorsal	5 -
Fra Dorsalernes Begyndelse til Halespidsen	59 -
1ste Dorsals Grundlinie	19 -
1ste Dorsals Højde	15 -
2den Dorsals Grundlinie	21 -
2den Dorsals Højde	13 -
Øjets Længdediameter	14 -
Tverdiameter af Spiracula	11 -
Snudespidsen til 1ste Gjællespalte	148 -
Bredden mellem 1ste Gjællespalte paa hver Side	110 -

Beskrivelse. *Legemsbygning.* Snuden er tilspidset, dog ikke særdeles uddragen; dens Længde indtil Øjets forreste Rand er knapt dobbelt saa stor, som Pandens Bredde mellem Øjnene.

Legemets største Bredde mellem Pectoralernes Spidse er større, end Legemets Længde fra Snudespidsen til Enden af Hjælpegenitalierne. Legemets forreste Profillinie er næsten ret indtil i Højde med Kjæverne; derpaa er den noget concav, indtil ud mod Spidsen af Pectoralerne, der paa hver Side danne en temmelig afrundet Vinkel. Legemets bagre Profillinie, der kun har noget over den forreste Linies halve Længde, er næsten ret, kun i sit bagre Hjørne noget afrundet, og idethele parallel med den modsatte forreste Linie, saaledes at Legemet næsten danner et Parallelogram.

Halen er paa Undersiden fuldkommen flad, men har oventil afrundede Sider; den er dog idethele fladtrykt, idet Bredden overalt er betydelig større, end Højden (ved Roden dobbelt, ved Begyndelsen af 1ste Dorsal tredobbelt større). En distinct afsat Hudfold løber langs Halens hele Længde paa hver Side af Underfladen. I Forhold til Legemet er Halen kort, idet den blot udgjør 1 Trediedel af Totallængden.

De accessoriske Generationsorganer ere hos det eneste undersøgte Individ ikke særdeles lange; deres Længde omtrent lig Pandens Bredde mellem Øjnene.

Tænderne ere forholdsvis lange og spinkle, med særdeles liden Grundflade. Sandsynligvis har dog Hunnen kortere, og ved Grunden bredere Tænder. I hver Kjævehalvdel findes oventil 18, nedentil 21 Tverrækker, saaledes

Greatest distance between the pectorals	405 mm
Length of tail	168 -
From point of snout to the eye	90 -
Interorbital space	49 -
From point of snout to the extremity of the pectoral fin	305 -
From the extremity of the pectoral fin to the posterior extremity of the ventral	175 -
Length of sexual appendages	48 -
From point of snout to nostrils	77 -
Distance between the nostrils	64 -
Width of mouth	66 -
Ventrals at base	86 -
Extreme length of ventrals	110 -
Breadth of tail at base	26 -
Breadth of tail at commencement of first dorsal fin	15 -
Depth of tail at base	12 -
Depth of tail at commencement of first dorsal fin	5 -
From the first dorsal to the tip of the tail	59 -
First dorsal at base	19 -
Height of first dorsal	15 -
Second dorsal at base	21 -
Height of second dorsal	13 -
Longitudinal diameter of orbit	14 -
Transverse diameter of spiracles	11 -
From point of snout to first branchial aperture	148 -
Width between first branchial aperture on each side	110 -

Description. *Structure of the Body.* — The snout terminates in a point, without however being greatly produced. Length from tip to the anterior margin of the orbit a trifle less than twice the interorbital space.

The diameter of the disk across the pectorals exceeds the distance from the point of the snout to the termination of the sexual appendages. The anterior free margin almost straight up to the jaws; from thence slightly concave to the tips of the pectorals, the extreme lateral angle of each being rather convex. The posterior free margin, but little more than half the length of the anterior marginal line, is almost straight — the hindmost part only being slightly convex — and running as it does nearly parallel to the anterior margin, the disk closely resembles a rhomboid.

The under surface of the tail is perfectly flat, the sides of the upper are rounded; its general appearance is depressed, the breadth greatly exceeding the vertical thickness (at the origin twice, at the commencement of the first dorsal three times as great). A cutaneous flap, distinctly developed, extends along the entire length of the tail on each side of the under surface. Tail short in proportion to the body, being only one-third of the total length.

The accessory sexual appendages are not particularly long in the specimen examined, their length being about equal to the width of the interorbital space.

The teeth are comparatively long and slender, and exceedingly narrow at the base. Probably the females have shorter teeth with broader bases. The upper jaw is furnished with 18, the lower with 21 transverse rows in each

ialt $\frac{8}{12}$ Tverrækker. Mundspaltens Bredde udgjør ikke fuldt Halvdelen af Afstanden fra Snudespidsen til 1ste Gjællespalte.

Den forreste af de 5 Gjællespalter ligger i en Afstand fra Mundvinkelen, der omtrent er lig dens egen Afstand fra den bagerste Gjællespalte.

Spiracula er forholdsvis vid, idet dets Tverdiameter er omtrent lig den ubedækkede Del af Øjet; det er stillet ikke skraat bagenfor dette, men fuldkommen tvers mod Øjets Længdediameter.

Finnerne. Ventralerne have henimod Spidsen et dybt Indsnit, der fortil lader frit et kegleformigt, noget udspærret Parti, der dog er af forholdsvis ringere Højde, idet det blot udgjør Halvdelen af den hele Finnes Grundlinie, eller omtrent Trediedelen af Finnens hele Længde til den bagre Spidse.

1ste Dorsal begynder i en Afstand fra Halespidsen, der indeholdes $2^5/_6$ Gange i Halens hele Længde. Dens Grundlinie er ubetydelig større, end dens Højde; den bagre Spidse er noget tilspidset, og den lodrette Bagrand lidt concav.

2den Dorsal er adskilt fra 1ste gjennem et ubetydeligt Mellemrum (opfyldt af en mindre Torn). Den er lavere, end 1ste Dorsal, idet Højden er kun lidt over Halvdelen af Grundlinien. Dens bagre Spidse er stærkt nedadbøjet, dog tilspidset, saaledes, at dens lodrette Bagrand er temmelig kort.

En Antydning til en Caudal findes i Form af en kort og lav, vertical Hudflig, der rager ubetydeligt udenfor Halespidsen, og har paa Halespidsens Underside en kort Kjøl.

Hudens Beklædning. Oversiden er ru, samt tildels beklædt med større Torne; Undersiden er glat.

De større Torne findes blot 1) over Øjnene, 2) paa Skulderpartiet, samt 3) midt nedad Ryggen og Halen; de ere alle riflede fra Grunden udad mod Spidsen, der er yderst skarp, og noget bagudbøjet; de ere ikke synderlig høje, undtagen paa Halens øvre Del. Deres samlede Antal er hos det undersøgte Individ 37.

Øjentornene ere ialt 6 i Antal, og danne paa hver Side en fuldkommen ret Linie (bestaaende af 3 Torne) indenfor Øjeranden, saaledes, at Afstanden mellem begge Linier bliver mindre, end Pandens Bredde mellem Øjnene. 1ste Torn er stillet foran, 2den bagenfor Øjets øvre Rand, 3die umiddelbart bagenfor Spiracula. 1ste Torn ligger i en Afstand fra Snudespidsen, der omtrent er dobbelt saa stor, som Rækkernes indbyrdes Afstand; 1ste og 3die Torn danne med de tilsvarende i den modsatte Række et næsten fuldkomment Qvadrat.

Skulderpartiet bærer i Midten en Række af 3, og paa hver Side en Række af 2, tilsammen 7 Torne. Sidetornene sidde tættere sammen, end Midtrækkens Torne, og have idethele samme Afstand indbyrdes, som mellem 2den og 3die Øjentorn (14^{mm}), eller noget over en Øjendiameter. Den bagerste Torn i Midtrækken danner med den bagerste Torn i hver af Siderækkerne en næsten ret Linie. Afstanden mellem 1ste og 3die Torn i Midtrækken er næsten saa

half, the total number of transverse series being thus $\frac{8}{12}$. Width of mouth not quite equal to half the distance from point of snout to first branchial aperture.

The foremost of the five branchial apertures is about the same distance from the angle of the mouth as it is from the hindmost aperture.

The spiracles are comparatively large, their transverse diameter being nearly equal to the width of the uncovered portion of the eye; their position is not oblique, but strictly vertical to the longitudinal diameter of the orbit.

Fins. — Towards their extremity, the ventrals are distinguished by a deep incision, exposing to view a cuneiform and somewhat expanded part, the height of which however is inconsiderable, being not more than half of the base of the fin, and but one-third of its entire length to the posterior extremity.

The first dorsal commences at a distance from the tip of the tail which is to the entire length of the tail as 1 to $2^5/_6$; basal line a trifle longer than the vertical height; posterior extremity pointed, posterior perpendicular margin slightly concave.

Second dorsal nearly contiguous to first, the intervening space being occupied by a diminutive spine. Height less than that of the first dorsal, hardly exceeding half the length of the basal line; the posterior extremity directed downwards and terminating in a point; the posterior perpendicular margin is consequently somewhat short.

Caudal fin rudimentary, having the appearance of a vertical membraneous lappet, furnished on the under surface of the extremity of the tail with a keel-shaped ridge, projecting but slightly beyond the tip.

Armature of the skin. — Upper surface rough and partially studded with powerful spines; under surface smooth.

The large spines occur: — 1) above the eyes; 2) on the humeral region; 3) along the mesial line of the disk and the central ridge of the tail. All the spines are grooved from the base up to the point, which is exceedingly sharp and slightly hooked; the longest are in the row on the upper part of the tail. Total number in the specimen examined 37.

The spines about the eyes are 6 in number, arranged in two lines, perfectly straight (three spines in each), one on either side within the margin of the eye, making the distance between them a trifle less than the width of the interorbital space. The first spine is placed before, the second above the upper margin of the eye, the third immediately behind the spiracles. Distance of first spine from point of snout about double that between the rows; the first and third spines form with the corresponding spines on the opposite side an almost perfect square.

The humeral region is furnished with 7 spines, a row of 3 along the dorsal ridge and 2 on either side. The lateral spines are more closely set than those disposed along the mesial line, their relative distance being nearly equal to that between the second and third spines in the series above the eyes (14^{mm}), or slightly exceeding the longitudinal diameter of the eye. The hindmost spine in the central series is almost in a line with the hindmost spine in each

stor, som mellem 1ste og 3die Øjentorn; noget større er derimod Afstanden mellem Midtrækken og hver af Siderækkerne.

Rygtornene ere 6 i Antal, der danne en enkelt Række, hvori Mellemrummet mellem hver Torn har omtrent samme Længde, som mellem 1ste og 2den Torn i Øjenrækkerne (25^{mm}), eller mellem 1ste og 2den Torn i Skulderpartiets Midtrække. Rygtornenes Række ophører et kort Stykke foran Halen.

Haletornene danne en enkelt Række, bestaaende af 17 Torne, der staa tættere sammen, end Rygtornene, og tiltage i Størrelse indtil den 6te, men aftage derefter indtil den sidste, der er ganske liden og sidder tæt ind til 1ste Dorsal. Rækken begynder i nogen Afstand fra sidste Rygtorn. Endelig findes en liden Torn mellem de 2 Dorsaler, den 18de.

Hele Oversiden er forøvrigt ru af særdeles smaa og spidse Smaatorne, der intetsteds naa tilnærmelsesvis den samme Størrelse, som de større Torne. Dog er et Parti langs Legemets forreste Siderand (omtrent ret udenfor Øjnene) beklædt med noget større Torne, end de øvrige Smaatorne; disse udgjøre de for Hannerne ejendommelige „Kardetorne“ *(carmines maris*, ifølge Fries). Ligeledes findes enkelte noget længere Torne langs Midten af Snuden. Glat er blot den bagre Rand af Pectoralerne, hele Ventralerne, samt et Stykke af Ryggens Sider op imod Skulderpartiets Sidetorne.

Hele Undersiden af saavel Legemet, som Halen, er fuldkommen glat.

Slimporer. Paa bestemte Steder af Oversiden, samt over den forreste Del af Legemets Underside findes Rækker af Slimporer, der idethele ere symmetrisk stillede paa hver Side af Legemets Midtlinie. Paa Oversiden findes en Række af omtr. 20 Porer, der strækker sig fra Spiracula hen under Øjet, og gaar derfra omtrent i ret Linie ud mod Snuden; denne Række løber parallelt med den tilsvarende paa den anden Side. Fra Skulderbeltet udgaa endvidere 2 noget længere Rækker, der efter et noget buet Løb udmunde noget nedenfor Pectoralens Sidevinkel; en kortere tredie løber parallelt med Legemets bagre afrundede Hjørne. Endelig løber paa hver Side af Ryglinien en Række, der fortsætter sig uafbrudt langs Halens Overside til Halespidsen.

Paa Skivens Underside findes talrige længere og kortere Rækker, men disse ere her tilsyneladende mindre ordnede. Paa hele Legemets bagre Del sees her ingen Porer; paa den forreste løber en lang Række parallelt med Sideranden; kortere Rækker løbe fra hver Mundvige hen mod Snudespidsen, og andre kortere Rækker findes bagenfor Mundspalten.

Farven er paa Oversiden temmelig jevnt mørkt graabrun, medens Undersiden er hvid med store symmetriske Pletter og Felter af Oversidens Farve. Paa Oversiden ere Pectoralerne og Ventralerne især mørkt farvede ud mod

of the lateral rows. The distance between the first and third spines in the central series nearly equals that between the first and third spines above the eyes; the distance between the central series and each of the lateral rows is somewhat greater.

The dorsal spines are 6 in number, arranged in a single row, the distance between each spine being about equal to that between the first and second spines in the series above the eyes (25^{mm}), or between the first and second spines in the central humeral row. This series terminates in close proximity to the tail.

The caudal spines, numbering 17, extend in a single row; they are more closely set than the dorsal spines, increasing in size down to the sixth; at this point they gradually decrease, the terminal spine being quite diminutive and close to the first dorsal fin. The caudal row commences at some distance from the terminal dorsal spine. A small spine, the eighteenth, occurs between the two dorsals.

The whole of the upper surface is rough, being everywhere studded with minute spines and denticles, none of which attain to a size approaching that of the large spines. Part of the anterior lateral margin of the disk (almost directly in front of the eyes) is however furnished with spinules somewhat larger than the other denticles; a few spines of greater length occur too along the ridge of the snout. The only smooth parts are the posterior margin of the pectorals, the entire surface of the ventrals, and a strip of skin extending along the sides of the back up towards the lateral spines in the humeral region.

The whole of the under surface, both of the body and of the tail, is perfectly smooth.

Mucous pores. — On certain parts of the upper surface, and the anterior part of the lower, are numerous series of mucous pores, for the most part symmetrically arranged on either side of the mesial line. On the upper surface occurs a series of about 20 pores, extending from the spiracle to the eye, and from thence, nearly in a straight line, towards the snout; this series runs parallel to the corresponding series on the opposite side. Two series of somewhat greater length issue from the humeral zone, and, after a slightly inflected course, terminate a little below the lateral angle of the pectoral fin; a third and shorter series runs parallel to the posterior convex angle of the disk. On either side of the mesial line a series extends uninterruptedly to the tip of the tail.

Numerous series of greater or less extent occur too on the under surface, their arrangement, however, being apparently less regular. On the posterior part of the disk pores are nowhere visible here, on the anterior division a long row runs parallel to the lateral margin; several shorter series extend from each angle of the mouth towards the point of the snout, and short series also occur behind the mouth.

Coloration. — Upper surface almost uniformly dark greyish brown; under surface plain white, relieved with large symmetrical spots and patches. Upper surface of pectorals and ventrals darkest along the edges approximate

Randen, hvor Undersidens Felt af samme Farve støder til. Fremdeles er Snudespidsen mørkt brunsort, ligesom Hovedets hele forreste Rand. Paa Undersiden have de mørkfarvede Partier og den hvide Bundfarve omtrent ligestor Udstrækning. Disse farvede Felter gaa hen imod Randen af Legemet (hos det i nogen Tid paa Spiritus opbevarede Exemplar) over til næsten brunsort. Ingen af disse Felter overskrider Bugens Midtlinie.

Deres Udstrækning hos det forhaandenværende Individ kan kortelig beskrives paa følgende Maade. Et stort sort Felt udbreder sig over den ydre Del af Pectoralen; fra Pectoralvinkelen fortsætter dette sig langs hele den forreste Profilrand (men blot umiddelbart i selve Randen), lige hen til Snudespidsen. Bagtil forener dette Felt sig med et større Parti af samme Farve, der skyder sig op paa Bugens Sider. Foran Mundspalten findes intet farvet Parti (undtagen Randen af Snuden); men mellem Gjællespalterne findes en mindre Samling runde, tildels sammenflydende Pletter. Ventralerne have, ligesom Pectoralerne, brunsorte Rande; de accessoriske Generationsorganer ere ligeledes paa Undersiden sorte, hvilken Farve udbreder sig til en større Plet foran deres Rod. Hele Halens Underside er ensfarvet sort.

Sandsynligvis vil denne Farvefordeling vise sig noget varierende hos Individerne.

Føde. Ventrikelen var fuldproppet af Crustaceer og Fiske. Den væsentligste Del bestod af omkr. 50 kjæmpemæssige Individer af *Themisto libellula,* tildels endnu ganske hele; fremdeles Stykker af den i 1874 af Buchholz i „2te Deutsche Nordpolarfahrt" beskrevne smuktfarvede Decapode *Hymenodora glacialis*[1].

Fiskene vare 3 i Antal, hvoraf idetmindste de 2 vare Lycoder. Den største af dem havde en Totallængde af 185 mm, og en Hovedlængde af 41 mm; den yderste Halespids manglede, ligesom Huden og de fleste Finnestraaler, saaledes, at Individet ikke lod sig med Sikkerhed bestemme; men paa Grund af Tandbygningens Styrke, de lange og brede Pectoraler, samt det store Hoved, kan det maaske henføres under *L. lütkeni.* Den anden Unge af en *Lycodes* var stærkere angreben af Fordøjelsen, og ganske ubestemmelig; af et tredie Individ fandtes blot Rygraden i Behold, og denne kan ligeledes have tilhørt en ung *Lycodes.*

Udbredelse. Hidtil er blot kjendt det eneste, ovenfor beskrevne Individ, en Han, optaget omtrent under 80° N. B. i Havet vestenfor Nord-Spitsbergen; dette er tillige det nordligste Punkt paa Jorden, hvor denne Slægt hidtil har været bemærket.

[1] *Pasiphaë glacialis,* Buchholz 1874; *Hymenodora glacialis,* G. O. Sars 1877.

to the similarly coloured patch on the under surface. Extremity of the snout, too, and the entire anterior margin of the head dark-brown, approaching to black. On the under surface, the space occupied by the dark portions of the skin and the white of the ground is about equal in extent. The dark symmetrical patches deepen in colour as they approach the margin of the disk, almost to a brownish black; none of them cross the central abdominal line.

Their distribution in the example obtained may be briefly described as follows. A large black patch occurs on the lateral margin of the pectorals; from the angle of the pectorals it extends along the anterior line of the margin of the body (at the extreme edge however only) to the tip of the snout. Behind, this patch unites with another, similarly coloured, running up the sides of the belly. Anterior to the cleft of the mouth the skin is uniformly white, save the margin of the snout; between the branchial apertures occur a small cluster of round spots, some of which are confluent. Edges of ventrals brownish black like those of pectorals; the accessory sexual appendages on the under surface black, this colour expanding to a large spot opposite their base. Under surface of tail entirely black.

This distribution of colour will probably be found to vary in different individuals.

Food. — The stomach was full of crustaceans and divers fishes. The principal part of the contents consisted of about 50 enormous examples of the Hyperoid *Themisto libellula,* several of them quite entire; and of fragments of the Decapod *Hymenodora glacialis*[1], described in 1874, by Buchholz, in "Zweite Deutsche Nordpolarfahrt."

The fishes were 3 in number, of which two at least were Lycodes. Total length of the largest 185 mm; length of head 41 mm; the tip of the tail, the whole of the skin, and most of the fin-rays were gone; hence this individual could not with certainty be determined; but the structure of the teeth however, the great length and breadth of the pectoral fins, and the size of the head gave reason to regard it as an example of *L. lütkeni,* afterwards described. Another young *Lycodes* was wholly indeterminable, being in still a more advanced stage of the digestive process; of the third, the vertebral column only remained — not improbably, too, that of a young *Lycodes.*

Distribution. — The only example hitherto met with is the male specimen now described; taken in lat. about 80° N., at sea, west of the northern coast of Spitzbergen, the most northerly locality, too, in which this genus is yet known to occur.

[1] *Pasiphaë glacialis,* Buchholz 1874; *Hymenodora glacialis,* G. O. Sars 1877.

2. **Raja radiata**, Donov. 1808.

† *Raja fullonica*, Fabr. Fauna Groenl. No. 87, p. 125 (1780).
Raja radiata, Donov. Nat. Hist. Brit. Fish., vol. 5, tab. 114 (1808).

Localit. fra Nordh.-Exp. Tanafjord i Finmarken, samt Havet mellem Beeren Eiland og Spitsbergen.

	Stat. 261.	*Stat.* 326.	*Stat.* 362.
Beliggenhed.	Tanafjord, Finmarken.	105 Kilom. N. Beeren Eiland.	115 Kil. V. Norskøerne, Sptb.
Dybde.	127 Favne (232 m).	123 Favne (225 m).	459 Favne (839 m)
Temp. paa Bunden.	+ 2.8° C.	+ 1.6° C.	— 1.0° C.
Bunden.	Ler.	Mørkt Ler.	Blaagraat Ler.
Datum.	25de Juni 1878.	3die Aug. 1878.	14de Aug. 1878.
Antal Individer.	5 Indiv.	1 yngre Ind.	2 yngre Ind.

Alm. Bemærkninger. Ingen Forskjel kunde opdages mellem Individerne fra disse Localiteter, og andre fra Norges sydlige Fjorde. Antallet af de lange Torne nedad Ryggen fra Skulderpartiet til Dorsalerne varierede mellem 12 og 14.

Ved en tidligere Lejlighed[1] har jeg gjort opmærksom paa, at naar der i Diagnoserne for denne Art opgives, at den mangler Torn mellem de 2 Dorsaler, er dette unøjagtigt, idet et ikke ubetydeligt Antal Individer besidde en saadan, medens vistnok Flertallet mangler den. Blandt et stort Antal Individer, som jeg i 1876 og 1878 havde Lejlighed til at undersøge i Porsangerfjorden i Finmarken, havde idetmindste en Fjerdepart en saadan Torn mellem Dorsalerne. Af de under Nordhavs-Expeditionen erholdte 8 Individer fandtes denne Torn ogsaa netop hos de 2.

Føde. I Ventrikelen af et af Individerne fra Tanafjorden fandtes flere Amphipoder, hvoriblandt kunde nogenlunde sikkert kjendes Arterne *Anonyx lagena*, Kr., og *Aceros phyllonyx*, (M. Sars).

Udbredelse. *Raja radiata* har en større geographisk Udbredelse, end nogen anden af de europæiske Arter, og forekommer lige fra de engelske Kyster gjennem Nordsøen og Kattegat til den sydlige Del af Østersøen, fremdeles langs hele Norges Vestkyst op til Finmarken, i hvis Fjorde den er yderst talrig; derfra gaar den i Ishavet op til Spitsbergen, hvor den hidindtil ikke var iagttaget, men hvor den forekommer lige op til de nordligste Dele, ligesom den gjennem Faber er kjendt fra Island. Endelig opføres den og beskrives allerede af Fabricius i 1780 fra Grønland under Navn af *Raja fullonica* (Fauna Groenl. No. 87). Ved de amerikanske Kyster gaar den mod Syd idetmindste til New-England under 40° N. B.

[1] Forh. Vid. Selsk. Chra. 1879, No. 1, p. 105.

2. **Raja radiata**, Donov. 1808.

† *Raja fullonica*, Fabr. Fauna Groenl. No. 87, p. 125 (1780.)
Raja radiata, Donov. Nat. Hist. Brit. Fish., vol. 5, tab. 114 (1808).

Locality (North Atl. Exped.): — The Tana Fjord, in Finmark, and the sea between Beeren Eiland and Spitzbergen.

	Stat. 261.	*Stat.* 326.	*Stat.* 362.
Exact Locality.	The Tana Fjord, Finmark.	105 Kil. N. of Beeren Eiland.	115 Kil. W. of N. Isl., Spitzb.
Depth.	127 Fathoms (232 m).	123 Fathoms (225 m).	459 Fathoms (839 m).
Temp. at Bottom.	+ 2.8° C.	+ 1.6° C.	— 1.0° C.
Bottom.	Clay.	Dark Clay.	Bluish-grey Clay.
Date.	25th June 1878.	3rd Aug. 1878.	18th Aug. 1878.
Numb. of Specim.	5 Indiv.	1 Indiv. (young).	2 Indiv. (young).

General Remarks. — No difference could be detected between the individuals taken in these localities and specimens obtained from the southern fjords of Norway. The number of long spines extending down the dorsal ridge was from 12 to 14.

On a former occasion[1] I called attention to the fact that, contrary to the diagnosis of this species given by some ichthyologists, a spine between the two dorsals *does* occur in a considerable number of individuals, though wanting in most. Opportunity was afforded me in 1876 and 1878 of examining numerous individuals from the Porsanger Fjord, in Finmark, and one-fourth had a spine between the dorsals. Of the 8 examples obtained on the North Atlantic Expedition, this spine occurred in 2.

Food. — In the stomach of one of the specimens from the Tana Fjord were divers Amphipods, amongst which *Anonyx lagena*, Kr., and *Aceros phyllonyx*, (M. Sars), could alone be determined with comparative certainty.

Distribution. — *Raja radiata* (Starry Ray) has a wider geographical range than any other of the European species; it is met with on the British coast, in the North Sea, the Cattegat, and the South-Baltic; along the entire line of the coast of Norway, as far north as Finmark, being exceedingly numerous in the fjords of that province; from thence its range extends to the Arctic Ocean as far north as Spitzbergen (where it had not previously been observed); according to Faber, it occurs, too, on the coast of Iceland; and the species was mentioned and described (as *Raja fullonica*) by Fabricius, as far back as 1780, among the fishes of Greenland. The range of this species on the North American coast certainly extends as far south as the New England States, in lat. 40° N.

[1] Forh. Vid. Selsk. Chra. 1879, No. 1, p. 105.

B. Teleostei.

Subord. Acanthopterygii.

Fam. Scorpaenidae.

Gen. Sebastes, Cuv.

Règne Animal, éd. 2, tom. 2, p. 166 (1829).

3. Sebastes marinus, (Lin.) 1766.

Pl. I, Fig. 3—4.

Perca marina, Lin. Syst. Nat. ed. 12, tom. 1, p. 483 (1766).
Perca norvegica, Ascan. Ic. Rer. Nat. pt. 2, p. 7, tab. 16 (1772).
Holocentrus norvegicus, Lacép. Hist. Poiss., tom. 4, p. 327 (1789).
Holocentrus sanguineus, Faber, Naturg. Fische Isl. p. 126 (1829).
Sebastes norvegicus, Cuv. & Val. Hist. Nat. Poiss., tom. 4, p. 327 (1829).
Sebastes marinus, Lütk. Vid. Med. Naturh. Foren. Kbhvn. 1876, p. 358 (1876).

Localit. fra Nordh.-Exped. Yngel Indiv. fra Havet udenfor Beeren Eiland og Spitsbergen; Unger fra Tanafjorden i Finmarken, samt fra Havet mellem Beeren Eiland og Spitsbergen.

	Stat. 183.	*Stat.* 248.	*Stat.* 286.	*Stat.* 261.	*Stat.* 275.	*Stat.* 326.
Beliggenhed.	354 Kil. NV. Lofoten.	364 Kil. V.Lofoten	215 Kil. SV. BeerenEil.	Tanafjorden, Finmarken.	360 Kil.Ø. BeerenEil.	100 Kil.S. Spitsb.
Dybde.	I Overflad.	I Overflad.	I Overflad.	127 Favne (232 m).	147 Favne (269 m).	123 Favne (225 m).
Temp. p. Bunden.	+ 8.7° C.	+ 10.2° C.	+ 7.2° C.	+ 2.8° C.	— 0.4° C.	+ 1.6° C.
Bunden.				Ler.	Grønl. Ler	Mørkt Ler
Datum.	5te Juli 1877.	8de Juli 1877.	6te Juli 1878.	25de Juni 1878.	2den Juli 1878.	3die Aug. 1878.
Antal Individ.	4 Yngel-Ind.	1 Yngel-Ind.	18 Yngel-Ind.	2 Unger.	1 Unge.	2 Unger.

Forplantning etc. Paa flere Stationer erholdtes, saavel under 2det, som 3die Aars Togt, Yngel-Individer svømmende om i Vandskorpen midt ude paa Havet, og i en Afstand fra nærmeste Land, der kunde gaa op til henimod 400 Kilom. De erholdtes altid blot i det fine Overfladenet, blandede med forskjellige pelagiske Crustaceer og Molluskyngel, og dreve øjensynlig om med Strømmen fra den ene Del af Havet til den anden. Da de gjentagne Gange bleve trufne under de samme Forholde, og paa vidt adskilte Localiteter, kunne de ikke antages at være komne

B. Teleostei.

Subord. Acanthopterygii.

Fam. Scorpænidæ.

Gen. Sebastes, Cuv.

Règne Animal, éd. 2, tom. 2, p. 166 (1829).

3. Sebastes marinus, (Lin.) 1766.

Pl. I, fig. 3—4.

Perca marina, Lin. Syst. Nat. ed. 12, tom. 1, p. 483 (1766).
Perca norvegica, Ascan. Ic. Rer. Nat. pt. 2, p. 7, tab. 16 (1772).
Holocentrus norvegicus, Lacép. Hist. Poiss., tom. 4, p. 390 (1789).
Holocentrus sanguineus, Faber, Naturg. Fische Isl. p. 126 (1829).
Sebastes norvegicus, Cuv. & Val. Hist. Nat. Poiss., tom. 4, p. 327 (1829).
Sebastes marinus, Lütk. Vid. Med. Naturh. Foren. Kbhvn. 1876, p. 358 (1876).

Locality (North Atl. Exped.): — The open sea, west of Beeren Eiland and Spitzbergen (fry); the Tana Fjord in Finmark; and the expanse of ocean stretching between Beeren Eiland and Spitzbergen (young examples).

	Stat. 183.	*Stat.* 248.	*Stat.* 286.	*Stat.* 261.	*Stat.* 275	*Stat.* 326.
Exact Locality.	354 Kil. N. W. Lofot.	364 Kil. W. Lofoten.	215 Kil. SW. BeerenEil.	Tana Fj. Finmark.	360 Kil. E. Beeren Eiland.	100 Kil. S. Spitzb.
Depth.	Surface.	Surface.	Surface.	127 Fath. (232 m).	147 Fath. (269 m).	123 Fath. (225 m).
Temp. at Bottom.	+ 8.7° C.	+ 10.2° C.	+ 7.2° C.	+ 2.8° C.	— 0.4° C.	+ 1.6° C.
Bottom.				Clay.	GreenClay	Dark Clay.
Date.	5th July 1877.	8th Aug. 1877.	6th July 1878.	3rd Aug. 1878.	2nd July 1878.	3rd Aug. 1878.
Numb. of Specim.	4 Ind.(fry).	1 Ind.(fry).	18 Ind. (fry).	2 Indiv. (young).	1 Indiv. (young).	2 Indiv. (young).

Propagation of Species &c. — At several stations on the two last voyages fry-specimens were taken at the surface of the water in mid-ocean, some nearly 400 kilom. from land. They were invariably captured in the surface-net, together with divers pelagic crustaceans and fry of molluscs, and evidently drifted with the current from one part of the sea to the other. Having been repeatedly observed in localities widely distant under precisely similar circumstances, this peculiarity of occurrrence can hardly be explained as the result of accident alone,

tilfældigt under disse Omgivelser, men maaske tør man slutte, at denne Art, i Lighed med adskillige andre Dybvandsformer, tilbringer de første Perioder af sit Liv i de øvre Vandlag.

Ved en tidligere Lejlighed har jeg berørt[1], at *S. marinus* (ligesom *S. viviparus*) føder levende Unger, der i Gydningsøjeblikket befinde sig omtrent paa samme lidet udviklede Standpunkt, som det allerede gjennem Krøyer har været bekjendt hos den sidstnæynte, mindre Art[2]. Yngelens Totallængde i udstrakt Stilling hos *S. marinus* er i Gydningsøjeblikket omtrent 6^{mm}; de ere dog strax istand til at svømme om, og føre et selvstændigt Liv.

Yngletiden falder ved de norske Kyster i Vaarmaanederne, i Regelen fra Midten af April til Midten af Maj, medens *S. viviparus* neppe normalt yngler før i Juli eller August. Dog erholdes ogsaa af *S. marinus* gydefærdige Exemplarer endnu langt ud paa Sommeren; under Gydningstiden findes Individerne sjeldnere paa ringere Dyb, end 100 Favne, men de fleste gyde sandsynligvis paa langt større Dybder. Naar den gydefærdige Fisk faaes op i Baaden, rinder ofte en Del af Yngelen ud af sig selv, og flere Fiskere have iagttaget, at den levende Yngel svømmer livligt om i Vandet i Bunden af Baaden; det samme kan man iagttage, om man opfanger den udrindende Yngel i et Øsekar.

Efter Gydningen maa saaledes Yngelen antages at søge op i de højere Vandlag, og først naar de have naaet en Længde af omkring 50—60^{mm}, og faaet Farve og den voxne Fisks almindelige Udseende, søge de atter ned paa Dybet.

Antallet af Rogn hos et noget større Individ (550^{mm}) anslaar jeg til mellem 100,000 og 150,000 St. (Til Sammenligning kan anføres, at jeg hos et Individ af *S. viviparus* med en Totall. af omtr. 300^{mm} fandt blot omkr. 18—20,000 St.)

Hos de mindste af de under Expeditionen erholdte Individer (fra Stat. 183), hvis Totall. var 9,5^{mm}, var hele Legemets Dorsal- og Ventralside endnu omhyllet af Embryonalhinden; Finnestraalerne vare alene i Caudalen tydelige, men manglede i de øvrige Finner; Ventralerne vare neppe antydede. De 2 parallele Kamme paa Baghovedet vare endnu ikke fremkomne, hvorimod Tænderne paa Præoperculum vare tydeligt afsatte.

Hos andre fra samme Station, hvis Totall. var 12^{mm}, vare Straalerne antydede i Pectoralen, ligesom Analens Pigstraaler, medens Dorsalen endnu udgjør en sammenhængende Membran uden Straaler. Nakkekammen var nu ansat, og endte bagtil med en dobbelt Torn.

Hos det største Yngel-Individ (Stat. 248), hvis Totallængde var 19^{mm}, vare alle Finner og deres Straaler

[1] Forh. Vid. Selsk. Chra. 1879, No. 1, p. 7.

[2] Nogen Distinction mellem de 2 Former kan saaledes ikke hentes fra dette Forhold, hvorfor Navnet *viviparus* ikke er synderligt betegnende.

and the species may, perhaps, in common with other deep-sea forms, pass the earliest stages of its existence in the upper strata of the sea.

On a former occasion[1] I alluded to the fact, that *S. marinus* as well as *S. viviparus* brings forth its young alive; they are produced however at the same low stage of development that Krøyer has already pointed out as characterising at birth those of the latter and smaller species.[2] Total length of the fry of *S. marinus* extended in a straight line at moment of birth about 6^{mm}; they are, however, immediately able to swim and provide for themselves.

Off the Norwegian coast the spawning-season is in the spring months, and generally extends from the middle of April to the middle of May; *S. viviparus*, on the contrary, does not, as a rule, produce its young earlier than July or August. Examples of *S. marinus* with fully developed ova are, however, occasionally met with late in summer. During the season in which they bring forth, individuals are seldom taken at a depth less than 100 fathoms, the greater part probably produce their young in far greater depths. When a fish in that stage is taken, mature fry will frequently drop out; and fishermen have observed fry swimming friskly about in the water at the bottom of the boat, which they will continue to do if transferred to a scoop for examination.

It thus appears that the fry of this species rise towards the surface shortly, or perhaps immediately, after they are produced, choosing for their haunts the upper strata of the sea, and do not descend to any considerable depth till they have attained a length of about 50—60^{mm} and are of the colour, form, and general appearance of the adult fish.

The number of ova in a large, full-grown individual (total length 550^{mm}), may be computed at from 100,000 to 150,000 (in an example of *S. viviparus*, total length 300^{mm}, I found only 18—20,000).

In the smallest specimens of the fry obtained on the Expedition (at station 183), total length 9.5^{mm}, the whole of the dorsal and ventral margin was still enveloped in the embryonic membrane; the fin-rays were distinct in the caudal, but wanting in the other fins; of the ventrals there was hardly a rudiment; the two parallel combs on the occiput were not yet developed, but the teeth on the preoperculum were distinctly set.

In other examples, taken at the same station, total length 12^{mm}, the rays of the pectorals and the spines of anal were still rudimentary; the dorsal in this stage of growth still constituted a membranous flap without a trace of rays; the comb on the nape was now partially developed, and terminated behind in a douple spine.

The largest individual in the fry stage of growth (station 248), total length 19^{mm}, had all the fins and their

[1] Forh. Vid. Selsk. Chra. 1879, No. 1, p. 7.

[2] This circumstance cannot therefore be regarded as a specific distinction between the two forms, and hence the term *viviparus* does not furnish a very appropriate designation.

ansatte, og med normalt Antal. Skjæl mangle endnu, og hele Legemet er transparent (paa Spiritus hvidagtigt) med en Række sorte Pigmentpuncter langs Dorsalerne. Enkelte Tænder ere fremkomne paa Underkjæven; Nakkekammen er temmelig skarp og tydelig, og ender bagtil i en tredobbelt Pig.

Foruden de nævnte Yngel-Individer erholdtes under Expeditionen flere Unger, der optoges med Bundskraben eller Trawlnettet fra 120 indtil 150 Favnes Dyb paa tildels iskoldt Vand.

Hos den mindste af disse Unger, hvis Totall. er 62^{mm} (Stat. 275), er Legemet allerede bleven livligt farvet med 3—4 brunsorte Tverpletter over Ryggen; tydeligst og bredest er den næstsidste, der stiger ned paa begge Sider af Dorsalens bløde Del; den sidste staar over Haleroden. Dette er den samme Fordeling af Pletter, der er gjennemgaaende hos de yngre Individer af de fleste cottoide Fiske. En Samling Pigmentpunkter danne en utydelig Plet paa Gjællelaagets øvre Del (en Character, der tilkommer de fuldt udvoxede Individer af den deciderede Kystform *Seb. viviparus,* Kr.), men denne Plet forsvinder efterhaanden hos de større Unger næsten ganske. Skjælbeklædningen var fuldt udviklet.

Disse Unger havde følgende Maal, og Straaleantal i Analen:

	Total-længde.	Hovedets Længde.	Øjets Diameter.	Straaler i A.
a.	62^{mm}	18^{mm}	6^{mm}	3.8.
b.	80 -	23 -	7.8 -	3.8.
c.	85 -	25 -	8 -	3.9.
d.	134 -	41 -	15 -	3.8.
e.	143 -	42 -	14 -	3.9.

Udbredelse. *S. marinus* er en nordisk Art, der har sit Tilhold ved Grønland, Island, Spitsbergen, Novaja Zemlja, samt ved Nord-Europas Kyster ned til Stavanger og Lindesnæs; paa den americanske Side gaar den sandsynligvis ned lige til New England, omtrent under 40° N. B. Som en ægte Dybvandsart synes den normalt ikke at trænge ind i Nordsøen, og er derfor blot sporadisk truffen ved Danmarks og Englands Kyster, og den gaar heller ikke ind i Kattegat og Østersøen.

Ved Norges Kyster østenfor Lindesnæs, og i de sydligste Fjorde, samt ved Bohuslen erstattes den af den meget nærstaaende Form *S. viviparus,* Kr., der tillige, ifølge Dr. Lütken, optræder ved Færøerne, men mangler ved Danmark. I Norge gaar denne op idetmindste til Trondhjemsfjorden.

I Nord-America synes Forholdet mellem de 2 Arter endnu ikke at være bragt fuldkommen paa det rene. Medens Gill (Proc. Ac. Nat. Sci. Philad. 1863, p. 333) opfører den ved New Englands Kyster forekommende Form som *S. viviparus,* ganske med Udelukkelse

rays developed, and the number of the latter normal. The scales were as yet wanting; the body was everywhere transparent (preserved in spirits whitish), dotted along the dorsals with a series of black pigmentary points; a few teeth developed in the lower jaw; the comb on the nape was sharply defined, terminating behind in a trifurcate spike.

Exclusive of the individuals described above, in the fry stage of growth, several young specimens were obtained on the Expedition; they were taken when dredging the bottom or trawling, at a depth varying from 120 to 150 fathoms, the water having in places the temperature of ice.

In the smallest of these young examples (station 275), total length 62^{mm}, the body was already brightly coloured with 3—4 brownish-black transverse spots in the dorsal region; the broadest and most distinct is the last but one, which descends down along the soft portion of the dorsal; the terminal spot is immediately above the origin of the tail. This is the common distribution of spots in young examples of most Cottoid fishes. A cluster of pigmentary points gives the appearance of an indistinct spot on the upper portion of the operculum (a characteristic peculiar to full-grown individuals of the coastal form *Seb. viviparus*, Kr.); but this spot gradually disappears with the growth of the fish, leaving hardly a vestige in adult examples. The scales were fully developed.

Measurements of the young specimens, with number of rays in anal: —

	Total Length.	Length of Head.	Diam. of Eye.	Numb. of Rays in A.
a.	62^{mm}	18^{mm}	6^{mm}	3.8.
b.	80 -	23 -	7.8 -	3.8.
c.	85 -	25 -	8 -	3.9.
d.	134 -	41 -	15 -	3.8.
e.	143 -	42 -	14 -	3.9.

Distribution. — *S. marinus* is a northern species; it occurs off the coasts of Greenland, Iceland, Spitzbergen, Nova Zemlja, and the shores of northern Europe, at least as far south as Stavanger and the Naze; in the western hemisphere its range probably extends along the coast of North America, as far south as the New England States, in lat. about 40° N. As a true deep-sea species, it can hardly pass the North Sea; hence it occurs, sporadically, off the coasts of Denmark and Great Britain, and does not frequent the waters of the Cattegat or the Baltic.

On the coast of Norway, east of the Naze, and in the most southern of the fjords, as well as off Bohuslen, this species is replaced by the closely allied *S. viviparus,* Kr., which, according to Dr. Lütken, also occurs off the Faröe Islands; but it is not met with on the coast of Denmark. In Norway it certainly extends as far north as the Trondhjem Fjord.

The distribution of the two species in North America does not appear to have been fully ascertained. Gill (Proc. Ac. Nat. Sci. Philad. 1863, p. 333) describes the form occurring on the coast of New England as *S. viviparus*, and does not even mention *S. marinus;* on the other hand,

af *S. marinus,* opgiver Bean og Goode i sin nyeste Catalog over samme Districts Fiske (Bull. Ess. Inst. vol. 9, 1879), at de af dem undersøgte Individer „correspond most nearly with *S. marinus*".

Fam. Cottidae.

Gen. Cottunculus, Coll.

Norges Fiske, Tillægsh. til Forh. Vid. Selsk. Chra. 1874, p. 20.
Chra. 1875 (1874).

Hovedet bredt ægformigt, forholdsvis stort og højt; Legemet kort og tyndt, beklædt med chagrinartede Bentornegrupper, men uden Skjæl. Gjællelaagene uvæbnede, men med stumpe Knuder. Tænder i Kjæverne og paa Vomer. Sidelinie tilstede. Dorsalerne fuldstændigt sammenvoxede. Gjællehinderne ere ikke indbyrdes sammenhængende paa Hovedets Underside.

4. Cottunculus microps, Coll. 1874.

Pl. I, fig. 5—6.

Cottunculus microps, Coll. „Norges Fiske", Tillægsh. til Forh. Vid. Selsk. Chra. 1874, p. 20, Pl. 1, Fig. 1—3 (1874).

Diagn. *Hovedet, Legemet og Finnerne tæt chagrinerede. Hovedets Længde indeholdes $2^3/_4$ Gange i Totallængden. Øjnene forholdsvis smaa, med stor Lindse; Interorbitalrummet særdeles bredt. Praeoperculum har 4 stumpe Knuder, men ingen Torne; Operculum er helrandet. Paa Panden 2 Par Tuberkler, der danne et Qvadrat. Gjællespalten vid. Sidelinien uvæbnet, har omtr. 10 Porer. Straalerne i Dorsalens forreste Del (Pigstraalerne) særdeles lave, spinkle og svage, næsten 3 Gange kortere, end de bagre Straaler. Pectoralerne brede og lange, naa tilbage forbi Begyndelsen af Analen. Ventralerne korte og spinkle, med stort Mellemrum; Analen er uden Pigstraaler. Anus ligger midt mellem Snudespidsen og sidste Halehvirvel. Farven hvidagtig med 4 brunsorte Tverbaand, hvoraf det forreste gaar tvers over Snuden. Appendices pyloricae 2. Størrelsen indtil 175 mm.*

M. B. 6; D. 6/13—6/15; *A. 10; P. 15—19; V. 3; C.* 4/12/4.

Localit. fra Nordh. Exped. Havet sønden- og vestenfor Spitsbergen.

Fam. Cottidæ.

Gen. Cottunculus, Coll.

"Norges Fiske," Appendix to Forh. Vid. Selsk. Chra. 1874, p. 20
Chra. 1875 (1874).

Head broad, ovate, size and height considerable; body short and thin, covered with clusters of rough granulations; scales wanting; gill-covers with obtuse knotty protuberances, but not armed; teeth in maxillaries and on vomer; lateral line obvious; dorsals continuous, forming a single fin; branchial membrane disconnected on the inferior surface of the head.

4. Cottunculus microps, Coll. 1874.

Pl. I. fig. 5—6.

Cottunculus microps, Coll. "Norges Fiske," App. to Forh. Vid. Selsk. Chra. 1874, p. 20, Pl. 1, Fig. 1—3 (1874).

Diagnosis. — *Head, body, and fins thickly covered with rough granulations; length of head to total length as 1 to $2^3/_4$; eyes comparatively small, with the lenses large; interorbital space exceedingly wide; four obtuse knotty protuberances on the preoperculum, but no spines; margin of operculum entire; two pairs of tubercles on the crown, arranged quadrangularly; gill-openings wide; lateral line smooth, with about 10 pores; the anterior rays of the dorsal (the spiny portion) exceedingly short, slender, and feeble, the rays in the soft portion almost 3 times longer; pectorals broad and long, extending backwards beyond the origin of the anal; ventrals short and slender, far apart; anal without spiny rays. Vent midway between tip of snout and the last caudal vertebra. Colour whitish, with 4 brownish-black bands, the first of which traverses the snout; pyloric appendages 2. Length reaching 175 mm.*

M. B. 6; D. 6/13 *or* 6/15; *A. 10; P. 15—19; V. 3; C.* 4/12/4.

Locality (North Atl. Exped.): — The open sea, south and west of Spitzbergen.

	Stat. 290.	*Stat.* 362.	*Stat.* 363.
Beliggenhed.	216 Kil. N.V. Hammerfest.	115 Kil. V. Norskøerne, Spitsb.	60 Kil. V. Norskøerne, Spitsb.
Dybde.	191 Favne (349 m).	459 Favne (839 m).	260 Favne (475 m).
Temp. paa Bunden.	+ 3.5° C.	— 1.0° C.	+ 1.1° C.
Bunden.	Sandholdigt Ler.	Blaagraat Ler.	Blaaler.
Datum.	7de Juli 1878.	14de Aug. 1878.	14de Aug. 1878.
Antal Indiv.	1 yngre Indiv.	1 Indiv.	1 Indiv.

Bemærkninger til Synonymien. Slægten *Cottunculus* er ikke nær beslægtet med nogen af de øvrige arctiske Cottoider. Dens enkelte (sammenvoxede) Dorsal, og de uvæbnede Gjællelaag skiller den vidt fra disse; men Bygningen af Ventraler og Pectoraler, Tandforholdene og Legemets almindelige Habitus er saa overensstemmende med det characteristiske for denne Familie, at den neppe kan udsondres herfra.

Hidtil er blot en enkelt Art kjendt, der opstilledes i 1874 i „Norges Fiske" efter en 15 mm lang Unge, optagen paa 200 Favnes Dyb ved Hammerfest i Vestfinmarken i Aug. s. A. Da den oprindelige Beskrivelse maatte affattes efter dette eneste og diminutive Specimen, er det en Selvfølge, at den i flere Puncter maatte blive ufuldstændig, hvad jeg ogsaa har udtalt paa det ovenciterede Sted. Det har derfor været af særdeles Interesse at faa Lejlighed til at undersøge af denne i flere Henseender mærkelige Form 3 større Individer, hvoraf det ene sandsynligvis er fuldvoxent eller nær derved; og skjønt den oprindelige Beskrivelse af det nys udklækkede Individ endnu i alle væsentlige Dele passer paa de udvoxede, meddeles dog her en ny, hvorved især Slægts- og Artsdiagnosen bedre har kunnet fixeres. Allerede Figurerne paa ovennævnte Sted gjengive ganske kjendeligt ogsaa de udvoxede Individer, om de end i flere Punkter have kunnet corrigeres, som det vil sees af de i nærværende Skrift meddelte Figurer.

Udmaalinger.

	a. (*St.* 290).	b. (*St.* 362).	c. (*St.* 363).
Totallængde	93 mm	136 mm	175 mm
Længde uden Caudalen	73 -	103 -	145 -
Længde fra Snudespidsen t. Dorsalen	34 -	45 -	65 -
Længde fra Snudespidsen til Anus	37 -	51 -	69 -
Længde fra Snudespidsen til Analen	45 -	65 -	88 -
Længde fra Anus til Analen . .	8,5 -	14 -	19 -
Længde fra Anus til sidste Halehvirvel	35 -	57 -	73 -
Hovedets Længde	33 -	48 -	65 -
Hovedets Bredde	28 -	41 -	58 -
Legem. største Højde over Nakken	25 -	31 -	46 -
Legem. Højde over Beg. af Analen	12 -	16 -	25 -
Gjællespaltens Højde	19 -	28 -	38 -
Længde fra Snudespidsen t. Lindsen	11 -	14 -	21 -

	Stat. 290.	*Stat.* 326.	*Stat.* 363.
Exact Locality.	216 Kil. NW. of Hammerfest.	115 Kil. W. of Norsk Islands.	60 Kil. W. of Norsk Islands.
Depth.	191 Fathoms (349 m).	459 Fathoms (839 m).	260 Fathoms (475 m.)
Temp. at Bottom.	+ 3.5° C.	— 1.0° C.	+ 1.1° C.
Bottom.	Sabulous Clay.	Bluish-grey Clay	Blue Clay.
Date.	7th July 1878	14th Aug. 1878	14th Aug. 1878
Number of Specim.	1 Indiv. (young).	1 Indiv.	1 Indiv.

Remarks on the Synonymy. — The genus *Cottunculus* is not closely related to any of the Arctic Cottoids. The dorsals, occurring continuous as a single fin, together with the unarmed opercles, widely distinguish it from the other genera; but, on the other hand, the structure of the ventral and pectoral fins, the teeth, and the general structure of the body correspond so closely with the salient characteristics of the latter family, that we can hardly venture to exclude it from the *Cottidæ*.

Up to the present time one species only has been met with, which was described in 1874, in "Norges Fiske," the specimen being a young fry-individual, 15 mm in length, taken at a depth of 200 fathoms, off Hammerfest, West Finmark, in August that year. The only specimen examined having been a diminutive example, it naturally follows that the description itself, to a certain extent, was defective, which I took occasion to point out in the paper cited above. Such being the case, I eagerly availed myself of an opportunity to examine three larger specimens of this, in many respects, remarkable form, one of which, probably, was a full-grown adult or, at least, not far short of maturity. The original description of the very young specimen does not materially differ from the new diagnosis here given, in which the generic and specific characters are, however, set forth with greater precision. As will be seen, the figures in the paper mentioned above closely resemble those of the adult fish given in the present work.

Measurements.

	a. (*St.* 290.)	b. (*St.* 362.)	c. (*St.* 363.)
Total length	93 mm	136 mm	175 mm
Length, exclusive of caudal . . .	73 -	103 -	145 -
Length, from tip of snout to dorsal	34 -	45 -	65 -
Length, from tip of snout to vent	37 -	51 -	69 -
Length, from tip of snout to anal	45 -	65 -	88 -
Length, from vent to anal . . .	8.5 -	14 -	19 -
Length, from vent to last caudal vertebra	35 -	57 -	73 -
Length of head	33 -	48 -	65 -
Breadth of head	28 -	41 -	58 -
Greatest height of body (at the nape)	25 -	31 -	46 -
Height of body above origin of anal	12 -	16 -	25 -
Height of gill-opening	19 -	28 -	38 -
Length, from tip of snout to lens.	11 -	14 -	21 -

Lindsens Længde	4 mm	5 mm	5 mm
Længden fra Lindsen til Gjælle-spalten	20 -	29 -	39 -
Afstanden mellem Lindserne . .	9 -	13 -	16 -
Overkjævens Længde	13 -	22 -	25 -
Underkjævens Længde	15 -	23 -	28 -
Højden af Dorsalens første Afdeling (Pigstraalerne)	3,5 -	5 -	6 -
Højden af Dorsalens anden Afdeling (den bløde Del)	8,6 -	12 -	14,5 -
Længste Dorsalstraale	12 -	20 -	29 -
Dorsalens Grundlinie	40 -	58 -	70 -
Højden af Analen	6 -	9 -	11 -
Længste Analstraale	10 -	16 -	21 -
Analens Grundlinie	22 -	27 -	37 -
Pectoralens Længde fra dens nedre Rand	27 -	44 -	60 -
Pectoralens Længde fra dens øvre Rand	14 -	29 -	36 -
Ventralens Længde	8 -	15 -	15 -
Ventralernes indbyrdes Afstand .	6 -	6 -	9 -
Caudalens Længde	20 -	31 -	32 -
Halerodens Højde	5,5 -	6 -	10 -

Longitudinal diameter of lens . .	4 mm	5 mm	5 mm
Distance from lens to branchial aperture	20 -	29 -	39 -
Distance between lenses	9 -	13 -	16 -
Length of upper maxillary . . .	13 -	22 -	25 -
Length of lower maxillary . . .	15 -	23 -	28 -
Height of first division of dorsal (spiny part)	3.5 -	5 -	6 -
Height of second division of dorsal (soft part)	8.6 -	52 -	14.5 -
Longest ray of dorsal	12 -	20 -	29 -
Base of dorsal	40 -	58 -	70 -
Height of anal	6 -	9 -	11 -
Longest ray of anal	10 -	16 -	21 -
Base of anal	22 -	27 -	37 -
Length of pectorals from lower margin	27 -	44 -	60 -
Length of pectorals from upper margin	14 -	29 -	36 -
Length of ventrals	8 -	15 -	15 -
Distance between ventrals . . .	6 -	6 -	9 -
Length of caudal	20 -	31 -	32 -
Height of tail at base	5.5 -	6 -	10 -

Beskrivelse. *Legemsbygning.* Det egentlige Legeme er forholdsvis kort og svagt, medens Hovedet er uforholdsmæssigt stort. Den største Højde falder lige over Nakken, og indeholdes omtr. 3 Gange i Legemets Længde indtil Haleroden. Bagenfor Nakken aftager Højden hurtigt, og har ved Haleroden, der er kun lidt over en Hovedlængde fjernet fra Hovedet, omtrent Højden af en Øjendiameter. Samtidig bliver Legemet stærkt sammentrykt fra Siderne; især er Halepartiet temmelig skarpt afsat fra Kroppen, og dets Tykkelse allerede ved Anus betydeligt mindre, end dets Højde. Legemets nedre Profillinie er næsten ret, kun ubetydeligt indkneben bagenfor Anus; den øvre er stærkt nedstigende fra Nakken af, og tildels noget concav. Anus ligger langt foran Analen, næsten ligesaa langt fra denne Finne, som fra Ventralernes Fæste, eller næsten midt mellem Snudespidsen og den sidste Halehvirvel; hos den nyklækkede Yngel (fra Hammerfest) ubetydeligt nærmere den sidste. Analpille er ikke tilstede hos noget af de undersøgte Individer, hvoraf idetmindste det ene var en Han. 2 *Appendices pyloricae* ere tilstede.

Hovedet er særdeles stort, og seet ovenfra bredt ægformigt; dets Længde indeholdes i Totallængden blot $2^3/_4$ Gange, og dets største Bredde er næsten lig dets Længde.

Gjællelaagene ere uvæbnede, og dækkede af en fælles, tyk Hud, ligesom Gjællespaltens indre Beklædning er særdeles blød og tyk. Praeoperculum har ingen fri Torne, men Huden dækker paa dets nedre Rand 4 stumpe Knuder, der hæve sig kun ubetydeligt, og som svare til de paa dette Sted optrædende Torne eller Pigge hos de fleste øvrige cottoide Fiske. Mellem disse stumpe Knuder danner Huden rundagtige Fordybninger, der ere fuldstændig lukkede i Bunden.

General description. *Structure of the Body.* — The body proper comparatively short and slender, head disproportionately large. The greatest height is across the nape, being contained 3 times in the length of the body to the origin of the caudal. Posterior to the nape, the height rapidly decreases, being at the base of the tail, which is distant from the head but little more than its length, about equal to the diameter of the eye. At the nape, too, the body becomes much depressed; the tail in particular is narrow and thin, projecting distinctly from the body; its thickness even at the vent is considerably less than its height. Ventral line almost straight, but slightly deflected posterior to the vent; dorsal line rapidly descending, and somewhat concave. Vent considerably in advance of the anal, being distant from that fin almost as far as from the base of the ventrals, or nearly mid-way between the point of the snout and the terminal vertebra; in the very young specimen (taken off Hammerfest), a trifle nearer the latter. Anal papilla wanting in the individuals examined, one of which at least was a male. Pyloric appendages two.

Head unusually large, and seen from above broadly ovate; its length is contained $2^3/_4$ times in the total length, and its greatest breath is nearly equal to its length.

The opercles are unarmed, and protected by a thick continuous membrane; the inner integument of the gill-openings, too, is exceedingly soft and thick. Preoperculum without true spines; under the skin however, along the margin, occur four knotty protuberances, but slightly prominent, corresponding with the osseous spines or spikes on that part of the cranium in most of the other Cottoid fishes. Between these obtuse tubercles, the skin exhibits circular depressions, which are completely closed at the bottom.

Over Bagranden af Øjnene staa paa hver Side et Par kegleformige Knuder, der lige til Spidsen ere klædte af Hovedhuden; af disse er den ydre den mindste (hos det mindre Ex. fra Stat. 362 er den næsten umærkelig). I omtrent en Orbitaldiameters Afstand bagenfor disse staa paa hver Side en enkelt Knude, der er af Højde og Form som den største af de forreste. Tilsammen danne disse 4 største Knuder et Qvadrat, hvis Bredde indeholdes omtr. $1^1/_2$ Gang i deres Længde, og de repræsentere selvfølgelig den samme Anordning af Pandeknuderne, som hos de fleste øvrige Arter af denne Familie. Endelig findes et Par stumpere Knuder paa hver Side af Hovedet i den Linie, der strækker sig mellem Øjets og Gjællespaltens øvre Rand.

Øjnene ere forholdsvis smaa, men have stor Lindse; dog er Øjets ydre Begrændsning vanskelig at drage, da Overhuden er beklædt med de samme spidse Bentorne, som ere strøede ud over hele Hovedet, lige ind mod Lindsen. Navnet *microps* er derfor kun forsaavidt betegnende, som næsten hele Iris er skjult under denne farvede og ru Overhud. Dog maa Orbitas Længde antages at indeholdes over 5 Gange i Hovedets Længde; Afstanden fra Lindse til Lindse indeholdes omtrent $3^1/_2$ Gange i Hovedlængden, og Interorbitalrummet bliver paa Grund heraf temmelig bredt.

Munden er bred og vid, og Mundspalten gaar tilbage til under Midten af Lindsen. Underkjæven rager ganske ubetydeligt frem foran Overkjæven.

Næseborene ere 2 Par, hvoraf de nederste ere rørformigt forlængede. Overkjævens Rand, det forreste Næsebor, det bagerste Næsebor, og Øjet, ligge fjernede i en indbyrdes Afstand fra hinanden af omtr. en Lindsediameter. Tungen er særdeles bred og tyk, og fortil fri.

Gjællehinderne have 6 Straaler; de ere ikke sammenvoxede paa Hovedets Underside, saaledes at de danne en tvers over denne løbende fri : old, saaledes som hos alle de øvrige Slægter af vore cottoide : iske *(Cottus, Phobetor, Centridermichthys, Icelus, Triglops,* etc.*)*, men ophører ved den nedre Ende af hver Gjællespalte. Den indbyrdes Afstand mellem Gjællespalterne paa Hovedets Underside er omtrent lig Hovedets postorbitale Del, saaledes forholdsvis betydelig.

Gjællespalten er forholdsvis vid og strækker sig fra Pectoralens nedre Fæste op til ovenfor Legemets Midtlinie. Operculum er særdeles stort og bredt, og dækker et ikke ubetydeligt Parti af Legemet mellem Gjællespalten og Pectoralen; den øvre fri Rand af Operculum danner derfor en næsten ret Linie af Længde som en Øjendiameter. Gjællerne ere af normal Bygning.

Tænderne ere tilstede i Kjæverne og paa Vomer, men mangle paa Palatinbenene. I Over- og Underkjæven danne de flere Rækker; paa Vomer sidde de i 2, neppe sammenhængende Felter.

Finnerne. Straaleantallet i de forskjellige Finner viste sig at være følgende:

	a.	b.	c.
Dorsalen	20 (6 + 14);	21 (6 + 15);	20 (6 + 14).

Above the posterior margin of the eyes, on either side, occur a couple of cuneiform protuberances or tubercles, enveloped up to the point in the skin of the head; the exterior is the smaller of the two (in the small example from Station 362 scarcely obvious). Posterior to these tubercles, on either side, distant about the length of the orbital diameter, is an isolated tuberbcle, the same in shape and size as the larger of the two anterior ones. The four largest tubercles form a quadrangle, the breadth being to the length as 1 to $1^1/_2$; hence the disposition of these protuberances is precisely the same as in most of the other species of *Cottidæ*. On either side of the head 2 tubercles, somewhat more obtuse, occur along the line extending between the eye and the upper margin of the gill-opening.

Eyes comparatively small, but with large lenses; the exterior limit of the eye, however, is difficult to determine, the cuticle being studded, nearly to the edge of the lens, with sharp osseous prickles, similar to those dispersed over the entire surface of the head. Hence the name *microps* is not otherwise appropriate than from the circumstance of the iris being almost entirely hidden beneath the rough and coloured cuticle. The diameter of the orbit cannot, however, be much less than one-fifth of the length of the head; the distance between the lenses is to the length of the head as 1 to $3^1/_2$; interorbital space consequently broad.

Mouth wide, the maxillary extending to the middle of the eye. The lower jaw slightly projecting beyond the upper.

Nostrils double, each of the lower tubular. Distance between the margin of upper jaw, the anterior nostril, the posterior nostril, and the eye in each case about equal to the diameter of the lens. Tongue exceedingly broad and thick, the forepart detached.

Brancheostegous rays 6; the gill membrane not continuous across the isthmus and connecting the gill-openings by a detached cutaneous flap, as is the case in almost all the other genera of our Cottoid fishes *(Cottus, Phobetor, Centridermichthys, Icelus, Triglops,* etc.*)*, but attached to the isthmus, and terminating at the lower extremity of each opening. Distance between the lower margin of the gill-openings about equal to the length of the postorbital region of the head, and hence comparatively great.

The gill-openings are comparatively wide, extending from the base of the pectorals to some distance above the mesian line of the body. Operculum very large and broad, covering a considerable portion of the body between the gill-openings and the pectorals; upper free margin of operculum, in length about equal to the diameter of the eye, consequently almost straight. Structure of gills normal.

Teeth in jaws and on vomer, wanting on the palatine bones. Along the maxillaries they are regularly disposed in several well-defined series; on the vomer, the arrangement is in two quadrangular divisions, probably continuous.

Fins. — The fin-ray formula in the 3 specimens was as follows: —

	a.	b.	c.
Dorsal	20 (6 + 14);	21 (6 + 15);	20 (6 + 14).

Analen	10;	10;	10.
Caudalen	12;	12;	12.
Pectoralerne . .	17—18;	19—19;	18—19.

Dorsalerne ere fuldstændigt sammenvoxede til en enkelt, der udspringer allerede over den bagre Flig af Gjællelaaget, og løber ned til omtrent i en Lindsediameters Afstand fra Haleroden. Dens forreste Del, der svarer til 1ste Dorsal, og som tæller 6 Straaler, er særdeles lav, og neppe over en Lindsediameter hævet over Legemet; Straalerne ere her Pigstraaler, men yderst svage og spinkle. Dorsalens bagre Del, der svarer til 2den Dorsal, er temmelig skarpt afsat fra den første ved sine længere Straaler, der dog ere skraat bagudrettede, saaledes, at de aldrig kunne rejse sig til sin fulde Højde. Antallet er her 14—15; de ere leddede og kløvede, og deres største Længde er omtr. lig Afstanden fra Snudespidsen til Øjets bagre Rand. Begge Partier ere fuldstændigt sammenvoxede, uden større Mellemrum, end mellem de øvrige Straaler, og den forbindende Membran er ligesaa høj, som Finnens forreste Del. Straalerne, hvis samlede Antal saaledes er 20—21, ere indhyllede i den fælles, tykke, med smaa Bentorne bedækkede Hud, der beklæder Legemet; især er dette Tilfældet med Pigstraalerne, hvis Antal og Bygning blot ved Dissection kan undersøges.

Analen er forholdsvis kort, udspringer et betydeligt Stykke bagenfor Anus, og har 10 Straaler, der alle ere leddede, og hvoraf de første ere særdeles spinkle. Disse Straalers Længde naar ikke Længden af de tilsvarende Straaler i Dorsalen; ligesom i denne ere de rettede skraat bagover. Analen ophører i noget større Afstand fra Haleroden, end Dorsalen (Afstanden er næsten 2 Lindsediametre); dens Grundlinie svarer omtrent til Længden af Hovedets postorbitale Del.

Pectoralerne ere i Forhold til det spinkle og korte Legeme forholdsvis lange og brede; de begynde paa Hovedets Underside lidt nedenfor Gjællespaltens nedre Ende, og have en Grundlinie, der omtrent er saa stor, som Snudens Afstand fra Bagranden af Lindsen. Straalernes Antal er 17—19, hvoraf den nederste er temmelig kort. Alle have noget fri Spidser; hos de 4—5 nederste ere disse Spidser temmelig lange. Alle Pectoralstraaler ere leddede, men ikke kløvede mod Spidsen. Finnens Længde, regnet fra dens nederste Rand, indeholdes 3—$3^1/_2$ Gange i Totallængden; Spidsen naar tilbage til den 3die Straale i Analen, og med næsten Finnens halve Længde forbi Anus.

Ventralerne have 3* Straaler, hvoraf den indre er længst. De ere smale og spinkle, samt temmelig korte, og alle i Spidserne fri. Deres Længde hos de undersøgte Individer er omtrent lig Afstanden mellem de forreste Næsebor; tilbageslaaede ere de en halv Finnelængde fjernede fra Anus. De ere skilte ved et forholdsvis betydeligt Mellemrum, der er omtr. ligt $^2/_3$ af Finnernes egen Længde.

Caudalen er af middels Længde, eller noget derover; den er stumpt afrundet, og har 12 Straaler, der mod Spidsen ere spaltede i 2 tætsluttende Grene.

Anal	10;	10;	10.
Caudal	12;	12;	12.
Pectorals . . .	17—18;	19—19;	18—19.

Dorsals continuous, forming a single fin, which commences immediately above the posterior lappet of the gill-cover, terminating in close proximity to the root of the tail, from which it is distant about the length of the diameter of the lens. The anterior division, answering to the first dorsal, and furnished with 6 rays, is much depressed, the greatest height being not more than the length of the lens; here the rays are spiny, but exceedingly slender and feeble. The posterior division, answering to the second dorsal, rather abruptly connected with the anterior part, from the greater length of the rays, which, however, incline backwards, and do not admit of being raised to their full height; they are cleft and articulated, the length of the longest being about equal to the distance from the point of the snout to the posterior margin of the eye; number 14—15. The space between the two divisions, which are continuous, not greater than that between the rays, the connecting membrane being on a level with the anterior part of the fin. The rays (total number 20—21) are enveloped in the thick skin — studded with minute granulations — that covers the body; this is more particularly the case with the spiny portion, for the examination of which dissection is necessary.

Anal comparatively short, commencing at a considerable distance from the vent; it is furnished with 10 rays, all of them articulated, those on the anterior part extremely slender. Length of anal rays less than that of the corresponding rays in the dorsal; like the latter, they incline backwards. The anal terminates at a somewhat greater distance from the root of the tail than the dorsal (about twice the diameter of the lens); basal line nearly equal to the length of the postorbital region of the head.

Pectorals long and broad as compared with the short and slender body; they commence on the under surface of the head, a little below the inferior extremity of the branchial opening; basal line about equal to the distance from the snout to the posterior edge of the lens. Number of rays 17—19, the undermost rather short; all the points detached, and rather long in 4 or 5 of the undermost. All the rays articulated, but not cleft towards the points. The length of the fin, measured from the inferior margin, is to the total length as 1 to 3—$3^1/_2$; the point extends backwards to the third ray of the anal, and nearly half the length of the fin beyond the vent.

Ventrals furnished with 3 rays, the innermost of which is the longest; they are narrow and slender, rather short, with all the points detached; length in the specimens examined about equal to the distance between the anterior nostrils; their points are half the length of the fin from the vent. Space between these fins considerable, being about two-thirds of the whole length of the fin.

Caudal of moderate length, obtusely convex; it is furnished with 12 rays, cleft towards the points into two close branches.

Hos et noget mindre Individ, hvis Totallængde var 50 mm, og som var optaget Høsten 1878 fra 180 Favnes Dyb ved Rissen i Trondhjemsfjorden af Conserv. Storm, og som blev mig tilsendt til Undersøgelse, var Straaleantallet følgende: D. 19 (6 + 13); A. 10; P. 15—17; C. 12. Individet, som opbevares i Videnskabernes Selskabs Samling i Trondhjem, svarede iøvrigt ganske til de øvrige Individer (med Undtagelse af den ringe Afvigelse i Straaleantallet), og er nærmere omtalt i Forh. Vid. Selsk. Chra. 1879, No. 1, p. 11.

Sidelinie. Denne, der var usynlig hos det 15 mm lange Typ-Exemplar, er tilstede hos de større, og fremhæver sig som en ophøjet Stribe mellem Hudens tætte Beklædning af Bentorne. Porerne, der blot er 10 i Antal, ere dog saa smaa, at de kun med nogen Vanskelighed lade sig forfølge i deres hele Række. Sidelinien udspringer ved Gjællelaagets øvre Ende, stiger strax i skraa Retning ned mod Legemets Midtlinie, som den naar noget bagenfor Analens Begyndelse, og løber derfra uden yderligere Sænkning ud til Caudalen.

Langs Roden af Underkjæven strækker sig paa hver Side en Række af 3 dybe Porer; en lignende Række løber langs Overranden af Overkjæven, ligesom enkelte Porer findes langs den nedre Rand af Praeoperculum. Skjægtraade paa Kjæverne mangle.

Hudens Beklædning. Huden er næsten overalt tæt beklædt med Smaagrupper af yderst fine Bentorne, der især paa Legemets Overside sidde saa tæt, at de næsten ikke lade nogen glat Del af Huden tilsyne. Hver Gruppe har her en rundagtig Omkreds, og er sammensat af omtr. 10 Bentorne, der ere yderst lave, saa at Huden blot faar en ru Overflade. Lige saa tætte og af samme Omfang ere Tornegrupperne paa Gjællelaagene, medens de paa den øvrige Del af Hovedets Overside have mindre Omkreds, og staa mere spredte. Ligeledes ere de noget mindre paa Legemet nedenfor Sidelinien.

Paa det egentlige Bugparti mangle disse Bentornegrupper næsten ganske hos det største Individ (*c*), saavelsom paa hele Hovedets Underside; hos det næststørste Individ (*b*, Totall. 136 mm) vare de langt færre og mindre paa Bugsiden, og manglede ganske paa Hovedets Underside; derimod vare Grupperne hos det mindste af de nyerholdte Individer (*a*, Totall. 93 mm) tilstede overalt paa disse Legemsdele lige hen til Underkjævespidsen, og lige saa tæt, som oventil. Hos det tidligere beskrevne Yngel-Exemplar (Totall. 15 mm) vare Bentornene blot komne tilsyne paa Hovedets Overside, og vare i Frembrud paa Bugsiden, men endnu ikke fremkomne paa de øvrige Legemsdele. Heraf synes at kunne udledes, at Ujevnhederne paa Legemets Underside, der fremkomme tidligere, end paa Oversiden, afslides næsten ganske, inden Individerne have naaet sin fulde Størrelse.

Paa Finnerne gaa Bentornene ud langs Straalerne lige til Randen af Dorsalen; paa Pectoralerne beklæde de hovedsagelig de øvre Straaler, ligesom paa Caudalen. Der-

In a comparatively small-sized example (total length 50 mm), taken in the autumn of 1878, at a depth of 180 fathoms, near Rissen, in the Drontheim Fjord, by conservator Storm, and kindly sent me for examination, the fin-ray formula may be thus stated: D. 19 (6 + 13); A. 10; P. 15—17; C. 12. This individual, preserved in the collection of the Videnskabernes Selskab in Drontheim, corresponded in every respect with the other individuals (setting aside the slight disagreement in the number of fin-rays), and is more fully described in Forh. Vid. Selsk. Chra. 1879, No. 1, p. 11.

Lateral Line. — The lateral line, of which there was not even a vestige in the typical and very young specimen (total length 15 mm), is distinctly obvious in the larger examples, as an elevated series between the osseous denticles of the skin. The pores, not more than 10, are, however, so small that some difficulty is experienced in tracing them throughout the entire length of the series. The lateral line commences at the upper extremity of the gill-cover, strikes off in an oblique direction, and reaches the mesial line a short distance from the commencement of the anal, passing from thence straight to the caudal.

Along the base of the lower jaw, on either side, is a row of three deep pores; a similar series extends along the superior margin of the upper jaw, and a few pores occur too along the inferior margin of the preoperculum. Cirri on jaws wanting.

The Skin. — The skin is almost entirely covered with small clusters of granulations, so closely disposed, more particularly on the upper surface of the body, as hardly to leave any smooth portion visible. Each cluster is circular in form, and composed of about 10 spiculæ, exceedingly depressed, giving to the skin merely a rough, or slightly prickly feel. On the opercles, the clusters or groups are disposed in like manner; on the rest of the surface of the head they present a more scattered appearance, the circumference of each being considerably less. They are somewhat smaller, too, on the body below the lateral line.

In the abdominal region, as well as on the entire surface of the head, there is scarce a vestige of these clusters in the largest specimen (*c*); in the specimen next in size (*b*, total length 136 mm) they were smaller and far less numerous in the abdominal region, and altogether wanting on the under surface of the head; on the other hand, in the smallest of the individuals newly obtained (*a*, total length 93 mm) they occurred everywhere on those parts of the body, extending to the extremity of the lower jaw, and as closely disposed as on the upper surface. The fry-specimen before described (total length 15 mm) had denticles on the upper surface of the head only, they were developing on the abdominal surface; on the rest of the body they had not yet begun to appear. From these data may be inferred that the asperities on the under surface of the body, which develop earlier than on the upper, to a great extent get worn away before the fish has attained its full size.

On the fins, the denticles extend along the rays to the upper margin of the dorsal; on the pectorals, they chiefly cover the rays of the upper part, as also on the caudal. The under

imod ere Pectoralernes Underside, Analen og Ventralerne nøgne, undtagen hos Expl. *a*, hvor ogsaa Analen var ru. Paa Hovedet gaa Bentornene, som allerede nævnt, lige ud paa den Hud, der bedækker Cornea, saa at blot Partiet over Lindsen og èn smal Ring omkring denne lades fri. Læberne ere ligeledes altid glatte, selv hos det mindste af de under Expeditionen erholdte Individer, der iøvrigt viser sig at være beklædt med disse Bentorne saagodtsom overalt.

Farven. Farven er hvidgraa, med mer eller mindre tydelige Pletter og brede Baand. Hos de mindre Exemplarer ere disse Pletter skarpere begrændsede, end hos de større; hos Yngelen (fra Hammerfest) fandtes saaledes blot et enkelt bredt, sort Baand, der steg op fra Bagranden af Kjæverne gjennem Øjnene, og udfyldte den mellemste Del af Hovedets Overside; et andet, noget svagere farvet Baand gik over Dorsalens bagre Del tvers over Legemet ikke langt fra Haleroden.

Hos det mindste af de nye Individer (*a*) er tilkommet paa det egentlige Legeme et bredt Baand, der gaar ud fra Roden af Pectoralerne op over Begyndelsen af Dorsalen, ligesom et smalere gaar tvers over Haleroden. Saaledes er den typiske cottoide Tegning med de 3 brede verticale Baand nedad Legemet, som fremtræder især hos de yngre Individer af et Flertal af denne Families Arter, ogsaa her tilstede.

Hos de 2 største ere Baandene noget mere utydelige; hos *b* er saavel Hovedets, som Legemets første Tverbaand næsten ganske forsvundet, medens disse hos det største Individ vel ere tilstede, men opblandede med Felter af Bundfarven.

Pectoralerne og Caudalen ere marmorerede af afbrudte Baand. Ventralerne ere ufarvede, ligesom hele Bugsiden hen til Underkjævespidsen. Derimod er Underkjæven selv, saavelsom Snuden, forsynet med uregelmæssige større Pletter.

Levemaade og Føde. Denne Art har øjensynlig, ligesom de øvrige Cottoider, sit Tilhold umiddelbart paa eller ved Bunden. Den ringeste Dybde, hvori noget af de hidtil fundne Exemplarer ere erholdte, er 191 Favne, den største 459 Favne. Som allerede ovenfor nævnt, ere alle Pectoralens Straaler i Spidsen fri, og skjønt disse fri Spidser ikke ere synderlig lange, tjene de dog utvivlsomt til Understøttelse under Krybningen om paa Bunden. Den Temperatur, som Havbunden har havt paa de Steder, hvor de erholdtes, har vexlet mellem + 3,5° C. og — 1,0° C.

Det største af de erholdte Individer var en Han, hvis Testes dog vare for Tiden lidet udviklede. Hos de yngre Ind. vare Generationsorganerne endnu ganske utydelige.

Ventrikelen af det største Individ, optaget paa 459 Favnes Dyb, fandtes fuldproppet af diverse Dyrelevninger, hvoraf kunde kjendes følgende: Smaastykker af Røret af den mærkelige Annelide *Spiochaetopterus typicus,* M. Sars, (beskreven i „Fauna Littoralis Norvegiae", 2 H. 1856), af-

surface of the pectorals, the anal, and the ventrals are naked, except in the specimen *a*, which has also the anal rough. On the head, the denticles, as before observed, encroach on the skin covering the cornea, and thus the skin immediately above the lens, together with a narrow annular edge round it, are the only parts left free from spiculæ. The lips are always smooth; this is the case even with the smaller specimen *a*, which everywhere else appears almost entirely covered with denticles.

Colour. — Whitish-grey, relieved with spots and broad, riband-shaped bands, more or less distinct. In the smaller examples, these spots appear more sharply defined than in the larger specimens; the fry-specimen (from Hammerfest) has only one band, broad and black, which, stretching from the posterior margin of the jaws through the eyes, occupies the whole of the central portion of the upper surface of the head; a similar band traverses the posterior division of the dorsal, extending right across the body, at a short distance from the base of the tail.

In the smallest of the individuals newly obtained (*a*) a broad band has developed on the body, extending from the base of the pectorals towards the commencement of the dorsal; another and narrower band traverses the base of the tail. Thus, the typical Cottoid marking, three broad vertical bands down the body, a salient feature, particularly in young individuals, of most species belonging to this family, is also characteristic of *Cottunculus microps.*

In the two largest examples, the bands are not so distinct; in specimen *b*, the transverse bands traversing the head and body have become much fainter; in the largest example, though obvious, they are a good deal patched with the ground-colour.

The bands across the pectorals and the caudal are abruptly disconnected, giving to the surface a mottled appearance. Ventrals and abdominal surface to extremity of lower jaw whitish. Lower jaw and snout irregularly marked with large spots.

Habits and Food. — This form, in common with the other species of the family *Cottus*, must have its haunts on, or in close proximity to, the bottom. Of the examples hitherto obtained, not one was taken at a depth less than 191 fathoms, the greatest depth being 459 fathoms. As before observed, the extremities of the pectoral rays are free; and those detached points, though comparatively short, no doubt prove a great support to the fish when moving ever the surface of the bottom. The temperature at the bottom of the sea where this species was met with varied from + 3.5° C. to — 1.0° C.

The largest of the individuals was a male, with the testicles however as yet but slightly developed. In the young specimens, the generative organs were quite indistinct.

The stomach of the largest individual, taken at a depth of 459 fathoms, was found distended with the remains of divers species of marine animals, of which the following admitted of being determined: — small fragments of the alimentary canal of the remarkable Annelid species

bidte i Stykker af omtrent 8 mm Længde; Laaget og store Stykker af Legemet af *Buccinum hydrophanum,* Hanc., medens intet Spor fandtes af Skallet, som den saaledes maa have itubidt og atter udspyttet, inden Dyret blev slugt; Smaastykker af en af de guldhaarede Annelider, der syntes at være *Lætmonice filicornis,* Kinb.; et helt Expl. af den af G. O. Sars beskrevne Isopode *Ilyarachna hirticeps;* Dele af den i næsten alle Fiskemaver optrædende Hyperide *Themisto libellula,* Mandt, samt endelig Kjæverne af en liden Unge af en Cephalopode, maaske en *Rossia.* Hos det næststørste Individ, optaget fra 459 Favne, var Ventrikelen fuldproppet af *Themisto libellula,* men indeholdt ingen andre gjenkjendelige Levninger.

Udbredelse. Ligesom de øvrige arctiske Cottoider synes *C. microps* ikke at have nogen særdeles indskrænket Udbredelse, men forekommer endnu temmelig langt mod Syd paa Dybderne udenfor de norske Kyster. Foruden Nordhavs-Expeditionens 3 Individer fra Havet omkring Spitsbergen, hvoraf det nordligste optoges under 80° N. B., foreligger, som tidligere nævnt, et Yngel-Individ fra Hammerfest i Vestfinmarken, optaget i 1874; samt en noget større Unge, optaget af Conservator Storm fra 180 Favnes Dyb i Trondhjemsfjorden Høsten 1878 (63½° N. B.). Som en ægte Bundfisk forekommer den sandsynligvis stationær paa passende Localiteter langs hele den mellemliggende Del af de norske Kyster, og utvivlsomt ogsaa ved de øvrige arctiske Landsdele eller i Havet mellem dem, idetmindste paa Ishavets europæiske Side; dog bebor den vistnok blot de større Dybder, hvor Apparaterne hidtil ikke have været fuldt hensigtsmæssige til Optagelsen af saadanne Dybvandsformer.

Gen. Cottus, Lin.

Syst. Nat. ed. 12, tom. 1, p. 451 (1766).

5. Cottus scorpius, Lin. 1766.

Cottus scorpius, Lin. Syst. Nat. ed. 12, tom. 1, p. 452 (1766).
Cottus groenlandicus, Cuv. & Val. Hist. Nat. Poiss. tom. 4, p. 156 (1829).
Cottus mitchillii, Cuv. & Val. Hist. Nat. Poiss. tom. 4, p. 188 (1829).
Cottus porosus, Cuv. & Val. Hist. Nat. Poiss. tom. 8, p. 498 (1831).
Acanthocottus labradoricus, Gir. Bost. Journ. Nat. Hist. vol. 6, p. 247, tab. 7, fig. 3 (1850).
Acanthocottus ocellatus, H. R. Storer, Bost. Journ. Nat. Hist. vol. 6, p. 253 (1850).
Cottus glacialis, Rich. Last. Arct. Voy. Belch. vol. 2, p. 349, tab. 23 (1855).

Et yngre Individ med en Totall. af 81 mm, en Hovedlængde af 27 mm, erholdtes paa ringe Dyb ved Norsk-Øerne paa Spitsbergens Nordside den 16de Aug. 1878. Intet Indiv. optoges paa de øvrige fra Land mere fjernede Stationer, og Arten er utvivlsomt en Kystform blandt Cottoiderne.

Spiochætopterus typicus, M. Sars (described in "Fauna Littoralis Norvegiæ," Part 2, 1856), about 8 mm in length; the operculum, together with large fragments of the body, of *Buccinum hydrophanum,* Hanc. (no vestige could be detected of the shell, which the fish must have crushed and ejected before proceeding to swallow the animal); small fragments of one of the golden haired Annelids, apparently *Lætmonice filicornis,* Kinb.; an entire example of the Isopod *Ilyarachna hirticeps,* G. O. Sars; portions of the Hyperoid *Themisto libellula,* Mandt, occurring in the stomachs of almost all fishes; and finally the jaws of a young Cephalopod, possibly a *Rossia.* In the specimen next in size (459 fathoms) the ventricle was distended with numerous individuals of *Themisto libellula.*

Distribution. — As is the case with the Arctic Cottoids generally, *C. microps* would not appear to have a very limited range, occurring as it does comparatively far south, in deep water off the coast of Norway. Exclusive of the three individuals obtained on the Expedition off Spitzbergen, the most northerly in lat. 80° N., a fry-specimen was, as before mentioned, taken near Hammerfest, West Finmark, in 1874, and a young example, by conservator Storm, at a depth of 180 fathoms, in the Drontheim Fjord, in the autumn of 1878 (lat. 63½° N.). As a true bottom-species, this form probably is met with stationary, in favourable localities, along the entire intermediate line of the Norwegian coast, and no doubt, too, throughout the Arctic regions generally, or the intervening tracts of ocean, at least in the European division of the Polar Sea; without doubt, however, its habitat lies at depths from which the apparatus hitherto devised has not been fully adapted for obtaining specimens.

Gen. Cottus, Lin.

Syst. Nat. ed. 12, tom. 1, p. 451 (1766).

5. Cottus scorpius, Lin. 1766.

Cottus scorpius, Lin. Syst. Nat. ed. 12, tom. 1, p. 452 (1766).
Cottus grœnlandicus, Cuv. & Val. Hist. Nat. Poiss. tom. 4, p. 156 (1829).
Cottus mitchillii, Cuv. & Val. Hist. Nat. Poiss. tom. 4, p. 188 (1829).
Cottus porosus, Cuv. & Val. Hist. Nat. Poiss. tom. 8, p. 498 (1831).
Acanthocottus labradoricus, Gir. Bost. Journ. Nat. Hist. vol. 6, p. 247, tab. 7, fig. 3 (1850).
Acanthocottus ocellatus, H. R. Storer, Bost. Journ. Nat. Hist. vol. 6, p. 253 (1850).
Cottus glacialis, Rich. Last. Arct. Voy. Belch. vol. 2, p. 349, tab. 23 (1855).

A young individual, total length 81 mm, length of head 27 mm, was obtained off the Norsk Islands, northern coast of Spitzbergen, Aug. 16th 1878. No example was taken at any of the other stations farther from land; the species is undoubtedly a littoral form of the family.

Straaleantallet var: 1 D. 9; 2 D. 16; A. 13.

Udbredelse. I Europa forekommer denne Art omtrent uforandret fra Kanalen (48° N. B.) og Østersøen af, og langs Frankrigs, Storbritanniens, Danmarks, Færøernes, Norges og Sveriges Kyster lige op i Østersøen, fremdeles ved Nord-Rusland, Novaja Zemlja, Beeren Eiland og Spitsbergen, hvor den paa flere Stater hører til de hyppigst forekommende littorale Fiske. Fremdeles er den mere eller mindre talrig ved Islands, Grønlands og det arctiske Amekas Kyster; dog ere de Former, der bebo disse Landsdele, af forskjellige Forfattere blevne udskilte under særegne Navne, hvoraf det tidligste er *C. groenlandicus,* opstillet i 1829 af Cuv. og Val. efter den af Fabr. i hans *Fauna Groenl.* meddelte Beskrivelse. Disse Arter ere dog af Malmgren[1], Lütken[2] o. fl. henviste til Synonymernes Række, idet de samtlige gaa ind under den nævnte vestlig-arctiske Form af denne Art, *C. groenlandicus,* der maaske vil med nogen Ret kunne opføres som en constant Varietet af den normale *C. scorpius.*

Ved Nordamerikas Kyster findes, foruden den nævnte østlige Varietet, der er særdeles talrig, ogsaa Hovedarten. Den førstnævnte gaar ned til Cap Hatteras under 36° N. B.; Hovedarten er fundet, ifølge Goode & Bean (Bull. Ess. Inst. vol. XI, 1879) ved New Englands Kyster (Maine), under 44° N. B.

Number of rays: — 1 D. 9; 2 D. 16; A. 13.

Distribution. — In Europe the range of this species, as an almost constant form, extends from the British Channel (lat. 48° N.) along the coast of France, the entire coast of Great Britain, the coast of Denmark, the Faröe Islands, the coasts of Norway and Sweden, the shores of northern Russia, Novaja Zemlia, Beeren Eiland, and Spitzbergen, where it occurs, in divers localities, as one of the commonest of the littoral fishes. It is abundant, too, more or less, on the coast of Iceland and Greenland, and the Arctic shores of North America. The forms inhabiting those regions have, by some authors, been excluded as distinct species, the earliest synonym being *C. grœnlandicus,* Cuv. & Val. 1829, from the description given by Fabricius in his *Fauna Grœnlandica.* Malmgren[1], Lütken[2], however, and other ichthyologists regard these suppositious species as identical with the aforesaid west Arctic form of the species, *C. grœnlandicus,* which, perhaps, with some reason may be regarded as a constant variety of the normal *C. scorpius.*

On the shores of North America, exclusive of the aforesaid eastern variety, which occurs in great numbers, the principal species is also met with. The range of the former extends as far south as cape Hatteras, in lat. 36° N.; the principal species, according to Goode and Bean, (Bull. Ess. Inst. Vol. XI, 1879) has been observed on the coast of New England (Maine), in lat. 44° N.

Gen. Gymnacanthus, Swains.

Nat. Hist. Fish. Amph. Rept. II, p. 181 og 271. (1839.)

Hovedet fladtrykt og bredt, Kjæverne korte. Legemet trindt, uden Skjæl. Praeoperculum væbnet. Tænder i Kjæverne (ingen paa Vomer og Palatinbenene). Sidelinie tilstede. 2 Dorsaler. Gjællehinderne sammenhængende paa Hovedets Underside.

6. G. pistilliger, (Pall.) 1811.

† *Cottus gobio,* Fabr. Fauna Groenl. No. 115, p. 159 (1780).
Cottus pistilliger, Pall. Zoogr. Ross. Asiat. tom. 3, p. 143, pl. 20, 1811, trykt 1831 (1811).
Cottus ventralis, Cuv. & Val. Hist. Nat. Poiss. tom. 4, p. 194 (1829).
Cottus tricuspis, Reinh. Overs. 1829—30, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 5. Del, p. LII. Kbhvn. 1832 (1829—30).
Gymnocanthus ventralis, Sw. Nat. Hist. Fish. Amph. Rept. II, p. 271 (1839).
Phobetor tricuspis, Kr. Naturh. Tidsskr. 2. Række, 1. B. p. 263 (1844).
? *Cottus intermedius,* Temm. & Schleg. Fauna Jap. Poiss. p. 38 (1850).
Acanthocottus patris, H. R. Storer, Bost. Journ. Nat. Hist. vol. 6, p. 250, pl. 7 (1850).
Cottus fabricii, Gir. Proc. Amer. Ass. Adv. Sci. vol. 2, p. 411 (1850); Proc. Bost. Soc. Nat. Hist. vol. 3, p. 189 (1850).

[1] Öfv. Kgl. Vet. Ak. Förh. 1864, p. 495.
[2] Vid. Medd. Nat. Foren. Kbhvn. 1876, p. 370.

Gen. Gymnacanthus, Swains.

Nat. Hist. Fish. Amph. Rept. II, p. 181 and 271. (1839.)

Head broad and depressed; jaws short; body without scales; preoperculum armed; teeth in jaws, wanting on vomer and palatine bones; lateral line obvious; two dorsals; branchial membrane continuous on under surface of head.

6. G. pistilliger, (Pall.) 1811.

† *Cottus gobio,* Fabr. Fauna Grœnl. No. 115, p. 159 (1780).
Cottus pistilliger, Pall. Zoogr. Ross. Asiat. tom. 3, p. 143, pl. 20, 1811, printed 1831 (1811).
Cottus ventralis, Cuv. & Val. Hist. Nat. Poiss. tom. 4, p. 194 (1829).
Cottus tricuspis, Reinh. Overs. 1829—30, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 5 Del, p. LII. Kbhvn. 1832 (1829—30).
Gymnocanthus ventralis, Sw. Nat. Hist. Fish. Amph. Rept. II, p. 271 (1839).
Phobetor tricuspis, Kr. Naturh. Tidsskr. 2. Række, 1. B. p. 263 (1844).
? *Cottus intermedius,* Temm. & Schleg. Fauna Jap. Poiss., p. 38 (1850).
Acanthocottus patris, H. R. Storer, Bost. Journ. Nat. Hist. Vol. 6, p. 250, pl. 7 (1850).
Cottus fabricii, Gir. Proc. Amer. Ass. Adv. Sci. vol. 2, p. 411 (1850); Proc. Bost. Soc. Nat. Hist. vol. 3, p. 189 (1850).

[1] Öfv. Kgl. Vet. Ak. Förh. 1864, p. 495.
[2] Vid. Medd. Nat. Foren. Kbhvn., 1876, p. 370.

Gymnacanthus patris, Gill, Proc. Ac. Nat. Sci. Philad. 1861, Suppl. p. 42 (1861).
Phobetor ventralis, Malmgr. Sv. Exped. till Spetsb. och Jan Mayen 1863—64, p. 249 (1867).
Gymnacanthus tricuspis, Gill, Rep. Comm. Fish & Fisheries, 1871—72, p. 800 (1873).
Gymnacanthus pistilliger, Bean, Bull. U. St. Nat. Mus. No. 15, p. 127 (1879).

Diagn. *Hovedets Overside med chagrinartede Bentornegrupper, Legemet selv næsten glat. Sidelinien glat, retløbende, med en Sænkning ved Slutningen af 2den Dorsal, har omtr. 35 Porer. Hovedet indeholdes næsten 4 Gange i Totall., har et Par stumpe Knuder over Øjnene, ingen paa Panden eller Baghovedet. Praeoperculum har 4 Torne, den øvre lang og stærk, oftest 3-tandet, hos yngre bredt 2-delt. Pectoralen lang, Ventralerne hos Hannen lange. Farven graabrun med 3 større Rygpletter, og mere uregelmæssige Pletter nedad Siderne; Finnerne med Tverbaand. Hannen har hvide Pletter paa Bugen, samt Analpapille. Størrelsen indtil 200 mm (Hannen), eller 250 mm (Hunnen).*

M. B. 6; 1 D. 11 (10 eller 12); 2 D. 15—17; A. 16—18 (19); P. 18 (19); V. 4; C. 7/11/7. Lin. lat. 35.

Localit. fra Nordh. Exped. Spitsbergen.

	Stat. 366.
Beliggenhed.	Magdalenebay, Spitsbergen.
Dybde.	50 Favne (91 m).
Temp. paa Bunden.	— 1,0° C.
Bunden.	Mørkgraat Ler.
Datum.	17de Aug. 1878.
Antal Individer.	8 Indiv.

Bemærkninger til Beskrivelsen. De erholdte Exemplarer havde følgende Maal og Straaleantal:

	Totallængde.	Hovedets Længde.	1 D.	2 D.	A.
a.	75 mm	20 mm	10	15	17
b.	76 -	21 -	10	16	16
c.	84 -	22,5 -	11	17	18
d.	99 -	26,5 -	11	16	18
e.	115 -	31 -	11	16	18
f.	116 -	29 -	11	16	18
g.	122 -	31 -	11	15	17
h.	123 -	32 -	11	15	17

Straaleantallet varierede saaledes hos de 8 Individer i 1ste Dorsal mellem 10 og 11, i 2den Dorsal mellem 15 og 17, i Analen mellem 16 og 18. De 2 Dorsaler vare hos enkelte fuldstændigt sammenstødende, medens de hos de fleste vare fjernede fra hinanden ved et kort, men tydeligt Mellemrum.

Blot 2 af de erholdte Individer vare Hanner, og havde en forholdsvis lang Analpapille.

Hos de 2 mindste var Hovedet endnu glat, men hos de større fandtes ovenpaa Hovedet og paa Praeoperculum en Samling af fladtrykte ru Bentorne, hver omgivne (hos

Gymnacanthus patris, Gill, Proc. Ac. Nat. Sci. Philad. 1861, Suppl. p. 42 (1861).
Phobetor ventralis, Malmgr. Sv. Exped. till Spetsb. och Jan Mayen 1863—64, p. 249 (1867).
Gymnacanthus tricuspis, Gill, Rep. Comm. Fish. & Fisheries, 1871—72, p. 800 (1873).
Gymnacanthus pistilliger, Bean, Bull. U. St. Nat. Mus. No. 15, p. 127 (1879).

Diagnosis. — *Upper surface of head with groups of granulations; body almost smooth; lateral line smooth, passing straight to termination of second dorsal, at that point slightly deflected, number of pores 35; length of head one-fourth of total length; two obtuse protuberances above the eyes, none on the sinciput or occiput; preoperculum furnished with four spines, the uppermost long and powerful, generally tridented, in younger examples broad, bidental; pectorals long; ventrals long, in the male; colour greyish-brown, with three large dorsal patches and numerous spots down the sides; fins traversed by transverse bands; abdominal surface spotted with white, in the male, which is furnished with an anal papilla. Length reaching 200 mm (male) or 250 mm (female).*
M. B. 6; 1 D. 11 (10 or 12); 2 D. 15—17; A. 16—18 (19); P. 18 (19); V. 4; C. 7/11/7. Lin. lat. 35.

Locality (North Atl. Exped.): Spitzbergen.

	Stat. 366.
Exact Locality.	Magdalene Bay, Spitzbergen.
Depth.	50 Fathoms (91 m).
Temp. at Bottom.	— 1.0° C.
Bottom.	Dark-grey Loam and Shingle.
Date.	17th Aug. 1878.
Numb. of Specim.	8 Indiv.

Descriptive Observations. — Dimensions of, and number of fin-rays in, specimens obtained.

	Total Length.	Length of Head.	1 D.	2 D.	A.
a.	75 mm	20 mm	10	15	17
b.	76 -	21 -	10	16	16
c.	84 -	22.5 -	11	17	18
d.	99 -	26.5 -	11	16	18
e.	115 -	31 -	11	16	18
f.	116 -	29 -	11	16	18
g.	122 -	31 -	11	15	17
h.	123 -	32 -	11	15	17

The number of fin-rays in the 8 examples varied accordingly: — 1st dorsal, between 10 and 11; 2nd dorsal, between 15 and 17; anal, between 16 and 18. In one or two of the specimens the dorsals were contiguous, in most however separated, the space between, though short, being distinctly obvious.

Two only of the specimens obtained were males, and had a rather long anal papilla.

In the two smallest individuals the head was as yet perfectly smooth; but the frontal region and the preoperculum of the largest were furnished with a cluster of depressed

det endnu fuldkommen uskadte Individ) af en Ring af Slimporer. Disse Grupper af Bentorne, der omtrent have en Lindsediameters Størrelse, danne oprindelig blot et Par Rækker, hvoraf hver strækker sig fra Øjet skraat bagover til Gjællespalten; men efterhaanden bliver Antallet større, Mellemrummet mellem de 2 Rækker opfyldes, og hos de største er en stor Del af Hovedets Overside beklædt paa denne Maade. Dog kan, ifølge Lütkens Undersøgelser, denne Hovedets Beklædning mangle endog hos udvoxede Individer.

Hos ganske unge Individer er den øvre Torn paa Praeoperculum forholdsvis længere, end hos de ældre, idet den med sin Spidse næsten naar til den bagre Rand af Operculum. Hos Ind. med en Totallængde af indtil 80^{mm} er den i Spidsen endnu blot grundt tvedelt, medens den først hos de ældre Individer er skarpt og tydeligt tretandet; et udvoxet Individ (fra Vadsø i Finmarken, en Hun) har endog den højre Torn 4-delt, den venstre med 5 tydelige Tænder[1].

Føde. Hos et af de erholdte Individer var Ventrikelen udspændt af Smaastykker af Annelider *(Polynoë)*. De Individer, som jeg i 1874 havde Lejlighed til at undersøge i Varangerfjorden i Øst-Finmarken, indeholdt blot Crustaceer, tilhørende forskjellige Arter Gammarider og Idotheer.

Udbredelse. *G. pistilliger* (bedre kjendt som *Phobetor ventralis* eller *Ph. tricuspis)* er sandsynligvis endnu den eneste sikkert bekjendte Art af sin Slægt, der iøvrigt kun ved Mangelen af Vomerintænder adskiller sig fra Slægten *Cottus*. Dens Synonymi er udtømmende behandlet af Dr. Lütken i Vid. Medd. Naturh. Foren. Kbhvn. 1876, p. 363. I sin Udbredelse synes den at være næsten ganske circumpolær, og den vil neppe savnes paa noget nøjere undersøgt Gebet af de til Europas, Asiens og Americas Kyster stødende Dele af Ishavet. Allerede i 1780 blev den af Fabricius beskreven fra Grønland (under Navn af *Cottus gobio)*; senere er den bleven bekjendt fra Kamtschatka og Beringshavet lige ned til Japan, samt vestover langs Asiens Nordkyst til Kysterne af Novaja Zemlja, Spitsbergen, Finmarken i Norge, fremdeles ved Island, Grønland og det arctiske America ned til Nova Scotia under 45° N. B. Paa flere af disse Localiteter, saaledes ved Spitsbergen, er den særdeles talrig.

[1] „Norges Fiske", p. 30 (1874).

osseous granulations, each (in the specimen exhibiting no trace of mutilation) surrounded by a ring of mucous pores. These clusters of granulations, in size about equal to the diameter of the lens, are first arranged in two rows, extending from the edge of the eye to the branchial opening, but, gradually increasing in number, they encroach upon the intermediate space; and in the largest specimens a very considerable portion of the upper surface of the head is armed in this manner. According to Lütken, however, this spinous covering does not always occur even in full-grown individuals.

Very young examples have the uppermost spine on the preoperculum proportionately longer than individuals in a more advanced stage of growth, the tip of the point almost reaching to the posterior margin of the operculum. In examples with a total length of 80^{mm}, this spine, at the point, is still obtuse bipartite, maturer individuals only having it sharp and distinctly trifurcate; in an adult specimen (a female, from Vadsø, in Finmark) the spine on the right side was furcated with four, that on the left with five well-defined denticles.[1]

Food. — In one of the specimens examined the stomach was distended with small fragments of Annelids *(Polynoë)*. The ventricles of the individuals I had the opportunity of examining in 1874, in the Varanger Fjord, East Finmark, contained only remains of crustaceans, *Gammaridæ* and *Idotheæ*.

Distribution. — Up to the present time *G. pistilliger* (better known as *Phobetor ventralis* or *Ph. tricuspis*) is the only well determined species of its genus, the sole character distinguishing it from the genus *Cottus* being the absence of vomerine teeth. Its synonomy has been exhaustively treated of by Dr. Lütken, in Vid. Medd. Naturh. Foren. Kbhvn. 1876, p. 363. In its distribution it would appear to be almost circumpolar, and will hardly fail to be met with throughout any region of the Arctic Ocean off the shores of Europe, Asia, and America. As far back as 1780, Fabricius described the species (under the name of *Cottus gobio*) as occurring on the coast of Greenland; more recently it has been met with off Kamtschatka and Bering's Straits, as far east as Japan, and, in a westerly direction, along the northern coast of Asia, as far as Novaja Zemlja, Spitzbergen, Finmark, Iceland, Greenland, and Arctic America, and southwards, off Nova Scotia, in lat. 45° N. In many of these localities, e. g. on the coast of Spitzbergen, it is exceedingly numerous.

[1] "Norges Fiske," p. 30 (1874).

Gen. Centridermichthys, Richards.

Zool. Voy. Sulph. Fishes, p. 73 (1843).

Hovedet forholdsvis fladtrykt og bredt, Legemet trindt, glat eller granuleret. Præoperculum væbnet. Tænder i Kjæverne, paa Vomer og paa Palatinbenene. Sidelinie tilstede. 2 Dorsaler. Gjællehinderne sammenhængende paa Hovedets Underside.

7. Centridermichthys uncinatus, (Reinh.) 1833—34.

(Pl. I. fig. 7).

Cottus uncinatus, Reinh. Overs. 1833—34, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 6. Del, p. XLIV, Kbhvn. 1837 (1833—34).
Icelus uncinatus, Kr. Naturh. Tidsskr. 2. Række, 1. B., p. 263 (1844).
Centridermichthys uncinatus, Günth. Cat. Fish. Brit. Mus. Vol. 2, p. 172 (1860).

Diagn. *Legemet overalt glat, ligesom Sidelinien; den sidste bestaaende af omtr. 18 Porer. Hovedet indeholdes $3^1/_2$ Gange i Totall. Øjnene særdeles tætstaaende og store, indeholdes omtrent $2^4/_5$ Gange i Hovedlængden. Præoperculum har 2 Torne, den øvre kloformig krummet og særdeles skarp. Et Par stumpe Knuder paa Baghovedet. Bundfarven hvidagtig med graabrune Pletter, der hos de Yngre oftest ere 3 nedad Ryggen, men mere uregelmæssige hos de Ældre. Analpapille mangler. Størrelsen indtil 100 mm.*

M. B. 6. 1 D. 7—8; 2 D. 13 (12 eller 14); A. 11; P. 18—19 (20—21); V. 4; C. 4/11/4. Lin. lat. 18.

Localit. fra Nordh. Exped. Havet mellem Nordcap og Spitsbergen.

	Stat. 262.	*Stat.* 275.	*Stat.* 290.	*Stat.* 323.	*Stat.* 326.
Beliggenhed.	50 Kil. Ø. Vardø.	370 Kil. Ø. Beeren Eiland.	210 Kil. NV. Hammerfest.	180 Kil. SO. Beer. Eiland.	100 Kil. S. Spitsbergen.
Dybde.	148 Favne (271 m).	147 Favne (269 m).	191 Favne (349 m).	223 Favne (408 m).	123 Favne (225 m).
Temp. p. Bunden.	+ 1,9° C.	— 0,4° C.	+ 3,5° C.	+ 1,5° C.	+ 1,6° C.
Bunden.	Ler.	Grønligt Ler.	Sandholdigt Ler.	Brungraat Ler.	Mørkt Ler.
Datum.	27de Juni 1878.	2den Juli 1878.	7de Juli 1878.	30te Juli 1878.	3die Aug. 1878.
Antal Indiv.	1 Indiv.	3 Indiv.	4 Indiv.	1 Indiv.	3 Indiv.

Bemærkninger til Synonymien. Slægten *Centridermichthys,* opstillet af Richardson i Zool. Voy. Sulph. Fishes p. 73 (1843) for et Antal cottoide Fiske fra det arctiske Nord-America samt Nordost-Asiens Kyster, adskiller sig alene ved Tilstedeværelsen af Tænder paa Palatinbenene fra den typiske Slægt *Cottus.* Hidtil er alene en enkelt Art, *C. uncinatus,* (Reinh.), funden i Europa; denne opstilledes af Reinhardt sen. fra Grønland i 1833 under Navnet *Cottus uncinatus.*

Den korte Diagnose, hvormed Reinhardt ledsagede sin nye Art, er indtil de seneste Aar bleven uden Tillæg gjentaget, saaledes i 1844 af Krøyer (Naturh. Tidsskr. 2den

Gen. Centridermichthys, Richards.

Zool. Voy. Sulph. Fishes, p. 73 (1843).

Head comparatively depressed and broad; body plump, smooth or granulated; preoperculum armed; teeth in jaws, on vomer, and palatine bones. Lateral line obvious; two dorsal fins; branchial membrane continuous on the under surface of the head.

7. Centridermichthys uncinatus, (Reinh.) 1833—34.

(Pl. I. fig. 7.)

Cottus uncinatus, Reinh. Overs. 1833—34, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 6. Del p. XLIV, Kbhvn. 1837 (1833—34).
Icelus uncinatus, Kr. Naturh. Tidssk. 2. Række, 1. B. p. 263 (1844).
Centridermichthys uncinatus, Günth. Cat. Fish. Brit. Mus. Vol. 2, p. 172 (1860).

Diagnosis. — *Body and lateral line smooth; the latter consisting of 18 pores; length of head to total length as 1 to $3^1/_2$; eyes exceedingly close together, and large, longitudinal diameter to length of head as 1 to $2^4/_5$; two spines on preoperculum, the upper ungueal, hooked, and exceedingly sharp; two blunt obtuse protuberances on the occiput; ground colour whitish, with greyish brown spots, generally three in young examples, varying more in adults. Anal papilla wanting; length reaching 100 mm.*

M. B. 6. 1 D. 7—8; 2 D. 13 (12 or 14); A. 11; P. 18—19 (20—21); V. 4; C. 4/11/4. Lin. lat. 18.

Locality (North Atl. Exped.): — The open sea, between the North Cape and Spitzbergen.

	Stat. 262.	*Stat.* 275.	*Stat.* 290.	*Stat.* 323.	*Stat.* 326.
Exact Locality.	50 Kil. E. of Vardø.	370 Kil. E. of Beeren Eiland.	210 Kil. NW. Hammerfest.	180 K. SE. Beeren Eiland.	100 Kil. S. Spitzbergen.
Depth.	148 Fath. (271 m).	147 Fath. (269 m).	191 Fath. (349 m).	223 Fath. (408 m).	123 Fath. (225 m).
Temp. at Bottom.	+ 1.9° C.	— 0.4° C.	+ 3.5° C.	+ 1.5° C.	+ 1.6° C.
Bottom.	Clay.	Greenish Clay.	Sandy Clay.	Brownish-grey Clay.	Dark Clay.
Date.	27th June 1878.	2nd July 1878.	7th July 1878.	30th July 1878.	3rd Aug. 1878.
Numb. of Specim.	1 Indiv.	3 Indiv.	4 Indiv.	1 Indiv.	3 Indiv.

Remarks on the Synonymy. — The genus *Centridermichthys,* etablished by Richardson in Zool. Voy. Sulph. Fishes, p. 73 (1843) for divers Cottoid fishes occurring in the Arctic regions of North America and off the northeastern shores of Asia, is distinguished from the typical genus *Cottus* solely by the presence of teeth on the palatine bones. Up to the present time, but a single species, *C. uncinatus,* (Reinh.), has been met with in Europe; it was first described by Reinhardt sen. from the coast of Greenland, in 1833, under the name of *Cottus uncinatus.*

The brief diagnosis given by Reinhardt has been copied, till but a few years since, without addition, by Krøyer in 1841 (Naturh. Tidsskr. 2. Række, 1. Bind), and by Gün-

Række, 1ste B.), og i 1860 af Günther (Cat. Fish. Brit. Mus. vol. 2), hvilke begge ikke kjendte Arten af Autopsi. I 1868 anmeldtes den af Professor Esmark fra Finmarkens Kyster (Forh. Skand. Naturf. 10de Møde), ligesom Dr. Lütken i 1876 gav en Del Bemærkninger om Arten i Medd. Nat. Foren. Kbhvn. for samme Aar. Nogen udførligere Beskrivelse er, saavidt vides, ikke fremkommet, uden i 1874 i Forfatterens Afhandling „Norges Fiske" (efter Exemplarer fra Norge), ligesom den hidtil ikke har været afbildet. Jeg gjengiver derfor her Artens Beskrivelse, sammenholdt med de nytilkomne og vel vedligeholdte Exemplarer fra Nordhavs-Expeditionen.

Beskrivelse. *Legemsbygning.* Fra alle de øvrige nordatlantiske Cottoider kan *C. uncinatus* i Regelen let kjendes ved sin af faatallige og store Porer dannede Sidelinie, der især hos yngre Individer er iøjnefaldende, i Forbindelse med hele Legemets Glathed, idet dette ikke viser Spor af Protuberantser eller Granulationer. Særdeles characteristisk er fremdeles den krogformige Klo paa Praeoperculum, medens Palatintænderne først blive tydelige hos de noget større Unger.

Legemet har iøvrigt den for den nærstaaende Slægt *Cottus* almindelige Form, idet Hovedet er temmelig fladtrykt, og det egentlige Legeme er fortil næsten trindt, bagtil mere sammentrykt.

Hovedet er bredt ægformigt, og indeholdes hos de udvoxede omkring $3^1/_2$ Gange i Totallængden, eller lidt over $2^1/_2$ Gange i Legemets Længde uden Caudal. Øjnene ere særdeles tætstaaende, saaledes, at Benbroen mellem Orbitae blot er en Brøkdel af Lindsens Diameter. De ere tillige overordentlig store; deres Længdediameter er saaledes betydeligt større, end Snudens Længde, og udgjør omtrent $2^4/_5$ af Hovedets Længde.

Størrelsen af Crystallindsen er en mærkelig Variation underkastet, idet denne, som bekjendt, plejer at være constant af samme Størrelse hos ligestore Individer af samme Art. Medens saaledes hos det største af de under Expeditionen erholdte Individer, hvis Totall. var 83 mm, Lindsen havde en Diameter af 2,5 mm, var den hos et yngre Individ, hvis Totall. var blot 68 mm, omtr. 3,5 mm; andre udviste Overgange mellem begge. Nogen Forskjel i Legemsbygningen forøvrigt kunde ikke opdages; heller ikke stod denne Variation i noget bestemt Forhold til Dybden, idet netop det største Individ var taget paa det grundeste Vand (123 Favne), og det mindre paa en kun ubetydeligt større Dybde (148 Favne).

Tænderne ere temmelig fine, og tilstede (foruden i Kjæverne) tillige paa Vomer og paa Palatinbenene. Hos Unger med en Totall. af under 20 mm ere Vomerin- og Palatintænderne endnu ikke fremkomne. Gjællehinderne ere sammenhængende paa Hovedets Underside; Antallet af Gjællestraaler er 6.

Kjæverne ere omtrent af samme Længde; dog bevirker den tykkere Overlæbe, at Overkjæven synes ubetydeligt længere, end Underkjæven.

ther, in 1860 (Cat. Fish. Brit. Mus. Vol. 2), neither of whom knew the fish from autopsy. In the year 1868 Professor Esmark gave notice of its occurrence on the coast of Finmark (Forh. Skand. Naturf. 10 Møde); and in 1876 Dr. Lütken communicated sundry observations on the species in Medd. Nat. Foren. Kbhvn. for that year. No full description however had, we believe, appeared previous to that given in "Norges Fiske" (1874), from Norwegian specimens; nor has the species yet been figured. The detailed description, supplemented from an examination of the specimens — in an excellent state of preservation — obtained on the North Atlantic Expedition, is given below.

General Description. *Structure of the Body. — C. uncinatus* may as a rule be readily distinguished from all other North Atlantic Cottoids by the large size and fewness of the pores constituting its lateral line, a conspicuous character, more particularly in young examples; moreover, by the smoothness of the skin, not a vestige of granulations or protuberances can be detected in any part of the body. Another salient feature is the ungueal spine on the preoperculum; the palatine teeth, on the contrary, are not developed in very young individuals.

In other respects the form and structure of the body corresponds with that of the allied genus *Cottus,* the head being considerably depressed and the body roundish, the posterior part somewhat compressed.

Head broad, ovate; length to total length, in adult examples, about as 1 to $3^1/_2$ or, to length of body, exclusive of caudal, a trifle more than as 1 to $2^1/_2$. Eyes set exceedingly close, the length of the osseous ridge between the orbits being but a fraction of the diameter of the lens; they are also remarkably large, the longitudinal diameter considerably exceeding the length of the snout and nearly equal to $2^4/_5$ of the length of the head.

The size of the crystal lens, generally constant in individuals of equal dimensions belonging to the same species, varies remarkably in *C. uncinatus.* In the largest of the specimens obtained on the Expedition, total length 83 mm, the diameter of the lens was 2.5 mm, whereas in a younger example, total length not more than 68 mm, it reached 3.5 mm; others represented the transition stages. No other difference could be detected in the form and structure of the body; nor was this characteristic peculiarity in any way dependent on depth, the largest individual having been taken in the shallowest water (123 fathoms), and the small example at a depth but very little greater (148 fathoms).

Teeth — rather slender — on the vomer and palatine bones, and in the jaws. In young examples, total length less than 20 mm, the vomerine and palatine teeth were not yet developed. Branchial membrane continuous on under surface of head; brancheostegals 6.

Jaws equal in length, the upper, however, appearing to be somewhat longer than the lower, from the thickness of the upper lip.

Praeoperculum har 2 Torne, den nederste kort, nedadrettet, og lidet fremtrædende; den øverste lang og krogformigt bøjet indad, overordentlig spids og stærk, samt fra oven og neden noget sammentrykt; med sin Spidse naar den ikke tilbage til den øvre Flig af Operculum. I fuldkommen uskadt Stand er denne kloformige Torn lige ud til Spidsen beklædt med Hud, der ganske udfylder dens indre concave Del. Ved Grunden af den store Torn findes paa Forsiden en mindre, der dog hos uskadte Individer neppe lader sig iagttage, uden ved Følelsen. Operculum har en enkelt Torn nedentil, men ender oventil i en blød og afrundet Flig, nedenfor hvilken der skjuler sig en lav, men skarp Torn. Mellem det forreste og bagre Par Næsebor findes et Par korte opstaaende Torne, og paa Baghovedet et Par lignende, der ere bagudrettede, men som alle ere, ligesom de øvrige Torne, lidet fremtrædende af Huden.

Sidelinie, Porer og Hudtraade. En Række af 5—6 Porer strækker sig fra det forreste Par Næsebor paa hver Side bagover under Øjet, og standser omtrent ved Bagkanten af Orbita. Lignende Rækker strække sig paa Undersiden af Underkjæven.

Sidelinien er hos de yngre Ind. dannet af store og aabentstaaende Porer, hvis Antal sjelden overstiger 18, skjønt det ikke altid er det samme paa begge Sider. Hos de ældre Ind. ere Porerne mindre, men deres oprindelige Omkreds kan endnu sees som afbrudte, lidt ophøjede Ringe. Hos Yngel med en Totall. af under 12^{mm} er Sidelinien endnu usynlig, men allerede, hvor Legemet har naaet en Længde af 15^{mm}, ere omtrent 5—6 Porer fremkomne paa Legemets forreste Del.

Af Hudtraade paa Hovedet findes en yderst kort paa Bagranden af Overkjæven, umiddelbart foran Mundvinkelen, altsaa paa samme Punkt, hvor en lignende er tilstede hos *Cottus bubalis* og *C. lilljeborgii*. Hos alle uskadte Individer findes endvidere en enkelt Traad ved den øvre Rand af Orbita, der ikke (som hos *Icelus hamatus)* er haandformig fladtrykt, men tilspidset; denne gaar let tabt ved Berøring.

Finnerne. Straaleantallet synes idethele at være en forholdsvis ringe Variation underkastet, sammenlignet med, hvad der finder Sted hos *Icelus hamatus* og flere andre Cottoider.

1ste Dorsal har 7 eller 8 Straaler, der begynde umiddelbart over Pectoralernes øvre Fæste, og ende noget bagenfor Anus. Den har ingen betydelig Højde, idet denne sjeldent overstiger Hovedets halve Længde.

2den Dorsal har 13 Straaler, hos enkelte Individer 12 eller 14, og begynder uden Interdorsalrum bag 1ste Dorsal; den har noget større Højde, end denne, og naar med Spidsen af sine længste Straaler i omtr. en halv Orbitaldiameters Afstand fra Roden af Caudalen, eller undertiden kortere.

Two spines on preoperculum, the lower short, inclining downwards, and but slightly developed; the upper long, hooked, remarkably sharp and powerful, above and below slightly depressed; the point does not reach back to the upper edge of the operculum. Specimens in perfect preservation have this strong hooked spine protected to the apex by the integument, which fills up and conceals the inner groove. At the base of the large spine, on the anterior side, occurs a smaller one, which, however, in well-preserved examples can hardly be observed, save by the touch. Operculum furnished below with a single spine; above, it terminates in a soft, convex flap, concealing beneath a depressed, but sharp-pointed spine. Between the anterior and posterior pairs of nostrils occur two short spines, and, on the occiput, two others, all of which, however, in common with the other spines, are directed backwards, and project but slightly above the integument.

Lateral Line, Mucous Pores, and Cirri. — A row of 5 or 6 pores extends from the anterior nostrils, on each side, backwards under the eye, terminating in close proximity to the posterior edge of the orbita. Similar series occur on the under surface of the lower jaw.

In young examples, the lateral line is composed of large and open pores, seldom exceeding 18, which, however, are not always equal in number on both sides. In more mature individuals the pores are smaller; their original circumference being, however, distinctly obvious, as disrupted and slightly protuberant rings. In fry-specimens (having a total length of less than 12^{mm}), the lateral line cannot yet be distinguished, but so soon as the body has attained a length of 15^{mm}, 5 or 6 pores are obvious in the anterior region.

The head is furnished with one cirrus, exceedingly short, on the posterior margin of the upper jaw, immediately in front of the angle of the mouth, in the exact spot where a similar cirrus occurs in *Cottus bubalis* and *C. lilljeborgii*. In perfect specimens a cirrus is also observed on the superior margin of the orbits, tapering to a point (not thin and riband-shaped as in *Icelus hamatus)*; being very slenderly attached to the skin, great care must be taken to preserve it uninjured.

Fins. — In *C. uncinatus* the number of fin-rays is apparently subjected to but slight variation as compared with this feature in *Icelus hamatus* and divers other species of Cottoids.

The first dorsal, furnished with 7 or 8 rays, commences immediately above the upper extremity of the base of the pectorals, and terminates at a short distance behind the anus; its height is not considerable, rarely exceeding half the length of the head.

The 2nd dorsal has 13, in some individuals 12 or 14 rays; it is contiguous to the 1st dorsal, exceeding it however somewhat in height, the tip of the longest rays extending to a distance of about half the diameter of the orbit from the base of the caudal, sometimes not quite so far.

Analen har 11 Straaler, og begynder umiddelbart bag Anus; den har Højde og Udstrækning omtr. som 2den Dorsal, og slutter i en neppe kjendelig større Afstand fra Caudalens Rod, end denne.

Pectoralerne, der tælle 18 Straaler, undertiden 19—21, ere bredt afrundede, som hos Slægten *Cottus;* i Spidsen ere de nedre Straaler fri og noget fortykkede. Tilbageslaaede naa de med Spidserne langt forbi Anus, eller (hos de udvoxede Individer) ved eller noget forbi Begyndelsen af 2den Dorsal.

Ventralerne ere forholdsvis lange, og naa med sine fri Spidser næsten til Anus. De have 4 Straaler.

Caudalen har 11 leddede Straaler, der i sin ydre Fjerdedel ere kløvede. Paa hver Side af de leddede Straaler findes 3—4 uleddede Støttestraaler, der dog kunne være næsten rudimentære.

Farven. Denne viser hos de yngre Individer den sædvanlige Fordeling af 3 graabrune Tverbaand tversover Legemet, hvis Bundfarve er hvidagtig; det mellemste af disse Tverbaand, der udgaar fra Grunden af 2den Dorsal, er bredest, og har omtr. en Orbitaldiameters Bredde. Hos ældre Individer ere Tverbaandene ikke saa skarpt tegnede, idet de ofte indeslutte Felter af den lyse Bundfarve, ligesom ogsaa Mellemrummene mellem dem kunne være saa opfyldte af Smaapletter, at Tverbaandene blive ganske utydelige.

Finnerne, hvis Grundfarve er hvid (især hos de ældre), ere forsynede med skarpttegnede, skraatløbende Tverbaand; svagest tegnet er Analen, hvis Tverbaand oftest ere utydelige. Iøvrigt er saavel Finnernes, som Legemets Farvetegning ikke ubetydeligt varierende hos de forskjellige Individer.

Spæd Yngel, hvoraf jeg har et stort Antal fra Varangerfjorden med en Totall. af indtil 10 ^{mm}, have en ret characteristisk Farvetegning, idet et sort Baand strækker sig rundt Nakken og Struben som et Halsbaand; paa Siderne af Legemet gaar dette mørke Parti ud som en bred Stribe.

Forplantning, etc. Yngletiden for denne Art falder sandsynligvis i Juli og August, da flere af de erholdte Individer havde Bugen stærkt udspilet af Rogn. Et af disse (fra Stat. 275), der erholdtes den 2den Juli, og som havde en Totall. af 69 ^{mm}, havde omtr. 32 Rogn i hvert Ovarium; disse Rogn havde en forholdsvis betydelig Størrelse, idet deres Diameter var omtr. 2 ^{mm}. Foruden disse 64 Rogn, der alle vare jevnstore, og syntes at være fuldmodne, fandtes et Antal yderst fine Rognkorn, der vare forblevne uudviklede.

Individernes Størrelse varierede hos de fleste mellem 66 og 83 ^{mm}, og de maa, da de viste sig forplantningsdygtige, have været fuldvoxne eller nær derved. Dr. Lütken har undersøgt et Exemplar fra Grønland (i Musæet i Kbhvn.), der havde en Totallængde af 100 ^{mm}.

The anal, furnished with 11 rays, commences immediately behind the vent; height and extent about that of second dorsal; it terminates, too, very nearly at the same distance from the base of the caudal, as does that fin.

The pectorals, furnished. with 18 rays, sometimes 19—21, are broad and rounded, as in the genus *Cottus;* extremities of lower rays free and somewhat thick. Directed backwards, the points extend some distance past the vent; or (in full-grown specimens) a short distance beyond the commencement of the second dorsal.

The ventrals are comparatively long, the free points extending almost to the vent; number of rays 4.

The caudal is furnished with 11 articulated rays, cleft in their outer fourth. On either side of the articulated rays occur 3—4 auxiliary rays without articulation, which, however, in some examples are almost rudimentary.

Colour. — Young individuals exhibit the normal distribution: 3 greyish brown transverse bands across the body, ground-colour whitish; the middle band, commencing at the base of the second dorsal, is the broadest, having a breadth about equal to the diameter of the orbit. In maturer individuals the transverse bands are less distinctly traced, being broken up with patches of the ground-colour; the intermediate space, too, is blurred with such a multitude of spots and macules as to be frequently almost confluent with the bands.

The fins, the ground-colour of which is whitish, are (more particularly in mature examples) marked with well-defined, oblique transverse bands; marking of anal faint, the transverse bands being frequently indistinct. For the rest, both the fins and the body generally display very considerable variation in the distribution of colour.

Fry in the earliest stage of growth, of which I am in possession of a large number of specimens from the Varanger Fjord (total length 10 ^{mm}), exhibit a most characteristic peculiarity of marking, a black band encircling the throat and nuchal region like a necklace; on the sides, this dark colour stretches posteriorly in the form of a broad stripe.

Propagation &c. — The spawning season of this species is probably in the months of July and August, the abdomen in several of the specimens obtained having been found distended with roe. One (Station 275), taken July 2nd, total length 69 ^{mm}, had about 32 ova in each ovary; these ova were comparatively of large size, the diameter being about 2 ^{mm}. Exclusive of these ova, 64 in number, all of which were large and apparently mature, the ovaries contained a number of minute ovarious germs, which had remained undeveloped.

The dimensions varied in most of the individuals between 66 and 83 ^{mm}, and these specimens, seeing they were about to spawn, must have been full-grown, or very nearly so. Dr. Lütken has examined an individual from the coast of Greenland (preserved in the Zoological Museum, Copenhagen) with a total length of 100 ^{mm}.

Ventrikelen indeholdt hos de undersøgte Individer følgende: Hos 3 Indvider fra en Dybde af 191 Favne (Stat. 290), hvor Bunden bestod af sandholdigt Ler, indeholdt Ventrikelen hos det ene Anneliden *Notomastus latericeus,* M. Sars; hos det andet ligeledes en Annelide, *Chloraema pellucidum,* M. Sars; det tredie havde Ventrikelen fyldt med smaa Mollusker, som (ifølge Bestemmelse af Dr. Friele) vare *Velutina undata,* Brown, og *Yoldia intermedia,* M. Sars. Et Individ fra Stat. 275 (fra 147 Favnes Dyb) havde Ventrikelen fyldt med forskjellige smaa Annelider, hvoraf kunde kjendes en *Clymene* og en liden *Polynoë,* der dog ikke lode sig nærmere bestemme.

Samtlige disse Dyr ere Bunddyr, og Arten lever utvivlsomt, ligesom de øvrige cottoide Former, umiddelbart paa og ved Bunden, hvad der ogsaa fremgaar af dens Legemsbygning.

Udbredelse. *Centrid. uncinatus* er en arctisk Art, der sandsynligvis optræder paa den noget grundere Havbund paa de fleste Steder mellem Grønland, Spitsbergen, Novaja Zemlja og Norge. Oprindelig blev Arten beskreven af Reinh. sen. i 1833—34 efter Exemplarer fra Grønlands Sydkyst (Nennortalik i Julianehaabs Distrikt). Senere er den fra og til nedsendt til Musæet i Kjøbenhavn fra Grønland, men synes, ifølge Dr. Lütken, ikke at forekomme talrigt her. At den ikke indsamledes under den engelske Nordpol-Expedition i 1875—76 i de nordgrønlandske Farvande mellem 78° og 83°, synes forklarligt, naar man betragter dens forholdsvis sydlige Udbredelse i Europas arctiske Egne. Den er nemlig hidtil ikke fundet under nogen af de talrige Expeditioner omkring Spitsbergen; det nordligste Punkt, hvor den hidtil vides iagttagen, er paa den ovenfor nævnte Stat. 326, under 75° 31′, eller omtr. midtveis mellem Beeren Eiland og Spitsbergen; imidlertid tør det med Sikkerhed forudsættes, at den naar op til de sydligste Dele af denne Øgruppe. Mellem Spitsbergen og Norges Kyster synes den at være jevnt udbredt over Havbunden, hvor denne hæver sig op til et Par Hundrede Favnes Dybde, hvorimod den ikke erholdtes paa de vestenfor liggende større Dyb; mod Øst gaar den idetmindste til Novaja Zemlja, hvor et Par Individer erholdtes ved Sælhundbugten, under Heuglins Expedition i 1871, hvilke afgaves til Universitetsmusæet i Christiania af Expeditionens Deltager, Cand. Aagaard.

Ved Jan Mayen erholdtes intet Individ under Nordhavs-Expeditionens (vistnok ikke særdeles talrige) Skrabninger omkring denne Ø i 1877; heller ikke er den hidtil fundet ved Island.

Langs Norges Kyster optræder den paa forskjellige Punkter fra Varangerfjorden og Nordkap af, og ned til Stavangerfjorden, som det synes, ikke særdeles sparsomt. Den sidstnævnte Localitet (59°) er det sydligste Punkt, hvor Arten hidtil er observeret, men den vil sandsynligvis ogsaa vise sig at bebo Bankerne udenfor Orknøerne og Shet-

The *ventricles* of the specimens examined were on dissection found to contain marine animals of the following species: — Of 3 individuals taken at a depth of 191 fathoms (Station 290), bottom argillaceous clay, I found a *Notomastus latericeus,* M. Sars, in the stomach of one; in that of the second, an example of another Annelid, *Chloræma pellucidum,* M. Sars; that of the third was full of small mollusks, belonging (as determined by Dr. Friele) to the species *Velutina undata,* Brown, and *Yoldia intermedia, M. Sars.* An individual taken at Station 275 (depth 147 fathoms) had its ventricle full of divers small Annelids, among which a *Clymene* and a small *Polynoë* admitted of being determined.

These animals are all of them bottom-species, and *C. uncinatus,* in common with the other Cottoid forms, unquestionably has its habitat either directly on, or very near to, the bottom, a circumstance also explained by the structure of its body.

Distribution. — *Centr. uncinatus* is an Arctic species, occuring, where the bottom is comparatively shallow, in most localities between Greenland, Spitzbergen, Nova Zemlja, and Norway. The species was first described by Reinhardt sen., 1833—34, from specimens taken on the south coast of Greenland (Nennortalik, in the district of Julianehaab). More recently it has now and again been sent from Greenland to Copenhagen, but, according to Dr. Lütken, does not seem to be common there. Its not having been taken on the English Polar Expedition (1875—76) off North-Greenland, in lat. between 78° and 83° N., is hardly a matter of surprise, if we consider the comparatively southern range of the species in the Arctic regions of Europe. Hitherto no example has been obtained from the shores of Spitzbergen; the most northerly point at which, up to the present time, it is known to have been observed, is Station 326, mentioned above, in lat. 75° 31′ N., or about mid-way between Beeren Eiland and Spitzbergen; we may however safely regard its range as extending to the southern part of that group of islands. Between Spitzbergen and the coast of Norway it would appear to be equably distributed over the surface of the bottom in all localities where the depth of the ocean does not exceed a couple of hundred fathoms; further west, at greater depths, it has not been met with. In an easterly direction the species occurs at least as far as Nova Zemlja, where two examples were taken on Heuglin's Expedition in 1871, in Seal Bay, by Dr. Aagaard.

Off the coast of Jan Mayen no individual of this species was obtained on the Expedition when dredging (not very frequently, it is true) round that island, nor has it as yet been observed on the coast of Iceland.

On the Norwegian coast it occurs in divers localities, from the Varanger Fjord and the North Cape as far south as Stavanger; and apperently not as a rare species. The last-mentioned locality (in lat. 59° N.) is the most southerly point at which the species has been observed; probably, however, it will be found to inhabit the banks

landsøerne, saavel som Færøerne, Island, og mod Øst det kariske Hav.

Ved de amerikanske Kyster synes den atter at forekomme talrigt, og at gaa særdeles langt mod Syd. Den optræder saaledes i stort Antal paa Dybderne i Massachusetts Bay ved New England-Staterne under 41° N. B. (Goode & Bean, 1879).

Gen. Icelus, Kr.

Naturh. Tidsskr. 2 Række, 1 B. p. 261, Kbhvn. 1844—45 (1844).

Hovedet forholdsvis sammentrykt. Legemet fortil trindt, bagtil stærkt sammentrykt. Huden tildels granuleret, og forsynet med en Række Bentorne langs Ryggen; Sidelinien ligeledes med skarpe Bentorne. Tænder (som hos Centridermichthys) tilstede i Kjæverne, paa Vomer, og paa Palatinbenene. Præoperculum væbnet. 2 Dorsaler. Gjællehinderne sammenhængende paa Hovedets Underside.

8. Icelus hamatus, Kr. 1844.

Pl. I, Fig. 8.

? *Cottus bicornis,* Reinh. Overs. 1839, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 8 Del, p. LXXV, Kbhvn. 1841 (1839).
Icelus hamatus, Kr. Naturh. Tidsskr. 2 Række, 1 B. p. 253 og 261 (1844).
? *Centridermichthys bicornis,* Günth. Cat. Fish. Brit. Mus. vol. 2, p. 172 (1860).
? *Icelus bicornis,* Gill, Proc. Acad. Nat. Sci. Philad. 1861, Suppl. p. 42 (1861).
Icelus furciger, Malm, Förh. Skand. Naturf. 9 Möte 1863, p. 410 (1863).

Diagn. *Legemet oventil tæt granuleret, ligesom Hovedet. Tornene langs Ryggen og i Sidelinien fint tandede; ofte findes tillige en kortere Tornerække langs Analen, samt spredte Bentorne langs Siderne. Hovedet indeholdes $3^1/_2$—4 Gange i Totall. Øjnene store og tætstaaende, indeholdes omtr. 3 Gange i Hovedlængden. Præoperculum har 4 Torne, den øverste med kløvet Spidse; 1 Par Knuder over Øjnene, 2 Par paa Panden. Sidelinien fortil højtliggende, men bøjer skraat nedad over Pectoralen; senere ret. 1ste Dorsalstraale dobbelt. Farven hvidlig gul med uregelmæssige brunsorte Pletter paa Hovedet og Legemets Overside (hos de yngre 3 større Ryggpletter); en distinct mørk Plet under Øjet, og en lignende ved Roden af Pectoralen. Hannen med Analpapille. Størrelsen indtil 115^{mm} (Hun).*

M. B. 6. 1 D. 8—9 (7); 2 D. 18—20 (17); A. 13—15 (16); P. 17—19; V. 4; C. 5/12/5. Lin. lat. indtil 45.

lying off the Orkney and Shetland Islands, also the shores of the Faröe Islands, the coast of Iceland, and the Kara Sea.

On the coast of North America it would appear to be a common fish, occurring abundantly — and here too far south — in Massachusetts Bay, on the coast of New England, in lat. 41° N. (Goode and Bean, 1879).

Gen. Icelus, Kr.

Naturh. Tidsskr. 2 Række, 1 B. p. 261, Kbhvn. 1844—45 (1844).

Head comparatively compressed; fore part of body plump, hind part compressed; skin granulated in places, armed along the dorsal ridge with a row of osseous spines; sharp spines, too, along the lateral line; teeth (as in Centridermichthys) in jaws, on the vomer, and on the palatine bones; preoperculum armed; 2 dorsal fins; branchial membrane continuous on under surface of head.

8. Icelus hamatus, Kr. 1844.

Pl. I, fig. 8.

? *Cottus bicornis,* Reinh. Overs. 1839, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 8 Del, p. LXXV, Kbhvn. 1841 (1839).
Icelus hamatus, Kr. Naturh. Tidsskr. 2 Række, 1 B. p. 253 and 261 (1844).
? *Centridermichthys bicornis,* Günth. Cat. Fish. Brit. Mus. vol 2, p. 172 (1860).
? *Icelus bicornis,* Gill, Proc. Acad. Nat. Sci. Philad. 1861, Suppl. p. 42 (1861).
Icelus furciger, Malm, Förh. Skand. Naturf. 9 Möte 1863, p. 410 (1863).

Diagnosis. — *Upper surface of body and head covered with rough granulations; spines along dorsal ridge and lateral line slightly denticulated; frequently a shorter row occurs along the anal, and spines, irregularly disposed on the sides. Length of head to total length as 1 to $3^1/_2$—4, eyes large and closely set, longitudinal diameter $^1/_3$ of the length of the head. Preoperculum with 4 spines, point of uppermost bifurcate. One pair of obtuse protuberances above the eyes, two pairs on the front. Lateral line in fore part of body high up the side, deflected downwards over the pectorals, from thence straight; first ray of first dorsal double. Colour whitish-yellow, on the head and upper surface of the body maculated with irregular brownish-black spots (in young examples 3 large dorsal spots); a distinct darkish spot under the eye, another at base of pectorals. The male with an anal papilla. Size reaching 115^{mm} (female).*

M. B. 6; 1 D. 8—9 (7); 2 D. 18—20 (17); A. 13—15 (16); P. 17—19; V. 4; C. 5/12/5. Lin. lat. up to 45.

Localit. fra Nordh. Exped. Jan Mayen; Spitsbergen.

	Stat. 223.	*Stat.* 224.	*Stat.* 366.
Beliggenhed.	Jan Mayen.	Jan Mayen.	Magdalenebay, Spitsbergen.
Dybde.	70 Favne (128 m).	95 Favne (174 m).	50 Favne (91 m).
Temp. paa Bunden.	— 0,6° C.	— 0,6° C.	— 1,0° C.
Bunden.	Sort Sand og Ler.	Sort Sand og Ler.	Mørkgraat Ler.
Datum.	1ste Aug. 1877.	1ste Aug. 1877.	17de Aug. 1878.
Antal Indiv.	1 Indiv.	1 Indiv.	1 Indiv.

Bemærkninger til Synonymien. Slægten *Icelus*, opstillet i 1844 af Krøyer (Naturh. Tidsskr. 2 Række, 1ste B.) for ovennævnte, hidtil eneste bekjendte Art, danner ved sine Rækker af skarpe Bentorne langs Ryggen og i Sidelinien blandt de arctiske Cottoider en Tilnærmelse til Slægten *Triglops*, med hvem den ogsaa har tilfælles det noget sammentrykte Hoved; i Tandbygning er den nærmest overensstemmende med *Centridermichthys*. Arten er udførligt beskreven allerede af Krøyer paa ovennævnte Sted, og herefter er dens Diagnose i Günthers Cat. Fish. Brit. Mus. vol. 2 (1860) affattet. Senere ere af flere Forfattere meddelte Bemærkninger vedrørende dens Optræden, saaledes ved Spitsbergen og de norske Kyster af Malmgren (Öfv. Kgl. Vet. Ak. Förh. 1864), af Esmark (Forh. Skand. Naturf. 10de Møde 1868), og af Collett (Norges Fiske 1874), ligesom Dr. Lütken har behandlet dens Synonymi etc. i 1876 (Vid. Medd. Naturh. Förh. Kbhvn., 1876, p. 380). Den er afbildet, (men ikke tilfredsstillende) i Gaimards Plancheværk til Corvetten la Recherche's Reise (Voyage Scand. Lap. etc. pl. 1). Endelig har Malm i 1877 (Göteb. och Boh. Fauna, p. 393) givet udførlig Beskrivelse af sin i 1863 (Forh. Scand. Naturf. 9de Möte 1863, p. 410) under Navn af *I. furciger* opstillede Art fra Bohuslen, der alene ved Tilstedeværelsen af en Række Bentorne ogsaa langs Analen adskiller sig fra *I. hamatus*, en Character, der dog ikke viser sig constant, men synes at være af ganske individuel Natur.

Bemærkninger til Beskrivelsen. De under Nordhavs-Expeditionen erholdte Individer havde følgende Maal:

	a. (Hun), Spitsbergen.	b. (Hun), Jan Mayen.	c. (Han), Jan Mayen.
Totallængde	43 mm	49 mm	61 mm
Længde uden Caudal .	36 -	40 -	50 -
Hovedets Længde . .	11,5 -	15 -	19 -
Øjets Længdediameter	4 -	5 -	6 -

Flere af de ydre Characterer ere hos denne Art i en mærkelig Grad varierende, saaledes Hudens mere eller mindre rigelige Beklædning med Bentorne, de sidstes Bygning i Rækkerne langs Ryggen og i Sidelinien, ligesom ogsaa Sideliniens Længde; endelig er Straaleantallet temmelig lidet constant.

Locality (North Atl. Exped.): — Jan Mayen and Spitzbergen.

	Stat. 223.	*Stat.* 224.	*Stat.* 366.
Exact Locality.	Jan Mayen.	Jan Mayen.	Magdalene Bay, Spitzbergen.
Depth.	70 Fathoms. (128 m).	95 Fathoms. (174 m).	50 Fathoms. (91 m).
Temp. at Bottom.	— 0.6° C.	— 0.6° C.	— 1.0° C.
Bottom.	Black Sand and Clay.	Black Sand and Clay.	Dark-grey Loam.
Date.	1st Aug. 1877.	1st Aug. 1877.	17th Aug. 1878.
Numb. of Specim.	1 Indiv.	1 Indiv.	1 Indiv.

Remarks on the Synonymy. — Among the family of the Arctic Cottoids the genus *Icelus*, established, in 1844, by Kröyer, for the only species then and yet known, approximates the genus *Triglops* in the rows of sharp-pointed osseous spines extending along the dorsal ridge and lateral line, another salient character common to both being the somewhat compressed head. In the structure of the teeth it bears greatest resemblance to *Centridermichthys*. The first to give a full description of the species was Kröyer (*vide* list of synonyms), and from the above description Dr. Günther has compiled a diagnosis in Cat. Fish. Brit. Mus. vol. 2 (1860). Observations have been subsequently furnished by several authors on its occurrence, by Malmgren, off Spitzbergen and the shores of Norway (Öfv. Kgl. Vet. Ak. Förh. 1864); by Esmark (Forh. Skand. Naturf. 10de Møde 1868); and by Collett (Norges Fiske 1874); a paper by Dr. Lütken, treating of the synonomy of the species &c. appeared, too, in 1876 (Vid. Medd. Naturh. For. Kbhvn., 1876, p. 380). *Icelus hamatus* is figured, but somewhat imperfectly, in the series of plates to Gaimard's Narrative of the voyage of the "Recherche" (Voyage Scand. Lap. etc., pl. 1). Finally, Malm furnished i 1877 (Göteb. och Boh. Fauna, p. 393) a detailed description of the form, from Bohuslen, described by him as *I. furciger*, which is distinguished from *I. hamatus* chiefly by a series of osseous spines along the anal fin, a character, however, which has not shown itself constant, but would seem to be altogether individual.

Descriptive Observations. — The individuals obtained on the Expedition measured as follows: —

	a. (female) Spitzb.	b. (female) Jan Mayen.	c. (male) Jan Mayen.
Total length	43 mm	49 mm	61 mm
Length exclusive of caudal	36 -	40 -	50 -
Length of head	11.5 -	15 -	19 -
Longitudinal diameter of eye	4 -	5 -	6 -

Many of the external characters in this species vary to a remarkable extent in different individuals, for instance, the space furnished with osseous denticles; the form and structure of these spinules in the rows along the dorsal ridge and the lateral line; the length of the lateral line; and the number of fin-rays.

Medens saaledes den Række af disse Bentorne, der løber langs Ryglinien, altid synes at strække sig uafbrudt lige til Roden af Caudalen, og det saaledes her er væsentlig de enkelte Tuberklers Bygning, der varierer med flere eller færre Tænder, med længere eller kortere Spidser, kan Sidelinien undertiden være manglende i sin sidste Del, uden at dette begrundes i Individets unge Alder. Medens 2 unge Hanner fra Stavangerfjorden i Norge (59°), optagne fra 100 Favnes Dyb i 1872, have Sidelinien fuldt udviklet lige til Haleroden med 35—37 Torne, skjønt Individernes Totallængde ikke er over 38 mm, er Sidelinien ufuldstændig hos alle de 3 større, der erholdtes under Nordhavs-Expeditionen; hos det mindste standser den henimod Slutningen af Analen, og har ialt 27 af disse benede Tuberkler; hos de 2 ældre, der have 33 Tuberkler, standser den noget bagenfor Analens Slutning. Det største Antal fandt Krøyer, der angiver 41—42 for sine Typ-Exemplarer, og Malm, som hos sin *I. furciger*, hvis Totallængde blot var 51 mm, fandt 45. I hvilken Grad disse benede Tuberkler selv variere i sin Bygning, har allerede Esmark gjort opmærksom paa i sine ovennævnte Bemærkninger i det 10de Naturforsker-Mødes Forhandlinger.

Intet af Nordhavs-Expeditionens 3 Individer havde Spor af den Række benede Tuberkler langs Analen, som ofte er tilstede hos Individer af Middelsstørrelse ved de scandinaviske Kyster, ligesom denne ogsaa fandtes (ifølge Dr. Lütken) hos det ene af Kröyers Typ-Exemplarer fra Grønland. En lignende Række udviste et Exemplar fra Spitsbergen, som jeg i 1879 havde Leilighed til at undersøge i Riks-Musæet i Stockholm. Disse Individer repræsentere Malms *I. furciger*.

At ligeledes den øvre gaffeldelte Torn paa Praeoperculum kan være ganske eller næsten udelt (hvilket er Regelen hos ganske unge Individer), har tidligere været gjort opmærksom paa. Dette var saaledes Tilfældet paa den ene Side af et af Nordhavs-Expeditionens større Individer.

Straaleantallet findes ligeledes at variere ikke ubetydeligt, hvad der fremgaar af nedenstaaende Fremstilling af de forskjellige Forfatteres Angivelser.

1 *D.*	2 *D.*	*A.*	
9	20	16	Grønland (Kr. 1844); Typ-Expl.
8—9	19—20	15—16	Spitsbergen 1861 (Malmgr. 1864).
8	18—19	14	Grønland (Malmgr. 1864).
9	17	13—14	Norge 1866—72 (flere Expl. C. 1874).
8	19	13	Norge 1866—72 (C. 1874).
9	19—20	14—15	(flere Expl. Lütken 1876).
9	20	15	Bohuslen 1861 (Malmgr. 1877).
8	18	13	Spitsbergen 1868 (C.).
8	20	15	Spitsbergen 1868 (C.).
7	19	13	Spitsbergen 1872 (C.).
8	19	15	Spitsbergen 1872 (C.).

The row of osseous spines along the mesial line invariably appearing to exend as a continuous series to the origin of the caudal fin, and the exceptional character of the armature in this region being chiefly displayed in the structure of the individual tubercles, which vary in the number of the teeth and the length of the points, the terminal part of the lateral line is sometimes wanting altogether, which cannot be accounted for by the immaturity of the individual. Two young male examples from the Stavanger Fjord, in Norway (in lat. 59° N.), taken at a depth of 500 fathoms, in 1872, had the lateral line fully developed to the root of the tail, number of spines 35—37; and yet the total length did not exceed 38 mm, whereas in all three of the larger specimens, obtained on the Expedition, the lateral line is more or less imperfect; in the smallest, furnished with 27 osseous spines, it breaks off a short distance from the termination of the anal; in the two maturer examples it has 33 tubercles, and terminates a little beyond the posterior extremity of the anal. The largest number of tubercles yet observed is 41—42, in Kröyer's typical specimens, and 45 in Malm's *I. furciger* (total length only 51 mm). The extent to which the tubercles vary in structure has been pointed out by Professor Esmark, in a paper read before the 10th General Meeting of Naturalists.

No one of the three specimens taken on the Expedition exhibited traces of the series of osseous tubercles along the anal fin frequently observed in half-grown examples from the shores of Scandinavia, and which, according to Dr. Lütken, occurs in one of Kröyer's typical specimens from Greenland. An example from Spitzbergen which I had the oppertunely of examining in 1879, in the Riks Museum at Stockholm, was furnished with a similar series. These individuals represent *I. furciger*, Malm.

That the upper spine on the preoperculum, commonly bifurcate, in some individuals occurs with little or no appearance of furcation, more particularly in the early stage of growth, has been noticed before. This distinction was observed in a specimen taken on the Expedition.

The very considerable variation in the number of the fin-rays is apparent from the subjoined table, comparing the formulae given by the different authors.

1 *D.*	2 *D.*	*A.*	
9	20	16	Greenland (Kr. 1844); typ. spec.
8—9	19—20	15—16	Spitzbergen, 1861 (Malmgr. 1864).
8	18—19	14	Greenland (Malmgr. 1864).
9	17	13—14	Norw. 1866—72 (sever. spec. C. 1874).
8	19	13	Norway 1866—72 (C. 1874).
9	19—20	14—15	(several specim. Lütken 1876).
9	20	15	Bohuslen 1861 (Malmgr. 1877).
8	18	13	Spitzbergen 1868 (C.).
8	20	15	Spitzbergen 1868 (C.).
7	19	13	Spitzbergen 1872 (C.).
8	19	15	Spitzbergen 1872 (C.).

Nordhavs-Expeditionens Individer havde følgende Straaleantal:

1 *D.* 8; 2 *D.* 19; *A.* 15. Spitsbergen 1878.
1 - 8; 2 - 20; - 15. Jan Mayen 1877.
1 - 8; 2 - 20; - 15. Jan Mayen 1877.

1ste Dorsal har saaledes 8 eller 9, sjelden 7 Straaler; af disse er den første altid kløvet til Grunden, et Forhold, der er ganske mærkeligt, og som jeg ikke hidtil har fundet omtalt. De øvrige ere alle enkelte. 2den Dorsal, der tæller 18—20, sjelden 17 Straaler, er højere, end 1ste Dorsal; omtrent den 6te Straale er den længste. Alle Straaler ere her enkelte. Analen, der har 13—15, eller hos enkelte Individer 16 Straaler, har omtrent den 8de Straale længst.

Pectoralerne have alle noget fri Spidser, især de nederste, der tillige, som det er Regelen hos de cottoide Fiske, ere noget fortykkede; den 7de eller 8de Straale fra neden af er den længste. Caudalen er tydeligt emargineret, med afrundede Hjørner.

Til Krøyers og Malmgrens detaillerede Beskrivelser af Arten kan yderligere føjes, at der, hvad allerede af Esmark er bemærket, hos uskadte Individer findes 3 særdeles fine Hudtrevler paa Hovedet. Den største af disse sidder ovenfor Øjets bagre Rand, og er fladtrykt, samt haandformig fryndset i Randen; de øvrige ere enkelte, korte Hudtrevler. Alle ere særdeles løstsiddende, og gaa tabte ved den mindste Berøring, hvorfor de i Regelen kun findes hos forholdsvis særdeles faa af de i Musæerne opbevarede Individer.

Medens fremdeles Bundfarven hos Individet fra Spitsbergen var temmelig lys, næsten hvidagtig, og viste de regulære 4 Tverpletter over Ryggen særdeles tydeligt, vare de i 1878 ved Jan Mayen erholdte Individer oventil saa rigeligt forsynede med brunsorte Smaapletter og Streger, at Bundfarven var næsten ganske skjult, og Tverpletterne kun utydeligt markerede. Dette tør maaske antages at staa i Forbindelse med de Bundforholde, under hvilke Individerne levede; ved Jan Mayen bestod Bunden af vulkansk sort Mudder, hovedsagelig af Lava; ved Spitsbergen var der Lerbund.

Udbredelse. *I. hamatus* hører til de i den arctiske Zone hyppigt optrædende Arter, og gaar (tilligemed *Cottus quadricornis)* sandsynligvis længere mod Nord, end nogen anden af de hidtil kjendte Cottoider. Fra Grønland er den oftere nedsendt til Musæet i Kjøbenhavn; i Vest-Grønland er den af den engelske Nordpol-Exped. (1875—76) fundet at være en af de almindeligste Fiske mellem 80 og 82° N. B., og gydefærdige Individer fandtes her i August. I Fjordene i Øst-Grønland er den af Germania- og Hansa-Expeditionen i 1869 fundet i 2 smaa Individer under 75° N. B.

I et temmelig stort Antal er den fremdeles indsamlet under de svenske Polar-Expeditioner 1861—72 ved Spitsbergen, hvor den neppe har manglet paa noget under-

Number of fin-rays in examples obtained on the North Atlantic Expedition: —

1 *D.* 8; 2 *D.* 19; *A.* 15. Spitzbergen 1878.
1 - 8; 2 - 20; - 15. Jan Mayen 1877.
1 - 8; 2 - 20; - 15. Jan Mayen 1877.

The first dorsal has accordingly, as a rule, 8 or 9 rays, rarely 7; the first ray is invariably furcate to the base, a feature truly remarkable, and which I have not met with mentioned in any description of the species; the rest are all simple. In the 2nd dorsal, the number of rays is 18—20, rarely 17; height greater than that of 1st; the 6th ray generally the longest; all rays in this fin simple. Anal furnished with 13—15, sometimes 16 rays; longest ray about the eighth.

Points of pectoral rays all somewhat detached, in particular the undermost, which, too, as is mostly the case with Cottoid fishes, are somewhat thick; the seventh or eighth counting from below, the longest. Caudal emarginate, with rounded edges.

A specific character not found enumerated in the detailed descriptions by Kröyer and Malmgren, but mentioned for the first time by Esmark, is the occurrence, on the head, of three exceedingly slender membranous filaments, or cirri. The largest of these, thin, compressed, and fringed along the edges, is located above the posterior margin of the eye; the rest are short, simple cirri. They are all of them most slenderly attached to the skin, the slightest touch sufficing to detach them, and hence but rarely observed on specimens preserved in museums.

The ground-colour in the specimen obtained off Spitzbergen was rather light, nay almost whitish, exhibiting with great distinctness the 4 transverse bands across the back, whereas the individuals obtained in 1878 on the coast of Jan Mayen were streaked and maculated to that extent with interjacent brownish-black stripes and spots as to conceal almost entirely the colour of the ground; and the transverse bands were very indistinct. The character of the bottom may possibly have had something to do with this; off the coast of Jan Mayen the bottom consists of black eruptive mud; off Spitzbergen of clay.

Distribution. — *I. hamatus* is a common species in the Arctic zone, and probably occurs (in company with *Cottus quadricornis*) further north than any other of the *Cottidæ* yet known. From Greenland specimens have been frequently sent to the Museum in Copenhagen; off the coast of West Greenland it was found on the English North Pole Expedition (1875—76) to be one of the fishes occurring in greatest abundance between lat. 80°—82° N., and individuals about to spawn were met with here in the month of August. On the eastern coast of Greenland it was taken on the Germania and Hansa Expedition, 1869, in lat. 75° N.

A considerable number, too, were obtained on the Swedish Expeditions in 1861 and 1872, off Spitzbergen; indeed it can hardly fail to have been observed in every

søgt Punkt omkring denne Øgruppe. Ogsaa her fandtes rognfulde Individer i August Maaned. Ved Jan Mayen er den hidtil blot erholdt under Nordhavs-Expeditionen. Den findes ikke omtalt fra Island, men optræder langs Norges Nord- og Vestkyst lige ned i Kattegat under 58° N. B., altid paa det noget dybere Vand (ikke under 20 Favne). Et enkelt Individ (*I. furciger*, Malm) er fundet paa den svenske Kyst (Gullmarfjärden) ved Bohuslen i 1861.

Ved Americas Kyster er den hidtil ikke omtalt søndenfor Grønland.

Gen. Triglops, Reinh.

Overs. 1829—30, Kgl. D. Vid. Selsk. Nat. Math. Afh. 5 D. p. LII, Kbhvn. 1832 (1829—30).

Hovedet af middels Størrelse, bedækket af en granuleret Hud; Kjæverne spinkle. Praeoperculum svagt væbnet, Operculum uden Torne. Sidelinien med Benplader; Legemet nedenfor denne bedækket af skraatløbende, bagtil tandede Hudfolder. Tænder i Kjæverne og paa Vomer. 2 adskilte Dorsaler. Pectoralernes Straaler ere nedtil næsten fri, og noget forlængede.

9. Triglops pingelii, Reinh. 1838.

Pl. I, Fig. 9—10.

Triglops pingelii, Reinh. Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 Del p. 114 og p. 118 (1838).
Triglops pleurostictus, Cope, Proc. Acad. Nat. Sci. Phil. 1865, p. 81, Noten (1865).

Diagn. *Hovedet indeholdes omtr. $3^3/_4$ Gange i Totallængden. Snuden kort; Øjnene store, indeholdes ikke fuldt 3 Gange i Hovedlængden. Praeoperculum har 4 svage Torne. Legemet ovenfor Sidelinien granuleret, og med en Række Bentorne langs Grunden af Dorsalerne. Sidelinien højtliggende, med en Sænkning under 1ste Dorsal. Sidernes tandede Hudfolder særdeles talrige. Farven blegt hvidgul med brunsorte Tverpletter, hvoraf 4 ere større, eller med afbrudte uregelmæssige Længdepletter. Hannen har en lang Analpapille. Størrelsen indtil 200 mm (Hannen).*

M. B. 6. 1 D. 10—12 (13); 2 D. 24—25 (23 ell. 26); A. 24—25 (23—26); P. 17—21; V. 4; C. 10/12/10.
Lin. lat. 47—49 (45—46).

well investigated locality there. Examples having the abdomen distended with roe also occurred there in August. Off the coast of Jan Mayen, the only individuals hitherto observed were those taken on the Expedition. The species is nowhere mentioned as occurring on the shores of Iceland; it is met with, however, along the entire line of the Norwegian coast, extending as far south as the Cattegat, in lat. 58° N., invariably at some depth (not less than 20 fathoms). A solitary example (*I. furciger*, Malm) was observed off Bohuslen in 1861.

On the shores of North America, it is not mentioned as extending further south than Greenland.

Gen. Triglops, Reinh.

Overs. 1829—30, Kgl. D. Vid. Selsk. Nat. Math. Afh. 5 D. p. LII, Kbhvn. 1832 (1829—30).

Head of moderate length, enveloped in a rough, granulated skin; jaws slender, unarmed. Preoperculum slightly armed; operculum without spines. Lateral line with osseous plates. Body covered below with oblique membranous folds, dentate along the posterior margin; dorsals 2, disconnected. Teeth in jaws and on vomer. Pectoral rays in lower part of fin almost free, and somewhat elongated.

9. Triglops pingelii, Reinh. 1838.

Pl. I, fig. 9—10.

Triglops pingelii, Reinh.; Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 Del, p. 114 & p. 118 (1838).
Triglops pleurostictus, Cope, Proc. Acad. Nat. Sci. Phil. 1865, p. 81, Note (1865).

Diagnosis. — *Length of head to total length as 1 to $3^3/_4$; snout short. Eyes large, longitudinal diameter not quite $^1/_3$ of the length of the head. Preoperculum with four slender spines. Body above lateral line granulated, a series of osseus spines extending along base of dorsals. Lateral line high up the side, bending downwards under first dorsal. The dentate membranous folds exceedingly numerous. Colour pale whitish-yellow, relieved with transverse spots of brownish-black, 4 larger than the rest, or with disrupted longitudinal patches, irregulary disposed. The male has a long anal papilla. Length reaching 200 mm (male).*

M. B. 6. 1 D. 10—12 (13); 2 D. 24—25 (23—26); A. 24—25 (23—26); P. 17—21; V. 4; C. 10/12/10.
Lin. lat. 47—49 (45—46).

Localit. fra Nordh. Exped. Jan Mayen; Spitsbergen.

	Stat. 223.	*Stat.* 237.	*Stat.* 366.
Beliggenhed.	Jan Mayen.	Jan Mayen.	Magdalenebay, Spitsbergen.
Dybde.	70 Favne (128 m).	263 Favne (481 m).	50 Favne (91 m).
Temp. paa Bunden.	— 0,6° C.	— 0,3° C.	— 1,0° C.
Bunden.	Sort Sand og Ler.	Brunt Sand og Ler.	Mørkgraat Ler.
Datum.	1ste Aug. 1877.	3die Aug. 1877.	19de Aug. 1878.
Antal Indiv.	1 Indiv.	1 Indiv.	1 Indiv.

Bemærkninger til Synonymien. Slægten *Triglops* opstilledes af Reinh. sen. allerede i Overs. for 1829—30, Kgl. D. Vid. Selsk. Nat. Math. Afh. 5 B. p. LII (Kbhvn. 1832) efter et Exemplar fra Grønland; men først i 1838 blev den i samme Tidsskrifts 7de Bind meddelt sit Artsnavn. Den viser i flere Henseender en Tilnærmelse til Slægten *Trigla,* saaledes i Tandbygningen, Hovedets Form, de fintandede Skraalinier nedad Legemets Sider, og de nedtil stærkt fri Pectoralstraaler.

T. pingelii er den eneste hidtil sikkert bekjendte Art af denne Slægt. Ligesom det var Tilfældet med *Centrid. uncinatus,* blev den af Reinh. kun ganske kort characteriseret; derimod gav Krøyer i 1844 (Naturh. Tidsskr. 2den R. 1ste B.) efter det i Kbhvns. Musæum foreliggende Materiale en udførligere Diagnose af saavel Slægt, som Art, og efter disse ere Günthers Diagnoser i Cat. Fishes Brit. Mus. vol. 2 (1860) affattede, da endnu intet Indiv. forelaa i British Museum. I 1864 erholdt Malmgren et Individ ved Spitsbergen; senere er den gjentagne Gange bleven kortelig omtalt fra Norge, ligesom Dr. Lütken har nærmere omhandlet de i Musæet i Kbhvn. opbevarede Exemplarer fra Grønland i Vid. Medd. Naturh. Foren. Kbhvn. for Aaret 1876.

Af Kröyer er den bleven afbildet i Gaimards Plancheværk (Voy. Scand. Lap. etc. 1838—40, Poiss. pl. 1), men denne Afbildning er i flere Henseender ufuldkommen. En udførligere Beskrivelse af *T. pingelii* er hidtil intetsteds bleven leveret.

Beskrivelse. *Legemsbygning.* Hele Legemet er oventil, ligesom Hovedet, tæt beklædt med fine Granulationer, og nedenfor Sidelinien med tandede Hudfolder; blot Gjællemembranen er nøgen. Pectoralerne og Øjnene ere forholdsvis særdeles store. Hannerne ere kjendelige ved sin overordentlig store Analpapille, der ved Grunden omtrent har en Lindsediameters Tykkelse, og er rettet noget fremad; dens Længde udgjør omtrent en Orbitaldiameters Bredde. Halen er temmelig lang og uddragen, og Haleroden er forholdsvis lav.

Locality (North Atl. Expedition): — Jan Mayen and Spitzbergen.

	Stat. 223.	*Stat.* 237.	*Stat.* 366.
Exact Locality.	Jan Mayen	Jan Mayen.	Magdalene Bay, Spitzbergen.
Depth.	70 Fathoms (128 m).	263 Fathoms (481 m).	50 Fathoms (91 m).
Temp. at Bottom.	— 0.6° C.	— 0.3° C.	— 1.0° C.
Bottom.	Black Sand and Clay.	Brown Sand and Clay.	Dark-grey Loam.
Date.	1st Aug. 1877.	3rd Aug. 1877.	19th Aug. 1878.
Numb. of Specim.	1 Indiv.	1 Indiv.	1 Indiv.

Remarks on the Synonymy. — The genus *Triglops* was first established by Reinhardt sen., in Kgl. D. Vid. Selsk. Nat. Math. Afh. Overs. for 1829—30, 5 B. p. LII (Kbhvn. 1832), from a specimen taken on the coast of Greenland; it did not however receive its specific name before 1838, in the 7th volumne of the said Journal. This genus approximates in many of its characters the genus *Trigla;* for instance, in the dentition, the form of the head, the oblique serrate lines traversing the sides of the body, and in the pectoral rays being to a great extent free.

T. pingelii is the only species of this genus with certainty known to have been observed. As had been the case with *Centrid. uncinatus,* its generic characters were but briefly set forth by Reinhardt sen.; on the other hand, Kröyer, in 1844, from materials in the Zoological Museum at Copenhagen, gave a detailed diagnosis both of the genus and the species, which is the source whence Günther has furnished his diagnosis in Cat. Fishes Brit. Mus. vol. 2 (1860), as the British Museum had no example of the species. In 1864 Malmgren obtained a specimen from the coast of Spitzbergen; since then it has been repeatedly mentioned as occurring off the Norwegian coast; and in 1876 Dr. Lütken treated of the specimens preserved in the Zoological Museum of Copenhagen in Vid. Medd. Naturh. Foren. Kbhvn. for that year.

The species has been figured by Kröyer in one of the plates to Gaimard's work (Voy. Scand. Lap. etc. 1838—40; Poiss. pl. 1); but this representation is in several respects faulty. A detailed description of *T. pingelii* has not as yet been furnished.

General description. *Structure of the Body.* — Body, above, and head, closely studded with minute granulations; dentate membranous folds below the lateral line, branchial membrane only smooth. Pectorals and eyes comparatively large. Male individuals easily distinguished by the remarkable size of the anal papilla, which projects slightly forward; its thickness at base about equal to the transverse diameter of the lens, and its length, to the diameter of the orbit. Tail rather long and elongate, slender at base.

Hovedet har en forholdsvis kort, men temmelig tilspidset Snude, og den tæt chagrinerede Hud er fast beklædende Craniet; tykke Læber, som hos *Cottus, Centridermichthys* og *Gymnacanthus*, findes ikke, og Kjæverne synes derfor temmelig spinkle. I Totallængden indeholdes Hovedets Længde omtr. $3^3/_4$ Gange.

Øjnene ere særdeles store, og Orbita's Diameter længere, end Snudens Længde. Hos det største af de under Expeditionen erholdte Individer (Totall. 108^{mm}) indeholdes Snuden næsten 2 Gange i Længden af Orbita, men hos de yngre er Øjendiameteren noget mindre. I Hovedlængden indeholdes Øjet fra $2^3/_4$ til 3 Gange. Interorbitalrummet er distinct, og har en Bredde, der omtrent er lig Lindsens Diameter.

Tænder ere tilstede i Mellem- og Underkjæven, samt paa Vomer, men ere yderst fine; Palatinbenene er tandløse.

2 Par Næsebor findes; det øverste Par er beliggende temmelig nær Orbitalranden, det nederste omtrent midt mellem denne og Randen af Overkjæven. Kjæverne ere omtr. af samme Længde; hos enkelte Ind. synes Underkjæven at være ubetydeligt længere, end Overkjæven.

Gjællestraalerne ere 6, eller (ifølge Lütken og Kröyer) undtagelsesvis 7 i Antal.

Huden. Hudtraade paa Hovedet, saaledes som hos flere af de øvrige Cottoider, har jeg ikke kunnet opdage hos denne Art. Derimod strækker sig (tydeligst hos de yngre Individer) rundt Orbita en tæt Række smaa Hudpapiller (omtrent som hos Gobierne); nedtil støder denne Kreds mod en horizontal Række, der strækker sig fra Næseborene til den øvre Rand af Praeoperculum.

Hovedets Væbning er mindre stærkt udviklet, end hos de fleste øvrige beslægtede Former. Praeoperculum er tandet, men Tænderne ere lave, og ikke synderligt fremtrædende af Huden. Deres Antal er 4, og deres Stilling er den hos Cottoiderne almindelige, idet den øverste peger opad og bagud, de øvrige nedad. Operculum er uvæbnet, og ender med en afrundet Flig.

Den skarpe og bagudrettede Torn, der hos de fleste cottoide Fiske findes paa hver Side af Snuden, støttende sig til Næsebenene, er ogsaa tilstede hos *Triglops;* hos en Unge fra den norske Kyst var den ene af dem kløvet i Spidsen. Ungerne have fremdeles paa Panden de sædvanlige 2 Par skarpe Bentorne, men disse ere næsten umærkelige hos de ældre.

Hovedets chagrinartede Beklædning strækker sig hos ældre Individer ud over Øjets øvre Del, men mangler altid paa Hovedets Underside; hos smaa Unger, hvis Totallængde er under 30^{mm}, ere dog endnu Gjællelaagene næsten ganske glatte.

Det egentlige Legeme har alene det ubetydelige Parti af Bugen mellem Ventralerne og Anus glat; ovenfor Laterallinien er Legemet granuleret, ligesom Hovedet, og nedenfor denne, samt paa Struben, forsynet med de ejendommelige skraatløbende, bagtil tandede Hudfolder.

Head furnished with a rather short, but comparatively sharp-pointed snout, and the rough granulous skin firmly attached to the cranium; lips not thick and fleshy (as in *Cottus, Centridermichthys,* and *Gymnacanthus*), giving to the jaws a somewhat slender appearance. Length of head to total length about as 1 to $3^3/_4$.

Eyes remarkably large, the diameter of the orbit exceeding the length of the snout. In the largest specimens obtained on the Expedition (total length 108^{mm}), the diameter of the orbit is to the length of the snout almost as 2 to 1, in the younger examples a trifle less. Diameter of eye to length of head as 1 to $2^3/_4$—3. Interorbital space distinctly obvious, breadth about equal to diameter of lens.

Teeth in intermaxillary and lower jaw, and on vomer, but exceedingly minute; none on the palatine bones.

Two pairs of nostrils, the upper pair placed in close proximity to the margin of the orbit, the lower about midway between the margin of the orbit and that of the upper jaw. Length of jaws about equal; in some examples the lower jaw appears to protrude slightly beyond the upper.

Branchiostegals 6, or (according to Kröyer and Lütken) exceptionally 7.

Skin. — Of membranous filaments, such as occur in divers of the other *Cottidæ*, I have not been able to detect any vestige; but, encircling the orbits (and most conspicious in young individuals), is an annular series of minute warty protuberances (much the same as in the Gobioids); below, this ring is met by a horizontal series, extending from the nostrils to the upper margin of the preoperculum.

Armature of head less fully developed than in most of the other allied forms; preoperculum dentate, the teeth however depressed, and but slightly projecting above the skin; number, 4, position and arrangement that common to the Cottoids, the uppermost oblique, pointing upwards and backwards, the rest downwards. No arming is observed on the operculum, which terminates in a membranous flap.

The sharp spine, inclining backwards, which in most Cottoid fishes occurs on either side of the snout, projecting from the nasal bones, is also observed in *Triglops;* a young example, taken on the Norwegian coast, had one of these spines furcated at the point. In young individuals the front is furnished with the normal number of osseous spines (2 pairs); these are hardly perceptible in adults.

The rough, granulous skin of the head extends, in mature individuals, beyond the upper part of the eye, the under surface of the head is invariably smooth; in very young examples (total length under 30^{mm}), however, the opercles occur as yet smooth.

Of the body proper a very small portion comparatively is smooth — that on the abdomen, extending between the ventrals and the anus; above the lateral line, the whole of the body is rough with granulations, as also the head; the region below it, and the throat, furnished with the characteristic oblique and dentate membranous folds.

Sidelinien dannes af en sammenhængende Række tandede Benplader, hvis Antal, der svarer til Hvirvelantallet, er 47—49, eller undertiden et Par færre; den ligger i sit hele Løb noget ovenfor Legemets Midtlinie, gjør en ubetydelig Sænkning ned under 1ste Dorsal, men hæver sig atter, og løber herefter lige ud mod Caudalen. Fra Unger af *Icelus hamatus,* hvor de Udvoxedes Characterer endnu ikke ere fuldt udviklede, kunne ligestore Unger af *Triglops* kjendes ved Sideliniens Løb, idet denne hos *Icelus* danner en opad convex, hos *Triglops* en opad concav Bue under 1ste Dorsal.

Ovenfor Sidelinien strækker sig en Række Bentorne langs hele Grunden af Dorsalerne, der taber sig omtrent ved Midten af 2den Dorsal. Hos de yngre Individer ere disse Bentorne højere og skarpere, end hos de ældre, hvor de tildels ere lidet fremtrædende af Hudens chagrinerede Parti.

De skraatløbende Hudfolder danne oprindelig Fortsættelser af Sideliniens Benplader, og bedække fuldkommen Legemets Sider nedenfor denne. Ikke altid fortsætter den samme Hudfold sig uden Afbrydelse lige ned til Ventrallinien, men nye af forskjellig Længde begynde og ophøre næsten overalt, saaledes at deres Antal nedad bliver langt større, end Benpladernes i Sidelinien. Enhver af disse Hudfolde er i sin bagre Rand fint tandet; de gaa lige ud til Caudalen, og med lignende Hudfolder er ligeledes Struben beklædt.

Det Tidspunkt, da disse characteristiske Tverstriber, samt Tornerækkerne udvikle sig hos Ungerne, synes at være noget varierende. Sandsynligvis blive Hannerne tidligere væbnede, end Hunnerne. Saaledes har jeg undersøgt Unger (fra Norge), der sandsynligvis have været Hanner, hvis Totallængde har været mellem 26 og 30^{mm}, og som allerede havde saavel Tverstriberne, som Tornerækkerne antydede eller i Frembrud; derimod var et andet Individ fra Spitsbergen (erholdt under den svenske Expedition i 1864), hvis Totall. var 37^{mm}, og som jeg i 1879 havde Lejlighed til at undersøge, endnu glat overalt; Sidelinien var her synlig som en Række hvidagtige, parvis stillede Papiller, der standsede før Slutningen af 2den Dorsal, men intet Spor viste sig af Tvèrstriberne; den øvre Tornerække var ligeledes blot antydet ved bløde Papiller, der endnu knapt vare ossificerede eller væbnede. Dette sidste Individ var sandsynligvis en Hun.

Finnerne. De 2 Dorsaler ere adskilte ved et Mellemrum, der dog ikke plejer at være større, end Lindsens Diameter. Alle Straaler ere spinkle og skjøre som Glas, saaledes at Finnerne ofte ere mere eller mindre defecte. 1ste Dorsal er højere, end 2den, og har 10 til 13 Straaler; 2den Dorsal har 23 til 26 Straaler. Analen, der har den samme Længde og Bygning, som 2den Dorsal, har det samme Straaleantal, som denne sidste Finne; begge disse slutte i betydelig Afstand fra Caudalen. Pectoralernes Straaleantal ligger mellem 17 og 21. Caudalen, der næsten er ret afskaaret i sin bagre Rand, eller svagt emargineret, har, foruden paa hver Side et Antal korte Støttestraaler,

The lateral line consists of a continuous series of dentate osseous plates, corresponding in number (47—49, sometimes one or two fewer) with the vertebræ; it extends, throughout its entire length, a little above the mesial line, bending slightly downwards under the first dorsal, from whence, after regaining its original position, it passes straight to the caudal fin. Young individuals of *Icelus hamatus,* which have not as yet the adult characters fully developed, may be readily distinguished from young examples of *Triglops* by the upward sweep of the lateral line under the first dorsal, which in *Icelus* is convex, in *Triglops* concave.

Above the lateral line is a series of osseous spines, extending along the base of both dorsals; about the middle of the second it ceases however to be obvious. In young examples these spines are longer and sharper than in adults, which have them in some cases but very sligtly elevated above the granulous surface of the skin.

The oblique membranous folds are at first continuations of the osseous plates of the lateral line, covering the whole of both sides of the body beneath it. The same fold does not always extend uninterruptedly to the ventral line, others commencing and breaking off almost everywhere, and hence the total number of folds greatly exceeds that of the osseous plates on the lateral line. Each of these membranous folds is dentate, or rather serrate along its posterior margin; they extend to the caudal fin; similar transverse folds cover the throat.

The exact stage of growth at which these characteristic transverse stripes and series of osseous spines begin to develop would appear to vary. Probably males acquire armature earlier than females. I have examined young individuals (from Norway), most likely males, having a total length of between 26 and 30^{mm}, in which both the transverse stripes and the series of spines were either rudimentary or in course of development, whereas an example from the coast of Spitzbergen (taken on the Swedish Expedition in 1864), total length 37^{mm}, which I had an opportunity of examining in 1879, was as yet perfectly smooth. In that specimen, the lateral line was obvious as a row of whitish papillæ, terminating near the extremity of the 2nd dorsal; but of transverse stripes no vestige was perceptible; also the upper row of spines in the rudimentary stage was marked out with soft and tumid papillæ, which as yet exhibited little or no trace of arming. This individual was probably a female.

Fins. — The two dorsals separate; space between them generally not greater than the diameter of the lens; all the rays slender, and brittle as glass; hence the fins themselves, in the great majority of examples, are in a more or less mutilated condition. Height of first dorsal exceeds that of second; number of rays in former 10—13, in latter 23—26. The anal fin, length and structure corresponding to that of second dorsal, also furnished with 23—26 rays; both these fins placed at a considerable distance from caudal; number of rays in pectorals varying from 17 to 21. Posterior margin of caudal square, furnished on either side with a number of short auxiliary

11, eller oftest 12 ordinære Straaler, der i Spidserne ere kløvede. Ventralstraalernes Tælling er forbunden med nogen Vanskelighed paa Grund af Straalernes Tæthed og dybe Kløvning; Antallet er 4. Hos det største af de under Expeditionen erholdte Han-Individer fortsætter Membranen sig som en bred Bræm langs Ydersiden af denne Finne.

De under Nordhavs-Expeditionen erholdte Individer havde følgende Straaleantal:

a. (Hun) *1 D.* 12; *2 D.* 24; *A.* 24; *C.* 10/12/10; *P.* 21; *V.* 4.
b. (Han) — 10; — 24; - 24; - 10/12/6; - 18; - 4.
c. (Hun) — 10; — 26; - 26; - 10/12/10; - 21; - 4.

Farvetegning. Denne er temmelig varierende, og synes at forandre sig noget under Væxten. Medens de unge Individer oftest have paa den hvide eller svagt gulagtige Bundfarve 4 større, skarptbegrændsede Pletter, hvortil senere støde andre og mindre nedad Legemets Sider, blive disse Pletter hos de større Individer opløste til korte langsløbende eller skraa Baand, der kunne være afbrudte, og delte i mindre Pletter. Denne sidste Farvetegning have begge de under Expeditionen erholdte Hanner, medens Hunnen har den mere overensstemmende med Ungernes. Af Finnerne have Dorsalerne, Pectoralerne og Caudalen tydelige Tverbaand.

Størrelse. De største Individer, der hidtil ere fundne af denne Art, opbevares i Musæet i Kjøbenhavn, og ere fra Grønland. Ifølge Dr. Lütken (l. c. p. 378) har af disse en Han naaet en Totallængde af 145^{mm}, en Hun endog 200^{mm}, og denne Forskjel mellem Kjønnene synes at være gjennemgaaende.

De 3 under Expeditionen erholdte Individer havde følgende Maal:

	a. Hun, Jan Mayen.	*b.* Han, Spitsb.	*c.* Hun, Jan Mayen.
Totallængde	70^{mm}	90^{mm}	108^{mm}
Længden uden Caudal	60 -	79 -	93 -
Hovedets Længde . .	20 -	24 -	29 -
Øjets Diameter . . .	7 -	7,5 -	11 -

De ved de norske Kyster hidtil fundne Individer have i Regelen været smaa, og deres Totallængde aldrig overskredet 102^{mm}.

Levemaade og Føde. Som alle Arter af denne Gruppe er *Triglops pingelii* henvist til at leve nærved eller umiddelbart paa Bunden, hvilket allerede fremgaar af Pectoralernes Bygning, hvis nedre Straaler ere mere eller mindre fri. Hos unge Individer er det dog blot Straalernes yderste Spidser, der rage ud over Membranen; men Indsnittet mellem dem tiltager med Alderen, og hos de udvoxede ere de nederste Straaler skilte næsten til Grunden, de nærmest paafølgende noget mindre. Ialt deltage 7—8 Straaler heri, og samtidig ere disse beklædte med en tykkere Hud, og tillige livligere farvede, end de øvrige 13—14, ligesom de øverste af dem ere noget længere, end de tilgrændsende normale Straaler. Herved fremkommer en Tilnærmelse til

spines, exclusive of 11, or more frequently 12 ordinary spines, all of which are cleft at the points. The numbering of the ventral rays is attended with some dificulty, in consequence of the extreme closeness and deep furcation of the rays; they are 4 in number. In the largest of the male specimens obtained on the Expedition the membrane extends as a wide border along the outer margin of this fin.

Number of rays in the specimens taken on the North Atlantic Expedition: —

a. (female) *1 D.* 12; *2 D.* 24; *A.* 24; *C.* 10/12/10; *P.* 21; *V.* 4.
b. (male) — 10; — 24; - 24; - 10/12/6; - 18; - 4.
c. (female) — 10; — 26; - 24; - 10/12/10; - 21; - 4.

Colour. — The marking is subject to considerable variation in different individuals, and changes, too, apparently, as the growth progresses. Young individuals are generally characterised by having on the whitish groundcolour, or rather whitish with a faint tinge of yellow, 4 comparatively large and well-defined spots, meeting other and smaller macules disposed down the sides of the body, whereas in more mature examples these spots break up, appearing as a number of horizontal or oblique bands, sometimes disrupted into smaller spots. The latter marking distinguishes both of the male specimens taken on the Expedition; the female bore in this respect a greater resemblance to the young individuals. Well-defined transverse bands on the dorsals, the pectorals, and the caudal.

Dimensions. — The largest individuals of this species hitherto met with are preserved in the Zoological Museum at Copenhagen; they were sent from Greenland. According to Dr. Lütken, one male has attained a total length of 145^{mm}, a female 200^{mm} even; and this difference in size between the sexes would appear to be characteristic.

Measurements of the three specimens obtained on the Expedition: —

	a. Female. Jan Mayen.	*b.* Male. Spitzb.	*c.* Female. Jan Mayen.
Total length . . .	70^{mm}	90^{mm}	108^{mm}
Length excl. of caudal	60 -	79 -	93 -
Length of head . .	20 -	24 -	29 -
Diameter of eye . .	7 -	7.5 -	11 -

Most of the individuals hitherto observed on the Norwegian coast have been small, their total length not exceeding 102^{mm}.

Habits and Food. — In common with all other species of this Arctic group, *Triglops pingelii* occurs immediately on, or in close proximity to, the bottom, a fact necessarily involved in the structure of the pectorals, the lower rays being to a greater or less extent free. In young individuals, however, the extreme points only are found to have pierced the membranous integument; but the incision continues to deepen with the growth, and in mature examples the lowermost rays are cleft almost to the base, those next above them to a somewhat less extent. This characteristic feature is shared by 7—8 of the rays, which have a thicker integument and a deeper colour than the rest (13—14); moreover, the uppermost are of somewhat

det Krybe- og Føleorgan, som er højest udviklet hos Slægten *Trigla,* hvor Straalernes absolute Frihed tilsteder en Bevægelse af denne Finnedel i alle Retninger, saaledes at disse Fiske i Virkeligheden kunne krybe henad Havbunden, medens Straalernes Spidser under famlende Bevægelser nedstikkes i Gruset.

Triglops pingelii forekommer blot paa det noget dybere Vand, og gaar neppe højere op, end til 16—20 Favne. Den største Dybde, hvor denne Art hidtil er fundet, beboedes af den store Han fra Nordhavs-Expeditionen, der optoges paa 263 Favnes Dyb. Alle de under denne Expedition erholdte Individer bleve fundne i den iskolde Area, hvor Temperaturen paa Bunden var under 0°. C.

I Ventrikelen af det største Individ, en Han fra Jan Mayen, fandtes blot et middelstort Exemplar af *Themisto libellula,* Mandt; hos den mindre Hun (fra Spitsbergen) Dele af en Annelide *(Polynoë),* samt af en Crustacé. En fuldt udviklet Hun fra Gjæsvær ved Nordcap, med en Totallængde af 102^{mm}, det største Individ af denne Art, der hidtil er fundet ved Norges Kyster, indeholdt blot Levninger af Crustaceer, nemlig Dele af en *Hippolyte* og af en *Pandalus.*

Legetiden foregaar maaske om Vinteren, idet Generationsorganerne hos Expeditionens Individer ikke for Øjeblikket befandt sig i fuld Udvikling. Ovarierne hos Hunnen indeholdt saaledes endnu uudviklede Æg; Antallet af disse var i hvert Ovarium mellem 250 og 300, saaledes ialt 5—600.

Udbredelse. *Tr. pingelii* har Udbredelse fælles med de fleste øvrige europæisk-arctiske Cottoider, og forekommer sandsynligvis overalt paa passende Localiteter mellem Grønland, Novaja Zemlja, Island, Færøerne, og Norges Kyster. Ved Grønland synes den ikke at være sjelden, og flere Exemplarer ere herfra indløbne til Musæet i Kjøbenhavn, ligesom den i August 1876 erholdtes under den engelske Nordpol-Expedition i Vest-Grønland under 79° 29′ N. B.

I Nord-America gaar den, ligesom et Flertal af rent arctiske Fiske, forholdsvis langt længere mod Syd, end i Europa, og er saaledes erholdt i Massachusetts Bay udenfor New England under 42° N. B. Under de svenske Expeditioner til Spitsbergen er den funden ved denne Øgruppe allerede i 1861; ifølge Dr. Lütken er den ligeledes funden ved Færøerne og Island, og Nordhavs-Expeditionen har, som ovenfor nævnt, erholdt den ved Jan Mayen. Endelig forekommer den langs Norges Kyster fra Varangerfjorden ned til Stat eller Christiansund (61½°), men synes intetsteds her at forekomme i noget betydeligt Antal.

greater length than the adjacent normal rays. In this peculiarily of structure an approximation is shown to the motory and sensory organ, developed most in the genus *Trigla;* the rays in that genus being entirely free, this part of the fin can be moved about in all directions, and, on the points of the rays being pressed into the gravel, the fish appears to creep over the bottom.

Tr. pingelii occurs in comparatively deep water only, never ascending nearer the surface than 16—20 fathoms. The greatest depth at which the species has hitherto been observed is that from which the large-sized male specimen was taken on the North Atlantic Expedition — 263 fathoms. All the examples obtained on the Expedition inhabited the cold area, where the temperature at the bottom was below 0° C.

In the ventricle of the largest specimen, a male from Jan Mayen, was found only a moderate-sized example of *Themisto libellula,* Mandt; in that of the smallest, a female (from Spitzbergen), fragments of an Annelid *(Polynoë)* and of a crustacean. The stomach of a full-grown female, from Gjæsvær, near the North Cape, total length 102^{mm}, the largest example of this species hitherto taken in Norway, contained only fragments of crustaceans, viz. of a *Hippolyte* and of a *Pandalus.*

The spawning-season is perhaps in winter, since the generative organs in the specimens taken on the Expedition were not then in a fully developed condition. The ovaries, too, contained immature ova; the number in each ovary was from 250 to 300, in both together from 500 to 600.

Distribution. — *Triglops pingelii* has the range common to most of the other Arctic *Cottidæ* in Europe, occurring probably in all favourable localities between Greenland, Novaja Zemlja, Iceland, the Faröe Islands, and the coast of Norway. On the coast of Greenland, it would appear to be not a rare species, and examples from that region have repeatedly been sent to the Zoological Museum in Copenhagen; it was taken, too, in 1876, on the English North Pole Expedition, off the west coast of Greenland, in lat. 79° 29′ N.

On the shores of western North America it occurs, in company with a large majority of true Arctic forms, comparatively farther south than in Europe, having been observed in Massachusetts Bay, off the coast of New England, in lat. 42° N. On the Swedish Expeditions to Spitzbergen, in 1861, it was obtained off that group of islands; according to Dr. Lütken, it has also been met with off the shores of the Faröe Islands and the coast of Iceland; and on the North Atlantic Expedition, as previously stated, it was met with on the coast of Jan Mayen. Finally, it occurs along the Norwegian coast, from the Varanger Fjord as far south as Stat or Christiansund (61° 30′ N.), but nowhere, it seems, as a common species.

Fam. Agonidae.

Gen. Agonus, Schneid.

Bloch, Syst. Ichth., (ed. Schneid.), p. 104 (1801).

10. Agonus decagonus, Schneid. 1801.

Pl. II, Fig. 11—12.

† *Cottus cataphractus,* Fabr. Fauna Groenl. No. 112, p. 155 (1780).
Agonus decagonus, Schneid. Bloch, Syst. Ichth. p. 105 (1801).
Aspidophorus decagonus, Cuv. & Val. Hist. Nat. Poiss. tom. 4, p. 223 (1829).
Aspidophorus spinosissimus, Kr. Naturh. Tidsskr. 2 Række, 1 B. p. 250 (1844).
Aspidophorus malarmoides, Deslongch. Mém. Soc. Lin. Norm. tom. 9, p. 167 (1853).
Leptagonus spinosissimus, Gill, Proc. Acad. Nat. Sci. Philad. 1861, p. 167 (1861).
Archagonus decagonus, Gill, Proc. Acad. Nat. Sci. Philad. (*teste* Lütk.)

Diagn. *Legemet smalt, dets største Bredde indeholdes 8, Hovedets Længde 5 Gange i Totall. Det gjennemsnitlige Antal af Skjolde er: mellem Dorsalerne 4 Par; fra Nakken til 1ste Dorsal 5 Par, indtil 2den Dorsal 17 Par; mellem Ventralerne og Analen 12 Par. Foran Ventralerne findes 23—25 Skjolde. Pectoralens Længde ubetydeligt større, end Hovedets. Skjægtraadene 5 paa hver Side, (4 enkelte i Mundvigen, 1 kløvet fortil i Underkjæven). Sidelinien har 23—25 Porer. Et Par korte Torne paa Snuden, et Par Knuder over Øjnene, og et Par større Knuder paa Panden. Farven graagul, med 2—3 større graabrune Tverpletter; Pectoralen og Caudalen henimod Spidsen brunsorte. Hannen har længere Ventraler, end Hunnen. Størrelsen indtil 210 mm.*

M. B. 6; 1 D. 6 (5 ell. 7); 2 D. 6—7 (8); A. 7 (6 ell. 8); P. 14—16; V. 3; C. 2/11/2. Lin. lat. 23—25.

Localit. fra Nordh. Exped.: Havet mellem Nordcap og Spitsbergen.

	Stat. 323.	*Stat.* 326.	*Stat.* 338.	*Stat.* 363.
Beliggenhed.	180 Kil. S. O. Beeren Eiland.	105 Kil. N. Beeren Eiland.	Sydcap, Spitsbergen.	60 Kil. V. Norskøerne, Spitsb.
Dybde.	223 Favne (408 m).	123 Favne (225 m).	146 Favne (267 m).	260 Favne (475 m).
Temp. p. Bunden.	+ 1,5° C.	+ 1,6° C.	— 1,1° C.	+ 1,1° C.
Bunden.	Brungraat Ler.	Mørkt Ler.	Stenbund.	Blaaler.
Datum.	30te Juli 1878.	3die Aug. 1878	6te Aug. 1878.	14de Aug. 1878
Antal Indiv.	1 Indiv.	6 Indiv.	1 Indiv.	1 Indiv.

Bemærkninger til Synonymien. En udførlig Beskrivelse er givet, foruden af Cuvier og Valenc. (Hist. Nat. Poiss. tom. 4), af Krøyer i Naturh. Tidsskr. 2 Række 1 B., som i 1844 beskriver saavel det udvoxede Individ *(Aspidophorus decagonus),* som Ungen *(Aspidophorus spinosissimus)* som separate Arter, og afbilder begge i Gaimards Reise-Værk (Voyage Scand. Lap. etc. 1838—40,

Fam. Agonidæ.

Gen. Agonus, Schneid.

Bloch, Syst. Ichth., (ed. Schneid.), p. 104 (1801).

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Pl. II, fig. 11—12.

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Aspidophorus malarmoides, Deslongch. Mém. Soc. Lin. Norm. tom. 9, p. 167 (1853).
Leptagonus spinosissimus, Gill, Proc. Acad. Nat. Sci. Philad. 1861, p. 167 (1861).
Archagonus decagonus, Gill, Proc. Acad. Nat. Sci. Philad. (*teste* Lütk.)

Diagnosis. — *Body slender, greatest breadth to total length as 1 to 8, length of head as 1 to 5. Normal number of shields: between the dorsals 4 pairs, from nuchal region to 1st dorsal 5 pairs; to commencement of 2nd dorsal 17 pairs; between the ventrals and the anal 12 pairs. Anterior to ventrals 23—25 shields. Length of pectorals slightly exceeding that of head. Five cirri on either side (4 at the angle of the mouth, 1 cleft, out on the lower jaw). Lateral line with 23—25 mucous pores. One pair of short spines on snout; above the eyes one pair of knotty protuberances, and a pair, of larger size, on the front. Colour greyish-yellow, relieved with 2—3 large transverse spots of greyish-brown; points of pectorals and caudal brownish-black; ventrals longest in male. Length reaching 210 mm.*

M. B. 6. 1 D. 6 (5 or 7); 2 D. 6—7 (8); A. 7 (6 or 8); P. 14—16; V. 3; C. 2/11/2. Lin. lat. 23—25.

Locality (North Atl. Exped.): — The open sea, between the North Cape and Spitzbergen.

	Stat. 323.	*Stat.* 326.	*Stat.* 338.	*Stat.* 363.
Exact Locality.	180 Kil. S. E. Beeren Eiland.	105 Kil. N. Beeren Eiland.	South Cape, Spitzbergen.	60 Kil. N. Norsk Isl. Spitzb.
Depth.	223 Fathoms (408 m).	123 Fathoms (225 m).	146 Fathoms (267 m).	260 Fathoms (475 m).
Temp. at Bottom.	+ 1.5° C.	+ 1.6° C.	— 1.1° C.	+ 1.1° C.
Bottom.	Brownish-grey Loam.	Dark Clay.	Rocky Bottom.	Bluish Clay.
Date.	30th July 1878.	3rd Aug. 1878.	6th Aug. 1878.	14th Aug. 1878
Numb. of Specim.	1 Indiv.	6 Indiv.	1 Indiv.	1 Indiv.

Remarks on the Synonymy. — A full description of this species has been given by Cuvier and Valenc. (Hist. Nat. Poiss. tom. 4); also by Kröyer (Naturh. Tidsskr. 2 Række, 1 B.), who, in 1844, described the full-grown fish *(Aspidophorus decagonus)* and the immature form *(Aspidophorus spinosissimus)* as two species, both of which he subsequently figured for Gaimard's work (Voyage Scand.

pl. 5). Yngelen er yderligere beskreven (efter norske Individer) af Forf. i 1874 i „Norges Fiske“ p. 40, ligesom Dr. Lütken efter Materiale i Kjøbenhavns Musæum har givet værdifulde Bidrag til Kundskaben cm denne og de nærstaaende Arters Synonymi og Variabilitet i Vid. Medd. fra Naturh. Foren. Kbhvn 1876, p. 382.

Bemærkninger til Beskrivelsen. Straaleantallet i de verticale Finner var hos Nordhavs-Expeditionens Individer en ikke ubetydelig Variation underkastet, idet dette vexlede i 1ste Dorsal mellem 5 og 7, i 2den Dorsal og i Analen mellem 6 og 8.

	Totallængde.	Hovedets Længde.	*1 D.*	*2 D.*	*A.*	*P.*
a.	140 mm	27,5 mm	5;	7;	7;	15—15.
b.	141 -	27 -	6;	7;	7;	14—14.
c.	147 -	30 -	5;	6;	7;	15—15.
d.	152 -	29,5 -	6;	5;	7;	14—14.
e.	152 -	29 -	6;	8;	8;	14—15.
f.	156 -	29 -	6;	7;	7;	15—15.
g.	168 -	31 -	6;	7;	7;	14—14.
h.	174 -	33 -	5;	6;	7;	14—14.
i.	178 -	33 -	7;	7;	6;	15—15.

Hos grønlandske Individer har Dr. Lütken, ifølge den ovenfor citerede Afhandling, fundet Straaleantallet at være: 1 D. 6 (5); 2 D. 6—7; A. 7 (5—8); P. 16 (15). Hos 3 Yngel-Individer fra Varangerfjorden fandt jeg: 1 D. 5—6; 2 D. 7; A. 7—8. Maaske have de grønlandske Individer regulært 1 Straale flere i Pectoralerne, end de, der bebo de spitsbergenske Farvande.

Antallet af Legemets Benskjolde varierede hos de 9 Individer inden følgende Grændser: Langs Ryglinien fra Nakken til Halen var oftest 44, undertiden 41—43 Skjolde; langs Buglinien oftest 39—40, undertiden 38 eller 41 Skjolde.

Fra Nakken til 1ste Dorsal fandtes i Regelen 5 Par Skjolde, fra Nakken til 2den Dorsal 17 Par. (2 Expl. havde 6 Par indtil 1ste Dorsal, saaledes ialt 18 Par, og et Individ havde paa den ene Side 5, paa den anden Side 6 Skjolde, saaledes indtil 2den Dorsal 17—18).

Gruppen foran Ventralerne talte 22—25 Skjolde, hvoraf enkelte vare ganske smaa.

Mellem begge Dorsaler vare 4 Par Skjolde. (Hos 1 Individ var der blot 3 Par, hos et andet $3^1/_2$ Par, hos et tredie 5 Par).

Mellem Ventralerne og Analen var somoftest Antallet 12 Par. (Hos 1 findes 13 Par, hos et andet blot 10 Par).

Sidelinien er ganske tydelig efter hele sin Længde. Porernes Antal varierede hos de 9 Individer mellem 23 og 25; i Begyndelsen staa de forholsvis tæt, omtrent ved hvert Skjold, men bagenfor Spidsen af Pectoralerne ere Afstandene længere.

Lap. etc. 1838—40, pl. 5). The fry of this fish (from the Norwegian coast) have been further treated of by the present author in 1874 (*vide* “Norges Fiske,” p. 40); and Dr. Lütken has furnished valuable contributions to our knowledge of the synonomy and relative variability of this and other nearly related species in Vid. Medd. fra Naturh. Foren. Kbhvn. 1876, p. 382.

Descriptive Observations. — The number of rays in the vertical fins varied considerably in the specimens obtained on the North Atlantic Expedition, ranging in 1st dorsal from 5 to 7, in 2nd dorsal from 5 to 8, and in the anal from 6 to 8.

	Total Length.	Length of Head.	*1 D.*	*2 D.*	*A.*	*P.*
a.	140 mm	27.5 mm	5;	7;	7;	15—15.
b.	141 -	27 -	6;	7;	7;	14—14.
c.	147 -	30 -	5;	6;	7;	15—15.
d.	152 -	29.5 -	6;	5;	7;	14—14.
e.	152 -	29 -	6;	8;	8;	14—15.
f.	156 -	29 -	6;	7;	7;	15—15.
g.	168 -	31 -	6;	7;	7;	14—14.
h.	174 -	33 -	5;	6;	7;	14—14.
i.	178 -	33 -	7;	7;	6;	15—15.

In examples from the coast of Greenland the number of fin-rays, according to Dr. Lütken, was as follows: — 1 D. 6 (5); 2 D. 6—7; A. 7 (5—8); P. 16 (15). In three fry-specimens, from the Varanger Fjord, I found the fin-ray formula to be: 1 D. 5—6; 2 D. 7; A. 7—8; perhaps the additional ray in the pectorals is a peculiarity of structure in which the examples from Greenland differ from individuals inhabiting the shores of Spitzbergen.

The number of osseous shields on the body was found to vary, in the 9 individuals examined, within the following limits: along the dorsal line, from nape to origin of tail, most frequently 44, sometimes 41—43; along the line of the abdomen most frequently 39—40, sometimes 38—41.

From nape to 1st dorsal, in most of the specimens, 5 pairs of shields; from nape to 2nd dorsal 17 pairs (2 examples were furnished with 6 pairs from nape to 1st dorsal, or, in all, with 18 pairs, and one individual had 5 shields on one side and 6 on the other, or, in all, 17—18).

The group situated in front of the ventrals comprised 22—25 shields, some of which were very small.

Between the two dorsals occur 4 pairs of shields (in one individual only 3 pairs, in another 3 pairs and a half, in a third 5 pairs).

Between the ventrals and the anal the number of pairs is commonly 12 (one individual had 13, another only 10 pairs).

Lateral line distinctly obvious in its entire length. The number of pores varied in the 9 individuals from 23 to 25; the first in the series were arranged comparatively close, one at every shield almost, but, posterior to the extremities of the pectorals the interspace is greater.

Legemet er betydeligt slankere og mere langstrakt, end hos *A. cataphractus;* den største Bredde, der falder over Nakken, indeholdes omtr. 8 Gange i Totallængden.

Af Skjægtraade har denne Art paa hver Side 5; i Mundvigerne sidde 2 i Over-, og 2 i Underkjæven; den 5te sidder langt fortil i Underkjæven. Den sidste er altid kløvet, de øvrige ere enkelte. (1 Individ havde ogsaa den indre Traad i Overkjæven kløvet, et andet Individ havde Underkjævens forreste Traad ikke dobbelt, men endog 5-kløvet).

Ligesom det er Tilfældet med flere Cottoider, synes ogsaa hos denne Art Kjønnene at være ganske ulige repræsenterede i Antal. Af de 9 erholdte Individer var nemlig blot det ene (*c*) en Han, hvad der strax fremgik af de forlængede Ventraler. Medens de 2 Straaler, der danne denne Finne, hos alle de øvrige vare af lige Længde, og saa korte, at Finnens Længde ikke synderlig oversteg en Øjendiameter, havde hos dette ene Individ den ydre Straale, der var betydeligt længere, end de indre, en Længde af 17 ^{mm}, eller omtrent 2 Øjendiametre.

Farven var i det væsentlige ens hos alle. Bundfarven er gulgraa, og forsynet med 2—3 større Tverpletter, der danne Antydning til Baand, men idethele ikke ere særdeles skarpt markerede. Det forreste af disse ligger over Roden af Pectoralen, det andet (ofte utydeligt) over Slutningen af 1ste Dorsal, det 3die over Midten af 2den Dorsal. Mellem disse findes mindre, utydeligt begrændsede Petter og Skygninger. Finnerne ere ud mod Spidsen brunsorte; især er dette Tilfældet med Pectoralen og Caudalen. Undersiden af Legemet er uplettet graagul. Paa Hovedet gaar en temmelig bred, sort Streg fra Spidsen af Snuden gjennem Øjet, og fortsætter sig bagover paa Praeoperculum.

Levemaade og Føde. Den synes at være en afgjort Dybvandsart; de under Expeditionen erholdte Individer optoges fra en Dybde, der laa mellem 123 og 260 Favne, medens et Par Yngel-Individer fra Varangerfjorden (1874) erholdtes fra det noget grundere Vand (50—120 Favne). Som ovenfor nævnt, erholdtes et af Nordhavs-Expeditionens Individer fra den iskolde Area, hvor Vandets Temperatur var under 0° C.

I Ventrikelen af et af Individerne fandtes Amphipoder, væsentlig *Themisto libellula,* Mandt, og enkelte Individer af *Erythrops goësii,* G. O. Sars.

Udbredelse. *A. decagonus* er allerede af Fabricius omtalt fra Grønland i 1780 i hans Fauna Groenl. (under Navn af *A. cataphractus),* og den er senere gjentagne Gange nedsendt fra disse Landsdele til Musæet i Kjøbenhavn. Paa samme Side af Atlanterhavet gaar den idetmindste ned til Newfoundland. Fremdeles er den, ifølge Dr. Lütken, erholdt ved Island. Ved Spitsbergen er den maaske ikke

The body is much more slender and elongate in form than is the case with *A. cataphractus;* extreme breadth, across the nape, about one-eighth only of total length.

The cirri in this species number 5 on each side, disposed as follows: 2 on the upper and 2 on the lower jaw, at the angle of the mouth, and the fifth far out on the lower jaw. This barbel is always cleft, the rest consist each of a single filament; in one specimen the posterior barbel on the upper jaw was likewise cleft; another had the anterior cirrus on the lower jaw not doubly, but quintuply cleft.

As is the case with several species of Cottoids, the sexes appear to be very unequally represented in *A. decagonus* with regard to number. Of the 9 individuals obtained, one only (*c*) was a male, a fact immediately apparent from the elongated ventrals. In all the other examples the 2 rays composing this fin were of equal length, and so short, that the length of the fin hardly exceeded the longitudinal diameter of the eye, whereas in this individual the exterior ray, which was considerably longer than the inner, had a length of 17 ^{mm}, about equal to twice the diameter of the eye.

The colour was in all these specimens essentially the same. Ground-colour yellowish-grey, relieved with two or three comparatively large transverse spots or bands, not very clearly defined however. The first of these spots occurs immediately above the origin of the pectorals, the second (in many individuals indistinct) above the termination of the 1st dorsal, the third above the central portion of the 2nd dorsal. In between these patches are a number of small indistinct spots and cloudings. The fins brownish-black towards the points; this is the case more especially with the pectorals and the caudal. The under surface of a uniform greyish-yellow. A black streak extends from the point of the snout through the eye, passing from thence backwards over the preoperculum.

Habits and Food. — This species decidedly appears to be a deep-sea fish; the specimens obtained on the Expedition were brought up from a depth of 123—260 fathoms; three individuals in the fry stage of growth, from the Varanger Fjord (1874), were taken in shallower water (50—120 fathoms). As before stated, one of the examples taken on the Expedition was brought up from the cold area, where the temperature was below that of ice.

In the stomach of one of the individuals examined were divers Amphipods, chiefly *Themisto libellula,* Mandt, and examples of *Erythrops goësii,* G. O. Sars.

Distribution. — *A. decagonus* was mentioned, as occurring on the coast of Greenland, as far back as 1780, by Fabricius, in his Fauna Grœnl. (the name given it being *A. cataphractus),* and since then specimens have been repeatedly sent from those regions to the Zoological Museum in Copenhagen. On the shores of North America its range extends at least as far south as Newfoundland. According

særdeles sjelden, idetmindste paa Dybderne udenfor denne Øgruppe. Endelig er den fundet ved Finmarkens Kyster saavel østenfor Nordcap (i Varangerfjorden), som i Vest-Finmarken (Lyngen); den er i Norge hidtil ikke fundet søndenfor 70° N. B.

Fam. Cyclopteridae.

Gen. Eumicrotremus, Gill.

Proc. Ac. Nat. Sci. Philad. 1864, p. 190 (1864).

Legemet næsten kugleformigt, med kort Hale, og beklædt med store, conisk tilspidsede Bentuberkler. 1ste Dorsal distinct, af Bygning som 2den Dorsal; de øvrige Finner, samt Sugeskiven, som hos Cyclopterus. Gjællespalten særdeles liden, dens Højde mindre, end Øjets Diameter, beliggende højt ovenfor Pectoralernes Fæste. Sidelinie tilstede. Flere Rækker fine Tænder i Kjæverne.

11. Eumicrotremus spinosus, (Müll.) 1776.

Pl. II, Fig. 13.

Cyclopterus spinosus, Müll. Prodr. Zool. Dan. p. IX (1776).
Eumicrotremus spinosus, Gill, Proc. Acad. Nat. Sci. Philad. Sept. 1864, p. 190 (1864).
Cyclopterus orbis, Günth. Cat. Fish. Brit. Mus. vol. 3, p. 158 (1861).

Diagn. *Hovedet stort, indeholdes $2^1/_2$—3 Gange i Totallængden. 2 Par tubeformige Næsebor. Sugeskiven stor, indeholdes lidt over 4 Gange i Totallængden. Anus ligger nærmere Sugeskiven, end Analen. Bentuberklerne have bredt rundagtig Basis, ere tæt chagrinerede, og danne 5—6 uregelmæssige Længderækker; Trakten om Anus, samt Finnerne ere nøgne. Sidelinien højtliggende, har omtrent 13 Porer. Haleroden lav, indeholdes blot $^2/_3$ Gange i Øjets Diameter. Størrelsen indtil 160 mm.*

1 D. 6—7; 2 D. 10—12 (13); A. 10—12; P. 23—25; C. 10—11. Lin. lat. 13.

Localit. fra Nordh.-Exped. Spitsbergen.

Beliggenhed.	Isfjorden, Spitsbergen.
Dybde.	129 Favne (236 m).
Temp. paa Bunden.	— 1,2° C.
Bunden.	Stenbund og Mudder.
Datum.	19de August 1878.
Antal Individer.	1 Indiv.

to Dr. Lütken it has also been met with off the coast off Iceland. On the coast of Spitzbergen it is not, perhaps, very rare, at least in deep water off that group of islands. It occurs, too, on the coast of Finmark, both east of the North Cape (in the Varanger Fjord) and in West Finmark (Lyngen), but has not hitherto been met with further south than 70° N.

Fam. Cyclopteridæ.

Gen. Eumicrotremus, Gill.

Proc. Ac. Nat. Sci. Philad. 1864, p. 190 (1864).

Body almost globular, studded with large osseous tubercles, cuneiform in shape and pointed. First dorsal distinct, similar in structure to second dorsal; the other fins and the ventral disk as in Cyclopterus. Branchial opening placed high above the base of the pectorals, exceedingly narrow, its depth being less than the diameter of the eye. Lateral line obvious. Several series of minute teeth in the jaws.

11. Eumicrotremus spinosus, (Müll.) 1776.

Pl. II, fig. 13.

Cyclopterus spinosus, Müll. Prodr. Zool. Dan. p. IX (1776).
Eumicrotremus spinosus, Gill, Proc. Acad. Nat. Sci. Philad. Sept. 1864, p. 190 (1864).
Cyclopterus orbis, Günth. Cat. Fish. Brit. Mus. vol. 3, p. 158 (1861).

Diagnosis. — *Head large, length to total length as 1 to $2^1/_2$—3; 2 pairs of tubular nostrils; ventral disk large, its diameter slightly exceeding one-fourth of the extreme length of the body; vent nearer the disk than the anal; the osseous tubercles, disposed in 5—6 irregular longitudinal rows, are closely granulated, and broad at the base; the region environing the vent and the fins is smooth; lateral line, consisting of about 13 pores, high up the side; root of tail slender, its height being two-thirds only of the diameter of the eye. Length reaching 160 mm.*

1 D. 6—7; 2 D. 10—12 (13); A. 10—12; P. 23—25; C. 10—11. Lin. lat. 13.

Locality (North Atl. Exped.): — Spitzbergen.

Exact Locality.	The Isfjord, Spitzbergen.
Depth.	129 Fathoms (237 m).
Temp. at Bottom.	— 1.2° C.
Bottom.	Rock and Mud.
Date.	19th August 1878.
Numb. of Specim.	1 Indiv.

Bemærkninger til Synonymien. Opførelsen af denne Art under en særegen Slægt synes tilstrækkeligt at kunne begrundes ved Bygningen af Gjællespalten, der er reduceret til en trang Aabning højt over Pectoralernes Rod, samt ved den normalt byggede 1ste Dorsal, der ikke er omhyllet af den tykke Beklædning, der, som hos Slægten *Cyclopterus,* bringer denne Finne til næsten at forsvinde under Legemets almindelige Omrids. *Eumicrotremus* danner en bestemt Overgang til Lipariderne, baade paa Grund af Gjællespaltens Form og Stilling, og fordi Tænderne danne tydelige Rækker i Kjæverne.

Som en anden Art af samme Slægt har Dr. Günther i 1861 opstillet *Cyclopterus orbis,* beskreven efter et enkelt Individ med en Totallængde af 22 eng. Linier (omtr. 57 mm) fra Beringshavet. Denne adskiller sig fra *E. spinosus* hovedsagelig blot ved et ringere Antal Straaler i 2den Dorsal og i Analen, idet dette hos Dr. Günthers Individ (Cat. Fish. Brit. Mus. vol. 2 p. 158) var blot 9 i begge de nævnte Finner.

Da Universitets-Musæet i Christiania nylig har modtaget et velconserveret Exemplar af denne Form fra samme Trakt (Kamtschatka), har jeg kunnet anstille en nøje Sammenligning mellem begge Former, og tror efter denne ikke at kunne opføre *C. orbis* som en fra *E. spinosus* distinct Art. Totallængden af dette sidste Exemplar var 70 mm, hvoraf Hovedets Længde var 22 mm; Øjets Diameter 7 mm, og udgjorde saaledes $^1/_3$ af Hovedlængden[1]. Interorbitalrummet var 13 mm, Sugeskivens Længdediameter 15 mm. Straaleantallet var følgende: 1 D. 7; 2 D. 10; A. 10; C. 11; P. 24.

Da *E. spinosus* (ifølge Günther) kan have 10 Straaler i Analen, og 11 i 2den Dorsal, synes sikre Distinctions-Characterer ikke at kunne hentes af dette Forhold, og da heller ikke de øvrige Characterer kunne sees i nogen væsentlig Grad at være forskjellige fra *E. spinosus*, synes det rettest at henføre *C. orbis* som synonym under denne Art, der saaledes er den eneste hidtil kjendte i sin Slægt.

Allerede i 1776 blev Arten af O. F. Müller tildelt sin første foreløbige Diagnose efter et Individ, nedsendt fra Grønland gjennem Fabricius. I 1780 blev den udførligere beskreven af Fabricius selv i Fauna Groenland. (No. 93, p. 134), og senere i 1798 af samme Forf. i Naturhistorie-Selskabets Skrifter (4de B. 2 Afd. p. 77). Fuldstændig Beskrivelse er endvidere givet i 1847 i Naturh. Tidsskrift (2 Række, 2 B. p. 262) af Krøyer, som ligeledes i 1851 har afbildet Arten i Gaimards Plancheværk (Voyage etc. 1838—40, Poiss. pl. 4). Senest er den i 1861 af Dr. Günther beskrevet i Catal. Fish. Brit. Mus. (vol. 3, p. 157); samme Forf. har i 1877 i Proc. Zool.

[1] Naar Dr. Günther i sin Diagnose af *E. spinosus* anfører Øjet som udgjørende $^1/_4$ af Hovedets Længde, er dette ikke Tilfældet hos Nordhavs-Expeditionens Individ, hvis Hovedlængde er 25 mm, og Øjets Diameter 9 mm, saaledes, at den sidste udgjør lidt over $^1/_3$ af Hovedlængden.

Remarks on the Synonymy. — For the establishing of this species under a separate genus there would appear to be sufficient reason in the characteristic form of the branchial opening, reduced as it is to a narrow slit, placed high above the pectoral fin; also in the fact of the 1st dorsal being normal in structure, and not enveloped in the thick membranous integument which, in the genus *Cyclopterus,* well nigh conceals this fin beneath the contour of the body. *Eumicrotremus,* both from the form and position of the branchial orifices, and from the teeth being arranged in distinct series in the jaws, may be regarded as a well-defined transition-genus, approximating the *Liparididæ.*

As a second species of the same genus, Dr. Günther, in 1861, established *Cyclopterus orbis,* describing it from a single specimen, having a total length of 22 English lines (about 57 mm), taken in Bering's Straits. *C. orbis* is distinguished from *E. spinosus* chiefly by the smaller number of rays in the second dorsal and in the anal; the individual examined by Günther had, for instance, only 9 rays in each of those fins.

The University Museum in Christiania having lately come into possession of a well-preserved example of this form, taken in the same region (Kamtschatka), I have had an opportunity of closely comparing the two forms, and am of opinion that *C. orbis* can not be classed as a separate species, distinct from *E. spinosus.* The total length of this individual was 70 mm; length of head 22 mm; diameter of eye 7 mm, or about one-third of the length of the head;[1] interorbital space 13 mm; longitudinal diameter of ventral disk 15 mm. The fin-ray formula was as follows: — 1 D. 7; 2 D. 10; A. 10; C. 11; P. 24.

E. spinosus, can, according to Dr. Günther, have 10 rays in the anal and 11 in the 2nd dorsal fin, and hence the fin-ray formula is of itself hardly sufficient to furnish a distinctive character; and not differing materially in other respects from *E. spinosus, C. orbis* may, it would seem, be safely regarded as identical with the former, which, in that case, is the only species hitherto observed of its genus.

As for back as 1776, O. F. Müller gave the first preliminary diagnosis of the species, from a specimen sent from Greenland by Fabricius. In 1780 it was more fully described by Fabricius himself, in his Fauna Grœnland. (No. 93, p. 134), and subsequently, in 1798, by the same author (Naturhistorie-Selskabets Skrifter, 4 B. 2 Afd. p. 77). A full description also appeared in 1847, by Kröyer (Naturh. Tidsskr., 2 Række, 2 B. p. 262), who, in 1851, likewise figured the species for the plates to Gaimard's work (Voyage etc. 1838—40, Poiss. pl. 4). The latest diagnosis is that by Dr. Günther, in 1861 (Catal. Fish. Brit. Mus. vol. 3, p. 157); and in 1877 the same

[1] In Dr. Günther's diagnosis of *E. spinosus,* the diameter of the eye is stated to measure one-fourth of the length of the head; this was not the case, however, in the individual obtained on the North Atlantic Expedition, the length of the head having been 25 mm, and the diameter of the eye 9 mm, or a fraction more than a third.

Soc. of London (p. 294) givet i Træsnit Afbildninger af Yngelen.

Bemærkninger til Beskrivelsen. Totallængden af det under Expeditionen erholdte Individ var 79^{mm}, hvoraf Hovedets Længde var 25^{mm}. De conisk tilspidsede Bentuberkler beklæde Legemet saa tæt, at deres Grundlinier paa Siderne af det egentlige Legeme i Regelen berøre hinanden; paa Halen ere de alle mindre. Paa de 5 første Straaler af 1ste Dorsal sidder paa hver Side hen mod Spidserne en liden, chagrineret Bentorn. Endvidere er Grunden af Pectoralerne paa Ydersiden beklædt paa samme Maade, som Legemet og Hovedet.

Straaleantallet var: 1 D. 7; 2 D. 12; A. 12; P. 23; C. 10.

Tilstedeværelsen af en Sidelinie synes ikke at være omtalt i noget af de ovenfor anførte Skrifter, og Kröyer nævner udtrykkelig, at den mangler. En Sidelinie er ikkedestomindre tilstede, og Porerne ere overalt tydelige, om end ikke særdeles store[1]. Den udspringer ved Gjællespaltens øvre Ende, er i Begyndelsen temmelig højtliggende, men bøjer under 2den Dorsal skraat nedad mod Legemets Midtlinie, som den naar i omtrent $^1/_3$ Hovedlængdes Afstand fra Haleroden, og løber herfra ret ud mod Caudalen. Antallet af Porer er paa den ene Side 13, paa den anden 14.

Udbredelse. I Modsætning til *Cyclopterus lumpus* synes denne at være en Dybvandsart, der blot forekommer paa 60—200 Favnes Dyb (eller derover). Den hører til de Arter Fiske, som ere fundne længst mod Nord. Fra Grønland, hvor den er talrig, er den, som ovenfor nævnt, allerede kjendt fra forrige Aarhundrede gjennem Müller og Fabricius, og fandtes sidst i 1875 af den engelske Nordpol-Expedition paa flere Punkter af Vest-Grønland op til mellem 79 og 80° N. B. Fremdeles er den, ifølge Faber, funden ved Island (Fische Isl. p. 54, 1829); ved Spitsbergen er den ligeledes, som det synes, hyppig, og er her funden af Kröyer allerede i 1838, og senere af alle de efterfølgende Expeditioner i disse Farvande. Den er hidtil ikke fundet ved det europæiske Continent, men forekommer sandsynligvis ogsaa her paa passende Dybder af Ishavet. Da, som ovenfor nævnt, *Cyclopterus orbis* fra Beringshavet neppe kan opfattes som en fra *Eumicrotremus spinosus* skilt Art, er den saaledes i sin Udbredelse maaske circumpolær.

[1] Sandsynligvis er den oftest utydelig hos Individer, der have ligget længe i Spiritus, men vil i Regelen atter vise sig, om Individet opblødes en Tid i Vand.

author figured the fry of the species on wood. (Proc. Zool. Soc. of London, p. 294).

Descriptive Observations. — The total length of the individual taken on the Expedition was 79^{mm}; length of head 25^{mm}. The cuneiform osseous tubercles are so closely disposed over the body that their basal lines, in the lateral region, are as a rule contiguous; on the tail, these tubercles are all considerably smaller. The 5 first rays in the first dorsal are furnished on either side towards the point with a small granulated spine. Moreover, the base of the pectorals, exteriorly, is invested with a tegument similar to that covering the head and the body.

Number of fin-rays: — 1 D. 7; 2 D. 12; A. 12; P. 23; C. 10.

The occurrence of a lateral line does not appear to have been observed by any of the naturalists whose works are cited above; nay, Kröyer emphatically declares it to be wanting. A lateral line nevertheless there is, and the pores, though not particularly large, are distinctly perceptible.[1] It commences at the upper extremity of the branchial opening, extending from thence nearly straight till a little below the 2nd dorsal, where it suddenly bends downwards, striking off obliquely to the mesial line, which it meets at a point distant about half the length of the head from the origin of the tail, and then passing straight to the caudal. Number of pores 13—14.

Distribution. — Unlike *Cyclopterus lumpus*, this would appear to be a deep-sea species, occurring at a depth of from 60 to 200 fathoms (or still deeper), and is one of the fishes whose range extends furthest north. On the coast of Greenland, where it is common, it was observed as far back as the last century, by Müller and Fabricius, having been latest met with on the English North Pole Expedition, 1875, in divers localities on the western shores of Greenland, as far north as 79° and 80°. According to Faber, (Fische Isl. p. 54, 1829) it inhabits the coast of Iceland; off Spitzbergen it is likewise said to be numerous, having been observed in those regions by Kröyer, in 1838, and since then on all subsequent Arctic Expeditions. Up to the present time it has not been met with off the continent of Europe, but occurs probably here too at the right depth. *Cyclopterus orbis,* from Bering's Straits, being, as before observed, hardly entitled to rank as a species distinct from *E. spinosus*, it is perhaps circumpolar in its range.

[1] Probably it is more or less obliterated in specimens preserved for any length of time in spirits, but will again become obvious if the skin be sufficiently moistened with water.

Fam. Liparididae.

Gen. Liparis, Cuv.

Règne Anim. éd. I, tom. 2, p. 227 (1817).

12. Liparis lineatus, (Lepech.) 1774.

Cyclopterus liparis, Lin. Syst. Nat. ed. 12, tom. 1, p. 414 (1766).
Cyclopterus lincatus, Lepech. Nov. Comm. Acad. Petr. tom. 18, p. 522 (1774).
? *Cyclopterus musculus,* Lacép. Hist. Poiss. tom. 4, p. 685 (1798).
Liparis vulgaris, Flem. Hist. Brit. Anim., p. 190 (1828).
Liparis barbatus, Ekstr. Kgl. Vet. Akad. Handl. 1832, p. 168 (1832).
Liparis lincata, Kr. Naturh. Tidsskr. 2. Række, 2. B., p. 284, 1846—49 (1847).
Liparis stellatus, Malm, Förh. Skand. Naturf. 9de Möte 1863, p. 412 (1863).
? *Liparis arctica,* Gill, Proc. Ac. Nat. Sci. Philad. 1864, p. 191 (1864).

Diagn. *Hovedet mindre, end Legemets største Højde, og indeholdes 4 Gange i Totall. Øjnene smaa, indeholdes 5 Gange i Hovedets Længde. Analen bedækker* $^1/_4$ *(hos Ungerne* $^1/_3$*) af Caudalens Rod; Dorsalen naar til (hos Ungerne lidt udover) samme. Snuden længere, end Øjets Diameter. Underkjæven kortere, end Overkjæven. Sugeskiven stor, udgjør* $^1/_8$ *(hos Ungerne* $^1/_7$*) af Totall., eller Halvdelen af Hovedets Længde. Pectoralen med en dyb Indskjæring, og de nedre Straaler atter forlængede. Caudalen tvert afrundet, indeholdes 8 (hos Ungerne 7) Gange i Totall. Anus beliggende midt mellem Sugeskiven og Analen. Farven varierende; ensfarvet, plettet eller stribet. Længden indtil 130*^{mm} *(og derover).*
M. B. 7. D. 32—42; A. 26—38; P. 32—42; C. 10—11[1].

Localit. fra Nordh. Exped. Spitsbergen.

	—	*Stat.* 366.
Beliggenhed.	Norskøerne, Nord-Spitsbergen.	Magdalenebay, Nord-Spitsbergen,
Dybde.	Ubetydelig.	50 Favne (91 *m*).
Temp. paa Bunden.	—	— 1,0° C.
Bunden.	—	Mørkegraat Ler.
Datum.	15de Aug. 1878.	17de Aug. 1878.
Antal Indiv.	3 Indiv.	1 Indiv.

Bemærkninger til Beskrivelsen. De 3 først erholdte Individer tilhøre den Farve-Varietet, som jeg i en tidligere Afhandling[2] har benævnt *var. i, arcticus,* og som sandsynligvis gaar ind under den af Gill i Proc. Acad. Nat. Sci. Philad. 1864 opstillede *L. arctica.* Denne Farve-

[1] Østersøen: D. 32—35; A. 28 (Malmgr.).
Norge: D. 34—38; A. 28—31 (C.).
Spitsbergen: D. 36—40; A. 29—34 (Malmgr.).
Spitsbergen: D. 38—42; A. 31—38 (Nordh.-Exped.).
Grønland: D. 41—43; A. 33—37 (Malmgr., Gill).
[2] Forh. Vid. Selsk. Chra. 1879, No. 1, p. 44.

Fam. Liparididæ.

Gen. Liparis, Cuv.

Règne Anim. éd. I. tom. 2, p. 227 (1817).

12. Liparis lineatus, (Lepech.) 1774.

Cyclopterus liparis, Lin. Syst. Nat., ed. 12, tom. 1, p. 414 (1766).
Cyclopterus lincatus, Lepech. Nov. Comm. Acad. Petr., tom. 18, p. 522 (1774).
? *Cyclopterus musculus,* Lacép. Hist. Poiss. tom 4, p. 685 (1798).
Liparis vulgaris, Flem. Hist. Brit. Anim. p. 190 (1828).
Liparis barbatus, Ekstr. Kgl. Vet. Akad. Handl. 1832, p. 168 (1832).
Liparis lincata, Kr. Naturh. Tidsskr. 2. Række, 2. B. p. 284, 1846—49 (1847).
Liparis stellatus, Malm, Förh. Skand. Naturf. 9 Möte, 1863, p. 412 (1863).
? *Liparis arctica,* Gill, Proc. Ac. Nat. Sci. Philad. 1864, p. 191 (1864).

Diagnosis. — *Length of head less than depth of body, and equal to one-fourth of total length; eyes small, diameter one-fifth of the length of the head; anal covering one-fourth (in young examples one-third) of the base of the caudal; dorsal extending back to this point (in young examples a little beyond it); length of snout greater than diameter of eye; lower jaw shorter than upper; ventral-disk large, equalling one-eighth (in young examples one-seventh) of total length, or half the length of the head; pectorals with a deep incision, lower rays elongate; caudal slightly convex, length to total length as 1 to 8 (in young examples as 1 to 7); vent placed midway between ventral-disk and anal. Colour varying; uniform, spotted, or striped. Length reaching 130*^{mm}.
M. B. 7; D. 32—42; A. 26—38; P. 32—42; C. 10—11.[1]

Locality (North Atl. Exped.): — Spitzbergen.

	—	*Stat.* 366.
Exact Locality.	Norsk Øer, North Spitzbergen.	Magdalene Bay, North Spitzbergen.
Depth.	Trifling.	50 Fathoms (91 *m*).
Temp. at Bottom.	—	— 1.0° C.
Bottom.	—	Dark-grey Clay.
Date.	15th Aug. 1878.	17th Aug. 1878.
Numb. of Specim.	3 Indiv.	I Indiv.

Descriptive Observations. — The three first of these individuals belong to the variety which I designated in a former paper,[2] *var. i, arcticus,* and which probably is comprised in Gill's *L. arctica* (Proc. Acad. Nat. Sci. Philad. 1864). This variety, more numerous it would appear off

[1] The Baltic: D. 32—35; A. 28 (Malmgr.).
Norway: D. 34—38; A. 28—31 (C.).
Spitzbergen: D. 36—40; A. 29—34 (Malmgr.).
Spitzbergen: D. 38—42; A. 31—38 (North Atl. Exped.).
Greenland: D. 41—43; A. 33—37 (Malmgr., Gill).
[2] Forh. Vid. Selsk. Chra. 1879, No. 1, p. 44.

varietet, der synes at være den paa Spitsbergen, eller idethele i det rent arctiske Gebet hyppigst optrædende Form af Arten, er næsten ensfarvet uden større Pletter eller Striber. Bundfarven, som er graagul, er næsten skjult af yderst fine, tætstillede, brune Punkter; hos de yngre ere disse især udbredte over Finnerne og paa Legemets Sider, som derved erholde en brunlig Afskygning, ligesom hist og her, saaledes som paa Bugen, Bundfarven kan optræde uplettet.

Disse Individers Maal og Straaleantal var følgende:

	Totallængde.	Hovedets Længde.	*D.*	*A.*
a.	45 mm	12 mm	41;	34.
b.	49 -	13,5 -	38;	31.
c.	104 -	24 -	40;	32.

Det 4de Individ, der er det største, og noget defect, idet Huden tildels er afrevet, ligesom Caudalen mangler, har jeg i min foreløbige Oversigt[1] troet at burde henføre under *L. tunicatus,* Reinh., væsentlig paa Grund af et større Straaleantal i Analen og Pectoralen, samt den sidstnævnte Finnes betydelige Længde, idet Spidsen naar lidt forbi Begyndelsen af Analen. Sandsynligvis udgjør det dog blot et stort Individ af *L. lineatus,* og gaar blandt de i den ovenfor anførte Afhandling nævnte Varieteter nærmest ind under *var. c, subfuscus.* Af denne Varietet har Universitets-Musæet allerede flere mindre Exemplarer fra Varangerfjorden i Norge.

Dette sidstnævnte Individ, der var en Hun med et overordentlig stort Antal fine Rogn i Ovarierne, havde følgende Maal: Totall. 122 mm (omtr.); Hovedets Længde 33 mm. Straaleantallet var: *D.* 42. *A.* 38. *P.* 39—42.

Bundfarven, der er lyst graagul, er omtrent ligesaa stærkt fremtrædende, som de smaa uregelmæssige Pletter (under en Orbitaldiameters Størrelse), der er jevnt fordelte over den. Hist og her ere Pletterne lidt sammenhængende, uden dog at danne Linier; de horizontale Finner ere derimod stribede paa tvers. Huden er overordentlig løst vedhængende, skjønt Individet var vel conserveret.

Paa Gjællerne af dette Individ snyltede et Exemplar af en stor Lernæide (sandsynligvis *Haemobaphes cyclopterina,* Fabr.).

Føde. Ventrikelen af det ene Individ fandtes fyldt med smaa Crustaceer, nemlig en *Caprella septemtrionalis,* Kr., samt flere Individer af *Protomedeia fasciata,* Kr.; den sidste Amphipode fandtes ligeledes hos et af de unge Individer. I Ventrikelen af det største Individ fandtes Dele af en større Annelide, *Pectinaria auricoma,* (Müll.).

[1] Forh. Vid. Selsk. Chra. 1878, No. 14, p. 30.

Spitzbergen and throughout the Arctic regions generally than any other form of the species, is of an almost uniform colour, exhibiting no vestige of large spots or stripes. The ground-colour, greyish-yellow, nearly concealed by a multitude of closely disposed minute brown specks; in comparatively young individuals these minute spots are dispersed in particular over the fins and along the lateral region of the body, which they blur with a brownish tinge; and here and there, too, as on the abdominal surface, the ground-colour occurs uniformly spotless. . . .

Principal dimensions, and number of fin-rays: —

	Total Length.	Length of Head.	*D.*	*A.*
a.	45 mm	12 mm	41;	34.
b.	49 -	13.5 -	38;	31.
c.	104 -	24 -	40;	32.

The fourth specimen is much the largest, but somewhat mutilated, portions of the skin having been torn off; the caudal, too, is wanting; in my preliminary report[1] I have referred it to *L. tunicatus,* Reinh., chiefly by reason of the greater number of fin-rays in the anal and the pectorals, and from the very considerable length of the latter fin, the points of which extend a short distance past the origin of the anal. Probably, however, this specimen was merely a large-sized individual of *L. lineatus,* and should in that case rank under *var. c, subfuscus,* mentioned in the paper cited above. Of this variety the University Museum is already in possession of several smaller specimens from the Varanger Fjord.

This, the last of the individuals, a female, having in the ovaries large quantities of minute ova, measured as follows: — Total length 122 mm (about); length of head 33 mm; number of fin-rays: — *D.* 42; *A.* 38; *P.* 39—42.

The ground-colour, a uniform light greyish-yellow, and the small irregularly disposed spots (somewhat less in diameter than the length of the orbit) cover about an equal extent of surface. In places, the spots exhibit a tendency to approximate, without however forming lines; the horizontal fins, on the other hand, are distinctly marked with transverse stripes. The skin is remarkably lax, notwithstanding the individual was in all respects a well-preserved specimen.

On the gills of this individual occurred a large example of a Lernæan parasite (possibly *Hæmobaphes cyclopterina,* Fabr.).

Food. — The stomach of this one specimen was found distended with small crustaceans, viz. a *Caprella septemtrionalis,* Kr., and divers examples of *Protomedeia fasciata,* Kr.; the latter Amphipod was likewise detected in the ventricle of one of the young specimens. The stomach of the largest individual contained fragments of a large Annelid, *Pectinaria auricoma,* (Müll.).

[1] Forh. Vid. Selsk. Chra. 1878, No. 14, p. 30.

Udbredelse. Da Artsbegrændsningen hos denne Slægt endnu i flere Henseender er usikker, kan Udbredelsen af *L. lineatus* endnu ikke med Nøjagtighed opgives. Flere Omstændigheder tyde dog paa, at den har en forholdsvis vid Udbredelse; foruden at den under en Mangfoldighed af Farvevarieteter forekommer fra Østersøen og England af, og langs den svensk-danske og hele den norske Kyst op til Spitsbergen, hvor den endnu under 80° N. B. naar en frodig Udvikling, forekommer den desuden ved Island, Grønland, og Nordamericas Kyster ned til New England-Staterne, idet den er funden, ifølge Goode & Bean, i Massachusetts Bay. Mod Øst gaar den idetmindste ind i det hvide Hav (hvorfra den beskreves af Lepechin allerede i 1774).

Distribution. — The specific limits of this genus being as yet in many respects undetermined, the exact range of *Liparis lineatus* cannot be given. Divers circumstances lead us however to infer that the species is widely distributed; besides occurring — with regard to colour in numerous varieties — in the Baltic, on the shores of Great Britain, and on the Swedish, Danish, and Norwegian coasts, as far north as Spitzbergen, where, in lat. 80° N., it attains a high degree of development, the species likewise inhabits the shores of Iceland and Greenland, its range extending from thence along the North American coast, as far south as New England, having been observed in Massachusetts Bay. *L. lineatus* has been met with as far east as the White Sea, the first to describe it as occurring there having been Lepechin, in 1774.

13. **Liparis bathybii**, Coll. 1878, (n. sp.)

Pl. II, Fig. 14.

Liparis (Paraliparis) bathybii, Coll. Forh. Vid. Selsk Chra. 1878, No. 14, p. 32 (1878).

Diagn. *Hovedet kort og rundt; dets Længde lig Legemets største Højde, og indeholdes $5^1/_2$ Gange i Totall. Øjet (Orbita) stort; dets Længdediameter indeholdes $3^1/_2$ Gange i Hovedets Længde, og omtrent $1^2/_3$ Gange i Interorbitalrummets Bredde. Dorsalen og Analen bedække $^2/_3$ af Caudalen. Snuden kort, ubetydeligt længere, end Orbita. Pectoralens øvre og nedre Parti adskilte ved et Mellemrum, der er opfyldt af 3—4 rudimentære Straaler. (Øjnene, Sugeskiven, og Beliggenheden af Anus ubekjendt). Farven sandsynligvis overalt brunsort. Størrelsen hos det undersøgte Individ (en Hun) 208mm.*

M. B. 7. D. 59; A. 51; P. 13/3(4)/3; C. 8.

Localit. fra Nordh. Exped. Havet vestenfor Beeren Eiland.

	Stat. 312.
Beliggenhed.	108 Kilom. V. Beeren Eiland.
Dybde.	658 Favne (1203m).
Temp. paa Bunden.	— 1,2° C.
Bunden.	Brunt og grønt Ler.
Datum.	22de Juli 1878.
Antal Individer.	1 Indiv.

Bemærkninger til Synonymien. Det erholdte Individ fandtes ved Trawlnettets Undersøgelse i en særdeles medtagen Tilstand indeklemt mellem Stene og Ler, saaledes, at det kun med den største Vanskelighed lod sig løsne. Huden, der sandsynligvis har siddet ganske løst, var næsten overalt frareven, eller hængte i løse Fryndser; dette har i

13. **Liparis bathybii**, Coll. 1878, (n. sp.)

Pl. II, fig. 14.

Liparis (Paraliparis) bathybii, Coll. Forh. Vid. Selsk. Chra. 1878, No. 14, p. 32 (1878).

Diagnosis. — *Head short and globular; equal in length to the depth of the body, and is to total length as 1 to $5^1/_2$; eyes (orbitæ) large, their longitudinal diameter being to the length of the head as 1 to $3^1/_2$, and to width of interorbital space about as 1 to $1^2/_3$; the dorsal and anal fins covering two-thirds of the caudal; snout short, but slightly exceeding the diameter of the orbit; the upper and lower divisions of the pectorals are separated by a space furnished with 3—4 rudimentary rays (concerning the eyes, the ventral disk, and the position of the vent nothing is known). Colour brownish-black. Length of body in the specimen examined (female) 208mm.*

M. B. 7; D. 59; A. 51; P. 13/3(4)/3; C. 8.

Locality (North Atl. Exped.): — The open sea, west of Beeren Eiland.

	Stat. 312.
Exact Locality.	108 Kil. W. of Beeren Eiland.
Depth.	658 Fathoms (1203m).
Temp. at Bottom.	— 1.2° C.
Bottom.	Brown and Green Clay.
Date.	22th July 1878.
Numb. of Specim.	1 Indiv.

Observations on the Synonymy. — The specimen obtained was brought up with the trawl-net in a very mutilated condition, being jammed in between stones and clay, in such a manner that the greatest difficulty was experienced in extricating it. The skin, which in all probability was very lax, had been torn off over the whole

flere Henseender været uheldigt, fornemmelig fordi Pectoralerne ere af en særegen Bygning, som det havde været af særdeles Interesse at komme til fuld Klarhed om. Fremdeles manglede hele Sugeskiven, medens dog dens Plads sandsynligvis endnu kan sees; og da Bugen paa Siderne og nærmest Analen var opreven, kan heller ikke Beliggenheden af Anus med Sikkerhed angives. Endelig vare Øjnene udfaldne; derimod vare saagodtsom alle Finnestraaler bibeholdte, ligesom Legemet iøvrigt paa intet Sted var afbrudt eller defect. Den efterfølgende Beskrivelse tiltrænger derfor i høj Grad at suppleres, ihvorvel den maaske i det væsentlige vil vise sig at være correct.

Endskjønt saaledes Individet mangler et af de for Familien væsentligste Organer, nemlig Sugeskiven, kan det dog paa Grund af Legemets almindelige Bygning ikke betvivles, at det tilhører Liparidernes Familie, medens det ikke er klart, hvilken af de hidtil beskrevne Arter det kommer nærmest.

Til Underslægten *Careproctus*, Kr., kan forhaandenværende Art ikke vel henregnes, uagtet den har det hos denne optrædende betydelige Antal Straaler i Dorsalen og Analen, samt det relativt lille Hoved. Hos *Careproctus reinhardi* ere de mellemste Pectoralstraaler vistnok korte, men dog fuldstændig normalt udviklede; Legemet aftager hos denne Art hurtigt i Højde bag Nakken, og ender i en lang og smal Hale. Hos *L. bathybii* ere de nederste Pectoralstraaler næsten af samme Længde, som de øvre, men adskilte fra disse ved et Mellemrum, der er opfyldt af nogle faa og ganske rudimentære Straaler. Legemshøjden er fremdeles den samme omtrent fra Nakken indtil Analens Begyndelse, og senere ligeledes forholdsvis høj lige til henimod Halespidsen, der aftynder jevnt og hurtigt. Endelig findes intet Spor af, at Analaabningen har siddet i kort Afstand fra Sugeskiven, idet Partiet bagenfor det Punkt, hvor denne sidste har siddet, er uskadt indtil henimod Analen; Analaabningen maa saaledes have ligget forholdsvis langt tilbage, maaske næsten henimod Analens Begyndelse.

Det er en Selvfølge, at Charactererne for den nye Art ikke med det forhaandenværende Materiale lade sig tilfredsstillende udvikle. Dog synes Pectoralernes Bygning at være saa væsentlig afvigende fra, hvad der finder Sted hos de øvrige kjendte Liparider, at Oprettelsen af en ny Underslægt vistnok alene af Hensynet hertil kunde forsvares; hertil komme andre mindre væsentlige Afvigelser, ligesom det er sandsynligt, at disse yderligere ville forøges med et fuldstændigere Materiale. For det Tilfælde, at et nyt Slægtsnavn skulde blive nødvendigt, har jeg allerede i den foreløbige Oversigt over Expeditionens Fiske (1878) som et saadant foreslaaet Navnet *Paraliparis*.

surface almost, or depended in loose strips. This proved in several respects most unfortunate, chiefly, however, owing to the peculiar structure of the pectoral fins, which it would have been of considerable interest to have determined. The ventral disk, too, was wanting, but the spot where it occurs could, I think, be detected; and the abdomen having been crushed, the position of the vent cannot be given. Both the eyes, too, were gone, whereas the fin-rays were nearly all perfect; nor did the body proper exhibit any other traces of mutilation. The following description, therefore, stands greatly in need of supplementary revision, though, perhaps, in all essential particulars, it will be found correct.

One of the organs characteristic of the family, viz. the ventral disk, is indeed wanting in the specimen acquired, yet from the general structure of the body there can be little doubt that it belongs to the family *Liparididæ*, whereas it is by no means clear to which of the species as yet described it presents the closest resemblance.

Under the sub-genus *Careproctus*, Kr., the species in question cannot be classed, notwithstanding it is characterised, in common with the species of the former, by a large number of rays in the dorsal and anal fins, and a head proportionately small. In *Careproctus reinhardi*, the intermediate rays in the pectorals, though short, exhibit a development in every respect normal; in this genus, too, the body posterior to the nape decreases rapidly in height, terminating in a long and narrow tail. *L. bathybii* has the lowest of the pectoral rays nearly equal in length with the uppermost, but separated from the latter by a space on which are disposed a few rays, quite rudimentary. Moreover, the depth of the body is very nearly the same from the nuchal region to the commencement of the anal, the posterior portion likewise being proportionately deep almost to the tip of the tail, which rapidly becomes slender and tenuous. Finally, there was no trace of the vent having been in close proximity to the ventral disk, the region posterior to the point where the latter was situated having been wholly uninjured to within a short distance from the anal fin; hence the vent must lie comparatively far behind, perhaps in close proximity to the anal.

From a specimen in so mutilated a condition, it is obvious that the characters of the new species cannot all of them be accurately determined. Meanwhile, the structure of the pectoral fins is to that extent divergent from that distinguishing the other known forms of the family of Suckers, that, for this reason alone, the introduction of a new sub-genus may be defended; other less important deviations also occur, the number of which will doubtless be found to increase with further examination of perfect examples. To meet the case of a new generic designation becoming needful, I took occasion, in my preliminary report (1878), to suggest the name *Paraliparis*.

Udmaalinger.

Totallængde	208 mm
Længde til Enden af sidste Halehvirvel	189 -
Største Højde ved Begyndelsen af Dorsalen	37 -
Højde ved Begyndelsen af Analen	33 -
Hovedets Længde	37 -
Hovedets største Højde	30 -
Hovedets Tykkelse over Kinderne	24 -
Overkjævens Længde	17 -
Mellemkjævens Længde	13 -
Snudens Længde	10 -
Længdediameter af Orbita	11 -
Hovedets postorbitale Del	17 -
Interorbitalrummets Bredde	17 -
Snudespidsen til Begyndelsen af Dorsalen	42 -
Snudespidsen til Begyndelsen af Analen	70 -
Analen til Halespidsen	138 -
Længste Straale i Dorsalen	22 -
Længste Straale i Analen	22 -
Pectoralstraalernes største Længde	27 -
Caudalens Længde	19 -
Halerodens Højde	2 -

Beskrivelse. *Legemsbygning.* Legemet er temmelig langstrakt, med kort og rundt Hoved, og særdeles bred Pande; dets Højde er størst over Nakken, hvor denne er lig Hovedlængden. Bagenfor Nakken vedbliver Højden omtrent uforandret, indtil over Begyndelsen af Analen; senere aftager den, især i Halepartiets ydre Dele, successive til Halespidsen.

Hovedet indeholdes i Totallængden $5^1/_2$ Gange. Fra Nakken af er Hovedets Profillinie stærkt bøjet, og skraaner jevnt nedad indtil foran Øjnene; herfra gaar Profillinien stejlt ned indtil Mundspalten.

I Totallængden indeholdes:

Legemets Højde, samt Hovedets Længde	5,54.
Snudespidsens Afstand fra Dorsalen	4,88.
Snudespidsens Afstand fra Analen	2,92.

Gjællelaagene ere uvæbnede; Bagranden af Praeoperculum ender i en flad Spidse, der imidlertid neppe har været synlig over Huden. Operculum er yderst lidet, og bestaar (efterat Huden er forsvundet) væsentlig af et kort, noget opadbøjet og krummet Benparti, der er sammensat af 3 smale Benstraaler.

Gjællespalten er beliggende, som hos de øvrige Liparider, højt oppe mod Nakken ovenfor Pectoralerne, og har et Tversnit, der er mindre, end en halv Orbitaldiameter. Gjællehindens Straaler ere 6, der med sine øvre Spidser naa op til Gjællelaagets nedre Rand. De ere forholdsvis lange og krumme, mod Spidsen særdeles tynde, og ende her med en næsten umærkelig Fortykkelse.

Blot det ene Par Næsebor kan hos det mutilerede Individ med Sikkerhed paavises. Dette er beliggende nær ved Øjets Rand, i omtrent en halv Øjendiameters Afstand fra Mellemkjæven.

Measurements.

Total length	208 mm
Length to termination of last caudal vertebra	189 -
Greatest height at commencement of dorsal	37 -
Height at commencement of anal	33 -
Length of head	37 -
Greatest depth of head	30 -
Thickness of head across the cheeks	24 -
Length of upper jaw	17 -
Length of intermaxillary	13 -
Length of snout	10 -
Longitudinal diameter of orbit	11 -
Postorbital region of head	17 -
Interorbital space	17 -
From tip of snout to commencement of dorsal	42 -
From tip of snout to commencement of anal	70 -
From anal to tip of tail	138 -
Longest ray in dorsal	22 -
Longest ray in anal	22 -
Greatest length of pectoral rays	27 -
Length of caudal	19 -
Depth of tail at base	2 -

General Description. *Structure of the Body.* — Body rather elongate; head short and globular; front remarkably wide; extreme depth at nape, where it is equal to the length of the head; posterior to the nape, the depth continues the same till a little above the anal, from thence steadily diminishing, more especially in the exterior caudal region, to the tip of the tail.

Length of head to total length as 1 to $5^1/_2$; from the nuchal region the marginal line of the head extends in a sharp curve, bending gradually downwards till a little in front of the eyes, and from thence striking off abruptly to the cleft of the mouth.

The total length contains —

Depth of body and length of head	5.54
Distance of snout from dorsal	4.88
Distance of snout from anal	2.92

No arming on gill-covers; posterior margin of preoperculum terminating in a flat point, which, however, could hardly have been observable above the skin; operculum exceedingly small, consisting (the skin being entirely gone) chiefly of a curved bony part, composed of three narrow osseous rays.

The gill-opening, as in the other Suckers, placed high up towards the nape, its transverse diameter being less than half the length of the orbit. Brancheostegous rays 6, the uppermost points extending to the inferior margin of the gill-cover; these rays are comparatively long and curved, towards the points exceedingly slender, terminating with a scarcely perceptible inspissation.

One pair of nostrils only could be accurately determined in this mutilated specimen; their position is near the margin of the eye, and distant about half the diameter of the orbit from the intermaxillary.

Pseudobranchier ere ikke tilstede. Gjællernes Antal er det normale $3^1/_2$. Det linieformige Infraorbitalben er normalt udviklet.

Orbitae ere forholdsvis store, med Højdediameteren ubetydeligt kortere, end Længden; den sidste indeholdes i Hovedlængden næsten $3^1/_2$ Gange. Interorbitalrummet er fladt eller svagt convext, og næsten lig Hovedets halve Længde. (Øjnene ere, som ovenfor nævnt, hos det undersøgte Individ udfaldne).

Tænderne ere tilstede i Mellemkjæverne og i Underkjæven. De ere yderst fine, og ordnede i regelmæssige, skraatløbende Tværrækker; fortil i Underkjæven findes omtrent 10 Tænder i hver saadan Række.

Skulderbeltet ender oventil i en temmelig spids Torn, der maaske hos det uskadte Individ har vist sig som en lav Knude over Nakken. Det til den indre Rand af Coracoidbenet fæstede ribbenformede Benstykke (Atlas's Hæmapophyse-Del) er efter sin hele Længde smalt, særdeles langt og spidst, og strækker sig lige ned mod Bugranden, uden dog at danne nogen lukket Bue med det tilsvarende paa den anden Side.

Anus's Beliggenhed kan, som tidligere nævnt, ikke med fuld Sikkerhed angives, da Individet er skadet i Bugen. Dog er det sandsynligt, at det har ligget temmelig nær Analen, idet et forholdsvis langt Parti bagenfor (den manglende) Sugeskive er helt, og uden at vise Spor af Analaabning.

Sugeskiven er, som ovenfor nævnt, afreven. Dog antydes dens Beliggenhed ved et Hul paa Bugen noget bagenfor de nedre Pectoralstraaler. Skiven har ikke været særdeles langt fremrykket (saaledes som hos Slægten *Careproctus)*, men den nævnte Aabning er forholdsvis liden, og synes at antyde, at det samme har været Tilfældet med Sugeskiven.

Finnerne. Dorsalen begynder lige bagenfor Nakken; dens Afstand fra Snudespidsen indeholdes næsten 5 Gange i Totall. De forreste Straaler ere ufuldkomne Pigstraaler, og særdeles korte og svage, samt have Ansats til at være dobbelte nedtil. Omtrent fra den 7de Straale af ere de alle kløvede til Grunden, eller fuldkommen dobbelte, samt tydeligt articulerede efter hele sin Længde; midt paa Ryggen er Mellemrummet mellem hver Straales Halvdele saa distinct, at de næsten synes at være stillede parvis. Den største Højde har Finnen paa Midten af Halepartiet, hvor Straalerne have en Længde, der er lig Hovedets Længde indtil Øjets Bagrand; dog har sandsynligvis aldrig Finnen kunnet hæve sig til denne Højde. Bagtil aftage Straalerne kun ubetydeligt i Højde, og de ere ved Haleroden efter hele sin Længde tilvoxede Caudalen, samt ere her tættere stillede, end længere fortil. Straalernes Antal er 59, et Tal der ikke er naaet hos nogen hidtil nøjagtigt undersøgt Art af Liparidernes Familie.

Analen, der tæller 51 Straaler, er i Bygning temmelig overensstemmende med Dorsalen, og begynder, (som hos

Pseudobranchiæ not present; normal number of gills $3^1/_2$; the linear infraorbital bone normally developed.

Orbitæ comparatively large, the vertical diameter somewhat less than the transverse; the latter is to the length of the head as 1 to $3^1/_2$ almost. Interorbital surface flat or slightly convex, width nearly equal to half the length of the head. (In the specimen examined both the eyes were gone).

Teeth in intermaxillaries and in lower jaw; they are exceedingly slender and minute, regularly arranged in oblique transverse rows; each row in the anterior part of lower jaw composed of about 10 teeth.

The scapulary arch terminates above in a rather sharp-pointed spine, which, in specimens not mutilated perhaps would appear as a depressed protuberance on the nape. The costal-shaped bone (the hæmapophysis of Atlas) attached to the inner margin of the coracoid is narrow throughout its entire length, and very long and sharp at the point, extending straight down to the margin of the abdomen, without however meeting that on the opposite side and forming a perfect arch with it.

As before observed, the exact position of the vent cannot be given, the specimen examined having been mutilated in the abdominal region. Probably, however, it is in close proximity to the anal fin, a comparatively extensive portion of the surface posterior to the ventral-disk (wanting in this individual) exhibiting no vestige whatever of an anus.

The ventral disk, as mentioned above, had been torn off. Its position however was clearly indicated by an orifice in the abdominal surface somewhat posterior to the lower pectoral rays. The disk cannot therefore have been very far back (as in the genus *Careproctus);* but the said orifice was comparatively small, denoting apparently that such, too, is the case with the ventral disk.

Fins. — Dorsal commencing in close proximity to the nape; its distance from tip of snout is to total length nearly as 1 to 5. The foremost rays spinous, but exceedingly short and fragile, towards the base inclining to branch. From the 7th ray about, they are all of them double, being cleft to the base, and distinctly articulated throughout their entire length; in the middle of the back the interspace between the halves of each ray is so conspicuous as almost to give these rays the appearance of being arranged in pairs. Greatest depth of the fin in the middle of the tail, where the length of the rays equals the length of the head measured to the posterior margin of the eye; it is not probable however that the fin can be elevated to that extent. The posterior rays, which diminish but slightly in height, are at the base of the tail attached to the caudal throughout their entire length; these terminal rays, too, are more closely arranged. Number of rays 59, — hence exceeding that in any accurately determined species of the family *Liparididæ.*

The anal, furnished with 51 rays, very similar in structure to the dorsal, having at the commencement (as

andre Liparider) med længere Straaler, end de tilsvarende i den nævnte Finne. Straalerne have sin største Længde noget bagenfor Midten, hvor denne er lig de længste Dorsalstraalers. Alle Straaler ere kløvede til Grunden, saa de næsten synes parvis stillede; i Begyndelsen ere de utydeligt, men senere tydeligt articulerede. De ere bagtil tætstillede, samt efter hele sin Længde tilvoxede Caudalen, og ere her omtrent af samme Længde, som de tilsvarende Straaler i Dorsalen.

Caudalen bestaar af 8 Straaler, hvoraf maaske det yderste Par ere enkelte, men alle de øvrige kløvede lige til Grunden. De ere alle yderst spinkle, tætstillede, samt fint articulerede. Af Form er denne Finne noget tilspidset; de mellemste Straaler, (der ere noget kortere, end de længste Dorsal- eller Analstraaler), rage med omtrent $^1/_3$ af sin Længde ud over sin Forbindelse med Dorsalen og Analen.

Pectoralens Bygning er ganske ejendommelig, idet dens øverste og nederste Parti, som tidligere nævnt, ere adskilte ved et Mellemrum, der blot bærer nogle faa rudimentære Straaler. Øverst sidde 13 Straaler, der ere tætstillede, smale, dobbelte og articulerede; deres største Længde er ubetydeligt større, end de længste Dorsalstraaler, men de tør maaske have været afbrudte i Spidsen, og have derfor havt større Længde. Efter disse Straaler følge 3, paa den anden Side 4, rudimentære Straaler, der ende som fine Traade, og hvis Længde ikke overskrider $^2/_3$ af en Orbitaldiameter. Den indbyrdes Afstand mellem hver af disse Straaler er omtrent lig Halvdelen af deres Længde. Nedenfor disse følger Pectoralens nederste Parti, der bestaar af 3 tætstillede, lange Straaler af Bygning ganske som de øverste, og omtrent af disses Længde; alene den nederste er noget kortere, end de øvrige. Overgange fra de rudimentære til de normalt byggede Straaler findes ikke, ligesom Finnen idethele ikke bærer Spor af at være defect i anden Henseende, end at de lange Straaler maaske kunne have været afbrudte i Spidsen.

Forbindelsen mellem disse 3 Partier kan paa Grund af den fuldkommen afrevne Membran ikke angives. Sandsynligvis have de mellemste rudimentære Straaler blot ved Roden været særdeles kort forbundne indbyrdes, ligesom med det øvre og nedre Parti, saaledes at de fine og korte Traade have raget frem over Membranen. Pectoralen faar saaledes et Udseende af at være delt i 2 Dele, hvoraf dets nederste Del, der er nedadrettet og særdeles bevægelig i alle Retninger, har virket som et Par Ventraler, hvis Plads de næsten have indtaget.

Farve, etc. Legemet var særdeles blødt og halvt gjennemsigtigt; Huden overalt graasort, ligesom Mundhulen og Gjællespaltens indre Beklædning; Bughinden gjennemskinnende blaasort. En Række af 3—4 dybe Porer kan sees at strække sig langs Underkjæven.

in all the other genera of the family) somewhat longer rays than the corresponding ones in the latter fin. Greatest length of rays occurring slightly posterior to the medial part, where it equals that of the longest in the dorsal. All the rays cleft to the base, giving them the appearance almost of being arranged in pairs; articulation, indistinct at first, becoming gradually obvious and well-defined. The terminal posterior rays attached to the caudal in their entire length, which is about equal to that of the corresponding rays in the dorsal.

Caudal composed of 8 rays, the two outermost perhaps undivided, all the rest cleft to the base. They are exceedingly slender, close, and finely articulated. Form of the fin somewhat tapering; the medial rays (a trifle shorter than the longest in the dorsal or anal) project to a distance equalling about one-third of their length beyond the tips of the dorsal and anal.

The structure of the pectorals is highly characteristic, the upper and lower parts of these fins, as mentioned above, being separated by a space over which are dispersed a few rudimentary rays only. The upper division furnished with 13 rays, closely arranged, slender, branched, and articulated; greatest length slightly exceeding that of the longest in the dorsal; possibly, however, the points were broken off, in which case the actual length would be somewhat greater. Next to these rays occur 3 — on the opposite side 4 — rudimentary, terminating in membranous filaments, their length not exceeding two-thirds of the diameter of the orbit. The relative distance between these rays about equal to half their length. Immediately beneath them extends the lower division of the pectoral, composed of 3 long and closely arranged rays, in structure precisely similar to the uppermost, and of about the same length, the lowest ray being a trifle shorter than the other two. No transition stages from the rudimentary rays to those of normal structure, nor did the fin itself exhibit the slightest trace of mutilation other than that the points of the long rays might possibly have been broken off.

The exact connexion between these three divisions of the fin could not be determined, the membrane uniting them having been torn off. Probably, however, the medial rudimentary rays are connected with one another, as also with the upper and lower divisions, at the base alone, in such manner that the short and slender connective filaments project beyond the membrane. Hence the pectorals have the appearance of being divided in two, of which the lower half, inclining downwards and having great freedom of motion, performs the office of ventrals, indeed almost supplying the place of those fins.

Colour &c. — The body, in the specimen examined, was exceedingly soft, and semi-transparent; skin greyish-black, also that covering the cavity of the mouth, and the inner branchial integument; abdominal membrane a translucent bluish black. Three or four deep pores, distinctly obvious, extending along the lower jaw.

Individet var en Hun, med Ovarierne fulde af moden Rogn. Rognkornene, hvis Antal var omtr. 100, have en betydelig Størrelse, næsten som en Lindsediameter (deres Tversnit er 4,5^{mm}). Foruden disse Æg, der sandsynligvis vare gydefærdige, fandtes som sædvanligt et stort Antal, der vare forblevne uudviklede. Artens Gydetid falder saaledes i Sommermaanederne.

Føde. Ventrikelen var særdeles stærk og musculøs, og indeholdt Levninger af *Themisto libellula,* Mandt, samt Dele af en stor Myside; desuden fandtes Laaget og Dele af Kappen af en liden Gasteropode, der synes at have været en *Natica.*

Udbredelse. Individet optoges, som ovenfor nævnt, fra det iskolde Vand (Temperaturen — 1,2° C.), og fra en betydelig Dybde (658 Favne, eller 1203^{m}) i Havet vestenfor Beeren Eiland, og er det eneste hidtil bekjendte Exemplar af sin Art.

This individual was a female, with the ovaries full of mature roe; the ova, in number about 100, were of considerable size, their longitudinal diameter being equal to that of the lens (transverse diameter 4.5^{mm}). Exclusive of these ova — probably ready for depositing — the ovaries likewise contained a large quantity of undeveloped roe. Hence the species spawns in the summer months.

Food. — In the ventricle, exceedingly strong and muscular, were divers remains of *Themisto libellula,* Mandt, together with fragments of a large Myside; also the operculum and parts of the mantle of a small Gasteropod, apparently belonging to the genus *Natica.*

Distribution. — As before stated, this individual was taken at a considerable depth (658 fathoms = 1203^{m}), in the open sea, west of Beeren Eiland, the temperature of the water being — 1.2° C., and is the only example of its species yet obtained.

Gen. Careproctus, Kr.

Naturh. Tidsskr. 3 R. 1 B. p. 253, Kbhvn. 1861—63 (1862).

Som Slægten Liparis, men Legemet har langt og tyndt Haleparti, og særdeles spinkle Straaler. Sugeskiven særdeles liden, ligger langt fortil, lige under Øjets forreste Del. Anus langt fremrykket, ligger i kort Afstand fra Sugeskiven. Pectoralerne strække sig fremad indtil hen imod Underkjævens Spidse. Tænderne danne uregelmæssige Rækker, ere svagt rummede, og uden Flige.

Gen. Careproctus, Kr.

Naturh. Tidsskr. 3 R. 1 B. p. 253, Kbhvn. 1861—63 (1862).

Closely resembling the genus Liparis, but with the caudal region long and tenuous, and the fin-rays exceedingly slender. The ventral disk exceedingly small, placed far in front, immediately beneath the anterior portion of the eye. The vent far in advance, in close proximity to the ventral disk. The pectorals extending forwards to the symphysis of the lower jaw. The teeth, arranged in irregular rows, are slightly curved, and simple.

14. Careproctus reinhardi, Kr. 1862.

Pl. II, Fig. 15—16.

Liparis gelatinosus, Reinh. (ex Pall.) Overs. 1842, Kgl. D. Vid. Selsk. Nat. Math. Afh. p. LXXVII, Kbhvn. 1843 (1842).
? *Liparis gelatinosus,* Günth. Cat. Fish. Brit. Mus. vol. 3, p. 163 (1861).
Liparis (Careproctus) reinhardi, Kr. Naturh. Tidsskr. 3 Række, 1 B. p. 252, Kbhvn. 1861—63 (1862).
Careproctus reinhardi, Gill, Proc. Acad. Nat. Sci. Philad. 1864, p. 194 (1864).

Diagn. *Hovedet kort og rundt, indeholdes 4—5 Gange i Totallængden. Øjnene indeholdes hos yngre Individer 4—5, hos de ældre omtrent 6 Gange i Hovedets Længde. Caudalen særdeles spinkel, ved Roden bedækket af Dorsalen og Analen. Overkjæven næsten af samme Længde, som Underkjæven. Sugeskiven har en Størrelse af blot lidt over en*

14. Careproctus reinhardi, Kr. 1862.

Pl. II, fig. 15—16.

Liparis gelatinosus, Reinh. (ex Pall.) Overs. 1842, Kgl. D. Vid. Selsk. Nat. Math. Afh. p. LXXVII, Kbhvn. 1843 (1842).
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Liparis (Careproctus) reinhardi, Kr. Naturh. Tidsskr. 3 Række, 1 B. p. 252, Kbhvn. 1861—63 (1862).
Careproctus reinhardi, Gill, Proc. Acad. Nat. Sci. Philad. 1864, p. 194 (1864).

Diagnosis. — *Head short and globular, its length compared to total length being as 1 to 4—5. The diameter of the eye, in young individuals, is to the length of the head as 1 to 4—5, in adults, about as 1 to 6. The caudal fin exceedingly slender, covered at the base by the dorsal and anal. The upper jaw nearly equal in length to the lower.*

Øjendiameter. Pectoralen nedtil indskaaren; de nedre Straaler i Spidsen fri, og danne (hos yngre) korte, snoede Traade. Anus i en Øjendiameters Afstand (eller kortere) bag Sugeskiven. Huden slimet og gelatinøs, Legemet halvt gjennemsigtigt. Farven rødgraa eller hvidlig. Størrelsen indtil 79mm (Nordh. Exped.), eller 150mm (Mus. Hafn.).

M. B. 6. D. 54—55; A. 45—46; C. 11—14; P. 32—33.

Localit. fra Nordh.-Exped. Jan Mayen; Havet vestenfor Beeren Eiland.

	Stat. 237.	*Stat.* 312.
Beliggenhed.	Jan Mayen.	108 Kilom. V. Beeren Eiland.
Dybde.	263 Favne (481 m).	658 Favne (1203 m).
Temp. paa Bunden.	— 0,3° C.	— 1,2° C.
Bunden.	Vulcansk Grus, Lava.	Brunt og grønt Ler.
Datum.	3die Aug. 1877.	22de Juli 1878.
Antal Indiv.	1 Indiv.	2 Indiv.

Bemærkninger til Synonymien. Ihvorvel denne Art i sit ydre Habitus har den typiske Slægt *Liparis'* almindelige Bygning, vil den dog med nogen Ret kunne udsondres fra denne paa Grund af Afvigelser saavel i den indre, som ydre Bygning. Dette har allerede Krøyer paa ovenanførte Sted (1862) antydet; og skjønt han ikke endnu har villet gjennemføre denne Forandring i sin Helhed, opstiller han dog det nye Slægtsnavn *Careproctus* som en Benævnelse, der vil kunne anvendes, naar senere Undersøgelser have fundet dette nødvendigt.

Disse Afvigelser fra den typiske Slægt *Liparis* ere væsentlig, som ovenfor angivet, den stærkt reducerede Sugeskive og dennes Stilling, Pectoralernes Bygning, samt Beliggenheden af Anus. Idethele vil *C. reinhardi* i de Stadier, hvori Arten hidtil er kjendt, ikke let kunne forvexles med nogen af de nordeuropæiske eller hidtil bekjendte grønlandske Liparider.

Hvorvidt imidlertid forhaandenværende Art er specifik skilt fra den af Pallas allerede i forrige Aarhundrede beskrevne kjæmpemæssige *Cyclopterus gelatinosus* fra Kamtschatka, der, ifølge Beskrivelsen, har en lignende ubetydeligt udviklet Sugeskive, og langt fremrykket Anus, er endnu ikke bleven positivt bekræftet, men flere Grunde tale for begge Formers Adskillelse.

Da Reinhardt i 1842 for Videnskabs-Selskabet i Kjøbenhavn omtalte de fra Grønland nedsendte Individer, der udgjøre Typerne for den senere *Careproctus reinhardi,* og som efter hans Mening besad de af Pallas omtalte Ejendommeligheder, antog han dem for synonyme, og opførte Arten som *Liparis gelatinosus*, Pall.; men Krøyer har, som det synes med Rette, betvivlet deres Identitet, og opstillede

The diameter of the ventral disk but slightly exceeding that of the eye. The pectorals deeply notched; their inferior rays free at the points, constituting (in young examples) a series of short, twisted filaments. The vent placed one eye-diameter (or less) behind the ventral disk. Skin viscid and glutinous; body semi-transparent. Colour reddish-grey or whitish. Length reaching 79mm (North Atl. Exped.); 150mm (Mus. Hafn.).

M. B. 6. D. 54—55; A. 45—46; C. 11—14; P. 32—33.

Locality (North Atl. Exped.): — Jan Mayen; the open sea west of Beeren Eiland.

	Stat. 237.	*Stat.* 312.
Exact Locality.	Jan Mayen.	108 Kilom. W. Beeren Eiland.
Depth.	263 Fathoms (481 m).	658 Fathoms (1203 m).
Temp. at Bottom.	— 0.3° C.	— 1.2° C.
Bottom.	Volcanic Rubble.	Brown and Green Clay.
Date.	3rd Aug. 1877.	22nd July 1878.
Numb. of Specim.	1 Indiv.	2 Indiv.

Remarks on the Synonymy. — This species, notwithstanding its striking resemblance to the typical genus *Liparis,* may, by reason of divers peculiarities of structure, both external and internal, be safely regarded as distinct. To this fact Kröyer, as stated above, has already drawn attention, in the Naturh. Tidsskr. 3rd Series (1862); he has not, however, as yet wholly adopted the change, but suggests the generic name of *Careproctus,* which, when subsequent researches shall have shown the need of a new designation, will, he opines, prove appropriate.

The salient characters distinguishing *Careproctus* from the typical genus *Liparis* are, as enumerated above, chiefly the greatly reduced dimensions of the ventral disk, and its position, the structure of the pectorals, and the position of the vent. Indeed there is little probability of confounding this species with any one of the various forms inhabiting the shores of Northern Europe, or of those as yet met with in the Greenland seas.

Meanwhile, whether the form in question be specifically distinct from the gigantic *Cyclopterus gelatinosus* inhabiting the coast of Kamtschatka, described in the last century by Pallas, according to whose diagnosis it is similarly characterised by the slight development of the ventral disk and the advanced position of the vent, has not yet been finally determined; but there is much to urge in favour of specific distinction.

Reinhardt, who, in 1842, at a Meeting of the "Videnskabs-Selskabet" of Copenhagen, called attention to the individuals sent from Greenland, — the types of *Careproctus reinhardi,* afterwards established, and which, as he conceived, exhibit the characteristic features mentioned by Pallas, — regarded them as identical, and referred the species to *Liparis gelatinosus,* Pall.; but Kröyer has seen fit, and

derfor i 1862 de samme Individer, der iøvrigt vare yderst slet vedligeholdte, som ovenfor nævnt under Navnet *Liparis (Careproctus) reinhardi*. Indtil nye og authentiske Undersøgelser af Pallas' Art foreligge, vælger jeg derfor, ligesom Krøyer, at betegne vor Art med den af den sidstnævnte Naturforsker givne Benævnelse, der er den første, der utvivlsomt vedrøre denne Art.

Det kan i denne Forbindelse nævnes, at Prof. Peters i Pallas's *Liparis gelatinosus*, (der iøvrigt er opstillet efter et slet og tørret Exemplar), ser blot de senere Forfatteres *L. fabricii*, og han opstillede derfor alle de under Germania- og Hansa-Expeditionen ved Øst-Grønland i 1870 og 71 indsamlede Individer under denne Pallas's Art, under hvilken som Synonym opføres baade *L. tunicatus*, Reinh., og *L. fabricii*, Kr. (2te Deutsche Nord-Polarfahrt, II, Säugeth. und Fische, p. 171).

Blandt de atlantiske Liparider kommer idethele Slægten *Careproctus* vistnok nærmest denne saakaldte *Liparis fabricii*, der synes at have tilfælles med *Careproctus* det høje og stumpe Hoved, og den i Størrelse noget reducerede Sugeskive. *L. fabricii*, der maaske blot vil vise sig at udgjøre Ungformen af de senere Forfatteres *L. tunicatus*, er imidlertid fuldstændig adskilt ved sin forholdsvis korte og plumpe Form, og fremfor alt ved Stillingen af Anus, der hos denne Art ikke afviger væsentlig fra det typiske hos Slægten *Liparis*. (Denne Art erholdtes ikke under Nordhavs-Expeditionen).

Bemærkninger til Beskrivelsen. Arten er af Krøyer (Naturh. Tidsskr. 3 Række, 1 B. 1862) udførligt bleven beskrevet, saaledes at der nedenfor blot meddeles et Par supplerende Bemærkninger. Det characteristiske for denne mærkelige Form er Sugeskiven, der er saa overordentlig reduceret i Størrelse, at den kun bliver ubetydeligt større, end Øjendiameteren. Den er fremdeles saa langt fremrykket, at den har sit Leje lige mellem Pectoralernes forreste Ende, og næsten skjult af disses Straaler.

Umiddelbart bagenfor Sugeskiven, i neppe over en Øjendiameters Afstand fra denne, ligger Analaabningen, der er fjernet omtrent ligesaa langt fra Analfinnen, som fra Snudespidsen. Denne abnorme Stilling har selvfølgelig ogsaa sin Indflydelse paa Anordningen af Indvoldenes Leje og deres Form.

Halen er særdeles lang og tynd. Ved Sammenligning af alle Nordhavs-Expeditionens 3 Individer, hvis Størrelse ligger mellem 56 og 79^{mm}, fremgaar det, at Halepartiet tiltager stærkere under Legemets fremadskridende Vækst, end de øvrige Legemsdele. Saaledes indeholdes Hovedlængden hos det mindste Individ ikke fuldt 4 Gange, hos det største næsten 5 Gange i Totallængden, Legemshøjden hos det mindste noget over 4½ Gange, hos det største over 6 Gange i Totallængden.

Øjnene ere forholdsvis store, og indeholdes knapt 4 Gange i Hovedets Længde. Blot 1 Par Næsebor kan sees paa de foreliggende Exemplarer; disse ere ikke forsynede med Tuber.

apparently with good reason, to question their identity, and hence he classed, as previously stated, in 1862, the same specimens (in a bad state) under the name of *Liparis (Careproctus) reinhardi*. Till new individuals of Pallas's species shall have been procured and carefully examined, I prefer, with Kröyer, to designate the species in question by the appellation that naturalist suggests, — the first unquestionably referring to this species.

In connexion with this subject it may not be out of place to remark that Professor Peters regards Pallas's *Liparis gelatinosus* (which was established from a dried and defective specimen) as identical with the *L. fabricii* of later authors, and he has therefore referred all of the individuals collected on the "Germania" and "Hansa" Expeditions off the east coast of Greenland to that species, including both *L. tunicatus*, Reinh. and *L. fabricii*, Kr. as synonyms (Zweite Deutsche Nord-Polarfahrt, II, p. 171).

Of the Atlantic Liparides, the genus *Careproctus* resembles on the whole the so-called *Liparis fabricii*, having in common with that species the head deep and obtuse and the ventral disk somewhat reduced in size. But *L. fabricii*, which possibly will prove to be merely the immature form of the *L. tunicatus* of subsequent authors, is nevertheless perfectly distinct, as seen by its comparatively short and clumsy body, more especially however by the position of the anus, which in this species deviates but little from that typically characteristic of the genus *Liparis*. (No specimen of this species was taken on the Expedition).

Descriptive Observations. — Of this species, a detailed description has been furnished by Kröyer (Naturh. Tidsskr. 3 Række, 1 B. 1862), and hence but a few supplementary observations are here subjoined. The characteristic feature distinguishing this very peculiar form is the ventral disk, of so reduced dimensions that its diameter scarcely exceeds that of the eye. Moreover, it is placed so far in advance as to give it a position between the anterior extremities of the pectorals, by the rays of which it is almost hidden.

Not more than an eye-diameter posterior to the ventral disk is the vent, at about the same distance from the anal fin as from the point of the snout. This abnormal position, too, cannot but influence the arrangement and form of the intestines.

Tail very long and tenuous. On comparing together the three specimens obtained on the North Atlantic Expedition, of dimensions ranging from 56^{mm} to 79^{mm}, it was manifest that, as the growth of the body progresses, the caudal region develops more rapidly than do the other parts. Thus, the length of the head, in the smallest example, was not quite one-fourth, in the largest, nearly one-fifth of the total length; the proportion of the depth of the body to the total length, in the smallest example, slightly exceeded that of 1 to 4½, in the largest that of 1 to 6.

Eyes comparatively large, rather more than one-fourth of the length of the head. Only one pair of nostrils can be discerned in the specimens examined; they are not furnished with tubes.

De erholdte Individer havde følgende Maal:

	Total-længde.	L. uden Caudal.	Hovedets Længde.	Legemets Højde.
a. (*Stat.* 237)	56 *mm*	52 *mm*	15 *mm*	12 *mm*
b. (*Stat.* 312)	62 -	56 -	15 -	12,5 -
c. (*Stat.* 312)	79 -	73 -	16 -	13 -

I Totallængden indeholdes saaledes:

a.	Hovedets	Længde	3,73;	Legemets største	Højde	4,66.
b.	—	—	4,13;	—	—	4,96.
c.	—	—	4,93;	—	—	6,07.

Finnestraalerne ere særdeles bløde og spinkle, temmelig fast nedtrykte mod Legemet, og kunne neppe nogensinde rejses til sin fulde Højde. De ere tillige saaledes indhyllede i den bløde og slimede Hud, der bedækker Legemet, at de ikke, uden at Exemplaret delvis ødelægges, kunne tælles, og selv da kun med Vanskelighed. Straaleantallet hos Individ *a* syntes at være følgende: D. 55; A. 45; P. 33; C. 14. Hos Individ *c* var der mindst 52 Straaler i Dorsalen.

Analen og Dorsalen bedække bagtil omtrent det halve af den temmelig korte og spinke Caudal, og uden at Analen rager længere tilbage, end Dorsalen.

Pectoralerne have sit Udspring lige foran paa Struben, umiddelbart mellem Underkjævernes Symphyse, og støde her ganske tæt sammen, uden dog, som det synes, at være helt sammenvoxne fortil. De forreste 8—10 Straaler ere lidt forlængede, og rage som korte snoede Traade ud over Membranen; herved dannes maaske et mere udviklet Føleorgan, end hos de øvrige Liparider. Finnens mellemste og største Del har lave Straaler, den øvre Del atter forlængede. Den hele Finne danner en halvcirkelformig Bue langs Hovedets Underside, og følger næsten nøjagtigt den Linie, som den nedre Rand af Operculum og Suboperculum danne.

Farven er blegt rødgraa eller hvidagtig, uden Tegninger eller Baand; under Forstørrelse viser den sig at være dannet af yderst smaa, sorte Punkter, der dog staa saa jevnt fordelte, at de blot tildels give Rygsiden en ubetydeligt mørkere Skygning, men ikke danne Pletter. Iris var i levende Live violet.

Hele Legemet er iøvrigt indhyllet i en løs, klæbrig, næsten gelatinøs Hud, ligesom hele Legemet er af en løs og halvt transparent Consistents, skjønt alle Individer bleve satte levende paa stærk Alcohol.

Føde. I Ventrikelen af det mindste Exemplar (fra Jan Mayen) fandtes blot et Stykke af en Kalksvamp; sandsynligvis har der paa det afbidte Stykke siddet et eller andet lidet Dyr.

Udbredelse. Idet vi altsaa gaa ud fra, at Nordhavs-Expeditionens Individer ere identiske med de 2 Typ-Exemplarer fra Grønland, der ere beskrevne under Navnet *Careproctus reinhardi*, foreligger Arten, fraregnet alle usikre Synonymer, for det første fra de rent arctiske

The examples measured as follows: —

	Total Length.	L. excl. Caudal.	Length of Head.	Depth of Body.
a. (*Stat.* 237)	56 *mm*	52 *mm*	15 *mm*	12 *mm*
b. (*Stat.* 312)	62 -	56 -	15 -	12.5 -
c. (*Stat.* 312)	79 -	73 -	16 -	13 -

Hence the total length contains —

a.	Length of	Head	3.73;	Greatest D. of	Bdy.	4.66.
b.	— -	—	4.13;	— - -	—	4.96.
c.	— -	—	4.93;	— - -	—	6.07.

Fin-rays exceedingly soft and slender, rather firmly pressed against the body, and rarely if ever admitting of being raised to their full height. Moreover, wholly enveloped as they are in the soft and viscid membrane covering the body, they cannot be counted, except by mutilating the specimen, nor even then without difficulty. The number of fin-rays in example *a* was apparently as follows: — D. 55; A. 45; P. 33; C. 14. In example *c*, the dorsal was furnished with at least 52 rays.

The anterior half of the somewhat short and slender caudal is almost covered by the anal and dorsal, — and without the anal extending farther back than the latter fin.

The pectorals commence far forwards on the throat, immediately between the symphysis of the lower jaw, approximating, but without, it seems, being strictly contiguous at their origin. The foremost 8 or 10 rays slightly elongated, projecting beyond the membrane, as short, spiral-shaped filaments; by this peculiarity of structure the species, perhaps, is furnished with a more delicate organ of touch than are any of the other Liparides. The intermediate and largest portion of the fin has short rays, the upper is elongated. The entire fin, semi-circular in form, extends along the under surface of the head, and almost exactly in a line with the lower margin of the operculum and suboperculum.

Colour pale reddish-grey or whitish, no bands or markings of any kind; a microscopic examination shows it to be produced by a multitude of exceedingly minute black maculæ, in distribution, however, so uniform as merely to give the upper surface a slightly darker shade; spots there are none. Irides, in the living specimen, violet.

For the rest, the whole body is enveloped in a lax, viscid, almost glutinous membrane, the body itself being semi-transparent, and of a jelly-like consistency, notwithstanding the specimens were all of them, while yet living, immersed in proof-spirits.

Food. — The ventricle of the smallest example (from Jan Mayen) contained only a small portion of a calcareous sponge; probably there had been some small animal on the fragment bitten off.

Distribution. — Assuming, therefore, the individuals taken on the North Atl. Expedition to be identical with the two typical specimens from Greenland, described under the name *Careproctus reinhardi*, this species — disregarding all doubtful synonyms — is known to inhabit the Arctic waters

Farvande, nemlig Grønland, Jan Mayen, og Beeren Eiland. Men sandsynligvis er dens Udbredelse betydeligt større, endskjønt den paa Grund af sine Finners Bygning maa antages at have en ringe Bevægelighed, og saaledes idethele at være særdeles stationær, og den optræder derfor utvivlsomt ogsaa paa Havbunden overalt paa passende Localiteter imellem de nævnte Landsdele.

I afvigte Høst (1879) havde jeg, ved Prof. Smitts Imødekommen, Lejlighed til at undersøge de under „Gunhild"s Expedition Sommeren 1879 udenfor Arendal i Norge optagne Fiske, der, uden endnu at være nøjere undersøgte, opbevaredes i Riks-Musæum i Stockholm. Blandt disse fandtes 4 særdeles vel conserverede Exemplarer af denne Art, optagne fra 350—370 Favnes Dyb (under 58° N. B.); det maa derfor antages, at den heller ikke vil savnes paa Dybderne udenfor den øvrige Del af den norske Kyst. De sidstnævnte Individer, hvis Totallængde varierede mellem 56 og 63^{mm}, afvege i ingen Henseende fra Individerne fra Jan Mayen og Beeren Eiland (cfr. Forh. Vid. Selsk. Chra. 1880, No. 8).

Arten er utvivlsomt blandt Lipariderne en Dybvandsform, og kan, som ovenfor nævnt, trænge ned idetmindste til mellem 6 og 700 Favnes Dyb, hvor den i Regelen bebor det iskolde Vand, hvis Temperatur kan gaa ned til — 1° C. og derunder. Flere end de Individer, der ere omtalte i de ovennævnte Bemærkninger, synes ikke at være hidtil erholdte.

of the globe, viz. the coasts of Greenland, Jan Mayen, and Beeren Eiland. Probably, however, it has a more extended range of distribution, although, by reason of the structure of the fins, it may be regarded as possessing but limited powers of locomotion, and in consequence, on the whole, as stationary in its habits; it occurs, too, no doubt at the bottom of the ocean in all favourable localities between the aforesaid regions.

Last autumn (1879) Professor Smitt kindly afforded me an opportunity of examining the fishes taken on the "Gunhild" Expedition, in the summer of 1879, off Arendal, in Norway, which, without having been specially examined, were preserved in the Riks Museum at Stockholm. Amongst the fishes obtained on that occasion were 4 good examples of this species, brought up from a depth of 350—370 fathoms (lat. 58° N.); and hence we may safely assume, that it will not be found wanting in the depths off the remainder of the Norwegian coast. The specimens in question, whose extreme length ranged between 56^{mm} and 73^{mm}, differed in no wise from the individuals obtained from the shores of Jan Mayen and Beeren Eiland.

This species is unquestionably a deep-sea form of the *Liparididæ*, and, as stated above, can descend at least 600—700 fathoms below the surface, inhabiting as a rule the frigid depths, where the temperature of the water can be as low as, and even lower than, — 1° C. The specimens mentioned here would appear to be the only examples of the species as yet obtained.

Fam. Blenniidae.

Gen. Lumpenus, Reinh.

Overs. 1835—36, Kgl. D. Vid. Selsk. Nat. Math. Afh. 6te Del, p. CX, Kbhvn. 1837 (1835—36).

Legemet særdeles langstrakt, beklædt med smaa Skjæl. Sidelinie tilstede, men utydelig. Tænder altid i Kjæverne, undertiden tillige paa Vomer og paa Palatinbenene, eller paa et enkelt af disse Ben. Snuden kort. Dorsalen lang, ligesom Analen; den første dannet udelukkende af Pigstraaler. Caudalen distinct (undertiden ved en Membran delvis forenet med Dorsalen og Analen). Ventralerne temmelig korte og spinkle, siddende foran Pectoralerne. Gjællespalten vid; Gjællehinderne ere sammenvoxede over Isthmus, uden dog at danne nogen fri Fold. Gjællestraalerne 6. Pseudobranchier tilstede, ligesom Appendices pyloricae; Svømmeblære mangler.

Fam. Blenniidæ.

Gen. Lumpenus, Reinh.

Overs. 1835—36, Kgl. D. Vid. Selsk. Nat. Math. Afh. 6te Del, p. CX, Kbhvn. 1837 (1835—36).

Body exceedingly elongated, covered with minute scales. Lateral line present, but indistinct. Teeth in jaws; sometimes on the vomer and the palatine bones, or on one of these bones only. Snout short. Dorsal, like the anal, long; the former composed exclusively of spinous rays. Caudal distinct, sometimes united to dorsal and anal by a connective membrane. Ventrals short and slender, anterior to the pectorals. Gill-aperture wide, branchial membranes continuous across the isthmus, without however producing a free fold. Branchiostegous rays 6. Pseudobranchiæ and pyloric appendages present; swimming-bladder wanting.

15. **Lumpenus medius**, Reinh. 1838.

Pl. II, Fig. 17.

Lumpenus medius, Reinh. Overs. 1835—36, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 6. Del, p. CX (Kbhvn. 1837). Uden Beskrivelse eller Diagnose.

Clinus medius, Reinh. Kgl. D. Vid. Selsk. Naturv. Math. Afh. 7. Del, p. 114 og 121 (Kbhvn. 1838).

Stichaeus medius, Günth. Cat. Fish. Brit. Mus. vol. 2, p. 281 (1861).

Anisarchus medius, Gill, Proc. Acad. Nat. Sci. Philad. 1864, p. 210 (1864).

Lumpenus medius, Malmgr. Öfv. Kgl. Vet. Akad. Förh. 1864, p. 517 (1864).

Diagn. *Tænder i Kjæverne og paa Palatinbenene, ingen paa Vomer. Hovedet indeholdes hos de yngre $5^1/_4$, hos de ældre indtil 6 Gange i Totall. Kjæverne omtrent lige lange, naa tilbage til Øjets Forrand. Pectoralerne afrundede, kortere end Hovedet, indeholdes 8 Gange i Totall. Caudalen ægformig afrundet, ved Roden forbundet ved en Membran med Analen og Dorsalen. Analen tiltager i Højde bagover. Legemets Længde foran Anus forholder sig til Halepartiet, som 1:1,4. Farven gulagtig, næsten uden Pletter, eller med enkelte svagtbegrændsede Pletter paa Legemet og paa Dorsalen. Appendices pyloricae 4. Størrelsen indtil 140 mm.*

M. B. 6. D. 61—62 (60 eller 63); A. 41—42 (40 eller 43); P. 14 (13 eller 15); V. 4; C. 2/17/2.

Localit. fra Nordh. Exped. Spitsbergen.

	Stat. 366.	*Stat.* 374.
Beliggenhed.	Magdalenebay, Nord-Spitsbergen,	Adventbay, Vest-Spitsbergen.
Dybde.	50 Favne (91 m).	60 Favne (110 m).
Temp. paa Bunden.	— 1,0° C.	+ 0,7° C.
Bunden.	Mørkegraat Ler.	Mørkt Ler.
Datum.	17de Aug. 1878.	22de Aug. 1878.
Antal Indiv.	4 Indiv.	3 Indiv.

Bemærkninger til Synonymien. I Aarsoversigten for 1835—36 af Forhandlingerne i Det kgl. D. Vid. Selsk. (aftrykt i 5te Del, 1837) blev Slægtsnavnet *Lumpenus* tildelt en Gruppe af Blenniider fra de grønlandske Have, for hvilken Müller's *Blennius lumpenus* (Zool. Dan. Prodr. p. IX, 1776, senere af Fabricius nøjagtigt beskreven i hans Fauna Groenl. 1780), var Typen, og som af Reinhardt paa det anførte Sted benævnedes *Lumpenus fabricii;* til samme Gruppe henførte han yderligere 2 nye, i Kjøbenhavns Musæum opbevarede Arter, nemlig *L. medius* og *L. aculeatus*, dog uden paa dette Sted at anføre disse nye Arters Diagnoser.

Den vigtigste af de paa det anførte Sted meddelte Characterer for denne Slægt var den utydelige Sidelinie, den paa Struben „fri" Gjællehud, hvori fandtes 6 Straaler, foruden Tilstedeværelsen af Tænder paa „Plovskjærbenet",

15. **Lumpenus medius**, Reinh. 1838.

Pl. II, fig. 17.

Lumpenus medius, Reinh. Overs. 1835—36, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 6. Del p. CX (Kbhvn. 1837). No description or diagnosis.

Clinus medius, Reinh. Kgl. D. Vid. Selsk. Naturv. Math. Afh. 7. Del, p. 114 and 121 (Kbhvn. 1838).

Stichæus medius, Günth. Cat. Fish. Brit. Mus. vol. 3, p. 281 (1861).

Anisarchus medius, Gill, Proc. Acad. Nat. Sci. Philad. 1864, p. 210 (1864).

Lumpenus medius, Malmgr. Öfv. Kgl. Vet. Akad. Förh. 1864, p. 517 (1864).

Diagnosis. — *Teeth in jaws and on palatine bones, wanting on vomer. Length of head to total length, in young examples, as 1 to $5^1/_4$, in adults, as 1 to 6. Jaws about equal in length, reaching back to the anterior margin of the eye. Pectorals rounded, shorter than head, length to total length as 1 to 8. Caudal truncate, at base united by a connective membrane to the anal and dorsal. The anal increases in depth towards the posterior extremity. Length of body anterior to vent is to that of the tail as 1 to 1.4. Colour yellowish, almost without spots, a few only, faintly defined, occurring on the body and the dorsal fin. Pyloric appendages 4. Length reaching 140 mm.*

M. B. 6. D. 61—62 (60 or 63); A. 41—42 (40 or 43); P. 14 (13 or 15); V. 4; C. 2/17/2.

Locality (North Atl. Exped.): — Spitzbergen.

	Stat. 366.	*Stat.* 374.
Exact Locality.	Magdalene Bay, North Spitzbergen.	Advent Bay, West Spitzbergen.
Depth.	50 Fathoms (91 m).	60 Fathoms (110 m).
Temp. at Bottom.	— 1.0° C.	+ 0.7° C.
Bottom.	Dark-grey Clay.	Dark Clay.
Date.	17th Aug. 1878.	22th Aug. 1878.
Numb. of Specim.	4 Indiv.	3 Indiv.

Remarks on the Synonymy. — In the annual review of Danske Videnskabernes Selskab for 1835—36 (printed in Part 5, 1837), the generic name of *Lumpenus* was given to a group of *Blenniidæ* occurring on the coast of Greenland and in the waters adjacent, Müller's *Blennius lumpenus* (Zool. Dan. Prodr. p. IX, 1776), of which Fabricius a few years afterwards (1780) furnished a full description, in his Fauna Grœnlandica, serving as the typical form; by Reinhardt this species is designated *Lumpenus fabricii.* In the same group he further comprised *L. medius* and *L. aculeatus*, two new species, examples of which were preserved in the Zoological Museum at Copenhagen, without however giving any diagnosis of the species.

The chief generic characters enumerated by the author were as follows: — lateral line indistinct; branchiostegous membrane "free" on the throat, and furnished with 6 rays; teeth on the "Plovskjærbenet" (ploughshare-bone, i. e.

hvilket Udtryk Reinhardt senere i sin Afhandling om de grønlandske Fiske (1838) rettede som en Tryk- eller Skrivfejl til „Ganebuerne". Paa dette sidste Sted omhandler han atter Grupperingen af denne Slægt, og samler Arterne i 3 Grupper eller Underslægter, der dog ikke gives særskilte Benævnelser, under Cuviers Slægtsnavn *Clinus*. Denne Gruppering, der er baseret udelukkende paa Tandforholdene, bør vistnok ogsaa bibeholdes, saafremt man i Virkeligheden finder det fornødent yderligere at inddele denne Slægt.

I den første Afdeling sammenstiller Reinh. (i 1838) fremdeles de 2 Arter *Clinus lumpenus* (ɔ: *Lumpenus fabricii*), og *Clinus medius*; da det derimod havde vist sig, at *Clinus aculeatus* tillige havde Tænder paa Vomer, blev denne Art stillet i 2den Gruppe; den 3die Gruppe dannedes endelig af *Clinus gracilis*, en ny Art, der blot havde Kjævetænder, men ingen Tænder paa Vomer og Palatinbenene.

Udskillelsen af de til *Lumpenus*-Gruppen henhørende Arter under særskilt benævnede Slægter er først bleven gjennemført af Gill, der i sin Catal. over Fiskene paa Nord-Americas Nordostkyst (Proc. Acad. Nat. Sci. Philad. 1861), og senere i sin Oversigt over Familien *Stichaeidae* (samme Tidsskr. for 1864) henførte de 6 af ham nævnte Arter fra dette Gebet under ikke mindre end 5 forskjellige Slægter. Af disse bør dog utvivlsomt idetmindste de 2, nemlig *Anisarchus* og *Centroblennius*, inddrages, da de Characterer, hvorpaa de er grundede, maa ansees for at være af udelukkende specifik Natur. Det samme er Tilfældet med den af Ayres i 1855 opstillede Slægt *Leptogunellus*, for hvilken Pallas's *Blennius anguillaris* fra det Stille Hav er Typen (Proc. Acad. Calif. Nat. Sci. 1855).

Disse Underslægter ville saaledes efter Tandforholdene kunne characteriseres saaledes:

A. Subg. **Lumpenus,** Reinh. 1835—36. *Tænder i Kjæverne og paa Palatinbenene.*

1. *L. fabricii,* Reinh. 1835—36. (Grønland, Spitsbergen).
2. *L. medius,* Reinh. 1838. (Grønland, Spitsbergen).
3. *L. anguillaris,* (Pall.) 1811. (Nord-Americas Vestkyst).

B. Subg. **Leptoclinus,** Gill (1861) 1864. *Tænder i Kjæverne, paa Palatinbenene, og paa Vomer.*

1. *L. maculatus,* (Fries) 1837. (Grønland, Nord-Americas Østkyst, Spitsbergen, Nord-Europas Vestkyst).

C. Subg. **Leptoblennius,** Gill 1860. *Tænder blot i Kjæverne.*

1. *L. lampetraeformis,* (Walb.) 1792. (Grønland, Island, Spitsbergen, Nord-Europas Vestkyst).
2. *L. nubilus,* (Richards.) 1855. (Arctisk Nord-America, Spitsbergen?).
3. *L. serpentinus,* (Storer) 1848—51. (Nord-Americas Østkyst).

vomer), corrected by Reinhardt in his treatise on the fishes of Greenland (1838), as a misprint or an error in the manuscript, to "Ganebuerne" (palatine bones). In this paper the author again discusses the genus, distributing its several species among three groups or sub-genera — not however with a separate nomenclature — under the common generic name of *Clinus,* given by Cuvier. This classification, based wholly on the arrangement of the teeth, should doubtless be retained, in the event of further sub-division of the genus proving needful.

In the first group, or sub-genus, Reinhardt classes together (1838) the two species *Clinus lumpenus (Lumpenus fabricii)* and *Clinus medius;* whereas *Clinus aculeatus,* since found to be furnished with teeth on the vomer also, is assigned a place in the second group; the third sub-division comprises *Clinus gracilis,* a new species, having teeth in the jaws only, none on the vomer and the palatine bones.

The first to arrange the different species of *Lumpenus* among distinct genera was Gill, who, in his catalogue of fishes occurring on the north-western shores of North America (Proc. Acad. Nat. Sci. Philad. 1861), and subsequently in his synoptical review of the family *Stichæidæ* (ibid 1864), refers the 6 species there mentioned as inhabiting that wide region to no less than 5 different genera. Of these, however, 2 at least, viz. *Anisarchus* and *Centroblennius,* should unquestionably be excluded, the characters on which they are based being wholly specific. The same, too, is the case with the genus *Leptogunellus,* established by Ayres in 1855, typical form Pallas's *Blennius anguillaris,* inhabiting the Pacific Ocean (Proc. Acad. Calif. Nat. Sci. 1855).

These sub-genera, based accordingly on peculiarities connected with the teeth, may be characterised as follows: —

A. Subg. **Lumpenus,** Reinh. 1835—36. *Teeth in jaws and on the palatine bones.*

1. *L. fabricii,* Reinh. 1835—36 (Greenland, Spitzbergen).
2. *L. medius,* Reinh. 1838 (Greenland, Spitzbergen).
3. *L. anguillaris,* (Pall.) 1811 (Western coast of North America).

B. Subg. **Leptoclinus,** Gill (1861) 1864. *Teeth in jaws, on the palatine bones, and on the vomer.*

1. *L. maculatus,* (Fries) 1837 (Greenland, east coast of North America, Spitzbergen, west coast of Northern Europe).

C. Subg. **Leptoblennius,** Gill (1860). *Teeth in jaws only.*

1. *L. lampetræformis,* (Walb.) 1792 (Greenland, Iceland, Spitzbergen, west coast of Northern Europe).
2. *L. nubilus,* (Richards) 1855. (Arctic regions of North America, Spitzbergen?).
3. *L. serpentinus,* (Storer) 1848—51 (Eastern shores of North America).

Uagtet det maa erkjendes, at en Optrædèn eller Mangel af Tænder paa Craniets tandbærende Ben hos Fiskene i Regelen kunne afgive Characterer af en afgjørende Betydning ved Slægternes Adskillelse, maa dette Forhold hos *Lumpenus*-Gruppen utvivlsomt ansees for at være af mindre Vægt, idet Tandsættet idethele baade er lidet constant, og uden samtidig at være ledsaget af tilsvarende Forskjelligheder i den øvrige Legemsbygning, der er særdeles overensstemmende hos alle Arter.

Hertil kommer, at de Tænder, der kunne optræde paa Vomer og Palatinbenene, ere uden Undtagelse yderst fine, og i mange Tilfælde er det først efter nøje Undersøgelser muligt at paavise deres Tilstedeværelse, selv hos de større Individer. At de paa disse Ben forekommende Tænder ikke kunne være af nogen særdeles Betydning for Individet, fremgaar alene af den Omstændighed, at de først udvikles længe efter Kjævetænderne (der aldrig mangle), saaledes at Characterer, hentede af dette Forhold, hos yngre Individer ganske tabe sin Anvendelse. Hos *L. medius* ere saaledes Palatintænderne endnu umærkelige hos Individer, der ere halvvoxne (eller hvor Totallængden er under 70^{mm}); hos *L. maculatus* er netop det samme Tilfældet med Vomerin- og Palatintænderne. Det synes saaledes ikke hensigtsmæssigt at tillægge de paa disse Tandforholde byggede Characterer hos denne Slægt en videre Vægt, end i det højeste til Adskillelse af Underslægter.

L. medius tilhører saaledes Slægten *Lumpenus* i begrændset Forstand, ligesom *L. fabricii* fra Spitsbergen og Grønland, samt Pallas's *Blennius anguillaris* fra det stille Hav. Overensstemmelsen mellem disse Arter er visselig saa gjennemgaaende, at det bliver ganske unaturligt at henføre dem under forskjellige Slægter, saaledes som af Gill og Ayres er forsøgt. For *L. medius* har Gill, som ovenfor nævnt, i 1864 opstillet Slægten *Anisarchus;* men den eneste af de Characterer, der skulde kunne have Værdi som Slægtsmærke, nemlig Antallet af Gjællestraaler, hvilket opgives at være 7 hos *Lumpenus,* 6 hos *Anisarchus,* er ikke fuldkommen constant. Vistnok har Kröyer altid hos sine Exemplarer af *L. fabricii* fundet 7 Gjællestraaler; derimod opgiver baade Fabricius (for sin *Blennius lumpenus*) 6, og Malmgren har fundet samme Antal idetmindste hos 3 af sine 4 spitsbergenske Exemplarer. Hos denne Art synes saaledes Gjællestraalernes Antal at variere, og er følgelig ikke skikket til at opstilles som eneste Slægtscharacter.

Den første korte Diagnose af *L. medius* meddeler Reinhardt i 1838 i sin ovennævnte Afhandling om Grønlands Fiskefauna. I Günthers Diagnose i Cat. Fish. Brit. Mus. vol. 3 (1861), der var affattet efter et grønlandsk Individ i Leydner-Musæet, angaves Arten at mangle Palatintænder, hvilket sandsynligvis har havt sin Grund deri, at det undersøgte Individ var ungt, og endnu ikke havde faaet disse udviklede. Udførligere Beskrivelse er dog først i 1862 meddelt af Krøyer i Naturhistorisk Tidsskrift (3die Række, 1ste Bind 1861—63), og til denne Beskrivelse føjer Malmgren i sin Afhandling om Spitsbergens Fiske

It cannot indeed be denied that, as a rule, the arrangement of the teeth on the dental bones of the cranium does furnish characters of very great importance in distinguishing between allied genera of fishes; but, in the case of the *Lumpenus* group, less weight must decidedly be attached to the dental characters, which, on the whole, prove anything but constant; nor does the structure of the body in other respects exhibit any corresponding distinction, being remarkably uniform in all the species.

Besides, the teeth that can occur on the vomer and the palatine bones are without exception exceedingly small, so minute, indeed, that considerable difficulty is often experienced in detecting them, even in large-sized adults. Moreover, it is obvious that the teeth on these bones cannot be essential, or of much importance even, to the individual, seeing that they do not appear till long after those on the maxillaries (never wanting) are fully developed; and hence such distinctive dental characters do not apply to young individuals. In *L. medius,* the palatine teeth are therefore scarcely perceptible in half-grown individuals (with a total length under 70^{mm}); in *L. maculatus,* precisely the same is the case with the vomerine and palatine teeth. Hence it is hardly advisable to attach much weight to characters based on such dental divergences, otherwise than as a means of distinguishment between sub-genera.

Accordingly *L. medius* belongs, in a limited sense, to the genus *Lumpenus;* also *L. fabricii,* occurring on the shores of Spitzbergen and Greenland, and Pallas's *Blennius anguillaris,* inhabiting the Pacific Ocean. These species exhibit *inter se* a uniformity so general and striking, that classification under separate genera, as suggested by Gill and Ayres, seems quite out of the question. For *L. medius,* Gill, in 1864, established the genus *Anisarchus,* as mentioned above; but the sole character of any real value as a generic distinction, viz. the number of branchiostegous rays — 7 in *Lumpenus,* 6 in *Anisarchus* — is not strictly constant. True, Kröyer has found 7 branchestegals in all his specimens of *L. fabricii;* but Fabricius (in his description of *Blennius lumpenus*) gives 6, and Malmgren observed the same number in at least 3 of the 4 specimens he obtained on the coast of Spitzbergen. Thus, to some extent the number of branchiostegous rays does vary in this species, and cannot therefore be appropriately regarded as the sole generic character.

The first brief diagnosis of *L. medius* was furnished by Reinhardt, 1838, in his treatise — cited above — on the Fauna of Greenland. Günther's diagnosis in Cat. Fish. Brit. Mus. vol. 3 (1861), from a Greenland specimen, preserved in the Museum at Leyden, describes the species as not having palatine teeth; probably, however, the specimen examined was a young individual, and the teeth on the palatine bones accordingly as yet obsolete. The first detailed description was given in 1862, by Kröyer (Naturh. Tidsskr. 3 Række, 1 B. 1861—63); and this description has been since supplemented by Malmgren in his treatise

i 1864 flere Tillæg. Saavidt vides, er Arten tidligere ikke bleven afbildet.

Udmaalinger. Af de under Nordhavs-Expeditionen erholdte Individer var alene et enkelt Individ sandsynligvis nærved at være fuldvoxent (122 mm); de øvrige vare mindre.

	Totallængde.	Hovedets Længde.
a. (Advent Bay) . . .	62 mm	11,5 mm
b. (Advent Bay) . . .	66 -	12,5 -
c. (*Stat.* 366)	68 -	13 -
d. (*Stat.* 366)	84 -	16 -
e. (Advent Bay) . . .	89 -	16,5 -
f. (*Stat.* 366)	89 -	16,5 -
g. (*Stat.* 366)	122 -	22 -

Beskrivelse. *Legemsbygning.* Legemets Højde over Nakken indeholdes hos alle de erholdte Individer omtrent 11 Gange i Totallængden; bagenfor Nakken er Legemet jevnhøjt indtil Anus, eller hæver sig ganske ubetydeligt, især hos enkelte mindre Individer, indtil Begyndelsen af Dorsalen.

Anus er beliggende forholdsvis langt tilbage, saaledes, at Legemets Længde foran Anus forholder sig til Partiet bag Anus (Halen), som 1 til 1,4.

Hovedet er relativt noget mindre hos de udvoxede Individer, end hos de yngre; hos de sidste indeholdes det 5,2 til 5,4 i Totallængden, hos de ældre 5,5 til 5,9, eller endog 6 Gange i denne. Kjæverne ere omtrent lige lange fortil, og naa tilbage til Øjets forreste Rand.

Øjnene ere temmelig tætstaaende og store, samt længere end Snuden, og indeholdes $3^1/_2$ til 4 Gange i Hovedlængden. Næseborene ere 1 Par, endende i korte Tuber; i Nærheden af hvert af dem findes en større Pore, der maaske kunne opfattes som et andet Par Næsebor.

Gjællespalten er vid, og naar nedtil frem under Midten af Øjet (saaledes længere frem, end hos de øvrige Lumpener). Gjællehinderne, der have hver 6 Straaler, ere nedtil sammenstødende, uden egentlig at danne nogen fri Fold paa Struben.

Tænderne, der ere tilstede i Kjæverne og paa Palatinbenene, ere samtlige smaa og svage; hos alle Nordhavs-Expeditionens yngre Individer ere Tænderne paa disse sidste Ben endnu umærkelige, og selv hos det største ere de særdeles svage, skjønt fuldt udviklede.

Finnerne. Straaleantallet viste sig idethele temmelig constant hos de erholdte Individer.

a.	D. 61;	A. 40;	P. 14—14.
b.	- 61;	- 40;	- 14—14.
c.	- 62;	- 40;	- 14—14.
d.	- 63;	- 41;	- 14—15.
e.	- 61;	- 41;	- 15—15.
f.	- 60;	- 41;	- 15—15.
g.	- 61;	- 41;	- 14—15.

on the fishes of Spitzbergen. The species is not known to have been previously figured.

Measurements. — Of the specimens obtained on the North Atlantic Expedition, one only appeared to have nearly reached the adult stage of growth (122 mm); all the rest were immature individuals.

	Total Length.	L. of Head.
a. (Advent Bay) . . .	62 mm	11.5 mm
b. (Advent Bay) . . .	66 -	12.5 -
c. (*Stat.* 366)	68 -	13 -
d. (*Stat.* 366)	84 -	16 -
e. (Advent Bay) . . .	89 -	16.5 -
f. (*Stat.* 366)	89 -	16.5 -
g. (*Stat.* 366)	122 -	22 -

General Description. *Structure of the Body.* — Depth of body at nape, in all the specimens obtained, is to total length about as 1 to 11; posterior to the nuchal region, the depth continues uniform as far as the vent, or, in the smaller examples, slightly increases up to the commencement of the dorsal.

The vent placed comparatively far back, the length of the body anterior to the orifice being to the length of the postanal region (the tail) as 1 to 1.4.

Head somewhat smaller in adults than in young examples: in the latter, the length is to the total length as 1 to 5.2—5.4; in the former, as 1 to 5.5—5.9 (or even 6). Jaws about equal in length, reaching back to the anterior margin of the eye.

Eyes rather close and large; their longitudinal diameter, exceeding the length of snout, is to length of head as 1 to $3^1/_2$—4. Nostrils — one pair only — terminating in short tubes; in close proximity to each occurs a large pore, which, perhaps, may be regarded as forming together a second pair of nostsils.

Branchial opening wide, extending forwards under the middle of the eye (farther accordingly than in any of the other *Lumpenus* species). Branchiostegous membranes, each furnished with 6 rays, contiguous on the isthmus, without however producing a free fold on the throat.

Teeth, small and feeble, in the jaws and on the palatine bones. In all the younger examples taken on the Expedition, the palatine teeth were as yet obsolete, and in the largest even, exceedingly feeble, though fully developed.

Fins. — The number of fin-rays was comparatively constant in all the specimens obtained.

a.	D. 61;	A. 40;	P. 14—14.
b.	- 61;	- 40;	- 14—14.
c.	- 62;	- 40;	- 14—14.
d.	- 63;	- 41;	- 14—15.
e.	- 61;	- 41;	- 15—15.
f.	- 60;	- 41;	- 15—15.
g.	- 61;	- 41;	- 14—15.

Dorsalen begynder over Pectoralernes Rod; dens Straaler, der ere 61 eller 62, sjeldnere 60 eller 63 i Antal, ere i Begyndelsen korte, og 1 eller et Par af dem ere ved Roden næsten fri; den har omtrent fra Midten af en jevn Højde bagover, og den sidste Straale er ved en Membran forbunden med Caudalen.

Analen har 41—42 Straaler (sjeldnere 40 eller 43); den første, der er ganske kort, er en Pigstraale, de øvrige leddede, og i Spidsen kløvede. Den er fortil lav, men tiltager i Højde bagtil, saaledes at dens sidste Straale er $^1/_5$ længere, end den tilsvarende i Dorsalen. Denne sidste Analstraale er (ligesom Dorsalens) efter sin hele Længde ved en Membran forenet med Caudalen, og lægger sig længere ud over dennes Rod, end det er Tilfældet med den tilsvarende Straale i Dorsalen.

Caudalen er jevnt ægformigt afrundet, hos de yngre noget stumpere; som ovenfor nævnt er den ved Grunden forbundet ved en Membran med Dorsalens og Analens sidste Straale. Den bestaar af omkring 17 længere Straaler, der alle ere leddede (og med Undtagelse af et Par paa hver af Siderne, tillige delte), foruden af et Par korte og uleddede Støttestraaler.

Pectoralerne ere jevnt afrundede, noget kortere, end Hovedet, eller omtrent af Caudalens Længde, samt relativt noget længere hos de yngre, end hos de ældre Individer; de indeholdes i Totallængden omtrent 8 Gange. Straalernes Antal er typisk 14, sjeldnere 13 eller 15; alle ere leddede, og de øverste og mellemste tillige kløvede. Hos de nederste Straaler rager Spidsen et kort Stykke udenfor Membranen.

Ventralerne ere forholdsvis smaa, indeholdes hos det største af de erholdte Individer (Totall. 122^{mm}) 24 Gange i Totallængden, hos de mindre omtr. 22 Gange i denne. De bestaa af en særdeles kort Pigstraale, og 3 leddede Straaler, alle yderst spinkle.

Sidelinien. Som hos alle Arter er Sidelinien utydelig, men kan dog overalt forfølges i sin Helhed. Den udspringer ved Gjællespaltens øvre Ende, og gaar derfra ret ud mod Caudalen i den Fure, som danner Legemets Midtlinie. Porerne ere overalt ganske smaa og tætstaaende, saaledes, at der i det Hele kommer omtrent 2 Porer for hver Hvirvel.

Skjællene. Disse ere smaa og lidet fremtrædende; de ere særdeles fastsiddende, og ordnede i tætstillede Rækker. De strække sig frem paa Hovedet, hvor de bedække Kinderne, men ere her cycloide, medens de paa Legemet ere imbricate.

Farven er afvigende fra de øvrige Arters derved, at Pletterne ere faa og utydelige. Bundfarven er graagul; Krøyer og Reinhardt beskrive sine Individer som ganske ensfarvede; Malmgren paaviser derimod, at Pletter ere tilstede hos det friske Individ, men forsvinde efterhaanden mere, naar dette en Tid har været opbevaret paa Spiritus. Hos de fleste af de under Nordhavs-Expeditionen erholdte Individer ere endnu disse Pletter delvis i Behold, skjønt de ofte ere svage og næsten usynlige. Hos det største af

Dorsal commencing immediately above the origin of the pectorals; number of rays 61 or 62, more rarely 60 or 63, the first in the series short, 1, or sometimes 2, almost free at the base; from about the middle of the fin, the depth continues uniform, the terminal ray being connected with the base of the caudal by a thin membrane.

Anal furnished with 41—42 rays (more rarely 40 or 43), the first, which is spinous, being quite short, the rest articulated and branched at the points. In the anterior part depressed, this fin gradually increases in depth, its terminal ray being one-fifth longer than that corresponding with it in the dorsal. The last of the anal rays (in common with that of the dorsal) attached throughout its entire length by a connective membrane to the base of the caudal, and extending farther beyond it than does the terminal ray in the dorsal.

Caudal rounded (subtruncate), in younger individuals somewhat more obtuse; at the base connected by a membrane with the terminal rays in the dorsal and anal. This fin consists of about 17 long rays, all of them articulated, and, saving one or two on either side, bipartite also, exclusive of a couple of short rudimentary rays without articulation.

Pectorals uniform convex, in length somewhat shorter than than the head, or about equal to the caudal, and relatively a trifle longer in young than in adult individuals; their length is to total length nearly as 1 to 8. Typical number of rays 14, — 13 or 15 more rarely observed; they are all articulated, the uppermost and the medial likewise cleft. In the lowermost rays, the points slightly projecting above the membrane.

Ventrals comparatively small; length in the largest of the specimens obtained (total length 122^{mm}) is to total length as 1 to 24, in the smaller examples, about as 1 to 22. They consist of one exceedingly short spinous ray, and 3 articulated rays, all extremely slender.

Lateral Line. — As in all the other species, the lateral line is indistinct, but can be traced throughout its entire length. It commences at the upper extremity of the branchial opening, passing from thence straight to the caudal, along the furrow forming the mesial line. The pores are exceedingly minute and close, about 2 to each vertebra.

Scales. — Small, and not plainly visible, firmly attached to the skin, and closely arranged in regular series. They extend out on the head, where they cover the cheeks; here, however, they are cycloid, but imbricate on the body.

Colour. — In its marking, this species is distinguished by the spots, which are few and indistinct. Ground-colour greyish-yellow. Kröyer and Reinhardt both describe their specimens as of a uniform colour; Malmgren, however, has shown that spots undoubledly occur in individuals newly taken, but gradually become obsolete in spirit-specimens. In most of the examples obtained on the Expedition these spots are still obvious, though less distinct. The largest individual is marked with a number of light brown-

Individerne strække sig en Del saadanne af lys brunlig Farve langs hele Legemet, ligesom der findes flere brunsorte Længdepletter paa Midten af Dorsalen. Flere af de mindste Individer derimod ere næsten uplettede, og have en smudsig graagul Bundfarve, der næsten ligner den, som Fiske pleie at antage, naar de i nogen Tid have været udsatte for Fordøjelsen i en Fiskemave.

Appendices pyloricae befandtes hos et af de yngre Individer at være 4 i Antal, de 2 kortere, end de øvrige.

Føde. I Ventrikelen af et mindre Exemplar fra Magdalenebay fandtes fintfordelte Crustaceer, der ikke lode sig bestemme. Selv tjener Arten, ifølge Malmgrens Observationer paa Spitsbergen i 1861, til Føde for flere Fugle, især *Uria grylle.*

Udbredelse. *L. medius* er hidtil blot funden ved Grønlands og Spitsbergens Kyster. I 1835 anmeldtes den af Reinhardt for Videnskabs-Selskabet i Kjøbenhavn fra Grønland; senere er den hjembragt i adskillige Individer fra Spitsbergen under de svenske Expeditioner, og den angives at forekomme talrigere her, end de øvrige Arter. Dette synes ogsaa at kunne bekræftes ved Nordhavs-Expeditionen, som erholdt den, som ovenfor nævnt, i 7 Individer fra et Par forskjellige Localiteter paa denne Øgruppe. Ved Finmarken eller paa andre Steder af Ishavet er den hidtil ikke angivet som funden.

ish spots, extending along the whole of the body; longitudinal patches occur, too, in the middle of the dorsal fin. Some of the youngest individuals, however, are of a uniform dirty greyish-yellow, closely resembling that which the skin of fishes assumes in the stomach of a fish some time after the process of digestion has commenced.

In one of the younger individuals, the pyloric appendages were 4 in number, 2 shorter than the others.

Food. — In the stomach of one of the small specimens, from Magdalene Bay, were found minute fragments of crustaceans, which did not admit of being determined. According to Malmgren, this species is preyed upon by several birds, more especially *Uria grylle.*

Distribution. — *L. medius* has hitherto been observed on the shores of Greenland and Spitzbergen only. In 1835, Reinhardt communicated its occurrence on the coast of Greenland to the "Vidensk.-Selskabet" in Copenhagen; since then, individuals have been repeatedly taken off Spitzbergen, on the several Swedish Expeditions to that region, where it is said to be more numerous than any of the other allied species. This statement would appear corroborated by the experience of the North Atlantic Expedition, on which seven specimens were obtained. On the coast of Finmark, or in other parts of the Polar Sea, it is not as yet known to have been observed.

16. **Lumpenus maculatus,** (Fries) 1837.

Pl. II, Fig. 18.

Lumpenus aculeatus, Reinh. Overs. 1835—36, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 6 Del, p. CX (Kbhvn. 1837). Uden Beskrivelse eller Diagnose.

Clinus maculatus, Fries, Kgl. Vet. Ak. Handl. 1837, p. 49 (1837).

Clinus aculeatus, Reinh. Kgl. D. Vid. Selsk. Naturv. Math. Afh. 7 D., p. 114 og 122 (1838).

Lumpenus (Ctenodon) maculatus, Nilss. Skand. Fauna, 4 Del, p. 190 (1855).

Stichaeus maculatus, Günth. Cat. Fish. Brit. Mus. vol. 3, p. 281 (1861).

Stichaeus aculeatus, Günth. Cat. Fish. Brit. Mus. vol. 3, p. 281 (1861). Straaleantallet fejlagtigt.

Leptoclinus maculatus, Gill, Proc. Acad. Nat. Sci. Philad. 1861, App. p. 45 (1861).

Lumpenus aculeatus, Kr. Naturh. Tidsskr. 3 R. 1 B., p. 268, Kbhvn. 1861—63 (1862).

Diagn. *Tænder i Kjæverne, paa Vomer og Palatinbenene. Hovedet indeholdes hos de yngre Individer 5$^1/_3$, hos de ældre indtil 6 Gange i Totallængden. Overkjæven ubetydeligt længere, end Underkjæven, naar tilbage til Øjets Midte eller dets bagre Rand. De 2—4 første Dorsalstraaler korte, og ved Roden fri. Pectoralerne forholdsvis store, indeholdes omtrent 6—7 Gange i Totallængden; de 5—6 nedre Straaler pludseligt forlængede. Caudalen ved Roden fri, bagtil ret*

16. **Lumpenus maculatus,** (Fries) 1837.

Pl. II, fig. 18.

Lumpenus aculeatus, Reinh. Overs. 1835—36, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 6 D. p. CX (Kbhvn. 1837). No description or diagnosis.

Clinus maculatus, Fries, Kgl. Vet. Ak. Handl. 1837, p. 49 (1837).

Clinus aculeatus, Reinh. Kgl. D. Vid. Selsk. Naturv. Math. Afh. 7 D., p. 114 and 122 (1838).

Lumpenus (Ctenodon) maculatus, Nilss. Skand. Fauna, 4 Del, p. 190 (1855).

Stichæus maculatus, Günth. Cat. Fish. Brit. Mus. vol 3, p. 281 (1861).

Stichæus aculeatus, Günth. Cat. Fish. Brit. Mus. vol. 3, p. 281 (1861). Fin-ray formula inaccurate.

Leptoclinus maculatus, Gill; Proc. Acad. Sci. Philad. 1861, App. p. 45 (1861).

Lumpenus aculeatus, Kr. Naturh. Tidsskr. 3 R. 1 B., p. 268, Kbhvn. 1861—63 (1862).

Diagnosis. — *Teeth in jaws, on the vomer, and on the palatine bones. Length of head in young individuals is to total length as 1 to 5$^1/_3$, in adults as 1 to 6. Upper jaw, slightly projecting beyond lower, reaches back to the middle of the eye or its posterior margin. The 2—4 first dorsal rays short, and free at base. Pectorals comparatively large, length to total length as 1 to 6—7; the 5 or 6 lower rays suddenly elongated. Caudal free at base; posterior margin*

afskaaret. Legemet foran Anus forholder sig til Halepartiet, som 1 : 1,3. Farven gulagtig med 5 store brunagtige Tverpletter nedad Ryggen; Mellemrummene opfyldte af mindre og svagere Pletter, der kunne være næsten manglende; Caudalen og Dorsalen med Tverbaand. Appendices pyloricae 2—3. Hannerne have stærkere Tænder, end Hunnerne. Størrelsen indtil 180 mm.

M. B. 6. D. 58—60 (61); A. 36—37 (35 eller 38); P. 15 (16); V. 4; C. 4/15/4 (14).

Localit. fra Nordh. Exped. Spitsbergen.

	Stat. 366.
Beliggenhed.	Magdalenebay, N. Spitsbergen.
Dybde.	50 Favne (91 m).
Temp. paa Bunden.	— 1,0° C.
Bunden.	Mørkgraat Ler.
Datum.	17de August 1878.
Antal Indiv.	1 Indiv.

Bemærkninger til Synonymien. Som det under foregaaende Art er nævnt, fandt allerede Prof. Reinhardt (sen.) i 1838 det hensigtsmæssigt at henføre denne Art, der i Modsætning til de øvrige Lumpener besad Tænder (foruden i Kjæverne) tillige paa Palatinbenene og paa Vomer, under en egen Afdeling, der blot indbefattede denne Art. For denne foreslog Nilsson i 1855 i sin Skand. Fauna Navnet *Ctenodon.* Men da dette Navn allerede i 1830 var benyttet af Wagler for et Reptil (Fam. *Ameividae*), i 1838 af Ehrenberg for en Infusorie *(Rotatoria),* og i 1839 af Swainson for en Fisk, bliver Navnet *Leptoclinus,* fremsat af Gill i 1861, men først i 1864 characteriseret, at anvende for denne Underslægt.

Mellem den Reinhardtske *L. aculeatus* fra Spitsbergen, og Fries's Art *L. maculatus* fra Bohuslen, kan der ikke paavises nogensomhelst Forskjel. Jeg har nøje sammenlignet det forhaandenværende Individ fra Spitsbergen med andre fra Christianiafjorden og Bohuslen, og finder dem i alle Henseender overensstemmende. Straaleantallet er gjennemsnitligt det samme; det under Nordhavs-Expeditionen erholdte Individ havde D. 61; A. 37; P. 15—15, medens et andet Individ fra Isfjorden paa Spitsbergen, som jeg har havt til Undersøgelse fra Tromsø Musæum, havde i Dorsalen 59, i Analen 35, saaledes at Tallet synes at variere. 2 Exemplarer fra Christianiafjorden havde begge i Dorsalen 58, i Analen 36 Straaler.

At Fries's Navn *maculatus* ved Spørgsmaalet om Prioriteten bliver at anvende, kan neppe ansees for tvivlsomt. Det Bind af det D. Vidensk. Selsk. Forh. (6te Del), hvori Reinhardt opstillede sin *Lumpenus aculeatus,* udkom i 1837, samme Aar, som Fries i Kgl. Vet. Akad. Handl. udførligt beskrev sin *Clinus maculatus* fra Bohuslen. Men uagtet Reinhardt allerede havde omtalt sin Art under Navn

square. Length of body anterior to the vent is to that of the caudal region as 1 to 1.3. Colour yellowish, the back marked with 5 large brownish transverse spots; the intervals filled up with smaller and less distinct spots, in some examples almost obsolete; caudal and dorsal traversed by transverse bands. Pyloric appendages 2—3. The males have stronger teeth than the females. Length reaching 180 mm.

M. B. 6. D. 58—60 (61); A. 36—37 (35 or 38); P. 15 (16); V. 4; C. 4 15/4 (14).

Locality (North Atl. Exped.): — Spitzbergen.

	Stat. 366.
Exact Locality.	Magdalene Bay, N. Spitzbergen.
Depth.	50 Fathoms (91 m).
Temp. at Bottom.	— 1.0° C.
Bottom.	Dark-grey Clay.
Date.	17th August 1878.
Numb. of Specim.	1 Indiv.

Remarks on the Synonymy. — As previously stated, in connexion with the foregoing species, Prof. Reinhardt sen., so far back as 1838, saw fit to class *L. maculatus,* which, unlike the other species, is furnished with teeth on the vomer and the palatine bones as well as in the jaws, in a separate sub-division, comprising this one species only. In 1855, Nilsson suggested the name *Ctenodon* for the species, in his "Skandinavisk Fauna." But this designation having been adopted by Wagler, in 1830, for a reptile (fam. *Ameividæ*), by Ehrenberg, in 1838, for a species of infusoria *(Rotatoria),* and by Swainson, in 1839, for a fish, the name *Leptoclinus* — given by Gill in 1861, but not characterized till 1864 — will have to be retained for this sub-genus.

Between Reinhardt's *L. aculeatus,* from Spitzbergen, and Fries's species *L. maculatus,* from Bohuslen, in Sweden, no difference whatever can be shown to exist. I have carefully compared the individual in question from Spitzbergen with examples taken in the Christiania Fjord, and find them to be in every respect identical. The number of fin-rays was generally the same. For the individual taken on the North Atlantic Expedition, the fin-ray formula is as follows: — D. 61; A. 37; P. 15—15; another example, from the Isfjord, Spitzbergen, in the Tromsø Museum, had D. 59; A. 35: hence the number would appear to vary. Two individuals, taken in the Christiania Fjord, had each 58 in the dorsal and 36 in the anal.

The question of priority with regard to nomenclature must be decided in favour of *maculatus,* the synonym suggested by Fries. In 1837 was published the volume of D. Vid. Selsk. containing Reinhardt's establishment of the species by the name of *Lumpenus aculeatus;* and the same year Fries furnished a full description of his *Clinus maculatus* (from Bohuslen) in Kgl. Vet. Akad. Handl. Reinhardt

i Oversigten over Selskabets Forhandlinger for 1835—36, der danner Indledningen til det ovennævnte Bind, bør dog vistnok hans Navn vige for Fries's, da han ikke ledsagede sin Art med nogensomhelst Diagnose eller Beskrivelse. Først i 1838 meddelte han en saadan i sin Afhandling om Grønlands Fauna i 7de Del af samme Tidsskrift.

Arten har tidligere været afbildet i Gaimard's Plancheværk til Corvetten „La Recherche"'s Rejse (Voyage Scand. Lap. etc. 1838—39, Poiss. pl. 14), men lidet tilfredsstillende; desuden hos Wright og Ekström, Skand. Fiskar, 5 Hefte, Pl. 1 (1838), men heller ikke den sidste Figur er synderlig vellykket.

Beskrivelse. *Legemsbygning.* Mellem Han og Hun er der allerede i det ydre en tydelig Forskjel, idet Hannen har stærkere Kjæver, der strække sig længere tilbage, end Hunnernes, ligesom Tænderne ere stærkere.

Anus' Beliggenhed er omtrent, som hos *L. medius,* idet Legemets Længde foran Anus forholder sig til Partiet bag Anus, som 1 : 1,3. Ligesom Kröyer har jeg hos Hunnerne fundet en yderst liden Analpapille bagenfor Anus, hvilken mangler hos Hannerne.

Legemets Højde over Nakken indeholdes 12,5 til 13 Gange i Totallængden. Bagenfor Nakken tiltager Legemet noget i Højde; omtrent midt mellem Ventralernes Rod og Anus, hvor Legemshøjden idethele er størst, indeholdes denne 9,5 til 10 Gange i Totallængden.

Hovedet indeholdes næsten nøjagtigt 6 Gange (eller ubetydeligt derunder) i Totallængden; hos yngre er det forholdsvis større, og indeholdes hos et Individ med en Totall. af 69^{mm} omtr. 5,3 Gange i denne. Overkjæven er tydeligt længere, end Underkjæven, og Snuden krumbøjet; hos udvoxede Hanner, hvis Kjæveparti er langt stærkere udviklet, end hos Hunnerne, naar Mundspalten tilbage til Øjets bagre Rand, medens den hos Hunnerne og de yngre Individer neppe naar over Øjets Midte. Øjnene ere store og tætstaaende, betydeligt længere, end Snudens Længde, og indeholdes i Hovedlængden hos de yngre Individer 3, hos ældre indtil $3^3/_4$ Gange. Næseborene ere 1 Par, der bære en kort Tube; en større Slimpore (eller Næsebor) aabner sig lige i Nærheden af hvert Næsebor.

Gjællespalten er vid, og naar paa Hovedets Underside frem til under Øjets bagre Rand (eller undertiden ikke fuldt saa langt). Gjællehinderne have 6 Straaler, og ere nedtil sammenstødende, uden i Regelen at danne nogen fri Fold paa Struben. (Hos et fuldt udvoxet Han-Individ er dog en saadan ganske kort Fold tilstede, hvis Bredde imidlertid ikke synderligt overskrider 1^{mm}).

Tænderne ere tilstede saavel i Kjæverne, som paa Vomer og paa Palatinbenene. Kjævetænderne ere størst og stærkest, især de forreste; ældre Individer, især de gamle Hanner, have enkelte af disse forlængede, især i Overkjæven, saa at de danne et Slags *dentes canini;* af saadanne findes 1 eller 2 paa hver Side. Ogsaa hos Hunnerne og de yngre Individer ere disse Hjørnetænder tilstede,

did indeed name the species in the Summary of the Proceedings of the Society, which forms the introduction to the aforesaid volume, but without annexing any description or diagnosis whatever; and hence his synonym must give way to that of Fries. The species was not described by Reinhardt till 1838, in his paper on the Fauna of Greenland.

L. maculatus has been previously figured in the plates accompanying Gaimard's Narrative of the Expedition with the corvette "La Recherche" (Voyage Scand. Lap. &c., 1838—39, Poiss. pl. 14), but the representation is far from satisfactory; and likewise by Wright and Ekström, "Skand. Fiskar", Part 5, Pl. 1 (1838), whose drawing however, also leaves much to be desired in point of accuracy.

General Description. *Structure of the Body.* — In this species, the sexes can be distinguished by the outward form alone, the male having stouter jaws, which extend farther back than in the female; the teeth, too, are stronger.

Position of vent about the same as in *L. medius,* the length of the body anterior to the vent being to that of the postanal region as 1 to 1.3. Posterior to the vent, in female individuals, occurs an exceedingly minute anal papilla, also observed by Krøyer, which is wanting in males.

Depth of body at nape is to total length as 1 to 12.5—13. Posterior to the nape, there is a slight increase in depth; midway between the origin of the ventrals and the vent, the depth of the body, which is greatest here, is contained from 9.5 to 10 times in the total length.

Length of head to total length almost exactly as 1 to 6 (or but a fraction less). In young examples, the length of the head is relatively greater, being to total length, in one individual (total length 69^{mm}), as 1 to 5.3. Upper jaw perceptibly longer than lower; snout curved; in adult males, which have the whole region of the jaws much stronger than females, the cleft of the mouth extends back to the posterior margin of the eye, whereas in females and immature individuals it hardly reaches above the middle of the eye. Eyes large and close together, longitudinal diameter slightly exceeding length of snout, and proportionate to the length of the head: in young individuals, as 1 to 3, in adults, as 1 to $3^3/_4$. One pair of nostrils, furnished with a short tube; a mucous pore (possibly a nostril) occurs close to each nostril.

Branchial opening wide, extending, on the under surface of the head, a little beneath the posterior margin of the eye (sometimes not quite so far). Branchiostegous membranes, furnished with 6 rays, contiguous on the under surface, but, as a rule, not producing a free fold on the throat (in a full-grown male, however, a short fold of this kind was observed, the length scarcely exceeding 1^{mm}).

Teeth in jaws, on the vomer, and on the palatine bones. The maxillary teeth, more especially the foremost, larger and stronger than the others; mature individuals, in particular old males, have some of these teeth elongated, mostly in the upper jaw, resembling *dentes canini,* 1 or 2 on either side. The females, and all mature individuals, also distinguished by these canine teeth, which are,

men ere her kortere. Tænderne paa Palatinbenene og paa Vomer ere mindre, og blive først bemærkelige, naar Individerne have naaet en Totallængde af omtr. 70^{mm}.

Totallængden af Nordhavs-Expeditionens Individ er 127^{mm}, hvoraf Hovedets Længde udgjør 21^{mm}. Individet var en Hun, med Bughinden udspændt af Rogn. Appendices pyloricae vare 2, temmelig tykke; Kröyer fandt 3 hos det af ham beskrevne Individ.

Finnerne. Dorsalen begynder ubetydeligt foran Pectoralernes øvre Rod, og har 58 til 60, sjeldnere 61 Straaler. De forreste 2—4 ere altid ganske korte, og fuldkommen fri ved Roden; senere tiltager deres Højde indtil henimod Finnens Midte, hvorefter den atter sænker sig noget henimod Caudalen.

Analen har 36 eller 37 Straaler, undertiden 35 eller 38; den første er en kort Pigstraale, de øvrige leddede, og i Spidsen tydeligt kløvede. Den har efter hele sit Løb en temmelig jevn Højde, uden saaledes, som Dorsalen, at aftage mod begge Ender.

Caudalen er ved en distinct Halerod adskilt fra Dorsalen og Analen, uden ved noget Spor af Membran at være forenet med disse Finner. Antallet af Straaler er 15, sjelden 14, alle leddede, og de 12 mellemste tillige kløvede; desuden findes paa hver Side et Par korte Støttestraaler. Af Form er den ret afskaaret i Randen, med ganske ubetydeligt afskaarne Hjørner.

Pectoralerne, der tælle 15, eller sjeldnere 16 Straaler, hvoraf den øverste er udelt, de øvrige i Spidsen kløvede, have en ejendommelig Form, idet de 5—6 nederste Straaler pludselig rage forlængede ud af Membranen, saaledes at Finnens nedre Parti bliver kjendeligt længere, end det øvre. Disse forlængede Straaler aftage noget i Længde nedad, men selv den nederste er længere, end de længste Straaler i Finnens øvre Del. Pectoralernes største Længde er hos de yngre Individer omtrent lig Hovedlængden, og indeholdes saaledes 6 Gange i Totallængden; hos de udvoxede ere de blevne relativt noget forkortede, og ere altid kortere, end Hovedlængden; hos et gammelt Han-Individ indeholdes de saaledes 7 Gange i Totallængden.

Ventralerne ere af middels Længde, have 1 særdeles kort Pigstraale og 3 leddede Straaler, tilsammen 4, og indeholdes i Totallængden hos de yngre 12 til 14 Gange, hos de ældre indtil 17 Gange.

Sidelinien er ogsaa hos denne Art tilstede, men er efter sit hele Løb særdeles utydelig. Porerne ere overalt temmelig tætstaaende, og følge i sit Løb den Fure, som danner Legemets Midtlinie.

Skjællene ere tætsiddende og ganske smaa, og strække sig frem paa Hovedet, hvor de beklæde Nakken og Kinderne; paa det sidstnævnte Sted ere de mindre tætsiddende samt cycloide, medens de paa det egentlige Legeme ere imbricate, og dække hinandens Rande.

Farven er characteristisk ved den Række af 5 store brunsorte Tverpletter, der ere stillede med lige Mellemrum henad Rygsiden; den første af disse Pletter findes omtrent

however, shorter than in the males. The teeth on the palatine bones and on the vomer not so large as those on the maxillaries; they continue obsolete till the individual has attained a total length of about 70^{mm}.

Total length of the individual taken on the North Atlantic Expedition 127^{mm}; length of head 21^{mm}. This example was a female, having the abdominal cavity distended with roe. Appendices pyloricæ 2, rather thick; Kröyer found 3 in his specimen.

Fins. — Dorsal commencing in close proximity to the base of the pectorals; number of rays 58—60, more rarely 61. The foremost 2—4 invariably short, and quite free at base, the length of the rest increasing about to the middle of the fin, which again begins to slope a little towards the caudal.

Anal furnished with 36 or 37 rays, sometimes with 35 or 38; the first short and spinous, the rest articulated, and distinctly divided at their points. The depth of this fin about the same throughout its entire length, not diminishing towards both extremities as in the dorsal.

Caudal distinctly separated from dorsal and anal, no trace of a connective membrane. Number of rays 15, seldom 14; all articulated, and the 12 middlemost also branched; on either side, too, occur a couple of rudimentary rays. In form, this fin is square, slightly docked at the extremities.

The pectorals, furnished with 15, more rarely 16 rays, all divided at the points with the exception of the uppermost, are peculiar in form, the 5—6 lowermost becoming suddenly elongated, and projecting through the membrane, in such manner that the lower part of the fin is perceptibly longer than the upper. These elongated rays diminish somewhat in length as they descend, but even the lowest is longer than the longest in the upper portion. Greatest length of pectorals in young individuals about equal to length of head, being, accordingly, to total length as 1 to 6; in adults, these fins are relatively somewhat shorter, their length never equalling that of the head; in an old male, for instance, the proportion to total length was as 1 to 7.

The ventrals, of medium length, furnished with one exceedingly short spinous ray and 3 articulated rays; length, in young individuals, is to total length as 1 to 12—14, in adults, as 1 to 17.

Lateral Line. — Occurs, too, in this species, but exceedingly indistinct throughout its entire length. The pores closely set, extending along the furrow of the mesial line of the body.

Scales. — Close and small, extending out on the head and covering the nape and the cheeks; on the latter, they are less closely arranged, and cycloid, whereas on the body proper they are imbricate, overlapping each other.

Colour. — This species is distinguished by a row of 5 large transverse spots, laterally arranged at equal distances along the back; the first in the series occurs almost

under den 6te Dorsalstraale, den sidste en halv Hovedlængde fra Haleroden. Mellemrummene mellem dem kunne være næsten uden Pletter, saaledes som hos enkelte Hunner, eller opfyldte af mindre Pletter, der ogsaa udbrede sig nedenfor Legemets Midtlinie, uden dog nogensinde at naa en saadan Størrelse, som de 5 store Tverpletter. Nedad Dorsalen løbe hos de ældre Individer omtrent 14 skraa Tverbaand, ligesom ogsaa Caudalen altid har distincte Tverbaand.

Hos et Individ fra Christianiafjorden, som jeg havde Lejlighed til at undersøge i levende Tilstand (en gammel Han, med en Totallængde af 171 mm), fandt jeg Hovedets Farve blaalig-grøn, marmoreret med brune Pletter; et smalt gulagtigt Baand løb ned foran hvert Øje, og et lignende tvers over Snuden, hvilke tilsammen indesluttede en triangulær brunsort Plet. En sort Plet fandtes ogsaa paa Gjællelaaget. Iris var mat messingfarvet, dets øvre Rand næsten sort.

Føde. Ventrikelen indeholdt adskillige hele yngre Individer af *Themisto libellula,* samt en af de skjælbeklædte Annelider *(Lepidonote).*

Udbredelse. Reinhardts Exemplarer af hans *L. aculeatus* vare alle fra Grønland. Fra Spitsbergen har den hidtil ikke været omtalt; men foruden Exemplaret fra Magdalenebay har jeg, som ovenfor nævnt, havt Anledning til at undersøge endnu et ved Spitsbergen erholdt Exemplar. Fremdeles optræder den langs den norske Kyst, dog som det synes, idethele ikke talrigt, lige ned til Christianiafjorden; mod Syd gaar den ned til Kysterne af Bohuslen (58°), fra hvilken Localitet Arten oprindelig af Fries blev beskreven i 1837, og hvor flere Exemplarer ogsaa i de senere Aar ere fundne. Paa Nord-Americas Østkyst gaar den ifølge Goode & Bean (1879) ned lige til New-Englands Kyster, idet den er i flere Individer erholdt i Bugten udenfor Massachusetts (42°).

immediately beneath the 6th dorsal ray, the terminal spot being distant half the length of the head from the origin of the tail. The disjunctive spaces sometimes almost spotless, for instance in some females, or covered with smaller spots, likewise extending below the mesial line, but all of them of a size considerably less than that of the large transverse spots. The dorsal, in mature individuals, marked with about 14 oblique transverse bars; the caudal, too, is invariably traversed by distinct transverse bands.

In one individual, taken in the Christiania Fjord, which I had an opportunity of examining while still alive (an old male, total length 171 mm), the colour of the head was bluish-green, freckled with brown spots; a narrow, yellowish band extended downwards in front of each eye, and another traversed the snout, enclosing together a triangular patch of brownish-black. A black spot occurs, too, on the gill-plate. Irides of the colour of tarnished brass, almost black above.

Food. — The ventricle contained several perfect examples of *Themisto libellula,* and a testaceous Annelid *(Lepidonote).*

Distribution. — Reinhardt's specimens of *L. aculeatus* were all from the coast of Greenland. From Spitzbergen, it had not previously been mentioned. But, exclusive of the specimen from Magdalene Bay, I have had an opportunity, as before observed, of examining another individual taken on the coast of Spitzbergen. Moreover, the species occurs along the shores of Norway, but not, it would seem, as a common fish, from the extreme north to the Christiania Fjord; its range southwards extends to Bohuslen (58°), the locality in which the specimen described by Fries in 1837 was taken, and several examples have been met with there of late years. On the eastern coast of North America, according to Goode & Bean (1879), the range of the species extends as far south as the coast of New England, divers individuals having been obtained in Massachusetts Bay (42°).

17. **Lumpenus lampetraeformis,** (Walb.) 1792.

Blennius capite laevi, etc., Mohr, Isl. Naturh. p. 84, tab. 4 (1786).
Blennius lampetraeformis, Walb. Art. Gen. Pisc. p. 184 (1792).
Centronotus islandicus, Bloch, Schneid. Syst. Ichth. p. 167 (1801).
Blennius lumpenus, pt. Faber, Fische Isl. p. 79 (1829).
Centronotus lumpenus, Nilss. Prodr. Ichth. Scand. p. 104 (1832).
Clinus nebulosus, Fries, Kgl. Vet. Ak. Handl. 1837, p. 49 (1837).
Clinus mohrii, Kr. Naturh. Tidsskr. 1 R. 1 B. 1837, p. 32 (1837).

17. **Lumpenus lampetræformis,** (Walb.) 1792.

Blennius capite lævi, etc. Mohr, Isl. Naturh. p. 84, tab. 4 (1786).
Blennius lampetræformis, Walb. Art. Gen. Pisc. p. 184 (1792).
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Blennius lumpenus, pt. Faber, Fische Isl. p. 79, (1829).
Centronotus lumpenus, Nilss. Prodr. Ichth. Scand. p. 104 (1832).
Clinus nebulosus, Fries, Kgl. Vet. Ak. Handl. 1837, p. 49 (1837).
Clinus mohrii, Kr. Naturh. Tidsskr. 1 R. 1 B. 1837, p. 32 (1837).

Blennius gracilis, Stuwitz, Nyt Mag. f. Naturv. 1 B., p. 406 (1838).
Lumpenus (Clinus) gracilis, Reinh. Kgl. D. Vid. Selsk. Naturv. Math. Afh. 7 Del, p. 194 (1838).
Lumpenus nebulosus, Nilss. Skand. Fauna, 4 Del, p. 195 (1855).
Stichaeus islandicus, Günth. Cat. Fish. Brit. Mus., vol. 3, p. 281 (1861).
Centroblennius nebulosus, Gill, Proc. Acad. Nat. Sci. Philad. 1861, App. p. 45 (1861).
Lumpenus gracilis, Kr. Naturh. Tidsskr. 3 R. 1 B., p. 282, Kbhvn. 1861—63 (1862).
Leptoblennius gracilis, Gill, Proc. Acad. Nat. Sci. Philad. 1864, p. 210 (1864).
Lumpenus lampetraeformis, Coll. Norges Fiske, Tillægsh. til Forh. Vid. Selsk. Chra. 1874, p. 72 (1874).

Diagn. *Tænder i Kjæverne; ingen paa Vomer eller Palatinbenene. Hovedet indeholdes hos de yngre 5—7, hos de ældre indtil 10 Gange i Totallængden. Overkjæven ubetydeligt længere, end Underkjæven, naar tilbage til Øjets Forrand. De 3—4 første Dorsalstraaler korte, og ved Roden næsten fri. Pectoralerne jevnt afrundede, og kortere, end Hovedet, indeholdes 8—10, hos enkelte gamle Individer indtil 13 Gange i Totallængden. Caudalen ved Roden fri, hos ældre Individer stærkt, hos yngre svagere tilspidset. Anus forholdsvis fremrykket; Legemet foran Anus forholder sig til Halepartiet som 1 : 1,7; hos ældre Individer er Forholdet som 1 : 2, og derover. Farven gulagtig med talrige større og mindre graabrune Pletter, der ofte ere delvis sammenløbende; Caudalen med Tverbaand. Appendices pyloricae 2. Størrelsen indtil 350mm (Norge), eller 412mm (Island; Mus. Hafn.).*

M. B. 6. D. 71—72 (68—70, eller 73—74); A. 49—52; P. 15 (14); V. 4; C. 3/15/3.

Localit. fra Nordh.-Exped. Lofoten i Norge; Spitsbergen.

	—	*Stat.* 366.
Beliggenhed.	Røst i Lofoten, Norge.	Magdalenebay. N. Spitsbergen.
Dybde.	50 Favne (91 m).	50 Favne (91 m).
Temp. paa Bunden.	+ 5,0° C.	— 1,0° C.
Bunden.	Sandbund.	Mørkegraat Ler.
Datum.	26de Juni 1877.	17de Aug. 1878.
Antal Indiv.	1 ungt Indiv.	1 ungt. Indiv.

Bemærkninger til Synonymien. Ved Adskillelsen af den oprindelige Slægt *Lumpenus* angav Reinhardt i 1838 (Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 Del, p. 194) som Character for den 3die Gruppe Tilstedeværelse af Tænder blot i Kjæverne, medens saavel Palatinbenene, som Vomer manglede saadanne. Som Typus og eneste Art under denne Gruppe opfører han en Form, som han netop havde modtaget i et Par Exemplarer fra Grønland, og som han foreløbig identificerede med den norske *Blennius gracilis,* Stuw. Et specielt Slægtsnavn ved Siden af de øvrige Grupper, modtog denne Art først i 1861 af Gill, der i sin Catalog over Fiskene paa Nord-Americas Nordostkyst opførte den

Blennius gracilis, Stuwitz, Nyt Mag. f. Naturv. 1 B. p. 406 (1838).
Lumpenus (Clinus) gracilis, Reinh. Kgl. D. Vid. Selsk. Naturv. Math. Afh. 7 Del, p. 194 (1838).
Lumpenus nebulosus, Nilss. Skand. Fauna, 4 Del, p. 195 (1855),
Stichæus islandicus, Günth. Cat. Fish. Brit. Mus., vol. 3, p. 281 (1861).
Centroblennius nebulosus, Gill, Proc. Acad. Nat. Sci. Philad. 1861, App. p. 45 (1861).
Lumpenus gracilis, Kr. Naturh. Tidsskr. 3 R. 1 B. p. 282, Kbhvn. 1861—63 (1862).
Leptoblennius gracilis, Gill, Proc. Acad. Nat. Sci. Philad. 1864, p. 210 (1864).
Lumpenus lampetræformis, Coll. Norges Fiske, Tillægsh. til Forh. Vid. Selsk. Chra. 1874, p. 72 (1874).

Diagnosis. — *Teeth in jaws, none on vomer and palatine bones. Length of head to total length, in young examples, as 1 to 5—7, in adults, as 1 to 10. Upper jaw slightly longer than lower, extending back to the anterior margin of the eye. The first 3 or 4 dorsal rays short, and almost free at base. Pectorals uniform convex; length less than that of the head, being to total length as 1 to 8—10, in some old individuals as 1 to 13. Caudal free at base, and acuminate, in adults considerably, in young individuals but slightly. The vent placed comparatively far in advance, the length of the body anterior to the vent being to that of the caudal region as 1 to 1.7; in old individuals, as 1 to 2, and above. Colour yellowish, mottled with numerous greyish-brown spots, large and small, confluent in places; caudal marked with transverse bands. Pyloric appendages 2. Length reaching 350mm (Norway); 412mm (Iceland: Mus. Hafn.).*

M. B. 6. D. 71—72 (68—70 or 73—74); A. 49—52; P. 15 (14); V. 4; C. 3/15/3.

Locality (North Atl. Exped.): — Lofoten, in Norway; Spitzbergen.

	—	*Stat.* 366.
Exact Locality.	Röst, in Lofoten, Norway.	Magdalene Bay, N. Spitzbergen.
Depth.	50 Fathoms (91 m).	50 Fathoms (91 m).
Temp. at Bottom.	+ 5.0° C.	— 1.0° C.
Bottom.	Sandy Bottom.	Dark-grey Clay.
Date.	26th June 1877.	17th Aug. 1878.
Numb. of Specim.	1 Young Indiv.	1 Young Indiv.

Remarks on the Synonymy. — Reinhardt, in his classification of the genus *Lumpenus,* in 1838 (Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 Del, p. 194), gave, as the salient character distinguishing the 3rd group, the occurrence of teeth in the jaws only, none on the vomer or on the palatine bones. As the typical and sole species of this group, he established a form, of which one or two examples had just been sent him from Greenland, regarding it, provisionally, as identical with the Norwegian species *Blennius gracilis,* Stuw. No special generic appellation ranking with those of the other group was conferred on this species, till Gill (1861) classed it in his Catalogue of

under den (i 1860) opstillede Slægt *Leptoblennius,*[1] hvilken han senere i 1864 characteriserede væsentlig i Overensstemmelse med Reinhardt.

Paa det sidstnævnte Sted opfører han ved Siden af *Leptoblennius* yderligere en ny Slægt, *Centroblennius,* for hvilken Richardson's *Lumpenus nubilus* (Last Arct. Voy. vol. 2, 1855) udgjorde Typen. Men Forskjellen mellem disse 2 Slægter, som væsentlig er grundet paa en ringe Ulighed i Straaleantallet, er af ganske specifik Natur, og *Leptoblennius* bør derfor neppe engang anerkjendes som Underslægt.

Ved Undersøgelsen og Beskrivelsen af Individer fra de forskjellige vidt adskilte Localiteter, som denne Art bebor, er der jevnlig bleven lagt speciel Vægt paa Characterer, der ere hentede fra Hovedets og Legemshøjdens Forhold til Totallængden, et Forhold, der hos denne Art er særdeles betydelige Forandringer underkastede under Individernes Vext. *L. lampetraeformis,* der har været kjendt i næsten et Aarhundrede, har derfor hyppig været miskjendt, og modtaget et stort Antal forskjellige Navne, idet de for den oprindelige *L. lampetraeformis* opgivne Characterer blot passe ind paa Individerne af et bestemt Alderstrin (nemlig det noget over halvt udvoxede). Jeg har allerede ved en tidligere Lejlighed berørt dette Forhold i „Norges Fiske" (Tillægshefte til Forh. Vid. Selsk. Chra. 1874, p. 72).

I 1776 blev Arten første Gang kjendeligt beskrevet og afbildet af Mohr i hans „Islandske Naturhistorie" (p. 84) fra Island, dog uden paa dette Sted at erholde noget Artsnavn. At Mohr har havt denne Art for Øje, og ikke nogen anden af de grønlandske Former, synes bl. a. at fremgaa af hans Angivelse af Straaleantallet. Et Artsnavn *(Blennius lampetraeformis)* erholdt den først i 1792 af Walbaum i den nye Udgave af Artedi's *Genera Piscium* (tom. 3, p. 184), hvor Mohr's Beskrivelse og Tegning gjengives.

I 1801 erholdt samme Mohr's Art yderligere et nyt Navn af Schneider, i hans Udgave af Bloch's *Systema Ichthyologiae,* og under dette Navn har Dr. Günther optaget Arten i sin Cat. Fish. Brit. Mus. *(Stichaeus islandicus).*

Den islandske Form blev fremdeles i 1837 gjort til Gjenstand for Behandling, nemlig af Kröyer, der (Nat. Tidsskr. 1 R. 1 B.) beskriver et fra Island nedsendt Individ under Navnet *Blennius lampetraeformis,* men foreslaar til Slutning som en mere passende Benævnelse *Clinus mohrii* (et Navn, som dog Kröyer selv ikke senere har adopteret).

I den Beskrivelse af *„Blennius lumpenus",* Lin., som Faber giver i 1822 i sin „Naturgesch. Fische Islands" (p. 79), sammenblandes saavel i Beskrivelsen, som i Synonymien Mohr's Art med Fabricius' *Blennius lumpenus* fra Grønland (= *Lumpenus fabricii,* Reinh.); dog kan det sees, at Faber neppe kan have kjendt nogen af Arterne af Autopsi.

At Walbaum's *Bl. lampetraeformis* fra Island er identisk med Stuwitz's *Blennius gracilis* fra Norges Vestkyst

[1] Opstillet for Storer's *Blennius serpentinus.*

Fishes occurring on the north-eastern coast of North America under the genus *Leptoblennius* (established 1860[1]), which he afterwards (1864) characterized much the same as Reinhardt.

Along with *Leptoblennius,* Prof. Gill introduced into his Catalogue a new allied genus, *Centroblennius,* Richardson's *Lumpenus nubilus* (Last. Arct. Voy. vol. 2, 1855) furnishing the type. The characteristic distinction between these two genera, founded principally on a slight inequality in the number of the fin-rays, is however strictly specific; and hence *Leptoblennius* can hardly be entitled to rank even as a sub-genus.

Now, when examining and describing individuals from the numerous and widely distant localities inhabited by this species, particular importance has usually been attached to characters resting on the proportion which the head and depth of the body bear to the total length; and this proportion in the present species is found to vary very considerably with the growth of the fish. Hence *L. lampetræformis,* known to ichthyologists for the space of a century almost, has frequently been misapprehended, and has been given a large number of synonyms, the characters originally believed to belong to *L. lampetræformis* being those of individuals arrived at a particular stage of growth (a little more than half-grown). On a former occasion I called attention to this fact, viz. in "Norges Fiske" (Tillægshefte til Forh. Vid. Selsk. Chra. 1874, p. 72).

In 1776, the species was first described and figured with comparative accuracy, by Mohr, in "Islandske Naturhistorie" (p. 84), but without his assigning a specific name. That it was this species Mohr had before him, and not one of the other Greenland forms, seems evident from the fin-formula given. A specific name *(Blennius lampetræformis)* was first suggested, in 1792, by Walbaum, in his edition of Artedi's *Genera Piscium* (tom. 3, p. 184), accompanied by Mohr's diagnosis and representation.

In 1801, Mohr's species had a new synonym given it, by Schneider, in his edition of Bloch's *Systema Ichthyologiæ;* and this name Dr. Günther has adopted in his Catalogue Fish. Brit. Mus. *(Stichæus islandicus).*

This Icelandic form was made the subject of further treatment by Kröyer, who (Nat. Tidsskr. 1 R. 1 B.) describes an example sent from Iceland by the name of *Blennius lampetræformis,* proposing, however, at the close of his paper, as a more appropriate designation, *Clinus mohrii;* but the latter synonym was not afterwards adopted by Kröyer himself.

In the description of *Blennius lumpenus,* Lin., given by Faber (1822) in his "Naturgesch. Fische Islands" (p. 79), Mohr's species and Fabricius's *Blennius lumpenus* from Greenland (i. e. *Lumpenus fabricii,* Reinh.) are confounded throughout, both as regards the description and the synonymy; it is evident, however, that Faber can have known nothing of either species from autopsy.

That Walbaum's *Bl. lampetræformis,* from Iceland, is identical with Stuwitz's *Bl. gracilis,* from the west coast of

[1] For Storer's *Blennius serpentinus.*

(1837), og at begge udgjøre de næsten udvoxede Individer af Fries' *Clinus nebulosus* fra Bohuslen (1837), har jeg i den ovennævnte Afhandling (Norges Fiske) tidligere søgt at begrunde; og det kan neppe være nogen Tvivl underkastet (hvad allerede Nilsson i 1855 har antydet), at den ligeledes er identisk med Reinhardts ovenfor nævnte *Lumpenus (Clinus) gracilis* fra Grønland, der omtaltes første Gang i 1838. Vistnok berøres denne af Reinhardt blot med nogle faa Ord; men Kröyer har senere (i 1862) givet en detailleret Beskrivelse af denne Form, der sees at have været et stort Individ med en Totallængde af omtr. 340 mm, og dette er i alle væsentlige Henseender overensstemmende med ligestore Individer fra de norske Kyster, saavel i den ydre, som den indre Bygning.

Foruden de Beskrivelser, der ere fremkomne gjennem Kröyer, Nilsson og Fries, haves allerede fra 1838 en særdeles udførlig saadan, forfattet af Stuwitz i Nyt Mag. f. Naturv., 1 B., hvori et næsten udvoxet Individ med en Totall. af omtr. 265 mm, fundet tilligemed et Par andre lignende i Christianiafjorden i 1835 og 1836 af Prof. Esmark, beskrives med den yderste Nøjagtighed. Der er saaledes ingen Mangel paa Beskrivelser af denne Art, men da de alle ere indbyrdes mere eller mindre uoverensstemmende, alt efter Størrelsen og de ydre Variationer hos de foreliggende Individer, har jeg troet det ikke overflødigt her at lade følge en ny og mere kortfattet, hvor der saavidt muligt er taget Hensyn til alle disse individuelle Uoverensstemmelser.

Exemplaret fra Magdalenebay havde en Totallængde af 62 mm, hvoraf Hovedets Længde udgjorde 10,5 mm. Det var saaledes (ligesom Exemplaret fra Røst i Lofoten) blot en Unge, og svarede fuldkommen til Unger af samme Størrelse fra de norske Kyster.

Beskrivelse. *Legemsbygning.* Sammenlignet med de øvrige Arter er Legemet forholdsvis langstrakt, især hos de ældre Individer. Ligeledes er Hovedet betydeligt mindre hos de ældre, end hos de yngre Individer, og hos ingen anden Art er den gradvise Forandring i denne Henseende saa betydelig.

Højden over Nakken indeholdes hos de yngre Individer (omkr. 60—70 mm) omtr. 12 Gange i Totallængden, hos de ældre lige til 20 Gange og derover; bagenfor Nakken bliver Legemets Højde ubetydeligt større, men indeholdes dog endnu hos et større Individ (Totall. 265 mm) 20 Gange i Totallængden.

Hovedet er forholdsvis lidet; dets Forhold til Totall. varierer fra $5^1/_2$ lige til 10 og derover. Saaledes indeholdes Hovedlængden i Totallængden hos de forskjellige Individer efter følgende Forholde:

Totallængde	50 mm;	Hovedets	Forhold	til Totall.	5,5
—	96 -	—	—	—	6,0
—	130 -	—	—	—	7,0
—	192 -	—	—	—	8,3
—	265 -	—	—	—	9,8
—	320 -	—	—	—	10,3

Norway (1837), and that both represent the nearly full-grown examples of Fries's *Clinus nebulosus,* from Bohuslen (1837), I have sought to show in the treatise cited above ("Norges Fiske"); nor does there (as suggested by Nilsson in 1855) exist any valid reason for questioning its identity with Reinhardt's *Lumpenus (Clinus) gracilis,* from Greenland, mentioned for the first time in 1838. True, Reinhardt alludes to the species in a few words only; but a detailed description was furnished by Kröyer (in 1862) of this form; and the diagnosis of the specimen examined, a large individual, total length about 340 mm, corresponds in all essential particulars precisely with that of individuals of equal size from the coast of Norway, both as regards its outer and inner structure.

Exclusive of the diagnoses by Kröyer, Nilsson, and Fries, an elaborate description was furnished by Stuwitz, as far back as 1838, and published in "Nyt Mag. f. Naturv.", 1 B., in which an individual, almost mature (total length about 265 mm), found, together with one or two other examples of the same species, in the Christiania Fjord, in 1835 and 1836, by Prof. Esmark, is described with the greatest accuracy. There is accordingly no want of descriptions of this species; but all of them being, when compared together, more or less divergent, from the difference in size and external features generally characterising the specimens examined, I have not deemed it superfluous to annex a new and more compendious description, in which, so far as possible, regard has been had to these individual incongruities.

The example from Magdalene Bay had a total length of 62 mm, the length of the head being 10.5 mm. This specimen (like the example taken off Røst, in Lofoten) was accordingly a young individual, corresponding exactly with young individuals of equal size from the coast of Norway.

General Description. *Structure of the Body.* — Compared with the other species, body rather elongated, more especially in mature examples. The head, too, considerably smaller in adults than in young individuals; and in none of the other species are the gradations during growth so considerable.

Depth of body at nape, in young individuals (60—70 mm), bears to total length the proportion of 1 to 12; in mature examples, of 1 to 20, and above; posterior to the nape, the depth of the body exhibits a slight increase, being nevertheless to total length, in a comparatively large-sized individual (total length 265 mm), as 1 to 20.

Head comparatively small, its proportion to total length varying from that of 1 to $5^1/_2$ to 1 to 10, and above. The length of the head, accordingly, in the several specimens, was to the total length as follows: —

Total length	50 mm;	length of	head to	total length	5.5
—	96 -	—	—	—	6.0
—	130 -	—	—	—	7.0
—	192 -	—	—	—	8.3
—	265 -	—	—	—	9.8
—	320 -	—	—	—	10.3

Overkjæven er tydeligt længere, end Underkjæven, og Snuden krumbøjet; Mundspalten naar tilbage til Øjets Forrand.

Øjnene ere middels store og tætstaaende, samt indeholdes omtrent 4 Gange i Hovedlængden; hos ældre Individer blive Øjnene relativt mindre, og Forholdet er her omtrent som 1 : 5.

Næseborene ere 1 Par, der bære korte Tuber; ligesom hos de øvrige Arter aabner sig foran og bag hvert af dem en større Pore.

Gjællespalterne ere vide, og naa paa Hovedets Underside frem til under Øjets bagre Rand. Gjællehinderne have 6 Straaler, der ikke ere bedækkede af Gjællelaaget (saaledes, som det er Regelen hos *L. maculatus*), og som derfor altid let kunne tælles.

Tænderne ere tilstede blot i Kjæverne, og ere i enhver Alder temmelig spinkle, hvilket staar i Overensstemmelse med de idethele spinkeltbyggede og korte Kjæver. I Overkjæven danne de flere tætte Rækker, i Underkjæven blot en enkelt, der fortil bliver dobbelt.

Anus er, sammenlignet med hvad det er Tilfældet hos de foregaaende Arter, *L. medius* og *L. maculatus*, beliggende langt fortil, saaledes at Halepartiet bliver relativt længere, end hos de 2 nævnte Arter. Især er dette Tilfældet hos de ældre Individer, hvor Halen bliver over dobbelt saa lang, som Partiet foran Anus. Medens saaledes hos disse sidste Legemets Længde foran Anus forholder sig til Længden bag samme (Halen), som 1 : 2,1, er samme Forhold hos de yngre omtrent som 1 : 1,7.

Finnerne. Dorsalen begynder ret over Pectoralernes øvre Rod, og har de første Par Straaler kortere, end de øvrige, og ved Roden næsten fri, dog aldrig saa distinct, som hos *L. maculatus*. Antallet af Straaler er nogen Variation underkastet, men er dog idethele højere, end hos nogen af de øvrige arctiske Arter[1] af denne Slægt. Det højeste Antal i Dorsalen synes at være 74, hvilket Kröyer har fundet hos et grønlandsk Individ, ligesom jeg har fundet det samme hos et Individ fra Norge. 73 har Stuwitz (i 1837) fundet hos 2 Individer, ligeledes fra Norge; de fleste norske Individer synes at have 71 eller 72 Straaler i Dorsalen, de samme Tal, som Malmgren fandt hos et Par Individer fra Spitsbergen, ligesom Nordhavs-Expeditionens Individ fra samme Localitet havde 71. Mohr opgiver ligeledes 72 for sit Typ-Exemplar fra Island, og samme Tal fandt Malm hos et Individ fra Bohuslen i Sverige. Det laveste observerede Antal synes at have været 68 (hos 5 norske Individer). Sin største Højde har Finnen noget foran Midten, uden dog at aftage i nogen særdeles betydelig Grad bagtil.

Analen har, som de øvrige Arter, 1 kort Pigstraale, og Resten leddede, og i Spidsen kløvede Straaler. Denne Kløvning tiltager med Alderen, saaledes at den hos ældre

[1] *L. serpentinus,* (Storer) fra Nordamericas Østkyst har: D. 76, A. 55 (Gill 1864, efter 1 undersøgt Expl.).

Upper jaw perceptibly longer than lower; snout aquiline; cleft of mouth reaching back to anterior margin of the eye.

Eyes of moderate size, and closely set; longitudinal diameter is to total length about as 1 to 4; in mature specimens, the eyes relatively smaller, the proportion being nearly as 1 to 5.

One pair of nostrils, furnished with short tubes; a large pore occurs, as in the other species, anterior and posterior to each nostril.

Branchial opening wide, reaching forward on under surface of head to the posterior margin of the eye. Branchiostegous membranes furnished with 6 rays, not covered by the gill-plate (as is generally the case with *L. maculatus)*, and hence easy to number.

Teeth in jaws only, and at every stage of growth rather slender, a feature corresponding with the character of the jaws, which are feeble and short. In the upper jaw, they constitute several closely arranged series; in the lower, a single row only, the fore part of which is double.

Vent placed far in advance, as compared with its position in *L. medius* and *L. maculatus*, the caudal region being relatively of greater length than in either of the two latter species. This is more particularly the case with adults, which have the tail twice as long as the region anterior to the vent. Hence the length of the body anterior to the vent in mature individuals, is to the postanal region (the tail) as 1 to 2:1, whereas the proportion in comparatively young examples is as 1 to 1.7.

Fins. — Dorsal commencing immediately above the upper root of the pectorals, the two first rays shorter than the rest, and almost free at base, but never so distinct as in *L. maculatus*. The number of rays is found to vary somewhat, as a rule however exceeding that in any of the other Arctic species[1] of this genus. The greatest number of dorsal rays would appear to be 74, observed by Kröyer in a Greenland specimen; and I have myself met with the same number, in an individual taken on the coast of Norway. Stuwitz found (1837) 72 rays in two specimens obtained off the Norwegian coast; the majority of Norwegian individuals would appear to have 71 or 72 rays, the number found by Malmgren in two specimen from Spitzbergen; the individual taken on the North Atlantic Expedition in the same locality had also 71 rays. Mohr, too, gives 72 for his typical specimen from Iceland, and Malm observed 72 in an example taken on the coast of Sweden, off Bohuslen. The smallest number appears to be 68 (in 5 Norwegian individuals). The greatest depth of the fin occurs a little anterior to the medial point, diminishing but very slightly throughout the posterior half.

Anal, as in the other species, furnished with one short spinous ray; the other rays are all articulated and cleft at the points. This division, increasing with the growth

[1] *L. serpentinus,* (Storer), occurring on the eastern shores of North America, has: D. 76; A. 55 (Gill 1864; one specimen only examined).

Individer er tildels dobbelt. Straalernes Antal ligger mellem 49 og 52; naar Mohr for sit Typ-Exemplar opgiver 54, tør dette ansees som en individuel Afvigelse, hvis det ikke beror paa en fejlagtig Undersøgelse.

Caudalen udmærker sig fremfor de øvrige Arters ved sin tilspidsede Form, der især hos de ældre Individer er stærkt udpræget. Den er fuldkommen adskilt fra Dorsalens og Analens sidste Straaler, endskjønt disse lægge sig ud over Haleroden. Hos yngre Individer er Finnen noget mindre tilspidset. Straalernes Antal er omtr. 15, hvortil kommer et Antal korte og uleddede Støttestraaler paa hver Side; de 11—12 mellemste er tydeligt articulerede, samt kløvede.

Pectoralerne tælle 15, sjeldnere 14 Straaler, ere jevnt afrundede, forholdsvis korte, samt indeholdes hos de yngre Individer 8—10, hos ældre lige til 13 Gange og derover i Totallængden. Med Undtagelse af den øverste ere de alle kløvede.

Ventralerne ere af middels Længde, have 1 særdeles kort, uleddet Straale, og 3 længere leddede, tilsammen 4 Straaler. Hos yngre Individer indeholdes den endnu 17 Gange i Totallængden, men hos ældre lige til 29 Gange (og derover).

Sidelinien er særdeles utydelig, udspringer over Gjællespalten, og følger efter sit hele Løb Legemets Midtfure. Porerne ere yderst smaa og tætsiddende.

Farven er blegt gulbrun med et stort Antal dels større, dels mindre graabrune Pletter nedad Legemets Sider; alene Bugen er uden Pletter, og noget mere sølvfarvet. Størrelsen og Antallet af disse Pletter varierer betydeligt; hos de fleste middelsstore Exemplarer sees omtrent 8 større saadanne at strække sig henad Siderne under Midtlinien, og undertiden tillige en lignende Række over denne, hvis Pletter, der tildels gaa ud over Grunden af Dorsalerne, alternere med den nedre Rækkes. Mellem disse staa altid mindre Pletter og Skygninger, der ofte ere stærkt sammenløbende.

Dorsalen har skraatløbende Tverbaand, Caudalen ligeledes 3—4 (hos ældre Individer flere) Tverbaand, medens de øvrige Finner synes uden Tegninger. Hovedet er mere marmoreret, og har en messingfarvet Iris, hvis øvre Rand er sort.

Udbredelse. *L. lampetraeformis* er for Tiden kjendt fra Grønland, Island, Spitsbergen, samt fra Europas Nordvestkyst ned til Kattegat. Medens der endnu foreligge blot faa Individer fra Grønland og Island, er den flere Gange erholdt ved Spitsbergen allerede under de svenske Expeditioner, og den gaar her op til idetmindste 80° N. B. Derimod synes den ikke at være sjelden paa de fleste Punkter langs den norske Kyst fra Finmarken af og ned til Christianiafjorden, og jeg har optaget indtil et Dusin Individer i et enkelt Kast med Torskegarn i Porsangerfjorden i Vest-Finmarken. Dens Sydgrændse synes at være Bohuslen, hvor et Par Individer ere erholdte saa langt

of the fish, sometimes becomes double in mature individuals. Number of rays varying between 49 and 52; it is true, Mohr gives 54 for his typical specimen, but this, if correctly observed, must be a mere individual deviation.

Caudal, more especially in adults, characterised by its acuminate form; it is separated from the terminal rays in the dorsal and anal, which extend notwithstanding beyond the base of the tail. Individuals comparatively young have this fin somewhat less acuminate. Number of rays about 15, exclusive of numerous short auxiliary rays on either side, without articulation; 11 or 12 of the middle ones distinctly articulated, and branched.

Pectorals furnished with 15, more rarely with 14 rays; uniform convex, comparatively short, their length, in young individuals, being as 1 to 8—10, in mature individuals as 1 to 13, and above. Pectoral rays all branched, with the exception of the uppermost.

Ventrals of moderate length; have 1 short ray, not articulated, and 3 longer articulated rays, or, altogether, 4. Length of fin, in young individuals, is to total length as 1 to 17, but in adults the proportion becomes as 1 to 29 (and even above).

Lateral Line. — Very indistinct; commences immediately above the branchial opening, passing from thence straight down the medial furrow of the body. The pores closely set, and extremely minute.

Colour. — Colour pale yellowish-brown, relieved with a number of greyish-brown spots, extending laterally along the body; the abdomen alone spotless, and of a somewhat more silvery appearance. These spots vary considerably in magnitude and number; most middle-sized examples are marked with a row of eight, stretching along the sides below the mesial line, and occasionally, too, with a similar series above, the spots composing it, which sometimes extend beyond the base of the dorsals, alternating with those in the lower row. The interspace always exhibiting spots and cloudings, the former frequently confluent.

Dorsal marked with oblique transverse bands; the caudal likewise has 3 or 4 transverse bands (in adults a greater number), whereas the other fins would appear to be without markings of any kind. Head to a greater extent mottled; irides of a brassy yellow, black above.

Distribution. — Up to the present time, *L. lampetræformis* is known to occur on the coast of Greenland, Iceland, Spitzbergen, and the shores of north-western Europe, as far south as the Cattegat. But few examples of the species have been hitherto obtained from Greenland and Iceland; off Spitzbergen, however, it has been repeatedly observed, individuals having been taken on each of the Swedish Expeditions to the Polar Sea, and its range extends at least as far north as 80°. Along the coast of Norway, from Finmark to the Christiania Fjord, it would appear to be rather a common fish in most localities; I once took as a many as a dozen individuals at a single

ned, som ved Gøtheborg under 58° N. B. (Malm, Gøtheb. Boh. Fauna, p. 470).

Idethele er det ikke uden Interesse, at Arten forekommer fuldkommen uforandret under den forholdsvis høje Temperatur, som Havvandet har ved Norges og Sveriges Sydkyst, og i den iskolde Area ved Nordspidsen af Spitsbergen.

Fam. Lycodidae.

Gen. Lycodes, Reinh.

Overs. 1830—31, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 5te Del, p. LXXIV, Kbhvn. 1832 (1830—31).

Legemet langstrakt, i Regelen skjælbeklædt; Skjællene smaa, runde, nedtrykte i Huden. Sidelinie tilstede, ofte mindre tydelig, undertiden dobbelt. Øjet af middels Størrelse. Kjæverne uden Skjægtraade; Overkjæven længere, end Underkjæven. Finnestraalerne bløde, articulerede; Caudalen utydelig, og er uden Overgang forenet med Dorsalen og Analen. Ventraler tilstede, anbragte paa Struben, bestaaende af faa, særdeles spinkle Straaler; deres Længde mindre, end Øjets Længdediameter, eller mindre, end $^1/_4$ af Pectoralernes Længde. Gjællespalten temmelig trang; Gjællehinderne ikke indbyrdes sammenvoxede paa Hovedets Underside. Tænder i Kjæverne, samt i Regelen tillige paa Vomer og Palatinbenene. Pseudobranchier tilstede; Analpapille og Svømmeblære mangler. Appendices pyloricae 2 eller ingen.

Af denne i flere Henseender mærkelige Slægt have de seneste Aars Undersøgelser efterhaanden bragt for Dagen et ikke ringe Antal nye Former, saaledes at den er kommen til at udgjøre den artrigeste Slægt af alle hidtil bekjendte arctiske Dybvandsfiske[1].

[1] **Lycodes-Slægtens Litteratur.** Om Slægten *Lycodes* foreligger for Tiden følgende Litteratur.

1824. Sabine. (Account of the) "Fish", Suppl. to Append. Capt. Parry's Voy. for the Disc. of a NW. Passage, 1819—20, p. CCXII—III. Lond. 1824.

haul with a net, in the Porsanger Fjord, West Finmark. The southern limit of its range is probably Bohuslen, in Sweden, one or two individuals having been obtained off Gothenburg (58° N.).

It is an interesting fact, that individuals taken on the southern coast of Norway and Sweden, where the temperature of the water is comparatively high, differ in no respect from those met with in the frigid expanse of ocean at the northern extremity of Spitzbergen.

Fam. Lycodidæ.

Gen. Lycodes, Reinh.

Overs. 1830—31, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 5 Del, p. LXXIV, Kbhvn. 1832 (1830—31).

Body elongated, as a rule scaled. Scales small, circular, imbedded in the skin; lateral line present, frequently indistinct, sometimes double. Eyes moderate, jaws without fringes; upper jaw longer than lower. Fin-rays soft, articulated; caudal indistinct, continuous with the dorsal and anal. Ventrals present, placed on the throat, each furnished with a few exceedingly slender rays, of a length less than the longitudinal diameter of the eye, or less than $^1/_4$ of the length of the pectorals. Gill-opening rather narrow; branchial membrane disconnected on the inferior surface of head. Teeth in the jaws, and, as a rule, also on the vomer and palatine bones. Pseudobranchiæ present; anal papilla and swimming-bladder wanting. Pyloric appendages 2, or altogether wanting.

Within the last few years the labours of ichthyologists have brought to light a considerable number of new forms belonging to this, in many respects, remarkable genus, which is now shown to comprise a greater number of species than any of the other Arctic deep-sea fishes yet known[1].

[1] **Bibliography of the genus Lycodes.** The genus *Lycodes* is treated of in the following works: —

1824. Sabine. (Account of the) "Fish," Suppl. to Append. Capt. Parry's Voy. for the Disc. of a NW. Passage, 1819—20, p. CCXII—III. Lond. 1824.

Udredelsen af disse nyere Arter, og deres rette Forhold til de allerede bekjendte ældre Typer, frembyder imid-

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Under Navn af *Blennius polaris* beskrives en Fisk, der i Aaret 1819 fandtes opkastet paa Strandbredden i Arctisk America (North Georgia), og som synes at have været en Art af den senere opstillede Slægt *Lycodes,* ejendommelig ved sit nøgne Legeme, skjønt Totallængden var 7 eng. Tommer (omtr. 180^{mm}), og med de for adskillige af denne Slægts Arter characteristiske Tverbaand over Legemet. Beskrivelsen er iøvrigt saa ufuldstændig, at Arten maa siges at være ganske ubestemmelig, og den er aldrig senere med Sikkerhed gjenfunden. (1 a. *L. polaris,* [Sab.]).

1828. Ross, J. C. "Appendix Nat. Hist.", Parry, Narrat. Att. to reach the North Pole 1827, p. 200. Lond. 1828.

Et Individ, der af Ross henførtes under Sabine's ovenfor nævnte Art, *Blennius polaris,* optoges under Parry's Nordpol-Expedition i Juni 1827 paa 80 Favnes Dyb nordenfor Spitsbergen, under 81° 6′ N. B. Denne er utvivlsomt en *Lycodes,* men synes at afvige fra Sabine's Art ved Finnernes Straaleantal samt Farven, og ansees af Malmgren for at være synonym med hans i 1865 fra Spitsbergen beskrevne *L. rossi.* (1 b. *L. polaris,* [J. C. Ross.]).

1830—31. Reinhardt, sen. Overs. 1830—31, Kgl. D. Vid. Selsk. Nat. Math. Afh. 5 Del, p. LXXIV. Kbhvn. 1832.

Slægten *Lycodes* opstilles, og dens Characteristik meddeles temmeligt udførligt; som dens Typus opstilles *L. vahlii,* efter et enkelt, omtrent 360^{mm} langt Individ fra Grønland, udtaget af Ventrikelen af en *Somniosus microcephalus.* Uddrag af denne Meddelelse findes i Okens „Isis" for 1848, p. 124—125. (2. *L. vahlii,* Reinh.).

1834—35. Reinhardt, sen. Overs. 1834—35, Kgl. D. Vid. Selsk. Nat. Math. Afh. 6 Del, p. LXXV. Kbhvn. 1837.

Forfatteren giver en udførlig Diagnose af Slægten, saavelsom af Arterne *L. vahlii,* samt af den ny tilkomne *L. reticulatus,* den sidste opstillet efter 2 større Individer fra Grønland, erholdte i Aarene 1833 og 34, og ligeledes udtagne af Ventrikelen af *S. microcephalus.* Uddrag af denne Meddelelse findes i Okens „Isis" for 1848, p. 134—135. (3. *L. reticulatus,* Reinh.).

1835. Ross, J. C. "Account Nat. Hist. Fish", Sir J. Ross, App. Narr. Sec. Voy. in Search North-West Passage 1829—33, p. LII. Lond. 1835.

Et Individ, der antoges at have været Sabine's *Blennius polaris,* udtoges af Ventrikelen af en *Gadus* ved Boothia, Arctisk America. Det var stærkt mutileret, og Bestemmelsen usikker.

1838. Reinhardt, sen. „Ichthyologiske Bidrag til den grønlandske Fauna" (Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 Del, p. 123—124, 147—174, og 223—228. Kbhvn. 1838).

En udførlig Beskrivelse meddeles af *L. vahlii* (hertil Pl. 5), og *L. reticulatus* (hertil Pl. 6), samt af den ny tilkomne Art *L. seminudus,* hvoraf i 1837 var erholdt et Individ med en Totallængde af omtrent 480^{mm} ved Grønland. Et udførligt Uddrag af denne Afhandling findes i Okens „Isis" for 1848, p. 279—290. (4. *L. seminudus,* Reinh.).

1844. Krøyer. „Notice angaaende Forøgelse af den grønlandske Fiskefortegnelse" (Overs. Kgl. D. V. Selsk. Forh. 1844, p. 140. Kbhvn. 1845).

En kort og foreløbig Diagnose meddeles af 2 nye Arter, *L. perspicillum* og *L. nebulosus,* begge opstillede efter et Par Individer fra Grønland. Typ-Exemplaret af den sidste af disse Arter er tilsyneladende gaaet tabt, og den lader sig paa Grund af den ufuldstændige Beskrivelse neppe nogensinde identificere; den førstnævnte er, efter hvad der nedenfor skal søges paavist, maaske Ungen af *L. reticulatus.* (5. *L. perspicillum,* Kr. 6. *L. nebulosus,* Kr.).

184? Krøyer. Voy. Comm. Sci. Scand. Lap., Spitsb., Feroë, 1838—40, Corv. "la Recherche". Zool. Pisc. pl. 7. Paris 184?

The working out of these new species and of their true relation to the types already established is, however,

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The name of *Blennius polaris* was given to a fish found stranded in the year 1819 on the coast of Arctic America (North Georgia), and which would seem to have been a species of the subsequently established genus *Lycodes,* a salient feature being the naked body, although the total length of the specimen reached 7 English in (about 180^{mm}); it was marked, too, with the transverse bands across the body distinguishing several species of that genus. The description, however, is far too incomplete to admit of characterising the species, and it is not known to have been subsequently met with. (1 a. *L. polaris,* [Sab.]).

1828. Ross, J. C. "Appendix Nat. Hist.," Parry, Narrat. Att. to reach the North Pole 1827, p. 200. Lond. 1828.

An individual, referred by Ross to Sabine's *Blennius polaris,* was taken on Parry's North Pole Expedition, in June 1827, at a depth of 80 fathoms, north of Spitzbergen, lat. 81° 6′ N. This specimen is unquestionably a *Lycodes,* but would seem to differ from Sabine's species in the number of fin-rays and in the colour; Malmgren regards it as identical with his *L. rossi,* also from Spitzbergen, described 1864. (1 b. *L. polaris,* [J. C. Ross]).

1830—31. Reinhardt sen. Overs. 1830—31, Kgl. D. Vid. Selsk. Nat. Math. Afh. 5 Del, p. LXXIV. Kbhvn. 1832.

The genus *Lycodes* is introduced, and its characters enumerated somewhat at length; as the type, Reinhardt gives *L. vahlii,* determined from a single specimen from Greenland, total length about 360^{mm}, taken from the ventricle of a *Somniosus microcephalus.* Extracts from this paper will be found in Oken's "Isis" for 1848, p. 124—125. (2. *L. vahlii,* Reinh.).

1834—35. Reinhardt sen. Overs. 1834—35, Kgl. D. Vid. Selsk. Nat. Math. Afh. 6 Del, p. LXXV. Kbhvn. 1837.

The author furnishes a detailed diagnosis of the genus, and of the species *L. vahlii* and *L. reticulatus,* the latter established from 2 large individuals obtained on the coast of Greenland, in the years 1833 and 1834; these specimens, too, were taken from the ventricle of a *S. microcephalus.* Extracts from this paper will be found in Oken's "Isis" for 1848; p. 134—135. (3. *L. reticulatus,* Reinh.).

1835. Ross, J. C. "Account Nat. Hist. Fish.," Sir J. Ross, App. Narr. Sec. Voy. in Search North-West Passage 1829—33, p. LII. Lond. 1835.

An individual, believed to have been Sabine's *Blennius polaris,* was taken from the ventricle of a *Gadus,* at Boothia, Arctic America. Being greatly mutilated its determination is doubtful.

1838. Reinhardt sen. "Ichthyologiske Bidrag til den grønlandske Fauna" (Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 Del, p. 123—124, 147—174, and 223—228. Kbhvn. 1838).

A full description is furnished of *L. vahlii* (Pl. 5) and of *L. reticulatus* (Pl. 6); also of a newly established species *L. seminudus,* of which a specimen — total length about 480^{mm} — had been obtained, in 1837, on the coast of Greenland. Extracts from this treatise will be found in Oken's "Isis" 1848, p. 279—290. (4. *L. seminudus,* Reinh.).

1844. Krøyer. "Notice angaaende Forøgelse af den grønlandske Fiskefortegnelse" (Overs. Kgl. D. V. Selsk. Forh. 1844, p. 140. Kbhvn. 1845).

A brief and preliminary diagnosis is furnished of 2 new species, *L. perspicillum* and *L. nebulosus,* both established from 2 examples taken on the coast of Greenland. The typical specimen of the latter species would appear to have been lost, and on account of the incomplete description will hardly admit of being identified; the former — from reasons to be subsequently advanced — is perhaps a young example of *L. reticulatus.* (5. *L. perspicillum,* Kr. 6. *L. nebulosus,* Kr.).

184? Kröyer. Voy. Comm. Sci. Scand. Lap. Spitzb. Feroë, 1838—40, Corv. la "Recherche." Zool. Pisc. pl. 7. Paris 184?

lertid særegne Vanskeligheder, ikke blot paa Grund af den mindre gode Tilstand, hvori disse ældre Typ-Individer be-

I Gaimards Plancheværk, tilhørende Beretningen om Corvetten „La Recherche's" arctiske Reise, giver Krøyer Afbildninger af de 2 hidtil erholdte Individer af *L. perspicillum.* Text blev ikke leveret til denne, eller til de øvrige ichthyologiske Plancher.

1855. Richardson. "Account of the Fish", Last Arct. Voy. Command. of Sir Edw. Belcher, 1852—54, vol. 2, p. 362, Pl. XXVI. Lond. 1855.

En ny Art, *L. mucosus,* fra Arctisk America (Northumberland Sound) beskrives udførligt og afbildes; ligesom Sabine's *L. polaris* var den uden Skjæl, men afveg fra denne ved Straaleantallet i Pectoralen, samt ved Antallet af Legemets Tverbaand. Totallængden af det største af de 2 erholdte Individer var omtrent 176$^{mm.}$ Først i 1876 er denne Art gjenfundet i et stort Individ fra Cumberland Gulf, ligeledes i Arctisk America. (7. *L. mucosus,* Rich.).

1857. Reinhardt, jun. „Fortegnelse over Grønlands Pattedyr, Fugle og Fiske," Rink, Grønl. 2 B. App. p. 22—23. Kbhvn. 1857.

Arterne *L. vahlii, L. reticulatus, L. seminudus, L. perspicillum,* og *L. nebulosus* opregnes som tilhørende Grønlands Fauna.

1861. Gill. "Catalogue of Fishes of the Eastern Coast of North America, from Greenland to Georgia" (Proc. Acad. Sci. Philad. 1861, Appendix p. 46. Philad. 1862).

De hidtil kjendte 7 Arter, *L. vahlii,* Reinh., *L. reticulatus,* Reinh., *L. seminudus,* Reinh., *L. perspicillum,* Kr., *L. nebulosus,* Kr., *L. mucosus,* Rich., og *L. polaris,* Sab., opregnes som tilhørende det ovennævnte Gebet.

1862. Krøyer. „Nogle Bidrag til nordisk Ichthyologie" (Naturh. Tidsskr. 3 Række, 1 B. p. 288—294, Mai 1862. Kbhvn. 1861—63).

Krøyer giver her Diagnoser og Beskrivelser af sine i 1844 opstillede 2 Arter, *L. perspicillum* og *L. nebulosus;* af den sidstnævnte Art dog lidet udførligt.

1862. Günther. Cat. Fish. Brit. Mus. vol. 4, p. 319—326. Lond. 1862:

Fam. *Lycodidae* opføres her under Ordenen *Anacanthini,* Underordenen *Gadoidei,* og stilles som dennes 2den Familie umiddelbart foran *Gadidae* (saaledes vidt adskilt fra Familien *Blenniidae*). Familien indbefatter 3 Genera: 1. *Lycodes,* 2. *Gymnelis,* 3. *Uronectes.* Til Slægten *Lycodes* (i egentlig Forstand) henregnes og gives Diagnoser af Arterne 1. *L. vahlii,* 2. *L. perspicillum,* 3. *L. reticulatus,* 4. *L. seminudus,* 5. *L. micosus,* og 6. *L. polaris,* men ingen nye Arter opstilles. Den anden Gruppe indbefatter de antarctiske Arter, henhørende under (Under-)Slægterne *Ilnocaetes* og *Phucocaetes,* Jen., samt den senere opstillede *Paralycodes,* Bleek.

1863. Gill. "Synopsis of the Family of Lycodoidae" (Proc. Acad. Nat. Sci. Philad. 1863, p. 254—261, Sept. 1863).

Efter en almindelig Oversigt over Familien *Lycodidae,* gives en udførlig Characteristik af Slægten *Lycodes,* hvorpaa de i hans foregaaende Catalog (af 1861) opregnede 7 Arter gives sammenlignende Diagnoser, med Angivelse af Synonymer. Familien indbefatter efter hans Opfatning Underfamilierne *Zoarceinae, Lycodinae,* og *Gymnelinae,* en Anskuelse, der synes at have god Grund til at blive anerkjendt som naturlig.

1864. Malmgren. "Om Spetsbergens Fiskfauna" (Öfv. Kgl. Vet. Akad. Förh. 1864, p. 516—517).

2 unge Individer af *L. rossi,* n. sp. beskrives, optagne i Nord-Spitsbergen i 1861 under den første svenske Polar-Expedition. Arten ansees af Malmgren som synonym med Ross' *Blennius polaris* (fra 1828), og forskjellig fra Sabine's Art af samme Navn (fra 1824); sandsynligvis falder den sammen med *L. perspicillum,* Kr.

Malmgrens Fund af *L. rossi* omtales atter, men uden videre Bemærkninger: 1) af Malmgren 1864 i "Svenska Exp. till Spets-

exceedingly difficult, not merely owing to the defective state of the older typical specimens, but also to the fact,

In the plates to Gaimard's work on the voyage with the corvette la "Recherche" to the Artic regions, Kröyer figured the 2 specimens of *L. perspicillum* as yet obtained. There is no letter-press to this or any of the other ichthyological plates.

1855. Richardson. "Account of the Fish," Last. Arct. Voy. Command of Sir Edw. Belcher, 1852—54, vol. 2, p. 362, Pl. XXVI. Lond. 1855.

A new species, *L. mucosus,* from Arctic America (Northumberland Sound), is fully described, and figured; it resembles Sabine's *L. polaris* in not having scales, but differs from that species in the number of pectoral rays, and in the number of transverse bands on the body. The total length of the largest of the 2 individuals obtained was about 176$^{mm.}$ Not till 1876 was this species again met with, in a large individual from Cumberland Gulf, also in Arctic America. (7. *L. mucosus,* Rich.).

1857. Reinhardt jun. "Fortegnelse over Grønlands Pattedyr, Fugle og Fiske," Rink, Grønl. 2 B. App. p. 22—23. Kbhvn. 1857.

The species *L. vahlii, L. reticulatus, L. seminudus, L. perspicillum,* and *L. nebulosus* are enumerated as belonging to the Fauna of Greenland.

1861. Gill. "Catalogue of Fishes of the Eastern Coast of North America, from Greenland to Georgia" (Proc. Acad. Nat. Sci. Philad. 1861, Appendix, p. 46. Philad. 1862).

The 7 species as yet known, viz: *L. vahlii,* Reinh., *L. reticulatus,* Reinh., *L. seminudus,* Reinh., *L. perspicillum,* Kr., *L. nebulosus,* Kr., *L. mucosus,* Rich., and *L. polaris,* Sab., are enumerated as belonging to the Fauna of that region.

1862. Kröyer. "Nogle Bidrag til nordisk Ichthyologie" (Naturh. Tidsskr. 3 Række, 1 B. p. 288—294, May 1862. Kbhvn. 1861—63).

In this paper Kröyer gives diagnoses and descriptions of his 2 species, established 1844, *L. perspicillum* and *L. nebulosus;* those of the latter are however rather brief.

1862. Günther. Cat. Fish. Brit. Mus., vol 4, p. 319—326. Lond. 1862.

The Fam. *Lycodidæ* is classed under the order *Anacanthini,* suborder *Gadoidei,* and as the 2nd family, immediately preceding *Gadidæ* (hence widely removed from the family *Blenniidæ*). This family comprises 3 genera, viz: 1. *Lycodes,* 2. *Gymnelis,* 3. *Uronectes.* To the genus *Lycodes,* in a limited sense, are referred, and diagnoses given, of the following species: 1. *L. vahlii,* 2. *L. perspicillum,* 3. *L. reticulatus,* 4. *L. seminudus,* 5. *L. mucosus,* and 6. *L. polaris;* but no new species are established. A second group compsises the Antarctic species, belonging to the (sub-)genera *Ilnocætes* and *Phucocætes,* Jen. and the subsequently established *Paralycodes,* Bleek.

1863. Gill. "Synopsis of the Family of Lycodoidæ" (Proc. Acad. Nat. Sci. Philad. 1863, p. 254—261, Sept. 1863).

After a summary review of the family *Lycodidæ,* the author gives in detail the characteristic features distinguishing the genus *Lycodes,* and then proceeds to furnish comparative diagnoses of the 7 species enumerated in his former Catalogue (1861), accompained by a list of synonyms. The family comprises, according to his view, the sub-families *Zoarceinæ, Lycodinæ,* and *Gymnelinæ,* which there is good reason to believe will prove correct.

1864. Malmgren. "Om Spetsbergens Fiskfauna" (Öfv. Kgl. Vet. Akad. Förh. 1864, p. 516—517).

Descriptions are given of 2 young examples of *L. rossi,* n. sp., taken on the north coast of Spitzbergen in 1861, on the first Swedish Polar Expedition. Malmgren regards the species as identical with Ross's *Blennius polaris* (1828), and differing from Sabine's species of the same name (1824); probably it is identical with *L. perspicillum,* Kr.

Malmgren's discovery of *L. rossi* is again referred to, but with no additional observations, 1) by Malmgren, 1864, in "Svenska Exp.

finde sig, men ogsaa fordi der synes at kunne raade en ganske betydelig Variation inden Individerne af samme

bergen Âr 1864", Bihang p. 249; 2) af Frisch 1865, i hans Bearbeidelse af Malmgrens foregaaende Afhandling i Petermann, Geogr. Mittheill. 1865, Erg. Heft Nr. 16, p. 39; 3) af Heuglin 1874 i "Reisen n. dem Nordpolar-Meer 1870 u. 1871", 3 Theil, p. 215, Braunschweig 1874. (8. *L. rossi,* Malmgr.).

1866. Sars, M. „Om *Lycodes gracilis*, en ny norsk Fisk" (Forh. Vid. Selsk. Chra. 1866, p. 40—45, Pl. 1, Fig: 1—3).

Lycodes gracilis, n. sp. beskrives og afbildes efter et ungt Individ med en Totallængde af 43^{mm}, fra 50—60 Favne i Drøbaksund i Norge. Dette Individ er dog utvivlsomt synonymt med *L. rossi,* Malmgren, og saaledes, efter hvad jeg antager, ligeledes med *L. perspicillum*, Kr. 1844, og udgjør ligesom disse sandsynligvis den spæde Unge enten af *L. reticulatus,* eller maaske af en anden nærstaaende Art. (9. *L. gracilis,* M. Sars).

1868. Esmark. „Bidrag til Finmarkens Fiskefauna" (Forh. Scand. Naturf. 10 Møde, Chra. 1868, p. 524).

3 store Individer af en *Lycodes,* som Univ.-Musæet havde modtaget fra Varangerfjorden (de 2 nedsendte i 1864, det tredie medbragt af Prof. Esmark fra en Reise i disse Egne i 1865), henføres under *L. vahlii,* Reinh. Disse Individer ere senere (1874) af nærværende Forfatter erkjendte og nærmere beskrevne som en egen Art, *L. esmarkii.*

1871. Collett. „*Lycodes sarsii,* n. sp., ex ordine Anacanthinorum Gadoideorum" (Forh. Vid. Selsk. Chra. 1871, p. 62—67, Pl. I. Chra. 1872).

L. sarsii, n. sp. beskrives og afbildes efter et (Yngel-)Individ med en Totallængde af 44^{mm}, optaget i 1869 i Hardangerfjorden i Norge fra 100—150 Favnes Dyb. Den er ensfarvet, allerede fuldt pigmenteret, men endnu uden Skjæl; den tilhører sandsynligvis de mest anguilliforme Arter, og udgjør den spæde Unge af en maaske endnu ukjendt Art. (10. *L. sarsii,* Coll.).

1872. Gill. "Arrangement of the Families of Fishes" (Smithson. Misc. Coll. No. 247, vol. XI, Nov. 1872. Washingt. 1874).

Familien *Lycodidae* opføres her under Ordenen *Teleocephali*, Subord. *Anacanthini.* Arter omtales ikke.

1872. Gill. "Catalogue of the Fishes of the East Coast of North America" (U. S. Comm. Fish and Fisheries, Part 1, Report 1871—72, p. 796—797. Wash. 1873).

I denne reviderede og supplerede Catalog (cfr. Catalogen af 1861), er Fam. *Lycodidae* opført væsentlig i Overensstemmelse med Anordningen i foregaaende Skrift, (Smiths. Misc. Coll. vol. XI, 1872). Af Slægten *Lycodes* opregnes de samme Arter fra Nord-Americas Østkyst, som i Catalogen af 1861, men uden Diagnoser eller Beskrivelser.

1873. Fitzinger. "Versuch einer natürlichen Classification der Fische" (Sitz. Ber. Math. Nat. Cl. Akad. Wiss. 67 B. 1 Abth. Jan. 1873, p. 43. Wien 1873).

Slægten *Lycodes* opføres her blandt Ser. II. *Heterocormi;* Ord. 2. *Arthropteri;* Subord. 2. *Gastronecta;* Fam. 6. *Zoarcae* (den sidste indbefattende 1. *Zoarces,* 2. *Lycodes).* Arter omhandles ikke.

1874. Collett. „Norges Fiske" (Tillægsh. Forh. Vid. Selsk. Chra. 1874, p. 95—103. Chra. 1875).

Som tilhørende Landets Fauna omhandles de 3 Arter, *L. gracilis,* M. Sars, fra Christianiafjorden, *L. sarsii,* Coll., fra Hardangerfjorden, samt *L. esmarkii,* n. sp., den sidstnævnte opstillet efter de 3 store Individer fra Finmarken (med en Totall. af 595—650^{mm}), der af Prof. Esmark tidligere (1868) vare opførte som tilhørende *L. vahlii,* Reinh. (11. *L. esmarkii,* Coll.).

1874. Bleeker. "Typi nonnulli generici piscium neglecti" (Versl. Med. Kon. Akad. Wet. Amst. 2 R. 8 Del, p. 369. 1874).

that individuals of the same species are found to vary very considerably *inter se,* resulting partly from sexual

till Spetsbergen, Âr 1864," Bihang, p. 249; 2) by Frisch, 1865, in his revision of Malmgren's treatise in Petermanns Geogr. Mittheill. 1865, Erg. Heft Nr. 16, p. 39; 3) by Heuglin, 1874, in "Reisen n. dem Nordpolar-Meer, 1870 u. 1871," 3 Theil, p. 215. Braunschweig 1874. (8. *L. rossi,* Malmgr.).

1866. Sars, M. "Om *Lycodes gracilis,* en ny norsk Fisk" (Forh. Vid. Selsk. Chra. 1866, p. 40—45, Pl. I, Fig. 1—3).

Lycodes gracilis, n. sp., is here described and figured from a young specimen (total length 43^{mm}) taken at a depth of 50—60 fathoms, in Drøbaksund, Norway. This individual is unquestionably identical with *L. rossi,* Malmgr., and therefore, as I conceive, also with *L. perspicillum,* Kr. 1844; hence it probably agrees with the two latter in being a very young example of *L. reticulatus*, or some closely related species. (9. *L. gracilis,* M. Sars).

1868. Esmark. "Bidrag til Finmarkens Fiskefauna" (Forh. Scand. Naturf. 10 Møde, Chra. 1868, p. 524).

Three large examples of a *Lycodes*, obtained by the University of Christiania from the Varanger Fjord (2 of the specimens were sent in 1864, the third was brought home, in 1865, by Professor Esmark) are referred to *L. vahlii,* Reinh. Subsequently (1874) these specimens were recognised by the present author as a distinct species, *L. esmarkii.*

1871. Collett. "*Lycodes sarsii,* n. sp., ex ordine Anacanthinorum Gadoideorum" (Forh. Vid. Selsk. Chra. 1871, p. 62—67, Pl. I. Chra. 1872).

L. sarsii, n. sp., is described and figured from a (fry-)specimen, total length 44^{mm}, taken, in 1869, in the Hardanger Fjord, Norway, at a depth of 100—150 fathoms. It is of a uniform colour, with the pigment fully developed, but exhibiting as yet no trace of scales; belongs probably to the anguilliform species, being, perhaps, a very young example of an unknown species. (10. *L. sarsii,* Coll.).

1872. Gill. "Arrangement of the Families of Fishes" (Smithson. Misc. Coll. No. 247, vol. XI, Nov. 1872. Washingt. 1874).

The family *Lycodidæ* is here classed under the order *Teleocephali,* sub-order *Anacanthini.* No species referred to.

1872. Gill. "Catalogue of the Fishes of the East Coast of North America" (U. S. Comm. Fish and Fisheries, Part 1, Report 1871—1872, p. 796—797. Wash. 1873).

In this revised and enlarged Catalogue (*vide* Catalogue 1861), the author classes the family *Lycodidæ* chiefly in accordance with the arrangement adopted in the foregoing work (Smithson. Misc. Coll. vol. XI, 1872). Of the genus *Lycodes*, he enumerates the same species from the east coast of North America as in his Catalogue of 1861, but without furnishing any diagnoses or descriptions.

1873. Fitzinger. "Versuch einer natürlichen Classification der Fische" (Sitz. Ber. Math. Nat. Cl. Akad. Wiss. 67 B. 1 Abth. Jan. 1873. p. 43. Wien 1873).

The genus *Lycodes* is here classed among Ser. II. *Heterocormi;* Ord. 2. *Arthropteri;* Sub ord. 2. *Gastronecta;* Fam. 6. *Zoarcæ* (comprising 1. *Zoarces,* 2. *Lycodes*). No species referred to.

1874. Collett. "Norges Fiske" (Tillægsh. Forh. Vid. Selsk. Chra. 1874, p. 95—103. Chra. 1875).

As comprised in the Norwegian fauna, the author enumerates the 3 species: *L. gracilis,* M. Sars, from the Christianiafjord, *L. sarsii,* Coll., from the Hardangerfjord, and *L. esmarkii,* n. sp., the last-mentioned being established from the 3 large specimens taken on the coast of Finmark (total length from 595^{mm} to 650^{mm}), which Prof. Esmark, in 1868, had referred to *L. vahlii,* Reinh. (11. *L. esmarkii,* Coll.).

1874. Bleeker. "Typi nonnulli generici piscium neglecti" (Versl. Med. Kon. Akad. Wet. Amst. 2 R. 8 Del, p. 369. 1874).

Art, baade grundet paa Forskjel i Kjøn, og med Hensyn til Farvetegning, Udstrækning af Skjælbeklædning, og tildels

Som nye Slægter blandt Familien *Lycodidae* opfører Bleeker *Lycodalepis* for *L. mucosus,* Rich., samt *Paralycodes* for *L. variegatus,* Günth. Den sidstnævnte Art tilhører vistnok en fra den typiske *Lycodes* skilt Slægt; derimod synes Opstillingen af en særskilt Slægt for Richardson's Art, grundet paa Mangelen af Skjæl, at være overflødig, naar man tager i Betragtning den store Variation i Skjælbeklædningens Udstrækning hos de øvrige Arter.

1875. Lütken. "Revised Catalogue of the Fishes of Greenland" (Man. Nat. Hist. etc. of Greenl., prepared for the Arct. Exped. of 1875, p. 118—119. Lond. 1875).

Indeholder en Fortegnelse over de hidtil bekjendte grønlandske Arter, de samme, som i Gill's Catalog (af 1861), med en Angivelse af Synonymi.

1876. Wallace. Geographical Distribution of Animals, vol. 2, p. 439 (Lond. 1876).

Den geographiske Udbredelse af Familien *Lycodidae* angives (i Overensstemmelse med Günthers Catalogue af 1862) til Arctisk America og Grønland, samt de antarctiske Have omkring Falklandsøerne og Chiloë. (De antarctiske Arter udgjøre dog utvivlsomt destincte Genera).

1877. Goode & Bean. "Descriptions of two new Species of Fishes, *Macrurus bairdi* and *Lycodes verrillii*" (Amer. Journ. Sci. Arts, vol. XIV, p. 473—476; Dec. 1877).

L. verrilli, n. sp. opstilles og beskrives udførligt efter 6 Individer, erholdte af U. S. Fish Commission paa 90—100 Favnes Dyb udenfor Kysterne af Nova Scotia Sommeren 1877. Arten tilhører de langstrakte Former af denne Slægt, og er blandt disse characteristisk ved at besidde Tverbaand. (12. *L. verrillii,* Goode & Bean).

1877. Malm. Götheborgs och Bohusläns Fauna, p. 502 (Götheb. 1877).

L. gracilis, M. Sars, omtales som maaske forekommende udenfor Bohuslän, en Antagelse, der blot er grundet paa Fundet af Individet i Christianiafjorden.

1878. Collett. „Fiske, indsamlede under den norske Nordhavs-Expeditions 2 første Togter, 1876 og 1877" (Forh. Vid. Selsk. Chra. 1878, No. 4, p. 11—20; Februar 1878).

Under *L. vahlii,* Reinh., henføres og beskrives et Yngel-Individ af en *Lycodes,* (der dog sandsynligvis er skilt fra denne Art, og udgjør Yngelen af *L. esmarkii,*) samt et Par (ligeledes Yngel-Individer) af den senere beskrevne *L. frigidus.* Som ny opstilles *L. muraena,* der er ensfarvet, skjælbeklædt, og tilhører de mest langstrakte Former af denne Slægt. Alle Individer vare optagne under Aarets 2det Togt, i 1877, paa Bankerne udenfor Nordland og Lofoten.

(13. *L. muraena,* Coll.).

1878. Collett. „Fiske fra Nordhavs-Expeditionens sidste Togt, Sommeren 1878" (Forh. Vid. Selsk. Chra. 1878 No. 14, p. 45—77; Dec. 1878).

Af dette Togts righoldige Materiale henføres 15 Individer under en ny Art, *L. frigidus,* der er ensfarvet, skjælbeklædt, og tilhører *vahlii*-Typen, samt 2 under *L. pallidus,* n. sp., der i det hele er overensstemmende med *L. frigidus,* men har characteristiske Tegninger over Finnerne. Under *L. vahlii* henføres 3 Individer, der dog (sammen med Yngel-Individet fra forrige Aar) uden Tvivl udgjøre de hidtil ukjendte yngre Stadier af *L. esmarkii,* som danner denne Arts Repræsentant i de europæiske Dele af Ishavet. Fremdeles angives 1 Individ at tilhøre *L. seminudus,* Reinh., 3 Individer *L. muraena,* Coll., medens 1 med nogen Tvivl henføres under *L. reticulatus* (i nærværende Værk opstillet som distinct under Navn af *L. lütkeni*). Alle vare erholdte Sommeren 1878 fra Havet omkring Beeren Eiland og Spitsbergen; af de fleste gives udførlige Beskrivelser.

(14. *L. frigidus,* Coll. 15. *L. pallidus,* Coll.).

differences, and partly from variation in colour and extent of scaling, as well as in the proportions of the body.

As new genera of the family *Lycodidæ,* Bleeker proposes *Lycodalepis* for *L. mucosus,* Rich., and *Paralycodes* for *L. variegatus,* Günth. The latter species belongs unquestionably to a genus distinct from the typical *Lycodes;* on the other hand, the establishment of a separate genus for Richardson's species on the basis of its not having scales, would seem superfluous, if we call to mind the great variation in the extent of the scaled integument exhibited by the other species.

1875. Lütken. "Revised Catalogue of the Fishes of Greenland" (Man. Nat. Hist. etc. of Greenland, prepared for the Arct. Exped. of 1875, p. 118—119. Lond. 1875).

Contains a list of the Greenland species known up to that time — the same as in Gill's Catalogue (1861) — with the synonyms annexed.

1876. Wallace. Geographical Distribution of Animals, vol. 2, p. 439 (Lond. 1876).

The geographical range of the family *Lycodidæ* is given (in conformity with Günther's Catalogue of 1861), as comprising Arctic America and Greenland, together with the Falkland Islands and Chiloë, in the Antarctic Ocean. (The Antarctic species belong however to distinct genera).

1877. Goode & Bean. "Descriptions of two new Species of Fishes, *Macrurus bardii* and *Lycodes verrillii*" (Amer. Jour. Sci. Arts, vol. XIV, p. 473—476; Dec. 1877).

L. verrillii, n. sp., is established and fully described from 6 specimens obtained by the U. S. Fish. Commission, at a depth of 90—100 fathoms, off the coast of Nova Scotia, in the summer of 1877. This species belongs to the elongated forms of the genus, among which it is distinguished by the transverse bands.

(12. *L. verrillii,* Goode & Bean).

1877. Malm. Götheborgs och Bohusläns Fauna, p. 502 (Götheb. 1877).

L. gracilis, M. Sars, is spoken of as possibly occurring on the coast of Bohuslän, a supposition which has nothing beyond the specimen from the Christiania Fjord to support it.

1878. Collett. "Fiske indsamlede under den norske Nordhavs-Expeditions 2 første Togter, 1876 og 1877" (Forh. Vid. Selsk. Chra. 1878, No. 4, p. 11—20; Februar 1878).

The author refers to *L. vahlii,* and describes a fry-specimen of a *Lycodes,* which, however, is doubtless distinct from that species, most likely the young of *L. esmarkii;* likewise two examples (both of them very young) of *L. frigidus,* afterwards described. As new, he establishes *L. muræna,* which is scaled, uniform in colour, and the most elongated form of the genus. The specimens were all taken during the second voyage, in 1877, on the banks off the coasts of Nordland and Lofoten. (13. *L. muræna,* Coll.).

1878. Collett. "Fiske fra Nordhavs-Expeditionens sidste Togt, Sommeren 1878" (Forh. Vid. Selsk. Chra. 1878, No. 14, p. 45—77; Dec. 1878).

No less than 15 individuals of the valuable collection made on this voyage are referred to a new species, *L. frigidus,* uniform in colour, scaled, and of the *vahlii* type; 2 to *L. pallidus,* n. sp., which agrees in its chief characters with *L. frigidus,* but with distinctive markings on the fins. To *L. vahlii* are referred 3 individuals, which, however (along with the young specimen taken the year before), represent the earlier stages, unknown before, of *L. esmarkii,* the representative of *L. vahlii* in the European tracts of the Arctic Ocean. Moreover, 1 individual is referred to *L. seminudus,* Reinh., 3 to *L. muræna,* Coll., and 1 individual, though somewhat doubtfully, to *L. reticulatus* (in this General Report established as distinct, under the name of *L. lütkeni*). These specimens were all obtained in the summer of 1878, off Beeren Eiland and Spitzbergen; most of them are fully described. (14. *L. frigidus,* Coll. 15. *L. pallidus,* Coll.).

ogsaa Legemsproportionerne. Endvidere ere flere af Arterne, saavel de ældre, som de nyere, opstillede efter ganske unge

1879. Goode & Bean. "Discoveries of the U. S. Fish Commission" (Am. Journ. Sci. Arts, vol. XVII, p. 42—43; Jan. 1869).

L. verrillii, Goode & Bean, omtales som erholdt paa 73—114 Favnes Dyb udenfor Kysterne af Nova Scotia.

1879. Collett. „Meddelelser om Norges Fiske i Aarene 1875—78", (Forh. Vid. Selsk. Chra. 1879, No. 1, p. 62; Febr. 1879).

Identiteten af *L. esmarkii* og *L. vahlii* omhandles og bekræftes fremdeles, efterat Forf. i 1878 havde medbragt fra Finmarken 2 nye, men atter fuldt udvoxede Individer af den førstnævnte Form til Universitets-Musæet. Nordhavs-Expeditionens Yngel-Individer af *L. frigidus* fra Bankerne udenfor Lofoten anføres som gaaende ind under Norges Fauna.

1879. Bean. "Fishes collected in Cumberland gulf and Disco Bay" (Bull. U. S. Nat. Mus. No. 15, p. 112—115; Contrib. to the Nat. Hist. of Arct. Am., by L. Kumlien; 23de Mai 1879).

Af *L. mucosus,* Rich. 1855, hvoraf tidligere vare blot kjendte de 2 Typ-Individer fra Northumberland Sound, erholdtes et nyt Individ i Cumberland Gulf i 1876. Totallængden var 430^{mm}; Richardsons originale Beskrivelse bliver i alle væsentlige Henseender bekræftet.

1879. Collett. "On a new Fish of the Genus *Lycodes* from the Pacific" (Proc. Zool. Soc. Lond. 1879, p. 381—382).

L. pacificus, n. sp., angivelig fra Japan, og tilhørende Berliner-Musæet, beskrives og afbildes i et Træsnit. Paa Grund af de manglende Vomerin- og Palatintænder antages den maaske rettere at henføres under en egen Underslægt, for hvilken Navnet *Lycodopsis* er foreslaaet. (16. *L.* [*Lycodopsis*] *pacificus,* Coll.)

1879. Bean. "Description of a species of *Lycodes* (*L. turneri*) from Alaska" (Proc. U. S. Nat. Mus. vol. I; 22de April 1879; Wash. 1879).

En ny Art, den 2den fra det stille Hav, opstilles og beskrives nøjagtigt, efter et Individ med en Totallængde af 330^{mm}, under Navn af *L. turneri.* Den tilhører de skjælløse Arter, hvoraf der egentlig blot existerer 1 sikker Art foruden denne, nemlig *L. mucosus,* Rich.; af de øvrige Arter, der ere beskrevne som skjælløse, er nemlig den ene utilstrækkeligt beskreven, og ikke senere gjenfunden (*L. polaris,* Sab.), og de 2, *L. rossi,* Malmgr., og *L. gracilis,* M. Sars, ere Yngelstadier af andre, skjælbeklædte Former, hvilket maaske ogsaa gjælder om den 4de, *L. sarsii,* Coll. Farven er hos denne Art mørk med lyse Tverbaand; Legemet og Tandbygningen typiske.

(17. *L. turneri,* Bean 1879).

1879. Goode & Bean. "Descr. of a species of *Lycodes* (*L. paxillus*) obtained by the U. S. Fish. Comm." (Proc. U. S. Nat. Mus. vol. II, p. 44—46; 22de Marts [trykt 23de Maj] 1879).

Den nye Art, *L. paxillus,* opstilles efter et enkelt, ikke fuldkommen uskadt Individ med en Totallængde af 363^{mm} fra Kysterne af Nova Scotia. Som characteristiske Kjendetegn opgives det særdeles korte Hoved, en ejendommelig Krumning af Overkjæven, den stærke Udvikling af Kjævernes Muskler, og de faatallige Pectoralstraaler. Den tilhører de langstrakte Former, og har et trindt, skjælbeklædt, og ensfarvet Legeme. (18. *L. paxillus,* Goode & Bean).

1879. Goode & Bean. "On the occurrence of *Lycodes vahlii,* Reinhardt, on la Have and Grand Banks" (Proc. U. S. Nat. Mus. vol. 2, p. 209—210; 21de Maj [trykt 6te Dec.] 1879).

2 Individer af, hvad der antages at være *L. vahlii,* Reinhardt, optoges paa Bankerne søndenfor Nova Scotia i Løbet af 1879. Totallængden af de erholdte Individer var 540 og 632^{mm}. Jeg skal senere vise, at disse Individer ere identiske med *L. esmarkii*, idet jeg har været sat istand til at anstille en directe Undersøgelse mellem et af disse Individer, og Typ-Exemplarerne af den nævnte Art.

Moreover, several of the species, both the old and the new, are established from specimens in a very early stage of

1879. Goode & Bean. "Discoveries of the U. S. Fish Commission" (Am. Journ. Sci. Arts, vol. XVII, p. 42—43; Jan. 1869).

L. verrillii, Goode & Bean, is mentioned as having been taken, at a depth of 73—114 fathoms, off the coast of Nova Scotia.

1879. Collett. "Meddelelser om Norges Fiske i Aarene 1875—78" (Forh. Vid. Selsk. Chra. 1879, No. 1, p. 62; Febr. 1879).

Here too, the identity of *L. esmarkii* and *L. vahlii* is dwelt upon and maintained, the author having, in 1878, brought from Finmark to the University Museum two full-grown examples of the former. The fry-specimen of *L. frigidus,* taken on the North Atlantic Expedition in 1878, on the banks off the Lofoten coast, is mentioned as comprised in the Norwegian Fauna.

1879. Bean. "Fishes collected in Cumberland Gulf and Disco Bay" (Bull. U. S. Nat. Mus. No. 15, p. 112—115; Contrib. to the Nat. Hist. of Arct. Am., by L. Kumlien; 23rd May 1879).

Of *L. mucosus,* Rich. 1855, previously represented by the 2 typical specimens from Northumberland Sound, a new example was taken in Cumberland Gulf, in 1876, having a total length of 430^{mm}. Richardson's original description is confirmed in all essential particulars.

1879. Collett. "On a new Fish of the Genus *Lycodes* from the Pacific" (Proc. Zool. Soc. Lond. 1879, p. 381—382).

L. pacificus, n. sp. (preserved in the Berlin Museum), stated to be from Japan, is here described and figured. The species being without vomerine and palatine teeth should, perhaps, be classed under a separate sub-genus, for which the name of *Lycodopsis* is suggested.

(16. *L.* [*Lycodopsis*] *pacificus,* Coll.).

1879. Bean. "Description of a species of *Lycodes* (*L. turneri*) from Alaska" (Proc. U. S. Nat. Mus., vol. I; 22th April 1879; Wash. 1879).

A new species, the second met with in the Pacific Ocean, is here established and fully described, from an individual having a total length of 330^{mm}, under the name of *L. turneri.* It belongs to the scaleless species, of which, in a strict sense, but one other true species is known to exist, viz. *L. mucosus*, Rich.; for, of the remaining species stated to be scaleless, 1 is imperfectly described, and has not since been met with (*L. polaris,* Sab.); and 2, *L. rossi,* Malmgr., and *L. gracilis,* M. Sars, are other, scaled forms in the fry stage of development, which, perhaps, is also the case with the fourth, *L. sarsii,* Coll. The colour is dark, with light transverse bands; body and structure of teeth typical. (17. *L. turneri,* Bean 1879).

1879. Goode & Bean. "Descr. of a species of *Lycodes* (*L. paxillus*) obtained by U. S. Fish. Comm." (Proc. U. S. Nat. Mus. vol. II, p. 44—46; 22nd March [printed 23rd May] 1879).

The new species, *L. paxillus,* is described from a single individual, not wholly free from mutilation, with a total length of 363^{mm}, taken on the coast of Nova Scotia. Its characteristic features are stated to be the short head, a peculiar curvature of the upper jaw, the powerful development of the maxillary muscles, and the small number of pectoral rays. It belongs to the elongated forms, and has a plump, scaled body, uniform in colour.

(18. *L. paxillus,* Goode & Bean).

1879. Goode & Bean. "On the occurrence of *Lycodes vahlii,* Reinhardt, on la Have and Grand Banks" (Proc. U. S. Nat. Mus. vol. 2, p. 209—210; 21st May [printed 6th Dec.] 1879).

Two individuals, believed to belong to *Lycodes vahlii,* Reinhardt, — total length respectively 540^{mm} and 632^{mm}, — were taken on the banks south of Nova Scotia, in 1879. I shall subsequently show that these individuals are identical with *L. esmarkii,* having had an opportunity of instituting a direct comparison between one of them and the typical specimens of that species.

Individer, tildels Yngel, hvoraf der kan have foreligget blot et enkelt Individ til Undersøgelse, og det lader sig nu i flere Tilfælde directe paavise, at Yngel-Individer af denne Slægt kunne frembyde en betydelig Ulighed med de ældre af samme Art. Med fuld Sikkerhed at henføre alle disse Yngel-Individer, der endnu opføres under sine særegne Navne i Musæer og i Skrifter, til sin rette Plads, er derfor ofte vanskeligt eller endog umuligt, og denne Usikkerhed vil først forsvinde, naar der foreligger langt større Rækker af de forskjellige Udviklingsstadier, end det for Tiden er Tilfældet.

Det under Nordhavs-Expeditionen vundne Materiale maa vistnok kaldes forholdsvis betydeligt, idet der indsamledes ialt 29 Individer, henhørende efter min Antagelse under 6 forskjellige Arter, men som dog ikke er tilstrækkeligt til overalt at bringe fuld Klarhed i Forholdet mellem disse Arter og de allerede bekjendte.

Ved den endelige Bearbejdelse af dette Materiale har jeg havt en værdifuld Bistand af Dr. Lütken, som samtidigt har underkastet de i Kjøbenhavns Universitets-Musæum opbevarede Typer fra Grønland en nøjere Gjennemgaaelse; fremdeles har jeg ved denne Naturforskers Velvilje været sat istand til under et Par Ophold i Kjøbenhavn personlig at kunne undersøge disse Typexemplarer. Dette har havt til Følge, at jeg nu har troet at burde i enkelte Puncter modificere min tidligere provisorisk givne Opfatning af de under Expeditionen og de øvrige ved de norske Kyster erholdte Former. Det hele Antal af de hidtil under særegne Navne opstillede Arter af denne Slægt er 19, hvortil kommer den i nærværende General-Beretning beskrevne nye Art, *L. lütkenii.*

At forsøge paa at reducere til sit rette Antal alle disse 20 hidtil beskrevne Arter, hvoraf idetmindste et Par, efter min Opfatning, bestemt ikke kunne ansees for at

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1879. Goode & Bean. "List of the Fishes of Essex County, including those of Mass. Bay" (Bull. Ess. Inst. vol. IX, p. 1—38, Salem 1879).

Som erholdte udenfor Kysterne af Maine og Nova Scotia i de senest forløbne Aar omtales af Lycoder Arterne *L. verrillii, "L. vahlii"*, og *L. paxillus.*

1880. Lütken. „Korte Bidrag til nordisk Ichthyographi. III. Grønlands og Islands Lycoder" (Vid. Medd. Naturh. Foren. Kbhvn. 1880, p. 307—332; meddelt 6te Febr. 1880).

Indeholder en critisk Gjennemgaaelse af det i Musæet i Kjøbenhavn opbevarede Materiale af Lycoder fra Grønland og Island, der indeholder Typerne for de fleste af Reinhardt og Krøyer beskrevne Arter. Forfatteren characteriserer *L. vahlii*, *L. reticulatus* og *L. seminudus*, og antager den førstnævnte skilt fra *L. esmarkii.* Som ny opstilles *L. lugubris* fra Island, en Art, der i Legemsform, Skjælbeklædning og Sidelinie kommer *L. vahlii* nær, men skiller sig fra denne ved færre Pectoralstraaler, kortere Tandrække paa Palatinbenene, samt ensartet graabrun Farve uden Baand eller Pletter. Fremdeles gjør Forfatteren Rede for sin Opfatning af flere af de øvrige Lycoder, og giver til Slutning en kort Oversigt over de grønlandske og islandske Arter tilligemed dem af de øvrige Arter, hvorom han har personlig Kundskab (dog uden nærmere at characterisere disse sidste).

(19. *L. lugubris*, Lütk.).

growth, nay some from fry, of which, maybe, but a solitary individual was at hand for examination; and in many cases it now admits of the clearest proof that fry and adult individuals of the same species exhibit a marked dissimilarity. Therefore, to classify aright the numerous fry-specimens, for which, in museums and ichthyological works, a specific name continues to be employed, is exceedingly difficult, or rather impossible; and this uncertainty will not cease to be felt till specimens representing the various stages of development shall have been obtained in greater number.

The results of the North Atlantic Expedition, as affecting this question, must certainly be regarded as considerable, 29 individuals, belonging, I conceive, to 6 different species, having been collected, — though insufficient for fully elucidating the relation between these new species and those already known.

When engaged in working up these materials, I received valuable assistance from Dr. Lütken, who also submitted the typical specimens from Greenland, preserved in the Copenhagen University Museum to a critical examination; and that naturalist having kindly permitted me to examine those specimens when, on one or two occasions, I visited Copenhagen, I have seen fit, in some respects, to modify my former, to a certain extent preliminary, views concerning forms obtained on the Expedition and off the coasts of Norway. The whole number of species hitherto instituted under special names is 19, exclusive of the new species, *L. lütkenii,* established in this General Report.

An attempt to reduce to their true number the 20 forms as yet described, some of which, in my opinion, cannot be regarded as distinct species, is hardly pos-

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1879. Goode & Bean. "List of the Fishes of Essex County, including those of Mass. Bay" (Bull. Ess. Inst. vol. IX, pp. 1—38, Salem 1879).

Among the various species of *Lycodes* obtained of late years off the coasts of Maine and Nova Scotia are mentioned *L. verrillii, "L. vahlii,"* and *L. paxillus.*

1880. Lütken. "Korte Bidrag til nordisk Ichthyographi. III. Grønlands og Islands Lycoder." (Vid. Medd. Naturh. Foren. Kbhvn. 1880, pp. 307—232; read Feb. 6th 1880).

In this Memoir are embodied the results of a critical examination of the specimens from Greenland and Iceland preserved in the Zoological Museum in Copenhagen, which comprise the types of most of the species described by Reinhardt and Kröyer. The author characterises *L. vahlii, L. reticulatus,* and *L. seminudus,* and regards the first of these species as distinct from *L. esmarkii.* As a new species, he establishes *L. lugubris,* from Iceland, which, as regards the structure of the body, the scaled integument, and the lateral line, bears considerable resemblance to *L. vahlii*, but is distinguished from it by having fewer pectoral rays, a shorter series of teeth on the palatine bones, and a uniform greyish-brown colour, without either bands or spots. Moreover, the author explains his views concerning several of the other *Lycodes,* and gives in conclusion a summary of the Greenland and Iceland species, together with such of the remaining species as are known to him from autopsy, without however diagnosticating the latter.

19. *L. lugubris,* (Lütk.).

repræsentere virkelige Arter, lader sig neppe iværksætte med det Materiale, der for Tiden staar til vor Raadighed. Den nedenstaaende Oversigt kan derfor blot ansees som et foreløbigt Forsøg paa deres Gruppering.

A. *Tænder i Kjæverne, paa Vomer og paa Palatinbenene* (**Lycodes,** Reinh. 1830—31).

I. Legemsbygningen typisk; Legemets Højde indeholdes 6—10 Gange i Totallængden.

a. Legemet hos de udvoxede helt el. delvis skjælbeklædt.

1. *L. vahlii,* Reinh. 1830—31. Grønland.
2. *L. reticulatus,* Reinh. 1834—35. Grønland. *L. polaris,* Ross (nec Sab.) 1828; Spitsbergen. *L. perspicillum,* Kr. 1844; Grønland. *L. rossi,* Malmgr. 1864; Spitsbergen. *L. gracilis,* M. Sars 1866; Christianiafjorden (Norge).
3. *L. seminudus,* Reinh. 1838. Grønland; Spitsbergen.
(4) *L. nebulosus,* Kr. 1844. Grønland. (Utilstrækkeligt beskreven, og ubestemmelig).
5. *L. esmarkii,* Coll. 1874. Finmarken; Spitsbergen; Nova Scotia.
6. *L. frigidus,* Coll. 1878. Spitsbergen; Beeren Eiland; Norges NV.-Kyst.
7. *L. pallidus,* Coll. 1878. Spitsbergen.
8. *L. lugubris,* Lütk. 1880. Island.
9. *L. lütkenii,* n. sp. Spitsbergen.

b. Legemet i alle Aldre nøgent. (*Lycodalepis,* Bleek. 1874).

(10) *L. polaris,* Sab. 1824. Arctisk America. (Utilstrækkeligt beskreven, og ubestemmelig).
11. *L. mucosus,* Rich. 1855. Arctisk America.
12. *L. turneri,* Bean 1879. Alaska (Russisk N. America).

II. Legemsbygningen langstrakt; Legemets Højde indeholdes 12—24 Gange i Totallængden.

13. *L. sarsii,* Coll. 1871. Hardangerfjord (Norge). (Blot kjendt i et Yngel-Individ).
14. *L. muraena,* Coll. 1878. Spitsbergen; Beeren Eiland; Norges NV.-Kyst.
15. *L. verrillii,* Goode & Bean 1879. Nova Scotia (N. Americas Østkyst).
16. *L. paxillus,* Goode & Bean 1879. Nova Scotia (N. Americas Østkyst).

B. *Tænder i Kjæverne, ingen paa Vomer eller Palatinbenene* (**Lycodopsis,** Coll. 1870).

17. *L. pacificus,* Coll. 1879. Japan.

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18. **Lycodes esmarkii,** Coll. 1874.

Pl. II, Fig. 19—21; Pl. III, Fig. 22.

Lycodes esmarkii, Coll. Norges Fiske, Tillægsh. til Forh. Vid. Selsk. Chra. 1874, p. 95, Chra. 1875 (1874).
Lycodes vahlii, Coll. (nec Reinh.) Forh. Vid. Selsk. Chra. 1878, No. 4, p. 11, Febr. 1878; No. 14, p. 54, Dec. 1878; Chra. 1879 (1878).
Lycodes vahlii, Goode & Bean, Proc. U. S. Nat. Mus. vol. 2, p, 209 (1879).

sible with the comparatively meagre stock of materials now before us. The subjoined summary is therefore to be regarded merely as a preliminary attempt towards the grouping of this genus.

A. *Teeth in the jaws, on the vomer, and the palatine bones* (**Lycodes,** Reinh. 1830—31).

I. Structure of the body typical; height of the body contained from 6 to 10 times in the total length.

a. The body in adults more or less scaled.

1. *L. vahlii,* Reinh. 1830—31. Greenland.
2. *L. reticulatus,* Reinh. 1834—35. Greenland. *L. polaris,* Ross (nec Sab.) 1828; Spitzbergen. *L. perspicillum,* Kr. 1844; Greenland. *L. rossi,* Malmgr. 1864; Spitzbergen. *L. gracilis,* M. Sars 1866; the Christiania Fjord (Norway).
3. *L. seminudus,* Reinh. 1838. Greenland; Spitzbergen.
(4) *L. nebulosus,* Kr. 1844. Greenland. (Insufficiently described, and indeterminable).
5. *L. esmarkii,* Coll. 1874. Finmark; Spitzbergen; Nova Scotia.
6. *L. frigidus,* Coll. 1878. Spitzbergen; Beeren Eiland; North-west coast of Norway.
7. *L. pallidus,* Coll. 1878. Spitzbergen.
8. *L. lugubris,* Lütk. 1880. Iceland.
9. *L. lütkenii,* n. sp. Spitzbergen.

b. The body naked in all stages of growth (*Lycodalepis,* Bleek. 1874).

(10) *L. polaris,* Sab. 1824. Arct. America. (Insufficiently described, and indeterminable).
11. *L. mucosus,* Rich. 1855. Arct. America.
12. *L. turneri,* Bean 1879. Alaska (Russian N. America).

II. The body elongate; height of the body contained from 12 to 24 times in the total length.

13. *L. sarsii,* Coll. 1871. The Hardanger Fjord (Norway). (Known only from a fry-specimen).
14. *L. muræna,* Coll. 1878. Spitzbergen; Beeren Eiland; North-west coast of Norway.
15. *L. verrillii,* Goode & Bean 1879. Nova Scotia (N. America).
16. *L. paxillus,* Goode & Bean 1879. Nova Scotia (N. America).

B. *Teeth in the jaws; none on the vomer or the palatine bones.* (**Lycodopsis,** Coll. 1879).

17. *L. pacificus,* Coll. 1879. Japan.

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18. **Lycodes esmarkii,** Coll. 1874.

Pl. II, fig. 19—21; Pl. III, fig. 22.

Lycodes esmarkii, Coll. Norges Fiske, Tillægsh. til Forh. Vid. Selsk. Chra. 1874, p. 95, Chra. 1875 (1874).
Lycodes vahlii, Coll. (nec Reinh.) Forh. Vid. Selsk. Chra. 1878 No. 4, p. 11, Feb. 1878; No. 14, p. 54, Dec. 1878; Chra. 1879 (1878).
Lycodes vahlii, Goode & Bean, Proc. U. S. Nat. Mus. vol. 2, p. 209 (1879).

Diagn. *Farven brunsort med hvidgul Nakkeplet, og med 5—8 hvidgule Tverbaand, der gaa ud over Dorsalen, bagtil ogsaa ud over Analen; hos fuldt udvoxede Individer ere Tverbaandene opløste i ringformige, af Bundfarven opfyldte Pletter, der nedtil kunne være utydelige, eller ogsaa indbyrdes sammenhængende. Skjællene beklæde hele Legemet indtil foran Dorsalerne, fremdeles Dorsalen og Analen indtil henimod deres Rande; fuldt udvoxede Individer have tillige Nakken og Roden af Pectoralerne skjælbeklædt, samt tildels spredte Skjæl paa Panden. Legemets Højde indeholdes 7—8, hos smaa Unger 9—10 Gange i Totallængden. Hovedet har stump Snude, og indeholdes 4'/$_4$—4'/$_2$ Gange i Totallængden; Tandrækken paa Palatinbenene kortere, end Mellemkjævens, og naar hos gamle Individer neppe dennes halve Længde. Overkjæven aldrig længere, end det halve Hoved. Pectoralerne, der indeholdes hos yngre neppe 8 Gange, hos fuldt udvoxede Hanner omtrent 9 Gange i Totallængden, ere hos de første tydeligt indskaarne i Yderranden. Sidelinien dobbelt, lige bag Pectoralfæstet delt i en mediolateral og en ventral Gren; hos udvoxede utydelig. Appendices pyloricae mangle. Størrelsen indtil 595^{mm} (Hunnen), eller 622^{mm} (Hannen), og derover.*

M. B. 6. D. + 1/$_2$ C. 102—118; A. + 1/$_2$ C. 88—102; P. 20—23; V. 4.

Localit. fra Nordh. Exped. Bankerne udenfor Lofoten i Norge; Nordvestkysten af Spitsbergen.

	Stat. 124.	*Stat.* 362.	*Stat.* 363.
Beliggenhed.	325 Kil. VSV. Bodø, Norge.	115 Kilom. V. Norskøerne,Sptb.	60 Kil. V. Norskøerne,Sptb.
Dybde.	350 Favne (640^m).	459 Favne (839^m).	260 Favne (475^m)
Temp. paa Bunden.	— 0.9° C.	— 1.0° C.	+ 1.1° C.
Bunden.	Ler.	Blaagraat Ler.	Blaaler.
Datum.	19de Juni 1877.	14de Aug. 1878.	14de Aug. 1878.
Antal Individer.	1 spæd Unge.	2 Indiv.	1 Unge.

Bemærkninger til Synonymien. Spørgsmaalet om, under hvilken af de hidtil bekjendte Lycoder de 4 under Nordhavs-Expeditionen erholdte Individer, hvilke i mine foreløbige Beretninger have været omtalte under Navnet *L. vahlii,* Reinh., burde henføres, har ikke været løst uden efter nogen Tvivl. Allerede i disse Beretninger har jeg paavist, at de i alle væsentlige Henseender gaa ind under Reinhardts Beskrivelse af *L. vahlii,* og jeg troede derfor at burde henføre dem under denne Art, skjønt Original-Exemplarerne i det zoologiske Musæum i Kjøbenhavn og Berlin, hvilke jeg ved Dr. Lütkens og Prof. Peters' Imødekommenhed har havt Lejlighed til at underkaste en (omend flygtig) Undersøgelse, frembød visse iøjnefaldende Uligheder; dog vare intet af disse Exemplarer af det samme Alderstrin, som Nordhavs-Expeditionens, ligesom de vare idethele

Diagnosis. — *Colour brownish-black, with a whitish yellow patch on the nape and 5—8 transverse bands of the same colour across the dorsals, and, posteriorly, across the anal; in full-grown individuals, the bands are broken up into annular spots, filled with the ground colour; below, sometimes indistinct or contiguous. The scales cover the body to the region in front of the dorsals, also the dorsals and the anal, nearly to their margins; adults have the nape and the base of the pectorals scaled, and sometimes isolated scales on the forehead. The height of the body is to the total length as 1 to 7—8; in very young individuals, as 1 to 9—10. Snout obtuse, length of head to total length as 1 to 4'/$_4$—4'/$_2$; the dental series on the palatine bones are shorter than those on the intermaxillaries, and, in old individuals, scarcely attain half the length of the latter. The upper jaw never longer than half of the head. The pectorals, in young examples scarcely 1/$_8$, in full-grown males about 1/$_2$ of the total length, are in the former distinctly notched along their outer margin. Lateral line double, being divided immediately posterior to the origin of the pectorals into a medio-lateral and a ventral branch; indistinct in full-grown specimens. Pyloric appendages wanting. Length reaching 595^{mm} (female) or 622^{mm} (male), and above.*

M. B. 6. D. + 1/$_2$ C. 102—118; A. + 1/$_2$ C. 88—102; P. 20—23; V. 4.

Locality (North Atl. Exped.): — The banks off Lofoten, in Norway. The north-west coast of Spitzbergen.

	Stat. 124.	*Stat.* 362.	*Stat.* 363.
Exact Locality.	325 Kil. WSW. of Bodø, Norway.	115 Kil. W. of Norskøerne,Sptb.	60 Kil. W. of Norskøerne,Sptb.
Depth.	350 Fathoms (640^m).	459 Fathoms (839^m).	260 Fathoms (475^m).
Temp. at Bottom.	— 0.9° C.	— 1.0° C.	+ 1.1° C.
Bottom.	Clay.	Bluish-grey Clay.	Blue Clay.
Date.	19th June 1877.	14th Aug. 1878.	14th Aug. 1878.
Numb. of Specim.	1Ind.(very young).	2 Indiv.	1 Indiv. (young).

Remarks on the Synonymy. — The question, as to which of the species of *Lycodes* hitherto known the 4 individuals taken on the North Atlantic Expedition, which, in my previous, preliminary reports, are mentioned under the name *L. vahlii,* should be referred, has proved somewhat difficult to decide. In the said reports I have shown that, in all essential particulars, they agree with Reinhardt's description of *L. vahlii;* and hence I deemed they might be correctly referred to that species, notwithstanding the original specimens in the zoological museums of Copenhagen and Berlin, which Dr. Lütken and Professor Peters kindly afforded me an opportunity of examining, with regard to certain features, exhibited a striking dissimilarity; none of these specimens, however, were in the same stage of growth as those taken on the Expedition; their state of

ikke vel vedligeholdte, saaledes at flere Characterer under den flygtige Gjennemgaaelse ikke lode sig med Sikkerhed erkjende.

Dr. Lütken har imidlertid senere under Revisionen af de Individer af denne Slægt, der opbevares i Kjøbenhavner-Musæet, bleven opmærksom paa visse, af Reinhardt overseede eller lidet paaagtede Ejendommeligheder hos *L. vahlii*, og det er i Overensstemmelse med disse sidst vundne Resultater, som han har nedlagt i sit sidste, ovenfor nævnte Artikel om denne Slægts grønlandske og islandske Arter[1], at jeg har troet det rettest at holde Nordhavs-Expeditionens Individer ud fra den typiske *L. vahlii*, væsentlig paa Grund af Forskjel i Sideliniens Bygning, i Hovedets og Kjævernes relative Længde, i Tandbygningen, foruden i Farven.

Medens *L. vahlii* typisk besidder 1 Sidelinie, der er ventral, har Nordhavs-Expeditionens Individer 2, nemlig tillige en medio-lateral; dog maa hertil bemærkes, at et af Typ-Exemplarerne af *L. vahlii* tillige viser Spor af en medio lateral Sidelinie.

Medens Hovedets Længde hos *L. vahlii* indeholdes hos yngre Hun-Individer 5,4 Gange i Totallængden, og saaledes er forholdsvis lidet, hos gamle Hanner derimod 4,3, er Forholdet hos Nordhavs-Expeditionens Individer hos intet Kjøn over 4,6, selv hos smaa Unger. Fremdeles er Tandrækken paa Palatinbenene hos *L. vahlii* i Regelen længere, end Rækken i Mellemkjæven (ialfald ikke, eller kun lidet kortere, end denne), medens den hos Nordhavs-Expeditionens Individer altid er kortere, tildels naaende blot den sidstes halve Længde. Endelig er Farven hos begge ulige, hvorved dog maa erindres, at Typ-Exemplarerne af *L. vahlii* ikke ere fuldt ud skikkede til at oplyse dette Forhold, dels fordi de ere gamle (fra 40-aarene), dels fordi de i Regelen have været udtagne af Ventriklerne paa Hajer; enkelte ere dog forholdsvis vel vedligeholdte. Medens nemlig *L. vahlii* er forsynet med større mørke Tverfelter ned ad Legemet og de verticale Finner, mellem hvilke Felter findes omtrent lige saa brede Partier af en lysere Bundfarve (der hos gamle Individer synes ganske at forsvinde, saaledes, at Legemet hér bliver næsten ensfarvet brunsort), have Expeditionens Individer paa brunsort Bundfarve et Antal skarpt begrændsede hvidgule Tverbaand, der ere forholdsvis smale, og paa Dorsalen ere næsten hvide, ligesom der hos alle de undersøgte Individer findes en hvid Plet ovenfor hver Gjællespalte.

Med Hensyn til Benævnelsen *L. esmarkii*, og de nye Individers Identification med denne Art, efterat jeg tidligere havde opført dem under Navnet *L. vahlii*, kan følgende bringes i Erindring.

Da jeg i 1874 udarbejdede min Afhandling om „Norges Fiske“ (Tillægsh. til Forh. Vid. Selsk. Chra.), forelaa til Bestemmelse i Universitets-Musæet 3 store Individer af

[1] Vid. Medd. Nat. Foren. Kbhvn. 1880, p. 307.

preservation, too, is anything but good, so that several of the characters could not be accurately determined from a cursory examination.

But Dr. Lütken, when re-examining the specimens of this genus preserved in the Copenhagen Museum, had his attention drawn to divers characteristics distinguishing *L. vahlii*, which Reinhardt must have either overlooked or thought undeserving of notice; and in conformity with these results, which he has embodied in his latest Memoir, on the Greenland, and Iceland species of this genus,[1] I have seen fit to regard the individuals taken on the North Atlantic Expedition as distinct from the typical *L. vahlii*, chiefly by reason of differences in the character of the lateral line, in the relative length of the head and jaws, in the structure of the teeth, and in the colour.

L. vahlii is typically distinguished by one lateral line, which is ventral, whereas the specimens from the Expedition have two, a ventral and a medio-lateral; it must however be admitted, that one of the typical specimens of *L. vahlii* exhibits traces of a medio-lateral line.

The length of the head in *L. vahlii* is in young female individuals 5.4 of the total length, and therefore comparatively short, in old males 4.3; whereas in the specimens from the North Atlantic Expedition, the proportion does not exceed in either sex 4.6, even in very young individuals; moreover, the row of teeth on the palatine bones in *L. vahlii* is as a rule longer than that on the inter-maxillary, and, when shorter, but very little, whereas it is invariably shorter in the specimens obtained on the North Atlantic Expedition, sometimes reaching not more than half the length of the latter. Finally, they differ in colour; it must, however, be borne in mind, that the typical specimens of *L. vahlii* are not in a condition fully calculated to elucidate this question, partly from their age (upwards of 40 years in the Museum), and partly from their having in the majority of cases been taken from the ventricles of sharks; one or two are, however, comparatively well preserved. *L. vahlii* is distinguished by large, dark transverse quarterings down the body and the vertical fins, with rather broad patches between, of a lightish ground-colour, which in old individuals would appear to become obsolete, the body here being almost uniformly brownish-black; the specimens of the Expedition have the brownish-black ground-colour marked with a number of sharply defined whitish-yellow (on the dorsal almost white) transverse bands; a white spot occurs too above each of the gill-openings.

As regard the name *L. esmarkii*, and the identification of the new individuals with that species (I had previously referred them to *L. vahlii*), the following remarks should be borne in mind.

In 1874, when I was occupied in writing my treatise on "Norges Fiske" (Tillægsh. til Forh. Vid. Selsk. Chra.), the University Museum had 3 large specimens of a *Lycodes*,

[1] Vid. Medd. Nat. Foren. Kbhvn. 1880, p. 307.

en *Lycodes*, fangne i Varangerfjorden i Finmarken, de 2 nedsendte af Lensmand Klerk i 1864, det 3die erhvervet i 1865 paa Stedet af Professor Esmark. Senere har jeg (1876) under et Ophold i Finmarken erholdt 2 nye Individer fra denne Localitet; alle ere de fuldstændig overensstemmende indbyrdes, og da deres Totallængde ligger mel- 575 og 622^{mm}, udgjøre de Kjæmpe-Individer af denne Slægt.

Da de nævnte Individer i flere Henseender frembøde en Uoverensstemmelse med Reinhardt's Beskrivelse af *L. vahlii,* hvilket end mere bestyrkedes, efterat jeg gjennem Dr. Lütken havde erholdt et af Typ-Exemplarerne udlaant til umiddelbar Sammenligning, opstilledes de i den nævnte Afhandling som en ny Art, *L. esmarkii.* Senere har jeg dog, inden Dr. Lütken har iværksat sine nye Undersøgelser af *L. vahlii,* troet at burde opfatte disse Uoverensstemmelser som mindre væsentlige, og at opføre *L. esmarkii* i Synonymernes Række, hvad jeg ved et Par Lejligheder, og sidst i den omtalte foreløbige Beretning om Nordhavs-Expeditionens Materiale, har gjennemført.

Den ene af de Characterer, der adskilte *L. esmarkii* *L. vahlii,* var Farven, der nemlig var brunsort med et Antal smale, hvidagtige Tverbaand, som dels i Midten indesluttede Felter af den mørke Bundfarve, dels vare opløste i ringformige Tegninger, der nedtil kunde være indbyrdes forbundne med Ringene af næste Tverbaand[1].

Det er overvejende sandsynligt, at Nordhavs-Expeditionens nye Individer udgjøre de yngre Stadier af denne, som *L. esmarkii* beskrevne Form. Overensstemmelserne mellem dem ere gjennemgaaende; i de samme Puncter, hvori Nordhavs-Expeditionens Individer afvige fra den typiske *L. vahlii,* stemme de overens med Typ-Exemplarerne af *L. esmarkii,* ihvorvel en mindre Forskjel hist og her kan iagttages, der dog vel kan tilskrives den store Forskjel i Alder og Størrelse. Dette er saaledes Tilfældet med Farvetegningen; fremdeles har Skjælbeklædningen faaet en større Udstrækning hos Typ-Exemplarne af *L. esmarkii,* idet der foruden spredte Skjæl paa Panden og fuldt Skjælbelæg paa Nakken, ogsaa her vil findes et lignende paa den indre Del af Pectoralerne.

Det endelige Resultat bliver saaledes, at Nordhavs-Expeditionens Individer, der samtlige ere yngre, vistnok ere identiske med den hidtil blot i fuldt udvoxede Indivi-

[1] Den anden Character, ifølge hvilken jeg ved Opstillingen af den nye Art troede at burde adskille den fra *L. vahlii,* og som var hentet fra Sjælbeklædningen, er af mindre Betydning, men maa her berøres, fordi den i den originale Beskrivelse var Gjenstand for Mistydning. Naar *L. esmarkii* nemlig opgaves som skjælbeklædt lige ud til Snuden, medens *L. vahlii* havde nøgent Hoved, var dette ucorrect, idet de som Skjæl antagne Dannelser hos den førstnævnte Art blot vare de tætstaaende, næsten cirkelrunde Indtryk i Huden, der vare fremkomne under dennes Sammentrækning. Blot efter en senere omhyggelig Undersøgelse af de foreliggende 5 Individer har jeg kunnet opdage enkelte isolerede Skjæl paa Panden, der utvivlsomt ere tilkomne i den senere Alder.

from the Varanger Fjord, in Finmark; 2 of the individuals had been presented by Lensmand Klerk, in 1864, the third was obtained on the spot by Professor Esmark, in 1865. During a short stay in Finmark (1876), I succeeded in procuring 2 new examples from the same locality. All of these specimens agree closely *inter se,* and their total length, ranging from 575^{mm} to 622^{mm}, they must be regarded as unusually large examples of the genus.

These individuals differing, I conceived, in several respects from *L. vahlii* as described by Reinhardt, a supposition still further confirmed by a direct comparison with one of the typical specimens, lent me for that purpose by Dr. Lütken, they were established as a new species, *L. esmarkii,* in the said treatise. Subsequently, however, before Dr. Lütken had completed his latest examination of the original specimens of *L. vahlii,* I was lead to regard these distinctive characteristics as comparatively unessential, and to include *L. esmarkii* in the list of synonyms, a view I continued to retain on one or two subsequent occasions, the last being that of the above-mentioned preliminary report of the North Atlantic Expedition.

One of the characters distinguishing *L. esmarkii* from *L. vahlii* was the colour — brownish-black, with a number of narrow, whitish transverse bands, some of which had patches of the dark ground-colour enclosed in the middle, or were broken up into annular spots, continuous below with the rings of the next transverse band[1].

It is in the highest degree probable, that the new individuals obtained on the North Atlantic Expedition represent immature stages of the form described as *L. esmarkii.* The resemblance between them is constant; in the same features that serve to distinguish the former from the typical *L. vahlii* they agree with the type-specimens of *L. esmarkii,* though here and there some minor distinction may be observed, doubtless arising from the great difference in age and size. This applies, for instance, to the distribution of colour; the scaled surface, too, is of greater extent in the type-specimens of *L. esmarkii,* which, exclusive of isolated scales on the forehead, has also the nape fully scaled and the inner portion of the pectorals,

The final conclusion, therefore, is this, that the individuals from the North Atlantic Expedition, all of them comparatively young, are certainly identical with *L. esmarkii*

[1] The other character — derived from the scaling — which led me, when establishing the new species, to distinguish it from *L. vahlii*, is of minor importance; it must not however be passed by unnoticed, having in the original description given rise to misunderstanding. The scales in *L. esmarkii* were stated to extend as far as the snout, whereas *L. vahlii* had the head maked; this was incorrect, the closely set, almost circular impressions in the skin, resulting from its contraction, having been mistaken for scales. Not till the 5 individuals before me had been submitted to a close examination, did I succeed in detecting a few isolated true scales on the forehead, which had unquestionably developed in an advanced stage of growth.

der kjendte *L. esmarkii* fra Finmarken, og at de tilsammen udgjøre en fra den grønlandske *L. vahlii* forskjellig Art. Men med det forholdsvis ringe Materiale, der for Tiden staar til vor Raadighed, er det umuligt at komme til fuld Klarhed i dette, saavelsom i flere andre Spørgsmaale vedrørende denne Slægt.

Ved Godhed af Dr. Tarleton Bean og Prof. Spencer Baird har jeg efter Anmodning erholdt tilsendt et fuldt udvoxet Exemplar af den store *Lycodes*-Art, som erholdtes under U. S. Fish Commission udenfor Kysterne af Nova Scotia paa Nord-Americas Østkyst, og som i 1879 er opført som *L. vahlii* i Proc. U. S. Nat. Mus. vol. 2, p. 209. Dette Exemplar (Smiths. Inst. No. 24, 239), har en Længde af 645^{mm}, en Hovedlængde af 152^{mm}. Exemplaret er exviscereret, saa Kjønnet ikke kan bestemmes, men ifølge Hovedlængdens Forhold til Totallængden (4,04), synes Individet at have været en Han. Jeg har nøje sammenlignet dette Exemplar med de omtrent ligestore Typ-Exemplarer af *L. esmarkii* fra Finmarken, og finder dem i enhver Henseende overensstemmende. Farvetegningen er næsten fuldstændig den samme, alle Legemsproportioner ligeledes, og det samme er Tilfældet med det characteristiske Forhold mellem Tandrækken paa Palatinbenene og Mellemkjæven. Jeg nærer derfor ingen Tvivl ved at identificere begge, og Arten har herved faaet nn interessant Udvidelse i sin geographiske Udbredelse.

from Finmark, of which none but full-grown examples were previously known, and that both constitute a species distinct from the Greenland form *L. vahlii*. But with the materials at present before us, it is not possible to decide this question satisfactorily, as indeed is also the case with various other doubtful points connected with the genus *Lycodes*.

At my special request, Dr. Tarleton Bean and Professor Spencer Baird kindly sent me an example of the large species of *Lycodes*, taken on the cruize of the U. S. Fish Commission, off the coast of Nova Scotia, and which, in 1879, was referred to *L. vahlii* in Proc. U. S. Nat. Mus. vol. 2, p. 209. This specimen (Smith's Inst. No. 24, 239) has a length of 645^{mm}; the length of the head is 152^{mm}. Having been exviscerated, the sex cannot be determined; but judging from the proportion which the length of the head bears to the total length (4.04), the individual would appear to be a male. I have carefully compared this specimen with the typical specimens of *L. esmarkii*, about equal in size, from Finmark, and found the closest resemblance between them. The distribution of colour is almost exactly the same; the proportions of the body correspond, in like manner, as does also the characteristic relation subsisting between the series of teeth on the palatine bones and those on the intermaxillary. Such being the case, no hesitation can be felt in identifying the two forms, which shows an interesting extension in the range of *L. esmarkii*.

Udmaalinger.	a. *Stat.* 124.	b. *Stat.* 363.	c. Han. *Stat.* 362.	d. Hun. *Stat.* 362.
Totallængde	81^{mm}	114^{mm}	265^{mm}	295^{mm}
Hovedets Længde	18,5 -	25 -	60 -	65 -
Overkjævens Længde	7 -	9 -	24 -	26 -
Legemets Højde over Begyndelsen af Dorsalen	8 -	13 -	34 -	44 -
Legemets Højde over Begyndelsen af Analen	7 -	11 -	30 -	37 -
Snudens Afstand fra Dorsalen	21 -	29 -	70 -	80 -
Kroppens Længde (Snudespidsen til Anus)	31,5 -	45 -	105 -	160 -
Halens Længde (Anus til Halespidsen)	49,5 -	69 -	160 -	171 -
Snudens Afstand fra Øjet	6 -	8 -	18 -	21 -
Lindsens Diameter	2 -	3 -	6 -	7 -
Øjets Længde (Diameter af Iris)	5,5 -	6,5 -	11,5 -	12,5 -
Fra Lindsen til Gjællelaagets Spidse	10 -	14 -	34 -	36 -
Afstanden mellem Lindserne	3,5 -	4 -	10 -	13 -
Hovedets Højde over Øjnene	6,5 -	11 -	23 -	25 -
Hovedets Bredde over Kinderne	8 -	14 -	30 -	33 -
Hovedets Højde umiddelbart bag Ventralerne	8 -	13 -	30 -	33 -
Afstanden fra Ventralerne til Anus	16 -	23 -	56 -	69 -
Pectoralens største Længde	11 -	17 -	36 -	40 -
Afstanden fra Pectoralspidsen til Anus	3 -	4 -	20 -	18 -

Measurements.	a. *Stat.* 124.	b. *Stat.* 363.	c. Male. *Stat.* 362.	d. Fem. *Stat.* 362.
Total length	81^{mm}	114^{mm}	265^{mm}	295^{mm}
Length of head	18.5 -	25 -	60 -	65 -
Length of upper jaw	7 -	9 -	24 -	26 -
Depth of the body above origin of dorsal	8 -	13 -	34 -	44 -
Depth of the body above origin of anal	7 -	11 -	30 -	37 -
Distance of snout from dorsal	21 -	29 -	70 -	80 -
Length of the body proper (from point of snout to vent)	31.5 -	45 -	105 -	160 -
Length of the tail (from vent to tip of tail)	49.5 -	69 -	160 -	171 -
Distance of snout from eye	6 -	8 -	18 -	21 -
Diameter of the lens	2 -	3 -	6 -	7 -
Length of the eye (diameter of iris)	5.5 -	6.5 -	11.5 -	12.5 -
Distance from the lens to the extremity of the opercle	10 -	14 -	34 -	36 -
Distance between the lenses	3.5 -	4 -	10 -	13 -
Height of the head above the eyes	6.5 -	11 -	23 -	25 -
Breadth of head across the cheeks	8 -	14 -	30 -	33 -
Height of the head immediately posterior to the ventrals	8 -	13 -	30 -	33 -
Distance from ventrals to vent	16 -	23 -	56 -	69 -
Greatest length of pectorals	11 -	17 -	36 -	40 -
Distance from extremity of pectorals to vent	3 -	4 -	20 -	18 -

Til Sammenligning vedføjes et Par Maal af de 5 fuldt udvoxede Individer fra Finmarken.

	A. (Skel.)	B. Han.	C. Hun (tørr.)	D. Han.	E. (tørr.)
Totallængde	575mm	582mm	595mm	610mm	622mm
Hovedets Længde	126 -	133 -	128 -	143 -	138 -
Overkjævens Længde . . .	55 -	64 -	56 -	68 -	65 -
Legemets Højde	?	80 -	?	84 -	?
Kroppens Længde (Snuden til Anus)	220 -	226 -	255 -	242 -	250 -
Halens Længde (Anus til Halespidsen)	360 -	362 -	350 -	371 -	375 -

Beskrivelse. *Legemsbygning.* Nær beslægtet med *L. vahlii,* fra hvilken den, som ovenfor nævnt, er skilt ved sin (dog blot i yngre Alder tydeligt) dobbelte Sidelinie, de korte Kjæver, det altid forholdsvis store Hoved, den korte Ganetandrække, og Farven.

Legemet er af typisk *Lycodes*-Bygning; den største Højde indeholdes hos de ældre Individer omtrent 7—8 Gange i Totallængden, hos Ungerne 9, eller endog 10 Gange i denne, og Legemet bliver saaledes noget undersætsigere under Opvæxten.

Hovedet er forholdsvis stort, og har en høj og stump Snude, der er temmelig kort. Hovedet indeholdes fra $4^1/_4$ til noget over $4^1/_2$ Gange i Totallængden; hos intet af Individerne har Hovedlængdens Forhold til Totallængden været under 4,7, selv hos smaa Unger. Hos 2 udvoxede Han-Individer fra Finmarken er Forholdet 4,30 og 4,26, hos en ligeledes udvoxet Hun 4,64; sammenlignes 2 noget nær ligestore Individer af forskjelligt Kjøn, sees Hovedlængden hos den yngre Han fra Nordhavs-Expeditionen at indeholdes i Totallængden 4,41, hos den ligeledes yngre Hun 4,53, ligesom hos den fuldvoxne Han fra Finmarken 4,26, hos Hunnen 4,64, saaledes at Hannen, hvad der ogsaa var at vente, altid synes at have et større Hoved, end Hunnen.

Underkjæven er betydeligt kortere, end Overkjæven, og dette er allerede særdeles stærkt fremtrædende hos det mindste foreliggende Individ (med en Totallængde af blot 81mm).

Overkjæven er altid kortere, end den halve Hovedlængde, hvad der vil fremgaa af de ovenfor meddelte Udmaalinger, og naar tilbage under Midten, eller henimod Bagranden af Øjet. Sammenlignet med *L. vahlii* maa saaledes *L. esmarkii* siges at have et forholdsvis kort Ansigtsparti, skjønt Hovedet idethele er større.

De skaalformige Fordybninger langs Randen af Kjæverne, der ere characteristiske for denne Slægt, ere stærkest synlige hos Ungerne, hvor Hovedets Hud er tyndest; i Bunden sees her en tydelig og aaben Pore, men denne bliver svagere fremtrædende hos de ældre.

For comparison are subjoined a few measurements of the 5 full-grown individuals from Finmark.

	A. (Skel.)	B. Male.	C. Fem. (dried).	D. Male.	E. (dried).
Total length	575mm	582mm	595mm	610mm	622mm
Length of the head . . .	126 -	133 -	128 -	143 -	138 -
Length of the upper jaw .	55 -	64 -	56 -	68 -	65 -
Depth of the body . . .	?	80 -	?	84 -	?
L. of the body (from snout to vent)	220 -	226 -	255 -	242 -	250 -
L. of the tail (from vent to tip of tail)	360 -	362 -	350 -	371 -	375 -

General Description. *Structure of the Body.* — Nearly related to *L. vahlii,* from which, as above stated, it is distinguished by a double lateral line (conspicuous however in young specimens only), the short jaws, the head, always comparatively large, the short series of palatine teeth, and the colour.

The body is of the typical *Lycodes* structure; its greatest depth equals, in mature individuals, from $^1/_7$ to $^1/_8$, in young examples, not more than $^1/_9$ or $^1/_{10}$ of the total length; hence the body increases in thickness with the growth of the fish.

The head is comparatively large, and terminates in an obtuse and elevated snout; the length of the head is contained from $4^1/_4$ to a trifle over $4^1/_2$ times in the total length; the proportion borne by the length of the head to the total length was in no case under 4.7, not even in the very young examples. In two full-grown males from Finmark, the proportion is as 1 to 4.30 and 4.26; in a full-grown female, as 1 to 4.64. If two individuals nearly equal in size, but of different sexes, be compared together, the length of the head in the young specimens obtained on the Expedition will be found to be 4.41 in the male, and 4.53 in the female; in the full-grown male from Finmark it is 4.26, in the female 4.64: hence the male, as was indeed to be expected, has invariably a larger head than the female.

The mandible is considerably shorter than the upper jaw, and this character shows very conspicuously even in the smallest of the specimens examined (total length only 81mm).

The upper jaw is invariably shorter than half the head, as appears from the measurements given above, extending back under the middle of the eye, or very nearly to its posterior margin. Compared with *L. vahlii, L. esmarkii* has the region of the face comparatively short, although the head itself is larger than in the former species.

The bowl-shaped depressions along the margin of the jaws are peculiar to this species; they are most conspicuous in the early stages of development, when the skin on the head is thinnest, terminating in a distinct and open pore; as the growth progresses, they gradually become less distinct.

Disse Porer føre oventil ind til den lange Række af de tynde Infraorbitalben, der ere forholdsvis store, og hvoraf hver danner en udad aaben Cavitet, der er begrændset af Benets nederste Del, samt af den øvre overbøjede Rand; den hele Række af disse Caviteter danne tilsammen en fælles slimafsondrende Canal. Paa Underkjæven føre Porerne ind til en lignende Canal, der løber ind i selve *maxilla inferior,* og som udad danner store rundagtige Aabninger i Lighed med de udad aabne Caviteter i Infraorbitalbenene; noget tilsvarende i Kjævernes Bygning finder Sted hos *Zoarces viviparus*, hvilket yderligere bidrager til at nærme disse 2 Slægter til hinanden.

Næseborene ere enkelte, rørformige, og sidde noget opløftede over Kjæveranden; deres indbyrdes Afstand er betydeligt mindre, end Pectoralens Grundlinie.

Øjnene ere aflange, med en tydelig tilspidset Øjekrog fortil og bagtil; de indeholdes hos middelsstore Exemplarer mellem 6 og $6^1/_2$ Gange i Hovedlængden, men ere forholdsvis mindre hos de fuldt udvoxede, hvor de indeholdes 7—8 Gange i denne. Iøvrigt er Øjnenes rette Begrændsning vanskelig at drage, da denne viser sig forskjellig, eftersom Individerne ere bedre eller mindre vel vedligeholdte.

Gjællespalten er fuldkommen vertical, og forholdsvis trang; dens nedre Vinkel ligger omtrent lige foran Pectoralernes nederste Fæste. Gjællerne ere 4 i Antal; Pseudobranchier ere tilstede. Gjællestraalernes Antal er 6.

Tænderne, der ere tilstede i Mellem- og Underkjæven, paa Palatinbenene, og paa Vomer, som hos alle typiske Lycoder, ere forholdsvis lange og stærke, svagt krummede, samt noget cylindriske. Det er characteristisk for *L. esmarkii,* sammenlignet med *L. vahlii,* at Tandrækken paa Palatinbenene aldrig er længere, end Rækken i Mellemkjæven, men oftest (især hos udvoxede Individer) betydeligt kortere, lige indtil neppe Halvdelen af denne. Saaledes er den absolute Længde af de nævnte 2 Tandrækker hos de 2 største af Nordhavs-Expeditionens Individer, samt af de foreliggende 5, fuldt udvoxede Individer fra Finmarken, følgende:

	Totallængde.	Længden af Tandrækken	
		paa Palatinbenene.	paa Mellemkjæverne.
c. Stat. 362. Ung Han . .	265^{mm}	10—11^{mm}	11—11^{mm}
d. Stat. 362. Ung Hun . .	295 -	10—11 -	11—11 -
A. Finmarken. (Skelet) . .	575 -	15—16 -	26—27 -
B. — Gl. Han. .	582 -	16—18 -	27—28 -
C. — Gl. Hun .	595 -	14—16 -	26—26 -
D. — Gl. Han. .	610 -	17—17 -	30—31 -
E. — (tørret) . .	622 -	12—13 -	32—34 -

Hos de fuldvoxne Individer danne Tænderne i Mellemkjæven bagtil en enkelt, fortil en 3dobbelt Række, hvori de yderste Tænder ere de længste. Underkjævens Tænder danne fortil 3—4 uregelmæssige Rækker, bagtil en dobbelt Række, der gaar betydeligt længere tilbage, end den tilsvarende i Overkjæven, og Tænderne i denne Kjæve corre-

Above, these pores extend inwards to the thin infraorbital bones, which are comparatively large, forming each a cavity, open exteriorly, which is bounded by the inferior portion of the bone and the superior overlapping margin; these cavities constitute together a mucous canal. On the mandible, too, the pores terminate in a secretory canal, which is produced interiorly into the *maxilla inferior,* and constitues a series of large circular openings similar to the cavities, open exteriorly, in the infraorbital bones. To this peculiarity of structure the jaws in *Zoarces viviparus* present analogous features, a circumstance tending still further to increase the resemblance between the two genera.

The nostrils are single, tubular, and situated slightly above the margin of the jaw; their distance from each other measures much less than the base of the pectorals.

Eyes ovate, distinctly angular anteriorly and posteriorly; their diameter, in examples of moderate size, is to the length of the head as 1 to 6—$6^1/_2$; in full-grown individuals they are proportionately smaller — as 1 to 7—8. For the rest, the limits of the eyes are difficult to determine, varying as they do with the state of preservation of the specimens.

The gill-opening a strictly vertical slit, and comparatively narrow; its inferior angle almost immediately in front of the lowest extremity of the pectorals. Gills 4; pseudobranchiæ present; branchiostegals 6.

Teeth, as in all typical *Lycodes,* on the inter and inferior maxillaries, the palatine bones, and the vomer; they are comparatively long and powerful, slightly curved and cylindrical. A characteristic feature of *L. esmarkii,* as compared with *L. vahlii,* is the length of the dental series on the palatine bones, which is never greater than that of the series on the inter-maxillary, but as a rule (more especially in full-grown examples) considerably less, sometimes by as much as one-half. Thus, for instance, the two series in the two largest of the specimens taken on the North Atlantic Expedition, and in the five full-grown examples from Finmark, measured respectively as follows: —

	Total L.	Length of Dental Series	
		On Palatine bones.	On Intermaxillaries.
c. Stat. 362. Young Male .	265^{mm}	10—11^{mm}	11—11^{mm}
d. Stat. 362. Young Female	295 -	10—11 -	11—11 -
A. Finmark. (Skeleton) . .	575 -	15—16 -	26—27 -
B. — Old Male . .	582 -	16—18 -	27—28 -
C. — Old Female .	595 -	14—16 -	26—26 -
D. — Old Male . .	610 -	17—17 -	30—31 -
E. — (dried specim.)	622 -	12—13 -	32—34 -

In adults, the teeth constitute on the inter-maxillary posteriorly a single, anteriorly a triple series, the exterior teeth being the longest. The teeth in the mandible constitute anteriorly 3—4 irregular series, posteriorly a double row, which extends considerably farther back than that corresponding with it in the upper jaw; indeed the man-

spondere nærmest med Palatinbenenes. I den yderste Række ere de rettede skjævt udad, eller ligge tildels næsten horizontalt. Paa Palatinbenene findes paa hver Side 9—11 Tænder samlede i en enkelt, eller undertiden i en dobbelt Række. Endelig findes en Samling Tænder (af samme Størrelse, som de øvrige) paa Vomer.

Hos yngre Individer ere Tænderne noget færre, og Rækkerne fortil blive først efterhaanden fuldtallige.

Kjæverne ere, som hos alle Lycoder, dækkede af en tyk, fedtholdig Hud, der paa Underkjæven danner en nedhængende, noget aflang Flig.

Anus ligger i en Afstand fra Snudespidsen, der indeholdes omtrent $2^1/_2$ Gange i Totallængden.

Af Totallængden udgjør .	a. Totall. 81mm	b. Totall. 114mm	c. Han. Totall. 265mm	d. Hun. Totall. 295mm
Hovedets Længde . . .	4,37	4,58	4,41	4,53
Legemets Højde	10,12	8,76	7,79	7,02
Snudens Afstand fra Dorsalen	3,68	3,93	3,78	3,68
Kroppen (Snuden til Anus)	2,57	2,53	2,52	2,37
Halen (Anus til Halespidsen)	1,64	1,65	1,65	1,72

Til Sammenligning vedføjes endel Forholde, der kunne udledes af de 5 foreliggende større Individer fra Finmarken, hvoraf 2 opbevares i tørret Tilstand, 1 som Skelet.

Af Totall. udgjør . . .	A. (Skelet.) Totall. 575mm	B. Han. Totall. 582mm	C. Hun (tørret). Totall. 595mm	D. Han. Totall. 610mm	E. (tørret). Totall. 622mm
Hovedets Længde .	4,56	4,37	4,64	4,26	4,52
Legemets Højde .	?	7,27	?	7,26	?
Kroppen (Snuden til Anus)	2,61	2,57	2,33	2,52	2,48
Halen (Anus til Halespidsen) . .	1,59	1,60	1,70	1,62	1,65

Ovarierne og *Testes* ere enkelte. Af Expeditionens Individer var det ene (hvis Totallængde var 265mm) en ung Han, med endnu ikke fuldt udviklede Testes, det noget større Individ (Totallængde 295mm) en Hun, med fuldmodne Æg i det eneste Ovarium. Disse Æg vare forholdsvis store, neppe over 300 i Antal, alle jevnt udviklede; desuden fandtes et mindre Antal, der tilsyneladende ikke vilde have udviklet sig. Ovariet var enkelt.

Af de store Exemplarer fra Finmarken er det ene, der har været tørret, en Hun, idet der endnu vedhænger Dele af Ovariet med (ufuldbaarne) Æg. Dette viser, at Hunnen saaledes kan opnaa en lignende betydelig Størrelse, som Hannen. Af de øvrige vare de 2 velbevarede Individer Hanner, med udviklede Testes. Den venstre af disse var saa kort, at den næsten kan kaldes rudimentær (14—17mm), den højre lang (70mm).

Appendices pyloricae mangle.

dibular teeth correspond rather with those on the palatine bones. In the exterior series they incline obliquely outwards, or are some of them almost horizontal. The palatine bones are furnished on each side with 9—11 teeth in a single, sometimes a double row. Finally, a patch of teeth occurs on the vomer.

Young individuals have somewhat fewer teeth, and the full number of the anterior series is attained gradually.

As in all the *Lycodes*, the jaws are protected by a thick adipous skin, depending from the mandible in the form of an oval lappet.

The distance from the vent to the point of the snout is to the total length about as 1 to $2^1/_2$.

The Total Length contains	a. Total L. 81mm	b. Total L. 114mm	c. Male. Total L. 265mm	d. Female. Total L. 295mm
Length of the head . .	4.37	4.58	4.41	4.53
Depth of the body . .	10.12	8.76	7.79	7.02
Distance of snout from dorsal	3.68	3.93	3.78	3.68
Body (from snout to vent)	2.57	2.53	2.52	2.37
Tail (from vent to tip of tail)	1.64	1.65	1.65	1.72

For comparison are subjoined a few proportions deduced from measurements of the 5 large Finmark specimens, 2 dried, and 1 a skeleton.

The Total Length cont.	A. (Skel). Total L. 575mm	B. Male. Total L. 582mm	C. Fem. (dried). Total L. 595mm	D. Male. Total L. 610mm	E. (dried). Total L. 622mm
Length of the head	4.56	4.37	4.64	4.26	4.52
Depth of the body	?	7.27	?	7.26	?
Body (from snout to vent)	2.61	2.57	2.33	2.52	2.48
Tail (from vent to tip of tail) . . .	1.59	1.60	1.70	1.62	1.65

Ovaries and *testes* single. Of the two largest individuals obtained on the Expedition, one (total length 265mm) was a young male, with the testes not fully developed, the other, of somewhat larger size (total length 295mm), a female, with mature ova in the single ovary. These ova, hardly more than 300 in number, were comparatively large, all of them uniformly developed, exclusive of which was a smaller number that in all probability would not have arrived at maturity. The ovary was single.

Of the large specimens from Finmark, one, which had been dried, was a female, portions of the ovary, with (immature) ova, being still attached to the abdomen. This shows that females can attain as large a size as males; of the remaining examples, the 2 well preserved specimens were males, with well developed testes. That on the left side is so short as to be almost rudimentary (14—17mm), that on the right is long (70mm).

No pyloric appendages.

Finnerne. Straaleantallet hos de 4 under Expeditionen erholdte yngre Individer var følgende (Caudalen indbefattet i Dorsalen og Analen):

	a.	*b.*	*c.*	*d.*
Dorsalen (+ ½ Caudal)	103	103	103	102
Analen (+ ½ Caudal)	88	91	92	90
Pectoralerne	20—21	22—23	22—23	21—22

Hos de store Individer fra Finmarken lod Straaleantallet sig kun hos de 2 med nogenlunde Sikkerhed tælle, og dette viste sig at være følgende:

	A.	C.
Dorsalen (+ ½ Caudal)	118	113
Analen (+ ½ Caudal)	102	97
Pectoralerne.	23—23	23—23

At Straaleantallet hos disse fuldt udvoxede Individer er større, end hos de yngre, maa forklares paa den Maade, at der har vedblevet at afsætte sig Hvirvler med tilhørende Straaler under hele Opvæxten.

Dorsalen, som udspringer i en Afstand fra Nakken, der er omtrent lig en halv Pectorallængde, indeholder saaledes 102 til 103, eller hos særdeles gamle Individer lige til 118 Straaler, om den halve Caudal (6 Straaler) medregnes. Dorsalstraalerne ere alle kløvede indtil Grunden, og fra Midten af fint articulerede; hos de længste Straaler (paa Midten af Halepartiet) er ligeledes hver Halvdel atter kløvet. Den hele Finne er, ligesom Analen, indhyllet i en tyk og fedtholdig Hud, der meget ligner den, der findes hos *Anarrhichas*-Arterne.

Analen tiltager, ligesom Dorsalen, i Straaleantal med Alderen, og har hos yngre 88—92, hos fuldt udvoxede indtil 102 Straaler, Caudalens nedre Halvdel (5 Straaler) iberegnet. Den er iøvrigt bygget ligesom Dorsalen, og en Dobbeltkløvning finder ogsaa her Sted hos de længste Straaler.

Caudalen har sandsynligvis hos alle Lycoder den samme Bygning, og er dannet af et øvre Straaleknippe, bestaaende af 6, et nedre af 5 Straaler, alle korte, spinkle og særdeles tætstaaende, saa at de kun med Vanskelighed lade sig tælle.

Pectoralerne tælle 20 til 23 Straaler, og Tallet er ofte ulige paa hver Side hos samme Individ. De ere forholdsvis længst hos yngre Individer; hos den mindste foreliggende Unge (hvis Totallængde er 81^{mm}) indeholdes de 6,7 Gange i Totallængden, hos et fuldt udvoxet omtrent 8,5 Gange i denne.

Fremdeles undergaar denne Finne en Forandring i sin Form under Opvæxten, hvortil jeg ikke har seet noget tilsvarende hos de øvrige Arter. Hos alle yngre ere de 6 nederste Straaler noget forlængede, saaledes at de rage kjendeligt frem forbi de mellemste Straaler; derved bliver Finnens Rand tydeligt indskaaret. Hos de ældre Individer ere derimod de nedre Straaler gradvis forkortede, og et-

Fins. — The number of rays, inclusive of caudal, in the 4 young individuals obtained on the Expedition was as follows: —

	a.	*b.*	*c.*	*d.*
Dorsal (+ ½ caudal)	103	103	103	102
Anal (+ ½ caudal)	88	91	92	90
Pectorals	20—21	22—23	22—23	21—22

In 2 only of the large individuals from Finmark could the number of fin-rays be determined with comparative accuracy; the formula was as follows: —

	A.	C.
Dorsal (+ ½ caudal)	118	113
Anal (+ ½ caudal)	102	97
Pectorals	23—23	23—23

The fact of the rays in these full-grown examples having been more numerous than in the young individuals may be explained by assuming vertebræ to have successively developed along with the rays throughout the whole period of growth.

The dorsal, commencing at a distance from the nape about equal to half the length of the pectorals, contains from 102 to 103, or, in very old examples, as many as 118 rays, including half of the caudal (6 rays). The dorsal rays are all cleft to the base, and from the middle finely articulated; moreover, in the longest rays (middle of caudal region) each half is cleft. As with the anal, the whole fin is enveloped in a thick adipous skin, closely resembling that observed in the genus *Anarrhichas*.

As in the dorsal, the number of rays in the anal increases with the growth, being in young examples 88—92, and in adults reaching 102, inclusive of the lower half of the caudal (5 rays). The structure of the anal is similar to that of the dorsal; the longest rays of this fin, too, are double-cleft.

The structure of the caudal is probably the same in all the *Lycodes;* there is an upper fascicle of rays, consisting of 6, and a lower one, consisting of 5 rays, all short, slender, and exceedingly close, which renders it a matter of no little difficulty to count them.

The pectorals are furnished with from 20 to 23 rays, and the number is not infrequently different on each side in the same individual. They are relatively longest in young examples; in the smallest of the young specimens (total length 81^{mm}), their length is to the total length as 1 to 6.7; in an adult, nearly as 1 to 8.5.

This fin undergoes, too, a change in its form during the period of growth, to which I have observed nothing analogous in any of the other species. All young individuals have the 6 lowest rays somewhat elongated, causing them to project perceptibly past the middle rays, which gives to the margin of the fin a notched appearance. In more mature examples, the inferior rays gradually decrease

nvert Spor af denne Ejendommelighed forsvundet. Disse nedre Straaler ere beklædte med en tykkere Hud, end de øvrige, samt have fri Spidser, et tydeligt Bevis paa, at de tjene Dyret til Krybe- eller Føleorgan. Straalerne ere delte til Grunden, og ere i Spidserne, der ere fint articulerede, i Regelen tvedelte. Naar Pectoralerne bøjes fremover, naa de til Lindsens Forrand eller hos enkelte til dens Midte.

Ventralerne ere korte, og indeholde 1 enkelt og yderst spinkel Straale, samt derefter 3 noget tykkere, der ere kløvede til Grunden. De ere samtlige indhyllede i en tyk Hud, og lade sig blot ved Dissection tælle; den første udelte Straale har blot de øvriges halve Længde, og er yderst let at overse. Alle ere leddede.

Hvirvlernes Antal var hos det ovennævnte Skelet af et udvoxet Individ fra Finmarken 23 + 95, saaledes tilsammen 118.

Skjælbeklædning. Som hos alle Lycoder synes Skjælbeklædningen at udbrede sig videre over Legemet under Individets hele Vækst, og er saaledes mindst udbredt hos Ungerne, endskjønt Forskjellen er forholdsvis ikke stor. Hos Expeditionens 2 største Individer (Totallængden 265—295 ^{mm}) er Skjælbeklædningen udbredt til et Stykke foran Begyndelsen af Dorsalen, og paa Bugen hen til Ventralerne; ligeledes er saavel Dorsalen som Analen skjælbeklædte lige ud imod Randen, eller i omtrent $^3/_4$ af Finnernes Højde. Derimod er Hovedet og Nakken nøgne, ligesom Pectoralerne og Ventralerne.

Hos de fuldt udvoxede Exemplarer fra Finmarken, hvor Totall. er 500 ^{mm} eller derover, strækker Skjælbeklædningen sig frem over Nakken, hvorimod Hovedet regulært synes at være nøgent; blot efter den omhyggeligste Undersøgelse har det været mig muligt at opdage enkelte spredte Skjæl paa Siderne af Panden, og disse synes ikke engang at være tilstede hos alle Individer. Dorsalen og Analen er tæt skjælbeklædte lige ud til deres yderste Rande, og Skjællene gaa paa Halen lige ud til Caudalens Spidse. Fremdeles ere Pectoralerne, der hidtil have været nøgne, skjælbeklædte paa sin indre Trediedel.

Hos de 2 Unger fra Expeditionen er Skjælbeklædningen i det hovedsagelige allerede fremkommen i sin Helhed paa Legemet; hos det største Individ (*b*, Totall. 114 ^{mm}) ere Finnerne, saavelsom Grunden langs disse, endnu nøgne; hos det mindste (*a*, Totall. 81 ^{mm}) er Skjælbeklædningen paa hele Halepartiet endnu sparsom, og blot i sit Frembrud.

Skjællene ere runde eller noget elliptiske, og ligge nedsænkede i Huden med saa stort Mellemrum, at deres Rande ikke berøre hinanden. Paa Bugen staa Skjællene mest spredte, paa Halen tættest. De Skjæl, der beklæde Finnerne, ere mindre, end Legemets. Skjællene ere beklædte af en yderst fin, noget mørkfarvet Hud.

Sidelinjen er hos denne Art dobbelt, og hos vel conserverede Exemplarer af Middelstørrelse ret tydelig. Den udspringer enkelt ved Gjællespaltens øvre Ende, gjør en liden skarp Bue over Gjællelaagets Flig, deler sig derpaa kort bagenfor denne i 2 Grene, hvoraf den øvre, mediolaterale, der er den tydeligste, løber langs hele Legemets

in length till every trace of this peculiarity has disappeared. These inferior rays are enveloped in a thicker skin than the rest, and have free points, a sure sign that they serve the animal as a means of creeping or as an organ of sensation. The rays are cleft to the base, and, at the points, which are finely articulated, as a rule double-cleft. If pressed forwards, the pectorals extend to the anterior margin or to the middle of the lens.

The ventrals are short, and consist of one exceedingly slender ray and 3 somewhat thicker rays, cleft to the base. They are all enveloped in a thick skin, dissection being necessary in order to count them; the first simple ray is only half as long as the others, and may be easily overlooked; they are all articulated.

The number of vertebræ in the above-mentioned skeleton of a full-grown example from Finmark was 23 + 95 = 118.

Scales. — As in all *Lycodes,* the scaled integument continues, it would seem, to spread over the body during the entire period of growth; and hence it covers a smaller surface in young specimens, though the absolute difference is comparatively but slight. In the 2 largest examples taken on the Expedition (total length respectively 265 ^{mm} and 295 ^{mm}), the scaling extends almost to the origin of the dorsal, and on the belly as far as the ventrals; both the dorsal and anal, too, are scaled nearly to the margin, or about three quarters of the height of the fin. The head and nape, however, are naked, as also the pectorals and the ventrals.

In the full-grown specimens from Finmark (total length exceeding 500 ^{mm}), the scaled integument extends forwards over the nape, the head being apparently as a rule naked; not till after a most careful examination did I succeed in detecting a few isolated scales on the sides of the forehead, and even these would seem not to occur in all individuals. The dorsal and anal are densely scaled to their extreme margin, and on the tail the scales extend to the tip of the caudal. The pectorals, too, previously naked, are now scaled on their inner third.

In the 2 young specimens taken on the Expedition, the scaled integument is for the most part fully developed on the body; in the largest individual (*b*, total length 114 ^{mm}), both the fins and the skin along their base are still naked; in the smallest (*a*, total length 81 ^{mm}), the scales on the tail are just beginning to develop.

The scales are round or slightly elliptic, and lie embedded in the skin, the space between them being just sufficient to prevent contact. On the belly, the scales are most distant, densest on the tail. The scales covering the fins are smaller than those on the body; all are invested with an exceedingly thin, darkish membrane.

Lateral Line. — The lateral line in this species is double, and in well preserved specimens of moderate size distinctly perceptible. It originates single on the upper extremity of the branchial opening, makes a sharp bend above the flap of the gill-cover, and then divides a short distance posterior to the latter into two branches, the su-

Midtlinie lige ud til Caudalen. Den nedre Gren, den ventrale, løber skraat nedad mod Analen, og naar dennes Grund omtrent ved den 16de Straale, hvorefter den følger langs denne Finne henimod Caudalen. Paa Stykket fra Gjællespalten til det Sted, hvor den øvre (mediolaterale) Linie naar Legemets Midtlinie (hvilket finder Sted omtrent ved Pectoralens indre Trediedel), findes omtrent 24 Porer, idet de paa dette Stykke ere særdeles tætstaaende; paa det næste Stykke indtil Perpendiculæren over Anus staa omtrent 14 Porer.

Hos de fuldt udvoxede Individer fra Finmarken, der længe have været opbevarede paa Spiritus, ere Sidelinierne idethele lidet synlige, og kunne blot efter omhyggelig Undersøgelse paavises, men ere dog ikke ganske forsvundne. Den mediolaterale er dog undertiden neppe til at paavise, og synes saaledes under Opvæxten efterhaanden ganske at forsvinde.

Hos den mindste Unge (*a*, Totall. 81^{mm}) ere begge Linier endnu utydelige, men allerede synlige hos den større Unge *(b,* Totallængde 114^{mm}*)*.

Farven. Denne er hos alle Expeditionens Individer, ogsaa hos de smaa Unger, dyb brunsort med smale, skarptbegrændsede, hvidgule Baand, hvis Antal varierer fra 5—8, løbende verticalt nedad Legemet. Desuden findes, som Antydning til et yderligere Baand, en hvidgul Plet paa hver Side af Nakken, umiddelbart over Gjællespalten. Bugsiden er ubetydeligt lysere.

Af Tverbaandene begynder det første noget bagenfor Begyndelsen af Dorsalen; det sidste kan bedække Halespidsen, eller ligge kort foran denne. De stige alle fra Dorsalens yderste Rand ret nedover Legemet; de bagre gaa lige ud over Analen, de forreste naa blot til, eller noget over Midtlinien. Baandenes Bredde er omtrent lig en Lindsediameter; deres Farve er hvidgul, og da de ere temmelig skarpt begrændsede, staa de særdeles tydeligt mod den sorte Bundfarve. Hovedet er graabrunt, med mørkere Skygning paa Gjællelaagets Flig; Skjællene ere noget lysere, end Bundfarven, og have paa de Partier af Legemet, hvor de lyse Tverbaand findes, ligeledes disses hvidgule Farve.

Den ovenfor beskrevne Farvetegning tilkommer sandsynligvis alle Individer, hvis Totallængde ikke overskrider 400^{mm}, eller der omkring, ligesom den allerede findes hos Ungerne, naar disse have naaet en Totall. af 80^{mm} (den spæde Yngel af denne Art er endnu ukjendt). Hos Expeditionens 2 Unger er imidlertid Nakkepletten endnu ikke fremkommen; men Baandene, hvis Antal hos begge er 8, ere alle tydeligt ansatte.

Derimod har Farven hos de fuldt udvoxede (Finmarkske) Individer, som det vil sees af den medfølgende Figur, undergaaet en ret mærkelig Forandring, der synes at være constant, da den (blot med visse uvæsentlige Variationer) har optraadt hos alle de hidtil paaviste 5 Individer.

perior, mediolateral branch, which is the most distinct, running parallel to the mesial line of the body, and passing straight to the caudal. The inferior, ventral branch descends obliquely towards the anal, reaching the base of that fin at about the 16th ray, after which it accompanies the latter to the caudal. In the portion extending from the branchial opening to the point at which the mediolateral branch reaches the mesial line of the body (about at the inner third of the pectoral) there are about 24 pores, their arrangement here being exceedingly close; the succeeding portion, reaching to a point perpendicular to the vent, has 14 pores.

In the full-grown specimens from Finmark, preserved a long time in spirits, the lateral lines are far less distinct, nay very considerable difficulty is experienced in tracing them; but they are not wholly obliterated. In some individuals the mediolateral branch can hardly be distinguished, and would seem therefore to disappear altogether during the progress of growth.

In the smallest of the immature examples (*a*, total length 81^{mm}), both branches are as yet indistinct, but already perceptible in the largest *(b,* total length 114^{mm}*)*.

Colour. — In all the specimens taken on the Expedition, including the immature examples, the colour is a deep brownish-black, with narrow, clearly defined whitish-yellow bands, from 5 to 8 in number, extending vertically down the body. Exclusive of these, there is a rudimentary indication of another band, in the shape of a whitish-yellow patch on either side of the nape, immediately above the branchial opening. The ventral surface is a trifle lighter.

The first of the transverse bands commences a little posterior to the origin of the dorsal; the terminal band sometimes covers the tip of the tail, or, if not, extends in close proximity to it. They descend all of them from the margin of the dorsal straight down the sides of the body; the posterior bands extend across the anal, the anterior ones reaching only as far as, or a short distance above, the mesial line. The width of these bands is about equal to the diameter of the lens; they are whitish-yellow in colour, and being rather sharply defined form a strong contrast to the black ground-colour. The head is greyish-brown, with a darker clouding on the flap of the gill-cover; the scales are a trifle lighter than the ground-colour, sometimes of the same colour as the transverse bands.

The coloration described above is probably common to all individuals with a total length not exceeding 400^{mm}, or thereabouts; it is characteristic, too, of young examples which have attained a total length of 80^{mm} (the fry of this species is as yet unknown). In the two young specimens taken on the Expedition, the nuchal patch, however, has not yet developed, but the bands, numbering 8, are all of them distinctly obvious.

On the other hand, the colour in the full-grown (Finmark) specimens, as will be seen from the accompanying figure, has undergone a remarkable change, which would appear to be constant, seeing that it characterises (with but few and immaterial variations) each of the 5 indi-

Hos disse ere de verticale hvidgule Tverbaand i sin Midte opfyldte af den sorte Bundfarve, eller tildels opløste til hvidagtige, aflange Ringe; Baandenes Antal og Beliggenhed er den samme, som hos Expeditionens Exemplarer, men undertiden kunne de være indbyrdes forenede nedtil, og danne her sammenhængende, guirlandeformige Tegninger. Deres Begrændsning er mindre skarp, end hos de yngre Individer. Hos et af Individerne ere de paa det egentlige Legeme ganske utydelige, men endnu paa Dorsalerne skarpt begrændsede; hos dette er saaledes Legemet næsten ensfarvet mørkt brunsort. Nakkepletterne kunne være sammenhængende, og danne et tversover Nakken løbende distinct Baand.

Føde. I Ventrikelen af det største af Expeditionens Individer, en Hun (fra 459 Favnes Dyb), fandt jeg Røret af en Annelide, maaske af en *Terebella,* fremdeles adskillige Individer af *Themisto libellula,* Mandt, samt endelig en Del Grus fra Bunden, hvoriblandt saaes mange smukke Foraminiferer, især af en af de *Nautilus*-lignende Slægter *(Rotalina?).* Hos det noget mindre Han-Individ fra samme Localitet og Dybde fandtes blot Levninger af *Themisto libellula.*

Hos 2 gamle Hanner fra Finmarken, optagne paa et Par hundrede Favnes Dyb i Varangerfjorden, har jeg fundet alene knuste Echinodermer, hvoriblandt kunde kjendes *Ctenodiscus crispatus,* (Retz.), *Ophiacantha spinulosa,* Müll. & Tr., samt *Antedon sarsii* (Düb. & Kor.). Endskjønt disse Individer saaledes vare henviste til denne kalkholdige Føde, vare deres Tænder dog ikke synderlig slidte.

Udbredelse. *L. esmarkii* foreligger allerede saavel fra den europæiske, som fra den americanske Side af Atlanterhavet. Af Expeditionens Individer erholdtes de 3 i Trakterne af Spitsbergen i 1878, det ene i faa Miles Afstand fra denne Øgruppes Nordvestkant. Det 4de, en spæd Unge, optoges fra Bankerne udenfor Helgeland i Norge i 1877. Endelig foreligge 5 fuldt udvoxede Individer fra Fjordene i Finmarken, erholdte i Aarene 1864—76; de 4 ere fangede paa Dybsagn (Line) i Varangerfjorden i Østfinmarken, hvor jeg ligeledes har erfaret, at andre (ikke opbevarede) Individer i de sidste Aar have været erholdte; det sidste erholdtes i Øxfjord søndenfor Hammerfest (Vest-Finmarken).

Som tidligere bemærket, henhøre ligeledes de under Navn af *L. vahlii* foreløbig opførte Individer fra Nord-Americas Østkyst under forhaandenværende Art. Paa den sidstnævnte Localitet erholdtes i Aarene 1878—79 4 fuldvoxne Individer udenfor Kysterne af Nova Scotia, hvor dog Havfaunaen endnu er ganske arctisk. Det ene af disse opbevares paa Univ. Mus. i Christiania.

viduals. In these specimens, the middle portion of the vertical whitish-yellow transverse bands is filled up with the black ground-colour, or broken up into whitish elliptic rings; the number of these bands and their position is the same as in the specimens taken on the Expedition; sometimes, however, they are united together and form continuous chaplet-shaped markings; they are less sharply defined than in the younger examples. In one of the individuals they are quite indistinct on the body, but continue to be sharply defined on the dorsals; this specimen, therefore, has the body of an almost uniform brownish-black. The nuchal patches are sometimes continuous, forming a transverse band across the nape.

Food. — In the ventricle of the largest specimen taken on the Expedition, a female (brought up from a depth of 459 fathoms), I found the house of an Annelid, possibly a *Terebella,* several examples of *Themisto libellula,* and a quantity of gravel from the bottom, in which were many fine *Foraminiferæ,* belonging chiefly to one of the Nautilus-like genera *(Rotalina?).* The stomach of the male, a somewhat smaller individual, from the same locality, contained only fragments of *Themisto libellula.*

In the ventricles of two old males from Finmark, taken at a depth of a couple of hundred fathoms, in the Varanger Fjord, I found only crushed *Echinodermata,* amongst which could be determined *Ctenodiscus crispatus,* (Retz.), *Ophiacantha spinulosa,* Müll. & Tr., and *Antedon sarsii* (Düb. & Kor.). Although the individuals in question had subsisted on this calcareous food, their teeth were but little worn.

Distribution. — *L. esmarkii* has been met with both in the European and the American tracts of the North Atlantic. Three of the specimens of *L. esmarkii* collected on the Expedition were taken in the tract adjacent to Spitzbergen, in 1878, one of them but a few miles from the north-western extremity of that group of islands; the fourth, a very young individual, was taken on the banks off Helgeland, in Norway, in 1877. Finally, 5 full-grown specimens were obtained from the fjords of Finmark, in the period from 1864 to 1876, 4 of them from the Varanger Fjord, in East Finmark, where, as I am given to understand, other individuals, not preserved, have been taken of late years, that last obtained having been captured in the Øxfjord, south of Hammerfest (West Finmark).

As already observed, the specimens from the eastern coast of North America, provisionally referred to *L. vahlii,* belong likewise to the present species. In that region were obtained in the years 1878 and 1879 four full-grown examples off the coasts of Nova Scotia, where the marine fauna has quite an Arctic character. One of the specimens is preserved in the University Museum, Christiania.

19. **Lycodes frigidus,** Coll. 1878 (n. sp.).

Pl. III, Fig. 23—24.

Lycodes vahlii, pt. Coll. (nec Reinh.) Forh. Vid. Selsk. Chra. 1878, No. 4, p. 11 (1878).
Lycodes frigidus, Coll. Forh. Vid. Selsk. Chra. 1878, No. 14, p. 45 (1878).

Diagn. *Farven ensartet rødligt graabrun, uden Baand eller Pletter. Skjællene beklæde hele Legemet indtil Hovedet, samt hos fuldt udvoxede tillige Grunden af Dorsalen og Analen; hos de yngre er oftest Bugen i Midten, Finnerne, samt Grunden langs disse nøgne. Legemets Højde indeholdes $6^1/_2$, hos de yngre indtil $9^1/_2$ Gange i Totall. Hovedet er fladtrykt, og indeholdes i Totallængden 4 til $4^1/_2$ Gange. Sidelinien enkelt, ventral. Pandens Bredde indeholdes 20 Gange i Hovedets Længde. Appendices pyloricae mangle. Størrelsen indtil 510 mm (og derover).*

M. B. 6. D. + $^1/_2$ C. 99—104; A. + $^1/_2$ C. 85—90; P. 20—21.

Localit. fra Nordh. Exped. 15 Individer, de fleste halvvoxne, 1 sandsynligvis fuldt udvoxet, optoges fra Havet omkring Beeren Eiland og Spitsbergen; 2 (Yngel-)Individer optoges fra Bankerne udenfor Helgeland og Lofoten i Norge.

	Stat. 124.	*Stat.* 164.	*Stat.* 295.	*Stat.* 303.	*Stat.* 312.	*Stat.* 353.	*Stat.* 363.
Beliggenhed.	325 Kil. V. Bodø.	117 Kil. V. Lofoten.	453 Kil. V. Hammerfest.	450 Kil. V. Beeren Eil.	108 Kil. V. Beeren Eil.	230 Kil. V. Isfj., Spitsb.	60 Kil. V. Norskø. Spitsb.
Dybde.	350 Favne (640 m).	457 Favne (836 m).	1110 Favne (2030 m).	1200 Favne (2195 m).	658 Favne (1203 m).	1333 Favne (2438 m).	260 Favne (475 m).
Temp. p. Bunden.	— 0,9° C.	— 0,7° C.	— 1,3° C.	— 1,6° C.	— 1,2° C.	— 1,4° C.	+ 1,1° C.
Bunden.	Ler.	Graat Sandler.	Biloculina-Ler.	Brunt Ler.	Brunt og grønt Ler.	Biloculina-Ler og Sten.	Blaaler.
Datum.	19deJuni 1877.	29deJuni 1877.	14de Juli 1878.	19de Juli 1878.	22de Juli 1878.	10deAug. 1878.	14deAug. 1878.
Antal Individ.	1 Yngel-Indiv.	1 Yngel-Indiv.	5 Indiv. (udvox.)	1 Indiv.	5 unge Indiv.	3 Indiv.	1 Indiv.

Bemærkninger til Synonymien. Da jeg i Februar 1878 (Forh. Vid. Selsk. Chra. No. 4) afgav den foreløbige Beretning om de under de 2 første af Expeditionens Togter indsamlede Fiske (1876—77), forelaa et Par Yngel-Individer af en *Lycodes,* som henførtes under *L. vahlii,* uagtet de ikke udviste Spor af de for denne Art characteristiske Tverbaand. Tilværelsen af en stor, skjælbeklædt, og i alle Aldre ensfarvet *Lycodes* var dengang endnu ukjendt. De nævnte 2 Yngel-Individer omtaltes derfor og beskreves (sammen med en samtidig erholdt Unge af *L. esmarkii*) som *L. vahlii,* da der i Legemsbygning og Straaleantal forekom mig intet at være til Hinder for en saadan

19. **Lycodes frigidus,** Coll. 1878 (n. sp.).

Pl. III, fig. 23—24.

Lycodes vahlii, pt. Coll. (nec Reinh.) Forh. Vid. Selsk. Chra. 1878, No. 4, p. 11 (1878).
Lycodes frigidus, Coll. Forh. Vid. Selsk. Chra. 1878, No. 14, p. 45 (1878).

Diagnosis. — *Colour a uniform greyish-brown, tinged with red, no bands or spots. The entire body scaled, and in adults the base of the dorsal and anal; young individuals have generally the middle of the belly, the fins, and the region beneath naked. The height of the body is to the total length as 1 to $6^1/_2$, in immature examples the proportion can be as 1 to $9^1/_2$. Head depressed, its length being to the total length as 1 to 4—$4^1/_2$. Lateral line single, ventral. Width of interorbital space equals $^1/_{20}$ of the length of the head. Pyloric appendages wanting. Length reaching 510 mm, and above.*

M. B. 6. D. + $^1/_2$ C. 99—104; A. + $^1/_2$ C. 85—90; P. 20—21.

Locality (North Atl. Exped.): — Fifteen individuals, the greater part half grown, one probably an adult, were captured in the tract of ocean surrounding Beeren Eiland and Spitzbergen; and two (fry-specimens) on the banks off Helgeland and Lofoten, in Norway.

	Stat. 124.	*Stat.* 164.	*Stat.* 295.	*Stat.* 303.	*Stat.* 312.	*Stat.* 353.	*Stat.* 363.
Exact Locality.	325 Kil. W. Bodö.	117 Kil. W. Lofoten.	453 Kil. W. Hammerfest.	450 Kil. W. Beeren Eil.	108 Kil. W. Beeren Eil.	230 Kil. W. Isfj., Spitzb.	60 Kil. W. Norskø. Spitzb.
Depth.	350 Fathoms (640 m).	457 Fathoms (836 m).	1110 Fathoms (2030 m).	1200 Fathoms (2195 m).	658 Fathoms (1203 m).	1333 Fathoms (2438 m).	260 Fathoms (475 m).
Temp. at Bottom.	— 0.9° C.	— 0.7° C.	— 1.3° C.	— 1.6° C.	— 1.2° C.	— 1.4° C.	+ 1.1° C.
Bottom.	Clay.	Grey sabulous Clay.	Biloculina Clay.	Brown Clay.	Brown and Grey Clay.	Biloculi. Clay and Stones.	Blue Clay.
Date.	19thJune 1877.	29thJune 1877.	14th July 1878.	19th July 1878.	22th July 1878.	10thAug. 1878.	14thAug. 1878.
Numb. of Specim.	1 Indiv. (fry).	1 Indiv. (fry).	5 Indiv. (1 adult).	1 Indiv.	5 Indiv. (young).	3 Indiv.	1 Indiv.

Remarks on the Synonomy. — When, in February 1878, I made a preliminary report of the fishes collected on the two first voyages of the Expedition (1876—77), a couple of fry-specimens of a *Lycodes* had been obtained, which, though exhibiting no traces of the transverse bands characteristic of that species, I referred to *L. vahlii.* The occurrence of a large, scaled *Lycodes* of a uniform colour in all stages of development was as yet unknown. Hence, the 2 fry-specimens were named and described along with the young example of *L. esmarkii,* taken at the same time, under the name *L. vahlii,* there being nothing in the structure of the body and the fins to oppose the assumption of

Sammenstilling. Efterat det sidste Aars Togt (1878) har bragt *L. frigidus,* der ikke tidligere var beskrevet, for Dagen i sin fuldt udvoxede Stand, henfører jeg uden Betænkning de nævnte 2 Yngel-Individer under denne Art, og afbilder det mindste af dem, sammen med et noget over halvvoxent Individ af Typ-Exemplarerne.

Udmaalinger. De 2 Yngel-Individer fra Bankerne udenfor de norske Kyster (1877) havde følgende Maal:

	Totallængde.	Hovedets Længde.	Legemets Højde (ved Begyndelsen af Dors.)	Snudens Afstand fra Dorsalen.	Snudens Afstand fra Anus.
A. (*Stat.* 164)	37 mm	9 mm	4,5 mm	10 mm	13,5 mm
B. (*Stat.* 124)	62 -	14 -	6,5 -	16 -	24 -

De øvrige Individer fra Havet omkring Beeren Eiland og Spitsbergen, erholdte under sidste Togt, 1878, havde følgende Maal:

	Totallængde.	Hovedets Længde.	Legemets Højde (ved Begyndelsen af Dors.)	Snudens Afstand fra Dorsalen.	Snudens Afstand fra Anus.
a. (*Stat.* 312)	118 mm	28 mm	12 mm	32 mm	48 mm
b. (*Stat.* 312)	139 -	31 -	14 -	36 -	55 -
c. (*Stat.* 312)	161 -	36 -	17 -	42 -	61 -
d. (*Stat.* 312)	179 -	38 -	20 -	42 -	70 -
e. (*Stat.* 312)	182 -	40 -	21 -	44 -	70 -
f. (*Stat.* 295)	238 -	53 -	28 -	67 -	100 -
g. (*Stat.* 363)	270 -	65 -	43 -	80 -	115 -
h. (*Stat.* 303)	325 -	81 -	45 -	103 -	148 -
i. (*Stat.* 295)	332 -	82 -	42 -	103 -	146 -
k. (*Stat.* 295)	339 -	85 -	46 -	108 -	157 -
l. (*Stat.* 295)	342 -	86 -	48 -	107 -	150 -
m. (*Stat.* 353)	345 -	88 -	50 -	112 -	159 -
n. (*Stat.* 353)	372 -	90 -	48 -	114 -	162 -
o. (*Stat.* 353)	375 -	95 -	49 -	115 -	170 -
p. (*Stat.* 295)	510 -	124 -	79 -	165 -	220 -

Beskrivelse. *Legemsbygning.* Med *Lycodes esmarkii* deler den nye Art omtrent Straaleantal og Skjælbeklædning, ligesom Legemsproportionerne idethele ere næsten overensstemmende hos begge Arter. Derimod adskiller den sig ved første Øjekast fra denne ved sin enkelte, lavtliggende Sidelinie, samt fra saavel *L. esmarkii,* som fra de øvrige Arter af samme Gruppe ved sit i alle Aldre ensfarvede Legeme.

Legemet er af typisk *Lycodes*-Bygning, saaledes hverken særdeles langstrakt, eller kort. Ungerne ere noget mere langstrakte, end de ældre, men selv Yngel af et Par Tommers Længde har en Legemshøjde, der er forholdsvis

identity. But the last voyage of the Expedition having brought to light *L. frigidus,* not previously described, in the adult stage of growth, I feel no hesitation in referring the said fry-specimens to that species; the smaller of the two I have figured, along with one of the typical specimens, rather more than half grown.

Measurements. — The two fry-individuals from the banks off the Norwegian coast (1877) measured as follows: —

	Total Length.	Length of the Head.	Height of Body (at commencem. of Dorsal).	Distance of Snout from Dorsal.	Distance of Snout from Vent.
A. (*Stat.* 164)	37 mm	9 mm	4.5 mm	10 mm	13.5 mm
B. (*Stat.* 124)	62 -	14 -	6.5 -	16 -	24 -

The remaining individuals, taken in the tract of ocean surrounding Beeren Eiland and Spitzbergen (1878), measured as follows: —

	Total Length.	Length of the Head.	Height of Body (at commencem. of Dorsal).	Distance of Snout from Dorsal.	Distance of Snout from Vent.
a. (*Stat.* 312)	118 mm	28 mm	12 mm	32 mm	48 mm
b. (*Stat.* 312)	139 -	31 -	14 -	36 -	55 -
c. (*Stat.* 312)	161 -	36 -	17 -	42 -	61 -
d. (*Stat.* 312)	179 -	38 -	20 -	42 -	70 -
e. (*Stat.* 312)	182 -	40 -	21 -	44 -	70 -
f. (*Stat.* 295)	238 -	53 -	28 -	67 -	100 -
g. (*Stat.* 363)	270 -	65 -	43 -	80 -	115 -
h. (*Stat.* 303)	325 -	81 -	45 -	103 -	148 -
i. (*Stat.* 295)	332 -	82 -	42 -	103 -	146 -
k. (*Stat.* 295)	339 -	85 -	46 -	108 -	157 -
l. (*Stat.* 295)	342 -	86 -	48 -	107 -	150 -
m. (*Stat.* 253)	345 -	88 -	50 -	112 -	159 -
n. (*Stat.* 353)	372 -	90 -	48 -	114 -	162 -
o. (*Stat.* 353)	375 -	95 -	49 -	115 -	170 -
p. (*Stat.* 295)	510 -	124 -	79 -	165 -	220 -

General Description. *Structure of the Body.* — The fin-ray formula and the scaled integument distinguishing the new species are very nearly the same as in *Lycodes esmarkii;* the dimensions of the body, too, correspond closely in the two species. On the other hand, it is seen at a glance to be distinct from *L. esmarkii,* by reason of the lateral line, which is single and ventral, and also from this and the other species of the same group, by the uniform colour of the body in all stages of growth.

The body is of the typical *Lycodes* structure, neither particularly elongate nor short. The young specimens are somewhat more elongated than the older examples, but even fry an inch or two in length have a depth of body

større, end hos nogen af de anguilliforme Arter. Hos Ungerne indeholdes Legemets Højde mellem $8^1/_2$ og $9^1/_2$ Gange i Totallængden, hos de fuldvoxne blot $6^1/_2$ Gange. Halepartiet er fra Siderne af temmelig stærkt sammentrykt (mindst hos Ungerne).

Hovedet er bredt, oventil temmelig fladtrykt, har forholdsvis lav Snude, og indeholdes i Totallængden 4 til $4^1/_2$ Gange.

Snudens Længde indtil Lindsen er omtrent lig Hovedets Højde over Øjnene, og indeholdes i Hovedlængden $2^1/_2$ til 3 Gange. Hovedets Længde bagenfor Lindsen er omtrent lig Hovedets største Bredde over Kinderne, og ubetydeligt større, end Hovedets største Højde midt over Nakken.

Underkjæven er betydeligt kortere, end Overkjæven, og denne sidste er kortere, end Hovedets halve Længde. Panden er forholdsvis bred; hos et Ex. (*o*), der er præpareret som Skelet, viser Interorbitalrummets smaleste Parti sig at udgjøre $^1/_{20}$ af Hovedets Længde. Som hos alle Lycoder findes langs begge Kjæver skaalformige Fordybninger, i hvis Bund der skjuler sig en Pore.

Næseborene ere enkelte, rørformige, og sidde temmelig nær Kjæveranden, og i en indbyrdes Afstand, der er omtrent lig Pectoralens Grundlinie.

Øjnene ere forholdsvis smaa; deres rette Begrændsning er vanskelig at drage, da Cornea tildels er bedækket af Hovedets Hud, hvorfor alle Dimensioner bedst regnes til eller fra Lindsen. De ere temmelig tætstaaende; Mellemrummet mellem Lindserne indeholdes næsten 2 Gange i deres Afstand fra Snudespidsen.

Tænderne ere, som hos alle typiske Lycoder, tilstede paa Mellem- og Underkjæven, paa Vomer og paa Palatinbenene. De ere forholdsvis ikke store; hos udvoxede Individer sidde de i Mellemkjæverne bagtil i en enkelt, paa Midten i en dobbelt, og fortil i en omtrent 3-dobbelt Række; paa Underkjæven danne de overalt flere Rækker. Paa Palatinbenene, hvor Tandrækken strækker sig tilbage lige hen under Øjnene, sidde de ligeledes i en enkelt Række; paa Vomer danne de omtrent 3 Rækker. Hos de yngre Individer ere Rækkerne, som sædvanligt, færre; hos de 2 Yngel-Individer ere ikke alle Tænder synlige over Tandkjødet.

Anus er omgiven af en hvidagtig, opsvulmet Hud, og ligger i en Afstand fra Snudespidsen, der indeholdes omtrent $2^1/_2$ Gange i Totallængden.

Af Totallængden udgjør . .	A. 37mm	B. 62mm	a. 118mm	c. 161mm	f. 238mm	h. 325mm	n. 372mm	o. 375mm	p. 510mm
Hovedets Længde . .	4,11	4,42	4,21	4,47	4,49	4,01	4,13	3,94	4,17
Legemets Højde . . .	8,32	9,59	9,83	9,47	8,50	7,22	7,75	7,65	6,45
Snudens Afstand fra D.	3,70	3,87	3,68	3,83	3,55	3,15	3,26	3,26	3,09
Snudens Afstand fra A.	2,74	2,58	2,45	2,63	2,38	2,19	2,20	2,20	2,31

relatively greater than any of the anguilliform species. In young examples, the depth of the body is to the total length as 1 to $8^1/_2$—$9^1/_2$; in full-grown specimens, as 1 to $6^1/_2$. The tail is rather compressed (least so in immature examples).

Head broad, the upper part flattish, with the snout depressed, and is contained in the total length from 4 to $4^1/_2$ times.

The length of the snout, as compared with the diameter of the lens, is about equal to the height of the head above the eyes, and is contained in the length of the head from twice and a half to three times. The length of the head posterior to the lens about equals the greatest breadth of the head across the cheeks, and slightly exceeds the greatest height of the head above the nape.

The mandible is considerably shorter than the upper jaw, the latter measuring less than half the length of the head. The forehead comparatively broad; in one specimen (*o*), preserved as a skeleton, the interorbital space measures where it is narrowest $^1/_{20}$ of the length of the head. As in all the *Lycodes,* circular depressions extend along both jaws, each concealing at the bottom a pore.

The nostrils are single, tubular, and placed in comparatively close proximity to the margin of the jaw, the distance between them being about equal to the length of the pectorals at base.

Eyes comparatively small; their exact limits are difficult to determine, the cornea being in part covered by the skin of the head; all dimensions should, therefore, be calculated to or from the lens. They are rather closely set, the space between the lenses being contained almost twice in their distance from the point of the snout.

Teeth, as in all typical *Lycodes,* on the inter-maxillary and in the lower jaw, the vomer, and the palatine bones; they are not large, comparatively. On the inter-maxillaries in adults, they are disposed, posteriorly in a single, midwards in a double, anteriorly in a triple series; in the lower jaw, they constitute several series. On the palatine bones, where the teeth extend back under the eyes, they are also arranged in a single series; on the vomer, they constitute as a rule three series. In immature examples, the series are as a rule less numerous; in the 2 fry-specimens, the teeth are not all perceptible.

The vent is surrounded by a whitish, tumid skin, its distance from the snout being to the total length as 1 to $2^1/_2$.

The T. Length contains	A. 37mm	B. 62mm	a. 118mm	c. 161mm	f. 238mm	h. 325mm	n. 372mm	o. 375mm	p. 510mm
Length of the head	4.11	4.42	4.21	4.47	4.49	4.01	4.13	3.94	4.17
Depth of the body . . .	8.32	9.59	9.83	9.47	8.50	7.22	7.75	7.65	6.45
Dist. of snout fr. dorsal . .	3.70	3.87	3.68	3.83	3.55	3.15	3.26	3.26	3.09
Dist. of snout fr. anal . . .	2.74	2.58	2.45	2.63	2.38	2.19	2.20	2.20	2.31

Appendices pyloricae har manglet hos de af mig aabnede Individer.

Finnerne. — Straaleantallet fandtes hos en Del undersøgte Individer at være følgende (i de verticale Finner er indbefattet den halve Caudal):

	A.	B.	a.	e.	f.	l.	m.	o.	p.
Dorsalen . .	102	103	99	103	104	102	103	103	102
Analen . . .	88	85	87	88	90	87	87	87	87
Pectoralerne	19	19	20	20	20	21	$\frac{20}{21}$	20	20

Dorsalen udspringer i en Afstand fra Gjællelaagets bagre Flig, der somoftest er lig Lindsens Afstand fra Snudespidsen, eller ubetydeligt mindre. Dens Afstand fra Snudespidsen indeholdes hos de større Individer omtrent 3 Gange, hos de mindre omtrent $3^1/_2$ Gange i Totallængden; dog er dette Forhold noget varierende. Dens første Straale ligger omtrent lige langt mellem Anus og Øjets Bagrand. Af Bygning er Dorsalen ganske, som hos de øvrige Lycoder, med sin største Højde i den forreste Del, og svagt aftagende bagtil.

Straalerne, som hos de større Individer ligge indhyllede i en tyk Hud, som ofte gjør dem vanskelige at tælle, ere mellem 93 og 98 i Antal, hvortil kommer Caudalens øvre Halvdel med 6 Straaler, tilsammen 99 til 104 Straaler. De ere alle (ogsaa den første) kløvede til Grunden, men begge Halvhele ere yderst spinkle og tætstaaende, ved Grunden uleddede, men udad fint articulerede, og i Spidserne divergerende.

Analen, der udspringer et Stykke bagenfor Anus, er af Bygning som Dorsalen, og tæller mellem 80 og 85 (gjennemsnitlig 82) Straaler, som, tilligemed Caudalens nedre Halvdel (der bestaar af 5 Straaler), udgjøre tilsammen 85 til 90 Straaler.

Caudalen danner 2 sammenhængende Straaleknipper, Dorsalsidens bestaaende af 6, Ventralsidens af 5 Straaler, der ere særdeles fine og yderst tætstaaende, og derfor vanskelige at tælle. Dens hele Længde er omtrent lig Længden af Ventralerne (eller hos de ældre Individer noget derover).

Pectoralerne have 19—21 Straaler, oftest 20, af hvilke de øvre ere de længste; hos enkelte Individer er Finnens nederste Del atter noget længere, end den mellemste, saaledes at Randen hos disse bliver svagt concav. De nedre Straaler ere beklædte med en tykkere Hud, end de øvrige, og have fri Spidser. Straalerne ere forholdsvis korte, saaledes at Finnen, naar den bøjes fremover, med sin Spidse blot hos de yngste Individer naar frem til Bagranden af Lindsen, men er hos de større en halv, hos det største (et sandsynligvis fuldt udvoxet Individ) endog en hel Øjendiameter fjernet fra denne. Hos dette sidste opnaar Pectoralen blot Hovedets halve Længde, hos de yngre noget mere, end denne. Straalerne ere alle kløvede til Roden, og fint articulerede.

Pyloric appendages wanting in all the specimens examined.

Fins. — The number of rays found in divers individuals examined was as follows (half of the caudal included in the vertical fins): —

	A.	B.	a.	e.	f.	l.	m.	o.	p.
Dorsal	102	103	99	103	104	102	103	103	102
Anal	88	85	87	88	90	87	87	87	87
Pectorals . .	19	19	20	20	20	21	$\frac{20}{21}$	20	20

The dorsal commences at a distance from the posterior flap of the opercle generally equal to the distance from the lens to the point of the snout, or a trifle less. Its distance from the snout, in the larger specimens, is to the total length about as 1 to 3; in the smaller, about as 1 to $3^1/_2$; this proportion varies however to some extent. Its first ray is about equidistant from the vent and the posterior margin of the eye. The structure of the dorsal as in all species of *Lycodes,* the greatest height of the fin being in its anterior portion.

The rays, which in the larger individuals are enveloped in a thick cutaneous integument, rendering them often difficult to count, number from 93 to 98, to which must be added those in the upper half of the caudal; so that the total number is from 99 to 104. They are all (including the first) cleft to the base; but both halves are exceedingly slender and close, simple at the base, but in the outer part finely articulated, and diverging at the points.

The anal, commencing a short distance posterior to the vent, is of the same structure as the dorsal, and furnished with from 80 to 85 (generally 82) rays, or, including the 5 rays in the lower half of the caudal, 85 to 90.

The caudal is composed of 2 continuous bunches of rays, that on the dorsal side with 6, that on the ventral side with 5 rays, exceedingly slender and very closely set; therefore difficult to count. The length of this fin about equals that of the ventrals (in the older specimens it exceeds it).

The pectorals are furnished with from 19 to 21 rays, most frequently with 20, of which the upper ones are the longest; in some individuals, the inferior portion of the fin is a trifle longer than the middle part, and its margin therefore slightly concave. The lower rays are enveloped in a thicker skin than the upper, and have free points. The rays are comparatively short, their points reaching forward to the posterior margin of the lens in the youngest specimen only, being in the larger examples distant from it one-half of the diameter of the eye, and in the largest individual a whole eye-diameter; in the latter, the pectorals do not attain more than half the length of the head; in the younger specimens, the proportion is greater. Rays all cleft to the base, and finely articulated.

Ventralerne ere korte, især hos de ældre, hvor de udgjøre $^1/_9$ af Hovedets Længde; de ere altid kortere, end Øjets Længdediameter. Hver af dem er indhyllet i en tyk Hud, der gjør det umuligt uden ved Dissection at adskille de enkelte Straaler; disses Antal synes at være 2, der begge ere kløvede til Grunden (idetmindste er dette Tilfældet hos de ældre).

Skjælbeklædning. Denne har hos *L. frigidus* en betydelig Udbredelse, og har allerede hos forholdsvis unge Individer opnaaet den største Del af sin Udvikling. Dog optræde mindre, individuelle Afvigelser, idet enkelte mindre Partier kunne være nøgne, som hos andre Ind. af samme Størrelse ere skjælbeklædte. Hos det største af de erholdte Individer (*p*) har Skjælbeklædningen naaet sin største Udbredelse; hos alle de øvrige ned til Indiv. *a* (med en Totallængde af 118^{mm}), er den i det store taget temmelig ligeligt udviklet.

Det Tidspunkt, da Skjælbeklædningen begynder at udvikle sig hos Yngelen, synes at være, naar denne har naaet en Længde af omtrent 50^{mm}. Hos det mindste af de erholdte Yngel-Individer, hvis Totallængde er blot 37^{mm}, er Legemet endnu ganske nøgent; hos det noget større Individ, hvis Totallængde er 62^{mm}, ere Skjællene fremspirende paa Legemets forreste Dele, medens Halen og Finnerne endnu ere nøgne.

Skjællene ere hos denne Art forholdsvis smaa og tætstillede. De ere størst paa den forreste Del af Halen og paa Legemets Sider; op imod Ryg- og Buglinien blive de betydeligt mindre, og ere særdeles smaa, hvor de optræde paa selve Finnerne, ligesom de blive mindre ud mod Halespidsen.

I sin fulde Udvikling er Legemet skjælbeklædt lige hen til Hovedet, og paa Bugsiden lige hen mod Grunden af Ventralerne. Ligeledes er Skjælbeklædningen her tilstede langs hele Grunden nærmest Dorsalen og Analen, og strækker sig ud over disse Finner indtil henimod deres Midte, længst paa Dorsalens mellemste Del, men ophører ganske henimod Finnernes Slutning. Paa Hovedet kan aldrig opdages Skjæl; ligeledes ere Pectoraler og Ventraler altid nøgne.

Hos de ikke fuldvoxne Exemplarer er i Regelen Nakken nøgen, ligesom Grunden langs Analen og Dorsalen, tilligemed disse Finner selv. Dog have enkelte mindre Individer ogsaa disse Partier skjælbeklædte, ligesom de udvoxede. Bugen er hos enkelte af disse yngre Individer fuldt skjælbeklædt, hos andre blot paa Siderne, ligesom Skjællene langs dennes Midte kunne delvis eller fuldkommen mangle.

For at vise Skjælbeklædningens Varieren hos de forskjellige Individer, meddeles kortelig dennes Fordeling hos alle de hidtil erholdte Exemplarer.

1. Fuld Skjælbeklædning lige hen mod Hovedet og paa Undersiden af Ventralerne; paa Finnerne er Grunden af Dorsalen og Analen skjælbeklædt (*k, l, p*).

2. Fuld Skjælbeklædning, som foregaaende, men Skjælbeklædningen strækker sig ikke ud over Analen (*f*).

The ventrals are short, particularly in the older examples, which have them one-ninth of the length of the head; they are invariably shorter than the longitudinal diameter of the eye. Each of them is enveloped in a thick cutaneous integument, dissection being necessary to distinguish the separate rays. The number would appear to be 2, both cleft to the base (at least in the older specimens).

Scales. — In *L. frigidus* the scaled integument is of considerable extent, and almost developed even in comparatively immature individuals. The scaling, however, cannot be termed strictly constant, exhibiting as it does minor individual differences, some examples having a few small patches naked, which in others of the same size are scaled. In the largest of the individuals obtained (*p*), the scaled integument has attained its greatest development; in all the others, including specimen *a*, total length 118^{mm}, it is on the whole very nearly of uniform extent.

The exact point of time at which the scales commence developing in the fry, would appear to be, when they have attained a length of about 50^{mm}. In the smallest of the fry-specimens, total length only 37^{mm}, the entire body is as yet naked; in the other, somewhat larger individual, total length 62^{mm}, the scales have begun to appear on the anterior parts of the body, whereas both the tail and the fins are as yet naked.

In this species, the scales are comparatively small, and closely set; the largest occur on the anterior portion of the tail, and down the sides of the body; near the dorsal and ventral lines they diminish considerably in size, being exceedingly small on the fins, and towards the tip of the tail.

When fully developed, the body is scaled up to the head, and, on the under surface, up to the base of the ventrals. The scaled integument extends, too, along the whole of the basal tract contiguous to the dorsal and anal, reaching nearly to the middle of those fins; it is longest on the middle of the dorsal, terminating near the extremity of the said fins. On the head, no scales can ever be detected; the pectorals and ventrals, too, are both invariably naked.

In the specimens not quite full-grown, the nape is as a rule scaleless, also the base of the body along the dorsal and anal, and the entire surface of those fins. One or two of the immature individuals, however, have these parts scaled, in common with the full-grown specimens. The belly in one or two of these immature examples scaled all over; in others, the sides only; the scales covering the middle portion sometimes wanting, wholly or in part.

The extent to which the scaling varies in the different specimens will be seen from the subjoined statement, briefly showing the distribution of the scales in all the individuals obtained.

1. Fully scaled to the head, and, on the under surface, within a short distance of the ventrals; the base of dorsal and anal scaled (*k, l, p*).

2. Fully scaled, as in the foregoing specimens; the scaled integument however not extending over the anal (*f*).

3. Næsten fuld Skjælbeklædning, men Nakken, Finnerne, samt Stykket mellem Anus og Analen ere nøgne (*i*).

4. Nakken, Finnerne, samt oftest tillige Grunden nærmest Dorsalen og Analen nøgen. Bugen er i Midten enten ganske nøgen, eller har blot en kort isoleret Skjælstribe fortil, medens Siderne af Bugen altid ere skjælbeklædte (*a, b, c, d, e, g, m, o*).

5. Som foregaaende; paa Legemets Sider strækker Skjælbeklædningen sig blot noget indenfor Pectoralens Spidse (*h, n*).

Sidelinien er enkelt, og særdeles lavtliggende (ventral). Den er hos de fleste Individer forholdsvis særdeles tydelig, og lader sig i Regelen med Lethed forfølge, ialfald i sin første Halvdel. Den udspringer ved Gjællespaltens øvre Ende, løber derfra hurtigt og skraat nedover omtrent midt under Pectoralens Midte, hvorfra den bøjer næsten ret bagover, og løber parallelt med Buglinien i ringe Højde over denne, indtil den har naaet omtrent over den 25de Straale af Analen (eller næsten Midten af denne Finne). Her synes den hos de fleste Individer at ophøre eller blive utydelig; hos enkelte lader den sig dog forfølge videre, idet den ved det nævnte Punkt gjør en liden Bøjning næsten lige ned til Grunden af Analen, og løber nu langs denne lige ud mod Halespidsen.

Porerne i Sidelinien ere forholdsvis smaa, hvidagtige, og forbundne indbyrdes med en smal Linie af samme Farve; de ere overalt temmelig tætstaaende, og jeg har talt omtrent 53 Stykker indtil Sideliniens Bøjning over Analens Midte.

Af Hovedets Slimporer kan mærkes en Række, bestaaende af omtrent 7 Porer, der udspringer paa hver Side af Panden, omtrent i en Øjendiameters Afstand bag Øjnene, og løber bagover mod Nakken, hvor den møder en tvergaaende, kortere Række af omtrent 3 Porer paa hver Side. Paa Gjællelaagene staar en vertical Række af omtrent 6 Porer. Endelig løber en Række, der i Regelen kun med Vanskelighed kan sees, fra Gjællespaltens øvre Ende bagover i ringe Afstand under Dorsalen; Mellemrummet mellem hver Pore er vexlende, men altid betydeligt større, end mellem Porerne i Sidelinien. Den ophører noget bagenfor Legemets Midte.

Farven er hos alle Individer ensartet mørkt rødagtig graa eller brungraa, uden Spor af Baand eller Pletter i nogen Alder. Skjællene ere ubetydeligt lysere, end Grundfarven. De yngre Individer ere noget lysere, end de ældre, og have brunligrød Dorsal og Anal. Bugsiden er kun ubetydeligt lysere, end Oversiden; hos yngre Individer er den blaasorte Bughinde gjennemskinnende. Alene Hovedets Underside er noget lysere, end Legemets øvrige Del; Anus' Rande ere hvidagtige. Mundhulen er hvid. Efterat have været opbevarede paa Spiritus er Farven bleven noget mattere.

Generationsorganerne vare hvilende. Det største Individ (*p*) var en Han; blot højre Testis var udviklet, medens den venstre var rudimentær, og havde en Negls Størrelse.

3. Almost fully scaled, the nape, fins, and the space between the vent and the anal only being naked (*i*).

4. The nape, the fins, and generally too the basal tract next to the dorsal and anal naked. The belly either wholly naked in the middle or with a scaly strip, which is short and isolated; the sides of the belly invariably scaled (*a, b, c, d, e, g, m, o*).

5. Similar to the foregoing; on the sides of the body, the scaled integument extends but very little farther than the extremity of the pectorals (*h, n*).

Lateral line single and low in position (ventral). In most of the individuals very distinct, comparatively, and may be easily traced, the first half at least. It commences at the upper extremity of the gill-opening, passing from thence obliquely downwards, about under the middle of the pectorals, where it bends almost straight backwards, running parallel to the ventral line, at a slight elevation above it till about over the 25th ray of the anal (or nearly to the middle of that fin); here, in most of the specimens, it would appear to terminate, or to become obsolete; in some, however, it may be traced some distance further; when such is the case, it makes at the said point a small bend, descending obliquely almost to the base of the anal, and accompanying that fin straight to the tip of the tail.

The pores in the lateral line are comparatively small, whitish, and connected together by a narrow line of the same colour; they are rather closely set, and I have counted as many as 53 from the origin to the bend above the middle of the anal.

Of the mucous pores of the head, may be mentioned a series consisting of 7 pores; it originates on each side of the forehead, distant about an eye-diameter from behind the eyes, extending backwards towards the nape, where it meets a transverse, shorter series of pores, mostly 3, on either side. On the opercles, there is a vertical series of about 6 pores. Finally a series, as a rule difficult to distinguish, extends backwards from the upper extremity of the gill-opening, a short distance under the dorsal; the space between these pores varies in extent, but is always considerably greater than that between the pores in the lateral line. The series terminates a little posterior to the middle of the body.

Colour in all specimens a uniform dark reddish-grey or brownish-grey, without a trace of bands or spots in any stage of development. Scales considerably lighter than the ground-colour. The younger individuals are somewhat lighter than the older, and have the dorsal and anal of a brownish-red. The under surface is but very little lighter than the upper; in the young specimens the bluish-black ventral membrane is translucent. The under surface of the head alone is somewhat lighter than the rest of the body; margin of vent whitish. Gape white. The action of spirits causes the colour to fade.

The generative organs were quiescent. The largest individual (*p*) (a male) had the right testis only developed; the left was rudimentary, and about half an inch in length.

Føde. Hos de Individer, der aabnedes for at undersøge Ventrikelens Indhold, fandtes dette at udgjøre i Regelen mindre Dyr, især Crustaceer.

Individet *l*, optaget fra 1110 Favnes Dyb, indeholdt af bestembare Dele et Par Amphipoder, hvoriblandt en *Phoxus crenulatus*, (Boeck), samt en *Dulichia*, sp.; fremdeles et Exemplar af den blodrøde Decapode *Hymenodora glacialis* (Buchh.), et stort Individ af en Isopode, der tidligere var opført som *Idothea sabini*, Kr., men som af Prof. G. O. Sars i 1880 er beskreven som en ny Art under Navn af *Chiridothea megalura*. Endelig fandtes en Del *Calanus finmarchicus*, (Gunn.).

Individet *m*, optaget fra 1333 Favne, havde i Ventrikelen et usædvanligt stort Individ af *Themisto libellula*, (Mandt), et Exemplar af *Eurycope cornuta*, G. O. Sars, samt Dele af en Spongie.

Individet *o*, optaget sammen med foregaaende fra 1333 Favne, indeholdt et Exemplar af *Hymenodora glacialis*, (Buchh.), et Exemplar af den samme nye *Chiridothea megalura*, G. O. Sars, samt af Amphipoder *Themisto libellula*, (Mandt), samt en *Stegocephalus*, sp. Endelig fandtes Dele af Kappen af en Cephalopode, der maaske tilhørte den under Expeditionen fra et lignende Dyb optagne Art af Slægten *Cirrotheuthis*.

Individet *g*, optaget fra 260 Favnes Dyb, indeholdt af Amphipoder flere Exemplarer af *Themisto libellula*, (Mandt), samt et Exemplar af en *Anonyx;* af Isopoder *Eurycope cornuta*, G. O. Sars; af Copepoder *Calanus finmarchicus*, (Gunn.) i adskillige Exemplarer, samt et Individ af en endnu ubestemt Slægt af Calanider, der af Prof. Sars ansees for at staa nær Slægten *Euchaeta;* endelig af Cumaceer en *Diastylis stygia*, G. O. Sars.

Endelig fandtes i det største Individ (*p*), optagen fra 1110 Favnes Dyb, en stor *Pasiphaë tarda*, Kr.

Det fremgaar af disse Lycoders Næringsmidler, at de fleste af de velbekjendte, ægte pelagiske Sødyr, der til visse Tider i enorme Masser ere udbredte i de allerøverste Vandlag, ogsaa formaa at trænge ned til de allerstørste Dybder, hvor vi hidtil have kunnet granske Ishavets Dyreliv; og at Lycoderne maa opfattes som udprægede Bundfiske, og derfor blot kunne hente sine Næringsmidler ved eller paa Bunden, fremgaar bl. a. af den Omstændighed, at der blandt Næringsmidlerne hos *L. frigidus* indgaa Former, som den ovennævnte *Chiridothea*, der neppe er istand til at hæve sig synderligt op fra Bunden.

Opbevarede levende i et Kar ombord, udviste Individerne ringe Livlighed, men holdt sig gjerne stille i halvt sammenrullet Tilstand, omtrent saaledes, som man kan se hos *Zoarces viviparus;* Svømningen skeede med stærke Svingninger af Legemet. Da de lagdes paa Spiritus, vare de dog yderst voldsomme, og viste sig, som de fleste Bundfiske, temmelig seiglivede.

Udbredelse. Under den Forudsætning, at de oftere nævnte 2 spæde Yngel-Individer, der optoges paa Havbroens ydre Skraaning udenfor Lofôten og Helgeland i Norge, ere identiske med *L. frigidus*, foreligger Arten fra den is-

Food. — In the individuals opened with the object of examining the contents of the ventricles, the food was found to consist chiefly of small animals, in particular crustaceans.

Specimen *l*, taken at a depth of 1110 fathoms, had in its stomach determinable parts of Amphipods, amongst which were a *Phoxus crenulatus*, (Boeck), and a *Dulichia*, sp.; also an example of the crimson Decapod, *Hymenodora glacialis*, (Buchh.), a large Isopod, formerly mentioned as *Idothea sabini*, Kr., but which Prof. G. O. Sars, in 1880, described as a new species under the name of *Chiridothea megalura;* finally, divers examples of *Calanus finmarchicus*, (Gunn.).

Specimen *m*, taken at a depth of 1333 fathoms, had in its ventricle an exceptionally large individual of *Themisto libellula*, (Mandt), an example of *Eurycope cornuta*, G. O. Sars, and parts of a sponge.

Specimen *o*, taken with the foregoing example at a depth of 1333 fathoms, had in its stomach an example of *Hymenodora glacialis*, (Buchh.), an individual of the new species *Chiridothea megalura* (G. O. Sars), and of Amphipods, *Themisto libellula*, (Mandt), and a *Stegocephalus*, sp.; finally, parts of a Cephalopod, possibly belonging to the species of the genus *Cirrotheuthis* obtained on the Expedition from a similar depth.

Specimen *g*, taken at a depth of 260 fathoms, had in its stomach — of Amphipods: divers examples of *Themisto libellula*, (Mandt), and an *Anonyx;* of Isopods: *Eurycope cornuta*, G. O. Sars; of Copepods: *Calanus finmarchicus*, (Gunn.) divers examples, and an individual of a genus of Calanids, not yet determined, which Prof. Sars believes to be a near congener of the genus *Euchæta;* finally, of Cumaceans: a *Diastylis stygia*, G. O. Sars.

The ventricle of the largest specimen (*p*), taken at a depth of 1110 fathoms, contained a large *Pasiphaë tarda*, Kr.

It is evident from the food on which these *Lycodes* subsist, that most of the well known, true pelagic animals, which, at certain seasons, occur in vast quantities near the surface, can descend to the greatest depths in which we have as yet been able to investigate the Fauna of the Polar Seas; and that the *Lycodes* — which must unquestionably be regarded as strongly marked bottom-fishes — *do* seek means of subsistence on or near the bottom, is shown, for instance, by the circumstance, that the food of *L. frigidus* comprises forms such as the above-mentioned *Chiridothea*, which can hardly ascend far from the bottom.

Preserved alive on board in a tub of water, the individuals displayed but little vivacity, remaining the greater part of the time half rolled up and motionless, much the same as *Zoarces viviparus;* in swimming, the body is powerfully vibrated. On being immersed in spirits, they were exceedingly violent in their movements, and proved rather tenacious of life.

Distribution. — Assuming the 2 fry-specimens (of which mention has been repeatedly made) that were taken on the outer slope of the great bank, or "sea-bridge," (Havbro), off Lofoten and Helgeland, in Norway, to be

kolde Area lige fra Spitsbergens Vestkyst, og ned forbi Finmarken indtil søndenfor Polarcirkelen. Da Trawlnettet gjentagne Gange har bragt flere Individer for Lyset i det samme Kast, synes de ikke at være sparsomt fordelte, men høre maaske blandt de ægte Dybvandsarter til de hyppigere Bundfiske.

Samtlige Individer optoges fra en betydelig Dybde, 260 til 1330 Favne, og alle, paa en enkelt Undtagelse nær, fra det iskolde Vand.

identical with *L. frigidus,* the range of the species in the cold area extends from the west coast of Spitzbergen past Finmark to some distance south of the Arctic circle. Several individuals having been frequently brought up at once in the trawl-net, it would not appear to be sparingly distributed, and of the true deep-sea forms it possibly belongs to the commoner bottom-fishes.

The specimens were all of them taken at a considerable depth, from 260 to 1330 fathoms, and, with one exception, all in water of a temperature below that of ice.

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20. **Lycodes lütkenii,** n. sp.

Pl. III, Fig. 25.

Lycodes reticulatus, Coll. (nec Reinh.) Forh. Vid. Selsk. Chra. 1878, No. 14, p. 59 (1878).

Diagn. *Nærmest beslægtet med L. reticulatus, Reinh. Farven lyst graaagtig, med utydelige mørke Felter nedad Legemet, og hvidt Nakkebaand; disse Felter ere i Dorsalen næsten sorte. Hovedet iøvrigt uplettet. Skjællene beklæde hele Legemet til et Punkt lige under Pectoralens indre Trediedel; Finnerne, Hovedet, Bugen, Nakken, samt Grunden langs Analen og langs Begyndelsen af Dorsalen nøgen. Legemets Højde indeholdes neppe 6½ Gange, Hovedets Længde ikke fuldt 4 Gange i Totall. Sidelinien enkelt, medio-lateral. Pandens Bredde indeholdes 16 Gange i Hovedets Længde. Pectoralerne særdeles store, indeholdes 5½ Gange i Totallængden. 2 yderst korte Appendices pyloricae. Størrelsen (af det eneste Individ, en Hun) 370mm.*

M. B. 6. D. (+ ½ C.) 94; A. (+ ½ C.) 76; P. 23.

Localit. fra Nordh. Exped. Havet vestenfor Nord-Spitsbergen.

	Stat. 362.
Beliggenhed.	115 Kil. V. Norskøerne, Spitsbergen.
Dybde.	459 Favne (839 m).
Temp. paa Bunden.	— 1,0° C.
Bunden.	Blaagraat Ler.
Datum.	14de August 1878.
Antal Indiv.	1 Indiv.

Bemærkninger til Synonymien. Forhaandenværende Individ, det eneste, der foreligger, henførte jeg ved den foreløbige Beretning om Udbyttet af sidste Aars Togt under *L. reticulatus,* Reinh. (Forh. Vid. Selsk. Chra. 1878, No. 14), da Individet i alle Hovedtræk, saaledes i Tandbygning, Straaleantal i de verticale Finner, Skjælbeklædning,

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20. **Lycodes lütkenii,** n. sp.

Pl. III, fig. 25.

Lycodes reticulatus, Coll. (nec Reinh.) Forh. Vid. Selsk. Chra. 1878, No. 14, p. 59 (1878).

Diagnosis. — *Nearly related to L. reticulatus, Reinh. Colour a light grey, with indistinct dark patches (almost black on the dorsal) down the body, and white nuchal bands; the rest of the head uniform. The entire body scaled to a point opposite the inner third of the pectorals; the fins, head, belly, nape, and basal tract along the anal and commencement of the dorsal naked. The height of the body is contained not quite 6½ times, the length of the head nearly 4 times, in the total length. Lateral line single, medio-lateral. Width of the frontal bone 1/16 of the length of the head. Pectorals exceedingly large, contained 5½ times in the total length. Pyloric appendages two, very short. Length (of the only specimen: a female) 370mm.*

M. B. 6. D. (+ ½ C.) 94; A. (+ ½ C.) 76; P. 23.

Locality (North Atl. Exped.): — The open sea, west of North Spitzbergen.

	Stat. 362.
Exact Locality.	115 Kil. W. Norskøerne, Spitzbergen.
Depth.	459 Fathoms (839 m).
Temp. at Bottom.	— 1.0° C.
Bottom.	Bluish-grey Clay.
Date.	14th August 1878.
Numb. of Specim.	1 Indiv.

Remarks on the Synonymy. — The individual here described, the only specimen yet obtained, I referred in my preliminary report on the results of the last voyage of the Expedition to *L. reticulatus,* Reinh. (Forh. Vid. Selsk. Chra. 1878, No. 14), agreeing as it did in all salient features, viz. the dentition, the number of rays in the vertical fins,

Sidelinie, samt tildels Legemsbygning stemmede overens med den nævnte Art, medens det dog var indlysende, at der fandt enkelte Uoverensstemmelser Sted mellem dem. Den fornyede Undersøgelse, som jeg ved Dr. Lütkens og Prof. Steindachner's Velvillie har været istand til at anstille ogsaa i det sidst forløbne Aar over Typ-Exemplarerne af *L. reticulatus* fra Grønland i Kjøbenhavner-Musæet og i Musæet i Wien, sammenholdt med de Resultater, hvortil Dr. Lütkens egne Undersøgelser over disse Individer have ført (Vid. Medd. Nat. Foren. Kbhvn. 1880, p. 307), har dog bevirket, at jeg i Overensstemmelse med den nævnte Forsker anser det rettest at opføre det spitsbergenske Individ under en egen Art, for hvilken Navnet *L. lütkenii* foreslaaes.

Sammenlignet med *L. reticulatus* udmærker den nye Art sig væsentlig ved følgende:

Medens Farven hos alle de i Kjøbenhavner-Musæet opbevarede udvoxede Ind. af *L. reticulatus,* tilligemed et, ligeledes udvoxet og udmærket vel bevaret Ind., der opbevares i Musæet i Wien, er characteristisk ved sine (oprindelig af mørke Felter fremgaaede) reticulerede sorte Linier, der omgive Felter af den lysere Bundfarve, og som ere stillede i mere eller mindre regelmæssig Række nedad Legemet, er hos det nye Individ *(L. lütkenii)* neppe Spor af disse sorte Linier, men Bundfarven er her lyst graaagtig, kun med yderst svage Antydninger til mørke Felter over Kroppen, medens derimod Dorsalen viser afvexlende sorte og lyse Partier; endvidere mangler Snuden de hvide, skarpt markerede ringformige Tegninger, der findes hos næsten alle Individer af *L. reticulatus.*

Legemsbygningen er hos *L. lütkenii* mere undersætsig. Hos *L. reticulatus* indeholdes Legemets Højde 7—8 Gange i Totallængden, hos *L. lütkenii* neppe $6^1/_2$ Gange i denne.

Den, som det synes, mest paafaldende Ulighed mellem begge Arter frembyder Pectoralernes Bygning. Hos *L. lütkenii* ere nemlig disse større og bredere, end hos nogen af de øvrige bekjendte Lycoder, og udbredes de vifteformigt, rage de, uagtet Individets betydelige Legemshøjde, et godt Stykke udover Legemets Ryg- og Bugside. I Totallængden indeholdes de blot $5^1/_2$ Gange, medens de hos *L. reticulatus* indeholdes 7—9 Gange i denne. Fremdeles er Straaleantallet højere hos *L. lütkenii,* nemlig 23, medens Dr. Lütken hos den anden Art har kun sjeldent fundet 21, men i Regelen blot 19—20.

Iøvrigt ere, som ovenfor berørt, Overensstemmelserne mellem begge Arter ganske betydelige, og der findes ingen væsentlig Forskjel i Sideliniens og Tændernes Bygning, eller i Skjælbeklædningens Udstrækning, ligesom de 2 Arter idethele maa siges at være overensstemmende i sit almindelige ydre Habitus. Sandsynligvis bør de dog opfattes som 2 nærstaaende Arter, der i sin udvoxede Stand kunne adskilles ved de ovenfor paapegede Forskjelligheder i Farvetegning, Legemshøjde, og i Pectoralernes Bygning; om de derimod i sine yngre Stadier vise en ligesaa paatagelig Forskjel, er os endnu ganske ubekjendt, men idethele mindre sandsynligt.

the lateral line, the scales, and to a certain extent the structure of the body, with that species, though several minor points of divergence evidently existed between them. The subsequent examination which Dr. Lütken and Prof. Steindachner kindly enabled me to make last year of the typical specimens from Greenland, preserved in the museums of Copenhagen and Vienna, tested by the results with which Dr. Lütken's own researches in connexion with the said individuals have been attended (Vid. Medd. Naturh. Foren. Kbhvn. 1880, p. 307), induces me to establish the Spitzbergen example, in accordance with the views of that naturalist, as a separate species, for which the name of *L. lütkenii* is suggested.

Compared with *L. reticulatus,* the new species is chiefly distinguished by the following characteristics: —

The coloration in all the full-grown examples of *L. reticulatus* preserved in the Copenhagen museum, and in one, also an adult and in an excellent state of preservation, in the museum at Vienna, is characterised by reticular black lines (issuing from dark patches), which surround large patches of the lighter ground-colour, and are arranged in a more or less regular series extending down the body, whereas there is scarcely a trace of these black lines in the specimen of *L. lütkenii;* the ground-colour in this individual is a light grey, with but the faintest indications of dark patches over the body; the dorsal, on the other hand, exhibits an alternation of dark and light patches; moreover, the snout has none of the white annular markings observed in almost all individuals of *L. reticulatus.*

The structure of the body in *L. lütkenii* is more thickset. In *L. reticulatus,* the height of the body is contained 7—8 times in the total length; in *L. lütkenii,* not quite $6^1/_2$.

But the most striking dissimilarity between the two species is, I think, exhibited in the structure of the pectorals. In *L. lütkenii,* these fins are larger and broader than in any of the other *Lycodes,* and, spreading like a fan, they project, notwithstanding the very considerable depth of body, some distance above and below the dorsal and ventral margins. They are contained only 5 times and a half in the total length, whereas in *L. reticulatus* they are contained 7—9 times. Moreover, the number of rays is greater in *L. lütkenii,* viz. 23, whereas in the other species Dr. Lütken has only once found 21, generally not more than 19—20.

For the rest, the two species resemble each other closely, and there is no material difference in the lateral line, or in the structure of the teeth, or in the extent of the scaled integument; on the whole, too, they must be said to agree in their habitus. Probably, however, they should be regarded as nearly related species, which in the adult stage of growth may be distinguished by the differences pointed out above in the coloration, the height of the body, and the structure of the pectorals; but whether they exhibit an equally obvious distinction in the earlier stages of development, is a question which we are as yet wholly unable to answer; that such should be the case is however not very probable.

Det bliver i denne Forbindelse nødvendigt kortelig at omtale et Par Yngelformer af Lycoder, der hidtil ere blevne opførte som distincte Arter, medens de sandsynligvis blot udgjøre de unge Stadier af 1, eller maaske 2 Arter, der i sin fuldt udvoxede Tilstand ere dem betydeligt ulige i Farvetegning og Skjælbeklædning. Disse Former ere: *L. perspicillum,* Kr. 1844, fra Grønland, *L. rossi,* Malmgr. 1864, fra Spitsbergen, samt *L. gracilis,* M. Sars 1866, fra Norge; det er sandsynligt, at alle disse blot udgjøre Ungdomsstadiet enten alene af *L. reticulatus,* eller tillige af en anden Art, der staar denne nær, maaske *L. lütkenii.*

I 1844 anmeldte Krøyer med en kort og foreløbig Diagnose en ny *Lycodes* fra Grønland under Navn af *L. perspicillum,* og afbildede den nye Art i Gaimards Voy. etc. Poiss., pl. 7, men gav den først i 1863 i Naturh. Tidsskr. 3 R. 1 B. en udførlig Beskrivelse. Af denne Art forelaa 2 Individer med en Totallængde af 39—65^{mm}, af hvilke jeg ved Dr. Lütkens Imødekommen har kunnet undersøge det største i Musæet i Kjøbenhavn. Paa den brungule Bundfarve har det 8 brede, i Midten lysere Felter, ligesom et hvidagtigt Baand forbinder begge Gjællespalter; denne Farvetegning viser en saa paafaldende Overensstemmelse med den, der findes hos det mindste af Typ-Individerne af *L. reticulatus,* der ligeledes opbevares i Kjøbenhavn, og hvis Totall. er 223^{mm}, at der nødvendigvis maa opstaa en Formodning om begge Arters Identitet. Den væsentligste Forandring, der er foregaaet med det omhandlede unge Individ af *L. reticulatus* er, at de mørke Felter, der findes hos *L. perspicillum,* ere blevne mindre skarpt begrændsede, ligesom de begynde at bære Spor af de mørkere reticulerede Linier, der hos de mere udvoxede Individer blive de mest fremtrædende Træk i Farvetegningen hos denne Art.

Finnestraalernes Antal, som hos *L. reticulatus,* ifølge Dr. Lütken, varierer i Dorsalen mellem 91 og 95, i Analen mellem 75 og 76 (eller en Gang 70), er hos *L. perspicillum,* ifølge Krøyer, D. 80, A. 65; de ere saaledes vistnok noget færre, men Tallet tør maaske ikke være correct, hvad Krøyer selv anfører tildels tør være Tilfældet[1], eller man kunde antage Muligheden af, at der yderligere under Væxten vilde udvikle sig et Par nye Hvirvler og tilsvarende Straaler.

Derimod beror Uoverensstemmelsen i Skjælbeklædningens Udstrækning utvivlsomt paa Individets unge Alder, sammenlignet med de udvoxede Individer af *L. reticulatus.* Medens nemlig de sidste ere skjælbeklædte paa Legemet hen til Pectoralens ydre Trediedel, medens hele Bugen og den forreste Del af Ryggen er nøgen, ere Skjællene hos *L. perspicillum,* efter hvad jeg selv har kunnet overbevise mig om, netop i sit første Frembrud paa Halepartiet, medens Skjælbeklædningen paa Legemets Sider strækker sig frem til Midten af Pectoralen. Det er saaledes klart,

[1] Naturh. Tidsskr. 3 R. 1 B. p. 291.

Here it is necessary to make brief mention of certain fry-specimens of one or two forms of *Lycodes* hitherto regarded as distinct species, though in all probability merely representing 1, or possibly 2, species in the early stages of development, which, when full-grown, are found to have undergone a striking change in coloration and the extent of the scaled integument. The forms in question are as follows: — *L. perspicillum,* Kr. 1844, from Greenland; *L. rossi,* Malmgr. 1864, from Spitzbergen; and *L. gracilis,* M. Sars, 1866, from Norway; and they are probably all of them examples either of *L. reticulatus* or of some other species nearly related to it, possibly *L. lütkenii* in an early stage of development.

In 1844 Kröyer announced, with a preliminary diagnosis, the occurrence of a new *Lycodes* off the coast of Greenland, under the name of *L. perspicillum,* and figured it in Gaimard's Voy. &c. Poiss, pl. 7, but did not furnish a detailed description till 1863, in Naturh. Tidsskr. 3 R. 1 B. Of this species two examples had been obtained, total length respectively 39 and 65^{mm}, the largest of which, preserved in the Copenhagen Museum, Dr. Lütken kindly permitted me to examine. Over the brownish-yellow groundcolour are distributed 8 broad patches, lighter in the middle; and a whitish band connects the gill-openings. Now, this peculiarity of coloration exhibits so striking a resemblance to that distinguishing the smallest of the typical specimens of *L. reticulatus,* also preserved in Copenhagen (total length 223^{mm}), that the identity of the two species cannot but suggest itself. The principal change which this immature example of *L. reticulatus* has undergone, consists in the dark patches characteristic of *L. perspicillum* having become less sharply defined, and in their commencing to show indications of the dark reticular lines, which, in a more advanced stage of development, are the most prominent characteristics of coloration in this species.

The number of fin-rays, which in *L. reticulatus,* according to Dr. Lütken, varies in the dorsal between 91 and 95, in the anal, between 75 and 76 (in one specimen 70), is in *L. perspicillum,* according to Kröyer, D. 80, A. 65: this is certainly a somewhat smaller number; but it may possibly be incorrectly given, which Kröyer himself suggests as not improbable, to a certain extent[1]; or the development during the further progress of growth of one or two additional vertebræ and rays might be assumed.

On the other hand, the want of agreement in the extent of the scaled integument, as compared with that distinguishing adults of *L. reticulatus,* must unquestionably be ascribed to the immaturity of the individual. The former are scaled on the body as far as the outer third of the pectorals, the whole of the belly and the anterior part of the back being naked, whereas in *L. perspicillum* the scales, (a fact of which from my own examination I am convinced) are just beginning to develop over the caudal region, but on the sides of the body they extend to the middle of the

[1] Naturh. Tidsskr. 3 R. 1 B. p. 291.

at Skjællene efterhaanden skulle beklæde et større Parti af Legemet, end det, som Krøyer i sin Beskrivelse angiver, idet han ikke synes at have iagttaget de fremspirende Skjæl paa Halen.

L. perspicillum er med andre Ord en spæd Unge, som godt kan antages senere at ville forandre sin Farvetegning, ligesom den endnu ikke havde faaet sin fulde Skjælbeklædning. Da Legemsforholdene iøvrigt hos begge ere overensstemmende, er det ikke usandsynligt, at i de nærmest paafølgende Stadier af denne Forms Liv ville de mørke Tverfelter efterhaanden lysne, og blive forandrede til mindre Pletter eller reticulerede Linier, saaledes som det netop viser sig hos det ovenfor omtalte unge grønlandske Individ af *L. reticulatus* med en Totallængde af 223^{mm}.

Den næste i Rækken er *L. rossi,* opstillet af Malmgren i 1864 i Öfv. Kgl. Vet. Akad. Förh. efter et Individ fra Spitsbergen, erholdt under en af de første svenske Expeditioner til denne Øgruppe. Dette Individ havde en Totallængde af blot 32^{mm}, og et Straaleantal af: D. 82, A. 63; i Farvetegning var det fuldkommen overensstemmende med *L. perspicillum,* men Individet var, i Modsætning til dette, helt nøgent.

Det var paa Grund af det sidstnævnte Forhold, at Malmgren troede at burde opstille det som en distinct Art, skilt fra *L. perspicillum.* Men da *L. perspicillum,* som ovenfor nævnt, netop befandt sig i det Stadium, da Skjællene vare i Frembrud, og Skjælbeklædningen endnu ikke var fuldt udviklet, skjønt det beskrevne Individ havde en Totallængde af 65^{mm}, er det ikke uventet, at en spæd Unge med en Totallængde af blot 32^{mm}, som *L. rossi,* endnu intet Spor viser af nogen Skjælbeklædning. Ved velvillig Imødekommen af Prof. Smitt har jeg erholdt til Undersøgelse dette Individ, og jeg kunde ingen væsentlig Forskjel opdage mellem dette og *L. perspicillum.*

Da endelig Prof. M. Sars i 1866 i Christiania Videnskabs-Selskabs Forh. opstillede sin *L. gracilis* efter et i Drøbaksund i Christianiafjorden erholdt Individ med en Totallængde af 43^{mm}, skeede dette alene af den Grund, at hans Exemplar havde 10 mørke Tverfelter over Legemet, medens *L. rossi* blot havde 8, og da fremdeles hans Exemplar var nøgent, ligesom *L. rossi,* kunde det ikke henføres under *L. perspicillum.* Men allerede Krøyer har paavist, at hans 2 Typ-Exemplarer af *L. perspicillum* ingenlunde vare fuldt overensstemmende i Tegningen af Kroppen; og hvad Skjælbeklædningen angaar, gjælder det samme, som ovenfor er anført under *L. rossi.*

Dog maa paa dette Sted bemærkes, at Krøyers ene Typ-Exemplar blot var 39^{mm} langt (saaledes mindre, end *L. gracilis*), og dog nævner han intet om, at der var nogen Forskjel mellem de 2 Individer med Hensyn til Skjælbeklædningen; men selv om denne i Virkeligheden hos begge[1] har været lige, haves der Exempler paa, at dennes Udvik-

[1] Dette Forhold lader sig ikke længere oplyse. Ifølge Dr. Lütken er saavel det mindste Exemplar af *L. perspicillum*, som det eneste af *L. nebulosus* ikke til at finde paa Musæet i Kjøbenhavn, og sandsynligvis ere de forsvundne.

pectorals. Hence it is evident, that a larger part of the body will gradually become scaled than is stated by Krøyer, who does not appear to have observed these incipient scales on the tail.

L. perspicillum is, in short, a very young individual, in which a subsequent change of coloration may not unreasonably be assumed: as we have seen, the scaled integument had not yet attained its full development. The proportions of the body being in all respects the same in both, it does not appear unprobable that, in the succeeding stages of growth, the dark transverse patches will gradually become lighter, and change to smaller spots or reticular lines, as is seen to be the case with the smallest Greenland specimen of *L. reticulatus,* total length 223^{mm}.

The next of the proposed forms is *L. rossi,* established by Malmgren, in 1864 (Öfv. Kgl. Vet. Akad. Forh.), from a specimen taken off Spitzbergen on one of the first Swedish expeditions to that group of islands. This individual had a length of only 32^{mm}, the number of fin-rays being: D. 82; A. 63; in coloration, it agreed precisely with *L. perspicillum,* but differed from that form in being naked.

It was this feature which Malmgren deemed sufficient to warrant his establishing it as a separate species. But the specimen of *L. perspicillum,* though with a total length of 65^{mm}, having, as stated above, not yet reached tke stage of growth in which the scales begin to form (of some of the scales indications had only just begun to appear), it is not surprising that a very young individual such as *L. rossi,* having a total length of only 32^{mm}, should as yet be without the slightest trace of scales. On application to Prof. Smitt, this individual was kindly lent me for examination, but I failed to detect any essential feature distinguishing it from *L. perspicillum.*

Finally, when Prof. M. Sars in 1866 (Christiania Videnskabs Selskabs Forh.) described his *L. gracilis,* from an individual with a total length of 43^{mm}, taken in Drøbak Sound, in the Christiania Fjord, his sole reason for doing so lay in the said example having 10 dark transverse patches across the body, instead of 8, the number in *L. rossi;* and his specimen being, like the latter, naked, it could not be referred to *L. perspicillum.* But Kröyer had already shown that his two typical specimens of *L. perspicillum* did not by any means exhibit perfect agreement in the marking of the body; and with regard to the scaled integument, what has been said in connexion with *L. rossi,* will apply with equal force here.

The fact, however, must not be passed by, that one of Kröyer's typical specimens was only 39^{mm} long (accordingly of smaller dimensions than *L. gracilis*); and yet no mention whatever is made of any difference between the two individuals as regards the scaled integument; but even assuming it to have been the same in both,[1] instances

[1] Unfortunately, it is no longer possible to settle this question. According to Dr. Lütken, the smallest specimen of *L. perspicillum* and the only one yet obtained of *L. nebulosus*, could not be found in the Copenhagen Museum, and are no doubt both of them lost.

ling foregaar højst forskjelligt hos de forskjellige Individer (cfr., hvad nedenfor anføres under *L. muraena*). Den umiddelbare Sammenligning mellem *L. rossi* og *L. gracilis* har desuden fuldstændigt overbevist mig om, at disse ere identiske.

are not wanting to show that its development can vary to a great extent in different individuals (*vide* what is stated overleaf in connexion with *L. muræna*). A direct comparison of *L. rossi* with *L. gracilis* has fully convinced me of their identity.

L. gracilis, M. Sars. Christiania-Fjord, Norge ($\frac{1}{1}$).

Hovedsummen af de ovenfor anførte Bemærkninger er, at medens der er overvejende Sandsynlighed for, at *L. perspicillum,* Kr. 1844, *L. rossi,* Malmgr. 1864, og *L. gracilis,* M. Sars 1866, ere alle identiske, vil det først med et større Materiale, end det, som for Tiden foreligger i Musæerne, kunne afgjøres, om disse Ungdomsformer tilhøre den som mere udvoxet under Navnet *L. reticulatus,* Reinh. 1838, bekjendte Art, eller maaske tillige en anden nærstaaende Art, der i dette Tilfælde kunde være *L. lütkenii.*

From the data set forth in the above observations there is, I opine, every reason to infer, that *L. perspicillum,* Kr. 1844; *L. rossi,* Malmgr. 1864; and *L. gracilis,* M. Sars 1866, are all three identical; but whether the individuals representing these early stages of development belong to *L. reticulatus,* Reinh. 1838, or possibly to some other nearly related species, which in that case might be *L. lütkenii,* must be left an open question till more extensive materials shall have been furnished us than our museums at present afford.

Udmaalinger.

Totallængde (Hun)	370^{mm}
Legemets største Højde (ved Begyndelsen af Dorsalen)	58 -
Legemets Højde ved Begyndelsen af Analen	47 -
Snudens Afstand fra Dorsalen	111 -
Snudens Afstand fra Anus	175 -
Anus' Afstand fra Halespidsen (Halens Længde)	195 -
Hovedets Længde	95 -
Snudens Længde (til Iris)	31 -
Øjets Længde (Iris' Længdediameter)	13 -
Hovedets postorbitale Del (fra Bagranden af Iris)	52 -
Interorbitalrummet (mellem begge Irides)	12 -
Overkjævens Længde	42 -
Hovedets Højde over Øjnene	37 -
Hovedets Højde lige bag Ventralerne	48 -
Ventralernes Afstand fra Anus	107 -
Pectoralens Grundlinie	28 -
Pectoralens største Længde	64 -
Pectoralens Afstand fra Anus	30 -

Measurements.

Total length (female)	370^{mm}
Greatest height of body (at origin of dorsal)	58 -
Height of body (at origin of anal)	47 -
Distance of snout from dorsal	111 -
Distance of snout from vent	175 -
Distance of vent from tip of tail (length of tail)	195 -
Length of the head	95 -
Length of snout (to iris)	31 -
Length of the eye (longitudinal diameter of iris)	13 -
Postorb. region of head (from post. marg. of iris.)	52 -
Interorbital space (between the irides)	12 -
Length of upper jaw	42 -
Height of head above the eyes	37 -
Height of head immediately posterior to ventrals	48 -
Distance of ventrals from vent	107 -
Base of pectorals	28 -
Greatest length of pectorals	64 -
Distance of pectorals from vent	30 -

Beskrivelse. *Legemsbygning.* I det hovedsagelige stemmer *L. lütkenii,* som ovenfor under Bemærkningerne til Synonymien er paapeget, i sin Skjælbeklædning, Legemsbygning og Straaleantal overens med *L. reticulatus,* men den kan skilles fra denne bl. a. ved sit kortere og stærkere Legeme, ved Pectoralernes betydelige Størrelse, samt ved Farvetegningen.

Legemet er forholdsvis særdeles undersætsigt og stærktbygget; dets Højde indeholdes ikke fuldt $6^1/_2$ Gange i Totallængden (et Forhold, der blot er naaet af det største Individ af *L. frigidus,* en Han, hvis Totallængde var noget over 500^{mm}).

Hovedet er forholdsvis stort, skjønt Individet er en Hun, og indeholdes ikke fuldt 4 Gange i Totallængden. Snuden er temmelig fladtrykt; Øjnene ere relativt smaa, og indeholdes i Hovedlængden $9^1/_2$ Gange. Paa Craniet

General Description. *Structure of the Body.* — As previously observed when treating of the synonomy, *L. lütkenii* agrees in all essential particulars, viz. the development of the scaled integument, the structure of the body, and the number of fin-rays, with *L. reticulatus,* but may be distinguished from that species by its body, which is shorter and stronger, the very considerable size of the pectorals, and by the coloration.

L. lütkenii has comparatively a very thickset and strongly built body; its height is contained not quite $6^1/_2$ times in the total length (a proportion met with in the largest specimen of *L. frigidus* alone, total length upwards of 500^{mm}).

Head comparatively large, though the individual described is a female, equalling not quite $^1/_4$ of the total length. Snout slightly depressed; eyes rather small, being contained $9^1/_2$ times in the length of the head. Measured

udgjør Pandens Bredde $^1/_{16}$ af Hovedlængden, og dette Parti er saaledes forholdsvis bredt.

Overkjæven er kortere, end Hovedets halve Længde, og naar tilbage hen under Lindsens Bagrand.

I Totallængden indeholdes:

Hovedets Længde	3,89
Legemets største Højde	6,37
Snudens Afstand fra Dorsalen	3,33
Snudens Afstand fra Anus	2,11
Halens Længde	1,89

Af Tænder findes i Mellemkjæverne en længere Række af omtrent 15 paa hver Side, hvoraf de forreste ere de længste; hertil kommer en kortere Række i Spidsen bagenfor den første Række. Samtlige disse Tænder ere forholdsvis smaa, og blot de 2 allerforreste ere længere, end de øvrige. I Underkjæven, hvis tandbærende Del er længere, end den tilsvarende i Overkjæven, findes 12 længere og grovere Tænder, foruden et Antal finere Tænder foran disse i Spidsen. Palatinbenene bære fremdeles i en enkelt Række 15, Vomer 5 Tænder, der alle ere forholdsvis grove.

Finnerne. Dorsalen, som (fraregnet den halve Caudal) tæller 89 Straaler, begynder i en Afstand fra Snudespidsen, der indeholdes $3^1/_3$ Gange i Totallængden. Analen har paa samme Maade 71 Straaler; og da Caudalen har paa sin dorsale Side 6, paa den ventrale 5 Straaler, bliver det samlede Antal Straaler i Dorsalen 95, i Analen 76.

Pectoralerne ere overordentlig store og brede, og have paa begge Sider 23 Straaler. Udbredt optager Finnen en større Højde, end hele Legemshøjden og Dorsalhøjden tilsammen; fremslaaet naar den omtrent midt paa Øjet, tilbageslaaet i en Snudelængdes Afstand fra Anus. Dens Længde indeholdes i Totallængden blot ubetydeligt over $5^1/_2$ Gange. Straalerne ere i Spidsen særdeles brede.

Skjælbeklædning. Skjælbeklædningen mangler, foruden paa Hovedet og Finnerne, paa hele Bugen, samt langs Grunden af Analen indtil en halv Hovedlængde bag Anus; fremdeles er hele Nakken og Grunden langs Dorsalen omtrent indtil Verticalen fra Anus nøgen. Skjælbeklædningen strækker sig saaledes paa Legemets Midte frem indtil et Punkt under Pectoralens indre Trediedel. Skjællene ere forholdsvis ikke store. Finnerne ere nøgne; dog gaa paa Halens nedre Del enkelte Skjæl ud et kort Stykke over Finnernes Grund.

Sidelinien. Denne er mediolateral og enkelt, samt udspringer, som hos de øvrige Arter, over Gjællespalten; i en skraa Retning gaar den med et Antal af omtrent 17 tætstillede Porer ned til Legemets Midtlinie, som den følger til Halespidsen. Intet Spor af nogen lavere (ventral) Sidelinie kan opdages hos det foreliggende Individ; derimod strækker sig en Række af 10—12 Porer fra Gjællespaltens øvre Ende langs Ryggen, og slutter omtrent ved Legemets 3die mørke Felt.

Paa forskjellige af Hovedets Dele findes spredte Slimporer, tildels forsynede med en ophøjet Rand. Saale-

on the cranium, the interorbital space equals $^1/_{16}$ of the length of the head, and is therefore comparatively broad.

Upper jaw shorter than the head by one half, and extending backwards under the posterior margin of the lens.

The Total Length contains: —

The length of the head	3.89
The greatest height of the body	6.37
The distance of the snout from the dorsal	3.33
The distance of the snout from the vent	2.11
The length of the tail	1.89

The intermaxillaries are furnished with a row of 15 teeth on either side, the foremost being the longest; and a shorter series at the extremity, posterior to the first. All of these teeth are comparatively small, the two foremost only being somewhat longer than the rest. In the mandible, of which the part furnished with teeth is longer than the corresponding part in the upper jaw, occur 12 longer and stouter teeth, exclusive of a number of minute teeth anterior to them at the extremity. The palatine bones have 15 teeth, the vomer 5, all of which are rather strong.

Fins. — The dorsal, which, exclusive of half of the caudal, is furnished with 89 rays, commences at a distance from the point of the snout contained $3^1/_3$ times in the total length. The anal is furnished in like manner with 71 rays, and the caudal having on the dorsal side 6, on the ventral 5 rays, the total number of rays in the dorsal amounts to 95, in the anal to 76.

The pectorals are exceedingly large and broad, with 23 rays on either side; when spread out, their height exceeds that of the body and of the dorsal put together; the spread forwards reaches almost to the middle of the eye; backwards, within the length of the snout from the vent; its length compared to the total length slightly exceeds the proportion of 1 to $5^1/_2$; rays remarkably broad at the points.

Scales. — Scales wanting on the head, fins, the entire belly, and the base along the anal to within half the length of the head posterior to the vent; the whole of the nape, too, and the base along the dorsal, naked to a point perpendicular to the vent. Hence the scaled integument extends along the middle of the body to a point opposite to the inner third of the pectorals. The scales are not large, comparatively. Fins naked; on the inferior portion of the tail, however, a few scales cross their base.

Lateral Line. — Single and medio-lateral, commencing, as in the other species, above the gill-opening; taking an oblique direction, it runs on to the mesial line of the body, accompanying it to the tip of the tail. There is no trace of a lower (ventral) lateral line in the specimen here described, but a series of 10 or 12 pores extends from the upper extremity of the gill-opening down along the back, terminating at about the third dark patch on the body.

On several parts of the head occur isolated mucous pores, some of them with an elevated margin. Thus, for

des staa paa Kinderne hen mod den øvre Rand af Operculum paa hver Side i en Triangel 3 Porer; bag Øjnene findes 2 mindre, og atter nedenfor disse 3 større Porer. En stor Pore aabner sig ved den nedre Vinkel af Operculum, ligesom den normale Række er tilstede langs Kjæverne.

Farve. Legemets Bundfarve er blegt graaagtig brun; under passende Belysning kan skimtes, men højst utydeligt, 6 mørkere Felter, der i Midten ere lysere, og have enkelte sorte Smaapletter, som danne en Tilnærmelse til de reticulerede Linier, der findes hos *L. reticulatus.* Tydeligst ere disse mørke Felter henad Dorsalen, hvor deres Rande ere næsten sorte, og skarpt markerede. Mellemrummet mellem Felterne er paa Legemet kun lidet lysere, end Felterne selv, men næsten renhvidt paa Dorsalen og Halespidsen.

Hovedet har ingen andre Tegninger, end et hvidt Baand, der strækker sig tvers over Nakken fra den ene Gjællespalte til den anden, og er begrændset af en utydelig sort Linie; iøvrigt er Hovedet blegt rødlig graat, noget lysere, end Kroppen, hvilket ogsaa er Tilfældet med Pectoralerne.

Føde, etc. Individet var en Hun, med umodne Æg i det eneste Ovarium. Ventrikelen, der var meget musculøs, indeholdt et noget fordøjet Individ af *Cottunculus microps,* Coll. (med en Totallængde af 110^{mm}), samt Dele af en anden mindre Fisk, der var stærkere fordøjet, og ubestemmelig.

2 afrundede Udvidelser af Tarmen ved Pylorus kunne opfattes som et Par rudimentære Appendices pyloricae.

Udbredning. Det eneste hidtil bekjendte Exemplar af denne Art optoges fra betydeligt Dyb og iskoldt Vand i Havet nogle Mile vestenfor Nord-Spitsbergen, omtrent under 80° N. B.

Af den nærstaaende Art *L. reticulatus* findes, som ovenfor nævnt, udvoxede Individer fra Grønland i Musæet i Kjøbenhavn, samt et i Wiener-Musæet, alle erholdte i Aarene 1830—40. Af *L. perspicillum,* Kr., fra Grønland findes ligeledes et Individ i Musæet i Kjøbenhavn; af *L. rossi,* Malmgr., fra Spitsbergen opbevares det eneste Individ i Riks-Museum i Stockholm, og endelig findes Individet af *L. gracilis,* M. Sars, fra Christianiafjorden, i Universitets-Musæet i Christiania. Alle disse 3 sidstnævnte Arter maa, som ovenfor omhandlet, antages at udgjøre Ungdomsformerne af *L. reticulatus,* eller af *L. liitkenii* (eller af begge?)

instance, on the cheeks, near the upper margin of the operculum, a triangular figure is formed by pores, three in each of its sides; behind the eyes are two smaller ones, and below these pores three larger ones. A large pore occurs at the inferior angle of the operculum, and the normal series along the jaws is also present.

Colour. — The ground-colour of the body is a greyish-brown; in a good light, 6 dusky patches can be discerned, very indistinctly however; they are lighter in the middle, and marked with a few small black spots, an approximation to the network of lines in *L. reticulatus.* These dark patches show most distinct down the dorsal, their margins on that fin being almost black, and sharply defined. On the body, the space between the patches is very little lighter than are the patches themselves, but on the dorsal and the tip of the tail, it is nearly pure white.

The only marking on the head consists of a white band stretching across the nape from one gill-opening to the other, and margined by an indistinct black line; the rest of the head is of a uniform pale reddish-grey, a shade lighter than the body, which is also the case with the pectorals.

Food, etc. — The individual here described was a female, with immature ova in its single ovary. The ventricle, which was very muscular, contained an example of *Cottunculus microps,* Coll., in a partially digested state (total length 110^{mm}), together with parts of a smaller fish, which did not admit of being determined.

Two globular swellings of the intestine at the pylorus may be regarded as a pair of obtuse pyloric appendages.

Distribution. — The only example of this species as yet obtained was brought up from a considerable depth in the frigid area of the ocean, a few leagues west of the north coast of Spitzbergen, in lat. about 80° N.

Of its nearly related congener *L. reticulatus,* Reinh. full-grown specimens from Greenland are, as above stated, preserved in the Museum at Copenhagen and in the Vienna Museum, all of which were obtained in the decade from 1830 to 1840; of *L. perspicillum,* Kr., also from Greenland, there is, too, an example in the Museum at Copenhagen; of *L. rossi,* Malmgr. from Spitzbergen, the only specimen taken is preserved in the "Riks Museum" at Stockholm; and finally, the specimen of *L. gracilis,* M. Sars, from the Christiania Fjord, is in the Christiania University Museum. The three last-mentioned individuals must, as suggested above, be regarded as representing the early stages of development of *L. reticulatus,* or of *L. liitkenii* (or possibly of both).

21. **Lycodes pallidus,** Coll. 1878 (n. sp.)

Pl. III, Fig. 26—27.

Lycodes pallidus, Coll. Forh. Vid. Selsk. Chra. 1878, No. 14, p. 70 (1878).

Diagn. *Farven (hos yngre Individer) blegt graabrun, med en Række (5—6) sorte Felter nedad Dorsalen, samt et enkelt, længere Felt af samme Farve paa Analen hen imod Spidsen. Skjællene forholdsvis store, og beklæde Legemet indtil henimod Pectoralernes Grund; Hovedet, Finnerne, samt Midten af Bugen ere nøgne. Legemets Højde indeholdes 9$^1/_2$ Gange, Hovedet næsten 4$^1/_2$ Gange i Totallængden (hos yngre Indiv.) Sidelinien enkelt, ventral, løber fra Gjællespaltens øvre Ende skraat nedad mod Anus. Størrelsen hos de foreliggende unge Individer indtil 164^{mm}.*

M. B. 6. D. 98—101; A. 84—86; P. 18—19.

Localit. fra Nordh. Exped. Havet udenfor NV. Spitsbergen.

	Stat. 362.	*Stat.* 363.
Beliggenhed.	115 Kilom. V. Norskøerne, Spitsb.	60 Kilom. V. Norskøerne, Spitsb.
Dybde.	459 Favne (839 ^{m}).	260 Favne (475 ^{m}).
Temp. paa Bunden.	— 1,0° C.	+ 1,1° C.
Bunden.	Blaagraat Ler.	Blaaler.
Datum.	14de Aug. 1878.	14de Aug. 1878.
Antal Indiv.	1 yngre Indiv.	1 Unge.

Udmaalinger.

	a. (*Stat.* 363).	*b.* (*Stat.* 362).
Totallængde	93^{mm}	164^{mm}
Længde til sidste Halehvirvel	90 -	161 -
Højde ved Begyndelsen af Dorsalen	10 -	17 -
Højde ved Begyndelsen af Analen	8,5 -	14 -
Snudespidsen til Begyndelsen af Dorsalen	25 -	46 -
Snudespidsen til Anus	37 -	64 -
Anus til Halespidsen (Halens Længde)	56 -	100 -
Hovedets Længde	21 -	37 -
Snudens Længde (til Begyndelsen af Iris)	7 -	13 -
Øjets Længde (Længde-Diameteren af Iris)	4 -	7 -
Hovedets postorbitale Del	10 -	17 -
Underkjævespidsens Afstand fra Ventralen	16 -	27 -
Ventralernes Afstand fra Anus	19 -	34 -
Ventralernes Længde	3 -	4 -
Pectoralernes Længde	13 -	16 -

Beskrivelse. *Legemsbygning.* I Legemsbygning, Sidelinie og Skjælbeklædning væsentlig overensstemmende med *L. frigidus;* dog ere Skjællene forholdsvis større, Pectoraler og Ventraler noget kortere, og Øjnene (især Lindsen) mindre, end hos denne Art. Som characteristisk for denne

21. **Lycodes pallidus,** Coll. 1878 (n. sp.)

Pl. III, Fig. 26—27.

Lycodes pallidus, Coll. Forh. Vid. Selsk. Chra. 1878, No. 14, p. 70 (1878).

Diagnosis. — *Colour (in young examples) pale greyish-brown, with a series (5—6) of black patches extending down the dorsal, and a patch of greater length, but similar in colour, near the extremity of the anal. Scales relatively large, covering the body almost to the base of the pectorals; the head, the fins, and the middle of the belly naked. The height of the body is to the total length (in immature individuals) as 1 to 9$^1/_2$; the length of the head, nearly as 1 to 4$^1/_2$. Lateral line single, ventral, passing from the upper extremity of the gill-opening obliquely downwards to the vent. The length in the specimens obtained reaching 164^{mm}.*

M. B. 6. D. 98—101; A. 84—86; P. 18—19.

Locality (North Atl. Exped.): — The sea off NW. Spitzbergen.

	Stat. 362.	*Stat.* 363.
Exact Locality.	115 Kilom. W. Norskøer, Spitzb.	60 Kilom. W. Norskøer, Spitzb.
Depth.	459 Fathoms (839 ^{m}).	260 Fathoms (475 ^{m}).
Temp. at Bottom.	— 1.0° C.	+ 1.1° C.
Bottom.	Bluish-green Clay.	Blue Clay.
Date.	14th Aug. 1878.	14th Aug. 1878.
Numb. of Specim.	1 Indiv. (young).	1 Indiv. (young).

Measurements.

	a. (*Stat.* 363).	*b.* (*Stat.* 362).
Total length	93^{mm}	164^{mm}
Length to last caudal vertebra	90 -	161 -
Height at origin of dorsal	10 -	17 -
Height at origin of anal	8.5 -	14 -
From point of snout to origin of dorsal	25 -	46 -
From point of snout to vent	37 -	64 -
From vent to tip of tail (length of tail)	56 -	100 -
Length of head	21 -	37 -
Length of snout (to origin of iris)	7 -	13 -
Length of the eye (longit. diam. of iris)	4 -	7 -
Postorbital region of head	10 -	17 -
From extremity of mandible to ventrals	16 -	27 -
Distance of ventrals from vent	19 -	34 -
Length of ventrals	3 -	4 -
Length of pectorals	13 -	16 -

General Description. *Structure of the Body.* — In the structure of the body, the lateral line, and the scales closely agreeing with *L. frigidus;* the scales are however somewhat larger, the pectorals and ventrals somewhat shorter, and the eyes (particularly the lens) smaller than in

Arts Ydre kan endvidere nævnes den med sorte Felter forsynede Dorsal og Anal.

Legemet er, som hos alle de typiske Lycoder, omtrent jevnhøjt fra Nakken af og til forbi Anus, derfra afsmalnende, og efterhaanden løbende ud i en tilspidset Halespids; hele Halepartiet stærkt sammentrykt. Den største Højde (ved Begyndelsen af Dorsalen) indeholdes i Totallængden omtr. $9^1/_2$ Gange; ved Begyndelsen af Analen er Højden kun lidet aftaget, og indeholdes her lidt over 10 Gange i Totallængden. Afstanden fra Snudespidsen til Anus indeholdes $2^1/_2$ Gange, Halen $1^6/_{10}$ Gange i Totallængden.

Hovedet er temmelig fladtrykt, og indeholdes i Totallængden næsten $4^1/_2$ Gange. Overkjæven naar tilbage hen under Midten af Lindsen; hos det mindre Exemplar er Snuden noget stumpere og højere, Overkjæven er tillige noget kortere, og naar her blot hen under Lindsens Forrand.

De skaalformige Fordybninger langs Randen af Kjæverne ere særdeles fremtrædende, især hos det mindste Individ. Næseborene sidde temmelig nær ved Mellemkjæveranden, ere enkelte, og have, som hos de øvrige Arter, en lang hvidagtig Tube.

Øjnene ere forholdsvis mindre, end hos *L. frigidus*. Sammenlignes det største Individ af *L. pallidus* med et ligestort (ungt) Ind. af *L. frigidus*, sees Lindserne hos den sidste at være omtr. dobbelt saa store, som hos den første.

I Totallængden indeholdes	a. Totallængde 93 mm	b. Totallængde 164 mm
Hovedets Længde	4,42	4,43
Legemets Højde.	9,30	9,64
Snudens Afstand fra Dorsalen . .	3,72	3,56
Snudens Afstand fra Anus . . .	2,51	2,56
Halens Længde	1,66	1,64
Pectoralens Længde	7,15	10,25

Tænder ere tilstede i Mellemkjæverne, i Underkjæven, paa Vomer, og paa Palatinbenene, som hos de øvrige nordiske Lycoder. De ere forholdsvis stærke, stillede i Mellemkjæven fortil i 2, bagtil i 1 eller 2 Rækker; i Underkjæven danne de fortil flere Rækker. Da Individerne endnu ikke kunne antages at være fuldt udvoxede, har Antallet af Tænderne og disses Rækker maaske endnu ikke naaet sin fulde Udvikling.

Finnerne. Dorsalen, der hos det større Individ tæller omtrent 92, hos det mindre omtrent 95 Straaler, eller, sammenlagt end den halve Caudal, 98—101, begynder i en Afstand fra Snudespidsen, der indeholdes i Totallængden ikke fuldt 4 Gange.

Analen har hos det større Individ omtrent 79, hos det mindre omtrent 81 Straaler, hvilket sammen med Caudalens nedre Halvdel udgjør 84—86 Straaler. Straalerne ere hos de 2 undersøgte Individer vanskelige at tælle, hvor-

that species. As a conspicuous exterior feature characterising *L. pallidus*, may be mentioned the black patches on the dorsal and anal.

As in the typical *Lycodes*, the height of the body is very nearly uniform from the nape till past the vent, at which point the body gradually tapers, terminating in a pointed tail; the whole of the caudal region greatly compressed. Greatest height (at the origin of dorsal) is to the total length about as 1 to $9^1/_2$; at the origin of the anal the height is but little diminished, equalling rather more than $^1/_{10}$ of the total length. The distance from the point of the snout to the vent is to the total length as 1 to $2^1/_2$; the length of the head, as 1 to $1^6/_{10}$.

Head rather compressed; its length compared to the total length is nearly as 1 to $4^1/_2$. Upper jaw extending backwards under the middle of the lens; in the smaller specimen, the snout is somewhat more obtuse, and higher, the upper jaw not reaching further back than under the anterior margin of the lens.

The bowl-shaped depressions extending along the margin of the jaws are very distinct in the smaller specimen. Nostrils placed in close proximity to the margin of the inter-maxillary; they are single, and furnished with a whitish tube.

Eyes relatively smaller than in *L. frigidus*. On comparing the largest example of *L. pallidus* with a (young) specimen of equal size of *L. frigidus*, the lenses in the latter are found to be about twice as large as in the former.

The Total Length contains	a. Total Length 93 mm	b. Total Length 164 mm
The length of the head	4.42	4.43
The height of the body	9.30	9.64
The dist. of the snout from the dors.	3.72	3.56
The dist. of the snout from the anus	2.51	2.56
The length of the tail	1.66	1.64
The length of the pectorals. . .	7.15	10.25

Teeth on the intermaxillaries, in the mandible, on the vomer, and on the palatine bones, as in the other northern species. They are comparatively strong, arranged on the intermaxillary anteriorly in 2, posteriorly in 1 or 2 series; in the mandible they constitute several series. The individuals having none of them, it is conceived, attained the adult stage of development; the number alike of the teeth and of their series is possibly not yet complete.

Fins. — The dorsal which, in the larger individual, is furnished with about 92, in the smaller with about 95 rays, or, including half the caudal, with 98 and 101 respectively, commences at a distance from the point of the snout not quite equal to one-fourth of the total length.

In the larger individual, the anal is furnished with about 79; in the smaller, with about 81 rays; or, including the lower half of the caudal, with 84 and 86 respectively. The rays in the two specimens examined cannot be accu-

for Antallet maaske i hver af Finnerne ere et Par flere eller færre.

Pectoralerne have hos det større Individ paa begge Sider 18, hos det mindre 19 Straaler, og ere forholdsvis korte, især hos det større Individ, hvor de fremlagte ere med sine Spidser fjernede mindst en Lindselængde fra Lindsen; hos det mindre Exemplar naa de derimod frem til Lindsens Bagrand. I Totallængden indeholdes de hos det yngste Individ kun lidt over 7, hos det ældre endog over 10 Gange i Totallængden. De nedre Straaler ere stærkt forkortede.

Ventralerne ere ligeledes forholdsvis kortere, end hos de øvrige Arter, og synes at indeholde 2 yderst spinkle Straaler.

Skjælbeklædning. Næsten hele Legemet er skjælbeklædt; Hovedet, Nakken, Bugens Midte og Finnerne ere nøgne. Skjællene ere forholdsvis store, iøvrigt af Bygning, som hos de øvrige Lycoder. Fortil strækker Skjælbeklædningen sig frem mod Grunden af Pectoralerne; Bugen er derimod nøgen i Midten, men skjælbeklædt paa Siderne. Finnerne ere ligeledes nøgne, men der er ingen nøgen Rand langs deres Grundlinier; paa Hovedet og Nakken findes ingen Skjæl.

Det mindre Exemplar er ligesaa stærkt beklædt, som det større, og Skjællene strække sig her endog noget længere frem, eller umiddelbart til Pectoralernes Grund, ligesom der blot findes en smal Stribe langs Bugens Midtlinie, der ikke er skjælbeklædt.

Sidelinien er hos de forhaandenværende (yngre) Individer vanskelig at forfølge; dog er den utvivlsomt ventral, idet den udspringer ved Gjællespaltens øvre Ende, gjør en liden Bue over Gjællelaagets Flig, og gaar derpaa i skraa Retning, uden at have noget ret Parti, lige ned mod Anus; herfra er den paa begge de 2 Individer utydelig, men kan dog tildels øjnes som løbende langs Grunden af Analen ud mod Halespidsen. Porernes Antal indtil Anus er omtrent 34. Af nogen mediolateral Sidelinie kan ikke sees Spor.

Farven er paa selve Legemet blegt graabrun, uden Tegninger; Skjællene ere overalt lysere, end Bundfarven, der under Lupen sees at have forholdsvis store og skarpt farvede Pigmentpunkter. Derimod ere Dorsalen og Analen paa hvidagtig Grund forsynede med en Række sorte Felter, der paa den førstnævnte Finne ere 5—6 i Antal. Det første af disse begynder umiddelbart ved Dorsalens første Straaler; de øvrige ere stillede med omtrent lige langt Mellemrum, som det, de selv optage, henad hele Finnens Længde. I Lighed med, hvad der finder Sted hos de med Tverbaand forsynede Lycoder, ere de dog noget forskjellige hos begge Individer; saaledes er det sidste Felt utydeligt hos det større Individ, hvorved dette faar en længere hvid Halespids, end det mindre. Analen har et enkelt, meget langt sort- eller sortagtigt Felt henimod Spidsen, men er forresten ensfarvet hvidagtig.

rately counted, and hence the true number in each of the fins may be greater or less by one or two rays.

The pectorals in the larger individual have on both sides 18, in the smaller 19 rays, and are comparatively short, more especially in the larger individual, the tips, when the fin is spread forwards, being removed at least the length of the lens from the lens; in the smaller individual they reach to its posterior margin. In the youngest specimen, the length of the pectorals compared to the total length slightly exceeds the proportion of 1 to 7; in the older example, of 1 to 10. The inferior rays are much shortened.

The ventrals, too, are relatively shorter than in any of the other species, and would seem to the composed of 2 rays.

Scales. — Almost the whole of the body in this species scaled; the head, the nape, the middle of the belly, and the fins naked. The scales are comparatively large, in other respects of the same structure as in the other species. Anteriorly, the scales extend towards the base of the pectorals; the belly, however, is naked in the middle, but scaled on the sides. Fins likewise naked, but there is no naked part along their basal lines; the head and nape are without scales.

The smaller example as extensively scaled as the larger, the scales reaching even somewhat farther in advance, or up to the base of the pectorals; indeed there is only a narrow strip along the mesial line of the belly that is scaleless.

The lateral line can with difficulty be traced throughout in these young individuals; it is, however, unquestionably ventral, commencing as it does at the upper extremity of the gill-opening, and passing from thence, after a slight bend above the gill-cover, straight down to the vent; here, in both specimens, it begins to be indistinct, but can however be distinguished, taking a course along the base of the anal to the extremity of the tail. Number of pores from origin to vent about 34. No trace of a medio-lateral line can be detected.

Colour on the body proper pale brownish-grey, with no markings whatever. The scales are everywhere of a lighter shade than the ground-colour, which, seen through a lens, appears dotted over with comparatively large and sharply defined pigmentary spots. The dorsal and anal are, on the contrary, distinguished by a series of black patches extending over a whitish ground, on the former fin 5 or 6 in number. The first of these blackish patches covers the first rays of the dorsal, the rest are arranged, with interspace about equal to their own breadth, down the whole extent of the fin. As is the case with the *Lycodes* that have transverse bands, they slightly differ, however, in the two individuals; thus, the last of the patches is indistinct in the larger specimen, giving greater length to the white termination of the tail. The anal has a solitary black or dusky elongated spot near its extremity; with this exception it is uniformly whitish.

Disse mørke Felter ere hos det mindre Exemplar kulsorte og skarpe, hos det større noget mindre tydelige og graasorte; de gaa lige ud til Randen af Finnerne, men ikke ud over Legemet, endskjønt der sees en næsten umærkelig mørk Skygning under hvert af dem. Hovedet har ingen Tegninger, undtagen forsaavidt, som Gjællelaagets Flig er ubetydeligt mørkere, end Hovedets øvrige Dele. Bughinden er hos det mindre Exemplar blaasort gjennemskinnende.

Det er sandsynligt, at den ovenfor beskrevne Farvetegning, der tilkommer de forholdsvis unge Individer, vil forandres, eftersom Individerne voxe til, og da sandsynligvis paa den Maade, at Dorsalens og Analens sorte Felter blive end mere utydelige.

Udbredelse. Hidtil foreligge blot de 2 under Nordhavs-Expeditionen ved Spitsbergens Nordkyst fundne unge Individer, der optoges fra 260—459 Favnes Dyb, og under en Temperatur paa Bunden, der i det ene Tilfælde var lidt over, i det andet lidt under 0°. C.

22. **Lycodes seminudus**, Reinh. 1838.

Pl. IV, Fig. 28.

Lycodes seminudus, Reinh. Kgl. D. Vid. Selsk. Naturv. Math. Afh. 7 Del, p. 221 (1838).

Diagn. *Farven i alle Aldre blegt graabrun, uden Pletter eller Baand. Skjælbeklædningen mangler paa Legemets forreste Parti omtrent indtil Verticalen fra Anus; samt paa Hovedet og Finnerne. Legemets Højde indeholdes hos et yngre Individ næsten $8^1/_2$ Gange i Totallængden, hos et ældre (Typ-Individet) 7 Gange i denne. Hovedet forholdsvis stort, dets Længde indeholdes hos yngre Individer 4 Gange (hos et ældre neppe $3^1/_2$ Gange) i Totallængden. Sidelinien medio-lateral, enkelt. Halepartiet og Pectoralerne forholdsvis korte. Appendices pyloricae 2 (Reinh.). Størrelsen indtil 450mm.*

M. B. 6. D. 91—92; A. 73—75; P. 19—22.

Localit. fra Nordh. Exped. Spitsbergen.

	Stat. 363.
Beliggenhed.	60 Kil. V. Norskøerne, Spitsbergen.
Dybde.	260 Favne (475m).
Temp. paa Bunden.	+ 1,1° C.
Bunden.	Blaaler.
Datum.	14de Aug. 1878.
Antal Individer.	1 ungt. Indiv.

In the smaller specimen, these dark patches are black and sharply defined; in the larger, less distinct and dusky. They extend to the margin of the fins, but do not encroach upon the body, though a scarcely perceptible clouding of a darker shade may be discerned under each of them. No markings on the head, save inasmuch as the flap of the gill-cover is a trifle darker than any other part of it. Ventral membrane in the smaller specimen translucent bluish-black.

It is probable that the coloration above described, characteristic of comparatively young individuals, will undergo a change as the course of development progresses, the black patches on the dorsal and anal becoming more and more indistinct.

Distribution. — The only individuals as yet met with, are the 2 young examples obtained on the North Atlantic Expedition off the northern shores of Spitzbergen, which were taken at a depth of 260 and 459 fathoms respectively, one in water a little below, the other in water a little above, the temperature of ice.

22. **Lycodes seminudus**, Reinh. 1838.

Pl. IV, fig. 28.

Lycodes seminudus, Reinh. Kgl. D. Vid. Selsk. Naturv. Math. Afh. 7 Del, p. 221 (1838).

Diagnosis. — *Colour in all stages of development a pale greyish-brown, destitute of spots or bands. Scales wanting on the anterior part of the body to a perpendicular from the vent, as also on the head and the fins. The height of the body is to the total length in one young individual nearly as 1 to $8^1/_2$; in a maturer (typical) individual, as 1 to 7. Head comparatively large, its length in one young individual being to the total length as 1 to 4; in an older example the proportion was not quite as 1 to $3^1/_2$. Lateral line single, medio-lateral. Caudal region and pectorals comparatively short. Pyloric appendages 2 (Reinh.). Length reaching 450mm.*

M. B. 6. D. 91—92; A. 73—75; P. 19—22.

Locality (North Atl. Exped): — Spitzbergen.

	Stat. 363.
Exact Locality.	60 Kil. W. Norskøer, Spitzbergen.
Depth.	260 Fathoms (475m).
Temp. at Bottom.	+ 1.1° C.
Bottom.	Blue Clay.
Date.	14th Aug. 1878.
Numb. of Specim.	1 Indiv. (young).

Bemærkninger til Synonymien. Efterat denne Art i 1838 blev beskrevet af Reinhardt efter et (fuldvoxent?) Individ med en Totall. af 445 mm fra Grønland, synes den ikke at have været gjenfunden; den er ikke senere bleven omtalt af nogen Forfatter efter Autopsi, idet Günther's og Gill's Diagnoser ere affattede efter Reinhardt's Beskrivelse. Det nye unge Individ fra Spitsbergen, der er udmærket vel vedligeholdt, stemmer, uagtet sin unge Alder, i alle væsentlige Dele overens med Reinhardt's Typ-Exemplar, som jeg i 1878 ved Dr. Lütken's Velvilje havde Lejlighed til at undersøge i Musæet i Kjøbenhavn; og de mindre væsentlige Afvigelser kunne neppe endnu begrunde nogen Artsdistinction mellem dem, saalænge blot disse 2 Individer foreligge. I sit Bidrag til Kundskaben om de grønlandske og islandske Lycoder i det zoologiske Musæum i Kjøbenhavn har Dr. Lütken (Vid. Medd. Nat. Foren. Kbhvn. 1880, p. 325) nærmere afhandlet Artens Characteristik (efter det foreliggende Typ-Exemplar), og paapeger der den store Overensstemmelse, der i det hele finder Sted mellem *L. seminudus* og *L. reticulatus*.

Udmaalinger.

Totallængde	128 mm
Hovedets Længde	32 -
Legemets Højde over Beg. af Dorsalen	15 -
Legemets Højde over Beg. af Analen	12,5 -
Snudens Afstand fra Dorsalen	37 -
Snudens Afstand fra Anus	57 -
Halens Længde	71 -
Snudens Afstand fra Øjets forreste Rand	9 -
Lindsens Diameter	3,5 -
Øjets Længde (Diameter af Iris)	7 -
Afstanden fra Lindsen til Gjællelaagets Spidse	18 -
Afstanden mellem Lindserne	7 -
Hovedets Højde over Øjnene	11 -
Hovedets Bredde over Kinderne	15 -
Hovedets Højde lige bag Ventralerne	13,5 -
Afstanden fra Ventralerne til Anus	34 -
Pectoralernes største Længde	14 -
Pectoralspidsens Afstand fra Anus	14 -

Beskrivelse. *Legemsbygning.* De mest characteristiske Kjendemærker for denne Art er det blot halvt skjælbeklædte Legeme, i Forbindelse med dettes ensartede graabrune Farve uden Baand eller Pletter paa nogen af Legemets Dele, og den enkelte, medio-laterale Sidelinie.

Legemet er forholdsvis kort og noget bredt, med stort Hoved og stærkt sammentrykt Haleparti; det er temmelig jevnbredt indtil noget bagenfor Anus, men løber derfra ud i en hurtig tilspidset Spidse. Halen er relativt kort, idet den blot er en Pectoralfinnelængde længere, end det foran Anus liggende Parti af Legemet. Legemets Højde indeholdes omtr. $8^1/_2$ Gange i Totallængden, medens Typ-Exemplaret fra Grønland, der maaske var fuldt udvoxet, var forholdsvis kortere, idet Højden her blot indeholdtes 7 Gange i Totallængden.

Remarks on the Synonymy. — Since 1838, the year in which Reinhardt described this species, from an (adult?) individual — total length 445 mm — taken on the coast of Greenland, no author has recorded it from autopsy, both Günther's and Gill's diagnoses having been compiled from Reinhardt's description. The new specimen, a young individual from Spitzbergen, exceedingly well preserved, agrees in all essential features with Reinhardt's typical example, which, in 1878, Dr. Lütken kindly afforded me an opportunity of examining in the Zoological Museum at Copenhagen; and the minor points of difference can hardly be deemed sufficient to warrant our assuming a specific distinction with only these two specimens before us. In his contributions to our knowledge of the Greenland and Iceland *Lycodes* preserved in the Zoological Museum at Copenhagen, Dr. Lütken (Vid. Medd. Nat. Foren. Kbhvn. 1880, p. 325) has treated of the species and its characteristics (from the typical specimen), and calls attention to the great general resemblance existing between *L. seminudus* and *L. reticulatus*.

Measurements.

Total length	128 mm
Length of head	32 -
Height of the body above origin of dorsal	15 -
Height of the body above origin of anal	12.5 -
Distance of snout from dorsal	37 -
Distance of snout from vent	57 -
Length of the tail	71 -
Distance of snout from the anterior margin of the eye	9 -
Diameter of the lens	3.5 -
Length of the eye (diameter of iris)	7 -
Dist. from the lens to the extremity of the gill-cover	18 -
Distance between the lenses	7 -
Height of the head above the eyes	11 -
Breadth of the head across the cheeks	15 -
Height of the head immediately posterior to ventrals	13.5 -
Distance from ventrals to vent	34 -
Greatest length of pectorals	14 -
Distance from extremity of pectorals to vent	14 -

General Description. *Structure of the Body.* — The most salient characteristics of this species consist in one-half only of the body being scaled; in the uniform grey-brown colour, unmarked by bands or spots on any part of the body; and in the single, medio-lateral line.

Body comparatively short, and somewhat broad; head large, and the caudal region greatly compressed; the breadth of the body is nearly uniform till within a short distance posterior to the vent, from whence it gradually tapers, terminating in a pointed extremity. Tail comparatively short, being longer than the part of the body anterior to the vent by the length of the pectoral fin only. The height of the body is to the total length about as 1 to $8^1/_2$; but the typical specimen from Greenland, possibly an adult, was relatively shorter, the height equalling $^1/_7$ only of the total length.

Underkjæven er forholdsvis kun lidet kortere, end Overkjæven; Snuden er flad, Øjnene forholdsvis store, idet Diameteren af Iris næsten er lig Snudens Længde. Hovedet indeholdes i Totallængden præcis 4 Gange, medens Typ-Exemplaret, der var udvoxet, havde et større Hoved, der indeholdtes neppe $3^1/_2$ Gange i Totallængden. Spidsen af Gjællelaagets Flig er opadbøjet.

Næseborene bære temmelig lange Tuber, og sidde nær Kjæverahden.

Tænderne ere tilstede paa alle de hos de typiske Lycoder tandbærende Ben (Mellem- og Underkjæven, Palatinbenene, og Vomer). De ere forholdsvis ikke store, men talrige, og danne blot en enkelt Række, undtagen fortil i Underkjæven og paa Vomer, hvor de danne en dobbelt Række.

I Totallængden indeholdes:

Hovedets Længde	4,00
Legemets Højde	8,53
Snudens Afstand fra Dorsalen	3,45
Snudens Afstand fra Anus	2,24
Halens Længde	1,80
Pectoralens Længde	9,14

Finnerne. Dorsalen tæller hos det foreliggende unge Individ 86 Straaler, hvortil kommer Caudalens øvre Halvdel med omtr. 6 Straaler, tilsammen 92 Straaler. Analen havde 68 Straaler, eller, sammen med de 5 nedre Caudalstraaler, ialt 73 Straaler. Dorsalen udspringer i en Afstand fra Snudespidsen, der indeholdes i Totallængden ikke fuldt $3^1/_2$ Gange.

Pectoralerne ere særdeles korte, og tælle paa den ene Side 19, paa den anden 20 Straaler, hvis yderste Spidser ere fri; de nederste Straaler ere betydeligt kortere, end de øvrige. I Totallængden indeholdes de noget over 9 Gange; fremslaaede ere de fjernede omtrent en Øjendiameter fra Lindsen.

Hos Reinhardt's Typ-Exemplar havde Dorsalen 91, Analen (ifølge Dr. Lütken) 75 Straaler, Caudalen medregnet; fradrages dennes Halvdel paa hver Side (med 5 nedentil, og 6 oventil), fremkommer D. 85, A. 70, eller meget nær det samme Tal, som hos Individet fra Nordhavs-Expeditionen. Pectoralerne havde 21, paa den anden Side 22 Straaler, og vare saaledes noget flere, end hos Ungen fra Nordhavs-Expeditionen.

Skjælbeklædning. Ligesom hos Typ-Exemplaret, der maa antages at have været udvoxet, mangler hos den foreliggende Unge Skjælbeklædningen paa hele Legemets forreste Parti, ligesom paa Finnerne. Hele Halen er skjælbeklædt; fortil strækker Skjælbeklædningen sig frem i en Spidse, der naar ubetydeligt frem foran Verticalen fra Anus, medens Grunden langs Dorsalen og Analen er nøgen et godt Stykke bagenfor denne Linie. Skjællene ere forholdsvis smaa, størst paa det forreste Parti. Hos Typ-Exemplaret i Kjøbenhavn strækker Skjælbeklædningen sig knapt frem til Anus, saaledes at Forkroppens nøgne Parti her er noget større.

Sidelinie. Sidelinien, der er medio-lateral og enkelt, udspringer foran Spidsen af Gjællelaagets Flig, gjør en

Mandible but little shorter comparatively than the upper jaw; snout depressed, eyes rather large, the diameter of the iris nearly equalling the length of the snout. The head measures exactly one-fourth of the total length, whereas the typical specimen, a full-grown individual, had a larger head, which was contained not quite $3^1/_2$ times in the total length. Flap of gill-cover curving upwards.

Nostrils — placed near the margin of the jaw — provided with longish tubes.

Teeth on all the bones furnished with them in the typical *Lycodes* (the inter and inferior maxillaries, the palatine bones, and the vomer). They are not large comparatively, but numerous, and constitute a single series, except on the anterior part of the inferior maxillary and on the vomer, where they are arranged in a double row.

The Total Length contains: —

The length of the head	4.00
The height of the body	8.53
The distance of the snout from the dorsal	3.45
The distance of the snout from the vent	2.24
The length of the tail	1.80
The length of the pectorals	9.14

Fins. — The dorsal in the immature example obtained, is furnished with 86 rays, or, including the rays in the upper half of the caudal — about 6 — in all with 92. The anal had 68 rays, or, including the 5 lower caudal rays, in all 73. The dorsal commences at a distance from the point of the snout contained not quite three times and a half in the total length.

Pectorals exceedingly short, and furnished on one side with 19, on the other with 20 rays, the extreme points of which are free; the lowermost rays considerably shorter than the rest. The fin measures rather more than one-ninth of the total length; when spread forwards, they are removed an eye-diameter from the lens.

In Reinhardt's typical specimen, the dorsal had 91, the anal (according to Dr. Lütken) 75 rays, including the caudal: now, deducting on each side half of that fin (the lower part with 5, the upper with 6 rays), we get — D. 85; A. 70, or very nearly the same number as in the specimen from the North Atlantic Expedition. The pectorals had 21—22 rays, accordingly a somewhat greater number than in the young example taken on the Expedition.

Scales. — As in the typical specimen (most probably an adult), scales wanting in this young example on the whole of the anterior portion of the body, and on the fins. The tail scaled all over; anteriorly, the scaled integument extends forwards as an angle, to a point reaching but very little in advance of a perpendicular from the vent; the basal tract stretching along the dorsal and anal is naked for some distance posterior to that limit. Scales comparatively small; largest on the anterior part. In the typical specimen preserved at Copenhagen, the scales hardly reach to the vent, whereby greater length is given to the naked anterior part of the body.

Lateral Line. — Medio-lateral, single, originating immediately anterior to the extremity of the flap of the

kort Bue over denne, gaar derpaa i skraa Retning nedover indtil noget nedenfor Legemets Midtfure, men har omtrent ret over Anus atter naaet op til denne, og løber nu henad denne ud til Halespidsen. Indtil Anus er Antallet af Porer omtrent 35; paa Halens bagerste Parti ere Porerne temmelig utydelige.

En anden, næsten umærkelig Række Porer, der ere betydeligt mindre og mere fjerntstaaende, løber fra Gjællefligen bagover noget ovenfor Legemets Midtlinie. Antallet af Porer i denne (dorsale) Sidelinie er indtil Anus blot 7 (Reinhardt fandt hos Typ-Exemplaret 11 i denne Linie); senere tabe de sig mellem Skjællene. Ogsaa hos enkelte andre Arter har jeg kunnet se Spor af denne supralaterale Sidelinie, men paa Grund af Skjælbeklædningens større Udstrækning hos disse mindre tydeligt; sandsynligvis maa den opfattes som en Fortsættelse af Hovedets Slimpore-Net, men ikke som nogen egentlig Sidelinie.

Paa Gjællelaaget løber endvidere i en Halvkreds en Række Porer, ligesom en kort Række løber tvers over Snudespidsen lige ved Randen.

Farven. Farven er ensartet hvidagtig graabrun, uden Pletter og Baand. En utydelig mørkere Stribe løber langs henad Midtlinien, en anden langs den bagre Del af Dorsalens Grund. Paa Hovedet er der et mørkt Parti paa Gjællelaaget hen mod Spidsen. Pectoralerne ere hvidagtige, ligesom Analen og Hovedets Underside; Bugen blaasort, Randene omkring Anus hvide. Skjællene ere ligeledes lysere, end Bundfarven.

Udbredelse. Af denne Art har hidtil blot været omtalt det ene, Typ-Exemplaret, nedsendt til Musæet i Kjøbenhavn fra Omenak (Umanak) i Grønland i 1837. Dets Totallængde var omtrent 449^{mm}, hvoraf Hovedets Længde var 123^{mm}. Det nye Individ fra Spitsbergens Nordkyst er, som ovenfor nævnt, en Unge, der optoges fra den tempererede Area (Bundtemperatur + 1,1° C.) fra Lerbund i August 1878.

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23. **Lycodes muraena**, Coll. 1878 (n. sp.).

Pl. IV, Fig. 29—31.

Lycodes muraena, Coll. Forh. Vid. Selsk. Chra. 1878, No. 4, p. 15; No. 14, p. 74 (1878).

Diagn. *Særdeles langstrakt. Farven ensartet graabrun. Skjælbeklædningen sildigt og uregelmæssigt frembrydende; Skjællene i fuldt udviklet Stand udbredte over hele Legemet, medens Hovedet og Nakken, samt Finnerne ere nøgne. Tænderne forholdsvis stærke; Rækken paa Palatinbenene særdeles kort. Legemets Højde indeholdes 20—22$^1/_2$ Gange i Totallængden. Hovedet er fladt med opadvendte*

gill-cover, above which it makes an abrupt bend, passing from thence obliquely downwards till a little *below* the mesial furrow of the body, but reaching it again at a point almost straight above the vent, and running along it to the tip of the tail. Number of pores from origin to vent about 35; they are indistinct on the posterior portion of the tail.

Another, almost imperceptible series of pores, considerably smaller and farther apart, extends from the branchial flap backwards, somewhat above the mesial line of the body. Number of pores in this (dorsal) line only 7 from origin to vent (Reinhardt counted 11 in his typical specimen); the remainder cannot be distinguished among the scales. In one or two other species I have also found traces of this supra-lateral line, but less distinct, owing to the greater extent of the scaled integument; probably, however, it must be regarded as a continuation of the mucous pores of the head, and not strictly as a lateral line.

On the operculum, too, occurs a semicircular series of pores, and a short series extends straight across the point of the snout, close to the margin.

Colour. — A uniform whity greyish-brown, without spots or bands. An indistinct dusky stripe extends along the mesial line, and another along the posterior portion of the base of the dorsal. On the head, there is a dark patch, near the extremity of the gill-plate. Pectorals whitish, as also the anal and the under surface of the head; belly bluish-black, margin of vent white. The scales are lighter than the ground-colour.

Distribution. — The only individual of this species ever recorded, is the typical specimen sent to the Zoological Museum at Copenhagen, from Omenak (Umanak), in Greenland, 1837. Its total length is about 449^{mm}; the length of the head 123^{mm}. The new specimen from the north coast of Spitzbergen — a young individual — was, as mentioned above, taken in the temperate area (temperature at bottom + 1.1° C.) on a clay bottom, in August 1878.

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23. **Lycodes muræna**, Coll. 1878 (n. sp.).

Pl. IV, fig. 29—31.

Lycodes muræna, Coll. Forh. Vid. Selsk. Chra. 1878, No. 4, p. 15, No. 14, p. 74 (1878).

Diagnosis. — *Exceedingly elongate. Colour a uniform greyish-brown. The scales (they develop late and irregularly) cover in the fully developed stage the whole of the body, whereas the head, the nape, and the fins are naked. Teeth comparatively strong; the series on the palatine bones exceedingly short. The height of the body is to the total length as 1 to 20—22$^1/_2$. Head depressed, with the eyes turned*

Øjne, og indeholdes i Totallængden 8, hos Ungerne 7 Gange. Gjællehindens Straaler 5. Sidelinien ventral, gaar fra Gjællespaltens øvre Ende skraat ned mod Anus, derfra langs Grunden af Analen ud mod Caudalen. Størrelsen (hos de foreliggende yngre Individer) indtil 217mm.

M. B. 5. D. 101—118; A. 97—103; P. 13—17.

Localit. fra Nordh. Exped. Bankerne udenfor Helgeland i Norge; Havet udenfor Beeren Eiland og Spitsbergen.

	Stat. 124.	*Stat.* 312.	*Stat.* 362.
Beliggenhed.	325 Kil. VSV. Bodø, Norge.	108 Kil. V. Beeren Eiland.	115 Kilom. V. Norskøerne, Spitb.
Dybde.	350 Favne (640m).	658 Favne (1203m).	459 Favne (839m).
Temp. paa Bunden.	— 0.9° C.	— 1.2° C.	— 1.0° C.
Bunden.	Ler.	Brunt og grønt Ler.	Blaagraat Ler.
Datum.	19de Juni 1877.	22de Juli 1878.	14de Aug. 1878.
Antal Individer.	1 Indiv.	1 spæd Unge.	2 Indiv.

Bemærkninger til Synonymien. Ved sin særdeles langstrakte Legemsbygning, i hvilken Henseende den næsten overgaar selv de større Individer af *Lumpenus*-Arterne, afviger den betydeligt fra de øvrige i denne Afhandling omhandlede Lycoder. 3 andre Arter have imidlertid tilnærmelsesvis den samme langstrakte Legemsbygning, nemlig *L. sarsii,* Coll. 1871, fra Hardangerfjorden i Norge (Forh. Vid. Selsk. Chra. 1871, p. 62), *L. verrillii,* Goode & Bean 1877, fra Nova Scotia, Nord-America (Dana and Silliman, Am. Journ. Sci. Arts, 3 Ser. vol. 14, p. 470, Dec. 1877), samt *L. paxillus,* Goode & Bean 1879, ligeledes fra Nova Scotia (Proc. U. S. Nat. Mus. vol. II, p. 44, 1879). Der bliver saaledes et Spørgsmaal, om nogen af alle disse Arter falder sammen.

L. sarsii er beskreven efter en Unge med en Totallængde af blot 43mm, optagen fra 100—150 Favnes Dyb i Hardangerfjorden i Sept. 1869. Endskjønt denne ved sit Udseende tydelig bærer Præget af at være en Unge, kan den ikke være identisk med *L. muraena,* dels paa Grund af de temmelig afvigende Legemsforholde, som det vil fremgaa af nedenstaaende Sammenligning mellem begge Arter, dels fordi *L. sarsii,* skjønt en Unge, dog øjensynlig er langt videre udviklet, end den mindste foreliggende Unge af *L. muraena,* hvis Totall. er 112mm. Legemet er nemlig hos *L. sarsii* fuldstændig pigmenteret, som hos udvoxede Lycoder, medens den 2 til 3 Gange større Unge af *L. muraena* endnu er halvt transparent, og Legemet næsten uden Pigment. Sandsynligvis udgjør *L. sarsii* Ungen af en i sin udvoxede Tilstand endnu ukjendt Art, der paa Grund af den foreliggende Unges forholdsvis langt fremskredne Ud-

upwards; its length is one-eighth of the total length, in young individuals one-seventh. Branchiostegals 5. Lateral line ventral, descending from the upper extremity of the gill-opening obliquely to the vent, and from thence passing along the base of the anal to the caudal. Length (in the young specimens) reaching 217mm.

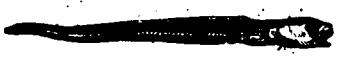
M. B. 5, D. 101—118; A. 97—103; P. 13—17.

Locality (North Atl. Exped.): — Banks lying off Helgeland, in Norway; the open sea, off Beeren Eiland and Spitzbergen.

	Stat. 124.	*Stat.* 312.	*Stat.* 362.
Exact Locality.	325 Kil. W. Bodø, Norway.	108 Kil. W. Beeren Eiland.	115 Kil. W. of Norskøer, Spitzb.
Depth.	350 Fathoms (640m).	658 Fathoms (1203m).	459 Fathoms (839m).
Temp. at Bottom.	— 0.9° C.	— 1.2° C.	— 1.0° C.
Bottom.	Clay.	Brown and green Clay.	Bluish-grey Clay.
Date.	19th June 1877.	22th July 1878.	14th Aug. 1878.
Numb. of Specim.	1 Indiv.	1 Ind. (very young).	2 Indiv.

Remarks on the Synonymy. — The remarkably elongated form of the body, in which respect it almost surpasses the largest individuals of the *Lumpenus* species, is a feature essentially distinguishing it from the other Lycods described in this Report. Three other species, however, have approximately a similar structure of body, viz. *L. sarsii,* Coll. 1871, from the Hardangerfjord, Norway (Forh. Vid. Selsk. Chra. 1871, p. 62); *L. verrillii,* Goode & Bean 1877, from Nova Scotia, North America (Dana and Silliman, Am. Journ. Sci. Arts, 3 Ser. vol. 14, p. 470, Dec. 1877); and *L. paxillus,* Goode & Bean 1879, likewise from Nova Scotia (Proc. U. S. Nat. Mus. vol. II, p. 44, 1879): hence the question arises, are any of these species identical.

L. sarsii is described from a young specimen, total length only 43mm, taken at a depth of 100—150 fathoms in the Hardanger Fjord, Norway, in Sept. 1869. Though its general appearance plainly shows this specimen to have been a young individual, it cannot be identical with *L. muræna,* partly by reason of its differing not immaterially in the proportions of the body (as will appear from the comparison given below of the two species), and partly from the fact of the specimen of *L. sarsii,* though a young individual, having attained a far more advanced stage of development than the smallest of the young specimens of *L. muræna,* with a total length of 112mm. In *L. sarsii,* the coloration of the body is complete, as in full-grown Lycods, whereas the young specimen of *L. muræna,* of from double to treble its dimensions, was still semi-translucent, and the body almost without a trace of pigment. Probably *L. sarsii* is



Lycodes sarsii, Coll. Hardanger-Fjord, Norge (½).

vikling utvivlsomt maa antages at være en af de anguilliforme Arter.

L. verrillii er opstillet efter 5 Individer, hvoraf det beskrevne Typ-Exemplar havde en Længde af 5 eng. Tommer (omtrent 127^{mm}), og som vare optagne i August 1877 fra 90—100 Favnes Dyb udenfor Kysterne af Nova Scotia i Nord-America. Fra *L. muraena* afviger *L. verrillii*, foruden ved sine 6 Gjællestraaler, tillige ved sit med mørke Tverfelter forsynede Legeme, saavel som ved bestemte Forskjelligheder i Legemsbygningen, saaledes et større Hoved, stærkere Tænder, og større Legemshøjde; med denne Art kan *L. muraena* aldrig falde sammen. Da jeg ved Professor Spencer Baird's Velvillie har erholdt et authentisk Exemplar af *L. verrillii*, har jeg kunnet anstille en fuldkommen afgjørende Sammenligning mellem begge de omhandlede Arter.

Af *L. paxillus* foreligger blot et enkelt Individ med en Totallængde af 363^{mm}, optaget i mindre vel vedligeholdt Stand (maaske fra en Fiskemave) udenfor Kysterne af Nova Scotia i 1879. Ifølge den af Forfatterne givne Beskrivelse er Arten kjendelig ved de overordentlig stærkt udviklede Kjævemuskler, der give det næsten Udseendet af en Giftslanges; Legemets største Højde indeholdes over 16 Gange i Totallængden. Kjæverne ere ejendommeligt krummede mod hinanden; blandt de øvrige Uoverensstemmelser mellem begge Arter kunne nævnes de langt kortere Pectoraler hos *L. paxillus*.

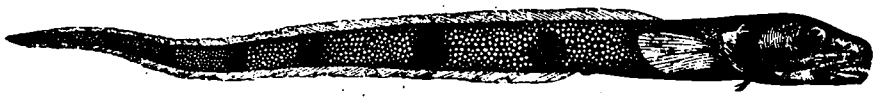
Af Totall. udgjør. . .	*L. muraena*, jun. Totall. 112^{mm}	*L. muraena*. Totall. 217^{mm}	*L. sarsii*, jun. Totall. 43^{mm}	*L. verrillii*. Totall. 115^{mm}	*L. paxillus*. Totall. 363^{mm}
Hovedets Længde .	7,00	8,34	5,97	5,77	—
Legemets største Højde	22,40	21,70	14,33	12,70	over 16,00
Snudens Afstand fra Dorsalen . . .	5,09	5,56	3,90	3,84	—
Snudens Afstand fra Ventralerne .	8,61	10,85	6,61	6,04	—
Snudens Afstand fra Anus	3,73	4,01	3,07	3,09	—

Da Legemsproportionerne hos *L. verrillii* og *L. sarsii* synes at være temmelig overensstemmende, kunde det tænkes, at disse Arter vare identiske. For Øjeblikket, saalænge som de mellemliggende Stadier mangle, lader den sidstnævnte sig med Lethed skille fra *L. sarsii* bl. a. ved sine mørke Tverfelter ud over Legemet, og ved de stærkere Tænder.

Det kan ligeledes nævnes, at Dr. Lütken i sin oven-

a young individual of a species as yet unknown in the adult stage, which, judging from its advanced development, must unquestionably belong to the anguilliform species.

L. verrillii is described from 5 individuals: the typical specimen, with a total length of 5 inches (about 127^{mm}), was taken in August, 1877, at a depth of from 90 to 100 fathoms, off the coast of Nova Scotia, North America. *L. verrillii* differs from *L. muræna* in having 6



L. verrillii, Goode & Bean. Nova Scotia (½).

branchiostegals, and the body flecked with dark transverse patches; also by reason of differences in its general structure, viz. a larger head, stronger teeth, and greater depth of body: hence *L. muræna* cannot possibly agree with this species. Professor Spencer Baird having kindly sent me an authentic example of *L. verrillii*, I have had the means of instituting a direct and conclusive comparison between the two species.

Of *L. paxillus*, but one individual has as yet been obtained, total length 363^{mm}; it was met with, in rather a mutilated condition (having possibly been taken from a fish's stomach), off the coast of Nova Scotia, in 1879. According to the description given of the species, it may be recognised by the remarkable development of the maxillary muscles, giving them almost the appearance of a venomous serpent's. Greatest height of the body slightly exceeding one-sixteenth of the total length; the jaws incurvating towards each other. Amongst other distinctive features in *L. paxillus*, may be mentioned the shortness of the pectorals.

The Total L. contains.	*L. muræna*, jun. Total L. 112^{mm}	*L. muræna*. Total L. 217^{mm}	*L. sarsii*, jun. Total L. 43^{mm}	*L. verrillii*. Total L. 115^{mm}	*L. paxillus*. Total L. 363^{mm}
The L. of the head	7.00	8.34	5.97	5.77	—
The greatest height of the body . . .	22.40	21.70	14.33	12.70	upwards of 16.00
The dist. of the snout from the dorsal . .	5.09	5.56	3.90	3.84	—
The dist. of the snout from the ventrals .	8.61	10.85	6.61	6.04	—
The dist. of the snout from the vent . . .	3.73	4.01	3.07	3.09	—

The dimensions of the body in *L. verrillii* and *L. sarsii* agreeing, it appears, so closely, these two species might by some be regarded as identical. But, till specimens in the intermedial stages of development shall have been discovered, the former may be readily distinguished from *L. sarsii* by the dark transverse spots on the body, and by the strong teeth.

It may likewise be observed, that Dr. Lütken, in the

for ofte berørte Afhandling om de grønlandske og islandske Lycoder angiver som en Mulighed, at *L. verrillii* udgjør et yngre Trin af *L. vahlii*, eller en anden nærstaaende Form. Til denne Anskuelse har nærværende Forfatter vanskeligt for at slutte sig paa Grund af den udprægede anguilliforme Habitus; der udmærker *L. verrillii*, medens *L. vahlii* hører til de typiske Former, hvis Unger maa have den samme relativt betydelige Legemshøjde, som f. Ex. *L. frigidus* og *L. esmarkii* have i Unge-Stadiet.

Udmaalinger.	a. *Stat.* 312.	b. *Stat.* 124.	c. Han. *Stat.* 362.	d. Hun. *Stat.* 362.
Totallængde	112mm	141mm	198mm	217mm
Hovedets Længde	16 -	18 -	25 -	26 -
Legemets Højde over Begyndelsen af Dorsalen	5 -	7 -	9 -	10 -
Legemets Højde over Begyndelsen af Analen	3,5 -	6 -	8 -	7,5 -
Snudens Afstand fra Dorsalen	22 -	24 -	41 -	39 -
Snudens Afstand fra Anus	30 -	39 -	55 -	54 -
Halens Længde (Anus' Afstand fra Halespidsen)	82 -	112 -	143 -	163 -
Snudens Afstand fra Øjet	5 -	5 -	8 -	9 -
Øjets Diameter (Længden af Iris)	3,5 -	4 -	5 -	5 -
Afstanden fra Lindsen til Gjællelaagets Spidse	7,5 -	9 -	12 -	12 -
Afstanden mellem Lindserne	2,5 -	3 -	3,8 -	4 -
Hovedets Højde over Øjnene	4,5 -	6 -	8,5 -	8 -
Hovedets Bredde over Kinderne	8 -	8,5 -	14 -	12 -
Hovedets Højde lige bag Ventralerne	5 -	7 -	9,5 -	9,5 -
Afstanden fra Ventralerne til Anus	17 -	25 -	33 -	33 -
Pectoralens største Længde	10 -	12 -	17,5 -	18 -

Beskrivelse. *Legemsbygning.* Legemet er overordentlig langstrakt og smalt, alene over Hovedet og Bugen trindere, men forresten stærkt sammentrykt fra Siderne. Da Anus er forholdsmæssig langt fremrykket, er det hovedsagelig Halen, der har faaet denne betydelige Længde.

Idethele er *L. muraena* den mest langstrakte af alle hidtil kjendte Arter. Legemets største Højde ved Begyndelsen af Dorsalen indeholdes saavel hos Ungen, som de større Exemplarer 20—22½ Gange i Totallængden; denne Højde aftager yderligere lige over Anus, og paa Midten af Halen er Forholdet omtrent, som 1 til 36—40.

Hovedet er stort i Forhold til Legemshøjden, paafaldende fladtrykt, og fortil temmelig bredt, med særdeles tykke og fremfaldende Læber; dets Bredde over Kinderne er ikke synderlig større, end over Snuden, men dog betydelig større, end dets største Højde. Overkjæven rager betydeligt frem over Underkjæven. Hovedet indeholdes i Totallængden hos et Yngel-Individ 7, hos det største Individ næsten 8,4 Gange i Totallængden.

Øjnene ere, paa Grund af det fladtrykte Hoved, næsten ganske opadvendte; deres Længdediameter er, som hos de

memoir frequently alluded to above, on the Greenland and Iceland Lycods, states that *L. verrillii* possibly represents an immature stage of *L. vahlii* or some other closely allied species. This view, however, I can hardly myself share, *L. verrillii* being so decidedly anguilliform in its habitus, whereas *L. vahlii* belongs to the typical forms, the young of which must certainly be characterised by a height of body as considerable, for instance, as that of *L. frigidus* and *L. esmarkii* in the earlier stages of growth.

Measurements.	a. *Stat.* 312.	b. *Stat.* 124.	c. Male. *Stat.* 362.	d. Fem. *Stat.* 362.
Total length	112mm	141mm	198mm	217mm
Length of the head	16 -	18 -	25 -	26 -
Height of the body above origin of dorsal	5 -	7 -	9 -	10 -
Height of the body above origin of anal	3.5 -	6 -	8 -	7.5 -
Distance of snout from dorsal	22 -	24 -	41 -	39 -
Distance of snout from vent	30 -	39 -	55 -	54 -
Length of the tail (distance of vent from tip of tail)	82 -	112 -	143 -	163 -
Dist. of the snout from the eye	5 -	5 -	8 -	9 -
Diameter of the eye (length of iris)	3.5 -	4 -	5 -	5 -
Distance from the lens to the extremity of the opercle	7.5 -	9 -	12 -	12 -
Distance between the lenses	2.5 -	3 -	3.8 -	4 -
Height of head above the eyes	4.5 -	6 -	8.5 -	8 -
Breadth of head across the cheeks	8 -	8.5 -	14 -	12 -
Height of the head immediately posterior to the ventrals	5 -	7 -	9.5 -	9.5 -
Distance from ventrals to vent	17 -	25 -	33 -	33 -
Greatest length of pectorals	10 -	12 -	17.5 -	18 -

Description. *Structure of the Body.* — The body is exceedingly narrow and elongated, a trifle rounder across the head and belly only; at the sides very much compressed. The vent being far in advance, it is more especially the tail that exhibits this very considerable elongation.

L. muræna is the most elongate in form of all the species yet known. The greatest height of the body at the origin of the dorsal, alike in the very young specimen and the maturer examples, is to the total length as 1 to 20—22.5; nay, even this height diminishes immediately above the vent, the proportion in the middle of the tail being about as 1 to 36—40.

The head large compared to the height of the body, remarkably depressed, and rather broad anteriorly, with very thick and prociduous lips; its breadth across the cheeks not much greater than across the snout, though greatly exceeding its extreme height. The upper jaw considerably overlapping the lower. The length of the head in the fry-specimen is to the total length as 1 to 7; in the largest example, as 1 to 8.4.

The eyes, owing to the depressed form of the body, directed almost straight upwards; their longitudinal diameter

øvrige Arter, større, end deres Højde, og indeholdes $4^1/_2$—5 Gange i Hovedlængden. Interorbitalrummet er ganske smalt, men Lindserne store.

Næseborene ere enkelte og rørformige; Tubens Længde er næsten lig en halv Lindsediameter.

Gjællestraalerne ere hos denne Art blot 5 i Antal. Pseudobranchier ere tilstede; Gjællerne ere normale.

Tænderne, der ikke mangle paa noget af de regulært tandbærende Ben, ere forholdsvis lange og noget cylindriske, (dog kortere, end hos *L. verrillii*). I Mellemkjæven danne de en enkelt Række af omtrent 10 Tænder paa hver Side; i Underkjæven findes hos de mindre Exemplarer blot en enkelt, hos de større flere Rækker. Mindre Tandsamlinger findes paa Vomer og paa Palatinbenene. Rækken paa det sidstnævnte Ben er særdeles kort.

De langs Over- og Underkjæven optrædende store og aabne Porer ere hos ingen anden Art saa distincte, som hos denne (maaske, fordi disse Individer samtlige ere forholdsvis ganske unge). Især ere de 5 langs Overkjæven, og de 6 langs Underkjæven særdeles dybe, og sidde i brede, skaalformige Fordybninger, svarende til Caviteterne i Infraorbitalbenene og i Underkjæven. Paa Hovedets Overside, paa Gjællelaagene, samt paa Nakken findes et stort Antal enkeltstaaende, eller i kortere Rækker fordelte smaa Slimporer; enkelte af disse kunne sees at ende i særdeles korte Tuber.

I Totallængden indeholdes	a. Totall. 112mm	b. Totall. 141mm	c. Totall. 198mm	d. Totall. 217mm
Hovedets Længde . . .	7,00	7,83	7,92	8,34
Legemets Højde ved Beg. af Dorsalen . .	22,40	20,14	22,00	21,70
Legemets Højde ved Beg. af Analen . . .	32,00	23,50	24,75	29,05
Snudens Afstand fra Dorsalen	5,09	5,87	4,82	5,56
Snudens Afstand fra Anus	3,73	3,61	3,60	4,01
Halens Længde (Anus til Halespidsen) . . .	1,36	1,25	1,38	1,33

Anus er længere fremrykket, end hos nogen af de øvrige Lycoder, eller med andre Ord, Halepartiet er usædvanligt langt, og udgjør omkring $^3/_4$ af Totallængden.

Finnerne. Straaleantallet synes hos denne Art at være særdeles lidet constant, ligesom det Punkt, hvor Dorsalen tager sin Begyndelse, kan være forholdsvis længere fremrykket hos et Indidid, end hos et andet.

Antallet af Straaler var hos de 4 foreliggende Individer følgende (i de verticale Finner ere Caudalstraalerne medregnede):

	a. Totall. 112mm	b. Totall. 141mm	c. Totall. 198mm	d. Totall. 218mm
Dorsalen	101	118	104	108
Analen	97	100	98	103
Pectoralerne	13—14	13—13	17—17	15—16

both in this and in the other species, is greater than the vertical, and compared to the length of the head, as 1 to $4^1/_2$—5. Interorbital space narrow; lenses large.

Nostrils single and tubular. The length of the tube almost equal to half the diameter of the lens.

Branchiostegals in this species 5 only. Pseudobranchiæ present; gills normal.

The teeth, wanting on none of the bones regularly furnished with them, are comparatively long (shorter, however, than in *L. verrillii*), and somewhat cylindrical. On the intermaxillary, they constitute a single series of about 10 teeth on each side; in the lower jaw, the smaller examples have only a single row, the larger several series. Small patches of teeth occur on the vomer and the palatine bones; the series on the latter is exceedingly short.

The large pores disposed along the upper and lower jaws are in none of the other species so distinct as in this (possibly from the specimens being all of them relatively young individuals). The 5 extending along the upper jaw, and the 6 along the lower, are in particular exceedingly deep, occupying broad, bowl-shaped depressions corresponding with the cavities in the infraorbital bones and in the lower jaw. On the upper surface of the head, on the opercles, and on the nape, are a large number of small mucous pores, either isolated or arranged in short rows, part of them terminating in exceedingly short tubes.

The Total Length contains	a. Total L. 112mm	b. Total L. 141mm	c. Total L. 198mm	d. Total L. 217mm
The length of the head	7.00	7.83	7.92	8.34
The height of the body at origin of dorsal .	22.40	20.14	22.00	21.70
The height of the body at origin of anal . .	32.00	23.50	24.75	29.05
The dist. of the snout from the dorsal . . .	5.09	5.87	4.82	5.56
The dist. of the snout from the vent	3.73	3.61	3.60	4.01
The length of tail (from vent to tip of tail) .	1.36	1.25	1.38	1.33

The vent is farther in advance than in any of the other Lycods; hence the caudal region is exceptionally long, well nigh three-fourths of the total length.

Fins. — The number of fin-rays in this species would appear to be anything but constant; the point, too, at which the dorsal commences, lies farther in advance in some individuals than in others.

The fin-ray formula in the 4 specimens examined was as follows (caudal rays included in the vertical fins): —

	a. Total L. 112mm	b. Total L. 141mm	c. Total L. 198mm	d. Total L. 218mm
Dorsal	101	118	104	108
Anal	97	100	98	103
Pectorals	13—14	13—13	17—17	15—16

Dorsalstraalerne varierede saaledes i Antal fra 101—118; fradrages den øvre Halvdel af Caudalen med 6 Straaler, bliver den hele Række 95—112, et Straaleantal, som blot de ældre Individer af *L. vahlii* og *L. esmarkii* have opnaaet. Hos et af Individerne (*b*) ligger Dorsalens Begyndelse betydeligt nærmere hen mod Nakken, end hos de andre. Dorsalens største Højde er omtrent lig $^1/_3$ af Legemshøjden; dog er Straalernes virkelige Længde, paa Grund af deres skraa Stilling, noget større, eller omtrent lig Legemets halve Højde, men de kunne neppe nogensinde rejses til sin fulde Højde.

Analens Straaler variere i Antal fra 97—103; fradrages den nedre Halvdel af Caudalen, der sandsynligvis tæller 5 Straaler, bliver Rækken 92—98, et Antal, som hidtil ikke er fundet hos nogen anden Art.

Pectoralerne ere forholdsvis lange og slanke, noget tilspidsede, og have faa Straaler, idet Antallet har vist sig at variere mellem 13 og 17.

Ventralerne ere ligeledes temmelig lange (dog kortere, end Øjets Længdediameter), og indeholdes i Hovedlængden 6—$6^1/_2$ Gange. Straaleantallet kan ikke med Sikkerhed opgives.

Skjælbeklædning. I én Henseende frembød Skjælbeklædningen hos Individerne af denne Art en højst mærkelig Variation, nemlig med Hensyn til det Tidspunct, da denne begynder at udvikle sig under Individernes Vext. Typ-Exemplaret af denne Art, beskrevet i den første af de foreløbige Beretninger om Nordhavs-Expeditionens Fiske, og som havde en Totall. af 141^{mm}, havde tæt Skjælbeklædning paa hele Legemet, medens Hovedet med Nakken, samt Finnerne vare nøgne. Af de 3 nyerholdte Exemplarer fra 1878 havde den ene, en spæd Unge, intet Spor af Skjæl, hvad der heller ikke var at vente, da Legemet endnu var halvt gjennemsigtigt, og næsten uden Pigment. Det 2det Exemplar, hvis Totallængde er 198^{mm}, stemmer i alle Dele overens med Typ-Exemplaret, og var, som dette, fuldt skjælbeklædt.

Det allerstørste Individ derimod, hvis Totallængde er næsten dobbelt saa stor, som Typ-Exemplarets, nemlig 217^{mm}, var, mærkeligt nok, endnu næsten ganske uden Skjæl. Blot enkelte Skjæl, der øjensynlig netop befinde sig i Frembrud, kunne opdages henad Halen, men paa hele den forreste Del af Legemet er der ikke Spor af saadanne. I alle andre Henseender ere disse 2 største Individer, der begge erholdtes paa samme Localitet og ved samme Lejlighed, fuldstændig overensstemmende.

Det maa saaledes antages, at Skjælbeklædningen baade anlægges paa et forholdsvis sildigt Stadium, og ganske uregelmæssigt, hos enkelte Individer langt sildigere, end hos andre. Saafremt man vil antage, at Hannerne hos denne Art, i Lighed med, hvad der er paavist hos andre Lycoder, kunne opnaa en betydeligere Størrelse, end Hunnerne, var det at vente, at Skjælbeklædningen anlagdes tidligere hos de sidste, end hos Hannerne. Men det største, og næsten ganske nøgne Individ er netop en Hun, medens det noget mindre, der er tæt skjælbeklædt, er en Han.

The number of the dorsal rays ranged accordingly from 101 to 118. If we deduct the 6 rays in the upper half of the caudal, the whole series will contain 95—112, a number greater than is met with in any of the other species, save in maturer examples of *L. vahlii* and *L. esmarkii*. One of the specimens (*b*) has the origin of the dorsal considerably nearer the nape than have the others. The greatest height of the dorsal about equals one-third of the height of the body; but the true length of the rays, owing to their obliquity, is somewhat greater, or about equal to half the height of the body.

The anal rays range in number from 97 to 103. If we deduct the rays in the lower half of the caudal, probably 5, this series will contain 92—98, a greater number than has yet been met with in any other species.

The pectorals are comparatively long and slender, somewhat elongated, and with but few rays, the number having been found to vary between 13 and 17.

The ventrals are also rather long (shorter however than the longitudinal diameter of the eye), being contained from 6 to $6^1/_2$ times in the length of the head. The number of rays cannot be accurately stated.

Scales. — In one respect, the scaled integument in the specimens of this species exhibited a most remarkable variation, viz. as to the exact point of time at which it begins to develop during the growth of the individual. The typical specimen of this species, described in the first of the preliminary reports treating of the fishes collected on the Expedition, total length 141^{mm}, had the whole body covered with scales; the head, the nape, and the fins were naked. Of the 3 individuals newly obtained (1878), one, a fry-specimen, exhibited no trace of scales, as was indeed to be expected, the body being still semi-translucent and almost colourless. The second example, total length 198^{mm}, agrees perfectly with the typical specimen, being, like that, entirely scaled.

The largest individual, on the contrary, with a total length twice as great as that of the typical specimen (217^{mm}), was, strange to say, well nigh scaleless. A few scales only, and obviously in the first stage of development, could be detected along the tail; on the whole of the anterior part of the body there was no trace of any. In all other respects, these two largest individuals, both of them taken in the same locality and at one time, agree perfectly.

There is, accordingly, every reason to infer, that the scaled integument makes its appearance at a comparatively late stage of growth, and quite irregularly, much earlier in some individuals than in others. Now assuming that the males of this species, in common with what has been shown to hold good with other Lycods, can attain a greater size than the females, the scaled integument would naturally develop earlier in the latter than in the males. But the largest and well nigh naked example, is a female, whereas the smaller specimen, which is densely scaled, is a male.

Det vil heraf være indlysende, hvor vanskeligt det er efter et enkelt eller nogle faa Individer at fremsætte sikre Artscharacterer inden denne Slægt, hvorfor Arternes Begrændsning endnu idethele er i flere Punkter usikker.

Skjællene ere, som hos alle skjælbærende Lycoder, runde, adskilte, og nedtrykte i Huden, hvidagtige af Farve, samt overalt af temmelig lige Størrelse, blot ubetydeligt mindre paa Halen. Langs Ryglinien staa de ubetydeligt tættere, end paa andre Steder af Legemet; dog berøre Skjællenes Rande intetsteds hinanden.

Sidelinien. En Sidelinie, der er ventral, er tilstede, om den end blot med Vanskelighed lader sig forfølge i sin Helhed. Fra Gjællespaltens øvre Ende nedløber i skraa Retning indtil et kort Stykke bagenfor Anus en Række temmelig tætstaaende, særdeles smaa Porer, forbundne indbyrdes ved en fin Linie; efterat have naaet ned næsten til Grunden af Analfinnen, løber Rækken langs med denne et Stykke ud mod Caudalen, uden at det med Nøjagtighed kan angives, hvor den ophører. Maaske vil den hos fuldt udvoxede Exemplarer lade sig forfølge lige til Halespidsen. Den er tydeligst hos det største Individ, hvis Skjælbeklædning endnu blot er i sit Frembrud.

Samtidig kan under gunstig Belysning spores hos et Par af Individerne en Række yderst smaa og fjerntstillede Porer langs Legemets Midtlinie, men uden at denne Række har Characteren af nogen Sidelinie.

Farve. Farven er ensfarvet lyst graabrun; Skjællene overalt lysere, end Legemets Bundfarve. Nedenfor Midtlinien er Legemet hos et af Individerne ubetydeligt lysere, end ovenfor denne. Bughinden er gjennemskinnende sort, selv hos de største Exemplarer, hvilket i Forbindelse med Skjælbeklædningens Udvikling antyder, at intet af dem har naaet sin fulde Udvikling.

Størrelse. Flere Omstændigheder tyde saaledes hen paa, at intet af Individerne endog tilnærmelsesvis have naaet sin fulde Størrelse. Vi have i det foregaaende paavist, at Yngelen af *L. frigidus* er fuldkommen normalt udviklet og har fuld Pigmentering, som de Udvoxede, med en Totallængde af 37 og 62^{mm}, og Arten kan dog opnaa en Størrelse af over 500^{mm}; hos *L. esmarkii,* der kan opnaa en Størrelse af over 600^{mm}, var det samme Tilfældet hos en Unge med en Totallængde af 81^{mm}.

Da det mindste Exemplar af *L. muraena,* hvis Totallængde er 112^{mm}, endnu var transparent, og har fuldkommen Characteren af en spæd Yngel, ligesom fremdeles Skjælbeklædningen hos et Individ med en Totallængde. af 217^{mm} endnu blot befandt sig i sit første Frembrud, er det sandsynligt, at man i Fremtiden vil lære at kjende Arten som en mærkelig, aalelignende Form af ganske betydelig Størrelse, naar Apparaterne til Dybvandsfiskes Erhvervelse blive saa fuldkomne, at de ere istand til at ophente saadanne Former, (som det paa Grund af deres Legemsbygning maa antages ere særdeles hurtige), i sin fuldt udviklede Tilstand.

Hence we see how difficult it is from a single specimen, or several individuals even, to work out specific characters for this genus; and the limits of its species are therefore in many respects as yet uncertain.

As in all of the scaled Lycods, the scales are round, non-contiguous, and imbedded in the skin, whitish in colour, and everywhere nearly equal in magnitude, those on the tail only being a trifle smaller. Down the dorsal line they lie a little closer than on the other parts of the body, the margins however coming nowhere in contact.

Lateral Line. — A lateral line (ventral) is present, though difficult to trace throughout its entire length. From the upper extremity of the gill-opening, a series of small, and rather closely set, pores, passes obliquely downwards to within a short distance behind the vent; after descending nearly to the base of the anal, the series accompanies that fin a short distance in the direction of the caudal, the exact point at which it terminates not admitting however of being determined. In full-grown examples, it will, perhaps, be traceable to the tip of the tail. It is most distinct in the largest individual, on which the scales are just beginning to appear.

Exclusive of the above, a series of minute pores may be discerned, in a good light, in one or two of the specimens, extending along the mesial line of the body; but this series has not the character of a lateral line.

Colour. — A uniform light greyish-brown; the scales everywhere lighter than the ground-colour of the body. Below the mesial line, the body, in one of the specimens, is somewhat lighter than above it. The ventral membrane a lustrous black, even in the largest individuals, from which, along with the peculiarities of development in the scales, we may infer that they have none of them attained maturity.

Size. — Several circumstances, therefore, give reason to infer that none of the individuals were full-grown. We have already shown, that the fry-specimens of *L. frigidus*, total length from 37^{mm} to 63^{mm}, have all the characters of the adult fish, including the coloration, and yet the species can attain a length of 500^{mm}, and above; this was the case, too, with a specimen of *L. esmarkii,* with a total length of 81^{mm}, the extreme length in this species being upwards of 600^{mm}.

The smallest example of *L. muræna,* total length 112^{mm}, being still semi-translucent, and its general appearance precisely that of a fry-specimen; and moreover, the scales in one individual, with a total length of 217^{mm}, having only just commenced developing, — it is not improbable, that at some future period the species will be met with as an anguilliform *Lycodes* of very considerable dimensions, when the apparatus for the capture of deep-sea fishes shall have been so far improved, as to admit of bringing up such forms (which from the structure of their body must be assumed to be rapid swimmers) in the final stage of development.

Føde. Det største af de erholdte Individer var en Hun, og havde umoden Rogn i det eneste Ovarium. Det noget mindre, fuldt skjælbeklædte Individ var en Han.

Ventrikelen af det største Individ indeholdt udelukkende Dele af *Themisto libellula,* Mandt; det noget mindre ligeledes Levninger af *Themisto,* samt et Individ af den af G. O. Sars nylig beskrevne diminutive Isopode *Nannoniscus bicuspis,* hvoraf tidligere blot et Par Individer vare fundne.

Udbredelse. *L. muraena* foreligger for Tiden i 4 Individer, alle optagne fra betydeligt Dyb og iskoldt Vand langt fra Land. Det første erholdtes under Nordhavs-Expeditionens 2det Togt, i 1877, paa Bankerne udenfor Helgeland[1] i Norge, saaledes søndenfor Polarcirkelen; de øvrige fra Expeditionens sidste Togt, i 1878, fra Dybderne udenfor Beeren Eiland og Spitsbergen op til 80° N. B., eller i det Hele saa langt mod Nord, som hensigtsmæssige Dybvandsskrabninger hidtil ere foretagne.

Food etc. — The largest of the specimens was a female, with immature ova in the single ovary. The somewhat smaller, fully scaled individual, was a male.

The ventricle of the female contained exclusively parts of *Themisto libellula,* Mandt; that of the male contained likewise fragments of *Themisto*, and also an example of the diminutive Isopod *Nannoniscus bicuspis,* lately described by G. O. Sars, and of which one or two individuals only had previously been known.

Distribution. — Of *L. muræna* 4 specimens have been obtained up to the present time, all of which were brought up from a considerable depth in the cold area, far from land. The first was taken on the second voyage of the Expedition, in 1877, on the banks off Helgeland,[1] in Norway, accordingly south of the Arctic circle; the remaining three were brought up, on the last cruize, in 1878, from the depths off Beeren Eiland and Spitzbergen, — as far north as deep-sea dredging has been undertaken (80°).

Gen. Gymnelis, Reinh.

Overs. 1832—33, Kgl. D. Vid. Selsk. Nat. Math. Afh. 6 Del, p. XXI og XXII. 1837. „*Gymnelus*" (1832—33).

Kgl. D. Vid. Selsk. Naturv. Math. Afh. 7 Del, p. 116 og 131. 1838. „*Gymnelis*" (1838).

Legemet langstrakt, aalformigt, nøgent. Sidelinie tilstede, tildels utydelig. Hovedet rundagtigt, med lige lange Kjæver. Finnestraalerne bløde, articulerede og kløvede; Caudalen utydelig, og er uden Overgang forenet med Dorsalen og Analen. Ventralerne mangle. Gjællespalten temmelig trang og højtliggende; Gjællehinderne ikke indbyrdes sammenvoxede paa Hovedets Underside. Tænder i Kjæverne, paa Vomer, og paa Palatinbenene. Gjællestraalerne 6; Pseudobranchier tilstede. Svømmeblære mangler; Appendices pyloricae rudimentære.

24. **Gymnelis viridis,** (Fabr.) 1780.

Pl. IV, Fig. 32.

Ophidium viride, Fabr. Fauna Groenl., p. 141 (1780).
Ophidium unernak, Lacép. Hist. Nat. Poiss. tom. 2, p. 280 (1800)[2].
Gymnelus viridis, Reinh. Overs. 1832—33, Kgl. D. Vid. Selsk. Nat. Math. Afh. 6 Del, p. XXI, Kbhvn. 1837 (1832—33).

[1] Allerede under det første Aars Expedition, i 1876, erholdtes omtrent paa samme Sted et Exemplar af en *Lycodes,* der ved et Uheld blev bortkastet. Prof. Sars erklærer, at det utvivlsomt har tilhørt samme Art, som ovenfor er benævnt *L. muraena.*

[2] L'an VIII de la République.

Gen. Gymnelis, Reinh.

Overs. 1832—33, Kgl. D. Vid. Selsk. Nat. Math. Afh. 6 Del, p. XXI og XXII. 1837. "*Gymnelus*" (1832—33).

Kgl. D. Vid. Selsk. Naturv. Math. Afh. 7 Del, p. 116 and 131. 1838. "*Gymnelis*" (1838).

Body elongate, anguilliform, naked; lateral line present, but rather indistinct. Head roundish, with jaws equal in length. Fin-rays soft, articulate, and branched; caudal indistinct, continuous with the dorsal and anal. Ventrals wanting. Gill-openings rather narrow, and elevated; the branchial membranes non-continuous on the inferior surface of the head. Teeth in the jaws, on the vomer, and on the palatine bones. Branchiostegals 6; pseudobranchiæ present. Air-bladder wanting; pyloric appendages rudimentary.

24. **Gymnelis viridis,** (Fabr.) 1780.

Pl. IV, fig. 32.

Ophidium viride, Fabr. Fauna Grœnl., p. 141 (1780).
Ophidium unernak, Lacép. Hist. Nat. Poiss. tom. 2, p. 280 (1800).[2]
Gymnelus viridis, Reinh. Overs. 1832–33, Kgl. D. Vid. Selsk. Nat. Math. Afh. 6 Del, p. XXI, Kbhvn. 1837 (1832—33).

[1] On the first voyage of the Expedition, (1876), in the same locality about, an example of a *Lycodes* had been obtained, which was afterwards unintentionally thrown away. Professor Sars states it to have been unquestionably of the same species as that here termed *L. muræna.*

[2] L'an VIII de la République.

Gymnelis viridis, Reinh. Kgl. D. Vid. Selsk. Nat. Math. Åfh. 7 Del, p. 116 og 131 (1838).
Cepolophis viridis, Kaup, Wieg. Arch. f. Naturg. 1856, 1. B., p. 96 (1856).
Gymnelis pictus, Günth. Cat. Fish.. Brit. Mus. vol. 4, p. 324 (1862).

Diagn. *Farven varierende; ensfarvet, eller med rundagtige mørke Tverfelter; langs Grunden af Dorsalen staa i Regelen 1 eller flere sorte Øjenpletter. Dorsalen begynder over Pectoralens bagre Trediedel. Hovedet indeholdes 6—7 Gange i Totallængden. Størrelsen indtil 300mm.*
M. B. 6. D. 90—100; A. 70—72; C. 8—11; P. 11—13.

Localit. fra Nordh.-Exped. Jan Mayen; Spitsbergen.

	Stat. 237.	—
Beliggenhed.	Jan Mayen.	Norskøerne, N.V.-Spitsbergen.
Dybde.	263 Favne (481 m).	Af Ventrikelen
Temp. paa Bunden.	— 0,3° C.	af
Bunden.	GrovtGrusogSmaastene.	*Gadus morrhua.*
Datum.	3die Aug. 1877.	15de Aug. 1878.
Antal Indiv.	1 Indiv.	3 Indiv.

Bemærkninger til Beskrivelsen. En detailleret Beskrivelse af denne Art er meddelt af Kröyer i 1862 (Naturh. Tidsskr. 3 Række, 1 B. p. 258), hvorfor jeg her blot giver et Par Bemærkninger, vedrørende de foreliggende Specimina.

Totallængden af det første Exemplar er 76mm; heraf udgjorde Hovedets Længde 12mm, og indeholdtes saaledes lidt over 6 Gange i Totallængden; hos de øvrige erholdte Exemplarer har Forholdet ligget mellem 5,7 (det største Individ) og 7,3 (det mindste).

Bundfarven var hos Exemplaret fra Jan Mayen (1877) graagul med talrige (17) noget lysere Tverbaand, der vare smalere, end det mellemliggende Felt af Bundfarven. I Dorsalen stod, som vil sees af Figuren paa Pl. IV, Fig. 32, 3 Pletter, 2 tæt sammen noget bagenfor Finnens Udspring, og en enkelt omtrent paa dens Midte. Endskjønt Kröyer (Naturh. Tidsskr. 3 R. 1 B.) opstiller 33 forskjellige Farvevarieteter, gaar det forhaandenværende Exemplar ikke ind under noget af disse, hvilket viser denne Arts næsten ubegrændsede Varieren.

De 3 Exemplarer fra det sidste Aars Togt (1878), bleve alle udtagne af Ventrikelen af *Gadus morrhua* ved Norskøerne paa Spitsbergens Nordside. Alle ere noget angrebne af Fordøjelsen, saaledes, at Farvetegningen blot paa det ene er for en Del bibeholdt; Finnerne ere hos alle fortærede. Torskene fangedes paa et Dyb af mellem 5 og 10 Favne.

Totallængden af det mindste af disse Exemplarer er 78mm, Hovedlængden 10,6mm. Hos dette og det næste Exemplar, der begge ere yngre, ere Kjæverne relativt langt kortere, end hos de udvoxede Exemplarer, og naa blot hen under Midten af Øjet; Hovedet er ligeledes relativt større i Forhold til Legemet, og indeholdes blot $2^1/_2$ Gange i Afstanden fra Snudespidsen til Anus.

Gymnelis viridis, Reinh. Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 Del, p. 116 og 131 (1838).
Cepolophis viridis, Kaup, Wieg. Arch. f. Naturg. 1856, 1 B. p. 96 (1856).
Gymnelis pictus, Günth. Cat. Fish. Brit. Mus. vol. 4, p. 324 (1862).

Diagnosis. — *Colour varying; uniform or with dark, roundish, transverse patches; along the base of the dorsal, as a rule one or more black occelli. Dorsal commencing above the posterior third of the pectorals. Head contained from 6 to 7 times in the total length. Length reaching 300mm.*
M. B. 6; D. 90—100; A. 70—72; C. 8—11; P. 11—13.

Locality (North Atl. Exped.): — Jan Mayen; Spitzbergen.

	Stat. 237.	—
Exact Locality.	Jan Mayen.	Norsk Islands, NW. Spitzbergen.
Depth.	263 Fathoms (481 m).	From the Ventricles
Temp. at Bottom.	— 0.3° C.	of
Bottom.	Coarse Sand and Shingle.	*Gadus morrhua.*
Date.	3rd Aug. 1877.	15th Aug. 1878.
Numb. of Specim.	1 Indiv.	3 Indiv.

Descriptive Observations. — A detailed description of this species having been furnished by Kröyer in 1862 (Naturh. Tidsskrift, 3 Række, 1 B. p. 258), I shall confine myself to a few remarks on the specimens obtained on the Expedition.

Total length of the first individual 76mm; length of the head 12mm, being accordingly to the former as 1 to 6; in the remaining examples, the proportion varies between 5.7 (the largest individual) and 7.3 (the smallest).

The ground-colour in the specimen from Jan Mayen (1877) was greyish-yellow, with numerous (17) transverse bands of a somewhat lighter shade, and narrower than the space between. The dorsal had, as will be seen in the figure (Pl. IV, fig. 32), 3 spots: 2 close together, a little posterior to the origin of the fin, and 1 about in the middle. Kröyer (Naturh. Tidsskr. 3 R. 1 B.) has established 33 differently coloured varieties; but this specimen does not agree with any one of them: which shows the almost unlimited extent to which the species is found to vary.

The 3 specimens obtained on the last voyage of the Expedition (1878) were all taken from the ventricles of *Gadus morrhua,* captured off the Norsk Islands, on the north coast of Spitzbergen. All three are in a partially digested state; in one only can a few vestiges of the coloration be discerned, the fins are entirely gone in all. The cods were taken at a depth of from 5 to 10 fathoms.

Total length of the smallest of these examples 78mm; length of the head 10.6mm. In this, and in the specimen next in size, both of them immature, the jaws are relatively much shorter than in the full-grown individuals, not reaching farther back than under the middle of the eye; the head, too, is relatively larger in proportion to the body, being contained only $2^1/_2$ times in the distance from the point of the snout to the vent.

Totallængden af det andet Individ er 80^{mm}, Hovedlængden 12^{mm}. Farven er nogenlunde vel bibeholdt paa Legemets Sider, og viser omtrent 11 brede brunsorte ringformige Tverpletter, der i Midten ere lysere; dette Exemplar svarer idethele til den Form, som af Günther (Cat. Fishes Brit. Mus. vol. IV, p. 325) opføres som en distinct Art under Navn af *G. pictus,* men som neppe kan ansees som skilt fra den typiske *G. viridis,* hvilket allerede Malmgren tidligere har paavist (Öfv. Kgl. Vet. Ak. Förh. 1864, p. 514)[1]. Af de Kröyer-Reinhardt'ske Varieteter gaar det nærmest ind under *var. y,* uden dog ganske at svare til denne. (Cfr. Naturh. Tidsskr. 3 R. 1 B., p. 260, Kbhvn. 1861—63).

Totallængden af det største Individ er 143^{mm}, Hovedlængden 25^{mm}; Kjæverne naa tilbage til Bagranden af Øjet. Hovedet indeholdes $2^1/_3$ Gange i Afstanden fra Snudespidsen til Anus.

Ligesom hos Slægten *Lycodes* ere Dorsal- og Analstraalerne leddede, samt ved Grunden delte med et tydeligt Mellemrum, hvorimod hver Halvdel senere er sammenhængende. Straaleantallet var hos det største Individ: *D. 92; C. ?; A. 70.*

I Munden af det sidste Individ fandtes et Exemplar af *Modiolaria laevigata*, Gray.

Udbredelse. Er maaske circumpolær, og er truffet saavel i Berings-Strædet, som ved Kysterne af det arctiske America og Europa. I størst Antal er den indsamlet ved Grønlands Kyster, hvor den synes at maatte henregnes til de almindeligste Fiskearter. I Øst-Grønland blev den af den engelsk-arctiske Expedition indsamlet i 1875—76 mod Nord lige op til 81° 52′ N. B. Allerede de svenske Polar-Expeditioner have fundet den, men først under det sidste Togt (1872) i nogen Mængde, ved Spitsbergen, og den gaar her op til de nordligste Punkter, der have været undersøgte; derimod er den endnu ikke paavist paa Americas Østkyst søndenfor Grønland, eller ved det europæiske Continent.

[1] Næsten alle unge Individer, optagne ved Spitsbergen under de sidste Expeditioner (1864—72), og som opbevares i Riks-Museum i Stockholm, hvor jeg i 1879 ved Prof. Smitts Velvillie havde Lejlighed at undersøge dem, tilhøre Formen *pictus,* idet Legemet er tegnet med sadelformige Tverbaand; enkelte Individer ere i Midten af Legemet næsten ganske sorte, og havde blot oventil Spor af lysere Tverbaand.

Total length of the second specimen 80^{mm}; length of the head 12^{mm}. The coloration is comparatively well retained on the sides, exhibiting about 11 broad, brownish-black, annular transverse spots, lighter in the middle; this specimen agrees in all essential features with the form referred by Günther (Cat. Fishes Brit. Mus. vol. IV, p. 325) to a separate species, under the name of *G. pictus,* but which, as already shown by Malmgren (Öfv. Kgl. Vet. Ak. Förh. 1864, p. 514),[1] can hardly be distinct from the typical *G. viridis.* Of the varieties established by Kröyer and Reinhardt, it comes nearest to that indicated by *var. y;* but even with this form it does not strictly agree *(vide* Naturh. Tidsskr. 3 R. 1 B., p. 260, Kbhvn. 1861—63).

Total length of the largest individual 143^{mm}; length of the head 25^{mm}; jaws reaching back to the posterior margin of the eye; head contained twice and one-third in the distance from the point of the snout to the vent.

As in the genus *Lycodes*, the dorsal and anal rays articulated, and distinctly cleft to the base, the halves, however, being from thence connate. Number of fin-rays in the largest specimen: — *D. 92; C. ?; A. 70.*

The last-mentioned individual had in its mouth an example of *Modiolaria lævigata,* Gray.

Distribution. — Possibly circumpolar; it has been met with both in Behring's Straits and on the shores of Arctic America and Europe. The greatest number of specimens have been collected on the coasts of Greenland, where it would seem to be one of the commonest fishes. Off the coast of East Greenland, it was taken on the English Arctic Expedition in 1875—76, as far north as 81° 52′. The species had previously been met with on the Swedish Polar Expeditions; but not in any great abundance till 1872, off the coast of Spitzbergen, its range here extending to the most northerly localities; it has not as yet been observed on the eastern coast of America, south of Greenland, or on the shores of the European continent.

[1] Nearly all the young individuals taken off the coast of Spitzbergen on the latest of the Swedish Expeditions (1864—72), and which are preserved in the Riks Museum at Stockholm, where, in 1879, Professor Smitt kindly permitted me to examine them, belong to the form *pictus,* the body being marked with saddle-shaped transverse bands; some of the individuals, however, are almost black on the middle of the body, the upper part only exhibiting traces of transverse bands.

Subord. Anacanthini.

Fam. Gadidae.

Gen. Gadus, Lin.

Syst. Nat. ed. 12, tom. 1, p. 435 (1766).

25. Gadus saida, Lepech. 1774.

Pl. IV, Fig. 33.

Gadus saida, Lepech. Nov. Comm. Acad. Sci. Imp. Petrop. tom. 18, 1774, p. 512, Tab. 5, Fig. 1 (1774).
Gadus aeglefinus, Fabr. (nec. Lin.) Fauna Groenl. No. 100, p. 142 (1780)
Merlangus polaris, Sab. Suppl. App. Parry's First Voy. p. 211 (1824).
Gadus fabricii, Richards. Fauna Bor.-Am. vol. 3, p. 245 (1836).
Gadus polaris, Richards. Fauna Bor.-Am. vol. 3, p. 247 (1836).
Gadus agilis, Reinh. Kgl. D. Vid. Selsk. Natur. Math. Afh. 7 Del, p. 126 (1838).
Pollachius polaris, Gill, Proc. Acad. Nat. Sci. Philad. 1861, App. p. 48 (1861).
Gadus (Boreogadus) saida, Günth. Cat. Fish. Brit. Mus. vol. 4, p. 337 (1862).
Gadus (Boreogadus) fabricii, Günth. Cat. Fish. Brit. Mus. vol. 4, p. 336 (1862).
Boreogadus polaris, Gill, Proc. Acad. Nat. Sci. Philad. 1863, p. 233 (1863).
Gadus glacialis, Peters, 2te D. Nordpol.-Exp. B. II, p. 172 (Leipz. 1874).

Diagn. *Underkjæven længere, end Overkjæven. En rudimentær Skjægtraad tilstede. Hovedet indeholdes 4 Gange i Totallængden; Øjnene store, indeholdes 3—4 Gange i Hovedlængden. Legemet langstrakt og slankt, Haleroden særdeles smal. Caudalen dybt kløftet; Finnerne adskilte ved et tydeligt Mellemrum. Anus ligger under 1ste Straale af 2den Dorsal. Tænderne særdeles fine; i Overkjæven ere de i den ydre Række ubetydeligt større, end de øvrige Tænder. Skjællene cirkelrunde, smaa, adskilte. Sidelinien farveløs, ofte bagtil utydelig, noget sænket under 2den Dorsal; iøvrigt ret. Et fremtrædende System af Slimporer paa Hovedet. Farven oventil rødlig graabrun, nedtil sølvhvid; Finnerne mere eller mindre sortagtige. Størrelsen indtil 220 mm (og derover).*

1 D. 12 (13—14); 2 D. 12—15 (16); 3 D. 19—20 (17—18, eller 21—23); 1 A. 17 (16 eller 18); 2 A. 19—22 (23); P. 17—18; V. 6.

Subord. Anacanthini.

Fam. Gadidæ.

Gen. Gadus, Lin.

Syst. Nat. ed. 12, tom. 1, p. 435 (1766).

25. Gadus saida, Lepech. 1774.

Pl. IV, fig. 33.

Gadus saida, Lepech. Nov. Comm. Acad. Sci. Imp. Petrop. tom. 18, 1774, p. 512, Tab. 5, Fig. 1 (1774).
Gadus æglefinus, Fab. (nec Lin.) Fauna Grœnl. No. 100, p. 142 (1780).
Merlangus polaris, Sab. Suppl. App. Parry's First Voy. p. 211 (1824).
Gadus fabricii, Richards. Fauna Bor.-Am. vol. 3, p. 245 (1836).
Gadus polaris, Richards. Fauna Bor.-Am. vol. 3, p. 247 (1836).
Gadus agilis, Reinh. Kgl. D. Vid. Selsk. Natur. Math. Afh. 7 Del, p. 126 (1838).
Pollachius polaris, Gill, Proc. Acad. Nat. Sci. Philad. 1861, App. p. 48 (1861).
Gadus (Boreogadus) saida, Günth. Cat. Fish. Brit. Mus. vol. 4, p. 337 (1862).
Gadus (Boreogadus) fabricii, Günth. Cat. Fish. Brit. Mus. vol. 4, p. 336 (1862).
Boreogadus polaris, Gill, Proc. Acad. Nat. Sci. Philad. 1863, p. 233 (1863).
Gadus glacialis, Peters, 2te D. Nordpol.-Exp. B. II, p. 172 (Leipz. 1874).

Diagnosis. — *The lower jaw longer than the upper, and bearing a rudimentary barbel. Length of head to total length as 1 to 4; eyes large, the diameter being from 1/3 to 1/4 of the length of the head. Body slender and elongated; peduncle of tail narrow. Caudal deeply forked; the fins separated, a distinct space intervening. The vent placed under the 1st ray of the 2nd dorsal. Teeth extremely minute; in the upper jaw, those in the outer series are a trifle larger than the other teeth. The scales circular, small, and non-contiguous. Lateral line colourless, the posterior part often indistinct, slightly inclining under the second dorsal. On the head, a well-defined system of mucous pores. Colour above reddish-brown and grey, under surface of a silvery white; fins blackish. Length reaching 220 mm (and above).*

1 D. 12 (13—14); 2 D. 12—15 (16); 3 D. 19—20 (17—18 or 21—23); 1 A. 17 (16 or 18); 2 A. 19—22 (23); P. 17—18; V. 6.

Localit. fra Nordh.-Exped. Havet mellem Beeren Eiland og Spitsbergen, samt Magdalene-Bay paa Spitsbergen.

	Stat. 226.	—	*Stat.* 366.
Beliggenhed.	105 Kil. N. Beeren Eiland.	Norsk-Øerne, Spitsbergen.	Magdalenebay, N. Spitsbergen.
Dybde.	?	Ubetydelig.	Ubetydelig.
Temp. paa Bunden.	+ 1,6° C.	?	— 0,2 til — 2,1° C.
Datum.	3die Aug. 1878.	15de Aug. 1878.	17de Aug. 1878.
Antal Indiv.	1. yngre Indiv.	1 Unge.	72 unge Indiv.

Bemærkninger til Synonymien. Det kan neppe længere være Tvivl underkastet, at alle de Former, som ere beskrevne under Navnene *G. polaris,* (Sab.) 1824, *G. fabricii,* Richards. 1836, eller *G. agilis,* Reinh. 1838, fra Spitsbergen, Island, Grønland og andre Punkter af det arctiske America, i Virkeligheden gaa ind under den af Lepechin i 1774 fra det hvide Hav beskrevne *Gadus saida,* hvilket allerede Malmgren i sin Fortegnelse over Spitsbergens Fiskefauna af 1864 har antaget for sandsynligt[1], og Prof. Smitt har udtalt samme Anskuelse i en Meddelelse til Vetenskaps-Akademien i Stockholm i 1876. Vistnok er Lepechin's originale Beskrivelse ingenlunde udtømmende, eller endog synderlig nøjagtig[2]. Men en umiddelbar Sammenligning, som jeg har kunnet anstille mellem Exemplarer af *G. saida* fra Archangel, afgivne til Universitets-Musæet af Lieutn. Sandeberg, og de Individer, som Musæet i de seneste Aar modtaget fra Grønland, Spitsbergen og Novaja Zemlja, har bestyrket den Antagelse, at de alle ere identiske.

At Individerne fra Hvidehavet i Regelen have havt mørkere Finner, kan vistnok alene tilskrives, at de tilfældigvis havde en betydeligere Størrelse, idet de Individer fra de øvrige Localiteter, hvortil jeg har havt Adgang, saagodtsom alle have været mindre, end halvvoxne. Men iøvrigt stemme de alle i sin Skjælbeklædning, Tandbygning, Stillingen af Anus og i ethvert Punkt af Legemsbygningen saa fuldkommen overens, at nogen Adskillelse mellem dem som distincte Arter ikke er mulig. I Overensstemmelse hermed opføres Arten under det ældste Lepechin'ske Navn, *Gadus saida*[3].

En betydelig Lighed udviser Arten med den af Peters i „2te Deutsche Nordpolar-Exp.", B. II, p. 172 (Leipz. 1874)

[1] Öfv. Kgl. Vet. Ak. Förh. 1864, p. 531. Arten opføres dog paa dette Sted under Navnet *Boreogadus polaris,* (Sab.).

[2] Det er saaledes sandsynligvis efter denne Tegning, at Günther i Diagnosen for *G. saida* beskriver Stillingen af Anus i Cat. Fish. Brit. Mus. vol. 4, p. 337.

[3] Navnet *saida* er dannet af det Trivialnavn, hvorunder Arten er kjendt paa den russiske Kyst, og da dette utvivlsomt er det samme, som Nordmændenes „Sei" (*G. virens*), antydes herved en Overensstemmelse i det Ydre mellem disse 2 Arter. Denne Lighed er dog ikke større, end at Arterne allerede ved et hurtigt Blik kunne adskilles, saaledes ved Skjælbeklædningen, Legemsbygningen, Stillingen af Anus, etc.

Locality (North Atl. Exped.): — The open sea, between Beeren Eiland and Spitzbergen; Magdalene Bay, on the coast of Spitzbergen.

	Stat. 226.	—	*Stat.* 366.
Exact Locality.	105 Kil. N. Beeren Eiland.	Norsk Islands, Spitzbergen.	Magdalene Bay, N. Spitzbergen.
Depth.	?	Trifling.	Trifling.
Temp. at Bottom.	+ 1.6° C.	?	— 0.2 to — 2.1° C.
Date.	3rd Aug. 1877.	15th Aug. 1878.	17th Aug. 1878.
Numb. of Specim.	1 Indiv. (young).	1 Indiv. (young).	72 Indiv. (young).

Remarks on the Synonymy. — There can be very little reason to doubt, that the divers forms occurring on the coast of Spitzbergen, Iceland, Greenland, and Arctic America, described as *G. polaris,* (Sab.) 1824; *G. fabricii,* Richards., 1836; or *G. agilis,* Reinh. 1838, are identical with *Gadus saida,* the species diagnosticated by Lepechin in 1774, from an example taken in the White Sea: an assumption supported by Malmgren[1] in his List of Spitzbergen Fishes, published 1864; Professor Smitt, too, arrived at the same conclusion in 1876, as appears from his communication to the Swedish Vetenskaps Akademi. The diagnosis originally furnished by Lepechin is doubtless far from complete, and leaves, too, not a little to be desired in point of accuracy[2]; but direct, autoptical comparison between examples of *G. saida* from Archangel, procured for the University Museum by Lieut. Sandeberg, and individuals sent to the Museum from Greenland, Spitzbergen, and Novaja Zemlja, has still further convinced me of the plausibility of this hypothesis.

The darker colour of the fins characterising the majority of the White Sea specimens, must be unquestionably ascribed to their having been of a larger size, since the individuals from other localities that I have had opportunity of examining, were all of them in more or less early stages of growth. For the rest, however, they agree so closely, viz. in the arrangement of the scales, in the dental characters, the position of the vent, and every feature connected with the structure of the body, as to preclude the possibility of distinction. Hence the species is classed here with Lepechin's original name, *Gadus saida.*[3].

This species bears a close resemblance to *G. glacialis*, diagnosticated by Peters in "Zweite Deutsche Nordpolar-

[1] Öfv. Kgl. Vet. Ak. Förh. 1864, p. 531. The species is referred here, however, to *Boreogadus polaris,* (Sab.).

[2] Probably, it was Lepechin's representation from which Günther determined the position of the vent in his diagnosis of *G. saida*, in Cat. Fish. Brit. Mus. vol. 4, p. 337.

[3] The designation *saida*, is adopted from the trivial name by which the species is known on the Russian coast; and this term being obviously a corruption of the Norwegian "Sei" (*G. virens*), serves to indicate an external similarity in the two species. The resemblance, however, is not greater, but that a glance will suffice to distinguish them: viz. by reason of the deviation in the arrangement of the scales, the position of the vent, the general structure of the body, &c.

beskrevne *G. glacialis,* opstillet efter et enkelt i 1870 ved Sabine-Øen paa Grønlands Østkyst erholdt Individ, og det er sandsynligt, at denne ligeledes gaar ind under *G. saida.*

Dette Individ havde Tænder ogsaa paa Palatinbenene, en Ejendommelighed, der dog sandsynligvis maa opfattes som en blot individuel Variation, som ikke kan tillægges Vægt som Artscharacter, idet den samme Ejendommelighed, ifølge Dr. Lütkens Undersøgelser, nylig er bemærket undtagelsesvis ogsaa hos den ægte *Gadus saida.* Iøvrigt er dette Individ i alle Henseender overensstemmende med den sidstnævnte Art.

Dr. Günther har (1862) henført *G. saida* under Underslægten *Boreogadus,* characteriseret (blandt Arterne med Underkjæven længst) ved, at Tænderne i Overkjævens ydre Række ere større, end i den indre Række (Cat. Fish. vol. 4, p. 336). Imidlertid synes denne Character hos *G. saida* at være af temmelig underordnet Betydning, da baade Overkjævens Tænder samtlige ere ganske smaa, og Forskjellen mellem dem særdeles ringe.

Beskrivelse. *Legemsbygning.* *G. saida* udmærker sig fremfor de øvrige europæiske Arter ved sit langstrakte og smækre Legeme, den tynde Halerod, der indeholdes omtrent 4 Gange i Underkjævens Længde, den langt tilbagetrukne Anus, de smaa og runde Skjæl, og ved det stærkt udviklede System af Slimporer og Papiller paa Hovedet; fremdeles ved den næsten farveløse og noget bøjede Sidelinie, de forholdsvis store Øjne, og ved den dybt kløftede Caudal.

Det største af de under Expeditionen erholdte Individer har havt en Totallængde af 203^{mm}, hvoraf Hovedlængden udgjorde 49^{mm}. Det mindste Exemplar havde en Totallængde af 65^{mm}, en Hovedlængde af 16,5^{mm}; de fleste Individer i det store Stim, der optoges i et enkelt Kast med Trawlnettet i Magdalenebay, vare Unger, der havde en Længde af 90 til 110^{mm}.

I Totallængden indeholdes Hovedets Længde saaledes næsten nøjagtigt 4 Gange, Legemets Højde omtr. 7 Gange. Underkjæven rager tydeligt frem foran Overkjæven, og Mundvinkelen naar ikke fuldt hen under Øjets Midte.

Øjnene ere forholdsvis store, og udgjøre hos Ungerne (med en Totall. af 70^{mm}) omtrent $^1/_3$, hos de ældre næsten $^1/_4$ af Hovedlængden. Hos de første er Øjets Diameter omtrent af Snudens Længde, hos ældre Individer betydeligt kortere.

En liden Skjægtraad paa Hagen er altid tilstede; hos Ungerne er denne dog lidet fremtrædende, men naar hos de ældre en Længde af omtrent $^1/_4$ Øjendiameter.

Tænderne ere fine, men yderst skarpe, krummede indad, og danne en sammenhængende Række i Mellemkjæverne og i Underkjæven; indenfor denne kan spores en indre Række, bestaaende af yderst fine Tænder, der blot fortil ere nogenlunde tydelige. Disse sidstnævnte Tænder ere ubetydeligt lavere, end den ydre Rækkes. Vomer er ligeledes tandbærende, medens Palatinbenene ere regulært glatte, undtagelsesvis (ifølge Dr. Lütken og Prof. Peters) tandbærende.

Exped.," B. II, p. 172, and described from one individual, taken in 1870, off Sabine Island, on the east coast of Greenland; *G. glacialis,* too, must probably be referred to *G. saida.*

This example had also teeth on the palatine bones, a peculiarity of dentition that should probably be regarded as a mere individual feature, and to which no weight can be attached as a specific character, seeing that the same peculiarity, according to the result of Dr. Lütken's examination, has been lately observed even in the true *Gadus saida.* For the rest, the individual in question agrees in all respects with that species.

Dr. Günther has classed (1862) *G. saida* under the sub-genus *Boreogadus,* characterised (amongst the species that have the lower jaw longer than the upper) by having the teeth in the outer series on the upper jaw larger than those in the inner series (Cat. Fish. vol. 4). But this character in *G. saida* would appear to be of minor importance, seeing that the whole of the teeth in the upper jaw are exceedingly small, and the difference between them very trifling.

General Description. *Structure of the Body.* — This species is distinguished from its other congeners in Northern Europe as follows: — Body slender, elongated; peduncle of tail slender at the base, which is to the length of lower jaw nearly as 1 to 4; position of vent far behind; scales small, circular; head furnished with a well-developed system of mucous pores and papillæ; lateral line almost colourless, and slightly bending; eyes comparatively large; caudal fin deeply forked.

The largest of the individuals taken on the Expedition had a total length of 203^{mm}, the length of the head being 49^{mm}. Total length of the smallest example 65^{mm}; length of head 16.5^{mm}. Most of the individuals in the draught brought up with the trawl-net in Magdalene Bay, had a total length of from 90^{mm} to 110^{mm}.

Length of head equalling almost exactly $^1/_4$ of total length; depth of body about $^1/_7$. Lower jaw projecting perceptibly beyond upper; angle of mouth reaching back very nearly under the middle of the eye.

Eyes comparatively large; longitudinal diameter, in young examples (total length 70^{mm}), about $^1/_3$; in adults, almost $^1/_4$ of the length of the head. In the former, the diameter of the eye nearly corresponds with the length of the snout; in mature individuals, it is considerably less.

A small cirrus on the chin, never wanting; in young examples almost rudimentary; it attains in adults a length about equal to $^1/_4$ of the diameter of the eye.

Teeth minute, but exceedingly sharp, curving inwards; on the intermaxillaries and in the lower jaw constituting a continuous series; within this row extends another, composed of exceedingly minute teeth, distinct in the forepart only; these inner teeth are a trifle shorter than those forming the exterior series. The vomer likewise dentiferous; the palatine bones as a rule smooth; exceptionally, however, according to Dr. Lütken and Prof. Peters, also dentiferous.

Anus er forholdsvis langt tilbagerykket, saaledes, at det er stillet verticalt enten under den første Straale af 2den Dorsal, eller ialfald kun ubetydeligt foran denne.

Finnerne. Finnestraalernes Antal er hos denne Art, som hos de fleste øvrige *Gadidae,* saa store Variationer underkastet, at det ikke er skikket til at afgive bestemte Artscharacterer. Malmgren har i sin „Spetsbergens Fiskfauna" (1864) talt Straalerne hos 8 Individer, og fundet Antallet at variere mellem følgende Tal:

1 D. 12, undertiden 13 eller 14.
2 D. 12—15.
3 D. 19—20, hos et enkelt Individ 23.
1 A. 17, hos et enkelt Individ 16.
2 A. 19—22.
P. 17—18.

Hermed stemmer idethele overens Angivelserne hos Fabricius (*„G. aeglefinus"*, Fauna Groenl.), og Richardson *(Merlangus polaris);* dog har den sidste fundet 16 Straaler i 2den Dorsal, og 23 Straaler i 2den Anal. De Tællinger, som jeg har foretaget hos Individer fra Spitsbergen, Novaja Zemlja og Archangel, have idethele ligget indenfor de ovenfor nævnte Angivelser; dog har jeg fundet Tallet i 3die Dorsal at gaa ned til 17, og i 1ste Anal at gaa op til 18.

Mellemrummet mellem hver Finne er distinct, og idethele større, end hos de nærmest staaende Arter. Hos de ældre Individer er dette Mellemrum omtrent ligt en Øjendiameter, hos de yngre Individer kortere. Pectoralerne ere spinkle og tilspidsede; 2den Ventralstraale ender i et kort Filament. Caudalen er dybt kløftet.

Skjælbeklædning. Skjællene ere yderst smaa, ikke imbricate, men cirkelrunde, og have hos de ældre fuldstændigt fri Rande, idet de ere stillede med et tydeligt Mellemrum indbyrdes; mere tætstaaende ere de hos Ungerne. Skjælbeklædningen er jevnt udbredt over Legemet, og strækker sig fremover lige ud paa Snuden, ligesom ogsaa Gjællelaagene ere skjælbeklædte.

Sidelinie og Slimporer. Sidelinien er farveløs, eller ubetydeligt lysere, end Bundfarven; den strækker sig fra Gjællespaltens øvre Ende hen til Slutningen af 1ste Dorsal, hvor den bøjer skraat nedad til Legemets Midtlinie, som den nu følger ud til Caudalen. Hos yngre Individer er den, især i sin bagre Del, utydelig.

Særdeles characteristisk er det System af Slimporer, der hos friske og uskadte Individer danner et constant og regelmæssigt udbredt Net over Hovedet. Mellem disse større Slimporer findes talrige mindre omstrøede, ligesom der ogsaa findes enkeltvis, eller (paa et Sted) en Række af særdeles korte Hudtrevler eller Papiller, der altid paa uskadte Individer rage kjendeligt længere frem, end Slimporerne, og ikke synes at være perforerede, som disse.

Skjønt disse Rækker ere noget varierende hos de forskjellige Individer, lade sig i Regelen med Lethed gjenfinde følgende som de mest iøjnefaldende:

Paa Hovedets Overside gaar en lang Række Slimporer fra Snudespidsen bagover langs den øvre Rand af Øjet,

Vent comparatively far behind, its position being either vertical under the first ray of the second dorsal fin, or but very slightly anterior to it.

Fins. — The number of fin-rays in this species, as in most of the other *Gadidæ,* varies to so great an extent, that the fin-ray formula is of hardly any value as a specific character. Malmgren gives in his "Spetsbergens Fiskfauna" (1864) the number of fin-rays in 8 individuals; it varied as follows: —

1 D. 12; in some examples 13—14.
2 D. 12—15.
3 D. 19—20; in one specimen 23.
1 A. 17; in one specimen 16.
2 A. 19—22.
P. 17—18.

With these figures the fin-ray formulæ given by Fabricius *("G. æglefinus,"* Fauna Grœnl.) and by Richardson *(Merlangus polaris),* very nearly correspond; Richardson, however, observed 16 rays in the second dorsal, and 23 rays in the second anal. In the specimens from Spitzbergen, Novaja Zemlja, and Archangel examined by myself, the fin-ray formulæ lay in the majority of cases within the limits cited above, the number of rays in 3 D. having, however, been as low as 17, and in 1 A. as high as 18.

The space between the several fins is distinctly defined, and as a rule wider than in its nearest congeners. In mature individuals, the width of this space about equals the diameter of the eye; in young examples it is less. Pectorals slender and elongated; the second ventral ray terminating in a short filament. The caudal fin deeply forked.

Scales. — The scales exceedingly minute, not imbricate, but circular in form, and the margins perfectly free in adults, with a distinct space between; more closely set in young individuals. The scaling uniform, covering the whole surface of the body, and extending forwards over the snout; the gill-plates, too, covered with scales.

Lateral Line and Mucous Pores. — Lateral line colourless, or perhaps a shade lighter than the colour of the ground; it commences at the upper extremity of the branchial opening, extending from thence to the termination of the first dorsal, at which point it strikes off obliquely to the mesial line, passing straight along it to the caudal. Indistinct in young individuals, particularly throughout the posterior division.

The system of mucous pores is highly characteristic, extending in healthy individuals over the surface of the head, like network. Dispersed between these pores, are numerous smaller ones, together with minute cirri, or papillary warts, which occur either isolated or (in one place) arranged as a regular series, and, in all perfect specimens, rising perceptibly higher than the mucous pores; unlike the latter, they show no traces of being perforate.

These series of pores are found to vary in different individuals; but, as a rule, the most conspicuous among them admit of being determined without much difficulty.

On the head, a long series, extending from the point of the snout along the upper edge of the eyes, and ter-

og standser ved dettes bagre Rand; en kortere Række gaar fra Snudespidsen hen under forreste Næsebor til det bagre Næsebor, ligesom en anden Række gaar bueformigt under denne hen mod Øjets forreste Rand.

Paa Kinderne strækker en Række sig fra Snudespidsen langs Overranden af Overkjæven, og bøjer hen under Øjet. Paa Underkjæven strækker en Række sig fra Symphysis bagover, og standser i Regelen ved Underkjævens Led.

Paa Gjællelaagene gaar en Række fra Underkjæveleddet hen langs Gjællelaagets Rand, og en anden kortere næsten parallelt indenfor denne. Mellem begge disse Rækker strækker sig en Række af omtrent 4 yderst korte, hvidagtige Hudtrevler.

Paa Panden staar en i Regelen V-formig (men ofte uregelmæssig) Samling af Slimporer, og paa Siderne og Nakken mindre Grupper, tilligemed enkelte spredte Slimporer og Hudtrevler.

Farve. Farven er hos de yngre Individer i levende Live mat sølvglindsende, oventil mere rødlig, idet Legemet her er bestrøet med talløse rødbrune Punkter, der paa Hovedet staa tættest; opbevarede paa Spiritus blive de lysere uden tydelige Pletter, og blot hos enkelte Individer findes mørkere Skygninger henad Ryggen, ligesom Finnerne hos enkelte have tydelige mørke Rande. Bugen er stærkere sølvfarvet.

Ældre Individer ere mørkere farvede; især ere Finnerne stærkt pigmenterede, og synes, naar de ere sammenslaaede, næsten sorte i sin ydre Del. Analerne ere dog noget lysere.

Føde. De under Nordhavs-Expeditionen erholdte Individer optoges, som det syntes, i de mellemliggende Vandlag, men observeredes ikke umiddelbart i eller ved Vandskorpen, saaledes som tidligere under andre Expeditioner. Ved én Lejlighed ophentede Trawlen i et enkelt Kast 72 Stykker, alle Unger, med en jevn Størrelse af omkr. 100^{mm}, saaledes at de utvivlsomt gaa stimevis, som de øvrige Arter; men de Dyrelevninger, som fandtes i deres Ventrikel, tilhørte hovedsagelig (tildels udelukkende) *Calanus finmarchicus,* Gunn., eller hos et Individ *Themisto libellula,* Mandt, blandet med Calaner, saaledes pelagiske Former, der færdes i enhver Dybde.

Paa Gjællerne af et af Individerne snyltede en Lernæ (af Slægten *Haemobaphes);* et Par andre smaa Snyltekrebs vare fæstede til Huden af samme Individ.

Udbredelse, Under den Forudsætning, at de ovenfor nævnte, under Navnene *Merlangus polaris, Gadus fabricii, Gadus agilis* og *Gadus glacialis* opstillede Former ere identiske med *Gadus saida* fra Hvidehavet, optræder denne Art talrigt i Europas og Americas Polartrakter, og hører til de Fiske, der ere observerede længst mod Nord. Den færdes helst mellem Drivisen, og tilhører udelukkende den kolde Area.

minating at their posterior margin; a shorter series, extending from the point of the snout under the anterior nostril; and another, bending archwise beneath the latter to the anterior margin of the eye.

On the cheeks, a series extending from the point of the snout along the superior margin of the upper jaw, passing from thence obliquely under the eye. On the lower jaw, a series commencing at the symphysis, and terminating at the articulation of the inferior maxillary bone.

On the gill-plates, a series extending from the articulation of the inferior maxillary along the margin of the opercle; and a shorter, inner series running almost parallel to the former. Between these two series of pores, a row of about 4 whitish cirri, exceedingly short.

On the forehead, too, there is a collection of mucous pores, having, as a rule, the shape of the letter V; and on the sides of the head and on the nape there occur smaller groups, together with a few isolated mucous pores and cutaneous filaments.

Colour. — Live individuals, comparatively young, distinguished by a silvery lustre; upper surface reddish, being freckled with innumerable points of reddish-brown, more especially on the head; specimens preserved in spirits gradually fade, the spots becoming indistinct; darkish cloudings down the back are, however, observed in a few individuals, and the margin of the fins, too, keeps dark in some. The abdomen argenteous.

Mature examples relatively darker, in particular on the fins, which, owing to the pigment secreted under the skin, have almost the appearance of being bordered with black. The anals somewhat lighter.

Food. — The individuals obtained on the Expedition, contrary to the experience of former observers, were taken in the intermedial strata of the ocean, having on no occasion been met with at or near the surface. In Magdalene Bay, 72 individuals, all of them young, the total length averaging about 100^{mm}, were brought up together in the trawl-net, showing beyond doubt that this species, in common with its congeners, moves in shoals; but the animal remains found in the ventricles of the specimens examined, belonged chiefly (in some instances exclusively) to *Calanus finmarchicus,* or consisted of fragments of *Themisto libellula,* along with *Calani,* accordingly pelagic forms, occurring at all depths, from the surface to the bottom.

On the gills of one specimen was found an example of a *Hæmobaphes;* two other small parasitic crustaceans had attached themselves to the skin of the same individual.

Distribution. — Assuming the forms established as *Merlangus polaris, Gadus fabricii, Gadus agilis,* and *Gadus glacialis* to be identical with *Gadus saida,* inhabiting the White Sea, this species is common in the Polar tracts of Europe and America, and is one of the fishes observed farthest north. It is met with mostly between the drift-ice, its habitat being exclusively confined to the frigid area.

I Europa er den af Parry fundet lige op til 82° 40′, ovenfor Spitsbergen; den er idethele talrigt udbredt omkring denne Øgruppe, og er observeret stimevis at svømme om mellem Isstykkerne i Fjordene. Fra Novaja Zemlja ejer Universitets-Musæet Exemplarer, indsamlede af en Sælfanger ved Barentz-Øerne under 76° 20′, ligesom den af Heuglin i 1871 fandtes noget sydligere, i Matotskin Sharr; men den er hidtil ikke fundet ved Finmarkens Kyster. Derimod er den særdeles talrig i det hvide Hav, og fanges der i stort Antal, og bringes tiltorvs i Archangel. Den er fremdeles (ifølge Günther, Cat. Fish. vol. 4, p. 337) erholdt ved Island.

Endelig er den mer eller mindre talrig ved Grønland og i det arctiske America, hvor den er iagttaget under de fleste Expeditioner; Exemplarer fra Baffinsbugten, der i 1876 ere hjembragte til Universitets-Musæet af Hvalfangeren C. Brun, ere fuldkommen overensstemmende med de spitsbergenske Individer. I Americas Polartrakter gaar den ligesaa langt mod Nord, som i Europa, og er i 1876 hjembragt af den engelske Polar-Expedition fra Grinnell Land, under 82° 27′ N. B.

In Europe, this species was taken by Parry, north of Spitzbergen (82° 40′); it is abundant in most localities on the shores of that group of islands, and has been observed in shoals between the fragments of ice in the fjords. The University Museum (Christiania) is in possesion of several specimens, taken off the Barentz Islands, in lat. 76° 20′ N.; and Heuglin met with it (in 1871) a little farther south, at Matotskin Sharr; but it has not as yet been observed on the coast of Finmark. In the White Sea, the species is exceedingly abundant, being captured there in great numbers, and sent for sale to the Archangel market. According to Günther, it has been met with on the shores of Iceland.

Finally, it is a more or less common fish on the shores of Greenland and in the Artic regions of America, where it has been observed on most Expeditions. Specimens from Baffin's Bay, presented to the University Museum by the master of a whaler, C. Brun, correspond in every respect with the examples obtained from the coast of Spitzbergen. In America, the range of the species extends as far north as in Europe, specimens having been taken on the English Polar Expedition (1876), off Grinnel Land, in lat. 82° 27′ N.

Gen. Onos, Risso.

Hist. Nat. de l'Eur. Mér. tom 3, p. 214 (1826)[1].

26. Onos reinhardi, (Kr.) Mscr. 1852.

Pl. IV, Fig. 34.

? Motella argentata, Reinh. 1835—36, Kgl. D. Vid. Selsk. Nat. Math. Afh. 6 Del, p. CX, Kbhvn. 1837 (1835—36).
Motella mustela, Reinh. (nec Lin.) Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 Del, p. 115 (1838). Uden Beskr.
Motella reinhardti, Kr. (en skreven Etiket i Musæet i Kbhvn., omtr. 1852). Uden Beskr.
? Couchia argentata, Günth. Cat. Fish. Brit. Mus. vol. 4, p. 363 (1862).
Onos reinhardii, Gill, Proc. Acad. Nat. Sci. Philad. 1863, p. 241 (1863). Uden Beskr.
Motella reinhardi, Coll. Forh. Vid. Selsk. Chra. 1878, No. 14, p. 83 (1878).

Diagn. *3 Skjægtraade (2 ved Næseborene, 1 paa Hagen). Snuden temmelig kort, har en Længde af omtrent 1′/₂ Øjendiameter. Tænderne danne flere Rækker, hvoraf en enkelt har højere Tænder, end de øvrige. Hovedet indeholdes 5 Gange i Totallængden. 1ste Straale i 1ste Dorsal*

[1] *Onos,* opstillet af Risso i 1826, har Prioriteten for *Motella,* der først forekommer i 2den Udgave af Cuviers „Règne Animal", som udkom i 1829. Begge Slægter have de samme Arter som Typer.

Gen. Onos, Risso.

Hist. Nat. de l'Eur. Mér. tom. 3, p. 214 (1826)[1].

26. Onos reinhardi, (Kr.) MS. 1852.

Pl. IV, fig. 34.

? Motella argentata, Reinh. Overs. 1835—36, Kgl. D. Vid. Selsk. Nat. Math. Afh. 6 Del, p. CX, Kbhvn. 1837 (1835—36).
Motella mustela, Reinh. Kgl. D. Vid. Selsk. Nath. Math. Afh. 7 Del, p. 115 (1838). No description.
Motella reinhardti, Kr. (from a manuscript label in the Zool. Mus. Copenh. about 1852). No description.
? Couchia argentata, Günth. Cat. Fish. Brit. Mus. vol. 4, p. 363 (1862).
Onos reinhardii, Gill, Proc. Acad. Nat. Sci. Philad. 1863, p. 241 (1863). No description.
Motella reinhardi, Coll. Forh. Vid. Selsk. Chra. 1878, No. 14, p. 83 (1878).

Diagnosis. — *Three barbels; 2 close to the nostrils, 1 on the chin. Snout rather short; its length is to the diameter of the eye about as 1′/₂ to 1. Teeth arranged in several rows, those in one of the series being longer than the rest. Length of head about one-fifth of total length. First*

[1] *Onos,* suggested by Risso in 1826, is entitled to rank before the synonym *Motella,* applied for the first time in the 2nd Edition of Cuvier's "Règne Animal," published in 1829. Both genera have the same species as types.

kort, kun ubetydeligt længere, end Snuden. Anus ligger midt mellem Snudespidsen og sidste Halehvirvel. Afstanden fra Snudespidsen til 2den Dorsal indeholdes 3,3 Gange i Totallængden. Ensfarvet rødgraa, med Skjægtraadene og Finnernes Spidser røde. Længden indtil 318mm.

M. B. 7. D. 54—59; A. 45—46; P. 22—24; V. 8; C. 28.

Localit. fra Nordh. Exped. Havet vestenfor Beeren Eiland.

	Stat. 312.
Beliggenhed.	108 Kil. V. Beeren Eiland.
Dybde.	658 Favne (1203 m).
Temp. paa Bunden.	— 1,2° C.
Bunden.	Brunt og grønt Ler.
Datum.	22de Juli 1878.
Antal Indiv.	2 Indiv.

Bemærkninger til Synonymien. Denne Art, hvoraf Nordhavs-Expeditionen erholdt 2 Individer, kunde hidtil ikke opvise nogen Diagnose, og var ikke nogensinde bleven beskreven, endskjønt den allerede for omtr. 30 Aar siden erholdt det Navn, hvorunder den fremdeles opføres, og under hvilket den flere Gange er bleven omtalt. Henførelsen af Nordhavs-Expeditionens Individer under denne Art har derfor blot kunnet gjøres efter en umiddelbar Sammenligning med Typ-Exemplarerne i Kjøbenhavn.

Allerede i 1823 erholdt Musæet i Kjøbenhavn gjennem Holböll nedsendt et Exemplar af denne Art fra Grønland, og senere erholdtes yderligere 3, ligeledes fra Grønland. Det ene af disse, der er det største af alle, indsendtes den 24de Nov. 1836; af de øvrige bærer det ene Angivelsen 26de Aug. 1841, og det sidste er sandsynligvis indkommet omtrent samtidigt.

Først i 1838 findes et (det første) af disse Individer omtalt, nemlig i Reinhardt's Fortegnelse over Grønlands Fiske (Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 Del, p. 115), men er her blot opført uden videre Angivelse som „*Motella mustela,* Lin. Holböll, Godthaab". Med Krøyer's Haandskrift er Reinhardt's Benævnelse paa det nævnte holböllske Exemplar senere rettet til *M. reinhardti,* hvilket Navn ogsaa er tildelt de øvrige Individer; under dette Navn er den ogsaa af Krøyer opført i den haandskrevne Catalog over Musæets grønlandske Fiskesamling, men uden at han nogetsteds har meddelt den nye Arts Diagnose eller Beskrivelse.

Den næste Gang, Arten findes omtalt, er i 1857 i Reinhardt's (jun.) „Naturhistoriske Tillæg til Rinks Grønlands Beskrivelse" (B. 2, Appendix p. 25), hvor den opføres med det af Krøyer givne Navn uden videre Diagnose eller Beskrivelse. Det er øjensynlig efter dette Skrift, at Arten i 1861 omtales af Gill i hans „Catal. Fishes East

ray in first dorsal short, being very little longer than snout. Vent placed midway between the point of the snout and the last caudal vertebra. Distance from snout to second dorsal is to total length as 1 to 3.3. Colour a uniform reddish-brown; cirri and fin-points red. Length reaching 318mm.

M. B. 7. 2 D. 54—59; A. 45—46; P. 22—24; V. 8; C. 28.

Locality (North Atl. Exped.): — The open sea west of Beeren Eiland.

	Stat. 312.
Exact Locality.	108 Kil. W. of Beeren Eiland.
Depth.	658 Fathoms (1203 m).
Temp. at Bottom.	— 1.2° C.
Bottom.	Brown & green Clay.
Date.	22th July 1878.
Numb. of Specim.	2 Indiv.

Remarks on the Synonymy. — This species, of which two examples were obtained on the North Atlantic Expedition, had not previously been diagnosticated at all, and never once described, notwithstanding it was given the name by which it is still known, and under which it has been repeatedly recorded, upwards of 30 years ago. Hence the identification of the two individuals taken on the Expedition necessarily involved a direct, autoptical comparison with the typical specimens preserved in Copenhagen.

In 1823, the Zoological Museum at Copenhagen first came into possession of an example of this species, sent from Greenland by Holbøll; and subsequently three other specimens were obtained, likewise from Greenland. One of these individuals reached its destination Nov. 24th 1836; of the other two, one bears date Aug. 26th 1841, and the third probably came to hand about the same time.

No one of these examples was recorded till 1838, when Reinhardt included one of them in his List of Greenland Fishes (Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 Del, p. 115), merely recording it however, without further remark, as "*Motella mustela*, Lin. Holböll, Godthaab." Reinhardt's designation for this specimen was afterwards corrected, in Kröyer's handwriting, to *M. reinhardti,* and this name also assigned to the other individuals; with this name, too, Kröyer has classed the species in his manuscript Catalogue for the Collection of Greenland fishes, but without having anywhere furnished a diagnosis or description of the new species.

The species was next recorded in 1857, by Reinhardt jun., in his "Naturhistoriske Tillæg til Rinks Grønlands Beskrivelse" (B. 2, Appendix p. 25), where it is classed with the synonym given by Kröyer, no diagnosis or description, however, being annexed. It was obviously to this work Gill had recourse in 1861, when recording

Coast North America from Greenl. to Georgia" (Proc. Acad. Nat. Sci. Philad. 1861, Append. p. 48) under Navnet *Motella reinhardi,* Kr., fremdeles af samme Forfatter i 1863 i hans "Synopsis of the North America Gadoid Fishes" (samme Tidsskr. f. 1863, p. 241) under Navn af *Onos reinhardii,* Gill, samt endelig 1873 i den reviderede Catalog af 1861, der er indtaget i U. S. Fish Commission, Report 1871—72, p. 796 (Wash. 1873).

Gill giver iøvrigt ingen anden Oplysning om Arten, end følgende Ord, tilføjede i hans "Synopsis": "Closely related to the *O. mustela,* of Europe, and agreeing in having five barbels, one to each nostril, and one at the chin," en Diagnose, som det vil sees, er ganske ucorrect.

Den sidste Gang, Arten findes omtalt, er i 1875 i Lütken's "Revised Catalogue of the Fishes of Greenland" (Man. Nat. Hist. etc. Greenl., prep. for the Arct. Exped. of 1875). Den kaldes her *Motella reinhardti,* Kr., men er, ligesom de øvrige i Fortegnelsen opregnede Arter, ikke meddelt Diagnose eller Beskrivelse.

Flere end de 4, i Kjøbenhavns zoologiske Musæum opbevarede (udvoxede) Individer have hidtil ikke været fundne. Opdagelsen af 2 nye Exemplarer, der desuden for første Gang optræde paa det europæiske Gebet, er derfor ikke uden Interesse.

Endskjønt det ikke er i Overensstemmelse med Prioritetslovenes strengeste Principer, at en Arts Benævnelse blot begrundes ved et i en Catalog og paa en Etikette nedskrevet Navn, bør Arten dog fremdeles opføres under dette hidtil benyttede Navn, der ikke kan volde nogen Forvirring; dog lader dette Navn sig ikke med fuld Sikkerhed henføre til det bestemte Aar, 1852.

Imidlertid omtaler Reinhardt i en af sine tidligere Meddelelser om Grønlands Fiske en anden Art, som han kalder *Motella argentata,* der øjensynlig udgjør Ungdomsstadiet af en af de 3-traadede Moteller *(O. reinhardi,* eller *O. ensis).* Af *M. argentata* erholdt Reinhardt i Aarene 1831—36 fra Syd-Grønland, især fra Julianehaabs District, talrige Exemplarer, der samtlige havde en jevn Størrelse af 2 Tom. 7 Lin., til 2 Tom. 11 Linier. I Oversigten for 1835—36 af Danske Vidensk. Selskabs Skrifter characteriserer Reinhardt *M. argentata* ved dens „sølvblanke Farve, det forrelagtige stumpe Hoved, og især ved den fladt indskaarne Halefinne". I 1838 giver han i 7de Del af samme Selskabs Skrifter, p. 128, yderligere en Del Bemærkninger om denne Art, der omtales som bærende 2 Hudtrevler paa Snuden, og 1 paa Hagen; Gjællestraalernes Antal var 7, Appendices pyloricae 8; Svømmeblære manglede. Tydelige Forplantningsorganer fandtes ikke hos de aabnede Exemplarer.

Efter den Undersøgelse af disse i Kjøbenhavns zoologiske Musæum endnu opbevarede talrige Individer af *M. argentata* samt af 4 i Berliner- og Wiener-Musæet, i sin Tid sendte af Reinhardt, som jeg i 1878 og 1879 havde Anledning til at foretage, fandtes deres Størrelse at være mellem 70 og 80^{mm}, hvoraf Hovedets Længde indeholdtes

the species in his "Catal. Fishes East Coast North America from Greenl. to Georgia" (Proc. Acad. Nat. Sci. Philad. 1861, Append. p. 48), by the name of *Motella reinhardi,* Kr.; also (1863) for his "Synopsis of the North American Gadoid Fishes" (same journal for 1863, p. 241), where it is termed *Onos reinhardii,* Gill; and finally (1873), for the revised Catalogue of 1861, inserted in U. S. Fish Commission, Report 1871—72, p. 796 (Wash. 1873).

All that Gill says about the species is contained in the following words in his Synopsis: — "Closely related to the *O. mustela* of Europe, and agreeing in having five barbels, one to each nostril, and one at the chin," — as will be seen, a diagnosis absolutely incorrect.

This species was last noticed in Lütken's "Revised Catalogue of the Fishes of Greenland" (Man. Nat. Hist. etc. Greenland, prep. for the Arct. Exped. of 1875). Here it bears the name of *Motella reinhardti,* but, like the other species enumerated in the List, without being made the subject of any diagnosis or description.

Other individuals, exclusive of the 4 full-grown preserved in the Zoological Museum, Copenhagen, have not as yet been observed. Hence, this addition to the extant specimens of the species, and moreover from within the European limits of its range, cannot but prove of interest.

It is not indeed in strict accordance with the principles determining the right of priority, that the designation of a species should be derived solely from a name taken from a manuscript label or a Catalogue; but it will be best to retain the synonym hitherto employed, seeing that no confusion can arise from so doing; this name, however, will hardly admit of being referred to the year 1852.

But Reinhardt records in one of his earlier communications on the fishes of Greenland another species, *"Motella argentata,"* clearly one of the three-bearded species *(O. reinhardi* or *O. ensis)* in an early stage of growth. Of *M. argentata* Reinhardt obtained, during the period extending from 1831 to 1836, from South Greenland, chiefly from the distinct of Julianehaab, numerous examples, all of which averaged in length from 2 inch. 7 lines to 2 inch. 11 lines. In the "Oversigt" of the Proceedings of the "Danske Vidensk. Selskab," Reinhardt characterises *M. argentata* by its "bright silvery hue, obtuse head, resembling that of the trout, and more especially by the slightly forked caudal fin." In 1838, he communicated in Part 7 of the Proceedings of the said Society, p. 128, divers supplementary observations on this species, which is stated to have 2 cirri on the snout, and 1 on the chin. Brancheostegous rays 7; pyloric appendages 8; swimming-bladder wanting. On dissection, no trace of sexual characters could be detected.

From an examination which I had opportunity of making in 1878 and 1879 of numerous specimens of *M. argentata* still preserved in the Zoological Museum of Copenhagen (and of 4 in the Museums of Berlin and Vienna, originally sent by Reinh. sen.), their extreme length may be given as averaging between 70^{mm} and 80^{mm}, to which the

5—5½ Gange i Totallængden; den første Straale i 1ste Dorsal udgjorde ⅓ af Hovedlængden. Afstanden mellem Snudespidsen og 2den Dorsal indeholdtes omtrent 3,5 Gange i Totallængden. Skjælbeklædningen var endnu ikke fuldstændig, idet den paa Legemets forreste Del øjensynlig endnu blot var i Frembrud. At *M. argentata* blot er en Ungform, er især paa Grund af det sidstnævnte Factum øjensynligt, og det ligger vistnok nærmest at antage den for Ungen af *O. reinhardi*. Dette Spørgsmaal kan ikke afgjøres, førend sikre Ungdomsstadier af de 2 nærstaaende Arter, *O. reinhardi* og *O. ensis,* blive kjendte.

Viser det sig altsaa i Fremtiden, at Reinhardt's *Motella argentata* udgjør Ungformen af *O. reinhardi,* vil Artens rette Navn følgelig blive *Onos argentatus,* (Reinh.) 1838.

Den nævnte anden Art, *Onos ensis,* er den, som *O. reinhardi* i sin udvoxede Stand utvivlsomt staar nærmest. *O. ensis* er ligeledes en grønlandsk Form, og opstilledes af Reinhardt (samtidigt med *Motella argentata*) i Overs. 1835—36 af det oftere nævnte Selskabs Forhandlinger, 6 Del, p. CX, og senere i 7de Del, p. 116 og 128 (Kbhvn. 1837), efter 2 Individer, der i noget beskadiget Stand i 1834 vare udtagne af Ventrikelen af en *Cystophora cristata* ved Omenak (70° N. B.).

Den af Reinhardt paa de ovenanførte Steder givne korte Characteristik er dog saa ufuldkommen, at Dr. Günther ikke deraf har kunnet opstille nogen Diagnose, og Arten findes derfor i 1862 i hans Cat. Fish. Brit. Mus. ikke optagen som selvstændig Art (vol. 4, p. 366). De 2 originale Exemplarer, der endnu opbevares i det zoologiske Musæum i Kjøbenhavn, ere fremdeles, saavidt vides, de eneste, som existere, og de have hidtil ikke været Gjenstand for nøjagtigere Undersøgelse og Beskrivelse. Ingen af Arterne har hidtil været afbildet.

Ved den flygtige Gjennemgaaelse af denne og de øvrige nærstaaende Former, som jeg ved Dr. Lütkens Velvillie havde Lejlighed til at foretage i October 1878, viste det sig strax, at *O. ensis* og *O. reinhardi* ere fuldkommen distincte, om end beslægtede Arter. De mest iøjnefaldende Characterer hos *O. ensis* ligge i den stærkt forlængede 1ste Straale i 1ste Dorsal, det mindre Hoved, og den svagere Tandvæbning. Totallængden hos de 2 Individer var omtrent 310^{mm} og 392^{mm}.[1]

[1] **Onos ensis,** (Reinh.) 1835—36.

Overs. 1835—36, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 6 Del, p. CX, Kbhvn. 1837 (1835—36).

3 Skjægtraade; Hovedet indeholdes omtrent 5¾ Gange i Totallængden. 1ste Straale i 1ste Dorsal lang, omtrent af Hovedets Længde. Tænderne forholdsvis svage og ensartede. Anus ligger midt mellem Snudespidsen og Begyndelsen af Caudalen. Afstanden fra Snudespidsen til 2den Dorsal indeholdes 3,7 Gange i Totallængden.

2 D. 59; A. 45—46; P. 22—23.

Til Sammenligning kan vedføjes følgende Maal af et Par omtrent lige store Individer af de 2 Arter, begge fra Musæet i Kjøbenhavn.

length of the head bears the proportion of 5—5½. First ray in first dorsal one-third of the length of the head. Distance from point of snout to second dorsal is to total length as 1 to 3.5. The scales not yet fully developed; on the anterior part of the body indeed almost incipient. Hence, *M. argentata* must represent one of the earlier stages of growth, in which case it comes nearest to *O. reinhardi.* This question cannot, however, be decided until the stages through which the two closely related species, *O. reinhardi* and *O. ensis,* pass before reaching maturity, have become known.

Should future researches show that Reinhardt's *M. argentata* is merely *O. reinhardi* in an early stage of development, the name of the species will be *Onos argentatus,* (Reinh.) 1838.

Onos ensis is unquestionably the species presenting the closest resemblance to *O. reinhardi* in its adult stage of development. *O. ensis* is likewise a Greenland form; it was described by Reinhardt (along with *Motella argentata)* in Overs. 1835—36, Kgl. D. Vid. Selsk. Afh. D. 6, p. CX, and subsequently in Part 7, pp. 116 and 128 (1837), his specimens being two individuals, in a somewhat mutilated condition, which had been taken in 1834 from the stomach of a *Cystophora cristata,* near Omenak, in lat. 70° N.

The brief characterisation furnished by Reinhardt is very imperfect however, so much so indeed that Dr. Günther could not elaborate from it a diagnosis; and the species figures as undetermined in his "Cat. Fish. Brit. Mus." (vol. 4, p, 366), published 1862. The two original individuals still preserved in the Zoological Museum in Copenhagen, are the only specimens known to exist, and up to the present time they have not been accurately examined and described. Neither of the species has hitherto been figured.

The cursory examination of this and the other nearly related forms which, thanks to the kindness of Dr. Lütken, an opportunity was afforded me of making in October 1878, conclusively proved the specific distinction existing between the congeners *O. ensis* and *O. reinhardi.* The most conspicuous characters in *O. ensis* are the produced first ray in the first dorsal fin, the small size of the head, and the feeble dentition. Total length in the two specimens, respectively 310^{mm} and 392^{mm}.[1]

[1] **Onos ensis,** (Reinh.) 1835—36.

Overs. 1835—36, Kgl. D. Vid. Selsk. Naturv. Math. Afh. 6 Del, p. CX, Kbhvn. 1837 (1835—36).

Three barbels; length of head is to total length as 1 to 5¾. First ray in 1st dorsal produced, its length equalling that of the head. Teeth comparatively feeble, and uniform. The vent placed midway between the snout and the commencement of the caudal fin. Distance from point of snout to 2nd dorsal is to total length as 1 to 3.7.

2 D. 59; A. 45—46; P. 22—23.

For comparison are appended measurements of two individuals, about equal in size, of the two species — both specimens preserved in the Zoological Museum in Copenhagen.

Da *O. reinhardi* saaledes hidtil ikke er bleven beskreven, meddeles en Beskrivelse efter de 2 foreliggende Exemplarer, hvoraf det ene sandsynligvis er fuldvoxent, sammenholdte med de i Kjøbenhavner-Musæet opbevarede Typ-Exemplarer.

Udmaalinger.

	a.	*b.*
Totallængde	254 mm	293 mm
Hovedets Længde	49 -	59 -
Øjets Diameter	9 -	11 -
Snudens Længde	14 -	15 -
Hovedets postorbitale Del	27 -	34 -
Legemets Højde	40 -	45 -
Snudespidsen til 1ste Dorsal	46 -	55 -
Snudespidsen til 2den Dorsal	77 -	88 -
Snudespidsen til Anus	117 -	142 -
Anus til sidste Halehvirvel	117 -	130 -
Anus til Spidsen af Caudalen	143 -	159 -
Anus til Begyndelsen af Caudalen	109 -	113 -
Halerodens Højde	14 -	17 -
Interorbitalrummets Bredde	11 -	15 -
Pectoralernes Længde	37 -	44 -
Ventralernes Længde	49 -	49 -
Længden af 1ste Straale i 1ste Dorsal	16,5 -	18 -

Beskrivelse. *Legemsbygning.* Legemet er langstrakt; dets Højde, naar Bugen ikke er slap eller udspilet, er næsten, men ikke fuldt lig Hovedets Længde, og indeholdes omtrent $5^3/_4$ Gange i Totallængden.

Hovedet er forholdsvis lidet, med temmelig jevnt afrundet Profil, og stærke, muskuløse Kinder; dets Længde udgjør hos 4 Individer 4,8, hos 1 Individ 4,9, hos 1 (det mindste) 5,1 af Totallængden.

Underkjæven er kortere, end Overkjæven; Mundspalten er af middels Længde, idet Overkjæven strækker sig tilbage omtrent ret under Bagranden af Øjet (eller hos et yngre Individ ikke fuldt saa langt).

Tænderne ere tilstede i Mellemkjæverne og i Underkjæven, samt paa Vomer; overalt danne de flere Rækker, hvoraf en enkelt rager op over de øvrige; denne Række sidder i Mellemkjæven forrest, i Underkjæven inderst, paa Vomer omtrent i Midten.

Snuden har paa hver Side 1 Skjægtraad, fæstet til den bagre Rand at det forreste Næsebor; en tredie Traad findes paa Hagen.

Gjællehindens Straaler ere 7 i Antal.

Øjnene ere forholdsvis store, lateraltstillede; Længdediameteren indeholdes ikke fuldt $1^1/_2$ Gang i Snudens

O. reinhardi having accordingly not as yet been diagnosticated, a description is given here, from a careful examination of the two specimens obtained, one of which, probably, is an adult (compared to the typical examples preserved in the Copenhagen Museum).

Measurements.

	a.	*b.*
Total length	254 mm	293 mm
Length of head	49 -	59 -
Diameter of eye	9 -	11 -
Length of snout	14 -	15 -
Postorbital region of head	27 -	34 -
Depth of body	40 -	45 -
From point of snout to first dorsal	46 -	55 -
From point of snout to second dorsal	77 -	88 -
From point of snout to vent	117 -	142 -
From vent to last caudal vertebra	117 -	130 -
From vent to extremity of caudal	143 -	159 -
From vent to commencement of caudal	109 -	113 -
Depth of tail at base	14 -	17 -
Interorbital space	11 -	15 -
Length of pectorals	37 -	44 -
Length of ventrals	49 -	49 -
Length of 1st ray in 1st dorsal	16.5 -	18 -

General Description. *Structure of the Body.* — Body elongated; depth, when the abdomen is neither relaxed nor distended, almost equal to the length of the head, being to total length about as 1 to $5^3/_4$.

Head comparatively small, the upper profile line rounded; cheeks strong and muscular; length of head, in 4 individuals, is to total length as 1 to 4.8; in 1 individual, as 1 to 4.9; in the smallest, as 1 to 5.1.

Lower jaw shorter than upper; mouth of moderate length, the upper jaw extending backwards almost under the posterior margin of the eye (in a younger example not quite so far).

Teeth on intermaxillaries, in lower jaw, and on the vomer; on each bone several rows, one with longer teeth than the rest; on the intermaxillaries this row is the outermost, in the lower jaw the innermost, on the vomer the medial series.

On either side of the snout 1 barbel, attached to the posterior margin of the foremost nostril; a third barbel on the chin.

Brancheostegous rays 7.

Eyes comparatively large, position lateral; the longitudinal diameter of the eye is to the length of the snout very

	O. reinhardi.	*O. ensis.*
Totallængden	318 mm	310 mm
Hovedets Længde	66 -	52 -
Overkjævens Længde	30 -	22,5 -
Fra Snudespidsen til Beg. af 2den Dorsal	96 -	83 -
Længden af 1ste Straale i 1ste Dorsal	20 -	45 -

	O. reinhardi.	*O. ensis.*
Total length	318 mm	310 mm
Length of head	66 -	52 -
Length of upper jaw	30 -	22.5 -
From point of snout to com. of 2nd dorsal	96 -	83 -
Length of 1st ray in 1st dorsal	20 -	45 -

Længde, og omtrent $5^1/_2$ Gange i Hovedlængden. Interorbitalrummet er forholdsvis smalt, eller ubetydeligt større, end Øjendiameteren.

Anus ligger midt mellem Snudespidsen og sidste Halehvirvel; Halerodens Højde er omtrent lig Snudens Længde (Hovedets præorbitale Del).

Finnerne. 1ste Dorsals Grundlinie er forholdsvis lang, omtrent lig Længden af Hovedets postorbitale Del; dens 1ste forlængede Straale er ubetydeligt større, end Halerodens Højde, eller Snudens Længde, og er næsten lig 2 Gange Øjets Diameter.

2den Dorsal, der tæller hos det mindre Exemplar 54, hos det større 59 Straaler, udspringer i næsten en Øjendiameters Afstand fra 1ste Dorsal, og i en Afstand fra Snudespidsen, der omtrent svarer til Gjællespaltens Afstand fra Anus. Den er omtrent jevnhøj; dog ere de bagre Straaler noget længere, end de forreste. Afstanden fra den sidste Dorsalstraale til Hvirvelsøjlens Ende svarer omtrent til Afstanden fra Snudespidsen til Bagranden af Øjet.

Analen, der tæller hos det mindre Exemplar 45, hos det større 46 Straaler, udspringer umiddelbart bag Anus, og ophører ubetydeligt foran Verticalen fra Slutningen af 1ste Dorsal. Dens Bygning og Højde er ganske, som hos den sidstnævnte Finne.

Pectoralerne tælle 22—24 Straaler, ere forholdsvis brede, og have de nedre Straaler kortest; deres Længde er noget større; end Afstanden fra Øjets forreste Rand til Gjællespalten.

Ventralerne tælle 8 Straaler; den anden fra oven er forlænget, saaledes at Finnens største Længde omtrent bliver lig Hovedlængden, hos det mindre Exemplar endog større end denne. Den første Straale er omtrent $^2/_3$ saa lang, som 2den. Tilbageslaaet naar Finnens Spidse hos det yngre Individ bagenfor Pectoralernes Spidse, og er her blot en halv Finnelængde fjernet fra Anus; hos det ældre Individ ere Straalerne forholdsvis kortere, naa ikke fuldt Pectoralernes Spidse, og ere næsten i en Finnelængdes Afstand fjernede fra Anus.

Caudalen er svagt afrundet, og tæller omtrent 28 lange Straaler, foruden et Antal kortere Støttestraaler paa begge Sider af Roden. Dens største Længde, regnet fra sidste Halehvirvel, er omtrent lig Længden af Hovedets postorbitale Del.

Sidelinien og Slimporer. En fuldstændig Sidelinie er tilstede, men Porerne ere, som hos alle Moteller, stillede med temmelig langt Mellemrum indbyrdes. Den strækker sig fra Gjællespaltens øvre Rand først i noget skraa Retning opad, men bøjer noget bag Begyndelsen af 2den Dorsal skraat nedad mod Legemets Midtlinie, som den naar omtrent ret over Begyndelsen af Analen; herfra følger den Midtlinien ret ud til Caudalen. Antallet af Porer er omtrent 27; paa Legemets bagre Del ere Mellemrummene mellem disse større, end fortil.

Af de Rækker Slimporer, som udbrede sig over Ho-

nearly as 1 to $1^1/_2$, to the length of the head about as 1 to $5^1/_2$. Interorbital space but slightly exceeding the diameter of the eye.

The vent midway between the point of the snout and the last caudal vertebra; depth of tail at base about equal to the length of the snout (preorbital region of the head).

Fins. — Base of first dorsal long, about equal in length to the postorbital region of the head; the first elongated ray slightly exceeding in length the depth of the tail at base, or the length of the snout, or about equal to twice the diameter of the eye.

Second dorsal — in the smaller specimen with 54, in the larger, with 59 rays — is distant at its commencement the length of the diameter of the eye from the first, its distance from the point of the snout being about equal to that between the branchial opening and the vent. Depth nearly uniform, the posterior rays however slightly exceeding in length those in the anterior part of the fin. The distance from the last dorsal ray to the termination of the vertebral column about equal to that between the snout and the posterior margin of the eye.

The anal — in the smaller example with 45, in the larger with 46 rays — commences immediately behind the vent, terminating a little in advance of the last ray of first dorsal. Depth and structure as in that fin.

The pectorals, furnished each with 22—24 rays, comparatively broad; lower rays shortest; length slightly exceeding the distance from the anterior margin of the eye to the branchial opening.

The ventrals furnished with 8 rays; second anterior ray elongated, the length of the fin about equalling the length of the head; in the smaller specimen exceeding it even. The second ray longer than the first by about two-thirds. Spread backwards, the tip of the fin, in the younger specimen, reaching beyond the extremity of the pectorals, at which point it is removed not more than half the length of the fin from the vent; the rays in the older individual relatively somewhat shorter, not quite reaching the extremity of the pectorals, and removed almost the length of the fin from the vent.

The caudal slightly convex, furnished with 28 long rays, exclusive of a number of shorter rays protending along both sides of the base. Length, measured from the last caudal vertebra, about equal to that of the postorbital region of the head.

Lateral Line and Mucous Pores. — A lateral line, distinct throughout its entire length, extends from the upper margin of the gill-opening, at first somewhat obliquely upwards, but slants off at the commencement of the second dorsal in the direction of the mesial line, which it meets almost immediately above the origin of the anal, passing from thence straight along the said line to the caudal. Number of pores about 27; on the posterior part of the body, the spaces between are larger than in the anterior region.

Of the several series of mucous pores disposed over

vedet, ere følgende de mest iøjnefaldende. En Række af omtrent 9 Porer strækker sig fra Snudespidsen langs Randen af Overkjæven indtil bagenfor Mundvinkelen. Fra den sidste af disse Porer stiger verticalt nedad en Række finere Porer, oftest 4 i Antal, indtil den nedre Rand af Praeoperculum; herfra fortsætter sig en Række af omtrent 6 grovere Porer langs Randen af Praeoperculum bagover og opover, indtil den standser omtrent i Højde med Gjællespaltens øvre Ende. Endelig strække sig langs Underkjæven 2 næsten parallelle Rækker, den indre med 5 mindre, den ydre med 3 grovere Porer. Mellem Øjnene danne 3 (ligeledes grovere) Porer en fortil aaben Vinkel. Paa Siderne af Panden strækker sig fra Øjet hen til Gjællespaltens øvre Ende en Række af 4 Porer. Iøvrigt findes spredte Porer paa Panden, ligesom ogsaa Antallet i de normale Rækker viste sig at være noget varierende hos de 2 undersøgte Individer.

Skjælbeklædning. Skjællene ere udbredte over hele Legemet. Paa Hovedet strækker Skjælbeklædningen sig frem indtil mellem de bagre Næsebor, hvorimod selve Snuden er nøgen; paa Hovedets Underside er Skjælbeklædningen ligeledes udbredt overalt paa den ubedækkede Del af Gjællehinden indtil selve Spidsen af Underkjæven, der er nøgen. Paa Dorsalen og Analen strække Skjællene sig ud næsten lige til Spidsen af Straalerne; paa Pectoralerne findes de blot ved Roden.

Farve. Farven var i levende Live rødgraa, paa Hovedet og Bugen gaaende over i blaagraat; paa Hovedets Underside strækker denne Farve sig frem overalt paa Gjællehindens ubedækkede Dele. Spidsen af Dorsalen, Analen, og Caudalen vare smukt røde; samme Farve havde de 3 Skjægtraade, samt den første forlængede Straale i 1ste Dorsal. Pectoraler og Ventraler vare hos det ene Exemplar i Spidsen røde, hos det andet blaalige med lysere Spidser. Mundhulen var hvid. Efterat Individerne have været opbevarede paa Spiritus, er Farven bleven mere ensfarvet rødgraa overalt; Hovedets Skjægtraade, samt 1ste Dorsalstraale have tabt sin røde Farve, hvilket ogsaa er Tilfældet med Ventralerne og tildels med Pectoralerne. De sidste have derimod faaet lysere Pletter paa den rødlige eller blaalige Bund.

Føde. I Ventrikelen af det ene Individ fandt jeg Skelettet af en liden Fisk, hvis Længde var omtrent 100^{mm}; en sølvglindsende Svømmeblære var dog endnu tilstede, men Arten lod sig ikke bestemme, da Hovedet var næsten fortæret. Desuden fandtes diverse Stykker af Decapoder, som det syntes, af Hippolyter.

Det andet Individ havde Ventrikelen fyldt af *Themisto libellula,* en Amphipode af Hyperidernes Familie, der saaledes trænger ned til en anselig Dybde, skjønt den maa ansees for at have sit Hovedtilhold i de højere Vandlag; fremdeles en *Anonyx,* sandsynligvis *A. lagena.*

Udbredelse. Foruden Nordhavs-Expeditionens 2 Individer fra Havet mellem Spitsbergen og Beeren Eiland ere,

the surface of the head, the following are the most conspicuous: — A row, composed of about 9 pores, extending from the point of the snout along the margin of the upper jaw a little behind the angle of the mouth. Branching vertically downwards from the last of these pores, a series of about 4 smaller pores is seen extending to the lower margin of the preoperculum; from this point a series of about 6 large pores runs along the margin of the preoperculum, backwards and upwards, terminating in a line with the upper extremity of the gill-opening. On the lower jaw occur two rows almost parallel, the inner composed of 5 small, the outer of 3 large, pores. Between the eyes are 3 pores (these, too, comparatively large), marking off an angular space, open anteriorly. On either side of the forehead, from the eye to the upper extremity of the branchial opening, extends a row of 4 pores. Moreover, isolated pores occur on the forehead; and the number in the normal series varies somewhat in the 2 individuals examined.

Scales. — The scales cover the entire surface of the body. On the head, they extend forwards between the posterior nostrils, leaving the snout naked; on the under surface of the head, they likewise envelop the whole of the uncovered portion of the branchial membrane, saving the extreme point of the lower jaw, which is naked. On the dorsal and anal, the scales extend almost to the points of the rays; on the pectorals, they occur only on the base.

Colour. — Colour in live examples reddish-grey, changing to bluish-grey on the head and abdomen; the latter shade extends, too, over the whole of the uncovered portion of the branchial membrane. Tips of dorsal, anal, and caudal of a fine red; this colour likewise distinguishing the barbels and the first elongated ray in first dorsal. Tips of pectorals and ventrals in one example red; in the other, the tips were bluish. Cavity of the mouth white. The specimens having been preserved some time in spirits, the colour has changed to a more uniform reddish-grey; the barbels and the first dorsal ray have lost their brilliant red colour; this is the case too with the ventrals, and, to some extent, with the pectorals; in the latter, the reddish or bluish ground has become flecked with lighter spots.

Food. — In the ventricle of one of the individuals was the skeleton of a small fish, length about 100^{mm}; the swimming-bladder, of a silvery lustre, was still present, but the head being very nearly digested, there was no means of determining the species; the stomach also contained divers fragments of Decapods, apparently of the genus *Hippolyte.*

The other individual had the ventricle distended with *Themisto libellula,* of the family *Hyperidæ,* a species descending therefore to a considerable depth, though its true habitat has been held to be exclusively the upper strata of the ocean; an *Anonyx,* probably *A. lagena,* was also found.

Distribution. — Exclusive of the two individuals taken on the North Atlantic Expedition between Spitzbergen and

som tidligere nævnt, blot kjendte 4 udvoxede Individer, der alle vare erholdte ved Kysterne af Grønland i Aarene mellem 1823 og 1841, og som ere opbevarede i Musæet i Kjøbenhavn.

Nordhavs-Expeditionens nye Individer optoges fra betydeligt Dyb (mellem 600 og 700 Favne), og fra det iskolde Vand.

Hertil kommer et Antal Ungdomsformer *(Motella argentata,* Reinh.), der, efter hvad ovenfor er udviklet, med høj Grad af Sandsynlighed tilhøre denne Art, og som ligeledes ere erholdte ved Grønland i Aarene 1830—1840, og hvoraf de fleste opbevares i Musæet i Kjøbenhavn, enkelte i Musæerne i Berlin og Wien.

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27. **Onos septemtrionalis,** (Coll.) 1874.

Pl. IV, Fig. 35—36.

Motella septemtrionalis, Coll. Ann. Mag. Nat. Hist. Ser. 4, vol. 15, p. 82, Nov. 1874. (1874).

Diagn. *3 Skjægtraade (2 paa Næseborene, 1 paa Hagen), samt en Række af 8 kortere, tildels rudimentære Traade langs Overlæben. Øjnene forholdsvis smaa, indeholdes (hos ældre Individer) 2 Gange i Snudens Længde. Mundspalten strækker sig bagover langt bagenfor Øjnene. Tænderne temmelig smaa, af ulige Størrelse. Hovedet indeholdes ubetydeligt over 4 Gange i Totallængden. 1ste Straale i 1ste Dorsal kort, omtrent lig Snudens Længde. Anus ligger midt mellem Snudespidsen og sidste Analstraale. Sidelinien synlig, med omtrent 20 store Porer. Farven ensartet graabrun. Totallængden (hos det største undersøgte Individ) 173mm.*

M. B. 7. 2 D. 49—52; A. 41—43; P. 15—16; V. 7; C. 28—30.

Localit. fra Nordh. Exped. Røst, ved Indløbet til Lofoten (Norge).

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Beliggenhed.	Røst, Lofoten (Norge).
Dybde.	50 Favne (91 m).
Temp. paa Bunden.	+ 5° C.
Bunden.	Sandbund.
Datum.	26de Juni 1877.
Antal Indiv.	1 Unge.

Bemærkninger til Synonymien. *O. septemtrionalis,* der opstilledes i 1874 efter 2 Exemplarer fra Norges Vestkyst (det største med en Totallængde af omtr. $6^1/_2$ Tomme

Beeren Eiland, 4 full-grown specimens only are known to exist of this species, which, as previously stated, were all obtained off the coast of Greenland; they are preserved in the Zoological Museum at Copenhagen.

The individuals last obtained were taken at a considerable depth (6—700 fathoms), and in water of the temperature of ice.

There occur besides a number of forms in the earlier stages of growth *(Motella argentata,* Reinh.), which, as explained above, may be referred with a high degree of probability to the species in question; the specimens of these, too, were taken on the coast of Greenland (1830—1840), and are most of them preserved in the Copenhagen Museum, some in the Museums of Berlin and Vienna.

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27. **Onos septemtrionalis,** (Coll.) 1874.

Pl. IV, fig. 35—36.

Motella septemtrionalis, Coll. Ann. Mag. Nat. Hist. Ser. 4, vol. 15, p. 82, Nov. 1874 (1874).

Diagnosis. — *Three barbels (2 at the nostrils, 1 on the chin), and a row of shorter, in part rudimentary barbels along the upper lip. Eyes comparatively small, their diameter (in mature individuals) half the length of the snout. The angle of the mouth extending backwards far beyond the eyes. Teeth rather small, of unequal size. The head is contained a little more than 4 times in the total length. First ray in first dorsal short, about equal to the length of the snout. The vent placed midway between the point of the snout and the last anal ray. Lateral line obvious, composed of about 20 large pores. Colour a uniform greyish-brown. Total length (in the largest individual examined) 173mm.*

M. B. 7. 2 D. 49—52; A. 41—43; P. 15—16; V. 7; C. 28—30.

Locality (North Atl. Exped.): — Røst, Inlet to Lofoten (Norway).

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Exact Locality.	Røst, Lofoten (Norway).
Depth.	50 Fathoms (91 m).
Temp. at Bottom.	+ 5° C.
Bottom.	Sand.
Date.	26th June 1877.
Numb. of Specim.	1 Indiv. (young).

Remarks on the Synonymy. — *O. septemtrionalis,* described in 1874, from 2 examples taken on the west coast of Norway (length of the largest about $6^1/_2$ inches, or

(eller 173 mm), har hidtil ikke været kjendt fra andre Punkter, end fra de norske Kyster[1]. Imidlertid har jeg i 1878 havt Lejlighed til at undersøge et Exemplar af denne Art, der under et provisorisk, med Kröyer's Haandskrift (omtr. 1852) vedføjet Navn opbevares i den grønlandske Samling i Musæet i Kbhvn., men som aldrig hidtil har været omtalt.

Beskrivelse. *Legemsbygning.* Fra alle de øvrige Arter af denne Slægt kan denne kjendes ved sit relativt store Hoved med de lange Kjæver, samt ved en Række af rudimentære Skjægtraade (foruden de normale) langs Overlæben. Jeg gjengiver her Artens oprindelige Beskrivelse, med de Supplementer, som de senere fundne Exemplarer have foranlediget, og giver tillige en ny Afbildning af Typ-Exemplaret.

De Individer, alle fra de norske Kyster, der have foreligget til Undersøgelse, have havt følgende Maal og Straaleantal:

	a. Røst, Aug. 1877.	*b.* Bodø, Aug. 1874.	*c.* Florø, Juli 1873.
Totallængde	69 mm	100 mm	173 mm
Hovedets Længde	16,8 -	24,5 -	42 -
Straaler i 2den Dorsal . . .	49 -	49 -	52 -
Straaler i Analen	43 -	41 -	43 -
Straaler i Pectoralerne . . .	16 -	15 -	16 -

Legemet er forholdsvis kort og sammentrængt; dets Højde, der er betydeligt kortere, end Hovedlængden, indeholdes omtrent $5^2/_3$ Gange i Totallængden.

Anus ligger næsten nøjagtigt midt mellem Underkjævens Spidse og Slutningen af Analen. Haleroden har en Højde, der er lig Interorbitalrummets Bredde, og indeholdes næsten 3 Gange i Overkjævens Længde.

Hovedet er stort, stærkt fladtrykt ovenfra og nedenfra, og med tykke, muskuløse Kinder; dets Længde indeholdes ubetydeligt over 4 Gange i Totallængden. Underkjæven er kortere, end Overkjæven.

Mundspalten er særdeles vid, og større, end hos nogen anden Art, idet den, især hos de større Exemplarer, strækker sig bagover langt forbi Øjet. Længden af Overkjæven er nemlig lig Hovedets postorbitale Del, saaledes at Snudens Længde er ikke ubetydeligt mindre, end Afstanden fra Øjet til Mundvinkelen.

Tænder ere tilstede i Kjæverne og paa Vomer. I Kjæverne danne de flere Rækker, men disse ere af ulige Størrelse, idet i Overkjæven den ydre Rækkes Tænder ere de største, og stærkt indadkrummede, medens der i Underkjæven sidde flere grovere Tænder (der her idethele ere større, end Overkjævens), i den indre Række. Paa Forsiden af Vomer findes et halvcirkelformigt Baand af finere Tænder.

[1] Ann. Mag. Nat. Hist. Ser. 4, vol. 15, p. 82 (1874); „Norges Fiske", Tillægshefte til Forh. Vid. Selsk. Chra. 1874, p. 117, Tab. 2; Forh. Vid. Selsk. Chra. 1878, No. 4, p. 20.

173 mm), has not hitherto been known to occur in other localities than on the coasts of Norway.[1] In 1878, however, I examined a specimen of this species, which, with a provisional name, in Kröyer's handwriting (probably about 1852), is preserved in the Greenland Collection in the Zoological Museum of Copenhagen.

General Description. *Structure of the Body.* — *Onos septemtrionalis* is distinguished from all the other species by a comparatively large head, very long jaws, and by a series of rudimentary barbels extending (besides the normal ones) along the upper jaw. I give here the description originally furnished, together with supplementary data derived from the examination of later specimens, and annex a new representation.

The individuals examined, all from the coasts of Norway, are distinguished by the following dimensions and fin-formulæ.

	a. Røst, Aug. 1877.	*b.* Bodø, Aug. 1874.	*c.* Florø, July 1873.
Total length	69 mm	100 mm	173 mm
Length of head	16.8 -	24.5 -	42 -
Number of rays in 2 D. . .	49 -	49 -	52 -
Number of rays in A. . . .	43 -	41 -	43 -
Number of rays in P. . . .	16 -	15 -	16 -

Body comparatively short and compressed; its depth, considerably less than the length of the head, is to total length about as 1 to $5^2/_3$.

The vent placed nearly midway between the extremity of the lower jaw and the termination of the anal fin. Peduncle of tail about equal to the width of the interorbital space.

Head large, depressed, and with thick, muscular cheeks; its length is contained rather more than 4 times in the total length. Lower jaw shorter than upper.

The gape remarkably wide, more so indeed than in any other species, extending as it does, especially in large examples, far behind the eye. The upper jaw nearly as long as the postorbital part of the head, and the snout measuring accordingly a good deal less than the distance from the eye to the angle of the mouth.

Teeth in the jaws and on the vomer. In the jaws, arranged in several rows, which, however, are of unequal length on the upper jaw, the teeth in the exterior series being the largest, and curving considerably inwards; the lower jaw has several stouter teeth (the teeth in this jaw being generally larger than those in the upper) in the interior row. On the fore part of the vomer extends a semicircular patch of smaller teeth.

[1] Ann. Mag. Nat. Hist. Ser. 4, vol. 15, p. 82 (1874); "Norges Fiske," Appendix to Forh. Vid. Selsk. Chra. 1874, p. 117, Pl. 2; Forh. Vid. Selsk. Chra. 1878, No. 4, p. 20.

Øjnene ere forholdsvis smaa, og, paa Grund af Hovedets fladtrykte Form, temmelig stærkt opadvendte; de indeholdes hos større Individer 2 Gange i Snudens Længde, og omtrent $7^1/_2$ Gange i Hovedlængden. Hos de yngre ere Øjnene forholdsvis større; hos Nordhavs-Expeditionens Individ, der har en Totallængde af blot 69^{mm}, er Øjets Længdediameter ikke langt fra lig Snudelængden, og indeholdes blot 5 Gange i Hovedets Længde. Interorbitalrummet er forholdsvis bredt, og indeholdes $1^1/_2$ Gang i Øjets Højdediameter.

Skjægtraadene oventil ere 2 lange, og en hel Række kortere langs Overlæben. De første sidde, som sædvanligt, ved den bagre Rand af det forreste Par Næsebor. De sidste ere 8 i Antal, hvoraf de yderste ere ganske rudimentære; det mellemste Par ere de længste, uden dog at opnaa en Længde af en Øjendiameter. Paa Hagen findes en enkelt, lang Traad.

Gjællespalten er særdeles vid; Gjællehindens Straaler ere 7 i Antal.

Finnerne. 1ste Dorsal er kort; dens Grundlinie er omtrent lig Afstanden fra Snudespidsen til Øjets bagre Rand; dens første forlængede Straale har samme Længde, som Finnens halve Grundlinie, eller 2 Gange Øjets Diameter. Den begynder ubetydeligt foran Pectoralernes Rod, og ender ret over Begyndelsen af samme Finners ydre Trediedel.

2den Dorsal, der tæller 49—52 Straaler, udspringer lige bag 1ste i en Afstand fra Snudespidsen, der er ubetydeligt længere, end Afstanden fra Anus til Kjævernes bagre Kant. Den er næsten jevnhøj overalt, og slutter i omtrent en Øjendiameters Afstand fra Caudalens Rod. Dens største Højde er omtrent lig Grundlinien af 1ste Dorsal.

Analen, der tæller 41—43 Straaler, udspringer umiddelbart bag Anus, og ophører, som hos de fleste Arter, ubetydeligt før sidste Straale af 2den Dorsal. Dens Højde er næsten lig 2den Dorsals Højde.

Pectoralerne, der have 15—16 Straaler, ere brede, korte og afrundede, idet deres Længde neppe er større, end Underkjævens.

Ventralerne tælle 7 (ikke 8) Straaler, og have den 2den Straale noget forlænget, længst hos de yngre Individer, hvor den naar forbi Pectoralernes Spidse; hos de ældre er Spidsen fjernet næsten en Finnelængde fra Anus, og naar ikke Pectoralernes Spidse. Den første og sidste Straale ere enkelte, hvorimod de øvrige ere kløvede til Grunden.

Caudalen tæller 28—30 Straaler, og er noget afrundet, skjønt Hjørnerne ere tydeligt fremtrædende.

Skjælbeklædning. Skjællene ere smaa og fastsiddende, samt beklæde hele Legemet lige ud paa Snuden, saavelsom Grunden af Finnerne; mindst skjælbeklædte ere Ventralerne. Hos Nordhavs-Expeditionens Individ, hvis Totallængde blot er 69^{mm}, er Snuden og Hovedets Sider endnu nøgne, ligesom Skjælbeklædningen endnu ikke er fremkommet paa

Eyes rather small, and directed, from the depressed form of the head, considerably upwards; the diameter, in comparatively large individuals, is to the length of the snout as 1 to 2, and to the length of the head about as 1 to $7^1/_2$. In young individuals, the eyes are relatively larger; in the specimen taken on the Expedition, total length not more than 69^{mm}, the longitudinal diameter of the eye very nearly equals the length of the snout, and is to the length of the head as 1 to 5 only. Interorbital space comparatively wide, being to the vertical diameter of the eye as 1 to $1^1/_2$.

Of the cirri on the upper jaw, 2 are long, and a whole series of shorter (partly rudimentary) barbels extends along the upper lip; the former placed as usual at the posterior margin of the foremost pair of nostrils; the latter are 8 in number, the outermost quite rudimentary, the medial pair longest, their length, however, not equalling the diameter of the eye. One long barbule on the chin.

Branchial opening exceedingly wide; brancheostegous rays 7.

Fins. — First dorsal short, length about equalling the distance from the point of the snout to the posterior margin of the eye; the first elongated ray equal in length to half the fin, or to twice the diameter of the eye. It commences a little in advance of the pectorals, terminating immediately above the exterior third of that fin.

Second dorsal, furnished with from 49 to 52 rays, commencing immediately posterior to the first, at a distance from the point of the snout slightly exceeding the distance from the vent to the posterior edge of the jaws. Depth nearly uniform throughout. The fin terminates at a distance about equal to the diameter of the eye from the base of the caudal. Greatest depth about equal to length of basal line of first dorsal.

The anal, furnished with from 41 to 43 rays, commences immediately posterior to the vent, terminating, as in most of the species, a little before the last ray of the 2nd dorsal. Depth nearly equal to that of 2nd dorsal.

The pectorals, which have from 15 to 16 rays, are broad, short, and rounded; length hardly exceeding that of lower jaw.

The ventrals, furnished with 7 (not 8) rays, have the 2nd ray somewhat produced; it is longest in young individuals, the point reaching beyond the extremity of the pectorals. In comparatively old individuals, the extremity is distant almost the length of the fin from the vent, and does not reach the extremity of the pectorals. The first and last rays are simple, the rest cleft to the base.

The caudal, furnished with from 28 to 30 rays, slightly convex, the angles however distinctly perceptible.

Scales. — Scales small, and firmly attached to the skin; extending over the whole surface of the body out upon the snout, and also along the base of the fins; ventrals furnished with fewest scales. In the specimen taken on the Expedition, total length not more than 69^{mm}, the snout and the sides of the head are as yet naked, and the

Finnerne; hos et noget ældre Individ, med en Totallængde af 100^{mm}, ere Skjællene blevne synlige paa Grunden af Caudalen, medens de øvrige Finner endnu ere nøgne.

Sidelinie. Sidelinien er ikke overalt tydelig, især paa Legemets mellemste og bagre Del; den bestaar af en Række af omtrent 20 Porer, der med forholdsvis lange Mellemrum strække sig fra Gjællespaltens øvre Rand hen under 1ste Dorsal, men bøje ved de første Straaler af 2den Dorsal (7de Pore) ned mod Legemets Midtlinie, som de nu følge ud mod Caudalen.

Farve. Denne er mørkt graabrun uden Pletter, blot ubetydeligt lysere paa Undersiden; Iris er blaasort, Mundhulen hvid. Yngre Individer have forholdsvis lysere Farver oventil.

Udbredelse. *O. septemtrionalis* er en nordisk, maaske arctisk Art, hvoraf 3 Individer (med en Totallængde af 69 til 173^{mm}) hidtil foreligge fra Norges Kyster, foruden 1 fra Grønland. De norske Individer ere alle optagne fra det noget grundere Vand (20—50 Favne); det mindste af dem var det, der erholdtes under Nordhavs-Expeditionen ved Røst, den yderste af Lofotøerne ($66^1/_2{}^0$ N. B.). Den sydligste Localitet, Florø udenfor Søndfjord, ligger under $61^1/_2{}^0$ N. B.

Det grønlandske Individ, der opbevares i Universitets-Musæet i Kjøbenhavn, har en Totall. af omtr. 170^{mm}. Det er sandsynligvis allerede i Aarene omkring 1840 indsendt til det nævnte Musæum fra Grønland; en nøjere Angivelse af Localiteten findes ikke.

scales have not begun to develop on the fins; in another individual, total length 100^{mm}, the scales are perceptible along the base of the caudal, the other fins being still naked.

Lateral Line. — Lateral line not everywhere distinct; more especially, however, on the medial and posterior parts of the body. It is composed of a series of about 20 pores, and extends, with comparatively wide interstices, from the upper margin of the branchial aperture beneath the base of the first dorsal, but strikes off obliquely at the first rays of the second dorsal (7th pore) to the mesial line, passing from thence straight along it to the caudal.

Colour. — A uniform greyish-brown, without spots, somewhat lighter on the under surface; irides bluish-black; cavity of the mouth white. Young individuals comparatively lighter.

Distribution. — *O. septemtrionalis* is a northern, possibly an Arctic species, of which only 3 examples (total length ranging from 69^{mm} to 173^{mm}) have as yet been obtained from the Norwegian coast, and 1 from Greenland. The Norwegian specimens were all taken in comparatively shallow water (20—50 fathoms), the smallest being that obtained on the North Atlantic Expedition, off Lofoten, in lat. $66^1/_2{}^0$ N.; the most southerly locality, Florø, on the coast of Søndfjord, is in lat. $61^1/_2{}^0$ N.

The Greenland specimen, preserved in the University Museum, Copenhagen, has a total length of about 170^{mm}; it was probably sent to the Museum from Greenland, certainly not later than 1840; the exact locality is not given.

Fam. Pleuronectidae.

Gen. Platysomatichthys, Bleek.

Versl. Med. Kon. Akad. Wet. Amsterd. D. 13, p. 426 (1862).

Højrevendt. Tænderne stærke, omtrent lige udviklede paa begge Sider; i Overkjæven danne de 2, i Underkjæven 1 Række. Vomerin- og Palatintænder mangle. Mundaabningen vid; Overkjæven gaar tilbage til Øjets Bagrand. De nedre Svælgtænder danne en enkelt Række. Analtorn mangler. Sidelinien næsten ret. Caudalen indskaaren. Skjællene smaa og glatte. Blindsiden stærkt musculøs.

Fam. Pleuronectidæ.

Gen. Platysomatichthys, Bleek.

Versl. Med. Kon. Akad. Wet. Amsterd. D. 13, p. 426 (1862).

Body dextral. Teeth strong, nearly equal in development on both sides; in the upper jaw 2 series, in the lower 1; vomerine and palatine teeth wanting. Mouth wide, maxillary reaching back to the posterior margin of the eye. The lower pharyngeal teeth forming a single row. Preanal spine absent. Lateral line nearly straight. Caudal fin emarginate. Scales small and smooth. The blind side very muscular.

28. **Platysomatichthys hippoglossoides,** (Walb.) 1792.

Pleuronectes cynoglossus, Fabr. (nec Lin.) Fauna Groenl. No. 118, p. 163 (1780).
Pleuronectes hippoglossoides, Walb. Art. Gen. Pisc. Pars III, p. 115 (1792).
Pleuronectes pinguis, Fabr. Kgl. D. Vid. Selsk. Nat. Math. Afh. 1 D., p. 43 (1824).
Hippoglossus pinguis, Reinh. Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 D., p. 116 (1838).
Reinhardtius hippoglossoides, Gill, Proc. Acad. Nat. Sci. Philad. 1861, App. p. 50 (1861).
Platysomatichthys pinguis, Bleeker, Versl. Med. Kon. Akad. Wet. Amsterd. D. 13, p. 426 (1862).
Hippoglossus groenlandicus, Günth. Cat. Fish. Brit. Mus. vol. 4, p. 404 (1862).
Platysomatichthys hippoglossoides, Goode & Bean, Bull. Ess. Inst. vol. 11, p. 7 (1879).

Diagn. *Det øvre Øje ligger i Profilranden, og er halvt opadvendt. Dorsal- og Analstraalerne ere alle udelte. Legemets Højde indeholdes $3^1/_2$, Hovedets Længde 4 Gange i Totallængden. Dorsalens Afstand fra Caudalen er større, end Halerodens Højde. Legemet skjælbeklædt indtil mellem Øjnene; Finnerne tæt skjælbeklædte. Interorbitalrummet fladt. Ensfarvet mørkt graa- eller gulbrun; Blindsiden, der er ligesaa muskuløs, som Øjensiden, er kun ubetydeligt lysere, end denne.*

D. 92—102; A. 71—75; V. 6; P. 14—15; C. 20.

Localit. fra Nordh. Exped. Havet mellem Hammerfest og Beeren Eiland.

	Stat. 286.
Beliggenhed.	215 Kil. SV. Beeren Eiland.
Dybde.	447 Favne (817 m).
Temp. paa Bunden.	— 0,8° C.
Bunden.	Graagrønt Ler.
Datum.	6te Juli 1878.
Antal Individer.	1 yngre Indiv.

Bemærkninger til Synonymien. Endskjønt denne Art er forholdsvis ikke særdeles nær beslægtet med nogen anden Form, idet den besidder flere udprægede Characterer, der baade ere lette at opfatte og beskrive, har den dog en Række Synonymer at opvise, og dens rette Benævnelse har lige til den sidste Tid ikke været endelig fastsat eller anerkjendt.

Fabricius, der var den første, som i sin „Fauna Groenlandica" (1780) beskrev Arten, henførte den under Linné's *Pleuronectes cynoglossus,* hvilken Fejl han selv rettede i en Afhandling „Zoologiske Bidrag", der udkom i 1824 (i 1ste Del af Videnskabs-Selskabets Naturv. og Math. Afhandlinger), og hvor han kalder den *Pleuronectes pinguis.* Paa begge Steder er Arten kjendeligt beskreven, men den Afbildning, der ledsagede hans sidstnævnte Afhandling, er fuldstændig fejlagtig.

Denne slette Figur ledede Günther til i sin Cat. Fish. Brit. Mus. vol. 4 (1862) at anse Fabricii *Pl. cyno-*

28. **Platysomatichthys hippoglossoides,** (Walb.) 1792.

Pleuronectes cynoglossus, Fabr. (nec Lin.) Fauna Grœnl. No. 118, p. 163 (1780).
Pleuronectes hippoglossoides, Walb. Art. Gen. Pisc. Pars III, p. 115 (1792).
Pleuronectes pinguis, Fabr. Kgl. D. Vid. Selsk. Nat. Math. Afh. 1 D., p. 43 (1824).
Hippoglossus pinguis, Reinh. Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 D., p. 116 (1838).
Reinhardtius hippoglossoides, Gill, Proc. Ac. Nat. Sci. Philad. 1861, App. p. 50 (1861).
Platysomatichthys pinguis, Bleeker, Versl. Med. Kon. Akad. Wet. Amsterd. D. 13, p. 426 (1862).
Hippoglossus grœnlandicus, Günth. Cat. Fish. Brit. Mus. vol. 4, p. 404 (1862).
Platysomatichthys hippoglossoides, Goode & Bean, Bull. Ess. Inst. vol. 11, p. 7 (1879).

Diagnosis. — *The upper eye on the marginal line, directed half upwards. Dorsal and anal rays simple. The depth of the body is to total length as 1 to $3^1/_2$, the length of the head as 1 to 4. Distance of dorsal fin from caudal greater than the depth of the tail at base. Scales extending between the eyes; the fins closely scaled. Interorbital space flat. Colour a dark greyish- or yellowish-brown; the blind side, which is almost as muscular as the upper, only a shade lighter.*

D. 92—102; A. 71—75; V. 6; P. 14—15; C. 20.

Locality (North. Atl. Exped): — The open sea, between Hammerfest and Beeren Eiland.

	Stat. 286.
Exact Locality.	215 Kil. SW. Beeren Eiland.
Depth.	447 Fathoms (817 m).
Temp. at Bottom.	— 0.8° C.
Bottom.	Greyish green Clay.
Date.	6th July 1878.
Numb. of Specim.	1 Indiv. (young).

Remarks on the Synonymy. — This species, albeit in a comparative sense not very closely related to any other form of the genus, distinguished as it is by divers salient characters, easy alike to apprehend and describe, has nevertheless received a number of synonyms, and even now its true designation has not been finally determined or agreed upon.

Fabricius, who was the first to describe the species, in his "Fauna Grœnlandica" (1780), classed it under Linneus's *Pleuronectes cynoglossus,* an error which he corrected himself in a Memoir entitled "Zoologiske Bidrag," published 1824 (in Part I of "Videnskabs-Selskabets Naturv. og Math. Afhandlinger"), giving it the new name of *Pleuron. pinguis.* In both of these papers recognisable descriptions are furnished of the species; but a figure accompanying the last of the papers is a complete failure.

This eminently defective representation induced Günther, when compiling his Cat. Fish. Brit. Mus. vol. 4 (1862),

glossus (hans senere *pinguis)* som identisk med Linné's *Pl. cynoglossus*, en Anskuelse, som gjendreves af Gill allerede i 1864 (Proc. Acad. Nat. Sci. Philad. 1864). Günther havde imidlertid givet Arten, der efterhaanden ogsaa gjennem andre var bleven bekjendt, det nye Navn *Hippoglossus groenlandicus,* hvorhos Fabricii *Pl. hippoglossus* opføres som dens Synonym; dette sidste var imidlertid ucorrect, da *Pl. hippoglossus,* abr., utvivlsomt er den rette *Hippogl. vulgaris.*

Navnet *Hippoglossus pinguis* (Fabr.), under hvilket Arten oftest er omtalt, er yngre, end Walbaum's *Pleuronectes hippoglossoides* (1792), der saaledes indeholder det ældste Artsnavn.

Da forhaandenværende Art i flere Henseender adskiller sig fra Slægten *Hippoglossus,* med hvilken den i Regelen er slaaet sammen, har Gill allerede i 1861 henført den under en ny Slægt, *Reinhardtius* (Proc. Acad. Nat. Sci. Philad. 1861, App.), men da denne Slægt her, uden at være characteriseret, blot er nævnt i en Fortegnelse, vil Bleeker's Navn *Platysomatichthys,* opstillet i 1862 for den samme Art (13de Bind af Med. Kon. Akad. Wet. i Amsterdam), blive at anvende.

Bemærkninger til Beskrivelsen. Det under Nordhavs-Expeditionen erholdte Individ var yngre, og havde følgende Maal:

Totallængde	435 mm
Legemets Længde til sidste Halehvirvel	378 -
Legemets Højde	120 -
Halerodens Højde	34 -
Hovedets Længde	104 -
Pectoralens Længde paa Blindsiden	40 -

Tænderne hos dette Individ vare paa Øjensiden oventil 15, hvoraf de inderste vare meget smaa, nedentil 7, alle lange og naalspidse. Paa Blindsiden fandtes oventil 22, nedentil 6, samtlige af samme Bygning, som de tilsvarende paa Øjensiden.

Straaleantallet var: D. 92; A. 71; C. 20; V. 6; P. 14.

Farven paa Blindsiden var kun lidet lysere, end Øjensidens.

Interorbitalrummet var hos dette yngre Individ forholdsvis smalt, sammenlignet med Øjnenes Størrelse; dets Bredde var omtrent, som Øjets Tverdiameter, men mindre, end Længdediameteren.

Udbredelse. *Platysomatichthys hippoglossoides* er en arctisk Art, der tidligst har været kjendt fra Grønland, hvor den allerede er beskreven i 1780 af Fabricius; den synes her at være talrig paa det noget dybere Vand. Mod Syd gaar den i Nordamerica (ifølge Goode & Bean) lige ned til Dybderne udenfor Essex og Massachusetts i New England-Staterne (42° N. B.).

I de europæiske Farvande har den hidtil blot været omtalt fra Finmarken, hvor enkelte Exemplarer i de senere Aar ere fundne og opbevarede, men neppe søndenfor 70°

to regard Fabricii *Pl. cynoglossus* (subsequently *pinguis)* as identical with Linneus's *Pl. cynoglossus,* an assumption confuted by Gill in 1864 (Proc. Acad. Nat. Sci. Philad. 1864). Günther, however, had given the species (which had meanwhile been also recorded by others) the new name, *Hippoglossus grœnlandicus,* regarding Fabricius's *Pl. hippoglossus* as its synonym; but the latter was erroneous, and *Pl. hippoglossus* Fabr. is unquestionably the true *Hippogl. vulgaris.*

Hippoglossus pinguis, (Fabr.), the name under which this species has been most frequently mentioned, is anticipated by Walbaum's *Pleuronectes hippoglossoides* (1792), the earliest specific designation of the fish.

The species described being in several respects essentially distinct from the genus *Hippoglossus,* to which it has generally been referred, Dr. Gill, so far back as 1861, saw fit to class it as the type of a new genus, *Reinhardtius* (Proc. Acad. Nat. Sci. Philad. 1861, App.); but the name of this genus being merely recorded in a Catalogue, and no characters enumerated, *Platysomatichthys,* established by Bleeker in 1862 for the same type (Med. Kon. Akad. Wet. Amsterdam, D. 13), must be the correct designation.

Descriptive Observations. — The individual obtained on the Expedition was comparatively young, and measured as follows: —

Total length	435 mm
Length of body to last caudal vertebra	378 -
Depth of body	120 -
Depth of tail at base	34 -
Length of head	104 -
Length of pectoral on blind side	40 -

The teeth on the coloured side, above, in this individual 15, the innermost exceedingly small; below 7, all long and acicular; on the blind side the number above was 22, below 6, similar in structure to those corresponding with them on the coloured side.

The fin-ray formula was as follows: — D. 92; A. 71; C. 20; V. 6; P. 14.

The colour of the skin on the blind side but a shade lighter than on the upper.

Interorbital space in this immature example rather narrow compared to the eyes, its width being about equal to the vertical diameter of the orbit, but less than the longitudinal diameter.

Distribution. — *Platysomatichthys hippoglossoides* is an Arctic species, first observed on the coast of Greenland, and described, so far back as 1780, by Fabricius; throughout that region it would appear to be a common fish at some depth. In North America its range southwards (according to Goode & Bean) extends to the depths lying off the shores of Essex and Massachusetts, in New England (in lat. 42° N.).

In the regions of Northern Europe, the species had been previously met with on the coast of Finmark only, where examples have in later years been taken and pre-

N. B. Af en Bemærkning i Leem's bekjendte Værk over Finmarkens Lapper (Kbhvn. 1767), p. 315, synes den allerede i forrige Aarhundrede at have været erholdt og kjendt af Fiskerne i disse Landsdele. Nordhavs-Expeditionens Individ var optaget paa Havet sydvest for Beeren Eiland, paa det betydelige Dyb af omtrent 450 Favne; sandsynligvis vil denne Art vise sig ikke at mangle paa nogen tilsvarende Dybde i de arctiske Trakter mellem Europa og America.

served, though hardly farther south than in lat. 70° N. From an observation in Leem's well-known work on the Lapps of Finmark (Copenhagen 1767), p. 315, it would appear to have been known and captured by fishermen in those localities as early as the last century. The example obtained on the Expedition was taken in the open sea, south-west of Beeren Eiland, at the very considerable depth of 450 fathoms; probably, the species is nowhere wanting at corresponding depths in any of the Arctic tracts stretching between Europe and America.

Gen. Hippoglossoides, Gottsche.

Wiegm. Arch. f. Naturg. 1 Jahrg. 2 B., p. 164 (1835).

Højrevendt. Tænderne smaa, tilspidsede, paa begge Sider lige udviklede, og danne i begge Kjæver en enkelt Række; Vomerin- og Palatintænder mangle. De nedre Svælgtænder danne en enkelt Række. Mundaabningen særdeles vid; Overkjæven gaar tilbage til under Øjets Midte. Analtorn tilstede. Sidelinien næsten ret. Caudalen afrundet. Skjællene temmelig store, paa Øjensiden haartandede. Straaleantallet betydeligt.

Gen. Hippoglossoides, Gottsche.

Wiegm. Arch. f. Naturg. 1 Jahrg. 2 B., p. 164 (1835).

Body dextral. Teeth small and pointed; on either side equally developed; one row in each jaw; vomerine and palatine teeth wanting. Lower pharyngeal teeth forming a single row. Mouth exceedingly wide; maxillary reaching back to the middle of the eye. Preanal spine present. Lateral line almost straight. Caudal rounded. Scales rather large, on the coloured side ciliated. Number of finrays considerable.

29. **Hippoglossoides platessoides,** (Fabr.) 1780.

A. Nearctiske Synonymer.

Pleuronectes platessoides, Fabr. Fauna Groenl. p. 164 (1780).
Citharus platessoides, Reinh. Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 D., p. 116 og 130 (1838).
Platessa dentata, D. H. Storer, (nec Mitch.) Bost. Journ. Nat. Hist. 1838—39, vol. 2, p. 480 (1839); Hist. Fish. Mass. Camb. Bost. p. 197, pl. 30, Fig. 3 (1867), [teste Br. & Goode].
Drepanopsetta platessoides, Gill, Proc. Acad. Nat. Sci. Philad. 1861, App. p. 50 (1861).
Hippoglossoides dentatus, Gill, Proc. Acad. Nat. Sci. Philad. 1861, App. p. 50 (1861); Günth. Cat. Fish. Brit. Mus. vol. 4, p. 406 (1862).
Hippoglossoides platessoides, Gill, Proc. Acad. Nat. Sci. Philad. 1864, p. 217 (1864).
Potamopsetta dentata, Gill, Proc. Acad. Nat. Sci. Philad. 1864, p. 217 (1864).
Hippoglossoides limandoides, Goode & Bean, Am. Journ. Sci. Arts, vol. 17, 1879, p. 39 (1879).

B. Palæarctiske Synonymer.

Pleuronectes linguatula, Müll. (nec Lin.) Zool. Dan. Prodr. p. 45, No. 377 (1776).
Pleuronectes limandoides, Bloch, Naturg. Ausl. Fische, B. 3, p. 24 (1787).
Hippoglossoides limanda, Gottsche, Wiegm. Arch. f. Naturg. 1835, B. 2, p. 168 (1835).

29. **Hippoglossoides platessoides,** (Fabr.) 1780.

A. Nearctic Synonyms.

Pleuronectes platessoides, Fabr. Fauna Grœnl. p. 164 (1780).
Citharus platessoides, Reinh. Kgl. D. Vid. Selsk. Nat. Math. Afh. 7 D., p. 116 and 130 (1838).
Platessa dentata, D. H. Storer, (nec Mitch.), Bost. Journ. Nat. Hist. 1838—39, vol. 2, p. 480 (1839); Hist. Fish. Mass. Camb. Bost. p. 197, pl. 30, fig. 3 (1867), [teste Br. & Goode].
Drepanopsetta platessoides, Gill, Proc. Acad. Nat. Sci. Philad. 1861, App. p. 50 (1861).
Hippoglossoides dentatus, Gill, Proc. Acad. Nat. Sci. Philad. 1861, App. p. 50 (1861); Günther, Cat. Fish. Brit. Mus. vol. 4, p. 406 (1862).
Hippoglossoides platessoides, Gill, Proc. Acad. Nat. Sci. Philad. 1864, p. 217 (1864).
Potamopsetta dentata, Gill, Proc. Acad. Nat. Sci. Philad. 1864, p. 217 (1864).
Hippoglossoides limandoides, Goode & Bean, Am. Journ. Sci. Arts, vol. 17, 1879, p. 39 (1879).

B. Palæarctic Synonyms.

Pleuronectes linguatula, Müll. (nec Lin.) Zool. Dan. Prodr. p. 45, No. 377 (1776).
Pleuronectes limandoides, Bloch, Naturg. Ausl. Fische, B. 3, p. 24 (1787).
Hippoglossoides limanda, Gottsche, Wiegm. Arch. f. Naturg. 1835, B. 2, p. 168 (1835).

Pleuronectes limandanus, Parn. Edinb. New Philos. Journ. 1835, p. 210 (1835).
Platessa limandoides, Jen. Man. Brit. Vert. Anim. p. 459 (1835).
Hippoglossoides limandoides, Günth. Cat. Fish. Brit. Mus. vol. 4, p. 405 (1862).
Hippoglossoides platessoides, Coll. Forh. Vid. Selsk. Chra. 1878, No. 14, p. 92 (1878).

Diagn. *Legemet glat, dets Højde indeholdes $3^1/_4$, hos ældre Individer $2^2/_3$, Hovedets Længde $4—4^1/_2$ Gange i Totallængden. Dorsalens Afstand fra Caudalen er betydeligt mindre, end Halerodens Højde. Hovedet skjælbeklædt lige ud paa Kjæverne; Finnerne ligeledes skjælbeklædte. Interorbitalrummet smalt; Øjnene ligge fortil i samme Plan, og indeholdes 4, hos fuldt udvoxede Individer $4^1/_2$ Gange i Hovedets Længde. Underkjæven længst. Rødgraa, ofte med enkelte (4—6) utydelige større Pletter langs Grunden af Dorsalen og Analen; Blindsiden hvid.*

M. B. 8. D. 76—92 (93—101); A. 64—72 (60—79); P. 10—11 (9—12); V. 6.

Localit. fra Nordh. Exped. Tanafjord i Finmarken; Havet mellem Nordcap og Beeren Eiland, samt Havet søndenfor Spitsbergen.

	Stat. 261.	*Stat.* 323.	*Stat.* 326.
Beliggenhed,	Tanafjord, Finmarken.	180 Kil. SO. Beeren Eiland.	105 Kil. S. Spitsbergen.
Dybde.	127 Favne (232 m).	223 Favne (408 m).	123 Favne (225 m).
Temp. paa Bunden.	+ 2,8° C.	+ 1,5° C.	+ 1,6° C.
Bunden.	Ler og Mudder.	Brungraat Ler.	Mørkt Ler.
Datum.	25de Juni 1878.	30te Juli 1878.	3die Aug. 1878.
Antal Individer.	6 halvvoxne Indiv.	1 Indiv.	15 Unger og yngre Indiv.

Bemærkninger til Synonymien. I 1780 opstillede og beskrev Fabricius i „Fauna Groenlandica" under No. 119 sin *Pleuronectes platessoides,* og i 1789 blev Arten opført under dette Fabricii Navn i Gmelin's 13de Udgave af Linnæi „Systema Naturae" (p. 1234). Endnu engang gjorde Fabricius den til Gjenstand for en temmelig udførlig Beskrivelse, der indførtes i Kgl. D. Vid. Selsk. Nat. Math. Afh. 1 Del, p. 40 (1824), ledsaget af en Tegning, der dog var af meget primitiv Natur.

Senere er Arten under denne Benævnelse kun sjeldent, og aldrig med nogen Udførlighed eller efter Autopsi bleven omtalt, og specielt er dens rette Forhold til den europæiske *Pleuronectes limandoides,* opstillet af Bloch i 1787, ikke gjort til Gjenstand for nogen sammenlignende Undersøgelse[1], naar undtages, at Malmgren, der havde 2 spæde Unger af, hvad han antog var denne Art, fra Spits-

[1] Den udførlige Beskrivelse af „*Pleuronectes platessoides,* Fabr." fra Island, som Faber giver i sin „Naturg. Fische Islands", p. 140 (Frankf. 1829), vedrører ikke denne Art, men *Pl. limanda,* Lin.

Pleuronectes limandanus, Parn. Edinb. New Philos. Journ. 1835, p. 210 (1835).
Platessa limandoides, Jen. Man. Brit. Vert. Anim. p. 459 (1835).
Hippoglossoides limandoides, Günth. Cat. Fish. Brit. Mus. vol. 4, p. 405 (1862).
Hippoglossoides platessoides, Coll. Forh. Vid. Selsk. Chra. 1878, No. 14, p. 92 (1878).

Diagnosis. — *Body smooth; depth to total length as 1 to $3^1/_4$, in full-grown examples as 1 to $2^2/_3$; length of head as 1 to $4—4^1/_2$. Distance of dorsal from caudal considerably less than the height of the peduncle of the tail. Head scaled, out on the jaws; the fins, too, are covered with scales. Interorbital space narrow; the eyes equal in front; their diameter is to the length of the head as 1 to 4, in full-grown individuals as 1 to $4^1/_2$. Lower jaw longer than upper. Colour reddish-grey, frequently with a few (4—6) large, indistinct spots along the base of the dorsal and anal. The blind side white.*

M. B. 8. D. 76—92 (93—101); A. 64—72 (60—79); P. 10—11 (9—12); V. 6.

Locality (North Atl. Exped.): — The Tana Fjord (Finmark); the open sea, between the North Cape and Beeren Eiland; and the ocean tract south of Spitzbergen.

	Stat. 261.	*Stat.* 323.	*Stat.* 326.
Exact Locality.	The Tana Fjord, Finmark.	180 Kil. SE. Beeren Eiland.	105 Kilom. S. of Spitzbergen.
Depth.	127 Fathoms (232 m).	223 Fathoms (408 m).	123 Fathoms (225 m).
Temp. at Bottom.	+ 2.8° C.	+ 1.5° C.	+ 1.6° C.
Bottom.	Clay and Mud.	Brownish-grey Clay.	Dark Clay.
Date.	25th June 1878.	30th July 1878.	3rd Aug. 1878.
Numb. of Specim.	6 Indiv. (half-grown).	1 Indiv.	15 Ind. (half-grown and young).

Remarks on the Synonymy. — In 1780, Fabricius established and described the species *Pleuronectes platessoides* in his "Fauna grœnlandica" (No. 119); and in 1789 it was classed with this name in Gmelin's 13th Edition of Linneus's "Systema naturæ" (p. 1234). Once again Fabricius made *Pl. platessoides* the subject of a rather elaborate description, in Kgl. D. Vid. Selsk. Nat. Math. Afh. Part 1, p. 40 (1824); and on this occasion he furnished a drawing, which is however exceedingly primitive in character.

Under the name of *Pl. platessoides,* the species has since been rarely recorded, and never once described fully or from autopsy; nor has its true relation to the European form of *Pl. limandoides,* described by Bloch in 1787, been made the subject of comparative investigation,[1] saving that Malmgren, who was in possession of 2 very young examples (belonging, in his opinion, to this species), from Spitz-

[1] The "*Pleuronectes platessoides,* Fabr.," from the coast of Iceland, of which Faber gave a detailed description in his "Naturg. Fische Islands," p. 140 (Frankf. 1829), is not this species, but *Pl. limanda,* Lin.

bergen til Undersøgelse i 1864, troede indtil videre at burde opføre den som en fra *Pl. limandoides* distinct Art (Öfv. Kgl. Vet. Akad. Förh. 1864, p. 525), medens Günther (1862) i sin Cat. Fish. Brit. Mus. vol. 4, p. 405 (i Noten) kan sees at have været tilbøjelig til at betragte dem begge som identiske.

De Characterer, hvorved denne østlig-arctiske Art angives at kunne holdes ud fra den europæiske *Pleuronectes limandoides,* ere væsentlig et større Antal Straaler i de verticale Finner, samt en relativt større Legemshøjde. Jeg har allerede i 1878 i den foreløbige Beretning om Nordhavs-Expeditionens Fiske søgt at paavise, at disse Characterer ikke ere af nogen afgjørende Betydning, og fremsat den Formodning, at begge disse Arter vare identiske.

Efterat jeg i det sidstforløbne Aar, ved Dr. Lütken's Velvillie, har havt Lejlighed til at undersøge den Række typiske Exemplarer af Fabricii *Pleuronectes platessoides,* alle fra Grønland, der opbevares i Musæet i Kjøbenhavn, har jeg fundet denne Formodning bekræftet. En directe Sammenligning mellem de nævnte Typ-Exemplarer og Nordhavs-Expeditionens Individer fra Havet søndenfor Spitsbergen udviste, at de vare fuldstændig overensstemmende indbyrdes, ligesom disse spitsbergenske Individer i ingen væsentlig Henseende ere forskjellige fra ligestore Individer fra Christianiafjorden, som nedenfor skal udvikles.

Af Slægten *Hippoglossoides,* opstillet af Gottsche i 1835 for Bloch's *Pleuronectes limandoides,* findes der idethele blot 3 bekjendte Arter, nemlig foruden den nordatlantiske *H. platessoides,* Fabr., tillige 2 Arter fra de nordlige Dele af det stille Hav *(H. jordani,* Lock. 1879, og *H. exilis,* Jord. & Gilb. 1880).

Bemærkninger til Beskrivelsen. De under Expeditionen erholdte Individer havde følgende Maal og Straaleantal:

Stat. 326. (Søndenfor Spitsbergen).

	Totallængde.	Legemets Højde.	Hovedets Længde.	Straaler i Dorsalen.	Straaler i Analen.
a.	90 mm	25 mm	20 mm	89	70
b.	105 -	30 -	23 -	93	75
c.	105 -	30 -	24 -	91	74
d.	110 -	32 -	25 -	90	71
e.	149 -	43 -	33 -	88	71
f.	150 -	47 -	36 -	91	73
g.	172 -	55 -	39 -	84	68
h.	181 -	55 -	42 -	93	73
i.	182 -	56 -	41 -	92	74
k.	185 -	61 -	43 -	89	71
l.	189 -	59 -	43 -	94	73
m.	223 -	74 -	52 -	91	73
n.	225 -	73 -	51 -	101	79
o.	227 -	69 -	54 -	85	69
p.	235 -	75 -	59 -	91	74

bergen, saw fit to regard it preliminarily as distinct from *Pl. limandoides* (Öfv. Kgl. Vet. Akad. Förh. 1864, p. 525); and that Günther (1862), in his Cat. Fish. Brit. Mus. vol. 4, p. 405 (as appears from the note), was inclined to regard them as identical.

The characters which, as a rule, are said to distinguish this East Arctic species from the European *Pleuronectes limandoides,* consist chiefly in the vertical fins having a greater number of rays, and in the depth of the body being relatively greater. In my preliminary Report (1878) on the fishes from the North Atlantic Expedition, I sought to show that these characters were of no essential importance, and ventured to suggest the identity of the two species.

Since then, this view has received additional support, Dr. Lütken having kindly afforded me opportunity of examining, last year, the specimens of Fabricius's typical *Pleuronectes platessoides* (all from Greenland) preserved in the Zoological Museum at Copenhagen. On instituting a direct comparison between these typical specimens and the individuals collected on the North Atlantic Expedition south of Spitzbergen, they were found to exhibit the closest agreement; nor did the Spitzbergen individuals differ materially from examples of equal size taken in the Christiania Fjord, as will afterwards be shown.

In the genus *Hippoglossoides,* established by Gottsche, 1835, for Bloch's *Pleuronectes limandoides,* are comprised of known species only 3, viz: — the North Atlantic species *H. platessoides,* Fabr., and 2 species occurring in the northern tracts of the Pacific *(H. jordani,* Lock. 1879, and *H. exilis,* Jord. & Gilb. 1880).

Descriptive Observations. — Measurements of, and number of fin-rays in, the specimens obtained on the Expedition: —

Station 326 (South of Spitzbergen).

	Total Length.	Depth of Body.	Length of Head.	Rays in Dorsal.	Rays in Anal.
a.	90 mm	25 mm	20 mm	89	70
b.	105 -	30 -	23 -	93	75
c.	105 -	30 -	24 -	91	74
d.	110 -	32 -	25 -	90	71
e.	149 -	43 -	33 -	88	71
f.	150 -	47 -	36 -	91	73
g.	172 -	55 -	39 -	84	68
h.	181 -	55 -	42 -	93	73
i.	182 -	56 -	41 -	92	74
k.	185 -	61 -	43 -	89	71
l.	189 -	59 -	43 -	94	73
m.	223 -	74 -	52 -	91	73
n.	225 -	73 -	51 -	101	79
o.	227 -	69 -	54 -	85	69
p.	235 -	75 -	59 -	91	74

Stat. 323. (Sydost for Beeren Eiland).

	Totallængde.	Legemets Højde.	Hovedets Længde.	Straaler i Dorsalen.	Straaler i Analen.
q.	350 mm	125 mm	87 mm	87	69

Stat. 261. (Tanafjord, Øst-Finmarken).

	Totallængde.	Legemets Højde.	Hovedets Længde.	Straaler i Dorsalen.	Straaler i Analen.
r.	155 mm	45 mm	38 mm	89	71
s.	170 -	49 -	40 -	89	69
t.	211 -	63 -	50 -	97	74
u.	214 -	61 -	48 -	94	73
v.	245 -	71 -	57 -	96	74
x.	254 -	78 -	60 -	91	74

Til Sammenligning vedføjes en Angivelse af Straaleantallet hos en Del Individer af „*H. limandoides*“ fra et Par andre Punkter af den norske Kyst, hvoraf jeg personlig har kunnet undersøge Individer.

	Totall.	Legemets Højde.	Hovedets Længde.	Straaler i Dorsalen.	Straaler i Analen.
Ø. Finmarken	66 mm	19 mm	14 mm	93	75
—	386 -	138 -	91 -	90	69
Tromsø	32 -	?	?	91	70
—	215 -	66 -	44 -	85	66
—	285 -	88 -	65 -	85	69
Christianiafjorden	185 -	57 -	42 -	86	64
—	210 -	66 -	49 -	87	64
—	218 -	64 -	49 -	82	63
—	220 -	69 -	45 -	86	66
—	246 -	79 -	59 -	82	62
—	258 -	75 -	59 -	80	66
—	298 -	94 -	63 -	79	64

Hvad først den almindelige Legemsbygning angaar, udgjør den gjennemsnitlige Højde af Legemet i Forhold til Totallængden hos et Antal omtrent ligestore Individer fra disse forskjellige Localiteter følgende:

Spitsbergen (9 Ind., Totall. 172—235 mm) . . 3,10
Øst-Finmarken (5 Ind., Totall. 170—254 mm) . . 3,40
Tromsø (2 Ind., Totall. 215—285 mm) . . 3,24
Christianiafjorden (7 Ind., Totall. 185—298 mm) . . 3,26

Vistnok sees saaledes Individerne fra Spitsbergen at have havt en relativt noget større Legemshøjde, end Individerne fra Øst-Finmarken, men dette er ganske tilfældigt, da Individerne fra disse Localiteter ere absolut identiske; men mellem de nordligste (fra Spitsbergen) og de sydligste (fra Christianiafjorden) er Forskjellen atter ganske ubetydelig, saaledes at sikre Distinctionscharacterer ikke kunne hentes fra dette Forhold.

Det maa her bemærkes, at Legemshøjden er relativt større hos de fuldt udvoxede Individer, end den ovenfor anførte, der gjælder Individerne i et noget yngre Stadium. Hos 4 af de undersøgte Typ-Exemplarer fra Grønland,

Station 323 (South-east of Beeren Eiland).

	Total Length.	Depth of Body.	Length of Head.	Rays in Dorsal.	Rays in Anal.
q.	350 mm	125 mm	87 mm	87	69

Station 261 (The Tana Fjord, East Finmark).

	Total Length.	Depth of Body.	Length of Head.	Rays in Dorsal.	Rays in Anal.
r.	155 mm	45 mm	38 mm	89	71
s.	170 -	49 -	40 -	89	69
t.	211 -	63 -	50 -	97	74
u.	214 -	61 -	48 -	94	73
v.	245 -	71 -	57 -	96	74
x.	254 -	78 -	60 -	91	74

For comparison is annexed a list of fin-formulæ in divers examples of "*H. limandoides*" from other localities on the Norwegian coast which I have had an opportunity of examining.

	Total Length.	Depth of Body.	Length of Head.	Rays in Dorsal.	Rays in Anal.
East Finmark	66 mm	19 mm	14 mm	93	75
—	386 -	138 -	91 -	90	69
Tromsø	32 -	?	?	91	70
—	215 -	66 -	44 -	85	66
—	285 -	88 -	65 -	85	69
Christiania Fjord	185 -	57 -	42 -	86	64
—	210 -	66 -	49 -	87	64
—	218 -	64 -	49 -	82	63
—	220 -	69 -	45 -	86	66
—	246 -	79 -	59 -	82	62
—	258 -	75 -	59 -	80	66
—	298 -	94 -	63 -	79	64

First, as regards the general structure of the body. The proportion borne by the depth to the total length in a number of specimens, about equal in size, from the said localities is as follows: —

Spitzbergen 9 Ind. (Total L. 172—235 mm) as 1 to 3.10.
East Finmark 5 Ind. (Total L. 170—254 mm) as 1 to 3.40.
Tromsø 2 Ind. (Total L. 215—285 mm) as 1 to 3.24.
Christiania Fjord, 7 Ind. (Total L. 185—298 mm) as 1 to 3.26.

The majority of the Spitzbergen individuals were, indeed, distinguished by a depth of body relatively greater than those from East Finmark; this, however, is merely casual, the latter having been in the strictest sense identical with the former; but between the examples from the most northerly locality (Spitzbergen) and those obtained farthest south (the Christiania Fjord), the difference is very inconsiderable, far too slight indeed to admit of its furnishing distinctive characters.

It may be noticed, that the depth of the body in full-grown individuals is relatively greater than that here given, which refers to examples in a somewhat earlier stage of growth. In 4 of the typical specimens from Greenland,

hvor Totallængden laa mellem 350^{mm} og 451^{mm}, var Legemshøjden gjennemsnitlig 2,73; omtrent samme Forholde udviste Nordhavs-Expeditionens store Individ fra Beeren Eiland, hvis Totallængde var 350^{mm}, nemlig 2,80, og et stort Individ, som jeg erholdt i Juli 1878 i Varangerfjorden i Øst-Finmarken, hvis Totallængde var 386^{mm}, nemlig 2,79.

Derimod vil unegtelig Straaleantallet vise sig at være constant større hos Individerne fra de nordligste Localiteter (Grønland, Spitsbergen), end fra de sydligste (Christianiafjorden), hvad der fremgaar af de nedenfor anførte Straaleantal hos Individer, hvoraf der fra nogen Localitet have foreligget en Række til Undersøgelse, og denne Forskjel bliver endnu større, om man undersøger de forskjellige Angivelser, der foreligge fra endnu sydligere Landsdele, saasom fra Sverige (Sundström[1]), Danmark (Gottsche[2] og Kröyer[3]), samt England (Yarrell[4]), og Skotland (Parnell[5]).

Grønland	(5 Ind.)	D. 93—83; A. 70—68.
Spitsbergen	(15 Ind.)	D. 101—84; A. 79—68.
Øst-Finmarken, Norge	(8 Ind.)	D. 97—89; A. 75—69.
Vest-Finmarken, Norge	(3 Ind.)	D. 91—85; A. 70—66.
Christianiafjord, Norge	(7 Ind.)	D. 87—79; A. 66—62.
Sverige		D. 87—78; A. 66—64.
Danmark [Gottsche]	(6 Ind.)	D. 87—81; A. 65—64.
Danmark [Kröyer]	(9 Ind.)	D. 88—78; A. 68—60.
Storbritannien		D. 85—76; A. 69—64.

Stråalernes Middeltal i de ovennævnte Individ-Rækker har jeg fundet at være følgende paa disse forskjellige Localiteter:

Grønland	D. 88; A. 69.
Spitsbergen	D. 90; A. 72.
Øst-Finmarken, Norge	D. 92; A. 72.
Vest-Finmarken, Norge	D. 87; A. 68.
Christianiafjord, Norge	D. 83; A. 64.
Sverige	D. 82; A. 65[6].
Danmark [Gottsche]	D. 84; A. 65.
Danmark [Kröyer]	D. 82; A. 64.
Storbritannien	D. 80; A. 66[6].

Mellem de Finmarken-Spitsbergenske Individer og Individerne fra Christianiafjorden er der saaledes en gjennemsnitlig Forskjel af omtrent 9 Straaler i Dorsalen, og 8 i Analen, og mellem de førstnævnte og Individerne fra Storbritannien for Dorsalens Vedkommende endog 12. Men Middeltallet fra de mellemliggende Stationer udviser tydelige Overgange, og disse ville utvivlsomt blive endnu klarere, naar Individer blive undersøgte fra flere af disse mellemliggende Localiteter (saaledes f. Ex. fra Nordland i Norge).

[1] Fauna öfver Sveriges Ryggradsdjur, p. 255 (1877).
[2] Wiegm. Arch. f. Naturg. 1835, B. 2, p. 168 (1835).
[3] Danmarks Fiske, B. 2, p. 358 (1843—45).
[4] British Fishes, ed. 2, vol. 2, p. 312 (1841).
[5] Mem. Wern. Nat. Hist. Soc., vol. 7, p. 368 (1838).
[6] Da her intet Individ-Antal kan opgives, har Middeltallet maattet uddrages directe af de angivne Ydergrændser.

total length ranging from 350^{mm} to 451^{mm}, I found the proportional depth of the body to average 2.73, within a fraction that of the large individual taken on the Expedition off Beeren Eiland, viz. 350^{mm} (total length): 2.80; and of a large individual which I obtained in the Varanger Fjord, East Finmark, in July 1878, viz. 386^{mm} (total length): 2.79.

On the other hand, the number of fin-rays will be regularly greater in specimens from the most northerly localities (Greenland, Spitzbergen) than from those farthest south (the Christiania Fjord), as is shown by the numbers (given below) for series of individuals from several localities; and this difference becomes still more apparent on annexing the statements made for regions still farther south, for instance Sweden (by Sundström[1]), Denmark (by Gottsche[2] and Kröyer[3]), England (by Yarrell),[4] and Scotland (by Parnell[5]).

Greenland	(5 Ind.)	D. 93—83; A. 70—68.
Spitzbergen	(15 Ind.)	D. 101—84; A. 79—68.
East Finmark, Norway	(8 Ind.)	D. 97—89; A. 75—69.
West Finmark, Norway	(3 Ind.)	D. 91—85; A. 70—66.
Christiania Fjord, Norw.	(7 Ind.)	D. 87—79; A. 66—62.
Sweden		D. 87—78; A. 66—64.
Denmark [Gottsche]	(6 Ind.)	D. 87—81; A. 65—64.
Denmark [Kröyer]	(9 Ind.)	D. 88—78; A. 68—60.
Great Britain		D. 85—76; A. 69—64.

The mean number of rays in the said series of individuals from these localities I found to be as follows: —

Greenland	D. 88; A. 69.
Spitzbergen	D. 90; A. 72.
East Finmark, Norway	D. 92; A. 72.
West Finmark, Norway	D. 87; A. 68.
Christiania Fjord, Norway	D. 83; A. 64.
Sweden	D. 82; A. 65[6].
Denmark [Gottsche]	D. 84; A. 65.
Denmark [Kröyer]	D. 82; A. 64.
Great Britain	D. 80; A. 66.[6]

Between the Finmark-Spitzbergen individuals and those from the Christiania Fjord, there is, accordingly, in the dorsal an average difference of about 9 rays, in the anal of 8; and between the former individuals and those from Great Britain, of 12, even in the dorsal. But the mean number for the intervening stations exhibits a distinct transition tendency, which will unquestionably be found still more striking when individuals shall have been examined from more of these intermediate localities (Nordland, in Norway, for instance).

[1] Fauna öfver Sveriges Ryggradsdjur, p. 255 (1877).
[2] Wiegm. Arch. f. Naturg. 1835, B. 2, p. 168 (1835).
[3] Danmarks Fiske, B. 2, p. 358 (1843—45).
[4] British Fishes, ed. 2, vol. 2, p. 312 (1841).
[5] Mem. Wern. Nat. Hist. Soc., vol. 7, p. 368 (1838).
[6] There being no enumeration of the individuals, the mean number has to be deduced from the two extremes.

Desuden falde ikke sjelden de individuelle Variationer hos Individerne fra de nordligste og de sydligste Localiteter sammen, eller de kunne endog krydse hinanden. Saaledes udviste et af Individerne fra Havet mellem Beeren Eiland og Spitsbergen i Dorsalen 84, i Analen 68 Straaler, medens Kröyer hos et af sine Individer fra Danmark talte i Dorsalen 88, i Analen 67 Straaler.

Nogen Artsdistinction mellem de nordlige og sydlige Former, der kunde begrundes ved Straaleantallet i Finnerne, vil derfor neppe kunne forsvares.

I alle andre Forholde ere de arctiske Individer af Arten ikke til at adskille fra de sydligere. Det er dog en Selvfølge, at i Sammenhæng med det forøgede Straaleantal staar en tilsvarende Forøgelse i Antal af Skjælrækker, Porer i Sidelinien, samt af Hvirvler. Men fuldkommen constante Afvigelser lade sig ligesaalidt paavise i disse Forholde, som i Antallet af Straalerne.

Paa samme Maade altsaa, som *Liparis lineatus* (Lepech.) i de arctiske Landsdele optræder med et constant større Antal Straaler i de verticale Finner, end ved Norges og Sveriges Sydkyst, samt i Østersøen, og uden at herpaa kan begrundes en Adskillelse i Arter eller endog i constante Varieteter, er saaledes det samme Tilfældet med *Hippoglossoides platessoides;* og da Arten er beskreven under dette Navn allerede 7 Aar tidligere, end den sydligere, af Bloch opstillede *Pleuronectes limandoides,* maa dette sidste Navn vige for det ældre.

Som en Særegenhed ved en Del af de under Expeditionen erholdte Individer kan anføres, at Pectoralens Straaler paa Blindsiden havde en ret afskaaren Rand, og vare tillige kortere, end hos de øvrige Individer.

Føde. Blandt de mellem Beeren Eiland og Spitsbergen fra en Dybde af 123 Favne ophentede Individer blev Ventrikelen og dens Indhold undersøgt hos 11 af forskjellig Størrelse. Indholdet befandtes temmelig ensartet, hvad der ogsaa var at vente, da alle vare erholdte i det samme Kast med Trawlnettet.

Foruden *Themisto libellula,* Mandt, der neppe savnedes hos noget af de undersøgte Individer (hos enkelte fandtes næsten udelukkende denne Art, og i stor Mængde), var særdeles hyppig tilstede *Pecten groenlandicus,* Sow., tildels i talrige Exemplarer, og med fuldkommen hele Skaller. Andre Crustaceer, end den ovennævnte Hyperide, fandtes ikke i nogen Mængde; enkelte Exemplarer af en *Anonyx* fandtes hos flere af Individerne, fremdeles flere *Munnopsis typica,* M. Sars, samt enkeltvis *Syrrhoë crenulata,* Goës, en ung *Pasiphaë tarda,* Kr., en *Ampelisca,* samt en *Protomedeia fasciata,* Kr.

Endvidere fandtes af andre bestembare Dyr flere hele Exemplarer af en *Nephthys,* samt Stykker af Rørene af andre Annelider, hvoriblandt kunde kjendes *Chloræma pellucidum,* M. Sars; fremdeles et Par Exemplarer af *Ophiocten sericeum,* Forb., en *Yoldiá frigida,* Tor., en Pla-

Moreover, such individual differences in examples from the most northerly and examples from the most southerly localities, are not infrequently found to meet, or congrue, nay even to pass the differential limit. Thus, for instance, one of the specimens taken between Beeren Eiland and Spitzbergen has in the dorsal 84, in the anal 68 rays; and Kröyer counted in one of his Danish specimens 88 rays in the dorsal, and 67 in the anal.

A specific distinction between the northern and southern forms derived from the number of fin-rays, there is, accordingly, but little reason to assume.

In all other respects, the Arctic individuals of the species are not to be distinguished from individuals occurring in southern localities. As a matter of course, however, the increased number of fin-rays involves a proportionate augmentation in the number of scales, vertebræ, and pores in the lateral line; but the variation observed in these characters is not more constant than in the number of fin-rays.

As is the case with *Liparis lineatus,* which in the Arctic regions has the vertical fins invariably furnished with a greater number of rays than when occurring on the coasts of Norway and Sweden and in the Baltic (this feature, however, not sufficing to warrant division into species or constant varieties even), so too with *Hippoglossoides platessoides.* And the species having been diagnosticated under this name 7 years before the southern form *Pleuronectes limandoides,* established by Bloch, the latter name must give way to the earlier designation.

As a peculiar feature in some of the individuals taken on the Expedition, may be noticed the straight margin of the pectoral rays on the blind side; these rays were shorter, too, than in the other individuals.

Food. — Of the numerous individuals collected between Beeren Eiland and Spitzbergen, at a depth of 123 fathoms, the stomach and its contents were examined in 11, of different dimensions. The contents exhibited very little disparity, as was indeed to be expected, all of the individuals having been brought up at one haul with the trawl-net.

Exclusive of *Themisto libellula,* Mandt, which can hardly have been wanting in any one of the individuals examined (in some the ventricle was distended almost wholly with this species), *Pecten grœnlandicus,* Sow., frequently occurred; and with the scales entire. The only crustacean observed in considerable numbers, was the above-mentioned Hyperid. In some of the ventricles were found a few specimens of an *Anonyx,* also several examples of *Munnopsis typica,* M. Sars, and isolated examples of *Syrrhoë crenulata,* Goës, a young *Pasiphaë tarda,* Kr., an *Ampelisca,* and a *Protomedeia fasciata,* Kr.

Of other animals, occurred in one specimen several perfect examples of a *Nephthys,* also fragments of the tubes of other Annelids, amongst which *Chloræma pellucidum,* M. Sars, admitted of being determined; moreover, one or two examples of *Ophiocten sericeum,* Forb., a *Yoldia*

narie, samt hos de fleste af Individerne en Del Grus og Mudder.

Hos et af Individerne fra Tanafjord fandtes af Dyrelevninger intet uden *Pecten groenlandicus*, Sow., i flere Exemplarer.

Udbredelse. Da Bloch's *Pleuronectes limandoides*, efter hvad ovenfor er udviklet, maa antages blot at udgjøre den sydlige Stamme af Fabricii *Pleuronectes platessoides*, er Arten fundet fra Spitsbergen og Island ned langs Nordvest-Europas Kyster til den britiske Canal, fremdeles ved Nord-Americas Østkyst fra Grønland af ned til New-England Staterne.

Ved de scandinaviske Kyster har den hidtil væsentlig været kjendt fra det noget grundere Vand i Nærheden af Land; sandsynligvis er den dog udbredt paa passende Dybder overalt i de arctiske Have, men har hidtil paa Grund af mangelfulde Apparater ikke været erholdte i nogen betydelig Dybde, eller i nogen Afstand fra Land. At den dog her maa forekomme tildels i Mængde, fremgaar deraf, at den baade erholdtes (paa *Stat.* 323) i omtrent 200 Kilometres Afstand fra nærmeste Land, og ved en enkelt Lejlighed (paa *Stat.* 326) i et samlet Antal af 15 Individer, store og smaa, fra en Dybde af mellem 200 og 300 Favne.

frigida, Tor., a *Planaria*, and, in most of the individuals, a little gravel or mud.

In one of the Tana Fjord specimens, *Pecten grœnlandicus* — several examples — constituted the sole contents of the ventricle.

Distribution. — From what has been stated above, Bloch's *Pleuronectes limandoides* must be regarded as the southern branch of Fabricius's *Pleuronectes platessoides;* and the species ranges therefore from Spitzbergen and Iceland along the north-western shores of Europe to the British Channel; and in America, from Greenland to the coasts of the New England States.

On the coasts of Scandinavia, *H. platessoides* has heretofore been chiefly taken in comparatively shallow water, a short distance from land; probably, however, its range extends throughout all parts of the Arctic Ocean, though it has not as yet, owing to the defective construction of the apparatus employed for capturing it, been met with at any considerable depth, or in the open sea. But that it does occur, and even abundantly, in such localities, may be inferred from its having been taken at Station 323, nearly 200 kilometres from the nearest land; nay, on one occasion (Station 326) as many as 15 individuals, large and small, were obtained at a depth of 200—300 fathoms.

Gen. Glyptocephalus, Gottsche.

Wiegm. Arch. f. Naturg. 1 Jahrg. 1835, B. 1, p. 156 (1835).

Legemet højrevendt, glat, særdeles langstrakt, med kort Hålerod. Tænderne smaa, tætsiddende, mejseldannede, talrigst paa Blindsiden, og danne i begge Kjæver en enkelt sluttet Række; Vomerin- og Palatintænder mangle. Mundaabningen særdeles liden; Kjæverne omtrent lige lange, og naa hos de udvoxede neppe hen under Øjets forreste Rand. Analtorn i Regelen tilstede. Sidelinien næsten ret. Caudalen afrundet. Skjællene smaa, af ulige Størrelse, glatte. Hovedet lidet, med en Række Gruber paa Blindsiden; Øjnene tætsiddende. Straaleantallet betydeligt.

30. **Glyptocephalus cynoglossus,** (Lin.) 1766.

Pleuronectes cynoglossus, Lin. Syst. Nat. ed. 12, tom. 1, p. 456 (1766).
Pleuronectes pola, Lacép. Hist. Nat. Poiss. suites à Buffon, tom. 4, p. 401 (1819) [teste Br. & Goode].
Pleuronectes saxicola, Faber, Tidsskr. f. Naturv. 5 B., p. 244 (Kbhvn. 1828); Isis 1828, p. 877 (1828).

Gen. Glyptocephalus, Gottsche.

Wiegm. Arch. f. Naturg. 1 Jahrg. 1835, B. 1, p. 156 (1835).

Body dextral, smooth, elongated, peduncle of tail short. Teeth small, closely set, incisorial, most numerous on the blind side, forming a continuous cutting edge on either side; vomerine and palatine teeth wanting. Mouth very small; jaws about equal in length, in adults scarcely reaching the anterior margin of the eye. Preanal spine as a rule present. Lateral line almost straight. Caudal rounded. The scales small, varying in size, smooth. Head small, with a series of foveæ on the blind side. Eyes approximate. Fin-rays numerous.

30. **Glyptocephalus cynoglossus,** (Lin.) 1766.

Pleuronectes cynoglossus, Lin. Syst. Nat. ed. 12, tom. 1, p. 456 (1766).
Pleuronectes pola, Lacép. Hist. Nat. Poiss. suites à Buffon, tom. 4, p. 401 (1819) [teste Br. & Goode].
Pleuronectes saxicola, Faber, Tidsskr. f. Naturv. 5 B., p. 244 (Kbhvn. 1828); Isis 1828, p. 877 (1828).

Pleuronectes nigromanus, Nilss. Prodr. Ichth. Scand.. p. 55 (1832).
Glyptocephalus saxicola, Gottsche, Wiegm. Arch. f. Naturg. 1835, 1 B., p. 156 (1835).
Platessa pola, Jen. Man. Brit. Vertebr. Anim., p. 458 (1835).
Platessa elongata, Yarr. Suppl. to Brit. Fish., p. ? (1839); Hist. Brit. Fish. ed. 2, vol. 2, p. 318 (1841).
Platessa saxicola; Kr. Danm. Fiske, 2 B., p. 338 (1843—45).
Glyptocephalus cynoglossus, Gill, Proc. Acad. Nat. Sci. Philad. 1873, p. 360 (1873).
Glyptocephalus acadianus, Gill, Proc. Acad. Nat. Sci. Philad. 1873, p. 360 (1873).
Glyptocephalus elongatus, Gill, Proc. Acad. Nat. Sci. Philad. 1873, p. 362 (1873).
Pleuronectes elongatus, Day, Proc. Zool. Soc. Lond. 1879, p. 755, Pl. LXI (1879).

Diagn. *Legemet glat; dets Højde indeholdes hos yngre Individer 4, hos ældre 3 Gange (eller derunder), Hovedets Længde $5^1/_4$ til $5^3/_4$ Gange i Totallængden. Tænderne paa Øjensiden 6—13 i Over-, 7—14 i Underkjæven, paa Blindsiden 17—26 i Over-, 19—28 i Underkjæven. Legemet skjælbeklædt indtil Øjnenes Forrand; Finnerne ligeledes mere eller mindre skjælbeklædte. Interorbitalrummet smalt, med ophøjet Kjøl. Øjnene store, indeholdes 3—$3^1/_2$ Gange i Hovedets Længde; det nedre Øje ligger $^1/_3$ Øjenlængde foran det øvre. Analtorn tilstede. Pectoralen paa Blindsiden ikke forlænget. Ensfarvet rødagtig graa; Blindsiden hos de ældre mer eller mindre mørkfarvet. Pectoralen paa Øjensiden i sin ydre Halvdel sort.*

M. B. 7. D. 110 (95—120); A. 95 (87—102); P. 10—11 (9—14); C. 23 (18—26); V. 6.

Localit. fra Nordh. Exped. Lofoten; Tanafjord i Finmarken.

	—	*Stat.* 261.
Beliggenhed.	Røst, Lofoten.	Tanafjord, Finmarken.
Dybde.	150 Favne (276m).	127 Favne (232m).
Temp. paa Bunden.	+ 5,0° C.	+ 2,8° C.
Bunden.	Sandbund.	Mudder og Ler.
Datum.	26de Juni 1877.	25de Juni 1878.
Antal Indiv.	1 halvvoxent Indiv.	1 Indiv.

Bemærkninger til Synonymien. *Glyptocephalus cynoglossus* er, som det synes, Slægtens eneste Repræsentant i de atlantiske Have, efterat *Gl. acadianus*, Gill, fra Nord-Americas Østkyst har vist sig ikke at være artsforskjellig fra *Gl. cynoglossus*. Først i det stille Hav (California) optræde 2 andre, i afvigte Aar (1880) af Lockington beskrevne Arter.

Det yngste af Nordhavs-Expeditionens Individer, hvis Totallængde var 212mm ($8^1/_2$ eng. Tomme), tilhører øjensynlig det Stadium af Arten, hvori den af engelske Naturforskere er opstillet som en egen Art under Navn af *Pleuronectes elongatus* (Yarr.). Efterat denne Form, hvoraf blot enkelte Individer hidtil have været omtalte, alle fra de

Pleuronectes nigromanus, Nilss. Prodr. Ichth. Scand., p. 55 (1832).
Glyptocephalus saxicola, Gottsche, Wiegm. Arch. f. Naturg. 1835, 1 B., p. 156 (1835).
Platessa pola, Jen. Man. Brit. Vertebr. Anim., p. 458 (1835).
Platessa elongata, Yarr. Suppl. to Brit. Fish., p. ? (1839); Hist. Brit. Fish. ed. 2, vol. 2, p. 318 (1841).
Platessa saxicola, Kr. Danm. Fiske, 2 B., p. 338 (1843—45).
Glyptocephalus cynoglossus, Gill, Proc. Acad. Nat. Sci. Philad. 1873, p. 360 (1873).
Glyptocephalus acadianus, Gill, Proc. Acad. Nat. Sci. Philad. 1873, p. 360 (1873).
Glyptocephalus elongatus, Gill, Proc. Acad. Nat. Sci. Philad. 1873, p. 362 (1873).
Pleuronectes elongatus, Day, Proc. Zool. Soc. Lond. 1879, p. 755, Pl. LXI (1879).

Diagnosis. — *Body smooth; its depth, in young individuals is to total length as 1 to 4, in adults as 1 to 3 (or less); length of head as 1 to $5^1/_4$—$5^3/_4$. Teeth on coloured side in the upper jaw 6—13, in the lower 7—14; on the blind side in the upper jaw 17—26, in the lower 19—28. Body scaled to the anterior margin of the eyes; the fins likewise more or less covered with scales. Interorbital space narrow, with a sharp ridge; the eyes large, their diameter being to the length of the head as 1 to 3—$3^1/_2$; the lower eye about one-third of its diameter in advance of the upper. Preanal spine present. The pectoral on the blind side not produced. Colour rufous brown; the blind side in adults more or less tinged with the same colour. Outer half of pectoral on the coloured side black.*

M. B. 7. D. 110 (95—120); A. 95 (87—102); P. 10—11 (9—14); C. 23 (18—26); V. 6:

Locality (North Atl. Exped.): — Lofoten; the Tana Fjord (Finmark).

	—	*Stat.* 261.
Exact Locality.	Røst, Lofoten.	The Tana Fjord, Finmark.
Depth.	150 Fathoms (276m).	127 Fathoms (232m).
Temp. at Bottom.	+ 5.0° C..	+ 2.8° C.
Bottom.	Sand.	Mud and Clay.
Date.	26th June 1877.	25th June 1878.
Numb. of Specim.	1 Indiv. (half-grown).	1 Indiv.

Remarks on the Synonymy. — *Glyptocephalus cynoglossus* is apparently the only species of the genus inhabiting the Atlantic Ocean, *Gl. acadianus*, Gill, from the east coast of North America, having been shown to be specifically distinct from *Gl. cynoglossus*. Two other species (described by Lockington in the current year [1880]) occur, however, in the Pacific (coast of California).

The youngest of the specimens taken on the Expedition, total length 212mm ($8^1/_2$ English inches), obviously represents the stage of development in which *Gl. cynoglossus* has been referred by English naturalists to a separate species, under the name of *Pleuronectes elongatus* (Yarr.). This form, of which up to the present time a few specimens

engelske Kyster, i Regelen har været anseet som identisk med *Gl. cynoglossus*, har Dr. Day i forrige Aar paany hævdet dens Artsberettigelse, efterat et nyt Individ var kommet ham i Hænde i 1879, ligeledes fra de engelske Kyster (Cornwall). I Proc. Zool. Soc. London 1879, p. 755, giver han en ny Beskrivelse og en correct Planche (Pl. LXI) af denne efter hans Mening distincte Art; Individets Længde var 9 eng. Tommer (omtr. 228^{mm}), saaledes noget nær af samme Størrelse, som det mindste af Nordhavs-Expeditionens.

Det fremgaar af Dr. Day's Beskrivelse af *Pleuronectes elongatus*, at den væsentligste Ejendommelighed, sammenlignet med *Glyptocephalus cynoglossus*, ligger i Skjælbeklædningens Udstrækning, idet denne hos den førstnævnte ikke strækker sig ud over Finnestraalerne (undtagen over Caudalen), hvilket derimod er Tilfældet hos den sidste.

Undersøges dette Forhold hos det mindste af Expeditionens Individer, vil det sees, at ogsaa her strækker Skjælbeklædningen sig blot til Grunden af de verticale Finner, og blot langs den nederste Del af enkelte Straaler ville de første Spor af Skjæl vise sig. Det ældste Exemplar, hvis Totall. er 401^{mm}, har derimod Skjælbeklædning ud over Finnerne, dog ingenlunde særdeles rigeligt, men hovedsagelig blot langs Straalerne, og væsentlig paa disses nedre Del; et Par Unger fra Norges Vestkyst, hvis Totallængde dog ikke overstiger 65^{mm}, (de eneste Unger, som jeg har kunnet undersøge), ere endnu ganske skjælløse.

De øvrige Forskjelligheder mellem *Pleuronectes elongatus* og *Glyptocephalus cynoglossus* ere ganske uvæsentlige, og kunne samtlige begrundes ved den førstnævntes yngre Alderstrin[1].

Bemærkninger til Beskrivelsen. Ingen Forskjel kunde opdages mellem Individet fra Finmarken, og ligestore Individer fra Christianiafjorden. De 2 under Expeditionen erholdte Individer havde følgende Maal:

	a. Lofoten.	*b.* Tanafjorden.
Totallængde	212^{mm}	401^{mm}
Længde uden Caudal	170 -	325 -
Hovedets Længde	37 -	69 -
Legemets Højde	52 -	141 -

Tændernes Antal var hos det største Individ paa Øjensiden oventil 10, nedentil 10, paa Blindsiden oventil 21, nedentil 19; hos det mindste paa Øjensiden oventil 10, nedentil 11, paa Blindsiden oventil 21, nedentil 23.

Straaleantallet var:
a. D. 113; A. 97; P. 11; C. 23; V. 6.
b. D. 109; A. 90; P. 10; C. 26; V. 6.

Udbredelse. Arten er udbredt fra Canalen op langs Europas Nordvestkyst, men var hidtil ikke funden længere

[1] „B. V." er sandsynligvis en Trykfejl for B. VII (hvis B. skal være samme Tegn, som i Almindelighed udtrykkes som M.B.).

only have been taken — all from the English coasts — has been generally regarded as identical with *Gl. cynoglossus;* but in 1879 its supposed claim to specific distinction was again asserted, by Dr. Day, who in that year had obtained a new specimen, and this one too from the English coast (Cornwall). In Proc. Zool. Soc. London, 1879, p. 755, that naturalist furnished a new description, with a good drawing (Pl. LXI), of this, in his opinion, distinct species. The total length being 9 English inches (about 228^{mm}), it is of very nearly the same dimensions as the smallest of the specimens collected on the Expedition.

The chief distinctive feature in *Pleuronectes elongatus,* as compared with *Glyptocephalus cynoglossus,* is derived, according to Dr. Day, from the scaled integument, which in the former does not extend over the fin-rays (saving those of the caudal); in the latter, however, it does.

But, on examining the smallest of the specimens obtained on the Expedition, the scaled integument is found to reach to the base of the vertical fins, a few rays only exhibiting on their lower part traces of scales. In the oldest example, total length 401^{mm}, the scaling extends out on the fins; it is not dense however, the scales occurring chiefly along the rays, and in particular on their lower part. Two very young specimens (from the west coast of Norway), with a total length of not more than 65^{mm}, the only young examples I have had an opportunity of examining, were still entirely scaleless.

The other distinctive peculiarities supposed to distinguish *Pl. elongatus* from *Gl. cynoglossus,* are none of them specific characters, but may all be referred to the immaturity of the former.[1]

Descriptive Observations. — No difference could be detected between the individual from Finmark and examples of equal size taken in the Christiania Fjord. The specimens obtained on the Expedition, measured as follows: —

	a. Lofoten.	*b.* Tana Fjord.
Total Length	212^{mm}	401^{mm}
Length exclusive of Caudal	170 -	325 -
Length of Head	37 -	69 -
Depth of Body	52 -	141 -

Number of teeth on the coloured side in the largest individual 10 above and 10 below, on the blind side, 21 above and 19 below; in the smallest individual on the coloured side 10 above and 11 below, on the blind side 21 above and 23 below.

The fin-rays were as follows: —
a. D. 113; A. 97; P. 11; C. 23; V. 6.
b. D. 109; A. 90; P. 10; C. 26; V. 6.

Distribution. — The range of *G. cynoglossus,* which extends from the British Channel along the north-western

[1] "B. V" is probably a misprint for B. VII, assuming the signification of B. to be that usually attached to M.B.

mod Nord, end til Trondhjemsfjorden i Norge. Ved de engelske Kyster er den ikke sjelden, men den forekommer idethele sparsommere længere mod Nord; i Kattegat er den intetsteds talrig, og den gaar, saavidt bekjendt, ikke ind i Østersøen.

I Norge er den funden paa adskillige Localiteter, talrigst i Christianiafjorden, hvor den saagodtsom daglig i Høstmaanederne sees paa Fisketorvene; undertiden kunne 20—50 Individer erholdes i det samme Dræt. Ved Landets Vestkyst er den idethele sparsom; først i 1875 blev den med Sikkerhed fundet ved Bergen, ligesom et Par Individer ere erholdte ved Florø og ved Christiansund. Nordhavs-Expeditionens Individer vare, som ovenfor nævnt, fra Lofoten og Finmarken, og vare optagne fra en Dybde af indtil 150 Favne; disse ere de nordligste Punkter, fra hvilke Arten hidtil vides erholdt (71° N. B.), ligesom den hidtil ikke, saavidt vides, er observeret paa større Dybde, end den ovenfor anførte.

Ved de egentlig arctiske Ølande er den endnu ikke paavist; derimod forekommer den atter paa Østkysten af Nord-America, hvor den i 1872 fandtes første Gang, og senere (i 1877) optoges i stort Antal udenfor Kysterne af New England-Staterne, af U. S. Fish-Commission, paa en Dybde af indtil 90 Favne. Den hører saaledes blandt denne Families Dybvandsformer.

shores of Europe, but the species had not previously been observed farther north than the Drontheim Fjord. On the English coast it is anything but a rare fish; in the Cattegat it nowhere occurs abundantly, and it does not enter the Baltic.

In Norway, it is met with in several localities, more particularly the Christiania Fjord; and may almost dayly during the autumn months be seen exposed for sale in the fish-markets; from 20 to 50 individuals are sometimes brought up at a single haul. Off the western shores of this country the species is on the whole but rarely met with; indeed its occurrence off Bergen was not ascertained with certainty till 1875; one or two individuals have likewise been obtained near Florö and Christiansund. The specimens brought home by the North Atlantic Expedition — taken at a depth of 150 fathoms — were, as previously observed, from Lofoten and Finmark, the most northerly localities and the greatest depths in which the species is as yet known to have been met with (71° N.).

On the islands in the Polar Sea the species has not been shown to occur; it inhabits however the eastern shores of North America, where it was first observed in 1872, and subsequently (1877) captured, in large numbers, off the coast of the New England States, by the U. S. Fish-Commission, at depths reaching 90 fathoms. Hence it must be classed among the deep-sea forms of this family.

Fam. Ophidiidae.

Gen. Rhodichthys, Coll. 1878 (n. gen.).

Forh. Vid. Selsk. Chra. 1878, No. 14, p. 99 (1878).

Legemet forholdsvis højt, uden Skjæl eller Sidelinie, halvt gjennemsigtigt, bag Bughulen stærkt sammentrykt. Hovedet bredt og tykt; Caudalen distinct, blot ved Roden tilvoxet Analen og Dorsalen. Anus foran Pectoralerne, lige under Gjællespalten. Ventralerne bestaa af 2 lange Filamenter, fastvoxede til Tungebenet, og kløvede i sin ydre Halvdel. Analen begynder langt bagenfor Anus; Dorsalen enkelt. Tænder tilstede paa Mellemkjæverne og i Underkjæven. Gjællelaagene uvæbnede.

Fam. Ophidiidæ.

Gen. Rhodichthys, Coll. 1878 (n. gen.).

Forh. Vid. Selsk. Chra. 1878, No. 14, p. 99 (1878).

Body comparatively deep, without scales or lateral line, semi-translucent, posterior to the abdominal cavity much compressed. Head broad and thick; caudal fin distinct, at the base only connate with the anal and dorsal. The vent placed anterior to the pectorals, immediately beneath the branchial opening. The ventrals consisting of two long filaments attached to the hyoid bone, the exterior half bifid. The anal originating a considerable distance posterior to the vent. The dorsal single. Teeth on the intermaxillary and the lower jaw. Opercles unarmed.

31. **Rhodichthys regina**, Coll. 1878 (n. sp.).

Pl. V, Fig. 37—39.

Rhodichthys regina, Coll. Forh. Vid. Selsk. Chra. 1878, No. 14, p. 99 (1878).

Diagn. *Ensfarvet rød overalt. Hovedet indeholdes næsten 4 Gange, Legemets største Højde $4^{1}/_{5}$ Gange i Totallængden. Legemet fortil højt, bagtil stærkt afsmalnende, med lang og smal Halerod. Overkjæven længere, end Underkjæven. Dorsalen begynder umiddelbart over Gjællespalten; Caudalen rager med de ydre 3 Femtedele ud over Dorsalen og Analen. Øjnene smaa, indeholdes 7 Gange i Hovedets Længde; Interorbitalrummet bredt. Tænderne yderst fine, stillede i flere Rækker. Næseborene dobbelte. Appendices pyloricae 10. Størrelsen af det eneste undersøgte Individ, en Han, 297 mm.*

M. B. 6. D. 60; A. 57; C. 10; P. 11—12.

Localit. fra Nordh. Exped. Havet midt mellem Beeren Eiland, Jan Mayen og Finmarken.

	Stat. 297.
Beliggenhed.	465 Kil. NØ. Jan Mayen.
Dybde.	1280 Favne (2341 m).
Temp. paa Bunden.	— 1,4° C.
Bunden.	Biloculina-Ler.
Datum.	16de Juli 1878.
Antal Indiv.	1 Indiv.

Alm. Bemærkninger. *Rhodichthys regina* er ikke nær beslægtet med nogen hidtil fundet nordeuropæisk Fiskeslægt. Hele Legemet er fuldstændig glat, uden Spor af Skjæl eller Sidelinie, og havde en intens rød Farve. Huden er særdeles tynd, og halvt gjennemsigtig; oprindelig var den tilvoxet Legemet, men efterat Individet har været opbevaret paa Spiritus, har den overalt løsnet sig, og lader sig med Lethed forskyde med Fingeren. Individet, der endnu levede, da det bragtes op fra den store Dybde af 1230 Favne, holdtes en Tid levende, men viste sig herunder dorsk og lidet bevægeligt. Hele Legemet var af særdeles blød, eller næsten gelatinøs Consistens; det var oprindelig halvt gjennemsigtigt, saa at flere af de indre Organer kunde sees, saaledes Hvirvelsøjlen, Hjernens forskjellige Afdelinger, Høreapparatet, Gjællerne, og de fleste af Indvoldene; endnu efterat Individet i længere Tid har været opbevaret paa Spiritus, har denne Gjennemsigtighed tildels vedligeholdt sig.

Udmaalinger.

Totallængde	297 mm
Legemets Længde til sidste Halehvirvel	267 -
Legemets Højde ved Begyndelsen af Dorsalen	63 -
Legemets Højde ved Begyndelsen af Analen	59 -
Hovedets Længde	77 -
Hovedets Højde lige bag Ventralerne	60 -
Hovedets Tykkelse over Kinderne	46 -

31. **Rhodichthys regina**, Coll. 1878 (n. sp.).

Pl. V, fig. 37—39.

Rhodichthys regina, Coll. Forh. Vid. Selsk. Chra. 1878, No. 14, p. 99 (1878).

Diagnosis. — *Colour a uniform bright red. The length of the head is to the total length nearly as 1 to 4, the extreme depth of the body as 1 to $4^{1}/_{5}$. Anterior part of body deep, in the posterior region rapidly tapering; tail at base long and slender. Upper jaw longer than lower. The dorsal fin originating immediately above the branchial aperture; the caudal projecting to the extent of three-fifths of its length beyond the dorsal and anal. Eyes small, their diameter being to the length of the head as 1 to 7; interorbital space wide. The teeth exceedingly minute, arranged in several series. Nostrils double. Pyloric appendages 10. Length of the only individual obtained (a male) 297 mm.*

M. B. 6. D. 60; A. 57; C. 10; P. 11—12.

Locality (North Atl. Exped.): — The open sea, between Beeren Eiland, Jan Mayen, and Finmark.

	Stat. 297.
Exact Locality.	465 Kil. NE. Jan Mayen.
Depth.	1280 Fathoms (2341 m).
Temp. at Bottom.	— 1.4° C.
Bottom.	Biloculina Clay.
Date.	16th July 1878.
Numb. of Specim.	1 Indiv.

General Remarks. — *Rhodichthys regina* is not nearly related to any known genus of North European fishes. The body perfectly smooth, with no trace of scales or lateral line; colour a bright red. The skin exceedingly thin, and quite transparent; originally it was firmly attached to the body; but it has now, the individual having been preserved some time in spirits, become loose over the whole surface, and may be readily displaced with the fingers. The individual came up alive, from the great depth of 1230 fathoms, and survived some time in a tub of sea-water; but its movements were sluggish. The whole of the body exceedingly soft; originally, it was semi-translucent, so that divers of the internal organs could be distinctly seen, for instance the gills, the vertebral column, the various divisions of the brain, the auditory apparatus and the greater part of the intestines. Even in the present state of preservation, this transparency is still obvious.

Measurements.

Total length	297 mm
Length of body to last caudal vertebra	267 -
Depth of body at the origin of the dorsal	63 -
Depth of body at the origin of the anal	59 -
Length of head	77 -
Depth of head immediately posterior to the ventrals	60 -
Thickness of head across the cheeks	46 -

Snudens Længde	25 mm
Øjets Diameter (Iris)	11 -
Hovedets postorbitale Del	42 -
Lindsens Diameter	6 -
Afstanden mellem Øjnene (Interorbitalrummet)	30 -
Gjællespaltens Højde	46 -
Overkjævens Længde	39 -
Snudespidsens Afstand fra Ventralerne	52 -
Underkjævespidsens Afstand fra Ventralerne	42 -
Snudespidsens Afstand fra Anus	62 -
Underkjævespidsens Afstand fra Anus	52 -
Snudespidsens Afstand fra Beg. af Dorsalen	79 -
Snudespidsens Afstand fra Beg. af Analen	98 -
Anus's Afstand fra Analen	36 -
Dorsalens største Højde	19 -
Længden af sidste Dorsalstraale	10 -
Ventralens Længde	97 -
Pectoralens Grundlinie	16 -
Pectoralens Længde	43 -
Caudalens Længde	30 -
Analens største Højde	18 -
Længden af sidste Analstraale	11,5 -
Halerodens Højde	4 -
Fra Anus til Halespidsen (Halepartiets Længde)	235 -

Beskrivelse. *Legemsbygning.* Legemet er bagenfor Hovedet højt indtil Analens Begyndelse; herfra aftager hurtigt Højden, og Legemet løber i sin sidste Del ud i en lang og jevn Spidse, der yderst er særdeles lav (kun lidt over Halvdelen af en Lindsediameter). Imidlertid ere de verticale Finner næsten overalt temmelig høje, saaledes at Individet ser forholdsvis højt ud i den største Del af sin Længde. Bagenfor Nakken og den umiddelbart under Nakken liggende Bughule er Legemet overordentlig stærkt sammentrykt.

Anus er særdeles langt fremrykket, og ligger lige under Gjællespalten, saaledes i en Afstand fra Snudespidsen, der indeholdes ikke langt fra 5 Gange i Totallængden. Det ligger foran Pectoralerne, og i en betydelig Afstand fra Analens Begyndelse; ved dets bagre Rand findes en kort, tyk og stiv Papille.

Af Totallængden udgjør:

Hovedets Længde	3,85
Snudens Afstand fra Anus	4,79
Snudens Afstand fra Dorsalen	3,75
Snudens Afstand fra Analen	3,03
Halens Længde (fra Anus til Halespidsen)	1,21
Legemets Højde (ved Beg. af Dorsalen)	4,71

Hovedet er bredt og tykt; dets Længde indeholdes ikke fuldt 4 Gange i Totallængden (eller, Caudalen fraregnet, ikke fuldt $3^1/_2$ Gange). Dets Bredde over Kinderne er ubetydeligt større, end dets postorbitale Del; Snuden er særdeles bred og stump.

Panden og Nakken ere stærkt hvælvede, med underliggende tykke Muskler; paa Hovedets øvrige Dele ere Knoglerne blot beklædte med en tynd og løs Hud. Den øvre Profilrand er jevnt nedløbende, eller, hvor Huden

Length of snout	25 mm
Diameter of eye (iris)	11 -
Postorbital region of head	42 -
Diameter of the lens	6 -
Distance between the eyes (interorbital space)	30 -
Depth of branchial aperture	46 -
Length of upper jaw	39 -
From point of snout to ventrals	52 -
From extremity of lower jaw to ventrals	42 -
From point of snout to vent	62 -
From extremity of lower jaw to vent	52 -
From point of snout to origin of dorsal	79 -
From point of snout to origin of anal	98 -
Distance of vent from anal	36 -
Extreme depth of dorsal	19 -
Length of last dorsal ray	10 -
Length of ventral	97 -
Depth of pectoral at base	16 -
Length of pectoral	43 -
Length of caudal	30 -
Extreme depth of anal	18 -
Length of last anal ray	11.5 -
Depth of tail at base	4 -
From the vent to the tip of caudal (L. of tail)	235 -

General Description. *Structure of the Body.* — Depth of body considerable, as far as the origin of the anal fin; from thence it rapidly diminishes, the body terminating in a rather narrowish tail, the root very thin and slender, (the depth but slightly exceeding half the diameter of the lens); the vertical fins, however, are comparatively deep, and hence the height of the individual is throughout the greater part of its length considerable. Posterior to the nape and the abdominal cavity, placed immediately beneath, the body is remarkably compressed.

The vent far in front, immediately beneath the branchial aperture, the distance from the point of the snout being to the total length very nearly as 1 to 5. It is placed anterior to the pectorals, and at a considerable distance from the origin of the anal; at the posterior margin occurs a small papillary wart, thick and hard.

The Total Length contains: —

Length of head	3.85
Distance of snout from vent	4.79
Distance of snout from dorsal	3.75
Distance of snout from anal	3.03
Length of tail (from vent to tip of the caudal)	1.21
Depth of body (at origin of dorsal)	4.71

The head broad and thick; its length is to total length almost as 1 to 4, or, exclusive of the caudal, almost as 1 to $3^1/_2$; its breadth across the cheeks slightly exceeding the length of the postorbital region; snout extremely broad and obtuse.

The front and nape vaulted, with thick subjacent muscles; the bones in the other parts of the cranium merely invested with a thin and lax skin The superior profile line sloping gently downwards, or slightly and

er indfalden mellem Knoglerne, svagt eller uregelmæssigt concav. Hovedet er uvæbnet; paa Praeoperculum kan der under Huden føles enkelte lavere Knuder og Kamme, ligesom lignende Knuder findes over Øjnene, paa Siderne af Nakken, og paa hver Side af Snudespidsen.

Gjællelaagene ere ligeledes beklædte med en løs Hud, og ende bagtil i en Flig, understøttet af en smal og krummet Benknogle; Suboperculum rager ud over Gjællehinden. Gjællespalten er særdeles vid; Afstanden mellem begge Spalters nedre Ende paa Hovedets Underside er blot lidt over en Øjendiameter.

Snudespidsen rager noget frem foran Over- og Mellemkjæven; Underkjæven er ikke ubetydeligt kortere, end Overkjæven, som strækker sig tilbage indtil forbi Øjets bagre Rand.

Næseborene ere dobbelte; det bagre Par ligger i omtrent en Øjendiameters Afstand fra Øjet, det forreste omtrent midt mellem det bagre og Snudespidsen. Den indbyrdes Afstand mellem det bagre Par Næsebor er lig Snudens Længde; mellem det forreste Par omtrent det halve.

Øjnene ere forholdsvis smaa, og indeholdes 7 Gange i Hovedets Længde. Bredden mellem Øjnene (Interorbitalrummet) er næsten 3 Gange saa stor, som Øjendiameteren.

Tænderne, der ere tilstede i Mellemkjæverne og Underkjæven, ere yderst fine; de danne her flere Rækker, og ere særdeles tætstaaende. Vomer og Palatinbenene ere glatte.

Finnerne. Dorsalen, der er enkelt, tæller 60 Straaler, som overalt, især i dens forreste Del, ere indbyrdes forbundne med en tyk, fedtlignende Mellemsubstans, over hvilken den løse Hud ligger slapt og bevægeligt; Straalernes Bygning er derfor vanskelig at angive med Sikkerhed. De forreste Straaler ere kløvede til Grunden; de bagre synes at være enkelte, men ere tydeligt articulerede. De første Straaler ere særdeles korte, og hæve sig næsten ikke op over Ryggen; derpaa tiltage de successivt i Længde, indtil Finnen omtrent midt paa Halepartiet har naaet sin største Højde, der omtrent er lig Overkjævens halve Længde. Paa Haleroden staa Straalerne temmelig tæt, men ere endnu forholdsvis lange; den sidste Straale paa Dorsalsiden er med hele sin Længde, der udgjør næsten en Øjendiameter, tilvoxet Caudalen. Dorsalen begynder umiddelbart over Gjællelaagets bagre Flig, saaledes, at dens Afstand fra Snudespidsen indeholdes, ligesom Hovedet, omtrent $3^3/_4$ Gange i Totallængden.

Analen indeholder 57 Straaler, der ere af Bygning temmelig overensstemmende med Dorsalens. De forreste Straaler ere dog ikke fuldt saa korte, som de tilsvarende i Dorsalen, men de længste have næsten samme Højde, som disse; den ophører, ligesom Dorsalen, umiddelbart paa Haleroden, og da dens sidste Straale, der ogsaa her med hele sin Længde er tilvoxet Caudalen, er ubetydeligt længere, end den sidste Dorsalstraale, rager Analen noget længere ud over Caudalen, end Dorsalen, saaledes at den bedækker omtrent $^2/_5$ af denne. Analen udspringer i en Af-

irregularly concave between the bones where the skin is shrunk. The head unarmed; on the preoperculum a few obtuse protuberances and ridges can be felt underneath the skin; similar protuberances occur above the eyes, on both sides of the nape, and at the end of the snout.

The gill-plates are likewise covered with a lax skin, and terminate at the posterior extremity in a rounded flap, supported by a slender and curved bone. The suboperculum extending beyond the branchial membrane. The gill-opening exceedingly wide; distance between its lower extremities on the under surface of the head but slightly exceeding the diameter of the eye.

The point of the snout projecting beyond the superior and the intermaxillaries; lower jaw shorter than upper, the latter extending backwards past the posterior margin of the eye.

Nostrils double; the posterior pair distant about the diameter of the eye from the eye; the anterior situated nearly midway between the posterior and the point of the snout. Distance between the nostrils of the posterior pair equal to the length of the snout, between those of the anterior about half that length.

The eyes comparatively small, their diameter being to the length of the head as 1 to 7. Width of interorbital space almost three times the diameter of the eye.

Teeth on the intermaxillaries and in the lower jaw, exceedingly minute and arranged in several series; the vomer and the palatine bones smooth.

Fins. — One dorsal, furnished with 60 rays, which, more especially in the fore part of the fin, are all of them united together by means of thick adipous tissue, and enveloped in a lax and yielding membrane; hence the structure of the rays is difficult to determine. The anterior rays are cleft to the base; those in the posterior part of the fin appear to be simple, but are distinctly articulated. The foremost rays are exceedingly short, scarcely projecting above the surface of the back; the rest gradually increasing in length till the fin, about the middle of the caudal region, has attained its greatest height, which is about equal to half the length of the upper jaw. The rays at the base of the tail rather close, but here, too, comparatively long; the terminal ray on the dorsal side throughout its entire length, which is nearly equal to the diameter of the eye, connate with the caudal. The dorsal fin originates immediately above the flap of the gill-cover, its distance from the tip of the snout being to the total length about as 1 to $3^3/_4$.

The anal is furnished with 57 rays, in structure closely resembling those of the dorsal. The foremost rays, however, not quite so short as the corresponding rays in the dorsal; but the longest are almost equal in height with those of that fin; it terminates, like the dorsal, in immediate proximity to the caudal fin; and the last of its rays, also connate with the caudal throughout its entire length, being a trifle longer than the last dorsal ray, the anal extends somewhat farther beyond the caudal than does the dorsal, covering about two-fifths of that fin. The anal

stand af næsten en halv Hovedlængde fra Anus, dog forholdsvis langt fortil, idet dens Afstand fra Snudespidsen blot udgjør en Trediedel af Totallængden, saaledes at det egentlige Haleparti kommer til at udgjøre 2 Trediedele af denne.

Caudalen er særdeles smal og langstrakt, samt ubetydeligt tilspidset. Den bestaar af 10 særdeles fine og tætstillede Straaler, hvoraf det yderste Par ere kortere, end de øvrige, der samtlige omtrent have samme Længde; de ere udelte, men fint articulerede. Caudalen, der, som ovenfor nævnt, ved Roden er bedækket af den sidste Dorsal- og Analstraale, har en Længde af omtr. $^1/_{10}$ af Totall.

Pectoralerne udspringe noget bagenfor Anus, lige bag Gjællespalten, saaledes, at deres Rod berøres af Gjællehinden. De tælle 11, paa den anden Side 12 Straaler, der ere delte omtrent fra Midten af. Pectoralens Grundlinie udgjør lidt over Halvdelen af Interorbitalrummets Bredde. De øverste Straaler ere de længste, de følgende efterhaanden kortere; deres største Længde indeholdes i Totallængden næsten 7 Gange. Hele Finnen er yderst blød og bøjelig, samt halvt gjennemsigtig, og indhyllet i den samme løse Hud, som den øvrige Del af Legemet.

Ventralerne ere tilstede som 2 lange Filamenter, hver indhyllet i en tyk Hud, og fæstede til Tungebenet, umiddelbart ved Gjællespaltens nedre Ende. I sin første Halvdel ere de udelte, men dele sig paa Midten i 2 Traade, hvoraf den ene er længere, end den anden. Ventralens hele Længde udgjør hos det eneste undersøgte Individ omtrent $^1/_3$ af Legemets Længde, men varierer sandsynligvis hos Individerne.

Slimporer. Sidelinie eller Skjæl findes ikke. Langs Underkjæven strækker sig en Række af 4 store, aabne Porer, hvoraf den første staar nærved Symphysen, den sidste paa Kjævens bagre Rand. Paa hver Side af Overkjæven, umiddelbart ved Randen, staa 3 lignende Porer, samt en enkelt paa hver Side hen under Øjet.

Farven var overalt mørkt kjødrød med enkelte lysere Skygninger; den var yderst fint og jevnt fordelt, saaledes at tydelige Pigmentpunkter vare ikke synlige. Gjællehinden var intens carmosinrød; Iris var ikke metalliskfarvet, men dybt blaasort. Denne smukke røde Farve er efterhaanden hos det paa Spiritus opbevarede Exemplar saagodtsom ganske forsvundet, saaledes at dette nu er bleven jevnt hvidagtigt overalt.

Appendices pyloricae, hvis Antal var 10, vare tykke og cylindriske; deres Længde varierede mellem 15^{mm} og 18^{mm}. Bughinden var sort.

Individet var en Han; *Testes,* der dog neppe for Tiden vare i sin fulde Udvikling, havde en Længde af 45^{mm} (den venstre), og 55^{mm} (den højre).

Føde. Ventrikelen, der var særdeles musculøs, indeholdt endnu gjenkjendelige Levninger af Crustaceer, skjønt Individet var ophentet fra den enorme Dybde af næsten 1300 Favne, hvortil var medgaaet flere Timer, og derpaa i en Tid holdt levende ombord. Disse vare 2 Individer

commences nearly half the length of the head posterior to the vent, but comparatively far in front, being distant not more than one-third of the total length from the tip of the snout; and hence the caudal portion of the body equals two-thirds of that length.

The caudal is narrow, elongated, and very slightly pointed. It consists of 10 exceedingly close and slender rays; the outermost pair shorter than the rest, which are nearly uniform in length; they are simple, but minutely articulated. The caudal, covered at the base (as stated above) by the terminal ray in the dorsal and anal, is equal in length to about one-tenth of the total length.

The pectorals commence a short distance posterior to the vent, immediately behind the branchial opening, their base in contact with the branchial membrane. They are furnished on one side with 11, on the other with 12 rays, divided from about the middle. The base of the pectorals measures rather more than half the width of the interorbital space. The uppermost rays are the longest, the rest becoming gradually shorter; their length is to total length nearly as 1 to 7. The whole fin exceedingly soft and flexible, also semi-transparent, and, like the rest of the body, enveloped in a lax integument.

The ventrals occur as two long filaments, each invested with a thick membrane, and attached to the hyoid bone, close to the lower extremity of the gill-openings. In their first half simple, but divided about the middle of the fin into two cirri, one longer than the other. The length of the ventrals in this unicum equals about one-third of the length of the body, but will probably be found to vary in different examples.

Mucous Pores. — No scales or lateral line. Along the under surface, however, extends a row of 4 large, open pores, the first in close proximity to the symphysis, the last on the posterior margin of the jaw, On either side of the upper jaw, contiguous with the margin, are three similar pores, and a solitary pore occurs under each eye.

Colour. — The whole body of a bright red colour, here and there with lighter-tinted cloudings; and this ground-colour being remarkably uniform, no distinct pigmentary specklets were observable. Branchial membrane the brightest of crimsons; irides a deep bluish-black, without metallic lustre. The beautiful red colour has gradually faded, from the action of alcohol (the specimen is preserved in spirits), the fish being now uniformly whitish.

Pyloric appendages 10, thick and cylindric, varying in length from 15^{mm} to 18^{mm}; ventral membrane black.

This individual was a male; length of *testes,* which, however, had hardly then attained their full development, 45^{mm} (the left) and 55^{mm} (the right).

Food. — The ventricle — exceedingly muscular — contained still determinable fragments of crustaceans (and yet the specimen was brought up from the great depth of 1300 fathoms, which took several hours; and it was kept, too, some time alive), viz. 2 examples of *Bythocaris leucopis,*

af *Bythocaris leucopis,* samt 1 af *Pseudomysis abyssi,* begge Arter beskrevne i 1880 af G. O. Sars fra Nordhavs-Expeditionens Indsamlinger, men ingen af dem tidligere fundne i en saa betydelig Dybde. Endelig fandtes et Individ af en endnu ubestemt Hyperide, der sandsynligvis er ubeskreven.

Udbredelse. Det eneste hidtil erholdte Exemplar af denne mærkelige Art havde en Længde af omtrent $^1/_3$ Meter, og optoges, som ovenfor nævnt, fra det iskolde Vand paa næsten 1300 Favnes Dyb midt ude paa Havet, den 16de Juli 1878, omtrent lige langt fra Spitsbergen, Jan Mayen og Finmarken.

Subord. Physostomi.

Fam. Scopelidae.

Gen. Scopelus, Cuv.

Règne Anim. éd. 1, tom. 2, p. 169 (1817).

32. Scopelus mülleri, (Gmel.) 1788.

Salmo mülleri, Gmel. Lin. Syst. Nat. ed. 13, tom. 1, p. 1378 (1788).
Scopelus glacialis, Reinh. Overs. 1835—36, Kgl. D. Vid. Selsk. Nat. Math. Afh. 6 Del, p. CX. Kbhvn. 1837 (1835—36).
Scopelus mülleri, Coll. Norges Fiske, Tillægsh. til Forh. Vid. Selsk. Chra. 1874, p. 152. Chra. 1875 (1874).

Diagn. *Legemets Højde noget mindre, end Hovedlængden, der indeholdes 4—4$^1/_2$ Gange i Totallængden. Overkjæven gaar tilbage forbi Øjet, og ender triangulært afskaaret ved Randen af Praeoperculum. Dorsalen ligger over Mellemrummet mellem Ventralerne og Analen. Øjet overordentlig stort, indeholdes ikke fuldt 3 Gange i Hovedlængden, og er kun lidet mindre, end Hovedets postorbitale Del. 3 Skjælrækker ovenfor, 4 nedenfor Sidelinien. Skjællene glatte; Sideliniens Skjæl større, end de øvrige. 21—23 Par Pletter langs Buglinien (5 mellem Struben og Ventralerne; 3—4 mellem Ventralerne og Analen; 7—8 langs Analen, 6 mellem Analen og Caudalen). Farven grønlig-brun oventil, paa Midten gulagtig sølvglindsende, paa Bugen mørkere olivengrøn.*

D. 12—14; A. 16—18; P. 11; V. 8; C. 7/19/7.
Lin. lat. 36 (Günth.), 38 (Kr.).

and 1 of *Pseudomysis abyssi,* both species described (1880) by G. O. Sars from specimens collected on the North Atlantic Expedition, but not previously met with at so great a depth; finally, an example of a Hyperid, as yet undetermined, and probably undescribed.

Distribution. — The only example of this singular species yet obtained measured in length one-third of a metre, and, as previously mentioned, was taken in the frigid area at a depth of nearly 1300 fathoms, in mid-ocean, the locality being about equidistant from Spitzbergen, Jan Mayen, and Finmark, July 16th 1878.

Subord. Physostomi.

Fam. Scopelidæ.

Gen. Scopelus, Cuv.

Règne Anim. éd. 1, tom. 2, p. 169 (1817).

32. Scopelus mülleri, (Gmel.) 1788.

Salmo mülleri, Gmel. Lin. Syst. Nat. ed. 13, tom. 1, p. 1378 (1788).
Scopelus glacialis, Reinh. Overs. 1835—36, Kgl. D. Vid. Selsk. Nat. Math. Afh. 6 Del, p. CX. Kbhvn. 1837 (1835—36).
Scopelus mülleri, Coll. Norges Fiske, Tillægsh. til Forh. Vid. Selsk. Chra. 1874, p. 152. Chra. 1875 (1874).

Diagnosis. — *Depth of the body a trifle less than the length of the head, which is to total length as 1 to 4—4$^1/_2$. The maxillary extending backwards past the eye, and terminating in a triangular dilatation at the margin of the preoperculum. Dorsal fin placed above the space between the ventrals and the anal. Eyes remarkably large; their longitudinal diameter being to the length of the head very nearly as 1 to 3, and a trifle less than the postorbital region of the head. Above the lateral line 3 rows of scales, below 4. Scales smooth; those on the lateral line larger than the rest. Along the ventral line 21—23 pairs of spots (between the throat and the ventrals 5; between the ventrals and the anal 3 or 4; along the anal 7—8; between the anal and the caudal 6). Colour above a greenish-brown; in the medial region yellowish, with a silvery lustre; on the abdomen, a dark olive green.*

D. 12—14; A. 16—18; P. 11; V. 8; C. 7/19/7.
Lin. lat. 36 (Günth.), 38 (Kr.).

Localit. fra Nordh. Exped. Storeggen udenfor Aalesund (Norge); Havet vestenfor Finmarken.

	Stat. 33.	*Stat.* 295.
Beliggenhed.	Storeggen, 174 Kil. V. Aalesund.	453 Kil. V. Hammerfest.
Dybde.	Flydende i Vandskorpen.	1110 Favne (2030 m).
Temp. paa Bunden.	—	— 1.3° C.
Bunden.	—	Biloculina-Ler.
Datum.	30te Juni 1876.	14de Juli 1878.
Antal Indiv.	1 Indiv.	3 Indiv.

Bemærkninger til Synonymien. Spørgsmaalet om denne Arts Synonymi og rette Benævnelse kan blot løses efter en omhyggelig Prøvelse af en Del Data, hentede fra de af den lærde Præst og Naturforsker H. Strøm efterladte Dagbøger over hans naturhistoriske Observationer i Søndmør (paa Norges Vestkyst) i forrige Aarhundrede, hvilke Dagbøger, der opbevares paa Universitets-Bibliotheket i Christiania, endnu ere utrykte.

I disse Dagbøger[1], der omfatte Aarene 1756—1780, og som danne Grundlaget for de naturhistoriske Capitler i hans bekjendte Skrift, Søndmøres Beskrivelse (1762)[2], med Supplement (1784)[3], findes under Aaret 1766, § 38 anført, at han havde fundet i Stranden en liden Fisk af $2^1/_2$ Tommes Længde, hvilken han derpaa nøjere beskriver. Finnestraalernes Antal opgiver han at være: D. 9; A. 10; P. 15—16; V. 8. I denne Beskrivelse, hvori han især omhandler Hovedets Bygning, gjenkjendes uden Vanskelighed den senere *Maurolicus borealis,* (Nilss.) 1832.

Dernæst findes atter anført for Aaret 1774, § 4, at han den 3die Juni d. A. fangede en sjelden Fisk, der forfulgtes af de andre Smaafiske; ogsaa af denne giver han en temmelig udførlig Beskrivelse, og opfører som dens Straaleantal følgende: D. 11; A. 14; P. 11; V. 8. Han slutter Beskrivelsen med følgende Ord: „Den er saaledes *Coregonus mandibula inferiore majore*", idet han altsaa troede at have den af Artedi som No. 1 beskrevne *Coregonus* for sig.

Da dette sidste Exemplar faldt levende i Strøm's Hænder, maa det antages at have været forholdsvis complet, hvorfor Finnestraalernes Antal sandsynligvis er nogenlunde rigtigt angivet. Tages endvidere i Betragtning, hvad han anfører om Hovedets og Tunge-Apparatets Bygning, samt Sølvpunctternes Antal og Stilling, er det klart, at Strøm her har havt for sig en *Scopelus,* forskjellig fra den ovenfor nævnte *Maurolicus borealis.*

[1] „Annotations-Bog over forefaldende Merkværdigheder i Natur-Historien paa Syndmør" (2 Dele. 1756—1780).

[2] „Physisk og Oeconomisk Beskrivelse over Fogderiet Søndmør", 1ste Part (Sorøe 1762).

[3] Nye Saml. Kgl. D. N. Vid. Selsk. Skr., 1 B., p. 103 (Kbhvn. 1784).

Locality (North Atl. Exped.): — The Storeggen bank, off Aalesund (Norway); the open sea, west of Finmark.

	Stat. 33.	*Stat.* 295.
Exact Locality.	Storeggen, 174 Kil. W. Aalesund.	435 Kil. W. Hammerfest.
Depth.	Found floating.	1110 Fathoms (2030 m).
Temp. at Bottom.	—	— 1.3° C.
Bottom.	—	Biloculina Clay.
Date.	30th June 1876.	14th July 1878.
Numb. of Specim.	1 Indiv.	3 Indiv.

Remarks on the Synonymy. — This species cannot be correctly designated without carefully considering certain data from the posthumous Diaries of the Rev. H. Strøm (a scholar, naturalist, and divine) in which he has recorded his observations on natural history taken during the last century in the bailiwick of Søndmør, Norway. These Diaries, which are preserved in the University Library at Christiania, have not yet appeared in print.

In the said Diaries,[1] which extend from 1756 to 1780, and which form the substance of the chapters devoted to Natural History in Strøm's descriptive work on the bailiwick of Søndmør (1762),[2] with a Supplement (1784),[3] the author records (Section 38, *anno* 1766) his having found on the beach a small fish, $2^1/_2$ inches in length, of which he gives a description; the fin-ray formula was D. 9; A. 10; P. 15—16; V. 8. From this description, in which the author specially dwells upon the structure of the head, it is not difficult to recognise the species (afterwards established) *Maurolicus borealis*, (Nilss.) 1832.

Farther on (Section 4, *anno* 1774), it appears that on the 3rd June Strøm captured "a rare fish," which other fishes were in the act of pursuing. Of this specimen, in which the fin-ray formula is stated to have been: D. 11; A. 14; P. 11; V. 8, he also furnishes a comparatively detailed description, his concluding words being as follows: — "Hence it is *Coregonus mandibula inferiore majore;*" for he conceived the species before him to be identical with the *Coregonus* described by Artedi as No. 1.

Having been taken alive, this must in all probability have been a perfect example; and hence the fin-ray formula given by Strøm is no doubt comparatively correct. Assuming this to be the case, and regard being also had to the other salient characters, viz. the obtuse head, the large scales, the structure of the tongue, and the number and disposition of the argenteous spots, it is evident that Strøm had before him a *Scopelus,* essentially distinct from the above-mentioned *Maurolicus borealis.*

[1] "Annotations-Bog over forefaldende Merkværdigheder i Natur-Historien paa Syndmør" (2 Dele. 1756—1780).

[2] "Physisk og økonomisk Beskrivelse over Fogderiet Søndmør," Part I (Sorøe 1762).

[3] Nye Saml. Kgl. D. N. Vid. Selsk. Skr., 1 B., p. 103 (Kbhvn. 1784).

Strøm har ikke omtalt nogen af disse Fiske i sin Søndmøres Beskrivelse, eller i Supplementerne til denne. Derimod giver han i 1793 i Naturhistorie-Selskabets Skrifter[1] en Meddelelse om et Par sjeldnere norske Fiske, begge ledsagede af en kortfattet Beskrivelse og Afbildning. Den sidste af disse kalder han „en liden rar Fisk, som jeg tog med Haanden af Havstranden for mere end 20 Aar siden"; han nævner endvidere, at han strax havde ladet en Beskrivelse og Afbildning nedsende til O. F. Müller, for at den kunde indtages i dennes „Zoologia Danica", der netop skulde udkomme. Dette var efter hans Vidende ikke skeet, og han giver derfor paany dens Afbildning og Beskrivelse. Afbildningen fremstiller, som Enhver ser, en *Scopelus,* og ikke *Maurolicus*, men Beskrivelsen gjentager omtrent ordret hans Bemærkninger i Dagbogen af 1766, vedrørende denne sidste Art. Uoverensstemmelserne mellem Tegning og Beskrivelse kan derfor blot forklares paa den Maade, at Strøm ganske har forglemt sin Observation af *Scopelus* for Aaret 1774, men havde sin dengang udførte Tegning i Behold, som nu gjengives tilligemed den *Maurolicus* vedrørende Text fra Aaret 1766.

Müller havde i 1776 i sin „Zoologia Danica"[2] ikkedestomindre omtalt Strøm's Art, men, i Overensstemmelse med Strøm's egne Antydninger, og uden at give den et specielt Artsnavn, henført den blandt Coregonerne som No. 415 med følgende Ord: *„S.(almo) maxillis edentulis, inferiore longiore, ventre punctato. Cl. Strøm misit."* Den første Del af denne Diagnose er, som det vil sees, Artedi's ordlydende Diagnose af den senere *Coregonus albula.*

I Overensstemmelse med Müller opfører endelig Gmelin i 1788 i sin 13de Udgave af „Systema Naturae" Arten som *Salmo mülleri,* men giver ingen anden Oplysning om den, end Müller's Diagnose, der ordret gjengives.

Det kan efter det foranførte ansees for utvivlsomt, at Navnet *Salmo mülleri,* Gmel., ikke kan tilkomme nogen anden, end den af Strøm under Aaret 1774 beskrevne *Scopelus,* men ikke *Maurolicus borealis,* som Kröyer[3] har villet. Denne *Scopelus* er uden Tvivl identisk med Reinhardt's senere beskrevne *Sc. glacialis* fra Grønland, paa hvilken Art Strøm's første Beskrivelse og senere Afbildning i alle Dele synes at passe; sandsynligvis har Reinhardt ikke kjendt den sidste, og heller ikke ventet at gjenfinde sin Art i Gmelin's *Salmo mülleri.*

Bemærkninger til Beskrivelsen. Da Kröyer i 1847 i Naturh. Tidsskr.[4] har leveret en udførlig Beskrivelse af denne Art, og givet dens Afbildning i Gaimard's store Rejseværk, skal jeg nedenfor blot meddele et Par Bemærkninger vedrørende de nye Exemplarer, hvilke desuden ere samtlige i en saa slet Tilstand, at de ere ganske uskikkede til at beskrives i sin Helhed.

[1] Skr. af Naturh. Selsk. 2 B. 2 H., p. 15 (Kbhvn. 1793).
[2] Zool. Dan. Prodr., p. 49 (Havn. 1776).
[3] Danm. Fiske, 3 B., p. 114 (Kbhvn. 1846—49).
[4] Naturh. Tidsskr. 2 R. 2 B. 3 H., p. 230 (Kbhvn. 1847).

Neither in his descriptive work on Søndmør, nor in the Supplement, has Strøm recorded these fishes. But in 1793 a paper by that author on two rare Norwegian fishes, both of which were briefly described, and figured, appeared in the Journal of the Danish Society of Natural History.[1] One he terms "a singular little fish that I found more than 20 years ago on the sea-shore;" and goes on to mention his having forwarded without loss of time a description and drawing of the specimen to O. F. Müller, for insertion in that distinguished naturalist's forthcoming work "Zoologia Danica." No notice having, however, to the best of his knowledge, been taken of this communication, Strøm described and figured the species anew. The representation, as may be seen at a glance, is that of a *Scopelus*, and not of a *Maurolicus,* — but the description an almost verbatim transcript of the observations on the latter species in his Diary for 1766. Now, the manifest discrepancy between the drawing and the description, can be accounted for solely by assuming Strøm to have entirely overlooked his notice of *Scopelus* in 1774, and — the drawing executed on that occasion being still extant — to have annexed it to his diagnosis of *Maurolicus* from 1766.

Müller nevertheless did record the species in his "Zoologia Danica" (1766), but classed it in accordance with Strøm's views, and without assigning any special designation, among the *Coregoni* (No. 415), as follows: — *"S(almo) maxillis edentulis, inferiore longiore, ventre punctato. Cl. Strøm misit."* The first part of this diagnosis agrees, we see, word for word with Artedi's diagnosis of *Coregonus albula,* subsequently established.

In conformity with Müller's description, Gmelin records the species (1788) in his 13th Edition of "Systema Naturæ" as *Salmo mülleri,* but furnishes no additional information: his diagnosis is a verbatim copy of Müller's.

From the data set forth above, it is obvious that the name *Salmo mülleri* should not, as proposed by Kröyer,[3] be given to *Maurolicus borealis,* but to the *Scopelus* described by Strøm in 1774; and doubtless that *Scopelus* is identical with Reinhardt's *Sc. glacialis,* from Greenland, afterwards diagnosticated, Strøm's description corresponding in every respect with the characters of that species. Probably Reinhardt knew nothing of Strøm's figure, and was not prepared to meet with his species in Gmelin's *Salmo mülleri.*

Descriptive Observations. — Kröyer having furnished in 1847 a full description of this species in "Naturh. Tidsskr.,"[4] and figured it for the plates accompanying Gaimard's great work, I shall confine myself to a few observations on the new specimens, which, besides, are one and all in so mutilated a condition as to render them wholly unfit to serve as subjects for a general description.

[1] Skr. af Naturh. Selsk. 2 B. 2 H., p. 15 (Kbhvn. 1793).
[2] Zool. Dan. Prodr., p. 49 (Havn. 1776).
[3] Danmarks Fiske, 3 B., p. 114 (Kbhvn. 1846—49).
[4] Naturh. Tidsskr. 2 R. 2 B. 3 H., p. 230 (Kbhvn. 1847).

Det første Exemplar, fra Expeditionen i 1876, optoges med det fine Overfladenet fra Vandskorpen paa Fiskebanken Storeggen udenfor Christiansund (Norge), og var øjensynlig udkastet i halvfordøjet Stand af en Fiskemave. Skjælbeklædningen manglede saagodtsom overalt, ligesom mindre Dele af Legemets Sider vare fortærede; derimod vare Finnerne forholdsvis vel vedligeholdte, ligesom de sølvglindsende (phosphorescerende?) Pletter langs Bugen næsten overalt vare i Behold.

De 3 Exemplarer fra Expeditionen i 1878 vare alle noget over halvt udvoxede, og optoges fra Havet langt vestenfor Hammerfest med Trawlnettet, der her naaede Bund paa 1110 Favnes Dyb. Ogsaa her mangler Skjælbeklædningen saagodtsom fuldstændig, og flere Finner ere afbrudte; især er Caudalen defect, saa at Individernes Totallængde ikke nøjagtigt kan opgives.

De langs Ventrallinien løbende sølvglindsende Pletter ere (forsaavidt de kunne sees, eller ere i Behold) fordelte paa følgende Maade:

Mellem Struben og Ventralerne 5 Par; det øverste er bedækket af Gjællelaagene, naar disse ere helt tilsluttede.

Mellem Ventralerne og Analen 4 Par; dette Tal er constant hos alle de af mig hidtil undersøgte Exemplarer. (Kröyer angiver 3 i ovenfor anførte Beskrivelse).

Langs Analen findes 7 Par; hos et i Universitets-Musæet opbevaret nogenlunde fuldstændigt Exemplar fra Hasvig ved Hammerfest er der mellem den 5te og 6te Plet et noget større Mellemrum, end mellem de øvrige; hos de 2 af Exemplarerne fra Nordhavs-Expeditionen, hvor disse Pletter ere blevne bevarede, er der derimod et lignende Mellemrum mellem den 6te og 7de Plet.

Mellem Analen og Caudalen findes 6 Par, der alle staa tættere sammen, end i de foregaaende Rækker.

Ved Roden af Caudalen nedenfor Midtlinien findes 1 Par.

De forskjellige enkeltstaaende Pletter eller kortere Rækker, der findes hist og her paa Legemets Sider, kunne ikke efter de forhaandenværende Exemplarer beskrives.

De erholdte Exemplarer havde følgende Maal og Straaleantal:

	a. *Stat.* 295.	b. *Stat.* 295.	c. *Stat.* 295.	d. *Stat.* 33.
Totallængde (omtrent)	57 mm	61 mm	62 mm	78 mm
Længde uden Caudalen	50 -	53 -	54 -	70 -
Hovedets Længde . .	14 -	15 -	15,2 -	18 -
Straaler i Dorsalen .	14	13	14	12
Straaler i Analen . .	17	?	?	16

Straaleantallet i Analen kan blot hos 2 af Individerne med nogenlunde Sikkerhed angives. Hos det ene Exemplar er den sidste Analstraale dobbelt, hvilket er utydeligt hos det andet.

Føde. I Ventrikelen af det ene af de paa Stat. 295 erholdte Individer fandtes Dele af en *Themisto libellula,* Mandt, samt flere Exemplarer af *Concoecia borealis,* G. O.

The first individual, obtained on the cruise in 1876, was taken in the fine-meshed surface-net, on the Storeggen fishing-bank, off Christiansund (Norway), and had evidently been ejected in a half-digested state from a fish's stomach. The scales were almost everywhere wanting; moreover, small portions of the sides of the body had disappeared; the fins, on the other hand, were comparatively uninjured, as also the argenteous (phosphorescent?) spots extending along the abdomen.

The 3 specimens taken on the last cruise of the Expedition, in 1878, were all a little more than half-grown; they were captured at sea, far west of Hammerfest, in the trawl-net, which had been sunk to the depth of 1110 fathoms. On these specimens, too, hardly a scale remains, and several of the fins are broken, more especially the caudal; hence the total length cannot be accurately stated.

The silvery spots along the ventral line were disposed (so far as the condition of the individuals admitted of observing them), in the following order.

Between the throat and the ventrals 5 pairs, the uppermost covered by the gill-plates, when the latter are closed.

Between the ventrals and the anal 4 pairs; this number is constant in all the examples I have hitherto examined (Kröyer gives 3 in "Naturh. Tidsskr.").

Along the anal 7 pairs; in a specimen, comparatively perfect, preserved in the University Museum, from Hasvig near Hammerfest, the space between the 5th and 6th spots is somewhat wider than that between the others; 2 of the individuals obtained on the North Atlantic Expedition in which these spots are visible, have a similar space between the 6th and 7th spots.

Between the anal and the caudal 6 pairs, more closely arranged than in any of the foregoing series.

At the origin of the caudal, below the mesial line, 1 pair.

The various isolated spots or shorter series occurring here and there on the sides of the body cannot be determined from the specimens taken on the Expedition.

The measurements and fin-ray formulæ in the specimens obtained, were as follows: —

	a. *Stat.* 295.	b. *Stat.* 295.	c. *Stat.* 295.	d. *Stat.* 33.
Total Length (about) .	57 mm	61 mm	62 mm	78 mm
Length excl. of Caudal	50 -	53 -	54 -	70 -
Length of Head . .	14 -	15 -	15.2 -	18 -
Rays in the Dorsal .	14	13	14	12
Rays in the Anal . .	17	?	?	16

The number of fin-rays in the anal could be determined with comparative accuracy in but two of the individuals; One of them had the terminal anal ray double; in the other specimen this character is not distinct.

Food. — The stomach of one of the individuals taken at Station 295 contained fragments of a *Themisto libellula,* Mandt, together with several examples of *Concœcia borealis,*

Sars 1865 (en Ostracode, der hidtil kun er funden langs den norske Kyst paa en Dybde af 300 Favne eller derover).

Udbredelse. Denne arctiske Repræsentant for Slægten var hidtil kjendt fra Grønland og fra de norske Kyster. Overalt er den kun sparsomt erholdt, enten som døde, ilanddrevne Individer, eller udtagne af Sælernes Maver. Af Nordhavs-Expeditionens Individer vare de 3 optagne fra Havet vestenfor Hammerfest; sandsynligvis er Arten udbredt paa gunstige Localiteter over hele Polarhavets Dyb, og vil med mere fuldkomne Redskaber oftere kunne erholdes.

Fra Grønland havde Musæet i Kjøbenhavn, ifølge Reinhardt sen., allerede i 1836 erholdt 6 Individer fra de nordligste Colonier Omenak (Umanak), Ritenbank og Jacobshavn. Senere er flere Exemplarer nedsendte til samme Musæum fra Syd-Grønland.

Fra de norske Kyster kjendtes tidligere blot 3 Individer, hvoraf det første var det, der af Strøm töges ved Volden i Søndmør i 1774; det andet hjembragtes til Bergens Musæum, angivelig fra Hardangerfjorden, af Stiftamtmand Christie mellem Aarene 1830 og 1840. Det tredie, der opbevares paa Universitets-Musæet i Christiania, er indsendt fra Handelspladsen Hasvig ved Hammerfest, og befinder sig, ligesom foregaaende, i mindre god Stand, skjønt ulige bedre, end Nordhavs-Expeditionens Exemplar fra Storeggen; sandsynligvis er ogsaa dette udtaget eller udkastet af en Fiskemave.

En anden Art, *Scopelus resplendens,* Rich. 1845, oprindeligt beskreven fra Guineakysten, har i de sidst forløbne Aar, 1879 og 1880, vist sig at være stationær i Trondhjemsfjorden (63° N. B.), og adskillige Exemplarer ere allerede fundne, hvoraf flere opbevares paa Musæerne i Trondhjem og Christiania[1].

Af en tredie nordisk Art, *Sc. kröyeri,* Malm 1860, er et enkelt Exemplar funden i Maven af en *Gadus morrhua* udenfor Skagen i 1856[2].

G. O. Sars 1865 (an Ostracod hitherto not met with on the Norwegian coast at a depth of less than 300 fathoms).

Distribution. — The coast of Greenland and the northern shores of Norway were the only localities in which this Arctic representative of the genus had previously been met with, and but sparingly, for instance floating dead or washed ashore, or found in the stomachs of seals. Of the individuals obtained on the Expedition, 3 were taken in the open sea west of Hammerfest. Probably the species occurs everywhere throughout the depths of the Polar Sea, and with improved apparatus will no doubt be more frequently captured.

According to Reinhardt sen., the Zoological Museum in Copenhagen had obtained 6 individuals so far back as 1836, from the most northerly colonies in Greenland, viz. Omenak, Ritenbank, and Jacobshavn. Subsequently, divers examples were sent to the same Museum from South Greenland.

On the shores of Norway, but 3 individuals had previously been observed, one of which was the example taken by Strøm at Volden in Søndmør, 1774; the second, stated to have been captured in the Hardanger Fjord, was presented to the Bergen Museum by the Stiftamtmand Christie, between 1830 and 1840. The third, preserved in the University Museum, Christiania, was sent from Hasvig near Hammerfest; its state of preservation is far from perfect, though better than that of the specimen obtained on the Expedition from the Storeggen fishing-bank; probably this individual too had been in a fish's stomach.

Quite lately (1879 and 1880), another species, *Scopelus resplendens,* Rich. 1845, originally described from the Guinea coast, has been met with as stationary in the Trondhjem Fjord (lat. 63° N.), and several specimens, preserved in the Museums of Trondhjem and Christiania,[1] have been already collected.

A single example of a third Northern species, *Sc. kröyeri,* Malm 1860, was found in the stomach of a *Gadus morrhua,* taken off the Scaw in 1856.[2]

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[1] Forh. Vid. Selsk. Chra. 1880, No. 8, p. 3.
[2] Forh. Skand. Naturf. 8 Møde Kbhvn. 1860, p. 617 (Kbhvn. 1861).

[1] Forh. Vid. Selsk. Chra. 1880, No. 8, p. 3.
[2] Forh. Skand. Naturf. 8 Møde Kbhvn. 1860, p. 617 (Kbhvn. 1861).

Forklaring over Plancherne.

Pl. I.

Fig. 1. *Raja hyperborea,* Han. Oversiden; halv Størrelse.
— 2. *Raja hyperborea,* Han. Undersiden; halv Størrelse.
— 3. *Sebastes marinus,* Yngel; 5 Gange forstørret.
— 4. *Sebastes marinus,* Yngel; 3 Gange forstørret.
— 5. *Cottunculus microps.*
— 6. *Cottunculus microps.* Oversiden.
— 7. *Centridermichthys uncinatus.*
— 8. *Icelus hamatus,* Han.
— 9. *Triglops pingelii,* Han.
— 10. *Triglops pingelii,* Hun.

Pl. II.

Fig. 11. *Agonus decagonus,* Hun.
— 12. *Agonus decagonus,* Han; Undersiden.
— 13. *Eumicrotremus spinosus.*
— 14. *Liparis bathybii,* Hun.
— 15. *Careproctus reinhardi,* yngre Individ.
— 16. *Careproctus reinhardi,* yngre Individ; Undersiden.
— 17. *Lumpenus medius.*
— 18. *Lumpenus maculatus,* Hun.
— 19. *Lycodes esmarkii,* Unge.
— 20. *Lycodes esmarkii,* yngre Han.
— 21. *Lycodes esmarkii,* yngre Hun.

Pl. III.

Fig. 22. *Lycodes esmarkii,* gammel Han; $^2/_3$ Størrelse.
— 23. *Lycodes frigidus,* Yngel.
— 24. *Lycodes frigidus.*
— 25. *Lycodes lütkenii,* Hun.
— 26. *Lycodes pallidus,* Unge.
— 27. *Lycodes pallidus,* yngre Individ.

Explanation of the Plates.

Pl. I.

Fig. 1. *Raja hyperborea,* male (from above); half size.
— 2. *Raja hyperborea,* male (from beneath); half size.
— 3. *Sebastes marinus,* fry; magnified 5 diameters.
— 4. *Sebastes marinus,* fry; magnified 3 diameters.
— 5. *Cottunculus microps.*
— 6. *Cottunculus microps* (from above).
— 7. *Centridermichthys uncinatus.*
— 8. *Icelus hamatus,* male.
— 9. *Triglops pingelii,* male.
— 10. *Triglops pingelii,* female.

Pl. II.

Fig. 11. *Agonus decagonus,* female.
— 12. *Agonus decagonus,* male (from beneath).
— 13. *Eumicrotremus spinosus.*
— 14. *Liparis bathybii,* female.
— 15. *Careproctus reinhardi,* young specimen.
— 16. *Careproctus reinhardi,* young specim. (from beneath).
— 17. *Lumpenus medius.*
— 18. *Lumpenus maculatus,* female.
— 19. *Lycodes esmarkii,* very young.
— 20. *Lycodes esmarkii,* young male.
— 21. *Lycodes esmarkii,* young female.

Pl. III.

Fig. 22. *Lycodes esmarkii,* old male; two-thirds of nat. size.
— 23. *Lycodes frigidus,* fry.
— 24. *Lycodes frigidus.*
— 25. *Lycodes lütkenii,* female.
— 26. *Lycodes pallidus,* very young.
— 27. *Lycodes pallidus,* young specimen.

Pl. IV.

Fig. 28. *Lycodes seminudus,* yngre Individ.
— 29. *Lycodes muraena,* Yngel.
— 30. *Lycodes muraena,* yngre Indiv. (Typ-Exemplaret).
— 31. *Lycodes muraena,* yngre Hun.
— 32. *Gymnelis viridis,* yngre Indiv.
— 33. *Gadus saida.*
— 34. *Onos reinhardi.*
— 35. *Onos septemtrionalis,* Unge.
— 36. *Onos septemtrionalis.* (Typ-Exemplaret).

Pl. V.

Fig. 37. *Rhodichthys regina,* Han.
— 38. *Rhodichthys regina.* Do. Oversiden.
— 39. *Rhodichthys regina.* Do. Undersiden.

Pl. IV.

Fig. 28. *Lycodes seminudus,* young specimen.
— 29. *Lycodes murœna,* Fry.
— 30. *Lycodes murœna,* young specim. (type of the species).
— 31. *Lycodes murœna,* young female.
— 32. *Gymnelis viridis,* young specimen.
— 33. *Gadus saida.*
— 34. *Onos reinhardi.*
— 35. *Onos septemtrionalis,* very young.
— 36. *Onos septemtrionalis,* (type of the species).

Pl. V.

Fig. 37. *Rhodichthys regina,* male.
— 38. *Rhodichthys regina,* „ (from above).
— 39. *Rhodichthys regina,* „ (from beneath).

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Errata.

Page 5, line 4, from foot of page, *for* '349^{m}' *read* '817.^{m}'
— 5, line 3, from foot of page, *for* 'grey-green sand' *read* 'grey-green clay.'
— 24, line 57 (the last) *for* 'alimentary canal' *read* 'tubiform house.'

Translated into English by **John Hazeland.**

Coloreringen af Pl. V er efter en Originalskizze udført efter det levende Individ af Maleren Schiertz.

PLANCHER.

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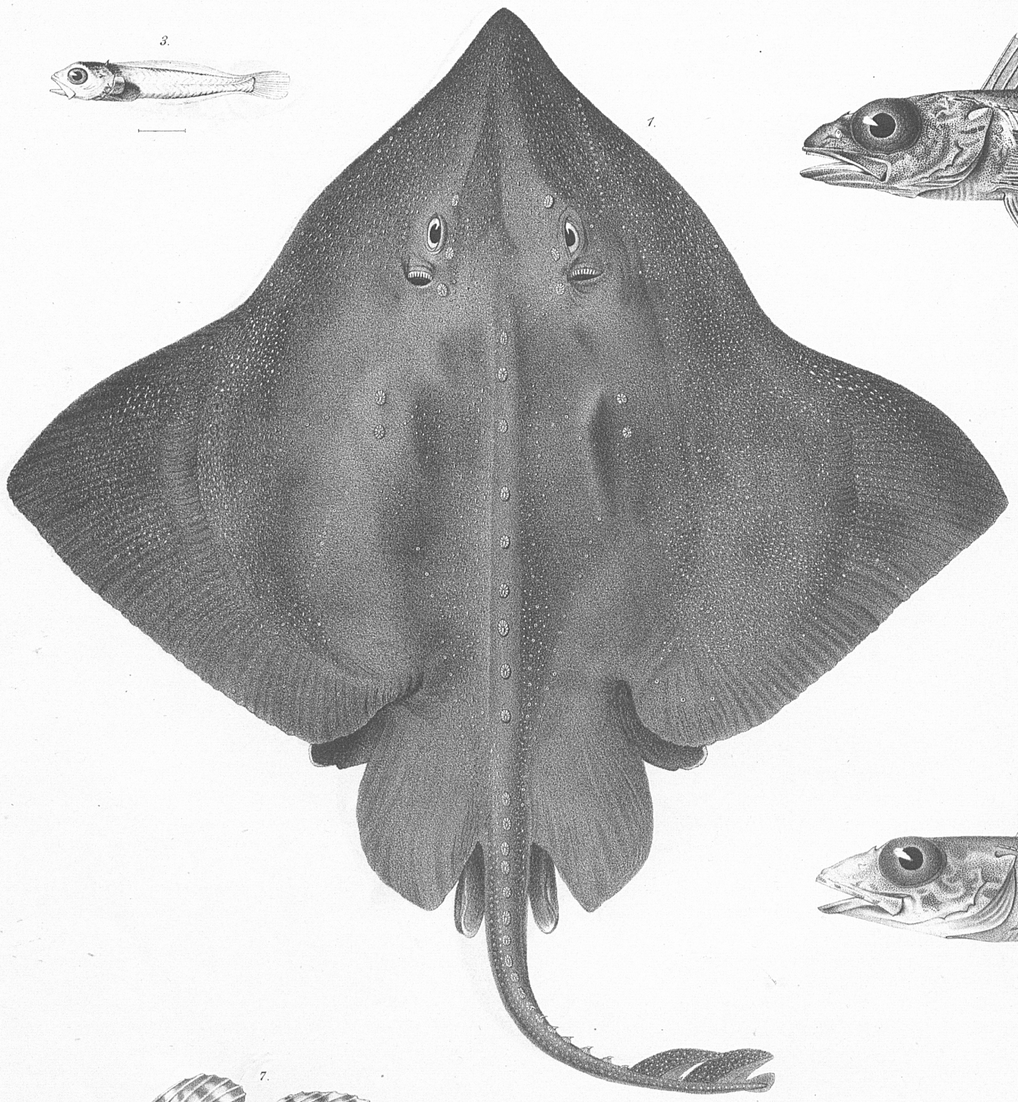
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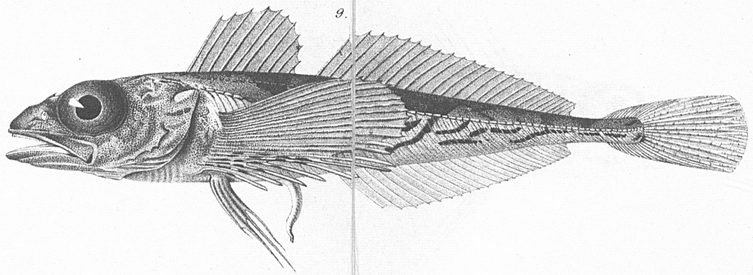
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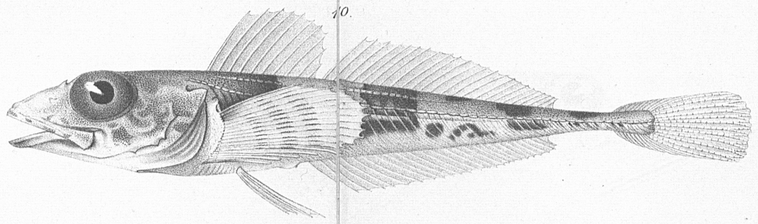
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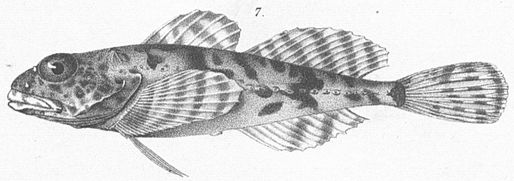
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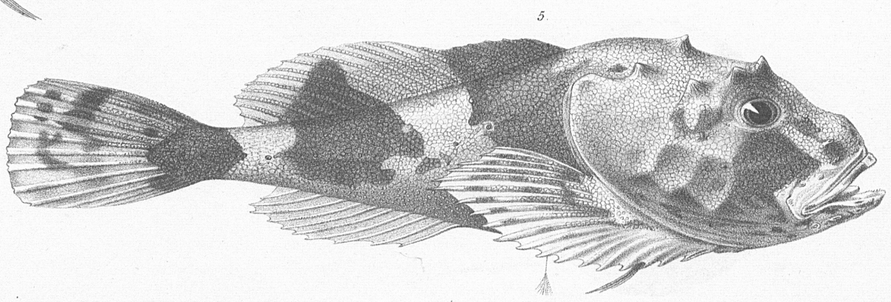
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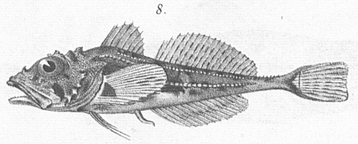
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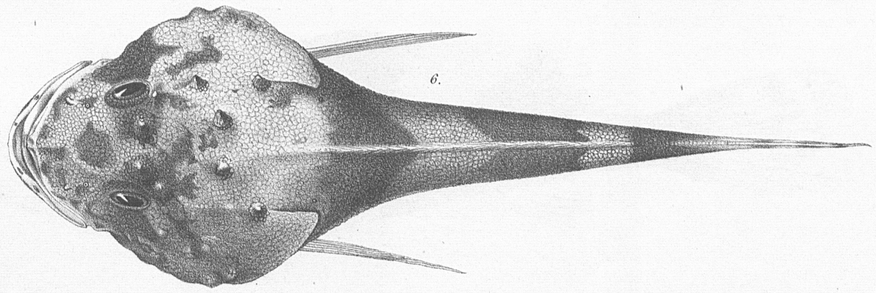
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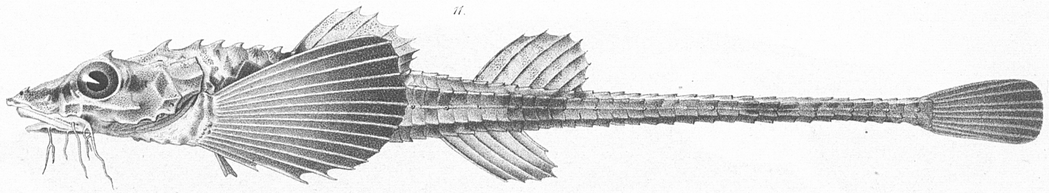

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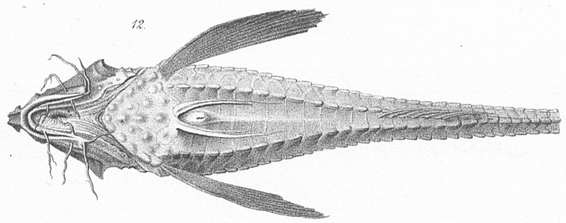

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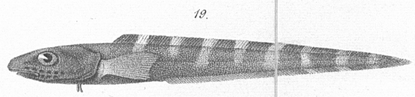

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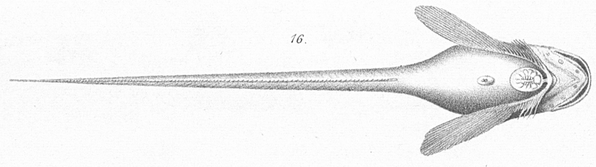

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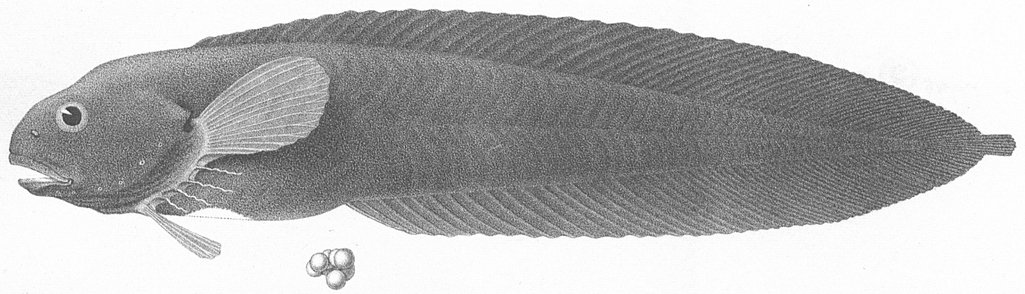

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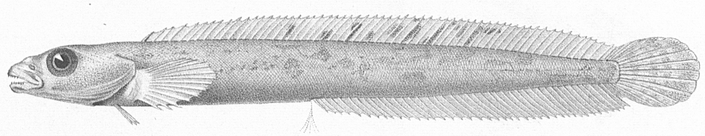

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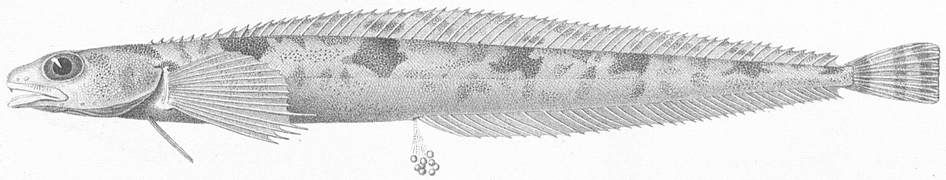

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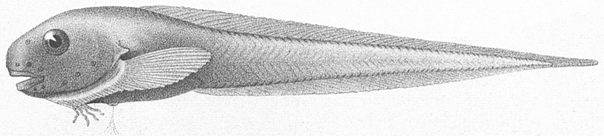

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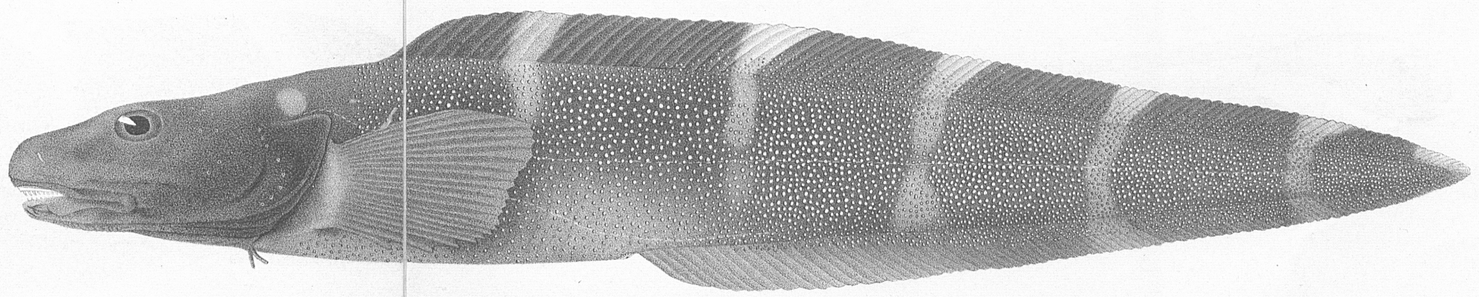

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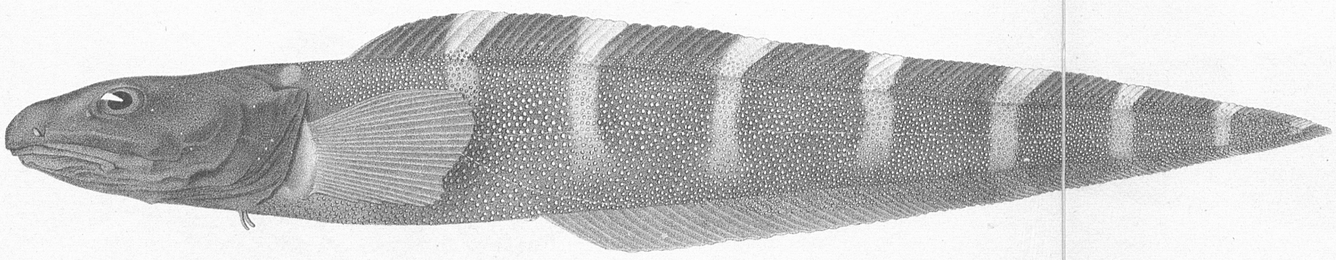

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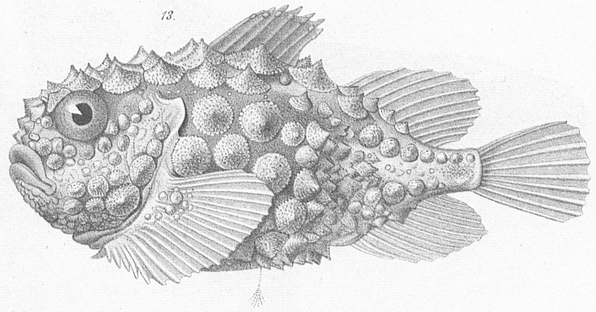

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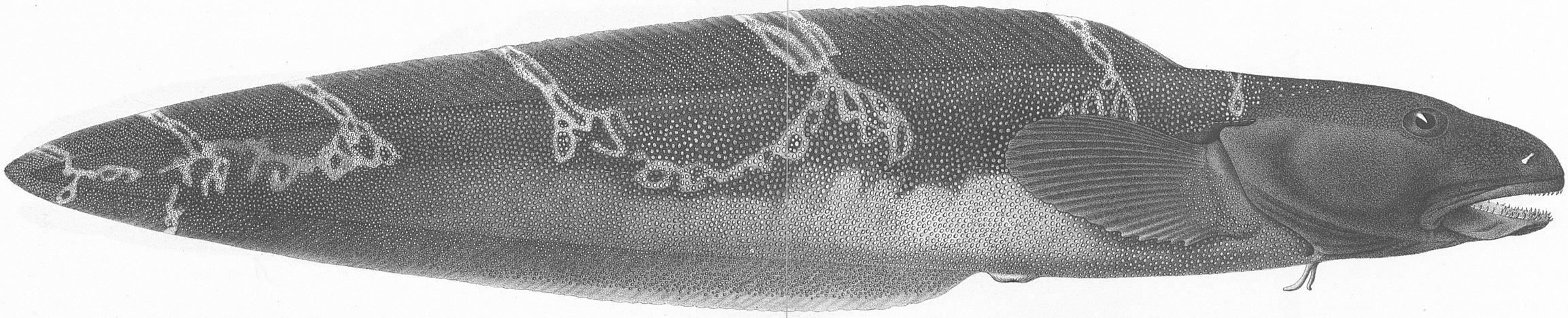

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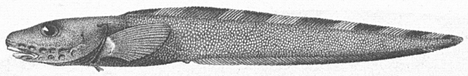

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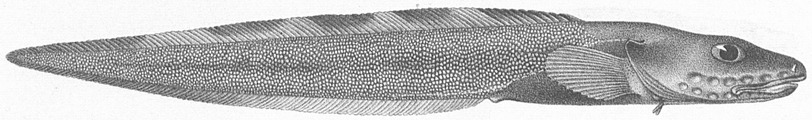

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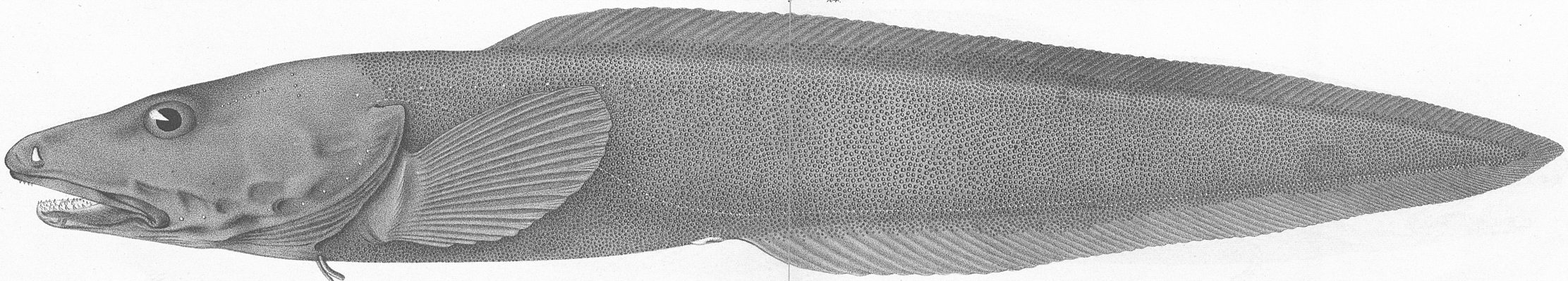

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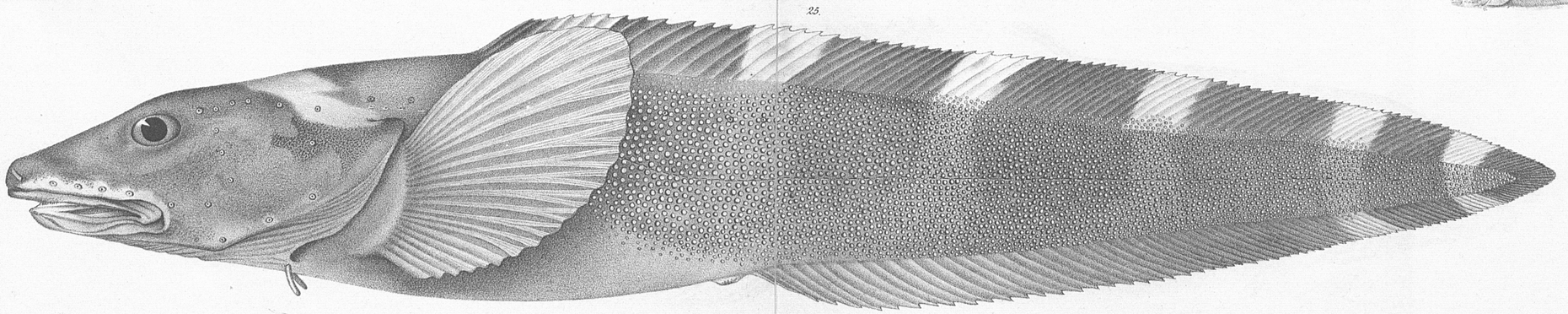

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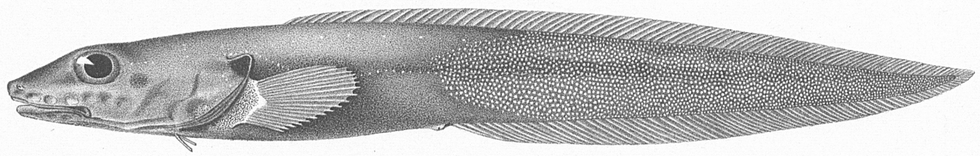

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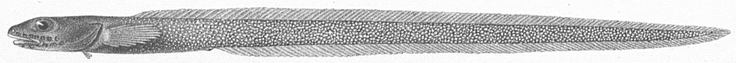

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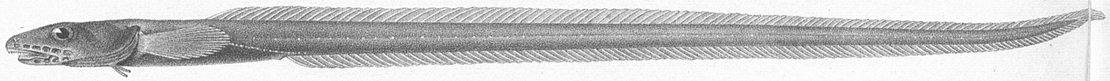

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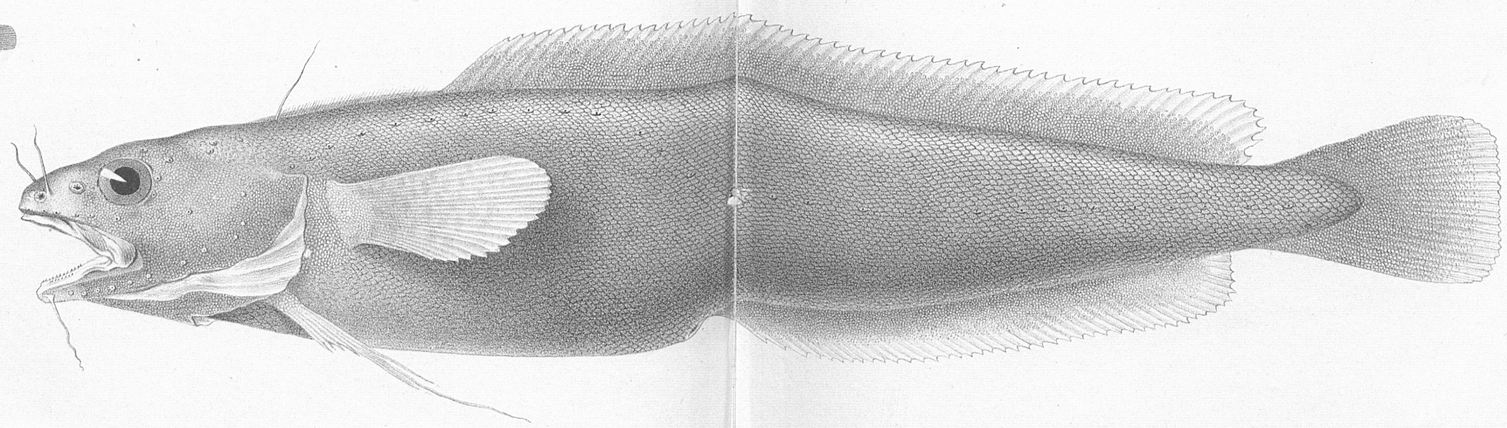

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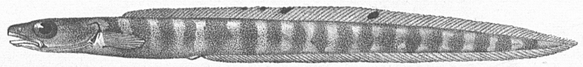

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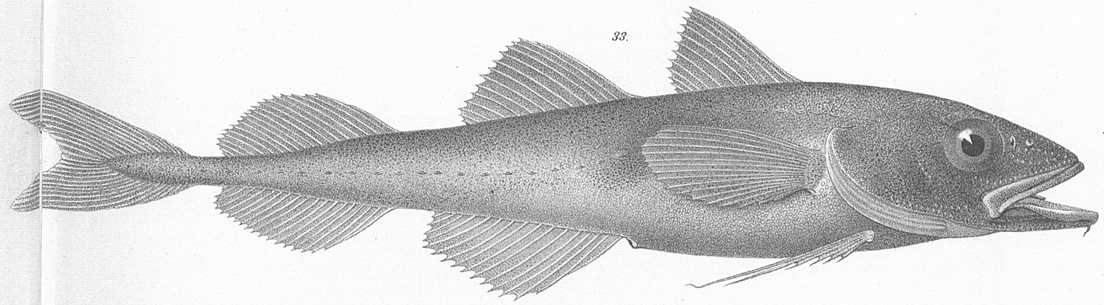

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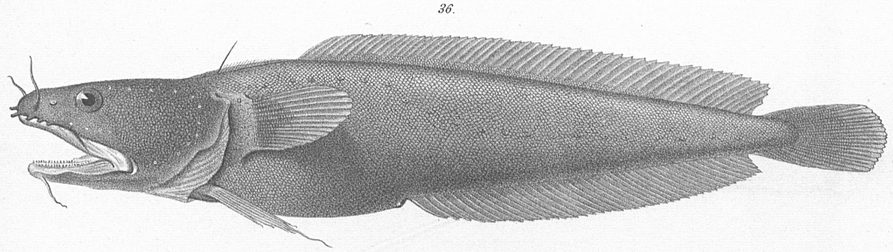

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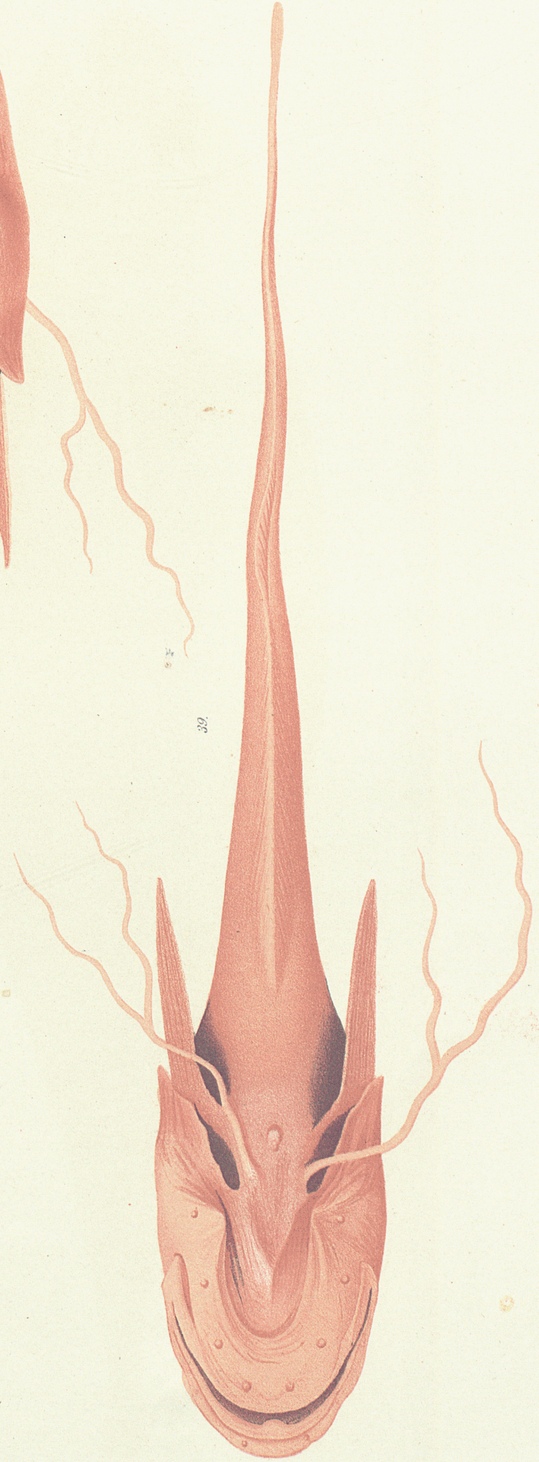

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DEN NORSKE NORDHAVS-EXPEDITION

1876—1878.

ZOOLOGI.

GEPHYREA,

VED

D. C. DANIELSSEN OG **JOHAN KOREN.**

MED 6 PLANCHER OG 1 KART.

CHRISTIANIA.
GRØNDAHL & SØNS BOGTRYKKERI.
1881.

THE NORWEGIAN NORTH-ATLANTIC EXPEDITION

1876—1878.

ZOOLOGY.

GEPHYREA,

BY

D. C. DANIELSSEN AND **JOHAN KOREN.**

WITH 6 PLATES AND 1 MAP.

CHRISTIANIA.

PRINTED BY GRØNDAHL & SØN.

1881.

Idet vi forelægge Resultaterne af vore kritiske Undersøgelser over de paa den norske Nordhavsexpedition fundne Gephyreer, skulle vi bemærke, at for flere af de for denne Klasse nye Dyrs Vedkommende, have vi kun havt et enkelt Exemplar at raade over, saa at den anatomisk-histologiske Bearbeidelse har været forbunden med store Vanskeligheder.

Af de 10 Slægter og 16 Arter, som ere indsamlede, findes to nye Familier, 4 nye Slægter og 7 nye Arter, og er end ikke Antallet meget stort, saa kan det dog med Rette siges, at de deriblandt fremtrædende nye Former ere i flere Henseender af stor videnskabelig Interesse.

Paa den følgende Side findes en Tabel over de Stationers geographiske Beliggenhed, hvilke ere omtalte i Arbeidet over Gephyreerne.

In laying before the scientific world the results of our critical examination of the *Gephyrea* obtained on the Norwegian North-Atlantic Expedition, we take occasion to notice, that, as regards several of the unknown animals belonging to this Class, a single specimen only was before us; and hence the anatomical-histological investigation has necessarily been attended with very considerable difficulty.

The 10 genera and 16 species collected on the Expedition, comprise 2 new families, 4 new genera, and 7 new species, — a number in itself, perhaps, not particularly great; but we may safely affirm, that the new and interesting forms here recorded will prove valuable acquisitions to science.

On the next page we give a Table showing the Geographical Position of the Stations referred to in this Memoir.

Tempereret Area.
(Warm Area.)

Station No.	Nordlig Bredde. (North Latitude).	Længde fra Greenwich. (Longitude).	Dybde. (Depth). Engl. Favne. (Fathoms).	Dybde. (Depth). Meter. (Metres).	Bundens Temperatur. (Temperature at Bottom) C.	Bunden.	Bottom.
1	61° 13′	6° 36′ E.	650	1189	6.°6	Sandler.	Sabulous Clay.
2	61° 10′	6° 32′ E.	672	1229	6. 7	Sandler.	Sabulous Clay.
9	61° 30′	3° 36′ E.	206	377	5. 9	Ler.	Clay.
10	61° 41′	3° 18′ E.	220	402	6. o	Slik, Ler.	Ooze, Clay.
79	64° 48′	6° 36′ E.	155	283	6. 9	Sandler.	Sabulous Clay.
147	66° 49′	12° 8′ E.	142	260	6. 2	Blødler, lidt Sand.	Soft Clay. A little Sand.
149	67° 52′	13° 57′ E.	135	247	4. 9	Ler.	Clay.
252	Vestfjorden	(Lofoten)	170	311			
255	68°. 12′	15° 40′ E.	341	624	6. 5	Blaat Ler.	Blue Clay.
257	70° 4′	23° 2′ E.	160	293	3. 9	Grønligt Ler.	Greenish Clay.
260	70° 55′	26° 11′ E.	127	232	3. 5	Ler.	Clay.
261	70° 47′	28° 30′ E.	127	232	2. 8	Ler.	Clay.
262	70° 36′	32° 35′ E.	148	271	1. 9	Ler.	Clay.
280	74° 10′	18° 51′ E.	35	64	1. 1	Haard Bund.	Hard Bottom.
290	72° 27′	20° 51′ E.	191	349	3. 5	Sandholdigt Ler.	Sabulous Clay.
326	75° 31′	17° 50′ E.	123	225	1. 6	Mørkt Ler.	Dark Clay.
336	76° 19′	15° 42′ E.	70	128	0. 4	Haard Bund.	Hard Bottom.
357	78° 3′	11° 18′ E.	125	229	1. 9	Mørkt grønt Ler.	Dark-green Clay.

Kolde Area.
(Cold Area.)

Station No.	Nordlig. Bredde. (North Latitude).	Længde fra Greenwich. (Longitude).	Dybde. (Depth). Engl. Favne. (Fathoms).	Dybde. (Depth). Meter. (Metres).	Bundens Temperatur. (Temperature at Bottom) C.	Bunden.	Bottom.
18	62° 44′	1° 48′ E.	412	753	—1.°0	Ler.	Clay.
34	63° 5′	0° 52′ E.	587	1073	—1. 0	Slik.	Ooze.
40	63° 22′	5° 29′ W.	1215	2222	—1. 2	Sandler.	Sabulous Clay.
48	64° 36′	10° 22′ W.	299	547	—0. 1	Sand og Slik.	Clay and Ooze.
51	65° 53′	7° 18′ W.	1163	2127	—1. 1	Biloculinler.	Biloculina Clay.
87	64° 2′	5° 35′ E.	498	911	—1. 1	Ler.	Clay.
176	69° 18′	14° 32′ E.	536	980	—0. 2	Ler.	Clay.
190	69° 41′	15° 50′ E.	870	1591	—1. 2	Sandblandet Ler.	Sandy Clay.
192	69° 46′	16° 15′ E.	649	1187	—0. 7	Sandler.	Sabulous Clay.
200	71° 25′	15° 40′ E.	620	1134	—1. 0	Ler.	Clay.
223	70° 54′	8° 24′ W.	70	128	—0. 6	Sort Sand og Ler.	Black Sand and Clay.
224	70° 51′	8° 20′ W.	95	174	—0. 6	Sort Sand og Ler.	Black Sand and Clay.
225	70° 58′	8° 4′ W.	195	357	—0. 6	Ler og Sand.	Clay and Sand.
237	70° 41′	10° 10′ W.	263	481	—0. 3	Brunt, sandholdigt Ler.	Brown sabulous Clay.
240	69° 2′	11° 26′ W.	1004	1836	—1. 1	Biloculinler.	Biloculina Clay.
248	67° 56′	4° 11′ E.	778	1423	—1. 4	Biloculinler.	Biloculina Clay.
251	68° 6′	9° 44′ E.	634	1159	—1. 3	Blaat Ler.	Blue Clay.
267	71° 42′	37° 1′ E.	148	271	—1. 4	Ler. Sten.	Clay. Stones.
270	72° 27′	35° 1′ E.	136	249	0. 0	Brunt Ler.	Brown Clay.
275	74° 8′	31° 12′ E.	147	269	—0. 4	Grønligt Ler.	Greenish Clay.
283	73° 47′	14° 21′ E.	767	1403	—1. 4	Biloculinler.	Biloculina Clay.
295	71° 59′	11° 40′ E.	1110	2030	—1. 3	Biloculinler.	Biloculina Clay.
338	76° 19′	18° 1′ E.	146	267	—1. 1	Haard Bund.	Hard Bottom.
366	79° 35′	11° 17′ E.	37	68	—0. 2	Mørkt, graat Ler.	Dark-grey Clay.

Fam. **Sipunculidæ,** Baird.

Phascolosoma Lilljeborgii, n. sp.

Tab. I., Fig. 1—4.

Hele Legemets Længde udgjør paa de største Exemplarer 80^{mm}. Kroppen, Fig. 1, *a*, der er cylindrisk, 40^{mm} lang, 2^{mm} tyk, med en lidt konisk tilspidset Bagende, har en glat perlemorglindsende, næsten vandklar Hud, som kun sparsomt er besat med Papiller, der ere saa smaa, at de vanskeligen kunne sees med stærk Loupe, dog staa disse Papiller noget tættere mod Snabelens Grund og paa den bageste Del af Kroppen.

Snabelen, Fig. 1, *b*, som neppe kan trækkes fuldkommen ind i Kroppen, er 40^{mm} lang, ligeledes glat, perlemorglindsende, forsynet med mere tætstaaende yderst smaa Papiller, og har paa Enden en Krands af 8—10 korte, temmelig brede Tentakler, Fig. 1, *c*, der omgiver den runde Mundaabning.

Analaabningen rund ved Snabelens Grund, Fig. 1, *d*.

Huden dannes af et meget tykt, finstribet Chitinlag (Cuticula), Fig. 3, *a*, 4, *a*, indenfor hvilket Epithelet (Matrix) findes, Fig. 3, *b*, 4, *b*, der bestaar af et Lag temmelig store Cylinderceller.

I Epithellaget sees fornemmelig paa Snabelen en Mængde Kjertler, som have en bred Grunddel, Fig. 3, *c*, 4, *c*, og en afsmalnende Udførselskanal, Fig. 3, *d*, 4, *d*, der gaar igjennem den tykke chitinøse Cuticula, paa hvis Overflade den aabner sig i en tragtformig Fordybning, Fig. 3, *e*, 4, *e*. Kjertelen dannes af en temmelig tynd Bindevævskapsel, Fig. 3, *f*, der paa den indvendige Flade er beklædt med Epithel, som ogsaa beklæder Udførselsgangen, Fig. 3, *g*, 4, *f*. Flere af Kjertlerne indeholdt en Samling af klare Moleküler (Slim). Til Matrix støder et meget tyndt Bindevævslag, Fig. 3, *h*, 4, *g*, hvortil den sædvanlige Muskelhud er bunden, Fig. 4, *h*.

Der er kun en Retractor, som tager sit Udspring lige bagenfor Kroppens Midtpunkt med to temmelig lange Rødder, Fig. 2, *a*, følger Bugfladen, Fig. 2, *b*, og fæster sig fortil strax bagenfor Tentakelkrandsen.

Fam. **Sipunculidæ,** Baird.

Phascolosoma Lilljeborgii, n. sp.

Pl. I., figs. 1—4.

Total length of the largest specimens 80^{mm}. The trunk, fig. 1, *a*, measuring 40^{mm} in length and 2^{mm} in thickness, is cylindrical, with the posterior extremity slightly acuminate; it has a smooth, nacrous, almost hyaline skin, sparingly furnished with papillæ, so minute as to be with difficulty perceptible under a strong magnifier; on the base of the proboscis, and on the posterior portion of the trunk, the disposition of these papillæ is somewhat closer.

The proboscis, fig. 1, *b*., which can hardly admit of being wholly retracted within the trunk, is 40^{mm} long, smooth, nacrous, studded with exceedingly minute papillæ, and bears at its extremity a cincture of short and rather broad tentacula, fig. 1, *c*, encircling the round buccal aperture.

Anal opening circular at the base of the proboscis, fig 1, *d*.

The skin is composed of an extremely thick, finely striated chitinous layer (the cuticle), figs. 3, *a*; 4, *a*, underneath which lies the epithelium (the matrix), figs. 3, *b*; 4, *b*, consisting of a layer of rather large cylindrical cells.

In the epithelial layer — more especially on the proboscis — occur numerous glands, broad at the base, figs. 3, *c*; 4, *c*, and with a tapering excretory canal, figs. 3, *d*; 4, *d*, which pierces the thick chitinous cuticle, on the surface of which it opens into a funnel-shaped cavity, figs. 3, *e*; 4, *e*. Each gland consists of a somewhat thin capsule of connective tissue, fig. 3, *f*, covered on its inner surface by the epithelium, which also invests the excretory duct, figs. 3, *g*; 4, *f*. Several of the glands contained an aggregation of pellucid molecules (mucus). Contiguous to the matrix extends a very thin layer of connective tissue, figs. 3, *h*; 4, *g*, to which is webbed the ordinary muscular integument, fig. 4, *h*.

There is only one retractor, which takes its origin immediately posterior to the medial point of the trunk, with two longish roots, fig. 2, *a*, protends along the ventral surface, fig. 2, *b*, and is attached to the proboscis in close proximity to the cincture of tentacles.

Segmentalorganerne ere to, temmelig lange, der fæste sig som almindeligt lidt bagenfor Analaabningen paa hver Side af Retractoren, Fig. 2, *c*.

Spiserøret er meget tyndt og langt, og ligger ligesom i en Fure paa Retractoren lige bag til det Sted, hvor dennes Rødder forene sig, Fig. 2, *d*; her gaar det over i Tarmen, der gjør et Par løse Bøininger, Fig. 2, *e*, for derefter spiralformig at løbe bagtil, næsten imod Kropshulhedens Ende, Fig. 2, *f*, hvor den bøier om, uden at være befæstet til denne, og slynger sig saa atter spiralformig fortil imod Kroppens Midte, Fig. 2, *g*, hvor den gaar over i en lang, næsten ligeløbende Rectum, Fig. 2, *h*, der munder ud paa Ryggen.

Tarmspiralen er ved enkelte tendinøse Traade bunden til Kropsvæggen; men nogen særskilt Spindelmuskel findes ikke.

Paa Spiserøret iagttages et langt slangeformigt, retractilt Kar, der bagtil imod Retractorens tvende Rødder ender blindt; men fortil omgiver Svælget og danner Vandkarringen, hvorfra Tentakelkarrene udgaa.

Nervestrængen løber langs Midten af Bugfladen, Fig. 2, *i*, afgiver en Mængde Sidegrene i sit Løb og danner fortil omkring Spiserøret, som sædvanligt, en Svælgring, hvorfra sendes Grene til Svælg og Tentakler.

Æggestokken er fæstet til den bagerste Trediedel af Spiserøret, er i Begyndelsen baandformig, men bliver snart cylindrisk og danner ligesom et Rør, der slynger sig flere Gange om Tarmen. Den indeholdt Æg i forskjellige Udviklingsstadier, ligesom fuldmodne Æg enkeltvis svømmede frit om i Kropsvædsken. De Exemplarer, vi undersøgte, vare Hunner.

Undertiden bebor den Anneliderør, men sædvanligt lever den uden noget saadant.

Findested.

Station: 34, 40, 51, 87, 176, 200, 295. Nogle faa Exemplarer paa hver Station.

Artskarakter.

Legemet cylindrisk, glasklart. Kroppen forsynet med spredte, fine Papiller; dens Bredde i Forhold til Længden som 1—20. Snabelen lige lang som Kroppen, besat med yderst smaa spidse Papiller. Tentaklerne 8—10. En Retractor.

Aspidosiphon armatum, n. sp.

Tab. I, Fig. 5, 6; Tab. II, Fig. 7—14.

Kroppen cylindrisk, 8^{mm} lang; den bagerste Ende er tvært afskaaren og forsynet med et rundt Chitinskjold, Fig. 5, der er sammensat af Plader, af hvilke de, som danne

The segmental organs — 2 in number — are comparatively long, and, as in other species, attached to the body a little posterior to the anal opening, on either side of the retractor, fig. 2, *c*.

The œsophagus is exceedingly thin and long, and extends, as it were, down a furrow in the retractor, back to the point at which the roots of the latter unite, fig 2, *d*, where it passes on into the intestine, which, after one or two lax convolutions, twists spirally back almost to the end of the perivisceral cavity, fig. 2, *f*; here it bends over, but without being attached to the latter, winding spirally on towards the middle of the body, fig. 2, *g*, where it enters a long and almost straight rectum, fig. 2, *h*, which disembogues on the back.

A few tendinous filaments web the spiral of the intestine to the walls of the body; but there is no separate fusiform muscle.

On the œsophagus is seen a long, sinuous, retractile vessel, with a cæcal termination in close proximity to the roots of the retractor, but anteriorly encircling the gullet as the vascular ring, from which issue the tentacular vessels.

The nervous chord extends along the middle of the ventral surface, with numerous subsidiary branches, forming, as usual, round the œsophagus anteriorly a pharyngeal ring, from which branches proceed to the gullet and the tentacles.

Anteriorly, the ovary is webbed to the posterior third of the œsophagus; at first riband-shaped, it soon becomes cylindric, constituting, as it were, a tube, that winds repeatedly round the intestine. It contained ova in various stages of development; also mature ova, floating here and there in the perivisceral fluid. The specimens we examined were all of them females.

This animal sometimes takes up its abode in the house of an Annelid, but is generally found to dispense with such an habitation.

Locality.

At Stations 34, 40, 51, 87, 176, 260, 295; a few specimens at each station.

Specific Character.

Body cylindrical, hyaline. Trunk furnished with minute, distant papillæ; its breadth compared to its length as 1 to 20. Proboscis, equal in length to trunk, studded with exceedingly minute pointed papillæ. From 8 to 10 tentacles. One retractor.

Aspidosiphon armatum, n. sp.

Pl. I, figs. 5, 6; Pl. II, figs. 7—14.

Body cylindrical, 8^{mm} long; posterior extremity truncate, and furnished with a round chitinous shield, fig 5, composed of plates, those forming the rim oval (petaloid), with the

Randen, ere bladformige med den smalere Del vendt indad imod Midtpartiet, og have paa deres Overflade 2—3 Korn, Fig. 7 *a*. Skjoldets Centrum derimod dannes af smaa næsten runde, og paa den ydre Flade ophøiede Plader, hvoraf en sidder i Centrum, Fig. 7, *b*. Der, hvor Skjoldets Rand ender, har Kroppen 5—6 Ringe, der ere besatte med større og mindre Chitinplader, som dels ere flade, dels runde og ordnede saaledes, at de runde, der ere meget smaa, altid sidde imellem de større flade, Fig. 7, *c*.

Omtrent 3^{mm} foran Endeskjoldet er en Indsnøring rundt Kroppen, Fig. 5, *a*, hvorefter denne aftager lidt i Tykkelse imod Snabelens Grund, hvor der paa Rygsiden findes det forreste Chitinskjold, Fig. 5, *b*. Dette er lidt hvælvet, 4^{mm} langt, 3^{mm} bredt ved Basis, 1.2^{mm} i Spidsen, Fig. 8.

Skjoldets Rand, der især bagtil er meget ophøiet over Hudfladen, er kraveformigt sammensat af temmelig regelmæssige, aflange, hvælvede, fortil tilrundede Plader, som ere smalere ved Grunden, Fig. 8, *a*, og forlænge sig et lidet Stykke indover Skjoldets Rand. Imellem disse Plader, det vil sige der, hvor den ene Plade nærmer sig den anden, er en lille Fure, Fig. 8 *b*, hvorved Randpladerne blive saameget desto tydeligere. Den centrale Del af Snabelskjoldet bestaar af runde, ophøiede Plader, som ere ordnede i Rækker, der gaa fra Peripherien imod Centrum, Fig. 8 *c*. Imellem disse Pladerækker findes ligeledes fine Furer.

Kroppens Overflade er besat med større og mindre Chitinplader, der ere grupperede omkring Aabningerne for Hudkjertlerne, Fig. 11, 12, 13, dog saaledes, at imedens de paa Kroppens Midtparti ere uregelmæssig leirede, sidde de i temmelig regelmæssige Ringe strax bagenfor det forreste, og foran det bagerste Skjold. Den runde Analaabning findes strax bagenfor det forreste Chitinskjold.

Snabelen er 16^{mm} lang, Fig. 5, og besat lige fra Grunden til dens forreste Ende med en stor Mangfoldighed af Hager, der sidde paa omtrent 600 Ringe, Fig. 9. Hagerne ere stærkt krumbøiede, hule langs den krumme Rand, Fig. 10.[1] Basaldelen er 0.028^{mm} og Høiden er 0.020^{mm}, Fig. 10.

Tentaklerne, Fig. 5 *c*, ere fra 10—12, temmelig smaa og sidde i Krands omkring den runde Mundaabning.

Hudens Cuticula er tynd, vandklar og strukturløs, Fig. 12, *a*, 13, *a*, og dækker Chitinpladerne, Fig. 12, *b*, 13, *b*, der ere leirede i den cellulære Matrix, Fig. 12, *c*, hvori findes mange Kjertler, som ere lidt langstrakte med en bred Basis, Fig. 12, *d*, og en kort Udførselsgang, Fig. 12, *e*, som aabner sig paa Kroppens Overflade med en liden Pore, Fig. 11, *a*, 13, *c*, omgivet af uregelmæssig grupperede Chitinplader, Fig. 11, 12, 13.

Indenfor Matrix er et tyndt Bindevævslag, Fig. 12, *f*, der støder til Muskelhuden, som er sammensat af Ring- og Længdemuskler. Ringmusklerne Fig. 12, *g*, bestaa af

slender part turned towards the middle of the plate, and having on their surface 2 or 3 granules, fig. 7, *a*. The centre of the shield consists of exceedingly minute, almost circular laminæ, raised on the outer surface, one of which occupies the centre, fig. 7, *b*. Where the rim of the shield terminates, the body exhibits 5 or 6 rings, covered with chitinous plates, varying in magnitude, some flat, some raised, and so disposed, that the raised plates, which are very minute, invariably occupy a position between the comparatively large flat ones, fig. 7, *c*.

About 3^{mm} in advance of the terminal shield is seen a constriction of the body, fig. 5, *a*, from whence the latter diminishes in thickness to the base of the proboscis, where, on the dorsal surface, occurs the foremost chitinous shield, fig. 5, *b*.

This shield, which is slightly arcuate, measures 4^{mm} in length, 3^{mm} in breadth, and 1.2^{mm} across at the apex, fig. 8. The rim of the shield, posteriorly projecting to a considerable extent above the surface of the skin, is jugal in form, and built up of comparatively uniform, oval, arcuate plates, rounded off anteriorly; being narrower at the base, fig. 8, *a*, they are produced a little within the rim of the shield. Between these plates, occurs a small groove, fig. 8 *b*, by reason of which the rim-plates are easier to distinguish. The central portion of the shield on the proboscis is composed of raised circular plates, proceeding in rows from the circumference to the centre, fig. 8, *c*. Here, too, minute furrows extend between the series of plates.

The surface of the body is furnished with chitinous plates, of varying magnitude, grouped round the apertures of the glands of the skin, figs. 11, 12, 13, — irregularly on the medial region of the body, but immediately posterior to the foremost and anterior to the hindmost shield, in comparatively uniform annular series. The round anal opening is placed immediately posterior to the foremost chitinous shield.

The proboscis measures 16^{mm} in length, fig. 5, and is studded from its base to its anterior extremity with a multitude of chitinous hooks, affixed to about 600 annulets, fig. 9. These chitinous hooks are much bent, and hollowed out along their curved margins, fig. 10. Width of basal portion 0.028^{mm}, height 0.020^{mm}, fig. 10.

The tentacles, fig. 5, *c*, from 10 to 12, are comparatively small; they encircle, cincture-like, the round buccal aperture.

The cuticle, thin, translucent, and structureless, figs. 12, *a*; 13, *a*, invests the chitinous plates, figs. 12, *b*; 13, *b*, disposed throughout the cellular matrix, fig. 12, *c*, which is furnished with numerous glands, somewhat elongate in form, with the base broad, fig. 12, *d*, and a short excretory duct, fig. 12, *e*, opening on the surface of the body through a small pore, fig. 11, *a*; 13, *c*, round which chitinous plates, figs. 11, 12, 13, are irregularly grouped.

Underneath the matrix extends a thin layer of connective tissue, fig. 12, *f*, contiguous to the muscular integument, which is composed of annular and longitudinal

stærke Muskelbundter, som sammenbindes ved Bindevæv til en sammenhængende Membran, hvilket ogsaa er Tilfældet med Længdemusklerne, hvis Bundter dog staa længere fra hverandre, hvorved Huden paa enkelte Steder af Kroppen faar ved gjennemfaldende Lys et gittret Udseende, Fig. 12, *h*.

Der, hvor det forreste Skjold danner en Fremstaaenhed paa den udvendige Flade af Kroppen, er en tilsvarende Fordybning paa den indvendige Flade, Fig. 6, *a*, og om hvilken, (egentlig om Skjoldranden), Ringmusklerne danne en temmelig tyk Vold, hvorved Hulheden bliver dybere, – og paa denne Vold fæste den Del af Længdemusklerne sig, hvilke løbe langs Rygfladen; thi de gaa, ligesaa lidt som Ringmusklerne, over Skjoldhulen. Derimod er denne forsynet med et eget Muskelapparat, der bestaar af 20 isolerede Muskler, Fig. 6, *b*, 14, *a*, som have en sølvglindsende Farve, og tage deres Udspring lidt udenfor den føromtalte Vold, gaar dækket af denne ned i Skjoldhulheden, hvor de fæste sig dels paa Midten, dels paa den forreste Trediedel af den indre hule Skjoldvæg. De midterste ere de længste og have lige Retning, Fig. 14, *b*; men alt eftersom de tage Udspring fra Siderne og fortil, Fig. 14, *a*, *c*, blive de kortere og faa da en skraa Retning, saa at det Hele antager Formen af en Glorie, Fig. 14. Disse Muskler synes at være bestemte til at dirigere Skjoldet. Den midterste og forreste Del af Skjoldhulen er kun beklædt af Peritoneum, der forresten giver hele Muskelhudens indre Flade sit Overtræk.

Imod den bagerste Kropsende, ved den tidligere omtalte Fure, blive Ringmusklerne noget tykkere og bidrage derved til at danne den før beskrevne Afdeling, Fig 5, *c*, paa Kroppens Overflade.

Saavel Ring- som Længdemusklerne ende ved det bagerste Skjolds Rand, hvis indvendige Flade er næsten plan.

Der er kun en Retractor, der tager sit Udspring paa Endeskjoldets indre Flade, nærmere Bugsiden, med to Rødder, Fig. 6, *c*, og følger saa denne lige op til Spiserøret, Fig. 6, *d*, som den forstørstedelen omgiver som en Skede, indtil den fæster sig strax bagenfor Tentakelkrandsen, Fig. 6, *e*.

Spiserøret. Fig. 6, *f*, der er cylindrisk, smalt og tildels indesluttet af Retractor, gaar ved en lille Indsnøring over i den lidt bredere Tarm, som spiralformig gaar bag til Kropshulhedens Ende, Fig. 6, *g*, bøier sig fortil fremdeles i Spiraler, indtil den gaar over i en temmelig kort Rectum, Fig. 6, *h*, der aabner sig paa Rygsiden, strax bagenfor det forreste Skjold.

Tarmspiralen er fæstet til det bagerste Skjolds indre Flade ved enkelte Bindevævstraade, og Rectum er paa sin forreste Ende bundet til Huden ved mange fine muskuløse Traade.

muscles. The former, fig. 12, *b*, are built up of powerful muscular fascicles, webbed together as a continuous membrane by connective tissue; this is likewise the case with the longitudinal muscles, the fascicles of which are, however, less closely arranged, giving to the skin, when held up to the light, in certain parts of the body a tessellated appearance, fig. 12, *h*.

On the outer surface of the body, occurs a prominence, formed by the shield; and on the inner surface, is seen a corresponding depression, fig. 6, *a*, round which (or rather, round the rim of the shield) the annular muscles constitute a thickish ridge, increasing the depth of the excavation: to this ridge are attached such of the longitudinal muscles as extend along the dorsal surface; for neither the longitudinal nor the annular muscles cross the hollow of the shield. The shield is provided with a special muscular apparatus, viz. 20 isolated muscles, figs. 6, *b*; 14, *a*, of a silvery lustre, originating a little without the aforesaid ridge, under cover of which they pass down into the hollow of the shield, and are there attached, either to the middle or to the anterior third of the hollow inner wall. The medial muscles are the longest, and protend in a right line, fig. 14, *b*; but the nearer the point of origin approaches the sides or the front part, fig. 14, *a*, *c*, the shorter and more oblique do the muscles become, causing the whole assemblage to resemble a halo, fig. 14. These muscles would seem to govern the shield. The middle and front part of the hollow is covered by the peritoneum alone, which also invests the inner surface of the whole muscular integument.

Near the posterior extremity of the body, along the groove noticed above, the annular muscles slightly increase in thickness, and thus contribute towards forming the section of the surface of the body, fig. 5, *c*, previously described.

Both the annular and the longitudinal muscles terminate at the rim of the posterior shield, the inner surface of which is almost flat.

This animal has but one retractor, which, springing from two roots, fig. 6, *c*, takes its origin on the inner surface of the terminal shield, nearest the ventral side, protending along the latter till it reaches the œsophagus, fig. 6, *d*, which it almost surrounds, in the form of a sheath, being affixed immediately posterior to the cincture of tentacles, fig. 6, *e*.

The œsophagus, fig 6, *f*, cylindric, slender, and partially enclosed by the retractor, passes, with a slight instriction, into the somewhat wider intestine, which coils spirally back to the termination of the perivisceral cavity, fig. 6, *g*, from whence, making a bend forwards, it continues on, twisting spirally as before, till it enters a comparatively short rectum, fig. 6, *h*, which opens on the dorsal surface, immediately posterior to the foremost shield.

The spiral of the intestine is attached to the inner surface of the hindmost shield by a few filaments of connective tissue, and the rectum webbed to the skin at its anterior extremity by numbers of delicate muscular filaments.

Langs Tarmspiralen laa et langt fladt, hvidgult Legeme, som var fæstet til Spiserøret, og som ved nærmere Undersøgelse viste sig at være Æggestokken, Fig. 6, *i*; der indeholdt Æg i forskjellige Udviklingsstadier; i Kropshulheden fandtes en Mængde fritsvømmende Æg. Disse vare flade, skivedannede, ovale med en noget tilspidset Pol, 0.136^{mm} lange, 0.112^{mm} brede og forsynede med Kimblære og Kimplet; forresten ligne de Æggene hos *Phascolosoma*.

To Segmentalorganer, der ere frithængende og brunfarvede, Fig. 6, *k*.

Nervestrængen løber imellem Rødderne af Retractor og følger Bugfladen lige til den forreste Ende af Spiserøret, om hvilket den danner en Ring.

Farven. Kroppen lys gulbrun med lidt mørkere Tentakler. Skjoldene mørkebrune.

Kun et Exemplar blev fundet paa 87de Station.

Artskarakter.

Kroppen cylindrisk, 8^{mm} lang, bedækket af større og mindre Chitinplader; den bagerste Ende tværs afskaaren. Snabelen dobbelt saa lang, som Kroppen, overalt besat med Hager og forsynet med 10—12 korte Tentakler. Endeskjoldet rundt, næsten fladt, sammensat af Chitinplader, der i Randen ere tungeformede, i Centrum runde. Udenom Skjoldet 6 Ringe, besatte med Plader. Det forreste Skjold omvendt hjerteformigt.

Af de hidtil beskrevne Arter af Slægten *Aspidosiphon* kommer *armatum* nærmest den af Dr. Théel[1] beskrevne *Asp. mirabilis*; men den adskiller sig fra denne derved, at Snabelen er meget længere og overalt besat med Hager, at Skjoldene have en noget forskjellig Form, og at Chitinpladerne, hvoraf disse ere sammensatte, ere forskjellig ordnede.

Destoværre have vi kun havt 1 Exemplar til vore Undersøgelser, der som Følge deraf ikke ere blevne saa udtømmende, som vi kunde ønske; men se vi hen til de Beskrivelser, der foreligge over Slægten *Aspidosiphon* og dens Arter, ere vi tilbøielige til at tro, at ogsaa de Forskere, som tidligere have beskjæftiget sig dermed, have ligesom vi manglet Materiale; thi ellers vilde sikkerligen Beskrivelserne have været mere fuldstændige, end de ere.

[1] H. Théel. Études sur les Gephyriens inermes. Bihang til Kong. Sv. Vet. Acad. Handlingar. 3 Bd. No. 6, Pag. 17.

Stretching along the spiral of the intestine, and attached to the œsophagus, was seen a flat, whitish-yellow body, which, on closer inspection, proved to be the ovary, fig. 6, *i*, containing ova in various stages of development; and numbers of isolated ova were found floating in the perivisceral cavity. The ova of this animal, measuring 0.136^{mm} in length and 0.112^{mm} in breadth, are flat, discoid, oval, with a slightly acuminate extremity; they have a germinal vesicle and a germinal speck, and for the rest resemble the eggs of *Phascolosoma*.

Two free depending segmental organs, brown in colour, fig. 6, *k*.

The nervous chord protends between the roots of the retractor along the ventral surface to the anterior extremity of the œsophagus, which it annulates.

Colour. — Body light yellowish-brown, with somewhat darker tentacles. The shields dark-brown.

One specimen only was brought up, at Station 87

Specific Character.

Body cylindric, 8^{mm} long, covered with chitinous plates of varying magnitude; posterior extremity truncate. Proboscis, twice the length of the trunk, studded all over with chitinous hooks, and furnished with 10 or 12 short tentacula. Terminal shield round, almost flat, composed of chitinous plates, which at the margin of the shield are linguiform, at the centre round. Round about the shield, 6 annular bands covered with plates. Foremost shield inverted cordiform.

Of the species belonging to the genus *Aspidosiphon* as yet described, *Asp. armatum* bears the closest resemblance to *Asp. mirabilis*, described by Dr. Théel,[1] but is distinguished from it by having a much longer proboscis, studded all over with chitinous hooks; moreover, the shields in the two species differ somewhat in form, and the arrangement of the chitinous plates composing them is different.

Unfortunately, we have had only one specimen on which to base our observations; and hence they are less exhaustive than we should have wished them to be; but, calling to mind the descriptions previously furnished of the genus *Aspidosiphon* and its species, the naturalists who have made these animals the subject of investigation, would, like ourselves, appear to have lacked sufficient materials; otherwise their descriptions had certainly approached nearer to completeness.

[1] H. Théel. Études sur les Gephyriens inermes. Bihang til Kongl. Sv. Vet. Acad. Handlingar, 3 Bd. No. 6, Pag. 17.

Onchnesoma glaciale, n. sp.

Tab. I, Fig. 15—20.

Legemets hele Længde paa de største Exemplarer er omtrent 105^{mm}.

Kroppen er 35^{mm} lang, 2^{mm} bred, cylindrisk, glat, glindsende, med en næsten tapformig Bagende og en vandklar Hud, der paa den bagerste Kropsende er yderst sparsomt besat med meget smaa uregelmæssig stillede Papiller, Fig. 15, 15^{1}.

Snabelen er omtrent dobbelt saa lang som Kroppen, ender knopformig med den runde Mundaabning i Midten, Fig. 15^{1}, Den forreste Fjerdedel af Snabelen er forsynet med mange regelmæssige, temmelig tætstaaende Rækker Hager, der tage deres Begyndelse strax bagenfor Mundaabningen og ere kun lidet krummede, Fig. 19.

Hagernes Basaldel er fra 0,040—0,060^{mm} bred og deres Høide er fra 0,045—0,064^{mm}, Fig. 18, 20. De ere bleg gulbrune, hule, have en næsten trekantet Basis og en mod Huden vendende Spids, forsynet med en fin Aabning, Fig. 18, 19. Den hule Grunddel optager for en Del Hudkjertelen.

Analaabningen er rund, noget foran Snabelgrunden, Fig. 16, *a*, og lidt bagenfor den sees en Aabning for Segmentalorganet.

Den vandklare Hud har en bred Cuticula, som er finstribet og hvis Linier løbe kredsformig om Dyrets Legeme, Fig. 17, *a*, 18, *a*; indenfor Overhuden er Epithellaget, der er smalt og dannes af en Række cylindriske Celler, Fig. 17, *b*, 18, *b*, der med et yderst smalt Bindevævsstratum, Fig. 17, *c*, ere bundne til Muskelhuden, som bestaar af de sædvanlige to Lag, Ring- og Længdemuskler, som hver for sig ved Hjælp af Bindevæv danner en sammenhængende Hud, Fig. 17, *d*, *e*.

I Epithellaget findes en Mængde temmelig store Kjertler, der have en noget konisk Figur, og hvis brede Del hviler paa det smale Bindevævslag, saa at det ser ud, som om den støder umiddelbart til Ringmuskelhuden, Fig. 17; *f*; 18, *c*. Den smalere, noget afrundede Del rager langt op i den klare Cuticula, Fig. 17, *g*, hvor den ender i Udførselsgangen, som aabner sig næsten tragtformig paa Hudens Overflade, Fig. 17, *h*. Disse Kjertler dannes af en Kapsel, der egentlig er en Fortsættelse af det smale Bindevævslag, og som indvendig er beklædt med Celler, Fig. 17, *i*, 18, *d*; Kjertlerne ere opfyldte af en seig Vædske.

Der er kun en Retractor, som udspringer fra Midten af Kroppen med en noget bred Rod, der paa enkelte Exemplarer havde et lidet Indsnit, Fig. 16, *b*; den smalner da strax af og løber fortil langs Bugfladen til Mundaabningen,

Onchnesoma glaciale, n. sp.

Pl. I, figs. 15—20.

The whole length of the body in the largest specimens about 105^{mm}. Trunk 35^{mm} long, 2^{mm} broad, cylindric, smooth, lustrous, the posterior extremity having much the shape of a faucet.

Skin hyaline, at the posterior extremity of the trunk very sparingly furnished with minute, irregularly scattered papillæ, figs. 15, 15^{1}.

The proboscis, about twice as long as the trunk, nodular at the terminal extremity, with the round buccal aperture in the middle, fig. 15. The anterior fourth of the proboscis is furnished with numerous regular, comparatively closely arranged series of chitinous hooks, but slightly bent, which take their origin a little posterior to the buccal aperture, fig. 19.

The basal portion of these ungueal spiculæ, or hooks, measures from 0.049^{mm} to 0.060^{mm} in breadth; their height is from 0.045^{mm} to 0.064^{mm}, figs. 18, 20. They are hollow, and pale yellowy-brown in colour; the base is almost triangular, and the point, turned towards the skin, furnished with a minute orifice, figs. 18, 19. The hollow basal portion is partly occupied by the tegumentary gland.

Anal opening round, placed a little anterior to the base of the proboscis, fig. 16, *a*; and about the same distance posterior to it is seen a small opening, or pore, for the segmental organ.

The hyaline skin has a broad, finely striated cuticle, the striæ completely encircling the body of the animal, figs. 17, *a*; 18, *a*. Underneath the cuticle extends the epithelial layer, which is narrow, and built up of a series of cylindric cells, figs. 17, *b*; 18, *b*, webbed by an exceedingly narrow stratum of connective tissue, fig. 17, *c*, to the muscular integument, consisting of the two ordinary layers of annular and longitudinal muscles, each of which constitutes by means of connective tissue a continuous tegumentary covering, fig. 17, *d*, *e*.

Throughout the epithelial layer are dispersed a number of comparatively large glands, somewhat conical in form, the broad portion of which, resting on the narrow layer of connective tissue, gives them the appearance of being in direct contact with the annular muscular integument, figs. 17, *f*; 18, *c*. The narrow, somewhat rounded part projects far up into the cuticle, fig. 17, *g*, where it terminates in the excretory canal, which disembogues through an almost funnel-shaped opening on the surface of the skin, fig. 17, *h*. These glands consist of a capsule, which, strictly, is a continuation of the narrow layer of connective tissue, invested on its inner surface with cells, figs. 17, *i*; 18, *d*: the glands contain a viscous fluid.

There is only one retractor, springing from the middle of the body, with a broadish root, which in some of the specimens had a slight incision, fig. 16, *b*; it immediately begins to taper, protending along the ventral surface as

hvor den fæster sig i den Vold, som omgiver denne. Den har en hvid glindsende Farve.

Der er et Segmentalorgan, som er omtrent 3^{mm} langt, smalt, og som ved sin bredere forreste Ende er fæstet til Bugfladen noget bagenfor Analaabningen til Høire, imellem Rectum og Retractor, Fig. 16, *c*. Det har en lidt brunlig Farve og temmelig tykke Vægge.

Spiserøret er meget smalt, ligger paa den forreste Del næsten omfattet af Retractor, noget længere bag hviler det paa dennes Midte, Fig. 16, *d*, hvortil det er bundet ved Bindevæv og løber bag mod Retractors Grund, hvor det bøier sig og gaar et Stykke fortil lidt til Høire, Fig. 16, *e*; her danner det en Bøining og gaar over i Tarmen, Fig. 16, *f*, der spiralformig slynger sig lige bag til Bunden af Kropshulheden, Fig. 16, *g*, hvorfra den igjen vinder sig om de bagtilgaaende Tarmslynger, Fig. 16, *h*, idet den løber fortil mod det Sted, hvor Spiserøret gaar over i Tarmen; herfra har den en lige Retning og danner en lang Rectum, Fig. 16, *i*, som aabner sig lidt foran Snabelens Grund.

Saavel Rectum som hele Tarmslyngen er ved enkelte Bindevævstraade bunden til Kropsvæggen. Den bagerste Ende er fri. Nogen Spindelmuskel findes ikke, ligesaalidt som noget Vandkarsystem.

Nervestrængen løber som sædvanligt langs Midten af Bugfladen, Fig. 16, *k*, og lægger sig lige ved Retractors venstre Rand, som den følger til Dyrets forreste Ende, hvor den slaar sig om Spiserøret for at danne Svælgringen. Paa denne Vei afgiver den en Mængde Sidegrene til Huden og Spiserøret.

Findested.

Flere Exemplarer paa Station 51, 240, 248. Et Exemplar Stat. 251. Mange Exempl., der vare sammenflettede ved den lange Snabel, paa Stat. 283.

Artskarakter.

Kroppen cylindrisk, 35^{mm} lang, 2^{mm} bred; dens Bagende sparsomt besat med yderst fine Papiller. Snabelen dobbelt saa lang som Kroppen; dens forreste Fjerdedel forsynet med mange regelmæssige Rækker Hager. Huden glasklar.

far as the buccal aperture, to the ridge surrounding which it is attached. The retractor is lustrous white.

There is one segmental organ, about 3^{mm} long, narrow, with its broader, anterior extremity attached to the ventral surface, to the right of, and a little posterior to, the anal opening, between the rectum and the retractor, fig. 16, *c*. It is of a brownish colour, and has comparatively thick walls.

The œsophagus is very narrow, its anterior part being almost surrounded by the retractor; a little farther back, it rests on the middle of that organ, fig. 16, *d*, to which it is webbed by connective tissue, protending from thence back to the base of the retractor, where it makes a bend, and passes forward, a little to the right, fig. 16, *e*; here it makes another bend, previous to entering the intestine, fig. 16, *f*, which winds spirally back to the bottom of the perivisceral cavity, fig. 16, *g*, from whence it coils round the receding convolutions of the intestine, fig. 16, *h*; here it takes a straight course, forming a long rectum, fig. 16, *i*, which disembogues a little anterior to the base of the proboscis.

Both the rectum and the whole spiral of the intestine, are attached to the wall of the body, by a few filaments of connective tissue. Posterior extremity free. There is no fusiform muscle; neither is there any aquiferous system.

The nervous chord protends as usual along the middle of the ventral surface, fig. 16, *k*, in immediate proximity to the left margin of the retractor, which it accompanies to the anterior extremity of the animal, and there winds round the œsophagus, forming the pharyngeal ring. On its course it sends off numerous subsidiary branches to the skin and the œsophagus.

Locality.

Several specimens at Stations 51, 240, and 248. One specimen at Station 251. At Station 283 numerous examples were brought up, with their long probosces interlaced.

Specific Character.

Trunk cylindrical, 35^{mm} long, 2^{mm} broad; the posterior extremity sparingly furnished with minute papillæ. Proboscis twice as long as trunk; its anterior fourth studded with numerous regular series of chitinous hooks. Skin hyaline.

Stephanostoma[1] **Hanseni**[2], n. g. n. sp.

Tab. II, Fig. 21—29; Tab. IV, Fig. 19.

Kroppen rund, næsten tenformig, 60^{mm} lang, 13^{mm} tyk i Nærheden af Analaabningen, Fig. 21, *a*. Den ba-

[1] Στέφανος, Krands, στόμα, Mund.
[2] Benævnt efter Overlæge G. Armauer Hansen.

Stephanostoma[1] **Hanseni**,[2] n. g. n. sp.

Pl. II, figs. 21—29; Pl. IV, fig. 19.

The trunk round, almost fusiform, 60^{mm} long, 13^{mm} thick in close proximity to the anal opening, fig. 21, *a*.

[1] Στέφανος, wreath; στόμα, mouth.
[2] Dedicated to G. Armauer Hansen, M. D.

gerste Ende er konisk tilspidset, Fig. 21, *b*. Den forreste Del bliver noget smalere, idet den gaar over i Snabelen.

Snabelen er cylindrisk, omtrent 64^{mm} lang, 5^{mm} tyk i dens Begyndelse, Fig. 21, *c*; men udvider sig efterhaanden lidt, saa at den op imod den forreste Ende bliver indtil 9^{mm}, Fig. 21, *d*; her bliver den i en Afstand af 3—4^{mm} fra Tentakelkraven noget smalere, danner en Slags Hals, Fig. 21, *e*, og ender i en temmelig bred, hvælvet, actinielignende Skive, Fig. 21, *f*, i hvis Midte findes den runde Mundaabning, Fig. 21, 22, *b*, og hvis Omkreds indtages for Størstedelen af Tentaklerne, Fig. 21, *g*, 22, *c*.

Tentaklerne indtage en særegen Stilling paa Mundskiven, idet den egentlige Tentakelkrave er meget stærkt bugtet, saaledes nemlig, at den danner 10 store Indbugtninger (Festons) og 10 smaa, Fig. 22, 23.

De store Indbugtninger strække sig et langt Stykke ind paa Mundskiven. Enhver saadan Feston er paa dens to Rande besat med Tentakler, 8 paa hver Rand, Fig. 22, 23, *a*, og faar derved et fryndset Udseende. De 4 inderste Tentakler ere de største; derefter aftage de betydeligt i Størrelse, saa at de to yderste ere temmelig smaa, og faa Udseende af at gaa over paa den lille Indbugtnings-Rand, naar Tentakelkrandsen ikke er fuldt udstrakt, Fig. 23.

De 10 smaa Indbugtninger ere egentlig Fortsættelser af de store; men strække sig kun lidt indenfor Mundskivens Rand, og ere kun forsynede med hver sine to Tentakler, Fig. 23, *b*, der ere i Størrelse som de 5te (indenfra) paa de store Festons.

Alle Tentaklerne ere flade, konisk tilspidsede, og have paa den ene Flade ligesom en Fure, der fremkommer derved, at Randene bøie sig lidt imod hinanden. Der er altsaa ialt 180 Tentakler.

Analaabningen er rund og findes i Centrum af en temmelig fremstaaende Papille paa Rygsiden, omtrent 10^{mm} fra Snabelens Grund, Fig. 21, *h*.

Kroppens Overflade er forsynet med fine Tværlinier, der blive tydeligere paa Snabelen, Fig. 21, og paa disse Linier iagttages yderst smaa Papiller, der især paa den forreste Del af Snabelen staa i temmelig regelmæssige Grupper, Fig. 22, *d*, 24. Tydeligst ere dog disse Papiller paa den bagerste Kropsende.

Huden er meget fast, læderagtig, tyk og stærkt contractil. Den bestaar af en tyk, gjennemsigtig, glasklar Cuticula, der er stribet baade efter Længden og Bredden, Fig. 25, *a*, 26, *a*. Paa den ydre Flade af Cuticula iagttages en stor Mængde fine Porer, Fig. 25, *b*, 26, *b*, der ere Aabninger for Slimkjertlernes Udførselsgange.

Indenfor Cuticula er den egentlige Matrix, bestaaende af Epithel- og Pigmentceller, Fig. 25, *c*, 26, *c*, og i dette Lag er en stor Mængde Slimkjertler leirede, Fig. 25, *d*. Disse have en konisk Form med en temmelig bred Grunddel, Fig. 26, *d*, og fra hvis noget afstumpede Spids, Fig.

Posterior extremity acuminate, fig. 21, *b*. The anterior part diminishes somewhat in circumference where it is produced into the proboscis.

The proboscis is cylindrical in form, about 64^{mm} long, and 5^{mm} thick at origin, fig. 21, *c*, but gradually expands to 9^{mm}, near the anterior extremity, fig. 21, *d*; here, 3 or 4^{mm} from the tentacular collar, it becomes a trifle slenderer, constituting a kind of neck, fig. 21, *e*, and terminates in a comparatively broad, arcuate disk, somewhat like the oral disk of an Actinia, fig. 21, *f*, in the middle of which is the round buccal aperture, figs. 21; 22, *b*, the greater part of the peripheral margin being taken up by the tentacles, figs. 21, *g*; 22, *c*.

The position of the tentacles on the buccal disk is peculiar, the collar itself being remarkably waved, forming as it does a series of undulations, 10 long (festoons) and 10 short, figs. 22; 23.

The long undulations extend far out on the buccal disk. Each of these festoons is studded along its two margins with tentacles, 8 on either margin, figs. 22; 23, *a*, which gives them a fringed appearance. The 4 innermost tentacles are the largest; the others diminish considerably in size, the two outermost being comparatively small, and when the whole assemblage forming the collar are not fully exserted, seemingly placed on the margin of the nearest short undulation, fig. 23.

The 10 short undulations are strictly continuations of the large ones, but reaching very little within the margin of the oral disk, and furnished with only two tentacles each, fig. 23, *b*, in magnitude equal to the fifth (counting from within) of those forming the festoons.

All of the tentacles are flat, acuminate; and the margins slightly inclining towards each other, a grooved depression extends along one of the surfaces. Total number of tentacles 180.

The anal opening is round, and placed in the centre of a rather prominent papilla on the dorsal side, about 10^{mm} from the base of the proboscis, fig. 21, *h*.

The surface of the body is transversely striate, the fine striæ being most conspicuous on the proboscis, fig. 21; and, dispersed along them, extend a multitude of exceedingly minute papillæ, which, more especially on the anterior part of the proboscis, are arranged in comparatively regular groups, figs. 22, *d*; 24; the papillæ are most conspicuous, however, on the posterior extremity of the trunk.

The skin is exceedingly firm, coriaceous, thick, and highly contractile. It consists of a thick, hyaline, translucent cuticle, transversely and longitudinally striate, figs. 25, *a*; 26, *a*. On the outer surface of the cuticle, are seen a multitude of minute pores, figs. 25, *b*; 26, *b*, — openings for the excretory canals of the mucous glands.

Underneath the cuticle, extends the true matrix, consisting of the epithelium and pigmentary cells, figs. 25, *c*; 26, *c*. Throughout this layer are disposed numbers of mucous glands, fig. 25, *d*, conical in form, with a comparatively broad base, fig. 26, *d*, and a somewhat obtuse sum-

26, *e*, løber en Udførselsgang, Fig. 26, *f*, op igjennem Cuticula for at aabne sig paa dennes Overflade.

Kjertelen er paa den indre Flade beklædt med et Epithel, Fig. 26, *g*, der afsondrer en seig, grønlig Slim, som tildels ganske udfyldte Kjertelen, og som fandtes baade i Udførselsgangen og paa Kroppens ydre Flade.

Matrixen er bundet til et meget smalt Bindevævslag, Fig. 26, *h*, der fæster sig til Muskelhuden. Denne er meget tyk og bestaar af et Lag Ringmuskler, Fig. 25, *e*, som ikke er meget bredt i Forhold til det andet Lag, nemlig Længdemusklerne, Fig. 25, *f*, der ere meget tykke med særdeles stærke Fibre. Indenfor Længdemusklerne er det flimrende Peritonealovertræk.

Fordøielsesapparatet.

Svælget er temmelig vidt og foldet, og gaar over i det smale, lange, muskuløse Spiserør, der er lidt indknebet ved Overgangen til Tarmen, Fig. 27, *a*. Denne danner først et Par smaa Bøininger, derefter slaar den sig paatvers imod høire Side, Fig. 27, *b*, gjør nu en Slyngning om Spiralmuskelen, Fig. 27, *c*, for derefter omkring denne spiralformig at løbe bagimod Kropshulhedens bagerste Ende, Fig. 27, *d*, hvorfra den atter i Spiral løber fortil, for at gaa over i Endetarmen, Fig. 27, *e*, der udmunder i den føromtalte Rygpapille.

Tarmspiralen, der ligger omtrent i Midten af Kropshulheden, bestaar af omkring 54 Slyngninger, Fig. 27.

Spindelmuskelen tager sin Begyndelse strax bagenfor den yderste Ende af Rectum, lidt til Siden, løber langs Rectum til Midten af Kropshulheden, hvor den gaar ind i Tarmspiralen, og løber i denne lige ned til den bagerste Ende af Kropshulheden, hvor den fæster sig, Fig. 27, *c*.

Svælget og Spiserøret er bundet ved meget stærke muskuløse Baand til den forreste Del af Snabelens indre Flade, og Tarmen er ved et stærkt Mesenterium, bestaaende af Bindevæv og tildels Muskelfibre, bundet til Bugfladen.

Rectum er ved mange, temmelig brede, stærke tendinøse Baand fæstet til Kropsvæggen, og fra dens forreste Del udgaar en lang Muskeltraad, som fæster sig paa den første Tarmslynge, Fig. 27.

Paa Bugsiden af Spiserøret iagttages et gulagtigt Kar, der er yderst fint, men bliver tykkere alt eftersom det løber længere bag over Tarmen, hvor det ender blindt paa den første Tarmslynge, Fig. 27, *f*, efter at det har givet nogle temmelig tykke Grene til Tarmen. Hvorledes dette Kar forholder sig fortil, kunne vi ikke afgjøre; thi paa Spiritusexemplarerne saa det ud, som om det forsvandt i Svælgvæggen. Indholdet bestod af en Mængde smaa runde Legemer med en Kjerne, og havde noget tilfælles med sammenløbet Kropsvædske.

Paa Rygfladen af Svælget, lidt til høire Side, findes

mit, fig. 26, *e*, from which an excretory canal, fig. 26, *f*, passes up through the cuticle, to disembogue on its surface.

Each of these glands is invested on its inner surface with epithelium, fig. 26, *g*, that secretes a viscid, greenish coloured mucus, with which some of the glands were entirely filled; it occurred, too, in the excretory canal, and on the outer surface of the body.

The true matrix is webbed to an extremely narrow layer of connective tissue, fig. 26, *h*, attached to the muscular integument. The latter is exceedingly thick, and consists of a layer of annular muscles, fig. 25, *e*, not particularly broad compared to the other layer, viz. that of the longitudinal muscles, fig. 25, *f*, which are very thick, with exceedingly strong fibres. Underneath the longitudinal muscles extends the ciliated peritoneal tunic.

Digestive Apparatus.

The gullet is comparatively wide, and folded; it opens into the long, narrow, muscular œsophagus, which is somewhat constricted at the entrance to the intestine, fig. 27, *a*. The latter, after a slight bend or two, strikes off, in a transverse direction, to the right, fig. 27, *b*, makes a twist round the spiral muscle, fig. 27, *c*, and then winds about it back to the posterior termination of the perivisceral cavity, fig. 27, *d*, from whence it passes forwards, coiling spirally as before, into the rectum, fig. 27, *e*, which disembogues through the aforesaid dorsal papilla.

The spiral portion of the intestine, lying as near as may be in the middle of the perivisceral cavity, consists of about 54 circumvolutions, fig. 27.

The fusiform muscle originates — a little on one side — immediately posterior to the outer extremity of the rectum, along which it protends to the middle of the perivisceral cavity, where it enters the spiral of the intestine, and passes straight down it to the posterior termination of the perivisceral cavity, to which it is attached, fig. 27, *c*.

The gullet and the œsophagus are webbed by strong muscular bands to the anterior portion of the inner surface of the proboscis; and a strong mesentery, consisting of connective tissue, and, in part, of muscular fibres, webs the intestine to the ventral surface.

The rectum is webbed to the wall of the body by numerous strong and rather broad tendinous bands; and from its anterior part issues a long muscular filament, attached to the first convolution of the intestine, fig. 27.

On the ventral surface of the œsophagus is seen a yellowish coloured vessel, exceedingly slender, but increasing in thickness as it passes farther back along the intestine, where, after sending off a few thickish branches to the intestine, it terminates cæcally, on the first convolution of the intestine, fig. 27, *f*. Anteriorly, we are unable to describe this vessel, coalescing as it apparently did, in the spirit-specimens, with the pharyngeal wall. Its contents, which bear a close resemblance to coagulated perivisceral fluid, consisted of numerous globular nucleal corpuscles.

On the dorsal surface of the gullet, a little to

et langt, rørformigt, gjennemsigtigt Legeme (det contractile Kar), der gaar et Stykke bag paa Tarmen, hvor det ender i en kolbeformig Blindsæk, Fig. 27, *g;* fortil løber det til Snabelens forreste Ende, hvor det deler sig, og danner Karringen, som følger Tentakelkraven i alle dens Bugtninger for at afgive Grene til Tentaklerne.

Retractorerne ere 4, hvoraf de to Bugretractorer ere meget lange og tage deres Udspring med 3 Rødder fra den forreste Del af Kropshulhedens bagerste Trediedel, Fig. 27, *l,* imedens Rygretractorerne udspringe fra det forreste Parti af Kropshulhedens midterste Trediedel, Fig. 27, *h.* Strax bagenfor Spiserørets forreste Ende forene de sig og danne ligesom en Skede om dette, idet de fæste sig som sædvanligt paa Mundskivens Rand.

To Segmentalorganer, Fig. 27, *i,* der ere meget smaa, omtrent 6^{mm} lange og 2^{mm} brede ved deres Tilhæftningssted. Lidt bagenfor dette og paa den Side, som vender imod Kropsvæggen, sees en liden oval, tragtformig Aabning, Fig. 28, *a,* der fører ind til Hulheden.

Centralnervestrængen ligger langs Midten af Bugfladen imellem begge Retractorerne og er temmelig tyk, Fig. 27, *k,* 29, *a.* Den afgiver paa sit hele Løb en Mængde Sidegrene, der som oftest udgaa afvexlende og tabe sig i Huden. Strax bagenfor Mundaabningen deler den sig i to Grene, Fig. 29, *b, b,* der slaa sig om Svælget for at komme op paa Rygsiden, hvor de tabe sig i et aflangt Ganglion (Hjerne), der er ligesom indsnøret paa Midten, Fig. 29, *c,* og som ligger imellem begge Rygretractorerne, just paa det Sted, hvor disse forene sig. Saavel fra Svælgringen som fra Gangliet udgaa flere Grene, Fig. 29.

Centralnervestrængen og dens Grene ere omgivne af en Bindevævsskede, der danner det egentlige Neurilem.

Paa hver Side af Nervestrængen iagttages et Muskelbaand, der er omtrent ligesaa bredt, som selve Nervestammen; det strækker sig fra Svælgringen op til Nervestrængens bagerste Ende og er fast forenet til den udvendige Sideflade af Neurilemmet. Dette Muskelbaand bestaar af stærke Muskelfibre, hvoraf enkelte strække sig ud over den Del af Sidegrenene, der ligger frit i Kropshulheden, men forsvinde efterhaanden som Grenene gaa ind i Muskellagene eller tabe sig i Huden.

Dr. Théel[1] har iagttaget og beskrevet lignende Muskelbaand hos *Phascolosoma Strombi.*

Intet Spor til Kjønsorganer har været at opdage.

Farven.

Selve Kroppen olivengrøn, mørkere paa den forreste og bagerste Del. Snabelen noget lysere; dens forreste

[1] Hjalmar Théel. Récherches sur le *Phascolion Strombi.* Kongl. Svenska Vetenskaps-Akademiens Handlingar, B. 24, No. 2.

the right, is seen a long, tubular, translucent body (the contractile vessel), protending a short distance back on the intestine, where it terminates in a cæcum, cucurbit-like in form, fig. 27, *g;* anteriorly, it passes forwards to the extremity of the proboscis, forming there the vascular ring, which accompanies the tentacular collar in all its windings, and sends off branches to the tentacles.

Number of retractors 4; two of them, the ventral retractors, which are exceedingly long, take their origin, with 3 roots, on the anterior portion of the posterior third of the perivisceral cavity, fig. 27, *l,* whereas the dorsal retractors originate on the anterior portion of the medial third of the perivisceral cavity, fig. 27, *h.* Immediately posterior to the anterior extremity of the œsophagus, the 4 retractors unite, and form, as it were, a sheath for that organ, being as usual attached to the margin of the oral disk.

Two segmental organs, fig. 27, *i,* exceedingly small, about 6^{mm} long and 2^{mm} broad at the point of attachement. A little posterior to the latter, and on the side facing the wall of the body, occurs a small, ovate, funnel-shaped aperture, fig. 28, *a,* leading down into the cavity.

The central nervous chord, which is comparatively thick, extends along the middle of the ventral surface, between the two ventral retractors, figs. 27, *k;* 29, *a.* Throughout its entire course it sends off numerous subsidiary branches, which, as a rule, issue alternately, and coalesce with the skin. Immediately posterior to the buccal aperture, it divides into two branches, fig. 29, *b, b,* which, winding round the gullet, reach up to the dorsal surface, and are there lost in an oval-shaped ganglion (brain), — constricted, as it were, in the middle, fig. 29, *c,* — lying between the two dorsal retractors, in the exact spot where they unite. Both from the pharyngeal ring and from the ganglion, proceed several branches, fig. 29.

The central nervous chord and its branches are invaginated in a sheath of connective tissue, which constitutes the true neurilem.

On either side of the nervous chord is observed a muscular band, about equal in breadth to the nervous trunk itself, extending from the pharyngeal ring to the posterior extremity of the nervous chord, and firmly affixed to the exterior lateral surface of the neurilem. These muscular bands consist of strong muscular fibres, some of which protend beyond the portion of the subsidiary branches lying free in the perivisceral cavity, but are gradually lost, as the branches pass into the muscular layers, or coalesce with the skin.

Dr. Théel[1] has observed and described similar muscular bands in *Phascolosoma Strombi.*

Of generative organs no trace could be detected.

Colour.

Trunk olive-green, both extremities of a darker shade. Proboscis somewhat lighter; its anterior extremity, for

[1] Hjalmar Théel. Récherches sur le *Phascolion Strombi.* Kongl. Svenska Vetenskaps-Akademiens Handlingar, B. 24, No. 2.

Ende fra Mundskiven og i en Strækning af omtrent 5^{mm} bagover smuk rosenrød, hvorefter følger et bredt mørkt brunliggrønt Belte. Mundskiven bleg, næsten hvid, med 10 røde Striber, der gaa fra Mundaabningen imod Tentakelbundterne. Tentakler rosenrøde, som Halsen.

Findested.

Et helt Exemplar og mange større og mindre Stumper paa Station 223. Et næsten helt Exemplar paa Station 267.

Slægtskarakter.

Mundskiven meget bred med 10 store Tentakelgrupper, mellem hvilke sidde enkelte Tentakler. Analaabningen strax bagenfor Snabelens Grund.

Artskarakter.

Legemet cylindrisk. Snabelen omtrent lige saa lang som Kroppen. Huden fast, læderagtig. Analaabningen paa en fremragende Papille. Tentaklerne sidde i 10 Grupper, 16 i hver Gruppe, og imellem hver to Grupper sidde et Par Tentakler, ialt 180. 4 Retractorer. Tarmen danner en Spiral. Spindelmuskel. Farven paa Kroppen olivengrøn, Snabelen lysere med en rosenrød Hals. Mundskiven næsten hvid med 10 røde Striber. Tentaklerne rosenrøde.

Fam. **Priapulidæ,** Baird.

Priapuloides typicus, Kor. & Dan.

Tab. III.

Fauna littoralis Norvegiæ. 3 Hefte, p. 147, Tab. XVI.

Priapulus bicaudatus, Dan.

Forhandlinger ved de skandinaviske Naturforskeres Møde, Christiania 1868, pag. 542.

Idet vi henvise til vor Beskrivelse af *Pr. typicus* i 3die Hefte af "Fauna littoralis Norvegiæ," skulle vi her meddele Resultaterne af vore yderligere Undersøgelser, som et paa Nordhavsexpeditionen indsamlet Materiale har sat os istand til at anstille.

Huden dannes af en halv gjennemsigtig, temmelig tyk, hvidgul Cuticula, der paa den udvendige Flade er tæt besat med Chitinpapiller, Fig. 3, *a.* Indenfor dette Chitinpantser er et smalt Epithellag, Fig. 3, *b*, som bestaar af korte, i en Række liggende Cylinderceller, der hvile paa et fibrillært Bindevævslag, Fig. 3, *c.* Dette er især bredt hvor det omgiver Centralnervestrængen, altsaa paa Midt-

about 5^{mm}, measuring backwards from the oral disk, a bright rosy-red, after which comes a broad belt of dark brownish-green. Oral disk pallid, almost white, with a series of 10 red stripes, stretching from the buccal aperture towards the tentacular fasiculi. Tentacles and throat rosy.

Locality.

A perfect specimen, and numerous fragments, varying in size, at Station 223. An almost perfect specimen at Station 267.

Generic Character.

Oral disk exceedingly broad, bearing 10 large tentacular groups, dispersed between which are a few isolated tentacles. Anal opening immediately posterior to the base of the proboscis.

Specific Character.

Body cylindrical. Proboscis and trunk about equal in length. Skin firm, coriaceous. Anal opening on a prominent papilla. Tentacles arranged in 10 groups, or fascicles, 16 in each group, and between every two groups a couple of isolated tentacles: total number accordingly 180. Retractors 4. The intestine forming a spiral. Fusiform muscle present. Colour of trunk olive-green, proboscis lighter, throat rosy-red. Oral disk almost white, traversed by 10 red-coloured stripes. Tentacles rosy.

Fam. **Priapulidæ,** Baird.

Priapuloides typicus, Kor. & Dan.

Pl. III.

Fauna littoralis Norvegiæ. Part III, p. 147, Pl. XVI.

Priapulus bicaudatus, Dan.

Forhandlinger ved de skandinaviske Naturforskeres Møde, Christiania, 1868, p. 542.

Referring to our description of *Pr. typicus* in Part III of "Fauna littoralis Norvegiæ," we will here record the results of further investigation, which additional materials, collected on the North-Atlantic Expedition, have enabled us to institute.

The skin consists of a semi-translucent, comparatively thick, whitish-yellow cuticle, densely studded over its outer surface with chitinous papillæ, fig. 3, *a.* Underneath this chitinous armature, extends a narrow epithelial layer, fig. 3, *b,* consisting of short cylindrical cells, arranged in a row, on a fibrillous layer of connective tissue, fig. 3, *c.* This layer is broadest where it envelops the central ner-

partiet af Bugfladen; men er paa den øvrige Del af Kroppen betydelig smalere.

Fra den ydre Flade af Bindevævslaget paa Glans udgaa Chitinpigge, Fig. 4, 5, der ere cylindriske, hule med en noget bredere Grunddel, Fig. 4, *a*, 5, *a*, og en lidt krumbøiet, smalere tilspidset fri Ende, Fig. 4, *b*, 5, *b*, forsynet med en fin rund Aabning. Indvendig ere de beklædte med Epithel, Fig. 4, *c*, 5, *c*, der forlænger sig op imod Spidsen, og udvendig ere de forsynede med en Skede, Fig. 4, *d*, 5, *d*, som er Fortsættelsen af Cuticula, der her er uden Chitinpapiller.

Ved Grunden af enhver Pig, og omfattet af denne, sees en næsten rund, temmelig stor Kjertel. Fig. 4, *e*, 5, *e*, der bestaar af en Bindevævsmembran, indvendig beklædt med runde Celler, Fig. 4, *f*, 5, *f*, og fra hvis hvælvede Del udgaar Udførselsgangen, Fig. 4, *g*, der løber op igjennem Piggens Hulhed, Fig. 4, *h*, 5, *g*, og munder ud just der, hvor dennes Epithelbeklædning ophører, Fig. 4, *i*, 5, *h*. Kjertelens Indhold var en seig, kornet, vandklar Masse, som vi et Par Gange saa i Piggens Aabning.

Paa den indvendige Flade af Piggens Skede, ved dennes Grund, inserer sig mange Muskelfibre, Fig. 4, *k*, 5, *i*, der have en skraa Retning nedenfra opad, indenfra udad, og som ere Grene af Ringmusklerne, Fig. 4, *l*.

Umiddelbart til Bindevævslagets indre Flade støder Muskellaget, der dannes af Ring- og Længdemuskler.

Ringmusklerne, Fig. 3, *d*, ere distinkt adskilte fra hverandre, staa tættere sammen i Glans, end paa den øvrige Kropsdel, og ligge nærmest Corium.

Længdemusklerne, Fig. 2, *a*, ligge indenfor Ringmusklerne, ere stærkere end disse og udgjøre 25 i Glans; men dele sig i to paa det Sted, hvor denne gaar over i Kroppen, saaledes at denne Del af Legemet bliver forsynet med 50.

I ethvert af de haleformige Appendices derimod er der kun 14 Længdemuskler, Fig. 2, *b*, der ere Fortsættelser fra enkelte af Kroppens saaledes, at i Regelen hver 3die eller 4de Længdemuskel afgiver en til Appendicet.

Saavel Ring- som Længdemusklerne ere omgivne af en temmelig fast Bindevævsskede, hvori spindelformige Bindevævslegemer ere leirede. Enhver af disse Muskler er sammensat af mange Bundter, 12—20, Fig. 3, *f*, der hver for sig er omgivet af en egen tynd Bindevævsmembran, Fig. 3, *g*, ligesom der imellem Bundterne er et med Kjerner forsynet Bindevæv, som egentlig er en Fortsættelse af den fælles Skede. I enhver Bundt er der en Mængde Fibriller, som ere stribede paa skraa, hvorved de faa et ganske eiendommeligt Udseende, naar de ere overskaarne. Fig. 3, *h*.

Paa store Exemplarer med udspændt Hud er denne gittret og ligner Sipunculushuden. Den indvendige Flade af Kropshulheden beklædes af et flimrende Peritoneum, der væsentlig bestaar af Bindevæv, hvori sees enkeltløbende Muskelfibre.

vous chord, accordingly in the middle of the ventral surface; elsewhere on the body it is much narrower.

From the outer surface of the layer of connective tissue on the glans (proboscis), spring a number of chitinous spikes, figs. 4, 5, cylindrical in form, hollow, broadest at base, figs. 4, *a;* 5, *a,* and with a slightly curved, acuminate free extremity, figs. 4, *b;* 5 *b,* in which is seen a minute circular opening. Internally, these spikes are invested with epithelium, figs. 4, *c;* 5 *c,* produced towards the point; externally, they are furnished with a sheath, figs. 4, *d;* 5 *d,* the continuation of the cuticle, which is destitute here of chitinous papillæ.

In the hollow of every spike, at the base, is seen an almost round, comparatively large gland, figs. 4, *e;* 5 *e,* composed of connective tissue, covered internally with round cells, figs. 4, *f;* 5 *f;* and from the arouate portion of these issues the excretory canal, fig. 4, *g,* which, passing up through the hollow of the spike, figs. 4, *h;* 5, *g,* disembogues exactly where the epithelial integument of the latter terminates, figs. 4, *i;* 5, *h.* The gland contained a viscid, granulous, pellucid substance, which we observed once or twice in the aperture at the free extremity of the spikes.

On the inner surface of the sheath, at its base, are inserted numerous muscular fibres, figs. 4, *k;* 5, *i,* protending obliquely — upwards from below, outwards from within; they are branches of the annular muscles, fig. 4, *l.*

Contiguous to the inner surface of the connective membrane, extends the muscular layer, composed of annular and longitudinal muscles.

The annular muscles, fig. 3, *d,* are distinctly separate, each from each, more closely arranged in the glans than elsewhere throughout the trunk, and adjoin the corium.

The longitudinal muscles, fig. 2, *a,* lying underneath the annular muscles, are stronger than the latter. They number 25 in the glans, dividing dichotomously where that organ meets the trunk, which is furnished therefore with 50.

Each of the caudiform appendages has only 14 longitudinal muscles, fig. 2, *b,* continuations of those in the trunk, every 3rd or 4th of which is as a rule produced to an appendix.

Both the annular and the longitudinal muscles are invested with a sheath of comparatively firm connective tissue, throughout which are dispersed fusiform corpuscles of connective tissue, fig. 3, *a.* These muscles are all of them built up of numerous fascicles, from 12 to 20, fig. 3, *f,* each enveloped in a separate covering of thin connective tissue, fig. 3, *g;* and in between the fascicles extends, too, a layer of nucleal connective tissue, which, in a strict sense, is a continuation of the common sheath. In each fascicle are numbers of fibrils, transversely striate, which gives them, on being cut through, a most characteristic appearance, fig. 3, *h.*

In large examples, the skin, when distended, is tesselated, and resembles the skin in *Sipunculus.* The inner surface of the perivisceral cavity is invested with a ciliated peritoneum, consisting chiefly of connective tissue, in which protend isolated muscular fibres.

I vor Beskrivelse over *Priapuloides typicus* ("Fauna littoralis Norvegiæ") omtalte vi, at der i Mundhulheden var 8 Rækker Tænder; dette maa vi nu berigtige.

Hele Mundhulheden er besat med Tænder, Fig. 2, *c*, der staa i ringformige Rækker i hele den forreste Del, imedens Rækkerne i den bagerste Del antage en mere skraa Retning.

I den første Række er der 5 store Tænder, som staa temmelig langt fra hverandre; men imellem hver 2 af disse findes paa fuldt udvoxede Individer to mindre Tænder, der paa det af os i "Fauna littoralis Norvegiæ" beskrevne Exemplar ikke vare fremkomne.

Bagenfor den 10de Række blive Tænderne saa smaa, at de ikke kunne sees med blotte Øine, og jo mere de nærme sig Indgangen til Spiserøret, jo mindre blive de, ligesom de antage en simplere Form. Disse Tænder, Fig. 6, 7, ere pyramideformede, have en bred, næsten firkantet Basaldel, Fig. 6, *a*, ere lidt krumbøiede og løbe ud i en noget bøiet Spids, Fig. 6, *b*, 7, der vender indad og lidt nedad mod Mundhulheden. Den Del af Tænderne, der vender imod Hulhedens Væg, er næsten flad. Disse Tænder udgjøre altsaa den tredie Form, der af os tidligere var overseet.

Samtlige Tænder ere hule og beklædte med et lidt forskjelligt formet Cylinderepithel. I de store Tænder, der indtage Mundhulens forreste Del, Fig. 8, bestaar Epithelet af Cylinderceller, som have en lidt langstrakt Form; men i de smaa enkle Tænder, som vi ovenfor have beskrevet, ere Cylindercellerne overmaade lange, Fig. 7, *a*, og ligne meget de Celler, der udgjør Epithelbeklædningen paa Tarmens Tverfolder, Fig. 10, og som senere skulle omtales.

Ligesom Tænderne egentlig ere Fortsættelser og Omdannelser af det almindelige Chitinovertræk, saaledes er deres indre Epithelialbeklædning en Fortsættelse af Hudens eller Tarmens Epitheliallag. Selve Tandspidsen er aldrig hul; men altid kompakt og fast, Fig. 7, *b*.

Svælghovedet, Fig. 9, har paa den ydre aflange Flade en hel Del Muskler, der ligge i 2 Lag.

Det ydre Lag bestaar af 8 temmelig brede, 8—10^{mm} lange Muskler, Fig. 9, *a*, som tage deres Udspring paa Svælghovedets bagerste Del med en lidt bredere Basis, og som fæste sig omkring Mundaabningen, indenfor Retractorerne.

Det indre Lag er sammensat af flere, men noget smalere Muskler, Fig. 9, *b*, der have samme Udspring og Fæstepunkt som det ydre Lags Muskler. Disse Muskler tjene sikkerlig til at presse Mundhulheden sammen og forkorte den. Bagenfor disse Musklers Udspring, hvor Svælghovedet gaar over i Spiserøret, har dette paa dets ydre Flade en stærk Indsnøring, Fig. 9, *c*; denne er omgivet af en Mængde Muskler, der fæste sig strax bagenfor de nysbeskrevne Svælgmuskler; men forene sig noget bagtil til en næsten tendinøs Membran, Fig. 9, *e*, som indsererer sig paa en Vold, der omgiver Spiserørets ydre Flade, Fig. 9, *f*.

In our description of *Priapuloides typicus* ("Fauna littoralis Norvegiæ"), the cavity of the mouth is stated to have 8 rows of teeth. This was an error, which we must now rectify.

The whole cavity of the mouth is dentiferous, fig. 2, *c*. Anteriorly, the teeth are disposed in annular series; posteriorly, in series somewhat oblique.

The first row consists of 5 large teeth, rather far apart; but in the space between, full-grown individuals have two smaller ones, 8 in all, which had not developed in the specimen described in "Fauna littoralis Norvegiæ."

Posterior to the 10th series, the teeth are so minute as to be invisible to the naked eye, and the nearer they approach the entrance to the œsophagus, the more minute do they become, assuming at the same time a simpler form. These teeth, figs. 6; 7, are pyramidic, having a broad and almost quadrangular base, fig. 6, *a*, somewhat arcuate and slightly bent at the point, figs. 6, *b*; 7, which is turned inwards, and a little downwards, towards the cavity of the mouth. The part of the teeth that faces the wall of the cavity is very nearly flat. These teeth constitute accordingly the third form, overlooked in our previous description.

The teeth are all hollow, and invested with cylindric epithelium, varying in form. On the large teeth, occupying the anterior portion of the cavity of the mouth, fig. 8, the epithelium consists of cylindric cells, somewhat elongate in form; but on the minute, simple teeth, described above, the cylindric cells are exceedingly large, fig. 7, *a*, and bear considerable resemblance to the cells of the epithelial integument on the transverse folds of the intestine, fig. 10, to be described in due course.

Precisely as the teeth, in a strict sense, are transformed continuations of the common chitinous integument, so too is the inner epithelial tunic simply a continuation of the skin, or of the epithelial layer of the intestine. The points of the teeth are never hollow, but invariably firm and compact, fig. 7, *b*.

The gullet, fig. 9, is furnished on its exterior oblong surface with numerous muscles, arranged in 2 layers.

The outer layer consists of 8, comparatively broad muscles, 8—10^{mm} in length, fig. 9, *a*, which have their origin on the gullet, with a somewhat broader base, and are attached round the buccal aperture, underneath the retractors.

The inner layer is built up of several muscles, a trifle narrower, fig. 9, *b*, having the same point of origin and attachment as those of the outer layer. These muscles must assuredly serve to close up and shorten the cavity of the mouth. Posterior to the origin of these muscles, where the gullet opens into the œsophagus, is seen, on the outer surface of the latter, a deep instriction, fig. 9, *c*, surrounded by numbers of muscles, which are attached immediately posterior to the pharyngeal muscles just described; they unite however a little farther back, forming an almost tendinous membrane, fig. 9, *e*, which is inserted

Imellem denne Muskelmembran og selve Spiserøret opstaar saaledes et Rum, Fig. 9, *g*, der udfyldes af Kropsvædsken. Dette Muskelapparat, som ogsaa findes hos *Priapulus caudatus*, men i en noget forandret Form, tjener til at holde Indsnøringen paa Spiserøret og den paa dettes indre Flade derved fremkomne Fold i Situs.

Men foruden det nævnte Muskelapparat findes endnu et andet og mere særegent, der er endnu mærkeligere, og som ikke *Pr. caudatus* har. Strax bagenfor den Vold, hvorpaa den førnævnte Muskelmembran fæster sig, sees en kredsformig Række af Muskler, Fig. 9, *h*, der omgive Spiserøret, som just her atter har en Indsnøring; men meget mindre end hin. Disse Muskler ere egentlig Grene af Tarmens Længdemuskler, hvilke her optræde selvstændigt, idet de danne egne isolerede Muskler, som fæste sig paa den oftere omtalte Vold, Fig. 9, *f*, og tjene til at dirigere den anden mindre Fold paa Spiserørets indre Flade. Ogsaa her er et Rum imellem denne Søilekreds af Muskler og Spiserørets ydre Flade, der beskylles af Kropsvædsken.

Hvor Mundhulheden gaar over i Spiserøret er der paa den indre Flade en stærkt fremragende, kredsformig Fold, Fig. 2, *d*, der er tæt besat med de smaa ovenfor beskrevne Tænder; strax bagenfor denne Fold er atter en anden lignende, der dog ikke er saa fremtrædende, som hin, og er uden Tandbeklædning. Imellem disse Folder er en Fordybning, hvor Spiserøret egentlig tager sin Begyndelse. Tandvæbningen ophører med den første Fold.

Spiserøret er temmelig kort, og paa den indre Flade forsynet med stærke Længdefolder, Fig. 2, *e*, som ligger tæt ved Siden af hverandre og sende tildels ligesom Broer over fra den ene til den anden; det udvider sig noget, idet det gaar over i Tarmen, Fig. 2, *f*, som er temmelig vid med meget tykke Vægge, og paa hvis indre Flade findes tæt i hverandre staaende Tværfolder, der rage noget ind i Lumenet, Fig. 2, *g*. Mod den bagerste Ende bliver Tarmen smal og ender i en kort Rectum, Fig. 2, *h*, med sin runde Analaabning, der er forsynet med en meget stærk Sphincter.

Langs Tarmens udvendige Flade, saavel paa Rygsom Bugsiden, løber en Muskelstræng fra Anus fortil og fæster sig paa Svælghovedet; den er bundet til Tarmen ved et yderst smalt Mesenterium, der dannes væsentligst af Bindevæv, og hvori sees enkelte Muskelfibre.

Den histologiske Bygning af Fordøielseskanalen er følgende: Svælghovedets Vægge kunne betragtes som en Indkrængning af Kropshuden. Den indre Flade er en temmelig tyk Chitinhud forsynet med Tænder, Fig. 8, *a*, udenfor den er Epithellaget, der bestaar af temmelig korte Cylinderceller, Fig. 8, *b*, lig dem der danne Hudens Subcuticularlag. Epithelet er bundet til et temmelig tykt, fibrillært Bindevævslag, der støder umiddelbart til Muskelhuden, som bestaar af Længde- og Ringmuskler, hvilke ere

into a ridge surrounding the outer surface of the œsophagus, fig. 9, *f*. Between this muscular membrane and the œsophagus, there extends accordingly a space, fig. 9, *g*, which is filled up by the perivisceral fluid. This muscular apparatus, with which *Priapulus caudatus* is also furnished, but in a somewhat different form, serves to keep *in situ* alike the instriction of the œsophagus and the fold it occasions on the inner surface of the latter.

But, exclusive of this apparatus, there is another, much more remarkable and characteristic, not met with in *Pr. caudatus*. Immediately behind the ridge to which the aforesaid muscular membrane is attached, occurs a circular series of muscles, fig. 9, *h*, surrounding the œsophagus, which at this point exhibits another instriction, much less deep however than that previously described. These muscles are strictly branches, proceeding from the longitudinal muscles of the intestine, which occur here as isolated independent muscles, affixed to the aforesaid ridge, fig. 9, *f*, and serve to govern the smaller fold on the inner surface of the œsophagus. Here, too, a space intervenes between the columnar circle of muscles and the outer surface of the œsophagus, which is washed by the perivisceral fluid.

Where the cavity of the mouth opens into the œsophagus, is seen, on the inner surface, an exceedingly prominent circular fold, fig. 2, *d*, densely studded with the minute teeth described above; immediately posterior to this fold, occurs another, but less prominent, and not dentiferous. Extending between these folds is a depression, in which the œsophagus strictly originates. The dentition terminates with the first fold.

The œsophagus is comparatively short, and furnished on its inner surface with longitudinal folds, fig. 2, *e*, protending side by side, with bridges, as it were, thrown across in places from one to the other; it slightly expands as it enters the intestine, fig. 2, *f*, which is comparatively wide, with exceedingly thick walls, and has on the inner surface a number of closely arranged transverse folds, jutting out a little into the lumen, fig. 2, *g*. Near its posterior extremity, the intestine narrows, terminating in a short rectum, fig. 2, *h*, with a round anal aperture, which is furnished with an exceedingly powerful sphincter.

Along the outer surface of the intestine, alike on the dorsal and on the ventral side, a muscular chord protends anteriorly from the anus, and is attached to the gullet; it is webbed to the intestine by an exceedingly narrow mesentery, composed chiefly of connective tissue, and in which are seen a few muscular fibres.

The histological structure of the alimentary canal is as follows: — The walls of the gullet may be regarded as an invagination of the skin of the body. A thickish chitinous membrane, furnished with teeth, fig. 8, *a*, forms the inner surface; above it, extends the epithelial layer, consisting of comparatively short cylindric cells, fig. 8, *b*, similar to those which constitute the subcuticular layer of the skin. The epithelium is webbed to a thickish layer of fibrillous connective tissue, directly adjoining the

meget stærke. Udenpaa Ringmuskellaget er Peritonealbeklædningen bunden ved Bindevæv.

Spiserørets og Tarmens Vægge ere noget forskjellige fra Svælgets. Epithellaget, der beklæder den indre Flade, er temmelig bredt og dannes af meget lange Cylinderceller, hvis bredere Del vender mod Tarmhulheden. Mangfoldige af disse Cylinderceller vare fyldte med en finkornet, gulagtig Protoplasmamasse, og adskilte sig fra de andre, der vare ganske vandklare og havde et mere grovkornet Indhold. Om disse gulagtige Cylinderceller fungere som Kjertler, der afsondrede den store Mængde Slim, som sammenkittete Tarmindholdet, skulle vi ikke afgjøre med nogen Bestemthed, ihvorvel det forekommer os sandsynligt. Dette Slim var altid i størst Mængde tilstede i den egentlige Tarm, hvor den paa enkelte Exemplarer dannede ligesom et membranøst Overtræk, der formentlig var dannet af det i Alcohol coagulerede Slim.

I det omtalte membranøse Overtræk saaes en stor Mængde yderst fine, lange Folder, der havde en saa skuffende Lighed med lange Haar eller Cilier, at vi i Begyndelsen antoge dem derfor, en Antagelse, der tilsyneladende var begrundet i den Omstændighed, at Prof. Ehlers i sit Arbeide over Slægten *Priapulus*[1] beskriver netop en Chitinhud paa Tarmfladen, hvorfra mange fine, stive Haar udgaa.

Epithellaget, der paa sin indre Flade synes at være forsynet med Cilier, er fæstet til et stærkt Bindevævslag; Fig. 10, *b*, der sender listeformige Forlængelser ind i Epithelet og danner derved de paa den indre Væg af saavel Spiserøret som Tarmen fremragende Folder, Fig. 10, *c*. Disse Bindevævslister ere rigere paa Bindevævslegemer, end det øvrige Bindevæv. Udenpaa Bindevævet er nu Muskelhuden med sine to bestemte Lag, nemlig Længde- og Ringmuskler, hvilke sidste ere bundne til Peritonealovertrækket ved et smalt Bindevævslag.

Centralnervestrængen løber langs Midten af Bugfladen, Fig. 1, *a*, ikke som hos Gephyreerne ialmindelighed paa dennes indre Flade; men i Hudens Bindevæv, imellem Muskel- og Epithellaget. Fig. 3, *k*. Hvor Nervestammen ligger, er det fibrillære Bindevæv stærkt udvidet og omgiver den paa en beskyttende Maade, Fig. 3, *c*.

Centralnervestrængen er indesluttet i en tyk Bindevævsskede, Fig. 3, *l*, der sender en Forlængelse fra den ene Væg til den anden, tvers igjennem Nervestammen, Fig. 3, *m*. Denne bliver derved delt i to Dele, hvoraf den indre er bredest, Fig. 3, *n*, og har en lidt mørkere Farve. Saavel fra denne Skillevæg, som fra Skedens indre Flade

[1] E. Ehlers. Ueber die Gattung *Priapulus*. Zeitschrift f. wiss. Zoologie. 11 Band, pag. 205.

muscular integument, which consists of longitudinal and annular muscles, exceedingly strong. The peritoneal tunic is webbed on to the layer of annular muscles by connective tissue.

The walls of the œsophagus and the intestine differ slightly from those of the gullet. The epithelial layer investing the inner surface is comparatively broad, and consists of exceedingly long cylindric cells, with the broader portion facing the intestinal cavity. Many of these cylindric cells were full of a finely granulous, yellowish protoplasmatic mass, and differed from the others, which were perfectly hyaline, and contained a more coarsely granulous substance. Whether these yellowish cylindric cells serve the purpose of glands, whose function is to secrete the abundant supply of mucus that glues together the contents of the intestine, we shall not venture to decide, though such, we conceive, is highly probable. Most of this mucus was met with in the intestine itself, where, in some of the specimens, it actually formed a kind of membranous tunic, the mucus having probably been coagulated by the action of the alcohol.

In this membranous tunic were seen a great number of long and exceedingly narrow folds, presenting so illusive a resemblance to long capillaments, or cilia, that at first we regarded them as such; and more especially, since Professor Ehlers, in his Memoir on the genus *Priapulus*,[1] describes such a chitinous membrane on the surface of the intestine, from which proceed numerous stiff, slender capillaments.

The epithelial layer, which would appear to be furnished on its inner surface with vibratile cilia, is webbed to a layer of strong connective tissue, fig. 10, *b*, from which cornice-like prolations of connective tissue are produced into the epithelium, thus occasioning the prominent folds, fig. 10, *c*, on the inner wall of both the œsophagus and the intestine. These cornice-like prolations are more abundantly furnished with corpuscles of connective tissue than any other part of the connective membrane. Next above the connective tissue comes the muscular integument, with its two layers of longitudinal and annular muscles, the latter webbed to the peritoneal tunic by a narrow layer of connective tissue.

The central nervous chord protends along the middle of the belly, fig. 1, *a*, not on the inner surface, as in most of the *Gephyrea*, but in the connective tissue of the skin, between the muscular and epithelial layers, fig. 3, *k*. Round the nervous trunk, the fibrillous connective tissue, which invests it with a protective covering, fig. 3, *c*, is greatly distended.

The central nervous chord is enclosed in a thick membranous sheath, fig. 3, *l*, which sends a filament from one wall to the other, piercing the nervous trunk, fig. 3, *m*. Hence the latter is divided into two sections, the inner, of a darker colour, being the broader, fig. 3, *n*. Both from this partition-wall and from the inner surface of the sheath,

[1] E. Ehlers. Ueber die Gattung *Priapulus*. Zeitschrift f. wiss. Zoologie. 11 Band, pag. 205.

udgaa Prolongationer af Bindevæv imellem Nervefibrillerne, hvilke ere forsynede med Bindevævslegemer i stor Mængde. Man har her aabenbart et Perineurium svarende til det hos de høiere Dyr.

Nervestrængen er sammensat af Nervefibriller i dens centrale Dele; og i dens Peripheri, altsaa nærmest Skeden, er et celluløst Lag, hvis enkelte Celler vare lidt aflange og forsynede med en Kjerne, uden at det var muligt at iagttage noget Protoplasmaindhold.

Uagtet Centralnervestrængen ligger særdeles nær Legemets ydre Flade, synes den dog at være godt beskyttet mod ydre Indvirkninger ved det stærke Bindevævslag, som omgiver den, ved den tykke Bindevævsskede og endelig ved dennes mange Prolongationer imellem Fibrillerne.

Fra Centralnervestrængen udgaa mange Grene til Hud og Muskler. Naar den er kommen fortil imod Svælget deler den sig i to Grene, der slaa sig omkring Spiserøret og danne derved Svælgringen, som er indesluttet i en Bindevævsskede.

Kjønnet er adskilt. Æggestokkene ligge en paa hver Side af Endetarmen, ere langstrakte med bladformige Indskjæringer, Fig. 2, *i*, og have en temmelig tyk, fast Udførselsgang, Fig. 2, *k*, der ligger overfladisk paa Rygsiden, tager sin Begyndelse et lidet Stykke bagenfor Æggestokkens frie afrundede Ende, Fig. 2, *l*, og aabner sig udad strax ovenfor Appendicet, Fig. 2, *k*.

Paa hele Bugsidens Midtparti er et stærkt, bredt Mesenterium, der binder Æggestokken til Kropsvæggens indre Flade. Dette Mesenterium strækker sig langt fortil, bliver smalere og ender omtrent der, hvor Kropshulhedens bagerste Trediedel tager sin Begyndelse.

Æggestokken dannes af en stor Mængde aflange, blæreformige Legemer med deres Udførselsgange, der aabne sig i den store Udførselskanal, hvis Lumen er temmelig vidt. Blærerne bestaa af en tynd Bindevævshud, der paa den indre Flade har et kjernerigt Epithel, hvori Æggene udvikle sig, og paa hvis ydre Flade saaes spredte Muskelfibre, beklædte af Peritoneum.

Udførselsgangene havde et meget stærkere Bindevævslag; Epithelet, som beklæder den indre Flade, bestod af Cylinderceller, og paa Bindevævets ydre Flade var en rigere Mængde Muskelfibre.

I mange af Blærerne vare, næsten fuldt udviklede Æg, i andre vare Æg i tidligere Stadier, og i atter andre saaes ingen Æg, men kun Epithelbeklædningen.

Hvad nu Hannens Kjønsorganer betræffer, saa kunne vi ikke meddele noget Væsentligt derom; thi Testiklerne paa det Exemplar, vi undersøgte, vare temmelig beskadigede; vi bleve dog overbeviste om, at vi havde med en Han at gjøre, saasom en Mængde ret vel vedligeholdte Spermatozoer med deres korte Haler iagttoges.

produced filaments of connective tissue pass between the nervous fibrils, which are abundantly furnished with corpuscles of connective tissue. We have here indubitably a true *perineurium*, the analogue of that organ in more highly developed animals.

The centre of the nervous chord consists of nervous fibrils, whereas the peripheral part, or that nearest the sheath, is a cellular layer, the cells composing it being slightly oblong in form, and furnished with a nucleus; we failed however to detect any protoplasmatic contents.

Although the central nervous chord protends in close proximity to the outer surface of the body, it would nevertheless appear to be sufficiently well protected, viz. by the strong layer of connective tissue that surrounds it, by its thick membranous sheath, and by the numerous filaments produced from the latter between the fibrils.

The central nervous chord sends off a great many branches to the skin and the muscles. Anteriorly, a short distance from the gullet, it divides into two branches, which, winding round the œsophagus, form the pharyngeal ring, sheathed in connective tissue.

The sexes separate. The ovaries — one on either side of the rectum — are elongate in form, with petaloid incisions, fig. 2, *i*, and have a firm-textured and comparatively thick eferent duct, fig. 2, *k*, protending close to the surface on the dorsal side; it takes its origin a little posterior to the free rounded extremity of the ovary, fig. 2, *l*, and opens externally, immediately above the appendix, fig. 2, *k*.

The medial portion of the ventral surface is wholly invested with a broad and strong mesentery, which webs the ovaries to the inner surface of the wall of the body. This mesentery, reaching a considerable distance forwards, gradually narrows, and terminates at the commencement of the posterior third of the perivisceral cavity.

The ovary is built up of numbers of elliptical, vesicular corpuscles, each with an eferent duct, opening into the great excretory canal, the lumen of which is comparatively wide. The vesicles consist of thin connective tissue, having its inner surface covered by nucleal epithelium, wherein the ova develop, and on the outer surface of which were seen isolated muscular fibres, invested with a peritoneal tunic.

The eferent ducts had a much stronger layer of connective tissue; the epithelium clothing the inner surface, consisted of cylindrical cells; and on the outer surface of the connective tissue, the number of muscular fibres, too, was greater.

Many of the vesicles contained almost fully mature ova; in some, the egg was in various stages of development; others exhibited no traces whatever of ova, being quite empty: nothing was seen but the epithelial covering.

As regards the generative organs in the male, we have nothing essential to communicate, since the testes in the specimen examined had been much injured; we felt convinced, however, that the individual in question was a male, having observed a considerable number of spermatozoa, with their short caudæ, comparatively perfect.

Professor Ehlers har i det nys citerede Tidsskrift leveret en særdeles god monographisk Bearbeidelse af Slægten *Priapulus*, hvortil *Priapuloides* i mange Henseender slutter sig. Vore histologiske Undersøgelser over begge disse Slægter have i enkelte Punkter ledet til Resultater, der ere noget forskjellige fra dem, Ehlers er kommen til over *Priapulus*, og om end Afvigelserne ikke ere meget store, skulle vi dog fremhæve dem.

Ved Huden omtaler Ehlers et subcuticulart Lag, der ligger indenfor Chitinlaget, og som efter ham bestaar af et finkornet Lag, hvori ingen Celler tydelig kunde sees, og som ligger imellem Ringmusklerne og Chitinhuden. Vi have fundet constant et temmelig udpræget Epithellag indenfor Chitinhuden, bestaaende af Cylinderceller; dette Epithellag er fæstet til et stærkt Bindevævslag, hvortil Muskelhuden er bunden. Det synes, som om Prof. Ehlers ganske har overseet dette Bindevævslag, hvis ikke han har antaget det finkornede Subcuticularlag derfor.

De paa Snabelens ydre Flade siddende Pigge ere omgivne af en Skede, Fig. 11, *a*, 12, *a*, der er en Forlængelse af Chitinhuden; kun er Skeden kortere hos *Priapulus* end hos *Priapuloides*. Den hule Pig har i Spidsen en Aabning, Fig. 11, *b*, 12, *b*, og er indvendig beklædt med et Epithel, Fig. 11, *c*, Continuation af Hudens Epithellag, ligesom der ved Grunden af Piggen er en Kjertel med sin Udførselsgang, Fig. 11, *d*. Ehlers omtaler hverken Skeden eller Kjertelen, ei heller Aabningen i Piggens Ende, hvorigjennem Kjertelsekretet udføres.

Cuticula (Chitinlaget) er hos *Priapuloides* tæt besat med koniske Chitinpapiller, imedens den hos *Priapulus* er glat.

Folderne paa Tarmrørets indre Flade dannes af fremspringende Bindevævslister, hvortil Epithelet er fæstet. Dette bestaar af meget lange Cylinderceller, der sandsynligvis ere forsynede med Cilier. Imellem Cylindercellerne saaes særegne Celler, som vi have antaget for Slimkjertler. Ehlers angiver, at den indre Flade af Tarmen paa *Priapulus* har et Chitinovertræk, der efter ham skal være en Fortsættelse af den ydre Huds Chitinlag, og at dette Chitinovertræk ikke alene danner Tarmfolderne; men at det i den midterste Tarmdel er forsynet med lange, stive Chitinhaar.

Vi have tidligere angivet, at vi paa Tarmens indre Flade af et Exemplar af *Priapuloides*, ligesom vi ogsaa paa et Exemplar af *Priapulus* saa noget, der kunde antages for en tynd Chitinhud med de nævnte Haar; men det viste sig ved nærmere Undersøgelse at være et Overtræk dannet af coaguleret Slim. De Cilier, vi have iagttaget paa Tarmepithelet, vare indenfor den omtalte og af Ehlers antagne Chitinhud, hvilket end mere bestyrker os i, at denne ikke kan være andet end en Tilfældighed.

Professor Ehlers has lately furnished, in the Journal cited above, a most excellent monographic review of the genus *Priapulus*, with which *Priapuloides* in many respects is found to congrue. Our histological investigation of both genera has been attended with results deviating slightly in certain points from those of Ehlers for *Priapulus;* and though the difference is not considerable, it will be well to point out wherein the observations that have led to it diverge.

Professor Ehlers describes a subcuticular layer in the skin, underlying the chitinous layer, and which consists of a finely granulous stratum — in which no cells could be readily distinguished — extending between the annular muscles and the chitinous cuticle. We have found, as a constant feature, underneath the chitinous integument a comparatively well developed epithelial layer, consisting of cylindrical cells; this epithelial layer is attached to a layer of strong connective tissue, webbed to the muscular integument. Professor Ehlers would appear to have overlooked altogether this layer of connective tissue, unless indeed it is this which he terms the finely granulous subcuticular layer.

The spikes on the outer surface of the proboscis are enclosed in a sheath, figs. 11, *a;* 12, *a*, — the chitinous integument produced; but the sheath is shorter in *Priapulus* than in *Priapuloides*. The hollow spikes have each an aperture at the point, figs. 11, *b;* 12, *b*, and are invested on the inner surface with epithelium, fig. 11, *c*, — a continuation of the epithelial layer of the skin; and moreover, there is at the base of every spike a gland, furnished with an excretory duct, fig. 11, *d*. Ehlers mentions neither the sheath, the gland, nor the aperture at the pointed extremity of the spike through which exudes the glandulous secretion.

The cuticle (chitinous layer) in *Priapuloides* is densely studded with conical chitinous papillæ, whereas it is smooth in *Priapulus*.

The folds on the inner surface of the intestinal canal consist of prominent membranous fillets, attached to the epithelium. The latter consists of exceedingly large cylindrical cells, furnished probably with vibratile cilia. Between the cylindrical cells were seen other cells, possibly mucous glands. According to Ehlers, the inner surface of the intestine in *Priapulus* is invested with a chitinous tunic, a continuation, as he conceives, of the chitinous layer in the outer integument; and in his opinion, this chitinous tunic not only produces the folds of the intestine, but is furnished on the medial portion of the latter with long, bristly chitinous capillaments.

We have previously stated, that we, too, detected on the inner surface of the intestine in a specimen of *Priapuloides*, and also in a specimen of *Priapulus*, what might be taken for a thin chitinous skin, bearing such capillaments; but, on closer examination, it proved to be coagulated mucus. The cilia we have observed on the intestinal epithelium, occurred underneath Ehlers' supposed chitinous integument, a circumstance affording additional proof of the feature in question being strictly casual.

Det er heller ikke godt at forstaa, hvorledes Fordøielsen og Ernæringen skulde kunne foregaa med Lethed, naar hele Tarmens indre Flade var overtrukket med en Chitinhud, der jo under almindelige Forhold er uigjennemtrængelig for Vædske, medmindre den var forsynet med en Mangfoldighed af Porer, og noget saadant omtaler ikke Prof. Ehlers. Vore Undersøgelser have overbevist os om, at Chitinovertrækket ophører ved Spiserørets Begyndelse.

Saavel hos *Priapuloides* som hos *Priapulus* have Muskelfibrillerne en skraa Stribning.

Professor Ehlers er den første, der har paavist Nervesystemet hos *Priapulus,* og vi have ved vore Iagttagelser saavel over denne Slægt som over *Priapuloides* ikke alene stadfæstet hans Observationer, men ogsaa i histologisk Henseende fuldstændiggjort dem.

Fam. **Bonellidæ,** Baird.

Hamingia[1] **arctica,** n. g. n. sp.

Tab. IV, V.

Lacaze-Duthiers omfatter kun 2 Slægter henhørende til denne Familie, nemlig *Bonellia,* Rolando, og *Thalassema,* Cuvier. Den af os nu opstillede 3die Slægt, *Hamingia,* have vi troet at maatte henføre til nævnte Familie, omendskjøndt den mangler baade Snabel og Børster, der jo ere angivne som Mærker for Familien. Men som vi senere skulle paavise, nærmer *Hamingia* sig i sin Organisation ikke alene til *Thalassema,* men i væsentlig Grad ogsaa til *Bonellia,* saa at vi ikke have kunnet opgive Familieforholdet til disse, trods de nævnte Mangler.

Bonellia viridis, der først er beskrevet af Rolando, tiltrak sig snart Zoologernes Opmærksomhed ved sine Besynderligheder baade i Form og Organisation; men desuagtet hengik omtrent et halvt hundrede Aar, inden dette mærkelige Dyrs Organisation blev fuldstændig opklaret. Aarsagen laa hovedsagelig i Vanskeligheden ved at erholde Dyret levende og i tilstrækkelig Mængde, omendskjønt det var temmelig almindeligt endog paa ringe Dybde i Middelhavet og paa de korsikanske Kyster.

Her i Norden er en af os (Koren), den første, der for omtrent 40 Aar siden fandt *Bonellia viridis* ved Bergen paa en Dybde af 50 Favne, og han paabegyndte dengang en anatomisk Undersøgelse af den, hvilken han af Mangel paa fornødent Materiale maatte opgive; thi *Bonellia viridis* er i det Hele taget sjelden ved de norske Kyster,

[1] Hamingja, Lykkegudinde i den nordiske Mythologie.

Indeed, it is hard to conceive how the animal could digest and assimilate its food with facility, were the whole of the inner surface of the intestine invested with a chitinous skin, impermeable as is the latter, under ordinary conditions, to all fluid substances, unless abundantly furnished with pores, of which no mention is made by Prof. Ehlers. Our examination of the new specimens has fully convinced us, that the chitinous tunic terminates at the origin of the œsophagus.

The muscular fibrils both in *Priapuloides* and *Priapulus* are obliquely striate.

Professor Ehlers was the first to show the existence of a nervous system in *Priapulus;* and our investigation alike of this genus and of *Priapuloides* bears out and, histologically, completes his observations.

Fam. **Bonellidæ,** Baird.

Hamingia[1] **arctica,** n. g. n. sp.

Pl. IV, V.

According to Lacaze-Duthiers, 2 genera only are comprised in the family *Bonellidæ,* viz. *Bonellia,* Rolando, and *Thalassema,* Cuvier. The animal representing the new genus established here, we have seen fit to class under this family, though wanting in two important characters assigned to the latter: bristles and a proboscis. *Hamingia,* however, as will afterwards appear, not only resembles *Thalassema* in its general organisation, but *Bonellia* too, and closely; wherefore we could not but regard the animal as a nearly related congener, in spite of defective characteristics.

Bonellia viridis, first described by Rolando, soon drew the attention of zoologists to its numerous peculiarities of form and organisation; but well nigh half a century was nevertheless to elapse, ere all questions pertaining to the economy of this remarkable animal had been finally settled. The chief reason of this lay in the difficulty of obtaining live-specimens in sufficient number, although the animal is rather common than otherwise in the Mediterranean, at a trifling depth, and on the coasts of Corsica.

In Northern Europe, the first who met with an example of *Bonellia viridis* was one of ourselves (Koren), about 40 years ago, near Bergen, at a depth of 50 fathoms. He commenced an anatomical examination of this specimen, but had to break it off from lack of materials; for *Bonellia viridis* is comparatively rare on the Norwegian

[1] Hamingja, the Fortuna of Northern Mythology.

og er ikke funden nordligere, end ved Bergen. Det er nu til dette Dyr, *Hamingia arctica* slutter sig mest, idet den danner en interessant Overgangsform; kun maa vi beklage, at vi kun have havt 1 Exemplar til vore Undersøgelser.

Ydre Karakterer.

Legemet er cylindrisk med en glat, lidt slimet Overflade, er 120^{mm} langt, 20^{mm} tykt paa Midten, men smalner noget af mod begge Ender, Fig. 1.

Den forreste Ende er langstrakt, but afskaaren, og paa den findes Mundaabningen, der danner en Spalte med tykke, foldede Læber, og vender mod Bugfladen, Fig. 1, *a*, 2, *a*. Omkring Mundaabningen sees to halvmaaneformige Hudfolder, Fig. 1, *b*, 2, *b*, der paa Rygfladen ere temmelig fremspringende og staa et Stykke fra hinanden, imedens de mere og mere nærme sig hinanden mod Bugfladen, hvor den forreste Fold forener sig med den bagerste i en stump. Vinkel, Fig. 2, *c*, saa at der bliver en liden Del af Munden, der ikke omfattes af de nævnte Folder. Imellem den forreste Fold og Munden er en yderst smal Indsynkning, hvorved Mundlæberne blive ligesom mere fremtrædende, Fig. 2, *d*; men imellem den forreste og bagerste Fold er Indsynkningen baade bredere og dybere, Fig. 2, *e*. Disse Folder kunne vel betragtes som en rudimentær Snabel.

Omtrent 20^{mm} fra Mundpartiet findes paa Bugsiden to lange, cylindriske, krumbøiede Papiller, der staa ved Siden af hinanden, og paa hvis fri Spids, der vender mod Munddelen, iagttages en fin Aabning, Fig. 1, *c*, 2, *f*.

Kroppens bagerste Ende er afrundet, og i dens Centrum sees den runde Analaabning, Fig. 3.

Huden.

Huden er blød, halv gjennemsigtig, og dannes af en yderst tynd, strukturløs Cuticula, Fig. 4, *a*, der dækker det hyaline Bindevævslag, som er temmelig bredt, og hvori er leiret dels enkeltvis, dels i Grupper, Celler, Fig. 4, *b*, 5, *a*; imellem hvilke sees uformede Pigmenthobe. Her findes ikke noget Epithellag; men de nævnte Celler, der som oftest ere fyldte med et finkornet, grønt Pigment, saa at Kjernen ganske skjules, kunne i større Strækninger være enkeltvis sammenhængende, og faar da et epithelignende Udseende, Fig. 4, *c*, imedens tilgrændsende Steder kunne være ganske blottede for Celler. Imellem disse Pigmentceller, men som oftest dybere end dem, sees aflange Bindevævslegemer.

Indenfor det hyaline Bindevævslag er Muskelhuden, der bestaar af 3 distinkte Lag, nemlig Ringmuskler, Længdemuskler og Skraamuskler.

Ringmusklerne ere de yderste og ligge nærmest det hyaline Bindevævslag; de bestaa af smale Fibriller, der

coast, and has not been taken farther north than Bergen. Now it is this animal with which *Hamingia arctica* exhibits the closest agreement, representing a transition-form of very considerable interest: we regret however to state, that we have had but one specimen whereupon to base our observations.

External Characters.

Body cylindrical, with a smooth and slightly mucid surface, 120^{mm} long, 20^{mm} thick in the middle, but narrowing a little towards the extremities, fig. 1.

On the anterior extremity, which is elongate and obtusely truncate, occurs the buccal opening, as a slit or cleft, with thick, folded lips, facing the ventral surface, figs. 1, *a*; 2, *a*. Round the buccal opening extend two lunate cutaneous folds, figs. 1, *b*; 2, *b*, rather prominent on the dorsal surface, and a little apart, whereas they gradually converge on the ventral surface, and form an obtuse angle, fig. 2, *c*, leaving a small portion of the mouth which the said folds do not encircle. Between the anterior fold and the mouth, occurs an exceedingly narrow depression, which gives increased prominence to the buccal labia, fig. 2, *d*; between the anterior and posterior folds, the depression is broader and deeper, fig. 2, *e*. These folds may be regarded as a rudimentary proboscis.

About 20^{mm} from the buccal region, on the ventral surface, are seen two long, cylindrical, arouate papillæ, placed side by side, the free extremity of which, facing the buccal section, is furnished with a minute aperture, figs. 1, *e*; 2, *f*.

Posterior extremity of the body rounded, with the anal orifice in the centre, fig. 3.

Skin.

The skin is soft, semi-translucent, and consists of an exceedingly thin, structureless cuticle, fig. 4, *a*, covering the hyaline layer of connective tissue, which is comparatively broad, and has dispersed throughout it, either isolated or in groups, a number of cells, figs. 4, *b*; 5, *a*, between which are seen amorphous lumps of pigment. There is no epithelial layer; but the cells are generally full of a finely granulous, green pigment, by which the nucleus is entirely hidden, and being sometimes connected, two and two together, they resemble epithelium in appearance, fig. 4, *c*, whereas spots directly adjacent will be sometimes altogether destitute of cells. Between these pigmentary cells, but, as a rule, deeper down, are seen elliptical corpuscles of connective tissue.

Underneath the hyaline layer of connective tissue, extends the muscular integument, composed of 3 distinct layers, viz. a layer of annular muscles, a layer of longitudinal muscles, and a layer of oblique muscles.

The annular layer, adjoining the hyaline layer of connective tissue, is the outermost; its muscles consist of

ved Bindevæv ere sammenbundne til en Hud, Fig. 4, *d*.

Længdemusklerne ere bredere, ligge indenfor Ringmusklerne og danne ligeledes en sammenhængende Hud, Fig. 4, *e*.

Indenfor Længdemusklerne, altsaa nærmest Kropshulheden, kun skilt fra denne ved Peritonealovertrækket, findes Skraamuskellaget, Fig. 4, *f*, hvis Muskler ere ligesaa stærke som Længdemusklerne, men ere fjernede noget længere fra hverandre, hvorved det sammenbindende Bindevæv bliver noget bredere. Ogsaa dette Lag danner en sammenhængende Hud.

Sammenlignes nu Huden hos *Hamingia* med Bonelliens, saa vil der findes baade Overensstemmelser og Afvigelser.

Efter Schmarda[1] skal der i Bonelliens Hud være et udpræget Epitheliallag, bestaaende af Cylinderceller, indenfor hvilket skal findes et maskedannende Hudlag, som dannes af stærke sammenvævede Cellevævsfibre og Kar.

I dette Lag fandt Schmarda enkelte Pigmentceller og større Hobe af samme, hvilke forenede sig til kjertelagtige Organer. Indenfor dette Lag angiver han Muskellaget bestaaende af Længde- og Ringfibre, paa den forreste Kropsdel føier sig dertil skjæve Muskelfibre.

Allerede Lacaze-Duthiers[2] har paavist, at der ikke findes noget særegent Kjertelapparat i Huden hos *Bonellia*, hvilket ogsaa stemmer overens med Grabers[3] Undersøgelser. Denne Forsker betvivler stærkt Tilstedeværelsen af Cylinderepithellaget; derimod tror han at have fundet en Mængde talrige Porekanaler gjennemboret Cuticula, indenfor hvilken han angiver et kornet Matrixlag, i hvilket findes kjerneagtige Indleiringer, snart enkeltvis, snart i Grupper. Indenfor dette Matrixlag har han fundet det egentlige Bindevævslag, der bestaar af hyalint Bindevæv, hvori findes sparsomt Bindevævslegemer. Sammenvævede Cellevævsfibre og Kar har Graber ikke fundet. Det vil heraf sees, at Huden hos *Hamingia* nærmer sig i histologisk Henseende meget til Bonelliens Hud ifølge Grabers Iagttagelser; men afviger dog noget fra den. Saaledes er Cuticula langt fra saa bred og heller ikke gjennemboret af Porekanaler hos *Hamingia*, som Tilfældet er hos *Bonellia;* noget Matrixlag findes ikke, derimod et hyalint Bindevævslag med indleirede, tildels pigmenterede Celler, nogenlunde svarende til hvad der findes hos *Bonellia*. Endelig har *Hamingia* et tredie Muskellag, nemlig de skraa Muskler, som Graber aldeles ikke omtaler hos *Bonellia*, imedens Schmarda angiver, at paa dennes forreste Kropsdel føier skraa Muskler

[1] Schmarda. Denkschrift. der k. k. Akad. der Wissenschaft in Wien. Tom. IV, pag. 117, pl. 4—7.

[2] Lacaze-Duthiers. Recherches sur la Bonellie. Annal. des Sciences nat. III Série. Tome X, pag. 53.

[3] Graber. Sitzb. der Akad. der Wissenschaften. Wien. 1te Abth. Jän.-Heft. Jahrgang 1873.

slender fibrils, which, being webbed together by connective tissue, constitute a continuous membrane, fig. 4, *d*.

The longitudinal muscles are broader, lie underneath those of the annular layer, and constitute, like the latter, a continuous membrane, fig. 4, *e*.

Underneath the longitudinal muscles — accordingly nearest the perivisceral cavity, with only the peritoneal tunic between — is seen the oblique layer, fig. 4, *f*, the muscles of which are as strong as those in the longitudinal layer, but somewhat farther apart, giving greater breadth to the connective tissue that webs them together. This layer, too, constitutes a continuous membrane.

On comparing the skin in *Hamingia* with that in *Bonellia*, it will be found to exhibit both agreement and difference.

According to Schmarda,[1] the skin in *Bonellia* has a well developed epithelial layer, consisting of cylindrical cells, underneath which is said to extend a reticulated tegumentary layer, composed of strong interwoven vessels and fibres of cellular tissue.

In this layer, Schmarda found a few isolated pigmentary cells, and agglomerations of such, which, uniting, formed glandulous organs. Underneath this layer, extends, he states, the muscular layer, composed of longitudinal and annular fibres, to which are united, on the anterior portion of the body, oblique muscular fibres.

Years ago, Lacaze-Duthiers[2] showed there was no special glandular apparatus in the skin of *Bonellia;* and since then, Graber[3] has been led to form a similar conclusion. Indeed, that observer very much questions the existence of a cylindric epithelial layer, whereas he believes to have detected a cuticle perforated by canaliculated pores, extending underneath a granulated layer of matrix, throughout which were dispersed, both isolated and in groups, agglomerations of nucleal corpuscles. Underneath this layer of matrix, was the true layer of hyaline connective tissue, sparingly furnished with corpuscles of connective tissue. Interwoven fibres of connective tissue, and vessels, Graber did not observe. Hence it is obvious, according to Graber's investigation, that the skin in *Hamingia* bears, histologically, considerable resemblance to that in *Bonellia*, though not strictly agreeing. Thus, for instance, the cuticle is far less broad in *Hamingia* than in *Bonellia*, nor is it perforated by canaliculated pores; moreover, it has no layer of matrix; but there is a layer of hyaline tissue, with cells, in part pigmentary, much the same as in *Bonellia*. Finally, *Hamingia* is furnished with a third muscular assemblage, viz. the oblique layer, of which Graber makes no mention whatever as occurring in *Bonellia*, whereas Schmarda distinctly states,

[1] Schmarda. Denkschrift. der k. k. Akad. der Wissenschaft in Wien. Tom. IV, pag. 117, pl. 4—7.

[2] Lacaze-Duthiers. Recherches sur la Bonellie. Annal. des Sciences nat. III Série. Tome X, pag. 53.

[3] Graber. Sitzb. der Akad. der Wissenschaften. Wien. 1te Abth. Jän. Heft. Jahrgang 1873.

sig til Ring- og Længdemusklerne.[1]

Fra Schmardas Iagttagelser afviger derimod vore temmelig betydeligt; thi hverken have vi fundet fibrillært Bindevæv, maskeformigt sammenvævet med Kar, eller Kjertelorganer. Vi ere tilbøielige til at betragte saavel de enkelte, som de i Grupper i det hyaline Bindevæv leirede Celler, hvori indeholdes et yderst finkornet, grønligt Pigment, for egne Pigmentceller, der vel i den ydre Hud ere bundne til det hyaline Bindevæv; men som vi senere skulle se træffes baade i fibrillært Bindevæv og i Muskellagene, uden at de tilkjendegive sig som Kjertelorganer.

Fordøielsesorganerne.

Mundspalten, der gaar paalangs og er begrændset af tykke muskuløse Læber, fører ind til en sækformig Udvidning (Mundhulheden), som er 9^{mm} lang og omtrent 10^{mm} i Gjennemsnit paa det Videste; men smalner saa stærkt af, at der, hvor den gaar over i Svælget, er den kun 3^{mm}. Denne Mundhulhed dannes af en rørformig Forlængelse af den ydre Hud, og paa dens indre Flade sees flere stærkt fremragende, temmelig brede, circulære Folder, der dog ere mest fremspringende paa Rygfladen, og hvoraf de to nærmest Mundspalten ere de betydeligste. De aftage noget imod Svælget.

Mundhulhedens Vægge bestaa af de samme Væv, som Huden. Paa den indre foldede Flade iagttages et tykt Lag Cylinderepithel (sandsynligvis flimrende), der rager ind i Hulheden, og er især tykt paa de fremragende Folder, som dannes af fortykket Bindevæv; udenfor Epithellaget er et temmelig bredt fibrillært Bindevævslag, hvor Fibrene anastomosere med hverandre, og hvori er leiret, dels enkeltvis, dels spredte Grupper af de samme Celler og Pigmenthobe, som findes i den ydre Hud, kun i en rigeligere Mængde. Dette Bindevævslag støder umiddelbart til Muskellaget, der bestaar af Ring-, Længde- og Skraamuskler, og i disse Lag sees ogsaa de nysnævnte Celler og Pigmenthobe, men sparsommere. Skraamuskellaget er beklædt af Peritoneum.

Hele Mundhulhedens ydre Flade er ved en Mængde stærke Bindevævstraade, hvortil enkelte Muskelfibre føie sig, bunden til den forreste Del af Kropsvæggen. Der, hvor Mundhulheden gaar over i Svælget, er paa den ydre Flade en meget stærk Indsnøring, og paa den tilsvarende indre Flade er der en bred Fold, der rager cirkelformig ind i Hulheden og danner en Slags Sphincter, idet den er forsynet med stærke Ringmuskelfibre. Folden dannes af fortykket Bindevæv.

[1] Dr. J. W. Spengel har fundet et Skraamuskellag overalt i Huden hos *Bonellia viridis*. Mittheilungen aus der zoologischen Station zu Neapel, 1te B. 3te Heft, 1879.

that on the anterior portion of the body, oblique muscles adjoin the annular and longitudinal layers.[1]

Meanwhile, Schmarda's observations differ materially from the results of our own examination; for neither did we remark any fibrillous connective tissue interlaced with vessels, nor any description of glandular organs. The cells scattered throughout the hyaline tissue, whether isolated or in groups, we are disposed to regard as special pigmentary cells (they contain a minutely granulous, greenish pigment), webbed indeed, in the outer skin, to the hyaline connective tissue, but which, as will afterwards appear, are met with alike in the fibrillous tissue and in the muscular layers, though not as glandulous organs.

Digestive Organs.

The buccal cleft, extending lengthwise, and margined by thick muscular labiæ, passes into a sac-like expansion (the buccal cavity), 9^{mm} long and about 10^{mm} in diameter where it is thickest, but narrowing so rapidly as to measure only 3^{mm} in diameter at the gullet. This buccal cavity is the result of a tubular elongation of the outer integument; and on its inner surface occur several broad, circular, exceedingly prominent folds, most protuberant on the dorsal surface, the two in immediate proximity to the buccal cleft being the largest. These folds become less salient in the vicinity of the gullet.

The walls of the buccal cavity consist of the same tissue as that in the skin. On the inner, folded surface, is seen a thick layer of cylindric epithelium (probably furnished with vibratile cilia), which extends into the cavity, and is thickest on the prominent folds, consisting of inspissated connective tissue. Above the epithelial layer lies a broadish layer of fibrillous connective tissue, with anastomosing fibres, throughout which are dispersed, isolated and in scattered groups, cells and amorphous lumps of pigment, similar to those in the outer skin, only in greater abundance. This layer of connective tissue directly adjoins the muscular integument, which is built up of annular, longitudinal, and oblique muscles; and these layers, too, are furnished with the aforesaid cells and pigmentary lumps, but more sparingly. The oblique muscular layer is invested with a peritoneal tunic.

The entire outer surface of the buccal cavity is webbed by numbers of strong filaments of connective tissue and a few muscular fibres to the anterior portion of the wall of the body. At the commencement of the gullet, is seen on the outer surface of the buccal cavity a very deep instriction, and on the inner surface occurs a broad fold, projecting with a circular sweep into the cavity, where it forms a kind of sphincter, being furnished with strong annular muscular fibres. The fold consists of incrassated connective tissue.

[1] Dr. J. W. Spengel has invariably observed a layer of oblique muscles in the skin of *Bonellia viridis*. Mittheilungen aus der zoologischen Station zu Neapel, 1te B. 3te Heft, 1879.

Svælget, Fig. 6, *b*, er yderst trangt, knapt 2^{mm} i Gjennemsnit, har en straagul Farve, løber i Bugtninger fra Høire til Venstre, og er bunden saavel paa Ryg- som Bugsiden ved et Mesenterium til Kropsvæggen.

Svælgets Vægge ere tykke og dannes af et indre Epithellag (Slimhud), der er tykt, bestaar af et Lag lange Cylinderceller, Fig. 7, *a*, der paa den indadvendte Ende synes at være forsynede med Cilier. Denne Slimhud gjør dybe, regelmæssige Indsynkninger, Fig. 7, *b*, *b*, i det tilgrændsende fibrillære, meget kjernerige Bindevæv, Fig. 7, *c*, saaledes nemlig, at derved fremkommer ringformige Fordybninger, hvilke give Spiserøret paa dets ydre Flade et ringet Udseende, noget lig en Trachea hos de høiere Dyr, Fig. 6, *c*. I Bunden af Slimhudsindsynkningerne er Epithellaget tykkere end paa Siderne. Til dette fibrillære Bindevæv fæster sig udad Muskelhuden, der bestaar af Længdemuskler, Fig. 7, *d*, der ere de inderste, samt Ringmuskler, Fig. 7, *e*, der ere tykkere end hine. Saavel Længde- som Ringmusklerne anastomosere med hinanden indbyrdes.

Spiserøret gaar nu over i en bredere Del af Tarmrøret, Fig. 6, *c*, som paa venstre Side gjør et Par Bøininger, gaar saa lidt til Høire, Fig. 6, *d*, løber derpaa horizontalt bag til Kropshulhedens forreste Trediedel, Fig. 6, *e*, bøier sig fortil langs venstre Side i en Længde af 12^{mm}, Fig. 6, *f*, hvor den ved en Bøining løber lidt paa Skraa over til høire Side, hvorved den første Tverslynge opstaar, Fig. 6, *g*; her gjør den en let Bøining, løber saa horizontalt langs høire Side til omtrent Midten af Kropshulheden, Fig. 6, *h*, hvor den danner en anseformig Bøining, Fig. 6, *i*, idet den gaar over til venstre Side, hvorved den 2den Tverslynge fremkommer, Fig. 6, *k*. Alt hvad der af Tarmrøret ligger foran den anseformige Bøining og lige til Mundaabningen kalder Lacaze-Duthiers Buccaldelen hos *Bonellia viridis*, idet han ikke som Schmarda differentierer Mundhulhed og Spiserør fra det øvrige Tarmrør.

I anatomisk-histologisk Henseende er Tarmrøret fra Svælget til den anden Tverslynge ikke væsentlig forskjellig fra Spiserøret; det er noget videre og Væggene noget tyndere.

Den anden Tverslynge, naar den er kommen over til Venstre, gjør en Bøining og løber saa over til Høire, hvorved 3die Tverslynge opstaar, Fig. 6, *l*; her danner den en stor Anse for at gaa stærkt paaskraa over til Venstre: den 4de Tverslynge, Fig. 6, *n*, hvor den bliver noget smalere og bøier sig atter for at komme over paa høire Side, hvorved den 5te Tverslynge, Fig. 6, *o*, dannes.

De 4 sidste Tverslynger svarer til Lacaze-Duthiers Leverdel hos *Bonellia viridis*. De ere i anatomisk-histologisk Henseende noget forskjellige fra det øvrige Tarmrør, idet Væggene ere tyndere; Epithellagets (Slimhudens) Ind-

The gullet, fig. 6, *b*, is exceedingly narrow, hardly 2^{mm} in diameter, straw-coloured, winds from right to left, and is webbed, both on the dorsal and the ventral side, to the wall of the body by a mesentery.

The pharyngeal walls are thick, and consist of an inner layer of epithelium (mucous integument), which is also thick; it consists of a layer of long cylindrical cells, fig. 7, *a*, furnished apparently, on the side turning inwards, with vibratile cilia. This mucous skin corrugates the fibrillous, nucleal tissue adjacent, fig. 7, *c*, with a number of deep, regular troughs, fig. 7, *b*, *b*, in such wise as to produce annular depressions, which give to the outer surface of the œsophagus an annulated appearance, not unlike that of the trachea in more highly organised animals, fig. 6, *c*. At the bottom of the troughs in the mucous skin, the epithelial layer is thicker than at the sides. To this fibrillous connective tissue, is webbed from without the muscular integument, composed of longitudinal muscles, fig. 7, *d*, — the innermost layer, — and of annular muscles, fig. 7, *e*, somewhat thicker than the former. Both the longitudinal and annular muscles anastomose reciprocally.

The œsophagus now opens into the broader portion of the intestinal canal, fig. 6, *c*, which, on the left side, makes a twist or two, passes a little to the right, fig. 6, *d*, protends from thence horizontally back to the anterior third of the perivisceral cavity, fig. 6, *e*, winds forwards along the left side for about 12^{mm}, fig. 6, *f*, where, after making a twist, it takes a somewhat oblique direction across to the right, thus completing the 1st transverse circumvolution, fig. 6, *g*. Here it makes a slight twist, protends horizontally along the right side about to the middle of the perivisceral cavity, fig. 6, *h*, where, after making an ansiform twist, fig. 6, *i*, it passes across to the left side, and terminates the 2nd transverse circumvolution, fig. 6, *k*. The whole of the intestinal canal extending forwards from the ansiform twist to the oral aperture, Lacaze-Duthiers terms the buccal region, that naturalist not having, like Schmarda, distinguished the oral cavity and the œsophagus from the remainder of the intestinal canal.

As regards its anatomical-histological structure, the section of the intestinal canal extending between the gullet and the second transverse circumvolution, does not differ materially from the œsophagus, being merely a little wider, and with somewhat thinner walls.

On reaching the left side, the second transverse circumvolution makes a twist, and then passes across to the right side, thus producing the 3rd transverse circumvolution, fig. 6, *l*. At this point it protends, with a wide bend, very obliquely across to the left side (4th transverse circumvolution, fig. 6, *n*,), where its thickness has slightly diminished. It now makes another twist, across to the right side, and forms the 5th transverse circumvolution, fig. 6, *o*.

The 4 last transverse circumvolutions represent the liver-section in *Bonellia viridis*, according to Lacaze-Duthiers. Their anatomical-histological structure differs somewhat from that distinguishing the remainder of the intestinal

synkninger i Bindevævet ere ikke saa dybe, og staa heller ikke saa tæt i hinanden, og foruden de almindelige Cylinderceller, som i Spiserøret, findes der i Epithelet en stor Mængde pæreformige encellede Kjertler, Fig. 11, *f* (Leverceller), der svare fuldkommen til Tarmkjertlerne hos Bonellien. Disse Kjertler ligge tildels i Grupper, der kunne sees med en stærk Loupe igjennem Tarmvæggen, Fig. 6, *k, l, m, o.*

Naar den 5te Tverslynge har naaet hen til høire Side, bliver den meget smalere. Tarmrøret løber nu i flere Bøininger skraa fortil under de tidligere omtalte paatversgaaende Slynger, lige henimod den første Tverslynge. Paa denne Strækning gjør den en Mangfoldighed af smaa Circumvolutioner, Fig. 6, *p, p.* Nu bøier den sig hen mod venstre Side, hvor den gjør en Bøining for at løbe langs denne i en horizontal Retning mod Kropshulhedens bagerste Trediedel, Fig. 6, *q, q,* hvor den danner en Slynge, Fig. 6, *r,* for i samme horizontale Retning at gaa fortil imod Midten af Kropshulheden, Fig. 6, *s,* her skraar den over mod høire Side under de øvrige Tarmslynger; den bøier sig nu i en skraa Retning mod Midtlinien af Kropshulheden, Fig. 6, *t,* og gjør atter en Mængde Circumvolutioner, indtil den gaar over i en paaskraa løbende Rectum, Fig. 6, *u,* der først udvider sig lidt, men bliver saa smalere, idet den munder ud i Kloaken.

Fra den 5te Tverslynge og indtil Analaabningen, — der svarer til den Del hos *Bonellia viridis,* som Lacaze-Duthiers har kaldet Analdelen, — har Tarmrøret den samme Bygning, som tidligere er angivet for den Del, der strækker sig fra Spiserøret til 2den Tverslynge, og er følgelig uden noget Kjertelapparat.

Langs Tarmrørets Bugflade, især paa den forreste Del, sees et Bindevævsbaand, hvortil Bugmesenteriet er fæstet, og hvori et Blodkar iagttages; paa den bagerste Del er dette Bindevævsbaand tyndere. Det synes paa enkelte Steder at stramme Tarmen saaledes, at dennes Bugflade bliver foldet; men det er kun paa et Par Slynger, at saa er Tilfældet.

Bugmesenteriet bestaar af en stor Mængde smalere og bredere Bindevævstraade, hvori tildels findes Muskelfibre, hvilke fæste Tarmrøret til Kropshulheden. Et lignende Mesenterium, men langt zartere, iagttages ogsaa langs Tarmens Rygflade, der fæster denne til Kropshulhedens Rygflade.

Kloaken er bunden ved en Mængde stærke fibro-muskuløse Baand til Kropsvæggen, hvilke udbrede sig straaleformigt paa denne og danne derved ligesom et Telt, Fig. 6, *v,* under hvilket 2de buskede Organer ere placerede, et paa hver Side af Rectum. Tarmrørets ydre Flade er forsynet med et flimrende Peritonealovertræk.

canal, the walls are thinner; the depressions of the epithelial layer (mucous membrane) in the connective tissue are not so deep, or so close together; and exclusive of the ordinary cylindrical cells (those in the skin of the œsophagus, for instance), numbers of pyriform, unicellular glands, fig. 11, *f* (hepatic cells), occur dispersed throughout the epithelium — the exact analogue of the intestinal glands in *Bonellia.* Part of these glands are arranged in groups, which may be seen, under a strong magnifier, through the wall of the intestine, fig. 6, *k, l, m, o.*

On reaching the right side, the 5th transverse circumvolution diminishes very considerably in thickness. The intestinal canal now passes obliquely forward, twisting repeatedly, beneath the transverse circumvolutions described above, to the first circumvolution. On its course it forms a great many small convolutions, fig. 6, *p, p.* It now bends across to the left side, along which it protends, after making a twist, in a horizontal direction, to the posterior third of the perivisceral cavity, fig. 6, *q, q,* where it forms a circumvolution, fig. 6, *r,* and then passes on, horizontally as before, to the middle of the perivisceral cavity, fig. 6, *s;* here it takes an oblique direction across to the right side, beneath the other circumvolutions, and then bends obliquely on towards the mesial line of the perivisceral cavity, fig. 6, *t,* again forming a number of convolutions, till it enters an obliquely protending rectum, fig. 6, *u,* which expands a little at its commencement, but grows narrower where it disembogues into the cloacum.

From the 5th transverse circumvolution to the anal opening, — which represents the part in *Bonellia viridis* termed by Lacaze-Duthiers the anal region, — the intestinal canal exhibits the structure described above as characterising the part that extends from the œsophagus to the 2nd transverse circumvolution: hence it has no glandular apparatus.

On the ventral surface of the intestinal canal — more particularly the anterior part — is seen a membranous band (webbed to the ventral mesentery), in which there is a blood-vessel: this membranous band has its posterior portion thinner than the remainder. In some places, it would appear to stretch the intestine, corrugating the ventral surface of the latter; this is the case, however, only with one or two of the convolutions.

The ventral mesentery consists of numerous filaments of connective tissue, in some of which are muscular fibres, that serve to attach the intestinal canal to the perivisceral cavity. A similar mesentery, but far more delicate in structure, is seen, too, on the dorsal surface of the intestine, which it webs to the dorsal surface of the perivisceral cavity.

The cloacum is webbed to the wall of the body by numerous strong fibro-muscular bands, which, radiating on the latter, form, as it were, a tent-like enclosure, fig. 6, *v,* under which are placed two bunchy organs, one on either side of the rectum. The outer surface of the intestinal canal is invested with a ciliated peritoneal tunic.

Man vil af ovennævnte Beskrivelse se, at Tarmrøret vel danner Slyngninger, men ikke, som hos *Bonellia viridis* (efter Lacaze-Duthiers), danner nogen Spiral omkring den lange Æggebeholder (matrix, la poche génitale).

Hele Mundhulheden var udfyldt af sandholdigt Ler, hvori fandtes forskjellige Foraminiferer, Diatomeer, Alger og Ascarider. Svælget var tomt; men strax bagenfor dette havde det sandholdige Indhold for endel formet sig til cylindriske, langstrakte Boli med afrundede Ender, 3—4^{mm} lange og 1.5—2^{mm} tykke, og jo længere bag i Tarmen, desto hyppigere bleve disse, saa at hele den Del, der strækker sig fra 5te Tverslynge og til Anus, var ganske opfyldt af disse Excrementer.

De to buskede Organer ere næsten kugledannede, 3—4^{mm} store, og ere fæstede et paa hver Side af Rectum, strax foran Kloakaabningen, Fig. 8, *a, a*. De have en cylindrisk Stamme, der danner et Rør, som ved Udspringet er nøgent i en Længde af omtrent 1^{mm}, Fig. 8, *b;* men fra den øvrige Del af Stammen udgaar en Mængde rørformige Grene, Fig. 9, *a,* hvorfra udspringer en stor Mangfoldighed af lange, smale, slangeformige Rør, Fig. 9, *b, b*. Disse have paa deres frie Ende en tragtformig Aabning, som fører ind til Rørets Hulhed, og hvis Rand er forsynet med lange Cilier, Fig. 9, *c, c,* 10.

I histologisk Henseende dannes de nævnte Organer væsentligst af de samme Elementer, som Tarm- eller Kloakvæggen, hvoraf de egentlig kunne betragtes som en Udstylpning. Den indre Flade er tapetseret af et rigt flimrende Epithel, der rager ind i Hulheden, og hvis Celler ere store, dels runde, dels mere eller mindre aflange; de have en temmelig stor Kjerne og et yderst finkornet brungrønt Pigment, der ofte er saa tæt og tykt, at det ganske skjuler Kjernen, Fig. 12, *a, a;* 13, *b, b*. Epithelet er fæstet til et fibrillært Bindevævslag, hvortil Muskelhuden støder, hvilken bestaar af Længde- og Ringfibre, som beklædes af det flimrende Peritoneum, som altsaa danner den ydre til Kropshulheden vendende Flade. Indeni Rørenes Lumen iagttoges en hel Del smaa fritliggende runde Legemer, der vare noget sammenskrumpede, forsynede enten med Kjerne eller nogle faa Molecular, Fig. 13, *c,* og som lignede de Legemer, Kropsvædsken indeholdt, hvilke tildels vare koagulerede i Klumper. Hovedstammen aabner sig paa Kloakens indre Flade imellem et Par af dens stærke Folder.

Af den her givne Beskrivelse af de buskede Organer, vil det sees, at de saagodtsom ganske svare til de, der findes paa samme Sted hos *Bonellia viridis*, og som Schmarda har antaget for Respirationsorganer, idet han finder dem analoge med Holothuridernes.

Lacaze-Duthiers har underkastet de nævnte Organer en nøiere Granskning, og derved paavist, at de først og fremst maa betragtes som et Kjertelapparat, som han kalder Analsække (poches anales), imedens han dog opstiller som en Mulighed, at de tillige kunne staa i Respirationens

From the description given above, it will be seen, that the intestinal canal does indeed form numbers of circumvolutions, but not, as in *Bonellia viridis* (according to Lacaze-Duthiers), a spiral coil round the elongated uterus (matrix, la poche génitale).

The whole of the buccal cavity was distended with sabulous clay, containing divers Foraminifera, Diatoms, Algæ, and Ascaridæ. The gullet was empty; but immediately posterior to that organ, part of the sabulous contents had become moulded into cylindrical, elongated boli, rounded at the extremities; and these fæcal pellets — 3.4^{mm} long and 1.5—2^{mm} broad — were found to increase in number, the farther they extended down the intestine, the part between the 5th transverse circumvolution and the anus being entirely filled with them.

The two bunchy organs, almost globular in form and 3—4^{mm} in diameter, are attached to the rectum, one on either side, immediately in front of the cloacal opening, fig. 8, *a, a*. They have a cylindrical trunk, forming a tube, which at the point of origin is smooth for about 1^{mm} of its length; but the remaining portion of the trunk sends off numbers of tubular branches, from which issue a multitude of long, slender, serpentine tubes, fig. 9, *b, b*. These tubes have at their free extremity a funnel-shaped aperture, leading to the hollow of the tube; the margin of the aperture is furnished with long cilia, fig. 9, *c, c;* 10.

As regards their histological structure, these organs are built up chiefly of the same elements as the intestinal and cloacal walls, of which indeed they may be regarded as a bossed expansion. The inner surface is clothed with vibratile epithelium, projecting into the hollow of the tube; and the cells, which are large, and in part round, in part elliptical, contain a largish nucleus and a minutely granulated brownish-green pigment, frequently so dense and opaque as to entirely conceal the nucleus, figs. 12, *a, a;* 13, *b, b*. The epithelium is webbed to a layer of fibrillous connective tissue, adjoining the muscular integument, which consists of longitudinal and annular fibres invested with the vibratile peritoneum; the latter accordingly constitutes the exterior surface facing the perivisceral cavity. In the lumen of the tubes were seen numbers of free globose corpuscles, somewhat shrunk or shrivelled, containing a nucleus or a few granular molecules, fig. 13, *c,* and which resembled the corpuscles in the perivisceral fluid, whereof part had coagulated into clots. The trunk itself opens on the inner surface of the cloacum, between two of its prominent folds.

From the above description, it is obvious that these bunchy organs almost perfectly correspond with the organs similarly located in *Bonellia viridis*, which Schmarda held to be respiratory tubes, analogous to the "trees" in Holothurians.

Lacaze-Duthiers, who subjected these organs to a more rigorous investigation, has shown them to be fundamentally a glandular apparatus — anal sacs (poches anales), though they may likewise, he thinks, in some way, be subservient to respiration. If so, one part would, in

Tjeneste. Han formener da, at et Parti af dem skulde udføre Secretionsorganets Rolle, imedens et andet kunde fungere som Lunger.

Ifølge vore Undersøgelser, som rigtignok ere foretagne paa et enkelt Exemplar, opbevaret i Spiritus, hvilket dog blev observeret og tegnet i levende Liv, antage vi, at de heromhandlede Organer hos *Hamingia* ere analoge med Holothuridernes saakaldte Lunger; men som vi for Molpadidernes Vedkommende have paavist at være Tarmappendices (Secretionsorganer), der intet have med Respirationen at bestille. At disse Organer hos *Hamingia* ogsaa ere Afsondringsapparater og ikke Lunger, synes at fremgaa ikke alene af deres Bygning, men ogsaa af den Omstændighed, at de ikke staa i nogen Forbindelse med Blodcirculationen.

I det Døgn, Dyret blev observeret i levende Liv, aabnede Kloakaabningen sig kun saa ofte Excrementerne bleve udstødte; noget Søvand kunde ikke trænge ind igjennem den ved en stærk Sphincter lukkede Aabning, ligesom Endetarmen og Kloaken viste sig at være propfulde af de før beskrevne Excrementer. Men det staar ikke til at nægte, at de her omtalte Organer ere noget forskjellige fra Holothuridernes benævnte Lunger. Disse, der hovedsagelig bestaa i større og mindre Samlinger af blæreformige Blindsække, staa ikke i nogen directe Communication med Kropshulhedens Fluidum. Sagtens yttrer Semper, at han formener at have iagttaget en Aabning paa Blærerne; men ingen anden Forsker har observeret dette.

Hos vor nye Slægt er der ligesom hos *Bonellia* en tragtformig, vid Aabning paa de beskrevne slangeformige Rør, forsynet med lange Cilier, hvori Kropsvædsken efter al Sandsynlighed optages; men om den saaledes optagne Kropsvædske undergaar paa denne Vei nogen Forandring, eller om den atter jages ud i Hulheden, se det er et Spørgsmaal, vi ikke kunne besvare, da vi dertil ikke have havt Materiale nok. Men skulle vi indlade os paa en Hypothese, saa var det den, at disse Organer, som vi antage for Secretionsorganer, tjene til at rense og forsaavidt ogsaa til at fornye Kropsvædsken; de virke, om man saa vil, som et Slags Nyrer.

Circulationssystemet.

Vore Undersøgelser over Kredsløbet ere vistnok ufuldstændige; men Skylden herfor tør mest ligge i det mangelfulde Materiale.

Naar Dyret er aabnet fra Rygsiden, iagttages paa Mundhulhedens ydre Flade en korktrækkerformig, hvid, glindsende Kanal, der er Rygkarret, Fig. 6, *x*. Dette løber fortil langs Mundhulhedens Rygflade, lige til dennes forreste Ende, hvor det deler sig i to Grene, en til hver Side. Det tiltager i Tykkelse, alt eftersom det kommer længere bag mod Svælget, og er slangeformig bugtet, saalænge det løber paa Mundhulheden, Fig. 14, *a*. Naar det forlader denne, bliver det tykkere, næsten lige, gaar under

his opinion, perform the office of a secretory organ, and the other that of lungs.

Our own results, based, it is true, on the examination of a single specimen, preserved in spirits, which was however observed and figured while alive, lead us to regard the aforesaid organs in *Hamingia* as the analogue of the so-called "lungs," or "respiratory trees," in the *Holothuriidæ,* but which, in the case of the *Molpadidæ,* we have shown to be intestinal appendages (a secretory apparatus), having nothing whatever to do with respiration. And that these organs in *Hamingia* are in like manner endowed with a secretory, and not a respiratory function, may be inferred, not only from their structure, but also from the fact of their being nowise connected with the circulation of the blood.

During the 24 hours the animal was kept alive, the cloacum was never once seen to open, save for the discharge of the fæces. A powerful sphincter, which closes up the aperture, effectually prevented the ingress of sea-water; and besides, the rectum and the cloacum were both found to be full of the fæcal pellets described above. Meanwhile, it is not to be denied, that the organs in question differ somewhat from those termed "lungs," or "respiratory trees," in the *Holothuriidæ.* The latter, chiefly consisting of larger and smaller assemblages of vesicular cæca, have no direct communication with the fluid of the perivisceral cavity. True, Semper alleges to have observed an opening on the surface of the vesicles, but no other zoologist has recorded its occurrence.

In our new genus, as in *Bonellia,* the sinuous tubes described above exhibit a wide, funnel-shaped aperture, furnished with long cilia, in all probability for the reception of the perivisceral fluid; but whether this fluid undergo any change on its passage, or be again ejected into the hollow of the body, is a question we are not at present prepared to answer, having lacked sufficient materials for conclusively deciding it. But were we to venture an hypothetical explanation, it would be this, that the organs in question, whose function we regard as secretory, serve to purify, and so far therefore to renew, the perivisceral fluid; their action being, we may say, nephritic.

Circulatory System.

Our investigation of this system in *Hamingia* is decidedly incomplete; but this will, we trust, be found to arise chiefly from insufficiency of materials.

On opening the animal on the dorsal side, a white, glistening, spirally twisted canal is seen extending along the outer surface of the buccal cavity. This is the dorsal vessel, fig. 6, *x*, which passes forward along the dorsal surface of the buccal cavity straight to its anterior termination, where it divides into 2 branches, one on either side. It increases in thickness the nearer it approaches the gullet, and retains a sinuous course on the buccal cavity, fig. 14, *a*, after crossing which it grows thicker, and

Svælget, Fig. 6, *x*, i Dybden og løber bagtil over venstre Æggebeholder, hvor det tiltager temmelig betydeligt i Tykkelse, Fig. 14, *b, c.* Herfra løber det hen til den venstre horizontale Tarmslynge, Fig. 14, *d,* paa dennes Rygflade, hvortil det er bundet ved Bindevævstraade ved Siden af Rygmesenteriet; naar det er kommet et Stykke bag paa Tarmslyngen, deler det sig i 2 Hovedstammer, Fig. 14, *e,* hvoraf den ene nu følger Tarmrørets Rygflade langt bagtil, hvor det synes at ophøre, efterat have forladt den 5te Tverslynge. Karret er overalt tæt bundet til Tarmen, og afgiver hist og her enkelte Grene til denne; hvorvidt disse igjen fordele sig og danne Anastomoser, kunne vi ikke afgjøre, da vi ikke have fundet noget saadant.

Den anden Hovedstamme deler sig derimod i mange Grene, som igjen forgrene sig og danne ligesom et bredt Belte, der dækker næsten hele Tarmens Rygflade, idet disse mangfoldige Smaagrene, som ere bundne sammen ved et tyndt Bindevæv, gaar over mod Bugfladen, Fig. 14, *g,* og træffe her paa lignende Smaagrene fra Bugkarret, hvormed de synes at forene sig. Disse Karbundter ere fæstede til Tarmen, have en skidden gulhvid Farve, ere samlede et Par Millim. brede og 4—5^{mm} lange.

Bugkarret er tykkere end Rygkarret, løber paa den horizontale Tarmslynges Bugside, Fig. 14, *h,* hvor det ogsaa deler sig i to Hovedstammer, hvoraf den ene ligesom ved Rygkarret løber langs Tarmens Bugflade bagtil, hvor den ender omtrent paa samme Sted, som Rygkarret — kun paa Tarmens Bugside, Fig. 14, *i.* Den anden Hovedstamme, Fig. 14, *k,* forgrener sig paa samme Vis som Rygkarret, og hjælper til at danne den føromtalte Karudbredning.

Fortil løber Bugkarret lidt tilhøire, Fig. 14, *l,* 15, *b,* efterat have afgivet en stærk Gren til det forreste Parti af Tarmrøret og Svælget, Fig. 15, *c,* en Gren, der gaar bagtil langs Nerven, Fig. 15, *d,* og endelig en Gren, der gaar over paa en anden Tarmslynge, Fig. 15, *e.* Naar det har afgivet disse Grene, løber det lidt i Dybden, krydser sig med Rygkarret, gaar nu langs Nerven, imellem begge Æggebeholderne, Fig. 14, *m,* og fortsætter sit Løb paa Mundhulhedens ydre Bugflade indtil dennes forreste Ende, strax bagenfor Mundaabningen, hvor det deler sig i to Grene, Fig. 15, *g,* der omgive Spiserøret, for, efter alt hvad vi kunde se, at forene sig med Rygkarrets tvende Grene, hvorved en Ringkanal fremkommer.

Den venstre Gren er temmelig tynd; men den høire udvider sig strax, Fig. 15, *h,* og fra denne Udvidning gaar et tykt Kar lidt bagover, bliver et kort Stykke smalere, Fig. 15, *i,* og taber sig i et stærkt muskuløst, aflangt, æggformigt, hult Legeme (Hjerte?), der var opfyldt med Blod og flotterede frit i Kropshulheden, Fig. 15, *k.* Fra Ringkanalen gik flere korte Grene ind imellem Hudens Muskellag.

becomes almost straight, passes under the gullet, at some depth beneath it, fig. 6, *x,* and then protends backward across the left uterus, where it increases considerably in thickness, fig. 14, *b, c.* Here it makes for the left horizontal circumvolution of the intestine, fig. 14, *d,* to the dorsal surface of which it is webbed by membranous filaments of connective tissue, alongside of the dorsal mesentery; it now passes some distance back on the said circumvolution, and then divides into 2 trunk-like stems, fig. 14, *e,* one of which protends far back along the dorsal surface of the intestinal canal, where, after quitting the 5th transverse circumvolution, it apparently terminates. The vessel is closely webbed to the intestine, to which it sends off every here and there a few branches; but whether these branches also ramify, forming anastomoses, we are unable to state.

The other trunk-like stem divides into a number of branches, which ramify in turn, and form, as it were, a broad cincture, covering almost the whole dorsal surface of the intestine; for these numerous branchlets, which are webbed together by a thin connective membrane, stretch across to the ventral surface, fig. 14, *g,* meeting there similar branchlets from the ventral vessel, with which they apparently unite. These vascular fascicles, dirty yellowish-white in colour, are attached to the intestine, and measure collectively about 2^{mm} in breadth and 4—5^{mm} in length.

The ventral vessel, which is thicker than the dorsal, protends along the ventral surface of the horizontal circumvolution of the intestine, fig. 14. *h,* where it likewise divides into 2 trunk-like stems, one of which passes backward, as does that of the dorsal vessel, along the ventral surface of the intestine, where it terminates in the same place about as the dorsal vessel, — but on the ventral surface of the intestine, fig. 14, *i.* The other trunk-like stem, fig. 14, *k,* divides in the same manner as the corresponding stem of the dorsal vessel, and helps to form the aforesaid vascular expansion.

Anteriorly, the ventral vessel swerves a little to the right, fig. 14, *l;* 15, *b,* after sending off a thick branch to the anterior portion of the intestinal canal and the gullet, fig. 15, *c;* a branch protending backwards along the nerve; and a branch passing over to the 2nd circumvolution of the intestine, fig. 15, *e.* It now runs on at some depth, intersecting the dorsal vessel, then strikes off along the nerve, between the two uteri, fig. 14, *m,* and, continuing its course along the outer ventral surface of the buccal cavity to the anterior termination of the latter, divides into two branches, fig. 15, *g,* which encompass the œsophagus, and unite, so far as we could distinguish, with the two branches from the dorsal vessel, forming an annular canal.

The left branch is comparatively thin, but the right one immediately expands, fig. 15, *h,* and from this expansion issues a thick vessel, which, after passing backwards a little, becomes for a short space somewhat narrower, fig. 15, *i,* and then coalesces with an exceedingly muscular, oblongo-ovate, hollow body (heart?), filled with blood, and floating freely in the perivisceral cavity, fig. 15, *k.*

Vi have vel seet, at baade Ryg- og Bugkarret afgive Grene til Tarmen, Mesenteriet og til Æggestokken; men vi have ikke kunnet iagttage nogen Forbindelse imellem dem, og langtfra den netformige Karudbredning paa Tarmen, som Schmarda angiver at være tilstede hos *Bonellia viridis*.

Der er hos *Hamingia* vistnok et afsluttet Kredsløb; men det er et Spørgsmaal, om dette ikke er dobbelt, saaledes nemlig, at den Gren af Ryg- og Bugkarret, Fig. 14, *i, e,* der fra den forreste store udbredte Karforgrening, Fig. 14, *g,* løber langs Tarmens Sider til bag imod de sidste Circumvolutioner, — om ikke disse Kar paa en lignende Maade udbrede og forene sig som ved den store Karforgrening; er dette Tilfældet, saa er der et andet Kredsløb, der jo er meget længere end det første. Men hvilket af disse Kar, der virker som Arterie eller Vene, det lader sig vanskelig afgjøre. Kan det antages, at det flotterende, muskuløse Legeme virker som et Hjerte, kan dette betragtes som et Centralorgan, da forekommer det os, at Bugkarret, med hvilket Hjertet staar saagodtsom i umiddelbar Forbindelse, maa repræsentere det arterielle System, og følgelig Rygkarret Venesystemet. Dette synes yderligere at bekræftes derved, at Bugkarret, der er tykkere, har fastere muskuløse Vægge, end Rygkarret.

Sammenligner man nu Circulationsorganerne hos vort Dyr med *Bonelliens,* saa viser det sig, at de afvige noget, hvilket ogsaa var at vente, alene af den Grund, at *Hamingia* ingen Snabel har; men Fællesskabet er ikke destomindre temmelig iøinefaldende. Hos Bonellien er den sækformige Udvidning af Bugkarret, der flotterer i den midterste Del af Kropshulheden, udtydet som muligens et pulserende Centralorgan (Hjerte, Lacaze-Duthiers), og forsaavidt kan det ansees som et Analogon til det særegne Organ hos *Hamingia,* som vi have fundet flotterende i den forreste Ende af Kropshulheden, og som staar i Forbindelse med Bugkarret. Men omtrent paa det Sted, hvor Lacaze-Duthiers har fundet den sækformige Udvidning af Bugkarret, der findes hos *Hamingia* den særegne Karforgrening, der danner Foreningen imellem Ryg- og Bugkar, hvilken ikke kan betragtes som nogen Centraldel, men snarere som et peripherisk Afsnit af Circulationen.

Nervesystemet.

Hos Gephyreerne ialmindelighed er Nervesystemet temmelig let tilgjængeligt, og anderledes er det heller ikke hos vor nye Slægt.

Naar Tarmrøret er borttaget eller skudt til Side, saa fremtræder tydeligt Centralnervestrængen, der langs Midten af Bugfladen strækker sig fra Munden til Anus, Fig. 16, *a*. Den har en hvid glindsende Farve, er bundet til Bugmesenteriet, og er beklædt paa sin indre i Kropshulheden fremragende Flade af Peritoneum. Den ligger altsaa imellem dette og Skraamuskellaget.

Branches proceeding from the dorsal and ventral vessels to the intestine, the mesentery, and the ovarium, we *have* observed, but have failed to detect any connexion whatever between them; we certainly did not observe the reticulating vascular expansion on the intestine alleged by Schmarda to occur in *Bonellia viridis*.

Hamingia is unquestionably furnished with a true circulatory system; but the question arises, whether that system be not bifold, inasmuch as the branches of the dorsal and ventral vessels, fig. 14, *i, e,* which, issuing from the greatly expanded anterior vascular ramification, fig. 14, *g,* protend backwards along the sides of the intestine to the last circumvolutions, may possibly in turn expand and unite, precisely as do the vessels at the great vascular ramification. Now, assuming this to be the case, a new circulation will commence, taking another and much longer course. But which of the said vessels conveys venous, and which arterial blood, is indeed difficult to decide. If, however, the floating muscular body be assumed to perform the function of a heart — be regarded as a central organ, the ventral vessel, with which it directly communicates, might, we think, with good reason be held to represent the arterial system, and the dorsal vessel the venous. And this view would seem to derive additional support from the fact of the ventral vessel, which is thicker, having more compact and muscular walls than the dorsal.

On comparing the circulatory organs in *Hamingia* with those in *Bonellia*, they are certainly found to differ somewhat, which was indeed to be expected, if for no other reason, because of the former not having a proboscis; but their mutual resemblance is nevertheless striking. The sac-like expansion of the ventral vessel floating in *Bonellia* in the middle of the perivisceral cavity, has been held to represent, possibly, a pulsating central organ (heart, Lacaze-Duthiers), and in that sense it may be regarded as the analogue of the organ in *Hamingia* found floating at the anterior extremity of the perivisceral cavity, and which is connected with the ventral vessel. Now, about in the place where Lacaze-Duthiers observed the sac-like expansion of the ventral vessel, occurs in *Hamingia* the vascular ramification, connecting together the dorsal and ventral vessels, — which can hardly be a central part, but should rather be regarded as a peripheral section of the circulatory system.

Nervous System.

In the *Gephyreæ,* the nervous system is as a rule easily accessible, — an assertion which also holds good of our new genus.

On removing or pushing aside the intestinal canal, the central nervous chord — of a lustrous white — is distinctly visible, protending along the middle of the ventral surface from mouth to anus, fig. 16, *a*. It is webbed to the ventral mesentery, and invested on its inner surface, which projects into the perivisceral cavity, with peritoneal membrane. It extends accordingly between the peritoneum and the oblique muscular layer.

Den midterste Del af Centralstrængen er noget tyndere end den forreste og bagerste Del, og udsender til begge Sider en Mængde Grene, hvoraf enkelte staa næsten lige overfor hinanden, medens andre alternere, endog med temmelig lange Mellemrum, Fig. 16, *a*. De fleste af disse Grene gaa meget snart ind imellem Hudens Muskellag, hvor de dele sig, enkelte andre kunne forfølges noget længere, førend de tabe sig i Huden. De have ved deres Udspring en næsten horizontal Retning.

Efterhaanden som Centralstrængen kommer længere fortil, bliver den noget tykkere, Fig. 16, *b;* den løber imellem begge Æggebeholderne, Fig. 16, *h, h,* ved Siden af Bugkarret, og afsender lignende Grene til Huden og Mesenteriet, som dens midterste Del, kun have de her en mere skraa Retning. Naar den er kommen lidt foran Æggebeholderne, afgiver den paa hver Side en fin Gren, Fig. 16, *c,* der gaar bag til Udførselskanalen for Æggebeholderne. Den afgiver fremdeles mange fine Grene til Mesenteriet og Huden, indtil den omtrent 3^{mm} fra Mundaabningen deler sig i to Stammer, Fig. 16, *d,* der gaar hver til sin Side og omfatter den forreste Del af Svælget, hvorefter de forene sig paa dettes Rygside, og danner derved en temmelig vid Ring, hvorfra udgaar Grene til Huden, Mundhulheden og Spiserøret, Fig. 16, *e.*

Bagtil fortsætter Centralstrængen sit Løb ved Siden af Æggestokken, Fig. 16, *f,* som for endel dækker den, og afgiver en Mængde Smaagrene til Huden, samt flere Grene til Mesenteriet og Æggestokken; henimod Anus deler den sig, Fig. 16, *g,* og slaar sig om Endetarmen, hvor begge Grene tabe sig ganske i Bindevævet.

Centralstrængen er fuldstændig uden Knuder eller Ganglier; den har en temmelig fast Skede, indenfor hvilken er et peripherisk cellulært Lag, og et centralt, der er det tykkeste, og bestaar af Nervefibriller. Det peripheriske Lag synes at være sammenvoxet med Skeden; noget Kar findes ikke. Grenene ere sammensatte paa lignende Maade, og det har ikke været os muligt at opdage nogen ganglionær Dannelse, ligesaalidt paa dem, som paa Centralstrængen.

Efter Lacaze-Duthiers Undersøgelser over Nervesystemet hos *Bonellia viridis* synes dette at stemme temmelig overens med hvad vi have fundet hos *Hamingia;* den væsentligste Forskjel ligger i, at hos denne, som ingen Snabel har, nærmer Svælgringen sig mere den for Gephyreerne almindelige.

Professor Greef[1] angiver, at ifølge hans Undersøgelser skal Centralnervestrængen hos *Echiurus Pallasii, Thalassema Baronii* og *Bonellia viridis,* samt hos mange børsteløse Gephyreer være uden Ganglier og indesluttet i et

[1] Sitzungsberichte d. Gesellschaft zur Beförderung der gesammten Naturwissenschaften zu Marburg, No. 2, Febr. 1874.

The medial section of the central nervous chord is somewhat thinner than are the anterior and posterior sections, and sends off from either side a multitude of branches, some of which have their points of origin nearly opposite, whereas those of others alternate one with the other, sometimes at considerable intervals, fig. 16, *a*. Most of these branches very speedily pass in between the muscular layers of the skin a few can be traced somewhat farther, before they coalesce with the integument. At the point of issue, they have all of them a well nigh horizontal direction.

Gradually increasing in thickness, fig. 16, *b,* the farther anteriorly it protends, the central nervous chord passes between the two uteri, fig. 16, *h, h,* alongside of the ventral vessel, and sends off to the skin and the mesentery branches of the same kind as those issuing from its mesial section; they take, however, a more oblique direction. A little anterior to the uteri, it sends forth from either side a slender branch, fig. 16, *c,* which strikes off backward to the oviducal canal, or uterine duct. It still continues to furnish the mesentery and the skin with numerous ramifications, till it divides, about 3^{mm} from the buccal aperture, into two principal branches, one on either side, fig. 16, *d,* which, proceeding to the gullet, coil round the anterior portion of that organ, and then unite on its dorsal surface, forming a large ring, from which branches are sent off to the skin, the buccal cavity, and the œsophagus, fig. 16, *e.*

Posteriorly, the central nervous chord protends alongside of the ovarium, fig. 16, *f,* by which it is partly covered, and sends off a multitude of ramifications to the skin, and several branches to the mesentery and the ovarium; in close proximity to the anus, it divides dichotomously, fig. 16, *g,* encircling the rectum, where both branches coalesce with the connective tissue.

The central nervous chord is entirely destitute of nodes or ganglions; it is furnished with a comparatively firm-textured sheath, underneath which extends a peripheral cellular and a central layer, the latter, consisting of nervous fibrils, being the thickest. The peripheral layer would appear to be connate with the sheath: there is no vessel. The branches are built up in like manner; and we have failed to detect any trace of ganglionous organs either on these subsidiary offshoots or on the central chord itself.

The nervous system in *Bonellia viridis,* as described by Lacaze-Duthiers, would appear to agree pretty closely with what we have observed relating to that system in *Hamingia;* the principal difference lies in this, that the latter, which is not distinguished by a proboscis, has the pharyngeal ring nearer in resemblance to that generally met with in the *Gephyrea.*

Professor Greef[1] states, that, according to his observations, the central nervous chord in *Echiurus Pallasii, Thalassema Baronii, Bonellia viridis,* and in many other asetous Gephyreans, is destitute of ganglions, and enclosed

[1] Sitzungsberichte d. Gesellschaft zur Beförderung der gesammten Naturwissenschaften zu Marburg, No. 2, Febr. 1874.

Blodkar. Hos *Hamingia* have vi ikke iagttaget noget saadant Kar, uagtet vi have ved vellykkede Tversnit havt Anledning til at skjænke dette Punkt vor fulde Opmærksomhed.

Generationsorganerne.

Vi have tidligere omtalt to Æggebeholdere (Uteri), der have deres Leie i den forreste Del af Kropshulheden, Fig. 16, *h, h.* De ere ægformige, 7^{mm} lange, 4^{mm} brede; enhver af dem er forsynet med en Udførselskanal, Fig. 16, *i,* 17, *a,* som er rund, 3^{mm} lang, omtrent 1^{mm} tyk, og som gaar ud igjennem de tidligere beskrevne krumbøiede Papiller paa Bugfladen, i hvis Spids den aabner sig.

Foruden Udførselskanalen har enhver Æggebeholder en tragtformig Kanal, der ligger over Udførselsgangen, hvortil den er fastvoxet i en Strækning af omtrent 2^{mm}, Fig. 16, *k.* 17, *b;* men bliver fri idet den bøier sig indad og nedad imod Bugfladen, Fig. 16, *l,* 17, *c,* og udvider sig nu saaledes, at den frie Ende danner Tragtens brede Del, Fig. 16, *m,* 17, *d.* Denne frie Ende, hvis Rand er indskaaren, foldet og besat med Cilier, Fig. 17, *e,* danner Indgangen til Kanalen, som fører ind til Æggebeholderens Hulhed. Hele Tragtens indre Flade, ligesom Kanalen, er beklædt med et flimrende Epithel. Igjennem Tragten føres de i Kropshulheden svømmende Æg ind i Æggebeholderne, der vare fuldproppede af fuldt udviklede Æg, Fig. 16, *h, h.*

Saavel Udførselskanalen, som Tragten med dens Indførselsgang bestaar af et fast Bindevævslag, hvis indre mod Lumenet vendende Flade er beklædt med et cilierende Epithel; men hvis ydre Flade støder til en meget stærk Muskelhud, der bestaar af Længde- og Ringfibre, hvilke strække sig udover selve Æggesækkene, der dannes af en temmelig fast, men næsten vandklar Bindevævsmembran, gjennemkrydset af Muskelfibre. Saavel Æggesækkene, som de med dem i Forbindelse staaende Kanaler ere udvendig beklædte med Peritoneum.

Æggebeholderne ere fæstede til Bugfladen ved enkelte tynde, temmelig lange Bindevævstraade; forresten hænge de frit i Kropshulheden.

Æggestokken er fæstet til en Fold af Bugmesenteriet, Fig. 16, *n, n,* er smal, fladtrykt-baandformig, og strækker sig fra den yderste Ende af Rectum, hvortil den fæster sig, til noget foran Midten af Kropshulheden; den følger Centralnervestrængen, som den næsten ganske skjuler, Fig. 16.

Æggene udvikle sig i Follikelgrupper; saaledes fandtes i den forreste Del af Æggestokken nogle isolerede Follikler, Fig. 16, *o, o,* hvori det begyndende Æg med Kimblære og Kimflæk fandtes, — fuldkommen lig den Udviklingsmaade, der for endel er antydet af Lacaze-Duthiers;

in a blood-vessel. In *Hamingia,* we failed to detect any such vessel, notwithstanding we were happy in our transverse sections of the chord, and took advantage of the opportunity afforded to give this point our full attention.

Generative Organs.

We have previously had occasion to mention two ovarian pouches (uteri), placed in the anterior portion of the perivisceral cavity, fig. 16, *h, h.* They are ovate in form, 7^{mm} long, 4^{mm} broad, and furnished each with an eferent duct, fig. 16, *i;* 17, *a,* which is round, 3^{mm} long, and about 1^{mm} thick; it passes out through the arcuated papillæ on the ventral surface, previously described, at the point of which it opens.

Exclusive of this eferent duct, each uterus has a funnel-shaped canal, protending above the genital duct, with which it is connate for about 2^{mm}, figs. 16, *k;* 17, *l,* becoming however free as it curves inward and downward in the direction of the ventral surface, figs. 16, *l;* 17, *b,* and then expanding in such wise, that the free extremity constitutes the broad part, or mouth, as it were, of the funnel, figs. 16, *m;* 17, *d.* This free extremity which has the margin folded, incised, and furnished with cilia, fig. 17, *e,* constitutes the entrance to the canal leading to the uterine cavity. The whole inner surface alike of the funnel-shaped opening and of the canal itself, is invested with vibratile epithelium; and through this opening it is, that the egg floating in the perivisceral cavity is exuded into the uteri, which in the specimen examined were distended with fully mature ova, fig. 16, *h, h.*

Both the eferent duct and the funnel-shaped canal, with its entrance-passage, are built up of a firm-textured layer of connective tissue, the inner surface of which, facing the lumen, is clothed with ciliated epithelium; its outer surface adjoins an exceedingly strong muscular membrane, composed of longitudinal and annular fibres, protending out beyond the uterine pouches, the walls of which consist of comparatively firm-textured, but almost hyaline connective tissue, intersected by muscular fibres. The uterine pouches, and the ducts and canals with which they are connected, have, investing them externally, a peritoneal tunic.

The uteri are webbed to the ventral surface by a few slender and comparatively long filaments of connective tissue; for the rest, they depend freely in the perivisceral cavity.

The ovary, attached to a fold of the ventral mesentery, fig. 16, *n, n,* is narrow, depressed, riband-shaped, and protends from the outer extremity of the rectum, whereto it is webbed, a little anterior to the middle of the perivisceral cavity, and accompanies the central nervous chord, almost entirely concealing it, fig. 16.

The ova develop in follicular groups; in the anterior part of the ovary were seen, for instance, a few isolated follicles, fig. 16, *o, o,* containing rudimentary ova, with a germinal vesicle and a germinal speck, — their mode of development being that in part suggested by

men som senere har faaet en fuldstændigere Løsning i Vejdovsky's[1] og Spengel's[2] Afhandlinger over Ægdannelsen og Hannen hos *Bonellia viridis,* og hvortil vi skulle tillade os at henvise for ikke at gjøre os skyldig i Gjentagelser. Længere bag vare Follikelgrupperne talrigere, Æggene mere udviklede, Fig. 16, *p;* i enhver Follikel var et Æg, der udviklede sig af en Centralcelle. Jo længere bag man kom, desto mere ere Æggene udviklede, saa at henimod Æggestokkens bagerste Ende findes de mest udviklede Æg, der ved sin Vext sprænger Follikelen og falder ud i Kropshulheden, hvor det fuldender sin Udvikling.

Æggestokken hos *Hamingia* lignede en Samling Drueklaser ophængte i et Baand.

Det fuldmodne Æg saaledes som det findes i Æggebeholderne og tildels i Kropshulheden har kun en Hinde, som Lacaze-Duthiers og for ganske nylig Dr. Spengel har paavist hos *Bonellia viridis;* den af Schmarda beskrevne anden Hinde eller Membran, hvormed Ægget skulde være omgivet, er utvivlsomt Follikelmembranen.

Indenfor Blommemembranen ligger Kimblæren med Kimplet omgiven af Protoplasmakorn, og udenom disse store Blommekorn, dentoplasmatiske Kugler (se Vejdovsky).

Ingen Hanner have vi fundet, uagtet vi vare meget opmærksomme derpaa.

De ovenfor beskrevne Kjønsorganer afvige forsaavidt fra Bonelliens, som der hos denne kun er en Uterus, imedens *Hamingia* har to. Men derimod nærmer den sig just derved til Slægten *Thalassema.* Omendskjøndt dennes Anatomi, saavidt vi vide, ikke er tilstrækkelig bekjendt, fremgaar dog af de Undersøgelser Max Müller[3] har anstillet over *Thalassema gigas,* at den har 2 Uteri, som Müller rigtignok kalder Ovarier. Han angiver, at de findes paa Bugfladen, ere langstrakte, indtil 2 Tommer lange og have en kort Udførselsgang, der munder ud i to paa den ydre Bugflade siddende yderst smaa Vorter. Paa disse Ovarier har Müller iagttaget en lille Fremstaaenhed, hvorpaa han tror at have seet en lille Aabning.

Diesing[4] har imidlertid opfattet Forholdet rigtigere, idet han benævner dem Uteri, uden at han dog omtaler

[1] Ueber die Eibildung und die Männchen von *Bonellia viridis.* Franz Vejdovsky. Zeitschrift f. wissensch. Zoologie, 30 B. 1878, pag. 487.

[2] Dr. J. W. Spengel. Beiträge zur Kenntniss der Gephyreen. Die Eibildung, die Entwicklung u. das Männchen der *Bonellia.* Mittheilungen aus der zoologischen Station zu Neapel. 1 B., 3 Heft, 1879.

[3] *Thalassema gigas,* Max Müller. Observ. anat. de vermibus quibusdam maritimis. 1852, pag. 20.

[4] Revision der Rhyngodeen, Karl Diesing, 1859, pag. 772.

Lacaze-Duthiers, but which, on a subsequent occasion, was made the subject of more exhaustive treatment in Memoirs by Vejdovsky[1] and by Spengel[2] on the growth of the egg, and the structure and economy of the males, in *Bonellia viridis;* and to these papers we beg leave to refer, with the object of avoiding needless repetition. Farther back, the follicular groups are more numerous, the ova in a relatively advanced stage of development, fig. 16, *p.* In every follicle was an egg, developing from a central cell. The maturity of the ova progressing with their passage down the ovarium, the posterior extremity contains of course the most developed, which, after bursting the follicle, drop through into the perivisceral cavity, and there attain the final stage of development.

The ovary in *Hamingia* resembled bunches of grapes attached to a piece of ribbon.

The fully mature egg, as found in the uteri, — and (some) in the perivisceral cavity, — is enveloped in a pellicle only, which Lacaze-Duthiers, and quite recently Dr. Spengel, have shown to be also the case with *Bonellia viridis;* the second pellicle, or membranaceous envelope, described by Schmarda as investing the egg, is unquestionably the membrane of the follicle.

Underneath the membrane of the yolk, lies the germinal vesicle, with the germinal speck, surrounded by protoplasmatic granula, and without these granula large yolk-globules, dentoplasmatic pellets *(vide* Vejdovsky).

No males were met with, though carefully looked for.

The generative organs described above differ, we see, from those of *Bonellia,* inasmuch as the latter has but one uterine pouch, whereas *Hamingia* is furnished with two uteri. But in thus differing from one congener, the new genus approximates another — *Thalassema.* True, the anatomy of this genus is as yet imperfectly known; but it nevertheless appears from Max Müller's[3] investigation of *Thalassema gigas,* that the animal has two uterine receptacles, which Müller, however, terms ovaries. These organs, placed, he states, on the ventral surface, and elongate in form, measuring as much as 2 inches in length, are each furnished with a short eferent duct, that disembogues through 2 minute, wart-like papillæ on the outer ventral surface. On these "ovaries" Müller has observed a small prominence, in which he believes to have detected a minute opening.

Diesing,[4] however, had a clearer apprehension of the office performed by these organs, and terms them accord-

[1] Ueber die Eibildung und die Männchen von *Bonellia viridis.* Franz Vejdovsky. Zeitschrift f. wissensch. Zoologie, 30 B. 1878, pag. 487.

[2] Dr. J. W. Spengel. Beiträge zur Kenntniss der Gephyreen. Die Eibildung, die Entwicklung u. das Männchen der *Bonellia.* Mittheilungen aus der zoologischen Station zu Neapel. 1 B., 3 Heft, 1879.

[3] *Thalassema gigas,* Max Müller. Observ. anat. de vermibus quibusdam maritimis. 1852, pag. 20.

[4] Revision der Rhyngodeen, Karl Diesing, 1859, pag. 772.

med et Ord selve Æggestokken, der for ham var ukjendt.

Det er neppe nogen Tvivl underkastet, at de Organer Max Müller kalder Æggestokke ere fuldstændig homologe med de af os beskrevne Æggebeholdere hos *Hamingia,* ihvorvel de i Formen afvige noget; men lægger man Mærke til, at Müller omtaler en lille Fremstaaenhed, paa hvilken han tror at have fundet en Aabning, kan dette neppe være noget andet, end den hos *Hamingia* og *Bonellia* paa Uterus værende Tragt, der tjener til at opsamle og lede de i Kropshulheden frit svømmende Æg ind i Æggebeholderen.

Hos *Thalassema* foregaar, efter Semper's og Spengel's Iagttagelser, Ægdannelsen paa en aldeles lignende Maade, som hos *Bonellia.*

Vi mene saaledes at have bevist, at den af os opstillede nye Slægt staar i et nært Forhold til *Thalassema* og *Bonellia;* men ser man hen til, at der hos vor Slægt, baade i de ydre Karakterer og i Anatomien er størst Fællesskab med *Bonellia,* turde det være et Spørgsmaal om den ikke i phylogenetisk Henseende staar i den inderligste Rapport til denne. *Hamingia* bærer virkelig Spor af en fordums Snabel, der tør være forsvunden, og ved hvis Forsvinden naturligvis saavel Circulations- som Nervesystemet maatte undergaa nogen Forandring, hvilket jo viser sig at være Tilfældet, idet den kredsformige Dannelse af de nævnte Systemer, hvilken foregaar i Snabelen hos *Bonellia,* træder op hos *Hamingia* under Form af en Nervering og Blodkarring, der omgive den forreste Del af Spiserøret.

Kan det antages, at Bonellien oprindelig har havt to Uteri, hvilket kan være rimeligt nok, da den ene har et meget usymetrisk Leie, og kommer dertil, at Lacaze-Duthiers har fundet hos et Exemplar 2 Uteri, som han forresten angiver som ganske exceptionelt, — saa er det ikke noget ukjendt, at det tabte Organ atter optræder i en høiere Afstamning, og vi ere tilbøielige til at antage, at *Hamingia* staar noget høiere i Organisationsrækken end *Bonellia.*

Hamingia arctica lever paa sandholdig Lerbund, bevæger sig temmelig meget ved Krumninger i forskjellige Retninger, uden at gjøre nogen synderlig Fremgang.

Farven er mørk græsgrøn, naar Dyret er sammentrukket, men bliver lysere med enkelte mørkere Partier, naar det er udspændt, og da bliver Huden saa gjennemsigtig, at en Del af Tarmkanalen kan sees. Mundskiven med Mundlæberne ere næsten hvide, spillende lidt i det Gule, ligeledes de lange cylindriske, krumbøiede Papiller paa Bugfladen.

Kun et Exemplar blev fundet paa Station 290.

Slægtskarakter.

Legemet valseformigt. Munden paa den forreste Ende, nærmere Bugfladen. Analaabningen i Centrum af den

ingly *uteri,* though he does not even allude to the true ovary, of whose existence indeed he knew nothing.

Meanwhile, it will hardly admit of doubt, that the organs by Max Müller termed ovaries are strictly homologous with the uteri, or uterine pouches, in *Hamingia,* though slightly different as to form; but calling to mind the minute papilla mentioned by Müller, and in which he believes to have detected an opening, the latter must assuredly be the funnel-shaped aperture which in *Hamingia* and *Bonellia* serves for the reception of the ova floating in the perivisceral cavity, and to afford them egress on their passage into the uterine pouch.

In *Thalassema,* according to Semper's and Spengel's observations, the ova are developed precisely as in *Bonellia.*

Hence we conceive to have shown, that the genus established in this Memoir is closely allied alike to *Thalassema* and to *Bonellia;* but whereas *Hamingia,* both as regards its habitus and anatomical structure, exhibits greatest resemblance to *Bonellia,* it is a question whether, phylogenetically too, the new genus will not prove to have most intimate relations with that animal. For *Hamingia* does indeed retain traces of a proboscis, once distinguishing the genus *Bonellia,* and the loss of which must naturally to some extent have modified the characteristics of the circulatory and nervous systems. And this is found to be the case; for the semi-circular formation of the said systems in the proboscis of *Bonellia,* occurs in *Hamingia* as a nervous ring and an annulary vascular blood-vessel, which represent together the anterior portion of the œsophagus.

Now, assuming *Bonellia* to have had originally two uterine pouches, — for the single uterus with which it is now furnished is anything but symmetrical in position, — and calling to mind, too, that Lacaze-Duthiers records his having once found two *uteri* in a specimen of this genus (quite an exceptional case, however, in his opinion) — science is not without instances in point showing the organ thus lost to have developed again in a congener of higher extraction; and we are indeed disposed to regard *Hamingia* as ranking above *Bonellia* in the scale of organisation.

Hamingia arctica affects a bottom of sabulous clay, moves about a good deal in disrupted curves, without however making much progress.

Colour, when the animal is contracted, a dark grassy-green, but lighter, with a few darkish patches, when it blows itself out; the skin is then so translucent, that part of the intestinal canal may be seen through it. Buccal disk and lips almost white, with a faint tinge of yellow; likewise the long, cylindrical, arcuate papillæ of the ventral surface.

One example only, at Station 290.

Generic Character.

Body cylindrical; mouth at the anterior extremity, nearest the ventral surface. Anal opening in the centre

bagerste Ende. En halvmaaneformig, lidt fremragende Fold omkring Munden (Rudiment af Snabel). Paa Bugfladens forreste Del to cylindriske, lange Papiller, paa hvis Spids en rund Aabning for Æggebeholdernes Udførselsgang.

Ingen Børster.

Tarmrøret danner Slynger, men ingen Spiral og ender i en Kloak, fra hvis begge Sider udgaar et forgrenet Kjertelapparat.

Centralnervestrængen glat, uden Ganglier.

En Æggestok, der ligger langs Nervestrængen i den bagerste Halvdel af Kropshulheden.

To Uteri med deres Udførselsgang og Tragt.

Hannen ukjendt.

Artskarakter.

Legemet valseformigt, glat, 120^{mm} langt, 20^{mm} tykt, antager under Kontraktioner forskjellige Former. Farven lysere eller mørkere græsgrøn med hvidgul Mundskive. De krumbøiede Papiller paa Bugfladen grønlige med hvidgule Ender.

Saccosoma[1] vitreum, n. g. & sp.

Tab. VI, Fig. 1—8.

Legemet kolbeformigt; den forreste smale forlængede Del, Fig. 1, 2, *a*, er cylindrisk, 12^{mm} langt, omtrent 5^{mm} bredt ved Grunden og 1.5^{mm} i Spidsen, hvor den runde, temmelig vide Mundaabning findes, Fig. 1, 2, *b*, der er omgiven med en Vold, hvorfra stærke Længdefolder strække sig ned i Spiserøret. Lidt bagenfor Mundaabningen sees paa Bugsiden en lille Papille, paa hvis Midte er en fin Aabning.

Huden er paa denne cylindriske Del uigjennemsigtig, tyk, fast og rynket. Legemets bagerste Del er næsten kuglerundt, Fig. 1, 2, *c*, 18^{mm} langt og 12—14^{mm} bredt.

Huden er overordentlig tynd, fuldkommen glasklar, saa at den af mangfoldige Slyngninger bestaaende Tarm sees som om den laa blottet; kun paa den bagerste Ende, der er konisk, Fig. 2, *d*, og paa hvis Spids den runde Analaabning, Fig. 2, *e*, findes, er Huden ligesom paa Kroppens forreste forlængede Del tyk, fast og uigjennemsigtig.

[1] Σάκκος = Sæk; σῶμα = Legeme.

of the posterior extremity. A lunate, somewhat prominent fold round the mouth (rudimentary proboscis). On the anterior portion of the ventral surface two long, cylindrical papillæ, having each at the apex a round aperture for the eferent duct of the corresponding uterus.

No bristles.

The intestinal canal with numerous circumvolutions, but no spiral coil; it disembogues into a cloacum, from both sides of which issues a ramifying glandular apparatus.

The central nervous chord smooth, destitute of nodes or ganglions.

One ovary, protending along the nervous chord in the posterior half of the perivisceral cavity.

Two uteri, each with an eferent duct and funnel-shaped tube.

The male as yet unobserved.

Specific Character.

Body cylindrical, smooth, 120^{mm} long, 20^{mm} thick, repeatedly changing its form as it contracts and expands. Colour a lighter or darker grassy green. Buccal disk whitish-yellow; the arcuate papillæ on the ventral surface greenish, with whitish-yellow extremities.

Saccosoma[1] vitreum, n. g. & n. sp.

Pl. VI, fig. 1—8.

Body cucurbit-like in form; the anterior, slender, produced portion cylindrical, figs. 1; 2, *a*, 12^{mm} long, about 5^{mm} broad at the base, and 1.5^{mm} broad at the apex, which is pierced with the round and comparatively wide buccal aperture, figs. 1; 2, *b*, surrounded by a cutaneous ridge, from which prominent longitudinal folds protend downwards into the œsophagus. A little posterior to the buccal aperture on the ventral surface, is seen a small papilla, with a minute opening in the middle.

The skin covering this cylindrical portion is opaque, thick, firm-textured, and rugose. The posterior portion of the body is almost globular, figs. 1; 2, *c*, 18^{mm} long and 12—14^{mm} broad.

The skin is remarkably thin, and hyaline, giving to the numerous circumvolutions of the intestine the appearance of being denuded; only on the posterior, acuminate extremity, fig. 2, *d*, pierced at the apex with the round anal opening, fig. 2, *e*, and on the anterior produced portion of the trunk, is the integument thick, firm-textured, and opaque.

[1] Σάκκος: sack; σῶμα: body.

Huden er, som tidligere angivet, opak, tyk og fast paa den forreste og bagerste Ende, imedens den paa Legemets næsten kuglerunde Del er yderst tynd og glasklar; men overalt har den omtrent samme histologiske Bygning. Den dannes af en tynd Cuticula, der paa et Tversnit af den tykke Hud viser sig stærkt foldet, Fig. 5, *a*, og det paa en saadan Maade, at Folderne faa et guirlandeformigt Udseende, Fig. 5. Lignende Folder findes ogsaa hos *Echiurus Palasii* efter Greeff's Angivelse[1].

Indenfor Cuticula er et Epithellag af temmelig korte, klare Cylinderceller, Fig. 5, *b*, der støde til et meget tyndt, hyalint Bindevævslag, hvori spredte Bindevævslegemer sees, Fig. 5, *c*, og hvortil Muskelhuden er fæstet. Denne bestaar af Ringmuskler, Fig. 5, *d*, og Længdemuskler, Fig. 5, *e*.

Ringmusklerne ligge som sædvanligt yderst, nærmest Bindevævslaget, ere temmelig tykke og danne en sammenhængende Hud.

Længdemusklerne ere distinct adskilte, saa at hver Muskelbundt tager sit Udspring fra Mundringen og gaar bag til den klare sækformige Kropsdel, Fig. 3, *a*; 4, *a*, hvor det deler sig for at gaa over paa denne. Imellem hver Længdemuskel er et temmelig tykt Bindevæv, der holder Muskelbundterne sammen[2]. Dette gjælder nu den forreste Kropsdel, hvor Huden er tyk og uigjennemsigtig; men anderledes forholder det sig paa den glasklare sækformige Del. Her vige Fibrene stærkt fra hverandre, forgrene sig og danne Anastomoser paa den Vis, at Grene fra Ringmusklerne, Fig. 6, *a*, tage en skraa Retning, løbe over Længdemusklerne, Fig. 6, *b*, og danne paa større Strækninger ligesom et Skraamuskellag, Fig. 6, *c*, der ligger indenfor Længdemusklerne og synes at tabe sig i tilstødende Ringmuskelfibre.

Fra Længdemusklerne udsendes ligeledes Grene, og mange af disse anastomosere med Grene fra Ringmusklerne. Der dannes paa denne Maade et fuldkommen muskuløst Netværk, Fig. 6, der indtager hele den kugledannede Kropsdel lige til den bagerste opake, fremstaaende Ende, hvor Muskelfibrene atter ordne sig i to bestemte sammenhængende Lag ligesom paa den forreste Kropsdel, kun med den Forskjel, at Længdemusklerne ikke som der ere distinkt adskilte, men danne en sammenhængende Hud.

Imellem Muskelmaskerne paa Sækken og Cuticula sees et yderst tyndt, hyalint Bindevæv, hvori Kjerner, samt et tyndt Lag Epithelceller, hvilke ere Fortsættelser af Bindevævs- og Epithellaget, som findes i den forreste, opake Kropshud. Da denne Hud, der danner Sækken, er overordentlig tynd som det fineste Silkepapir, og dertil fuldstændig glasklar, var det ikke muligt, selv ved stærk mikro-

[1] R. Greeff. Ueber den Bau und die Entwickelung der Echiuren. Archiv für Naturgeschichte. 43 Jahrgang, 3 Heft, pag. 343, Berlin 1877.

[2] Hos *Thalassema Baronii* har Greef paavist noget lignende.

The skin is, we say, thick, firm-textured, and opacous on the anterior and posterior extremities, and on the well nigh globular portion of the body exceedingly thin, and translucent; but everywhere it has very nearly the same histological structure. It consists of a thin cuticle, which, on making a transverse section of the thick integument, is found to be prominently folded, fig. 5, *a*, the folds presenting a wreathed or belted appearance, fig. 5. Similar folds occur, according to Greef,[1] in *Echiurus Palasii*.

Underneath the cuticle extends an epithelial layer of comparatively short, translucid, cylindric cells, fig. 5, *b*, adjoining an exceedingly thin, hyaline layer of connective tissue, webbed to the muscular integument, and scattered throughout which are seen corpuscles of connective tissue, fig. 5, *c*. The muscular membrane is composed of annular muscles, fig. 5, *d*, and longitudinal muscles, fig. 5, *e*.

The annular muscles lie as usual outermost, nearest the layer of connective tissue, are comparatively thick, and constitute a continuous integument.

The longitudinal muscles are distinctly separate, each muscular fascicle issuing from the buccal ring, and protending backwards to the hyaline sac-like portion of the body, figs. 3, *a*; 4, *a*, where they divide, branching across on to the latter. Between every pair of longitudinal muscles extends a comparatively thick connective tissue, banding together the muscular fascicles,[2] i. e. on the anterior region of the body, which has the skin thick and opaque; with the hyaline sac-like portion the case is different. Here the fibres diverge very considerably, ramify, and anastomose, in such wise that branches from the annular muscles, fig. 6, *a*, protending obliquely and intersecting the longitudinal muscles, fig. 6, *b*, form an extensive oblique layer, fig. 6, *c*, lying underneath the longitudinal muscles, and apparently coalescing with the adjacent annular fibres.

Branches proceed, too, from the longitndinal muscles, many of them anastomosing with branches from the annular muscles. Thus is produced a complete muscular network, fig. 6, extending over the whole of the globular portion of the body to the posterior, opaque, projecting extremity, where they are again arranged in two distinct continuous layers, as on the anterior portion of the body, with this difference, however, that the longitudinal muscles are not distinctly separate, but constitute a continuous membrane.

Between the muscular meshes on the sac and the cuticle, is seen an exceedingly thin, hyaline web of connective tissue, with nuclei scattered throughout it, and a thin layer of cellular epithelium, prolonged from the epithelial layer and the layer of connective tissue in the anterior opaque skin of the body. The skin constituting the sac being thin as tissue-paper, and moreover perfectly hyaline, it was impossible

[1] R. Greeff. Ueber die Bau und die Entwickelung der Echiuren. Archiv für Naturgeschichte. 43 Jahrgang, 3 Heft, pag. 343, Berlin 1877.

[2] Something similar to this Greef has observed in *Thalassema Baronii*.

skopisk Forstørrelse (Gunlach Im. No. 7, Oc. 1) at iagttage nogensomhelst Organisation; først ved Farvning af en Opløsning af Picrokarmin, differentserede de forskjellige Væv sig. Indenfor Muskelhuden er Peritonealovertrækket.

Fordøielsestragten tager sin Begyndelse ved den runde Mundaabning, der er omgivet af en Vold, som væsentlig dannes af Ringmusklerne, fig. 3, *b*.

Spiserøret er cylindrisk, Fig. 3, *c*, lidt videre ved Mundatriet, omtrent 8^{mm} langt, og har en tyk, fast, hvidrødlig Hud, der dannes af de sædvanlige Lag, dog saaledes, at Muskelhuden, der bestaar af Ring- og Længdemuskler, er meget tyk; indenfor denne er et kjernerigt Bindevæv, der danner listeformige Fremspring, som foranlediger de paa den indre Flade af Spiserøret langsgaaende Folder. Til dette Bindevæv er Epithellaget fæstet, som bestaar af temmelig lange Cylinderceller, hvoraf mange have foruden sin Kjerne et rigt kornet Indhold, og muligens fungere som Kjertler.

Naar Spiserøret, der ved stærke Bindevævstraade er bundet til Kropsvæggen, har naaet bag imod den glasklare Kropsdel, udvider det sig og danner en aflang Sæk, der ligeledes er stærk muskuløs og kan betragtes som en Mave, Fig. 3, *d*, hvis Vægge blive tyndere, idet den gaar over i Tarmen, Fig. 3, *e*, uden at der egentlig er nogen Indsnøring.

Tarmen bliver nu temmelig smal, dreier sig mod Høire, hvorfra den bøier sig og gaar til Venstre; paa denne Vei ere dens Vægge blevne alt tyndere og tyndere; men fra nu af gjør den en Mangfoldighed af Slyngninger, saa den ganske udfylder den glasklare, kugleformige Del, Fig. 2, *f*; 3, *f*, paa samme Tid som dens Vægge blive saa tynde, at det ser ud som der ingen Tarm var. Naar den paa denne Vei har naaet den bagerste Del af Kropshulheden gaar den over i en kort Rectum, Fig. 3, *g*, der ender med sin runde Analaabning paa Midten af den lidt fremstaaende koniske Bagdel, Fig. 2, *e*.

Endetarmens Vægge ere tykke og faste, omtrent som Spiserørets, og dens ydre Flade er ved en Mængde temmelig stærke, tendinøse Baand bundet saavel til den glasklare Sæks indre Væg, som til den koniske Fremstaaenheds indre Flade, Fig. 3, *h*, imedens dens ydre Rand, der danner Anus, er omgiven af en stærk Sphincter.

Muskelhuden paa Tarmen er, naar undtages Rectum, særdeles tynd, og Muskelfibrene i begge Lag staa meget langt fra hverandre. Paa Rectum derimod ere de tykke og sammenhængende.

Tarmens indre Flade er beklædt med et lignende Epithel, som Spiserørets, kun staa Cylindercellerne længere fra hverandre; men ogsaa her havde mange det føromtalte kornede Indhold.

Tarmen var ganske opfyldt af Excrementer; disse bestode af Boli, der havde en elliptisk Form, og vare paa Midten saa tykke, at en saadan Bolus udfyldte ganske Tarmen, Fig. 3, 7.

to detect, even with a powerful microscope (Gunlach Im. No. 7, Oc. 1), any structural appearance whatever; not till a portion had been tinted in a solution of picrocarmine, could the several species of tissue be observed. Underneath the muscular membrane extends the peritoneal tunic.

The alimentary canal originates at the round buccal aperture, which is encompassed by a ridge, chiefly consisting of annular muscles, fig. 3, *b*.

The œsophagus is cylindrical, fig. 3, *c*, a trifle wider at the buccal atrium, about 8^{mm} long, and has a thick, firm-textured whitish-red skin, built up of the usual layers, the muscular integument, composed of annular and longitudinal muscles, being however very thick. Underneath this integument extends a layer of nucleal connective tissue, forming cornice-like projections, which give rise the longitudinal folds on the inner surface of the œsophagus. To this connective membrane is webbed the epithelial layer, composed of comparatively long cylindrical cells, many of which contain, exclusive of the nucleus, a granulous substance, and possibly perform the function of glands.

On the œsophagus, which is webbed by strong filaments of connective tissue to the wall of the body, reaching back towards the hyaline portion of the latter, it expands, forming an oblong sac, also highly muscular, and which may be regarded as a stomach, fig. 3, *d*, with walls of diminished thickness where it passes into the intestine, fig. 3, *e*, though there is no instriction.

The intestine now becomes comparatively slender, swerves to the right, then makes a bend, striking off to the left, its walls getting thinner and thinner; but it now commences a series of circumvolutions, entirely filling up the hyaline globular portion, figs. 2, *f*; 3, *f*, and its walls become so thin, that it almost loses the appearance of an intestine. On thus reaching the posterior portion of the perivisceral cavity, it opens into a short rectum, fig. 3, *g*, terminating in the round anal aperture, which occupies the centre of the acuminate and slightly projecting posterior portion, fig. 2, *e*.

The walls of the rectum are thick and firm-textured, much the same as those of the œsophagus; and its outer surface is webbed by numbers of comparatively strong tendinous bands both to the inner wall of the hyaline sac and to the inner surface of the acuminate prominence, fig. 3, *h*, whereas its outer margin, forming the anus, is surrounded by a powerful sphincter.

The muscular integument of the intestine, excepting on the rectum, is exceedingly thin, and the muscular fibres in both layers lie far apart; on the rectum, they are thick and contiguous.

The inner surface of the intestine is invested with epithelium similar to the layer on the œsophagus, saving that the cylindric cells are more dispersed; but here, too, many of them contained the above-mentioned granulated substance.

The intestine was quite full of fæcal boli, elliptic in form, and so thick in the middle that one bolus sufficed to fill out the intestine, figs. 3; 7.

Man kan gjøre sig et Begreb om hvor tynd Tarmens Vægge var, naar vi sige, at det var en Stund, vi troede der ingen Tarm var, da denne var løsreven fra Rectum; men at hele Dyrets Bagdel udgjorde en Sæk for Excrementerne. Ved stærk Loupe kunde man dog imellem hver Bolus se en florfin Hinde, der var Tarmvæggen.

De særegent formede Excrementer dannes sandsynligvis idet Føden passerer Spiserørets bagre udvidede Del (Maven); thi lige der hvor denne gaar over i den egentlige Tarm laa en Bolus, imedens der i Spiserøret kun var den lerholdige Sand, hvori fandtes en Mængde Foraminiferer.

Centralnervestrængen løber som en fin gulhvid Traad, Fig. 4, *b*, langs den uigjennemsigtige forreste Kropsdels Midte, under Spiserøret, og følger dette til dets forreste Ende, hvor den slaar sig om Svælget og sandsynligvis danner en Ring. Paa denne Vei afgiver den mange Sidegrene til Spiserøret og Huden.

Det er ikke alene Hudens Muskler, der forsynes med Grene, men mange af disse forlænge sig igjennem Bindevævet ud i Epithelet lige under Cuticula, hvor de fine Ender dels tabe sig imellem Cylindercellerne, dels gaa over i aflange, næsten kølleformige Legemer, der ere forsynede med en stor Kjerne, og som vel maa betragtes som Organer, der staa i Følelsens Tjeneste, Fig. 5, *f*. Disse fine peripheriske Nervegrene danne i deres Løb smaa ganglieformige Knuder, som have en stor Kjerne omgivet af Protoplasma, Fig. 5, *g*, og fra hvilke udgaa snart en, snart flere Grene, der hyppig anastomosere med tilsvarende Grene fra andre Ganglier.

Det er ikke lykkedes os, trods al anvendt Møie, at forfølge Centralnervestrængen længere bag i den glasklare Sæk, eller paa Tarmen, ihvorvel det er sandsynligt, at den langs Sækkens indre Flade strækker sig bag imod Rectum.

Kjønsorganerne bestaa hos vort Individ af Æggestokken og en Æggebeholder (Uterus). Æggestokken ligger langs Centralnervestrængen, Fig. 4, *c*, og tager sin Begyndelse et Par Millimeter bagenfor Mundaabningen. Den dannes egentlig af en Fold af det Mesenterium, som binder Svælget til Kropsvæggen og ender noget bagenfor den glasklare Kropsdels Begyndelse.

Æggestokken er sammensat af en stor Mængde næsten pæreformige Follikler, Fig. 8, der bestaa af en klar Membran, hvori sees Bindevævslegemer, Fig. 8, *a*, og hvis indre Flade er beklædt med store Celler, Fig. 8, *b*. I den smalere Del af Follikelen saaes et begyndende Æg, omgivet ligesom af en Krands Celler. Vi saa kun Antydninger til Æg i Folliklerne.

Efter alt at dømme foregaar Æggets Udvikling paa

It will give some idea of the extreme thinness of the intestinal walls, that we were actually in doubt at first whether there was an intestine (it had been detached from the rectum), conceiving the whole posterior portion of the animal to constitute a receptacle for the fæces. With a strong magnifier could be just distinguished between the boli a gauzy pellicle, — and this was the wall of the intestine.

Probably the peculiar form into which the fæces are moulded, may be traced to the passage of the food through the posterior distended portion of the œsophagus (the stomach); for, exactly where that organ passes into the intestine lay a bolus, the contents of the œsophagus consisting exclusively of argillaceous sand, in which were numbers of Foraminifera.

The central nervous chord protends as a slender yellowish-white filament, fig. 4, *b*, along the middle of the anterior opaque portion of the body, underneath the œsophagus, accompanying that organ to its anterior extremity, where it winds round the gullet, forming probably a ring. On its course it sends off numerous subsidiary branches to the œsophagus and the skin.

Not only is it the muscles of the skin that are furnished with branches, — many of these offshoots, piercing the connective tissue, pass on into the epithelium, immediately beneath the cuticle, where their delicate extremities either coalesce with the cylindric cells, or expand into elliptic, more or less clavate corpuscles, furnished with a large nucleus, and which may, we think, be regarded as organs subservient to the sense of touch, fig. 5, *f*. These slender peripheral nervous branches form on their course numerous ganglionous nodules, with a large nucleus embedded in protoplasma, fig. 5, *g*, and from which proceed one or more branches, that frequently anastomose with corresponding branches from other ganglions.

We have failed, notwithstanding a most careful microscopic examination, to trace the central nervous chord farther back in the hyaline sac, or on the intestine, though it probably passes along the inner surface of the sac towards the rectum.

The generative organs consist in our specimen of the ovary and one uterus. The ovary protends along the central nervous chord, fig. 4, *c*, and takes its origin a millimetre or two posterior to the buccal aperture. It consists properly of a fold of the mesentery that webs the gullet to the wall of the body, and terminates a little posterior to the commencement of the hyaline portion of the body.

The ovary is built up of large numbers of almost pyriform follicles, fig. 8, consisting of a translucent membrane, in which are seen corpuscles of connective tissue, fig. 8, *a*, and whose inner surface is covered with large cells, fig. 8, *b*. In the narrower portion of the follicle, was seen a rudimentary egg, surrounded by a cincture, as it were, of cells. We saw none but incipient ova in the follicles.

Judging from analogy, there is every reason to believe

samme Maade, som den der er beskrevet af Vejdovsky[1] og senest af Spengel[2].

Æggebeholderen, Uterus, er langstrakt, næsten ægformig, noget fladtrykt, Fig. 4, *d*, og indtager omtrent den nederste Halvdel af den forreste opake Kropsdels venstre Side. Den bestaar af en gjennemsigtig, temmelig fast Membran, hvis udvendige Flade er beklædt af Peritoneum; indenfor denne er et Bindevævslag, hvortil Muskellaget, der udgjør Tver- og Længdefibre, som krydse hverandre, er bundet. I Hulheden laa fuldt udviklede Æg, to ved Siden af hinanden, Fig. 4, *e*, saa at Bredden af Hulheden indtages af 4 Æg, og det samlede Antal udgjorde omtrent 25.

Fra den nederste Del af Uterus' undre Flade tog Udførselsgangen sin Begyndelse, snoede sig korktrækkerformig langs den nævnte Flade op til den forreste Rand, forlod nu Uterus og løb langs Spiserørets venstre Side paa Bugsiden, Fig. 4, *f*, fortil mod dettes forreste Ende, hvor den gjennemborer Huden og udmunder i den før beskrevne lille Fremstaaenhed, lidt bagenfor Mundaabningen. I Udførselsgangen saaes et Par Æg nær Udgangen, Fig. 4, *g*.

Fra den forreste Rand af Uterus, noget til Høire, udgaar en kort, tyk Kanal, der bøier sig noget mod Bugfladen over Centralnervestrængen, hvor den udvider sig tragtformigt og former derved en temmelig vid Aabning, som er Indgangen for de i Kropshulheden fri blevne Æg, der igjennem den føres ned i Uterus.

Æggene i Uterus vare fuldt udviklede; de bestod af en enkelt, temmelig tyk Membram. Blommen, der havde sin Kimblære og Kimplet, var grønlig, og Kornene lignede meget Chlorophylkorn. Saavel Uterus, som dens begge Kanaler vare ved fine Bindevævstraade bundne til den indre Kropsvæg, og kun Tragten var frit flotterende.

Farven.

Den forreste, uigjennemsigtige Kropsdel er hvid, spillende lidt i det Bleg-rosenrøde. Den sækformige, glasklare Del er farvefri; men den bagerste, koniske Endespids er hvid, som den forreste Del.

Kun et Exemplar paa Station 40.

Slægtskarakter.

Legemet kolbeformigt. Den forreste Del cylindrisk, uigjennemsigtig, med en rund Mundaabning paa den fri

[1] Vejdovsky, F. Ueber die Eibildung und die Männchen von *Bonellia viridis*. Zeitschrift f. w. Zoologie. 30 Band, pag. 487. Leipzig 1878.

[2] Spengel, J. W. Beiträge zur Kenntniss der Gephyreen. Mittheilungen aus der Zoologischen Station zu Neapel. 1 Band, 3 Heft, pag. 357. Leipzig 1879.

that the egg develops in the manner described by Vejdovsky,[1] and latest by Spengel.[2]

The ovarian pouch (uterus) is elongate, well nigh oval, slightly depressed, fig. 4, *d*, and occupies about the lower half of the left side of the anterior opaque portion of the body. It consists of a translucent, comparatively firm-textured membrane, the outer surface of which is invested with peritoneum; underneath the latter extends a layer of connective tissue, to which is webbed the muscular layer, composed of transverse and longitudinal intersecting fibres. In the cavity lay fully developed ova, two side by side, fig. 4, *e*, 4 eggs abreast corresponding to the width of the cavity; the total number amounted to about 25.

From the inferior portion of the under surface of the uterus issues the genital duct; it winds spirally along the said surface up to the anterior margin, then diverges from the uterus, protending along the left side of the œsophagus, on the ventral surface, fig. 4, *f*, towards the anterior extremity of that organ, where it perforates the integument, disemboguing a little posterior to the buccal aperture into the small prominence described above. In the genital duct were seen two eggs near the outlet, fig. 4, *g*.

From the anterior margin of the uterus, a little to the right, issues a short, thick canal, which makes a slight bend across the central nervous chord in the direction of the ventral surface, where it expands, forming a comparatively wide, funnel-shaped opening, through which the eggs pass from the perivisceral cavity down into the uterus.

The ova in the uterus were all mature. They consisted of a single, comparatively thick membrane. The yolk, furnished with a germinal vesicle and a germinal speck, was of a greenish hue; the granules bore a close resemblance to those in *Chlorophyl.* Both the uteri and its two canals were webbed to the wall of the body by slender filaments of connective tissue; the funnel alone floated free.

Colour.

The anterior opaque portion of the body white, shot with a faint tinge of pale rosy red. The sac-like, hyaline portion colourless; but the posterior conical apex is, like the anterior part, white.

One specimen only: at Station 40.

Generic Character.

Body cucurbit-like in form. The anterior portion cylindric, opaque, with a round buccal opening at the free

[1] Vejdovsky, F. Ueber die Eibildung und die Männchen von *Bonellia viridis*. Zeitschrift f. w. Zoologie. 30 Band, pag. 487. Leipzig 1878.

[2] Spengel, J. W. Beiträge zur Kenntniss der Gephyreen. Mittheilungen aus der Zoologischen Station zu Neapel. 1 Band, 3 Heft, pag. 357. Leipzig 1879.

Ende. Den bagerste Del, optagende hele Tarmkanalen, næsten kuglerund, glasklar, endende i en opak Conus, paa hvis Spids Anus. Æggestokken i den forreste Del af Kropshulheden. Ingen Børster.

Artskarakter.

Kroppens forreste, cylindriske, opake Del 12^{mm} lang; den bagerste glasklare, kugleformige Del 18^{mm} lang, 12 til 14^{mm} bred. Farven er hvid paa den forreste Kropsdel, spillende lidt i det Blegrøde, og paa den koniske Ende, imedens den kuglerunde, glasklare Del er farvefri.

Ogsaa her ere vi i det beklagelige Tilfælde at maatte gjøre Undskyldning for den mindre fuldstændige Beskrivelse, vi have leveret; thi kun et enkelt Exemplar stod til vor Tjeneste, og da Dyret baade er lidet og paa Grund af dets Zarthed yderst vanskeligt at behandle, have de anatomisk-histologiske Undersøgelser været meget møisommelige, saa ufuldkomne de end ere blevne. Men *Saccosoma vitreum* er jo i sin Form en saa mærkelig Gephyre, at vi ikke kunne undlade at beskrive den; og det eneste Exemplar er derfor saagodtsom ganske ofret paa Videnskabens Alter.

Vi have henført dette høist mærkelige Dyr til Familien *Bonellidæ,* ihvorvel det i flere Henseender afvige derfra; men naar vi ikke vilde danne en ny Familie for det, hvortil vi for Tiden ingen tilstrækkelig Grund finder, maatte vi blive staaende ved den nævnte Familie, hvortil det mest nærmer sig.

Epithetosoma[1] norvegicum, n. g. & sp.

Tab. VI, Fig. 9—15.

Kroppen er cylindrisk, 12^{mm} lang, 2^{mm} bred med en lidt tykkere afrundet Forende, Fig. 9, *a,* hvorfra udgaar et Appendix (Snabel), der danner et hult halvgjennemsigtigt Rør, Fig. 9, *b,* som er 30^{mm} langt, omtrent 1^{mm} tykt ved Grunden og 0.8^{mm} i den øvrige Længde, indtil den yderste Spids, der er lidt tyndere, og hvori Røret ender blindt.

Kroppen smalner successivt af mod den bagerste Ende, der er konisk afrundet, og paa hvis Spids findes den runde Analaabning.

Strax bagenfor Snabelens Grunddel findes paa hver Side af Kroppen en Spalte, Fig. 13, *a,* der er omtrent 2.5^{mm} lang, har en lidt krum Retning, saa at den forreste Ende, der er den smaleste, bøier noget af mod Rygsiden;

[1] επίθετον = Tilhæng; σῶμα = Legeme.

extremity. The posterior portion, containing the whole of the intestinal canal, almost globular, hyaline, terminating in an opaque conus, at the apex of which is the anal aperture. The ovary in the anterior portion of the perivisceral cavity. No bristles.

Specific Character.

The anterior cylindric opaque portion of the body 12^{mm} long; the posterior, hyaline, globular portion 18^{mm} long, 12—14^{mm} broad. Colour white, shot with pale red, on the anterior portion of the body and on the conical apex; the globular, hyaline portion colourless.

Of this genus, too, our description is in some respects we regret to say, confessedly incomplete, referring as it does to a single specimen, the only one yet obtained. Besides, the small size and delicate organisation of the animal necessitating the greatest care in handling, its anatomical-histological investigation, however incomplete, has proved a toilsome and perplexing task. But *Saccosoma vitreum* is in form and structure a Gephyrean so truly remarkable, that we could not resist the call to describe it; and a unique specimen of a new genus has, we may say, been sacrificed to the paramount claims of Science.

We have referred this very curious animal to the family *Bonellidæ,* — with which, though differing from it in many important points, *Saccosoma* has most in common — since we are not at present prepared with conclusive reasons warranting the establishment of a new family for its reception.

Epithetosoma[1] norvegicum, n. g. & sp.

Pl. VI, figs. 9—15.

Trunk cylindrical, 12^{mm} long, 2^{mm} broad, with a somewhat thicker rounded anterior extremity, fig. 9, *a,* from which protends an appendix (the proboscis), constituting a hollow, semi-translucent tube, fig. 9, *b,* 30^{mm} long and about 1^{mm} thick at the base; elsewhere 0.8^{mm} throughout its length to the extreme point, which is a trifle slenderer, and in which the tube terminates cæcally.

The trunk gradually narrows towards its posterior extremity, which is conically rounded, and pierced at the point with the round anal opening.

Immediately posterior to the basal portion of the proboscis, on either side of the trunk, is seen a cleft or fissure, fig. 13, *a,* about 2.5^{mm} in length, and somewhat arcuate, the anterior extremity, which is narrower than the

[1] επίθετον: appendage; σῶμα: body.

den har temmelig tykke Læber, som ligge næsten til hinanden, uden ganske at slutte sig sammen.

I Bunden af denne Spalte syntes der at være flere fine Aabninger, men som paa Grund af Dyrets Opbevaring i Spiritus vare saa sammentrukne, at de ikke med Bestemthed kunde sees, selv med stærk Loupe.

Bagenfor Tilhængets Grund paa Bugfladen iagttoges den runde Mundaabning, Fig. 13, *b*, der er stærkt foldet, og lidt til Siden af Mundaabningen, noget bagenfor denne, sees en yderst lille, rund Aabning.

Huden er tyk, temmelig fast og ganske uigjennemsigtig paa Kroppen, imedens den paa Snabelen er noget tyndere og gjennemsigtig. Den dannes af en Cuticula, Fig. 14, *a*, der er glasklar, uden Stribning og meget tynd paa Kroppen, saa at den endog er vanskelig at iagttage uden ved meget stærk Forstørrelse; paa Snabelen er den derimod meget tykkere, Fig. 15, *a*.

Indenfor Cuticula er Epithelet, som dannes af et Lag Cylinderceller, der have en bleg, gulgrøn Farve, ere 0.060^{mm} lange, 0.008^{mm} brede ved deres Grunddel. De blive smalere jo mere de nærme sig Overhuden og faa her Udseende af en Række Orgelpiber, Fig. 14, *b*. 15, *b*.

Disse lange Cylinderceller have temmelig tykke Vægge, ere forsynede med en stor mørkere Kjerne og et noget lysere Kjernelegeme, hvilke ere omgivne af et finkornet Protoplasma.

Umiddelbart til dette Epithellag støder den egentlige Cutis, der udgjør et tykt, hyalint Bindevævslag, hvori findes en Mængde noget forskjelligt formede Bindevævslegemer, Fig. 14, *c;* 15, *c*.

Indenfor Bindevævslaget er Muskelhuden, der dannes af 3 Lag: det ydre, circulere Lag (Ringmusklerne), som er temmelig bredt med stærke, tæt i hinanden liggende Muskelfibre, som ere sammenbundne med Bindevæv, Fig. 14, *d;* det midterste Lag (Længdemusklerne), der ere bredere end de ydre Ringmuskler, Fig. 14, *e*, og hvis Fibre ere tykkere, og det indre Ringmuskellag, som er yderst smalt, og hvis Fibre ere meget tyndere end de to foregaaendes, Fig. 14, *f*. Det indre Ringmuskellag er beklædt af Peritoneum, der har et Epithelovertræk; om dette er flimrende, hvilket er sandsynligt, kunne vi ikke afgjøre.

Paa Snabelen ere Cylindercellerne noget kortere, og her ligge Fibrene i Muskellagene saa langt fra hverandre, at Muskelhuden er tydelig gittret.

Paa den indre Flade af Huden, just paa det Sted, der svarer til den tidligere beskrevne Spalte paa hver Side af den forreste Kropsende, sees en Række runde Aabninger (vi talte 4 paa hver Side), hvilke vare omgivne af en rund Vold, der dannede ligesom en Sphincter om Aabningen, som førte ind til Spaltens Bund, Fig. 11, *a*. 12, *a*. Her er et Slags Respirationsapparat, hvorved Søvandet

posterior, slightly inclining towards the dorsal surface; it has comparatively thick edges, near together, but not contiguous.

The bottom of this fissured opening was apparently pierced with divers minute apertures, which, however, had become so shrunk and contracted (the specimen was preserved in spirits) that even under a powerful lens they could not be plainly distinguished.

Posterior to the base of the appendix, on the ventral surface, is seen the round buccal aperture, fig. 13, *b*, prominently folded; and a little aside of, and posterior to, the buccal aperture, occurs an exceedingly minute circular opening.

The skin is thick, comparatively firm-textured, and quite opaque on the trunk; on the proboscis, it is somewhat thinner and translucent. It consists of a cuticle, fig. 14, *a*, which is hyaline, without striæ, and on the trunk exceedingly thin, so thin indeed as to be with difficulty distinguished even under a strong magnifier; on the proboscis, it is much thicker, fig. 15, *a*.

Underneath the cuticle extends the epithelium, consisting of a layer of cylindric cells, in colour a pale yellowish-green, 0.060^{mm} long and 0.008^{mm} broad at the base; they become gradually narrower the nearer they approach the cuticle, where they closely resemble a row of organ-pipes, figs. 14, *b;* 15, *b*.

These long cylindric cells have thickish walls, are furnished with a large, dark-coloured nucleus, and a somewhat lighter nucleolus, both surrounded by finely granulated protoplasma.

Immediately adjoining this epithelial layer, extends the true *cutis*, consisting of a thick hyaline layer of connective tissue, throughout which corpuscles of connective tissue are abundantly dispersed, figs. 14, *c;* 15, *c*.

Underneath the layer of connective tissue extends the muscular integument, composed of 3 layers: an outer circular layer (the annular muscles), comparatively broad, with strong, closely disposed muscular fibres, webbed together by connective tissue, fig. 14, *d;* a medial layer (the longitudinal muscles), broader than the outer annular muscles, fig. 14, *e*, and with thicker fibres; and the inner annular layer, which is exceedingly narrow, and with much slenderer fibres than the two foregoing layers, fig. 14, *f*. The inner annular layer is invested with peritoneum, having a thin epithelial tunic, but whether vibratile — which is probable — or without cilia, we could not determine.

On the proboscis, the cylindrical cells are somewhat shorter, and here the fibres of the muscular layer lie so far apart as to give the integument a distinct tessellated appearance.

On the inner surface of the skin, extending along either side of the anterior extremity of the body, inside the fore-mentioned fissure, are seen a series of round openings (we counted 4 on each side), surrounded by a circular ridge, constituting a kind of sphincter round the opening, which leads down to the bottom of the fissure, figs. 11, *a;* 12, *a*. Here (at the bottom of the fissure) is placed a

korresponderer med Kropshulheden; thi aabenbart kan Spalten udvide og sammentrække sine Læber, alt eftersom Strømningen skal gaa ind eller ud, — en Organisation, der er ganske fremmed for Gephyreerne.

Mundaabningen er omgivet af en muskuløs Vold. Spiserøret er omtrent 2.5^{mm} langt, Fig. 11, *b*, og har paa sin indre Flade stærke Længdefolder, som rage temmelig langt ind i Hulheden. Hvor Spiserøret gaar over i Tarmen er en Indsnøring, Fig. 11, *c*, som danner ligesom en Ring paa den indre Flade.

Tarmen, Fig. 10, 11, er meget vid og indtager en stor Del af Kropshulheden; den har en lige Retning bag mod Kroppens bageste Ende, hvor den danner en yderst kort Rectum med en rund Analaabning. Den er i hele sin Længde paa Bugfladen og Siderne til henimod et Par Millimeter fra Analaabningen forsynet med en Mængde brede ringformige Folder, Fig. 10, *a*; 11, *d*, der rage langt ind i Tarmens Lumen.

Tarmens Rygflade derimod er glat og har paa den udvendige Side et stærkt muskuløst Baand, Fig. 11, *e*, der ved en Mængde Bindevævs- og Muskeltraade er nøie bundet til Kropshulhedens Rygflade, saa at der intet Mellemrum findes imellem denne og Tarmen. Det indre Epithel, der beklæder Tarmen og dens Folder, dannes af temmelig store Cylinderceller, der — foruden Kjerne og Kjernelegeme — indeholder et kornet Protoplasma, Fig. 14, *g*; mange af disse Celler ere meget store og have en temmelig bred Grunddel, og kunne muligens tjene som Afsondringsorganer; forøvrigt er Tarmens histologiske Bygning som hos Gephyreerne i Almindelighed.

Spiserøret var temmelig fast bundet til Kropsvæggen ved mange muskuløse Baand, hvoraf enkelte vare meget lange. Tarmens Bugflade var ved et stærkt Mesenterium fæstet til Kropsvæggen.

Der var ingen af de buskede Organer ved Rectum, som findes hos *Bonellia, Thalassema, Echiurus* og *Hamingia*.

Hvad vi kunne meddele om Nervesystemet er destoværre meget ufuldkomment; thi Dyrenes slette Konservation har gjort det umuligt at kunne forfølge det i sin Helhed; ved Hjælp af endel Tversnit have vi dog kunnet udrede noget.

Nervestrængen følger langs Bugfladen ved Siden af Tarmmesenteriet og imellem Tarmvæggen og Kropsvæggens indre Ringmuskellag, fra Anus til den forreste Del af Spiserøret. Den er ikke indesluttet i noget Kar; men i dens Centrum er et Lumen, Fig. 14, *h*, hvori vistnok circulerer en Vædske og kan betragtes som et Centralkar. Et saadant har ogsaa Greeff iagttaget hos *Echiurus Palassi*[1].

[1] Ueber den Bau und die Entwickelung der *Echiurus* von R. Greeff. Aus den Sitzungsberichten der Gesellschaft zur Beförderung der gesammten Naturwissenschaften zur Marburg, No. 2, Februar 1874.

kind of respiratory apparatus, through which the sea-water is made to communicate with the perivisceral cavity; for the labia of the fissure can evidently expand and contract, for the admission and expulsion of the circulating fluid, — a peculiarity of organisation altogether alien to the *Gephyrea*.

The buccal aperture is surrounded by a muscular ridge. The gullet, about 2.5^{mm} long, fig. 11, *b*, exhibits on its inner surface prominent longitudinal folds, extending comparatively far down into the cavity. Where the œsophagus passes into the intestine, is seen an instriction, fig. 11, *c*, forming, as it were, a ring on the inner surface.

The intestine, figs. 10; 11, is exceedingly wide, occupying a considerable portion of the perivisceral cavity; it protends almost straight back towards the posterior extremity of the body, where it opens into an exceedingly short rectum, with a round anal opening. It is furnished throughout its entire length on the ventral surface, and on the sides, to within a millimetre or two from the anal opening, with numerous broad annulary folds, figs. 10, *a*; 11, *d*, projecting far down into the lumen of the intestine.

The dorsal surface of the intestine, on the other hand, is smooth, and furnished on the outer surface with an exceedingly muscular band, fig. 11, *e*, closely webbed by numbers of membranous and muscular filaments to the dorsal surface of the perivisceral cavity, no space being left between the latter and the intestine. The inner epithelium, investing the intestine and its folds, is composed of comparatively large cylindrical cells, which, exclusive of a nucleus and a nucleolus, contain granulous protoplasma, fig. 14, *g*; many of these cells are exceedingly large, with a broadish base; they perform, possibly, the office of secretory organs; for the rest, the histological structure of the intestine is that usually distinguishing the *Gephyrea*.

The œsophagus was strongly webbed to the wall of the body by numerous muscular bands, some of them remarkably long. The ventral surface of the intestine was attached to the wall of the body by a strong mesentery.

No trace of the bunchy organs observed on either side of the rectum in *Bonellia, Thalassema, Echiurus*, and *Hamingia*.

Unfortunately, we have but little to record of the nervous system; for owing to the bad state of the specimens it could not possibly be traced throughout; a few transverse sections enabled us however to observe some of its characteristics.

The nervous chord runs along the ventral surface, accompanying the intestinal mesentery between the wall of the intestine and the inner annular muscular layer in the wall of the body, from the anus to the anterior part of the œsophagus. It is not enclosed in any vessel; but in its centre there is a lumen, fig. 14, *h*, no doubt containing a circulating fluid, and this may be regarded as a central vessel. Greef observed a similar vessel in *Echiurus Palassi*.[1]

[1] Ueber den Bau und die Entwickelung der *Echiurus* von R. Greef. Aus den Sitzungsberichten der Gesellschaft zur Beförderung der gesammten Naturwissenschaften zu Marburg, No. 2, Februar 1874.

Centralnervestrængen bestaar af en tyk muskuløs Skede, Fig. 14, *i*, indenfor hvilken den egentlige Nervemasse er, som dannes af et ydre celluløst Lag, Fig. 14, *k*, som er det bredeste, og et indre fibrillært, Fig. 14, *l*, der ligesom omgiver Centralkarret. Imellem Cellerne og Fibrillerne er et fint Bindevæv, der kitter Elementerne sammen og som udgaar fra Skedens indre Flade. Paa den forreste Del af Spiserøret tabte Nervestrængen sig i ramolleret Væv, saa vi ikke kunne afgjøre, hvorvidt den danner nogen Svælgring, hvilket dog er det sandsynligste; thi i Snabelen forlænger den sig ikke, — det have vi overbevist os om baade ved Tver- og Fladesnit.

Hvad Blodkarsystemet angaar, saa kunne vi Intet derom meddele, da vi ikke have fundet Spor dertil paa Grund af den slette Konservation.

Langs den forreste Halvdel af Tarmens Bugflade og bundet til Mesenteriet saaes et baandformigt, langstrakt Organ, der syntes at være dannet af sækformige Udbugtninger, og hvori kunde iagttages Cellegrupper, der tydede hen paa en begyndende Ægdannelse. Vi antage dette Organ for en Æggestok.

Paa høire Side af Tarmen i Kropshulhedens forreste Del fandtes et langt, næsten cylindrisk Organ, hvis forreste noget smalere Del var fæstet til Bugen; og Tilheftningsstedet svarede til det Sted, hvor der udvendig paa Kroppen saaes den førbeskrevne Aabning.

Lige ved Tilheftningsstedet paa Organets undre Flade saaes en Forlængelse, der sandsynligvis var den tragtformige Aabning for Æggebeholderen, som vi antage dette Organ for at være; men da vi nærmere vilde undersøge denne Forlængelse, viste det sig at Vævet var saa ramolleret, at vi ikke vove med Sikkerhed at antage den for Tragten.

Det langstrakte Organ, Fig. 11, *f*, havde en afrundet fri Ende; men var forresten bundet til Kropsvæggen ved flere fine Bindevævstraade. Vi fandt intet Indhold i dette Organ. Væggene vare muskuløse, men sammenfaldne, og gik let i Stykker ved Berørelse.

Kropsvædsken var kun at iagttage i Snabelen, og den indeholdt en Mængde næsten skiveformige Celler, der havde en svag brungul Farve.

Farven.

Legemet er olivengrønt. Snabelen bleg grønlig, næsten klar.

Findested Station 190; kun to Exemplarer.

The central nervous chord consists of a thick muscular sheath, fig. 14, *i*, underneath which lies the true nervous substance, consisting of an outer cellular layer, fig. 14, *k*, comparatively broad, and of an inner fibrillous layer, fig. 14, *l*, surrounding, as it were, the central vessel. Between the cells and the fibrils extends a layer of delicate connective tissue, uniting the several elements, and which issues from the inner surface of the sheath. On the anterior portion of the œsophagus the nervous chord was lost in a layer of disintegrated tissue, and we could not therefore determine whether it forms an pharyngeal ring, which, however, it most probably does; for it is not produced into the proboscis; of this we are assured from a careful examination both of transverse and longitudinal sections.

As regards the circulatory system (blood vessels) we have nothing whatever to communicate, not having found so much as a trace thereof in the badly preserved specimens.

Along the anterior half of the ventral surface of the intestine, and webbed to the mesentery, was seen a riband-shaped, elongate organ, consisting apparently of a series of sac-like dilatations, and in which groups of cells could be distinguished having the appearance of developping ova. We regard this organ as an ovary.

On the right side of the intestine in the anterior portion of the perivisceral cavity, protended a long, almost cylindrical organ, with its anterior, somewhat slenderer, part webbed to the belly, the line of attachment corresponding to the place on the outer surface of the body in which was seen the fore-described opening.

Close to the line of attachment on the inner surface of the organ, was an elongated prolation, most probably the funnel-shaped opening to the uterine pouch, which we take the said organ to be; but on proceeding to a closer examination, the tissue proved so completely disintegrated that we dare not regard it as the funnel.

The elongate organ, fig. 11, *f*, had a rounded free extremity, but was webbed to the wall of the body by numerous delicate filaments of connective tissue. This organ we found to be void of contents. The walls were muscular, but had fallen in, and crumpled to the touch.

The perivisceral fluid was observed in the proboscis only, and it contained numbers of almost discoid cells, pale brownish-yellow in colour.

Colour.

The body olive-green. The proboscis pale-green, and almost hyaline.

Taken at Station 190: two specimens.

Fam. **Epithetosomatidæ**, Dan. & Kor.

Legemet forsynet med et cylindrisk, hult, med Kropshulheden korresponderende Rør. Bagenfor dette, paa hver Side af Kroppens Forende, en Spalte, i Bunden forsynet med Aabninger. Ingen Børster.

Slægtskarakter.

Legemet cylindrisk, paa dets forreste Ende forsynet med et langt, ikke retractilt, rørformigt Tilhæng (Snabel). Bagenfor dette, paa Bugsiden, den runde Mundaabning. Paa hver Side af den forreste Kropsende en Spalte, der i Bunden er forsynet med flere Aabninger. Ingen Analappendices. Anus i Kroppens bagerste Ende.

Artskarakter.

Kroppen cylindrisk, 12^{mm} lang, 2^{mm} bred. Det rørformige Tilhæng $2^1/_2$ Gang saa langt som Kroppen. Tarmen lige, stærkt foldet. Farven paa Kroppen olivengrøn, paa Snabelen bleg grønlig.

Den Beskrivelse vi her have leveret er jo i mange Punkter yderst ufuldkommen; thi det Materiale, der har staaet til vor Disposition, har baade været ringe — kun to Exemplarer — og slet konserveret. Ved et Uheld vare de blevne opbevarede paa et saa lidet Glas, at Spiritus-indholdet ikke var tilstrækkelig til en god Konservation.

Det var især de indre Organer, der havde lidt, og det i den Grad, at Vævene for en stor Del vare ramollerede. Men da det her omhandlede Dyr efter vor Formening i flere Henseender har stor Interesse for Videnskaben, fandt vi det rigtigt at offentliggjøre vore Undersøgelser, saa ufuldstændige, de end ere, i Haab om, at naar Opmærksomheden engang var vakt, vilde det senere lykkes Forskere at erholde et bedre og rigere Materiale, hvorved Iagttagelserne ikke alene kunde optages paany, men at ogsaa derved de i vor Beskrivelse muligens indløbne Feil kunne berigtiges og Manglerne udfyldes.

Det vil være indlysende af vor Beskrivelse, at vort nye Dyr ikke kan henføres til nogen af de af Gephyreerne hidtil bekjendte Familier eller Slægter. Det afviger paa saa mange Maader fra disse, og ikke mindst derved, at det har Spalter, der aabne Forbindelsen mellem Søvandet og Kropsvædsken, at vi et Øieblik var i Tvivl om, hvorvidt vi havde med en Gephyre at gjøre, — en Tvivl, der dog snart hævedes ved den Kundskab, vi erholdt om Dyrets Organisation. Denne tilhører overveiende Gephyreernes. De nævnte Aandespalter? ere jo ganske eiendommelige og fremmede for denne Klasse af Dyr, og har neppe noget Analogon.

Vi have saaledes ikke alene opstillet en ny Slægt for det; men vi have endog fundet det nødvendigt at grunde en ny Familie, hvortil Slægten kan henføres.

Fam. **Epithetosomatidæ**, Dan. & Kor.

Body furnished with a cylindrical, hollow tube, communicating with the perivisceral cavity. Posterior to this tube, on either side of the anterior extremity of the trunk, a cleft, or fissure, the bottom pierced with apertures. No bristles.

Generic Character.

Body cylindric, furnished at the anterior extremity with a long, non-retractile, tubiform appendix (proboscis). Posterior to the appendix, on the ventral surface, the round buccal opening. On either side of the anterior extremity of the trunk, a cleft, or fissure, the bottom pierced with several apertures. No anal appendices. The anus on the posterior extremity of the trunk.

Specific Character.

Trunk cylindric, 12^{mm} long, 2^{mm} in diameter. The tubiform appendix $2^1/_2$ times the length of the trunk. The intestine straight, with prominent folds. Colour of trunk olive-green; of proboscis pale-green.

The description we have here ventured to give is in many respects very incomplete, the materials from which it has been furnished having been not only scanty, but — a far greater drawback — also defective: two examples in a bad state of preservation. Unfortunately, the glass jar in which the specimens had to be brought home, was so small, that the quantity of spirits was insufficient for perfect preservation.

The internal organs had suffered most, to that extent indeed, that the greater part of the delicate tissue was found to have become more or less disintegrated. But, as this rare animal will, we opine, prove of great scientific interest, we feel no hesitation in publishing the results of our investigation, however meagre and incomplete, hoping that, when attention shall have been once aroused, zoologists may at some future period succeed in obtaining more extensive and better materials, wherewith could be resumed the observations prematurely arrested, and any errors rectified that may be found to detract from the value of our description.

It will be obvious from the criteria recorded, that *Epithetosoma* cannot be referred to any known genus or family of *Gephyrea*. It differs indeed from them all in so many respects, and not least by reason of the fissured opening through which the sea-water gains access to the perivisceral cavity, that we were a moment in doubt as to whether the animal before us could be a Gephyrean, — a doubt, however, speedily set at rest on our proceeding to investigate its organisation. The aforesaid respiratory fissure is, however, something eminently peculiar, and alien to this class of animals; its analogue probably does not exist.

Hence we have not only had to institute a new genus but have found it necessary to establish a new family for the reception of *Epithetosoma*.

Her skulle vi benytte Anledningen til at yttre, at de to Ordener, hvori Gephyreernes Klasse er inddelt, nemlig *Gephyrea inermia* og *Gephyrea armata,* neppe kan siges at være heldige.

Vi have opstillet 3 nye Slægter, der ifølge deres hele Organisation maa henføres til *Gephyrea armata,* omendskjøndt de ikke ere forsynede med de enkelte Organer (Børster), som udgjør det væsentligste Grundlag for denne Orden. Skulde vi altsaa have holdt os strængt til den systematiske Inddeling, maatte vore 3 nye Slægter henføres til *Gephyrea inermia,* med hvilke de dog kun have lidet tilfælles i Forhold til den store Lighed, de have med de Slægter, der tilhøre den anden Orden.

In conclusion, we will avail ourselves of the opportunity afforded, to remark that the two orders into which the Class *Gephyrea* is divided, viz. *Gephyrea inermia* and *Gephyrea armata,* can hardly be regarded as satisfactory.

We have established 3 new genera, which, by reason of their anatomical structure, are referred to *Gephyrea armata,* through they are not furnished with the characters (bristles) on which that order is based. Had, therefore, in this case, the systematic classification been rigorously applied, our 3 new genera would have had to be referred to *Gephyrea inermia,* with which order they have but little in common, compared to the striking resemblance they bear to the genera comprised in the other.

Fortegnelse

over de paa Nordhavsexpeditionen fundne Slægter og Arter af Gephyreer, samt over den vigtigste Del af deres Synonymi.

Fam. **Sipunculidæ,** Baird.

1. **Sipunculus priapuloides,** Koren & Dan., "Fauna littoralis Norvegiæ", Bergen, 1877, pag. 126, Tab. XIII, Fig. 1—6.

1 Exemplar paa Station 79. To hele, overordentlig store Exemplarer og 4 sønderrevne paa Stat. 252. Et Exemplar og nogle Stumper paa Stat. 255.

2. **Phascolosoma strombi,** Mont.
1799. "Snyltedyr", Jens Rathke. Skrifter af Naturh. Selskab. Hefte 1, pag. 124, Pl. III, Fig. 17. Kjøbenhavn.
1804. *Sipunculus Strombi,* G. Montagu. Transact. Linn. Soc. VII, pag. 74. London.
Sipunculus bernhardus. 1841. E. Forbes. A History of British Starfishes, pag. 251. London.
capitatus. 1843. H. Rathke. Nova Acta, Acad. Leop. Car. XX, pag. 143, Pl. VI, Fig. 20—23.
Phascolosoma concharum. 1844. A. S. Ørsted. De region. mar. pag. 80. Hafniæ.
strombi. 1865. Keferstein. Nachricht. d. K. Ges. d. Wiss. Göttingen, März, pag. 202. Zeitschr. f. wiss. Zool. XV, pag. 431, Pl. XXXI, Fig. 10, et Pl. XXXIII, Fig. 34, 35, 36. Leipzig.
Phascolion strombi. 1875. H. Théel. Bihang till K. Svenska Vet. Akad. Handl. Bd. 3, No. 3. K. Svenska Vet. Akad. Handl. Bd. 14, No. 2.

Den var hyppig og fandtes paa følgende Stationer: 10, 48, 79, 192, 224, 225, 240, 257, 260, 261, 275, 326, 337.

Phascolosoma strombi, varietas spitsbergense. Phascolion spitsbergense, Théel. Bihang till K. Svenska Vet. Akad. Handl. Bd. 3, No. 6, pag. 15, Pl. I, Fig. 1 et Pl. III, Fig. 16.

List

of the Genera and Species of *Gephyrea* collected on the Norwegian North-Atlantic Expedition, and of their chief Synonyms.

Fam. **Sipunculidæ,** Baird.

1. **Sipunculus priapuloides,** Koren & Dan., "Fauna littoralis Norvegiæ," Bergen, 1877, pag. 126; Pl. XIII, figs. 1—6.

One specimen at Station 79. Two perfect specimens, remarkably large, and 4 mutilated individuals, at Stat. 252. One specimen and a few fragments at Stat. 255.

2. **Phascolosoma strombi,** Mont.
1799. "Snyltedyr," Jens Rathke. Skrifter af Naturh. Selskab. Part. 1, pag. 124, Pl. III, fig. 17. Kjøbenhavn.
1804. *Sipunculus Strombi,* G. Montagu. Transact. Linn. Soc. VII, pag. 74. London.
Sipunculus bernhardus. 1841. E. Forbes. A History of British Starfishes, pag. 251. London.
capitatus. 1843. H. Rathke. Nova acta, Acad. Leop. Car. XX, pag. 143, Pl. VI, figs. 20—23.
Phascolosoma concharum. 1844. A. S. Ørsted. De region. mar. pag. 80. Hafniæ.
strombi. 1865. Keferstein. Nachricht. d. K. Ges. d. Wiss. Göttingen, März, pag. 202. Zeitschr. f. wiss. Zool. XV, pag. 431, Pl. XXXI, fig. 10 et Pl. XXXIII, figs. 34, 35, 36. Leipzig.
Phascolion strombi. 1875. H. Théel. Bihang till K. Svenska Vet. Akad. Handl. Bd. 3, No. 3. K. Svenska Vet. Akad. Handl. Bd. 14, No. 2.

Abundant, and brought up at the following Stations: — 10, 48, 79, 192, 224, 225, 240, 257, 260, 261, 275, 326, 337.

Phascolosoma strombi, varietas spitsbergense. Phascolion spitsbergense, Théel. Bihang till K. Svenska Vet. Akad. Handl. Bd. 3, No. 6, pag. 15, Pl. I, fig. 1 et Pl. III, fig. 16.

Paa Station 323 ved Spitsbergen blev fundet 3 Exemplarer af Théels *Phascolion spitsbergense;* og vi have derved faaet Anledning til at sammenholde den med en hel Del Exemplarer af *Phascolosoma strombi,* der ere indsamlede dels ved Finmarkens Kyster, dels paa flere Stationer i det norske Hav, saavel fra den kolde, som varme Area. Resultatet har da været, at den Tvivl vi nærede og udtalte i 3die Hefte af "Fauna littoralis Norvegiæ", pag. 154, med Hensyn til Artens Selvstændighed er saa langt fra bleven rokket, at vi tvertimod nu maa antage den for en ikke særdeles stærkt udpræget Varietet af *Phascolosoma strombi.*

3. **Phascolosoma eremita,** M. Sars. Nyt Magazin for Naturvid. 1851, pag. 197.
   — **boreale,** Keferstein. Nachrichten d. K. Ges. d. Wiss., Göttingen 1865, pag. 206. Zeitschr. f. w. Zool. 1865, pag. 437, Tab. XXXI, Fig. 7; Tab. XXXIII, Fig. 33.
   — **boreale,** H. Théel., Bihang till K. Sv. Vet. Akad. Handl. Bd. 3, No. 6, pag. 10, 1875—76.
   — **eremita,** Koren & Dan. "Fauna littoralis Norvegiæ" 3die Hefte, pag. 134, Tab. XV, Fig. 45.

3 Exemplarer paa Stat. 257, et lidet Exempl. paa Stat. 275 og et lignende paa Stat. 326.

4. **Phascolosoma margaritaceum,** M. Sars. Nyt Magazin for Naturv. 1851, pag. 196.
   — **Ørstedii,** Keferstein. Nachrichten d. K. Ges. d. Wiss., Göttingen 1865, pag. 205. Zeitschr. f. w. Zool. 1865, pag. 436, Tab. XXXI, Fig. 8; Tab. XXX, Fig. 39.
   — **Ørstedii,** Ehlers. Sitzungsber. d. phys. med. Soc. zu Erlangen 1871, III, pag. 83.
   — **Ørstedii,** Théel. Bihang till K. Sv. Vet. Akad. Handl. Bd. 3, No. 6, pag. 9, 1875—76.
   — **margaritaceum,** Koren & Dan. "Fauna littoralis Norvegiæ" 3die Hefte, pag. 135, Tab. XV, Fig. 43, 44. Bergen, 1877.

1 Exempl. paa Stat. 2, Sognefjord.

5. **Phascolosoma sqvamatum,** Koren & Dan. "Fauna littoralis Norvegiæ" 1877, pag. 130, Tab. XIII, Fig. 11; Tab. XIV, Fig. 14, 15.

Flere Exemplarer paa Stat. 9, 1 Exempl. paa Stat. 147, og to Exempl. paa Stat. 149.

6. **Phascolosoma Lilljeborgii,** Dan. & Kor.

Flere Exemplarer paa Stat. 34. Et Par Exempl. paa Stat. 40, 51, 87, 176, 200. 2 Exempl. i Rør paa Stat. 295.

7. **Stephanostoma Hanseni,** Dan. & Kor.

Et helt Exempl. og mange større og mindre Stumper paa Stat. 223. Et næsten helt Exempl. paa Stat. 267.

At Station 323, off Spitzbergen, were brought up 3 specimens of Théel's *Phascolion spitsbergense,* thus affording opportunity of comparing this animal with numerous specimens of *Phascolosoma strombi,* collected in part on the coasts of Finmark and in part at divers Stations in the Norwegian Sea, both from the cold and the warm area. The result of the comparison shows the doubt we entertained and had expressed in Part III of "Fauna littoralis Norvegiæ," pag. 154, touching the claim of *Phascolion spitsbergense* to be regarded as a distinct species, to have been well founded; indeed, we now regard the animal as a mere variety, by no means strongly marked, of *Phascolosoma strombi.*

3. **Phascolosoma eremita,** M. Sars. Nyt Magazin for Naturvid. 1851, pag. 197.
   — **boreale,** Keferstein. Nachrichten d. K. Ges. d. Wiss., Göttingen 1865, pag. 206. Zeitschr. f. w. Zool. 1865, pag. 437. Pl. XXXI, fig. 7, Pl. XXXIII, fig. 33.
   — **boreale,** H. Théel. Bihang till K. Sv. Vet. Akad. Handl. Bd. 3, No. 6, pag. 10, 1875—76.
   — **eremita,** Koren & Dan. "Fauna littoralis Norwegiæ," Hefte III, pag. 134, Pl. XV, fig. 45.

Three specimens at Stat. 257; a small specimen at Stat. 275; another small specimen at Stat. 326.

4. **Phascolosoma margaritaceum,** M. Sars. Nyt Magazin for Naturv. 1851, pag. 196.
   — **Ørstedii,** Keferstein. Nachrichten d. K. Ges. d. Wiss., Göttingen 1865, pag. 205. Zeitschr. f. w. Zool. 1865, pag. 436, Pl. XXXI, fig. 8, Pl. XXX, fig. 39.
   — **Ørstedii,** Ehlers, Sitzungsber. d. phys. med. Soc. zu Erlangen 1871, III, pag. 83.
   — **Ørstedii,** Théel. Bihang till K. Sv. Vet. Akad. Handl. Bd. 3, No. 6, pag. 9, 1875—76.
   — **margaritaceum,** Koren & Dan. "Fauna littoralis Norvegiæ," Hefte III, pag. 135, Pl. XV, figs. 43, 44. Bergen 1877.

One specimen, at Stat. 2, in the Sognefjord.

5. **Phascolosoma sqvamatum,** Koren & Dan. "Fauna littoralis Norvegiæ," 1877, pag. 130, Pl. XIII, fig. 11; Pl. XIV, figs. 14, 15.

Several specimens at Stat. 9; one specimen at Stat. 147; two specimens at Stat. 149.

6. **Phascolosoma Lilljeborgii,** Dan. & Koren.

Several specimens at Stat. 34; a few specimens at Stat. 40, 51, 87, 176, 200; two specimens, with tubes, at Stat. 295.

7. **Stephanostoma Hanseni,** Dan. & Koren.

One perfect specimen, and numerous fragments, at Stat. 223; one specimen, almost perfect, at Stat. 267.

8. **Onchnesoma Steenstrupii,** Koren & Dan. "Fauna littoralis Norvegiæ". Bergen 1877, pag. 142, Tab. XV, Fig. 28—36.

Mange Exemplarer paa Stat. 1, Sognefjorden. Nogle Exempl. paa Stat. 147.

9. **Onchnesoma glaciale,** Koren & Dan.

Flere Exempl. paa Stat. 51, 240, 248. 1 Exempl. paa Stat. 251. Mange Exempl., der vare sammenfiltrede ved den lange Snabel, paa Stat. 283.

10. **Aspidosiphon armatum,** Koren & Dan.

1 Exemplar paa Stat. 87.

Fam. **Priapulidæ,** Baird.

11. **Priapulus caudatus,** Lam.
Holothuria priapus, O. Fabr. "Fauna Grønl." O. Fr. Müller, Zoologia Dan. III, pag. 27, Tab. XCVI, Fig. 1. J. Rathke, Zool. Dan. IV, pag. 18, Tab. CXXXV, Fig. 2.
Priapulus caudatus, Frey und R. Leuckart. Beiträge zur Kenntniss wirbelloser Thiere. Braunschweig 1847, pag. 40.
— **caudatus,** Ehlers. Zeitschr. f. w. Zool., 11ter B., pag. 209, Tab. XX.
— **glandifer,** Ehlers. Zeitschr. f. w. Zool., 11ter B., pag. 209, Tab. XXI, Fig. 24.
— **brevicaudatus,** Ehlers. Zeitschr. f. w. Zool., 11ter B., pag. 209.
— **caudatus,** Koren & Dan. "Fauna littoralis Norvegiæ" pag. 150.

Temmelig hyppig ved Spitsbergen, nemlig ved Magdalene-Bay, Advent-Bay og Stat. 366.

12. **Priapuloides typicus,** Koren & Dan. "Fauna littoralis Norvegiæ", pag. 147, Tab. XVI, Fig. 10—14, 3die Hefte 1877.

1 Exemplar paa Stat. 18. 1 Exempl. paa Stat. 192. Et Par hele Exempl. og nogle Stumper paa Stat. 224, 225. Et lidet Exemplar paa Stat. 240. Et lignende paa Stat. 262. Et meget stort og et lidet Exempl. paa Stat. 290. Et meget stort Exempl. paa Stat. 226. Et lidet Exempl. paa Stat. 336 og 338. 2 Exempl. paa Stat. 357.

13. **Halicryptus spinulosus,** v. Siebold.
— **spinulosus,** v. Siebold, 1849. Neue preuss. Provincialblätter, VII, pag. 184. Königsberg.
— **spinulosus,** v. Siebold, 1862. Zeitschr. f. w. Zool., XI, pag. 413.
— **spinulosus,** Ehlers, 1862. Zeitschr. f. w. Zool., XI, pag. 401, Pl. XXIV.
— **spinulosus,** Ehlers, 1871. Sitzungsbericht d. phys.-med. Soc. zu Erlangen, III, pag. 84.
— **spinulosus,** Willemoes-Suhm, 1871. Zeitschrift f. w. Zool., XXI, pag. 385.

8. **Onchnesoma Steenstrupii,** Koren & Dan. "Fauna littoralis Norvegiæ." Bergen 1877, pag. 142, Pl. XV, figs. 28—36.

Numerous specimens at Station 1, in the Sognefjord; a few specimens at Station 147.

9. **Onchnesoma glaciale,** Koren & Dan.

Several specimens at each of the following Stations: — 51, 240, 248; one specimen at Stat. 251; numerous specimens, with the long probosces interlaced, at Stat. 283.

10. **Aspidosiphon armatum,** Koren & Dan.

One specimen at Stat. 87.

Fam. **Priapulidæ,** Baird.

11. **Priapulus caudatus,** Lam.
Holothuria priapus, O. Fabr. "Fauna Grønl." O. Fr. Müller, Zoologia Dan. Part III, pag. 27, Pl. XCVI. fig. 1. J. Rathke, Zool. Dan. Part IV, pag. 18, Pl. CXXXV, fig. 2.
Priapulus caudatus, Frey und R. Leuckart. Beiträge zur Kenntniss wirbelloser Thiere. Braunschweig, 1847, Part IV, pag. 40.
— **caudatus,** Ehlers. Zeitschr. f. w. Zool., Part XI, pag. 209, Pl. XX.
— **glandifer,** Ehlers. Zeitschr. f. w. Zool., Part XI, pag. 209, Pl. XXI, fig. 24.
— **brevicaudatus,** Ehlers. Zeitschr. f. w. Zool., Part XI, pag. 205.
— **caudatus,** Koren & Dan. "Fauna littoralis Norvegiæ," pag. 150.

Comparatively abundant off Spitzbergen, in particular in Magdalene Bay, Advent Bay, and at Stat. 366.

12. **Priapuloides typicus,** Koren & Dan. "Fauna littoralis Norvegiæ," pag. 147, Pl. XVI, figs. 10—14, Part III, 1877.

One specimen at Stat. 18; one specimen at Stat. 192; two perfect specimens, and a few fragments, at Stat. 224, 225; one small specimen at Stat. 240; another small specimen at Stat. 262; two specimens, one very large and one small, at Stat. 290; one specimen, very large, at Stat. 226; two small specimens, one at Stat. 336 and one at Stat. 338; two specimens at Stat. 357.

13. **Halicryptus spinulosus,** v. Siebold.
— **spinulosus,** v. Siebold, 1849. Neue preuss. Provincialblätter, VII, pag. 184. Königsberg.
— **spinulosus,** v. Siebold, 1862. Zeitschr. f. w. Zool., XI, pag. 413.
— **spinulosus,** Ehlers, 1862. Zeitschr. f. w. Zool., XI, pag. 401, Pl. XXIV.
— **spinulosus,** Ehlers, 1871. Sitzungsbericht d. phys.-med. Soc. zu Erlangen, III, pag. 84.
— **spinulosus,** Willemoes-Suhm, 1871. Zeitschrift f. w. Zool., XXI, pag. 385.

Fam. **Bonellidæ,** Baird.

14. **Hamingia arctica,** Dan. & Koren.
1 Exemplar paa Station 270.

15. **Saccosoma vitreum,** Dan. & Koren.
1 Exemplar paa Stat. 40.

Fam. **Epithetosomatidæ,** Dan. & Kor.

16. **Epithetosoma norvegicum,** Dan. & Koren.
2 mindre godt konserverede Exemplarer paa Station 190.

Fam. **Bonellidæ,** Baird.

14. **Hamingia arctica,** Dan. & Koren.
One specimen at Station 270.

15. **Saccosoma vitreum,** Dan. & Koren.
One specimen at Stat. 40.

Fam. **Epithetosomatidæ,** Dan. & Kor.

16. **Epithetosoma norvegicum,** Dan. & Koren.
Two specimens (state of preservation not very good), at Stat. 190.

Fortegnelse

over de Arbeider, der væsentligst ere benyttede ved denne Afhandling over Gephyreerne.

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Forklaring over Tavlerne.

Tab. I, Fig. 1. *Phascolosoma Lilljeborgii*, forstørret. *a* Kroppen; *b* Snabelen; *c* Tentaklerne; *d* Analaabningen.

— 2. Den samme aabnet, forstørret. *a* Retraktor med sine to Rødder; *b* Retraktoren længere fortil; *c* Segmentalorgan; *d* Spiserøret; *e, f* Tarmen; *g* Tarmen, idet den gaar over i Rectum; *h* Rectum; *i* Nervestrængen.

— 3. Tversnit af Huden, forstørret. *a* Cuticula; *b* Epithellaget; *c* Hudkjertelens Grunddel; *d* Udførselsgangen; *e* Den tragtformige Fordybning i Cuticula, hvori Udførselsgangens Aabning; *f* Kjertelens Bindevævskapsel; *g* Epithelet, som beklæder Kapselens indvendige Flade; *h* Bindevævslaget.

— 4. Tversnit af Huden, forstørret. *a* Cuticula; *b* Epithellaget; *c* Kjertelens Grunddel; *d* Udførselsgangen; *e* Udførselsgangens Aabning i Cuticularfordybningen; *f* Epithelet, der beklæder den indvendige Flade af Kjertelen, samt dennes Udførselsgang; *g* Bindevævslaget; *h* Tver- og Længdemuskler.

— 5. *Aspidosiphon armatum*, forstørret. *a* Indsnøring rundt Kroppens bagerste Ende; *b* det forreste Skjold; *c* det bagerste Skjold.

— 6. Den samme aabnet, forstørret. *a* Skjoldets indvendige Flade; *b* Muskler; *c* Retraktor med dens tvende Rødder; *d* den forreste Ende af Retraktor; *e* Tentaklerne; *f* Spiserøret; *g* Tarmen; *h* Rectum; *i* Æggestokken; *k* Segmentalorganet.

— 15. *Onchnesoma glaciale*, naturlig Størrelse.

— 15¹. Den samme, forstørret.

— 16. Den samme, aabnet, forstørret. *a* Analaabning; *b* Retraktor; *c* Segmentalorgan; *d, e* Spiserør; *f* Begyndende Tarm; *g* Bag-

Explanation of the Plates.

Pl. I, fig. 1. *Phascolosoma Lilljeborgi*, magnified: *a* trunk; *b* proboscis; *c* tentacles; *d* anal opening.

— 2. Same animal, opened, magnified: *a* retractor, with the two roots; *b* retractor, farther in advance; *c* segmental organ; *d* œsophagus; *e, f* intestine; *g* intestine, where it passes into the rectum; *h* rectum; *i* nervous chord.

— 3. Transverse section of skin, magnified: *a* cuticle; *b* epithelial layer; *c* basal portion of tegumentary gland; *d* excretory duct; *e* funnel-shaped depression in cuticle, with the opening of the excretory duct; *f* capsule of gland; *g* epithelium investing inner surface of capsule; *h* layer of connective tissue.

— 4. Transverse section of skin, magnified: *a* cuticle; *b* epithelial layer; *c* basal portion of gland; *d* excretory duct; *e* opening of excretory duct into the cuticular depression; *f* epithelium investing the inner surface of the gland and of its excretory duct; *g* layer of connective tissue; *h* transverse and longitudinal muscles.

— 5. *Aspidosiphon armatum*, magnified: *a* instriction round posterior extremity of body; *b* foremost shield; *c* hindmost shield.

— 6. Same animal, opened, magnified: *a* inner surface of shield; *b* muscles; *c* retractor, with both roots; *d* anterior extremity of retractor; *e* tentacles; *f* œsophagus; *g* intestine; *h* rectum; *i* the ovary; *k* segmental organ.

— 15. *Onchnesoma glaciale*, natural size.

— 15¹. Same animal, magnified.

— 16. Same animal, opened, magnified: *a* anal opening; *b* retractor; *c* segmental organ; *d, e* œsophagus; *f* commencement of in-

tilløbende Tarmslynge; *h* Fortilløbende Tarmslynge; *i* Rectum; *k* Nervestrængen.

Tab. I, Fig. 17. Tversnit af Huden, forstørret. *a* Cuticula; *b* Epithellag; *c* Bindevævslag; *d* Ringmuskler; *e* Længdemuskler; *f* Hudkjertelens Grunddel; *g* Dens afrundede Spids; *h* Udførselsgangen; *i* Kjertelens indre Epithelbeklædning.

— 18. Tversnit af Snabelens Hud, besat med Hager, forstørret. *a* Cuticula; *b* Epithellaget; *c* Kjertel; *d* Kjertelens Epithel; *e* Hage.

— 19. Den forreste Del af Snabelen med sine Hager, forstørret.

— 20. Hager, seet fra forskjellige Sider, forstørret.

Tab. II, Fig. 7. Endeskjoldet af *Aspidosiphon armatum*, forstørret. *a* Randplader; *b* Runde, mere centrale Plader; *c* 5—6 Ringe besatte med Chitinplader.

— 8. Det forreste Skjold, forstørret. *a* Skjoldets Randplader; *b* Furen imellem disse; *c* De runde, ophøiede Plader.

— 9. Hagerækkerne paa Snabelen, forstørret.

— 10. Hagerne, forstørret.

— 11. Et Stykke Hud af *Aspidosiphon armatum*, seet fraoven, forstørret. *a* Porer for Kjertlernes Udførselsgang; *b* Chitinplader.

— 12. Tversnit af Huden af *Aspidosiphon armatum*, forstørret. *a* Cuticula; *b* Chitinplade; *c* Epithellag; *d* Hudkjertel; *e* Dens Udførselsgang; *f* Bindevævslag; *g* Ringmuskler; *h* Længdemuskler.

— 13. Et Stykke Hud af *Aspidosiphon armatum*, seet fraoven, stærkt forstørret. *a* Cuticula; *b* Chitinplade; *c* Aabning for Hudkjertelens Udførselskanal.

— 14. Den indre Flade af det forreste Skjold med dets Muskelapparat, forstørret. *a* Sidemuskler; *b* Centrale Muskler; *c* De forreste Muskler.

— 21. *Stephanostoma Hanseni*, naturlig Størrelse. *a* Krop; *b* Bagenden; *c* Snabelens Grund; *d* Den forreste Del af Snabelen; *e* Snabelens Hals; *f* Mundskiven med den centrale Mundaabning; *g* Tentakler; *h* Analaabning.

— 22. Den forreste Ende af Snabelen med Mundskiven og Tentakelkraven, forstørret. *a* Mundskiven; *b* Mundaabning; *c* Tentakler; *d* De i Grupper siddende Papiller.

testine; *g* circumvolution passing backwards; *h* circumvolution passing forwards; *i* rectum; *k* nervous chord.

Pl. I, fig. 17. Transverse section of skin, magnified: *a* cuticle; *b* epithelial layer; *c* layer of connective tissue; *d* annular muscles; *e* longitudinal muscles; *f* basal portion of tegumentary gland; *g* rounded extremity of the gland; *h* excretory duct; *i* epithelial tunic investing inner surface of gland.

— 18. Transverse section of skin of proboscis, studded with chitinous hooks, magnified: *a* cuticle; *b* epithelial layer; *c* a gland; *d* epithelium of the gland; *e* hooks.

— 19. Anterior portion of proboscis, with the hooks, magnified.

— 20. Hooks, viewed in different positions, magnified.

Pl. II, fig. 7. Terminal shield of *Aspidosiphon armatum*, magnified: *a* marginal plates; *b* round plates, more central in position; rings covered with chitinous plates.

— 8. Foremost shield, magnified: *a* the marginal plates; *b* furrows between them; *c* the round, prominent plates.

— 9. Series of hooks on the proboscis, magnified:

— 10. Two of the hooks, magnified.

— 11. Strip of skin of *Aspidosiphon armatum*, viewed from above, magnified: *a* pores for the excretory duct of the gland; *b* chitinous plates.

— 12. Transverse section of the skin of *Aspidosiphon armatum*, magnified: *a* cuticle; *b* chitinous plates; *c* epithelial layer; *d* tegumentary glands; *e* excretory duct; *f* layer of connective tissue; *g* annular muscles; *h* longitudinal muscles.

— 13. A piece of the skin of *Aspidosiphon armatum*, viewed from above, highly magnified: *a* cuticle; *b* a chitinous plate; *c* opening for the excretory canal of the tegumentary gland.

— 14. Inner surface of foremost shield, with its muscular apparatus, magnified: *a* lateral muscles; *b* central muscles; *c* foremost muscles.

— 21. *Stephanostoma Hanseni*, natural size: *a* trunk; *b* posterior extremity; *c* base of proboscis; *d* anterior portion of proboscis; *e* neck of proboscis; *f* buccal disk with the buccal orifice in the centre; *g* tentacles; *h* anal opening.

— 22. Anterior extremity of proboscis, with the buccal disk and tentacular collar, magnified: *a* buccal disk; *b* buccal aperture; *c* tentacles; *d* grouped papillæ.

Tab. II, Fig. 23. Snabelens forreste Ende med Mundskiven og Tentakler, seet fra Siden, forstørret. *a* Store Tentakelgrupper; *b* Enkelte Tentakler imellem de store Grupper.

— 24. Et Stykke af Snabelens Hud, seet fraoven, for at vise Papillerne, forstørret.

— 25. Tversnit af Huden, forstørret. *a* Cuticula; *b* Indsynkninger i Cuticula, i hvis Bund Hudkjertlernes Udførselsgang aabner sig; *c* Epithellaget; *d* Hudkjertel; *e* Ringmuskler; *f* Længdemuskler.

— 26. Et Stykke af det nævnte Tversnit, stærkt forstørret. *a* Cuticula; *b* Fordybning i samme, i hvis Bund Udførselsgangen for Hudkjertelen aabner sig; *c* Epithellaget; *d* Kjertelens Grunddel; *e* Kjertelens Spids; *f* Udførselskanalen; *g* Epithelet, som beklæder Kjertelens indre Flade; *h* Bindevævslaget.

— 27. *Stephanostoma Hanseni*, aabnet fra Ryggen, noget forstørret. *a* Spiserøret; *b* Tarmen; *c* Spindelmuskelens bagerste og forreste Ende; *d* Spindelmuskelen; *e* Rectum; *f* Et Blodkar paa Spiserøret; *g* Det kontraktile Kar med sin blinde, frithængende Ende; *h* Rygretraktor; *i* Segmentalorgan; *k* Nervestræng; *l* Bugretraktor; *m* Indtrukken Snabel.

— 28. Et Segmentalorgan, forstørret. *a* Den ovale tragtformige Aabning.

— 29. Nervestrængen med dens Svælgring, forstørret. *a* Nervestrængen med Sidegrene; *b* Svælgringen; *c* Ryggangliet (Hjernen).

Tab. III, Fig. 1. *Priapulus typicus*, i naturlig Størrelse. *a* Nervestrængen.

— 2. Den samme aabnet fra Ryggen. *a* Hudens Længdemuskler; *b* Enkelte Længdemuskler, der gaa over i Tilhænget; *c* Mundhulen med Tandapparatet; *d* Indsnøring paa Spiserøret, hvorved Folden paa den indre Flade dannes; *e* Længdefolder paa Spiserørets indre Flade; *f* Spiserørets Overgang i Tarmen; *g* Tværfolder paa Tarmens indre Flade; *h* Rectum; *i* Æggestokken; *k* Dens Udførselsgang; *l* Udførselsgangens Begyndelse; *m* De lange Retraktorer; *n* De korte Retraktorer.

— 3. Tversnit af Huden, forstørret. *a* Cuticula med Chitinpapillerne; *b* Epithellaget; *c* Bindevævslaget; *d* Ringmusklerne; *e* Længdemusklerne med deres Skede; *f* Mu-

Pl. II, fig. 23. Anterior extremity of proboscis, with the buccal disk and the tentacles, side-aspect, magnified: *a* large groups of tentacles; *b* isolated tentacles dispersed between the large groups.

— 24. Strip of skin of proboscis, figured as seen from above, to show the papillæ, magnified.

— 25. Transverse section of skin, magnified: *a* cuticle; *b* depressions in the cuticle, through the bottom of which opens the excretory duct of the tegumentary glands; *c* epithelial layer; *d* tegumentary gland; *e* annular muscles; *f* longitudinal muscles.

— 26. Part of the same transverse section, highly magnified: *a* cuticle; *b* one of the depressions therein, through the bottom of which opens the excretory duct of the tegumentary glands; *c* epithelial layer; *d* basal portion of the gland; *e* extremity of the gland; *f* excretory canal; *g* epithelium investing the inner surface of the gland; *h* layer of connective tissue.

— 27. *Stephanostoma Hanseni*, viewed through the back, slightly magnified: *a* œsophagus; *b* intestine; *c* posterior and anterior extremities of fusiform muscle; *d* fusiform muscle; *e* rectum; *f* a blood-vessel of the œsophagus; *g* the contractile vessel, with its cæcal free depending extremity; *h* the dorsal retractor; *i* segmental organ; *k* nervous chord; *l* the ventral retractor; *m* proboscis, invaginated.

— 28. The segmental organ, magnified: *a* its oval, funnel-shaped opening.

— 29. The nervous chord, with its pharyngeal ring, magnified: *a* nervous chord with subsidiary branches; *b* pharyngeal ring; *c* dorsal ganglion (brain).

Pl. III, fig. 1. *Priapulus typicus*, natural size: *a* nervous chord.

— 2. Same animal, opened dorsally: *a* longitudinal muscles of the skin; *b* isolated longitudinal muscles passing into the appendix; *c* cavity of the mouth, with dental apparatus; *d* constriction of the œsophagus, producing a fold on the inner surface of the organ; *e* longitudinal folds on inner surface of œsophagus; *f* passage of the œsophagus into the intestine; *g* transverse folds on inner surface of intestine; *h* rectum; *i* the ovary; *k* its eferent duct; *l* origin of eferent duct; *m* the long retractors; *n* the short retractors.

— 3. Transverse section of skin, magnified: *a* cuticle, with chitinous papillæ; *b* epithelial layer; *c* layer of connective tissue; *d* annular muscles; *e* longitudinal muscles, with

skelbundter; *g* Deres Membran; *h* Fibrillerne; *i* Skraastribningen i Fibrillerne; *k* Nerven; *l* Dens Bindevævsskede; *m* Bindevævsseptum; *n* Den indre, brede Del af Nerven.

Tab. III, Fig. 4. Et Tversnit af Glans, forstørret. *a* Piggens Grunddel; *b* dens Spids; *c* Epithelbeklædningen; *d* Skeden, der omgiver Piggen; *e* Kjertelen; *f* Epithelet paa Kjertelkapselens indre Væg; *g* Udførselsgangens Begyndelse; *h* Dens Fortsættelse op igjennem Piggen; *i* Dens Aabning; *k* Muskelfibre, der gaa til den indre Flade af Skeden; *l* Ringmuskler.

— 5. Et Tversnit, ligeledes af Glans, forstørret. *a* Piggens Grunddel; *b* Dens Spids; *c* Epithelbeklædningen; *d* Skeden; *e* Kjertelen; *f* Dens Epithel; *g* Kjertelens Udførselsgang; *h* Dens Fortsættelse og Aabning; *i* Muskler til Skedens indre Flade.

— 6. Tversnit af den bagerste Del af Mundhulhedens Hud med de deri fæstede Tænder, forstørret. *a* Tandens Grunddel; *b* Dens Spids.

— 7. En Tand, stærkt forstørret. *a* Epithel, som beklæder Tandens Hulhed; *b* Tandens faste Spids.

— 8. Tversnit af den mellemste Del af Mundhulhedens Hud med de deri fæstede Tænder. *a* Chitinhud; *b* Epithel.

— 9. Svælghovedet med Spiserøret og den begyndende Tarm, forstørret. *a* De ydre, brede Muskler; *b* De indre smale Muskler; *c* Indsnøring paa Spiserøret; *d* Muskler, som gaa over i den muskuløse Membran *e*, som fæster sig paa Volden *f*; *g* Rummet imellem Indsnøringen paa Spiserøret og Muskelmembranen; *h* Muskler; *i* overskaarne og opslaaede Retraktorer.

— 10. Tversnit af Tarmens midterste Del, forstørret. *a* Tarmfolder med deres Epithelialbeklædning; *b* Bindevæv; *c* Bindevævslister, der danne Tarmfolderne.

— 11. Tversnit af Huden paa Glans af *Priapulus caudatus*, forstørret. *a* Skeden, som omgiver Piggens nedre Del; *b* Aabningen paa Piggens Spids; *c* Epithelet, som beklæder Piggens indre Flade; *d* Kjertelen.

— 12. Et Hudparti af Glans, seet næsten fraoven, forstørret. *a* Den noget sammen-

sheath; *f* fascicles of muscles; *g* their membrane; *h* fibrils; *i* oblique striature of fibrils; *k* the nerve; *l* its sheath of connective tissue; *m* septum of connective tissue; *n* inner, broad portion of nerve.

Pl. III, fig. 4. Transverse section of proboscis, magnified: *a* basal portion of spike; *b* its pointed extremity; *c* epithelial tunic; *d* sheath enclosing the spike; *e* the gland; *f* epithelium on the inner wall of the capsule of the gland; *g* origin of excretory duct; *h* its continuation up through the spike; *i* its opening; *k* muscular fibres protending to inner surface of sheath; *l* annular muscles.

— 5. Another transverse section of the proboscis, magnified: *a* base of spike; *b* point of spike; *c* epithelial tunic; *d* sheath; *e* the gland; *f* epithelium investing it; *g* excretory duct of gland; *h* its continuation and opening; *i* muscles protending to inner surface of sheath.

— 6. Transverse section of the posterior portion of the dentiferous integument clothing the cavity of the mouth, showing the teeth affixed thereto, magnified: *a* base of tooth; *b* point of tooth.

— 7. A tooth, highly magnified: *a* epithelium covering the hollow of the tooth; *b* the solid point of the tooth.

— 8. Transverse section of the medial portion of the dentiferous integument clothing the cavity of the mouth, showing the teeth affixed thereto, magnified: *a* chitinous integument; *b* epithelium.

— 9. The gullet, together with the œsophagus and the commencement of the intestine, magnified: *a* the broad exterior muscles; *b* the narrow interior muscles; *c* instriction of the œsophagus; *d* muscles passing into the muscular membrane *(e)*, which are attached to the tendinous ridge *(f)*; *g* the space between the œsophagus and the muscular membrane; *h* muscles; *i* retractors, cut through and laid open.

— 10. Transverse section of the medial portion of the intestine, magnified: *a* folds of the intestine, invested with epithelium; *b* connective tissue; *c* fillets of connective tissue, producing the folds of the intestine.

— 11. Transverse section of skin of proboscis, in *Priapuloides caudatus*, magnified: *a* sheath enclosing the lower portion of the spike; *b* opening at the point of the spike; *c* epithelium investing the inner surface of the spike; *d* the gland.

— 12. Portion of the skin of the proboscis, viewed almost from above, magnified: *a* the sheath,

trukne Skede; *b* Aabningen paa Piggens Spids; *c* Fordybning i Huden omkring Piggens Grund.

Tab. IV & V. Fig. 1. *Hamingia arctica* i naturlig Størrelse. *a* Mundaabning; *b* Den halvmaaneformige Hudfold (Antydning til en Snabel) omkring Munden; *c* Cylindriske, krumbøiede Papiller (egentlig Udførselsgange for Uteri); *d* Kloakaabning.

— 2. Kroppens forreste Ende, seet forfra, forstørret. *a* Mundaabning; *b, b* De to Hudfolder; *c* Foreningen imellem den forreste og bagerste Hudfold; *d* Furen imellem Mundlæberne og den forreste Hudfold; *e* Den brede Fordybning imellem den forreste og bagerste Hudfold; *f* De to krumbøiede Papiller.

— 3. Kroppens bagerste Ende med Kloakaabningen i Centrum, forstørret.

— 4. Tversnit af Huden, forstørret. *a* Cuticula; *b, b* Det hyaline Bindevævslag, hvori Cellegrupper ere leirede; *c* To sammenhængende Celler; *d* Ringmuskler; *e* Længdemuskler; *f* Skraamuskler; *g* Centralnerven.

— 5. Huden seet ovenfra, forstørret. *a* Cellegrupper.

— 6. *Hamingia arctica*, aabnet fra Ryggen, naturlig Størrelse. *a* Mundhulheden; *b* Spiserøret; *c* Ringformige Fordybninger, dannede af det fibrillære Bindevæv; *d—t*, Begge inklusive Tarmrøret med dets mange Bøininger; *u* Rectum; *v* Tendinøse Fibre, der binde Kloaken til Kropsvæggen; *x* Rygkarret.

— 7. Tversnit af Spiserøret, forstørret. *a* Epithellaget; *b* Indsynkningerne i det kjernerige, fibrillære Bindevæv; *c* fibrillært Bindevæv; *d* Længdemuskler; *e* Ringmuskler.

— 8. Den bagerste Kropsdel, aabnet, og endel af de tendinøse Fibre overskaarne og slaaede tilside for at vise de to Tarmappendices, lidt forstørret. *a, a* De buskformige Kjertelapparater; *b* Hovedstammen for disse; *c* Endetarmen; *d* de tendinøse Fibre; *e* Kloak.

— 9. *a* En rørformig Gren fra det buskformige Organs Hovedstamme; *b, b* Slangeformige Rør; *c* Tragtformig Aabning for et af disse Rør, forstørret.

— 10. Den øverste Ende af et slangeformigt Rør med sin tragtformigt udvidede Aabning, forsynet med Cilier, samt dens Vægge tapetserede med Celler, forstørret.

slightly contracted; *b* the opening at the point of the spike; *c* depression in the skin round the base of the spike.

Pls. IV & V, fig. 1. *Hamingia arctica*, natural size: *a* buccal aperture; *b* lunate fold of the skin (rudimentary proboscis) round the mouth; *c* cylindric, arcuate papillæ (strictly, eferent ducts for the uteri); *d* cloacal opening.

— 2. Anterior extremity of body (front aspect), magnified: *a* buccal aperture; *b, b* the two folds of the skin; *c* junction of the anterior with the posterior fold; *d* furrow between the buccal labia and the anterior fold; *e* broad depression between the anterior and the posterior fold; *f* the two arcuate papillæ.

— 3. Posterior extremity of body, with the cloacal opening in the centre, magnified.

— 4. Transverse section of skin, magnified: *a* cuticle; *b, b* hyaline layer of connective tissue, in which are dispersed groups of cells; *c* two connate cells; *d* annular muscles; *e* longitudinal muscles; *f* oblique muscles; *g* the central nerve.

— 5. The skin, viewed from above, magnified: *a* groups of cells.

— 6. *Hamingia arctica*, opened dorsally, natural size: *a* cavity of the mouth; *b* œsophagus; *c* annular depressions in fibrillous connective tissue; *d—t* (inclusive) the intestinal canal, with its numerous convolutions; *u* rectum; *v* tendinous fibres, webbing the cloacum to the wall of the body; *x* dorsal vessel.

— 7. Transverse section of the œsophagus, magnified: *a* epithelial layer; *b* impressions in the nucleal, fibrillous connective tissue; *c* fibrillous connective tissue; *d* longitudinal muscles; *e* annular muscles.

— 8. Posterior portion of the body, opened, and with part of the tendinous fibres cut through and reflected, to show the two intestinal appendices, slightly magnified: *a, a* the bushy glandular apparatus; *b* their principal stem; *c* rectum; *d* tendinous fibres; *e* the cloacum.

— 9. *a*, a tubular branch protending from the principal stem of the bushy organ; *b, b* sinuous tubes; *c* funnel-shaped opening for one of the tubes, magnified.

— 10. Superior extremity of one of the sinuous tubes, with its funnel-shaped, expanded opening, furnished with cilia, and having its walls lined with cells, magnified.

Tab. IV & V, Fig. 11. En Levercelle, forstørret.

— 12. Epithelet paa den indre Flade af de slangeformige Rør, forstørret.

— 13. *a, a, b, b* De enkelte Epithelceller i disse Rør; *c* Runde Smaalegemer, som fandtes i Kropsvædsken.

— 14. *a* Rygkarret paa Mundhulhedens ydre Flade; *b* Det Sted, hvor det gaar over paa venstre Uterus; *c* Løbet paa samme; *d* Hvor det gaar over paa den venstre horizontale Tarmslynge; *e* Hvor det deler sig; *f* Den ene Stammes Grene; *g* Sammentræffet med Grene fra Bugkarret; *h* Bugkarret; *i* Bugkarrets ene Stamme, der følger Tarmen; *k* Bugkarrets anden Stamme, hvis Grene forbinde sig med Rygkarrets; *l, m* Bugkarrets Fortsættelse fortil, imellem Uteri, idet det krydser Rygkarret.

— 15. *a* Centralnervestrængen; *b* Bugkarret; *c, d, e* Grene fra det; *f* Blodkårrets forreste Del, lidt før det deler sig; *g* Deling i to Grene; *h* Den høire udvidede Gren; *i* Det fra Udvidningen udgaaende Kar; *k* Hjerte (?).

— 16. *a* Centralnervestrængen, den midterste Del med dens Sidegrene; *b* Den forreste Del af Centralstrængen med Sidegrene; *c* Gren til Uterus; *d* Delingen fortil af Centralstrængen; *e* Grene til Spiserør og Mundhulhed; *f* Den bagerste Del af Centralstrængen; *g* Dennes Deling i to Grene; *h, h* Uteri; *i* Udførselsgang for den venstre Uterus; *k* Kanalen for Tragten; *l* Tragten; *m* Indgangen til Tragten; *n, n* Æggestokken; *o, o* Follikelgrupper; *p* Endnu ikke fuldt udviklede Æg.

— 17. *a* Udførselsgang for Uterus; *b* Kanalen for Tragten; *c* Den frie Del af Kanalen; *d* Tragtens Aabning; *e* Cilier, forstørret.

— 18. *Hamingia arctica,* tegnet i levende Live, naturlig Størrelse.

— 19. *Stephanostoma Hanseni,* tegnet i levende Live, naturlig Størrelse.

— 20. *Saccosoma vitreum,* tegnet i levende Live, ganske lidt forstørret.

Pls. IV & V, fig. 11. A hepatic cell, magnified.

— 12. Epithelium investing the inner surface of the sinuous tubes, magnified.

— 13. *a, a, b, b* isolated epithelial cells dispersed throughout the tubes; *c, c, d, e* round corpuscles, found floating in the perivisceral fluid.

— 14. *a* the dorsal vessel on the outer surface of the cavity of the mouth; *b* the point at which it passes across to the left uterus; *c* course of the vessel; *d* the point at which it passes across to the left horizontal circumvolution of the intestine; *e* that at which it divides; *f* the branches of one of the stems; *g* junction with the branches from the ventral vessel; *h* the ventral vessel; *i* one of the stems of the ventral vessel, accompanying the intestine; *k* the other stem of the ventral vessel, whose branches unite with those of the dorsal vessel; *l, m* continuation of the ventral vessel anteriorly, between the two uteri, where it crosses the dorsal vessel.

— 15. *a* central nervous chord; *b* ventral vessel; *c, d, e* branches proceeding therefrom; *f* anterior portion of the blood-vessel, just before it divides; *g* its dichotomous division; *h* the right, expanded branch; *i* the vessel proceeding from the expansion; *k* the heart (?).

— 16. *a* central nervous chord, medial portion, with the subsidiary branches; *b* anterior portion of central nervous chord, with subsidiary branches; *c* a branch passing to the right uterus; *d* anterior division of central nervous chord; *e* branches proceeding to the œsophagus and the cavity of the mouth; *f* posterior portion of central nervous chord; *g* dichotomous division of the chord; *h, h* the uteri; *i* eferent duct for the left uterus; *k* canal for the funnel; *l* the funnel; *m* entrance to the funnel; *n, n* the ovary; *o, o* groups of follicles; *p* ova, nearly developed.

— 17. *a* eferent duct for one of the uteri; *b* canal for the funnel; *c* the free portion of the canal; *d* opening of the funnel; *e* cilia, magnified.

— 18. *Hamingia arctica,* figured from a living specimen, natural size.

— 19. *Stephanostoma Hanseni,* figured from a living specimen, natural size.

— 20. *Saccosoma vitreum,* figured from a living specimen, very slightly magnified.

— 21. Den bagerste Ende af samme, seet fraoven.

Tab. VI, Fig. 1. *Saccosoma vitreum,* naturlig Størrelse.

— 2. Den samme, forstørret. *a* Den forreste, cylindriske, opake Del; *b* Mundaabning; *c* Den glasklare, kugleformige Del; *d* Den koniske, opake Ende; *e* Analaabning; *f* Tarmslyngninger.

— 3. Den samme, aabnet efter Rygsiden, forstørret. *a* Længdemuskler; *b* Mundaabning, omgivet af en Vold; *c* Spiserøret; *d* Maven; *e* Begyndende Tarm; *f* Tarmslynger, hvori sees Excrementer; *g* Rectum; *h* Tendinøse Fibre, som binde Rectum til Kropsvæggen; *i* Den tilbageslaaede Hud.

— 4. Den forreste, cylindriske, opake Del af Legemet, aabnet efter Ryggen og Spiserøret borttaget, forstørret. *a* Længdemuskler; *b* Centralnervestrængen med sine Sidegrene; *c* Æggestokken; *d* Æggebeholderen (Uterus); *e* Æg; *f* Udførselskanalen for Uterus; *g* Æg i Udførselskanalen; *h* Tragten.

— 5. Tversnit af Huden paa den forreste, cylindriske, opake Del af Legemet, forstørret. *a* Cuticula; *b* Epithel; *c* Bindevæv; *d* Ringmuskler; *e* Længdemuskler; *f* En fin Nervegren; *g* Ganglieformige Fortykkelser.

— 6. Huden af den glasklare Legemsdel, hvori Muskelfletninger sees, forstørret. *a* Ringmuskler; *b* Længdemuskler; *c* Skraamuskelfibre, der udgaa fra Ringmusklerne.

— 7. Excrementer, forstørret.

— 8. Et Stykke af Æggestokken, forstørret. *a* Follikel; *b* Celler.

— 9. *Epithetosoma norvegicum,* forstørret. *a* Kroppen; *b* Snabelen.

— 10. Den samme, forstørret og aabnet efter Bugfladen. *a* Tarmen.

— 11. Den samme, aabnet efter Ryggen, forstørret. *a* Aabningen paa Hudens indre Flade; *b* Spiserøret; *c* Indsnøring, hvor Spiserøret gaar over i Tarmen; *d* Tarmfolder; *e* Muskelbaand langs Tarmens Rygflade; *f* Uterus.

— 12. Den forreste Kropsende, aabnet for at vise Aabningerne for Sidespalterne, samt Aabningen for Snabelen, forstørret. *a* Spalteaabninger; *b* Snabelaabning.

— 21. Same animal, posterior extremity, viewed from above.

Pl. VI, fig. 1. *Saccosoma vitreum,* natural size.

— 2. Same animal, magnified: *a* anterior, cylindric, opaque portion; *b* buccal aperture; *c* the hyaline globular portion; *d* the conical, opaque extremity; *e* anal opening; *f* circumvolutions of the intestine.

— 3. Same animal, opened dorsally, magnified: *a* longitudinal muscles; *b* buccal aperture, surrounded by a ridge; *c* œsophagus; *d* stomach; *e* commencement of intestine; *f* circumvolutions of the intestine, in which are seen fæcal pellets; *g* rectum; *h* tendinous fibres, webbing the rectum to the wall of the body; *i* the skin, laid back.

— 4. The anterior, cylindrical, opaque portion of the body, opened dorsally, and with the œsophagus removed, magnified: *a* longitudinal muscles; *b* central nervous chord, with the subsidiary branches; *c* the ovary; *d* the uterine pouch (uterus); *e* ova; *f* the eferent canal for the uterus; *g* ova in the eferent canal; *h* the funnel.

— 5. Transverse section of the skin on the anterior, cylindrical, opaque portion of the body, magnified: *a* cuticle; *b* epithelium; *c* connective tissue; *d* annular muscles; *e* longitudinal muscles; *f* a slender nervous branch; *g* ganglionous inspissations.

— 6. Skin of the hyaline portion of the body, in which are seen muscular reticulations, magnified: *a* annular muscles; *b* longitudinal muscles; *c* oblique protending muscular fibres, issuing from the annular muscles.

— 7. Fæces, magnified.

— 8. A piece of the ovary, magnified: *a* a follicle; *b* cells.

— 9. *Epithetosoma norvegicum,* magnified: *a* the trunk; *b* the proboscis.

— 10. Same animal, magnified, and opened ventrally; *a* the intestine.

— 11. Same animal, opened dorsally, magnified: *a* opening on the inner surface of the skin; *b* œsophagus; *c* an instriction, where the œsophagus passes into the intestine; *d* folds of the intestine; *e* muscular bands passing along the dorsal surface of the intestine; *f* the uterus.

— 12. Anterior extremity of the body, opened to show the apertures for the lateral fissures and the orifice for the proboscis, magnified: *a* fissiform apertures; *b* orifice for the proboscis.

Tab. VI, Fig. 13. Den forreste Kropsende, forstørret. *a* Sidespalterne; *b* Mundaabning; *c* Snabel.

— 14. Tversnit af Kroppen, forstørret. *a* Cuticula; *b* Epithellag; *c* Bindevævslag; *d* Ydre Ringmuskler; *e* Længdemuskler; *f* Indre Ringmuskler; *g* Tarmfolder med sit Epithel; *h* Centralkar i Nervestrængen; *i* Nervestrængens Skede; *k* Nervens ydre cellulære Lag; *l* Nervens indre fibrillære Lag.

— 15. Tversnit af Snabelens Hud, forstørret. *a* Cuticula; *b* Epithel; *c* Bindevæv.

Pl. VI, fig. 13. Anterior extremity of body, magnified: *a* lateral fissures; *b* buccal aperture; *c* proboscis.

— 14. Transverse section of the body, magnified: *a* cuticle; *b* epithelial layer; *c* layer of connective tissue; *d* external annular muscles; *e* longitudinal muscles; *f* internal annular muscles; *g* folds of the intestine, with their epithelial covering; *h* central vessel in the nervous chord; *i* sheath of nervous chord; *k* external cellular layer of the nerve; *l* internal fibrillous layer of the nerve.

— 15. Transverse section of skin of proboscis, magnified: *a* cuticle; *b* epithelium; *c* connective tissue.

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Erratum.

Pag. 1, 8de Linie fra oven, staar 2 Familier, læs 1 Familie.

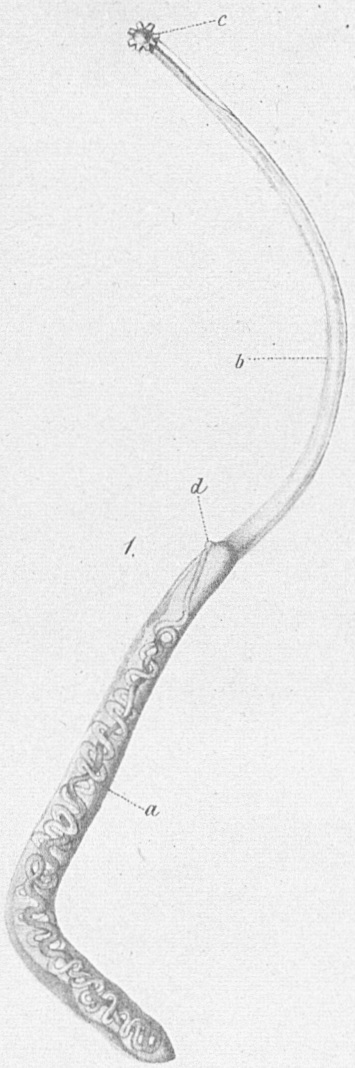
Erratum.

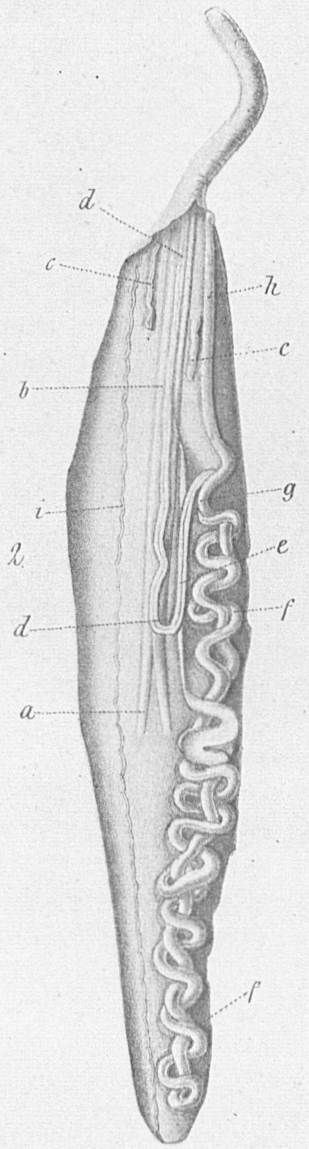
Page 1, line 9, from top of page, *for* '2 families' *read* 1 'family.'

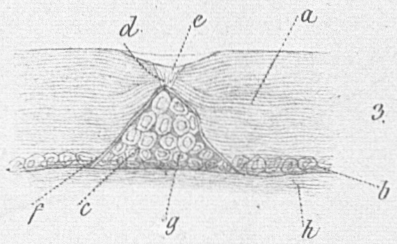
Indleveret til Redactionscomiteen den 18de Juni 1880.

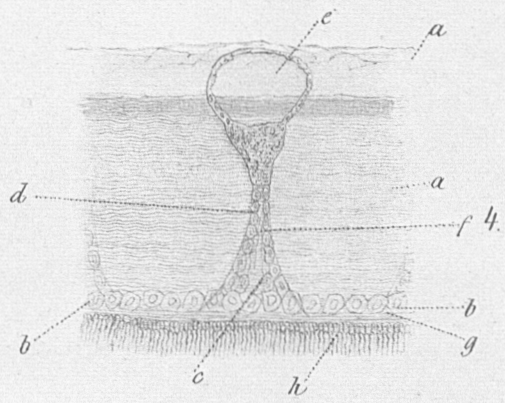
Sent in to the Editorial-Committee June 18th 1880.

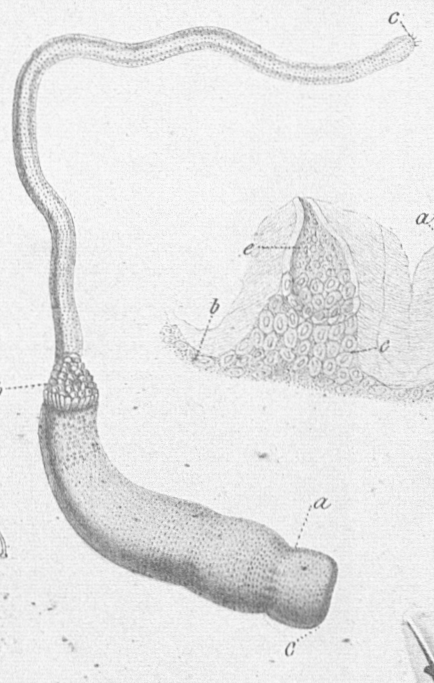
Translated into English by **John Hazeland.**

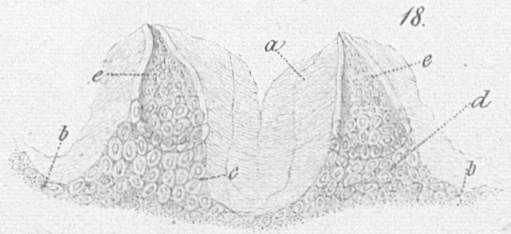


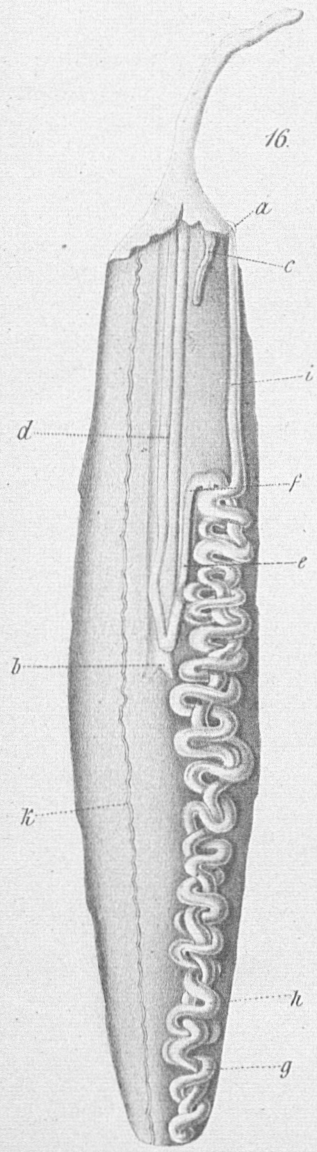


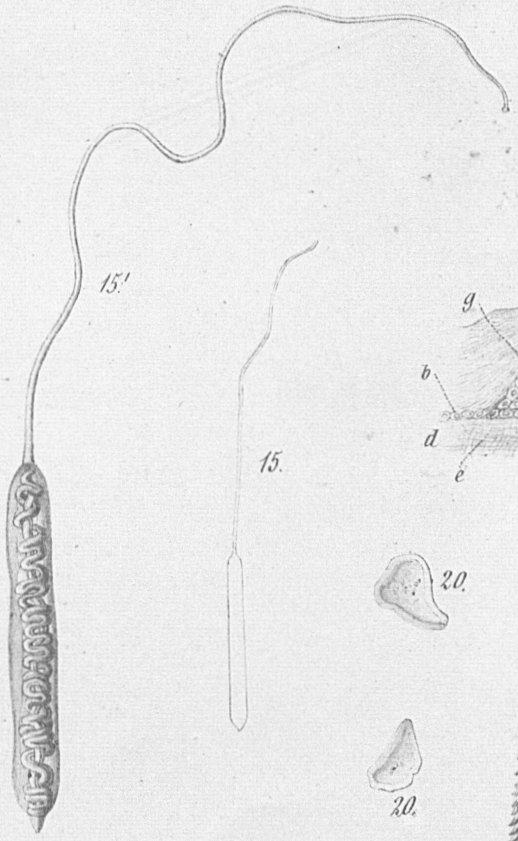


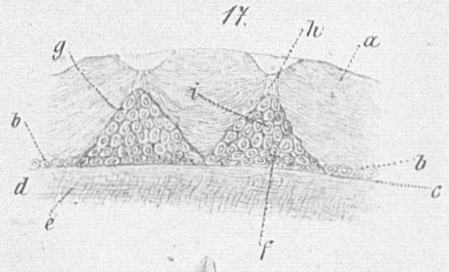


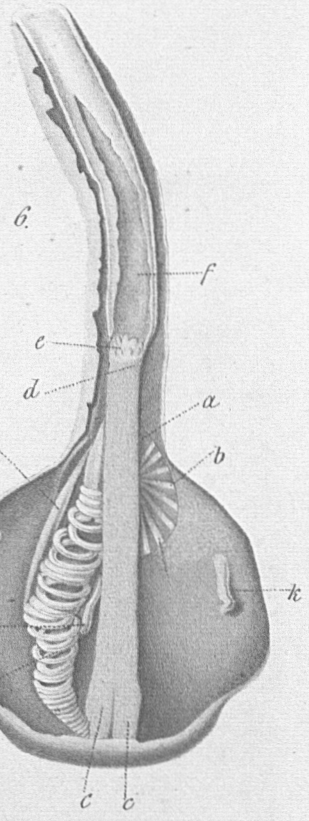


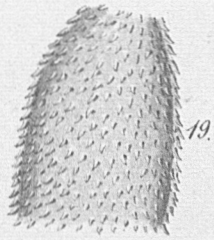












H. Bucher jnr. del.

Lith. Anst. v. J. G. Bach, Leipzig.

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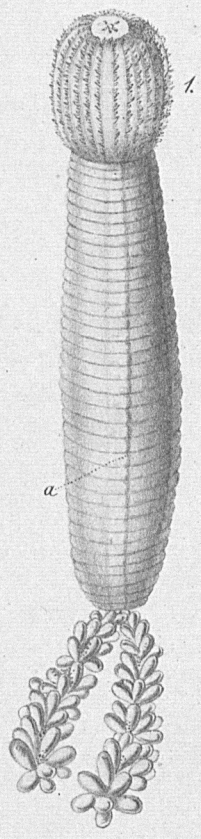

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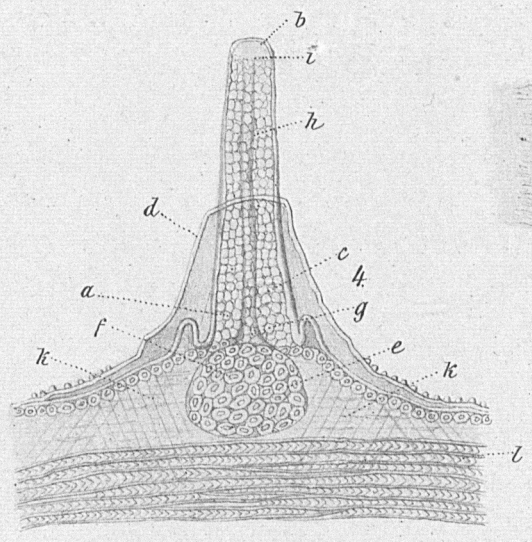

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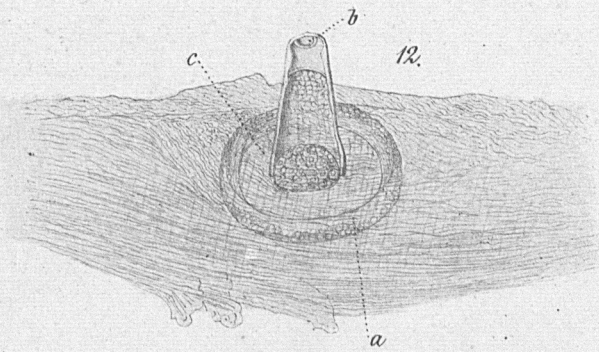

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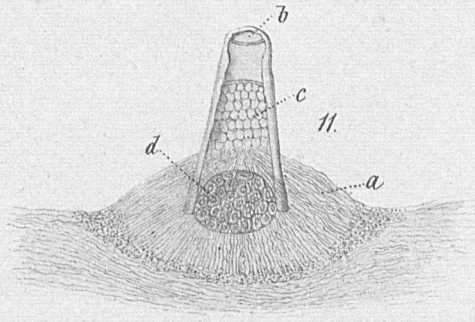

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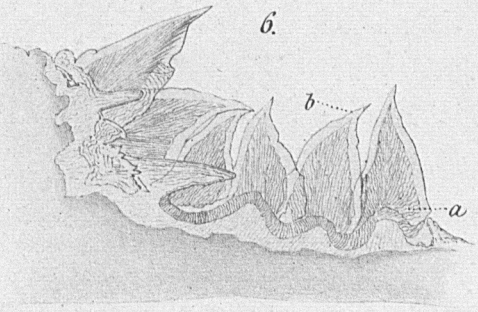

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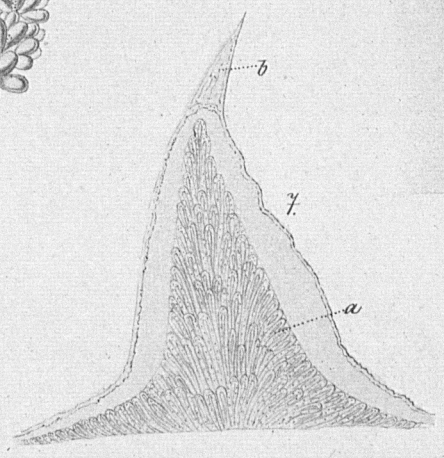

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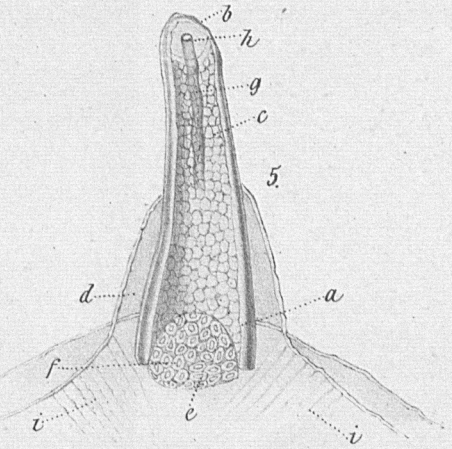

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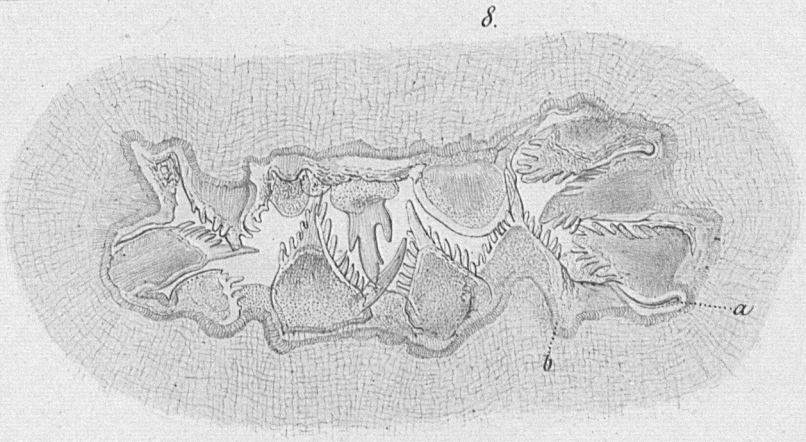

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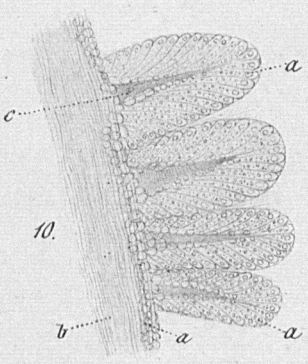

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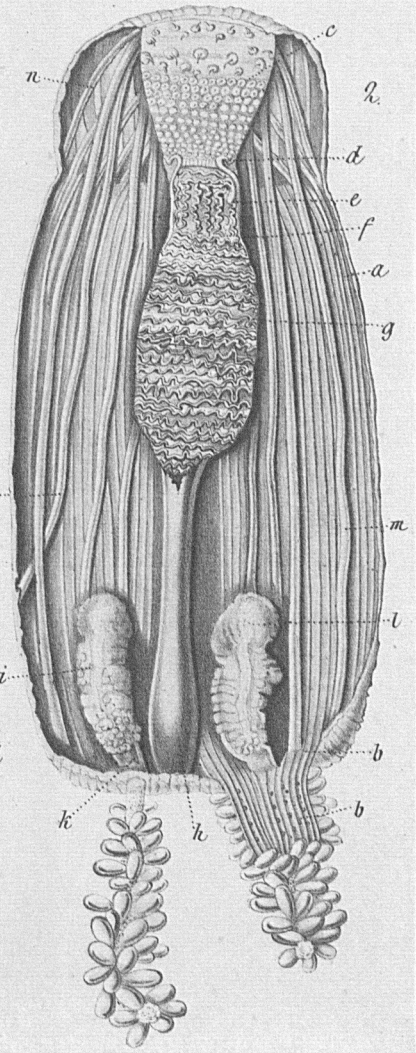

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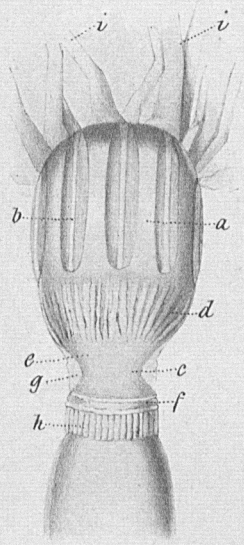

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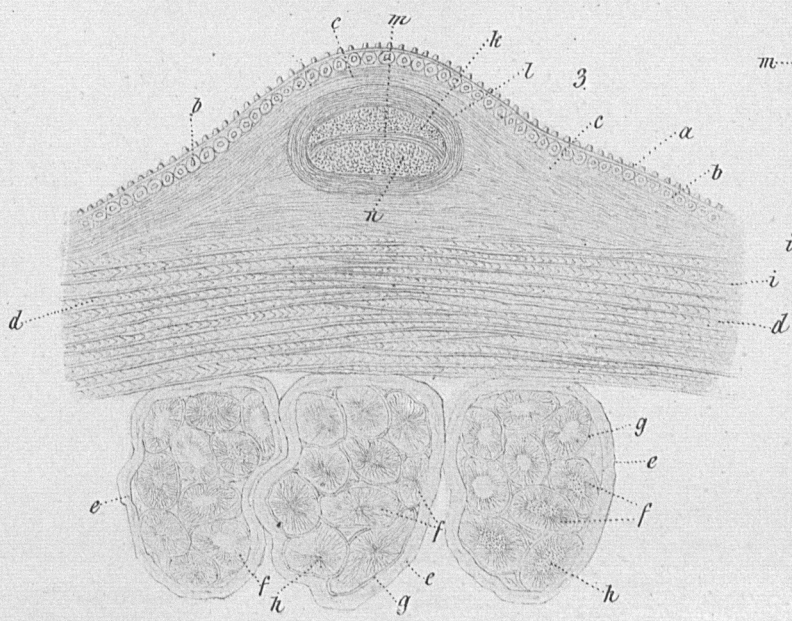

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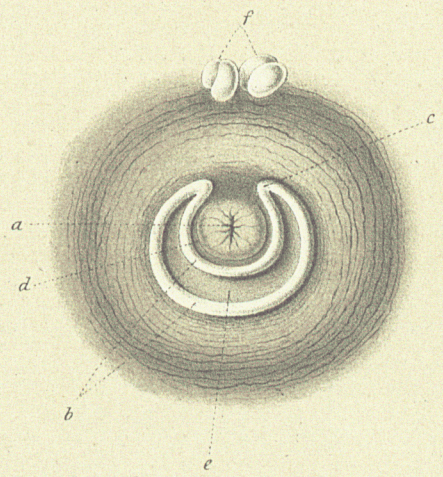

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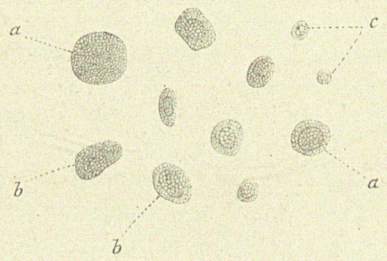

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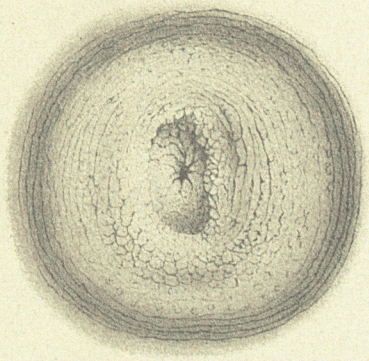

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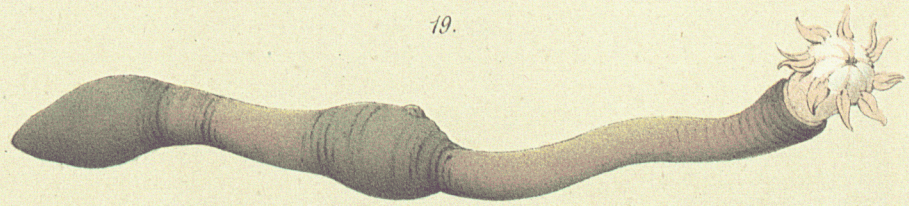

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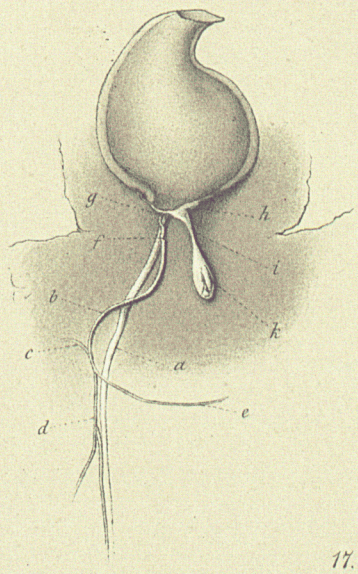

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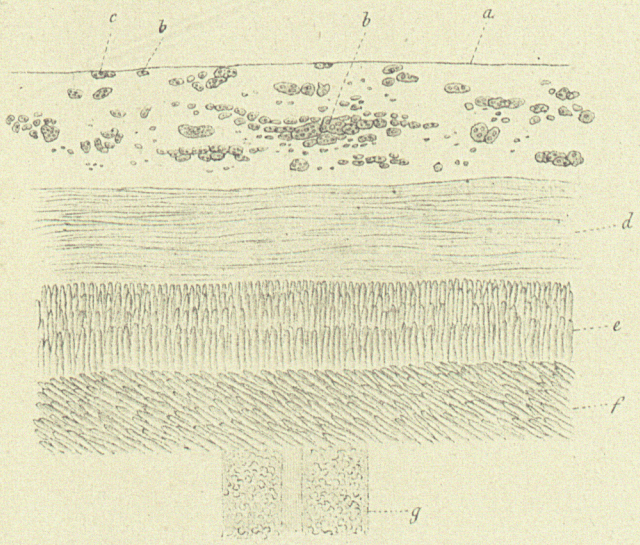

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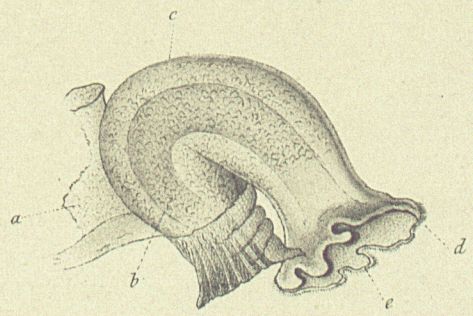

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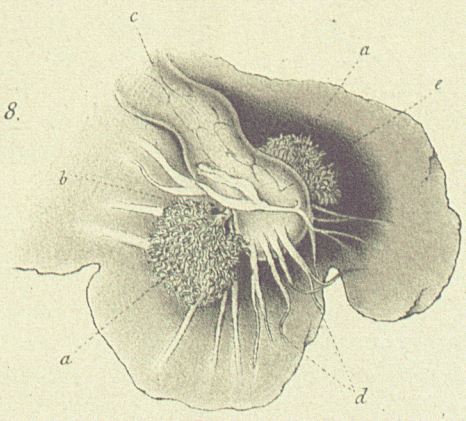

18.19.20.21. F.W. Schiertz del. H. Bucher jnn. del.

Lith. Anst. v. J.G. Bach, Leipzig.

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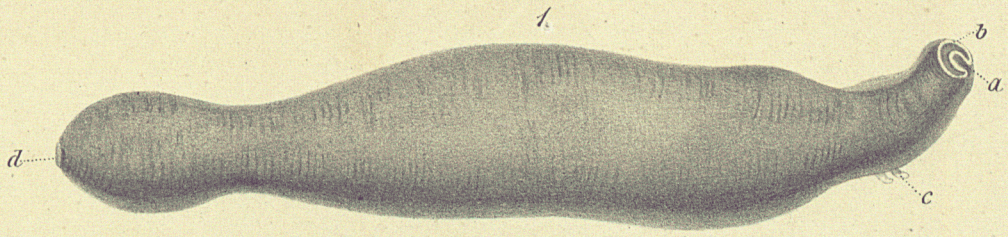

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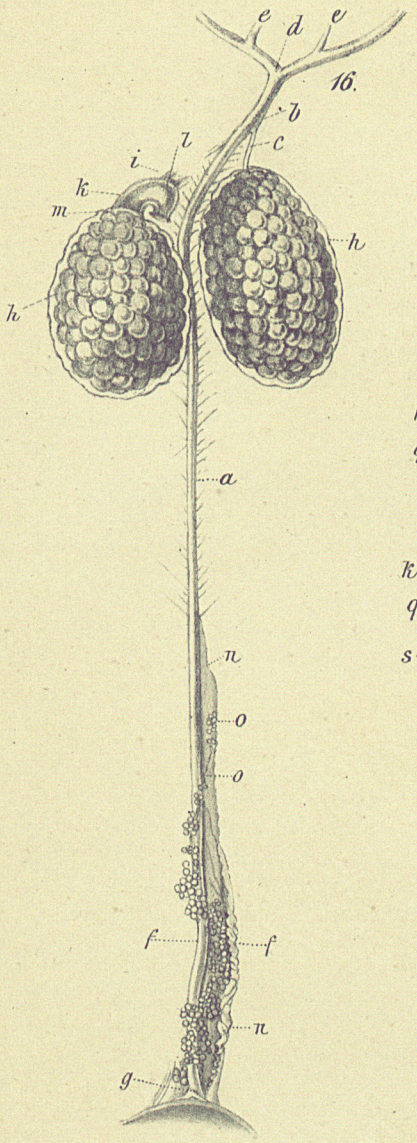

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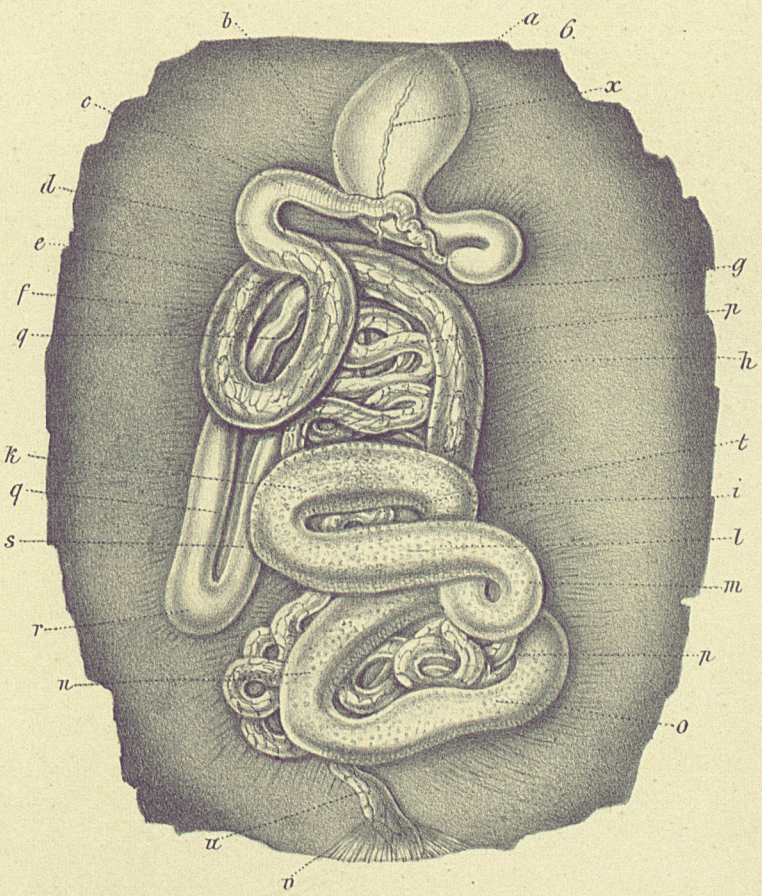

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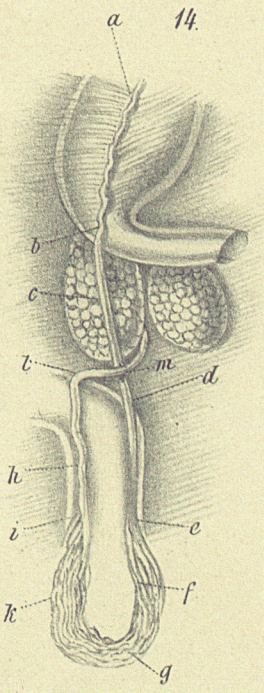

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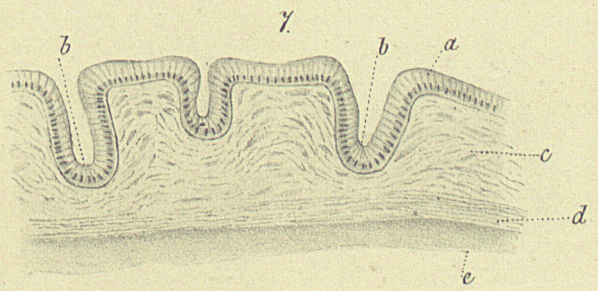

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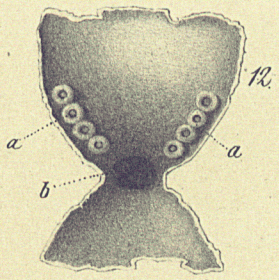
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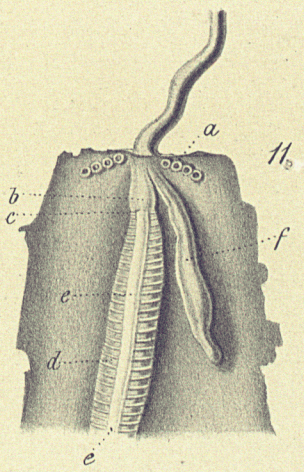
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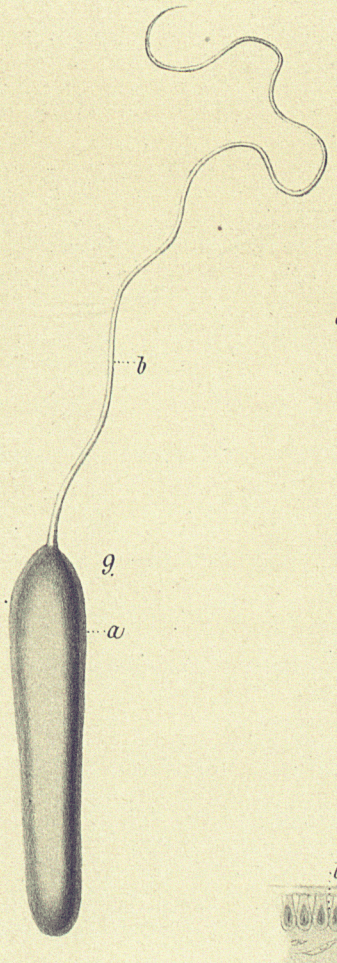
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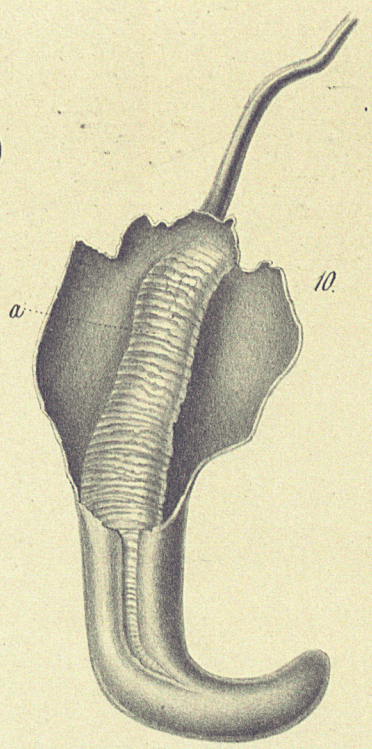
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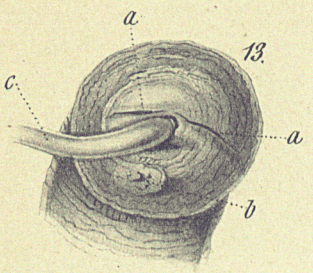
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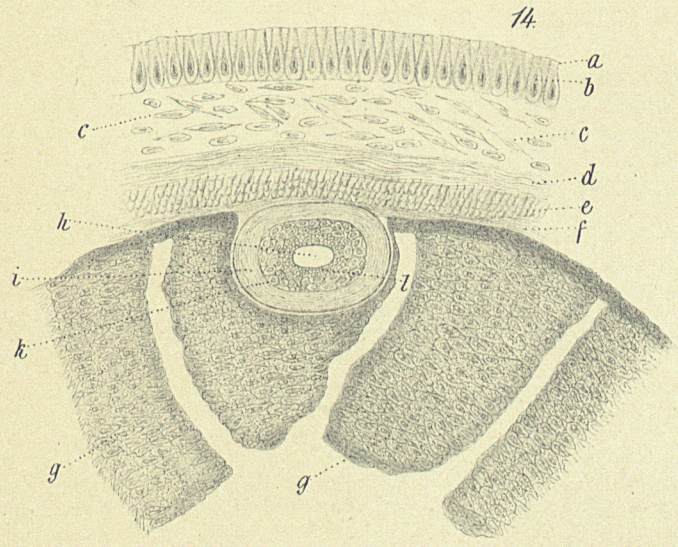
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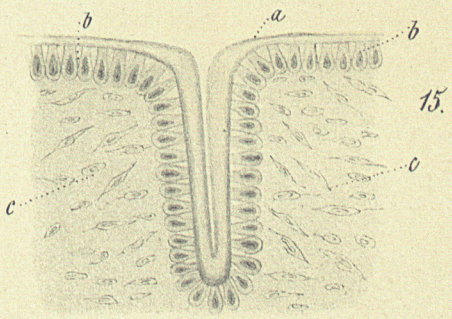
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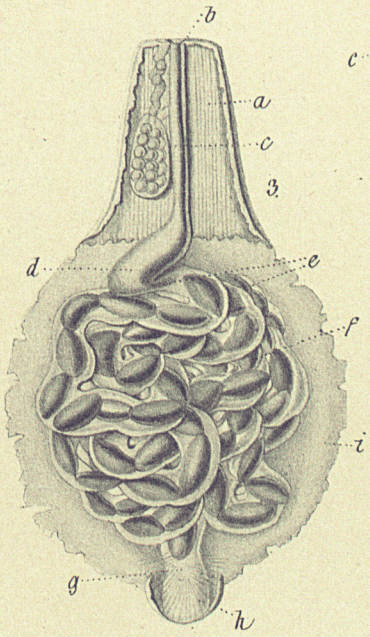
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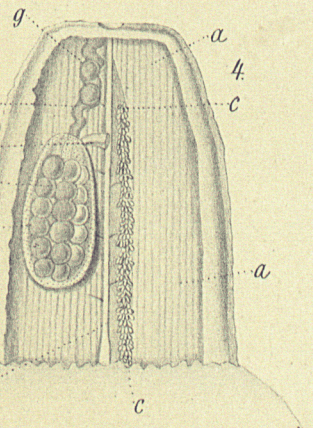
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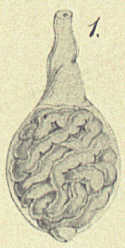
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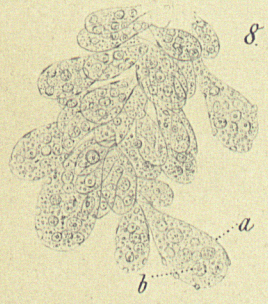
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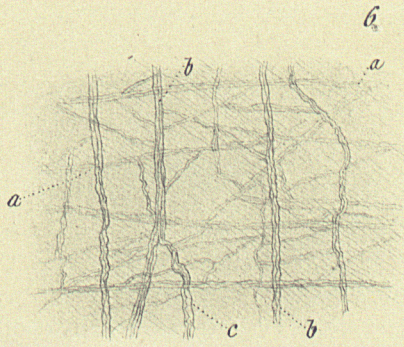
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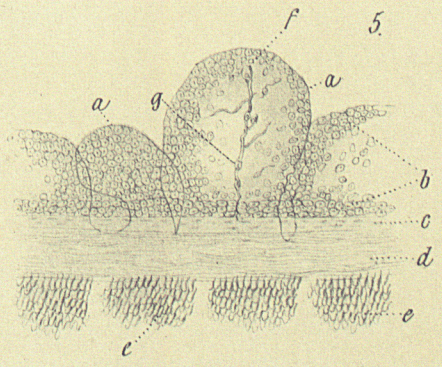
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Norske Nordhavs-Expedition.

Zoologiske Stationer.

Zoological Stations.

⊙ Skrabe – Dredge.
△ Trawl. □ Svabere – Swabs.
⊚ Skrabe og Trawl – Dredge & Trawl.
× Mislykket – Failure.

GRÖNLAND
SPITSBERGEN
ISLAND
NORGE
Jan Mayen
Bear. I.
Kuldegrader
Varmegrader
Cold Area
Warm Area
Kuldegrader ved Bunden
Varmegrader
Faer-Öerne
Shetland
500 F.
1000 F.
1500 F.
2000 F.
2500 F.
Greenwich.

Den private Opmaalings lith. Anstalt, Kristiania.

DEN NORSKE NORDHAVS-EXPEDITION

1876—1878.

HISTORISK BERETNING

AF

C. WILLE,
KAPTEJN I MARINEN.

MED ET KART.

CHRISTIANIA.
GRØNDAHL & SØNS BOGTRYKKERI.
1882.

THE NORWEGIAN NORTH-ATLANTIC EXPEDITION

1876—1878.

HISTORICAL ACCOUNT.

BY

C. WILLE,
CAPTAIN OF THE ROYAL NAVY.

WITH A MAP.

CHRISTIANIA.
PRINTED BY GRØNDAHL & SØN.
1882.

Under 19de Marts 1874 indsendte Professorerne H. Mohn og G. O. Sars til den kongelige norske Regjerings Departement for det Indre en Forestilling saalydende:

Gjennem vore Studier af vort Lands Naturforhold ere vi komne til den Overbevisning, at Forklaringen og Forstaaelsen af disse maa søges hovedsagelig i Forholdene i det Hav, som omsluttes af Norge, Færøerne, Island, Jan Mayen og Spidsbergen. Denne Del af Verdenshavet danner et stort Bassin, i hvilke Atlanterhavets varme Vande støde sammen med Ishavets kolde. De Bidrag til Kundskaben om dette Hav, som hidtil foreligge, gjælde hovedsagelig alene Bækkenets Rand, og skyldes for den største Del Forskninger, anstillede af Expeditioner, udsendte fra fremmede Lande. Saaledes have de forskjellige Svenske og Franske Expeditioner til Spidsbergen givet udmerkede Oplysninger om Bassinets østlige Rand, og de fra England med Dampskibene "Lightning" og "Porcupine" i 1869 og 1870 udsendte Expeditioner have tilvejebragt Oplysninger om dets sydvestlige Rand mellem Skotland og Færøerne, der i mere end en Henseende maa kaldes epokegjørende. Hvor Havet støder op til Norges Kyst ere Forholdene inde ved Kysten blevne undersøgte dels ved vore Zoologers Arbeider, dels i de senere Aar ved de med Oplodningsdampskibet "Hansteen" udførte Expeditioner. Fra det aabne Hav derimod er det yderlig lidet, der er tilveiebragt af Oplysninger. Norske Sælfangere have vistnok siden 1867 jevnlig hver Vaar anstillet meteorologiske Iagttagelser og lejlighedsvis forsøgt Maalinger af Temperaturen i Havets Dyb, men i Forhold til Gjenstandens Storhed ere disse Resultater kun at betragte som de første Vink om de sande Forhold.

Hvad de fysiske Forhold angaar, have de Franske, og i langt højere Grad de Svenske Spidsbergens-Expeditioner foretaget Lodninger mellem Norge og Spidsbergen samt langs denne Øgruppes Vestside, der vise, at der mellem de nævnte Lande ikke er dybere end 270 Favne, og Lodninger fra flere Tyske Expeditioner have godtgjort, at hele Østishavet mellem Norge, Spidsbergen, Novaja Semlja og Nord-Rusland danner et eneste Flak, der grunder op mod disse Landes Kyster.

On the 19th of March 1874, Professors H. Mohn and G. O. Sars memorialized the Home Department of His Norwegian Majesty's Government as follows: —

A careful study of the physical and biological conditions peculiar to our native country, has convinced us, that the means whereby to comprehend and explain them must be sought chiefly in a thorough exploration of the Sea stretching between Norway, the Færoe Islands, Iceland, Jan Mayen, and Spitzbergen. This part of the Ocean constitutes a wide basin, in which the warm water of the Atlantic meets the cold indraught from the Polar Seas. Our present knowledge of this ocean-tract refers principally to the margin of the basin, and is in greater part a result of Expeditions despatched by foreign countries. Thus, for instance, the various Swedish and French Expeditions to Spitzbergen have contributed very materially to furnish information concerning the eastern margin of the basin, and those sent out from England with the "Lightning" and the "Porcupine," in 1869 and 1870, have, as regards the south-western margin, between Scotland and the Færœ Islands, supplied data that may be said to mark an epoch in the history of marine research. The strip of ocean immediately adjacent to the Norwegian coast, has been investigated partly by our zoologists in the course of their labours, and partly on the annual expeditions of the Coast Survey, with the steamship "Hansteen." But as to the open sea, what we as yet know is meagre in the extreme. True, meteorological observations have, since 1867, been taken every spring by captains of Norwegian sealers, who now and again will make attempt to determine the temperature in the depths of the ocean; but such results must, compared to the magnitude of the problem, be regarded as mere intimations of the truth.

With respect to physical conditions, soundings were effected on the French, and more especially on the Swedish, Spitzbergen Expeditions, between Norway and Spitzbergen and along the western shores of that group of islands, showing the depth of the ocean between the said countries to be nowhere greater than 270 fathoms; and from soundings taken on divers German Expeditions, the whole eastern section of the Arctic Ocean is known to constitute an immense flat, shoaling gradually up to the coasts of Norway, Spitzbergen, Novaja Zemlja, and Northern Russia.

Vestenfor Linien mellem Tromsø og Spidsbergen og vestenfor samt nordenfor denne Ø styrter derimod Bunden sig ned til et stort Dyb, der midt imellem Spidsbergen og Grønland maaler 2650 Favne, en Dybde, der rivaliserer med selve Atlanterhavets. Fra den nordlige Side af Bassinet haves ingen Lodninger; kun ved man, at den vulkanske Ø Jan Mayen styrter sig meget brat ned i Havet. Heller ikke ved man, hverken hvorledes Bankerne paa Islands Vestkyst eller Flakket mellem Island og Færøerne gaa over til Ishavsdybet. Forholdene mellem Færøerne og Skotland ere derimod nøie undersøgte af "Porcupine"-Expeditionen i 1869. Her gaar fra Ishavet en smal Rende paa 600 Favnes Dyb ned i Atlanterhavet. Denne Rende samt den formodentlig dybe Rende mellem Island og Grønland synes at være de eneste Communicationsveje i Dybet mellem Atlanterhavet og vort Ishav. Paa den norske Side strækker Kundskaben om Havbundens Form sig saagodtsom ikke udenfor de af Fiskerne besøgte og af "Hansteen"-Expeditionerne oploddede Banker. Kun paa et eneste Sted, ved Storeggen, have disse Lodninger antruffet en rask Heldning af Bunden ud mod det store Hav-Bassin. Ellers ere vi totalt uvidende om, paa hvilken Maade vor Kysts Banker gaa over i Ishavsdybet, om det sker brat, eller langsomt, om det sker nær Kysten eller om det først finder Sted langt ude i Søen. Kundskaben om dette Punkt er det netop, som vi maa anse det for et Hovedpunkt at vinde.

Med Hensyn til Temperaturen i det her omtalte Strøg af Havet er vor Kundskab indskrænket omtrent til de samme Localiteter, som de hvor Dybdeforholdene ere undersøgte. Temperaturmaalingerne fra vor Kyst vise, at vore Banker og vore Fjordes tildels store Dyb dækkes af Vand, hvis forholdsvis høje Varmegrad viser hen til Atlanterhavet som dets Udspring. Intetsteds langs Norges Kyst er der paa Bankerne eller Fjordenes Bund fundet Kuldegrader. Saadanne ere derimod fundne ikke alene saavel i Overfladen som i Dybet ude i Havbassinets centrale Del og henimod dets vestlige Rand, men ogsaa i den dybe Rende mellem Færøerne og Shetland allerede i 300 Favnes Dyb.

Hvor langt vi maa gaa ud i Havet vestenfor Norge forat træffe paa iskoldt Vand paa Bunden, derom staa vi aldeles blottet for Kundskab. Her staa vi atter ved et Hovedpunkt, thi denne Grændse mellem det varme Atlanterhavsvand og det iskolde Polarvand maa, efter det hvad der kan sluttes af lignende Forhold, betegne Grændsen for de i Havet levende Væseners forskjellige Udbredelse til den ene eller til den anden Side. End ringere end vor Kundskab om Dybde- og Varmeforhold er vor Kundskab om Strømforhold, der spiller en saa stor Rolle i Dyrelivet, om Havvandets Bestanddele, der er af lige Vigtighed, og om de jordmagnetiske Forhold, der for Theorien som for Skibsfarten er af sær Betydning.

West of a line extending between Tromsø and Spitzbergen, as also west and north of the latter locality, the bottom sinks to a great depth, reaching between Spitzbergen and Greenland 2650 fathoms, and accordingly rivalling that of the Atlantic itself. Along the northern boundary of the basin no soundings have as yet been taken; all we know is, that the volcanic island of Jan Mayen plunges precipitately into the ocean. Nor is it yet known how or where the banks on the west coast of Iceland and the flat between Iceland and the Færoe Islands, pass into the depths of the Arctic Ocean. The section stretching between the Færoe Islands and Scotland, was, on the other hand, carefully explored on the "Porcupine" Expedition, in 1869. In this tract, a narrow channel, 600 fathoms deep, extends from the Arctic Ocean to the Atlantic. This channel, and probably too the deep channel between Iceland and Greenland, would appear to be the only highways by which the depths of the Atlantic are connected with those of the Arctic Ocean. Along the Norwegian coast, what we know of the nature and contour of the bottom is almost exclusively confined to that of the banks periodically visited by fishermen, and which of late years have been investigated on the Coast Survey expeditions with the "Hansteen." In but one locality — off the Storeggen bank — was the bottom found to sink rapidly down to the great ocean-basin. With this exception, we are totally ignorant as to how and where the banks lying off the coast of this country pass into the depths of the Atlantic, whether gradually or precipitately, whether in close proximity to the coast or possibly in mid-ocean. Now, the solution of this problem appears to us of the greatest importance.

As regards the temperature throughout the aforesaid ocean-tract, it is known only for most of the localities in which the depth has been measured. The comparatively high temperature distinguishing the water on our coastal banks and in our fjords, many of which are of great depth, points to the Atlantic Ocean as the source whence it is derived. Nowhere along the coast of Norway, whether on the banks or at the bottom of the deepest fjords, has 0° been observed; but in the central part of the ocean-basin, and at its western margin, the temperature has been found to be below zero, both at the surface and in the depths; nay, in the deep channel between the Shetlands and the Færoe Islands 0° is reached at a depth of 300 fathoms.

At what distance from the western shores of Norway the glacial bottom-area commences, we are unable to infer from the data as yet obtained. Here, then, we stand in face of another highly important question; for the limit at which the warm water of the Atlantic meets the cold indraught from the Polar Sea, must, reasoning from analogy, mark the limit of distribution for the animals inhabiting the warm and cold areas. But, trifling as is our knowledge of depth and temperature in that ocean-region, we know still less concerning the nature of its currents, — a physical condition which everywhere exerts such great influence on the character of the marine fauna, — concerning the chemical constituents of its water, — no less important in

Af hvad vi hidtil vide om det Hav, som omgiver Norges Kyster, kunne vi erkjende, at det er dette Hav, hvem vort Land skylder sin Existents som beboet og som civiliseret Land. Gaar man til de samme Breddegrader i Asien eller Amerika, træffer man kun Is-Ørkener, der sparsomt beboes af nomadiske Folkestammer. Det milde Klima, som i Norge gjør Landbruget, vor vigtigste Næringsvej, mulig, skyldes det varme Hav, som beskyller vore Kyster. Dette Havs Varme er ikke indskrænket til Overfladen: i saa Fald vilde dets Varmekraft snart være forbrugt under den lange Vinter; men, som anført, findes paa Kystens Banker og Fjordenes Dyb varmt Vand, der gjennem den lange Vinter, naar den koldere Luft stadig trækker Varme fra det varmere Vand, er det Reservoir eller den Ovn, som stadig forsyner Luften med Varme, og hvis Varmemængde er saa stor, at den holder ud den strengeste Vinter uden at tabe noget merkeligt af sin Varmeevne. Udenfor Bankerne have vi i Dybet Ishavets iskolde Vande, der fylde Færø- Shetlands-Rendens nederste Halvdel. Mod disses Indtrængen til Landet danne Bankerne den beskyttende Vold, de holde de iskolde Vande langt borte fra Kysten og hindre dem fra at trænge ind i vore Fjordes Dyb. Uden disse Banker skulde vi visselig i Norge have Grønlands Klima. Bankernes Udstrækning mod Vest eller Nordvest er saaledes en capital Sag for hele vor Tilværelse — men hidtil er den os ganske ubekjendt. De varme Vande, der flyde nordover fra Atlanterhavet, have en stadig Tendents til at gaa til højre, altsaa til at kaste sig ind paa Europas Vestkyst. Her møde de vore Banker, over hvilke de flyde. Denne Omstændighed er af den største Betydning. Thi Exempler fra andre Steder, f. Ex. fra Færø-Shetland-Renden, vise, at hvor de varme Vande flyde over et Underlag af iskoldt Vand, foregaar der fra dette en sterk Afkjøling, der endog naar til Overfladen, og saaledes bidrager til at gjøre Klimatet koldere. Men hvor det varme Vand flyder over en Landbund, der tjener denne til at bevare dets Varme i lange Strækninger. Det skyldes derfor vore Bankers Udstrækning, at Atlanterhavets varme Vande uden nogen sterk Afkjøling kunne omslynge vore Kyster helt op til Grændsen mod Rusland og videre. Den Udholdenhed, som det varme Vand har til at modstaa Vinterens Strenghed, beror foruden paa Landbundens, det er Bankernes, Udstrækning ogsaa paa deres Dybde — men derom have vi ikke Kundskab uden for den smale Rands Vedkommende, som de senere Aars Dyblodninger langs Kysten har skaffet os Kundskab om.

their operation, — and finally, concerning the phenomena of terrestrial magnetism, which, bearing as they do alike on science generally and on practical navigation, are of peculiar significance.

From the facts as yet determined respecting the sea that laves our shores, we may safely assume, that to its waters is Norway indebted for her existence as a habitable and civilised country. In Asia and America, the land within the same parallels of latitude constitutes a vast icy waste, thinly peopled by nomade tribes. The mild climate of Norway, indispensable for the prosecution of agriculture, whereby the great bulk of the population subsists, depends mainly upon the high temperature of the sea surrounding our coast. The heat given off by the water is not derived exclusively from the surface; were such the case, its source would soon be exhausted during the long northern winter; but, as previously stated, water of a high temperature is found on the banks and in the depths of the fjords, which, throughout the long winter, when the cold air is incessantly drawing off heat from the sea, constitutes, so to speak, a reservoir whence the atmosphere is supplied with heat; and the amount in store is much too great to admit of being sensibly reduced by the longest and most rigorous of winters. Without the banks, we have the cold water from the Arctic Ocean, filling the lower half of the channel between the Færoe and the Shetland Islands. Now, it is these banks that form a protective barrier, effectually preventing the cold water from forcing a passage to the coast, and from mingling its waters with those in the depths of our fjords. Deprived of these banks, Norway would assuredly have the climate of Greenland. Hence their extent in a westerly or north-westerly direction is a question of vital importance to the people of Norway, yet concerning which we have at present everything to learn. On its northward course, there is a marked tendency in the warm Atlantic water to keep to the right and bank up against the western coast of Europe. Here it reaches our banks, over which it passes. But this is a most important fact; for whenever a warm current flows over a substratum of cold water, as is the case in the channel extending between the Shetlands and the Færoe Islands, it parts with a considerable portion of its heat, being cooled up to the surface, and thus contributes towards the severity of the climate; but where the warm water flows directly over the bottom, it will retain its heat for a very considerable distance. Hence it is the magnitude and extent of our banks that enables the warm water of the Atlantic, without being deprived of any great amount of heat, to compass our shores as far north as, nay farther than, the Russian frontier. The tenacity evinced by this water in retaining its high temperature, how intense and protracted soever may be the cold, is due, not only to its flowing for a long distance in immediate contact with the bottom, or to the extent of the banks, but likewise to the depth in those localities. As regards these conditions, however, all that we know has reference solely to the narrow belt along the coast in which of late years soundings have been taken.

Med Hensyn til Dyrelivets Forhold i den omhandlede Havstrækning er vor Kundskab omtrent paa det samme Trin som med Hensyn til de fysiske Forhold. Denne Havstrækning er hidtil saagodtsom slet ikke undersøgt og meget synes at lade formode, at Dyrelivet her saavel oppe i Søen som paa de største Dyb vil vise sig særdeles rigt udviklet. Navnlig vil der til de paa de store Dybder (som her gaa ned til over 2000 Favne) levende Dyrformer knytte sig en ganske særlig Interesse ikke blot i zoologisk men ogsaa i geologisk Henseende, da det allerede har vist sig, at saadanne Dybvandsdyr ofte kunne aabne os ganske uventede Indblik i vor Jordklodes tidligere Forandringer. Det lidet vi til Dato kjende om de fysiske Forhold i den omtalte Havstrækning, tør nu ogsaa lade os formode, at der efter al Sandsynlighed her vil findes et rigere og mere varieret Dyreliv i Dybet, end maaske i nogen anden Del af Verdenshavene, og at man derfor netop her lettest vil kunne faa løst mange endnu uafgjorte Spørgsmaal vedkommende Dyrelivets Udbredning i Havets Dybder og Forhold til tidligere Jordperioders Dyreliv. De engelske Expeditioner med "Lightning" og "Porcupine" have allerede tilstrækkeligt vist os, hvilket vidt Felt for fremtidige Undersøgelser, berørende de vigtigste Spørgsmaal i Naturvidenskaben, der her ligger aabent for os, og det er ganske naturligt, at den videnskabelige Verden ogsaa venter, at der fra vort Lands Side skal gjøres noget til Fremme af en Sag, der er af saa stor Betydning for Videnskaben og hvori allerede saa mange Nationer have taget virksom Del.

Vi have ogsaa en dobbelt Opfordring hertil, da der ved Siden af de rent videnskabelige Resultater ogsaa kan ventes opnaaet Resultater af stor praktisk Betydning for vort Land. At Undersøgelserne af de fysiske Forhold i denne Havstrækning vil give vigtige Bidrag til Bedømmelsen af Vejrforholdene langs vor meget befærdede Vestkyst og derved altsaa komme Kystbefolkningen tilgode under dens haarde og farlige Bedrift tilsøs, er vel utvivlsomt. Ogsaa er det at vente, at mange Spørgsmaal vedkommende vore vigtigste Fiskerier herved vil kunne løses. Navnlig gjælder dette de for vort Land saa vigtige Sildefiskerier. Som allerede Undertegnede Sars har udtalt, er der al Sandsynlighed for, at de store Sildemasser, der om Vinteren og Vaaren besøge vore Kyster, netop have sit egentlige Tilhold i den omtalte Havstrækning, og at de Variationer, som gjennem Tidernes Løb ere iagttagne ved Vaarsildfiskerierne, væsentlig afhænge af og betinges af de forskjellige meteorologiske Forhold i det udenfor liggende Hav.

Den store saavel videnskabelige som praktiske Interesse, der saaledes knytter sig til Kundskaben om vort Vesterhavs Naturforhold, gjør det i mange Henseender ønskeligt, at en saadan Kundskab erhverves saa snart og saa fuldstændigt som muligt. En gradevis Fremgangsmaade med Benyttelse af de forhaandenværende Hjelpemidler vil

Of the fauna inhabiting the tract of ocean referred to in this Memorial, our present knowledge is no less limited than of its physical conditions. This extensive region has never yet been made the field of zoological investigation; and there is much to warrant our assuming, that the animal life prevailing there will prove to be distinguished alike at the surface and in the greatest depths by a high degree of development. And moreover, peculiar interest will attach to forms of animal life occurring in the great depths (upwards of 2000 fathoms), not only from a zoological, but also from a geological point of view, inasmuch as deep-sea animals have frequently afforded an unexpected insight into the earlier transformations of our planet. From the little at present known of the physical conditions distinguishing the aforesaid ocean-tract, we may infer, that, inhabiting its depths, will be in all probability found a fauna more extensive and varied than, perhaps, in any other part of the ocean; and hence that we may rely on its furnishing exceptional facilities for the elucidation of many still unsettled questions touching the occurrence of deep-sea animals, and the conditions affecting animal life in former geological periods. The results of the British Expeditions with the "Lightning" and the "Porcupine" have shown us how wide a field of research this subject opens, bearing as it does on the weightiest problems in Physics and Natural History; and it is but natural that our country should now be expected to contribute her quota towards the advancement of a cause so important to the interests of Science, and in which so many nations have already taken active part.

Besides, we have in this case an additional motive to impel us, since, apart from scientific expectations, there is reason to conclude that great material advantage would accrue to the country at large. Thus, for instance, a thorough investigation of the physical conditions peculiar to the said ocean-tract, must very materially assist in throwing light upon the meteorological influences so potent in determining the weather on our western shores, and thereby render special service to the coastal population when engaged in their arduous avocations. Moreover, many now open questions affecting the most important of our fisheries, would, we may reasonably opine, be elucidated. This refers in particular to the great periodical herring-fisheries. As already suggested by one of your memorialists (Sars), it is in all probability this tract of ocean within which lie the true haunts of those enormous shoals of herrings that in the winter and spring annually repair to our shores; and the marked irregularity of occurrence, observed, in the course of years, after a longer or shorter interval, to distinguish these fisheries, may no doubt be traced to meteorological influence at work off the coast.

Hence, as very great benefit would assuredly result alike to Science and to the material interests of the nation from an intimate knowledge of the physical and biological conditions distinguishing the Norwegian Seas, the sooner and the fuller, in our judgment, that knowledge be acquired, the better. A gradual mode of procedure, using

her ikke strække langt til. De norske Skibe, som fortrinsvis besøge disse Farvande, ere Sælfangerne. Fra disse kan man fremdeles vente Bidrag til Kundskab om Havets Vejrforhold, der efterhaanden ville sætte os istand til at lære disse vigtige Momenter for Dyrelivet og Havboernes Vandring at kjende. Sælfangernes Ophold i disse Egne foregaar dog kun til en Del af Aaret, Marts til Juni, og tildels langt Nord og inde i den med Drivis belagte Del af Havet, som udgjør den allernordligste Del af det Felt, hvortil vi her sigte. Endel norske Fartøjer fare tildels et godt Stykke udenfor Kysten til og fra Arkhangel om Sommeren. Ogsaa fra en Del af disse kunde man erholde meteorologiske Iagttagelser. Hvad der paa denne Maade kunde indvindes af Oplysninger, vil det meteorologiske Institut bestræbe sig for at lade komme til Nytte for den attraaede Kundskab om Havets Vejrforhold. Videre end til saadanne Iagttagelser kunne Handelsmarinens Bestræbelser ikke naa. Det har vist sig, at der med Maalingen af Havets Temperatur i Dybet om Vinteren for Sælfangerne er forbunden særegne Vanskeligheder, der have gjort mere end en Skibsførers ufortrødne Bestræbelser til Intet. Mere kunde vistnok udrettes, om en Videnskabsmand medfulgte et saadant Fartøj. Men da denne ikke kunde dirigere Skibet hen til de Steder, hvor hans Undersøgelser vilde være af størst Interesse, og Sælfangerne, som nævnt, opholde sig den meste Tid udenfor det Felt, der nærmest skulde være Gjenstand for den mest lovende Undersøgelse, vil ogsaa et saadant Middel blive for kortrækkende.

Vi blive saaledes staaende ved den Overbevisning, at Undersøgelsen af Havet vestenfor Norge, for at blive effectiv, maa udføres ved en dertil bestemt og udrustet videnskabelig Expedition. Som Forbillede for en saadan staa de Britiske Expeditioner med "Porcupine" og "Challenger". Den sidste, der gjælder alle de store Verdenshave og har en stor kraftig Dampcorvet til sin Disposition, er udrustet med alt hvad der til dens Øjemed kan fordres og er sit Land i enhver Henseende værdig. Saa storartet et Apparat vil til Undersøgelsen af vort Hav ikke være nødvendigt. Vi ville i enhver Henseende være hjulpne med en Expedition saadan som den med "Porcupine".

Fra den Norske Stats Side har der, uagtet saamange af vore Interesser knytte sig til Havet, ikke været foretaget nogen Expedition af videnskabelig Art til de os allernærmest omgivende Have. Undersøgelsen af de for vore nordlige Egne saa vigtige Fangstfelter i Nordishavet har ene og alene været overladt til den private Foretagsomhed, som her foruden de rent praktiske Resultater have medbragt skjønne Resultater for Videnskaben, saavel for Geografien som for Naturvidenskaben. Vi kunne nævne Carlsens Omsejling af Spidsbergen, hans Indtrængen i det kariske Hav, hans og Tobiesens samt senere Altmanns, Nilsens og

to their full extent the limited means now at our disposal, would certainly fail of its object. The Norwegian vessels that navigate those regions are mostly sealers. From this source we may indeed still hope to learn further valuable particulars of meteorological phenomena, which may eventually lead us to a juster estimate of their influence on animal life and the migratory instincts observed in the inhabitants of the deep. Meanwhile, the sojourn of our sealing-ships in those high latitudes is confined to part of the year only (from March to June), the vessels keeping, too, nearly the whole time, among the drift-ice, which constitutes the extreme northerly limit of the tract referred to. Moreover, the Norwegian ships that trade to Archangel, and which could also furnish meteorological observations from the open sea, do not extend their voyages beyond the summer months. Of all information from these sources, the Meteorological Institute will of course take advantage, to extend our knowledge of the causes determining the weather at sea. With other and more intricate observations it does not lie in the power of the merchant-navy to furnish us. Observing the temperature at any considerable depth in winter, is attended with very great difficulty, so great indeed as to have rendered worthless more than one captain's indefatigable exertions. True, greater results might be obtained were a gentleman whose profession was science to accompany such a vessel; but even in that case he could not shape her course and visit the best localities for observations; besides, the Norwegian sealers keep most of the season without the tract which, in preference to any other section of those Northern Seas, it is desirable to select as the field of exploratory research; and hence the alternative offered has little to advocate its adoption.

In face of the facts set forth above, we will emphasize our previously expressed conviction, that, in order to investigate effectively the tract of ocean stretching west of the shores of Norway, a special expedition must be despatched. As models we have the "Porcupine" and "Challenger" Expeditions. The latter, which has for its object the exploration of the great Oceans of the globe, is furnished with a powerful steam-corvette, has been fitted out on a scale commensurate with its importance, and is in every way worthy of the British Nation. But means so extensive and costly are not required for investigating the Norwegian Seas; an Expedition similar, for instance, to that sent out with the "Porcupine," would certainly be adequate for the attainment of the end proposed.

Though so many of our national interests are directly connected with the sea, no Scientific Expedition has yet been undertaken by the State to those parts of the ocean that lie next adjacent to the Norwegian coast. The exploration of the extensive sealing-grounds in the Arctic Ocean has been left altogether to private enterprise, which, apart from merely practical results, has enriched Science in the several branches of geography, physics, and natural history. As a few instances in point, we have only to mention Carlsen's circumnavigation of Spitzbergen, his exploring voyage far into the Kara Sea, and the discovery,

Johnsens Opdagelse af Kong Karl-Land, der saa længe svævede som en Taage for Geograferne, Tobiesens Iagttagelser fra Overvintringer paa Bjørne-Øen og paa Novaja Semlja, Johansens og Macks Omseiling af Novaja Semlja og Opdagelse af det varme Vand udenfor Obs og Jeniseis Mundinger. Ved disse Resultater har Norge kunnet hævde en Plads som Deltager i de Opdagelser, hvormed en Række af Nationer have bidraget til at sprede Lys over vor Planets nordligste Egne, og denne Plads har været en ærefuld selv ved Siden af de rigere Nationer med deres ganske anderledes vel udrustede offentlige og private Expeditioner.

Imidlertid tro vi, at Udrustningen af en egentlig Nordpol-Expedition, med det Maal at trænge frem i hidtil uudforskede Polar-Egne, ikke bliver vor Sag. Dette maa vi overlade til de rigere Nationer. Men naar der lige udenfor vor Kyst ligger et Hav, der indeslutter Ophavet til hele vor Existents, og dette Hav hidtil er saagodtsom ganske ukjendt i dets Naturforhold, da ligger Undersøgelsen af disse os Nordmænd nær og nærmere end nogen anden.

En videnskabelig Undersøgelse af Havet udenfor Norges Vestkyst er en Opgave, som fra norsk Side visselig skulde kunne udføres med samme Held som de Britiske Expeditioner af samme Art. Den maatte gaa ud paa at undersøge Havets Dybde, dets Temperatur, dets Vands chemiske Sammensætning og Gasindhold, dets Strømninger saavel i Overfladen som i Dybet, Bundens Beskaffenhed og geologiske Formation; dets Vejrforhold, de magnetiske Forhold og særlig dets Dyre- og Planteverden af enhver Art. Som Resultater af en saadan Undersøgelse kan man vente at erholde Oplysning om alle de Naturforhold, der betinge vort Lands Klima med dets Variationer og fremfor Alt om vore vandrende Fiskearters biologiske Forhold. Af hvilken Interesse saadanne Resultater vilde være for den hele Naturvidenskab, skulle vi ikke her videre udbrede os over; alene de vigtige Resultater, som kunne gjøres Regning paa for vore Fiskerier forekommer det os at være nok at henpege paa for at motivere en saadan Undersøgelses Ønskelighed. En til en saadan Undersøgelse udsendt Expedition maatte gaa ud fra den norske Kyst nordenfor Stat som sin Basis, og fra denne af studere Forholdene ud over Bankerne lige til selve Ishavsdybet, en Opgave, som den for Dampskibet "Hansteens" Oplodninger lagte Plan ikke tillader dette at udføre, paa samme Tid som "Hansteens" Arbeider ville bidrage i højeste Grad til at støtte den til Havets Undersøgelse udsendte Expeditions Arbeider. En anden Tilslutning vilde Hav-Expeditionen have til de Britiske Expeditioners Arbejde, navnlig til "Porcupine"-Expeditionens. Den vilde give denne, der nærmest er at anse for en Pioner-Expedition paa disse Felter, den rigtige Udvidelse og Afrunding i Retning af Polarhavet og saaledes mødes med al mulig Sympathi af de Britiske For-

first by that enterprising seaman and Tobiesen, and, some years later, by Altmann, Nilsen, and Johnsen, of Kong Karl's (Wyche) Land, which had so long flitted mirage-like before the minds of geographers; Tobiesen's valuable observations, taken when wintering on Beeren-Eiland, and on Novaja Zemlja; Johansen's and Mack's circumnavigation of Novaja Zemlja; and their discovery of the warm surface-water off the mouths of the Ob and the Yenisei. The exertions of these Norwegian mariners have given to their country her full share in the discoveries that have helped to throw light on the most northerly regions of the globe, thus securing to her an honourable position by the side of wealthier nations, with their numerous Expeditions, either fitted out at the expense of the State or by private munificence.

Meanwhile, a "North-Pole Expedition," having for its object the exploration of unknown Arctic regions, does not, we conceive, come within the scope of Norwegian enterprise. Such an undertaking must be left to nations better able to make the pecuniary sacrifice it would entail. But, off our coasts extends a tract of ocean which is the origin and preserver of our existence as a civilised nation; and that expanse of sea being as regards its physical conditions well nigh unknown, on Norway should first devolve the labour of their solution.

A scientific exploration of the sea west of Norway might certainly be accomplished by Norwegians with success equal to that which has attended the like British Expeditions. It would comprise the depth of the sea, its temperature, the chemical composition of its water, the currents prevailing there, both at the surface and in the depths, the nature and geological formation of the bottom, meteorological and magnetical phenomena, and more especially all forms of animal and vegetable life. The results of such an investigation might be expected to throw light upon the physical conditions determining our climate, and, above all, upon the biological characteristics of our migratory fishes. What value the acquirement of such information would have for Science generally, we will not dwell upon here; the great advantage which in all probability our fisheries would reap is alone sufficient to show the importance of such an undertaking. An Expedition with the object here set forth, would have as its basis the Norwegian coast north of Stat, and from this locality would proceed to investigate the banks, exploring thence down to the deepest parts of the basin, — a scheme that does not come within the limits of the plan laid down for the sounding-operations of the Coast Survey with the "Hansteen," the results of which would, however, very materially contribute to facilitate the scientific work of the Expedition. Moreover, a Norwegian Expedition must derive additional importance from its intimate relation to British Expeditions, and more especially to that despatched with the "Porcupine," since it would furnish the very desirable opportunity of carrying on and completing in the direction of the Arctic Ocean the work begun by the "Porcupine" Expedition (which bore a true pioneering character), and hence be met with the warmest sympathy

skere. Herom have vi allerede modtaget Vidnesbyrd fra disse Kanter. Paa samme Tid have vi og bragt i Erfaring, at den Britiske Regjering ikke agter at lade „Challenger" overtage denne Undersøgelse af vort Ishavsbækken, som vi her have for Øie.

Til Udførelse af Expeditionens Arbejder kræves en Zoolog med et Par Assistenter, en Fysiker og en Chemiker, forsaavidt det Videnskabelige angaar. Til Arbejdstid maatte vælges de roligste Sommermaaneder, thi med uroligt Hav er Arbejdet i de fleste Retninger umuligt. $2^1/_2$ Maaned, fra Midten af Juni til Slutningen af August er den længste Arbejdstid, man kunde gjøre Regning paa, og af denne Tid vilde mange Dage ikke kunne benyttes, naar Vejret er uroligt.

Af de til Expeditionen fornødne Apparater er Skibet det vigtigste og kostbareste. Et saadant maatte være et Dampskib, der besad tilstrækkelig Kraft til at manøvreres for Maskinen i ethvert saadant Vejr, hvori Undersøgelser af Havdybet overhovedet kunde foretages; det maatte kunne medtage Kul for en længere Tid og have en brændebesparende Maskine, have flere Baade til forskjellige Undersøgelser og et tilstrækkeligt Mandskab til Udførelse af alle med Dybvandsundersøgelser forbundne, ikke ganske lette Arbejder. Til disse udfordres ogsaa et Dampspil. Desuden udfordres et Arbejdsrum for de videnskabelige Undersøgelser, som kunne udføres ombord.

Efter de Undersøgelser, vi ved Sagkyndiges Hjelp have anstillet, findes der blandt norske Dampfartøjer for Tiden ikke noget, som opfylder de nævnte Betingelser. Med Hensyn til Tilvejbringelse af et passende Fartøj for Expeditionen stiller der sig nu trende Alternativer.

A. Anskaffelsen af et nyt Skib. Med Hensyn til dette Punkt ere vi saa heldige at kunne nævne et Overslag over dets Kostende, som er blevet os velvillig meddelt af Nylands mekaniske Verksted. Dette Verksted har nemlig fra den russiske Regjering modtaget Opfordring til at udarbejde Overslag over Omkostningerne ved Anskaffelse af et nyt Jerndampskib, med Skrue, skikket til Opsyns- og Opmaalingsfartøj, af en Størrelse og med en Udrustning og Indredning, som paa det allernærmeste falder sammen med, hvad vi efter Samraad med Sagkyndige anse passende for en Expedition som den af os her omhandlede. Et saadant Skib vilde efter Nylands Verksteds Overslag, med fuld Udrustning, Dampspil, Baade, Høj- og Lavtryks-Maskine af fuld Kraft for Fartøjet, koste 40,000 til 45,000 Spd. efter Nutidens Priser.

B. Den Krigsmarinen tilhørende Skrueskonnert "Alfen", som man havde tænkt at sælge, kunde med en passende Omforandring blive et for Expeditionen hensigtsmæssigt Skib. Naar man forsynede Fartøjet med ny hensigtsmæssigere og større Skrue, en ny større og sterkere Kjedel,

on the part of British *savants*. Of this we have already received assurance. We are also able to state, that the basin of the Arctic Ocean will not be investigated by the "Challenger" Expedition.

The scientific work involved in such an undertaking, would call for the services of a naturalist, with one or two assistants, a physicist, and a chemist. As regards the most fitting season of the year for the cruises of the Expedition, this would be obviously the finest summer months; for in rough weather the greater part of the work of which there can be question is utterly impracticable. Two months and a half — from the middle of June to the end of August — might be reasonably calculated upon, including of course many stormy days on which nothing could be done.

Of all that is needed for the Expedition, the choice of a vessel would be the chief consideration, as her acquisition would involve the greatest outlay. She should be a steamer, with an engine sufficiently powerful to admit of working her in any weather that did not render the exploration of the ocean-depths altogether impracticable; she must, too, be able to take out coals for a considerable period, have an engine specially adapted for economising fuel, be provided with several boats, in which, when occasion called, to put off from the ship, and moreover be manned by a crew sufficiently numerous to do all the work connected with sounding, dredging, trawling, &c, which, being mostly of a laborious character, would require a steam-winch for its effective execution. Finally, there must be room on board for instituting such observations and experiments as admit of being undertaken at sea.

Having made inquiry of persons specially conversant with the subject, we are in a position to state, that, at the present moment, there is no Norwegian steamer that fulfils the conditions specified above. Now, as regards the acquisition of a vessel for the proposed Expedition, choice can be made between three alternatives.

A. The purchase of a new vessel. With respect to this alternative, we are in possession of an estimate, kindly furnished by the Manager of the Nyland Mechanical Works. The said Works have been requested by the Russian Government to give an estimate of the cost of an iron screw-steamer for the Coast Survey of that country, which, as regards burden, tackling, and general equipment corresponds very nearly with the description of vessel that we, having duly consulted experts, believe to be most suitable for the Expedition proposed in this Memorial. Such a steamship, fully equipped, with compound engines, steamwinch, boats, &c., could, as prices now stand, according to the estimate of the Nyland Works, be built for a sum of from Spd. 40,000 to Spd. 45,000.

B. The screw-schooner "Alfen," belonging to the Royal Navy, which was to have been sold, might, by sufficiently extensive alterations, be made a suitable ship for the Expedition. Furnished with a new and improved propeller of increased dimensions, with larger and stronger

formindskede Riggen og foretog Forandringer ved Apteringen, saaledes at der blev Plads for de til Expeditionen hørende Videnskabsmænd og deres Arbejder, foruden til Officierer og Mandskab samt stort Rum til Kul, vilde man faa et Fartøj, som i saadant Vejr, som udfordres til de videnskabelige Arbejder, kunde manøvreres fuldstændigt for Maskinen, og i mere uroligt Vejr kunde manøvreres som Sejlskib, hvorved Betingelserne altsaa vare givne for den størst mulige Kulbesparelse og Kulbeholdningens Forslag for en længere Tid, noget som var nødvendigt for Expeditionens Arbejder ude paa det aabne Hav langt fra Kuldepot. Omkostningerne ved en saadan Forandring er af Nylands Værksted beregnet til 17,000 Spd. Skulde tillige ny Maskine udfordres, hvad der neppe er nødvendigt, ville Udgifterne stige til henimod 25,000 Spd.

C. Man kunde leje et Dampskib for den Tid, der var nødvendig for Expeditionen hver Sommer, saa længe den varede. Omkostningerne herved er det ikke muligt at opgive, da disse dels ville bero paa Conjuncturerne, dels være afhængige af de Indredninger, som Fartøjet nødvendig maatte gives, for at være skikket til Expeditionsfartøj.

Af disse tre Alternativer er det første det mest anbefalelsesværdige, da det vilde give den største Frihed med Hensyn til det hele Arrangement. I denne Henseende er man noget bundet ved Alternativ *B*, og i højeste Grad ved Alternativ *C*. Ved dette sidste havde man endog den ubehagelige Risico, at maatte foretage nye Foranstaltninger for hver Gang, Expeditionen skulde udrustes, og kunde aldrig gjøre Regning paa hver Gang at faa beholde det samme Skib.

Næst Skibet udfordres der til Expeditionens Øjemed en hel Del Apparater, som Dybvandsliner til forskjelligt Brug (Temperatur, Skrabninger, Strømundersøgelser) Lodder, Patentblokke, Accumulatorer, Thermometre, Skraber, Net, fysiske (magnetiske) Apparater, Glas, Spiritus m. m. Efter velvillig Opgave af Capt. Davis af det Britiske Admiralitets hydrografiske Afdeling vil man kunne udruste et mindre Skib med de for Dybvandsundersøgelser nødvendige Apparater for en Sum af 1,000 til 1,200 Lstrl. eller 4,500 til 5,400 Spd.

Omkostningerne ved at holde Expeditionen ude, nemlig Hyre, Kost, Kul, Vedligeholdelse m. m. ere af Capitainlieutenant C. Petersen, der velvillig har bistaaet os ved Udarbeidelsen af disse Overslag, beregnede til 2000 Spd. pr. Maaned. Dette giver for en Tid af $2^1/_2$ Maaned en Sum af 5000 Spd. aarlig.

Hvormange Sommere, der ville medgaa, førend Expeditionens hele Øjemed var naaet, er det ikke muligt paa Forhaand at sige. Det kommer her saa meget an paa hvilke Forhold man ved Undersøgelserne finder og hvorledes Vejret arter sig. Vi tro dog, at man i 2 meget gunboilers, less heavily sparred, and fitted up below deck in such manner as to afford room alike for the personal accomodation of the members of the Expedition, and for such part of their work as could be done on board, as also for the officers and crew, together with stowage for coal, the "Alfen" would be a vessel which, in weather admitting of the scientific exploration of the ocean, might be worked as a steamer, and, in a heavier sea, as a sailing-ship, thus securing the conditions requisite for the greatest possible economy in the consumption of fuel, and for adjusting the stock of coal to the length of the period during which the Expedition would have to cruise in the open sea, far from any coaling-station. The cost of such alterations has been estimated by the Manager of the Nyland Works at Spd. 17,000. New engines — which however will hardly be wanted — would raise the outlay to about Spd. 25,000.

C. A steamer might be chartered every summer for the period over which the cruise of the Expedition would extend. As regards the cost, nothing definite can be stated, since the amount must depend partly on the state of the freight-market, and partly on the expense entailed by adapting the vessel to the requirements of the Expedition.

Of these three alternatives, the first is, in our judgment, the most desirable, admitting as it does of greater freedom in the general arrangement. The character of the second alternative, *B*, would, to some extent, be found restrictive in its operation; but the third alternative, *C*, might, if selected, lead to serious inconvenience and uncertainty, involving as it would the risk of new arrangements having to be made for each successive cruise, since the Expedition could hardly rely on being able to retain during the whole period of its duration the vessel originally chosen.

Next in importance to the ship, are the apparatus and appliances of various kinds with which the Expedition would have to be furnished, such as deep-sea lines for divers purposes (temperature, dredging, investigation of currents), sounding-leads, patent blocks, accumulators, thermometers, dredges, nets, physical (magnetical) instruments, glass jars, tubes, &c., and spirits of wine, &c., &c. According to a statement kindly furnished by Captain Davis of the Hydrographic Department of the British Admiralty, a vessel of moderate size might be fitted out with the instruments and apparatus necessary for such an Expedition at a cost of from 1000*l.* to 1200*l.* (Spd. 4500—5400).

As regards the current expenses of the Expedition, viz. for seamen's wages, rations, coal, wear and tear of vessel, &c. &c., these are put by Commander C. Petersen, R. N., who has kindly assisted in furnishing the above estimates, at Spd. 2000 a month. Hence, according to this calculation, the cost of a $2^1/_2$ months' cruise would be Spd. 5000.

How many summers would elapse ere the object of the Expedition had been fully attained, it is of course impossible to state beforehand, so much must necessarily depend on the proportions the investigation would assume, and on the weather. Meanwhile, your memorialists are of

stige eller 3 rimelige Sommere vil kunne have erhvervet et antageligt Udbytte fra den hele Havstrækning, hvorom her er Tale.

Af de til Dybvandsundersøgelserne hørende Apparater er der flere som maa fornyes hvert Aar. Efter Expeditionens Slutning bliver der dernæst Spørgsmaal om Midler til Resultaternes videnskabelige Bearbejdelse og deres Publication. Thi først naar denne foreligger, kan Foretagendet siges at være afsluttet. De hertil udfordrende Summer kunne vi ikke give noget Overslag over; de bero paa det Udbytte, som Expeditionen i Havet kan yde.

Vi have fremsat vore Anskuelser om Vigtigheden af en Undersøgelsesexpedition til Havet udenfor Norges Vestkyst og om Maaden, hvorpaa den kan udføres, i den Overbevisning, at denne Sags Fremme vil være et Foretagende, som vil bidrage mere end noget andet til at hævde vort Land den Plads i den videnskabelige Verden, som dets Beliggenhed og Naturforhold har anvist det, og som vil give de mest tilfredsstillende Oplysninger om Spørgsmaal, der vedrøre vort Lands materielle Velvære i mange Retninger. At et saadant Foretagende er forbundet med større Omkostninger, der dog ikke kunne ansees betydelige i Forhold til det forventede Udbytte, har ikke kunnet holde os tilbage fra at foreslaa Udførelsen af et Verk, som vi maa anse for at være i Fædrelandets højeste Interesse.

Vi tillade os derfor ærbødigst at henstille til det kongelige Departement at søge bevirket de nødvendige Pengemidler bevilgede til Udførelsen af en naturvidenskabelig Undersøgelsesexpedition til Havet mellem Norge, Færøerne, Island, Jan Mayen og Spidsbergen.

Christiania den 19de Marts 1874.

H. Mohn. **G. O. Sars.**

opinion that in 2 exceptionally favourable or in 3 average summer-seasons, the whole of the ocean-tract here referred to might be satisfactorily explored.

Several of the instruments and appliances would have to be renewed each cruise. At the close of the Expedition a further grant of money would be needed, for working up and publishing the results. The amount thus required to terminate the undertaking, we are not in a position to name, since it must obviously be proportioned to the general success of the Expedition.

We have set forth in this Memorial our views touching the great importance of an Expedition having for its object the exploration of the ocean-tract lying off the West Coast of Norway, and also as to the means for achieving it, — in the firm conviction that such an undertaking would contribute above any other to insure our country that rank among civilised nations which by reason of her geographical position and physical conditions she is entitled to hold: and moreover, that it must help to throw light on many intricate subjects closely connected with her material prosperity. That the projected Expedition will involve an outlay considerable indeed if not great compared with its probable results, has therefore failed to deter your memorialists from advocating the claims of an undertaking the speedy realisation of which they cannot but regard as a question profoundly affecting the interests of our country.

We venture therefore to hope, that the Home Department of His Majesty's Government will take the necessary steps to obtain a grant of money sufficient to defray the cost of an Expedition having for its object the scientific exploration of the ocean-tract stretching between Norway, the Færoe Islands, Iceland, Jan Mayen, and Spitzbergen.

Christiania, March 19th, 1874.

H. Mohn. **G. O. Sars.**

Over dette Forslag afæskede Departementet Betænkninger fra Directionen for den geografiske Opmaaling, det mathematisk-naturvidenskabelige Facultet ved Universitetet i Christiania, Børskomiteerne i Kristianssand, Bergen og Throndhjem, Opsynscheferne ved Vaarsildfiskeriet og ved Lofotfiskeriet, samt fra Directionen for Bergens Museum, ligesom det ogsaa henstillede til Marine-Departementet at udtale sig i Sagen, navnlig om Anskaffelse af Skib og om hvilken Myndighed dettes Udrustning og Bestyrelse burde bevirkes overdraget. Samtlige disse Autoriteter udtalte sig

Touching this proposal, the Home Department advised with the Directors of the Geograpical Survey, the Faculty of Sciences of the University of Christiania, the Exchange-Committees in Christiansand, Bergen, and Throndhjem, the Government Inspectors of the Spring Herring Fishery and of the Lofoten Cod Fishery, and with the Directors of the Bergen Museum; moreover, the Navy Department was also desired to pass opinion on the subject, more particularly as to how a suitable vessel might be procured, and what official body should have charge of the

for Expeditionens Istandbringelse og tiltraadte i det Væsentlige de af Forslagsstillerne udtalte Anskuelser.

Da Departementet for det Indre var enig i Marine-Departementets Udtalelse, at Expeditionens Bestyrelse eventuelt burde underlægges Directionen for den geografiske Opmaaling, anmodedes denne under 15de October 1874 om at indkomme med detaljeret Overslag over de Omkostninger, som Expeditionen vilde udkræve. Dette Overslag indsendte Direktionen under 8de Marts 1875, og under 23de samme Maaned indgik Regjeringen med underdanigst Instilling i Sagens Anledning. Da samtlige indhentede Betænkninger gik ud paa, at det vilde være hensigstmæssigst, at der blev bygget et til Expeditionen særlig indrettet Fartøj, og da Directionen i sit ovennævnte Overslag ogsaa satte dette som første Alternativ, optoges det i Indstillingen, idet Departementet underdanigst androg om, at der for Storthinget maatte blive fremsat naadigst Proposition om Bevilgning af en Sum af 61,500 Spd. (246,000 Kroner) til Anskaffelse af Skib med Rig, af Instrumenter og Inventarium samt til forberedende Arbejder. Denne Indstilling blev bifaldt ved kongelig Resolution af 30te Marts 1875.

Den 20de og 21de Maj behandledes Sagen i Storthinget, hvis Beslutning gik ud paa, at Expeditionen skulde udføres med lejet Fartøj, idet følgende af Repræsentanten Haugland fremsatte Forslag vandt de fleste Stemmer:

"Til Anskaffelse af Apparater, Instrumenter m. V. samt til første Aars Drift af en videnskabelig Expedition til Undersøgelse af den Del af Atlanterhavet, der omsluttes af Norge, Færøerne, Island, Jan Mayen og Spidsbergen, bevilges for Budgetaaret fra 1ste Juli 1875 til 30te Juni 1876 indtil 20,000 Spd."

Da Expeditionens Udførelse saaledes var besluttet, blev Kaptein i Marinen *C. Wille,* der i en Række Aar havde ledet Dyblodningerne udenfor Norges Kyst som Chef for Oplodningsdampskibet "Hansteen", og som havde assisteret Opmaalingsdirectionen ved Udarbeidelsen af det ovennævnte Overslag over Expeditionens Kostende, af Departementet for det Indre overdraget Forberedelserne til dens Udrustning, hvilke tog sin Begyndelse 10 Dage efter at Storthingets Beslutning var faldt, med at Capt. Wille rejste til England, dels for at konferere med Chefen for "Challenger," Capt. Nares, der om kort Tid skulde afgaa med den Britiske Polar-Expedition, dels for at gjøre de forberedende Skridt til Anskaffelse af Apparater og Instrumenter.

Opmaalingsdirectionen foranstaltede derefter udstedt Indbydelse i de offentlige Blade saavel her i Riget som i Sverige til Anbud paa Bortleje af Fartøj. Der indkom Tilbud fra Rederierne for 11 Dampskibe, blandt hvilke

the same and superintend her equipment. The aforesaid authorities were unanimous in favour of the Expedition, and shared in the main the views set forth by the proposers in their Memorial.

The Department for Home Affairs agreeing with the Navy Department that the general management of the Expedition should devolve on the Directors of the Geographical Survey, the latter were desired, in a communication bearing date October the 15th, 1874, to prepare a statement of the probable outlay which such an Expedition would involve. On March the 8th, 1875, the Directors sent in their estimate, and on the 23rd of the same month His Majesty's Government brought the subject before the Privy Council in a formal proposition. The several declaratory statements from the above-mentioned authorities being to the effect, that it would be best to have a vessel built specially adapted for the Expedition, and the Directors of the Geograpical Survey having in their estimate also pronounced in favour of that alternative, it was advocated in the Government proposition, the Home Department most respectfully submitting, that application should be made to the Storthing for a grant of Spd. 61,500 (Kr. 246,000), to defray the cost of a fully equipped vessel, including instruments and preliminary expenses. This proposition was approved by an Order in Council, bearing date March the 30th, 1875.

On the 20th and 21st of May, the subject was deliberated in the Storthing, the issue of the debate being that a vessel should be chartered for the Expedition, the House declaring in favour of the following motion, brought forward by the representative Haugland: —

"For the purchase of instruments, apparatus, &c., and for defraying the current expenses of the first year's cruise of a Scientific Expedition to the tract of ocean stretching between Norway, the Færoe Islands, Iceland, Jan Mayen, and Spitzbergen, the Storthing doth hereby grant for the financial year commencing July the 1st, 1875, and terminating July the 1st, 1877, a sum not exceeding Spd. 20,000 (4,444 *l.*)

The State having accordingly resolved to despatch an Expedition, Captain *C. Wille,* R. N., who, as commander of the "Hansteen," a steamer built for the Norwegian coast survey, had been engaged in conducting deep-sea soundings off the coast, and who had assisted the Directors of the Geographical Survey when preparing their estimate of the cost of the Expedition, — was appointed by the Home Department to take the preparatory steps for fitting her out; and two days after the assent of the Storthing had been given, Capt. Wille left for England, partly that he might there confer with the captain of the "Challenger," G. S. Nares, who was shortly to set out on the British Polar Expedition, partly to arrange for the purchase of apparatus, instruments, &c.

Soon after Capt. Wille's departure, the Directors of the Geographical Survey invited ship-owners, both in this country and in Sweden, by advertisements in the public journals, to make offer of a vessel for the Expedition. The number

et svensk. Ved kongelig Resolution af 23de December 1875 blev Dampskibet "Vøringen" af Bergen antaget, da det ansaaes i det Hele hensigtsmæssigt og solid, da Rederiet strax havde gjort det billigste Tilbud og ligeledes gik ind paa de Fordringer, der stilledes angaaende Rig og Indredning.

Den af Departementet med Rederiet afsluttede Kontrakt, der i det væsentlige ligelydende fornyedes for hvert af de to følgende Aar 1877 og 1878 (med Undtagelse af at Lejen forhøjedes til 1,100 Spd. pr. Maaned) var saalydende:

"Rederiet bortforpagter herved Dampskibet "Vøringen" til Brug for Atlanterhavs-Expeditionen og leverer Skibet i Bergen omkring den 15de April, saafremt ikke Havari derfor er til Hinder. I dette Tilfælde skal Rederiet, saa snart ske kan, indsende Underretning til Departementet. Dersom Expeditionens Chef ikke anser det rimeligt, at Skibet vil kunne leveres senest de første Dage af Maj, er han berettiget til at anse nærværende Kontrakt som hævet. Skibet afleveres igjen i Slutningen af August eller Begyndelsen af September, saafremt intet uforudseet Tilfælde indtræffer.

Skibet leveres hægt og tæt, doksat, rengjort og malet, Maskinen efterseet og i fuld Orden, udstyret med Topsejl paa begge Master og dertil hørende Rig, samt forsynet med tilstrækkelig Ballast.

Rederiet tillader Skibets Indredning og Udbedring igjen efter endt Togt, overensstemmende med de af Hrr. Brunchorst & Dekke leverede Planer.

Det kongelige Departement vedtager at have befragtet "Vøringen" for ovennævnte Tidsrum paa ovennævnte Betingelser, samt at betale i Fragt 1000 Spd. pr. Maaned fra den Dag, Skibet afleveres til Indredningens Paabegyndelse, indtil det igjen tilbageleveres i Bergen i ryddiggjort og udbedret Stand. Maaneden regnes fra Dato til Dato og for overskydende Dage regnes 33 Spd. 40 Skill. pr. Dag. Betalingen erlægges ved hver Befragtningsmaaneds Udløb.

Skibet gaar for Rederiets Risico. Som Følge heraf ophører Lejen i Tilfælde af totalt Forlis eller af saadant Havari, hvis Reparation af Expeditionens Chef antages at ville medtage saa lang Tid, at Expeditionen ikke mere med Nytte kan fortsættes det Aar.

Ved totalt Forlis ophører Lejen strax. Er totalt Forlis ikke bevisligt, men Fartøjet udebliver, betales Lejen vedvarende, dog ikke længere end 10 Uger fra den Tid, da seneste Efterretninger indløb.

I Tilfælde af saadant Havari, som nævnt, har Expeditionens Chef, naar han kommer i Havn, derom at underrette Rederiet, med Opfordring til dette om ufortøvet at modtage Fartøjet. Leje betales i dette Tilfælde i en Maaned fra den Dag, Underretningen er givet, dog under

of tenders received was 11, one from Swedish owners. An Order in Council, bearing date December the 23rd, 1875, confirmed the selection of the steamship "Vøringen," of Bergen, a vessel strongly built, and, on the whole, well adapted for the requirements of the Expedition; moreover, her owners, whose offer was the lowest, had at once agreed to the stipulated conditions respecting equipment, &c.

The Contract between the Home Department and the owners of the "Vøringen," which, with the exception of a clause raising the hire to Spd. 1100 per month, was renewed in the same form for each of the following cruises (in. 1877 and 1878), ran as follows: —

"The owners of the S. S. "Vøringen" do hereby agree to let that vessel for the use of the North-Atlantic Expedition, and undertake to deliver her in the port af Bergen on, or about, the 15th of April, unless she have sustained damage, in which case her owners shall forthwith send notice to the Home Department. Should the Naval Director of the Expedition feel convinced that the vessel cannot be got ready by the first week in May, he shall be at liberty to cancel this Contract. The vessel to be given up to the owners at the end of August, or the beginning of September, no unforseen event intervening.

"The vessel to be delivered in warrantable condition, docked, careened, and painted, with her engines examined and in perfect working order; moreover, she shall be rigged with a top-sail to each mast, and have sufficient ballast.

"The owners agree to the ship being fitted up and repaired at the end of the cruise conformably to the plans furnished by Messrs. Brunchorst and Dekke.

"The Home Department of His. Majesty's Government doth hereby acknowledge to have chartered the S. S. "Vøringen" for the aforesaid term and on the aforesaid conditions, at the rate of Spd. 1000 per month, from the day on which the ship is delivered in Bergen to the deputed agent of the Government to the day on which she is given up, put in order and repaired, to the owners in Bergen. For every day over and above a full calender month shall be paid 33 Spd. 40 Skill. The freight to fall due at the expiration of each month of the term for which the vessel is chartered.

"The ship to sail at the owners' risk. Hence all payment of freight shall cease in the event of total loss, or of the vessel sustaining such damage that the repairs thereby entailed, in the opinion of the Naval Director of the Expedition, cannot be completed sufficiently soon to admit of continuing the cruise with advantage.

"Total loss cancels the contract at once. But should total loss not admit of proof, from the absence of the vessel, the freight shall continue to be paid, though not for longer than 10 weeks from the date at which intelligence of the vessel was last received.

"In the event of the ship sustaining damage as aforesaid, the Naval Director of the Expedition shall, on his arrival in port, communicate with the owners, desiring them to take charge of the vessel forthwith. In such case the liability for freight to extend one calender month from the

ingen Omstændigheder længere end til 7de September."

Ved kongelig Resolution af 5te Februar 1876 blev det overdraget følgende Videnskabsmænd at deltage i Expeditionen: Professor i Meteorologien *H. Mohn,* Professor i Zoologi *G. O. Sars,* Overlæge ved Lungegaardshospitalet i Bergen Dr. med. *D. C. Danielssen,* Kjøbmand i Bergen *Herman Friele* og Stud. real. *S. M. Svendsen.* Som Chef for Expeditionens Skib antoges ved samme Resolution Captein *C. Wille,* der tillige skulde overtage Udførelsen af de videnskabelige Iagttagelser, som vare forudsatte fremmede ved Expeditionen og som ikke specielt maatte gaa ind under nogen af de øvrige ved Expeditionen ansatte Videnskabsmænds Omraade. Som Tegner blev senere antaget Landskabsmaler *F. Schiertz.*

Efter Opmaalingsdirectionens Foranstaltning besørgede Capt. Wille Anskaffelsen af de til Expeditionen fornødne Instrumenter og Apparater samt Skibets Indredning og Udrustning.

For Expeditionens videnskabelige Medlemmer blev givet af Opmaalingsdirectionen følgende af Departementet for det Indre approberede Instrux, der var gjældende for hvert af de tre Aar 1876, 1877 og 1878.

§ 1.

Den for Expeditionen approberede Plan søges udført, saavidt Vejrforhold eller andre uforudseede Omstændigheder ikke er ivejen derfor. Afgjørelsen af hvorvidt Vejrforhold eller Skibets Tilstand maatte træde hindrende ivejen, tilligger Fartøjets Chef.

§ 2.

Planens Udførelse i det enkelte sker efter Samraad og Afstemning af Expeditionens videnskabelige Medlemmer, til hvilke ogsaa Fartøjets Chef hører.

Afgjørelsen sker efter simpel Pluralitet.

De videnskabelige Medlemmer vælge sig imellem en Formand, hvis Stemme i Tilfælde af Stemmelighed gjør Udslaget.

§ 3.

Skulde den under Rejsen gjorte Erfaring gjøre det sandsynligt, at Afvigelser fra den lagte Plan i højere Grad vilde ramme Expeditionens Formaal, kunne saadanne foretages, naar samtlige videnskabelige Medlemmer derom ere enige.

§ 4.

Chefen for Expeditionsskibet har at sørge for, at dette er hensigtsmæssigt udrustet og forsynet med de for Expeditionens Øjemed nødvendige Apparater, samt at de Rejser og Manøvrer blive udførte, der udfordres til Opnaaelse af Expeditionens Formaal.

§ 5.

Naar Havn anløbes meddeler Skibschefen Bestyrelsen fornøden Underretning om Expeditionens Fremgang, ligesom han ogsaa aflægger samlet Rapport efter endt Togt. Efter Expeditionens Afslutning indsendes fra dens viden-

day on which the intelligence was received, but not longer than the 7th of September."

By an Order in Council, bearing date February the 5th, 1876, the following gentlemen were appointed members of the Scientific Staff: — *H. Mohn,* Professor of Meteorology; *G. O. Sars,* Professor of Zoology; *D. C. Danielssen,* M. D., physician to Lungegaard's Hospital in Bergen; *Herman Friele Esq.,* merchant in the city of Bergen; and *S. M. Svendsen,* undergraduate of the University of Christiania. By the same Order, Capt. *C. Wille,* R. N., was appointed to command the vessel chartered for the Expedition, and to institute such scientific observations as there would, it was believed, be found facilities for taking, but which did not strictly come within the province of any member of the Civilian Scientific Staff. Subsequently, the services of *F. Schiertz,* artist, were also engaged.

At the instance of the Directors of the Geographical Survey, Capt. Wille procured for the Expedition the necessary instruments and apparatus, and superintended the general fitting-out of the vessel.

For the guidance of the Scientific Staff on board, the Directors of the Geographical Survey, with the sanction of the Home Department, issued the following Instructions, which remained in force on the three cruises of the Expedition, in 1876, 1877, and 1878.

§ 1.

The Scheme approved for the Expedition shall be strictly adhered to, unless bad weather, or some unforseen interfering cause, prevent its being carried out. It rests with the Captain to pronounce on the state of the weather and of the ship.

§ 2.

Previous to execution, all the details of the Scheme shall be discussed and put to the vote by the Scientific Staff on board, of which the Captain of the vessel is a member.

The decision of the majority to be final.

The Scientific Staff shall from among their number elect a chairman, who has the casting vote.

§ 3.

If, during the progress of the cruise, very considerable deviation from the Scheme approved for the Expedition be found advisable, such deviation is permitted, all the members of the Scientific Staff consenting thereto.

§ 4.

On the Captain of the vessel shall devolve the duty of fitting her out, and of furnishing her with the necessary apparatus, as also of navigating and working her in a manner calculated to attain the object of the Expedition.

§ 5.

From every port at which the vessel may touch, the Captain shall advise the Directors of the Geographical Survey of the progress of the Expedition; and after his return he has to report generally on the cruise. The Expedition

skabelige Medlemmer en Generalberetning til Bestyrelsen.

§ 6.

De Samlinger af videnskabelige Iagttagelser og Naturalier, som Expeditionen tilvejebringer, forblive denne tilhørende, indtil de efter Bestemmelse af Expeditionens videnskabelige Medlemmer ere bearbejdede. Publikationen af de gjorte Iagttagelser samt deres Resultater og Fordelingen af de indsamlede Naturalier bestemmes af Bestyrelsen efter Forslag af de videnskabelige Medlemmer.

For hvert Aars Togt udarbejdedes af Expeditionens Medlemmer i Forbindelse med Opmaalingsdirectionen (General Grïnsgaard, Fyrdirektør Diriks og Professor Mohn) en Arbejdsplan, der indsendtes til Departementet for det Indre til Approbation.

1876.

Den for dette Aar approberede Plan var følgende:

Saasnart Expeditionsfartøjet i Bergen har modtaget sin fulde Udrustning og de Instrumenter og Apparater, der skulle have sin Plads ombord, ere anbragte, kunne de Iagttagelser begynde, der ere nødvendige for Bestemmelsen af de forskjellige magnetiske Constanter ved Skibet og de respective Instrumenter.

Da saadanne Iagttagelser bør foretages paa et Sted, der er saavidt muligt frit for den saakaldte magnetiske Localattraction, og da Erfaringen fra "Hansteens" Togt i 1875 har vist, at man ikke kan gjøre Regning paa at blive fri for denne Virkning, førend man kommer ud paa de yderste Øer og Skjær paa Kysten, ville de nævnte Iagttagelser ikke kunne udføres med Fordel i Bergen.

Af Resultaterne af "Hansteens" Togt i 1875 fremgaar det, at Øerne Utvær, og navnlig Husø ved Sognefjordens Munding har den forønskede Frihed for Localattraction. Paa dette Sted ville derfor de forberedende magnetiske Iagttagelser antagelig bedst blive at udføre. Hvor lang Tid disse Iagttagelser ville tage, beror paa Vejrforholdene, navnlig fordi der til enkelte af dem kræves Sol til en bestemt Dagstid.

Da en Flerhed af de Instrumenter og Apparater, hvormed Expeditionen vil have at arbejde, paa denne komme til Anvendelse under Forhold, der paa Grund af Foretagendets større Maalestok og Udrustningens større Fuldstændighed ere Expeditionens Deltagere delvis nye, og da Mandskabet trænger til Opøvelse i de for de videnskabelige Operationer nødvendige Manøvrer, ansees det for mest hensigtsmæssigt og i Længden mest tidsbesparende at foretage foreløbige Forsøg til Øvelse med samtlige de under Expeditionen benyttende Apparater.

En udmerket Lejlighed til den første Prøve, der tillader Operationerne at foregaa i smult Vand paa samme

ended, the members of the Scientific Staff shall send in a General Report to the Managing Committee.

§ 6.

The observations instituted and natural objects collected shall belong to the Expedition till such time as, with the approbation of the Scientific Staff, they have been duly worked out and described. The publication of the observations and their results, and the distribution of the natural objects, to devolve on the Directors of the Geographical Survey, and to be in accordance with the proposition of the Scientific Staff.

For each cruise the members of the Scientific Staff, in conjunction with the Directors of the Geographical Survey (General Grimsgaard, F. Diriks, Director of Lighthouses, and Professor Mohn), drew up a Scheme of Work, which was laid before the Home Department for approval.

1876.

The Scheme approved for this year was as follows: —

When the vessel selected for the Expedition, now lying in the port of Bergen, has been fully equipped, and the instruments and apparatus with which she is to be furnished have been arranged on board, the observations necessary to determine the magnetic constants for the ship and the respective instruments may forthwith commence.

As such observations should be taken in a spot as nearly as possible free from the so-called magnetic local attraction, and the cruise of the "Hansteen" in 1875 having shown that this disturbing influence does not cease to be felt at a less distance from the coast than the outermost islands and skerries, the said observations cannot give satisfactory results if made in Bergen.

From observations instituted on the cruise of the "Hansteen" in 1875, it appears that the islands of Utvær, and more especially the island of Husø at the entrance to the Sognefjord, are well nigh uninfluenced by local attraction. On the latter island, therefore, it will be best to undertake the preliminary magnetic observations. What time will be required to complete these observations, must depend on the state of the weather, particularly since sunshine at a certain hour of the day is indispensable for some of them.

As very many of the instruments and appliances necessary for the Expedition, will have to be used under conditions which, by reason of the comparatively extensive scale whereon the Expedition has been planned, and the relative completeness of equipment, are in several respects new to the members of the Expedition; and the crew needing practice for the work connected with the scientific operations, it is deemed advisable, and will in the long run be the surest means of saving time, to make preliminary excursions, or trial-trips, with a view to acquire experience in handling the apparatus.

An excellent locality to begin with, that would admit of carrying on the operations both in smooth water and

Tid som den Dybde, paa hvilken der kan opereres, er betydelig, frembyder Sognefjorden, der i sin ydre Del, udenfor Ladvik, er over 660 Favne dyb.

Til Udførelsen af den Plan, i denne Del af Sognefjorden at foretage de første forløbige Arbejder, knytter sig den Interesse, som Undersøgelsen af Forholdene i Sognefjorden har, navnlig i zoologisk Henseende, i hvilken Retning Fjorden endnu er meget lidet undersøgt. Som bekjendt danner Sognefjorden ved sin ringe Dybde i Mundingen et fra Havet temmelig afsluttet Dybbassin.

Da der mellem det paapegede Punkt af Sognefjorden og Utvær kun er liden Afstand, vil man, naar Vejrforholdene falde ugunstige for de magnetiske Observationer paa dette Sted, med Lethed kunne benytte Tiden til Øvelserne i Sognefjorden og saaledes kunne gjøre Regning paa at faa begge disse forberedende Arbejder udførte i en rimelig Tid.

Efterat man saaledes har vundet det fornødne Kjendskab til Apparaterne og Øvelse i Brugen af dem i smult Vand, kræves, at man vinder Erfaring i deres Anvendelse paa Søen, i mindre roligt Vejr. De hertil fornødne Øvelser antages at kunne, paa den mest frugtbringende Maade, forenes med Udførelsen af Expeditionens egentlige Øjemed, ved følgende Ordning af Arbejdet.

Den dybe Rende, der ligger udenfor den norske Kyst fra Skagerak til Stat, fjerner sig her fra Kysten og synes at udmunde i Ishavsdybet. Der foreligger imidlertid Temperaturiagttagelser, der tyde hen paa Muligheden af, at Renden grunder op eller lukker sig. Undersøgelsen af dette Punkt vil derfor udgjøre en passende Gjenstand for Expeditionens Begyndelsesarbejder. Ved at følge Rendens Bund fra Sognefjorden af nordover og undersøge dens Forhold udenfor Stat og Romsdalskysten har man Fordelen af at være paa Søen i et Farvand, hvor Naturforholdene tilstede Apparaternes Anvendelse i forskjellige Retninger og hvor Undersøgelsernes Resultater ville blive baade instructive for Iagttagerne og oplysende for Videnskaben, og hvor man ikke er længere fra Land, end at man med Lethed vil kunne søge dette, for at iverksætte mulige Udbedringer eller ønskelige Forbedringer af Apparaterne, som Erfaring maatte vise det hensigtsmæssigt at foretage, førend man tiltræder Rejsen til fjernere Egne.

Efterat man saaledes havde vundet Erfaring i Søen og faaet undersøgt det Parti af de norske Kystbanker, hvorpaa Expeditionens videre Undersøgelser maa støtte sig, maatte man, forat komplettere Udrustningen for et længere Togt, anløbe en større Havn, f. Ex. Kristiansund. Her skulde Fartøjet blive at forsyne med komplet Udrustning af Kul og Vand, Kronometernes Stand og Gang bestemmes og mulige Udbedringer ved Apparaterne foretages.

Naar Expeditionen saaledes er i fuldt udrustet Stand (antagelig omkring St. Hanstider), kunne dens Arbejder

at a considerable depth, is the Sognefjord, which in its outer part, off Ladvik, is 660 fathoms deep.

Moreover, the selection of the Sognefjord as the tract wherein to commence the preliminary work of the Expedition, would afford a desirable opportunity of scientifically exploring that region, which has hitherto been but little investigated, in particular as regards its fauna. The Sognefjord constitutes, by reason of remarkable shallowness at its mouth, a deep basin well nigh cut off from the ocean without.

The distance between the above-mentioned point of the Sognefjord and Utvær being comparatively short, when the weather did not admit of continuing the magnetic observations in the latter locality, the time might be advantageously employed in the Sognefjord, and there would thus be a fair prospect of completing both parts of the preliminary work within a reasonable period.

Knowledge of the apparatus, and the requisite familiarity with their use in smooth water, having been thus attained, the next step will be to acquire experience of their application at sea in comparatively rough weather. The practice necessary for this purpose may, it is believed, be easily combined with the main object of the Expedition by conducting the work as follows: —

The deep channel extending along the shores of Norway from the Skagerak to Stat, leaves the coast in this locality, and would appear to disembogue into the depths of the Arctic Ocean. Perhaps, however, inferring from certain temperature-observations, the channel gradually shoals or closes. The clearing up of this question will form a fitting subject for the opening work of the Expedition. By following the channel from the Sognefjord northwards, and investigating its conditions off Stat and the coast of Romsdalen, the Expedition will secure the advantage of cruising in a tract of ocean which admits of a manifold use of the apparatus, and where the results of the investigation must prove alike instructive to the observers themselves and specially promotive of the interests of science; moreover, the distance from land being comparatively short, it will, if necessary, be easy to run in shore, for the purpose of repairing the apparatus, in case of accident, or of effecting such alterations in their construction as may be found desirable, before proceeding to more distant regions.

Having thus acquired experience in the use of the apparatus at sea, and investigated that portion of the Norwegian coastal banks on which the Expedition must base its subsequent operations, it will be necessary to touch at one of the larger ports, for instance Christiansund, and there complete the equipment of the vessel, — viz. by taking in a full supply of coal and water, examining the chronometers, repairing, if damaged, the apparatus, and effecting any improvements in their construction that experience may suggest.

Then, — so soon as the vessel shall in such wise have been fully equipped for the cruise (about the end of June), the work

fortsættes med Afslutningen af Undersøgelserne af Bankerne udenfor Romdalskysten henimod Shetland.

Fra dette Felt kommer man videre vestover til den dybe Rende mellem Shetland og Færøerne, der, navnlig i dens sydvestre Del, har været Gjenstand for "Porcupine"-Expeditionens Undersøgelser. Dens nordøstre Del vil det blive den norske Expeditions Opgave at undersøge nærmere og studere dens Overgang til det kolde Ishavsdyb. Paa denne Strækning ville Iagttagelser af Strømforholdene samt Undersøgelse af Havvandets Beskaffenhed i de forskjellige Dybder, til hvilke Forholds Undersøgelse den norske Expedition antagelig vil være bedre udrustet end den nævnte Britiske, kunne blive af fundamental Betydning for Havstrømmenes Theori.

En Betingelse for Held er imidlertid roligt Vejr.

Efter Afslutningen af Undersøgelsen af Færø-Shetland Renden, vil det af flere Grunde, der nedenfor ere nævnte, være hensigtsmæssigt, at man anløber Thorshavn paa Færøerne, for at forberede sig til Undersøgelsen af Strækningen mellem Færøerne og Island.

Undersøgelserne paa denne Strækning ville omfatte Forholdene ved Overgangen fra det forholdsvis grunde Hav mellem Færøerne og Island, der endnu tilhører Atlanterhavet, til det kolde Ishavsdyb, der ligger østenfor. Her kommer Expeditionen til at arbejde paa et saagodtsom i alle Henseender aldeles nyt Felt, hvad der ogsaa gjælder de følgende Strækninger.

Paa Island er det nødvendigt at foretage lignende magnetiske Iagttagelser som dem, der ere tænkte udførte paa Utvær. Antagelig vil Reykjaviks Havn i denne Henseende frembyde en bekvem Lejlighed.

Mellem Kap Farvel og Island er der i sidste Sommer af Chefen for den britiske Fregat "Valorous," Captein Jones, udført en Række Iagttagelser af Dybtemperatur i Forbindelse med Bundskrabninger. Denne Række udfylder paa en efter Omstændighederne tilfredsstillende Maade Overgangen mellem de tidligere undersøgte Dele af Atlanterhavet og den Linie, der — som dannende Overgangen fra Atlanterhavet til vort arktiske Havbassin — maa blive at sætte som den vestlige Grændse for den norske Expeditions Undersøgelsesfelt, nemlig Linien gjennem de Stræder og Havstrækninger, der adskille Shetlandsøerne, Færøerne, Island og Grønland.

For at fuldstændiggjøre Undersøgelserne paa denne Linie bliver det den norske Expeditions Opgave at forsøge undersøgt Strækningen mellem Island og Grønland, en Opgave, hvis Løsnings Vigtighed Dr. Carpenter, en af Deltagerne og Lederne af flere af de britiske Dybhavsexpeditioner, med Styrke har gjort opmerksom paa.

of the Expedition can be continued, by closing the investigation of the banks off the coast of Romsdalen in the direction of the Shetland Islands.

Westwards from this tract extends the deep channel between the Shetlands and the Færoe Islands, which — in particular its south-westerly portion — was explored on the "Porcupine" Expedition. The north-eastern part, together with the how and where this channel passes into the depths of the Arctic Ocean, will be made a subject of special investigation by the Norwegian Expedition. Observations on the direction and rate of the currents throughout this section of the channel, and on the chemical constituents of the water at different depths, which the Norwegian Expedition, from the character of its equipment, will, it is believed, have greater facilities for instituting than had the above-mentioned British Expedition with the "Porcupine," may prove of fundamental importance in elucidating the theory of ocean currents.

Meanwhile, a *sine quâ non* for achieving success is favourable weather.

After terminating the investigation of the Færoe-Shetland channel, it will, for divers reasons, specified below, be advisable to touch at Thorshavn on the Færoe Islands, previous to exploring the ocean-tract between the Færoe Islands and Iceland.

In this locality, the Expedition will investigate the nature of the transition from the comparatively shallow sea (part of the Atlantic) between the Færoe Islands and Iceland to the depths of the Arctic Ocean, stretching eastwards. Here, the exploratory work will be in a field essentially new, which also applies to the succeeding tracts.

In Iceland, magnetical observations must be instituted similar to those the Expedition will take at Utvær. For this purpose, the port of Reykjavik is believed to be a convenient locality.

Last summer a series of deep-sea temperatures, in connexion with dredgings, were taken by Loftus Jones, captain of the British frigate "Valorous," between Cape Farewell and Ireland. These observations have, as far as circumstances would permit, contributed greatly to our knowledge of the part of the Ocean lying between the sections of the Atlantic previously investigated and the line which — constituting as it does the boundary between the Atlantic and the basin of the Arctic Ocean — must be regarded as the western limit of the region it is the object of the Norwegian Expedition to explore, viz. the line passing through the straits and tracts of ocean that extend between the Shetlands, the Færoe Islands, Iceland, and Greenland.

With a view to render the investigation along this boundary-line as complete as possible, the Norwegian Expedition will endeavour to explore the tract between Iceland and Greenland, — a problem to the importance of which Dr. Carpenter, member and co-director of several of the British deep-sea Expeditions, has repeatedly drawn attention.

Det er ikke sandsynligt, at Isforholdene skulde lægge den norske Expedition Hindringer ivejen for Udførelsen af denne Undersøgelse, og heller ikke for dens Fortsættelse paa Strøget nordenom Island. Ved at denne Vej følges, banes en vigtig Overgang til det egentlige Ishavsdyb, som dernæst maatte blive at gjennemskjære med et Snit fra et Punkt i nordost for Island til et Punkt paa Norges Kyst nordenfor Trondhjem. Paa denne sidste Del af Rejsen ville sandsynligvis alle Ishavsdybets vigtigste Naturforhold komme tilsyne i Iagttagelserne.

Med gunstige Vejrforhold vil den ovennævnte Del af Expeditionens Plan muligens kunne blive udført i en saavidt kort Tid, at der efter Tilbagekomsten til Norge endnu bliver Anledning til videre Undersøgelser. Om disse da bør rettes paa en Linie tvers over Ishavet mod Jan Mayen eller paa Overgangen mellem Bankerne foran Nordlands Kyst og Ishavsdybet, vil bedst den indtil da vundne Erfaring og Hensyn til den tilbagestaaende Arbejdstid kunne afgjøre.

Bestyreren af det danske meteorologiske Institut, der har Stationer i Torshavn paa Færøerne, og paa Island i Berufjord og Papey paa Sydostsiden, i Reykjavik og Stykkisholm paa Vestsiden samt i Akureyri og paa Grimsey paa Nordsiden, har anmodet Bestyreren af det norske meteorologiske Institut om under Expeditionen at inspicere de af disse Stationer, hvortil der maatte blive Anledning. Da de nævnte Stationer ere erkjendte for at være af fundamental Betydning for hele Europas og ikke mindst for Norges Meteorologi, vil Expeditionen kunne yde denne Videnskab, hvis Fremme ligger indenfor dens Arbejders Kreds, en ganske væsentlig Tjeneste ved at imødekomme det af det danske Instituts Bestyrer fremsatte Ønske. Stationerne ligge lige i den Vej, som Expeditionsskibet efter denne Plan vil komme til at følge og ville afgive de mest passende Stoppepladse til Indtagelse af Forsyninger, til Verification af Kronometrene og de magnetiske Instrumenter, til Udførelse af Arbejder ombord, der kræve hurtigere Fremme og vanskelig kunne udføres i Søen, til Undersøgelse af Naturforholdene paa Kysten, til Tilflugtssteder under Vejrforhold, der umuliggjøre Arbejde i Søen m. v.

De Undersøgelser, der ville blive Gjenstand for Expeditionens Arbejder, ere i det væsentlige følgende:

1. *Lodninger* til Bestemmelse af Havbundens Configuration. Under disse komme Samling af Prøver af Bundens Materiale samt flere af de Operationer, der tjene til Grundlag for de nedenfor nævnte Undersøgelser.
2. Bestemmelse af *Strømmens* Retning og Hastighed. Overfladestrømmens Retning og Hastighed søges be-

That the Expedition will meet with impediments from ice, either in this region or in the tract north of Iceland, there is little reason to apprehend. This course will lead by a direct transit-passage to the depths of the Arctic Ocean, which have then to be traversed from a point north-east of Iceland to a point on the Norwegian coast north of Throndhjem. The observations taken on this, the latter part of the passage, will in all probability disclose the most important of the conditions distinguishing the depths of the Arctic Ocean.

Provided the weather be favourable, the Expedition will possibly get through this part of the Scheme and return to Norway in time for further operations. Whether, in that case, it will be best to conduct the investigation along a line traversing the Polar Sea in the direction of Jan Mayen, or in the tract extending between the banks off the coast of Nordland and the depths of the Arctic Ocean, must depend on the nature of the experience till then acquired, and on the time that may yet remain available for continuing the cruise.

The Director of the Danish Meteorological Institute, which has Stations on the Færoe Islands (Thorshavn) and in Iceland (south-east coast: Berufjord and Papey; west coast: Reykjavik and Stykkisholm; north coast: Akureyri and Grimsey), deems it highly desirable that the Director of the Norwegian Meteorological Institute should inspect such of those Stations as the Expedition may furnish opportunity of visiting. Now, the said Stations are acknowledged to be of fundamental importance to the meteorology of Europe, — and not least to that of Norway, — wherefore the Expedition could very materially promote that science by acceding to the request preferred by the Director of the Danish Institute to the Director of the Norwegian. Moreover, the Stations lie one and all in the route the Expedition will take pursuant to the Scheme of Work; they are excellently adapted for stopping-places, at which to provision the ship, verify the chronometers and the magnetic instruments, do work on board that does not admit of delay, or can with difficulty be accomplished at sea, investigate physical and other conditions on the coast, &c. &c.: and finally, they would serve as harbours in stress of weather, when all work at sea was impracticable.

The following is a General Specification of the objects which the Expedition will seek to carry out: —

1. To determine by *soundings* the contour of the sea-bed. When taking them, samples of the bottom will be simultaneously collected, and divers of the operations performed necessary to serve as a basis for the work specified below.
2. To determine the direction and rate of *currents*. The direction and rate of surface-currents will be

stemt dels ved hvert Lodskud, dels ved de sædvanlige nautiske Methoder. Undersøgelsen af Strømmen i Dybet, vil udkræve særskilte Methoder og kun lade sig udføre under gunstige Omstændigheder. Disse sidste Undersøgelser maa i Regelen forbeholdes enkelte Punkter, hvor de ere af fundamental Betydning, som Færø-Shetland-Renden, Færø-Island-Flakket, Island-Grønland-Strædet og det kolde Ishavsdyb samt Norges Banker.

3. Bestemmelse af *Havets Temperatur* i Overfladen falder nærmest ind under de meteorologiske Iagttagelser. Dybets Temperatur ved Bunden bestemmes ved hvert Lodskud. Under gunstige Omstændigheder og paa saa mange Punkter, det maa ansees at være af Interesse, tages Rækker af Temperaturiagttagelser i forskjellige Dybder fra Overfladen til Bunden med de forskjellige Instrumenter, som Expeditionen hertil disponerer over.
4. Undersøgelse af *Havvandets fysiske* og *chemiske* Forhold: Specifisk-Vægt-Bestemmelse med Areometer, Saltholdighed (Chlormængde) ved Titrering, Luftmængde og Kulsyremængde ved Udkogning. De yderlig fornødne Analyser af de opsamlede Gasarter samt af større Prøver af Havvand, som medtages fra Steder, hvor Forholdene ere typiske, maa udføres i Laboratoriet efter Expeditionens Slutning. Ved de fleste Lodskud tages Vandprøver fra Havbunden til Bestemmelse af specifisk Vægt og Saltholdighed. Paa særegne Steder tages en Række Prøver af Vand fra forskjellige Dybder til Undersøgelse i forskjellige Retninger, dels ombord, dels senere.

5. *Zoologiske* Undersøgelser. Indsamling af Havdyr med de dertil bestemte Apparater, deres foreløbige Undersøgelse og Gruppering, deres Præparation og Opbevaring. Indsamling af Specimina af Dyreriget forøvrigt efter Lejligheden. Ved de for disse Undersøgelser nødvendige Operationer vindes ogsaa Prøver af Havbundens Materiale til Opbevaring.

6. *Botaniske* Undersøgelser: Indsamling af Specimina af Planteriget, deres Præparation og Opbevaring til videre Undersøgelse.
7. *Meteorologiske* Iagttagelser. Stadig fortsatte Iagttagelser af Barometer, Psychrometer, Vindens Retning, Styrke og Hastighed, Skyernes Mængde, Form og Bevægelse, Søgang, Nedbør m. m. Forsøg med Hygrometer til Control for Psychrometret, med Regnmaaler og Fordunstningsmaaler, med Thermometre paa forskjellige Steder og i forskjellige Højder. Maaling af Havvandets Temperatur og specifiske Vægt i Overfladen.

determined partly by the operation of sounding, and partly by the usual nautical methods. For investigating deep-sea currents, recourse must be had to special methods, practicable only under favourable circumstances. Such investigations must therefore, as a rule, be confined to a few localities in which they will be of fundamental importance, viz. the Færoe-Shetland channel, the Færoe-Iceland flat, the channel between Iceland and Greenland, the cold area of the Arctic Ocean, and the banks off the coast of Norway.

3. To determine the *Surface-temperature of the Sea,* which comes strictly within the meteorological observations. The bottom-temperature will be determined with every sounding. Under favourable circumstances, serial temperature observations will be taken, in as many localities as may be deemed desirable, at different depths, from the surface to the bottom, with the various instruments provided for the purpose.

4. To investigate the *Physical Conditions* and *Chemical Constituents* of the sea-water. This will comprise: specific gravity determinations with the areometer; salt-determinations (amount of chlorine) by titration; air and carbonic acid determinations by the boiling-process. All further analyses of gases collected on the Expedition, as also of large samples of sea-water from localities characterised by typical conditions, must be made in the Laboratory after the return of the Expedition to Norway. When soundings are taken, samples of bottom-water will be generally collected, for determining the specific gravity and the amount of salt. At certain stations, samples of water will be collected from different depths, for examination either on board or at a subsequent date.
5. *Zoological* Work, comprising the collection of marine animals, with the apparatus provided for the purpose, their preliminary examination and classification, preparing and preserving them on board, and the occasional collection of other specimens of the animal kingdom. When conducting the operations for capturing marine animals, samples of the bottom will also be collected.
6. *Botanical* Work, comprising the collection of specimens of the vegetable kingdom, and preserving them for subsequent examination.
7. *Meteorological* Observations, comprising regular readings of the barometer and psychrometer; observations of the force, direction, and velocity of the wind, the form, amount, and motion of clouds, the state of the sea, precipitation, &c., &c.; experiments with the hygrometer, to control the psychrometer, with the rainguage, and with thermometers in different localities and at different heights above the level of the sea; determinations of the temperature of the sea and of the specific gravity of the water at the surface.

8. *Magnetiske* Iagttagelser. Daglige — om Vejret tillader det — Bestemmelser af Misvisningen, Inclination og Intensitet. Observationernes Beregning saavidt ske kan. Observationer paa Land- (Basis-)Stationer til Bestemmelse af de nødvendige magnetiske Konstanter.
9. Lejlighedsvise Iagttagelser, hvortil Tid og Sted maatte give Anledning, saasom hydrografiske Undersøgelser, astronomisk-geografiske Stedbestemmelser, geologiske Iagttagelser m. m.

8. *Magnetical* Observations (taken daily, weather permitting), to determine declination, inclination, and intensity, so far as practicable; with computation of the results. For determining the magnetic constants, observations will be instituted on shore, at base-stations.
9. Occasional observations, for which time and place may furnish opportunity, such as hydrographical observations, observations of latitude and longitude, geological observations, &c. &c.

Den 14de April blev Dampskibet "Vøringen" i Bergen overtaget for Expeditionens Regning, og det overdroges D'Hrr. Brunchorst & Dekke at udføre Forandringerne og Indredningsarbejderne efter den vedtagne Plan. Mod Slutningen af Maj Maaned var disse færdige og samtlige Apparater saavidt muligt paa Plads, hvorefter Expeditionens Deltagere, Professorerne Mohn og Sars, Dr. Danielssen, Hrr. Friele, Hrr. Svendsen og Landskabsmaler Schiertz embarkerede. Som Skibsofficerer var antagne Premierlieutnant i Marinen *R. M. Petersen* og Skibsfører *J. Grieg*.

On the 14th of April the S.S. "Vøringen," lying in the port of Bergen, was taken in charge for the Expedition, and Messrs. Brunchorst & Dekke commissioned to undertake the necessary alterations &c., in conformity with the approved plan. By the latter end of May the vessel was ready for sea; and all instruments and apparatus having been got on board, and so far as possible arranged, the several members of the Expedition, — Professors Mohn and Sars, Dr. Danielssen, Mr. Friele, Mr. Svendsen, and an artist, Mr. Schiertz, forthwith embarked. The chief officers (exclusive of the captain) were — *R. M. Petersen,* R.N., first lieutenant; *J. Grieg,* merchant-captain.

Om Morgenen den 1ste Juni afgik Expeditionen fra Bergen og sejlede ind i Sognefjorden, hvor den samme Dags Eftermiddag ankrede i Esefjord. Efter nogle Forberedelser foretoges i Fjorden udenfor Esefjord de første Lodninger og Skrabninger til Prøve. Lodningen foregik strax uden Vanskelighed. Ved den første Skrabning havde vi det Uheld, at Skrabetouget sprang, uden synderlig paagaaende Kraft, paa Grund af en Fejl i Sammenslagningen, hvilket var saameget mere uheldigt, som det vakte Tvivl om Tougverkets Godhed. Dette viste sig imidlertid senere udmærket, og den første var den eneste Skrabe, der paa hele Expeditionen gik tabt af denne Aarsag. Den næste Skrabning var ogsaa uden Resultat, da Farten havde været for stor, hvorved Skraben strax løftedes fra Bunden, men hermed var ogsaa den fornødne Erfaring indvunden med Hensyn til denne Manøvre.

On the morning of the 1st of June the Expedition left Bergen, steaming northward for the Sognefjord, which it reached on the afternoon of that day, and cast anchor in the Esefjord, an arm of the above. After a few preparations, the first soundings and dredgings were commenced, off the mouth of the Esefjord. No difficulty whatever attended the former operation; but at the first trial with the dredge, the rope, though not exposed to any considerable strain, unfortunately parted, owing to some defect in the manufacture; which was the more to be regretted, since it gave reason to apprehend that the general quality of the rope-work supplied to the Expedition might prove inferior. Happily, however, it turned out to be excellent, and no other dredge was lost in this manner. The next dredging also proved unsuccessful, from the speed of the vessel, which was too great, causing the dredge to be lifted off the bottom. Meanwhile, sufficient experience had been acquired in the use of the apparatus.

Anden Pintsedag, den 5te Juni, foretoges en Excursion til Bojum-Bræen i Fjærland. Forøvrigt anvendtes Tiden med Klargjøring af Lodde- og Skrabe-Apparaterne og med deres Anvendelse paa Dybet. Den 8de Juni gik vi udover Sognefjorden, tog nogle Lodskud udenfor Bøfjorden, hvor Dybden endnu var 600 Favne og ankrede om Aftenen paa nævnte Sted. Den 9de om Morgenen bestemtes

On Whit Monday, the 5th of June, an excursion was made to the Bojum glacier, in Fjærland. The following days were occupied with getting in order the sounding and dredging apparatus, and working them in deep water. On the 8th of June we steamed out of the Sognefjord, took a few soundings off the Bøfjord, where the depth was still found to be not less than 600 fathoms, and in the

Bundens Opgang fra det store Dyb inde i Sognefjorden til dennes ydre grundere Del og toges et Par Skraber i denne sidste, hvorpaa Expeditionen gik ud til Husø ved Fjordens Munding. Her blev den liggende i 10 Dage, der anvendtes til magnetiske Observationer i Land og til Svingning af Skibet for at bestemme de magnetiske Constanter for Navigationen og for de magnetiske Instrumenter ombord. Til samme Tid toges daglig Skrabninger fra Baad af Zoologerne.

Den 20de Juni gik Expeditionen tilsøs. Vejret, der under Opholdet i Husø havde været noget uroligt blev efterhaanden udmærket. Overensstemmende med Planen begyndte man strax med Bestemmelsen af den langs Kysten løbende dybe Rendes Affald mod Ishavet. Under dette Arbejde fik vi første Gang iskoldt Vand i Dybet om Aftenen den 21de Juni paa 62° 45′ N. Br. og 1° 48′ L. Ø. f. Gr. og ved Skrabningen sammesteds den første *Umbellularia*. Til Middag den 23de arbejdedes Dag og Nat med Lodninger, Skrabninger, Temperaturrækker og Optagning af Vandprøver fra Bund og Overflade. Skibets Vej og de Stationer, hvor der er foretaget Undersøgelser, er afsatte paa det medfølgende Oversigtskart.

Fredag den 23de Juni ankom Vøringen til Kristiansund. Den 24de og 26de anvendtes til at fylde Kul og Vand samt gjøre nogle mindre Anskaffelser. Mandskabet blev forøget med 3 Mand, da Zoologerne tiltrængte mere Assistance end paaregnet, ligesom Arbejdet med Apparaterne viste sig mere anstrængende for Folkene, end man havde tænkt sig.

Tirsdag den 27de Juni afgik Expeditionen atter fra Kristiansund, og ud paa Storeggen, hvor der toges 10 Lodskud og 5 Bundskrabninger, hvorpaa Kursen sattes videre vestover. Den 30te Juni loddedes, trawledes og skrabedes i 525 (eng.) Favne og den 1ste Juli i 587 Favne paa 63° 5′ N. Br., 0° 53′ L. Ø. f. Gr. Lige siden Afgangen fra Husø havde Vejret været særdeles smukt, men den 1ste Juli begyndte den første Storm, og siden holdt Vejret sig usædvanligt ugunstigt lige til den 15de August.[1] Kl. 10 om Aftenen den 1ste Juli var Vindens Hastighed 20 Meter i Sekundet, Vindens Retning SSØ. og Fartøjets Kurs ØSØ, begge retvisende. Bølgernes Højde maaltes til 5—6 Meter. Da Vinden efterhaanden gik om paa SV., lagdes Kursen om Eftermiddagen den 2den Juli mod Vest. Vinden var svagere, men Søgangen hindrede fremdeles vore Arbejder paa Dybet. Den 3die Juli avancerede vi fremdeles langsomt vestover, men uden at kunne bruge Dybhavsapparaterne. Vinden var noget mindre stærk, men Søen fremdeles urolig, Bølgehøjden 3 Meter. Den 4de Juli om Morgenen

[1] Man se "Cartes synoptiques journalières, construites par N. Hoffmeyer, directeur de l'institut météorologique Danois," i hvilke vor Expeditions meteorologiske Iagttagelser er benyttede.

evening ran in shore to anchor. On the morning of the 9th was determined the rise of the bottom from the great inner depths of the Sognefjord to its shallower outer part, where we took one or two hauls of the dredge, and then proceeded on to Husø, at the mouth of the fjord. Here the Expedition remained 10 days, with the object of instituting magnetical observations on shore, and of swinging ship for deviation and determining the constants of the magnetical instruments. During our stay the zoologists dredged the bottom daily from a boat.

On the 20th of June the Expedition put to sea. The weather, which had been somewhat blustering at Husø, now began to moderate, and turned out remarkably fine. Agreeably to the approved plan, we at once proceeded to investigate the deep channel that stretches along the coast, and to explore its slope towards the basin of the Arctic Ocean. Whilst thus engaged, we struck in the depths, for the first time, water of 0° temperature, on the evening of the 21st, lat. 62° 45′ N., long. 1° 48′ E., and a haul of the dredge brought up our first specimen of *Umbellularia*. Till noon of the 23rd, our time was fully occupied with sounding, dredging, taking serial temperatures, and collecting samples of sea-water from the bottom and from the surface. The accompanying Plate shows the track of the ship and the Stations at which any exploring work was done.

On Friday the 23rd of June the "Vøringen" reached Christiansund. Two days — the 24th and the 26th — were passed in taking in coal and water, and otherwise completing the equipment of the vessel. At this port 3 additional hands were shipped, the zoologists needing increased assistance; the working the apparatus ship, too, had proved more laborious than originally anticipated.

On Tuesday the 27th of June the Expedition left Christiansund, and steamed out to the *Storeggen* bank. Here we took a series of 10 soundings and 5 hauls of the dredge, after which the vessel pursued her westward course. On the 30th of June we sounded, trawled, and dredged, in 525 fathoms; and on the 1st of July, in 587 fathoms, lat. 63° 5′ N., long. 0° 53′ E. Since our departure from Husø the weather had been uncommonly fine; but on the 1st of July it blew a heavy gale, and from that date to the 15th of August the weather continued exceptionally foul.[1] On the 1st of July, at 10 p. m., the velocity of the wind was 20 metres a second, its direction (true) SSE., and the course of the vessel (true) ESE.; height of the waves 5—6 metres (18 feet). The wind having gradually veered to the south-west, on the afternoon of the 2nd the ship was given a westward course. The wind had fallen off, but the sea was still too high to admit of deep-sea operations. On the 3rd of July we continued steaming slowly westward, with no possibility however of working

[1] *Vide* "Cartes synoptiques journalières, construites par N. Hoffmeyer, directeur de l'institut météorologique Danois," in which part of our meteorological observations are incorporated.

Kl. 6 var Vejret blevet saavidt roligt, at der kunde tages et Lodskud paa 1081 Favne paa 63° 7′ N. Br. 1° 26′ L. V. f. Gr. og en Skrabe den 5te om Morgenen 10′ nordligere, men en om Aftenen paabegyndt Temperaturrække maatte afbrydes, da Vind og Sø atter tiltog fra Sydøst. Den 6te Juli, med Vind fra Syd af indtil 18 Meters Hastighed pr. Sekund, drev vi langsomt nordover, liggende bi for Styrbords Halser og sagte forover gaaende Maskine, da ved Middagstider en Braadsø kom over, som knuste Rækken, Nedgangskappe og Skylight forud og slog Fordækket lækt. Nu sattes Stevnen mod Søerne og for langsomt gaaende Maskine avanceredes smaat sydover. Den følgende Dags Aften kunde atter dampes med fuld Fart og Kursen sattes nu paa Thorshavn, hvor Expeditionen ankrede om Eftermiddagen den 8de.

Med Assistance fra Land blev her den lidte Søskade udbedret. Vejret var under Opholdet i Thorshavn uroligt, tildels stormende, med en Vindhastighed i Vestenvindsbygerne af over 20 Meter pr. Sekund. Udflugter gjordes af Expeditionens Medlemmer, saavel i zoologisk som i mineralogisk Retning. Paa den ligeoverfor Thorshavn liggende Naalsø samledes en Del Mineraler. Efterat Skibet igjen var sejlklart, gik vi med Vøringen søndenom Strømø til Vestmannahavn paa Øens Vestside for at søge gunstigere Lejlighed til at gaa tilsøs, men vendte den næste Dag, den 16de samme Vej tilbage til Thorshavn, hvorfra vi efter et Par Timers Ophold kunde gaa tilsøs.

Kursen sattes østover ud i Færø-Shetland-Renden og om Natten toges et Lodskud paa 148 Favne, 15 Mil ØNØ. for Naalsø. Næste Morgen toges atter et paa 690 Favne. 30 Mil fra Naalsø i samme Retning. Kulingen var atter tiltaget, saa at der ikke kunde skrabes, og om Eftermiddagen arbejdede Skibet svært i den oprørte Sø. Kursen holdtes NV.¼V. og om Aftenen toges et Lodskud paa 204 Favne, 18 Mil i NØ. for Færøerne. Med VNV.lig Kurs og aftagende Kuling holdtes gaaende til Kl. 8 Form. den 18de, til et Punkt 16 Mil retvisende NNØ. for Færøerne, hvor Dybden fandtes at være 1215 Favne. Her toges Bundskrabninger først med Skrabe og derefter med Trawlnet til om Morgenen den 19de. Samme Dags Aften begyndte den 4de Storm, der varede i noget over 24 Timer. Mod sydvestlig til vestsydvestlig Kuling og svær Sø arbejdedes stadig vestover, i det der den 20de og 21de toges to Lodskud med Temperaturrækker paa Strøget mellem Island og Færøerne. Den 22de om Morgenen bedredes Vejret og vi fik Island i Sigte omtrent ved Portland. Da vi om Aftenen var rukket indtil tvers af Vestmanna-Øerne, fik vi Taage med tiltagende Kuling, og da Barometret viste et raskt Fald, besluttedes det at søge ind under Heima-ey,

the deep-sea apparatus. The violence of the wind had somewhat abated, but there was a heavy sea, the height of the waves being 3 metres (10 feet). On the morning of the 4th, at 6 a.m., the weather was sufficiently moderate to admit of sounding, in 1081 fathoms, lat. 63° 7′ N., long. 1° 26′ W., and on the morning of the 5th we took a haul of the dredge, 10′ farther north; but in the evening it came on to blow again, from the south-east, with a rapidly rising sea, so that a series of temperatures commenced shortly before had to be broken off. On the 6th of July, in a heavy gale from the south, velocity of the wind 18 metres a second, we were drifting slowly north, hove to on the starboard tack, at slow speed, when, about noon, a sea struck the ship on her starboard bow, carrying away the fore bulwark, hatchway, and skylight, and springing the seams of the deck. The vessel was now put head to wind, and we steamed slowly south. By the evening of the following day, we could again run at full speed, and now steered for the harbour of Thorshavn, where the "Vøringen" dropped her anchor on the afternoon of the 8th.

With some assistance from the people of the place, we succeeded in repairing the damage the ship had sustained in the gale. During our stay at Thorshavn the weather was rough and unsettled, at times stormy, the velocity of the wind during the violent westerly squalls reaching 20 metres a second. Divers excursions, zoological and minerological, were made by the members of the Scientific Staff. The island of Nolsø, which lies abreast of Thorshavn, furnished interesting mineral specimens. When the ship was ready for sea, we proceeded, coursing south of Strømø, to Vestmannahavn, on the western shore of the island, there to await a favourable opportunity of continuing the cruise, but next day, the 16th, steamed back to Thorshavn, whence, after an hour or two's stay, we resolved on putting to sea.

Standing east, the "Vøringen" steamed out into the Færoe-Shetland channel, and in the night a sounding was taken, in 148 fathoms, 60 miles east-north-east of Nolsø. Next morning we sounded again, in 690 fathoms, 118 miles from Nolsø, in the same direction. Meanwhile, the violence of the gale had again augmented; dredging was out of the question, and in the afternoon the vessel laboured heavily in the agitated sea. Our course lay NW.¼W., and in the evening we sounded in 204 fathoms, 73 miles north-east of the Færoe Islands. Steering WNW., with the gale abating, we steamed on till the 18th, 8 a.m., and reached a point 65 miles NNE. (true bearing) of the Færoe Islands, where the depth was found to be 1215 fathoms. Here we explored the bottom, first with the dredge and then with the trawl, till the morning of the 19th. On the evening of that day it was again blowing a gale, the fourth we had encountered, which lasted something more than 24 hours. Steaming up against a strong wind, south-west to west-south-west, and a heavy sea, the ship was kept steadily on her westward course. On the 20th and 21st we sounded twice, and took serial temperatures in the tract between Iceland and the Færoe

den største af Vestmanna-Øerne. Dette lykkedes ogsaa trods Taagen, og Vøringen bragtes til Ankers paa Øens Østside udenfor Indløbet til den Bugt, der danner Havn for Handelsstedet, men som er utilgjængelig for større Fartøjer.

Vort Ophold ved Vestmannaøerne blev længere end paaregnet, da det de følgende Dage fremdeles blæste haardt fra Sydvest og gik svær Sø paa Havet. Den 23de gjordes Excursioner i Land, men den 24de blæste det saa haardt, idet Vindhastigheden gik op i 20 Meter pr. Sekund, at vi ikke kunde ligge for vort Anker, men maatte holde det gaaende hele Dagen i Læ af Øen paa den Maade, at Fartøjet drev udover, indtil der hvor Søgangen begyndte, derpaa dampede vi indover igjen til Ankerpladsen, og saa drev vi igjen udover, en Manøvre der i Dagens Løb gjentoges mange Gange. Den 25de kunde der atter gjøres Exkursioner i Land, men først den 26de var Havet blevet saa roligt, at Expeditionen kunde fortsætte sin Rejse. Kl. $3^1/_2$ Eftermiddag passeredes Reykjanes, Kl. $6^1/_2$ Skagen og Kl. 9 ankom Expeditionen til Reykjavik. Her traf vi det danske Stationsskib, Dampskonnerten "Fylla" og de franske Krigsskibe, Dampkorvetten "Dupleix" og Briggen "Beaumanoir," hvis Chefer strax sendte Officerer ombord i Vøringen for at komplimentere, efter almindelig Orlogsskik.

Under Vøringens Ophold i Reykjavik foretog Expeditionens Medlemmer, ledsaget af Næstcommanderende, en Tur til Thingvellir. Vejret vedblev at være yderst uroligt. Allerede Dagen efter vor Ankomst begyndte den 6te Storm og Natten mellem den 28de og 29de Juli laa Vøringen med Dampen oppe og Mandskabet i Søvagt. Desuagtet lykkedes det mig at faa udført absolute magnetiske Bestemmelser i Land, men om at svinge Skibet kunde der ikke blive Tale. Først den 30te om Aftenen blev Vejret saavidt roligt, at Kul- og Vandfyldningen kunde begynde. Den 2den August opdagedes under Opfyringen en Læk paa Kjedlen, hvorfor der atter maatte slukkes af, men det lykkedes Maskinbesætningen ved ihærdigt Arbejde at reparere den saa hurtigt, at Afrejsen kunde finde Sted den næste Dags Aften Kl. 7.

Da Tiden nu var temmelig langt fremskreden, blev den paatænkte Omsejling af Island opgivet, og Tilbageturen lagdes sønden om Island. Den 5te August toges et Lodskud paa 844 Favne paa den sydlige Skraaning af Færø-Islands-Banken. Fra dette Punkt udsejledes til om Aftenen den 7de 240 Kvartmil (60 geogr. Mile) i nordøstlig Retning, hvorunder den sydøstre Islandsbanke blev undersøgt ved Lodskud, Temperaturrækker og Bundskrabninger. Ved den

Islands. On the morning of the 22nd the weather began to abate, and we made Iceland in the vicinity of Portland. By the evening, we had reached a point abreast of the Vestmanna Islands, when a fog came on; the gale, too, had set in again; and this, together with a rapid fall of the barometer, determined us to run for Heima-ey, the largest of Vestmanna Islands, and there ride out the storm. We fortunately succeeded in spite of the fog, and the "Vøringen" let go her anchor on the eastern shore of the island, off the entrance to the bay that forms the harbour of the "town," but which is not accessible to large vessels.

Stress of weather protracted our stay at the Vestmanna Islands. For several days in succession it blew hard from the south-west, and there was a high sea running off the coast. On the 23rd we made excursions about the island, but on the 24th such was the violence of the gale, the velocity of the wind reaching 20 metres a second, that riding at anchor was impossible. The vessel had to be kept going all day long under lee of the land. She was allowed to drift out to where the sea was running high, and then steamed back to her anchorage, a manœuvre which had to be repeated many times in the course of the day. On the 25th we were again able to make excursions on shore; but not till the 26th had the sea gone down sufficiently to admit of continuing the cruise. At 3.30 p.m. we passed Reykjanes; at 6.30, Skagen; and by 9 the Expedition had reached Reykjavik. Here we found the Danish steam-schooner "Fylla," and two vessels belonging to the French navy, — the "Dupleix," steam-corvette, and the brig "Beaumanoir," officers from which were forthwith despatched on board the "Vøringen" to compliment her captain, according to navy-etiquette.

During our stay at Reykjavik, the members of the Scientific Staff, accompanied by the first lieutenant, made an excursion to Thingvellir. The weather still continued very unsettled. On the day after our arrival it again blew a gale, the sixth; and the 28th, after night-fall, the "Vøringen" was lying with the steam up and the sea-watch set. Still, I succeeded in getting absolute magnetical observations on shore; swinging the vessel was out of the question. Not till the evening of the 30th had the weather become sufficiently moderate to allow of our taking in coal and water. On the 2nd of August, when getting up steam, a leak was discovered in one of the boiler-plates, and the fires had to be put out; but, thanks to the engine-men, who worked with a will at repairing the damaged part, we were able to get off on the following day, at 7 o'clock in the evening.

The season being now comparatively far advanced, we had to relinquish our original intention of circumnavigating Iceland, and the homeward course of the "Vøringen" was laid south of the island. On the 5th of August we sounded in 844 fathoms, on the southern slope of the Færoe-Iceland ridge. From this point we stood north-east, exploring, by means of soundings, dredgings, and serial temperatures, the south-eastern section of the Iceland banks,

første Skrabning satte Skraben sig fast i den ujevne, haarde Bund, og efter langvarige Manøvrer for at faa den løs, maatte Touget sprænges. Vejret holdt sig taaget og regnfuldt med sydlig og sydøstlig Bris og uroligt Hav, hvorfor Undersøgelsen af Partiet mellem vor nordligste Station og Langanes, den nordøstlige Pynt af Island, opgaves, og Kursen sattes østover.

Den 8de loddedes og trawledes i 1861 Favne, det største Dyb, vi fandt i 1876, paa 65° 48′ N. Br. 3° 7′ L. V. f. Gr. Kulingen tiltog imidlertid igjen, saaat der sattes igang østover med kun halv Fart, og den næste Dags Eftermiddag blev Stevnen sat op mod Søerne, da Skibet slingrede for voldsomt med Søen tvers. Om Morgenen den 10de August sattes atter Kurs for Station, og Kl. 10 toges Lodskud paa 1539 Favne. Uagtet det var stiv Kuling (Vindhastighed 10 til 16 Meter pr. Sekund) og uroligt Hav, blev dog Bundskrabning udført fra Kl. 11 Form. til Kl. 7 Aften, hvorefter Kursen atter sattes østover, men om Morgenen den 11te maatte Stevnen atter sættes mod Søerne. Den næste Nat sejledes nogle Timer Kurs, og da Station naaedes, toges, uagtet det ugunstige Vejr fremdeles vedvarede med stiv Kuling og høj Sø, Lodskud og Temperaturrække. Da Dybden ikke var mere end 600 Favne, og Rejsen saavidt fremskreden, at et Tab af Apparater var af mindre Betydning, forsøgtes det Experiment at bruge til Bundskrabning Skrabe og Trawl paa en Gang, idet Otertrawlen gjordes fast bag efter Skraben. Experimentet lykkedes ogsaa forsaavidt, at Skraben kom vel ombord igjen, men Trawlen, der ikke hurtigt nok kunde hales ombord i sin hele Længde, blev grebet af Skruen, førend denne kunde standses. Vi satte da Sejl til og holdt undaf Vejret, og med megen Besværlighed, paa Grund af den høje Sø, blev saa meget af Trawlen bortkappet ved Hjelp af Knive og skarpe Spadeblade, fæstede til lange Stager, at Skruen efter et Par Timers Forløb atter kunde sættes i Gang. Kursen sattes nu mod Land, men næste Dag maatte atter Stevnen sættes mod Søerne, indtil en efter Middag erholdt Solhøjde gav Skibets Plads, saaledes at der kundes styres lige mod Halten Fyr, hvis Taarn ogsaa nogle Timer senere viste sig ret forud. Samme Dags Aften bragtes Vøringen til Ankers i Haltens Havn, efter i Løbet af 6 Uger at have udholdt 8 Storme. Den næste Dag, den 14de August, gik Expeditionen til Namsos.

I Namsos laa Expeditionen i 6 Dage, og under dette Ophold blev taget magnetiske og astronomiske Observationer i Land. Den 20de August gik Expeditionen atter tilsøs, og samme Dags Aften paabegyndtes Arbejderne atter udenfor Kysten. Med vestlig Kurs toges en Lodskudrække

and by the evening of the 7th had run 240 miles. At the first haul, the dredge caught against the hard and rugged bottom, and we were obliged to break the rope, after manifold manœuvres to disengage the apparatus. The weather still continuing wet and foggy, with strong winds from the south and south-east and a heavy sea, we decided on giving up the investigation of the tract between our most northerly observing-station and Langanes, the north-eastern promontory of Iceland, taking instead an eastward course.

On the 8th we sounded and trawled in 1861 fathoms, the greatest depth measured in 1876, lat. 65° 48′ N., long. 3° 7′ W. Meanwhile, it was again blowing so hard that we had to steam eastward at half speed; and on the afternoon of the following day the vessel was put head to sea, as she rolled too heavily with the sea on her beam. On the morning of the 10th of August we stood for the next observing station, and at 10 a. m. took a sounding in 1539 fathoms. Though it blew a gale (velocity of the wind from 10 to 16 metres a second) and the sea ran high, still we managed to dredge the bottom, — an operation which lasted from 11 a. m. to 7 p. m. Proceeding then on our eastward course, the next morning heavy weather again compelled us to put the ship with her head to the sea. During the night, the wind having fallen off a little, she was able to steam on her course for a few hours; and, arrived at the next observing station, we took, notwithstanding the very unfavourable weather, — it was still blowing hard with a heavy sea, — both soundings and serial temperatures. The depth here not exceeding 600 fathoms, and the advanced stage of the cruise rendering a possible loss of apparatus of less moment, the experiment was tried of working trawl and dredge simultaneously, the otter-trawl being made fast behind the dredge. The experiment succeeded, in so far at least as the dredge came safely on board; but the trawl, from its great length, could not be hove quick enough, and fouled the propeller, ere there was time to stop the engines. Getting sail on the ship, we ran before the wind, and with great difficulty, owing to the heavy sea, succeeded, after a couple of hours' unremitting exertions, in cutting away sufficient of the trawl, by means of knives and sharpened spade-blades at the end of long poles, to free the propeller. We now stood for the land, but next day the vessel lay to with her head to the sea till an observation of the sun's altitude, taken an hour after noon, had given us her position, and we could steer direct for the Halten lighthouse, the tower of which hove in sight a few hours after. On the evening of that day the "Vøringen" was moored in the harbour of Halten, having encountered a continued succession of heavy gales — no less than 8 — in the course of her six weeks' cruise. On the morrow, the 14th of August, the Expedition proceeded to Namsos.

At this place we remained 6 days, our stay being chiefly devoted to the taking of magnetical and astronomical observations on shore. On the 20th of August the Expedition again put to sea, and in the evening the exploratory work off the coast was resumed. Standing west,

paa 31 Stationer med 1 Mils Afstand indbyrdes, samt en Bundskrabning. Kystbankens Afheld mod Ishavsdybet fandtes først i en Afstand af 25 Mil fra Land og først her fandtes, i 381 Favne, iskoldt Vand ved Bunden. Kursen sattes derefter sydover og Opgangen fra Dybet af den samme Banke blev bestemt paa 64° Bredde, hvor der blev taget 6 Lodskud, 2 Temperaturrækker og 2 Bundskrabninger. Dette Arbejde blev udført til om Aftenen den 22de August, og da ophørte ogsaa det gode Vejr, som vi siden Ankomsten til Namsos havde havt.

I Taage og Kuling gjordes Land næste Morgen, den 23de August, ved Ona Fyr, hvor Lods kom ombord, og om Eftermiddagen ankredes ved Molde. Den 24de blev der loddet, taget Temperaturrække og skrabet i Romsdalsfjorden, og samme Dags Aften ankom Expeditionen til Aalesund. Her kom der Kl. 8 om Aftenen en Stormbyge, der rev Skibet løs fra sine Fortøjninger, og først Kl. 2 om Morgenen blev det atter bragt paa sikker Ankerplads igjen. Den næste Formiddag afgik vi fra Aalesund, laa om Natten i Florø og ankom Lørdag Middag den 26de August til Bergen.

Samtlige Expeditionens Medlemmer debarkerede samme Dag, og Mandag Morgen begyndte Desarmeringen, idet alle Expeditionens Sager bragtes i Land paa Marinens Værft, hvor det fornødne Magazinrum velvilligen var stillet til Expeditionens Raadighed. Samtidig udtoges Indredningen, og Skibet klargjordes til Fragtfart ved D'Hrr. Brunchorst & Dekkes Værft, hvorfra det den 7de September afleveredes til Rederiet.

1877.

Den for dette Aar vedtagne Plan var saalydende:

Fartøjets Udrustning og Bestemmelsen af dets magnetiske Konstanter antages færdige til den 1ste Juni.

Ved Studiet af Varmeforholdene i Dybet over Bankerne udenfor Vestkysten har det vist sig, at der endnu savnes nogle Temperaturrækker i den norske Rende. For at faa disse, begyndes Vejen til det egentlige Undersøgelsesfelt saaledes, at man fra Bergen gaar direkte tilsøs og, følgende Rendens Bund, tager nogle Temperaturrækker i denne. Længere Nord kunne nogle af forrige Aars Temperaturrækker verificeres.

Det første egentlige Arbejdsfelt er de norske Kystbanker nordenfor Namdalen.

Efter de Observationer, som foreligge, er det sandsynligt, at Havbroen, hvor Banken kaster sig ned mod Ishavsdybet, og hvor det iskolde Vand begynder ved Bunden,

we took a series of soundings at 31 Stations, 4 miles apart, and one haul of the dredge. The slope of the coastal bank towards the basin of the Arctic Ocean was found to commence 100 miles from land, and here, in 381 fathoms, we first met with bottom-water of 0°. Proceeding then on a southward course, the rise of the bank was determined in lat. 64° N., and here we took 6 soundings, 2 serial temperatures, and 2 hauls of the dredge. This deep-sea work was steadily prosecuted till the evening of the 22nd of August, when a gale of wind put an end to the spell of fair weather we had enjoyed after reaching Namsos.

Steaming southward in a fog and a heavy sea, we made land the next morning, the 23rd of August, near the Ona lighthouse; soon after a pilot came on board, and in the afternoon the "Vøringen" cast anchor at Molde. The next day we sounded, took a series of temperatures, and dredged in the Romsdalsfjord, the Expedition proceeding that day as far as Aalesund. At 8 p.m. the ship, struck by a violent squall, broke from her moorings, and it was 2 o'clock in the morning before she got safe anchorage. On the forenoon of the following day we left Aalesund, anchored for the night at Florø, and arrived at Bergen on Saturday the 26th of August, about noon.

The members of the Scientific Staff disembarked the same day. In the course of the next week the instruments, apparatus, and other things belonging to the Expedition were conveyed to the Royal Navy Yard (storage-room had been kindly placed at my disposal), and the crew paid off. The fittings below deck were then removed, and the vessel cleared for the freight-trade, in Messrs Brunchorst & Dekke's dockyard, where, on the 7th of September, she was given up to the owners.

1877.

The Scheme approved for this year was as follows: —

The equipment of the vessel and the determination of her magnetic constants are assumed to have been completed by the 1st of June.

Extended research into the thermal conditions of the deeper strata on the banks off the West Coast of Norway, has shown a few serial temperatures to be wanting for the Norwegian Channel. The Expedition will, therefore, on leaving Bergen, at once put to sea, and, following the axis of the channel, commence its exploratory work by taking serial temperatures. Farther north, a few of last year's serial temperatures might be verified.

The Norwegian coastal banks north of Namdalen will form on this cruise the first extensive field of exploratory research.

Judging from the observations already taken, it is highly probable that the edge of the bank where the sea-bottom begins to slope down towards the depths of the Arctic

ligger mindst 25 Mil ud fra Kysten. Mellem Røst og det Punkt udenfor Namdalen, hvor Expeditionen ifjor fandt omkring 60 Favnes Dyb med Fjeldbund 10 Mil af Land, antages det muligt, at der gaar en mere eller mindre sammenhængende Fjeldkam. Havbroens og den formodede Fjeldkams Sted og Naturforhold danne fremtrædende Punkter i Undersøgelsen af Bankerne. Denne foregaar ved Opgaaelse af Tversnit lodret mod Kysten. Tversnittene tages — i Overensstemmelse med forrige Aars — i en indbyrdes Afstand af 12 til 13 geografiske Mil. Deres indre Grændse er den yderste Linie for den specielle hydrografiske Kystundersøgelse. Deres ydre Grændse er der, hvor Temperaturen ved Havbunden er — 1° eller henimod denne.

Til Bestemmelse af Temperaturforholdene kræves i hvert Tversnit foruden Temperaturen ved Bunden ved hvert Lodskud, mindst 3 Temperaturrækker: en ved den indre Grændse, en ved Havbroen, paa dens indre Kant, og en ved Snittets ydre Grændse. Lodskuddenes Antal beror paa, om man under Arbejdet finder Bunden mere eller mindre jevn.

For at levne saameget Tid som muligt til Arbejderne i det store Ishavsdyb og ved Jan Mayen samt Grønlandsisen, medtages ved Bankernes Undersøgelse, i hvert 3die Tversnit, Undersøgelsen af Umbellularia-Regionen indtil et Dyb af 1000 Favne. Skulde Forholdene tillade det, kunne ogsaa flere af Banktversnittene udvides til denne Udstrækning. Under Arbejdet paa Bankerne og i Umbellularia-Regionen antages det hensigtsmæssigt at anløbe Bodø.

En Temperaturrække i Vestfjorden, udført med de nyeste Dybvandsthermometre, søges erholdt saavel paa Rejsen opover i Juni som paa Tilbagerejsen i August, til Undersøgelse af det abnorme Forhold, som fandtes her i Sommeren 1875, idet Temperaturen havde et Minimum i 70 Favnes Dyb. Da de zoologiske Undersøgelser i Vestfjorden hidtil kun omfatte Kysternes Fauna, søges Anledningen benyttet til zoologiske Arbejder i denne Fjord i større Afstand fra Land.

Magnetiske absolute Observationer søges udført paa Røst, hvor Forholdene derfor ifølge Lieutenant Petersens Observationer i 1875 antages gunstige, og hvor man har det mest fremskudte Punkt til Sammenligning med de eventuelle magnetiske Observationer paa Grønlandsisen.

I Løbet af Juni Maaned antages, under gjennemsnitlige Vejrforhold og med den fra ifjor hentede Erfaring, Undersøgelsen af Bankerne og Umbellularia-Regionen efter denne Plan at kunne naa til Bredden af Tromsø.

I Tromsø antages Expeditionen sidst i Juni eller først i Juli at kunne blive udrustet til en længere Rejse vestover.

Ocean, and where the temperature at the bottom falls below 0° C., lies not less than 100 miles distant from the coast. The section of the sea-bed between Røst and the point off Namdalen where, on last year's cruise, the depth, 40 miles from land, was found to be 60 fathoms, with a rocky bottom, will possibly prove to be traversed by a more or less continuous submarine ridge. To determine the exact position of the edge of the bank and of this supposititious ridge, and thoroughly to investigate their physical conditions, form important points in the exploration of the banks. This can be done by means of transverse sections perpendicular to the coast, at distances, as on last year's cruise, of about 50 miles. The inner limit of these sections to coincide with the extreme boundary line for the special hydrographic Coast Survey, their outer extending to where the temperature at the bottom is about — 1°.

To determine the thermal conditions, at least 3 serial temperatures will have to be taken in each section, exclusive of the temperature registered with each bottom-sounding, viz. — one at the inner limit, one on the edge of the bank, and one at the outer limit of the section. The number of soundings will depend on the contour of the bottom, whether it be more or less undulating.

With the object of prolonging the period for the exploration of the great Arctic basin, the depths off Jan Mayen, and the Greenland ice-barrier, it is deemed advisable that the work on the banks be made to embrace, in every third section, down to a depth of 1000 fathoms, the investigation of the *Umbellularia* region. Circumstances permitting, several of the transverse sections may be extended accordingly. When exploring the banks and the *Umbellularia* region, the Expedition should touch at Bodø.

A series of temperatures should, if possible, be taken in the Vestfjord with the latest deep-sea registering thermometers, both on the passage north in June and on the homeward course in August, to determine the abnormal condition observed here in the summer of 1875, viz. of a minimum temperature at a depth of 70 fathoms. Zoological investigations in the Vestfjord having hitherto been confined to the littoral fauna, the naturalists accompanying the Expedition will take every advantage of the opportunity afforded them to explore this fjord at a greater distance from land.

Absolute magnetical observations will, if possible, be taken at Røst, — the most advanced point on the coast, — where the physical conditions, as determined by lieutenant Petersen in 1875, are, it is believed, sufficiently favourable, for comparison with the magnetical observations to be instituted on the Greenland ice-barrier.

By the end of June, in moderately fair weather, the exploration of the banks and the *Umbellularia* region will, it is believed, inferring from last year's stormy cruise, have reached the latitude of Tromsø.

Refitting at Tromsø for a cruise westward of greater duration, the "Vøringen" will, it is hoped, be ready to leave that port by the end of June or the beginning of July.

Man gaar først efter Linien Andø—Jan Mayen ud i Ishavsdybet, undersøger dette og dets Skraaninger paa begge Sider. Omkring Nordøstenden af Jan Mayen som Centrum foretages nogle kortere Rækker Lodskud mod Nordøst, mod Nord og mod Nordvest. Paa dette Strøg nemlig, der antages at danne den islandske Vulkan-Regions yderste Forbjerg mod Nordøst, synes Bunden at falde særdeles brat af mod Dybet til de nævnte Sider.

Under den sandsynlige Forudsætning, at Adgangen til Jan Mayen ikke er spærret af Is, forsøges det at lande paa Øen til Foretagelse af Undersøgelser i geografisk, geologisk, hydrografisk, zoologisk, botanisk Retning m. v.

En Undersøgelse af Naturforholdene i Havet paa Vest- og Sydsiden af Jan Mayen søges udført. Der er nemlig Grund til at antage, at Jan Mayen er forbundet med Island ved en undersøisk Ryg.

For at undersøge Forholdene paa Grændsen mellem den varme Overfladestrøm fra Atlanterhavet og den kolde Polarstrøm i Grønlandshavet, opsøges Grønlandsisen i Nordvest for Jan Mayen. Naar Undersøgelserne langs et Stykke af Grønlandsisen ere afsluttede, styres til et Punkt omtrent midtvejs mellem Island og Jan Mayen, og derfra undersøges Tversnittet over Ishavsdybet i Retning af Ranen. Herved vil man kunne faa rede paa den formodede undersøiske Ryg mellem Island og Jan Mayen. Naar det sidstnævnte Tversnit er oparbejdet indtil dets tidligere undersøgte norske *Umbellularia*-Region, sejles til Tromsø, under Forudsætning af, at Tiden senere tillader, i August, flere Arbejder nordenfor Tromsø.

Naar Juli Maaned antages medgaaet til Jan Mayen-Turen, vil den første Halvdel af August kunne anvendes til Undersøgelse af Bankerne, Havbroen og endel af Ishavsdybet mellem Norge og Syd-Spidsbergen. Som Østgrændse sættes Linien Nordkap, Bjørneøen, Sydkap.

Den sidste Halvdel af August vil tiltrænges til Tilbagerejsen til Bergen og Desarmering.

De videnskabelige Arbejder udføres væsentlig paa samme Maade som i 1876.

Ved de zoologiske Arbejder lægges ved Siden af Fangst med Skrabe, Trawl og Svabere, særlig Vægt paa Anvendelse af Drivgarn og Net i intermediære Dybder, samt Fiskeri paa Bankerne. Paa Jan Mayen antages Fuglefangst at burde være Gjenstand af Betydning og ved Grønlandsisen muligens Fangst af Sæl og Isbjørn m. m.

Her course west will at first coincide with a line extending from Andø to Jan Mayen, and thence to the Arctic Ocean, the basin and slopes of which the Expedition has to investigate. From the north-eastern extremity of Jan Mayen will be taken a few short series of soundings in a north-easterly, a northerly, and a north-westerly direction; for off this point, which is supposed to form the north-eastern promontory of the volcanic region of Iceland, the bottom would appear to sink precipitately in those directions.

On the probable assumption that Jan Mayen is not inaccessible from ice, the Scientific Staff will land on the island, and prosecute exploratory work in divers branches — geographical, geological, hydrographical, zoological, botanical, &c.

The physical and biological conditions of the sea off the western and southern shores of Jan Mayen, should if possible be investigated, there being some reason to infer that a submarine ridge connects that island with Iceland.

To investigate the conditions where the warm surface-current from the Atlantic meets the glacial Polar flow in the Greenland sea, the Expedition will stand north-west of Jan Mayen when making for the Greenland ice-barrier. After exploring part of the Greenland ice-barrier, the Expedition will proceed to a point about midway between Iceland and Jan Mayen, and from thence investigate the bed of the Arctic Ocean in the direction of Ranen. The existence or non-existence of a submarine ridge connecting together Jan Mayen and Iceland will then be definitively settled. When the last-mentioned section of the Arctic basin has been explored throughout, irrespective of its Norwegian *Umbellularia* region, investigated previously, the Expedition will return to Tromsö, provided there be time for subsequent exploratory work (in August) north of that port.

If, as expected, the Expedition get back from Jan Mayen by the end of July, the first half of August can be devoted to further investigation of the banks, and part of the Arctic basin between Norway and the southern extremity of Spitzbergen. A line tangent to the North Cape, Beeren Eiland, and South Cape marks the eastern limit of the tract to be explored.

The latter half of August will be needed for the passage home to Bergen, and for discharging the vessel.

The scientific work of the Expedition to be carried out in all essential particulars as in 1876.

With regard to the zoological work, especial stress is laid on the use of the surface-net, and of the drag-net in intermediate depths, apart from that of the dredge, trawl, and swabs, as also on fishing when exploring the banks. During the stay at Jan Mayen, some time should, it is thought, be devoted to collecting ornithological spec-

Ved Lodskuddene søges bestemt Bankernes Form og Udstrækning, samt den Maade, paa hvilken Bunden falder af fra disse til de største Dybder i Ishavsdybet. Det er af fundamental Betydning for Forstaaelsen af Havets og de tilgrændsende Landes orografiske og geologiske Forhold, ligesom for Dyrelivets Udbredelsesforhold, at faa afgjort, om Bunden falder jevnt af mod Dybet, eller om den falder af i Trin, Terrasser eller Afsatser med mellemliggende Plateauer. Lodskuddenes Plads og Antal bestemmes derfor med disse Hensyn for Øje.

Maalingerne af Havets Temperatur i Dybet udføres i den Udstrækning, som er nødvendig til en sikker Bestemmelse af Dybets Isothermer i de efter denne Plan opgaaede Tversnit. Der tages Hensyn til det hensigtsmæssige i, at Punkterne i Tversnittene ogsaa kunne anvendes til Længdesnit. De nyeste Dybvandsthermometre anvendes saa ofte som muligt ved Siden af det ifjor brugte.

Ved hvert Lodskud tages Vandprøve fra Dybet og paa udvalgte Steder fra intermediære Dybder. Alle Vandprøvers specifiske Vægt bestemmes.

Ved hvert Lodskud tages Bundprøver, der opbevares til videre Undersøgelse. Af de med de zoologiske Fangstapparater optagne og sigtede Materiale af Havbunden tages Prøver til Opbevarelse.

De chemiske Arbejder udføres væsentlig som ifjor. Den specifiske Vægt af Havoverfladens Vand bestemmes en til to Gange daglig, og oftere paa Steder, hvor Strømforhold eller andre Forhold gjøre det ønskeligt.

Iagttagelsen af Strømmen i Havet søges udført, naar Naturforholdene gjøre det ønskeligt og Vejrforholdene muligt.

Magnetiske Observationer søges udført ombord i Søen, navnlig lægges Vægt paa Erholdelsen af Misvisningsobservationer. Absolute Bestemmelser søges udført paa Røst og paa Grønlandsisen, foruden ved Bestemmelsen af Skibets magnetiske Constanter i Husø, og desuden, hvor Lejligheden ellers maatte findes, som i Bergen, Bodø, Tromsø m. fl.

Geologiske Undersøgelser foretages paa Jan Mayen, om Landgang der er mulig, i al den Udstrækning, som Forholdene tillade. Paa Jan Mayen vil astronomisk-geografiske Stedbestemmelser, topografiske og hydrografiske Undersøgelser være af største Interesse at faa udført. En Stedbestemmelse paa Røst — i Forbindelse med de magnetiske Observationer — vil være ønskelig, da Stedet ikke er forbundet med det trigonometriske Net.

imens; and at the Greenland ice-barrier there might, perhaps, be opportunity of capturing a few seals, with an occasional shot at a Polar bear.

Deep-sea soundings will be taken to determine the contour and extent of the coastal banks, as. also their slope, or how the bottom shelves down into the greatest depths of the Arctic. Ocean. It is a point of fundamental importance in studying the orographical and geological conditions of the sea and the countries it surrounds, and the distribution of animal life in the ocean, to find whether the bottom slopes gradually down to the depths, or descends, as it were, step by step, in terraces, with interjacent plateaus. Hence, the position and number of the soundings will have to be determined with this object in view.

The temperature of the sea will be taken to the extent required for an indisputable determination of the isotherms of the transverse sections explored in accordance with the present scheme. Attention is directed to the position of the observing points in the transverse sections, which should admit of their being applied to longitudinal sections. Whenever practicable, the temperature shall be registered with the latest deep-sea thermometers as well as with the instrument used on last year's cruise.

With every sounding, a sample of water shall be brought up from the bottom, and in specially selected localities also from intermediate depths. All the samples to have their specific gravity determined.

With every sounding, a sample of the bottom shall be obtained, and preserved for subsequent examination. Samples of the sifted material brought up from the bed of the ocean with the dredge or trawl will also be preserved.

In the chemical work there will be no essential change. The specific gravity of the surface-water shall be registered once or twice a day, and more frequently in localities where the action of currents or other exceptional conditions may render it desirable.

Observations on ocean-currents will be made wheresoever the attendant physical conditions may render them desirable and the state of the weather practicable.

Magnetical observations shall, if possible, be taken at sea, especial stress being laid on obtaining determinations of the variation of the compass. Absolute determinations shall, if possible, be performed at Røst and on the Greenland ice, exclusive of those for the ship's magnetic constants to be made at Husø; and wheresoever else opportunity may be afforded, as at Bergen, Bodø, Tromsø etc., and other places.

Geological investigations will be undertaken on the island of Jan Mayen, should the Expedition succeed in landing there. Peculiar interest would likewise attach to astronomical determinations of latitude and longitude, as also to topographical and hydrographical observations made on that island. In connexion with the magnetical observations instituted at Röst, it will be desirable to perform determinations of latitude and longitude, that locality not being included in the trignometrical net of the country.

Botaniske Undersøgelser og Indsamlinger søges gjort paa Jan Mayen i størst mulig Udstrækning.

De meteorologiske Iagttagelser ombord udføres i alt væsentligt som i 1876.

Ligesom det foregaaende Aar overtoges Dampskibet "Vøringen" af Expeditionen den 14de April og Indredningsarbejderne udførtes ved samme Værft.

Den 19de Maj paamønstredes Mandskabet, og Kl. 2 om Morgenen den 23de Maj afgik Skibet til Husø, hvor jeg agtede at tage de til Fox-Cirkelens senere Benyttelse nødvendige forberedende Observationer. Efter Ankomsten hid opdagedes imidlertid en Fejl i agterste Krumtappinde, og da Vejret desuden var til Hinder for Observationernes Udførelse, returneredes strax til Bergen, hvor ny Mellemaxel blev indsat. Dette Arbejde var færdigt den 31te Maj, men Expeditionens Afgang blev yderligere forsinket derved, at Mr. Macintosh i London, der havde paataget sig til første Halvdel af Maj at levere nye Accumulatorstrenge, havde glemt Ordren og kunde ikke levere dem før 10de Juni. Der blev derfor gjort et nyt Forsøg paa at erholde de forberedende magnetiske Observationer, men det mislykkedes fuldstændigt paa Grund af det yderst urolige Vejr i Husø.

Den 11te Juni embarkerede i Bergen Professorerne Mohn og Sars, Overlæge Danielssen og Landskabsmaler Schiertz samt Overlæge Hansen, der havde erholdt Indredepartementets Tilladelse til at være med som Passager til Tromsø, hvor Kjøbmand Friele skulde støde til Expeditionen. Da Hr. Svendsen, der var Expeditionens Kemiker det første Aar, havde af Helbredshensyn meldt Forfald, blev i hans Sted antaget Hr. H. Tornøe, der under Professor Waages personlige Ledelse havde arbejdet paa Laboratoriets Indredning siden den 23de Maj. For at vinde Tid besluttedes at gaa Accumulatorerne imøde til Stavanger, og her kom de ombord den 13de Juni, hvorefter Expeditionen strax gik tilsøs.

Omtrent 3 Mil SV. for Udsire toges en Temperaturrække, og Dagen efter en lignende tvers af Feje (60° 42′ N. Br.), hvorefter Kursen sattes direkte paa Station No. 96 (66° 9′ N. Br., 3° 0′ L. Ø. f. Gr.), der naaedes Kl. 6 Morgen den 16de Juni.

Ved at tage 54 Lodskud, 6 Skraber, 3 Trawler og 7 Temperaturrækker undersøgtes 3 Tversnit udenfor Kysten mellem Foldenfjord og Vestfjorden af tilsammen 115 g. Miles Længde. Det nordligste af disse Snit gik helt fra 67° 53′ N. Br. og 5° 12′ L. Ø. f. Gr. til hen imod Trænen ($66^1/_2$° N. Br. 12° L. Ø. f. Gr.). Efter at have taget en Temperaturrække i Vestfjorden, ankom Expeditionen

Botanical work, comprising collections of the flora, will, if possible, be prosecuted on Jan Mayen.

The meteorological observations on board will be made essentially as in 1876.

As in 1876, the S.S. "Vøringen" was on the 14th of April given up by her owners to the agent of the Expedition, and her nautical equipment again undertaken by Messrs Brunchorst and Dekke.

On the 19th of May the crew came on board, and on the 23rd, at 2 o'clock in the morning, the vessel left Bergen for Husø, where I purposed taking the preliminary observations indispensible for the subsequent use of the Fox-circle. But, on arriving at that island, a defect was discovered in the pin of the after-crank, and the weather, too, being very unfavourable for such observations, we returned at once to Bergen, and had a new shaft put in. This was got done by the 31st of May; but unfortunately the final departure of the Expedition had to be still further delayed. Mr. Macintosh, the London manufacturer, who was to have furnished new straps for the accumulators, having overlooked the order, and being in consequence unable to execute it before the 10th of June. During this interval a fresh but, owing to the boisterous weather at Husø, wholly abortive attempt, was made to obtain the preliminary magnetical observations.

On the 11th of June Professors Mohn and Sars, Dr. Danielssen, Mr. Schiertz, artist, and Dr. Hansen, embarked in Bergen. Dr. Hansen, who was not a member of the Scientific Staff, having permission from the Home Department to proceed as passenger to Tromsø, where Mr. Friele was to join the Expedition. Mr. Svendsen, chemist to the Expedition on the first year's cruise, having by reason of ill-health been compelled to retire, Mr. H. Tornøe, who, since the 23rd of May, under the personal guidance of Professor Waage, had been at work fitting up the Chemical Laboratory, was engaged in his stead. Time being precious, we resolved on running south, to await in Stavanger the arrival of the new accumulators, which reached that place on the 13th of June; and having got them on board, the Expedition immediately put to sea.

About 12 miles south-west of Utsire we took a series of temperature-soundings, and on the following day another, off Feje (lat. 60° 42′ N.), after which the Expedition stood for Station 96 (lat. 66° 9′ N., long. 3° 0′ E.), arriving there on the 16th of June, at 6 o'clock in the morning.

Three transverse sections off the coast, between the Foldenfjord and the Vestfjord, measuring together 460 miles in extent, were now explored, by taking 54 soundings, 6 hauls of the dredge, 3 of the trawl, and 7 serial temperatures. The most northerly of these sections extended from a point in lat. 67° 53′ N. and long 5° 12′ E. to a point in the immediate vicinity of Trænen (lat.

den 23de Juni til Bodø, hvor Provisioner indtoges, og Kronometrenes Stand undersøgtes.

Den 25de Juni gik vi til Hopen i Saltenfjorden for at fylde Vand, og derfra om Natten over Vestfjorden til Røst, idet der paa Vejen toges en Række Lodskud. Ved Røst foretoges Deviationsprøve samt magnetiske og astronomiske Observationer i Land. Det viste sig imidlertid, at Stedet mod Formodning var uskikket til magnetisk Basis-Station, idet Declinationen kunde variere hele 7° paa to nærliggende Øer.

Om Middagen den 28de gik Expeditionen atter tilsøs mellem Røst og Værø, og i Løbet af to Dage oparbejdedes 3 Tversnit mellem Røst og Hadselfjorden, hvor vi løb ind Lørdagen den 30te Juni. Den paafølgende Søndag laa Expeditionen til Ankers i Sundet ved Sortland. Mandag Morgen gik vi atter tilsøs mellem Langø og Andø, og fandt Bankens Eg her meget nærmere Land end tidligere. Om Natten gik vi noget længere ind paa Banken, og her fiskedes fra Borde stor Torsk, Lange, Brosme og Kveite i betydelig Mængde med Haandsnøre. Den næste Dag, 4de Juli, fortsattes atter Rejsen udover i et længere Snit indtil 70° N. Br. og 6° 15′ L. Ø. f. Gr., paa hvilket Punkt der arbejdedes hele Dagen den 5te Juli i 1710 Favnes Dyb med Lodning, Temperaturrække, Skrabe og Trawl i et usædvanligt roligt og smukt Vejr. Herfra styredes igjen østover, under stadigt Arbejde paa en Række Stationer, til Malangenfjorden, hvis Munding passeredes om Formiddagen Søndag den 8de Juli. Samme Dags Middag ankrede Expeditionen i Tromsø.

Fra Røst af var taget 45 Lodskud, 5 Skraber, 5 Trawler og 8 Temperaturrækker. Ved denne Lodning opdagedes, at Atlanterhavs-Dybet eller Ishavsdybet her trænger ind i Banken, hvorved der dannes en Eg paa lignende Maade som ved Storeggen udenfor Romsdalskysten. Men denne nordlige Eg, som blev kaldt "Vesteraalseggen," har en ganske anden Udstrækning end Storeggen. Vesteraalseggen begynder omtrent 15 geogr. Mil retvisende Vest af Røst og strækker sig herfra nordøstover parallel med Lofotens Øgruppe i 10 til 11 Miles Afstand fra Land til Vest af Hadselø, hvor den bøjer mere østover ind mod Land. Ved Nordpynt af Langø er Kanten af Eggen ikke mere end 4 g. Mil fra Land. Den tager i Nord for Andenes og i Vest for Kvalø en mere nordlig Retning igjen, og paa 70½ Grads Bredde bøjer Isobatherne mere vestover, idet Affaldet af Banken antager en mere flaa Form. Vesteraalseggens Længde er saaledes omtrent 60 g. Mile og Bunden falder af mod NV. fra 100 til 1400 Favne paa en Distance af 5 Mil, hvilket, naar Talen er om Havbund, maa kaldes et stærkt Affald. Da de samme Fiske-

66½° N., long. 12° E.). After taking a series of temperatures in the Vestfjord, the Expedition stood for Bodø, reaching that place on the 23rd of June. Here we took in a supply of fresh provisons and got the chronometers rated.

On the 25th of June the "Vøringen" steamed up to Hopen, in the Salten Fjord, a good place for watering, and in the night stood across the Vestfjord to Røst, taking by the way a series of soundings. At Røst the ship was swung for deviation, and magnetical and astronomical observations were taken on shore. Contrary to expectation, this place proved wholly unsuited for a magnetical base-station, the declination on two adjacent islands varying as much as 7°.

On the 28th, about noon, the Expedition again put to sea, between Røst and Værø, and in the course of 2 days investigated 3 transverse sections, between Røst and the Hadselfjord, reaching the latter locality on Saturday the 30th of June. The next day being Sunday, the "Vøringen" lay at anchor in Sortland Sound. On Monday morning we again put to sea, between Langø and Andø, and struck the edge of the bank considerably nearer land than we had done in any other locality. After night-fall we steamed farther in shore, and took numbers of large cod, ling, torsk, or tusk, and halibut, fishing with hook and line from the ship's side. On the day following, the 4th of July, we pursued our outward course to a point in lat. 70° N., long. 6° 15′ E.; and here the Expedition passed the whole of the 5th, prosecuting exploratory work at a depth of 1710 fathoms, — sounding, dredging and trawling, and taking serial temperatures, in weather remarkably calm and fair. Again steering east, we kept on steadily, working at a number of stations, till we reached the Malangen Fjord, the mouth of which was passed on the forenoon of Sunday, the 8th of July. The same day, shortly after noon, the "Vøringen" dropped her anchor at Tromsø.

On our course from Røst we took 45 soundings, 5 hauls of the dredge, 5 of the trawl, and 8 serial temperatures. These soundings disclosed an important fact, viz. in showing that along this line the basin of the Arctic Ocean cuts deep into the bank, forming an edge, as at Stor-Eggen, off the coast of Romsdal. But this northern edge, to which we gave the name of "Vesteraals-Eggen," differs widely from the Stor-Eg in extent. The Vesteraals-Eg commences about 60 miles due west of Røst, stretching thence in a north-easterly direction, parallel to the Lofoten Islands, distant 40 or 44 miles from the coast, on to the west of Hadselø, where it makes a somewhat easterly landward bend. At the northern extremity of Langø, the edge is not more than 12 miles from land. North of Andenes and west of Kvalø, it again takes a more northerly direction, and in lat. 70° 30′ N. the isobaths bend more to the west, the slope of the bank being less sudden here. The length of the Vesteraals-Eg reaches accordingly about 240 miles, and the bottom shelves, in a north-westerly direction, over a distance of 20 miles, from 100 fathoms

sorter findes paa Vesteraalseggen som paa Storeggen, og da Bunden har en lignende Formation og er af samme Beskaffenhed, er der en høj Grad af Sandsynlighed for, at det samme Slags Fiskeri, der drives udenfor Kysten af Søndmør, ogsaa maatte kunne lønne sig udenfor Lofoten og Vesteraalen. Vesteraalseggen vil maaske være lettere at drive end Storeggen, idet der er kortere Udsejlads, gode Med paa Land, saaat man let kan tage op Fiskepladsen, og gode Havne i Nærheden.

I Tromsø blev Expeditionen liggende til den 14de Juli, Kjedlen rengjordes, Axelen i Indhivningsmaskinen omlagdes, der fyldtes Kul og Vand. Overlæge Hansen gik i Land, og Kjøbmand Friele embarkerede, men maatte atter flytte i Land efter et Par Dages Forløb, da han var saa uheldig at forvride sin Fod. Lieutenant Petersen flyttede ogsaa i Land, da han i flere Uger ikke havde befundet sig vel, og haabede ved et Ophold i Land at blive sat istand til senere at følge med Expeditionen paa Turen til Jan Mayen. Under Opholdet i Tromsø arbejdede Zoologerne med Skrabninger fra Baad, Dybvandsthermometrenes Nulpunkter undersøgtes, Kronometrenes Stand verificeredes og absolute magnetiske Iagttagelser erholdtes.

Da den første Halvdel af Juli Maaned allerede udløb, før Expeditionen kunde fortsætte sine Arbejder i Søen, besluttedes det først at tage under Arbejde Bankerne nordenfor Tromsø, og derpaa at foretage Rejsen til Jan Mayen, hvor man kunde vente at finde Havet mere isfrit i August Maaned.

Lørdag den 14de Juli besøgtes Kjosen i Ulfsfjorden og Kl. 2 Mandag Morgen gik Expeditionen herfra tilsøs nordover gjennem Fugløgabet. Der undersøgtes nu to Tversnit nordenfor Malangenfjord ved at tage 18 Lodskud, 3 Skraber, 1 Trawl og 3 Temperaturrækker. Ved disse Tversnit bestemtes ogsaa Vesteraalseggens nordre Ende. Under dette Arbejde var Vejret mindre gunstigt, vi havde østlig Kuling med adskillig Sø samt koldt Vejr og Taage, men ikke mere end at Arbejdet gik sin uforstyrrede Gang. Fredag den 20de kom vi atter tilbage til Tromsø, hvor baade Hr. Friele og Lieutenant Petersen kom ombord igjen, begge betydeligt restituerede.

Efterat Forsyningerne atter vare kompletterede, afgik Expeditionen igjen den 24de Juli, og med fuld Damp og alle Sejl i Træk for en frisk nordøstlig Vind sattes Kursen vestover. Efterat 680 Kvartmile var udsejlede, var paaværende Plads 70° 23′ N. Br. og 2° 30′ L. Ø. f. Gr., og her toges det første Lodskud paa 1760 Favne. Fra dette Sted loddedes med omtrent 48 Kvartmils Mellemrum videre vestover indtil Dybden begyndte at aftage til mindre end 1000 Favne, da Lodskuddene sattes tættere. Den 28de,

down to 1400, — a fall which, referring as it does to the sea-bed, must be regarded as rather rapid. The fish met with on the Vesteraals-Eg belonging to the same species as those frequenting the Stor-Eg, and moreover, the bottom in both localities being of a like nature and formation, there is every reason to believe that a fishery of the kind now flourishing off the coast of Søndmør might be successfully carried on off Lofoten and Vesteraalen. Nay, the Vesteraals-Eg will, perhaps, as regards facilities for fishing it, prove superior to the Stor-Eg: to begin with, the run from shore is considerably shorter; excellent landmarks, too, indicate the bearings of the fishing-grounds, and good harbours are within easy distance.

The "Vøringen" remained at Tromsø till the 14th of July. During our stay, her boilers were cleaned and examined and the shaft of the donkey-engine relaid; here, too, she coaled and watered. Dr. Hansen left the ship, and Mr. Friele embarked, but had to go on shore again after a couple of days, having had the misfortune to sprain his ankle. Lieutenant Petersen, too, who for some weeks past had been indisposed, took a lodging in the town, in the hope that a short residence on shore would recruit his health, and enable him to accompany the Expedition to Jan Mayen. The work done at Tromsø comprised dredging from a boat, determining the freezing-points of the deep-sea thermometers, verifying the errors of the chronometers, and performing absolute magnetical determinations.

The first half of July expiring before the Expedition could resume its investigations at sea, we determined to explore first the banks north of Tromsø, and then proceed to Jan Mayen; besides, the sea surrounding that island would in all probability be less encumbered with ice in the month of August.

On Saturday the 14th of July we steamed to Kjosen in the Ulfsfjord; and from here, on Monday, at 2 a.m., the Expedition put to sea, steering northward through the Fugløgab. We now investigated two transverse sections north of the Malangenfjord, taking 18 deep-sea soundings, 3 hauls of the dredge, 1 cast of the trawl, and 3 serial temperatures. In these sections was also determined the northern extremity of the Vesteraals-Eg. For this exploratory work we had anything but favourable weather; it was cold and foggy, and blowing hard from the east, with rather a heavy sea; no break, however, occurred in the investigations. On Friday the 20th of July the Expedition again arrived at Tromsø, where we were joined by Mr. Friele and Lieutenant Petersen, both gentlemen much benefitted by their brief sojourn there.

After taking in a few additional stores, the Expedition once more put to sea, on the 24th of July, standing westward, under full steam, and every sail drawing in a fresh north-easterly breeze. When the distance run had reached 680 miles, the ship's position was lat. 70° 23′ N., long. 2° 30′ E. Here the first sounding was taken, in 1760 fathoms. From this point, steering westward as before, we sounded at regular intervals of about 48 miles, till the depth had gradually diminished to less than 1000

da Skibet efter Bestikket nærmede sig Land, hvilket dog paa Grund af Taagen ikke kunde sees, blev Dybden atter over 1200 Favne, senere 1060 Favne og derpaa 654 Favne. Ikke en halv Time senere fik vi gjennem Taagen Øje paa en af de stejle Isbræer paa Østsiden af Jan Mayen, og da Taagen en Stund efter lettede sig noget op, kom ogsaa Øens Nordspidse tilsyne. Hvor vi stoppede, var Dybden 144 Favne. Pladsen blev nu bestemt, idet vi blev liggende med Loddet i Bund, først Afstanden fra Land ved Ekkoet af et Kanonskud, der tydelig lod sig iagttage, og dernæst Retningen ved Pejlinger af de synlige Pynter i Nord og Syd.

Da Søen stod paa Østsiden af Jan Mayen, besluttedes at sejle omkring Øen til Vestsiden. Vi tog da Loddet ind og stod nordover langs Kysten med de mange Isbræer, men i det samme Øjeblik vi var tvers af Nordpynten, lagde Taagen sig atter ned paa Havet og tog bort al Udsigt. Der var imidlertid nu Intet til Hinder for at gaa omkring til Vestsiden. Vi styrede først Nord, derpaa Vest, saa Sydvest og endelig Sydost, medens Havoverfladens Temperatur maaltes hvert femte Minut. Den holdt sig jevnlig over 3°, og gik kun en Gang ned til 2°.3 C. Af Is var intet Spor. Da vi efter Bestikket nærmede os Vestkysten, loddedes nogle Gange indtil endelig Taagen løftede sig igjen, saaat Strandpartierne blev synlige. Vi kunde saaledes vælge vor Ankerplads, og Kl. 11 om Aftenen faldt Ankeret paa 20 Favne Vand i Marie-Muss Bugten, hvor der, uagtet hele Havet staar paa, var saa roligt som i en indelukket Havn.

Den følgende Dag var Havet ligesaa roligt, men Taagen skjulte fremdeles alt undtagen de lavere Partier, og laa som et Tæppe over vore Hoveder i omtrent et Par hundrede Meters Højde. Strax om Morgenen blev der gjort Landgang paa Stranden søndenfor "Fugleberget," et ejendommelig formet og farvet Fjeld, Levningerne af et gammelt Krater, der springer noget frem søndenfor den paa denne Side af Øen værende Lagune. Der var forskjellige Partier iland hele Dagen, som gjorde botaniske og geologiske Iagttagelser, tog Skitser og gik paa Jagt efter Søfugl og Polarræve. Af de sidste blev skudt 3 Stykker.

Den 30te Juli foretoges Skrabninger fra Baad i Marie-Muss Bugten, men da det begyndte at blæse en Bris af nordvestlig Vind, blev Brændingerne paa Stranden snart saa store, at man ikke kunde komme iland. Over Middag tiltog Vindens Styrke, og Kl. 5 Eftm. lettede vi for at gaa om paa den anden Side af Øen. Under Letningen kom Solen frem et Øjeblik, der blev maalt et Par Højder af den, og strax efter rev Vinden en Aabning i Taagen, saa vi første Gang fik se Beerenberg, hvis blændende hvide,

fathoms, when the soundings were set closer. On the 28th, when by dead reckoning the vessel was nearing land, which, however, we could not see owing to fog, the depth had again increased to upwards of 1200 fathoms; it then fell off, the two next soundings giving respectively 1060 and 654 fathoms. Scarce half an hour later we caught sight through the fog of one of the beetling glaciers on the eastern shore of Jan Mayen, and shortly after, the fog lifting a little, the northern extremity of the island rose in view. The depth where we stopped the engine was 144 fathoms. Lying to, with the lead on the bottom, the position of the vessel was now determined, — viz. by computing the distance of the land, from the echo following the discharge of a cannon, which could be distinctly observed, and then by taking the bearings of the promontories visible in the north and south.

With the wind then blowing, the sea broke on the eastern shore of Jan Mayen, and we determined, therefore, on steaming round to the west side of the island. Accordingly, we hauled in the lead, and stood northward, coursing along the coast, with its numerous glaciers; but, at the very moment we were abreast of the northern extremity of the island, the fog dropped like a curtain, cutting off every glimpse of Jan Mayen from our view. Meanwhile, there was nothing to prevent us from steaming on to the western shore. First we steered north, then west, then south-west, and finally south-east, recording every five minutes the temperature of the surface-water. This, with one exception, when it sank to 2°.3 C., was everywhere registered above 3° C. Ice there was none. So soon as our reckoning showed us to be nearing the west coast of the island, we sounded at intervals, till the fog at length rose, disclosing the lower parts of the island. We could now look about us, and at 11 p.m. let go our anchor in 20 fathoms, in Mary Muss Bay, which, notwithstanding its exposed situation, was then as smooth as a mill-pond.

On the following day the sea was equally calm, but the dense fog, stretching like a blanket about a couple of hundred metres above our heads, shut out from view, as on the previous afternoon, all but a low-lying strip of shore. Early in the morning we landed, south of the "Fugleberg," or breeding-cliff, a rock of singular hue and formation, the remains of an ancient crater, jutting forward to the south of the lagoon that lies on this side of the island. Several exploring parties passed the day on shore, doing botanical and geological work, sketching the scenery, and shooting sea-fowl and Polar foxes. The number of foxes killed was three.

On the 30th of July we dredged the bottom from a boat in Mary Muss Bay; but a breeze springing up from the north-west, there was soon too much surf on the shore to admit of landing. Shortly after noon the wind began to freshen, and at 5 p.m. we weighed anchor, deeming it best to run back to the opposite side of the island. Whilst the ship was getting under weigh, the sun came out a moment, enabling us to obtain a couple of altitudes; and immediately after, through a sudden rent in the fog, we caught

solbelyste Top mod den dybe blaa Himmel var et ligesaa gribende som pragtfuldt Syn. Under Gangen rundt Øens nordre Del til Rækved-Bugten bestemtes de forskjellige synlige Pynters og Isbræers Beliggenhed ved Hjelp af Pejlinger og Vinkelmaalinger med Sextant. Ved Midnat ankredes i den store Rækved-Bugt udenfor Lagunen paa 12 Favne Vand en god Kvartmil VSV. af Egøen.

Paa denne Ankerplads blev vi liggende den følgende Dag. Brændingen var for stor til, at vi kunde føre nogen Instrumenter iland. Skyteppet laa fremdeles over Beerenberg og over Sydlandets Højder, men Solen trængte oftere gjennem, saaat der fra Skibsborde kunde faaes en længere Række Solhøjder. Om Eftermiddagen, efter et frugtesløst Forsøg paa at komme iland, bestemtes ved Vinkelmaalinger Retninger og indbyrdes Afstande mellem flere af de fremtrædende Punkter paa Østsiden og Fugleberget paa Vestsiden, hvis Top kunde sees over Øens laveste Del. Samme Dag toges Skitser af de synlige Partier af Øen, og arbejdedes paa grundt Vand af Zoologerne.

Onsdag den 1ste August erholdtes atter nogle Solhøjder fra Ankerpladsen om Formiddagen. Skydækket begyndte at løse sig over Øens nordlige Del, men laa fremdeles tungt over den sydlige. Havets Tilstand var den samme, som Dagen før. Vi lettede og stod udover paa Havet, loddede, tog Temperaturrækker og skrabede paa den af sort Sand og Ler bestaaende Havbund. Imidlertid blev Beerenberg efterhaanden befriet for Taagehyllet, og om Eftermiddagen havde vi Fjeldet ganske klart i hele sin Udstrækning. Paa Havet havde vi ofte sterke Hvirvelvinde, og paa Land saa vi dem hvirvle Egøens løse Tufsand højt i Vejret, et skuffende Billede af en vulkansk Eruption. Om Aftenen ankredes udenfor Lagunen et Par Kvartmil i Sydvest for den forrige Ankerplads.

Den 2den August var Brændingerne fremdeles hinderlige for Landgang. Vi lettede om Formiddagen og stod østover, ved hvilken Lejlighed Beerenbergs Højde blev bestemt ved udsejlet Distance og Vinkelmaalinger. Derefter skrabedes og loddedes, idet vi atter gik østenom og nordenom Øen. Beerenberg tilhyllede sig atter i sit Taageslør, og vi havde seet den for sidste Gang. Allerede 7 Kvartmil i Nordøst for Nordøstkap fandtes 1040 Favne. Derefter oploddedes et Snit mod Vest og senere Nordvest, i hvilket vi fik 1000 Favnes Dyb i omtrent 28 Kvartmils Afstand fra Land. Der viste sig heller ikke her nogen Is paa Havet, men Luftens Temperatur gik om Natten ned til $+0^{0}.1$. Da vi allerede østenfor Jan Mayen havde fundet Kuldegrader i Havet i et saa ringe Dyb som 20 Favne, og saaledes var komne ind i den grønlandske Polarstrøm,

our first glimpse of Beerenberg, with his dazzling, snow-clad summit, standing boldly out against the deep-blue northern sky — a truly grand and imposing spectacle. On our course round the northern shores of the island to the Great Wood-Bay, we determined the position of the glaciers and headlands then visible, by compass bearings and observations with the sextant. At midnight we came to anchor in the Great Wood-Bay, off the lagoon, in 12 fathoms, upwards of a mile west-south-west of the Egg-crater.

We lay at our anchorage the whole of the following day. There was too much surf to attempt conveying any instruments ashore. The canopy of clouds still extended over Beerenberg and the heights in the southern part of the island, — though not so dense but that the sun could occasionally pierce it; and hence we succeeded from our position on board the ship in obtaining a series of altitudes. In the afternoon, having made a fruitless attempt to land, we determined by trignometrical observations the bearings of several of the salient points on the east coast, and their respective distances from the Fugleberg on the western shore, the summit of that cliff being visible above the lowest parts of the island. Mr. Schiertz, artist to the Expedition, made sketches of the scenery then in view, and our naturalists dredged in shallow water.

On the forenoon of Wednesday the 1st of August we could again take a few altitudes of the sun. There was now a rent here and there in the cover of cloud over the northern parts of the island; but over the southern it still hung heavily. As on the day before, there was a considerable swell. Weighing anchor, we stood out to sea, sounding, taking serial temperatures, and dredging the bottom, which consisted of black sand and clay. Meanwhile, Beerenberg had begun to emerge from under his misty shroud; and in the afternoon the giant stood forth in all his grandeur. Off the coast, fierce eddying gusts (whirlwinds) repeatedly swept the surface of the ocean; and on shore, as could be plainly seen from the deck of the vessel, they whirled high into the air the loose tufaceous sand of the Egg-crater, presenting a striking resemblance to a volcanic eruption. In the evening we anchored off the lagoon, a couple of miles south-west of our last anchoring-place.

On the 2nd of August the surf still prevented our landing. Getting under weigh in the forenoon, we stood eastward, our first work being to measure the altitude of Beerenberg, by computing from the distance run and trignometrical observations. We then dredged and sounded, again coursing east and north of the island. Beerenberg once more retired within his misty covering, and we had seen him for the last time. At no greater distance than 7 miles north-east of the north-eastern extremity of the island, the depth was 1040 fathoms. We then explored a section bearing west and north-west, in which the depth reached 1000 fathoms, about 28 miles from land. No ice was met with here either in the sea; but the temperature of the atmosphere sank at night to $+0^{0}.1$. Having observed east of Jan Mayen at the trifling

havde vi ingen særlig Grund til at opsøge selve Isgrændsen, og sejlede derfor tilbage mod Jan Mayen, hvor vi om Morgenen den 3die August befandt os udenfor Marie-Muss Bugten. Vejret var meget taaget og Brændingerne forbød Landgang. Vi gik om Formiddagen langs Vestkysten sydvestover, tog enkelte Lodskud og Skitser, naar Taagen lettede. Ved Middag passeredes Sydkap og de syv Klipper, hvorpaa hele Jan Mayen forsvandt i Taagen. Der arbejdedes nu paa flere Stationer sydover til et Punkt omtrent midtvejs mellem Jan Mayen og Islands Banker (69° 2′ N. Br., 11° 26′ L. V. f. Gr.), hvor der var 1004 Favne. Her slukkedes af, og i stille og løj Bris drev vi med Polarstrømmen sydover, medens Fyrgangene rengjordes, hvilket Arbejde var færdigt om Eftermiddagen den 5te August, hvorefter Kursen sattes østover for at støde sammen med det før oparbejdede Snit fra Trænen. Under denne Del af Arbejdet fandtes vor største Dybde — 2005 Favne — paa 68° 21′ N. Br. og 2° 5′ L. V. f. Gr. Middag den 8de August naaedes det vestligste af de før tagne Lodskud, og den 10de om Morgenen passerede vi gjennem Moskenes-Strømmen, den berygtede Malstrøm, ind i Vestfjorden, der laa i det pragtfuldeste Vejr. Om Eftermiddagen toges omtrent 8 Kvartmil søndenfor Skraaven en Misvisnings- og Deviationsobservation, og om Aftenen tørnedes i Ørsnes. Den næste Dag toges to Skrabninger i Vestfjorden, og om Aftenen Kl. 11 ankom Expeditionen til Bodø.

Her blev nu Kjedlen ordentligt efterseet og Skibet rengjort udenbords. Samtidig toges magnetiske og astronomiske Observationer i Land. Onsdag den 15de August gik vi ind til Hopen, hvor vi fyldte en Del Vand, og gik derfra paa stille Vande gjennem Saltstrømmen ind i Skjerstadfjorden, hvor der blev taget 3 Lodskud, en Temperaturrække og 2 Skraber, hvoraf den ene strax indenfor Strømmen viste et særdeles rigt Dyreliv. Vi laa tilankers en Dag ved Rognan i Saltdalen, hvor vi fyldte det manglende af Vandbeholdningen. Lørdag den 18de August toges atter en Temperaturrække i Vestfjorden, hvorefter Kursen sattes sydover. Kl. $10^1/_2$ Form. den 23de August ankom Expeditionen til Bergen, hvor Desarmeringen strax paabegyndtes, og Skibet blev overleveret Rederiet færdig til Fragtfart paa den i Kontrakten stipulerede Dag, den 7de September.

Der blev dette Aar ialt taget 160 Lodskud, 27 Skraber, 9 Trawler og 37 Temperaturrækker. Expeditionen

depth of 20 fathoms a temperature below 0°, and thus struck the Greenland Polar current, we had no call to push on in search of the Ice-barrier itself, and accordingly steamed back to Jan Mayen, reaching that island, off Mary Muss Bay, on the morning of the 3rd of August. The weather was exceedingly foggy, and the surf forbade all thoughts of landing. During the forenoon we coursed along the western shore in a south-westerly direction, took a few soundings, and made sketches of the coast whenever the fog cleared off. By noon we had reached South Cape, after passing which and the Seven Cliffs Jan Mayen suddenly disappeared, the whole island having been swallowed up, as it were, by the fog. We now took a southward course, investigating at several stations, to a point about midway between Jan Mayen and the Iceland banks (lat. 69° 2′ N., long. 11° 26′ W.), where the depth was 1004 fathoms. Here, we had the engine-fires put out, preparatory to clearing the stoke-holes; and now in a dead calm, now before a light breeze, the "Vøringen" drifted south with the Polar current. On the afternoon of the 5th she was again under steam, standing east for the Trænen section, already explored. In this part of the ocean we found the greatest depth measured on the Expedition — 2005 fathoms, in lat. 68° 21′ N. and long. 2° 5′ W. On Monday the 8th of August, about noon, we reached the point at which the most westerly sounding had been taken, and on the morning of the 10th steamed through Moskenes Sound, with its whirlpool of dread repute — the celebrated Malstrøm, into the Vestfjord, that lay extended before us, peacefully slumbering in the glorious summer weather. In the afternoon, about 8 miles south of Skraaven, observations were taken to determine the deviation of the compass, and in the evening we anchored at Ørsnes. On the following day the dredge was twice sent down in the Vestfjord, and in the evening the Expedition arrived at Bodø.

Here the boilers were carefully examined, and the outside of the vessel washed. Moreover, we took advantage of our stay at this place to take magnetical and astronomical observations on shore. On Wednesday the 15th of August the Expedition proceeded to Hopen, and took in there a supply of water, after which we steamed, with a slack tide, through Saltstrømmen Sound into the Skjerstadfjord. Here we took 3 soundings, 1 set of temperatures, and 2 hauls of the dredge, one of which, viz. that taken on entering the Sound, was uncommonly successful, bringing up a rich freight of animal life. We passed a day at Rognan in Saltdalen, to complete our supply of water. On Saturday the 28th of August, after taking another serial temperature in the Vestfjord, the Expedition stood south for Bergen, where we arrived on the 23rd of August, at 10 o'clock in the morning. After paying off the crew, the work of clearing the vessel and getting her ready for the freight-trade was at once commenced, and on the 7th of September, the day stipulated in the Contract, she was given up to her owners.

This year there were taken in all 160 soundings, 27 hauls of the dredge, 9 casts of the trawl, and 37 serial

havde hele denne Sommer et for de besøgte Farvande vistnok usædvanligt smukt Vejr, der ikke alene tillod, at der blev arbejdet paa saamange flere Stationer end den første Sommer, men Arbejdet paa hver enkelt Station blev udført med Ro og Lethed, og der var fuld Anledning for Zoologerne til strax at foretage de foreløbige og som oftest vigtigste Iagttagelser, hvilket det hyppigt det første Aar blev aldeles umuligt at udføre paa Grund af Skibets voldsomme Bevægelser.

1878.

Den for dette Aar vedtagne Plan, der ledsagedes af et Kart over de eventuelle Stationer, var saalydende:

Ved Expeditionens Rejser i 1876 og 1877 ere Undersøgelserne af det norske Hav i de Retninger, der ere Expeditionens Formaal, naaede til den 71de Breddegrad. Hvad der staar tilbage, er saaledes den nordenfor den nævnte Breddegrad liggende Del af det europæiske Ishav, der om Sommeren er navigabel uden Hindringer, foraarsagede ved Is.

Den Del af dette Hav, der ligger mellem Nordkap, Spidsbergen, Novaja-Semlja og Nord-Rusland — kaldet Østishavet, Novaja-Semlja-Havet eller det Murmanske Hav — vides ifølge Observationer fra Finmarkens Kyster og fra Havet søndenom og østenom Beeren-Eiland at være for hele den sydlige og vestlige Dels Vedkommende fyldt med Vand, der holder Varmegrader. Det synes at være fra dette Hav at Lodden, der giver Finmarken sit bekjendte Vaartorskfiske, kommer ind til den norske Kyst. Da Grændsen for begge disse Fiskearters Vandring antagelig er omtrent der, hvor det varme Vand ved Havbunden afløses af iskoldt Vand, maa det ansees for at være af stor Interesse at faa bestemt, i alle Fald i større Omrids, Beliggenheden af den Linie, der betegner Grændsen mellem det varme og det iskolde Vand ved Havbunden i Østishavet samt de øvrige fysiske og biologiske Forhold paa begge Sider af denne Grændse. Forholdene ere her i mange Henseender overensstemmende med dem paa Kystbankerne paa Norges Vestkyst, men vise ogsaa Forskjelligheder derfra og frembyde saaledes et Felt for Studiet af saavel Havstrømningernes Natur som af Dyrelivets Forhold, der er af høj Betydning for disses Forklaring i sin Almindelighed.

Til at lette denne Undersøgelse tjener for det første den Omstændighed, at Østishavet er forholdsvis grundt — de største Dybder naa ikke 300 Favne. Desuden er Nordgrændsen for det varme Vand ved Bunden paa en større

temperatures. Throughout the entire season the weather continued remarkably fine for the high latitudes in which the Expedition had to cruise; and this fortunate circumstance admitted not only of our extending the exploratory work to a greater number of observing-stations than the year before, — at every single station, this could in consequence be accomplished with precision and comparative facility; moreover, ample opportunity was afforded the zoologists of instituting on ship-board their preliminary and, as a rule, most important observations, which, on the preceding cruise, had so frequently proved impossible, owing to the violent motion of the vessel.

1878.

The Scheme approved for this year, to which had been appended a Diagram showing the position of each observing-station, ran as follows: —

As the result of its cruises in 1876 and 1877, the Expedition has investigated the Norwegian Sea in the several directions that had necessarily to be taken for the attainment of the object proposed, up to the 71st parallel of latitude. Hence, what remains to be explored is the tract of the Arctic Ocean in Europe stretching north of the said line, and which in the summer months may be navigated without impediment from ice.

The section of this ocean-basin lying between the North Cape, Spitzbergen, Novaja Zemlja, and Northern Russia — differently designated as the East Arctic Ocean, the Novaja Zemlja Sea, the Murman Sea, and the Barentz Sea — is known, from observations instituted on the coasts of Finmark and in the open sea south and east of Beeren Eiland, to be filled with water of a temperature above 0^0 throughout the southern and western tracts. It is from this sea, apparently, that the capelan, the little fish to which Finmark is indebted for her spring cod-fishery, repairs to the Norwegian coast. The boundary that marks the migratory distribution of these two fishes, lying, we have reason to believe, about where the warm and cold bottom-water meet, it is obviously of great importance to determine — if not in detail, at least broadly — the line bounding the warm and cold areas at the bottom of the East Arctic Ocean, together with the physical and biological conditions dominant on either side. The general conditions there have in many respects not a little in common with those of the coastal banks off the western shores of Norway; but, differing materially in some, they present, as regards the nature of ocean-currents and the conditions of animal life, a specially valuable field of elucidative research.

Exploratory work in this tract will be much facilitated by reason of the comparative shallowness of the East Arctic Ocean, — the greatest depths not even reaching 300 fathoms. Besides, the northern boundary of the warm

Strækning allerede bestemt, nemlig østenfor Beeren Eiland, og en ydre Grændse foreløbig kjendt mod Øst ved de talrige og udmerkede Observationer, som den østerrigske Polarfarer Løitn. Weyprecht har anstillet og velvilligen meddelte Professor Mohn til Afbenyttelse. Disse Omstændigheder tillade en saa vidt gaaende Orientering i Feltet, at man kan gjøre en Beregning over den Tid, Undersøgelserne ved Expeditionen antagelig ville komme til at tage. En saadan Beregning, hvis Resultat nedenfor skal meddeles, viser, at der for Tidens Skyld Intet er til Hinder mod at optage denne Undersøgelse af Østishavet inden Expeditionens Undersøgelseskreds.

Ved de sidste Expeditioner af Professor Nordenskiöld er det kariske Havs fysiske og biologiske Forhold blevne undersøgte. Vor Expeditions Undersøgelse af Østishavet vil knytte Undersøgelserne fra det hele Atlanterhav til dem, der ere gjorte og forhaabentlig til Sommeren af Nordenskiöld blive gjorte ved Kysterne af det asiatiske Ishav og dem, der ere gjorte i endnu nordligere Egne af den østerrigsk-ungarske Polar-Expedition.

I Forbindelse med Undersøgelserne af Østishavet er det ønskeligt at benytte Anledningen paa Rejsen langs Finmarkens Kyst til zoologiske Undersøgelser i nogle af de Fjorde, der hidtil ikke ere undersøgte af vore Zoologer, saasom Altenfjord, Porsangerfjord eller Laxefjord og Tanafjord. Endvidere er det af Vigtighed for de meterologiske Observationer, som udføres paa Expeditionen, at de nærmeste Stationer i Norge, med hvilke Observationerne fra Havet blive at sammenstille, inspiceres ved samme Lejlighed i Lighed med hvad der de foregaaende Aar har fundet Sted. Disse Stationer ere Alten (Bossekop) Gjesvær og Vardø, af hvilke i alle Fald den første og sidste ligge lige i den til de ovennævnte Undersøgelsers Udførelse førende Vej.

Undersøgelserne af Havet mellem Nordkap, Jan Mayen og Spidsbergen antages at burde foretages paa samme Maade, som man tidligere er gaaet frem paa, nemlig ved Tversnit der opgaaes nogenlunde lodret mod Kysterne. Da Havbroen mellem Norge og Spidsbergen og Spidsbergens Vestkyst gaar i en mere nordlig og vestlig Retning end Norges Kyst ved Tromsø, blive Tversnittenes Retning at lægge mere langs Parallelcirklerne end tidligere. En Overgang heri kan naturligst ske ved at lægge et Par mindre Snit mellem Beeren-Eiland og Norge i Vinkel med Toppunkt ude i Havet omtrent midt imellem to større Tversnit.

Indtil Beeren Eiland (75° N.) lægges de store Tversnit med samme indbyrdes Afstand som Snittene søndenfor fra 1877. Det sydligste af de nye Snit er Fortsættelsen vestover af det nordligste i 1877 oparbejdede Snit. Vest-

bottom-water has been already determined for a considerable distance, viz. east of Beeren Eiland; and we are furnished, provisionally, with an extreme eastern limit in the many and excellent observations taken by the Austrian Arctic traveller, Lieutenant Weyprecht, and which he has kindly placed at the disposal of Professor Mohn. These data suffice to give some little familiarity with the salient features of the section, and hence afford a means of approximately computing the probable duration of the period required for the proposed investigations. A calculation has accordingly been made, and with such results that, as regards time, there will be nothing that need exclude a scientific investigation of the Barentz Sea from the exploratory work of the Expedition.

On the latest Swedish Expeditions, the physical and biological conditions of the Kara Sea were investigated by Professor Nordenskiöld. The exploration of the Murman Sea by the Norwegian Expedition will connect the investigations embracing the whole of the Atlantic with those that have been, and next summer, there is reason to believe, will be, carried out by Nordenskiöld in the Arctic Ocean off the coasts of Asia, and those achieved in still higher latitudes by the Austrio-Hungarian Polar Expedition.

When coursing along the coast of Finmark to the Murman Sea, advantage shall be taken of the opportunity then afforded of prosecuting zoological work in divers of the fjords not yet investigated by our naturalists, for example the Altenfjord, the Porsanger or Laxefjord, and the Tanafjord. Moreover, it is important, as regards the meteorological observations of the Expedition, that the stations — at the nearest points on the Norwegian coast — with which the observations taken in the open sea will have to be compared, shall on that occasion be duly inspected, as on the two preceding cruises. The stations in question are Alten (Bossekop), Gjesvær, and Vardø, two of which, the first and the last, lie directly in the route of the Expedition to the aforesaid field of investigation.

For the exploration of the Sea extending between the North Cape, Jan Mayen, and Spitzbergen, the best system will, it is believed, be that previously adopted, viz. of laying transverse sections as nearly as may be perpendicular to the coast. The edge of the bank between Norway and Spitzbergen, as also the western shores of that island, extending more to the north and west than does the coast of Norway at Tromsø, the transverse sections will have to be given a position somewhat more concentric with the parallels of latitude than in the tracts previously explored. With this object in view, the most natural transition may be effected by laying at an angle, with the vertex seawards, a couple of smaller sections beween Beeren Eiland and Norway, about midway between two larger sections.

As far north as Beeren Eiland (lat. 75°), the large transverse sections will have to lie at the same distance each from each as those explored south of that locality on last year's cruise (1877). The most southerly of the new sec-

grændsen for disse Tversnit er Østgrændsen for Grønlandsisen, eller om denne skulde være usædvanlig langt tilbagetrukket mod Vest, en Linje, der tillader ved Lodskuddene at opnaa en sikker Kundskab om Havbundens Form i det Store og et nøjagtigt Studium af det her antagelig værende dyriske Protoplasma, som fandtes i 1877 ved Jan Mayen. Vestenfor Spidsbergen er Bundens Form i det Store taget nogenlunde kjendt efter de svenske Expeditioners Lodninger. Men da paa den Tid disse foretoges (1868) endnu intet paalideligt Dybvandsthermometer havdes og Skrabninger paa store Dyb med store Apparater ikke vare komne igang, vil det for vor Expeditions Øjemed være nødvendigt at gjennemgaa det hele Felt systematisk. Da Afstanden mellem Spidsbergens Vestkyst og Grønlandsisen aftager raskt mod Nord, blive Tversnittene her efterhaanden kortere og kunne derfor samtlige lægges helt over den nævnte Afstand med en indbyrdes Afstand af en god Breddegrad.

Paa Bankerne sættes Lodskud saa tæt, at disses Afheld mod Dybet bliver bestemt paa en utvetydig Maade. Ude i det store Ishavsdyb vil en Meridiangrad (60 Kvartmil) antagelig være en passende Afstand mellem Lodskuddene i samme Tversnit.

En Gjenstand for speciel Undersøgelse bliver den varme Atlanterhavs Strøms Løb og Udstrækning mellem Beeren Eiland og Spidsbergen. Denne Undersøgelse, der fordrer Rækker af tættere Lodskud med Temperaturrækker, lover at blive af overordentlig stor Betydning for Havstrømmenes Theori, da den varme Strøm her flyder nordover mellem 2 sydovergaaende Polarstrømme, Grønlandshavets i Vest og Østspidsbergen — Beeren Eiland's mod Øst.

Dersom Isforholdene tillade det, udstrækkes Undersøgelserne til Spidsbergens Nordkyst. Antagelig er her Polarstrømmen alene raadende og dermed en passende Grændse sat for Expeditionens Arbejder mod Nord.

At udstrække Rejsen saa langt ind i Polarstrømmen, som Isforholdene tillade, er af Vigtighed for Undersøgelsen af det i 1877 ved Jan Mayen fundne Protoplasma.

Undersøgelserne antages at burde deles i 3 Afdelinger, mellem hvilke anløbes nærmeste norsk Havn (Hammerfest) for Udrustning med Kul, Vand, Proviant etc. Turen til Øst-Ishavet antages at burde foretages først, da Isen her antagelig tidligere trækker sig tilbage end i Grønlandshavet. Turen til Spidsbergen lægges til August Maaned, der er den bedste Aarstid paa disse Kanter. Turen vesterud til Grønlandshavet nordenfor Jan Mayen bliver saaledes den 2den i Rækken.

tions will extend westward from the most northerly section investigated the year before. The western limit for these sections will coincide with the eastern boundary of the Greenland ice-barrier, or, in the event of that barrier having receded unusually far west, with a line allowing the contour of the sea-bed on the Greenland side to be broadly determined, and offering ample opportunity for a detailed study of the animal protoplasma met with in 1877 off the island of Jan Mayen, and believed to occcur also in this region. West of Spitzbergen, the contour of the bottom was broadly determined by soundings taken on the Swedish Expeditions. No trustworthy deep-sea thermometer having however at that time been devised (1868), nor dredgings essayed at great depths with apparatus of proportionate dimensions, the whole of the tract will need to be gone over anew and systematically investigated. The distance between the west coast of Spitzbergen and the Greenland ice-barrier rapidly diminishing towards the north, the transverse sections here will get gradually shorter, and may accordingly be laid right across, at intervals slightly exceeding one degree of latitude.

On the banks, the soundings shall be taken with sufficient frequence to admit of clearly determining the seaward incline. In the great Arctic basin, intervals of 60 miles, or one meridional degree, will, it is believed, be a suitable distance at which to sound in one and the same section.

A subject for special investigation will be the flow and extent of the warm Atlantic current between Beeren Eiland and Spitzbergen. The solution of the problem therein involved, which calls for series of closer soundings, together with serial temperatures, cannot but furnish highly important data bearing directly on the theory of ocean currents, the warm Atlantic water here flowing northwards between two southward-setting Polar currents, — a western through the Greenland Sea, and an eastern passing along the shores of East Spitzbergen and Beeren Eiland.

Provided the further course of the vessel be unobstructed by ice, the Expedition will extend its investigations to the North Coast of Spitzbergen. In this region, probably, the Polar current alone prevails, and may, therefore, be taken as a proper boundary for the northern field of exploratory research.

By pushing on as far as practicable into the Polar current, i. e. till ice shall bar farther progress, much valuable material may be collected for prosecuting the investigation of the protoplasma found in 1877 off the island of Jan Mayen.

The exploratory work to be done on each cruise should, it is opined, embrace three intervals, or periods, the Expedition making, so soon as the investigations allotted to each shall have been completed, for the nearest Norwegian port (Hammerfest), to refit the vessel, taking in there a supply of coal, water, provisions, &c. The Murman Sea should, it is believed, be the first region explored, the ice there most probably breaking up somewhat earlier in the season than is the case with that of the Greenland Sea. The trip to Spitzbergen will be deferred till August, gener-

Expeditionen antages at afgaa fra Bergen i Midten af Juni til Tromsø. Forsaavidt Rejsen sker gjennem Vestfjorden, kunde Lejligheden benyttes til at tage en Temperaturrække i det dybeste af Vestfjorden udenfor Tranø, hvor de nye Dybvandsthermometre kunde prøves. Turen til Tromsø antages at kræve 4 Døgn. I Tromsø standses for at tage ombord en Mand, der medfølger Expeditionen som Kjendtmand for Finmarkens Kyst, Beeren Eiland og Spidsbergen. Derpaa gaar man ind til Alten, hvor den meteorologiske Station inspiceres, og Skrabning (Trawl) udføres i Altenfjorden. Herfra til Hammerfest, hvor Expeditionen indtager Forsyninger for Øst-Ishavsturen. Magnetiske Observationer til Bestemmelse af Misvisningen og Kompassets Deviation foretages i Altenfjord eller ved Hammerfest.

Fra Hammerfest sejles til Porsangerfjorden, hvor der loddes, tages Temperaturrækker og skrabes. Herfra, om Vejret (Taage) ikke er til Hinder, ind i Tanafjorden, hvor de samme Arbejder udføres. Derfra til Vardø, hvor den meteorologiske Station inspiceres.

Fra Vardø styres (omkring 27de Juni) først østover, derpaa nordover til Beeren Eilands Parallel og derpaa vestover, og Linjen for 0° ved Havbunden bestemmes. Ere Omstændighederne gunstige, forsøges Landgang paa Beeren Eiland. Herfra opsejles 2 Tversnit over Banken mellem Beeren Eiland og Norge for at bestemme dens Afheld mod Ishavsdybet, og derpaa sejles til Hammerfest, idet et Par Stationer lægges paa Vejen. Med en Fart af 6 Mil i Vagten, 16 Loddestationer (15 med Temperaturrække, 13 med Skrabe (Trawl)) vil Turen fra Vardø til Hammerfest (efter den Tid som Erfaringen fra 1877 har vist at der medgaar til de forskjellige Arbejder paa forskjelligt Dyb) tage 11 til 12 Døgn. I Hammerfest gjøres klar til 2den Tur vestover. Afgangen derfra kan sættes til omkring den 11te til 12te Juli.

2den Tur beregnes med 6 Knobs Fart, 18 Stationer (17 Temperaturrækker, hvoraf mange ganske korte i Polarstrømmen, 6 Skraber paa Banken, 2 Skraber paa stort Dyb — Lodning, Skrabe og Temperaturrække à 17 Timer) til 12½ Døgn. Paa Udrejsen fra Hammerfest undersøges Temperaturforholdene i Dybet omkring Station 201 fra 1877, hvor der viste sig et paafaldende anomalt Forhold.

ally the finest month in the year in those latitudes. Hence, the run westward and subsequent investigation of the Greenland Sea north of Jan Mayen, will occupy the second of the three intervals, or periods, planned in this Scheme of Work.

By the middle of June the Expedition will, if possible leave Bergen for Tromsø. Should the route selected lead through the Vestfjord, a series of temperatures might be taken in the deepest parts of the fjord, off Tranø, and the new deep-sea thermometers tested. Four days will probably be sufficient for the passage north to Tromsø. At this port the Expedition will take on board a pilot for the coast of Finmark, Beeren Eiland, and Spitzbergen. The next place on the route is Alten, where the Meteorological Station will be inspected, and the fjord dredged and trawled. From here the Expedition courses on to Hammerfest, at which port stores will have to be shipped for the exploratory tour to the Murman Sea. Magnetical observations to determine the deviation of the compass shall be taken either at Hammerfest or in the Altenfjord.

From Hammerfest the course runs on to the Porsangerfjord, where soundings and serial temperatures will be taken, and the dredge and trawl worked. From this point, weather permitting (it is frequently foggy hereabouts), the Expedition will steam on to the Tanafjord, and there prosecute similar exploratory work. The next place to be touched at is Vardø, where the Meteorological Station will be inspected.

From Vardø the Expedition will first stand eastward (about the 27th of June), then northward for the Beeren Eiland parallel of latitude, and then westward, determining by the way the boundary of the glacial bottom-area. If anyway practicable, the Scientific Staff will land on Beeren Eiland. From this point the Expedition shall explore a couple of transverse sections on the bank between Beeren Eiland and Norway, with the object of determining its incline towards the depths of the Arctic Ocean, and then run back to Hammerfest, working at one or two stations by the way. Steaming at the rate of 6 miles an hour, and with 16 sounding-stations, at 15 of which serial temperatnres will have to be taken and at 13 dredging and trawling-work done, the passage back to Hammerfest *viâ* Vardø (judging from last year's experience as to the time required for the different investigations at various depths) can be made in 11 or 12 days. At Hammerfest the vessel has to be got ready for the second of the cruises westward, the departure of the Expedition being fixed for about the 11th or 12th of July.

The speed of the vessel being supposed to average 6 knots, this second cruise will, with 18 stations (17 serial temperatures — many of those in the Polar current being however quite short — 6 hauls of the dredge on the bank, and 2 at great depths [sounding, dredging, and taking temperatures estimated to occupy 17 hours]), take 12 days and a half. On the run out from Hammerfest, the Expedition shall investigate the thermal conditions prevailing in deep water round Station 201, where, on last

Efter færdig Ekvipering i Hammerfest til Spidsbergensturen (antagelig omkring den 29de Juli) sejles til Farvandet mellem. Beeren Eiland og Spidsbergen, hvilket antages at kunne undersøges tilstrækkeligt ved 3 Tversnit. Fra Sydkap sejles vestover til Grønlandsisen, nordover langs Isgrændsen og derpaa østover mod Mundingen af Isfjorden. Det næste Tversnit tænkes lagt vestover fra Kingsbay til Isgrændsen og det sidste store Tversnit lidt nordenfor 80° Bredde. Den her nævnte Del af Turen med 27 Stationer (25 Temperaturrækker, hvoraf flere smaa, 11 Skrabninger) samt Tilbagerejse til Hammerfest beregnes med 6 Mils Fart til 13½ Døgn.

Paa Optur søges Arbejdet paa Søen først fremmet med den Hurtighed som Undersøgelsernes Nøjagtighed kræver og Vejrforholdene tillade. Ere de sidste gunstige, anvendes de følgende Dage til mere specielle Undersøgelser paa Spidsbergens Banker, i dens Fjorde, i Land. Under tidligere indtræffende ugunstige Vejrforhold, tages de sidstnævnte Arbejder i Mellemtiden, om muligt, og Arbejderne i Søen under de gunstigere Perioder. Tilbagerejsen tiltrædes omkring den 24de August og gaar til Hammerfest eller (nærmere) til Tromsø, hvor den kjendte Mand sættes af. Herfra til Bergen, hvor Expeditionens derboende Deltagere gaa fra Borde, hvorpaa Rejsen fortsættes til Christiania og Horten, hvor Desarmeringen finder Sted, og Fartøjet gjøres istand til Overleverelse til Rederiet.

De videnskabelige Arbejder udføres væsentlig paa samme Maade som i 1877.

Ved Lodningerne og Temperaturrækkerne søges erholdt saamange fuldstændige Sammenligninger mellem de forskjellige Slags Dybvandsthermometre, som Omstændighederne tillade. En nøjagtig Undersøgelse af de ved de to første Togter benyttede Dybvandsthermometre ved Sammenligning med nyere Sorter er af største Vigtighed for den nøjagtige Bestemmelse af Temperaturen i Dybet paa de af Expeditionen i 1876 og 77 besøgte Strækninger. Bundprøve tages ved hvert Lodskud og opbevares. Temperaturrækkerne tages saa tæt, at en utvetydig Kundskab erholdes om Varmefordelingen i Dybet. I Polarstrømmen kunne de fleste Temperaturrækker indskrænkes til de øverste Vandlag (til — 1°), idet et Par fuldstændige Rækker tages gjennem hele Dybet til Constatering af Temperaturforholdene. Strømmaalinger forsøges. Ligeledes tages om muligt ved hvert Lodskud og paa enkelte Stationer, hvor det ansees ønskeligt, i intermediære Dybder Vandprøver til Bestemmelse af specifisk Vægt og chemisk Undersøgelse. Et Piezometer bør medfølge hvert Lodskud, dels som Control for Dybden dels til Bestemmelse af Piezometrets Constanter.

year's cruise, a singular anomaly of temperature was observed.

Having refitted at Hammerfest (by about the 29th of July) for the excursion to Spitzbergen, the Expedition shall at once proceed to the tract between Beeren Eiland and Spitzbergen, for investigating which three transverse sections will probably prove sufficient. From South Cape the course will lie westward to the Greenland ice, then northward along the ice-barrier, and then eastward for the mouth of the Ice-Sound. The next transverse section should, it is opined, stretch westward from King's Bay to the ice-barrier, and the last of the large transverse sections lie north of the 80th parallel of latitude. This third part of the entire cruise, with 27 Stations (25 serial temperatures, several of them short, and 11 hauls of the dredge), including the run back to Hammerfest, is calculated, with a speed of 6 knots, to take 13 days and a half.

On the passage out, all deep-sea work shall be done first, as expeditiously as may prove consistent with accurate investigation and the state of the weather. Provided the latter be favourable, some few days may then be devoted to more special investigations on the banks of Spitzbergen, in the fjords of the island, and on shore. Bad weather supervening, the exploration of the depths shall be broken off, to be resumed under more favourable circumstances, and the work on the banks prosecuted, if possible, in the interim. On the homeward passage — to commence about the 24th of August — the Expedition will make for Hammerfest, or possibly a nearer point, Tromsø, where the pilot will quit the ship. From here the homeward course runs straight to Bergen, where the members of the Scientific Staff resident in that city disembark, after which the vessel will proceed to Christiania and Horten. At Horten she will be paid off, and put in order previous to being given up to her owners in Bergen.

The scientific work of the Expedition to be prosecuted essentially as in 1877.

When taking soundings and serial temperatures, the various kinds of deep-sea thermometers shall be compared together as closely and as frequently as circumstances may admit of. A rigorous testing of the deep-sea thermometers employed on the two first cruises, by comparing them with those of a later construction, is of the utmost importance as regards the true determination of the temperature in the deeper strata of the ocean-tracts then visited by the Expedition. A sample of the bottom shall be brought up at every sounding, and preserved for subsequent examination. The serial temperatures shall be taken sufficiently close to afford a clear insight into the thermal conditions throughout the ocean-depths. In the Polar current, most of the serial temperatures may be confined to the upper strata (to — 1°), two complete series being taken throughout the entire depth, to substantiate the nature of the thermal conditions. Observations are, if possible, to be taken for ascertaining the rate and direction of currents. Moreover, with every sounding, and at some stations from intermediate depths, a sample of the sea-water shall, if

Arbejde med Skrabe, Trawl, Svabere og Overfladenet foretages paa de Stationer, hvor saadanne ansees nødvendige for Studiet af Dyrelivet i de forskjellige Dybder, undersøiske Klimater og Bundarter.

De chemiske Arbejder, inclusive Bestemmelsen af Havvandets specifiske Vægt udføres i det væsentlige som i 1877.

Magnetiske Observationer søges udført i Søen, navnlig Misvisnings-Observationer. Absolute Bestemmelser af de jordmagnetiske Elementer søges gjort paa Land paa Spidsbergen, Beeren Eiland og i Norge. Saavidt muligt paa Steder, hvorfra der tidligere haves saadanne.

Geologiske og botaniske Iagttagelser udføres efter Lejlighed paa de Steder, som Expeditionen anløber. Ligesaa astronomiske Stedbestemmelser, topografiske og hydrografiske Undersøgelser.

De meteorologiske Iagttagelser ombord udføres som i 1877.

Ved de Lejligheder, Expeditionen passerer Beeren Eiland, forsøges, om Omstændighederne maatte være gunstige, Landgang der til Udførelse af astronomiske, geografiske, geologiske, zoologiske, botaniske, hydrografiske Undersøgelser.

Paa Spidsbergen foretages lignende Undersøgelser paa de Steder, hvor Expeditionen kommer til at anløbe — hvilke Steder blive at bestemme efter de Fordringer, som Arbejderne i Søen stille. Specielt haves Opmærksomheden rettet paa Undersøgelse af Fiskerierne ved Spidsbergens Kyst og i dens Fjorde, paa jordmagnetiske og hydrografiske Undersøgelser.

Som Følge af, at Expeditionen for dette Aar var besluttet forlagt 14 Dage senere end de foregaaende Aars, indførtes de nødvendige Forandringer i Kontrakten om Lejen af Skibet, og dette overtoges først den 1ste Maj. Indredningsarbejderne udførtes ved Brunchorst & Dekkes Værft aldeles som det foregaaende Aar, uden Forandring hverken i Apteringer eller i Apparaternes Placering.

Den 11te Juni hejstes Kommandoen og Mandskabet paamønstredes. Da Premierlieutenant Petersen havde frasagt sig Posten som Næstcommanderende paa Grund af Sygdom, blev denne Stilling overtaget af Skibsfører Grieg, medens en tredie Styrmand forhyredes, for om muligt at overtage noget af Trediecommanderendes Tjeneste. Den 13de Juni kom Professor Sars og Kemikerne Tornøe og Schmelck ombord, og den 14de halede vi ud fra Værftet

possible, be collected, for determining the specific gravity, and for chemical examination. A piezometer will have to be sent down with every sounding, partly as a means of controlling the depth, and partly to determine the constants of the piezometer.

Exploratory work with the dredge, trawl, surface-net, and swabs, will be prosecuted at all stations where it affords opportunity of investigating the forms of animal life in the various depths, as also submarine climatic conditions, and the materials of the sea-bottom.

The chemical work of the Expedition, including determinations of specific gravity, to be done essentially as on last year's cruise.

Magnetical observations shall, if possible, be taken at sea; in particular those for obtaining the variation of the compass, and absolute determinations ashore, on Spitzbergen, Beeren Eiland, and in Norway, if practicable at points from which such observations already exist.

Geological and botanical work will be prosecuted in suitable localities; likewise astronomical observations of latitude and longitude, together with topographical and hydrographical investigations.

The meteorological observations to be taken essentially as on last year's cruise.

When passing Beeren Eiland, attempt shall, on each occasion, if practicable, be made to land there, with the object of prosecuting astronomical, geographical, geological, zoological, botanical, hydrographical investigations.

On Spitzbergen, too, like investigations shall be undertaken in localities visited by the Expedition, the number and positions of the localities depending on the time required for the exploration in the open sea. Attention is specially directed to the fisheries off the coasts of Spitzbergen and in the fjords of the island, as also to the importance of magnetic and hydrographical observations.

The departure of the Expedition this year having been fixed to take place a fortnight later than on the two preceding cruises, a clause to that effect, modifying the terms originally agreed upon, was introduced into the Contract for the hire of the vessel; and accordingly she was not taken in charge till the 1st of May. This year, too, the ship was fitted out by Messrs. Brunchorst & Dekke, without change either as regards the general arrangement or the placing of the apparatus.

On the 11th of June I hoisted my pennant, and the crew came on board. Lieutenant Petersen, R.N., having from ill-health had to resign his post as first-lieutenant, Mr. Grieg, captain in the merchant-navy, was appointed to succeed him, and a third matè engaged to assist the first-lieutenant in the discharge of his duties. On the 13th of June Professor Sars embarked, along with Mr. Tornøe and Mr. Schmelck; and on the 14th we hauled out

og gik Prøvetur, under hvilken Loggemaskinen prøvedes og Kompassets Deviation undersøgtes. Lørdag den 15de kom D'Hrr. Mohn, Danielssen, Friele og Schiertz ombord og Kl. 4¾ samme Dags Eftermiddag afgik Expeditionen fra Bergen og styrede nordover langs Leden.

Mandag den 17de Juni, efter Afgangen fra Børøsund ved Throndhjemsleden havde vi det Uheld, at Skibet, omtrent tvers af Nordpynten af Fjeldvær, skurede over en Boe, og jeg saa, at en Del af Straakjølen gik tabt. Skibet blev ikke staaende, og heller ikke lækt, saa at der var stor Sandsynlighed for, at det ikke havde faaet nogen væsentlig Skade. Da der ikke existerer nyere, detaljerede Karter over denne Del af Kysten, var jeg her afskaaret fra Lejlighed til at kunne kontrollere Lodsen. Et Par Timer efter var vi saa heldige at træffe Havnevæsenets Dampskib "Nicolay," hvor Havnedirectør Roll med sin Dykker var ombord, og strax var villig til at yde fornøden Bistand. Begge Skibe gik da ind i Hopen-Fjord, hvor Dykkeren tre Gange var nede og undersøgte Vøringens Bund. Da han erklærede, at Skibet ingen anden Skade havde faaet, end det før nævnte Tab af en Del af Straakjølen, fortsattes Rejsen om Natten nordover. Under hele vor Rejse mærkedes ingensinde nogensomhelst Ulempe efter Stødningen, men ved Doksætningen om Høsten viste det sig, at selve Kjølen ogsaa for en Del var beskadiget, saaledes at Veritas-Besigtigelsen fordrede et Stykke ny Kjøl indsat.

Onsdag den 19de Juli toges en Temperaturrække og en Skrabe i Vestfjorden og Kl. 11 Form. den 20de ankom vi til Tromsø, hvor Kjendtmand Petter Bjørvik kom ombord. Denne Mand var gjennem velvillig Assistance af Hr. Toldkasserer Pettersen bleven engageret til at følge Expeditionen som Lods paa Finmarken og Spidsbergen. Kl. 4 samme Dags Eftermiddag afgik Expeditionen til Alten-Fjord, hvor der den 21de toges to Temperaturrækker, Skrabe og Trawl, medens Hr. Friele arbejdede langs Landet fra Baad og Professor Mohn inspicerede Altens meteorologiske Station. Kl. 5½ Form. den 22de Juni ankredes i Hammerfest, hvor vi fyldte Vand og blev liggende Søndagen over. Kl. 2 Form. Mandag den 24de afgik vi fra Hammerfest, og arbejdede de følgende Dage i Porsanger-Fjord og i Tana-Fjord. Udenfor Baads-Fjord toges Misvisnings- og Deviations-Observation og den 25de Kl. 11½ Eftm. ankom Expeditionen til Vardø. Efterat her var taget magnetiske og astronomiske Observationer og den meteorologiske Station inspiceret, gik vi tilsøs om Morgenen den 27de for efter Planen at begynde med Undersøgelserne i Øst-Ishavet.

from the wharf to take a trial-trip, during which the log-apparatus was tested and the deviation of the compass determined. On Saturday the 15th of June Professor Mohn, Dr. Danielssen, Mr. Friele, and Mr. Schiertz came on board, and on the afternoon of that day, at 4.45 p.m., the Expedition left Bergen, proceeding northward by the inshore route.

On Monday the 17th of June, shortly after our departure from Børøsund, a place on the inshore route to Throndhjem, the vessel chanced unfortunately to touch a sunken rock, and I saw part of the false keel carried away. Meanwhile, as the ship neither stuck fast nor sprang a leak, there was good reason to believe she could not have sustained any material damage. New, detailed charts for this part of the coast having not yet been constructed, I was unable to check the pilot. A couple of hours or so after our misadventure, we had the good fortune to fall in with the steamer "Nicolay," belonging to the Harbour Works; and Mr. Roll, the director, who happened to be on board and had with him his diving-assistant, at once volunteered assistance. Both vessels now steamed into the Hopen Fjord; and here Mr. Roll's diver went down three times in succession to examine the "Vøringen"'s bottom. His report, however, being to the effect that, beyond the aforesaid loss of part of her false keel, the ship had sustained no damage whatever, we resolved to continue the voyage, and after night-fall pursued our course northward. During the whole cruise no detrimental effects were found to result from the accident; but on docking the vessel in the autumn after our return, it seemed that the true keel had suffered to some extent too; indeed the Surveyor to the "Veritas" insisted on having a new piece put in.

On Wednesday the 19th of July a serial temperature and a haul of the dredge were taken in the Vestfjord; and on the forenoon of the 20th, at 11 a.m., we arrived at Tromsø, where a pilot, Petter Bjørvik by name, came on board. This man had been engaged by Mr. Pettersen, receiver of customs, to act as pilot to the Expedition for the coasts of Finmark and Spitzbergen. The same day, at 4 o'clock in the afternoon, the Expedition proceeded to the Alten Fjord, where, on the 21st, two serial temperatures were taken, together with a haul of the deep-sea apparatus, both dredge and trawl, Mr. Friele working the while along the shore from a boat, and Professor Mohn being occupied with inspecting the Meteorological Station at Alten. On the forenoon of the 22nd the Expedition arrived at Hammerfest, where we took in a supply of water, and spent the following day (Sunday) at anchor. On Monday the 24th of June, at 2 a.m., the Expedition left Hammerfest, and devoted the next few days to exploratory work in the Porsanger and Tana Fjords. Off the mouth of the fjord observations were taken to determine the variation and deviation of the compass, and on the 25th, at 11.30 p.m., the Expedition reached Vardø. After a series of magnetical and astronomical observations had been taken, and the Meteorological Station inspected, on the morning

Kursen sattes først i øst-nord-østlig Retning og samme Dag toges Trawl og Skrabe, samt tre Lodskud, men om Aftenen begyndte det at kule paa, og om Natten maatte vi lægge paa Vejret og blev liggende for Storm af VNV., Regn og noget Snedrev samt høj Sø til næste Dags Aften den 28de, da vi loddede og atter styrede øst-nord-østover. Der arbejdedes nu under stadig Kuling, surt og koldt Vejr først nordover til Beeren-Eilands Parallelcirkel og derefter vestover, indtil vi om Aftenen den 3die Juli fik Beeren Eiland i Sigte, og vi saa da den første Drivis, dog kun enkelte Flager. Om Formiddagen den 4de Juli ankrede vi under Beeren-Eiland udenfor den saakaldte Sydhavn, og landsatte den til den hollandske Expedition med Skonnerten "De Willem Barendsz" fra Bergen medtagne Post, der nedgravedes i Nærheden af Russestuen og merkedes paa den af den hollandske Konsul opgivne Maade. Samtidig blev der skudt en Del Fugle og foretaget botaniske og geologiske Indsamlinger. Højden af Mount Misery bestemtes ved Vinkelmaalinger. Om Eftermiddagen afgik vi fra Beeren-Eiland og arbejdede sydvestover for at bestemme Affaldet af Banken mod Vest. Kl. $5^1/_2$ Form. den 6te Juli fik vi 1024 Favne paa 73° 6′ N. Br. og 11° 56′ L. Ø. f. Gr., hvorefter Kursen sattes øst-syd-østlig for at bestemme Affaldet paa en sydligere Bredde, og Kl. 2 Eftermiddag Mandag den 8de Juli ankom vi til Hammerfest.

Fra Tirsdag Morgen til Fredag Aften benyttedes Tiden til at skrubbe Skibsbunden, fylde Kul og Vand, rengjøre Kjedlen og efterse Maskinen, samt til at tage magnetiske og astronomiske Observationer, der udførtes paa Fuglenes i Nærheden af Gradmaalingsstøtten.

Kl. 6 Formiddag den 13de Juli afgik vi i godt Vejr paa den anden Tur og satte Kursen vestover. Om Eftermiddagen toges en Misvisningsobservation med Azimuther Kompasset rundt. Med vest-nord-vestlig Kurs naaedes den næste Dags Middag vort nordligste Punkt fra det foregaaende Aar, hvor der toges Lodskud og Bundtemperatur med 4 Thermometre af forskjellig Konstruktion. Herfra sejledes videre mod Vest-Nord-Vest, under jevnt Arbejde med Lodskud, Temperaturrækker og Trawl, indtil vi Onsdag Aften den 17de mødte de første Flager af den grønlandske Vest-Is og Kl. $10^1/_4$ maatte vi stoppe for tættere Drivis. Vi var da paa 73° 10′ N. Br. og 3° 22′ L. V. f. Gr., og havde saaledes mødt Isen paa en ikke lidet østligere Længde end paaregnet. Vejret var blevet koldt og taaget med en stiv Kuling af nordvestlig Vind. Efterat der var taget en Temperaturrække i Nærheden af Isen, sattes Kursen nordøstover og senere nordover langs Isen, der snart tabtes af

of the 27th of June we steamed out of the harbour, on the morning of the 27th of June, *en route* for the Barentz Sea, where, according to the Scheme of Work, the Expedition was now to commence investigations.

Our course lay first east-north-east, and the same day we dredged and trawled and took three soundings; but in the evening it came on to blow, and in the night we lay to, and rode out a gale from the west-north-west, with rain and snow and a heavy sea, till the evening of the following day, the 28th; we were then able to sound, after which we steamed on again, steering as before east-north-east. We now pushed on, in cold and boisterous weather, first northward as for as the Beeren Eiland parallel of latitude, and then westward till, on the evening of the 3rd of July, that island hove in sight, and we passed the first drift-ice, — however only a few isolated floes. On the forenoon of the 4th we anchored off South Harbour, as it is called, and sent ashore the letter-box we had brought from Bergen for the Dutch Expedition with the schooner "De Willem Barendsz;" this we buried near the Russian Hut, after marking it in the manner indicated by the Dutch consul. While some of the party were thus engaged, others roamed about, shooting birds and collecting botanical and geological specimens. The altitude of Mount Misery was determined by trignometrical observations. In the afternoon we left Beeren Eiland, steering south-west to determine the slope of the bank in a westerly direction. On the 6th of July, at 5.30 a.m., we sounded in 1024 fathoms, lat. 73° 6′ N., long. 11° 56′ E., after which the course of the vessel was changed to east-south-east, with the object of determining the slope farther south; and on Monday the 8th of July, at 2 o'clock in the afternoon, the Expedition arrived at Hammerfest.

From Tuesday morning til Friday evening the time was occupied with scrubbing the ship's bottom, taking in coal and water, cleaning the boilers, and examining the engine, as also with taking magnetical and astronomical observations, at Fuglenes, near by the column indicating the terminus of the Russian-Swedish-Norwegian arc of meridian.

On the 13th of July, at 6 a.m., we left Hammerfest, in fine weather, standing west on the second excursion of the cruise. In the afternoon observations were taken to determine the variation of the compass. Steaming west-north-west, by next day at noon we had reached the most northerly point of last year's cruise. Here soundings were taken, and the bottom-temperature registered with 4 thermometers of different construction. From this point we continued to steer west-north-west, taking soundings and serial temperatures and working the trawl, till on the evening of Wednesday the 17th of July we reached the first floes of the Greenland ice, and at 10.15 p.m. the engines had to be stopped, owing to the closer packing of the drift-ice. We were then in lat. 73° 10′ N. and long. 3° 22′ W., having struck the ice considerably farther east than anticipated. The weather had now turned cold and foggy, with a stiff breeze from the north-west. After taking a series

Sigte, men hvis Nærhed tilkjendegaves af den lave Temperatur. Fremdeles herskede ogsaa Taage, Kuling og Sø. Fredag Morgen den 19de havde vi naaet 75° 16′ N. Br. 0° 54′ L. V. f. Gr. og fik her dette Aars dybeste Lodskud med 1985 eng. Favne, hvorefter Kursen sattes østover langs den 75de Breddegrad. Ved fortsatte Lodninger, Temperaturrækker og Trawlinger bestemtes paa Østgaaende, ligesom før paa Vestgaaende, den omtrentlige Grændse mellem Polarstrømmen og det varme Vand i Havets østlige Del. Ligeledes bestemtes Opgangen af Banken noget nordligere end Beeren Eiland, og Undersøgelserne fortsattes videre østover, indtil vi den 23de Juli befandt os paa 74° 57′ N. Br. og 19° 52′ L. Ø. f. Gr., hvor vi havde 21 Favne Vand med en Bundtemperatur af + 0°.2. Her toges en Skrabe, hvorpaa vi, under tiltagende Nordenvindskuling, holdt ned mod Beeren Eiland og derefter østenom Øen til dens Sydside. Søen var her allerede betydelig, saa det var forbundet med Vanskeligheder at gjøre Landgang. Vi saa imidlertid, at vort Flag var borte, og sluttede deraf, at Hollænderne havde været der og fundet Posten, hvilket viste sig at være rigtigt, efter de Efterretninger fra "Willem Barendtsz" som vi modtog fra Vardø ved vor Ankomst til Hammerfest. Den 24de lænsede vi med Storm af NNV., høj Sø, svære Slingringer og tilsidst Regntykke sydover mod Hammerfest. Kl. 10 om Aftenen fik vi et Øjeblik Kjending af Fruholm og Ingø tvers om Styrbord og Kl. 4 Formiddag den 25de kom vi i god Behold til Ankers i Hammerfest. Under Indsejlingen, da det var temmelig mørkt paa Grund af det tætte Regn, opstod Spørgsmaalet om at ankre, før vi kom til Hammerfest. Havde Nordhavs-Expeditionen gjort dette i Maasø, vilde den paa det nævnte Sted have stødt sammen med "Vega"-Expeditionen under Nordenskiöld og Palander, der laa her for at oppebie gunstigere Vejr. Da vi bestemte os til at gaa til Hammerfest med en Gang, passerede de to Expeditioner hverandre paa nogle faa Mils Afstand uden at vide det.

Fredag og Lørdag anvendtes til Fyldning af Vand og Kul, og Mandag den 29de Juli Kl. 6 Eftermiddag forlod vi atter Hammerfest for at udføre vor tredie Tur, idet vi til Afsked salutérede Byen med 4 Skud. Kursen sattes mod Beeren Eiland, som vi, efterat have taget 3 Lodskud og en Trawl undervejs, naaede Onsdag den 31te. Da vi ogsaa kom op under Øen, faldt Barometret 1^{mm} i Timen, ligesom Luften saa saa truende ud, at vi besluttede at se Vejret an i nogen Tid, og efter et Par Timers Forløb havde vi ogsaa fuld Storm. Da vi under disse Omstændigheder ikke kunde arbejde med Lodning og Skrabning, men godt nytte Tiden til Arbejder under Læ, naar Skibet var nogenlunde roligt, holdt vi det gaaende under Øens Østside, hvor Søen var nogenlunde rolig. Thorsdag Aften toges en Del Misvisnings-

of temperatures in close proximity to the ice; we stood on our course, steering first north-east and then north, along the ice, which was soon lost sight of, though the low temperature announced its comparative nearness. Fog, wind, and sea also continued to prevail. On the morning of Friday the 19th of July we had reached a point in lat. 75° 16′ N. long 0° 54′ W. Here a sounding was taken (1985 fathoms), the deepest on this year's cruise, after which we steamed eastward along the 75th parallel of latitude. By a continuous succession of soundings, serial temperatures, and trawlings, the boundary between the Polar current and the warm flow in the eastern section of the Sea was now on our passage east, as before on our passage west, approximately determined. We likewise determined the rise of the bank somewhat farther north than Beeren Eiland, and then continued investigating eastward till on the 23rd of July we found ourselves in lat. 74° 57′, long. 19° 52′ E., with a depth of 21 fathoms and a bottom-temperature of + 0°.2. Here we took a haul of the dredge, and then bore down, in a rising gale from the north, on Beeren Eiland, making for the south coast along its eastern shores. The sea here already running high, considerable difficulty would have been experienced in landing. Meanwhile, we could see that our flag was gone, and of course concluded that the Dutch explorers had found their letter-box, which, on our arrival at Hammerfest, proved to have been correct, a communication received there from the "Willem Barendtz" *viâ* Vardø apprizing us of the fact. On the 24th we stood south for Hammerfest, scudding before the wind in a gale from the north-north-west, with the ship rolling heavily, and a rainy mist coming on. About 10 p.m. we caught a glimpse of Fruholm and Ingø on the starboard beam, and next morning (July 25th), at 4 o'clock, dropped our anchor in Hammerfest harbour. When steaming up the fjord, it was rather dark, from the drizzly rain, and the question arose, whether it would not be best to anchor, for instance at Maasø, before proceeding to Hammerfest. Had this been done, the Norwegian North-Atlantic Expedition would have fallen in with the "Vega" Expedition, under the direction of Nordenskiöld and Palander, then lying at anchor here till the weather should moderate. As it was, the two Expeditions passed within a few miles of each other without knowing it.

Two days (Friday and Saturday) were spent in getting the ship ready for sea (watering, coaling, &c.), and on Monday the 29th of July, at 6 p.m., we again left Hammerfest, on the third excursion of the cruise, firing a salute of 4 guns in honour of the town, as we steamed out of the harbour. The Expedition stood straight for Beeren Eiland, which it reached on Wednesday the 31st of July. On the passage across, 3 soundings had been taken and one cast of the trawl. As we were nearing the land, the barometer began to fall, 1^{mm} an hour; the sky, too, wearing a threatening appearance, we resolved to wait and see how the weather would turn out. And it was well we did, for an hour or two after it blew a gale. Deep-sea operations, such as sounding and dredging, were now, of

og Deviations-Observationer med Skibet, og da Vejret nu havde bedaget sig noget, gjorde Kl. $9^1/_2$ D'Hrr. Mohn, Sars, Friele, Tornøe, Schmelck og Grieg Landgang ved Engelsk-Elven og foretog en Exkursion langs Østkysten i nordlig Retning. Imidlertid kom Taagen igjen og blev tættere efterhaanden, og Kl. 3 maatte jeg ankre op nær Land for ikke i den stærke Strøm at komme bort fra Landingspladsen eller støde paa Grund. Kl. 4 Fredag Morgen kom Exkursionspartiet ombord igjen, medbringende Fugle, Forsteninger og Planter. Efterat Baaden var ophejst, forsøgte vi at fiske, og det viste sig, at der stod en Mængde Torsk under Øen. Fra Kl. 5 til 7 droges 200 Stykker. Stormen vedvarede fremdeles og først den næste Dags Morgen bedagede den, saa at vi atter kunde sætte Kurs nordover. Samme Dags Eftermiddag naaede vi Station paa 75° 32′ N. Br. og 17° 50′ L. Ø. f. Gr., hvor vi fik 123 Favne og tog en Trawl. Vi oparbejdede nu Partiet til Spidsbergen i to mindre Tversnit, først et mod Vest-Nord-Vest, og derpaa et mod Øst-Nord-Øst og naaede ved Enden af dette Sydkap paa Spidsbergen Mandag den 5te August om Eftermiddagen. Da det blæste en frisk Bris af Nordvest, gik vi i Læ paa Østsiden af Sydkap, hvor vi om Aftenen tog en fuldstændig Misvisningsobservation, og gik om Natten op under den store Isbræ, der skyder som et mægtigt Forbjerg ud i Havet. Om Morgenen den 6te skrabede vi i Storfjorden paa 146 Favne, omsejlede Sydkap og satte derefter Kursen mod Vest. Med Undtagelse af enkelte Isflag, der drev sydover og enkelte mindre Isbjerge i den østlige Horizont var Storfjorden isfri indenfor vor Synskreds. Den 6te og 7de August arbejdede vi paa Snittet vestover og kom i godt Vejr Kl. 9 Eftermiddag den 8de atter under Isen paa 76° 26′ N. Br. og 0° 29′ L. V. f. Gr., hvor vi fik 1686 Favnes Dyb. Trawlen blev sat ud, og der arbejdedes med den hele Natten, men den maa sandsynligvis være bleven fyldt med Rullestene, da Accumulatoren angav en ellers uforklarlig svær Vægt paa Touget, da Indhivningen begyndte. Uagtet al anvendt Forsigtighed sprang Touget, efterat der var hivet ind 3 Timer, Kl. 10 den næste Dags Formiddag. Sprængningen foregik ved en Spleds, der allerede var 3 Tørn inde paa Spillet, og 2160 Favne Toug samt Apparater gik tabt. Vejret var usædvanligt smukt og før vi gik videre, toges en fuldstændig Misvisnings-Observation. Vi styrede derefter nordøstover mellem Isflagene, der nu vare komne rundt om os, og som i det klare Solskin og med sine fantastiske Former var et baade interessant og smukt Syn. Om Eftermiddagen kom vi atter ud af Isen og styrede nu mere nordlig Kurs, saaledes at vi Kl. 3 Formiddag den 10de vare paa 77° 50′ N. Br. og 0° 9′ L. V. f. Gr., hvor vi loddede 1640 Favne. Herfra sattes Kursen østover. Kl. 7 samme Dags Eftermiddag fik vi 1333 Favne, og da nyt Skrabetoug imidlertid var bleven sammenspledset og ny Trawl gjort istand, sattes denne ud. Kl. $9^1/_2$ næste Formiddag fik vi den hjem med rig Fangst af Dyr og deriblandt Fiske, men Bommen var brækket af paa Midten, og der var en stor Sten paa en Mands Løft i den. Ved det næste Lodskud, der toges om Eftermiddagen, fandt vi

course, out of the question; but as work below could still be done when the motion of the vessel was not too violent, we kept her going, under lee of the land, along the eastern shore, where the sea continued comparatively tranquil. On Thursday evening observations were made to determine the variation and deviation of the compass; and the weather having now begun to moderate, Professors Mohn and Sars, Mr. Friele, Mr. Tornøe, Mr. Schmelck, and Captain Grieg succeeded in landing, at 9.30 p.m., close to the English River, and made an excursion along the east coast in a northerly direction. Meanwhile the fog came on again, getting gradually denser; and at 3 a.m. I had to anchor close in shore, for fear of drifting away from the landing-place, or running aground, in the strong current. On Friday morning, at 4 a.m., the exploring party returned, bringing with them specimens of birds, fossils, and plants. After hoisting up the boat, we passed an hour or two fishing, and found that cod were abundant off that part of the island, our catch from 5 a.m. to 7 a.m. amounting to as many as ten score. It was still blowing hard, and another day had yet to elapse ere the weather became sufficiently moderate to admit of our again pursuing a northward course. On the afternoon of the same day we reached a station in lat. 75° 32′ N., long. 17° 50′ E., where we sounded in 123 fathoms, and took a cast of the trawl. We now explored the tract stretching from that point to Spitzbergen, by means of two smaller transverse sections, one (the first) extending west-north-west, and the other east-north-east, and reached at the end of the latter South Cape, the southern extremity of Spitzbergen, on the afternoon of Monday the 5th of August. As it was blowing fresh from the north-west, we ran in shore east of South Cape, where, during the course of the evening, a complete observation was taken for determining the variation of the compass, and after night-fall we steamed up under the lee of the great glacier that juts out into the sea like a gigantic promontory. On the morning of the 6th we dredged in the Storfjord, at a depth of 146 fathoms, doubled South Cape, and then stood out to sea, steering west. Saving a few isolated floes drifting southward, and several smaller icebergs on the verge of the eastern horizon, the Storfjord was wholly unencumbered with ice, as far as the eye could reach. This and the following day (the 7th) were devoted to exploring the section westward, and on the 8th, at 9 p.m., with the weather fine, we again reached the ice, at a point in lat. 76° 26′ N. long. 0° 29′ W., where we found a depth of 1686 fathoms. The trawl was put over and worked throughout the whole of the night, but probably had got a freight of boulders, the accumulator indicating an otherwise unaccountable strain on the line immediately we began to heave. On the following day, at 10 a.m., the rope parted, in spite of every precaution taken to prevent it, after three hours' continuous hauling. The rupture occurred in a splice, which had already passed 3 turns on the drums, the apparatus consequently carrying away with 2160 fathoms of rope. The weather was magnificent, and before proceeding on our course, we took a complete observation

Dybden at være 1343 Favne. Dette Lodskud har den særegne Interesse og Betydning, at den Svenske Expedition med "Sofia" under Nordenskiöld og von Otter i 1868 fandt en Dybde af 1350 Favne, altsaa kun 7 Favne mere end vi, paa et Punkt der ligger kun 2 Kvartmile længere Vest end vor Station. Resultatet af Lodningen blev derfor imødeseet med en vis Spænding, der maatte være bevirket ved Betragtningen af vore to foregaaende Lodskud, men med den udmerkede Overensstemmelse fulgte Forvisningen om den svenske Expeditions talrige Dyb-Lodskuds Sikkerhed og store Betydning for det Endemaal, som vor Expedition var ude for at søge fremmet. Vi arbejdede nu videre i Retning mod Isfjordens Munding, bestemte Bankens Affald mod Ishavsdybet, og gik derpaa nordover og nordvestover. Sø og Vind var meget hinderlige, saa vi kun gjorde ringe Fart. Om Morgenen Onsdag den 14de August fik vi atter Is i Sigte. Vi var da nær den 80de Breddegrad. Efterat have loddet og trawlet her og længere øst lidt nordenfor 80° Bredde, gik vi om Morgenen den 15de ind til Norskøerne ved Spidsbergens Nordvest-Kyst.

Sundet mellem Norskøerne er en god Ankerplads, men Isflag drev stadig gjennem det med det stærke Tidvand, og Aftenen før vi kom ind, havde et stort Isflag brukket Kjettingerne og taget 3 af de her liggende 5 Fangstfartøjer med sig ud af Sundet. Der var stor Fiskerigdom, saaledes at 3 Baade med 2 Mand i hver i Løbet af et Døgn kunde fiske og virke 2200 Torsk. De havde blot 20 Minutters Udroning og fiskede paa 16 Favne Vand. Paa Grund af Flueaat (Limaciner) havde Fisken imidlertid her, ligesom ved Beeren Eiland, en meget ubehagelig Smag, der imidlertid skal forsvinde, naar Fisken saltes og klippes.

Medens "Vøringen" laa ved Norskøerne, blev Bunden skrubbet, og der indtoges en Del Ballast, hvortil der lige i Stranden var Anledning til at tage Sten. Skibet

to determine the variation of the compass. Then, standing north-east, we steamed on between the floes, which by this time were floating round the vessel, and in the bright sunshine, with their thousand fantastic shapes, afforded a striking and beautiful sight. In the afternoon we again got clear of the ice, and now taking a more northerly course, had by the 10th, at 3 a.m., reached a point in lat. 77° 50′ N. long. 0° 9′ W., where the depth was found to be 1640 fathoms. We now steered east, and on the same day, at 7 p.m., sounded in 1333 fathoms. A new dredge-rope having meanwhile been spliced, and other trawling-gear prepared, the apparatus was sent down. It came up next morning, at about half-past 9 o'clock, bringing a rich freight of marine animals, among which were a few fishes, but with the boom broken through the middle, and a big stone, as much as a man could lift, enclosed in the bag. In the afternoon we sounded again, and now found the depth to be 1343 fathoms. To this sounding attaches special interest and importance, since the Swedish Expedition despatched with the "Sofia" in 1868, under the direction of Nordenskiöld and von Otter, found a depth of 1350 fathoms — only 7 fathoms more than we measured here — at a point but two miles farther west of our station. The result of the sounding had been awaited with some little excitement after recording the two foregoing depths, and the satisfaction felt at the very close agreement was accompanied by the assurance of the trustworthiness distinguishing the deep-sea soundings taken on the Swedish Expedition, and of their great value as adjuncts in working out the object which the Norwegian Expedition had been despatched to attain. We now explored farther, in the direction of the Ice Sound, determined the slope of the bank towards the depths of the Arctic Ocean, and then stood north and north-west. But the weather was boisterous — wind and sea — and we made but little progress. On the morning of Wednesday the 14th of August we again came in sight of ice, near the 80th parallel of latitude. After sounding and trawling both at this point and farther east, a little to the north of 80°, we proceeded on the morning of the 15th to the Norway Islands, on the north-western coast of Spitzbergen.

In the sound between the Norway Islands there is good anchorage, but floes kept drifting through it with the strong tidal current, and the evening before a large floe, after breaking the cables, had carried 3 of the 5 fishing-vessels that lay at anchor here out of the sound. The place abounded in fish; 3 boats — 2 men to each — could catch and cure in twenty-four hours as many as 2200 cod. The row out took only 20 minutes, and the depth on the fishing-ground did not exceed 16 fathoms. The fish, however, like those on the shores of Beeren Eiland, being infested with parasitic animals *(Limacinæ)*, have a rather disagreeable taste; but this they are said to lose on being salted and dried.

Whilst the "Vøringen" lay at anchor at the Norway Islands, her bottom was scrubbed, and extra ballast taken in, the beach supplying stones in plenty. The ship had

var nemlig blevet noget let paa Vandet, navnlig trængte Agterenden til at komme noget dybere. I Løbet af disse Dage gjordes Exkursioner til Landet indenfor Norskøerne.

Kl. 4 Fredag Eftermiddag den 16de afgik vi atter fra Norskøerne, tog et Lodskud med Temperaturrække udenfor Hakluyt Head, Spidsbergens Nordvestpynt, og sejlede derpaa ned igjennem Smeerenberg-Sundet, østenom Amsterdam-Øen og Dansk-Øen, og ud gjennem Syd-Gat, efter det af Beechey og Franklin i 1818 optagne Kart, hvorefter vi Kl. 12½ om Natten ankrede i Magdalena Bay indenfor Halvøen med Begravelsespladsen. Baade i Smeerenberg og i Magdalena Bay er Dalene fyldte med store Isbræer, der gaar lige i Søen, og de fra disse løsbrukne Isstykker flyder om i Sundene og Bugterne. Kl. 9 om Aftenen den 17de loddede og trawlede vi i Magdalena Bay, i hvis inderste Del vi fandt den laveste Temperatur i Søen paa hele Expeditionen, nemlig — 2° C., ved Bunden paa 61 Favnes Dyb, medens Dyrelivet sammesteds var meget rigt, ja selv Fiske kom op i Trawlen. Fra Magdalena Bay styrede vi mod Sydvest udenom Prince Charles Foreland. Den 18de tog vi 4 Lodskud og en Trawl, og den 19de var vi om Morgenen i Isfjordens Munding, hvor der loddedes, toges Temperaturrække og trawledes. Kl. 2½ Efterm. samme Dag gik Expeditionen til Ankers i Advent Bay paa Is-Fjordens Sydside. Landet her gjør en Undtagelse fra det ovenfor beskrevne Spidsbergenske Islandskab, idet Dalene her er fri for Isbræer. Jeg gik strax igang med at optage et Kart over denne af Spidsbergensfarere meget besøgte Bugt, og medens en Del af Medlemmerne var paa en Udflugt op i Landet, arbejdede jeg hermed, assisteret af Professor Mohn, der maalte Grundlinie, enkelte Horizontalvinkler og Solhøjder til Polhøjde- og Tidsbestemmelse, samt Skibsfører Grieg, der udførte Lodninger. Selv maalte jeg de fleste Horizontalvinkler, tog Azimutbestemmelsen, Lodskud og tegnede Kartet. Da de til Kartets Konstruktion nødvendige Observationer var udførte, lettede vi den 22de om Aftenen, tog en Trawl i Mundingen af Bugten, og styrede ud af Isfjorden. Det var Meningen den næste Dag at anløbe Bell-Sund, men det blev tyk Taage og Kursen sattes da hjem mod Norge. Kl. 12 om Natten mellem den 23de og 24de August toges sidste Lodskud og Temperaturrække, og Mandag Middag den 26de August ankredes i Tromsø, hvor vi strax gik i Gang med at fylde Kul og rengjøre Kjedlen. Vi havde da været under Damp uafbrudt i 30 Døgn, idet vi ikke slukkede af under Opholdet i Advent Bay paa Grund af den lave Temperatur, der gjorde Opvarmning af Arbejdsrummet nødvendigt.

Kl. 2 om Morgenen den 29de August afgik vi fra Tromsø og ankom Kl. 10¼ Form. den 4de September til Bergen.

got too high on the water, more especially her sternpart. During our stay here excursions were made to the mainland.

On Friday the 16th, at 4 o'clock in the afternoon, we again left the Norway Islands, took a sounding, along with a serial temperature, off Hakluyt Head, the north-western extremity of Spitzbergen, and then steamed on through Smeerenberg Sound, east of Amsterdam Island and Danish Island, and out through South Gat, steering by the chart Beechey and Franklin constructed in 1818, after which we proceeded to Magdalena Bay, where the ship dropped her anchor, at 12.30 a.m., east of the peninsula with the burial-ground. Both at Smeerenberg and Magdalena Bay the valleys are filled up with glaciers, projecting into the sea; and fragments of dislocated ice float about in the sounds and bays. At 9 o'clock on the evening of the 17th we sounded and trawled in Magdalena Bay, where, in its inner part, was found the lowest temperature registered on the Expedition, viz. — 2° C., at a bottom-depth of 61 fathoms. This spot was characterised by a rich variety of animal life, — nay even fishes came up in the trawl. From Magdalena Bay we steered south-west, rounding Prince Charles Foreland. On the 18th we took 4 soundings and a cast of the trawl, and on the morning of the 19th had reached the entrance to Ice Sound, where we sounded, took serial temperatures, and trawled. At half-past two, on the afternoon of the same day, the Expedition anchored in Advent Bay on the south shore of the Ice Sound. The land here forms an exception to the icy region of Spitzbergen described above, no glaciers encumbering the vallies. I immediately prepared to draw up a chart of this bay, so much visited by sealing and fishing vessels, and while part of the Scientific Staff were away on an excursion into the country, continued this work, with assistance from Professor Mohn, who measured the base, some of the horizontal angles and altitudes for determining latitude and time, and from Captain Grieg, who took soundings. Most of the horizontal angles I measured myself; I made, too, azimuth observations, took soundings, and drew the chart. After all the observations required for the construction of the chart had been taken, we weighed anchor, on the evening of the 22nd, took a cast of the trawl at the entrance to the bay, and steered out of Ice Sound. Our intention had been on the following day to touch at Bell-Sound; but a thick fog coming on, we stood direct for Norway. At midnight on the 23rd of August the last sounding and serial temperature were taken, and on Monday the 26th, about 12 o'clock at noon, the Expedition reached Tromsø, where we at once commenced taking in water and cleaning the boilers. The vessel had been under steam for 30 successive days, the engine-fires having been kept burning during our stay at Advent Bay, in order to heat the work-rooms, which the low temperature prevailing in that locality rendered necessary.

On the 29th of August, at 2 o'clock in the morning, the Expedition left Tromsø, and on the forenoon of the

hvor D'Hrr. Danielssen, Friele, Tornøe og Schiertz debarkerede. Den nu overflødige Del af Besætningen afmønstredes og endel af de Skibet tilhørende Sager bragtes ombord, ligesom Laanegods afleveredes til Bergens Værft. Lørdag Morgen den 7de afgik vi fra Bergen og ankom Kl. 4 Eftermiddag den 9de til Kristiania, hvor D'Hrr. Mohn, Sars og Schmelck gik iland. Næste Dags Middag den 10de September afgik jeg med Skibet til Horten, hvor Desarmeringen strax paabegyndtes. Den 20de var alle Sager bragt iland og Skibet klart til Aflevering med Undtagelse af Donkeykjedlen, der skulde tages ombord i Bergen. Kl. 5¼ Formiddag den 21de gik "Vøringen" fra Horten og ankom til Bergen den 23de.

Der var i 1878 ialt taget 117 Lodskud, 57 Temperaturrækker, 15 Skraber og 24 Trawler, samt, foruden de magnetiske Observationer i Land ved Hammerfest og Vardø, tillige 6 fuldstændige Misvisningsobservationer paa Søen, hvilke paa Grund af Observationsstedernes geografiske Beliggenhed er af megen Interesse.

Det i den oprindelige Plan angivne Farvand mellem Norge, Færøerne, Jan Mayen og Spidsbergen var saaledes befaret og Expeditionens Undersøgelsesrejser lykkelig tilendebragte i den for samme fastsatte Tid.

Den gode Forstaaelse mellem Expeditionens Medlemmer vedvarede uden Forstyrrelse lige til det Sidste. Sluttelig skal det ogsaa med Taknemmelighed bemærkes, at Expeditionen overalt blev mødt med den største Velvilje. Baade Amtmand Finsen paa Færøerne og Landshøvding Finsen paa Island, ligesom ogsaa Bergens, Kristiansunds, Namsos', Bodøs, Tromsøs og Hammerfests Borgere foranstaltede Festligheder i Anledning af Expeditionens Nærværelse og gjorde Alt, for at Opholdet paa de respective Steder skulde blive saa behageligt som muligt.

4th of September, at half-past ten o'clock, we arrived at Bergen, where Dr. Danielssen, Mr. Friele, Mr. Tornøe, and Mr. Schiertz disembarked. Part of the crew, viz. the now superfluous hands, were paid off, divers effects belonging to the ship brought on board, and borrowed gear returned to the Bergen Navy Yard. On the morning of Saturday the 7th of September we left Bergen, and on the 9th, at 4 o'clock in the afternoon, reached Christiania, where Professors Mohn and Sars and Mr. Schmelck went ashore. At noon on the following day I took the vessel to Horten. By the 20th, the ship had been cleared of everything belonging to the Expedition and got ready for her owners. On the 21st, at a quarter past five in the morning, the "Vøringen" left Horten, and arrived at Bergen on the 23rd.

On the third cruise of the Expedition, in 1878, there were taken in all 117 soundings, 57 serial temperatures, 15 hauls of the dredge, and 24 casts of the trawl, together — exclusive of the magnetical observations on shore at Hammerfest and Vardø — with 6 complete observations at sea for determining the variation of the compass, which, from the geographical position of the observing-points possess very considerable interest.

The tract of ocean embraced in the original Scheme, viz. that between Norway, the Færoe Islands, Jan Mayen, and Spitzbergen, had thus been investigated, and the exploring cruises of the Expedition happily terminated within the period appointed.

Nothing arose to cloud the friendly spirit prevailing among the members of the Scientific Staff. Nor must I, in conclusion, omit to record our debt of gratitude for the eager hospitality and ready assistance we everywhere received. Both the chief magistrate of the Færoe Islands, Amtmand Finsen, and the governor of Iceland, Landshøvding Finsen, had festivities arranged in honour of the Expedition, as did also the people of Bergen, Kristiansund, Namsos, Bodø, Tromsø, and Hammerfest, leaving nothing undone that might in any way tend to enhance the pleasure of our stay.

Til Expeditionens Udrustning og Drift har Storthinget bevilget følgende Summer:

i 1875	20,000 Spd.	=	80,000 Kroner.
i 1876	14,500 —	=	58,000 —
i 1877	28,327 —	=	113,308 —
Tilsammen:	62,827 Spd.	=	251,308 Kroner.

Efterat Apparater, Tougverk m. m., der var anskaffet til Expeditionen, blev realiseret ved Bortsælgelse, bliver den Sum, som Expeditionen har kostet ca. 249,000 Kroner. Heri medregnes ikke de Summer, som Storthinget siden 1879 hvert Aar har bevilget til Bearbejdelse af det indsamlede Materiale og til Udgivelse af nærværende Generalberetning.

For the equipment and current expenses of the Expedition the Storthing has granted the following sums: —

In 1875	Spd. 20,000	=	Kr. 80,000.
In 1876	— 14,500	=	— 58,000.
In 1877	— 28,327	=	— 113,308.
Total . . .	Spd. 62,827	=	Kr. 251,308.

After deducting the proceeds arising from the sale of apparatus, cordage &c., provided for the Expedition, the nett amount expended will be about Kr. 249,000. This does not include the annual grants made by the Storthing since 1879 for working up the materials collected and publishing the present Report.

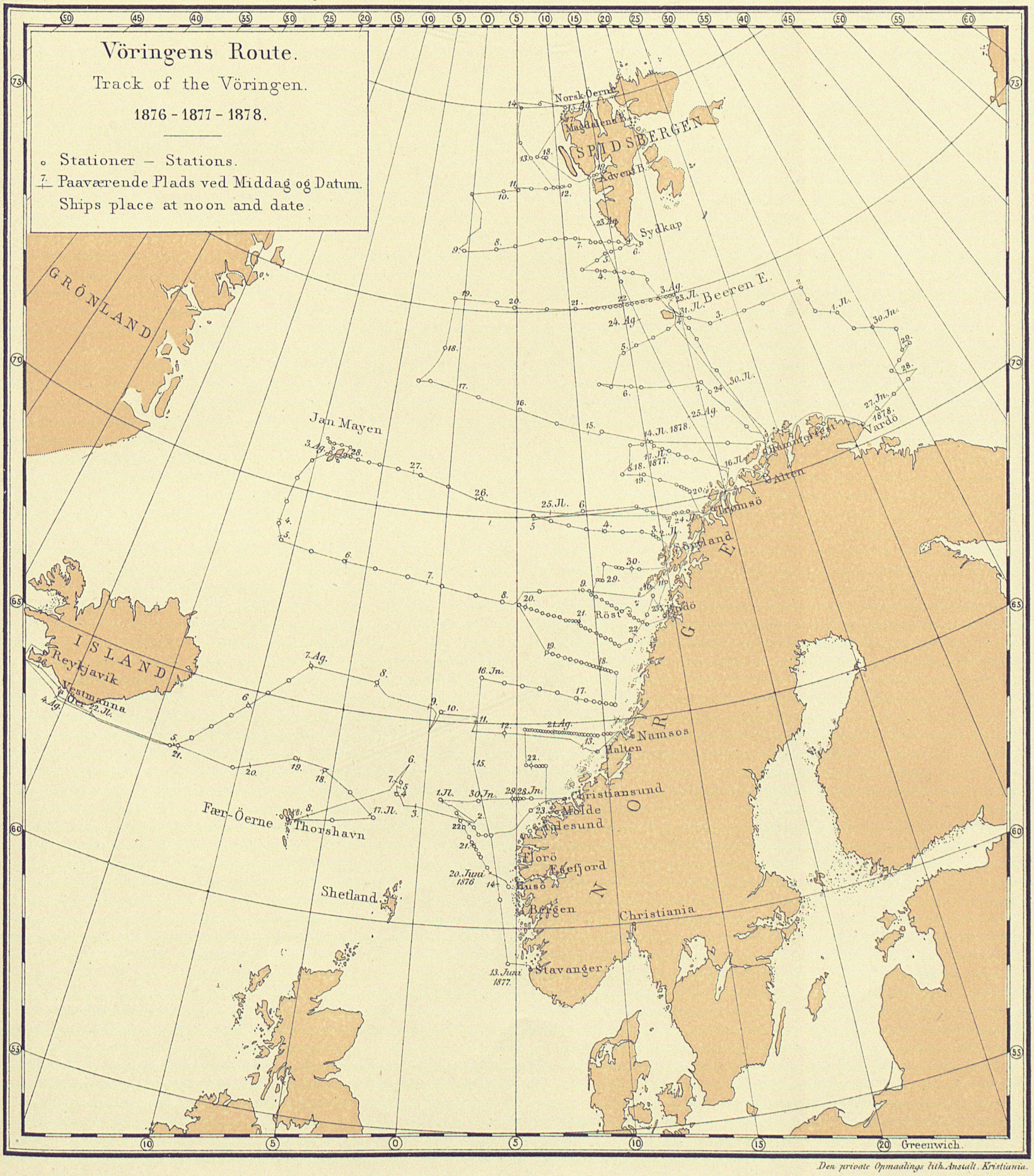
Vöringens Route.

Track of the Vöringen.

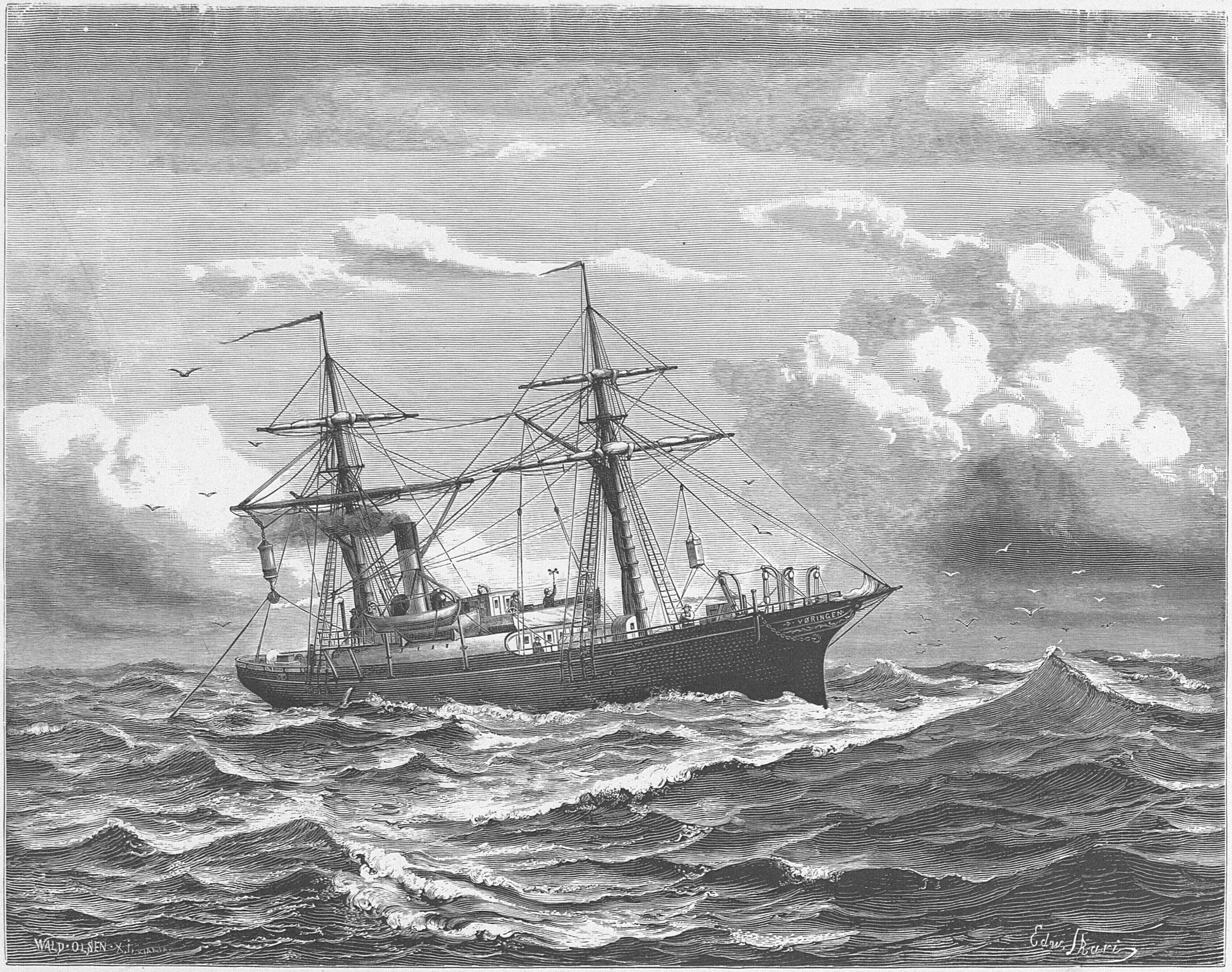
1876 - 1877 - 1878.

o Stationer — Stations.

7. Paaværende Plads ved Middag og Datum.
Ships place at noon and date.



Den private Opmaalings lith. Anstalt, Kristiania.



VØRINGEN.

DEN NORSKE NORDHAVS-EXPEDITION

1876—1878.

APPARATERNE OG DERES BRUG

AF

C. WILLE,

KAPTEJN I MARINEN.

MED ET TITELBILLEDE OG 21 TRÆSNIT.

CHRISTIANIA.

GRØNDAHL & SØNS BOGTRYKKERI.

1882.

THE NORWEGIAN NORTH-ATLANTIC EXPEDITION

1876—1878.

THE APPARATUS, AND HOW USED.

BY

C. WILLE,
CAPTAIN OF THE ROYAL NAVY.

WITH A FRONTISPIECE AND 21 ILLUSTRATIONS.

CHRISTIANIA.
PRINTED BY GRØNDAHL & SØN.
1882.

Apparaterne og deres Brug.

Indhold.

Skibet. Dækket. Indhivningsmaskinen. Mellemdæk. Pendelregulator.

Lodning. Rørlod. Baillie Maskine. Lodline. Accumulator. Vandhentere. Forberedelser til Lodning. Dækrulle. Manøvre med Fartøjet. Lodning med Rørlod. Bestemmelse af Dybden. Lodning med Baillie-Maskine. Lodlinens Ophaling. Loddernes Udløbshastigheder. Varighed af Lodskud. Temperaturrækker. Lodskud-Tabel.

Bundskrabning. Skrabe. Otter-Trawl. Bom-Trawl. Forberedelser til Skrabning. Manøvrer ved Skrabning og Trawling. Skrabens og Trawlens Ombordbringelse og Tømning. Varigheden af en Bundskrabning.

Navigering. Deviationsbestemmelser. Vandlog. Astronomiske Observationer. Kronometrene. Nøjagtigheden af Bestemmelsen af paaværende Plads.

Som nævnt i min Afhandling om Nordhavs-Expeditionens Oprindelse og Rejser blev det, da Expeditionens Iværksættelse var besluttet, overdraget mig at anskaffe de til Udførelse af de forskjellige Slags Iagttagelser og andre Arbejder nødvendige Apparater. Under min Rejse til England i 1875 anskaffedes saaledes flere Apparater og Instrumenter efter de fra tidligere Expeditioner anerkjendte Modeller. I Løbet af Vinteren 1875—76 udførtes de øvrige Apparater og andre Sager ved norske Værksteder efter de af mig opgivne Tegninger og Betingelser, ligesom jeg organiserede og jevnlig udførte Apparaternes Anvendelse ombord.

Til Grund for den følgende Afhandling, hvis Indhold er angivet ovenfor, er lagt de udførlige Rapporter om Ap-

The Apparatus, and How Used.

Contents.

The Ship. — The Deck. — The Donkey-engine. — The Orlop-deck. — The Pendulum-governor.

Deep-sea Sounding. — The Tube-lead. — Baillie's Machine. — The Sounding-line. — The Accumulators. — The Water-bottle. — Preparations for Sounding. — The Deck-reel. — Handling the Ship. — Sounding with the Tube-lead. — Determining the Depth. — Sounding with the Baillie Machine. — Hauling in the Line. — Velocity of the Sounding-lead. — Duration of a Sounding. — Serial Temperatures. — Table of Soundings.

Deep-sea Dredging. — The Dredge. — The Otter-trawl. — The Beam-trawl. — Preparations for Dredging. — Handling the Ship. — Getting over and emptying of Dredge and Trawl. — Duration of a Dredging.

Navigating the Ship. — Determining Deviation. — The Water-log. — Astronomical Observations. — The Chronometers. — Ship's Position, with what accuracy determined.

The Government having resolved to despatch a Scientific Expedition to the Northern Seas, I undertook, as already stated in my account of the origin and cruises of the Norwegian North-Atlantic Expedition, at the instance of the Directors of the Geographical Survey, to procure the various instruments and appliances wherewith it would have to be furnished. Several of these, tested and approved by the experience of former Expeditions, I had constructed in England, from models, when visiting that country in 1875. The remaining apparatus, together with all minor implements requisite for the equipment of the vessel, were made at Norwegian workshops, in the winter of 1875, myself furnishing the designs, and stipulating the conditions on which the work was supplied. Moreover, on the captain devolved the duty of placing and arranging the apparatus, and, as a general rule, of superintending their use on board.

This descriptive exposition, the contents of which have been given above, is in the main an abstract of the special

paraterne og deres Brug, som jeg navnlig i 1876 men ogsaa de følgende Aar indsendte til Direktionen for den geografiske Opmaaling. Fremstillingen er imidlertid bleven for en Del omarbejdet og udvidet, hvad der navnlig gjælder Kapitlet om Navigationen. Efter Professor Mohns Ønske er ogsaa medtaget de af ham, tildels til andre Øjemed, gjorte Studier over Loddernes Udløbshastigheder, over Varigheden af Lodninger og Skrabninger, over Vandloggens Theori og over Kronometrenes Gang, hvis Resultater finde sin naturlige Plads i denne Afhandling. Professor Mohn har ligeledes ydet værdifulde Bidrag til Udarbejdelsen af de denne Afhandling ledsagende Tegninger.

Skibet.

Det til Expeditionen lejede Dampskib, "Vøringen,"[1] var bygget af Træ, og var 35^m (140 n. F.) mellem Perpendiculærerne, 7^m (22$^1/_2$ n. F.) bredt, stak 4^m (13 n. F.) agter og maalte Brutto 344 Tons. Maskinen var paa 55 nominelle Hestekræfter og gav, med et Kulforbrug af 2 Tønder i Timen, Skibet en Fart af 7$^1/_2$ til 8 Knob i roligt Vejr. Besætningen bestod af Chef, 2 Officierer, 2 à 3 Styrmænd, 1 Baadsmand, 1 Tømmermand, 8 helbefarne og 8 halvbefarne Matroser, 2 Maskinister, 6 Fyrbødere, 1 Messekok, 1 Skibskok og 1 Tjener.

"Vøringen" viste sig at være et usædvanlig godt Søskib, og afgav i alle Dele tilstrækkelig Plads, uden at der dog kunde siges at være Rum tilovers. Under Expeditionerne var det, som Fig. 1 viser, foruden med de almindelige Stag- og Gaffelsejl, tillige rigget med Topsejl paa begge Master. Stængerne, der det første Aar (1876) vare ganske korte, forlængedes, saavelsom Topsejlene, 0.^{m}5 (1$^1/_2$ Fod) i 1877 for at skaffe større Sejlareal, men dette var alligevel for lidet til under almindelige Omstændigheder at bruges alene. Heldigvis indtraf der intet saadant Uheld ved Maskinen, at Expeditionen var henvist udelukkende til Sejlenes Brug. De gjorde imidlertid ofte god Nytte saavel ved Manøvrer som til at hjelpe paa Farten. Ved Skibets Udrustning var forøvrigt ikke gjort Regning paa dets Egenskaber under Sejl. Kulboxerne (Fig. 4 *k*) vare udvidede med en Del af Lasterummet under Mellemdækket, saa at de rummede indtil 1400 Tønder, en Forsyning, der var fuldt tilstrækkelig for den længste Tid, som Expeditionen holdt Søen.

Fig. 2 i Forbindelse med Fig. 1 viser de forskjellige Apparaters Plads paa det øverste Dæk. Midten af dette indtages af en Overbygning eller Hytte, hvis Dæk er frem-

[1] Opkaldt efter Vøringfossen i Hardanger.

Reports on the Apparatus and how to work them, drawn up by the author for the Directors of the Geographical Survey, chiefly in 1876, but also in the two following years. Meanwhile, the subject-matter has been carefully revised, and in part expanded, more particularly as regards the section that treats of navigating the ship. At the suggestion of Professor Mohn, Director of the Meteorological Institute, I have incorporated divers investigations, instituted by him partly for other purposes, on the velocity of the sounding-lead, the duration of soundings and dredgings, the theory of the water-log, and the rates of the chronometers, the results of which may be given an appropriate place in this division of the General Report. Furthermore, for not a few of the illustrations I am wholly, or in part, indebted to the pencil of Professor Mohn.

The Ship.

The S. S. "Vøringen,"[1] the vessel selected for the Expedition, was built of wood, had a length of 144 feet between the perpendiculars, 23$^1/_2$ feet beam, and measured 344 tons gross weight. Her engines were of 55 horse power, nominal, and propelled her in calm weather at the rate of from 7$^1/_2$ to 8 knots an hour, with a consumption of 430 pounds of coal. The ship's complement consisted of the captain, 2 chief officers, 2 mates (on the last cruise there was a third mate), the boatswain, the carpenter, 8 able and 8 ordinary seamen, 2 engineers, 6 firemen, a steward, the ship's cook, and one servant.

The "Vøringen" proved an excellent sea-boat, and afforded sufficient accomodation, though it cannot be said there was room to spare. She carried on the three cruises of the Expedition (see Frontispiece), exclusive of the usual fore-and-aft sails, a top-sail on either mast. The top-masts, which were rather short, I had lengthened a foot and a half for the second cruise, in 1877, as also the top-sails, to give greater spread of canvas; but this was still insufficient for working the ship under all plain sail. Fortunately, no such accident occurred to the engine or the screw as would have left the sails our only resource. Yet they often stood us in good stead, no less in handling the ship than to increase her speed. For the rest, the qualities of the "Vøringen" as a sailing-vessel had not been taken into account when equipping her for the Expedition. The dimensions of the coal-bunkers (Fig. 4 *k*) were increased, by encroaching on the hold below the orlop-deck, to admit, if necessary, of stowing about 150 tons, a supply amply sufficient for the longest cruise the Expedition would undertake.

Figs. 1 and 2 show together the general arrangement of the apparatus on the upper deck. The middle portion of the latter was occupied by a roundhouse, of which

[1] Named after the "Vøringfos," a celebrated waterfall in Hardanger.

Fig. 1.

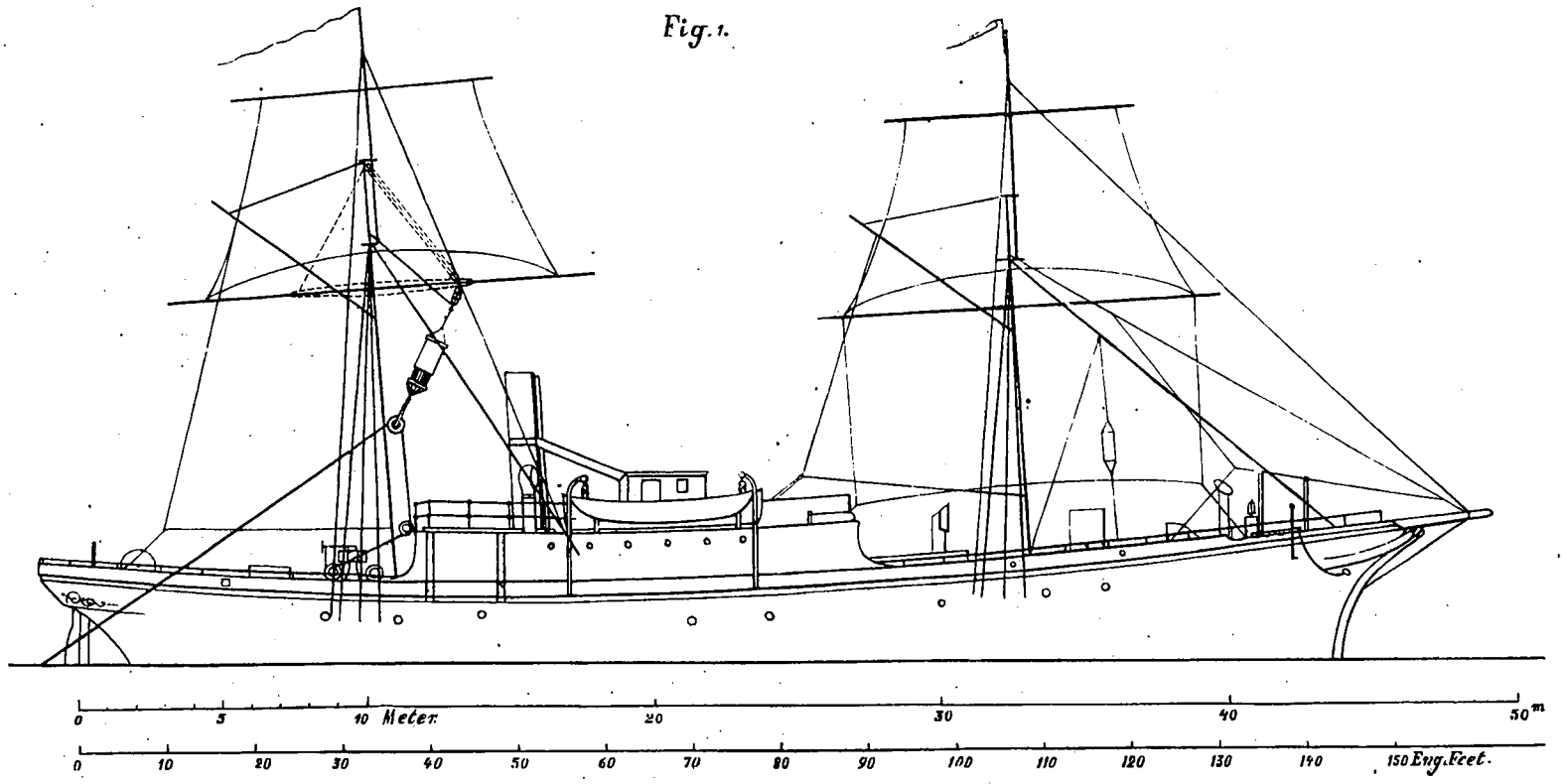


Fig. 2.

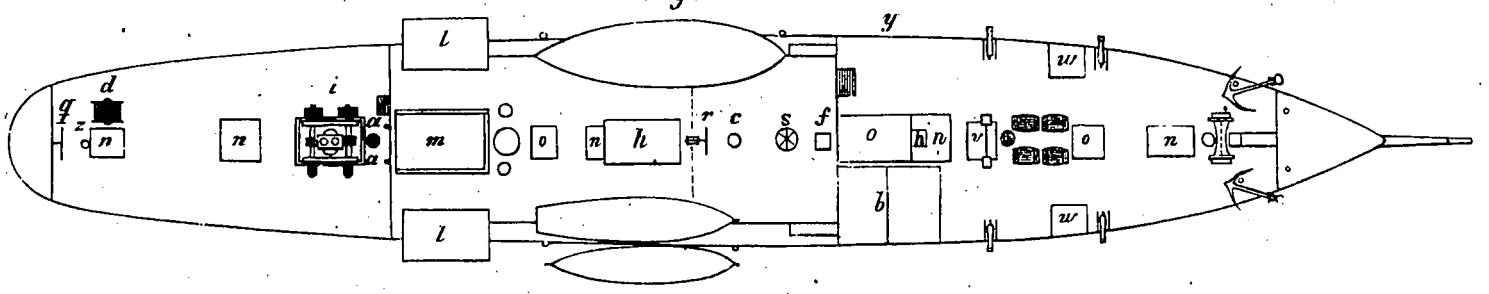


Fig. 3.

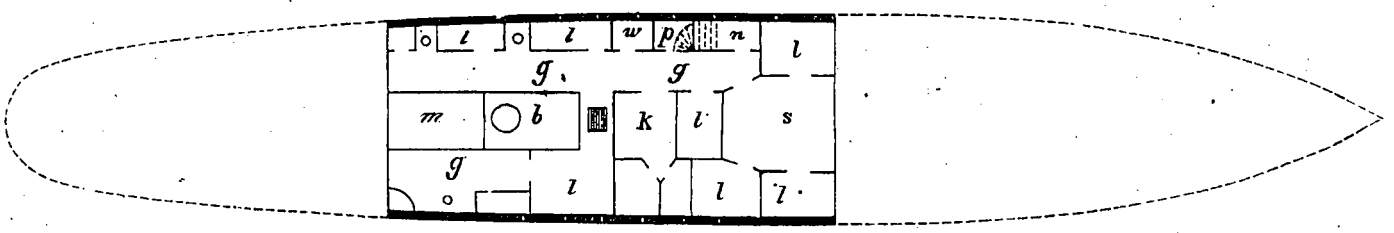
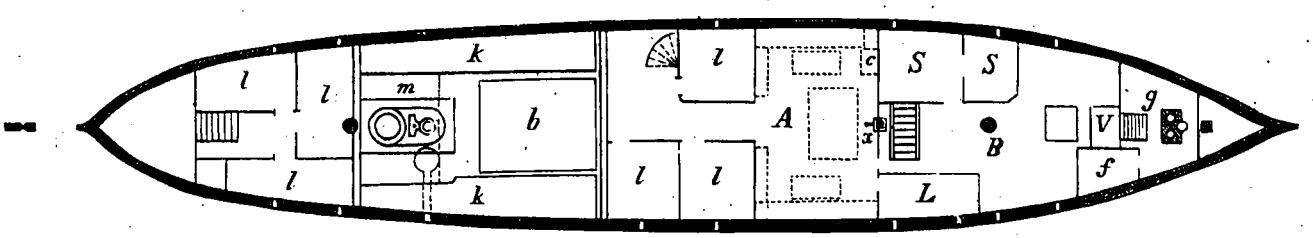


Fig. 4



stillet i Fig. 2 og Indredning under Læ i Fig. 3. Agtenfor Fokkemasten stod en almindelig *Dampwinch* (Fig. 2 *v*), der ved Hjælp af en Kjettingkabellaring kunde benyttes til Ankerhivning. Forrenfor Hytten om Styrbord var opslaaet af Planker en *Binge* (*b*) med 2 Afdelinger, der tilsammen rummede indtil 6000 Favne *Skrabetoug*, og i denne laa Touget klart og luftigt. Paa Fordækket var ligeledes i 1877 og 1878 anbragt 4 *Falconetter*, der med Rapperter og andet Tilbehør velvillig blev udlaant til Expeditionen fra Bergens Værft.

Paa *Hytten* var anbragt en af Skibets *Baade* om Styrbord og udenfor denne hang i Daviderne en Skjækte. Om Bagbord stod Expeditionens store Livbaad, 8.^{m}5 (27 Fod) lang, 2.^{m}3 (7 Fod) bred og 1.^{m}3 (4 Fod) høj i Stevnene. Midskibs i Forkant stod Stativet med Balancebordet til *Fox-Cirkelen* (*f*) og agtenfor Skylightet til Spisesalonen (*s*) stod *Standardkompasset* (*c*) og *Styreapparatet* (*r*). Rathjulet bevægede med Drev den lavere liggende Ratstamme, og i Tandkronen om denne laa Bugten af Kjettingen, der gik gjennem almindelige Skildpadder først ud i Borde, derefter langs Hyttetaget, saa ned paa Agterdækket og agterover langs dette, og endelig gjennem Skildpadder i Borde agterud og paa Rorpinden, der viste agterover. Paa Grund af denne lange Ledning virkede Apparatet langsomt. I 1876 var Kjettingen smekrere og virkede agterud med dobbelt Part paa Rorpinden, i hvis Ende der var tilsvarende Blokke. Den blev let slak og var tilbøjelig til at komme i Uorden. I 1877 anbragtes en sværere Kjetting, der virkede direkte paa Rorpinden, hvorved de nævnte Ulemper hævedes. Det blev aldrig nødvendigt at ty til Vararettet agter (*q*). Lige agtenfor Styreapparatet blev i 1877 opsat et *Bestikhus* (*h*). Paa begge Sider af Hyttedækket og i Agterkant af samme var udbygget *Loddebroer* 3.^{m}1 (10 Fod) lange og 1.^{m}9 (6 Fod) brede (Fig. 2, *l*, Fig. 14 og 21), forsynede med Jernrækverk og støttede med Stræbere mod Skibssiden. I Agterkant af Hytten og paa begge Sider af midtskibs var anbragt "antifriction" *Fodblokke* (Fig. 2 *a*, Fig. 14 og 21), der vare hukede i lange Øjebolte, som løb ned langs Agterkanten af Hytten og gjennem Dæksbjelken.

Paa *Agterdækket* strax agtenfor Stormasten stod *Indhivningsmaskinen* (Fig. 2 *i* og Fig. 5). Den var leveret fra Nylands mekaniske Verksted i Christiania. Den dobbelte vertikalt staaende Højtryksmaskine paa 8 Hestes Kraft drev rundt en under samme langskibs liggende Axel, der forrenfor og agtenfor Krumtapperne var forsynet med to Skruer uden Ende. Disse greb i Tandhjul (Diameter 0.^{m}47 = 1 Fod 6 Tom), der havde svære horizontalt og tverskibs liggende Axler, 2.^{m}37 (7 Fod 6$^{1}/_{2}$ Tom.) lange, og paa Nokkerne af disse udenfor Lagerne i Ramverket var Tapperne indsmøgede og fæstede med Kiler. Tapperne om Styrbord, der brugtes til Indhivningen af Skrabetouget.

Fig. 2 represents the roof and Fig. 3 the interior fittings. Abaft the foremast was a *Steam-winch* (Fig. 2 *v*), which, when connected with a chain-messenger, would serve for heaving the anchor. In front of the roundhouse, on the starboard side, had been fitted up a spacious and well-ventilated *Locker* (*b*), with two compartments, affording room for stowing away 6000 fathoms of *Dredge-rope,* ready for immediate use. On the forecastle had been mounted, for the cruises in 1877 and 1878, 4 howitzers, kindly lent to the Expedition, along with the carriages &c., from the Royal Dockyard at Bergen.

The roof of the roundhouse, on the starboard side, supported one of the ship's *Boats,* alongside of which, suspended on davits, hung a small skiff. On the port side was placed the lifeboat of the Expedition, 28 feet long, 7 feet beam, and 4 feet deep in the stems. In the forepart, amidships, stood the foot of the balance-board for the Fox-circle (*f*), and abaft the mess-room skylight (*s*) were the *Standard-compass* (*c*) and the *Steering-apparatus* (*r*). By means of cogwheels, the motion of the steering wheel was transmitted to the barrel; and round the latter, over a toothed wheel, lay the bight of the chain, which, on being rove through cheek-blocks in the ship's side, was carried along the roof of the roundhouse down along the after-deck, and then, through cheek-blocks in the ship's side, right aft on to the tiller. With so long a lead, the working of the apparatus proved somewhat slow. On the first cruise, in 1876, the chain had been of smaller size, and rove double on the tiller, through corresponding blocks at the end; hence it easily got slack, and was apt to kink. In 1877, therefore, we substituted a stouter chain, which led singly to the tiller, and were thus able to remedy the defect. On no occasion had we, however, been compelled to have recourse to the spare wheel aft (*q*). Immediately abaft the steering-apparatus, was a small deck-house (*h*), put up in 1877, containing the log-slate, charts, &c. From both sides of the roof of the roundhouse, and from its after extremity, projected *Sounding-bridges*, 10 feet long by 6 feet wide (Fig. 2 *l* and Figs. 14, 21), with an iron railing, and supported by stays against the ship's side. At the after end, and on both sides, of the roundhouse, there were antifriction *Blocks* (Fig. 2 *a*, and Figs. 14 and 21), hooked to long eye-bolts extending down along the after-bulkhead of the roundhouse and thence through the nearest deck-beam.

On the *After-deck*, immediately abaft the mainmast, was placed the the *Donkey-engine* for hoisting the dredging and sounding gear (Figs. 2 *i* and 5), made at the Nyland Works, Christiania. This double-cylinder, high-pressure, vertical engine, of eight horse-power nominal, imparted a rotary motion to a shaft extending fore and aft beneath it, and provided with a pair of endless screws, one before and one behind the cranks. These screws bit into cogwheels (diameter 1 foot 6$^{1}/_{2}$ inches), fixed on stout horizontal shafts, 7 feet 9$^{1}/_{2}$ inches long, lying athwartships; and to the ends of these shafts, which projected beyond the bearings on the frame, were fixed the drums, firmly secured

var 0.^{m}41 (1 Fod 4 Tom.) lange og 0.^{m}42 (1 Fod 4 Tom.) i Diameter. Tapperne om Bagbord, der brugtes til Indhivning af Lodlinen, vare 0.^{m}41 lange og 0.^{m}73 (2 Fod 4 Tom.) i Diameter. Alle 4 Tapper havde 5 Furer eller Rifler. Afstanden mellem forreste og agterste Tappecentrer var 1.^{m}14 (3 Fod 7.6 Tom.). Tapperne blev saaledes drevne samtidig rundt med lige Hastighed og samme Vej. Maskinen viste sig særdeles hensigtsmæssig, idet den arbejdede sikkert og kraftigt, kunde baade hale og fire, uden at man behøvede at skifte Linen paa Tapperne, og man undgik

by keys. The drums on the starboard side, for hauling in the dredge-rope, had a length of 1 foot $4^{1}/_{4}$ inches, and were 1 foot $4^{1}/_{2}$ inches in diameter; those on the port side, for bringing in the sounding-line, had a length of 1 foot $4^{1}/_{4}$ inches, with a diameter of 2 feet $4^{7}/_{8}$ inches. The 4 drums had each of them 5 flutes, or grooves. Between the foremost and hindmost pair of drums, measured from centre to centre, the distance was 3 feet $9^{5}/_{16}$ inches. Hence it is obvious, that the drums would revolve simultaneously, with equal velocity and in the same direction. The donkey-

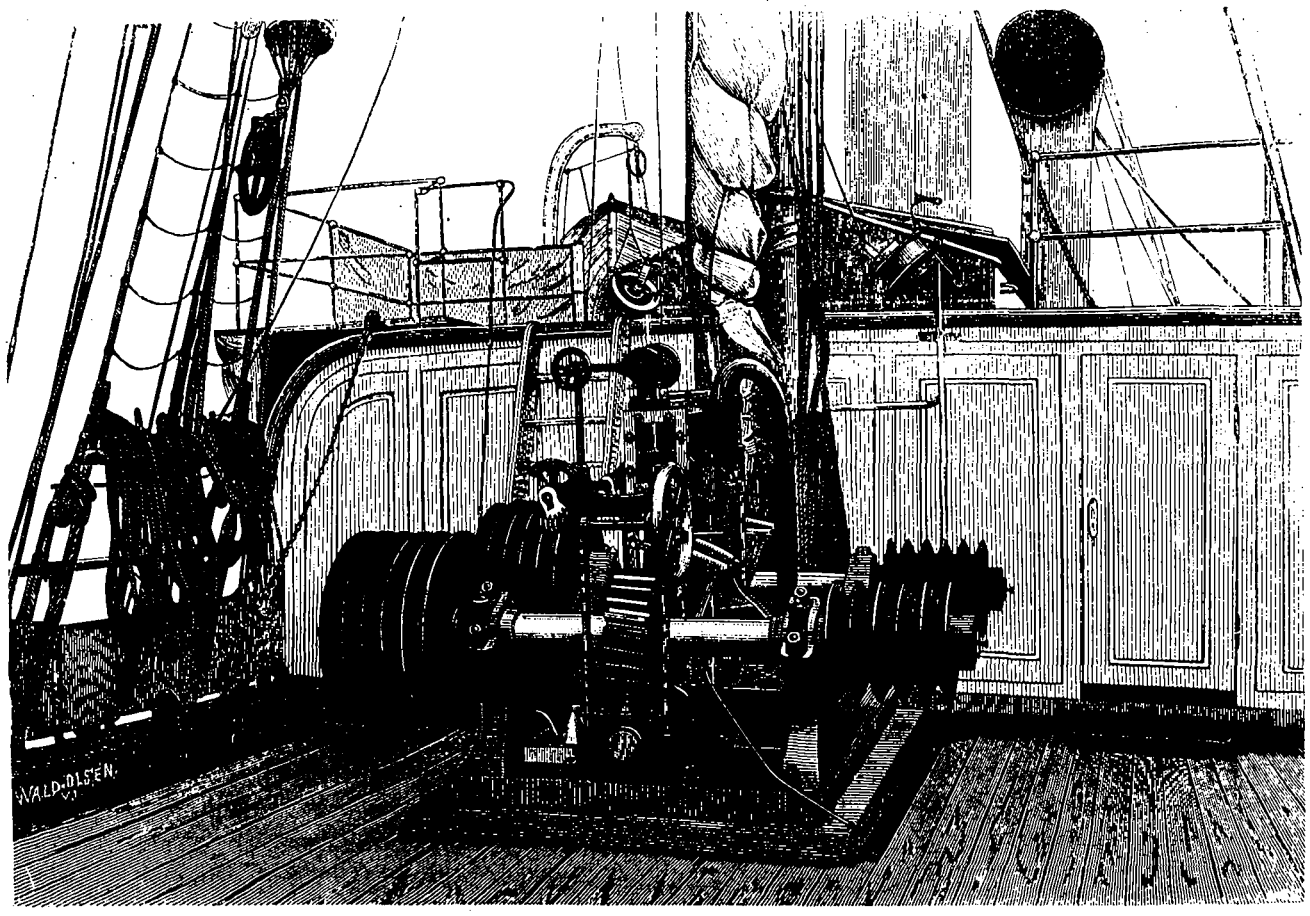


Fig. 5.

Skrændsningen, der følger med Indhivning paa én konkav Tap. De store Tapper om Bagbord tog ind 100 Favne (183 Meter) af Lodlinen i 3 Minuter, og de smaa om Styrbord 100 Favne af Skrabetouget i 6 à 7 Minuter.

I Begyndelsen blev den brugte Damp fra Højtrykscylinderne ledet i en Slange over Dækket og ud over Skibssiden om Styrbord. Da Dampen ved dette Arrangement jevnlig blæstes ind over Dækket og generede, sattes et Kobberrør som Dampskorsten ret op bag Stormasten, hvorved den nævnte Ulempe hævedes.

engine proved a most efficient little machine, working with surprising steadiness and ease; we could haul in or pay out the line without having to shift it on the drums, and there was no surging, which cannot be avoided when the drum is concave. The large drums on the port side delivered 100 fathoms of sounding-line in 3 minutes, and the small ones on the starboard side, 100 fathoms of dredge-rope in 6 or 7 minutes.

On the first cruise, the waste steam escaped through a hose on deck over the starboard side of the vessel; but being with this arrangement, frequently blown back, to the inconvenience of those on deck, the following year a copper steam-pipe was put up abaft the mainmast to get rid of the nuisance.

Ved Siden af agterste Luge var anbragt om Bagbord en Rulle (Fig 2 *d*, Fig. 13 og 14), paa hvilken der kunde oprulles indtil 3000 Favne (5500^{m}) Lodline. I 1876 havde vi en Reserve-Rulle om Styrbord, men denne blev aldrig benyttet.

I Fig. 2 er forresten *n* Nedgangskapper, *o* Skylighter, *m* Maskin-Skylightet, *h* Lufthat, *w* Waterclosets.

Fig. 3 viser Apteringen af *Rummet i Hytten*. *gg* ere Gange paa begge Sider, *s* Spisesalong, *k* Kabys, *l, l. l* ... Sovelugarer, *n* Nedgang til Mellemdækket, *p* Sterrids, *m* Maskin-Skylightet, *b* Kjedlen.

Baade forrenfor og agtenfor Maskinen blev lagt *Mellemdæk*. Apteringen af dette er vist i Fig. 4. *A* er Arbejdssalonen, der indtager Skibets hele Bredde. Den var i 1876 noget mindre, idet Forskuddet stod 0.^{m}6 (2 Fod) længere agter og der var her saavelsom i Lugarerne med Hensyn til Maling og Udstyr anvendt den største Sparsommelighed. Midt under Skylightet, der var anbragt i Skibets Storluge, stod Zoologernes Bord. Meteorologen havde sit Bord om Bagbord og Kemikeren sit om Styrbord. I Figuren betegner *c* om Bagbord Kronometerskabets Plads. Midskibs paa Forskuddet hang Søbarometret. *l, l. l* ... ere Sovelugarer, 3 foran og 3 agtenfor Maskinen. Fra Carljohansværns Verft erholdtes udlaant Chiffonierer, Vaskevandstole, Feltstole samt fornødent Køjetøj til Lugarer og Mandskab, men Rammekøjerne i Lugarerne blev senere paa Turen ombyttede med Slingrekøjer af Træ, som Tømmermanden forarbejdede. Erfaringen fra det første Aar viste, at det var nødvendigt at anvende noget mere Bekostning paa Indredningen, navnlig med Hensyn til Lys og Luft. Kemikerens Arbejde generede ofte de øvrige Herrer, ligesom Skibslugten var en stor Plage, naar Vejret ikke tillod Luftning gjennem Skylightet. Til 1877 Aars Togt blev der derfor gjort flere Forbedringer. Forskuddet i Arbejdssalonen flyttedes 0.^{m}6 (2 Fod) længere forefter. Om Styrbord indrettedes paa Banjerne (*B*) særskilt Laboratorium (*L*) for Kemikerne, med Indgangsdør fra Salonen. Denne blev ordentlig malet med lysgrøn Farve og Gulvet blev tættet og trukket med Voxdug. Langs Forskuddet opsattes en Luftrende (*h*) af 0.1^{qm} (1 Kvadratfods) Tversnit, der ledede frisk Luft ned i Salonen (Fig, 2 *h* og Lufthatten, Fig. 1, der kunde vendes mod Vinden). Den slette Luft førtes ud gjennem et Blikrør, der fra Gangen udenfor Lugarerne gik over Kjedlen (*b*) og op forrenfor Skorstenen. Skuddet paa Forkant af Dampkjedlen (*b*) blev gjort dobbelt og den i Mellemrummet staaende varme Luft givet Afløb paa lignende Maade. Lugarerne agterud havde ogsaa en lignende Ventilationsindretning. Samtlige Lugarer og Banjerne, hvor Folkene laa i Hængekøjer, havde Ventiler i Skibssiden, saaledes som man ser af Fig. 4 og Fig. 1. Lugarerne bleve trukne med hvidt Tapetpapir og Gulvet klædt med Voxdug. De vare meget rummelige og tørre, men varme, naar der var Fyr paa Kjedlen og noget mørke. Varmeledningen, som det første Aar kun bestod af et Jernrør, der var ledet gjennem de forskjellige Rum, blev forsynet med Aftapningskraner og særskilte Dampovne af Kob-

Alongside the aftermost hatchway, on the port side, was placed a large, strong reel (Fig. 2 *d*, and Figs. 13, 14), which held 3000 fathoms of sounding-line. In 1876, we had a spare reel on the starboard side; but it was never used.

Explanation of Fig. 2: — *n* companion hatchways; *o* skylights; *m* skylight over engine-room; *h* ventilator; *w* waterclosets.

Fig. 3 shows the arrangement of the *Deck below the Roundhouse*: — *gg* passages on both sides of the ship; *s* messroom; *k* cooking-range; *l, l, l* ... cabins; *n* companion-ladder to orlop-deck; *p* pantry; *m* skylight over engine-room; *b* boiler.

An *Orlop-deck*, fitted up as shown in Fig. 4, had been laid fore and aft from the engine. The common work-room, *A*, occupies the whole breadth of the ship. The first year of the Expedition it was a trifle smaller, the foremost bulkhead being 2 feet farther aft. Amidships, under the large skylight, for which an opening had been cut in the main-hatch, was placed the zoologists' table; another, that of our meteorologist, stood on the port side; and on the starboard side a third, for the chemical work done on board. In Fig. 4 *c*, on the port side, is shown the case for the chronometers. Amidships, from the foremost bulkhead, was suspended the marine barometer. In the same figure *l, l, l* ... are a row of cabins, 3 on either side of the engine, fore and aft. From the Royal Dockyard of Carljohansværn the Expedition procured cabin furniture, such as chests of drawers, washing-stands, camp-stools, &c., and the necessary bedding both for the cabins and the sailors' hammocks; but in place of the canvas berths we afterwards substituted wooden swinging-berths, made on board by the carpenter. The experience of the first year's cruise, showed some additional outlay for remedying defects in the general arrangements below deck, in particular those connected with light and ventilation, to be highly desirable. Unsavoury smells emitted during the chemical work, would hang about the room, and the foul air from the bilge proved a great nuisance in weather that did not admit of ventilating through the skylight. Divers improvements were accordingly effected before commencing the cruise in 1877. We had the dimensions of the work-room increased, by moving the foremost bulkhead 2 feet farther forward. On the starboard side of the orlop-deck (*B*), a separate laboratory (*L*), opening into the work-room, was fitted up for the chemical work to be done on board. The work-room got a good coating of light-green paint; and after filling up the chinks, the floor was covered with oil-cloth. Along the foremost bulkhead we put up a ventiduct (*h*), 1 foot square, down which an uninterrupted current of fresh air found its way into the work-room (Fig. 2 *h*; Fig. 1 represents the moveable top of the ventilator, which could be turned in any direction to catch the wind). To get rid of the vitiated air, a tin pipe was laid along the roof of the passage extending past the cabins, being carried thence over the boiler (*b*), and up the front of the funnel. Moreover, there being now a double bulkhead afore the boiler (*b*), like provision was made for the escape of

ber i hvert Rum. I Fig. 4 er endvidere *S*, *S* Styrmændenes Rum, *f* Fyrbødernes, *g* Kabysen for Mandskabet, *v* Vandtank, *b* Kjedlen, *m* Maskinen, *k* Kulboxerne.

the heated air between the two partitions. For the cabins aft, too, we adopted this mode of ventilation. Each compartment, as also the orlop-deck, where the crew slung their hammocks, had bull's eye windows (Figs. 4 and 1). The cabins were all of them papered white, and had their floors covered with oil-cloth. They were very commodious, and dry withal, but somewhat dark, and with the steam up, rather close, from their proximity to the boiler. The warming-apparatus, which on the first year's cruise had consisted merely af an iron pipe extending from compart-

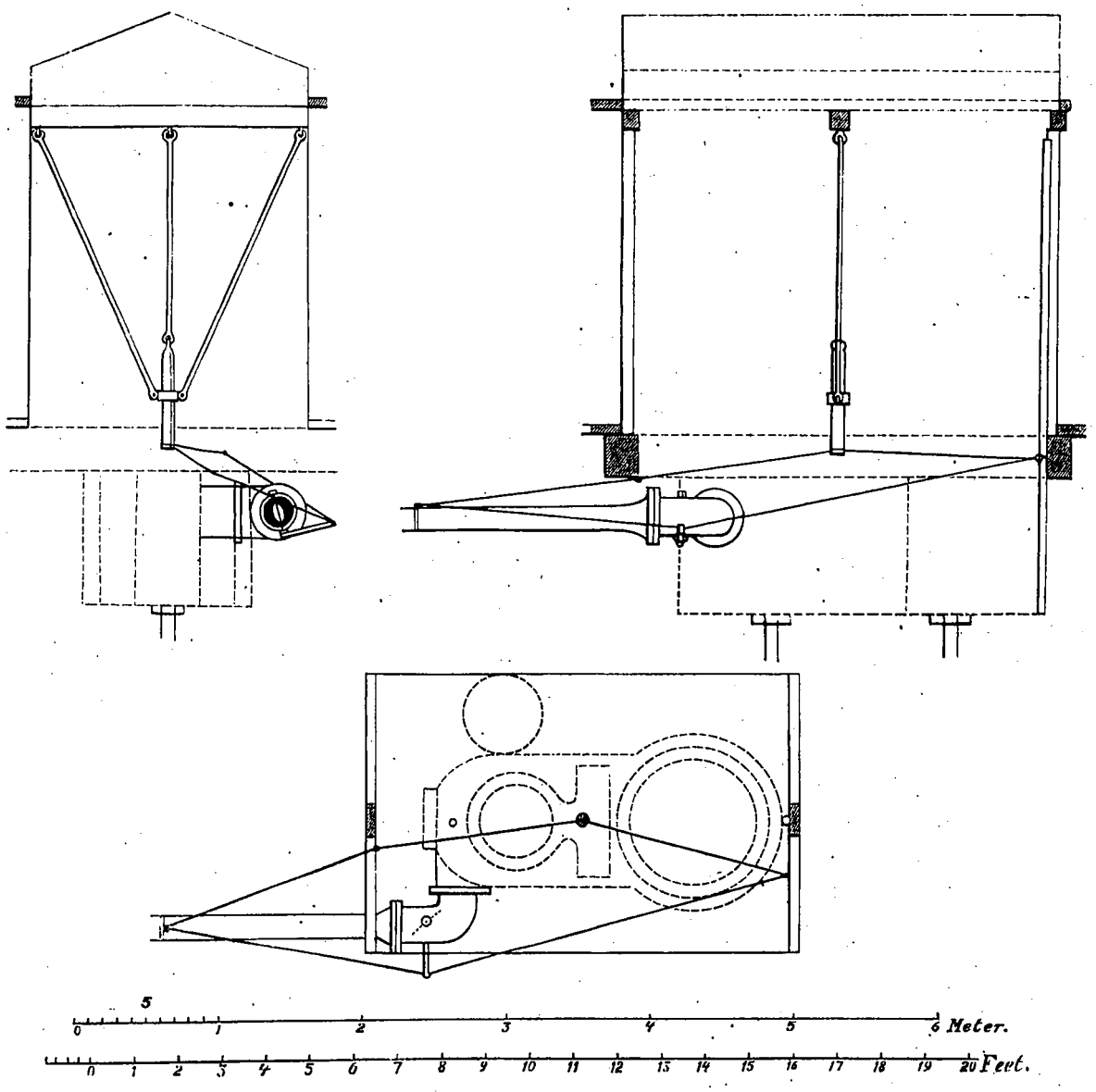


Fig. 6.

Samtidig med Skibet skal jeg omtale *Petersens Pendel-Regulator*, Fig. 6. Som bekjendt er det er stor Ulempe,

ment to compartment throughout the vessel, was now provided with stopcocks for turning on the steam into copper receptacles, or stoves, as they are called, of which each room and compartment had one. Fig. 4 also represents the mates' cabin (*S*, *S*), the firemen's compartment (*f*), the ship's galley (*g*), the water-tank (*v*), the boiler (*b*), the engine (*m*), and the coal-bunkers (*k*).

In my description of the ship and her equipment I must not omit to mention *Petersen's Pendulum-governor* (Fig. 6).

naar Skruefartøjer skal gaa ret mod eller ret undaf Vinden i høj Sø, at Skruen til enkelte Tider kommer ud af Søen, eller i alle Fald saa høit op i Vandet, at den tager en saadan Fart, at der let kan opstaa Havari i Maskinen. Erfaring lærte, at "Vøringen" klarede sig bedst i høi Søgang, naar den blev lagt med Stevnen ret mod Søerne, men naar Bølgetoppen havde passeret Skibets Midte, faldt Bougen ned i Bølgedalen og Skruen, som derved løftedes op i Vandets Overflade, slog da saa haardt, at Maskinisten stadig maatte staa med Throttlevalven i Haanden og bremse. Næstcommanderende, Premierlieutenant Petersen, fandt da paa at hænge op et af de store Lodder, der brugtes til Lodningerne, af 112 Pd.s Vægt, under Maskinskylightet, med Forstøtning til Siderne, saaat det blot kunde svinge frem og tilbage i Skibets Diametralplan. I den nedre Ende var fastgjort 2 Snore, der løb gjennem Kouse, en forrenfor Maskinen (over Kjedlen) og en agtenfor samme (i Maskinskylightet) noget ud i Borde, og begge Snore var med de nedre Ender fastgjorte i Haandtaget til Throttlevalven.

Idet Skibet nu faldt ned med Bougen, svingede Loddet forefter, trak derved i den agterste Snor og lukkede Throttlevalven. Naar Skibet atter rejste sig, faldt Loddet tilbage og aabnede igjen for Dampen ved Hjelp af den anden Snor. Grændserne for Loddets eller Ventilens Bevægelser i begge Retninger reguleredes ved et Par paa den agterste Snor fæstede Tværstykker af Træ, der stoppede op imod den agterste Kous i Maskinskylightet.

Gjennem dette enkle Arrangement udførte Loddet den for Maskinisten saa besværlige Tjeneste med Bremsningen, og bedre end han kunde, da Loddet følger Skibets Bevægelser sikkrere end Maskinisten kan. Med fuld Fart hjalp ikke Loddet, da Slideskabet og Cylinderen indeholdt for meget Damp selv efter Throttlevalvens Lukning; men da Maskinisten heller ikke kan gjøre mere end at lukke, er man i dette Tilfælde ved Omstændighedernes Medfør nødt til at regulere til mindre Fart.

Lodning.

Lodderne. Naar Dybden ikke antoges at være over 1000 Favne, anvendtes det saakaldte Rør-Lod. Til Lodning paa større Dyb brugtes Baillie-Maskinen.

Rør-Loddet (Fig. 7) er af Bly 0.^{m}77 (2 Fod 5$^{1}/_{2}$ Tom.) langt, 0.^{m}078 (3 Tom.) tykt og vejer 56 Kgr. (112 Pund). Det har i den nedre Ende et i en Messingmuffe indskruet Jernrør 0.^{m}23 (9 Tom.) langt, 0.^{m}052 (2 Tom.) bredt til Optagning af Prøver af Bunden. Dette Rør har i den øvre Ende nogle Huller for at Vandet kan slippe ud, naar Bundprøven trænger ind nedenfra, og i den nedre Ende en Butterfly-Ventil, der aabner sig opad, og som hindrer Bund-

It is a well-known drawback with screw-vessels steaming head or stern to wind in a heavy sea, that of the screw being at times either wholly lifted out of the water, or at least brought so near the surface as to cause it to revolve with a rapidity that cannot but expose the engine to serious damage. In rough weather, the "Vøringen" was found to behave best with her head to the sea; but when the crest of a wave had passed the middle of the ship, she would plunge her bows into the trough of the sea, and the screw, being then proportionally raised, tore round with such critical violence at the surface of the water that the engineer had to be constantly on the alert, ready at any moment to shut the throttle-valve and cut off the steam. Observing this and the trouble it entailed, Lieutenant Petersen, our second in command, hit upon the ingenious device of suspending as a governor under the engine-room skylight one of the heavy leaden sinkers, weight 112 lbs., which he made to swing right fore and aft. At the bottom end of the sinker were fastened two lines, rove through thimbles, one before the engine (over the boiler), and the other abaft it (on the engine-room skylight), a little to the port side, the other two ends being made fast to the hand-lever of the throttle-valve.

Now, when the vessel pitched, the sinker swung forward, and, pulling upon the afterline, closed the throttle-valve; on her again rising, the sinker swung back, opening the steam-passage by its drag on the other line. The motion both of the sinker and of the valve was kept within proper limits by two cross-pieces of wood on the after line, fixed one on each side of the after thimble.

By this simple arrangement, the engineer was relieved from the troublesome duty of throttling, which the sinker performed even more effectually, following the motion of the vessel with far greater nicety than the most watchful eye. At full speed, our pendulum-governor was of no avail, the valve-casing and the cylinder then containing too much steam, even with the throttle-valve closed; however, as the engineer can do no more than cut off the steam, in that case there is nothing for it but to reduce the speed.

Deep-sea Sounding.

When the depth was supposed not to exceed 1000 fathoms, we used the tube-lead, as it is called. For sounding in greater depths the Baillie machine was employed.

The *Tube-lead* (Fig. 7), 2 feet 6$^{1}/_{2}$ inches long by 3 inches thick, is of lead, and weighs 112 lbs. At the lower end it has a brass box, into which is screwed an iron tube, 9 inches long by 2 inches in diameter, for bringing up samples of the bottom. This tube has the upper end perforated with a number of holes, to allow of the water passing out above on the sample of the bottom pressing in from beneath, and is furnished at the lower end with a butterfly valve, open-

prøven fra at skylles ud af Røret under Ophalingen. Naar Røret er afskruet, kan et Sidestykke tages ud, hvorved Bundprøven kommer tilsyne med sine naturlige Lag og kan undersøges foreløbig, førend den bringes paa de dertil bestemte Opbevaringskar.

ing inwards, to prevent the washing out of the sample on its journey to the surface. The tube screwed off, the sample within, as it lies *in situ,* may, by removing a slip from the side, be disclosed for preliminary inspection, before being taken to the receptacles in which it is stored

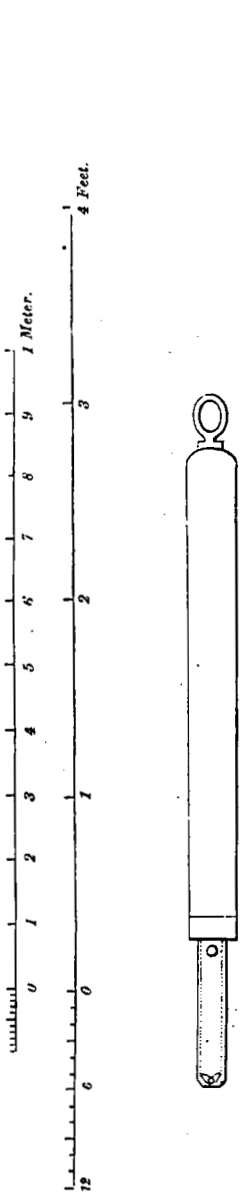


Fig. 7.

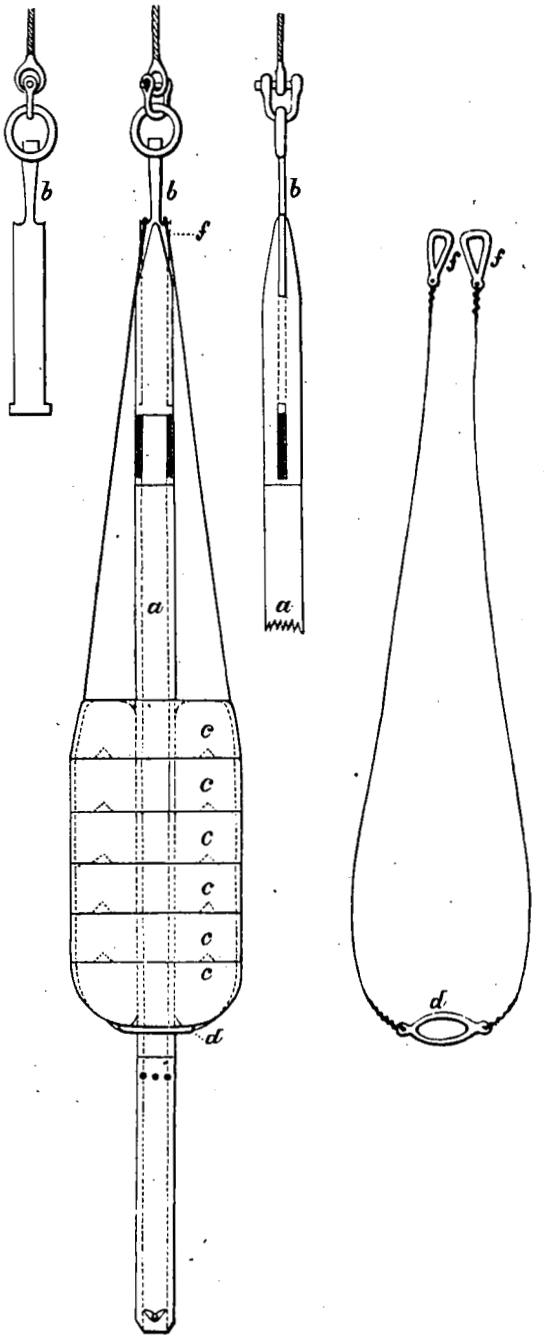


Fig. 8.

Baillie-Maskinen (Fig. 8) bestaar af et 1.^{m}75 (5 Fod 7 Tom.) langt, 0.^{m}061 ($2^{1}/_{3}$ Tomme) bredt Rør, *a,* hvis øvre Del er af Messing og tilspidset. I Spidsen er en Gjennemskjæring, og længere nede i Flugt med denne en

The *Baillie Sounding-machine* (Fig. 8) consists of a tube *a,* 5 feet 9 inches long by $2^{1}/_{3}$ inches in diameter, the upper portion of which is of brass, bevelled away to a long rounded slope. At this end it has a slot,

Aabning paa hver Side. Stykket *b*, der har en Bredde, som er noget mindre end Røret *a*'s indvendige Diameter, er indsat i dette saaledes, at Knasterne ved *b*'s nedre Ende kommer frem i Sideaabningerne, og Stykket *b* kan saaledes bevæges op og ned, fra at Knasten støder an mod Overkant til den støder an mod Underkant af Aabningen. I sidste Tilfælde er *b* ganske skjult inde i Røret med Undtagelse af Ringen. I den nedre Ende af Røret *a* er anbragt den samme Indretning til Optagning af Bundprøve som paa Rør-Loddet.

Til Maskinen hører Jernlodderne *c, c, c,* af hvilke hvert har en Vægt af omtrent 27 Kilogram (55 Pd.). De ere korte Cylindre af støbt Jern med et Hul i Midten af noget større Diameter end Røret *a*'s og med Knaster paa Oversiden samt tilsvarende Fordybninger paa Undersiden og desuden en Fure paa begge Sider, der ligger i Knasternes og Fordybningernes Plan. Naar det ene Lod stables ovenpaa det andet, danner deres Furer en fortløbende Rende. Underlod og Overlod har særskilt Form, som Figuren viser, idet det første er kugleformig afrundet paa Undersiden, for at gjøre mindre Modstand mod Vandet, og det sidste er noget konisk.

Naar Baillie-Maskinen skal rigges, bruges en større cylindrisk Træblok med et Hul i Midten. Over dette lægges Ringen *d,* der er af Støbejern, med isatte Jerntraade, og man stabler nu Lodderne ovenpaa, saa mange som man anser fornødent for med Sikkerhed at kunne angive Øjeblikket, da Loddet slaar i Bund. Derefter sættes Røret *a* gjennem Hullerne i Lodderne og Træblokken, Stykket *b* løftes op, Jerntraadene lægges i Jernloddernes Sidefurer, og Ringene *f* hukes paa de øvre Afsatser paa *b*. Naar man nu løfter op i Lodlinen, der er hexet fast til Ringen i Stykket *b,* hænge Lodderne paa Afsatserne paa Stykket *b,* og Røret *a* hænger med Overkant af Sideaabningerne paa Knasterne ved den nedre Ende af *b*, som i Figuren. Naar Maskinen støder mod Bunden, bliver det løst hængende Rør *a* drevet op og trykker med sin øvre koniske og afrundede Del Ringene *f* ud af Afsatserne paa *b*. Derved er Forbindelsen mellem Jernlodderne og Lodlinen ophævet, Lodderne med Ringen *d,* Jerntraadene og Ringene *f* falde ned og blive liggende paa Havbunden, medens Røret *a* og Stykket *b* bringes op til Overfladen, naar Lodlinen hives ind.

Der blev anvendt indtil 8 Lodder af samlet Vægt 216 Kilogram (432 Pd.). Røret, der hales op, vejer kun 17.5 Kilogram (35 Pd.).

Baillie-Maskinen viste sig at være et udmærket Apparat, idet Lodderne hver eneste Gang, den brugtes, gik af Røret, om end Bunden var noksaa blød. Den eneste Van-

and farther down, in a line with the latter, two other openings, one on either side. The piston-iron *b,* not quite equal in width to the inner diameter of *a,* being so fitted into the tube that the studs at its lower extremity correspond with the aforesaid slots, or openings, can accordingly work up and down within those limits. When the studs are at the bottom of the slots, the piston-iron *b* is just within the brass or upper end of the tube, the ring only by which the instrument is shackled to the sounding-line being then above it. For bringing up samples of the bottom, the lower end of the tube has an arrangement similar to that at the bottom of the tube-lead.

To the machine belong a number of sinkers *c, c, c,* weighing each about 55 pounds, — short cast-iron cylinders, with a hole through the middle slightly exceeding in diameter the tube of the instrument, and toothed and notched so as to fit into one another and make one mass, also having a groove on either side in the same plane with the notches. The top and bottom sinkers differ in shape, the former being slightly conical, and the latter having the lower end spherically rounded, to diminish the resistance and thus increase the velocity in descending.

The Baillie machine was placed for adjustment on a cylinder of wood, having a hole through the middle somewhat greater in diameter than that of the tube *a*. Over the bore of the cylinder is placed a cast-iron ring *d,* with iron wires attached; and upon the ring are piled a number of sinkers, sufficient to determine the exact moment at which the instrument reaches the bottom. The lower part of the tube *a* is next passed through the sinkers into the wooden cylinder beneath; and after drawing out the piston-iron *b,* the wires, forming a sling, are laid in the groove along the sides of the sinkers, and the rings *f* hooked upon the shoulders of the piston. Now, on the instrument being hung to the sounding-line by the ring of the piston-iron, the sinkers will depend, on the iron-wire sling, from the shoulders of *b,* and the tube *a* from the lower studs that retain the piston-iron in position, the brass cylinder being pulled down the entire length of the slots, as shown in the figure. When the tube and the weights touch the bottom, the brass cylinder is pushed upward the length of the slots, and its top rim striking against the rings *f,* the sling is slipped off the shoulders of the piston-iron. The sinkers, being thus deprived of their support, drop, carrying with them the ring *d,* the wires of the sling, and the rings *f,* down the tube *a,* which, on hauling in the line, comes up alone, with the piston-rod and a sample of the bottom.

For some soundings we used as many as 8 sinkers, weighing together 432 pounds. The weight of the tube is only 35 pounds.

The Baillie machine proved an excellent apparatus, the weights being without exception detached from the tube, however soft the bottom. The only difficulty

skelighed var Udfiringen over Rækken og ned i Søen, thi ved Slag mod Skibssiden kunde Jerntraadene løsne og Lodderne tabes. Man firede den derfor saa hurtig som muligt ned i Vandet, hvor dens Svingninger under Fartøjets Bevægelser lettere kunde dæmpes og gjøres uskadelige.

Lodlinerne, der var leverede af Reþslager Timm i Christiania, var af fineste Sort italiensk Hamp, 2.^{cm}6 (1 Tomme), i Omkreds, voxede og glatstrøgne. De holdt ved anstillet Prøve en Vægt af 750 Kilogram (1500 Pd.). De viste sig særdeles gode, og der blev brugt kun en Line hver Sommer. Linen blev mærket for hvert hundrede Favne med omviklede og paamerlede Stykker Flagdug af forskjellig Farve. De første 20 Favne var dobbelt Part med Kous og Hex til Loddet. I 1876 var Lodlinen inddelt i *norske* Favne, og de første 100 Favne havde Lædermærker for hver 10 Favne. I 1877 og 1878 var Lodlinen inddelt i *engelske* Favne og de første 200 Favne opmærkede for hver 10de Favn. Opmærkningen foretoges ombord, idet der med Tommestok blev sat Mærker i Dækket for en Længde af 5 Favne, hvilke ogsaa senere brugtes, naar Linen blev eftermaalt og rettet.

Som anført, havde vi ingen Sprængning af Lodlinen foraarsaget ved at Baillie-Maskinens Lodder ikke gik af Røret. Som Bevis paa Lodlinens Godhed kan anføres, at den under Lodningen en Gang, medens den altsaa var i fuld Fart, gik i Hus i Loddeblokken, idet denne ikke drejede sig hurtigt nok ind i Planet mellem Linens Parter. Uagtet det voldsomme Ryk og det snevre Rum, hvori Linen blev kneben ind i Blokken, over tildels skarpe Kanter, holdt den uden at lide Skade. Den eneste Sprængning af Lodline fandt Sted i 1877 paa Turen nordenfor Tromsø, idet Lodlinen, som under Indhivningen var kommen under Fartøjets Bund, blev grebet af Skruen og sprængt. Ved at fire et Lod i slak Bugt ud fra Stevnen og med Enderne af Linen langs hver af Fartøjets Sider hale det agterud, lykkedes det vagthavende Officer, Capt. Grieg, at fiske Lodlinen, der havde kastet sig om Propelleraxen saa vidt, at den ikke sank; derved reddedes flere Thermometre og de af dem registrerede Bund-Temperaturer.

Accumulatoren bestaar af en Samling Kautschuk-Stroppe (Fig. 9), hver bestaaende af 2 sammenføjede Strenge af 2^{cm} ($^3/_4$ Toms) Tykkelse. I hver Bugt er en Træ-Kous med Stjert, og Strengene holdes sammen om Trækousene ved tynde Kautschuk-Ringe. Stroppene ere ordnede mellem 2 stærke Træskiver, 0^m.442 (1 Fod 5 Tom.) i Diameter og 0^m.045 (1.7 Tom.) tykke, med ligesaamange smaa Huller som der er Stroppe. Stjerten tages gjennem Hullerne og samles om en svær Kous, saaledes at Stroppene blive jevnt stive. Fig. 10 viser Lodde-Accumulatoren. Den be-

lay in lowering the instrument; bumping against the ship's side was apt to disengage the sling, and thus occasion the loss of the sinkers. We therefore got the machine as quickly as possible into the water, where the swinging motion given to it by the rolling of the vessel could produce no injurious result.

The *Sounding-lines,* supplied by Mr. Timm, ropemaker of Christiania, were of the best Italian hemp, 1 inch in circumference, with a breaking strain of 1500 pounds, and well waxed and smoothened. They proved of excellent quality, one amply sufficing for a whole cruise. The lines were graduated into hundreds of fathoms by attached slips of different coloured buntine, wrapped round the surface. Each was rove double the first 20 fathoms, and provided with a thimble and a shackle, by which to make fast the sounding-machine. For the first year's cruise, in 1876, the line was graduated into Norwegian fathoms, and had slips of leather at every 10 fathoms of the first hundred; but for the two remaining cruises, in 1877 and 1878, we substituted English measure, graduating the first two hundred fathoms of the line into tens of fathoms. The line was graduated on board, 5 fathoms having been previously measured out along the deck with a foot-rule. These five-fathom intervals served, too, as a reliable standard when re-measuring and adjusting the line.

As stated above, the weights were detached at every sounding with the Baillie machine; and hence we never had the line carry away from their failing to drop off on the instrument striking the bottom. Meanwhile, the excellence of its quality came on one occasion to be severely tested. When running out with full velocity, the line suddenly caught in the sounding-block, which had not readily adjusted itself to the direction taken by the former on its rapid passage out. But, though brought up in this way with a violent jerk, and jammed besides into the block, partly, too, against sharp edges, the line was strong enough to stand the strain uninjured. The only sounding-line that parted was one used in 1877, on our cruise north of Tromsø. We were hauling in the lead, when it got underneath the ship's bottom, fouled the screw, and was broken. By lowering a weight over the bows in a slack bight, and then, with the ends of the rope extending one along either side of the vessel, hauling it aft, the officer of the watch, Captain Grieg, succeeded in fishing the sounding-line, which had twisted round the screw-shaft just sufficient to keep it from sinking, and thus recovered several thermometers, along with the temperatures they had registered at the bottom.

The *Accumulator* is built up of a number of straps (Fig. 9), each composed of 2 vulcanised india-rubber springs, three-quarters of an inch thick, joined lengthwise. In each of the loops is fixed a wooden thimble, with a lanyard, and the springs are kept together by means of thin india-rubber rings. The straps are kept free from one another and equably taut, by stretching them between a couple of strong wooden disks, 1 foot $5^1/_2$ inches in diameter and $1^3/_4$ inch thick, bored with a hole for every strap, the lanyards being rove through the holes and brought

staar af 15 Stroppe. I den nedre Kous hænger Loddeblokken, der er af Jern, forsynet med Hvirvel, Axe, der løber paa Friktionsruller og to Arme med Hængsler til Styring af Lodlinen. Den øverste Kous hukes i et Topreb, der senere skal beskrives, og det hele Apparat hænger,

together round a large thimble. Fig. 10 represents the Sounding-accumulator, composed of 15 straps. To the lower thimble is hung the cast-iron sounding-block, provided with a swivel, an axle revolving on antifriction rollers, and two hinged arms to act as fairleaders for the line. The upper

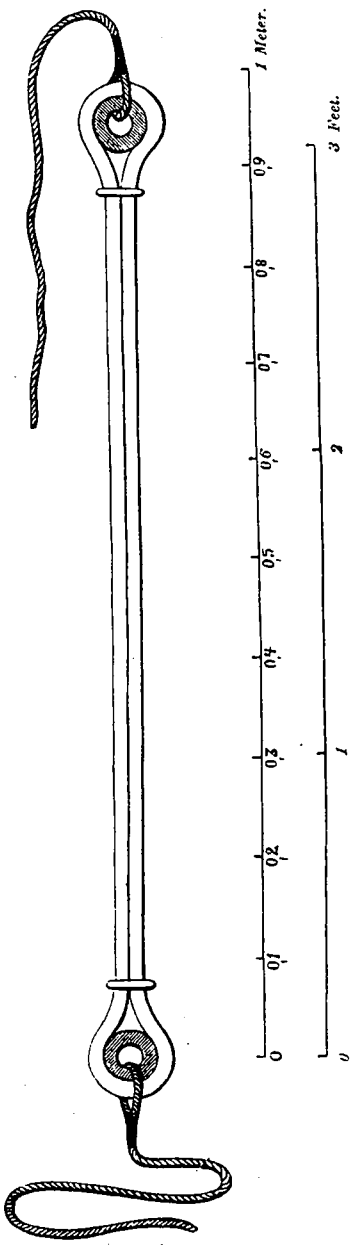


Fig. 9.

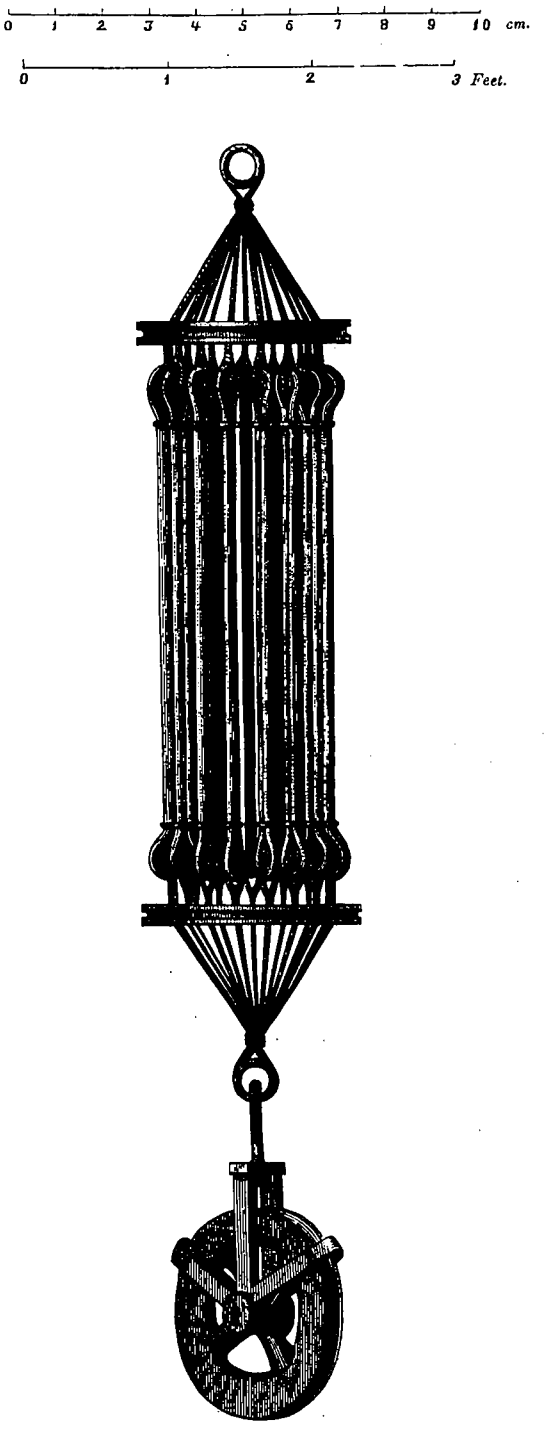


Fig. 10.

naar det er i Virksomhed, under Bagbords Storraa-Nok.

Hensigten med Accumulatoren er at kompensere Skibets Bevægelser op og ned i Søen, saaledes at Lodlinen

thimble is hooked on to a pendant, which will be afterwards described. When in use, the apparatus hangs suspended from the port main-yard-arm.

The most important function of the accumulator is to take off the suddenness of the strain on the line when

ikke bliver udsat for pludselige Ryk. Udvidelsen af Accumulatorens Stroppe tjener ogsaa til at angive Størrelsen af den Kraft, som gaar paa den.

Ved Afvejning i Land fandtes den Vægt, der svarede til hver Fods Udvidelse af en enkelt Strop, og derefter opsattes nedenstaaende Tabel, der dog selvfølgelig kun angiver omtrentlige Værdier. En Accumulator med 30 Stroppe brugtes til Bundskrabningerne.

Længde. Fod.	1 Strop.	15 Stroppe. Vægt i Pund.	30 Stroppe.
3	0	0	0
4	40	600	1200
5	61	915	1830
6	76	1140	2280
7	90	1350	2700
8	101	1515	3030
9	111	1665	3330
10	122	1830	3660
11	132	1980	3960
12	143	2145	4290
13	153	2295	4590
14	162	2430	4860
15	173	2595	5190
16	185	2775	5550
17	198	2970	5940
18	213	3195	6390
19	230	3450	6900

Ved $20^1/_2$ Fods Længde blev Stroppen sprængt.

Da Loddeblokken vejer sine 50 Pd., den største Loddevægt, som ovenfor anført, var 470 Pd., hvortil kommer Vandhenterens Vægt, ser man, at Accumulatoren, paa hvilken der i dette Tilfælde gik en Kraft af noget over 1000 Pd. før Lodderne kom i Vandet, ikke blev meget anstrengt i Forhold til hvad den kunde bære. Under Loddets Synken gaar der ikke stor Kraft paa Accumulatoren, derimod bevirker Lodlinens lange Overflade en saa betydelig Friktion mod Vandet under Ophalingen fra større Dybder, at Accumulatoren kan strækkes ud 0.^{m}2 til 0.^{m}3 (en halv til en hel Fod.)

Kautschukstroppene taaler godt Fugtighed, men angribes af fedtagtige Stoffe og lider vel ogsaa ved stadig Udsættelse for Vind og Vejr. Saasnart Lodningen var forbi, blev vistnok Accumulatoren strax firet ned i Vandet, men det kunde ikke altid undgaaes, naar den var udhalt under Raaen til Brug, at den for en kortere Tid kom i Røgen fra Skorstenen. Den i 1876 brugte Accumulator kunde ikke bruges den følgende Sommer. I 1877 anbragte jeg til Forsøg omkring Stropperne en Serk af Sejldug, der blev fastspigret rundt Kanten af øverste Træskive (se Fig. 1, Skrabe-Accumulatoren, og Titelbilledet samt Fig. 14) og var af samme Længde som Stroppene i Hvile. Ikke usandsynligt paa Grund af denne Beskyttelse holdt Accumulatorerne sig saa godt, at de kunde benyttes i 1878, dog i den sidste Tid forstærkede med nogle nye Reserve-Stroppe.

the vessel is rolling or pitching; but it is also valuable as indicating roughly the amount of the strain, by the greater or less extension of the straps.

By weighting one of the straps, I had found, before the Expedition left Norway on the first cruise, the amount of strain corresponding to its extension, for every successive foot. The results, which of course cannot but represent approximate values, are given in the following Table. An accumulator with 30 straps was used with the dredging-gear.

Length of Strap. Feet.	1 Strap.	15 Straps. Weight in Pounds.	30 Straps.
3	0	0	0
4	40	600	1200
5	61	915	1830
6	76	1140	2280
7	90	1350	2700
8	101	1515	3030
9	111	1665	3330
10	122	1830	3660
11	132	1980	3960
12	143	2145	4290
13	153	2295	4590
14	162	2430	4860
15	173	2595	5190
16	185	2775	5550
17	198	2970	5940
18	213	3195	6390
19	230	3450	6900

At twenty feet and a half the strap broke.

The weight of the sounding-block being 50 pounds, and that of our heaviest set of sinkers, as stated above, 470, to which must be added the weight of the water-bottle, the accumulator, which accordingly had to bear a strain of but little more than 1000 pounds before the sinkers reached the water, was not exposed to any severe test, considering the great strength of the straps. During the downward passage of the lead, there is very little strain on the accumulator; but when hauling in, the friction of one or two miles of cord in the water is so considerable, that the accumulator will be frequently stretched from half a foot to a foot.

The india-rubber springs stand wet and moisture well; they are, however, injuriously affected by grease and all kinds of fatty substances, and probably, too, suffer from continued exposure to wind and weather. Immediately after sounding, the accumulator was lowered into the shrouds; but when triced under the yard-arm for use, it was not always possible to keep it out of the smoke from the funnel. The accumulators provided for the first year's cruise, in 1876, had to be rejected on the next. To remedy this drawback, I tried, in 1877, the experiment of nailing round the rim of the upper disc a protective covering of canvass, of the same length as the unstretched straps (see Fig. 1, Dredge-accumulator, Frontispiece, and Fig. 14). Owing, probably, to this simple expedient, the accumulators kept in so good a condition as to admit of our using them

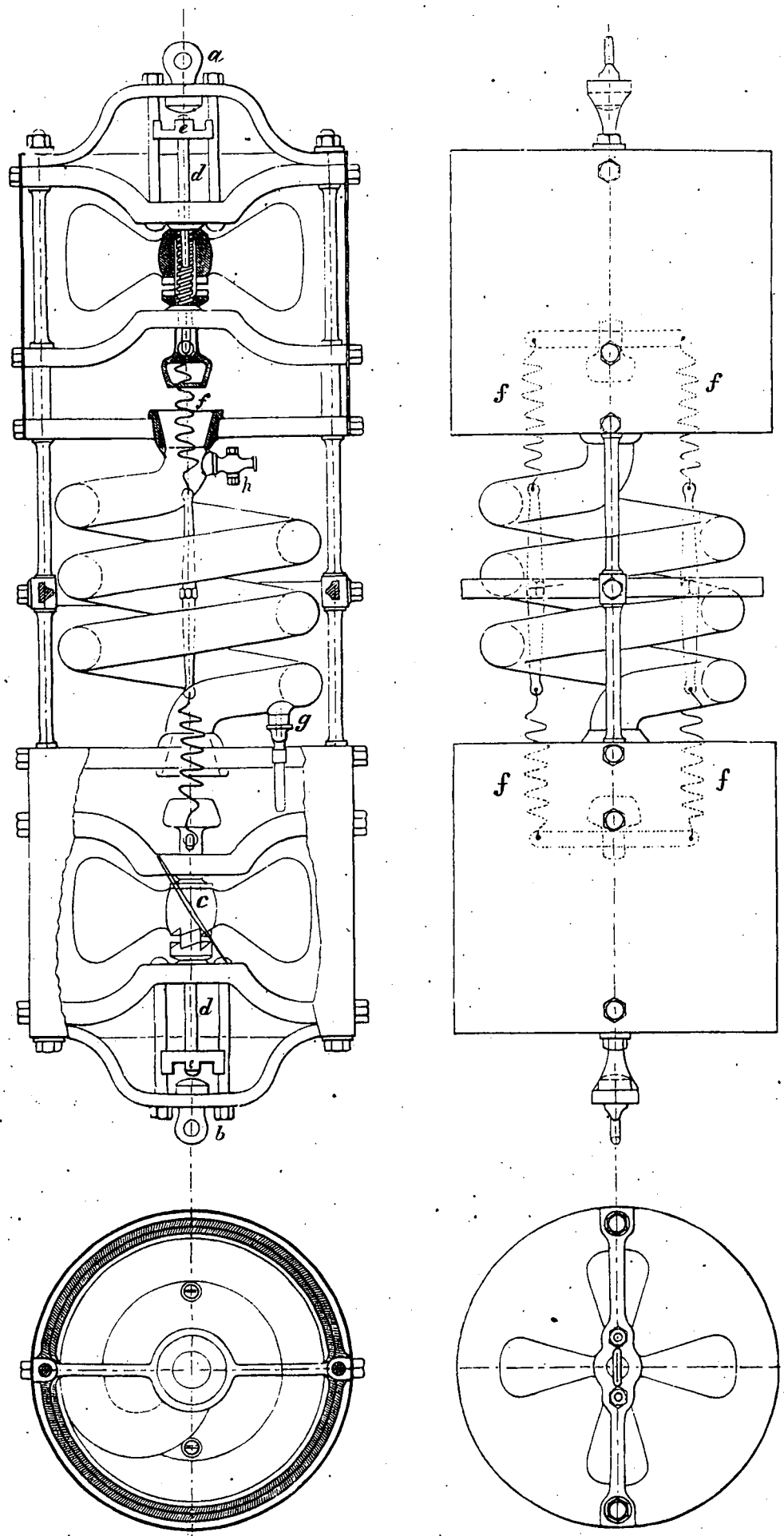


Fig. 11.

Thermometre. — De Dybvandsthermometre, der benyttedes paa vor Expedition, vare Casella-Millers, Buchanans (Kviksølvpiezometer) og Negretti og Zambras, den ældre og den nyere Model. Desuden gjordes Forsøg med Vand-Piezometre til Kontrolbestemmelser for de maalte Dybder. Alle disse Instrumenter ville blive beskrevne af Professor Mohn i hans Afhandling om Dybvands-Temperaturerne.

Vandhenter. — Paa vor Expedition anvendtes hovedsagelig den af mig dertil konstruerede, i Fig. 11 i $^1/_8$ af den sande Størrelse fremstillede Vandhenter. Instrumentet, der blev prøvet i Christiania før det blev antaget, blev brugt under den hele Expedition, saavel paa de større som paa mindre Dyb. Da Kemikeren havde stillet Fordring paa 5 Liter Vand, blev Apparatet meget stort, hvilket vistnok ikke generede Indhalingen i mærkelig Grad, men det gjorde det noget tungvindt at haandtere paa Dæk.

Vandhenteren er i Figuren fremstillet færdig til Udfiring. Tampen af Lodlinen hexedes i øverste (*a*) og Loddet i nederste Øjebolt (*b*). Under Udfiringen strømmer Vandet frit gjennem det, for Pladsens Skyld, spiralformig bøjede Rør, der var af Kobber og indvendig fortinnet. Samtidig løftes Propellerne op, saa at Taggerne i Underkant af Propelbosset *c* kommer klar af Taggerne i Muffen om Ventilstangen, og om de ikke skulde komme ganske klare, sker Propellens Omdrejning med Skraaplanerne, saaat Muffen og den gjennem samme gaaende Ventilstang *d* bliver staaende stille. Naar derimod Instrumentet under Indhivning bevæges opad, trykker Vandtrykket Propellerne ned, de drives rundt den anden Vej og tager Muffen med sig. Ventilstængerne, der styres af Tverstykkerne *e* og Ventilerne, der ere overtrukne med Kautschuk, skrues da mod Ventilsæderne i Enden af Røret, og naar de er næsten lukkede, glipper den sidste Skruegjænge i Ventilstangen ud af Skruegjængerne i Muffen og Spiralfjædrene (*f*) klappe da Ventilen i, og holder dem lukkede under Resten af Indhivningen, medens Propellerne og Mufferne gaa løse rundt den glatte Del af Ventilstangen og saaledes frembyde meget liden Modstand. Instrumentet lukkede sig efterat være indhalt 6 à 7 Favne. Skjærmene om Propellerne beskytter disse, saa at Instrumentet uden Skade kan ligge paa Bunden.

Da man ønskede at konstatere, om der var Overskud af Luft i de dybere Vandlag, blev der over Svikhullet (*g*) paa Røret paaskruet et gjennemboret Laag, og dette blev forenet med et i den ene Ende lukket Glasrør ved Hjælp af et Stykke Kautschukslange. Naar Vandet under Nedfiringen strømmede ind i Vandrøret, løb det ogsaa ned i

the year after (1878), strengthened, however, on the latter part of the cruise with a few spare straps.

Thermometers. — Of deep-sea thermometers, the Expedition was provided with the Miller-Casella, Buchanan's (mercury-piezometer), and Negretti & Zambra's (on the original and the improved construction.) Experiments were also made with water-piezometers, to control determinations of depth. These instruments will all be described by Professor Mohn, in his Memoir on the deep-sea temperatures.

The Water-Bottle. — For collecting water both from the bottom and intermediate depths, we made chief use, on each of the three cruises, of an instrument devised by myself, and tested in Christiania previous to the departure of the Expedition. Fig. 11 represents this water-bottle, one-eighth of the actual size. The apparatus having, as stipulated by Mr. Svendsen, chemist to the Expedition, to bring up 5 litres of waters, it was of course rather bulky; but this, though it made the instrument somewhat cumbersome to handle on deck, did not materially impede the heaving in.

In the figure, the water-bottle is shown ready to let go. The end of the sounding-line is shackled to the upper eyebolt (*a*), and the lead to the lower (*b*). On the downward journey, the water passes freely through the tube, which is of copper, tinned on the inside, and which, to save space, had been given a spiral form. Now, the pressure of the water will lift up the propellers, enabling the cogs in the under surface of the boss (*c*) to get clear of the cogs in the bush, through which passes the rod of the valve (*d*); and if not quite clear, the propeller will revolve *with* the inclined planes, the bush and the valve-rod remaining stationary as before. On the other hand, when the instrument, on being hauled in, is given an upward motion, the pressure of the water will force down the propellers, and they will then revolve in the opposite direction, carrying along with them the bushes. The valve-rods, which cannot revolve, being kept in position by the cross-pieces (*e*), will then, together with the valves, covered with india-rubber, be screwed against the valve-seats. When the valves are well-nigh closed, the last twist of the screw on the rod of the valve will slip out of the corresponding twist of the screw on the bush, and the spiral springs (*f*) instantly press down the valves and prevent the enclosed sample of water from escaping, the propellers and the bushes being left to revolve independently round the flush portion of the rods, thus affording very little resistance on the passage to the surface. The instrument closes on being hauled in 6 or 7 fathoms. The shields round the propellers serve to protect them from damage when the instrument is lying on the bottom.

With a view to ascertain whether the proportion of air were really greater in the deeper strata of the ocean, a perforated cover was screwed over the spigot-hole (*g*), and connected, by means of a short piece of india-rubber hose, with a glass tube, sealed at one end. Now, when the water on the downward passage of the instrument entered

Glasrøret, af hvilket saaledes den atmosfæriske Luft blev udjaget. Naar Instrumentet kom ombord, endevendtes det, saaledes at Kranen *h* kom ned og Glasrøret op. Man bevægede nu Vandhenteren lidt frem og tilbage med den øvre Ende, og hvis der havde været Overskud af Luft, maatte denne have arbejdet sig op, og vist sig i Toppen af Glasrøret. Dette viste sig imidlertid i ethvert Tilfælde fuldt af Vand lige til Tops, og blev derfor i den senere Tid ikke paasat.

Til mindre Dybder, og naar man ikke behøvede at standse Udfiringen, benyttedes en mindre Vandhenter konstrueret af Professor *Ekman* i Stockholm. Dette Apparat er fremstillet i Fig. 12. Det bestaar af en i begge Ender aaben Cylinder *c*, der har en Brem rundt om den øvre Kant. Denne Cylinder løber op og ned langs tre[1] Styrestænger *d*, hvis øvre Ender er forbundne med et Tværstykke, og de nedre Ender er fæstede til en Bund, der har en med Fedt eller Guttapercha fyldt Udskjølpning rundt om, i hvilken Cylinderens nedre Kant passer. I denne Bund er ogsaa en Udtapningskran. Fra Midten af Bunden staar op en Stang, der bærer en Skive med Kanter af ombøjet Kautschuk, og som lukker Cylinderen foroven, naar den er sluppet ned. I denne Skive er et Svikhul, lukket med en Prop. Cylinderen hukes med en Sliphage *a* i det øvre Tværstykke mellem Stængerne, og denne Hage holder da Cylinderen oppe, medens Apparatet løftes over og langs Skibssiden, men naar man lader det falde i Vandet, løftes Cylinderen lidt af Vandtrykket under Bremmen og Sliphagen falder ned. Vandtrykket holder da Cylinderen fremdeles oppe, saalænge Instrumentet synker raskt, men idet man standser Udfiringen eller ved Bunden, falder den ned og indeslutter Vandet. Hagen *b* griber fat under Bundstykket og hindrer Cylinderen fra at løfte sig mere, naar den engang er faldt ned.

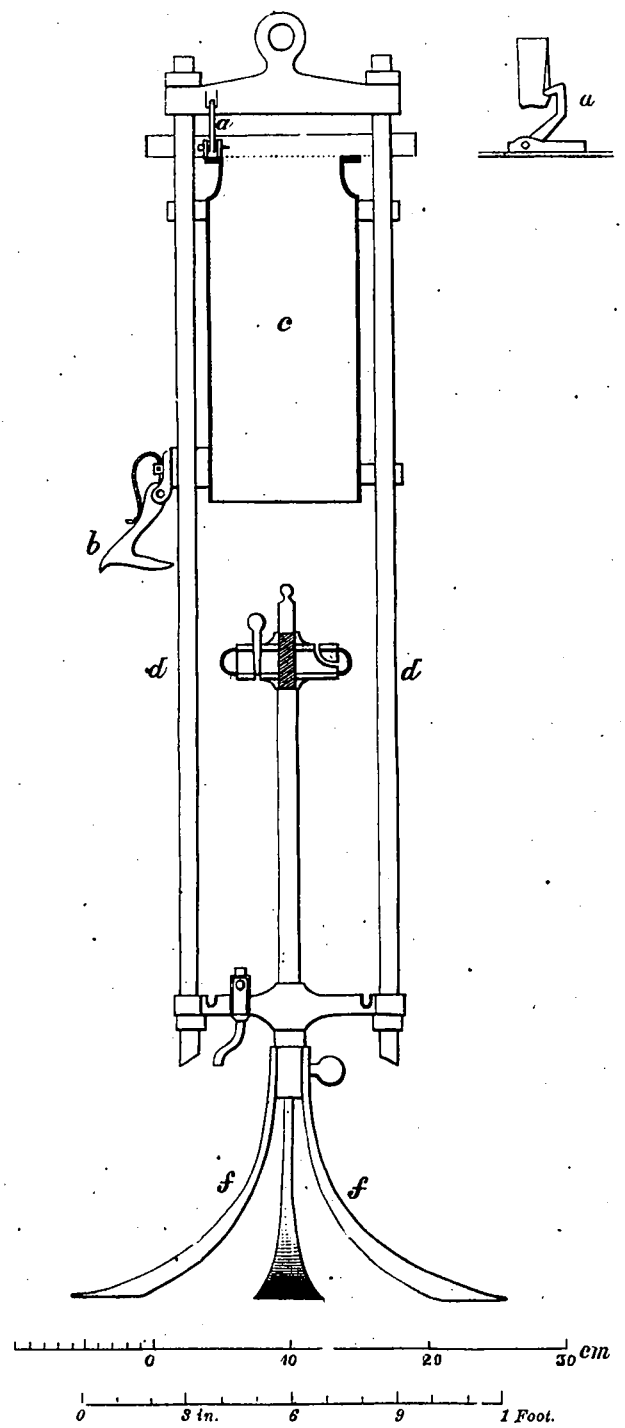


Fig. 12.

[1] I Figuren er for Tydeligheds Skyld kun tegnet to.

the spiral copper tube, it also flowed into the glass tube, expelling the atmospheric air. So soon as the instrument came on board, it was inverted, the stopcock (*h*) pointing down and the glass tube up. The upper end of the apparatus being then moved gently backwards and forwards, the surplus of air, had any such existed, must obviously have forced its way upwards, and have appeared, in the form of bubbles, at the top of the glass tube, which, however, was invariably found to be full of water; and hence we ceased to attach it when the fact would no longer admit of doubt.

For moderate depths, and when not obliged to check the line in veering out, we used a smaller water-bottle, constructed by Professor *Ekman* of Stockholm. This instrument is represented in Fig. 12. It consists of a brass cylinder (*c*), open at both ends, and with a flange round the upper rim. The cylinder slides up and down 3[1] metal guides, the upper ends of which are connected by a beam, the lower end being fixed to a circular bottom-piece, having a grooved rim filled with grease or guttapercha, into which the cylinder fits. The bottom-piece is also provided with a stopcock; and, projecting upwards from the centre, extends a stout rod, bearing a metal disk, the rim of india-rubber, which serves to close the top end of the cylinder, on the latter having slid down the guides. In the disk is a spigot-hole, stopped with a plug. The cylinder is attached to the beam, between the guides, by means of a slipping-hook (*a*), which keeps it suspended when lifting the apparatus and lowering it over the ship's side; but on its reaching the water, the pressure against the under surface of the flange slightly raises the cylinder and slips it off the hook. Meanwhile, the pressure of the water will retain the cylinder at the top of the instrument, the descent being sufficiently rapid; but on checking the line, or the instant the machine touches the bottom, it will slide down and shut in a sample of

[1] To avoid apparent complexity, only two of the guides are shown in the figure.

De nedentil paasatte Jernblade *f* støder mod Bunden og hindrer, at Kranen bliver fyldt med Mudder. Til vort Brug anbragtes istedetfor disse en fast Jernstang med Øjebolt i den nedre Ende, i hvilken Rør-Loddet indhexedes. Apparatet rummede 2 Liter Vand.

Under de før antydede Omstændigheder er Apparatet særdeles hensigtsmæssigt og Tætningen paalidelig, men kommer noget i Vejen under Nedfiringen, maa hele Operationen gjøres om igjen, og dertil kommer, at Bremmen tilligemed øverste Lukningsskive frembyder en ikke uvæsentlig Modstandsflade under en længere Indhivning.

Forberedelser til Lodning. Lodlinen, 3000 Favne lang, var oprullet paa den agterud om Bagbord i Dækket fastskruede Dækrulle, der sees i Fig. 1, 2 og 14. I Fig. 13 er denne vist tydeligere. Rullens Bom var 0.^{m}627 (2 Fod) lang, 0.^{m}157 (6 Tom.) tyk og af Træ. De cirkelformede Sideflader var af tykke, galvaniserede Jernplader, paa den indre Side plane, paa Ydersiderne forstærkede ved dobbelte Lag af Jernplader. Deres Diameter var 1.^{m}098 (3 Fod 6 Tom.) og deres Kanter var afrundede, saa at de frembød en glat, ringformig Flade af omtrent 2.^{cm}6 (en Tommes) Diameter. Paa Bagbord Side var anbragt en Svejv af 0.^{m}31 (1 Fods) Længde med Træhaandtag. Stativets tvende Dele var nedentil forbundne med Jernstænger, og det hele hvilede paa et Par langskibs løbende Bjælker, gjennem hvilke Stativet var skruet fast til Dækket.

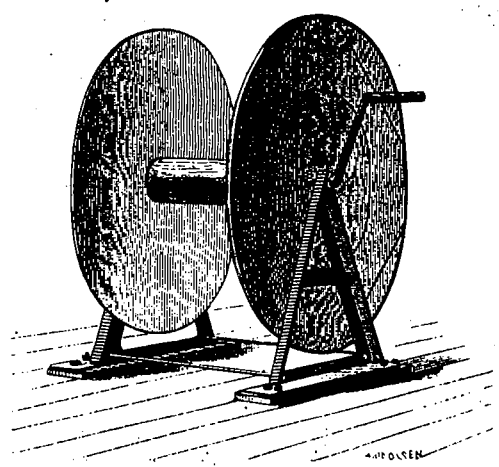


Fig. 13.

Tampen af Lodlinen toges fra Rullen og manedes gjennem Fodblokken paa Agterkant af Hytten (Fig. 14.) Denne Blok var lidt mindre end Loddeblokken, og Skiven solid, men forøvrigt af samme Konstruktion som denne. Derfra manedes Lodlinetampen videre gjennem Loddeblokken, der hang under Accumulatoren. Accumulatoren var i sin øvre Ende fæstet til et *Toqreb,* hvis anden Ende var fastgjort over Godset paa Storsalingen (Fig. 14.) Med en firskaaren Talje haledes nu Accumulatoren ud paa sin Plads under Bagbords Storraa-Nok. Storraaen brasedes saaledes, at Accumulatoren kom omtrent for Midten af Loddebroen, og blev i denne Stilling forstøttet med Braser, Toplenter og Rakke. Lodlinen ihexedes øverste Øjebolt i Vandhenteren, eller Ringen i Rørloddet, eller Ringen i Røret til Baillie-Maskinen, efter Omstændighederne. Benyttedes Willes Vandhenter, hexedes Rørlod eller Baillie-Maskinen i dennes nederste Øjebolt. Disse Forberedelser blev truffet, medens Fartøjet endnu var i Gang. De følgende Manøvrer, der udførtes dels for at holde Fartøjet saavidt mulig paa Plads under Lodningen, dels for at faa

water. Once down, the cylinder is kept in position by a hook (*b*), which catches on the under surface of the bottom-piece. The iron fenders (*f*) at the lower end of the instrument serve to protect it when striking the bottom, and prevent mud or rubble from fouling the stopcock. In lieu of the fenders, we substituted an iron rod, having at the lower end an eye-bolt, to which the tube-lead was attached. The apparatus brings up about 2 litres of water.

Properly used, the Ekman water-bottle gives every satisfaction. There is no leakage; but should any mishap occur in veering, the whole operation will have to be repeated; moreover, the flange of the cylinder and the disk at the top offer considerable resistance in hauling up the instrument.

Preparations for Deep-sea Sounding. — The sounding-line — length 3000 fathoms — was wound on the port side of the after-deck on a large, strong reel, secured by screws (Figs. 1, 2, and 14) to the deck. Fig. 13 conveys a clearer idea of the arrangement. The barrel of the reel was of wood, 2 feet $3^{3}/_{4}$ inches long by $6^{3}/_{16}$ inches in diameter, the two terminal disks being of thick, galvanized sheet-iron, strengthened on the outer surface by a double plating of the same material. They measured 3 feet $7^{1}/_{4}$ inches in diameter, and were rounded at the circumference, so as to give them a smooth annular rim, about an inch broad. At the port end, the reel had an iron lever-arm, 1 foot in length, with a wooden handle. The two supports of the frame were connected underneath by means of iron stays, the whole apparatus being made to rest on a couple of beams running fore and aft, through which the frame was screwed to the deck.

The end of the line was run off the reel and rove through the leading-block on the after part of the round-house (Fig. 14.) This block was a trifle smaller than the sounding-block and had a solid sheaf, though in other respects similarly constructed. From thence the line was rove through the sounding-block, which hung beneath the accumulator. This apparatus was attached to a strong pendant, made fast above the gear of the main cross-trees (Fig. 14), and by means of a gun-tackle purchase hauled out under the port main yard-arm, the yard being trimmed so as to bring the accumulator as near as possible abreast of the sounding-bridge, and kept in position by the braces, topping-lifts, and trusses. The line — according to the nature of the operation — was next shackled to the upper eye-bolt of the water-bottle, the ring of the tube-lead, or the ring of the tube of the Baillie machine. When using Wille's water-bottle, we hung the sounding-instrument — the tube-lead or the Baillie machine — to the lower eye-bolt. These preparations were made with the vessel steaming ahead; the subsequent manœuvres, for keeping the ship in position

Loddet i Bund, udførtes samtidig med Fartøjet og med Apparaterne paa Dæk.

Manøvre med Fartøjet. Ved Ankomsten til Loddestationen lagdes Fartøjet med Stevnen ret imod Vinden og stoppedes. I denne Stilling søgte man nu at holde

and for sinking the lead to the bottom, we carried out together, handling the vessel and the deep-sea apparatus simultaneously.

Handling the Ship. — On arriving at a sounding-station, the vessel was put head to wind and her way deadened. In this position we tried to keep the ship as

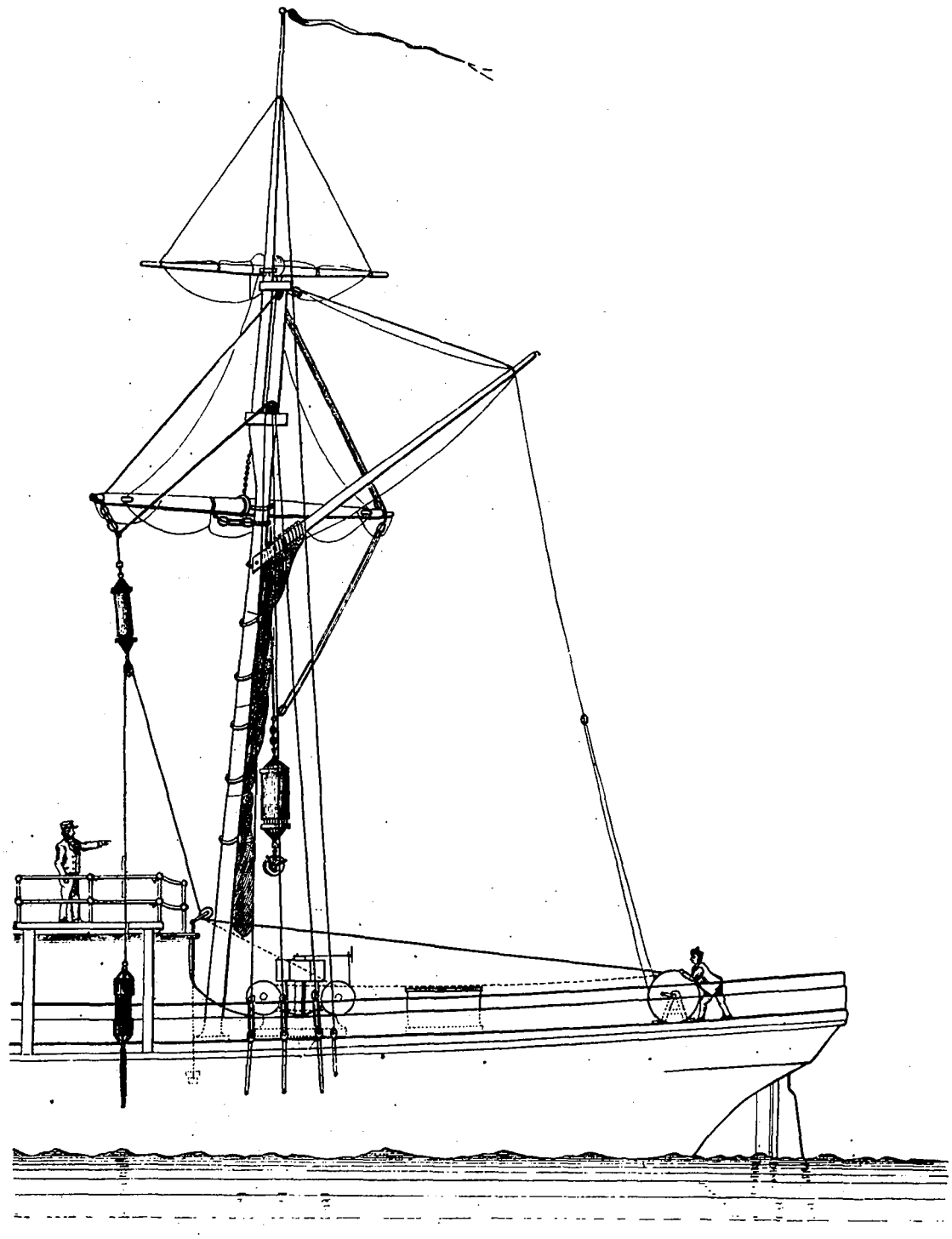


Fig. 14.

det paa samme Plads hele den Tid, Loddet behøvede for at komme til Bunds. Ved afvexlende at lade Maskinen gaa langsomt forover, naar Fartøjet begyndte at sakke, og stoppe, naar Lodlinen begyndte at vise agterover, opnaaedes i Regelen Hensigten, idet Skruevandet gav tilstrækkeligt Tryk,

near as possible stationary during the passage of the lead to the bottom. By alternately starting the engine as soon as the vessel had got sternway and stopping when the line began to point aft, we generally managed to gain our object, the water thrown back by the screw acting on the rudder

til at Roret kunde virke og benyttes til at støtte for Affald til den ene eller den anden Side. I løj Bris sattes undertiden bakt Fortopsejl, hvorved opnaaedes større Modstand mod Skruens Virkning, saaledes at Maskinen kunde gaa hurtigere forover og med mindre eller ingen Afbrydelse, hvorved Styringen blev saameget mere virksom. Desuden kunde Fartøjet ogsaa styres ved at brase Topsejlet.

Naar Vinden var meget svag, Søen rolig og Dybden ringe, kunde Lodningen udføres ved at lægge Fartøjet tvers paa Vinden med Lodlinen til Luvart.

Med stiv Kuling og høj Sø var det selvfølgelig nødvendigt at anvende stor Paapasselighed for at kunne holde Skibet i den rigtige Stilling med Stevnen mod Vinden. Det var under saadanne Omsændigheder ofte ikke muligt for Rorgjængeren med det langsomt virkende Styreapparat at undgaa, at Bougen faldt af til den ene eller til den anden Side. Et begyndende Affald til Styrbord kunde i Regelen standses med Styrbord Ror og et Par Slag fuld Fart forover, der kunde give Roret Drejningskraft, uden at Skibet begyndte at skyde over Stevn. Hjalp ikke dette, gaves derpaa fuld Fart agterover, hvorved Skruen drejede Agterskibet til Styrbord — denne Grund var væsentlig bestemmende for at lade Lodningen foregaa om Bagbord — og fjernede dette fra Lodlinen, og derefter fuld Fart forover med Styrbord Ror, indtil man fik Stevnen op i Vinden igjen og Lodlinen lodret.

Besværligere blev Manøvren, naar Skibet, uagtet al anvendt Forsigtighed, faldt med Bougen Bagbord ud over Linen. Dersom det da ikke lykkedes ved enkelte Slag forover og agterover og Skiftning af Roret at faa Vinden ind om Bagbord, saa man med Fart forover og Styrbords Ror kunde komme op i Vinden med Linen klar af Siden, var der intet andet at gjøre end med afvexlende fuld Fart forover og agterover at dreje Skibet helt rundt om Lodlinen Bagbord over, indtil man atter kom op med Stevnen mod Vinden, og Linen visende lodret.

Man kunde ogsaa i ikke altfor svær Sø med Fordel lægge Agterenden mod Vind og Sø, og med Lodlinen til Luvart holde Fartøjet paa Plads med Skruen gaaende agterover, idet Agterenden i saadant Fald altid søger op imod Vinden.

Lodning med Rør-Lod. Loddet (med Vandhenter) løftedes, saasnart Skibets Fart var standset, ud over Loddebroen, og firedes, idet en Mand drejede Svejven paa Rullen, omtrent en Favn ned. Dybvandsthermometerne sattes fra Loddebroen fast paa Lodlinen. Ved Rullen stod 2 Mand, med Læderhandsker paa Hænderne, paa hver sin Side af denne og trykkede med Magt paa Sidefladernes afrundede Kanter. Alt var nu færdigt til at „Lade gaa". Idet den kommanderende Officer fra Loddebroen gav Ordren: „Lad gaa"! slippedes Svejven paa Rullen løs, Loddet og Lodlinen tog Fart, og Rullen drejede sig rundt. Det er dette Øjeblik, der er fremstillet i Fig. 14. De to Mænd med Læderhandskerne regulérede ved sit Tryk paa Rullen Bevægelsen saaledes, at den blev saa jevn som muligt, hvad der

with sufficient force to give steerage way and prevent the ship from falling off. In a light wind we sometimes set the fore topsail aback, and thus, by occasioning greater resistance to the action of the screw, enabled the engine to work quicker a head and with little or no interruption, which made the steering more effective. The ship could be steered, too, by bracing the topsail.

If there was very little wind and no sea, we could sound, in comparatively shallow water, with the vessel laid beam to wind and the line to windward.

In a stiff breeze and with a heavy sea running, great care and attention were obviously needed to keep the ship in position with her head to the wind; nay, the helmsman, owing to the necessarily tardy action of the steering-gear, found it impossible to prevent her from now and again paying off. If she fell off to starboard, we generally managed to bring her up by putting the helm a-starboard and starting the engine ahead, a few strokes of the screw being sufficient for the rudder to act, without getting way on the ship. This failing, we gave her full speed astern, upon which the action of the screw, bringing the stern of the vessel to starboard, kept it clear of the sounding-line (the certain result of this manæuvre was indeed our main reason for carrying on the sounding operations from the port side), and then steamed full speed ahead till the ship was again head to wind and the line pointed right up and down.

When the vessel, in spite of every precaution, had fallen off with her head to port across the line, the difficulty of bringing her to was much greater. In that case, if we failed by a few strokes of the screw ahead and astern, and by shifting the helm, in getting the port side to windward, so as, on starting the engine ahead, with the helm a-starboard, to bring the ship head to wind and clear of the line, our only resource lay in working her head to port round the line, by steaming full speed alternately ahead and astern, till we had again got her head to wind, with the line right up and down.

In comparatively moderate weather, we found it a good plan to lay the ship stern to wind and sea, with the line to windward, and keep her in position with reversed engines, the stern then invariably working up against the wind.

Sounding with the Tube-lead. — As soon as the vessel had lost her headway, the lead (with the water-bottle attached) was lifted over the sounding-bridge, and then lowered about a fathom, a man turning the handle of the reel. The deep-sea thermometers were fastened to the line from the bridge. Two men, their hands protected by leather gloves, stood one on either side of the reel, and pressed against the annular rim of the sheet-iron disks. Everything was now ready for the operation. At the moment the officer in charge, from his station on the sounding-bridge, gave the word to let go, the man grasping the handle of the reel let go his hold, and the lead immediately dropped, dragging after it the line, which, in running out, caused the reel to revolve. This is the stage of the operation re-

er af Vigtighed for Nøjagtigheden af den følgende Beregning af Dybden. Det Stykke af Lodlinen, der er mellem Rullen og Fodblokken, maa altid have en passende Stramning, saaat Linen ikke under Bevægelsen slaar Bugter, der kunde bringe den til at kaste sig om en eller anden fremstaaende Gjenstand og derved foraarsage Havarier eller en pludselig Standsning af Lodlinens Bevægelse. Denne Bremsning fordrer derfor baade Opmerksomhed, Kraft og Øvelse.

I 1877 forsøgte jeg en mekanisk Bremse paa Rullen, men den viste sig upraktisk og anvendtes kun nogle Gange. Naar Skibet løfter sig paa Søen, rives Linen af Rullen med stor Kraft, og naar det atter sænker sig, formindskes Loddets Drag, ja ophæves undertiden næsten for et Øjeblik. Disse uafladelige Forandringer føles strax, naar man bremser med Haand, og med nogen Øvelse vænner man sig til at bremse netop det nødvendige, men med den mekaniske Bremse viste det sig ugjørligt at følge Forandringerne, der ikke føltes gjennem Apparatet.

Ved Dybder, der ikke oversteg 900 til 1000 Favne, mærkedes bedst, at Loddet slog i Bund, derved, at man lod Linen løbe ganske løst gjennem Haanden, og man følte da en pludselig Aftagen i Udløbshastigheden. Man kunde ogsaa tydelig se det derved, at Linen mellem Fodblokken og Rullen lagde sig pludselig flad ned paa Dækket. Saasnart over 700 Favne var ude, var den Bremsning, der udfordredes for at holde Linen stram, kun ringe. I nogle faa Tilfælder, i hvilke der blev loddet paa 1100 til 1200 Favne med Rørlod alene, viste det sig, at det ikke var muligt at iagttage det Øjeblik, da Loddet kom i Bund. Linen vedblev at løbe ud paa Grund af sin egen Vægt med en Hastighed, der ikke var synligt forskjellig fra den Hastighed, hvormed den løb med Loddet som Tillægsvægt. Under saadanne Omstændigheder loddedes om igjen med Baillie-Maskine, dersom det ansaaes fornødent at faa et nøjagtigt Lodskud. Med Rørlod og Willes Vandhenter sammen kunde der faaes gode Lodskud paa over 1100 Favne, som et Forsøg paa Station 247 viste. Her gav nemlig Baillie-Maskinen 1120 Favne, medens Rørlod med Vandhenter gav 1124 Favne.

Bestemmelse af Dybden. Da Lodlinen for de større Dyb kun var mærket for hver 100 Favne, maatte det nøjagtige Favnetal søges ved særegne Observationer og Beregninger. Den fra først af brugte Fremgangsmaade var følgende. I det Øjeblik, Loddet gik i Vandet, og naar et Hundrede-Favne-Mærke gik i Vandet, raabtes „Nu" og Klokkeslættet noteredes i Loddejournalen paa nærmeste Sekund. Forat give Noteringerne større Sikkerhed, varskoedes af Folkene ved Rullen altid i Forvejen „Mærke", naar et af Mærkerne gik af Rullen. I det Øjeblik Loddet var i Bund, raabtes „Bund" og det tilsvarende Klokkeslet noteredes. Af Rækken af de under hverandre noterede Klokkeslet toges første Differents. Disse Tal stige med Dybden, idet Udløbshastigheden aftager med Længden af den gjennem Vandet løbende Lodline. Dernæst beregnedes

presented in Fig. 14. The two men with leather gloves endeavoured, by pressing upon the reel, to keep the motion as uniform as possible, this being an essential condition for accurately computing the depth. When veering, the line between the reel and the leading-block must be kept sufficiently taut, to prevent its running out in bights, that might catch on some projecting object, and thus occasion damage, or possibly a sudden stoppage of the line. Hence, skilful braking requires care, practice, and physical strength. In 1877 I tried a mechanical brake; it proved, however, inefficient, and was used only a few times. When the vessel heaves, the line is run off the reel with great violence, and on her plunging into the trough of a sea, the drag of the lead becomes greatly diminished, nay, for a moment may be taken off altogether. These constant alternations are instantly felt when the braking is done by hand; and with some little practice, the brakesmen can calculate to a nicety the needful amount of pressure, whereas with the mechanical brake we found it impossible to follow the changes, which could not be felt through the machine.

In depths not exeeding 900 or 1000 fathoms, the best way of determining the exact moment when the lead struck the bottom, was to let the line run loosely through the hand, when a sudden disminishment of velocity would be felt. Nay, it could be distinctly *seen,* the line between the leading-block and the reel becoming all at once slack and dropping down on the deck. Having veered to a depth of 700 fathoms, there was no great need of braking to keep the line taut on the remainder of the downward journey. In some few instances, when sounding in from 1100 to 1200 fathoms with the tube-lead alone, we found it impossible to tell exactly when the lead touched the bottom. The line went on running out by its own weight only, and moreover, with a velocity that did not sensibly differ from that given it by the additional weight of the lead. Hence, when accuracy of measurement was the chief desideratum, we had to sound again, and with the Baillie machine. Sent down along with Wille's water-bottle, the tube-lead gave good results, as shown at Station 247. Here, the Baillie machine indicated a depth of 1120 fathoms, and the tube-lead used with Wille's water-bottle, 1124.

Determination of Depth. — The line for deep-sea soundings being graduated into hundreds of fathoms, the exact depth had in each case to be computed from special observations. Our mode of procedure was, at first, as follows: — The moment the lead entered the water, as also one of the slips of bunting on the line, an officer called out, and the time to a second was entered in the sounding-journal. To attain greater accuracy, the brakesmen had to give timely notice for every slip of bunting run off the reel; the instant the lead struck the bottom, the officer gave the word, and the time was entered in the journal. From the series of entries was computed the first difference, or set of intervals. These figures increase with the depth, the velocity diminishing with the length of the line running out through the water. The second difference of the series

2den Differents af Rækken, hvilken, fraregnet de uundgaaelige mindre Variationer i Udløbshastigheden, viste sig at være paa det nærmeste constant. Med denne anden Differents beregnedes Størrelsen af Tidsintervallet for Udløbet af det sidste observerede Hundredefavnemærke til det næste Mærke, inden hvilket 100 Favne-Interval altsaa Loddet kom i Bund. Ved Hjælp af dette Tal og den mellem Udløbsøjeblikket for det sidst observerede Hundrefavnemærke og Øjeblikket for „Bund" forløbne Tid beregnedes ved simpel Proportion, hvor mange Favne der vare udløbne mellem de tilsvarende Øjeblikke. Denne Længde, tillagt Numeret for sidste observerede Mærke, bliver Lodskuddet eller Dybden.

Som Exempel anføres her et Uddrag af Loddejournalen, der tillige viser dennes Indretning.

No. 129.	Dato 1877 Juni 20
	Bredde . 67° 40′.5 N.
Klokkeslet . . 4ʰ 30ᵐ p. m.	Længde . 6° 42′ E. Greenw.
Vind . . . . NE.	Lufttemperatur 5°.9
Styrke . . . 3	Overflade do. 6.8
Vejr . . . . Skyet.	Dybde . . . 709 e Fv.
Sø . . . . NE. 4	Bund . . . Brun Ler
Vægt . . . 112 Pd.	Karakter . . Godt.

Favne.	Tid.			Interval.		2den Diff.
	T.	M.	S.	M.	S.	Sec.
Lad gaa	4	46	30			
				1	11	
100		47	41			2
				1	13	
200		48	51			17
				1	30	
300		50	24			12
				1	42	
400		52	6			13
				1	55	
500		54	1			8
				2	3	
600		56	4			6
				2	9	
700		58	13			
				0	15	
Bund		58	28			

For Intervallet 700 til 800 Favne beregnes Udløbstiden til $2^m\ 9^s + 6^s = 2^m\ 15^s = 135^s$. Altsaa faaes Proportionen:

135^s : 100 Favne = 15^s : 11 Favne.

Efter dette skulde Dybden være 711 Favne. Ved Udmaaling af det Stykke af Lodlinen, der var i Vandet i det Øieblik, Loddet slog i Bund, over 700 Favne, efter den nedenfor beskrevne Methode, fandtes 9 Favne, altsaa Dybden 709 Favne, som opført i Loddejournalen.

Nøjagtigheden af Tidsintervalmethoden beror, som man ser, ganske paa den Grad af Jevnhed i Bevægelsen, som kan tilvejebringes ved Bremsningen. Resultatet tiltrænger derfor en Kontrol ved andre Methoder, saaledes som det stadig blev gjort paa vor Expedition. Ved at sammenligne Resultaterne af de forskjellige Methoder viser det sig, at Tidsintervalmethoden næsten altid giver for store Tal.

was calculated from the first, and the figures thus obtained, if we except all minor variations in velocity, proved very nearly constant. From the second difference was computed the interval that would have elapsed, had the depth been sufficient, ere the slip of bunting next in succession to that last run off could have entered the water, and within which the lead had accordingly reached the bottom. Then, with the figure thus found and that denoting the time between the moment when the last slip of bunting reached the water and that at which the lead struck the bottom, was computed, by simple proportion, the odd number of fathoms, which, added to the length on the slip last run off the reel, gave the true sounding, or depth.

The following is an extract from the sounding-journal, showing its mode of arrangement.

No. 129.	Date 1877 June, 20th.
	Lat. . . . 67° 40′ 5 N.
Time . . . . 4.30 p. m.	Long. . . . 6° 42′ E.
Wind . . . . NE.	Temp. of Air 5° 9
Force 3	Do. of Sea 6° 8
Weather . . . Cloudy	Depth . . 709 Fathoms.
Sea . . . . NE. 4	Bottom . . Brown Clay.
Weight . . . 112 pounds	Character . Good.

Fathoms.	Time.			Interval.		2nd Diff.
	h.	m.	s.	m.	s.	s.
				—		
0	4	46	30			—
				1	11	
100	4	47	41			—
				1	13	
200	4	48	54			2
				1	30	
300	4	50	24			17
				1	42	
400	4	52	6			12
				1	55	
500	4	54	1			13
				2	3	
600	4	56	4			8
				2	9	
700	4	58	13			6
				0	15	
Bottom.	4	58	28			

Now, the interval from 700 to 800 fathoms is found to be 2m 9s + 6s = 2m 15s = 135s; and hence

135s : 100 fathoms :: 15s : 11 fathoms.

This would make the depth 711 fathoms. Measuring by the method described below the part of the line which, in addition to the 700 fathoms, had run out when the lead struck the bottom, we get 9 fathoms, and thus a depth of 709 fathoms, the depth entered in the sounding-journal.

As regards the accuracy of the method of computation by time-intervals, it is obvious that this must be wholly dependent upon the degree of uniformity attainable in braking. The results will have in each case to be tested by some other method; and this was invariably done on the Norwegian Expedition. On comparing together the results of the different methods, the figures obtained

En anden Methode var at tage Tidsintervaller under Indhivningen af Lodlinen, idet man lod Indhivningsmaskinen gaa saa jevnt som muligt. Herved fik man bestemt det Tidsrum, Maskinen brugte for at tage ind 100 Favne saavelsom det Tidsrum, den med samme Hastighed tog ind Overskuddet over sidste Hundredefavnemærke, og Længden af det sidste kunde saaledes bestemmes ved simpel Proportion. Med jevnt Damptryk og jevn Damptilførsel til Maskinen, hvilke er lettere at holde end jevn Bremsning især i urolig Sø, giver denne Methode gode Resultater. Dens Resultater antoges, naar den anvendtes med de nævnte Forudsætninger, som de definitive, forsaavidt ikke den i det følgende beskrevne Methode kom til Anvendelse. De Lodskud, som i 1876 falde paa Dybderne mellem 100 og 300 Favne, beregnedes udelukkende efter den sidst beskrevne Methode.

Den tredie Methode, der er den sikreste, indførtes først i 1877. Idet Loddet løftedes af Bunden, viste Virkningen af dets Vægt sig paa Accumulatoren, der pludselig strakte sig noget ud. En Mand, som stod klar ved agterste Spiltap, greb i dette Øjeblik paa givet Signal med den ene Haand om halende Part af Linen over Midten af Tappen, og fulgte med Linen, idet denne rulledes op paa Rullen, agterover en paa Dækket afsat Længde af 3 Favne. Naar han kom til agterste Mærke, slap han Linen og raabte „En". Næste Mand greb da fat om Linen ved Tappen, og naar han kom til agterste Mærke, raabte han „To" o.s.v. Idet det sidst udløbne Hundredefavnemærke kom i Vandskorpen varskoedes „Stop". Den søgte Længde af Lodlinen fandtes saaledes ved direkte Udmaaling med en Nøjagtighed af en Brøkdel af en Favn.

Ved de mindste Dybder, for hvilke Lodlinen var mærket for hver 10de Favn, bestemtes det enkelte Favnetal i Regelen ved direkte Udmaaling, dels alene, dels som Control for Tidsintervaller med Indhivningsmaskinen.

Lodning med Baillie-Maskinen. Denne blev gjort i Stand paa Agterdækket lige agtenfor Hytten som før forklaret. Saasnart de nødvendige Forberedelser med Lodlinen og Accumulatoren, de samme som ovenfor beskrevne, var færdig, hexedes Lodlinen til Ringen i Baillie-Maskinen eller til øverste Øjebolt i Vandhenteren og i dette Tilfælde nederste Øjebolt i Vandhenteren til Ringen paa Røret. Linen stivhaltes og lagdes rundt Tapperne paa Indhivningsmaskinen. Med denne løftedes nu, naar Fartøjet var stoppet, det hele over Rækken mellem Hytten og Storvantet (Fig. 14) og firedes ned i Vandet for ikke at komme i Svingning og Berøring med Skibssiden under Fartøjets Bevægelser. Dybvandsthermometrene fastgjordes derefter paa Linen 1 à 2 Favne over Vandhenteren eller Lodderne, hvorpaa man med Indhivningsmaskinen udfirede raskt 200 eller 300 Favne. Maskinen standsedes, Stopper paasattes i Forhaand paa Hyttedækket, Linen kastedes af Spiltapperne og rulledes

from computation by time-intervals almost always proved too high.

Another method practised was to measure time-intervals during the winding in of the line, due care being taken to regulate with the greatest nicety the working of the donkey-engine. We could thus determine both the time required for bringing in 100 fathoms and that needed for hauling in the surplus portion of the line run out after the last 100 fathom slip had reached the water, the length of which was then computed by simple proportion. With an equable steam pressure and an equable supply of steam, which is much easier to keep up, more especially in a rough sea, than uniform manual braking, this method will give good results; and hence, when carefully obtained, we regarded such as final, save when the method described below was also had recourse to. The soundings taken in 1876 that embrace depths from 100 to 300 fathoms, were computed exclusively by this method.

The third method, which is the most trustworthy, was not adopted till 1877. On the lead being lifted from the bottom, its weight tells upon the accumulator, which instantly yields a little to the strain. Then, at a given signal, a man, stationed for the purpose at the after drum of the donkey-engine, laid hold of the line as near as may be above the middle of the drum, and while the leading part was being wound on the reel, went aft with it for a distance of 3 fathoms, which had been marked off on the deck, and thereupon let go, calling out as he did so — „One"! Another man then caught hold of the line above the drum, went the same distance aft, and cried — „Two"! and so on in like manner. The instant the 100 fathom slip last run out appeared above the surface of the water, a man called out — „Stop"! Thus, by actual measurement, we found the length of the line within a fraction of a fathom.

Soundings in shallower water, for which the line was graduated into tens of fathoms, we generally determined by direct measurement, whether taken as independent operations or as a means to test the accuracy of the time-intervals registered when heaving in the lead.

Sounding with the Baillie Machine. — As previously stated, this instrument was got ready for use on the after-deck, just abaft the roundhouse. After arranging, in the manner described above, the sounding-line and the accumulator, we shackled the former either to the ring of the Baillie machine or to the upper eye-bolt of the water-bottle, the lower eye-bolt being in the latter case attached to the ring of the tube. The line was now hauled taut and passed round the drums of the donkey-engine. Then, having deadened the ship's way, we hoisted, by means of the donkey-engine, the whole of the gear over the railing, between the roundhouse and the main shrouds (Fig. 14), and lowered it into the water, to prevent the machine from oscillating and from bumping against the side of the vessel. The deep-sea thermometers were next made fast to the line, 1 or 2 fathoms above the water-bottle or the weight, after which we rapidly veered 200 or 300 fathoms

fast paa Rullen agterud, hvor 2 Mænd stode færdige til at bremse. Derpaa kommanderedes „Lad gaa"! og Lodningen udførtes som ovenfor for Rør-Loddet beskrevet.

Udfiringen af Baillie-Maskinen til 200 eller 300 Favnes Dyb, før man lader gaa, er nødvendig paa Grund af den store Vægt, Lodlinen har at bære, og som vilde gjøre det umuligt med de havende Bremsemidler at kunne regulere Linens Bevægelse. De 200 til 300 Favne Lodline, der ved Operationens Begyndelse allerede er i Vandet, giver saamegen Friktion, at det er Bremserne muligt, om end med Anstrængelse, at holde Rullens og Linens Bevægelse under Kontrol.

Ved Lodning paa større Dyb er det ikke saa let at iagttage det Øjeblik, da Loddet naar Bund, som ved mindre Dybder. Linen lægger sig ikke ned i Dækket, men vedbliver at løbe fra Rullen, efterat Loddet er i Bund, med en Hastighed, der ofte kun er lidet mindre end under Loddets Synken. Ved med udelt Opmærksomhed at følge Linens Fart, navnlig dens Bevægelse gjennem Loddeblokken under Accumulatoren, har man imidlertid et næsten altid sikkert Middel til at observere Øjeblikket, naar Loddet slaar i Bund; man ser da nemlig Blokskivens Rotationshastighed pludselig formindsket. En første Kontrol har man strax deri, at Slakken af Lodlinen nu kan hales ind med Haandmagt, medens det, saalænge Loddet løber, i Regelen vil vise sig ugjørligt ved Haandmagt at standse Bevægelsen. Den sædvanlige Kontrol med Notering af Klokkeslet for hvert Hundredefavnsmærke, som gaar i Vandet, anvendtes jevnlig. Den sidste Kontrol havdes endelig deri, at Accumulatoren i det Øjeblik, Lodrøret (og Vandhenteren) løftedes af Bunden, tydelig strakte sig ud. Fra dette Øjeblik begyndte man, som ovenfor beskrevet, at maale Favnetallet over sidst udløbne Mærke. Naar Øjeblikket, da Loddet slog i Bund, var utvivlsomt at iagttage paa den udløbende Line, viste Methoden med Tidsintervaller for hver 100 udløbne Favne sig ulige paalideligere ved Baillie-Maskinen end ved Rørloddet.

Exempel.

No. 354.	Dato 1878 August 11.
	Bredde . . . . . 78° 1′ N.
Klokkeslet . . 4ʰ 40ᵐ p. m.	Længde . . 6° 54′ E. Greew.
Vind . . . . . N.	Lufttemperatur 3°.0
Styrke 3	Overflade do. 4°.5
Vejr . . . . . Skyet	Dybde . . . . . 1343 e. Fv.
Sø 3	Bund . . . . Biloculin - Ler
Vægt . . . . .315 Pd.	Karakter . . . Meget godt.

of line with the donkey-engine. The engine was now stopped, the fore part of the line secured with a stopper to an eye-bolt on the deck of the roundhouse, and the after part removed from the drums and tightly wound on the reel aft, where a couple of men stood ready to commence braking. The word being now given to let go, the operation was carried out in the manner described above for sounding with the tube-lead.

Veering the apparatus 200 or 300 fathoms preparatory to letting go, was indispensible with the Baillie machine, owing to the great strain upon the sounding-line, the motion of which would otherwise have been impossible to regulate with the means of braking at our disposal. The friction of the 200 or 300 fathoms of line in the water at the beginning of the operation, enable the brakesmen, though with some little exertion, to command the revolutions of the reel and the motion of the line.

When sounding in greater depths, it is by no means so easy as in water comparatively shallow to tell the exact moment at which the lead touches the bottom. The line will not drop flat on the deck, but go on running off the reel, even after the lead has reached the bottom, and with a velocity but very little inferior to that it had during the descent of the lead. Meanwhile, by closely noting the speed of the line, in particular where it passes through the sounding-block below the accumulator, we have, in the great majority of cases, a sure means of accurately determining the moment when the lead strikes the bottom, the rotation of the sheaf of the block becoming instantly slower. Moreover, the slack part of the line can then be readily brought in by hand, whereas so long as the lead is sinking, it will, as a rule, be found impossible to check its motion by physical strength alone. The usual mode of measurement, by noting down the exact time at which each of the 300 fathom slips entered the water, was frequently adopted. As a final resort, we had the test afforded by the visible extension of the accumulator the instant the sounding-tube and the water-bottle were lifted from the bottom. We then, as stated above, immediately began to measure off the number of fathoms run out after the last slip had entered the water. Provided the arrest of the weight at the bottom could be accurately determined by observing the velocity of the line, the method of measuring by time-intervals, for every 100 fathoms run out, was found to be far more trustworthy with the Baillie machine than with the tube-lead.

Extract from the Sounding-journal.

No. 354.	Date 1878 August 11th.
	Lat. . . . . 78° 1′ N.
Time . . . . . 4 40 p. m.	Long. . . . . 6° 54′ E.
Wind . . . . . N.	Temp. of Air 3°. 0.
Force 3	Do. of Sea 4°. 5.
Weather . . . . Cloudy	Depth . . . . 1343 Fath.
Sea 3	Bottom . . . Biloculina Clay.
Weight . . . 315 pounds	Character . . Very good.

Favne.	Tid.	Interval.	2den Diff.
	M. S.	M. S.	S.
200	16 32		
		0 55	
300	17 27		10
		1 5	
400	18 32		3
		1 8	
500	19 40		9
		1 17	
600	20 57		2
		1 19	
700	22 16		3
		1 22	
800	23 38		19
		1 41	
900	25 19		—5
		1 36	
1000	26 55		2
		1 38	
1100	28 33		1
		1 39	
1200	30 12		4
		1 43	
1300	31 55		
		0 49	
Bund	32 44		

Med det beregnede Interval 1m 47s for Længden 1300 til 1400 Favne findes for det observerede Interval af 49s en Længde af 46 Favne, eller den udledede Dybde 1346 Favne. Ved den nøjere Eftermaaling fandtes 1343 Favne. Paa 78° 2′ N, 6° 44′ E fandt den Svenske Expedition med „Sofia" den 14de August 1868 en Dybde af 1350 Favne. „Sofias" paaværende Plads var omtrent 2 Kvartmil W for „Vöringens", og da Bunden fra Spitsbergen af her skraanede nedad mod Vest er Overensstemmelsen mellem begge Expeditioners Lodninger efter al Sandsynlighed endnu større, end de ovennævnte Tal udtrykker.

Lodlinens Ophaling. Efterat Loddet var kommet i Bund, gaves de medsendte Dybthermometre Tid til at antage det omgivende Vands Temperatur, og derpaa lagdes Lodlinen om Tapperne paa Indhivningsmaskinen. Dens Visning sees af de prikkede Linier i Fig. 14. Fra Fodblokken gik Linen først til agterste Spiltap, derfra frem og tilbage gjennem begge Tappers Furer og endelig paa Rullen. Ophalingen begyndte, og under denne rulledes Lodlinen strax op paa Rullen, saaat den altid var klar til næste Lodskud. Maalingen af Dybden under Ophalingen er ovenfor beskrevet. Indhivningen gik jevnt, og Maskinen bragte 100 Favne Line hjem i Løbet af 3 Minutter.

Naar Loddet nærmede sig Vandskorpen, skede Indhivningen langsommere. Thermometerne toges af Linen, under fornøden Stands i Indhivningen, eftersom de kom over Rækken paa Loddebroen, og tilsidst toges Vandhenter og Lod ind paa denne, hvor de hexedes af. Vandhenteren endevendtes og tømtes af Chemikeren. Bundprøven undersøgtes først, som den laa i Lod-Røret og dens Art noteredes i Loddejournalen. Derpaa toges den ud af Røret og bragtes paa Flasker eller Glas, som forsynedes med Stationens Nummer paa Etiketten. I 1876 brugtes Selterswand-Flasker med Korkeprop, i 1877 og 1878 cylindriske Glas, ca. 10cm høje og brede, der lukkedes med Pergament-

Fathoms.	Time.	Interval.	2nd Diff.
	m. s.	m. s.	s.
200	16 32		
		0 55	
300	17 27		10
		1 5	
400	18 32		3
		1 8	
500	19 40		9
		1 17	
600	20 57		2.
		1 19	
700	22 16		3
		1 22	
800	23 38		19
		1 41	
900	25 19		—5
		1 36	
1000	26 55		2
		1 38	
1100	28 33		1
		1 39	
1200	30 12		4
		1 43	
1300	31 55		
		0 49	
Bottom	32 44		

The interval computed for 1300 to 1400 fathoms being 1m. 47s., the interval last observed, 49s., will correspond to a length of 46 fathoms, which, added to 1300, gives a depth of 1346 fathoms. By actual measurement, as described above, we got 1343 fathoms. The Swedish Expedition with the "Sophia," sounding on the 14th of August, 1868, in lat. 78° 2′ N., long 6° 44′ E., registered a depth of 1350 fathoms. The position of the "Sofia" was about two miles to the west of that of the "Vöringen;" and as the sea-bed shelves from the shores of Spitzbergen in a westerly direction past this locality, the agreement shown by the soundings of the two Expeditions is probably even greater than expressed by the above figures.

Heaving in the Line. — The lead having reached the bottom, sufficient time was allowed for the deep-sea thermometers to assume the temperature of the surrounding water, after which the sounding-line was passed round the drums of the donkey-engine, as shown by the dotted lines in Fig. 14. From the leading-block, the line was first led to the after drum, then passed backwards and forwards along the grooves of both drums, and finally on to the reel. Thereupon the heaving in commenced, the line, as it came up, being wound on the reel, ready for the next sounding. Our mode of determining the depth when heaving in the lead has been already described. The line was brought in at the uniform rate of 100 fathoms in 3 minutes.

On the lead nearing the surface of the water, the speed of the donkey-engine was reduced. The needful stoppages, too, were made to detach the thermometers as they came over the rail of the sounding-bridge; and finally, the water-bottle and the lead were taken in here and unshackled. The water-bottle was immediately inverted and emptied of its contents, whereas the sample of the bottom was first inspected *in situ,* and its nature registered in the sounding-journal, previous to being taken out of the tube, from which it was transferred to bottles or jars labelled with the number of the observing-station. On the first cruise, in 1876, we used corked soda-water bottles, but in

papir. Bundprøverne overleveredes derpaa til Kemikernes Varetægt.

Loddernes Udløbshastigheder. Efter de i Loddejournalen indeholdte Data gives her nogle Resultater af Studier over Loddernes Bevægelse under Lodningen.

Rørlod. Som tidligere bemærket, var Lodlinens første 200 Favne inddelt med Mærker for hver 10 Favne. Paa Station 375 gjordes et Forsøg til Bestemmelse af Linens eller Loddets Udløbshastigheder under de første 200 Favnes Udløb, idet Tidsøjeblikkene for hvert 10-Favne Mærkes Gaaen i Vandet noteredes, under det at Bremsningen paa Rullen søgtes holdt saa normal som muligt. Resultatet af dette Forsøg indeholdes i den følgende Tabel.

Favne.	Tid fra „Lad gaa".	Interval.	Hastighed. Favne pr. Sek.
0	0.m 0.s		
10	6	6.s	1.67
20	12	6	1.67
30	15	3	3.33
40	19	4	2.50
50	25	6	1.67
60	32	7	1.43
70	37	5	2.00
80	44	7	1.43
90	50	6	1.67
100	57	7	1.43
110	1 4	7	1.43
120	1 11	7	1.43
130	1 19	8	1.25
140	1 27	8	1.25
150	1 34	7	1.43
160	1 42	8	1.25
170	1 51	9	1.11
180	1 59	8	1.25
190	2 7	8	1.25
200	2 16	9	1.11

Man ser af Rubrikken „Hastighed i Favne pr. Sek.", at Hastigheden, hvormed Loddet synker, der er lig Nul i det Øjeblik, man „lader gaa", i Begyndelsen er voxende, men naar sit Maximum allerede ved 25 Favnes Dyb, og derpaa er den gjennemsnitlig aftagende med Dybden, idet Linens Friktion i Vandet samtidig med at Bremsningen er lettere at regulere, bevirker en større Modstand mod Bevægelsen.

Af Iagttagelser af Udløbstiderne for 100 Favnemærkerne paa en større Række Stationer findes som gjennemsnitlige Værdier de i den følgende Tabel opførte Tal:

1877 and 1878 cylindrical glass jars, about 4 inches high and wide and covered at the top with strong vellum paper. When ready for storing, the samples of the bottom were left in charge of the chemist to the Expedition.

Velocity of the Lead. — In this Section we give some results obtained by investigating the rate of descent from the data registered in the sounding-journal.

The Tube-lead. — As previously stated, the line was graduated for the first 200 fathoms into lengths of tens of fathoms. At Station 375, we sought to determine the absolute rate of descent down to a depth of 200 fathoms, by registering the exact moment at which each of the ten-fathom slips entered the water, striving the while to keep the braking as uniform as possible. The following Table shows the results of the experiment.

Fathoms.	Time.	Interval.	Velocity. Fath. pr. Sec.
0	0.m 0.s		
10	6	6.s	1.67
20	12	6	1.67
30	15	3	3.33
40	19	4	2.50
50	25	6	1.67
60	32	7	1.43
70	37	5	2.00
80	44	7	1.43
90	50	6	1.67
100	57	7	1.43
110	1 4	7	1.43
120	1 11	7	1.43
130	1 19	8	1.25
140	1 27	8	1.25
150	1 34	7	1.43
160	1 42	8	1.25
170	1 51	9	1.11
180	1 59	8	1.25
190	2 7	8	1.25
200	2 16	9	1.11

We see from a glance at the column headed "Velocity in fathoms pr. second," that the rate of descent, which at the moment of letting go is nil, tends at first to increase, soon however reaching its maximum, at a depth of 25 fathoms, after which it begins, and as a rule continues, to decrease with the depth, the augmenting friction in the water, along with increased facility of braking, together occasioning greater resistance to the downward motion of lead and line.

The figures in the following Table are deduced from the intervals, timed at a number of Stations, for every hundred-fathom slip that successively entered the water, and represent the average rate of decent.

Favne.	Tid fra „lad gaa".	Interval.	Hastighed Favne pr. Sek.
0	0m 0s		
100	55	0m 55s	1.82
200	2 12	1 17	1.29
300	3 42	1 30	1.11
400	5 18	1 36	1.05
500	7 6	1 48	0.92
600	9 7	2 1	0.83
700	11 15	2 8	0.78
800	13 29	2 14	0.75
(900)	(16 10)	(2 41)	(0.62)

For Intervallet 800—900 Favne haves kun en Observation.

De her fundne Hastigheder slutter sig meget godt til de ovenfor fundne, efter hvilke Gjennemsnitshastigheden mellem 0 og 100 Favne er 1.82 og mellem 100 og 200 Favne 1.28. Man ser endvidere, at Loddets Hastighed er stadig aftagende med Dybden. Udjevner man paa grafisk Vej Hastighederne i den første Tabel og slutter denne Række til den anden, der beror paa flere Iagttagelser, saaledes at Tidsintervallerne i den sidste beholdes, saa faar man et Billede af Rørloddets Bevægelse saaledes som Kurverne R i Fig. 15 og 16 viser. Fig. 15 viser de til de forskjellide Tider udløbne Længder af Lodlinen, og Fig. 16

Fathoms.	Time.	Interval.	Velocity Fath. p. Sec.
0	0m 0s		
100	55	0m 55s	1.82
200	2 12	1 17	1.29
300	3 42	1 30	1.11
400	5 18	1 36	1.05
500	7 6	1 48	0.92
600	9 7	2 1	0.83
700	11 15	2 8	0,78
800	13 29	2 14	0.75
(900)	(16 10)	(2 41)	(0.62)

For the 800—900-fathom interval we have only one observation.

The velocities thus determined agree pretty well with those previously found, which average 1.88 between 0 and 100 fathoms and 1.28 between 100 and 200 fathoms. Moreover, the rate of descent decreases steadily with the depth. Now, if we equalize, in a diagrammatic form, the velocities given in the first Table, and adjust that series to the second, retaining the time-intervals of the latter, as based on a greater number of observations, we shall have figured before us the descent of the tube-lead, as represented by the curves R, R, in Figs. 15 and 16. Fig 15 shows the lengths of sounding-line run out during succes-

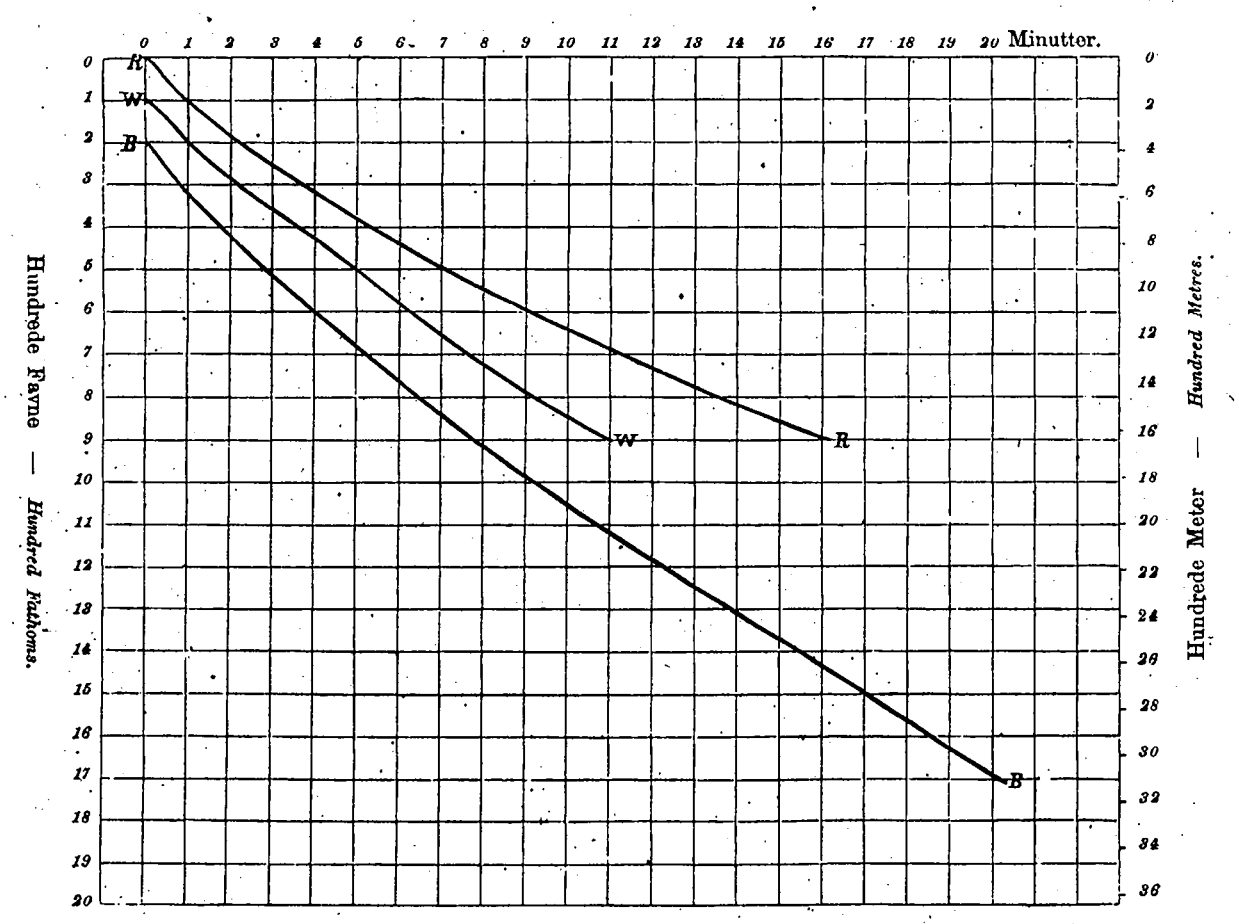


Fig. 15.

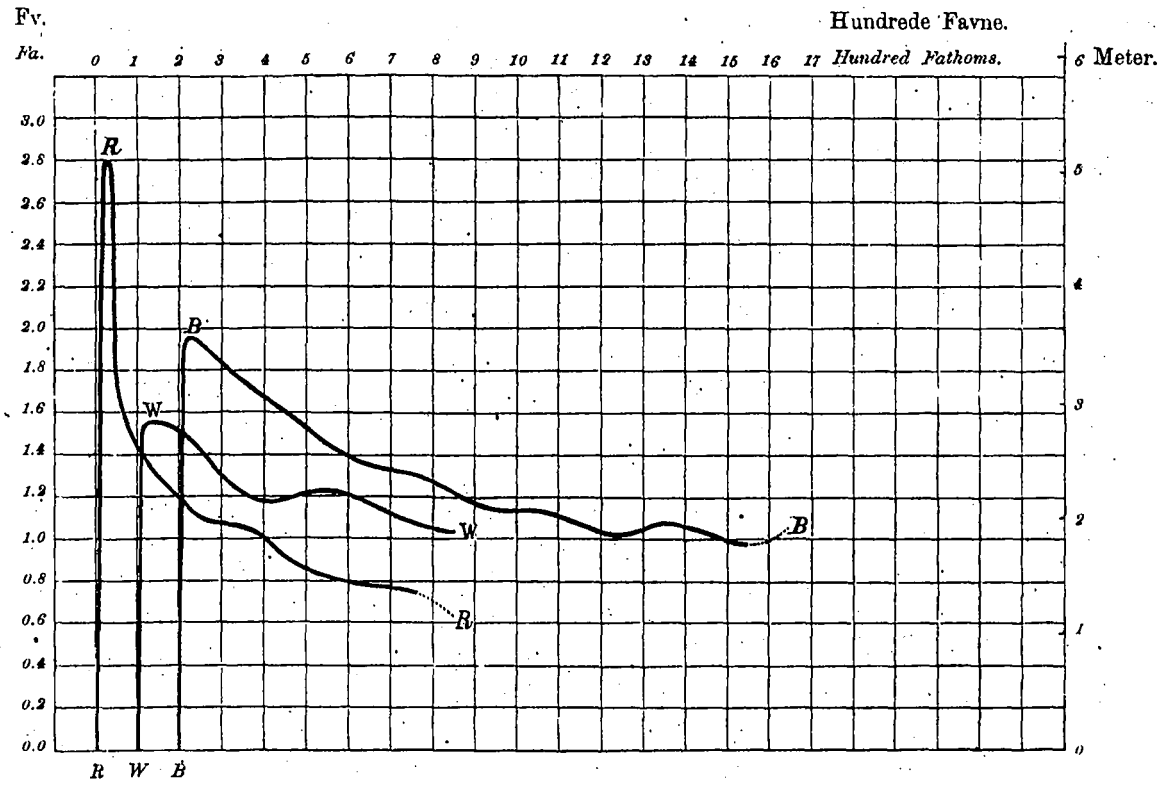


Fig. 16.

Hastighederne, udtrykt i Favne pr. Sekund, i de forskjellige Dybder. I den første Del af Fig. 16, fra 0 til 200 Favne, er Hastighederne afsat for hver 10de Favn, regnet fra 5 Favne af, i den sidste Del er Hastighederne afsat for hver 100 Favn, regnet fra 250 Favne af.

Rørlod med Willes Vandhenter. Nedenstaaende Tabel viser Synkningen af Rørloddet med Willes Vandhenter, fra 100 Favnes Dyb af, til hvilken Dybde det blev udfiret fra Indhivningsmaskinen, før man „lod gaa". Iagttagelserne hidrører for Størstedelen fra 1876.

Favne.	Tid fra „lad gaa".	Interval.	Hastighed. Fv. pr. Sek.
100	0^m 0^s		
200	1 4	1^m 4^s	1.56
300	2 14	1 10	1.43
400	3 36	1 22	1.22
500	5 0	1 24	1.19
600	6 22	1 22	1.22
700	7 46	1 24	1.19
800	9 18	1 32	1.09
900	10 55	1 37	1.03

Fra det Øjeblik, da man „lader gaa", i hvilket Hastigheden er Nul, voxer den raskt til et Maximum, og er siden gjennemsnitlig aftagende med Dybden. Tabellens Resultater er fremstillet grafisk i Figg. 15 og 16 ved Kurverne W. Man ser, at den Hastighed, med hvilken

sive intervals; and Fig. 16 the rate of descent, in fathoms pr. second, at the different depths. In the left part of Fig. 16, from 0 to 200 fathoms, the velocities are given for tens of fathoms; in the right part of the figure, for hundreds, beginning with 250 fathoms.

The Tube-lead with Wille's Water-bottle attached. — The following Table shows the rate of descent of the tube-lead when sent down along with Wille's water-bottle, beginning at 100 fathoms, to which depth the apparatus were sunk with the donkey-engine before being cast off. The observations date chiefly from 1876.

Fathoms.	Time.	Interval.	Velocity Fath. pr. Sec.
100	0^m 0^s		
200	1 4	1^m 4^s	1.56
300	2 14	1 10	1.43
400	3 36	1 22	1.22
500	5 0	1 24	1.19
600	6 22	1 22	1.22
700	7 46	1 24	1.19
800	9 18	1 32	1.09
900	10 55	1 37	1.03

From the moment of casting off, when the velocity is nil, the rate of descent rapidly increases up to a maximum, and then, as a general rule, decreases with the depth. The results set forth in the Table are represented diagrammatically, by the curves W, W in Figs. 15 and 16. It is obvious

Loddet slaar i Bund, er mærkelig større, naar Vandhenteren er paa, end med Rørloddet alene.

Baillie-Maskinen. Den følgende Tabel er Middelresultater af Forsøg med Baillie-Maskinen, med en total Belastning fra 142 til 182 Kilo (285 til 365 Pd.), gjennemsnitlig 171 Kilogram (342 Pd.), efter et større Antal Iagttagelsesrækker.

Favne.	Tid fra "lad gaa."	Interval.	Hastighed Favne pr. Sek.
200	0m 0s		
300	0 51	0m 51s	1.96
400	1 48	0 57	1.76
500	2 50	1 2	1.60
600	3 59	1 9	1.46
700	5 12	1 13	1.37
800	6 27	1 15	1.33
900	7 48	1 21	1.23
1000	9 15	1 27	1.16
1100	10 43	1 28	1.14
1200	12 16	1 33	1.08
1300	13 53	1 37	1.03
1400	15 27	1 34	1.07
1500	17 5	1 38	1.02
1600	18 46	1 41	0.99
1700	20 20	1 34	1.06

Kurverne B i Figg. 15 og 16 viser Tabellens Resultater.

Sammenligner man Kurverne i Fig. 16, saa ser man strax, hvorledes det tungere Lod slaar i Bund med en større Hastighed end det lettere, og Nødvendigheden af tungere Lod til de dybere Lodskud fremtræder med Styrke. Figuren viser tydelig, hvorledes Rørloddet alene kommer til kort paa Dybder over 1000 Favne, saaledes som Erfaringen har vist.

Et fælles Træk for alle tre Hastighedskurver er deres bølgeformige Løb paa større Dybder. Dette forklares ved Bremsningens Ujevnhed. Bremsningen paa Rullen er paavirket af Søgangen, idet den falder lettere at regulere i roligt Vejr end i uroligt, naar Fartøjet løfter og sænker sig og derunder snart rykker i Linen, snart gaar med dens Bevægelse. Men Ujevnheden i Bremsningen er vistnok ogsaa af fysiologisk Natur. Under den første Del af Loddets Udløb bremser Folkene paa Rullen med friske Kræfter og udelt Opmerksomhed. Figuren viser i den tilsvarende Del af Hastighedskurverne den største Regelmæssighed. Saa bliver Bremserne trætte og mindre agtpaagivende. Lodlinen begynder at slænge op og ned og til Siderne paa Vejen fra Rullen til Fodblokken. Et „brems ordentligt" fra den kommanderende Officiers Mund bringer atter Regelmæssighed i Bevægelsen, men denne afløses igjen af Virkningen af Træthed under det fortsatte anstrængende Arbejde og saa fremdeles. Disse Perioder i Hastigheden

that the velocity of the lead when it strikes the bottom is perceptibly greater with the water-bottle attached than without.

The Baillie Machine. — The following Table gives the mean results computed from an extensive series of soundings with the Baillie machine, the total sinking-weight, which varied from 285 to 365 pounds, having averaged 342 pounds.

Fathoms.	Time.	Interval.	Velocity Fath. pr. Sec.
200	0m 0s		
300	0 51	0m 51s	1.96
400	1 48	57	1.76
500	2 50	1 2	1.60
600	3 59	1 9	1.46
700	5 12	1 13	1.37
800	6 27	1 15	1.33
900	7 48	1 21	1.23
1000	9 15	1 27	1.16
1100	10 43	1 28	1.14
1200	12 16	1 33	1.08
1300	13 53	1 37	1.03
1400	15 27	1 34	1.07
1500	17 5	1 38	1.02
1600	18 46	1 41	0.99
1700	20 20	1 34	1.06

The curves B, B in Figs. 15 and 16, are constructed from the results set forth in this Table.

A glance at the curves in Fig. 16, shows that the heavier the lead the greater will be its velocity on reaching the bottom; and hence the need of increasing the sinking-weight for deeper soundings. The diagram clearly discloses the untrustworthiness of the tube-lead as a sounding-instrument for depths of more than 1000 fathoms, thus confirming the result of experience.

A common feature distinguishing the three curves of velocity is their sinuous course in great depths. This must be ascribed to want of uniformity in braking. The said operation is disadvantageously affected in a seaway, the revolutions of the reel being easier to regulate in calm than in rough weather, when the vessel heaves and sinks, now dragging after her the line, and now following its motion. Meanwhile, the cause of irregular braking is in part, no doubt, physiological. The men, who come to their work fresh, brake at first with skill and undivided attention. This is evident from the diagram, which exhibits greatest regularity of form in the corresponding portion of the curve of velocity. After a time, the brakesmen get tired, and in consequence less attentive. The sounding-line is jerked up and down and sideways on its passage from the reel to the leading-block. By an encouraging word, the officer in charge can, indeed, for a time, restore regularity to the braking; but soon the effects of lassitude, brought

falder nu vistnok ikke i ethvert Tilfælde paa samme Tid eller rettere samme Dybde, men Kurverne antyder, saaledes som ogsaa de grafisk opsatte Kurver for de enkelte Lodninger viser, at der er en vis Regelmæssighed i Ujevnhederne, saaledes at disse falder nogenlunde omkring samme Dybdetal ved de forskjellige Tilfælder.

Den Tid, som behøves til at tage et Lodskud er væsentlig afhængig af Lodskuddets Dybde. Efter Skibsjournalen, i hvilken anførtes Klokkeslettene for Lodningens Begyndelse, naar Fartøjet stoppede, og for dens Afslutning, naar der atter sattes i Gang igjen, eller naar en anden Operation, som Temperaturrække eller Skrabning, begyndte, findes ved en statistisk Beregning, at i Gjennemsnit krævede et Lodskud paa

100 Favne	20 Minutter.
500 —	40 —
1000 —	1 Time.
1500 —	1 Time 30 Minutter.
2000 —	henimod 2 Timer.

eller i Almindelighed

$$\text{Tiden for et Lodskud} = 20^m + 5^m \times \frac{(\text{Dybden i Fv.} - 100)}{100}.$$

Denne Tid forbruges omtrent saaledes som følgende Skema viser.

Dybde i Favne	100	500	1000	1500	2000
Vægt af Lod i Pund	112	112	285	350	365
			Minutter.		
Stopning af Fartøjet, Forbered. til Lodning	10m	10m	10m	10m	10m
Udfiring til 300 Favne à 3 Minutter pr. 100 Favne	0	0	9	9	9
Paasætning af Stopper, Linen taget fra Indhivningsmaskinen til Rullen	0	0	3	3	3
Udløbstid til Bunds efter Fig. 15	1	7	9	17	25
Thermometrenes Accomodation, Lodlinens Skiftning fra Rul til Spil	8	5	5	5	5
Indhivning à 3 Min. pr. 100 Favne	3	15	30	45	60
Ialt	22	37	66	89	112
Ovenst. Formel giver	20	40	65	90	115
Forskjel	+2	—3	+1	—1	—3

on by the unintermitting exertion, are again apparent, to be again counteracted for a still shorter interval, and so on *de novo,* to the end of the operation. True, these periodical deviations in velocity do not occur in every case precisely at the same time, or rather at the same depth, but the curves here given, as also those diagrammatically constructed for each individual sounding, indicate a certain regularity in the inequalities, and a tendency to occur at about the same depth in all cases.

The Time required for Sounding depends mainly on the depth. From data in the ship's log-book, comprising the time at which each sounding commenced, — viz. when the vessel was stopped, — and that of its termination, when she again went ahead, — or the time at which some other operation, such as dredging or taking a serial temperature, was begun, we found, by direct computation, the time each sounding occupied to average as follows: —

100 Fathoms	20 Minutes.
500 —	40 —
1000 —	1 Hour.
1500 —	1 Hour 30 Minutes.
2000 —	Nearly 2 Hours.

Hence a sounding occupied $20^m + 5^m \times$ (the depth in fathoms —100): 100; and this interval passed very nearly as set forth in the following tabular statement.

Depth in Fathoms	100	500	1000	1500	2000
Sinking-weight in pounds	112	112	285	350	365
			Minutes.		
Stopping vessel and preparing for sounding	10m	10m	10m	10m	10m
Veering 300 fathoms of Line, at 3 min. pr. 100 fathoms	0	0	9	9	9
Putting on stoppers and shifting Line from drum of donkey-engine to the reel	0	0	3	3	3
Time required for reaching bottom, according to Fig. 15	1	7	9	17	25
Time for Accomodation of the Thermometers, and for shifting Line from the reel to drum of donkey-engine	8	5	5	5	5
Heaving in at 3m. pr. 100 fathoms	3	15	30	45	60
Total	22	37	66	89	112
The above formula gives	20	40	65	90	115
Difference	+2	—3	+1	—1	—3

Paa Norhavsexpeditionens trende Undersøgelsesrejser toges nedenstaaende Lodskud. Til at betegne Bundens Beskaffenhed er anvendt følgende Forkortelser:

b — blaa, blk — sort, br — brun,
c — grov, cl — Ler, d — mørk,
f — fin, g — Singels, gn — grøn,
gy — graa, h — haard, m — Mudder,
oz — Slik, r — Fjeld, s — Sand,
sft — blød, sh — Skjæl, st — Sten,
B. cl — Biloculin-Ler, y — gul.

On the three exploring cruises of the Norwegian North-Atlantic Expedition, the following soundings were taken. The abbreviations given below denote the nature of the bottom.

b — blue. blk — black. br — brown.
c — coarse. cl — clay. d — dark.
f — fine. g — gravel. gn — green.
gy — grey. h — hard. m — mud.
oz — ooze. r — rock. s — sand.
sft — soft. sh — shells. st — stones.
B. cl — Biloculina clay. y — yellow.

Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich.)	Dybde. (Depth.) N. Favne. (Norw. Fths.)	E. Favne. (Fathoms.)	Meter. (Metres.)	Bund. (Bottom.)
2	61° 10.′	6° 32.′E	653	672	1229	s & cl
3	61 5	5 15 E	600	618	1130	do.
4	61 5	5 14 E	550	566	1035	s. cl. g
5	61 6	5 12 E	490	504	922	s. cl
6	61 6	5 9 E	205	211	386	r
7	61 6	5 11 E	200	206	377	r
9	61 30	3 37 E	200	206	377	cl
10	61 41	3 19 E	214	220	402	oz. cl
11	61 47	3 9 E	225	232	424	cl
12	61 53	3 0 E	217	223	408	cl
13	61 58	2 54 E	221	228	417	cl
14	62 4	2 45 E	220	226	413	cl
15	62 10	2 36 E	215	221	404	cl
16	62 24	2 17 E	215	221	404	r
17	62 33	2 4 E	280	288	527	r
18	62 44	1 48 E	400	412	753	cl
19	62 23	2 50 E	220	226	413	cl. s
20	62 16	3 8 E	213	219	400	cl
21	62 14	3 28 E	183	188	344	cl. s
22	62 13	3 41 E	125	129	236	cl. s
24	63 10	5 58 E	87	90	165	s. cl
26	63 10	5 16 E	230	237	433	s. cl
	63 7	5 17 E	87	90	165	r
27	63 6	5 18 E	85	87	159	r
28	63 10	5 11 E	385	396	724	s. cl
29	63 10	5 7 E	385	396	724	s. cl
30	63 10	5 4 E	390	401	733	s. cl
31	63 10	5 0 E	405	417	763	s. cl
32	63 10	4 51 E	418	430	786	s. cl
33	63 5	3 0 E	510	525	960	cl
34	63 5	0 53 E	570	587	1073	oz
35	63 2	1 12 W	1000?	—	—	cl
	63 7	1 26 W	1050	1081	1977	cl
36	62 15	4 34 W	144	148	271	st
37	62 28	2 29 W	670	690	1262	s. cl
38	63 1	3 58 W	198	204	373	r
40	63 22	5 29 W	1180	1215	2222	s. cl
41	63 37	7 10 W	677	697	1275	cl

Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich.)	Dybde. (Depth.) N. Favne. (Norw. Fths.)	E. Favne. (Fathoms.)	Meter. (Metres.)	Bund. (Bottom.)
42	63° 2.′	10° 17.′W	256	264	483	r
43	63 11	13 32 W	514	529	967	s
44	63 8	14 0 W	820	844	1543	r
45	63 28	12 58 W	370	381	697	r. cl
46	63 51	12 5 W	250	257	470	s. cl
47	64 13	11 14 W	185	190	347	r
48	64 36	10 22 W	290	299	547	s. oz
49	65 0	9 25 W	425	437	799	s. cl
50	65 26	8 24 W	555	571	1044	cl
51	65 53	7 18 W	1130	1163	2127	B. cl
52	65 47	3 7 W	1808	1861	3403	B. cl
53	65 13	0 33 E	1495	1539	2814	B. cl
54	64 47	4 24 E	584	601	1099	B. cl
55	64 38	10 22 E	90	93	170	r
56	64 39	10 11 E	173	178	326	s. cl
57	64 39	9 59 E	156	161	294	cl
58	64 39	9 49 E	215	221	404	s. cl
59	64 39	9 38 E	162	167	305	s. cl
60	64 40	9 30 E	115	118	216	h. cl
61	64 40	9 19 E	115	118	216	h. cl
62	64 41	9 10 E	105	108	198	h. cl
63	64 41	9 0 E	90	93	170	r
64	64 42	8 50 E	56	58	106	r
65	64 42	8 39 E	60	62	113	r
66	64 43	8 30 E	85	88	161	s. cl
67	64 44	8 19 E	116	119	218	s. cl
68	64 44	8 9 E	128	132	241	cl
69	64 45	8 2 E	124	128	234	cl, s
70	64 45	7 53 E	126	130	238	cl. s
71	64 45	7 46 E	128	132	241	s. cl
72	64 46	7 37 E	133	137	251	s cl
73	64 46	7 28 E	129	133	243	s. cl
74	64 47	7 20 E	128	132	241	s. cl
75	64 47	7 13 E	141	145	265	s. cl
76	64 47	7 4 E	145	149	272	s. cl
77	64 48	6 54 E	145	149	272	s. cl
78	64 48	6 45 E	151	155	283	s. cl
79	64 48	6 36 E	151	155	283	s. cl

Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich).	Dybde. (Depth.) N. Favne. (Norw. Fths.)	E. Favne. (Fathoms.)	Meter. (Metres.)	Bund. (Bottom.)
80	64° 48.′	6° 26.′E	140	144	263	cl
81	64 49	6 17 E	151	155	283	cl
82	64 49	6 7 E	170	175	320	
83	64 49	5 58 E	180	185	338	cl
84	64 49	5 49 E	215	221	404	cl
85	64 50	5 39 E	294	303	554	br. cl
86	64 50	5 30 E	370	381	697	cl
87	64 2	5 35 E	484	498	911	cl
88	64 1	5 53 E	345	355	649	cl
89	64 1	6 8 E	185	190	347	r
90	64 1	6 21 E	199	205	375	s. cl
91	64 0	6 32 E	185	190	347	gy. cl
92	64 0	6 42 E	173	178	326	cl
93	62 41	7 8 E	153	158	289	sft. cl
94	59 8	4 38 E	142	145	265	cl
95	60 42	4 14 E	170	175	320	cl
96	66 8	3 0 E	782	805	1472	B. cl
97	66 2	4 21 E	663,5	683	1249	cl
98	65 56	5 21 E	377	388	710	cl
99	65 51	6 25 E	207	213	390	cl
100	65 43	7 29 E	188	194	355	cl
101	65 36	8 32 E	216	223	408	cl
102	65 32	9 10 E	205	211	386	cl
103	65 30	9 37 E	187	193	353	cl
104	65 28	9 56 E	157	162	296	cl
105	65 26	10 13 E	141	145	265	s. cl
106	65 24	10 33 E	172	177	324	cl
107	65 21	10 44 E	167	172	315	cl. g
108	66 6	11 1 E	123	127	232	s. cl
109	66 10	10 41 E	175	180	329	s. cl
110	66 12	10 30 E	154	159	291	cl
111	66 15	10 21 E	152	157	287	s. cl
112	66 16	10 10 E	134	138	252	cl. s
113	66 18	10 0 E	119	123	225	cl. s
114	66 18	9 51 E	116	120	219	cl. s
115	66 20	9 41 E	128	132	241	cl. s
116	66 21	9 30 E	117	121	221	cl. st
117	66 23	9 20 E	137	141	258	cl. s
118	66 26	8 59 E	137	141	258	cl. s.
119	66 28	8 40 E	163	168	307	cl
120	66 30	8 20 E	184	190	347	cl
121	66 33	7 59 E	186	192	351	cl. sh
122	66 36	7 40 E	195	201	368	cl. s
123	66 39	7 19 E	239	246	450	cl. st
124	66 41	6 59 E	340	350	640	cl
125	67 52	5 12 E	680	700	1280	cl
126	67 49	5 33 E	709	730	1335	br. cl
127	67 47	5 54 E	694	715	1308	cl
128	67 43	6 21 E	668	688	1258	cl
129	67 40	6 42 E	689	709	1296	br. cl
130	67 38	7 3 E	669	689	1260	cl
131	67 35	7 26 E	772	795	1454	sft. br. cl
132	67 33	7 48 E	927	954	1745	br. cl
133	67 30	8 10 E	862	890	1628	br. cl
134	67 29	8 20 E	853	878	1606	cl
135	67 27	8 31 E	835	860	1573	cl
136	67 25	8 47 E	593	610	1116	h. cl. g
137	67 24	8 58 E	438	452	827	h. cl
138	67° 18.′	9° 9.′E	179	184	336	c. s. cl
139	67 14	9 25 E	170	175	320	cl. s. st
140	67 10	9 42 E	191	197	360	cl. s
141	67 6	9 59 E	186	192	351	cl. s
142	67 2	10 17 E	173	178	326	cl. s
143	66 58	10 33 E	183	189	346	cl.
144	66 53	10 50 E	178	183	335	cl. s st
145	66 49	11 7 E	192	198	362	cl. s
146	66 45	11 22 E	175	180	329	cl. s. st
147	66 49	12 8 E	138	142	260	sft. cl. s
148	67 27	13 25 E	146	150	274	cl
150	67 11	13 21 E	183	189	346	cl
151	67 15	13 4 E	123	127	232	r
152	67 18	12 46 E	121	125	229	sft. cl
153	67 22	12 29 E	118	122	223	s. cl
154	67 26	12 14 E	76	78	143	r
155	67 35	11 46 E	70	72	132	r
156	67 40	11 26 E	87	90	165	r
157	67 45	11 7 E	103	106	194	r
158	67 49	10 49 E	99	102	187	d. cl. s
159	67 54	10 30 E	115	118	216	s. g. sh
160	67 58	10 11 E	272	280	512	r. cl
161	68 3	9 53 E	575	592	1083	f. s. cl
162	68 23	10 20 E	772	795	1454	br. cl
163	68 22	10 30 E	670	690	1262	br. cl
164	68 21	10 40 E	443	457	836	gy. cl. s
165	68 46	10 51 E	1428	1470	2688	B. cl
166	68 40	11 40 E	394	406	742	cl
167	68 37	12 2 E	77	79	144	r
168	68 39	11 51 E	431	444	812	br. cl
169	68 36	12 53 E	70	72	132	r
170	68 32	13 18 E	65	67	123	r
171	69 18	14 29 E	624	642	1174	br. cl
172	69 12	14 47 E	79	81	148	r
173	69 14	14 43 E	233	240	439	r
174	69 16	14 38 E	327	337	616	cl. st
175	69 17	14 35 E	403	415	759	cl. g
176	69 18	14 33 E	521	536	980	cl
177	69 25	13 49 E	1402	1443	2639	br. cl
178	69 29	12 26 E	1533	1578	2886	B. cl
179	69 32	11 10 E	1561	1607	2939	B. cl
180	69 39	9 55 E	1549	1594	2915	B. cl
181	69 45	8 43 E	1549	1595	2917	B. cl
182	69 51	7 30 E	1636	1684	3080	B. cl
183	69 59	6 15 E	1661	1710	3127	B. cl
184	70 4	9 50 E	1503	1547	2829	B. cl
185	70 3	13 37 E	1442	1485	2716	B. cl
186	69 56	14 18 E	1378	1418	2593	B. cl. st
187	69 51	14 41 E	1297	1335	2441	br. cl
188	69 43	15 29 E	1151	1185	2167	br. cl
189	69 41	15 42 E	835	860	1573	br cl.
190	69 41	15 51 E	845	870	1591	br. cl. s
191	69 44	16 26 E	242	249	455	sh. st. s
192	69 46	16 15 E	630	649	1187	s. cl
193	69 44	16 54 E	45	46	84	r
194	69 43	17 16 E	28	29	53	r
195	70 55	18 38 E	104	107	196	st. cl
196	71 2	18 3 E	118	122	223	cl. s

Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich.)	Dybde (Depth.) N. Favne. (Norw. Fths.)	E. Favne. (Fathoms.)	Meter. (Metres.)	Bund. (Bottom.)
197	71° 7.′	17° 28.′ E	134	138	252	r
198	71 13	16 52 E	219	226	413	r
199	71 18	16 17 E	510	525	960	r
200	71 25	15 41 E	602	620	1134	br. cl
201	71 31	15 28 E	628	647	1183	br. cl. s
202	71 31	14 40 E	780	803	1468	cl
203	71 31	13 54 E	875	901	1648	br. cl. st
204	70 57	13 34 E	1230	1266	2315	B. cl
205	70 51	13 3 E	1250	1287	2354	B. cl
206	70 45	14 36 E	1212	1248	2282	B. cl
207	70 33	15 50 E	1079	1111	2032	B. cl
208	70 21	16 57 E	656	675	1234	br. cl. st
209	70 19	17 9 E	122	126	230	r
210	70 17	17 20 E	133	137	251	r
211	70 15	17 31 E	125	129	236	s. cl
212	70 12	17 41 E	138	142	260	s. cl
213	70 23	2 30 E	1710	1760	3219	B. cl
214	70 39	0 0	1700	1750	3200	B. cl
215	70 53	2 0 W	1617	1665	3045	B. cl
216	70 58	3 40 W	1196	1231	2251	s. cl
217	71 0	5 9 W	805	829	1516	B. cl
218	71 1	6 0 W	940	968	1770	B. cl
219	71 2	6 51 W	773	796	1456	B. cl
220	71 2	7 26 W	1238?	1275?	2332?	?
221	71 2	7 35 W	1030	1060	1938	r
222	71 2	7 46 W	635	654	1196	r
223	70 54	8 24 W	68	70	128	blk. cl. s
224	70 51	8 20 W	92	95	174	blk. s
225	70 58	8 4 W	189	195	357	blk. cl. s
226	70 59	7 51 W	330	340	622	blk. cl. s
227	71 13	7 33 W	1010	1040	1902	br. cl
228	71 12	8 9 W	906	933	1706	r
229	71 12	8 55 W	711	732	1339	br. cl
230	71 16	9 10 W	830	854	1562	br. cl
231	71 21	9 23 W	1002	1032	1887	br. cl
232	71 10	8 48 W	758	780	1426	br. cl
233	71 8	8 46 W	563	580	1061	br. cl
234	71 6	8 38 W	251	259	474	blk. cl. s
235	70 59	8 55 W	95	98	179	r
236	70 58	9 2 W	151	156	285	blk. s. cl
237	70 41	10 10 W	255	263	481	br. s. cl
238	70 13	10 54 W	821	845	1545	B. cl
239	69 35	11 13 W	1020	1050	1920	B. cl
240	69 2	11 26 W	975	1004	1836	B. cl
241	68 41	10 54 W	1087	1119	2046	B. cl
242	68 36	8 40 W	1003	1033	1889	B. cl
243	68 32	6 26 W	1345	1385	2533	B. cl
244	68 28	4 17 W	1895	1951	3568	B. cl
245	68 21	2 5 W	1948	2005	3667	B. cl
246	68 14	0 6 E	1546	1592	2911	B. cl
247	68 5	2 24 E	1088	1120	2048	y. cl
248	67 56	4 11 E	756	778	1423	B. cl
249	68 12	6 35 E	1033	1063	1944	B. cl
250	68 10	9 20 E		1150?		y. cl. g
251	68 6	9 44 E	616	634	1159	br. cl
253	I Skjærstadfjorden		255	263	481	gy. cl
254	67° 27.′	13° 25 E	139	143	262	b. cl.
255	68 12	15 40 E	331	341	624	b. cl
256	70° 8.′	23° 4.′ E	218	225	411	gn. cl
257	70 4	23 2 E	155	160	293	gy. cl
258	70 13	23 3 E	223	230	421	gn. cl
259	70 49	25 59 E	78	80	146	r
260	70 55	26 11 E	123	127	232	cl
261	70 47	28 30 E	123	127	232	cl
262	70 36	32 35 E	144	148	271	cl
263	70 44	34 14 E	117	121	221	cl
264	70 56	35 37 E	84	86	157	sft. cl
265	71 18	34 49 E	102	105	192	h. cl
266	71 27	35 39 E	126	130	238	sft. cl
267	71 42	37 1 E	144	148	271	cl. st
268	71 36	36 18 E	126	130	238	cl. s
269	72 11	36 40 E	134	138	252	gn. cl
270	72 27	35 1 E	132	136	249	br. cl
271	72 38	33 50 E	155	160	293	gn. cl
272	73 11	33 3 E	110	113	207	cl. s
273	73 25	31 30 E	191	197	360	gn. cl
274	73 46	31 16 E	177	182	333	cl
275	74 8	31 12 E	143	147	269	gn. cl
276	74 5	27 39 E	214	220	402	gn. cl
277	74 3	25 43 E	218	225	411	gn. cl
278	74 1	22 27 E	223	230	421	gn. cl
279	74 15	20 48 E	77	79	144	st. sh. cl
280	74 10	18 51 E	34	35	64	r
281	74 3	17 18 E	112	115	210	r
282	73 53	15 36 E	444	457	836	sft. gn. cl
283	73 47	14 21 E	745	767	1403	br. cl
284	73 1	12 58 E	777	800	1463	br. cl
285	73 6	11 56 E	995	1024	1873	br. cl
286	72 57	14 32 E	434	447	817	gy. cl
287	72 52	15 19 E	242	249	455	gy. cl
288	72 46	17 50 E	209	215	393	br. cl
289	72 41	20 18 E	213	219	400	gn. cl
290	72 27	20 51 E	185	191	349	cl. s
291	71 54	21 57 E	188	194	355	gy. cl
292	71 20	22 59 E	210	216	395	gy. cl
293	71 7	21 11 E	92	95	174	s. cl
294	71 35	15 11 E	619	637	1165	sft. br. cl
295	71 59	11 40 E	1078	1110	2030	B. cl
296	72 15	8 9 E	1399	1440	2633	B. cl
297	72 36	5 12 E	1243	1280	2341	B. cl
298	72 52	1 51 E	1457	1500	2743	B. cl
299	73 10	2 14 W	1327	1366	2498	B. cl
301	74 1	1 20 W	1636	1684	3080	B. cl
302	75 16	0 54 W	1928	1985	3630	B. cl
303	75 12	3 2 E	1166	1200	2195	B. cl
304	75 3	4 51 E	1686	1735	3173	B. cl
305	75 1	7 56 E	1545	1590	2908	B. cl
306	75 0	10 27 E	1296	1334	2440	B. cl
307	74 58	12 10 E	1181	1216	2224	B. cl
308	74 57	12 43 E	1104	1136	2078	B. cl
309	74 57	13 18 E	1035	1065	1948	br. cl
310	74 56	13 50 E	977	1006	1840	br. cl
311	74 55	14 25 E	872	898	1642	br. cl
312	74 54	14 53 E	639	658	1203	gy. cl
313	74 55	15 49 E	198	204	373	gy. cl
314	74 55	15 21 E	494	509	931	gy. cl

Stat. No.	Nordlig Bredde. (North Latitude.)	Længde fra Greenwich. (Longitude from Greenwich.)	Dybde (Depth.) N. Favne. (Norw. Fths.)	E. Favne. (Fathoms.)	Meter. (Metres.)	Bund. (Bottom.)
315	74° 53.′	15° 55.′ E	175	180	329	h. cl. s
316	74 56	16 29 E	125	129	236	b. cl
317	74 56	16 52 E	96	99	181	d. gy. cl
318	74 56	17 39 E	53	55	101	d. gn. cl
319	74 57	18 22 E	44	45	82	r
320	74 57	19 8 E	30	31	57	r
321	74 56	19 30 E	24	25	46	r
322	74 57	19 52 E	20	21	38	r
323	72 53	21 51 E	217	223	408	br. gy. cl
324	73 47	20 48 E	226	233	426	gy. cl
325	74 2	20 30 E	87	90	165	d. gn. cl
326	75 31	17 50 E	119	123	225	d. cl
327	75 39	16 33 E	183	188	344	gn. cl
328	75 42	15 39 E	194	200	366	gy. cl
329	75 45	14 45 E	193	199	364	d. cl
330	75 48	13 54 E	431	444	812	d. cl
331	75 51	13 5 E.	772	795	1454	red cl
332	75 56	11 36 E	1116	1149	2101	B. cl
333	76 6	13 10 E	727	748	1368	B. cl
334	76 12	14 0 E	392	403	737	d. cl
335	76 17	14 39 E	174	179	327	d. cl
336	76 19	15 42 E	68	70	128	h. cl
337	76 23	16 43 E	19	20	37	r
338	76 19	18 1 E	142	146	267	r
339	76 30	15 39 E	36	37	68	r
340	76 31	14 40 E	56	58	106	cl
341	76 32	13 53 E	115	118	216	r
342	76 33	13 18 E	508	523	956	d. gy. cl
343	76 34	12 51 E	722	743	1359	cl
344	76° 42.′	11° 16.′ E	988	1017	1860	d. cl
347	76 40	7 47 E	1388	1429	2613	B. cl
349	76 30	2 57 E	1445	1487	2719	B. cl
350	76 26	0 29 W	1638	1686	3083	B. cl
351	77 49	0 9 W	1593	1640	2999	B. cl
352	77 56	3 29 E	1638	1686	3083	B. cl
353	77 58	5 19 E	1295	1333	2438	B. cl
354	78 1	6 54 E	1305	1343	2456	B. cl
355	78 0	8 32 E	921	948	1734	cl
356	78 2	10 19 E	107	110	201	b cl.
357	78 3	11 18 E	121	125	229	gn. cl
358	78 2	9 46 E	90	93	170	cl. g.
359	78 2	9 25 E	404	416	761	b. gy. cl
360	78 47	6 58 E	409	421	770	h
361*	79 8	5 28 E	879	905	1655	B. cl
362*	79 59	5 40 E	446	459	839	b. cl
363	80 3	8 28 E	253	260	475	b. cl
364	79 48	10 50 E	189	195	357	sh
365	79 34	11 25 E	72	74	135	d. gy. cl
366	79 35	11 17 E	59	61	112	d. gy. cl
367*	78 44	7 46 E	520	535	978	cl
368*	78 43	8 20 E	306	315	576	b. cl
369*	78 42	8 53 E	84	87	159	st. cl
370*	78 48	8 37 E	106	109	199	gy. cl
371	78 8	13 46 E	191	197	360	gy. cl
372	78 9	14 7 E	125	129	236	d. cl
373	78 10	14 21 E	117	120	219	d. cl
374	78 16	15 33 E	58	60	110	d. cl
375	75 30	15 3 E	198	204	373	d. cl

* Paaværende Plads usikker, muligens 4′—5′ sydligere.

Position doubtful; possibly from 4 to 5 Miles farther South.

Temperatur-Rækker.

Til Undersøgelse af Temperaturen i forskjellige Dybder paa samme Station toges Temperatur-Rækker. Disse udførtes i Regelen saaledes: Rørloddet hexedes i Lodlinen, og lige ovenfor Loddet fastgjordes et Dybvandsthermometer, ganske som ved Lodning. Indhivningsmaskinen udfiredes 100 Favne, og Thermometer No. 2 gjordes fast i Lodlinen fra Loddebroen. Atter udfiredes det andet 100 Favne og Thermometer No. 3 paasættes Linen. Paa denne Maade anbragtes 5 a 6 Thermometre paa Linen med 100 Favnes Afstand og sænkedes ved Udfiring fra Indhivningsmaskinen til de Dybder, i hvilke man vilde maale Temperaturen. Naar alle Thermometre havde faaet Tid til at accommodere sig, haledes Linen ind med Maskinen. Der stoppedes saa lang Tid, som var nødvendig for at løse Thermometrene fra Linen, efterhvert som de kom op. Der lagdes megen Vind paa jevne Bevægelser under disse Operationer, for ikke at udsætte Indexthermometrene for pludselige Ryk eller Stød. I høj Søgang maatte der benyttes megen Forsigtighed ved Thermometrenes Aftagning af Linen. Fartøjet laa i Regelen, som ved Lodning, med Stevnen mod Søen, men man kunde ikke altid holde Lodlinen saaledes, at den kunde naaes med Haanden fra Loddebroen. Linen maatte da bringes ind til Broen ved Hjælp af en Baadshage, der maatte gribe Linen *under* Thermometret for ikke at komme til at berøre dette.

Temperaturrækkerne udførtes kun meget faa Gange ved at lade Linen løbe ud fra Rullen, da dens Standsning let medførte Ryk, som ialfald Indexthermometre ikke maa udsættes for.

Temperaturrækker paa Dybder mindre end 50 Favne udførtes ofte med Haandlod og Haandline, der havde Mærker for hver 5 eller 10 Favne.

Temperaturrækkerne toges i Almindelighed strax efter et Lodskud. Flere Gange blev der dog efter Lodskuddet arbejdet med Skrabe eller Trawl, naar saadant faldt belejligere, og Temperaturrækken toges da efter at disse Arbejder var færdige. Paa denne Maade er det gaaet til, at Temperaturrækkens paaværende Plads undertiden er lidt forskjellig fra Lodskuddets.

Varigheden af en Temperaturrække er naturligvis forskjellig efter Antallet af Dybder, hvori Temperaturen tages og efter Dybdernes Størrelse. En Statistik, taget af Skibsjournalen, viser, at der til *Lodskud og Temperaturrække* medgik omtrentlig:

Paa et Dyb af	100 Favne	30 til 50 Minutter.
- - - -	500 —	1 Time 40 —
- - - -	1000 —	2 Timer 30 —
- - - -	1500 —	3 —
- - - -	2000 —	3 — til 3 Timer 30 Minutter.

Serial Temperatures.

For determining the temperature of the sea in different depths at the same observing-station, we took series of temperatures. Our mode of operation was generally as follows: — After shackling the tube-lead to the sounding-line, we attached, just above the weight, a deep-sea thermometer, precisely as for ordinary soundings. Then, 100 fathoms of line were veered out with the donkey-engine, and Thermometer No. 2 made fast, from the sounding-bridge, at the first hundred-fathom slip, after which we veered another 100 fathoms, and attached Thermometer No. 3 to the line at the second slip. In this manner, as many as 5 or 6 thermometers were made fast to the sounding-line at intervals of 100 fathoms, and sent down to register the temperature in the desired depths. So soon as the thermometers had had time to take the temperature of the surrounding water, we started the donkey-engine and began hauling in the lead, stopping, as each of the thermometers came up over the rail of the bridge, to detach it from the line. Very great importance was attached to uniformity of motion pending these operations, so as not to expose the index-thermometers to any sudden jerk or shock. In a heavy sea, we had to be specially careful when taking the thermometers off the line. The ship generally lay head to sea, as she did during the descent of the lead; nevertheless, we sometimes found it impossible to keep the line within reach from the sounding-bridge, in which case it was got in with a boat-hook, care being taken to hook the line below the thermometer, and thus avoid coming in contact with the latter.

Only a few serial temperatures were taken by letting the line run out of itself, the necessary stoppages in that case easily occasioning jerks, to which the index-thermometers, at least, must not be exposed.

At depths of less than 50 fathoms, serial temperatures were frequently taken with the hand-lead, the line being graduated into fives or tens of fathoms.

As a rule, we took our serial temperatures immediately after sounding. On several occasions however, the dredge or trawl was worked in preference, the serial temperatures being in that case deferred till we had terminated those operations. This accounts for the position in which certain of the serial temperatures were taken differing slightly from that of the soundings.

The time required to take a serial temperature will obviously depend alike on the depth and the number of temperatures. Data obtained from the ship's log-book show the time occupied in taking a sounding and a serial temperature to have averaged as follows: —

For a Depth of	100 Fathoms	from 30 to 50 minutes.
- - — -	500 —	1 hour 40 minutes.
- - — -	1000 —	2 hours 30 —
- - — -	1500 —	3 —
- - — -	2000 —	from 3 hours to 3 hours 30 minutes.

I de dybere Lag, under 600 Favne, toges sjælden Temperaturrækker, da Vandets Temperatur her kun varierede fra 0° til —1.°5.

At depths exceeding 600 fathoms we seldom took serial temperatures, the temperature in the deeper strata varying only from 0° to — 1°.5.

Bundskrabning.

De Apparater, som brugtes til at hente Dyr op fra Havbunden, var Skraber, Svabere og Trawls.

Skrabe. — Dette Apparat var gjort efter engelsk Mønster. Skrabemunden bestaar af en smedet Jernramme, hvis Længde er omtrent 7 Gange saa stor som Bredden. Til denne er fæstet en Pose eller Sæk, og det hele drages langs Havbunden, idet Munden med sin nederste lange Læbe afskraber det øverste Lag af denne og dermed de deri værende Sødyr.

Af *Skraber* for større Dyb havde vi 3 Størrelser. Paa den største, fremstillet i Fig. 17, var Læbernes Længde 1^{m}.25 (4 Fod), paa den mellemste 0^{m}.94 (3 Fod) og paa den mindste 0^{m}.78 (2$^{1}/_{2}$ Fod). Paa alle 3 var Formen af *Skrabemunden* den samme. Med den oprindelige Form, som Skraberne havde, da de kom fra England, fandt vi, at de tog for Lidet af Bunden, og selv efter lang Skrabning var der altid meget lidet i dem. Medens Expeditionen laa i Thorshavn i Begyndelsen af Juli 1876 og udbedrede den

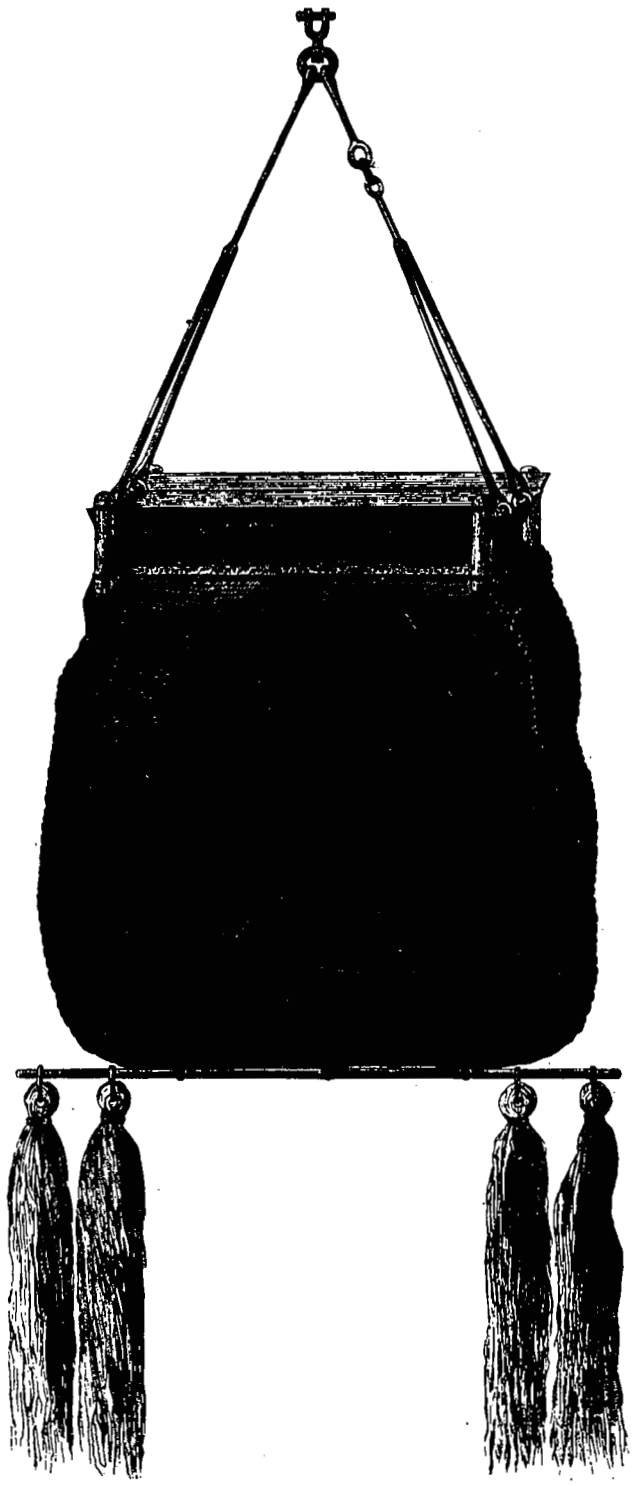


Fig. 17.

Dredging.

The apparatus employed on the Expedition for bringing up animals from the bottom of the sea comprised the dredge, the trawl, and swabs.

The Dredge. — This instrument was on an English pattern. The frame is of hammered iron, the length at the mouth being to the width as 7 to 1. From the frame is suspended a bag, into which, on the dredge being dragged over the bottom, the long nether lip of the mouth will scrape in the substance of the surface, along with the marine animals it contains.

For greater depths, we had dredges of three different sizes. In the largest (Fig. 17), the length of the lips, or scrapers, was 4 feet, in that of medium size 3 feet, and in the smallest 2$^{1}/_{2}$ feet. The shape of the *mouth* was the same in all three.

These instruments, which had been made in England for the Expedition, did not, we found, as originally constructed, bring up a fair sample of the bottom; the freight was invariably small, even after protracted dredging. We therefore, when refitting at Thors-

lidte Søskade, benyttede vi Anledningen til at give Læberne en hensigtsmæssigere Form, idet der udenpaa den oprindelige Læbe paaklinkedes tyndere Jernlæber, der rakte 3.9 cm. ($1^1/_2$ Tomme) frem foran de gamle. Mundingen blev herved ogsaa noget videre, da de nye Læber havde en divergerende Stilling udad, foruden at Læberne blev skarpere. I Fig. 17 ser man dem afbildet. Denne Anordning viste sig strax som en Forbedring. Det hændte dog undertiden, at Læberne greb altfor dybt, saaledes at Skraben i kort Tid fyldte sig med Bundmaterialet, istedetfor kun at skumme det Øverste af dette af og først efter længere Tids Skrabning at fylde Sækken. Denne Ulempe hævedes dog snart ved Anbringelsen af et Par korte Træmejer, som er viste i Figuren, paa begge Sider af Skrabens Jernramme. Mejerne var 4 til 5 Centimeter ($1^1/_2$ til 2 Tommer) brede og af lidt større Længde end Jernrammens Højde, paa Ydersiden og for begge Ender afrundede, og fastgjorte henimod sine Ender med Surringer dels til Jern-Hanefoden dels til den Kant af Skraberammen, hvor Sækken var fastsyet. Forenden rakte ganske lidt foran (i Figuren over) Læbernes Yderkant.

Sækken var af Kokostougverk, lagt som Matte. Den var syet til Skrabens Jernramme paa dennes Under- eller Bagside, og desuden sammensyet paa Siderne som vist i Figuren, saaledes at den let kunde aabnes og Indholdet lægges frit i Dagen.

Skraben var, saaledes som Figuren viser, forsynet med en *Hanefod*, i hvilken Skrabetouget blev fastgjort. Hanefoden var af Jernstænger, med dobbelt Part i den Skraben nærmeste Del, og fæstet til Skraberammen med stærke Ringe, der gik gjennem Huller i denne og gjennem Hanefodens Øjebolt. Den ene Side af Hanefoden bestod i Forhaand af 2 Dele, der endte i Øjebolte, som var forbundne med en Fangning af Skibmandsgarn. Denne var beregnet paa at springe, dersom Skraben stødte paa en større Hindring paa Havbunden, som kunde holde den fast, naar begge Hanefodens Arme trak i Skraben. Med alene den ene Arm som Drag, kunde man i mange Tilfælde gjøre Regning paa at faa Skraben halet rundt Hindringen og løs.

Til Sækkens Bund var fastgjort en Jernstang, til hvilken, ud imod dens Ender, nejedes 2 *Svabere* paa hver Side. Disse Svabere var af heglet Hamp, noget over 1^m (3 Fod) lange. Mange Dyr, som ikke eller i lidet Antal kom ind i Skrabesækken, hang fast ved Svaberne, der saaledes var, for visse Dyrearter, et udmærket Fangstapparat.

Enkelte Gange, paa meget ujevn Bund, hvor man vilde risikere at faa Skraben iturevet, brugtes Svabere alene, fæstede til en Jernstang, der med Hanefod var fæstet til Skrabetouget.

havn in the beginning of July 1876, took advantage of the opportunity afforded to modify the construction of the apparatus, with the object of remedying the above-mentioned defect, in which we succeeded, by rivetting on to the outer surface of the scrapers another, but thinner pair (Fig. 17), projecting an inch and a half beyond the former. In this way greater width was given to the mouth of the dredge, the additional pair of scrapers being made to diverge from each other; moreover, they had sharper edges. Our modification turned out a decided improvement. Now and again, however, the scrapers would cut too deep, and soon fill the dredge-bag with matter from the bottom, instead of skimming off a thin layer from the surface and gradually freighting the apparatus. But this drawback we got rid of by fixing to the frame of the dredge, as shown in the figure, a couple of wooden runners, one on either side. These runners had a width of $1^1/_2$—2 inches, and slightly exceeded in length the height of the frame; they were rounded on the outer side and at both ends, and were lashed, near their extremities, to the iron crow-foot, and to the end of the dredge-frame from which the bag depended. The fore part projected a very little beyond the edges of the scrapers.

The *Dredge-bag* — of strong cocoa-nut matting — was suspended from the lower end of the frame, and fastened together at the sides in such manner as to admit of being readily opened to expose its contents.

The dredge, as shown in the figure, was made fast to the dredge-rope by means of a *crow-foot*, consisting of iron rods, two-armed in the part nearest the dredge, and attached to the dredge-frame by strong iron rings, that passed through holes in the frame and through the eyes of the crow-foot. One arm of the crow-foot was in two parts terminating in eyebolts, connected together by a stop of spunyarn, so that in case the dredge got jammed among rocks and stones, a strain less than sufficient to break the dredge-rope would part the stop, alter the position of the dredge, — which would then be attached to the rope by only one arm of the crow-foot, — and probably enable it to free itself.

To the bottom of the dredge-bag was attached a long tranverse iron bar, with a couple of "swabs," or rather bunches of teazed-out hemp, about 3 feet in length, fastened at each of the free ends. Animals that never entered the dredge-bag, or, at best, but rarely and few in number, came up again and again on the tangles, which seem to be singularly well adapted for the capture of certain kinds of marine animals.

Once or twice, on a bottom exceptionally rugged, involving the risk of the dredge being torn or broken, we sent down the tangles alone, attached to an iron bar, which by means of a crow-foot was made fast to the dredge-rope.

Af *Trawls* havde vi 2 Slags, begge leverede af Dr. J. Hearder & Son i Plymouth, nemlig Otter-Trawl og Bom-Trawl,

Of *Trawls* we had two kinds, viz. the Otter-trawl and the Beam-trawl, both furnished by Dr. J. Hearder & Son of Plymouth.

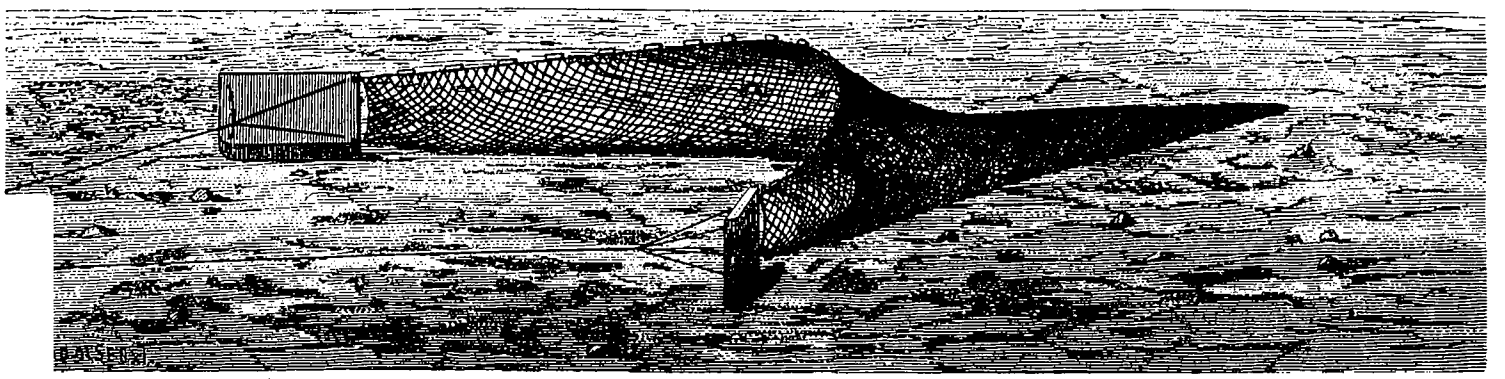


Fig. 18.

Otter-Trawlen (Fig. 18) er nærmest et Fiskeapparat ke særdeles meget skikket til zoologisk Brug: Det ır af et Net, der er aabent foran og bagtil snevrer mmen til en Spids. Til Netmundingen er fastgjort 2 Ottere eller firkantede Træplader, 0.m63 (2 Fod) høje, hvis Underkanter er belastede med Jernmejer. Enderne af Hanefoden, der forbinder Skrabetouget med Trawlen, er fastgjort til Stropper paa Indersiden af disse Ottere, saaledes at de under Farten ved Vandtrykket skjærer ud til hver Side. Overkanten af Netmundingen holdes oppe ved Korkstykker, medens Underkanten er belastet med Blystykker. Netmundingen er 7m.5 (24 Fod) bred mellem Otterne, og Posens hele Længde er 6.m3 (20 Fod).

Naar Otterne skal komme i Stilling, maa dette Apparat gives saa stor Fart gjennem Vandet, at det paa Grund af Tougets Visning paa større Dybder er udsat for at løftes fra Bunden.

The *Otter-trawl* (Fig. 18) is properly a fisherman's apparatus, and not very well adapted for scientific purposes. It consists of a long conical bag of cord-netting, to the mouth of which are attached two "otters," or quadrangular pieces of wood, 2 feet square, each weighted on the lower part with an iron runner. The ends of the crow-foot connecting the trawl with the dredge-rope are secured to straps on the inner side of the otters, in such manner as will cause the latter, when in motion, to sheer out, or diverge, from the action of the water. The top side of the mouth of the net is kept in position by pieces of cork, the under side being weighted with rolls of sheet-lead. The length of the trawl-bag is 20 feet, and its width at the mouth, measured between the otters, 24 feet.

To give the otters the right position, the trawl must move through the water with a rapidity that, by reason of the oblique direction of the dredge-rope, will easily cause the apparatus to be lifted from the bottom.

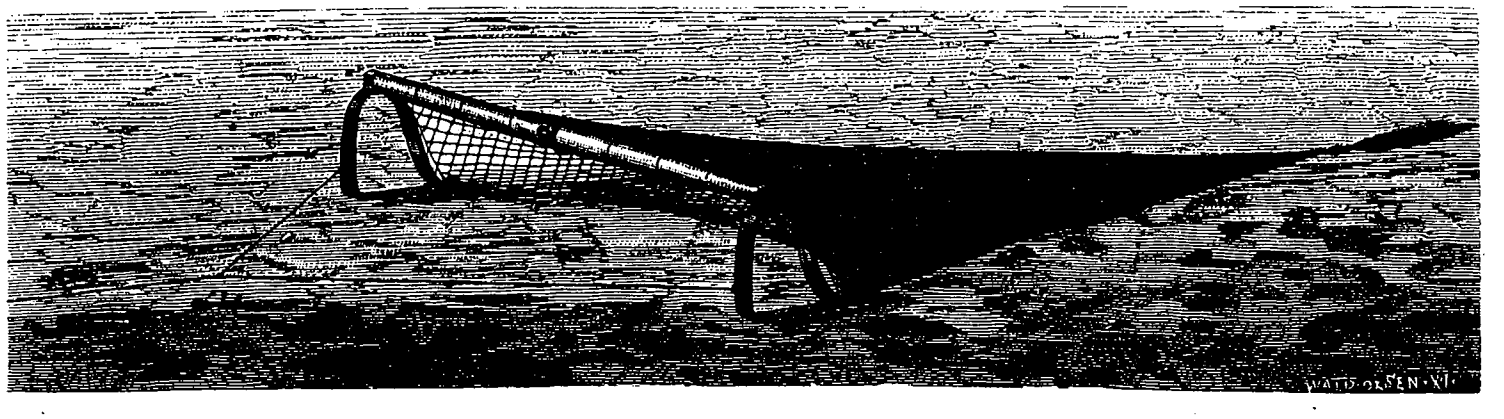


Fig. 19.

Bom-Trawlen (Fig. 19) bestaar af et poseformet, mod Bagenden spidst indsnævret Net, hvis Mundings Overkant er fastgjort til en, 4.m7 (15 Fod) lang, rund Bom af Træ, paa hvis firkantede Ender er indsmøget Jernmejer, 0m.8 ($2^1/_2$ Fod) høje, paa hvilke Apparatet kjøres langs Havbunden. Trawlens Længde fra Midten af Bommen til Spidsen af Nettet er 6m.5 (21 Fod). Den med Blystykker belastede, noget slakke Underkant af Netmundingen er i sine Ender fæstet til Mejernes Underdel og slæber langs Bunden mellem disse, idet den graver mere eller mindre dybt ned i Bundens Materiale. Gjennem en Hanefod af Tougverk, der er fæstet i Øjebolte paa Forkant af Jernmejerne, staar Trawlen i Forbindelse med Skrabetouget. Til Mejerne og til Netspidsen fæstedes ofte Hampsvabere.

Maskerne i Nettet var oprindelig temmelig aabne, saaat det kun kunde holde større Gjenstande tilbage, medens mindre Dyr og det fine Slam gik igjennem. Efter Professor Sars's Ønske blev derfor Spidsen af Nettet foret med finmasket Garn, saaledes at det kunde holde fint Slam. Med denne Forbedring var efter vor Erfaring Bom-Trawlen et udmærket Bundskrabningsapparat. Den fangede baade under hurtigere og langsommere Bevægelse langs Bunden og tog ikke alene Fiske og andre Dyr, der bevæger sig frit i Nærheden af Bunden, men den skummede ogsaa det øvre dyrholdige Bundmateriale af, ja tog endog Stene og det store, indtil 50 Kilograms (100 Pd.) Vægt ind i Nettet.

Bom-Trawlen havde i sin oprindelige Skikkelse ogsaa den Fejl, at hele Systemet kunde svinge sig rundt i Vandet under Udfiringen, og Apparatet kunde saaledes undertiden falde paa Ryggen, med Bommen ned, paa Havbunden. Denne Mangel blev rettet af Skibsfører Grieg ved at hænge et Lod i slak Bugt mellem Mejerne. Fig. 20 viser dette Arrangement. Naar Trawlen begynder at helde fra den rigtige Stilling, i hvilken den blev sendt ud, afslakkes den Del af Touget, der var fast i den Mej, som var nederst. Loddet trak i den anden Part alene og drog den Ende, som var øverst, ned til samme Højde som den anden.

Til *Skrabetoug* brugtes 5 centimeters (2 Toms) Toug de første 2000 Favne og 6.5 centimeters ($2^1/_2$ Toms) i Agterhaanden. Begge Slags var af bedste Sort russisk Hamp, og Prøvetrosserne besigtigede og prøvede ved Carl-Johansværns Værft.

Forberedelser til Bundskrabning. — Disse begyndte i Regelen strax efter at man var færdig paa Bagbord Side med Lodning eller Temperaturrække.

For at compensere Virkningen af Skibets og Skrabens Bevægelse paa Stramningen af Skrabetouget, navnlig for at undgaa farlige pludselige Ryk, var Skrabetouget vist gjennem en Blok, der hang i en *Accumulator*. Skrabeaccumulatoren var meget større end Loddeaccumulatoren. Den havde 30 Stropper, af samme Slags som de ved Lodningen benyttede. Træskiverne, gjennem hvilke Tougstjerterne gik, havde en Diameter af 0m.605 (1 Fod $11^1/_2$ Tomme) og en Tykkelse af 0m.050 (1.9 Tomme). Skrabeblokken var af

Fig. 19 represents the *Beam-trawl* used on the Expedition. A conical netted bag is suspended by one side from a round beam of wood 15 feet in length, to the square ends of which are fixed iron runners, 2 feet and a half high, that support the apparatus when riding over the bottom. The length of the trawl, measured from the middle of the beam to the apex of the bag, is 21 feet. The lower side of the mouth of the net, weighted with rolls of sheet-lead, hangs loose, and is fastened at either end to the bottom part of the runners, between which it drags along the sea-floor, scooping up more or less of solid matter. This trawl is attached to the dredge-rope by means of a rope crow-foot, lashed to eyebolts on the fore part of the iron runners. We often fastened hempen tangles both to the runners and to the end of the bag.

The commercial trawl, as furnished by the English maker, had a rather wide-meshed bag; and hence it brought up none but comparatively large bodies, small animals and fine mud being washed through. At the instance, therefore, of Professor Sars, the bottom of the bag was lined up to a certain height with yarn netting, sufficiently close to retain the finest mud. With this slight modification, we found the beam-trawl a most efficient instrument, whether quickly or slowly worked; it not only secured fishes and other marine animals that occur near the bottom, but skimmed off a thin layer of the surface; nay, it would take in stones, some of them weighing as much as 100 pounds.

In its original form, the beam-trawl was apt moreover to capsize in the water and reach the bottom with the beam down. Captain Grieg remedied this defective tendency by suspending one of the cast-iron sinkers in a slack bight between the runners. This arrangement is shown in Fig. 20. So soon as the trawl begins to incline from the right position given it at the commencement of the operation, the part of the rope made fast to the runner then deepest in the water will get slack, and the weight accordingly act only upon the runner at the opposite end of the beam, pulling it down to a level with the lower one.

The *Dredge-rope,* samples of which had been examined and tested at the Royal Dockyard of Carljohansværn, was of the best Russian hemp. The 2000 fathoms next the dredge were 2 inches in circumference, the remainder had a circumfererce of $2^1/_2$ inches.

Preparations for Dredging. — As a rule, the gear was got ready immediately after taking — on the port side — a sounding or a serial temperature.

With a view to take off the suddenness of the strain on the rope caused by the scraping of the dredge or the motion of the vessel, the rope was rove through a block suspended to an *accumulator*. The accumulator provided for the dredge exceeded considerably in size that used with the sounding-machine. The number of straps was 30, and the wooden disks through which the lanyards passed had a diameter of 1 foot $11^1/_4$ inches and a thickness of 2 inches. The dredging-block was of iron, similar in con-

Jern og forøvrigt af lignende Konstruktion som Loddeblokken. Skiven, der var solid, havde en Diameter af 0m.521 (1 Fod 8 Tommer), en Tykkelse af 0m.15 (5 3/4 Tomme), og Furens Dybde var 0m.079 (3 Tommer). Skrabeaccumulatoren hang paa Styrbord Side, *i et Topreb,* hvis øvre Ende var fastgjort til Stormasten over Godset. Fig. 14 viser Accumulatoren hængende i Styrbords Vant, hvor den havde sin Plads, naar den ikke benyttedes til Skrabning.

Skraben eller Trawlen gjordes klar paa Agterdækket mellem Nedgangskappen til Lugarerne og Kappen ved Siden af Dækrullen (Fig. 1, Fig. 2, Fig. 14). Skrabetouget, der laa i sine Binger (Fig. 2, b) agtenfor Fokkemasten, og som i Tampen havde Kous og Hex, toges gjennem en Kasteblok paa Fokkemasten (se Fig. 20), derfra over Hytten og gjennem Kasteblokken i Accumulatoren, og hexedes i Hanefoden til Skraben eller Trawlen. Paa Skrabetouget var indsmøget en Pukkenholts Dor eller Kous med en lang Stjert. Dens Plads var mellem Skrabeblokken og Skraben (Trawlen). Accumulatoren udhaltes med firskaaren Talje (Fig. 14) paa Plads under Styrbords Storraanok. Raaen brasedes saaledes, at Accumulatoren hang omtrent midt ud for Loddebroen. (Fig. 1, Fig. 20). Da der ved Skrabningen kunde gaa stor Kraft paa Raaen saavel nedad som indad, var den paa Styrbord Side faststøttet, foruden ved Toplent, Rakke og Braser, ogsaa ved en Talje som Extra-Toplent og en Støttalje paa Bagbord Side, som Fig. 14 viser.

Manøvrerne ved Bundskrabning var ikke meget forskjellige, enten man brugte Skrabe eller Trawl. For Tydeligheds Skyld skal de her særskilt beskrives, forsaavidt nødvendigt er.

Bundskrabning med Skrabe. — Skibet sattes med fuld Fart op mod Vinden med denne lidt ind om Styrbord. Naar det var kommet i godt Sig, standsedes Maskinen, Skraben løftedes ud over Rækken med Haandmagt og kastedes i Vandet. Forud ved Fokkemasten stod en Mand, med Læderhandsker paa Hænderne, færdig til at fire ud paa Skrabetouget, assisteret af en anden Mand, der ved Hjælp af en Haandspage holdt Touget klart til at løbe fra Kvejlen i Bingen. Strax Skraben var i Vandet, kommanderedes: "Fir"! og man firede langsomt paa Skrabetouget, saa man kunde se, om alting var klart. Naar Skraben var agtenfor Skruen, sattes denne atter igang til 4 Knobs Fart, som Maskinisten holdt jevn ved at observere Vandloggen. (Se nedenfor). Man firede nu, med jevnlige Anhold, for at holde Touget og Apparatet strakt, stadig under samme Kurs, som da Skraben kastedes overbord. Naar 200, 300 eller 400 Favne, efter den mindre eller større Dybde, var udfirede, standsedes atter, Touget haledes ved Hjælp af Kousen og Stjerten ind til Hakkebrættet, og der paasattes en Trætærs ved Hjælp af Skibmandsgarnsurring, agtenfor Kousen. Der sattes atter i Gang med samme Kurs og Fart, og man sejlede ud den hele Touglængde, der ansaaes fornøden, nemlig mindst det dobbelte af Dybden og for mindre Dybder mere.

struction to the sounding-block. The sheaf, which was solid, had a diameter of 1 foot 8 1/2 inches and a thickness of 6 inches; the depth of the groove was 3 inches. The accumulator used for the dredge hung — on the starboard side — in a *pendant,* the upper end of which was secured to the mainmast above the rigging. Fig. 14 represents this accumulator as it hung suspended in the starboard shrouds when not in use.

The dredge and the trawl were got ready on the after-deck, between the companion-hatchway to the cabins and the hatchway alongside of the reel (Figs. 1, 2, and 14). The dredge-rope, which at one end had a thimble and shackle, was rove from the lockers (Fig 2 b) in which it lay coiled abaft the fore-mast, through a snatch-block on the mast (Fig. 20), carried from thence over the roof of the roundhouse and through the snatch-block of the accumulator, and then shackled to the crow-foot of the dredge or trawl. Between the dredging-block and the dredge (or trawl) a thimble of lignum vitæ, with a lizard, was slipped on to the dredge-rope. The accumulator was triced up under the starboard main yard-arm by means of a guntackle purchase, the yard being trimmed so as to bring the accumulator nearly abreast of the sounding-bridge (Figs. 1 and 20). As the strain, inwards as well as downwards, to which the yard was exposed when dredging, might be very considerable, it was secured, not only by braces, lifts, and trusses, but also, on the starboard side, by a purchase, as a preventer-lift, and on the port side, by a rolling-tackle, as shown in Fig. 14.

Dredging and Trawling from the "Vøringen." — Both operations were conducted very much alike. We shall, however, for the sake of perspicuity, describe our mode of working each of the two instruments.

Working the Dredge. — We steamed full speed ahead, with the wind a little on our starboard bow. So soon as the vessel had got sufficient headway, the engine was stopped, the dredge lifted by hand over the railing and dropped into the sea. At the foremast, a man with thick leather gloves stood ready to pay out the dredge-rope, which another kept clear with a handspike as it ran out from the coil in the locker On the dredge entering the water, the word was immediately given to veer, when the paying out commenced, — slowly, however, to make sure that all was right. So soon as the dredge was clear of the propeller, the vessel again went ahead, steaming at a uniform rate of 4 knots, which the engineer was enabled to keep up by frequent reference to the water-log (see below). Meanwhile, we kept steadily veering, while taking care, by frequent holding on to the rope, that the length run out should be properly taut, and steering the course given to the ship when the dredge was put over. After paying out, according to depth, 200, 300, or 400 fathoms, we again stopped, hauled in the rope to the taffrail by means of the lizard and thimble, and fastened, below tbe latter, with spun-yarn, a wooden toggle to the rope. Starting again (same course and speed), we next ran out the whole length of rope deemed necessary for the operation, —

Farten standsedes. Med Stjerten haledes Skrabetouget atter ind til Hakkebrættet og holdtes inde med Bugten af en Ende. Til Stjerten i Pukkenholtskousen fastgjordes en efter Dybden afpasset Vægt, hvortil brugtes 3 eller 4, til de større Dybder 6 af Baillie-Maskinens Lodder, der vejede 27 Kilogr. (55 Pd.) hver. Man slap Tampen af Enden, væltede Vægten overbord, og denne løb da med Kousen nedover langs Touget, indtil den standsedes af den paasatte Trætærs. Dette kunde føles, naar man holdt Haanden paa Touget.

Skibet laa nu stille, medens Lodder og Skrabe sank. Vi regnede, efter flere Forsøg, at der behøvedes 12 Minutter for at Skraben skulde synke 100 Favne. Skrabens (eller rettere Trawlens) og Loddernes Synkning er anskueliggjort i Fig. 20. Den i Figuren antagne Dybde er 1300 Favne, følgelig er Skib og Trawl tegnet i forstørret Maalestok. De prikkede Linier viser Loddernes, Skrabetoughexens og Trawlbommens Bane under Synkningen, under Forudsætning af, at Trawlen synker med en Hastighed, der er lidt mindre end den, hvormed Lodderne nærmer sig Bunden. Idet Lodderne naar Bund, sværer endnu Trawlen i Vandet, og det sidste Stykke af dens Bane vil være næsten lodret. Erfaring viste, at Trawl og Skrabe med den brugte Fremgangsmaade i Regelen uden Vanskelighed kom i rigtig Stilling paa Bunden. Er Skrabens (Trawlens) Synken meget langsommere end Loddernes, vil den falde lodret ned paa Bunden med sin tunge Ende foran. Er derimod dens Syn-

not less than double the depth, nay for smaller depths even more.

The engine was now stopped, after which we hauled in the dredge-rope, as before, to the taffrail, and kept it up in a bight of rope's end. With the lizard was then made fast to the wooden thimble a weight proportioned to the depth, consisting of 3 or 4, and for the deepest dredgings, of as many as 6 of the sinkers of the Baillie sounding-machine, weighing each 55 pounds. We now, after letting go the rope, tilted the weight overboard, which spun down along it till stopped by the wooden toggle. The shock of its arrest was distinctly perceptible to a person who had his hand on the rope.

The vessel was now kept stationary, while the weight and the dredge were sinking. After some experience, we calculated the time required for the dredge to sink 100 fathoms, to be about 12 minutes. Fig. 20 will

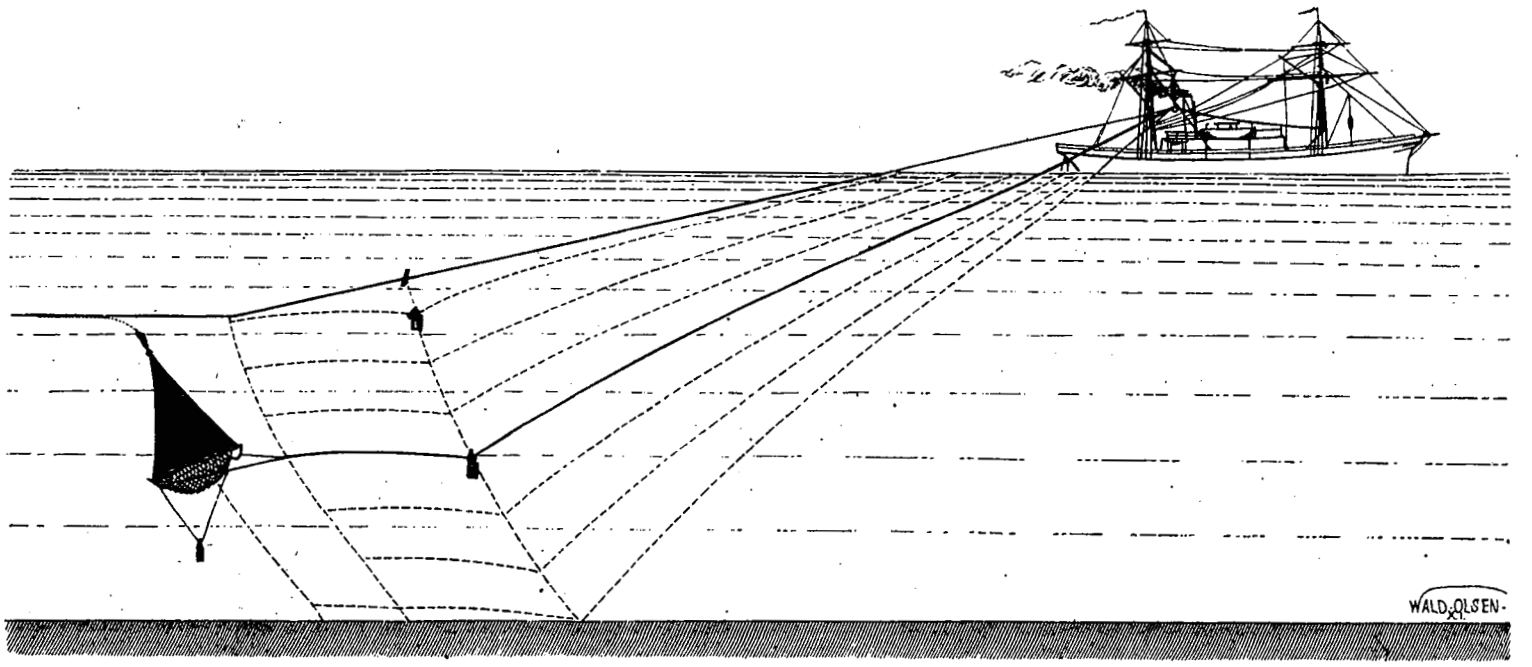


Fig. 20.

give an idea of the descent of the dredge, or rather of the trawl. The supposed depth in the diagram being 1300 fathoms, the vessel and the trawl are of course on a much larger scale. The dotted lines represent the lines of descent of the weight, the shackle, the dredge-rope, and the beam of the trawl, — assuming the trawl to sink more slowly than the weight. When the weight strikes the bottom, the trawl has still some distance to travel, and the last part of its line of descent will be well-nigh perpendicular. We found that, when worked in the manner described above, both trawl and dredge could as a rule without difficulty be made to reach the bottom in the right position. If the dredge or trawl descend much more slowly

ken ligesaa hurtig som Loddernes eller hurtigere, vil den komme til Bunds med en horizontal Component i sin Bevægelse, hvilket vistnok vilde være det sikreste Middel til at den blev klar under den følgende Bundskrabning.

Saasnart Skraben antoges at have naaet Bund, kastedes Touget los forud og Bugten bragtes agterover, lagdes ind i Fodblokken (a, Fig. 2) i Agterkant af Hytten og derpaa om Spiltapperne om Styrbord, saaledes som Fig. 1 viser.

Med 1, $1^1/_2$ og 2 Knobs Fart og samme Kurs som tidligere blev nu Skraben trukket henover Havbunden, idet Vægten i Forhaand holdt den første Del af Touget ned, saa at Draget blev horizontalt eller næsten horizontalt, og Skrabemunden ikke let løftedes fra Bunden. Under Skrabningen maatte man stadig have Opmærksomheden henvendt paa Accumulatoren. Dens Udvidelse og pludselige Sammentrækning igjen angav, naar Skraben tog Tag og atter slap Bunden, og selvfølgelig angav den ogsaa, naar Skraben satte sig fast. Naar Accumulatoren i dette Tilfælde havde udvidet sig saa meget, at man i den lave Stilling, som Loddeblokken indtog, ikke vilde have mere Kraft paa Touget, kommanderedes "Fir"! og Maskinisten ved Indhivningsmaskinen, som for dette Tilfældes Skyld altid stod klar, reverserede Maskinen og firede ud, paa samme Tid som Skibets Fart standsedes. I Regelen fik man Skraben løs ved at hive ind igjen paa Touget. Stod Accumulatoren stadig paa samme Mærke, antydede dette som oftest, at Farten var for stor, og at baade Vægt og Skrabe slæbtes gjennem Vandet fri af Bunden. For at have et Varsko, naar Accumulatoren pludselig udvidede sig over den tilbørlige Grændse, fastgjordes undertiden en Line med den ene Ende i Accumulatoren og med den anden i Damppiben, der saaledes peb, strax Accumulatoren blev for lang.

Skrabningen fortsattes ofte indtil et Par Timer, førend man begyndte *Indhivningen*. Under denne var Farten standset, og man lod Skibet drive tilbage. I Regelen foregik Indhivningen hurtigere end Skibet drev, saa at Touget viste klart ud i Læ. I modsat Fald gik man rundt med Fartøjet, lagde sig paa Læ Side af Touget og drev da tilsidst over Skraben.

Med fuld Fart paa Indhivningsmaskinen tog den ind 100 Favne i 6 à 7 Minutter. Var Skraben meget tung, maatte der hives langsommere. Eftersom Touget kom ind, haledes det fra Spillet over Hytten forefter og blev atter opskudt klart i Bingen forud. Dette var et meget anstrængende Arbejde, navnlig naar Indhivningen, som enkelte Gange Tilfældet, gik uden Stands i 4 til 5 Timer.

than the weight, it will fall vertically, with the heavy end foremost. If, on the other hand, its rate of descent be equal to or exceed that of the weights, it will, on reaching the bottom, have a horizontal component in its motion, — which is pretty sure to keep it from clogging during the ensuing operation.

So soon as the dredge, by our calculation, had reached the bottom, the rope was cast off forward, the bight brought aft, rove through the leading-block (a, Fig. 2) on the after part of the roundhouse, and then passed round the starboard drums, as shown in Fig. 1.

Steaming ahead at the rate of 1, $1^1/_2$, or 2 knots, on the same course as before, the dredge was pulled along the bottom, the tension of the motion of the vessel not however acting immediately upon it, but dragging forward the iron sinkers, which by their great weight serve to keep the direct traction horizontal, or nearly so, and thus prevent the mouth of the dredge from being readily lifted up. In dredging we had to keep our attention constantly fixed on the accumulator. Its extension and sudden contraction was a sure sign that the dredge was working properly, and of course the accumulator also told us when the dredge had fouled the bottom. A great and increasing strain upon the rope, pulling down the block and seriously stretching the accumulator, showed the dredge to have stuck fast, in which case we gave the word to veer, and an assistant engineer, who always stood ready for that purpose, reversed the donkey-engine and paid out the rope, the ship's way, too, being immediately deadened. By hauling in the rope we generally succeeded in extricating the dredge. Sometimes, the accumulator would remain stretched at the same point, and this we as a rule found to indicate that the speed of the vessel was too great, both weight and dredge being dragged through the water clear of the bottom. To give notice of any sudden stretching of the accumulator beyond the safe limit of extension, we hit on the expedient of fastening one end of a line to the apparatus and the other to the steam-whistle, which in that case would sound on the elastic bands running out too far.

Dredging from the "Vöringen" was frequently carried on for a couple of hours before *heaving in*. During the latter operation the vessel drifted before the wind. The rope being in the majority of cases brought in at a rate exceeding the drift of the ship, pointed leeward. If not, we steamed the vessel round, to get the rope to windward and drift over the dredge.

Working at full speed, the donkey-engine brought in 100 fathoms of dredge-rope in 6 or 7 minutes. When the dredge had got a very heavy freight to bring up, we heaved at a slower rate. As the rope came in, we hauled it from the drum of the engine over the roof of the roundhouse, and thence forward into the locker, where it was again coiled ready for the next operation. This was very fatiguing work indeed, particularly when the engine, as was

Naar Lodderne kom op, haledes Bugten af Touget ind til Loddebroen, hvor Vægten blev afstukken. Et godt Mærke paa, at Skraben havde været i Bund, var det, naar Lodderne var overtrukne med Bundler. Naar Skraben kom op, ihukedes et Takkel fra Gaffelen, og med dette løftedes den ind over Agterdækket.

Bundskrabning med Otter-Trawl. Naar man havde faaet denne klar ud i Søen, saa at Otterne skar ud og Nettet slæbte klart efter, foregik Operationerne som med Skrabe. Apparatet var imidlertid vanskeligt at faa klart til Bunds. Det behøvede en større Hastighed under Skrabningen, tog ikke meget af Bunden med og kom ikke sjælden uklart op. Det brugtes derfor efterhaanden mindre og blev det sidste Aar ganske fortrængt af Bom-Trawlen.

Bundskrabning med Bom-Trawl. Fra Agterdækket løftedes Bom og Mejer ud over Rækken ved en Jolle fra Gaffelen. Denne Jolle var fastgjort med en Tærs til en Strop paa Midten af Bommen. Dette gjordes, medens Skibet havde fuld Fart forover. Naar Bommen var kommen i den rette Stilling udenfor Rækken, standsedes Maskinen, Nettet kastedes ud, og man rykkede Tærsen ud ved en deri fastgjort Stjert, hvorefter Udfiringen af Skrabetouget begyndte. De videre Manøvrer var de samme som med Skraben, kun maatte Farten under Skrabningen være mindre, for at Trawlen skulde holde sig i Bund. En større Fart antoges at være hensigtsmæssig til at fange Fiske og anvendtes oftere en kortere Tid efter den egentlige Bundskrabnings Afslutning.

Naar Bomtrawlen kom op fuld af Bundler i hele sin nedre Del, maatte særegne Foranstaltninger til for at faa den ind paa Dækket, dels paa Grund af dens Længde dels paa Grund af dens Vægt, der var for stor til at dens nedre Ende kunde løftes ind med Haandmagt. Den fyldte Trawl havde Form af en Tragt, hvis Spids var udvidet til en Kugle af en Meters (3 Fods) Diameter. I dette Tilfælde sloges Stropper om selve Trawlnettet saa langt nede som muligt, og i disse hukedes Talje fra Gaffelen. Naar Trawlen med denne var løftet saavidt, at kun den nederste kugleformede Del var i Vandet, firedes ned under denne en "Indretning", bestaaende af en tyk Jernring, indvendig udforet med et meget stærkt Tougnet og som hang i 3 Ender, i hvilke man halede ombord under Indløftningen. Denne Sikkerhedsindretning, hvis Hensigt nærmest var at forhindre, at Trawlnettets nedre Ende skulde revne, naar den kom ud af Vandet, idet den bar en Del af Trawlnettets Vægt, var til stor Betryggelse og Hjælp ved at faa Trawlen ombord. Det hændte os ikke nogen Gang, at Trawlen aabnede sig selv under Indholdets Tryk; men før Indretningen kom i Brug, vovede vi ikke at hale Trawlen ombord, førend en stor Del af det fine Bundslam var udslemmet ved Trawlens Svingninger i Vandet.

often the case, had to be kept going for 4 or 5 hours at a stretch.

On the weights coming up, the bight of the rope was hauled in to the sounding-bridge, where they were severally detached. If covered with clay, it was a sure sign that the dredge had been at the bottom. When the dredge appeared, we hooked a tackle on to it from the gaff, by means of which the apparatus was got in on the after-deck.

Working the Otter-Trawl. — Once properly in the water, with the "otters" sheering out to either side, and the bag behind horizontally extended as the instrument was pulled along after the vessel, we worked the otter-trawl precisely as the dredge. The apparatus was, however, apt to foul before reaching the bottom, greater speed being requisite to work it; besides, it failed to secure a satisfactory sample of the bottom, and came up frequently foul. Hence, on discovering these drawbacks, we came to use it less; and on the last cruise it was entirely superseded by the beam-trawl.

Working the Beam-Trawl. — The beam and runners were hoisted over the railing of the after-deck by means of a whip from the gaff, secured with a toggle to a strap on the middle of the beam, — the vessel steaming ahead the while at full speed. So soon as the beam had been given the right position for letting go, the engine was stopped, the bag pitched out, and the toggle pulled off the strap by means of a lanyard, to which it was attached. This done, we began veering the rope. The remainder of the operation was the same as with the dredge, saving the speed, which we had to reduce lest the trawl should be lifted off the bottom. For catching fish, some increase in speed was presumed to be of advantage, and frequently tried as a wind-up to the bottom-trawling.

If the beam-trawl came up with the whole of the lower part filled with clay, special provision had to be made for getting it in, partly on account of its length, and partly owing to its great weight, which would not admit of lifting in the lower part by hand. With the bag full of clay or mud, the trawl had the shape of a cone, expanded at the apex into a sphere, 3 feet in diameter. A bight of rope was passed round the trawl-net as low down as possible, and a purchase hooked on from the gaff. Then, after hauling up the apparatus till the only part left in the water was the spherical extremity of the bag, we lowered under the latter a contrivance consisting of a thick iron ring, having the opening covered with strong cord netting, and the shank firmly secured to 3 stout hempen ropes, by which the apparatus was lifted over. This precautionary device, the main object of which was to prevent the trawl-bag, on its leaving the water, from bursting at the bottom while partially supporting the net and its contents, proved a safe and most efficient expedient for getting the instrument on board. On no single occasion did the bag give way from the pressure of its freight, whereas previous to our adoption of the contrivance, we had never dared to haul in the apparatus till

I Begyndelsen fulgte vi den efter "Challenger"-Expeditionen givne Anvisning med Hensyn til Manøvren, at sejle ud den hele Touglængde i Læ og lade Skraben trækkes af Skibet, eftersom dette drev for Vinden. Det er ogsaa rimeligt, at denne Maade maa benyttes, naar Skrabningen skal udføres fra store og fuldkrafts Skibe, som ikke kan gaa saa langsomt for Maskinen, som Skrabningen fordrer. Dersom der Intet kommer ivejen, er det forsaavidt ligegyldigt, hvilken Vej man vælger, men i modsat Fald taber man meget baade i Tid og Arbejde. Naar man skraber under Gang mod Vinden, kan man regulere Farten efter Ønske og standse en Stund, hvis man frygter for at Farten har løftet Skraben fra Bunden. Driver man i Læ af Skraben, bestemmes Farten af Vind og Strøm, og tror man, det gaar for hurtigt, maa man fire ud Toug til Overflod, hvilket senere atter skal hales ind. Sætter Skraben sig fast, og man er til Luvart, behøver man ikke at fire mere end nogle faa Favne, indtil Farten er standset, og kan derefter strax begynde at hive ind, eftersom Skibet driver ned mod Skraben. Er man derimod i Læ, maa der fires ud en Mængde Toug, før man kommer paa Kurs og kan begynde at gaa op mod Skraben.

At faa Skraben løs igjen, naar den har sat sig fast, kræver ofte en besværlig og langvarig Manøver, der desuden ikke altid lykkes. Man maa hive ind til næsten op og ned og derefter søge at trække den løs den modsatte Vej af den, man skrabede, da den gik sig fast. Da ukjendt Strøm ofte kan være tilstede, nødes man gjerne til at gjøre mange Forsøg. Lykkes disse ikke, staar det sidste Middel tilbage, at kaste Touget til en Pullert, gaa forover i Maskinen med fuld Kraft og enten rykke Skraben løs eller sprænge Touget.

Det første Aar forsøgte vi et Par Gange at fæste Otter-Trawlen efter Skraben, men dette viste sig ikke videre hensigtsmæssigt. Naar man skraber, er Farten saa langsom, at Otter-Trawlen slæber langs Bunden som en Bundt Linegods, og sætter man Fart paa, saa at Otterne kan skjære ud til Siderne og holde Trawlmundingen aaben, løfter Skraben sig fra Bunden og gaar med sine paahængte Svabere et kort Stykke foran Trawlaabningen. Den vil saaledes rimeligvis bortskræmme den Fisk, der muligens ellers kunde være fangen.

Paa Expeditionens Rejser faldt der naturligvis adskillige mislykkede Kast med Skrabe og Trawl. Det hændte, at Apparatet ikke kom i Bund, at det blev iturevet i Bunden eller satte sig fast, at Skrabetouget sprang under Ind-

a considerable portion of the finest mud had been washed out, by allowing the trawl-bag to swing backwards and forwards in the water.

Dredging from the "Vöringen" was carried on at first in the way adopted on the "Challenger" Expedition — viz. by paying out to leward the dué amount of rope, the dredge being then pulled along by the drift of the vessel. This is perhaps the only feasible method in dredging or trawling from large ships of full power, which cannot reduce their speed to the rate required for such operations. True, if all goes well, it is upon the whole immaterial which way is selected; but should, on the other hand, a mishap occur, a serious loss af time and labour will inevitably result. Dredging head to wind, the speed of a steamer may be regulated at pleasure, and her way immediately deadened should there be reason to believe the dredge is off the bottom. When drifting to leeward of the dredge, the speed will be dependent on the wind and the force and direction of currents, and if too high, an extra amount of rope has to be veered, which, of course, must afterwards be hauled in again. Should the dredge foul with the ship to windward, only a few fathoms will have to be veered before stopping the engine, after which the heaving in may be at once commenced, keeping pace with the ship as she drifts down upon the dredge. On the other hand, the ship being to leeward, a very considerable quantity of rope will have to be veered before she can be brought head to wind and steam up to the dredge.

To extricate the dredge when jammed fast at the bottom, is frequently a very difficult matter, involving hours of unremitting exertion, not always accompanied by a successful result. The rope must be hove in till nearly right up and down, attempt being made to extricate the dredge by hauling in a direction contrary to that in which it was moving when the mishap occurred. Moreover, the action of unknown currents will, by complicating the expedients adopted, often protract this laborious work. Should each in turn fail, there is nothing for it but to make fast the rope to a bollard head, and then, steaming full speed ahead, either free the dredge by sheer force or break the rope.

On the first cruise of the Expedition, by way of experiment, we sometimes made fast the otter-trawl behind the dredge, and worked both together; but this arrangement was not found to answer. With amply sufficient headway for dredging, the otter-trawl will drag along the bottom like a heap of cordage; and if, on the other hand, the speed be increased, to make the otters diverge and keep the mouth of the trawl open, the dredge, with its hempen tangles, will be lifted off the bottom and move along a short distance in front of the trawl-bag, scaring away probably many animals, in particular fishes, that might otherwise be captured.

Not every cast of the dredge and trawl was, of course, successful. Sometimes, the apparatus would fail to reach the bottom, or if there get broken, or jammed between rocks or stones; then again, we had the dredge-rope part.

hivningen, at Skrabeposen eller Trawlnettet lagde sig foran Aabningen og tilstoppede denne. Det første Aar brugtes mest Skrabe, hvortil tildels det uheldige Vejr var Grunden, enkelte Gange Ottertrawl og sjælden Bomtrawl. Det andet Aar kom Bomtrawlen i Brug ved Siden af Skrabe, medens Ottertrawlen heller ikke sjælden benyttedes. Det tredje Aar var Bomtrawlen vort Hovedapparat, som da var forsynet med alle de ovenfor nævnte Forbedringer, og brugtes overalt, selv paa de største Dybder, hvor Bunden var jevn og blød. Paa ujevn og haard Bund fik Skraben sin Anvendelse, hvorimod Ottertrawlen ikke blev benyttet.

Naar Skraben eller Trawlen var kommet ombord, begyndte Zoologernes og deres Assistenters Arbejde. Før Apparaterne kom ombord, fyldtes to store Baljer agterud med Søvand ved Hjelp af Donkeyen (en Hjælpepumpe i Maskinen). Til Sigtning af det optagne Bundmaterial brugtes et Sæt runde Sigter, hvert bestaaende af 3 saadanne, den ene staaende inde i den anden. Den underste Sigt havde en Diameter af 0.^{m}365 (1 Fod 2 Tom.), den mellemste af 0.^{m}33 (1 Fod 1 Tom.) og den øverste af 0.^{m}284 (11 Tom.) Paa alle 3 var Kantens Højde 0.^{m}087 (3$^{1}/_{3}$ Tom.) Maskerne var dannede af Kobbertraade og Aabningen mellem dem var paa den nederste Sigt 0.^{mm}3 til 0.^{mm}5, paa den mellemste 1.^{mm}5 og paa den øverste 2.^{mm} (1 Linie). Sigterne var forsynede med opstaaende Haandtag paa begge Sider.

Naar Skraben kom ombord, afkappedes først Svaberne og derefter blev den firet ned paa Dækket. Sømmen i Sækken blev opsprættet paa begge Sider, og den løsnedes ligeledes fra Jernrammen paa den Side, som laa op. Sækkens Overdel toges af, og Indholdet laa afdækket klart til at tages under Behandling. Fiske, Stene og større Gjenstande udtoges strax til Opbevaring og nærmere Bestemmelse. Med en Øse, hvis Bund var af Metalnet, toges af Assistenterne en Portion af Bundmaterialet op i den øverste af et Sæt Sigter. Dette sænkedes ned i Vandet i en af Baljerne, Sigterne bevægedes op og ned, frem og tilbage, indtil det fine Slam var udslemmet, hvorpaa alle Sigters Indhold undersøgtes af samtlige Zoologer. Naar Skrabesækkens hele Indhold paa denne Maade var undersøgt, skylledes Sækken ren med en Vandstraale fra Donkeyen og gjordes klar til senere Brug. Svabernes Indhold udtoges af Zoologerne, et Arbejde, hvortil der i de fleste Tilfælde maatte benyttes Sax. Af saadanne havdes et større Antal i Reserve.

Trawlens Indhold af Bundmateriale tømtes paa Dækket derved, at man løste op Sammensnøringen i Enden af Bunden.

Den Tid, som en Bundskrabning tager, er væsentlig afhængig af Dybden, foruden naturligvis af den Tid, hvori den egentlige Bundskrabning foregaar. En Statistik herover,

when heaving in the gear, and the bag of the dredge or trawl was apt at times to twist round and clog the mouth of the instrument. On the first cruise, in 1876, partly because of the boisterous weather, we made chief use of the dredge, working the otter-trawl occasionally; the beam-trawl was seldom sent down. On the second cruise, both the beam-trawl and the dredge were in constant use, and we also worked the otter-trawl with comparative frequence. On the third and last cruise, the beam-trawl, with the various modifications before described, had come to be our principal apparatus; indeed, we used it exclusively in every locality, even at the greatest depths, on a smooth and soft bottom. Where the bottom was hard and rugged, we had recourse to the dredge. Of the otter-trawl, no use whatever was made in 1878.

So soon as the dredge or trawl was hauled on deck, our naturalists and their assistants set to work. Shortly before the apparatus was got in, two large tubs on the the after-deck were filled with sea-water by means of the steam-pump. For sifting the contents of the bag, we had a set of 3 sieves, fitting freely one within the other The third or bottom sieve had a diameter of 1 foot 2 inches; the second of 1 foot 1 inch; and the first of 11 inches. The depth was the same in each — 3$^{1}/_{3}$ inches. These sieves were made of copper wire, the bottom sieve with 0.02 inch meshes, the second with 0.075 inch meshes, and the first with 0.1 inch meshes. Each sieve was provided with a pair of vertical iron handles.

Having hauled the dredge over the railing, the first thing we did was to cut off the hempen tangles, and then lower the apparatus on deck. After ripping open the seam of the bag, the netting, on the side lying up, was detached from the frame, and the top part of the bag removed, thus exposing the contents. Fishes, stones, and all larger bodies were at once laid aside, to be stored for subsequent examination. With a ladle having the bottom of brass wire netting, the assistants transferred to the top sieve part of the sample of the bottom brought up in the apparatus. The set of sieves were then moved gently up and down — from side to side — in one of the tubs of water, till the fine mud or ooze had passed through each, after which the three naturalists carefully examined the sieves in succession. When the whole contents of the dredge or trawl had been sifted and examined, the bag of the apparatus was thoroughly rinsed, by directing on to it a jet of water from the steam-pump, and then put by ready for use. The delicate organisms brought up on the hempen tangles had mostly to be clipped out with short scissors, of which there was an ample supply.

For emptying the trawl, we had a contrivance by means of which the bottom of the bag was made to unlace, and the contents could thus be deposited on deck without inverting the apparatus.

The time occupied in a dredging is mainly dependent on the depth, but of course to a considerable extent also on the length of the interval devoted to working the in-

udregnet af Skibsjournalens Opgaver over Klokkeslettet, da Skrabe (Trawl) blev sat ud, da Lodderne blev slupne, da man begyndte Bundskrabningen, da den endte, og Indhivningen begyndte, og da Skraben (Trawlen) kom op igjen, viser, at en Skrabning paa 100 Favnes Dyb gjennemsnitlig tog $1^1/_2$ Time, paa 500 Favnes Dyb $4^1/_4$ Time, paa 1000 Favnes Dyb $7^1/_3$ Time, paa 1500 Favnes Dyb $10^1/_2$ Time. Eller, udtrykt ved en Tilnærmelsesformel, kan man sige, at Tiden for en Bundskrabning =

1.5 + (Dybden —100 Fv.) 0.654 Timer.

Denne Formel giver for en Dybde af 2000 Favne en Tid af 14 Timer. Forresten kunde Tiden for en Bundskrabning paa en vis Dybde være temmelig forskjellig, eftersom Manøvren gik mere eller mindre heldig. Var Trawlen meget tung f. Ex., maatte der hives langsommere ind. I 1878, da Trawlen mest var i Brug, varede gjerne selve Skrabningen længere end tidligere (2 Timer mod $1^1/_2$ Time), og Trawlen var ofte meget tung. Det viser sig af vor Statistik ogsaa, at Varigheden af den hele Operation gjennemsnitlig i 1878 var større end i 1877.

Overfladenet. Foruden de ovenfor beskrevne Fangstredskaber brugtes ogsaa meget hyppigt af Prof. Sars et Overfladenet, som bestod af en omtrent 1 Meter (3 Fod) lang Pose af fin Kammerdug, spids i den ene Ende, og aaben i den anden, der var fæstet til en Ring af Messingtraad. Til denne blev fastgjort i Hanefod en smækker Line. Naar der ved Ankomsten til en Arbejdsstation blev kommanderet "Sagte", udkastedes Nettet, og det slæbte efter Skibet under den aftagende Fart. Undertiden blev det ogsaa blot kastet ud fra Fartøjet under Stilleliggen og strax indhalet.

Navigering.

Til Expeditionen var anskaffet et Admiralitets-*Kompas* fra England. Dets Plads var, som tidligere anført, strax forenfor Bestiklugaret paa Hytten (Fig. 2 c). Dets *Deviation* bestemtes ved Svingning af Skibet, i 1876 i Husø, i 1877 i Husø, ved Røst og i Vestfjorden, i 1878 i Bergen, paa Kysten af Øst-Finmarken nær Vardø, udenfor Sørøen ved Hammerfest, paa Ishavet vestenfor Beeren Eiland, under Beeren Eiland, under Spidsbergens Sydkap, under Grønlandsisen paa $76^1/_2$ Grads Bredde. Observationerne blev beregnede efter Archibald Smiths Methode strax efter, at de var tagne, og Resultaterne anvendte til Bestemmelse af Kursen. De benyttede Værdier af Misvisningen toges af de norske, britiske og danske Søkarter, naar Misvisningen ikke var bestemt ved vore egne Observationer.

strument when down. Reference to the ship's logbook, in which were recorded the details of every operation, comprising the moment at which the dredge (or trawl) was put over, that at which the sinkers were let go, the actual dredging was commenced and terminated, when the heaving in began, and when the apparatus was hauled on deck, — shows the average time to have been as follows: — At a depth of 100 fathoms, 1 hour 30 min.; at a depth of 500 fathoms, 4 hours 30 min.; at a depth of 1000 fathoms, 7 hours 20 min.; and at a depth of 1500 fathoms, 10 hours 30 min. Or, expressed by an approximate formula, the time required for a dredging =

1.5 + (the depth —100 fathoms) 0.654 hours.

For 2000 fathoms, this formula will give 14 hours. Meanwhile, the time a dredging would occupy at any given depth, was found to vary not a little according to the greater or less success attending the operation. And moreover, if the trawl had got an exceptionally heavy freight, the rate of heaving in had to be reduced. In 1878, when chief use was made of the beam-trawl, we as a rule kept the apparatus longer at the bottom than on the two preceding cruises, and it often came up very heavy. It appears, too, from the entries in the log-book, that the average duration of a cast of the trawl in 1878 was greater than in 1877.

The Tow-Net. — Among the apparatus for prosecuting zoological work was a tow- or surface-net, of which Professor Sars made frequent use. It consisted of a conical muslin bag, 3 feet deep, attached to a stout brass ring, which, by means of a crow-foot, was made fast to a line of suitable thickness. Shortly before our arrival at an observing-station, after the ship's way had been deadened, Professor Sars cast out the tow-net, which was pulled along after the vessel till she stopped. Sometimes, he merely threw it over and hauled it in when there was no way on the ship.

Navigating the Ship.

An Admiralty-compass had been procured from England for the Expedition. Its place, as previously stated, was just forward of the chart-room on the roundhouse. The deviation of the instrument we determined by swinging the ship, — in 1876 at Husø; in 1877 at Husø, at Røst, and in the Vestfjord; in 1878 at Bergen, off the coast of East Finmark (near Vardø), off Sørøen (near Hammerfest), in the Arctic Ocean (west of Beeren Eiland), off South Cape, Spitzbergen, and off the Greenland ice-barrier, in lat. 76° 30′ N. Immediately on being taken, the observations were computed by Archibald Smith's method, and the results employed for shaping the ship's course. The variation was taken from the Norwegian, British, or Danish charts, when not previously determined by our own observations.

I 1876 anvendtes, foruden den almindelige *Log* med Flyndre og Line, ogsaa Masseys Patentlog. Denne viste sig ikke synderlig hensigtsmæssig paa Grund af de hyppige Standsninger, og et Par Exemplarer gik i Skruen og tabtes. Der savnedes ogsaa god Lejlighed til at kontrollere dens Nøjagtighed. I 1877 indsattes den af Premierlieutenant *M. Petersen* arrangerede *Vandlog*, hvis Anordning

On the first cruise, in 1876, we used Massey's patent log, as well as the common log with logchips and line. The first instrument, however, did not answer well, owing to the frequent stoppages; and on one or two occasions it fouled the screw, and was lost. Moreover, we had no good opportunity whereby to test its accuracy. In 1877, the "Vøringen" was furnished with a *water-log*, the inven-

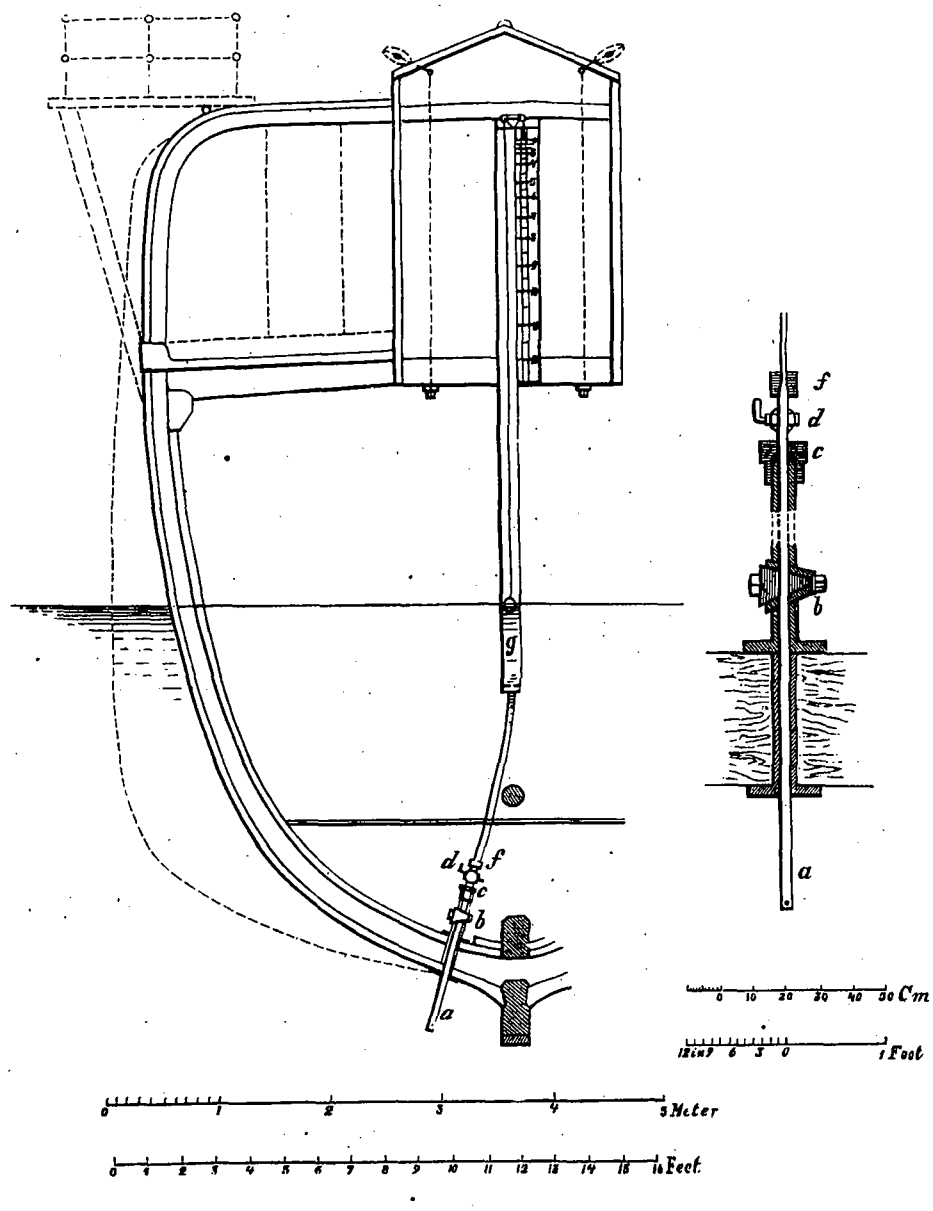


Fig. 21.

ombord i "Vøringen" sees af Fig. 21, der viser et Tversnit af "Vøringen" gjennem den agterste Del af Maskinrummet, seet forfra agterover. Vandloggen har følgende Indretning.

Paa et bekvemt Sted i Maskinrummet bores et Hul i Skibsbunden og fores med et 1 Toms Rør. Over dette anbringes med Flens Røret *b* (se den lille Figur) saaledes, at Aabningen i dette danner en Fortsættelse af Hullet i Bunden. Paa Midten af dette Rør er en konisk Kran og omkring dets øvre Ende er Skruegjænger til Pakningsringen *c*. Gjennem Røret *b* og Hullet i Skibsbunden nedsættes Røret *a* saa langt, at den lille Aabning i dets nedre Ende,

tion of Lieutenant *M. Petersen*. Fig. 21, representing a transverse section of the after part of the engine-room, as seen looking aft, shows the arrangement of the water-log on board.

In some convenient spot in the engine-room, a hole was bored in the ship's bottom to receive a one-inch metal tube, having fixed on to its top end the flange of the tube *b* (see small Figure), in such manner that the bore of the latter would form a continuation of the hole in the ship's bottom. This tube had a conical stop-cock, and its upper extremity screw-threads fitting into the gland *c*. The tube *a* was passed through the tube *b* and the hole in the ship's

der forøvrigt er lukket, kommer omtrent 0.^{m}5 (20 Tommer) under Skibsbunden og visende ret forefter. Denne Afstand fandt vi var den hensigtsmæssigste. En mindre Afstand bragte Hullet for nær det af Skibsbunden medslæbte Vand, en større Afstand rønnede for meget paa det fritstaaende Rør under større Fart. Pakningsskruen *c* tilskrues. Ovenfor *c* bør Røret *a* have en mindre Kran *d*. Fra *a*'s øvre Ende gaar et tyndt Blyrør til Stigerøret *g*, der har omtrent 10^{cm} (4 Tommers) Diameter. Dette maa placeres midtskibs, vertikalt og saa lavt, at dets nedre Ende er godt under laveste (nederste) Vandlinies Plan. Det er forsynet med Blænde, for at ikke Vandet under Skibets Bevægelse skal pumpe i Røret. I dette Stigerør er anbragt en Flyder, fra hvilken der gaar en Snor over en Metalrulle paa Toppen af Røret, derfra over en anden Rulle paa Toppen af Skalaen, og Tampen er stukket gjennem et lidet Blylod, der vandrer mellem to tynde Messingstænger langs Skalaen, og som fæstes til Snoren ved at man trykker ind en liden Trækile nedenfra i det Hul, gjennem hvilket Snoren er trukket.

Under Skibets Fart forover trykkes Vandet op i Stigerøret, og eftersom Flyderen kommer højere, synker Loddet langs Skalaen. Saasnart Farten er bleven jevn, staar Loddet uforandret paa samme Højde paa Skalaen, hvor Fartens Størrelse da kan aflæses i et Øjeblik.

Vandloggen er, som man ser, en speciel Anvendelse af *Pitot*'s *Rør*. Kaldes den Højde, hvortil Vandet stiger i Stigerøret over det Niveau, det indtager, naar Fartøjet ligger stille, *h*, Skibets Hastighed *v*, Tyngdens Acceleration *g* og er *M* en Coefficient, saa har man[1]

$$h = M \frac{v^2}{2g}$$

Coefficienten *M* har efter Dubuats Forsøg en Værdi, der er større end 1, men bliver mindre, naar Hastighederne bliver større, uden dog at naa Enheden. Ved en Hastighed af 1.^{m}8 pr. Sekund fandtes $M = 1.08$.

Ved Vandloggen, saaledes som den er indrettet af Lieutenant Petersen, er Coefficienten *M* sat lig 1. Rigtigheden eller Tilstrækkeligheden af denne Antagelse til ethvert praktisk Brug tilsøs, selv paa lange Rejser, er godtgjort ved den Anvendelse, Apparatet har havt paa "Vøringen" under 1877 og 1878 Aars Expeditioner og under dens Gang i Fragtfart paa Østersøen og Spanien, hvor lange Strækninger er udsejlede uden Afbrydelse. Endvidere har det samme Resultat vist sig af Vandloggens Anvendelse paa Oplodningsdampskibet "Hansteen" hvert Aar siden 1875 og paa Korvetten "Nornen" paa et Togt til Vestindien.

[1] Bresse, Cours de mécanique appliquée. Seconde partie, p. 335.

bottom, till the small aperture at its lower end, which for the rest was closed up, had been made to project about 20 inches beneath the bottom of the vessel, while pointing straight forward. This we found, by repeated experiment, to be the right distance. If diminished, it would bring the aperture too near the water carried along by adhesion to the ship's bottom; and if increased, it would, with greater speed, expose the projecting tube to a serious strain. The gland *c* has now to be screwed on. A little above the gland, the tube *a* should have a smaller stopcock *d*. From the top of *a* a slender leaden pipe led to the upper tube *g*, which had a diameter of nearly 4 inches. This tube must be given a vertical position amidships, and far enough down to bring its lower extremity well below the level of the lowest load water-line. It was provided with a blind, to prevent the water from pumping in the tube by reason of the motion of the vessel. In this upper tube there was a float, from which a line passed first over a brass roller at the top of the tube and then over another at the top of a graduated scale, the end of the line being rove through a small leaden weight that played against the scale between two slender brass rods, and was made fast to the line by inserting from below a small wooden wedge into the opening through which the former passed.

Now, on the ship moving ahead, the water will be forced into the upper tube and the weight descend along the scale as the float rises. So soon as the speed has become uniform, the weight will keep stationary, at the same point on the scale, and the rate may then be read off at a glance.

The water-log is obviously a special adaptation of *Pitot's tube*. Let *h* be the height to which the water in the upper tube rises above its level when the ship is stationary; *v* the speed of the vessel; *g* the acceleration of gravity; and *M* a coefficient, — we shall then have the formula[1]

$$h = M \frac{v^2}{2g}$$

The coefficient *M* has, according to Dubuat, a value greater than 1, which decreases however with the increasing velocities, though without reaching unity. For a velocity of 1.8^{m} pr. second, the value of *M* was found to be 1.08.

For the water-log on Lieutenant Petersen's construction, the coefficient *M* is put equal to 1. And this is practically correct, even for comparatively long voyages, as shown from experience derived on the cruises of the "Vøringen" in 1877 and 1878, and on her voyages in the freight-trade to the Baltic and to Spain, very considerable distances having then been run at a stretch. Equally favourable results have been obtained, too, by the use of the water-log (since 1875) on board the Coast Survey steamer "Hansteen," and on a cruise of the steam-corvette "Nornen" to the West Indies. Now, supposing the coef-

[1] Bresse, Cours de mécanique appliquée. Seconde partie, p. 335.

Sættes Coefficienten M lig 1, Kvartmilen lig $^1/_{60}$ af en Ækvatorsgrad og g lig 9.^{m}810 (50° N. Br.), saa faar man den følgende Tabel for Skalaens Inddeling.

ficient M to equal 1, a mile to equal $^1/_{60}$ of an equatorial degree, and g to equal 9.810^m (in lat. 50° N.), we have the following series of figures for graduating the scale.

Fart. (*Speed.*)	Skala. (*Scale.*)			Fart. (*Speed.*)	Skala. (*Scale.*)		
Kvartmil i Timen. (*Miles an Hour.*)	Meter. (*Metres.*)	Norske Fod. (*Norw. Feet*)	Eng. Fod. (*Eng. Feet.*)	Kvartmil i Timen. (*Miles an Hour.*)	Meter. (*Metres.*)	Norske Fod. (*Norw. Feet.*)	Eng. Fod. (*Eng. Feet.*)
1	0.014	0.043	0.044	7	0,663	2.114	2.176
2	0 054	0.172	0.178	7.5	0.761	2.427	2.498
2.5	0.085	0.270	0.278	8	0.866	2.761	2.842
3	0.122	0.388	0.400	8.5	0.978	3.117	3.209
3.5	0.166	0 529	0.544	9	1 096	3.495	3.597
4	0.217	0.690	0.711	9.5	1.222	3.894	4.008
4.5	0.274	0.874	0.899	10	1.354	4.314	4.441
5	0.338	1.079	1.110	10.5	1.492	4.756	4.896
5.5	0.410	1.305	1.343	11	1.638	5 220	5.373
6	0.487	1.553	1.599	11.5	1.790	5.706	5.873
6.5	0.572	1.823	1.876	12[1]	1.949	6.213	6.395

Vil man efterse, om Røret gjennem Bunden er i Orden, stænges Kranen *d*, Pakningsstykket *f* afskrues, og Blyrøret bøjes noget til Side; man løsner paa Pakningsringen *c*, Røret *a* løftes op, indtil dets nedre Ende har passeret Kranen paa Røret *b*, hvorefter denne afstænges, og Røret *a* kan løftes helt op og eftersees.

Ved Brugen af Vandloggen maa to Ting haves i Erindring:

1) at Skalaens Nulpunkt eller rettere Snorens Længde fra Flyderen til Vægten, der tjener til Viser paa Skalaen, retter sig efter Skibets Dybgaaende, og

2) Fejlen, der foraarsages ved stadig Krængning.

Med Hensyn til det første Punkt, reguleres dette lettest derved, at man standser Skibets Fart, udtager Trækilen og flytter Loddet paa Nul. Det hele kan udføres i nogle Minutter. Ved de hyppige Stopninger, som Lodning og Skrabning foranledigede, kunde vi paa Nordhavs-Expeditionen altid holde Vandloggen skarpt justeret. Paa Sejlskibe vil Forbruget ombord ikke saaledes forandre Dybgaaendet, som paa Dampskibe, men man bør dog imellem foretage et Par nøjagtige Logninger med den almindelige Log og Uhr, for at kontrollere Vandloggen og eventuelt justere den paany.

[1] Ved 80° Bredde med g = 9.^{m}830 bliver Skalastregen for 12 Miles Fart 1.945 Meter, altsaa kun 4^{mm} forskjellig fra Tabellens. For de mindre Hastigheder bliver Forskjellen forholdsvis mindre.

To ascertain whether the tube passing through the ship's bottom be in order, the stopcock *d* is turned back, the gland *f* screwed off, and the leaden tube bent a little aside; then, after partially unscrewing the gland *c*, the tube *a* is lifted up till its lower extremity is just clear of the cock of the tube *b*, and when this too has been turned back, the tube *a* may be taken out and examined.

When using the water-log, two things must be borne in mind, viz. —

1) That the position of zero on the graduated scale, or rather the length of the line from the float to the weight which plays against the scale, is regulated by the draught of the ship; and

2) The heeling error.

As regards the first source of error, the index is best regulated by stopping the vessel, and then, after taking out the wooden wedge, placing the weight at zero. This may be done in a few minutes. With the frequent stoppages involved in sounding and dredging on the North-Atlantic Expedition, we could always manage to keep the water-log accurately adjusted. In sailing-vessels the draught is not of course as in steamers affected by the consumption of coal; but now and then the speed should nevertheless be closely determined with the common log as a means of testing the results of the water-log, and, if necessary, of adjusting that instrument anew.

[1] In lat. 80° N., where g = 9.830^m, the division on the scale denoting a speed of 12 knots will correspond to 1.945^m, and thus exhibit a difference of only 4^{mm} as compared with the figures in the Table. For less velocities, the difference will be proportionally reduced.

Med Hensyn til det andet Punkt, Krængningsfejlen, da kommer denne i Betragtning kun ved større og stadig Krængning. Slingringernes Virkning er næsten ganske hævet ved Hullets Tranghed og Blænderen. Antages at Stigerøret staar midskibs og vertikalt, naar Skibet ligger paa ret Kjøl, og sættes den lodrette Afstand fra Havniveauet til det Punkt, om hvilket Fartøjet drejer sig, naar det begynder at krænge, lig x, regnet positiv fra Havniveauet nedad mod Kjølen, samt Krængningsvinkelen i og den under denne Krængning paa Skalaen aflæste Fart v', saa har man, idet de tidligere Benævnelser h og v beholdes:

$$v'^2 = 2g\left(\frac{h+x}{\cos i} - x\right) = \frac{2gh + 2gx}{\cos i} - 2gx =$$

$$\frac{v^2 + 2gx\ (1 - \cos i)}{\cos i}$$

$$v^2 = v'^2 \cos i - 4gx \sin^2 \frac{i}{2}$$

x, v og v' maa regnes i samme Enhed (Meter, Fod), Tidsenhed er Sekundet. 1 Kvartmil i Timen svarer til 0.5153 Meter pr. Sekund.

Den følgende Tabel giver en Oversigt over Resultaterne efter denne Formel. Den er beregnet for en Krængning $i = 20°$, og efter Værdierne af $x = 0$, $x = +\ 1^m$ og $x = -1^m$.[1]

[1] Værdien af x kan findes, naar man krænger Fartøjet, medens det ligger stille, og observerer Krængningsvinkelen i samt Længden o af det Stykke, Vandets Overflade har flyttet sig fra det oprindelige Niveau i Røret. Ligger Niveauet under Krængningen højere, det er over Nulpunktet (Loddet paa Tal paa Skalaen), er x positiv, ligger det lavere (Loddet ovenfor Nulpunktet paa Skalaen), er x negativ. Formelen er:

$$x = o\ \frac{\cos i}{2 \sin^2 \frac{i}{2}}$$

Ex. $i = 20°$, $o = 0.^m05$, $x = 0.^m779$.

Den negative Værdi af x lig en hel Meter er medtaget som Regneexempel for at vise Virkningen af en saadan, omendskjønt den ikke vil forekomme i Praxis.

The other source of error, viz. heeling, may be ignored altogether, save when the heeling is both great and continuous. The effect of rolling on the water-log will, as a rule, be almost wholly counteracted by the narrowness of the aperture of the tube, and by the blind. Supposing the upper tube, placed amidships, to have a vertical position when the ship is on an even keel, then, if x be the length of the perpendicular from the level of the sea to the point about which she turns on beginning to heel, — assumed positive from the level of the sea towards the keel, — i the heeling-angle, and v' the speed, as read off on the scale with the vessel at that angle, we have, h and v denoting as before, —

$$v'^2 = 2g\left(\frac{h+x}{\cos i} - x\right) = \frac{2gh + 2gx}{\cos i} - 2gx =$$

$$\frac{v^2 + 2gx\ (1 - \cos i)}{\cos i}$$

$$v^2 = v'^2 \cos i - 4gx \sin^2 \frac{i}{2}$$

The value of x, v, and v' must be taken in the same unit of measure (metre, foot). The unit of time is a second. One mile an hour corresponds to 0.5153 metre pr. second.

The following Table gives the results obtained by this formula, taking 20° as the angle of heel, and with the values $x = 0$, $x = +\ 1^m$, and $x = -1^m$.[1]

[1] The value of x may be found by heeling the ship when stationary, and then observing the angle of heel i, together with the distance o, through which the water in the tube has moved from its original level. If the level in heeling be higher, i. e. above zero (the weight within the divisions of the scale), the value of x will be positive; if lower (the weight above zero), x will be negative. The formula is as follows: —

$$x = o\ \frac{\cos i}{2 \sin^2 \frac{i}{2}}$$

Example: $i = 20°$, $o = 0.^m05$, $x = 0.^m779$.

The negative value of x put equal to a whole metre, is introduced merely by way of example, to show its *possible* effect, the case never occurring in practice.

Krængning 20°. *Angle of Heel* 20°.

Observeret Fart. *(Observed Speed.)* Kvartmil i Timen. *(Miles an Hour.)* v'	Virkelig Fart. *(Actual Speed.)* $x = 0$ v	Corr. *(Corr.)*	Diff. f. 1 Kvartmil. *(Diff. for 1 Mile.)*	v Kvartmil i Timen. *(Miles an Hour.)* $x = +1^m$ v	Corr.	$x = -1^m$ v	Corr.
12.0	11.6	—0.4	0.03	11.4	—0.6	11.8	—0.2
9.0	8.7	—0.3	0.03	8.5	—0.5	9.0	0.0
6.0	5.8	—0.2	0.03	5.4	—0.6	6.2	+0.2
4.0	3.9	—0.1	0.03	3.3	—0.7	4.4	+0.4
3.0	2.9	—0.1	0.03	2.0	—1.0	3.6	+0.6
2.5	2.4	—0.1	0.03	1.2	—1.3	3.2	+0.7
2.2	2.1	—0.1	0.03	0.4	—1.8	3.0	+0.8
2.177	2.1	—0.1	0.03	0.0	—2.2	3.0	+0.8
1.0	1.0	0.0				2.3	+1.3

Man ser, at Krængningsfejlen, selv med en saa stor Krængning som 20°, for de større Farter kun udgjør Brøkdele af en Knobs Fart. Svinger Fartøjet om et Punkt i eller nær Vandliniens Flade, er Krængningsfejlene i ethvert Tilfælde meget smaa.

Anderledes stiller Forholdet sig, dersom Stigerøret ikke staar midtskibs. Der kommer da under Krængning en ny Korrektion til, som bliver positiv for Krængning til den ene Side og negativ for Krængning til den anden, og hvis Størrelse voxer med Stigerørets Afstand fra Diametralplanet.

Efter vor Erfaring viste Vandloggen sig særdeles hensigtsmæssig og holdtes med største Lethed i Orden. Et Blik ned i Maskinskylightet var nok til at observere Skibets Fart i Øjeblikket. Maskinisten kunde under Skrabning og Trawling holde Skibet gaaende med den befalede Fart. Til Reduktion af de observerede Vindretninger og Vindhastigheder til sande kræves Skibets Hastighed i Observationsøjeblikket. Denne observeredes paa Vandloggen, der saaledes er et udmærket nautisk-meteorologisk Apparat.

Astronomiske Observationer. Da Expeditionen færdedes paa høje nordlige Bredder om Sommeren, var der ikke Tale om at observere andre Himmellegemer end *Solen* til Bestemmelse af Skibets paaværende Plads. Observationerne gjordes med flere *Sextanter*, der altid var godt verificerede, og hvis Indexfejl stadig blev kontrolleret. Sammenlignende Observationer med forskjellige Sextanter gav altid godt overensstemmende Resultater. Observationspladsen var i Regelen Hyttedækket. I Solobservationernes Udførelse og Beregning deltog, foruden jeg selv og Skibsofficiererne Petersen og Grieg, Professor Mohn og Hr. Tornøe. Solhøjder maaltes til alle Dagstider, naar der var Anledning. I 1878 iagttoges oftere Midnatsolen. Det var kun yderst faa Dage, paa hvilke der manglede Observationer.

It is evident that, with greater speed, the error involved in heeling, even at an angle of 20°, will amount to only a fraction of a mile. And if the point about which the vessel turns lie in or near the plane of the water-line, the error will be generally very small.

The case, however, is different in the event of the upper tube not being amidships. Another correction, positive with a heel to the one side, negative with a heel to the other, will then be needed for computing the speed, and the effect of the heeling will increase with the distance of the upper tube from amidships.

So far as our experience went, we had every reason to be satisfied with the water-log; it answered excellently, and was easy to keep in order. A glance down the engine-room skylight sufficed to tell the ship's speed. Hence, in dredging or trawling the engineer could keep the vessel at the exact rate required. For reducing observations of the wind's direction and velocity to their true value, the speed of the vessel at the moment of observation has to be found. Now, this we took from the water-log, which accordingly proved an excellent instrument for meteorological work at sea.

Astronomical Observations. — The North-Atlantic Expedition having to cruise in high northern latitudes during the summer season, observations of other celestial bodies than the sun for determining the ship's position were of course out of the question. The altitudes were taken with several sextants, accurately verified; the index-error, too, being determined for each separate observation. The results of comparative observations with different sextants never failed to exhibit satisfactory agreement. Our post of observation was, as a rule, the roof of the roundhouse. Besides myself and the ship's officers, Mr. Petersen and Mr. Grieg, Professor Mohn and Mr. Tornøe also assisted in taking the observations and computing their results. Solar altitudes were taken at all hours of the day; nay, on the last cruise, in 1878, we

Kronometrene stod i et Skab i Arbejdssalonen om Bagbord (Fig, 4, c). De blev optrukne hver Morgen og derpaa indbyrdes sammenlignede.

I 1876 havdes 3 Kronometre ombord, et af Kullberg, et af Mewes og et af Frodsham. Det første, der ved den paa Bergens Observatorium af Hr. Åstrand foretagne Undersøgelse før Rejsen viste den jevneste Gang, blev benyttet som Hoveduhr.

I 1877 og 1878 havdes 4 Kronometre ombord, nemlig foruden de 3 nævte. et af Reid, der var Skibet tilhørende. Dette Kronometer viste en saa fortræffelig jevn Gang, at det benyttedes som Hoveduhr de 2 sidste Aar.

Kronometrenes Stand blev bestemt, først paa Bergens Observatorium (undtagen Reid) og senere hovedsagelig ved de telegrafiske Tidssignaler fra Christiania. Disse Signaler gives fra Observatoriet i Christiania hver Onsdag Morgen Kl. 8 Formiddag og hver Søndag Morgen Kl. 9 Form., *Greenwich* Middeltid, til samtlige norske Telegrafstationer. Signalerne gives paa Observatoriet direkte efter Normalpendelen. Der telegraferes hver Gang 3 Signaler, hvert bestaaende af et enkelt Slag fra Nøglen paa Morses Telegrafapparat, nemlig $7^h\ 59^m\ 0^s$, $8^h\ 0^m\ 0^s$ og $8^h\ 1^m\ 0^s$ om Onsdagen og $8^h\ 59^m\ 0^s$, $9^h\ 0^m\ 0^s$ og $9^h\ 1^m\ 0^s$ om Søndagen. For at skille mellem Signalerne betegnes de henholdsvis med 1, 2 og 3 dobbelte Slag strax efter Signalet. Paa Modtagelsesstationen, hvor man indfinder sig med sit Kronometer eller Observationsuhr, høres Signalerne kort og skarpt paa Morses Apparat.

Ved 15 Par korresponderende Solhøjder paa Husø (4° 36′ 57″ øst f. Greenwich) fandt Prof. Mohn den 10de Juni 1876 Kronometret Kullberg $0^h\ 38^m\ 43.3^s$ foran Greenwich Middeltid.

Under Expeditionens Ophold i Reykjavik toges af Lieutn. Petersen og mig den 1ste August 1876 14 Par korresponderende Solhøjder paa en Plads, der ligger omtrent 200 Alen østenfor Kirken. Ifølge velvillig Meddelelse fra Chefen for det Kgl. Danske Søkaart-Archiv, Hr. Kommandør *Rothe,* er, ifølge saavel ældre som nyere Iagttagelser, Længden af et Punkt, der ligger 600 Alen vestenfor Kirken

21° 54′ 46″ W. Greenwich.

Vor Observationsplads ligger saaledes ca. 800 Alen øst for dette Punkt, hvilket, da Bredden er 64° 9′, svarer til 38″ i Længde, og Længden af vor Observationsplads bliver saaledes 21° 54′ 8″ W. Greenwich eller i Tid:

	$1^h\ 27^m\ 36.^s5$	
Kronometrets Stand for Stedets Middeltid fandtes	$2^h\ 6^m\ 55.^s7$	foran
altsaa dets Stand for Greenwich Middeltid	$0^h\ 39^m\ 19.^s2$	foran

frequently observed the sun at midnight. The days on which no observations could be taken were very few indeed.

The *Chronometers* we kept in a cupboard in the workroom, on the port side (Fig. 4, c). They were wound up every morning, and duly compared.

On the first cruise, in 1876, we had 3 chronometers, — one by Kullberg, one by Mewes, and one by Frodsham. That by Kullberg, which, previous to the departure of the Expedition, Mr. Åstrand, Director of the Bergen Observatory, had found to have the most uniform rate of the three, was our principal timekeeper in 1876.

In 1877 and 1878 there was a fourth chronometer, one of Reid's, belonging to the ship. This instrument having a remarkably uniform rate, we made it our chief timekeeper on the two last cruises.

The error of each chronometer was first determined at the Bergen Observatory (saving that of the Reid), and afterwards chiefly by comparison with the time-signals telegraphed from Christiania. The observatory of that city transmits these signals every Wednesday morning at 8 a. m. and every Sunday morning at 9 a. m., *Greenwich* mean time, to all Norwegian telegraph-stations. The time is taken at the observatory direct from the standard-clock. Three separate time-signals, each consisting of a single click, are telegraphed, from the key of Morse's apparatus, at intervals of one minute, viz.: — Wednesdays, at $7^h\ 59^m\ 0^s$, $8^h\ 0^m\ 0^s$, and $8^h\ 1^m\ 0^s$; Sundays, at $8^h\ 59^m\ 0^s$, $9^h\ 0^m\ 0^s$, and $9^h\ 1^m\ 0^s$. To distinguish between the signals, they are respectively indicated by double clicks, 1, 2, and 3, following after the signal in the order of succession. At the receiving station, where the observer stands by with his chronometer or hack-watch in hand, the signals come sharp and distinct from Morse's apparatus.

From 15 pairs of equal solar altitudes, taken at Husø (long. 4° 36′ 57″ E.) on the 10th of June 1876, Professor Mohn found the error of Kullberg's chronometer, on Greenwich mean time, to be $0^h\ 38^m\ 43.^s3$ fast.

During the stay of the Expedition at Reykjavik, Lieutenant Petersen and myself took 14 pairs of equal solar altitudes, at a point about 140 yards east of the cathedral. From information kindly furnished by Commodore *Rothe,* Hydrographer to the Royal Danish Navy, it appears that the longitude of a point 410 yards west of the church, has been found, by earlier as well as recent observations, to be —

21° 54′ 46″ W.

Our post of observation was thus about 550 yards east of this point, which corresponds, the latitude being 64° 9′, to 38″ in longitude. Hence, our post of observation was in

Longitude 21° 54′ 8″ W., or in time	$1^h\ 27^m\ 36.^s5$	
Error of chronometer on mean time of place	$2^h\ 6^m\ 55.^s7$	fast;
therefore on Greenwich mean time	$0^h\ 39^m\ 19.^s2$	fast.

I nedenstaaende Tabeller er givet en Oversigt over Hovedkronometrets Stand og Gang under vor Expedition.

1876. Kronometer Kullberg.

Dag.	Stand foran Gr. Middelt.	Daglig Acceleration.	Sted.
Mai 30	$0^h\ 38^m\ 37.^s8$	0.^{s}66	Bergens Observatorium.
Juni 10	38 43. 3	0. 50	Husø. Corr. Højder.
Juni 26	38 59. 6	1. 02	Kristiansund. Tel. Sig.
Aug. 1	39 19. 2	0. 54	Reykjavik. Corr. Højder.
Aug. 20	39 33. 6	0. 76	Namsos. Tel. Sig.

Sammenstilles de Værdier af Kronometrets Stand, som er benyttede ombord, med de som følger af Tabellens Tal ved ligefrem Interpolation, saa finder man, at den største Forskjel falder den 22de Juli, da den brugte Stand er $39^m\ 21^s$ og den efter Tabellen fundne $39^m\ 14^s$. Forskjellen er 7^s i Tid eller 1.′75 i Bue af Parallelgraden. Da Bredden her var mellem 63° og 64°, bliver Fejlen i Storcirkelbue 0.′78, en saa liden Størrelse, at vi i vore Opgaver over Skibets (Stationernes) paaværende Plads har beholdt de under Rejsen bestemte Værdier af Bredder og Længder. Den næststørste Afvigelse mellem den benyttede og beregnede Værdi af Kronometrets Stand findes den 13de August, da den er -5^s, hvilket svarer til en Afstand af 0.6 Kvartmil.

1877. Kronometer Reid.

Dag.	Stand efter Gr. Middelt.	Daglig Retardation.	Sted.	
Maj 23	$0^h\ 7^m\ 23.^s0$	0.^{s}90	Bergen.	Tel. Sig.
Juni 24	7 54. 0	0. 97	Bodø.	do.
Juli 11	8 10. 0	0. 94	Tromsø.	do.
Juli 22	8 21. 2	1. 02	Tromsø.	do.
Aug. 12	8 39. 5	0. 86	Bodø.	do.

Ved Ankomsten til Bodø den 23de Juni var den beregnede Stand af Kronometret $7^m\ 51^s$, og den af Verifikationen den følgende Dag udledede $7^m\ 53^s$, altsaa en Forskjel af 2^s, der paa 67° Bredde svarer til en Afstand af 0.2 Kvartmil. Ved Tilbagekomsten fra Jan Mayen beregnedes Observationerne ombord den 9de August udenfor Lofoten med en Kronometerstand af $8^m\ 39^s$. Den efter Verifikationen i Bodø den 12te August bestemte Stand er $8^m\ 36.^s7$. Forskjellen, 2.^{s}3, svarer til en Afstand af 0.2 Kvartmil.

1878. Kronometer Reid.

Dag.	Stand efter Gr. Middelt.	Daglig Retardation.	Sted.	
Juni 23	$0^h\ 15^m\ 4.^s5$	1.^{s}00	Hammerfest.	Tel. Sig.
Juli 10	15 19. 0	0. 85	do.	do.
Juli 28	15 36. 5	0. 97	do.	do.
Aug. 28	16 6. 8	0. 98	Tromsø.	do.

Dén 7de Juli, da sidste Observation toges Dagen før Tilbagekomsten til Hammerfest paa første Tur, regnedes

In the following Tables are set forth the error and rate of our chief chronometer.

1876. Kullberg's Chronometer.

Date.	Chron. Fast on G. M. T.	Gaining daily.	Place.
May 30	$0^h\ 38^m\ 37.^s8$	0.^{s}66	Bergen Observatory.
June 10	38 43. 3	0. 50	Husø. Equ. Altit.
June 26	38 59. 6	1. 02	Christiansund. Tel. Sig.
Aug. 1	39 19. 2	0. 54	Reykjavik. Equ. Altit.
Aug. 20	39 33. 6	0. 76	Namsos. Tel. Sig.

By comparing the assumed values of the error of the chronometer with those deduced, by simple interpolation, from the figures in the Table, the greatest difference is found to have occurred on the 22nd of July, the assumed error having been $39^m\ 21^s$ as against $39^m\ 14^s$, the error determined from the Table, — a difference of 7^s in time, or 1.′75 in arc of parallel of latitude. The latitude was between 63° and 64°, which reduces the error, in arc of great circle, to 0.′78, an error so small that we did not hesitate, when recording the position of the ship, to retain the latitudes and longitudes determined on the cruise. The next greatest difference between the observed and computed error occurred on the 13th of August; it was 5^s, which corresponds to 0.6 of a nautical mile.

1877. Reid's Chronometer.

Date.	Chron. Slow by G. M. T.	Losing daily.	Place.	
May 23	$0^h\ 7^m\ 23.^s0$	0.^{s}90	Bergen.	Tel. Sig.
June 24	7 54. 0	0. 97	Bodø.	do.
July 11	8 10. 0	0. 94	Tromsø.	do.
July 22	8 21. 2	1. 02	Tromsø.	do.
Aug. 12	8 39. 5	0. 86	Bodø.	do.

On our arrival at Bodø, June 23rd, the computed error of the chronometer was $7^m\ 51^s$, whereas the error found next day by verification amounted to $7^m\ 53^s$, making a difference of 2^s, which, on the 67th parallel of latitude, corresponds to a distance of 0.2 of a nautical mile. When returning from Jan Mayen, observations taken on the 9th of August, off Lofoten, were calculated with an assumed error of $8^m\ 39^s$. The error found by verification at Bodø on the 12th of August was $8^m\ 36.^s7$. The difference, 2.^{s}3, corresponds to 0.2 of a nautical mile.

1878. Reid's Chronometer.

Date.	Chron. Slow by G. M. T.	Losing daily.	Place.	
June 23	$0^h\ 15^m\ 4.^s5$	1.^{s}00	Hammerfest.	Tel. Sig.
July 10	15 19. 0	0. 85	do.	do.
July 28	15 36. 5	0. 97	do.	do.
Aug. 28	16 6. 8	0. 98	Tromsø	do.

For our last observation on the first cruise of the Expedition, taken July 7th, the day before returning to

ombord med Kronometerstanden 15^m 18.^{s}8. Efter Verifikationen den 10de i Hammerfest skulde Standen være 15^m 16.^{s}4. Forskjellen, 2.^{s}4 svarer, da Bredden var 72°, til en Afstand af 0.18 Kvartmil.

Den 24de Juli, da Expeditionen kom tilbage til Hammerfest fra den anden Tur, regnedes ombord med Kronometerstanden 15^m 31^s. Den efter Signalerne den 28de Juli korrigerede Stand er 15^m 32.^{s}6. Forskjellen, 1.^{s}6, svarer, da Bredden er 73°, til en Afstand af 0.12 Kvartmil.

Den 24de August, da sidste Observation toges paa. Tilbagerejsen fra Spidsbergen til Tromsø, regnedes Standen af Kronometret ombord til 16^m 2.^{s}0. Efter Verifikationen den 28de i Tromsø skulde den være 16^m 3.^{s}0. Forskjellen, 1.^{s}0, svarer, da Bredden var 74$^1/_2$°, til en Afstand af 0.06 Kvartmil.

Tager man Hensyn til Usikkerheden af Størrelsen af Kimmingdalingen — vi regnede med en konstant Værdi for alle fra Hyttedækket tagne Solhøjder — der beror paa Horizontalrefraktionen, og til Virkningen af Irradiation til at gjøre den iagttagne Solradius mere eller mindre for stor, eftersom Solbilledet ses mere eller mindre lyst, kan vel den sandsynlige Fejl af en paa Søen maalt Solhøjde neppe sættes under ± 1′. Da i Regelen nedre Solrand maaltes, gjør Irradiationen de maalte Højder for smaa, Bredderne for store ved Middag, for smaa ved Midnat, Timevinklerne for store paa Vestsiden, for smaa paa Østsiden, østlige Længder for store paa Vestsiden, for smaa paa Østsiden, vestlige Længder for smaa paa Vestsiden, for store af Observationer paa Østsiden.

Saa ofte Anledning gaves, og det paa ganske faa Undtagelser nær i Regelen hver Dag, og særlig ved Ankomsten til en Arbejdsstation, korrigeredes Bestikket ved Observationerne. Disse beregnedes altid (undtagen Meridianhøjder) med 2 vilkaarlige Bredder eller, naar de var nær Meridianen, med 2 vilkaarlige Længder. Nautical Almanacs Tabeller benyttedes. Stedlinien blev afsat i Kartet som en ret Linie mellem de 2 saaledes bestemte Punkter. Ved Hjælp af den imellem 2 Observationer udsejlede Kurs og Distance bestemtes den paaværende Plads i hver af Stedlinierne. Stationernes Bredde og Længde bestemtes saaledes af mig og indførtes i Loddejournalen. Bestik og Observationer svarede i Regelen meget godt. Under Skrabning og Trawling blev vi imidlertid altid sat ud af Bestik, da det var vanskeligt at holde Rede paa Kurser og udløbne Distancer under disse Manøvrer.

Efter det ovenfor anførte om vore Kronometres Gang og om den sandsynlige Fejl af en maalt Solhøjde fremgaar det, at vore Værdier for Stationernes Bredde og Længde har en sandsynlig Fejl af mellem 1 og 2 Minuter. For den største Dels Vedkommende overstiger Fejlen ikke synderlig 1 Minut.

Hammerfest, we assumed the error of the chronometer to be 15^m 18.^{s}8. From the verification at Hammerfest on the 10th, it was found to have been 15^m 16.^{s}4. The difference, 2.^{s}4, corresponds on the 72nd parallel of latitude to 0.18 of a nautical mile.

When returning to Hammerfest on the second cruise, we assumed the error of the chronometer for an observation taken July 24th to be 15^m 31^s. Corrected at Hammerfest on the 28th by comparison with the time-signals, it proved to have been 15^m 32.^{s}6. The difference, 1.^{s}6, corresponds, in latitude 73°, to 0.12 of a nautical mile.

On the 24th of August, when returning from Spitzbergen to Tromsø, we assumed the error of the chronometer to be 16^m 2.^{s}0. Verified at Tromsø on the 28th, it was found to have been 16^m 3.^{s}0. The difference, 1.^{s}0, corresponds, in latitude 74° 30′, to 0.06 of a nautical mile.

If we consider the difficulty of determining the dip of the horizon, — a constant value was assumed for all solar altitudes taken from the roof of the roundhouse, — depending as it does on horizontal refraction, and also take into account the effect of irradiation in magnifying to a greater or less extent the diameter of the sun, according as the solar disk appears more or less luminous to the eye of the observer, the probable error of a solar altitude taken at sea can hardly be put at less than ± 1′. The altitude of the lower limb having as a rule been observed, the effect of irradiation would make the measured altitude too low, the latitude too high at noon, too low at midnight, the hour-angles too great west, too small east, the results for longitude east too high on the west side, too low on the east side, for longitude west too low on the west side, too high on the east.

Whenever opportunity offered, which, as a rule, was almost every day, and in particular on arriving at a sounding-station, we corrected our dead-reckoning by means of observations. These were always computed (excepting only meridional altitudes) with two optional latitudes, or, when taken near the meridian, with two optional longitudes. The Tables used were those of the Nautical Almanac. The line of equal altitudes was marked out on the chart as a straight line between the two points thus determined. The ship's position on each of the lines of equal altitudes was computed from the course and the distance run between the observations. I thus determined the latitude and longitude of the observing-stations, and entered the results in the sounding-journal. The dead-reckoning and the observations exhibited in general satisfactory agreement. Meanwhile, we were invariably out of our reckoning after working the dredge or trawl; to calculate the day's work correctly is next to impossible with such operations in hand.

From what has been stated above concerning the rate of our chronometers and the probable error of an observed solar altitude, it is evident that the values for the latitude and longitude of the observing-stations will have a probable error of from 1 to 2 minutes. For the greater part of them, the error will not much exceed a minute.

Der findes imidlertid blandt vore Stationer nogle, hvor Usikkerheden af den paaværende Plads gaar op til 5 à 6 Minuter, nemlig udenfor den nordvestlige Del af Spidsbergen, nordenfor 78° Bredde. Efterat den paaværende Plads var bestemt ved Solobservationer saavel Formiddag som Eftermiddag, viste det sig, da vi fik Land i Sigte, at Resultatet af Pejlinger af Nordpynten af Pr. Charles Foreland gav en 5′ til 6′ sydligere Plads end Solobservationerne. Men Aarsagen viste sig ogsaa i en stærk Hildring, der krævede en anden Værdi for Kimmingdalingen end den normale, som var benyttet. Under saadanne Forhold er paaværende Plads umulig at bestemme med vanlig Nøjagtighed efter Solobservationer, selv om man laa for Anker og observerede Højder i alle Azimuther, thi Horizontalrefraktionen vil variere med Retningen og med Dagstiden paa en ganske uperiodisk Maade, der er umulig at bringe i Regning. Et lignende Exempel paa Virkningen af Hildring havde vi om Morgenen den 10de August 1877 udenfor Lofoten. Maaling af Horizontalvinkler mellem kjendte Punkter gav Fartøjet en paaværende Plads, der laa i en betydelig Afstand fra den Stedlinie, som en over den østlige, falske Horizont maalt Solhøjde gav.

Til Slutning skal jeg nævne, at Expeditionen var udrustet med Apparater til at maale Strøm i Overfladen og paa Dybet. Disse kom ikke til Anvendelse, først fordi Vejret det første Aar var saa særdeles ugunstigt, og senere fordi de andre Arbejder, som skulde udføres, krævede al vor Tid og ikke turde forsinkes af Operationer, om hvilke det altid maatte være tvivlsomt, hvorvidt noget brugbart Resultat kunde erholdes. Bestemmelser af Strømmen i Overfladen efter den almindelige nautiske Methode lod sig ikke, undtagen i yderst faa Tilfælde, udføre paa vor Expedition, da Sejladsen under Skrabning, som nævnt, umuliggjorde et skarpt Bestikhold.

Meanwhile, for some of our observing-stations, the possible error of the ship's position amounts to from 5 to 6 miles, viz. those off the north-western extremity of Spitzbergen, in latitude from 78° to 80° N. After determining the ship's position by observations of the sun's altitude, taken before as well as after noon, we found, on sighting land, the bearing of the northern promontory of Prince Charles' Foreland to give a point from 5 to 6 miles farther south than that determined by the solar altitudes. This, however, was obviously the result of mirage; and hence our constant value for the dip of the horizon would not serve. Under such circumstances it is impossible, were the ship at anchor even and the altitudes observed in all azimuths, to determine her position with the usual accuracy by observations of the sun, since the horizontal refraction according to the direction and the time of day will not vary periodically, and its true value cannot be taken into account. A similar instance of the effects of mirage occurred on the morning of the 10th of August 1877, off Lofoten. By measuring horizontal angles between known objects, we found the ship's position to be a considerable distance from the line of equal altitudes marked out from observations of the sun above the eastern delusory horizon.

Finally, I must not omit to mention that the Expedition was provided with instruments for determining both surface and deep-sea currents. These apparatus, however, were not made use of, — at first owing to the very unfavourable weather we encountered on the opening cruise, and afterwards to avoid impeding the chief exploratory work by operations from which it was anything but certain that practical results would be obtained. Nor had we, save in a very few cases, opportunity of determining the surface-current in the usual nautical way, the effect of dredging and trawling, as stated above, inevitably putting us out of our reckoning.

Translated into English by **John Hazeland.**

DEN NORSKE NORDHAVS-EXPEDITION

1876—1878.

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H. MOHN.

2. MAGNETISKE OBSERVATIONER.

C. WILLE.

3. GEOGRAFI OG NATURHISTORIE.

MED 6 FARVETRYKTE BILLEDER, 13 TRÆSNIT OG 2 KARTER.

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CHRISTIANIA.
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1882.

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H. Mohn. Astronomiske Observationer til Tids- og Stedsbestemmelse.

De i denne Afhandling meddelte astronomiske Observationer gjordes under Expeditionens Ophold i Havn væsentlig med det Maal for Øje at tjene til Grundlag for de Tids- og Azimuthbestemmelser, der udfordredes til de magnetiske Iagttagelser. Ved Siden deraf tilsigtedes ogsaa Bredde- og Længdebestemmelser, der kunde være af geografisk Interesse, som paa Jan Mayen og Spidsbergen. Den gunstige Lejlighed, som de gjennem Telegrafen givne Tidssignaler frembød til Verification af Længden af Punkter paa Kysten af det nordlige Norge, ønskede jeg ogsaa at benytte efter Lejligheden.

Observationerne ere Solhøjder, maalte med Sextant. Af Bestyreren for det astronomiske Observatorium i Christiania, Professor C. Fearnley, fik jeg udlaant en Observatoriet tilhørende Sextant af Troughton, med Kviksølvhorizont og Stativ, det samme Instrument, som Hansteen benyttede paa sin Rejse i Sibirien i Aarene 1828—1830. I Brugen af Instrumentet modtog jeg selv Prof. Hansteens Vejledning paa Observatoriet i 1861. Paa Sextanten aflæses ved Nonien directe 10″. Ved samtlige Observationer benyttedes den lange Kikkert med ca. 10 Ganges Forstørring. Glastaget over Kviksølvhorizonten prøvede jeg, paa Røst, ved at stille det foran Kikkerten paa en Theodolith, der var indstillet paa en god Mire (et Kirkespir); Virkningen af en prismatisk Form af Glassene var saagodtsom umerkelig, og kan neppe udgjøre et Par Sekunder.

Saagodtsom alle de her meddelte Observationer ere gjorte med dette Instrument. Under Jan Mayen observeredes fra Skibsborde ogsaa med et Par andre Sextanter.

Af Uhre havdes i 1876 ombord 3 Boxchronometre, af Kullberg, Frodsham og Mewes samt et Lommechronometer, foruden almindelige Lommeuhre, hvoraf et mig tilhørende Duplexuhr. I 1877 og 1878 havde vi foruden de nævnte Uhre et Boxchronometer af Reid og i 1878 havde

H. Mohn. Astronomical Observations for determining Time, Latitude and Longitude.

The astronomical observations set forth in this Memoir were made during our stay in certain of the harbours at which the Expedition touched, — chiefly to serve as a basis of the time and azimuth determinations required for the magnetical observations. A secondary object lay in performing, if possible, divers latitude and longitude determinations that might prove of geographical interest, as, for instance, on the islands of Jan Mayen and Spitzbergen. Moreover, of the excellent opportunity afforded by the telegraph time-signals to verify the longitude of points on the northern line of the Norway coast, I was specially desirous of taking advantage.

The observations are solar altitudes, measured with the sextant. On application to Professor C. Fearnley, Director of the Astronomical Observatory at Christiania, he kindly lent me a sextant belonging to that establishment, one of Troughton's, furnished with a mercury-horizon and stand, — the identical instrument used by Hansteen on his travels in Siberia (1828—1830). In the use of the instrument Hansteen had himself given me the necessary instructions, at the Observatory, in 1861. The vernier reads 10 seconds. For all the observations, the long telescope, magnifying about 10 diameters, was exclusively used. The glass covering the mercury-horizon I tested at Røst, by placing it in front of the telescope of a theodolite directed to a good mark (a church steeple). The effect resulting from a slightly prismatic form in the glasses was well-nigh inappreciable, amounting as it did to hardly a couple of seconds.

Almost all of the observations were made with this instrument, a very few only having been taken on board with other sextants, off the coast of Jan Mayen.

Of time-keepers, we had on the first cruise, in 1876, 3 box-chronometers, made respectively by Kullberg, Frodsham, and Mewes, and a pocket-chronometer, exclusive of watches, one of which — that belonging to myself — was a duplex lever. In 1877 and 1878, we had in addition a

jeg til Observationsuhr et Lommechronometer, der var prøvet paa Observatoriet i Neufchatel.

Boxchronometrene havde sin Plads ombord i et Skab i Arbeidssalonen. De bleve hver Morgen optrukne og sammenlignede indbyrdes. I 1876 tjente Kullberg som Hoveduhr og i 1877 og 1878 Reid. Kun Hoveduhret har været benyttet til Længdebestemmelserne, da det viste sig at have en meget jevnere Gang end de øvrige. Under Rejserne blev det af de daglige Sammenligninger constateret, at der ikke indtraf nogen merkelig Forrykkelse i Hoveduhrets daglige Gang.

Ved Observationer paa Land eller paa Dæk benyttedes saagodtsom uden Undtagelse et af de andre Boxchronometre eller et Lommechronometer, stundom ogsaa et almindeligt Lommeuhr. I ethvert Tilfælde blev Observationsuhret sammenlignet med Hoveduhret før og efter Observationerne.

Før Expeditionen tiltraadte sine Rejser, bleve Boxchronometrene, med Undtagelse af Reid, daglig sammenlignede med Pendeluhret paa Observatoriet i Bergen af dettes Bestyrer, Hr. Åstrand. Under Expeditionens Ophold i norske Havne blev deres Stand for Greenwich Middeltid bestemt ved de fra Observatoriet i Christiania gjennem Telegrafen givne Tidssignaler. Disse gives hver Søndag og hver Onsdag Morgen. Signalapparatet (Morse's) staar lige ved Siden af Observatoriets Normalpendel. Der gives hver Gang 3 Signaler, nemlig $8^h\ 59^m\ 0^s$, $9^h\ 0^m\ 0^s$ og $9^h\ 1^m\ 0^s$ Greenwich Middeltid om Søndagene og $7^h\ 59^m\ 0^s$, $8^h\ 0^m\ 0^s$ og $8^h\ 1^m\ 0^s$ om Onsdagene. Tidssignalet, der høres meget skarpt paa Modtagelsesstationens Morse-Apparat, bestaar i et enkelt Slag. For at skille mellem de 3 Signaler slaaes efter det første 1 Dobbeltslag, efter det andet 2 og efter det 3die Signal 3 Dobbeltslag. Signalerne sendes til alle norske Telegrafstationer.

Med Hensyn til Nøjagtigheden af de i det Følgende givne Tids-, Længde og Bredde-Bestemmelser maa jeg bemerke Følgende:

Den af Beregningerne udledede sandsynlige Fejl af en enkelt observeret Højde (paa Land med Stativ og Kviksølvhorizont) er omkring $\pm\ 5''$. Der er imidlertid, som det paa sit Sted skal vises, Tegn til, at der, foruden de egentlige tilfældige Observationsfejl, optræder constante Fejl, hvis Aarsag kunne ligge i forskjellige Omstændigheder, som i Bestemmelsen af Indexfejlen, mangelfuld Justering af Instrumentet, Excentricitet m. m. Hvad Indexfejlen angaar, da er den i Regelen bestemt samtidig med Observationerne og ved gjennemsnitlig 4 Satser Dobbeltcontacter af Solrenderne. Middelfejlen af Resultatet af en enkelt Sats finder jeg at være $\pm\ 5''.7$ og Middelfejlen for en Bestemmelse af Indexfejlen skulde saaledes være $\pm\ 2''.85$. Instrumentet holdtes altid godt justeret og om Excentricitet af nogen merkelig Virkning nævner Prof. Hansteen ikke Noget. Ved Observationerne i Hammerfest (Fuglenes) og i Bodø antydes imidlertid Tilstedeværelsen af constante Feil i Højden af respektive $+8''$ og $-8''$. En Del heraf kunde

box-chronometer by Reid, and in the latter year I took observations with a pocket-chronometer, tested at the Observatory of Neufchatel.

The box-chronometers were kept in a cupboard in the work-room. They were wound up every morning and duly compared. In 1876, Kullberg's served as chief time-keeper, in 1867 and 1878 that by Reid. For determinations of longitude, exclusive use was made of the chief time-keeper, its rate having proved much more uniform than that of the other chronometers. On each cruise the result of the daily comparison showed that no appreciable disturbance had occurred in the diurnal rate of the chief time-keeper.

For observations on shore, or from the deck of the vessel, we used almost without exception one of the other box-chronometers, or a pocket-chronometer, nay sometimes a watch. The chronometer or watch, whichever it might be, was, however, invariably compared with the chief time-keeper both before and after the observations.

Previous to the departure of the Expedition on its several cruises, the box-chronometers, with the exception of Reid's, were daily compared with the standard-clock of the Bergen Observatory, by the Director, Mr. Åstrand. During the stay of the Expedition at Norwegian ports, their error on Greenwich mean time was determined by the time-signals telegraphed from the Observatory at Christiania. These signals are sent every Sunday and Wednesday morning. The signalling apparatus (Morse's) stands close beside the standard-clock of the Observatory. Three signals are given, viz. at $8^h\ 59^m\ 0^s$, $9^h\ 0^m\ 0^s$, and $9^h\ 1^m\ 0^s$, Greenwich mean time, on Sundays, and at $7^h\ 59^m\ 0^s$, $8^h\ 0^m\ 0^s$ and $8^h\ 1^m\ 0^s$ on Wednesdays. Each signal, distinctly delivered by the apparatus of the receiving-station, consists of a single click. As a means of readily distinguishing between the 3 signals, the first is followed by a double-click, the second by 2 double-clicks, and the third by 3. These signals are transmitted to all Norwegian telegraph-stations.

As regards the accuracy of the observations for determining time, latitude, and longitude, I must observe as follows: —

The computed probable error of a single observed altitude (using on shore the sextant with a stand and mercury-horizon) is about $\pm\ 5''$. Meanwhile, there is reason to believe, as will afterwards appear, that, apart from the accidental errors of observation, certain constant errors occur, arising probably from various sources, such as the determination of the index-error, imperfect adjustment of the instrument, excentricity, &c. With regard to the index-error, this has usually been determined when taking the observations, and on an average from 4 sets of double contacts of the solar limbs. The mean error of the result of one double contact I found to be $\pm\ 5''.7$, and the mean error of the determination of the index-error should accordingly have been $\pm\ 2''.85$. The instrument was always kept well adjusted, and of excentricity that could have any appreciable effect, Hansteen says nothing whatever. Meanwhile, the observations taken at Hammerfest (Fuglenes) and at Bodö indicate the existence of constant errors in the

muligens tilskrives Ujevnhed i Chronometrets Gang, men saameget bliver tilbage som Fejl i Højderne, at jeg anser det rigtigst at antage, at mine Højder, med et rundt Tal, kunne være beheftede med en sandsynlig constant Fejl for hver Station af $\pm$ 10″.

Paa den Nøjagtighed, hvormed Observationsuhret angiver Greenwich Middeltid, har jeg søgt at faa et Maal ved følgende Overslag:

Observationsuhrets Sammenligning med Hoveduhret. Der toges flere Sammenligninger før og efter Højdeobservationerne. Af disse finder jeg for 1877, mit Duplexuhr, en sandsynlig Fejl af den anvendte Uhrforskjel af $\pm$ 0.ˢ15 (efter 4 Sammenligninger) og $\pm$ 0.ˢ11 af 4 Sammenligninger før og 4 efter Observationerne. For 1878 finder jeg for Sammenligningen mellem mit Lommechronometer og Chronometer Reid saavel i Søen som i Havn, Middelfejlen af en enkelt Sammenligning $\pm$ 0.ˢ10. I Regelen gjordes 3 Sammenligninger, saaat Middelfejlen ved en Sammenligning før eller efter Højdeobservationerne kan sættes til $\pm$ 0.ˢ06 og af Mediet af begge til $\pm$ 0.ˢ04. Jeg kalder i det følgende denne sandsynlige Fejl D_1 og sætter med et rundt Tal $D_1 = \pm$ 0.ˢ1.

Naar Tidssignal skulde observeres, var Regelen den, at Skibschefen, Capt. Wille, først sammenlignede Observationsuhret, et Lommechronometer, der slog 0.ˢ4, med Hovedchronometret, derpaa gik i Land paa Telegrafkontoret og efter Tilhagekomsten ombord atter tog en Uhrsammenligning. Jeg antager, efter et Skjøn, denne Operations Resultat at have en sandsynlig Fejl af $\pm$ 0.ˢ1, som jeg kalder D_2.

Paa Telegrafkontoret observerede Capt. Wille Tidssignalerne efter Observationsuhret. Den sandsynlige Fejl af Observationen af et enkelt Signal antager jeg at kunne sætte til $\pm$ 0.ˢ2. Da i Regelen neppe mere end 2 af de 3 Signaler kunne antages at blive godt observerede (ved de 2 sidste er man forberedt paa Secundet), sætter jeg den sandsynlige Fejl af Resultatet af Observationen af Tidssignalerne til $\pm$ 0.ˢ15 (D_3). Ved en Lejlighed, da vi begge observerede Tidssignalerne, stemte vor Bestemmelse af Hovedchronometrets Stand paa 0.ˢ1.

Ved Signalets Afsendelse paa Observatoriet i Christiania kan den sandsynlige Fejl, efter Vidnesbyrd fra vedkommende Astronomer, sættes til 0.ˢ15 pr. Signal, $\pm$ 0.ˢ10 pr. 2 Signaler (D_4).

Ligeledes sættes den sandsynlige Fejl af Normalpendelens beregnede Stand for Christiania Stjernetid, corrigeret efter efterfølgende Tidsbestemmelse, til $\pm$ 0.ˢ1 (D_5).

Den sandsynlige Fejl af den nedenfor antagne Tidsforskjel mellem Christiania og Greenwich Observatoriers Meridianer sættes til $\pm$ 0.ˢ2 (D_6).

Ved Længdeberegningerne er forudsat en jevn Gang hos Hovedchronometret mellem de Tidspunkter, da dets

altitude amounting respectively to +8″ and —8″. Some part of this error may perhaps be ascribed to want of uniformity in the rate of the chronometer; but even with this deduction, the remainder is, I think, as an actual error in the altitudes, sufficient to warrant assuming that my solar altitudes may be affected by a probable constant error at each Station of $\pm$ 10″.

Of the precision with which the chronometer used for noting the observations indicates Greenwich mean time, I have sought to find a measure as follows: —

Comparison of the watch or chronometer selected for the observation with the chief time-keeper. Several comparisons were made before and after the observations of altitude. Now, for 1877 (my duplex watch), I find a probable error of the assumed difference of the errors of the time-pieces (4 comparisons) of $\pm$ 0.ˢ15, and with 4 comparisons before and 4 after the observations, of $\pm$ 0.ˢ11. For 1878, I find the mean error of a single comparison between my pocket-chronometer and the box-chronometer by Reid, both at sea and in harbour, to have been $\pm$ 0.ˢ10. The number of comparisons having as a rule been three, the mean error of one comparison before or one after a series of altitudes may be put at $\pm$ 0.ˢ06, and the mean error of two comparisons, one before and one after, at $\pm$ 0.ˢ04. In the sequel I shall call this probable error D_1, and assume $D_1 = \pm$ 0.ˢ1.

The time-signals were generally observed as follows: — Shortly before their arrival, the commander of the vessel, Capt. Wille, compared a pocket-chronometer, beating 0.ˢ4, with our chief time-keeper. He then went on shore to the telegraph-office, observed the signals, and, on his return to the ship, again compared the respective time-pieces. The probable error of these comparisons on board may, I think, be estimated at $\pm$ 0.ˢ1, which I shall call D_2.

At the telegraph-office Capt. Wille observed the time-signals with the pocket-chronometer mentioned above. The probable error of the observation of one signal I have put at $\pm$ 0.ˢ2. Now, as only 2 of the 3 signals, on an average, will be accurately observed (for the 2 last the observer is prepared to the second), I shall estimate the probable error of the result of our observations of the time-signals at $\pm$ 0.ˢ15 (D_3). On one occasion, when both of us (myself and Capt. Wille) observed the time-signals, our determination of the error of the chief chronometer agreed within 0.ˢ1.

According to the estimate of the astronomers of the Christiania Observatory, the probable error of one signal as given with the key at the Observatory may be put at $\pm$ 0.ˢ15, of two signals $\pm$ 0.ˢ10 (D_4).

The probable error of the computed error of the standard clock on Christiania sidereal time, corrected from later transits of stars, is put at $\pm$ 0.ˢ1 (D_5).

The probable error of the difference in time, as given below, between the meridians of the Christiania and Greenwich Observatories, is put at $\pm$ 0.ˢ2 (D_6).

For computations of longitude, the chief chronometer is assumed to have had a uniform rate between the moments

Stand er bestemt ved Tidssignaler. Den sandsynlige Fejl eller Afvigelse fra den absolut jevne Gang sætter jeg, da den midlere Gang hos Chronometret Reid viser sig saa udmerket jevn, til $\pm$ 0.^{s}25 (D_7).

Den galvaniske Strøm, ved hvilken Tidssignalerne gives, gaar ikke directe gjennem alle Stationers Apparater, men sendes ved Overdrag videre fra visse Overdragsstationer. For de Stationers Vedkommende, hvorom her er Spørgsmaal, er der Overdrag i Christiania, Throndhjem, Lødingen og Kistrand. Ved Overdragene lider Signalet en Forsinkelse. Størrelsen af denne fik jeg ved Telegrafdirektør Nielsen's og Telegrafintendant Collett's Velvilje bestemt paa følgende Maade: Strømmen sendtes fra Christiania over Throndhjem til Lødingen og tilbage til Christiania ad to forskjellige Traade med 3 Overdrag paa Vejen. Det med en Nøgel givne Signal kom igjen og hørtes paa et ved Siden af Afsendelsesapparatet staaende Apparat. Naar jeg signalerede med Nøglen i Takt og Coincidents med mit Lommechronometer, hørtes det tilbagekommende Signal midt imellem de med Nøglen givne Signaler. Da mit Uhr slaar 4 Tiendedels Secunder, var Signalets Forsinkelse 0.^{s}20 for 3 Overdrag. Sættes Forsinkelsen lige stor for hvert Overdrag, bliver den 0.^{s}07 for hvert, og altsaa for 2 Overdrag 0.^{s}14, og for 4 Overdrag 0.^{s}28.

Ved Beregningen af Normalpendelens Angivelse for Signaløjeblikket er gaaet ud fra en Tidsforskjel af $0^h\ 42^m\ 54.^s5$ mellem Christiania og Greenwich. Efter den af Prof. Auwers i Geographisches Jahrbuch für 1880 givne Tabel over de vigtigste Observatoriers Bredde og Længde er den nævnte Tidsforskjel $0^h\ 42^m\ 53.^s8$. Forskjellen mellem de to Tal beror paa de nyere telegrafiske Bestemmelser af Længden af Kjøbenhavns Observatorium, med hvilket Christianias er forbundet chronometrisk. Idet jeg gaar ud fra den nyere Bestemmelse, bliver følgelig Klokkeslettet i Greenwich i Signaløjeblikket 0.^{s}7 større end oprindelig antaget.

Observator Geelmuyden har velvilligen meddelt mig de corrigerede Tidspunkter for Signalernes Afsendelse, der ere beregnede efter Tidsbestemmelser gjorte saavel før som efter Signalernes Afsendelse. Den følgende Tabel viser de efter de oven anførte Correctioner, Strømtid, Længdecorrection og senere Tidsbestemmelser, rettede Signaløjeblikke, som ere observerede under Expeditionen, samt Hovedchronometrenes Stand og Gang.

at which its error was found by the time-signals. The probable error or deviation from a uniform rate, I shall put — the mean rate of the Reid chronometer having proved so remarkably uniform — at $\pm$ 0.^{s}25 (D_7).

The galvanic current by which the time-signals are transmitted, does not reach every station direct, being sent on by relays from certain stations selected for that purpose. As regards the stations at which the time-signals were observed on the Expedition, the relay-stations were at Christiania, Throndhjem, Lödingen, and Kistrand. These breaks occasion some loss of time in transmitting the signal. The approximate extent of the delay I was enabled by the kindness of Mr. Nielsen, Director of Telegraphs, and of Mr. Collett, Electrician, to determine as follows: — The galvanic current was transmitted from Christiania, viâ Throndhjem, to Lödingen, and thence back to Christiania, by two different wires, and broken by three relays. The signal, given with a key, came back, being distinctly delivered from another apparatus, also standing beside the observer. When signalling with the key, its clicks coinciding with the beats of my pocket-chronometer, the returning signal would be heard at the mid-point of the interval between two successive signals given with the key. Now, as my pocket-chronometer beats four-tenths of a second, the delay in transmitting a signal must have been 0.^{s}20 with three relays; hence, with one relay, assuming it equal for each, the delay will be 0.^{s}07, with two relays 0.^{s}14, and with four 0.^{s}28.

In computing the indication of the standard-clock for the moment of the despatch of a signal, the difference in time between Christiania and Greenwich has been put at $0^h\ 42^m\ 54.^s5$. According to the Table furnished by Professor Auwers in Geographisches Jahrbuch for 1880, showing the latitude and longitunde of the chief Observatories, the difference is $0^h\ 42^m\ 53.^s8$. The want of agrement in the respective figures must be ascribed to the late telegraphic determination of the longitude of the Copenhagen Observatory, with which that at Christiania is chronometrically connected. Taking the latter of the two determinations, the assumed Greenwich time at the moment of despatch will require a correction of + 0.^{s}7.

Mr. Geelmuyden, of the Christiania Observatory, has kindly furnished me with the corrected moments for the despatch of the signals, computed from transists observed alike before and after transmission. In the following Table will be found the moments of despatch for the signals observed on the Expedition, corrected for the above-specified errors, viz. the propagation of the current, correction of assumed longitude, and subsquent determinations of clock error — as also the error and rate of the chief chronometers.

Sted. (Place.)	Datum. (Date.)	Greenwich Middeltid. (Greenwich Mean Time) a. m.	Hovedchronometer Corr. til G. M. T. (Standard Chronometer. Corr. to G. M. T.)	Daglig Gang. (Daily Rate.)
Christiansund .	1876 Juni (June) 25	$9^h\ 0^m\ 0.^s0$	$-\ 0^h\ 38^m\ 59.^s6$	$0.^s59$
Namsos . . .	„ Aug. (Aug.) 20	9 0 0. 8	— 0 39 32. 8	
Bergen . . .	1877 Maj (May) 23	8 0 0. 7	+ 0 7 23. 7	0. 97
Bodø	„ Juni (June) 24	9 0 0. 9	7 54. 9	0. 94
Tromsø . . .	„ Juli (July) 11	8 0 0. 9	8 10. 9	0. 87
Tromsø . . .	„ Juli (July) 22	8 59 59. 3	8 20. 5	0. 97
Bodø	„ Aug. (Aug.) 12	9 0 1. 3	8 40. 8	
Hammerfest . .	1878 Juni (June) 23	9 0 1. 0	+ 0 15 5. 5	0. 87
Hammerfest . .	„ Juli (July) 10	8 0 1. 2	0 15 20. 2	0. 96
Hammerfest . .	„ Juli (July) 28	9 0 1. 0	0 15 37. 5	0. 97
Tromsø . . .	„ Aug. (Aug.) 28	8 0 0. 8	0 16 7. 6	

I. Husø.

En liden Ø ved Sognefjordens Munding. Sterk Nordenvind. Observationerne gjordes i Læ af Hr. Lexaus Hus. Efter Kystkartet er Bredden $\varphi = 60^0\ 59.'6$, Længden $\lambda = 4^0\ 37' = 18^m\ 28^s$ E. Greenwich $= 2^m\ 41^s$ W. Bergen. Corresponderende Højder. Chronometer Mewes No. 575. 2h′ = aflæst dobbelt Højde. T_0 ucorrigeret Middag, ΔT_0 Middagscorrection, E. Tidsjevning, MT Middeltid.

I. Husø.

A small island at the mouth of the Sognefjord. Blowing hard from the north. The observations were taken to leeward of Mr. Lexau's house. On the coastal chart, the latitude, φ, is $60^0\ 59.'6$, the longitude, λ, $4^0\ 37' = 18^m\ 28^s$ E. Greenwich $= 2^m\ 41^s$ W. Bergen. Equal altitudes. Chronometer, Mewes No. 575. 2h′ signifies Observed double altitude; T_0 Mean of all chronometer-times; ΔT_0 Equation of equal altitudes; E Equation of time; MT Mean time.

1876. Juni (June) 10.

☉ 2h′	Chron. a. m.	Chron. p. m.	T_0
$89^0\ 30'$	$22^h\ 6^m\ 59.^s5$	$2^h\ 48^m\ 34.^s0$	$0^h\ 27^m\ 46.^s75$
50	8 51. 0	46 44. 0	47. 5
90 0	9 45. 5	45 48. 5	47. 0
10	10 42. 0	44 52. 5	47. 25
20	11 37. 0	43 56. 5	46. 75
30	12 33. 0	43 1. 0	47. 0
40	13 29. 5	42 3. 0	46. 25
50	14 27. 0	41 6. 0	46. 5
91 0	15 25. 5	40 9. 0	47. 25
10	16 22. 5	39 12. 5	47 5
20	17 21. 0	38 12. 5	46. 75
30	18 18. 0	37 14. 5	46. 25
40	19 17. 0	36 17. 9	47. 45
50	20 14. 7	35 19. 0	46. 85
92 0	21 15. 0	34 20. 0	47. 5

$T_0 =$	$0^h\ 27^m\ 46.^s97$
$\Delta T_0 =$	$-\ 4.\ 34$
	0 27 42. 63
E =	47. 32
Mewes foran Husø Middeltid *(Fast on Husø M. T.)* .	0 28 29. 95
Reduction t. *(to)* Bergen	2 41.
Correction t. *(Error on)* Bergen M. T.	$-\ 0^h\ 25^m\ 49.^s$

Maj *(May)* 30	$2.^h55$	Corr. t. *(Error on)*	Bergen	M. T. =		$-0^h\ 24^m\ 44.^s3$
Juni *(June)* 10	0. 45	— „ (— „)	—	„ „ =		— 0 25 49.0
Daglig Acceleration *(Gaining daily)*						$5.^s93$

2. Reykjavik.

Den 1ste August 1876 toges af Capt. Wille og Lieutn. Petersen følgende corresponderende Højder paa den grønne Plæne ved Konsul Simsons Hus. $\varphi = 64^0\ 9.'0$, $\lambda = 1^h\ 27^m\ 36.^s6$ W. Gr. Chronometer Kullberg.

2. Reykjavik.

On the 1st of August, 1876, Capt. Wille and Lieut. Petersen took the following equal altitudes from the grass-plot adjoining Mr. Simson's house. $\varphi = 64^0\ 9.'0$, $\lambda = 1^h\ 27^m\ 36.^s6$ W. Gr. Kullberg's chronometer.

⊙ 2h′	Chron. a. m.	Chron. p. m.	$T_0 + \Delta T_0$
$75^0\ 0'$	$23^h\ 49^m\ 8.^s0$	$4^h\ 36^m\ 10.^s0$	$2^h\ 12^m\ 57.^s75$
10	50 12.5	35 5.5	57.73
20	51 17.5	34 0.0	57.44
30	52 24.5	32 55.0	58.41
40	53 29.5	31 48.0	57.38
50	54 40.5	30 40.5	59.10
76 0	55 45.5	29 31.5	57.08
76 40	0 0 18.5	4 25 1.5	57.96
50	1 26.0	23 52.0	56.43
77 0	2 37.0	22 40.5	57.15
10	3 49.0	21 31.0	58.38
20	4 58.0	20 21.0	57.85
30	6 9.5	19 11.5	58.82
40	7 18.5	17 57.0	56.04
			2 12 57.68 ± 0.s13
		E.:	6 2.06
Chron. Corr. t. *(Error on)*		Reykjavik M. T.	$2^h\ 6^m\ 55.^s62$
— — „ (— „)		Greenwich —	39 21.8
Reykjavik W. Greenwich			$1^h\ 27^m\ 33.^s8$

Sættes $D_1 = 0$, da Hovedchronometret anvendtes til Observationerne, $D_2 = \pm\ 0.^s1$, $D_3 = \pm\ 0.^s15$, $D_4 = \pm\ 0.^s1$, $D_5 = \pm\ 0.^s1$, $D_6 = \pm\ 0.^s2$, $D_7 = \pm\ 0.^s25$, saa bliver den sandsynlige Fejl af den beregnede Længde

Now, putting $D_1 = 0$, the observations having been taken with the chief chronometer; $D_2 = \pm\ 0.^s1$, $D_3 = \pm\ 0.^s15$, $D_4 = \pm\ 0.^s1$, $D_5 = \pm\ 0.^s1$, $D_6 = \pm\ 0.^s2$, $D_7 = \pm\ 0.^s25$, the probable error of the computed longitude will be

$$D_\lambda = \pm \sqrt{(0.^s13)^2 + D_2^2 + D_3^2 + D_4^2 + D_5^2 + D_6^2 + D_7^2} = \pm\ 0.^s41$$

Den af ovenstaaende Observationer beregnede Længde stemmer paa $2.^s7$ med den, der ifølge de Opgaver, som velvillig ere mig meddelte af Commandør Rothe, Directør for det Kongelige Danske Søkaart-Archiv i Kjøbenhavn, efter tidligere Iagttagelser og Beregninger er antaget som den sandsynligste, nemlig $1^h\ 27^m\ 36.^s6$. Observations-

The longitude computed from the observations given above agrees within $2.^s7$ with that which, according to the results kindly furnished me by Commodore Rothe, Hydrographer to the Royal Danish Navy, from former observations and computations, is deemed the most probable, viz. $1^h\ 27^m\ 36.^s6$, the point of observation lying about 38″,

punktet ligger nemlig 38″ eller 2.ˢ5 østenfor det Punkt ved Reykjavik, hvis Længde er antaget at være 21° 54′ 46″ eller 1ʰ 27ᵐ 39.ˢ1.[1]

or 2.ˢ5, east of a point at Reykjavik of which the longitude is assumed to be 21° 54′ 46″, or 1ʰ 27ᵐ 39.ˢ1.[1]

3. Namsos.

Corresponderende Højder. $\varphi = 64^{\circ}\ 28.'2$, $\lambda = 0^{h}\ 46^{m}\ 6^{s}$ E. Greenw. Observationerne gjordes paa Nordsiden af Byen, c. 20 Skridt fra Stranden. Chron. Frodsham.

3. Namsos.

Equal altitudes; $\varphi = 64^{\circ}\ 28.'2$; $\lambda = 0^{h}\ 46^{m}\ 6^{s}$ E. Gr. The observations were taken north of the town, about 20 paces from the shore. Frodsham's chronometer.

1876. August 19.

$\overline{\odot}$ 2h′	Chron. a. m.	Chron. p. m.	$T_0 + \Delta T_0$
72° 50′	22ʰ 7ᵐ 26.ˢ5	0ʰ 54ᵐ 47.ˢ0	23ʰ 31ᵐ 30.ˢ94
73 0	9 14. 5	52 58. 5	30. 67
73 10	11 5. 0	51 7. 0	30. 14
20	13 0. 0	49 12. 5	30. 35
30	15 0. 5	47 20. 5	34. 57
40	16 54. 0	45 19. 0	30. 54
50	18 50. 5	43 21. 0	29. 73
74 0	21 2. 0	41 15. 0	32. 48
10	23 9. 0	39 7. 5	32. 21
			23 31 31. 29 ± 0.ˢ34
		E.	0 3 19. 14
Corr. t. *(Error on)* Namsos M. T.			+ 0 31 47. 85

Den 19de August, 21ʰ 0ᵐ 0.ˢ8 Greenwich M. T., var, ifølge Tidssignal pr. Telegraf, observeret directe efter Frodsham, af Capt. Wille, dette Chronometer 14ᵐ 23.ˢ0 foran Greenwich M. T. Da Chronometret accelerede 5.ˢ12 i 24ʰ, bliver for Signaløjeblikket dets Correction til Namsos Middeltid + 31ᵐ 43.ˢ22, og den af disse Tal resulterende Længde for Namsos

$$\lambda = 0^{h}\ 46^{m}\ 6.^{s}22 \text{ E. Greenwich}$$

med en sandsynlig Fejl af

On the 19th of August, 21ʰ 0ᵐ 0.ˢ8 Greenwich M. T., Capt. Wille found the Frodsham chronometer, with which he observed the time-signals, to be 14ᵐ 23.ˢ0 fast on Greenwich M. T.; and hence, gaining as it did 5.ˢ12 in twenty-four hours, the error on Namsos M. T. for the moment of despatch will be + 31ᵐ 43.ˢ22, and the longitude of Namsos computed from these figures,

$$\lambda = 0^{h}\ 46^{m}\ 6.^{s}22 \text{ E. Greenw.}$$

with a probable error of

$$\pm \sqrt{(0.^{s}34)^2 + D_3^2 + D_4^2 + D_5^2 + D_6^2 + D_7^2} = \pm\ 0.^{s}49$$

Efter det af den geografiske Opmaaling construerede, endnu ikke udgivne, nyeste Kart over disse Egne ligger mit Observationspunkt 0° 46′ 29″ eller 0ʰ 3ᵐ 5.ˢ9 E. Christiania, og skulde saaledes, med den her antagne

[1] Se ogsaa "Geografisk Tidskrift", udgivet af Bestyrelsen for det kongelige danske geografiske Selskab, 4de Bind, 1880, S. 111, 112.

On the latest charts of these regions, constructed by the Geographical Survey but not yet published, my point of observation lies 0° 46′ 29″, or 0ʰ 3ᵐ 5.ˢ9 E. Christiania, and should therefore, with the longitude here assumed

[1] See also "Geografisk Tidskrift," edited by the Directors of the Royal Danish Geographical Society, Vol. 4, 1880, pp. 111, 112.

Længde for Christiania, $0^h\ 42^m\ 53.^s8$, ligge $0^h\ 45^m\ 59.^s7$ E. Greenwich, det er $6.^s5$ vestligere, end min astronomiske Bestemmelse giver. Nogen Grund til denne betydelige Forskjel formaar jeg ikke at angive.

for that place, viz. $0^h\ 42^m\ 53.^s8$, lie $0^h\ 45^m\ 59.^s7$ E. Greenwich, that is, $6.^s5$ farther west than determined by my astronomical observations. Any reason for so considerable a difference I am unable to suggest.

4. Bodø.

Samtidig med at Capt. Wille gjorde magnetiske Observationer, tog jeg den 13de August 1877 en Række Solhøjder paa et Sted nogle hundrede Skridt østenfor den østligste Landgangsbrygge. En Del af Højderne vare correspondérende, en Række var Circummeridianhøjder, og senere om Eftermiddagen toges, med lav Solstand, en kort Række absolute Højder. Til de fleste Observationer benyttede jeg Chronometer Frodsham, men til nogle af Circummeridianhøjderne mit Duplexuhr, hvis Angivelser, efter samtidige Sammenligninger, umiddelbart reduceredes til Frodsham. Dette Chronometer sammenlignede jeg med Normalchronometret Reid Morgen og Aften.

Frodsham	19^h	54^m	$30.^s0$	7^h	0^m	$30.^s0$
Reid	18	50	46. 5	5	56	44. 25
Fr. Corr. t. Reid	— 1	3	43. 5	— 1	3	45. 75

Sextantens Indexfejl fandtes:

Før Middag	+ 1′ 58.″1	± 1.″8	4	Observationer.
Efter Middag	+ 1 50. 3	± 5. 2	4	—
Om Aftenen	+ 1 63. 5	± 1. 7	4	—

Højderne ere beregnede med en Indexfejl af + 1′ 57.″3. indtil Frodsham $12^h\ 10^m\ 55^s$ og de følgende med + 1′ 59.″5.

Efter de ombord gjorte meteorologiske Iagttagelser var

Kl. 8 a. m.	Barometer	770.^{mm}2,	Temperatur	21.^{0}0 C.
„ 2 p. m.	—	69. 8,	—	21. 0
„ 8 p. m.	—	69. 3,	—	16. 0

Efter en foreløbig Beregning fandt jeg som approximative Værdier af Bredden og Længden $\varphi_0 = 67^0\ 17'\ 10''$ og $\lambda_0 = 0^h\ 57^m\ 39.^s6$. Kaldes den af disse Værdier for hvert Observationsøjeblik beregnede Højde af Solens Centrum h_0, den af Observationerne, rettede for Indexfejl, Refraction, Parallaxe og Solradius, fundne Højde h, den sandsynligste Værdi af Bredden og Længden $\varphi_0 + \Delta\varphi$ og $\lambda_0 + \Delta\lambda$, saa giver hver Observation en Ligning af Formen

$$-\cos a\ \Delta\varphi - \cos\varphi \sin a\ \Delta\lambda = h - h_0$$

hvor a er Azimuth. Af samtlige Ligninger udledes ved de mindste Kvadraters Methode de sandsynligste Værdier af $\Delta\varphi$ og $\Delta\lambda$. Denne sidste Beregning er udført af Bestyreren af Bergens Observatorium, Hr. Åstrand, der efter min Anmodning velvillig paatog sig dette Arbejde.

Grupperes Differentserne mellem de observerede og de efter de fundne sandsynligste Værdier for Bredden og

4. Bodø.

Whilst Capt. Wille was engaged in making magnetical observations, I took on the 13th of August, 1877, a series of solar altitudes, from a point a few hundred paces east of the most easterly landing-pier. Part of them were equal altitudes, part (one series) circum-meridian altitudes, and later in the afternoon I took a short series of absolute altitudes. For most of the observations I used the Frodsham chronometer; but for some of the circum-meridian altitudes, my duplex watch, its indications, however, having been immediately compared with, and reduced to, those of the Frodsham. This chronometer I myself compared morning and evening with the Reid, our chief timekeeper.

Frodsham	19^h	54^m	$30.^s0$	7^h	0^m	$30.^s0$
Reid	18	50	46. 5	5	56	44. 25
Fr. Corr. to Reid	— 1	3	43. 5	— 1	3	45. 75

The index-error of the sextant was found to be —

Before Noon	+ 1′ 58.″1	± 1.″8	4	Observations.
After Noon	+ 1 50. 3	± 5. 2	4	—
In the Evening	+ 1 63. 5	± 1. 7	4	—

The altitudes have been computed with an index-error of + 1′ 57.″3 up to $12^h\ 10^m\ 55^s$ Frodsham, and the remainder with an error of + 1′ 59.″5.

The results of the meteorological observations taken on board, were as follows: —

8 a. m.	Barometer	770.^{mm}2,	Temperature	21.^{0}0 C.
2 p. m.	—	69. 8,	—	21. 0
8 p. m.	—	69. 3,	—	16. 0

As approximate values for latitude and longitude, a preliminary computation gave $\varphi_0 = 67^0\ 17'\ 10''$ and $\lambda_0 = 0^h\ 57^m\ 39.^s6$. Now, if the altitude of the sun's centre, computed for each moment of observation from these values, be called h_0, the altitude found from the observations, after correction for the index-error, refraction, parallax, and the sun's semidiameter, h, the probable value of the latitude and longitude, $\varphi_0 + \Delta\varphi$ and $\lambda_0 + \Delta\lambda$, — then each observation will give an equation of the following form —

$$-\cos a\ \Delta\varphi - \cos\varphi \sin a\ \Delta\lambda = h - h_0$$

in which a signifies the azimuth. From all the equations were found, by the method of the least squares, the most probable values of $\Delta\varphi$ and $\Delta\lambda$. This computation was made by Mr. Åstrand, Director of the Bergen Observatory, who at my request kindly undertook the work.

On grouping the differences between the observed altitudes and the altitudes computed from the most pro-

Længden beregnede Højder efter de observerede Solrender, finder man, at i Gjennemsnit give nedre Solrands Observationer Højderne 6.″8 for store, og øvre Solrands 6.″6 for smaa. Den i Beregningen benyttede Solradius, 15′ 59.″5, er saaledes for stor og bør, for at bringes i Overensstemmelse med Observationerne, formindskes til 15′ 52.″8. Beregnes med denne Værdi faar man de nedenstaaende Værdier for Forskjellen mellem observerede og beregnede Højder, hvis Kvadratsum er Minimum.

bable values resulting for the latitude and longitude according to the observed solar limbs, the lower-limb observations are found to give on an average the altitudes 6.″8 too high, the upper-limb 6.″6 too low. Hence, the assumed semidiameter of the sun, — 15′ 59.″5, will be too great, and should, to make it agree with the observations, be reduced to 15′ 52.″8. Computed with these figures, we get the subjoined values for the difference between observed and computed altitudes, the sum of the squares of which is a minimum.

1877. August *(August)* **12—13.**

Chron. Frodsham.	Dobbelt aflæst Højde. *(Double obs. Altitude.)*	Obs. — Ber. Højde. *(Obs. — Calc. Alt.)*	Chron. Frodsham.	Dobbelt aflæst Højde. *(Double obs. Altitude.)*	Obs. — Ber. Højde. *(Obs. — Calc. Alt.)*
21h 26m 35.s0	☉ 62° 40′ 0″	+ 8″	0h 4m 22.s0	☉ 75° 8′ 5″	+ 1″
27 51.5	50 0	— 4	5 40.0	8 5	+ 3
29 8.5	63 0 0	— 19	7 51.0	7 0	— 1
30 23.0	10 0	— 18	9 7.0	6 55	+ 11
31 35.5	20 0	— 9	10 57.0	5 40	+ 2
32 50.0	30 0	— 5	12 2.0	5 0	+ 2
34 4.7	40 0	— 8	13 8.0	4 35	+ 13
35 22.5	50 0	+ 8	14 12.0	3 20	— 5
36 35.5	64 0 0	+ 3	15 16.0	2 20	— 5
21 38 44.5	☉ 65 20 0	— 8	0 21 14.0	☉ 73 52 50	— 3
40 4.0	30 0	— 14	22 55.0	50 40	— 4
41 23.0	40 0	— 17	25 9.0	47 20	— 10
42 42.0	50 0	— 17	26 26.0	45 20	— 15
44 1.5	66 0 0	— 16	27 21.0	44 15	— 4
45 19.5	10 0	— 11	28 12.0	42 55	— 4
46 40.0	20 0	— 8	29 25.0	41 0	— 1
48 1.0	30 0	— 7	30 25.0	39 0	— 11
49 23.0	40 0	— 7	31 24.0	37 20	— 6
23 17 52.0	☉ 74 10 0	+ 9	0 36 27.0	☉ 74 31 5	— 13
19 47.0	14 30	— 14	37 33.0	28 40	0
20 51.0	18 15	+ 20	38 32.0	26 30	— 1
21 47.0	20 0	+ 5	39 25.0	24 20	— 4
22 33.0	22 0	+ 7	40 22.0	22 0	— 7
23 33.0	24 20	+ 8	41 18.0	20 0	0
24 25.0	26 30	+ 13	42 18.0	18 15	+ 14
25 28.0	28 40	+ 5	43 18.0	14 30	— 14
26 35.0	31 5	+ 7	45 13.0	10 0	+ 1
23 29 45.0	☉ 73 33 50	0	2 13 45.0	☉ 66 40 0	+ 7
31 20.0	36 40	+ 25	15 6.0	30 0	+ 2
32 39.0	39 30	+ 19	16 29.5	20 0	+ 9
34 32.0	42 25	0	17 48.5	10 0	— 10
36 4.0	45 5	+ 6	19 6.7	0 0	— 3
38 46.0	49 20	+ 14	20 28.0	65 50 0	+ 2
39 57.0	50 50	+ 7	21 46.0	40 0	— 2
41 0.0	52 5	+ 6	23 4.0	30 0	+ 1
41 55.0	53 10	+ 2	24 23.0	20 0	+ 5
23 55 32.0	☉ 74 3 55	— 8	2 26 32.0	☉ 64 0 0	+ 13
57 10.0	4 10	— 1	27 47.5	63 50 0	+ 17
58 12.0	4 25	— 2	29 3.0	40 0	+ 9
59 16.0	4 25	— 7	30 15.5	30 0	— 3
0 0 2.0	4 40	— 3	31 34.0	20 0	+ 14
1 0.0	4 35	— 7	32 46.5	10 0	+ 4
2 4.0	4 30	— 11	34 1.5	0 0	+ 4
2 46.0	4 25	— 11	35 16.0	62 50 0	+ 7
3 26.0	4 30	— 7	36 28.5	40 0	— 15
5 45 23.0	☉ 29 30 0	+ 1	5 50 48.0	☉ 29 30 0	+ 9
47 4.0	10 0	+ 12	51 41.0	20 0	+ 14
47 56.0	0 0	+ 13	52 31.0	10 0	+ 3
48 46.0	28 50 0	+ 2	53 24.5	0 0	+ 12

Ifølge Tidssignal var den 12te August $9^h\ 0^m\ 1.^s3$ a. m. Chronometer Reid's Correction til Greenwich Middeltid $+\ 8^m\ 40.^s8$, der voxer med $0.^s97$ i 24^h. Herefter bliver Correctionen for Reid til Greenwich Middeltid ved den første Observation om Formiddagen $+\ 8^m\ 41.^s8$, ved den sidste af de corresponderende Højder om Eftermiddagen $+\ 8^m\ 42.^s0$ og ved Aftenobservationerne $+\ 8^m\ 42.^s1$.

Af Ligningerne findes den sandsynlige Fejl af en enkelt Højde

$$\delta = \pm\ 6.''3$$

og de sandsynligste Værdier for

On the 12th of August, $9^h\ 0^m\ 1.^s3$ a. m., the correction for the Reid chronometer to Greenwich mean time, as determined by the time-signals, was $+\ 8^m\ 40.^s8$, increasing $0.^s97$ in twenty-four hours. Hence, the Reid correction to Greenwich mean time for the first observation in the forenoon, will be $+\ 8^m\ 41.^s8$; for the last of the equal altitudes in the afternoon $+\ 8^m\ 42.^s0$; and for the evening observations $+\ 8^m\ 42.^s1$.

From the equations, the probable error of a single altitude is found to be

$$\delta = \pm\ 6.''3,$$

and the most probable values for

$$\Delta\varphi = +\ 3.''9 \pm 0.''74 \qquad \Delta\lambda = -\ 2.''4 \pm 3.''3 = -\ 0.^s19 \pm 0.^s22$$

Forudsættes en sandsynlig constant Fejl af $\pm\ 10''$ i de maalte Højder, vil denne i den beregnede Bredde give en sandsynlig Fejl af $\pm\ 10.''76$, og man faar saaledes som Resultat

$$\varphi = 67^0\ 17'\ 13.''9 \pm 10.''8.$$

En constant Fejl af $10''$ i de maalte Højder giver en Fejl af $0.^s51$ i Længden. Den sandsynlige Fejl af den beregnede Længde kan derfor sættes lig

If we assume a probable constant error of $\pm\ 10''$ in the observed altitudes, this error will affect the computed latitude with a probable error of $\pm\ 10.''76$, and the final result will be

$$\varphi = 67^0\ 17'\ 13.''9 \pm 10.''8.$$

A constant error of $10''$ in the observed altitudes, entails an error of $0.^s51$ in longitude. The probable error of the computed longitude may accordingly be put at

$$\sqrt{(0.^s22)^2 + (0.^s51)^2 + D_1^2 + D_2^2 + D_3^2 + D_4^2 + D_5^2 + D_6^2 + D_7^2} = 0.^s63$$

og man faar som Resultat

$$\lambda = 0^h\ 57^m\ 39.^s4 \pm 0.^s63 \text{ E. Greenwich}$$
$$= 14^0\ 24'\ 51'' \pm 9.''5 \text{ „ —}$$

Ifølge de norske Kystkarter ligger mit Observationspunkt paa

Bredde $67^0\ 17'\ 15''$

Længde $14^0\ 25'\ 40'' = 0^h\ 57^m\ 42.^s7$ E. Greenwich.

Der er saaledes meget god Overensstemmelse i Bredden, medens min Bestemmelse lægger Bodø $3.'3$ vestligere end Kartet, en Afstand, der svarer til 594 Meter.

and the final result will be

$$\lambda = 0^h\ 57^m\ 39.^s4 \pm 0.^s63 \text{ E. Greenwich}$$
$$= 14^0\ 24'\ 51'' \pm 9.''5 \text{ „ —}$$

On the Norwegian coastal charts my point of observation is in

Latitude $67^0\ 17'\ 15''$

Longitude $14^0\ 25'\ 40'' = 0^h\ 57^m\ 42.^s7$ E. Greenwich.

Hence the agreement in latitude is quite satisfactory, whereas my determination, as compared with the chart, places Bodø $3.'3$ farther west, a difference corresponding to 594 metres.

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5. Røst.

Observationerne toges paa en større Holme, Skruholmen kaldet, den 26de Juni 1877. Ved Middagstider toges en Række Circummeridianhøjder og om Eftermiddagen en Række Højder i Nærheden af første Vertical. Ved den første Række benyttede jeg mit Duplexuhr, der sammen-

5. Røst.

The observations were made on a large holm, or islet, called Skruholmen, June the 26th 1877. At noon were taken a series of circum-meridian altitudes, and in the afternoon a series of altitudes near the prime vertical. For the first series, I used my duplex watch, which, imme-

lignedes, umiddelbart efter at Observationerne vare tagne, med Chronometer Frodsham, og hvis Angivelser paa Stedet reduceredes til dette. Ved Eftermiddagsobservationerne benyttede jeg Frodsham.

Indexfejlen fandtes ved Middag $= +2'\ 8.''8 \pm 5''.$ 5 Obs.
om Efterm. $= +2\ 1.\ 7 \pm 2\ .\ 3$ „

	8 a. m.	2 p. m.	8 a. m.
Barometer	750.^{mm}6	750.^{mm}6	749.^{mm}2
Temperatur	8.^{0}9	9.^{0}0	8.^{0}9

Efter Tidssignal, observeret i Bodø den 24de Juni, er for Frodshams Chronometer beregnet for Eftermiddagsobservationerne Correction til Greenwich Middeltid

$$-0^h\ 52^m\ 12.'7.$$

Som foreløbige Værdier er sat

diately after taking the observations, was compared with the Frodsham chronometer, and its several indications reduced on the spot to those of the latter timepiece. For the afternoon-series, I used the Frodsham.

Index-error at Noon $= +2'\ 8.''8 \pm 5''.$ 5 Observations.
— after Noon $= +2\ 1.\ 7 \pm 2\ .\ 3$ —

	8 a. m.	2 p. m.	8 a. m.
Barometer	750.^{mm}6	750.^{mm}6	749.^{mm}2
Temperature	8.^{0}9	9.^{0}0	8.^{0}9

The Frodsham correction to Greenwich mean time, as determined from the time-signals at Bodø on the 24th of June, was found to be

$$-0^h\ 52^m\ 12.'7.$$

As approximate values,

$$\varphi_0 = 67^0\ 29'\ 50''\ \text{and}\ \lambda_0 = 0^h\ 48^m\ 29.'1\ \text{E. Greenwich.}$$

1877. Juni *(June)* 26.

Chron. Frodsham.	2 h′	Δ
0^h 13^m 6.^{s}6	⊙ 92^0 13′ 45″	— 7″
14 6. 6	13 20	— 6
15 6. 6	12 50	— 3
19 6. 6	10 0	— 3
20 36. 6	8 30	— 9
21 58. 6	7 30	+ 4
22 36. 6	6 30	— 6
24 30. 6	☉ 91 1 35	+ 7
25 28. 6	0 10	— 2
26 38. 6	90 59 5	+ 14
27 46. 6	57. 30	+ 14
29 8. 6	55 30	+ 14
29 51. 6	54 0	+ 1
30 54. 6	51 .50	— 16

Chron. Frodsham.	2 h′	Δ
4^h 46^m 31.^{s}7	☉ 57^0 40′ 0″	— 14″
47 26. 7	30 0	— 2
48 19. 0	20 0	+ 4
49 12. 5	10 0	— 2
50 6. 5	0 0	+ 4
50 58. 7	56 50 0	+ 1
51 51. 0	40 0	— 2
52 43. 8	30 0	— 3
53 35. 5	20 0	— 8
55 37. 0	⊙ 57 0 0	+ 4
56 30. 0	56 50 0	+ 3
57 22. 0	40 0	— 1
58 15. 8	30 0	+ 6
59 8. 5	20 0	+ 8
5 0 0. 2	10 0	+ 1
0 54. 5	0 0	+ 12
1 45. 5	55 50 0	— 3
2 38. 8	40 0	+ 7

Differentserne Δ mellem de observerede og beregnede Højder ere tagne efterat den benyttede Solradius er formindsket med 7.″2 forat tilfredsstille Observationerne af begge Solrender.

Efter de mindste Kvadraters Methode har Hr. Åstrand fundet

The differences, Δ, between the observed and the computed altitudes, were found after diminishing the assumed semidiameter of the sun by 7.″2, to satisfy the observations of both limbs.

By the method of the least squares, Mr. Åstrand found

$$\delta = \pm\ 5.''1;\quad \Delta\varphi = -\ 2.''6 \pm 1.''4;\quad \Delta\lambda = +\ 0.'69 \pm 0.'21.$$

Forudsættes en sandsynlig constant Fejl af ± 10″, bliver dens Virkning paa den beregnede Bredde ± 9.″9, og Resultatet bliver

$$\varphi = 67^0\ 29'\ 47.''4 \pm 10.''0.$$

Assuming a probable constant error of ± 10″, the effect on the computed latitude will be ± 9.″9, and the result therefore

$$\varphi = 67^0\ 29'\ 47.''4 \pm 10.''0.$$

En constant Fejl af 10″ i de maalte Højder giver en Fejl af 1.′66 i den beregnede Længde. Sættes den sandsynlige Fejl af den beregnede Længde lig

A constant error of 10″ in the observed altitudes, entails an error of 1.′66 in the computed longitude. Putting the probable error of the computed longitude at

$$\sqrt{(0.'21)^2 + (1.'66)^2 + D_1^2 + D_2^2 + D_3^2 + D_4^2 + D_5^2 + D_6^2 + D_7^2} = \pm\ 1.'72$$

faaes som Resultat

the result will be

$$\lambda = 0^h\ 48^m\ 29.'8 \pm 1.'72 = 12^0\ 7'\ 27'' \pm 25.''8 \text{ E. Greenwich.}$$

Efter de norske Kystkarter ligger Skruholmen paa
Bredde 67° 29′ 48″
Længde 12° 6′ 36″ = 0ʰ 48ᵐ 26.′4 E. Greenwich.

Der er saaledes god Overensstemmelse i Bredden, medens min Bestemmelse lægger Røst 51″ eller 3.′4 østligere end Kartet, en Afstand, der svarer til 602 Meter.

On the Norwegian coastal charts, Skruholmen is in
Latitude 67° 29′ 48″
Longitude 12° 6′ 36″ = 0ʰ 48ᵐ 26.′4 E. Greenwich.

Hence the agreement in latitude is quite satisfactory, whereas my determination of longitude, as compared with the chart, places Røst 51″, or 3.′4, farther east, a difference corresponding to 602 metres.

6. Hammerfest.

Observationerne gjordes om Eftermiddagen den 9de Juli og om Morgenen den 10de Juli 1878 paa Fuglenes i Meridian-Støttens Meridian, omtrent 5 Meter i Syd for samme. Polhøjden af Meridian-Støtten, der danner det nordlige Endepunkt af den Russisk-Svensk-Norske Gradmaaling, er bestemt af Professor Lindhagen til 70° 40′ 11.″3. Omstændighederne vare meget gunstige, Luften klar og rolig.

6. Hammerfest.

The observations were taken in the afternoon of the 9th of July and on the morning of the 10th, 1878, at Fuglenes, in the meridian of the "Meridian-Column," about 5 metres farther south. The latitude of the Column, which constitutes the northern terminal point of the Russian-Swedish-Norwegian arc of meridian, has been determined by Professor Lindhagen at 70° 40′ 11.″3. Circumstances were remarkably favourable, the atmosphere both clear and still.

Den 9de Juli Eft. fandtes Indexfejlen (*Index-error p. m.*) + 2′ 7.″2 ± 2.″2. 6 Obs.
„ 10de „ Form. — — (— *a. m.*) + 2 3. 3 ± 3. 1. 3 „

Som Observationsuhr benyttede jeg mit Lommechronometer.

For these observations, I used my pocket-chronometer.

Chron. Reid	Juli	9	*(Reid's Chronometer)*	2ʰ	21ᵐ	30.′0	6ʰ	25ᵐ	0.′0	17ʰ	7ᵐ	0.′0	19ʰ	23ᵐ	0.′0	20ʰ	3ᵐ	30.′0.
Lommechron.	„	9	*(Pocket-chronometer)*	3	15	14.0	7	18	42.9	18	0	41.7	20	16	41.1	20	57	10.9.
Corr. t. Reid			*(Corr. to Reid)*	— 53		44.0	— 53		42.9	— 53		41.7	— 53		41.1	— 53		40.9.

Juli 9 Eft. Barom. 760.ᵐᵐ0 Temp. 8°
„ 10 Morgen — 759.ᵐᵐ3 — 11°

Paa Telegrafcontoret i Hammerfest observerede jeg den 10de Juli

Lommechronometer	8ʰ	38ᵐ	22.′0	
Corrigeret Tidssignal	8	0	1. 2	Greenwich M. T.
Corr. af Lommechron.	— 38		20. 8	til Gr. M. T.
„ „ —	53		41..0	„ Reid.
Corr. for Reid	+ 15		20. 2	til Greenwich M. T.

July 9 p. m. Barom. 760.ᵐᵐ0 Temp. 8°
„ 10 a. m. — 759.ᵐᵐ3 — 11°

At the telegraph-office in Hammerfest, I observed on the 10th of July

Pocket-chronometer	8ʰ	38ᵐ	22.′0	
Corrected Time-signals	8	0	1. 2	Greenwich M. T.
Corr. for Pocket-chron.	— 38		20. 8	to Gr. M. T.
— —	53		41. 0	to the Reid chron.
Corr. for the Reid	+ 15		20. 2	to Greenwich M. T.

Med Polhøjden 70° 40′ 11.″2 beregnede Hr. Åstrand Længden saaledes:

With the latitude 70° 40′ 11.″2, Mr. Åstrand computed the longitude as follows: —

Af Observationerne Juli 9 Eft. *(From the observations July 9th p. m.)*	☉	1^h	34^m	44.′5	1^h	34^m 43.′95
	☉	1	34	43. 4		
Juli 10 Morg. (— „ — *July 10th a. m.)*	☉	1	34	40. 7	1	34 40. 60
	☉	1	34	40. 1		

For at bringe Eftermiddagsobservationerne af begge Solrænder i Overensstemmelse, trænger den benyttede Solradius en Tilvæxt af 2.″7. For Morgenobservationernes Vedkommende trænges en Tilvæxt af 1.″4.

De to Observationsrækker give, som man ser, merkelig forskjellige Værdier af Længden. Sammenstillingen af de af begge udledede Uhrcorrectioner giver for Normalchronometret Reid en Acceleration af flere Secunder i Mellemtiden, 14 Timer, medens dette Chronometer stadig, ifølge Tidssignalerne, har en Retardation af henimod et Secund i Døgnet. De ovenfor anførte Uhrsammenligninger vise ogsaa, at Lommechronometret den hele Tid retarderer i Forhold til Reid, men langsommere i Løbet af Natten, medens det modsatte maatte være Tilfældet, om Reid i Løbet af Natten havde accelereret. Jeg tør derfor ikke lægge Skylden for Uoverensstemmelsen mellem de beregnede Resultater af Eftermiddags- og Morgen-Observationerne paa Chronometret. Da Højderne ikke ere langt fra at være corresponderende, antager jeg Tilstedeværelsen af en constant Fejl i alle maalte Højder, og har efter de mindste Kvadraters Methode søgt den sandsynligste Værdi af denne samtidig med den sandsynligste Værdi af Længden. Til denne Beregning kunde jeg benytte de Beregninger, som Hr. Åstrand, efter min Opfordring, havde gjort, uden at antage nogen constant Fejl. Som foreløbig Værdi for Længden satte jeg $\lambda_o = 1^h\ 34^m\ 41.'6$ og indførte de ovenfor nævnte Correctioner for den apparente Solradius.

To satisfy the p. m. observations of both solar limbs, will require an increase in the semidiameter of the sun of 2.″7. For the a. m. observations, is needed an increase of 1.″4.

The two series of observations give remarkably different values for the longitude. A comparison of the chronometer-errors deduced from both indicates for the chief chronometer — the Reid — an acceleration of several seconds during the interval (14 hours), whereas that chronometer, according to the time-signals, invariably exhibited a retardation of one second in twenty-four hours. Moreover, the comparisons of the respective timekeepers show the pocket-chronometer, as compared with the Reid, to have been steadily gaining, — more slowly however in the course of the night; whereas the reverse must have been the case had the Reid gained in the night. Hence, I cannot ascribe this want of agreement between the computed results of the p. m. and a. m. observations to the chronometer. The altitudes being very nearly equal, I have assumed the presence of a constant error in all the observed altitudes, and by the method of the least squares sought to find its most probable value, together with the most probable value of the longitude. For this computation, I could apply the greater part of the calculations kindly made at my request by Mr. Åstrand, who had not assumed any constant error. As a preliminary value for the longitude, I put $\lambda_o = 1^h\ 34^m\ 41.'6$, introducing also the above-mentioned corrections for the sun's apparent semidiameter.

1878. Juli *(July)* 9.

Lommechronometer. *(Pocket-Chronometer.)*	2 h′	Δ
$4^h\ 15^m\ 26.'0$	☉ 50° 20′	+ 4″
16 27.6	10	+ 8
17 27.1	0	+ 3
18 26.0	49 50	— 5
19 26.4	40	— 6
20 27.6	30	— 3
21 29.2	20	+ 1
22 28.8	10	— 3
23 29.6	0	— 4
4 26 52.0	☉ 49 30	+ 5
27 51.2	20	— 0
28 51.2	10	— 4
29 51.2	0	— 7
30 52.8	48 50	— 2
33 54.4	20	— 0
34 56.4	10	+ 8
35 56.0	0	+ 6
36 56.4	47 50	+ 3
37 55.2	40	— 3

Lommechronometer. *(Pocket-Chronometer.)*	2 h′	Δ
$18^h\ 50^m\ 48.'4$	☉ 59° 10′	— 14″
51 50.4	20	— 10
52 54.4	30	— 7
53 56.4	40	— 3
54 59.6	50	— 4
56 2.4	60 0	+ 1
57 8.4	10	— 10
58 10.4	20	— 1
59 13.2	30	+ 4
19 0 18.0	40	— 1
1 21.4	50	+ 4
2 23.6	61 0	+ 13
3 28.8	10	+ 8
4 34.0	20	+ 6
19 7 5.6	☉ 60 40	— 2
8 9.6	50	+ 2
9 13.2	61 0	+ 8
10 20.4	10	— 2
11 23.6	20	+ 7
12 30.4	30	+ 1
14 42.4	50	— 4
15 45.2	62 0	+ 10
16 52.8	10	+ 2
18 0.0	20	— 4
19 5.2	30	+ 10
20 12 8	40	— 5
21 20.0	50	— 9
22 24.8	63 0	+ 0

Beregningen giver $\delta = \pm\ 4.''0$.

$\Delta\lambda = +\ 11.''5 \pm 1.''8 = +\ 0.'77 \pm 0.'12$; Const. Corr. paa Højderne $= +\ 8.''0 \pm 0.''6$ og som Resultat, naar den sandsynlige Fejl af den beregnede Længde sættes

The computation gives $\delta = \pm\ 4.''0$.

$\Delta\lambda = +\ 11.''5 \pm 1.''8 = +\ 0.'77 \pm 0.'12$; const. corr. in the altitudes $= +\ 8.''0 \pm 0.''6$, and as result, the probable error of the computed longitude being put

$$= \sqrt{(0.'12)^2 + D_1^2 + D_2^2 + D_3^2 + D_4^2 + D_5^2 + D_6^2 + D_7^2} = \pm\ 0.'41$$

$$\lambda = 1^h\ 34^m\ 41.'7 \pm 0.'41 = 23°\ 40'\ 25.''8 \pm 6.''1 \text{ E. Greenwich.}$$

Den sandsynlige Fejl svarer til en Afstand af 74 Meter.

Efter Professor Fearnleys Beregning af Gradmaalingen, med Udgangspunkt Dorpat, skulde Længden af Meridianstøtten paa Fuglenes være 23° 40′ 0.″9 E. Gr. Efter den af Svenskerne (Meddelelse fra Prof. Rosén til den geografiske Opmaaling) senere udførte telegrafiske Længdebestemmelse af Kokkomäki ($\varphi = 65°\ 49'\ 16''$) — Stockholm, bliver Længden af Meridianstøtten paa Fuglenes

$$23°\ 40'\ 22.''1 = 1^h\ 34^m\ 41.'5 \text{ E. Gr.}$$

fra hvilken Bestemmelse min afviger kun 3.″7 eller 0.'25, der svarer til en Afstand af 39 Meter.

The probable error corresponds to a distance of 64 metres.

According to Professor Fearnley's computation from the triangulation, — starting from Dorpat, — the longitude of the Meridian Column at Fuglenes should be 23° 40′ 0.″9 E. Gr. Meanwhile, the telegraphic determination of longitude for Kokkomäki ($\varphi = 65°\ 49'\ 16''$) — Stockholm, subsequently performed by Swedish astronomers (communication from Professor Rosén to the Geographical Survey), places the Meridian Column at Fuglenes in longitude

$$23°\ 40'\ 22.''1 = 1^h\ 34^m\ 41.'5 \text{ E. Greenwich}$$

from which result my determination differs only 3.″7, or 0.'25, corresponding to 39 metres.

De norske Kystkarter give for samme Punkt

$$\varphi = 70^\circ\ 40'\ 25''\ \text{og}\ \lambda = 23^\circ\ 39'\ 54''$$

altsaa Bredden 14″ for stor og Længden c. 30″ eller 2′ for liden (310 Meter).

The Norwegian coastal charts give for the point in question

$$\varphi = 70^\circ\ 40'\ 25''\ \text{and}\ \lambda = 23^\circ\ 39'\ 54''$$

the latitude, therefore, 14″ too far north, and the longitude about 30″, or 2′ (310 metres), not far enough east.

7. Vardø.

Observationerne gjordes den 26de Juni 1878 omkring Middag paa et Punkt, der, ifølge Observationer med Theodolithen, ligger 175 Meter Nord og 51 Meter Vest for Midtpunktet af Fæstningen Vardøhus. Luften, der i Begyndelsen var klar, blev efter Middag taaget, saa at den sidste Række Højder maatte tages med svage Blændglas foran begge Spejle, og tilsidst maatte Observationerne afbrydes, da det skyede ganske over. Jeg opnaaede saaledes ikke at faa lige mange Højder af hver Solrand, og Indexfejlens Bestemmelse blev mangelfuld. I Middel af 4 Bestemmelser fandtes Indexfejlen + 2′ 13″ ± 3″.

Som Observationsuhr benyttede jeg mit Lommechronometer.

Reid	$18^h\ 43^m\ 0.^s0$
Lommechron.	19 37 52.8
Corr. t. Reid	−54 52.8

Lommechronometret taber i Forhold til Reid 0.ˢ23 pr. Time.

Efter de meteorologiske Observationer i Vardø var:

Juli 26 8 a. m. Barom. 765.^{mm}9 Temp. C. 6.°0
— „ 2 p. m. — 765. 9 — „ 9. 4

7. Vardø.

The observations were taken on the 26th of June, 1878, about noon, from a point which, as determined with the theodolite, lies 175 metres north and 51 metres west of the centre of Vardøhus fortress. The atmosphere, clear at first, soon got hazy, so that the last series of altitudes had to be taken with light-coloured glasses, and ere long the observations had to be broken off, the sky becoming quite overcast. Hence, I did not succeed in getting an equal number of altitudes of each solar limb; and the index-error was not very well determined. As a mean of 4 observations, the index-error was found to be + 2′ 13″ ± 3″.

On this occasion, I observed with my pocket-chronometer.

Reid	$18^h\ 43^m\ 0.^s0$
Pocket-chron.	19 37 52.8
Corr. to the Reid	−54 52.8

The pocket-chronometer was losing hourly 0.ˢ23 more than the Reid.

The meteorological observations at Vardø gave the following results: —

July 26 8 a. m. Barom. 765.^{mm}9 Temp. C. 7.°0
— „ 2 p. m. — 765. 9 — „ 9. 4

1878. Juni *(June)* 25—26.

Lommechron. *(Pocket-Chronometer.)*	2 h′	Δ
$21^h\ 31^m\ 36.'8$	☉ 83° 30′ 0″	— 0″
33 8.0	35 0	— 10
34 30.8	40 0	— 2
35 58.8	45 0	+ 1
37 30.0	50 0	+ 1
39 5.2	55 0	— 1
40 41.2	84 0 0	0
42 17.6	5 0	+ 4
44 5.6	10 0	— 5
52 36.4	☉ 85 36 10	+ 4
53 45.6	38 35	— 7
54 52.4	41 25	— 1
55 58.4	43 50	— 5
57 17.2	46 30	— 13
58 27.6	49 10	— 4
59 53.6	52 30	+ 0
22 1 44.4	56 0	— 6
2 57.6	58 10	— 12
4 51.2	86 2 0	— 11
5 43.6	3 35	— 1
7 17.6	6 5	— 5
8 18.8	7 45	— 6
9 59.6	10 50	+ 7
11 32.4	13 10	+ 9
12 40.0	14 30	+ 2
13 37.6	15 40	— 2
14 48.8	17 5	— 5
15 36.4	18 0	— 7
17 0.8	19 50	— 1
17 58.8	21 0	+ 1

Lommechron. *(Pocket-Chronometer.)*	2 h′	Δ
$22^h\ 18^m\ 54.'4$	☉ 86° 22′ 0″	+ 2″
19 55.6	23 5	+ 8
20 46.0	24 30	+ 22
22 58.0	25 55	+ 7
24 16.8	26 40	— 1
24 59.2	27 20	+ 2
25 55.8	27 45	— 3
26 44.8	28 35	+ 7
27 45.6	28 40	— 7
28 32.8	29 20	— 0
30 27.2	30 0	+ 9
31 32.0	31 0	+ 12
32 31.2	31 10	+ 8
22 37 17.2	☉ 85 28 20	— 6
38 29.6	28 35	+ 2
39 28.0	28 35	+ 4
40 37.2	28 35	+ 9
41 30.8	28 5	— 1
42 45.2	27 40	— 6
43 50.4	27 20	— 3
45 24.0	26 45	— 4
47 34.8	26 0	+ 5
49 32.4	25 0	+ 11
23 43 6.0	☉ 84 35 0	— 2
44 34.0	30 0	— 4
45 55.2	25 0	— 13
47 20.4	20 0	+ 0
48 50.0	15 0	+ 11
50 1.6	10 0	+ 5
51 14.0	5 0	— 5

I Betingelsesligningerne har Hr. Åstrand indført en Correction ($\Delta\ \varrho$) for den benyttede Solradius. Som tilnærmede Værdier er antaget $\varphi_0 = 70°\ 22'\ 28.''3$ og $\lambda_0 = 2^h\ 4^m\ 28.'8$, og Reids Correction til Greenwich Middeltid ved Observationernes Begyndelse sat til $+\ 15^m\ 8.'1$.

Af Ligningerne findes:

In the equations of condition, Mr. Åstrand introduced a correction ($\Delta\ \varrho$) for the assumed semidiameter of the sun. As approximate values, he put $\varphi_0 = 70°\ 22'\ 28.''3$ and $\lambda_0 = 2^h\ 4^m\ 28.'8$, and the Reid correction to Greenwich mean time at the beginning of the observations $= +\ 15^m\ 8.'1$.

From the equations, he found

$$\delta = \pm\ 4.''6;\ \Delta\ \varrho = +\ 5.''9 \pm 0.''66$$
$$\Delta\ \varphi = -\ 4.''3 \pm 0.''7;\ \Delta\ \lambda = +\ 34.''4 \pm 9.''4 = +\ 2.'29 \pm 0.'63.$$

Antages en sandsynlig constant Fejl i de maalte Højder af $\pm$ 10″, saa er dennes Indflydelse paa den beregnede Bredde $\pm$ 11.″4, og paa den beregnede Længde $\pm$ 0.′39. Resultatet bliver:

Assuming a probable constant error in the observed altitudes of $\pm$ 10″, its effect on the computed latitude will be $\pm$ 11.″4, and on the computed longitude $\pm$ 0.′39; as result we get

$$\varphi = 70°\ 22'\ 24.''0 \pm 11.''4$$
$$\lambda = 31°\ 7'\ 46.''4 \pm 12.''6 = 2^h\ 4^m\ 31.'1 \pm 0.'84 \text{ E. Greenwich.}$$

Reduceres til Fæstningens Midte faaes:
Vardøhus

Reduced to the centre of the fortress, we get for Vardøhus —

$$\varphi = 70°\ 22'\ 18.''4 \pm 11.''4$$
$$\lambda = 31°\ 7'\ 51.''3 \pm 12.''6 = 2^h\ 4^m\ 31.'4 \pm 0.'84 \text{ E. Greenwich.}$$

Efter de norske Kystkarter ligger Vardøhus paa:
Bredden 70° 22′ 5″
Længden 31° 7′ 35″ = 2ʰ 4ᵐ 30.ˢ3 E. Greenwich.

Efter en senere fundet Correction for en Regnefejl skulde imidlertid Punkterne østenfor Nordkap ligge c. 22″ østligere end i Kartet, altsaa Vardøhus paa Længden 31° 7′ 57″ = 2ʰ 4ᵐ 31.ˢ8, hvilken Værdi kun er 6″ eller 0.ˢ4 større end den af mig fundne.

On the Norwegian coastal charts, Vardøhus is in
Latitude 70° 22′ 5″
Longitude 31° 7′ 35″ = 2ʰ 4ᵐ 30.ˢ3 E. Greenwich.

Meanwhile, the points east of the North Cape should, according to an error of calculation subsequently discovered, lie about 22″ farther east than on the chart, Vardøhus therefore in longitude 31° 7′ 57″ = 2ʰ 4ᵐ 31.ˢ8; and this value exceeds my determination by only 6″, or 0.ˢ4.

Sammenstilles de af mig fundne Længder med de paa de norske Kystkarter udmaalte, faar man følgende Oversigt:

A comparison between my determinations of longitude and those on the respective Norwegian charts gives the following results: —

	Astron. telegr. Længde. (*Longitude Astr. Telgh.*)	Kartets Længde. (*Long. on Chart.*)	Forskjel. (*Difference.*)
Namsos . . .	11° 31′ 33″ ± 7.″4	11° 30′ 45″	45″ = 3.ˢ0
Bodø	14 24 51 ± 9. 5	14 25 40	— 49 = — 3. 3
Røst	12 7 27 ± 25. 8	12 6 36	59 = 3. 4
Hammerfest . .	23 40 26 ± 6. 1	23 39 54	32 = 2. 1
Vardø	31 7 51 ± 12. 6	31 7 35	16 = 1. 1

Med Undtagelse af Bodø ere Kartets Længder mindre østlige end mine. Forskjellen er imidlertid kun en Brøkdel af et Minut, i Storcirkel kun en Brøkdel af et halvt til et Trediedels Minut, og Tilstrækkeligheden af Nøjagtigheden af Karternes Længde for Skibsfarten antages saaledes godtgjort. Karternes Bredder synes gjennemgaaende nøjagtige, saavidt ovenstaaende Iagttagelser kunne tjene til deres Verification.

Saving that of Bodø, the longitudes on the chart are none of them so far east as mine. Meanwhile, the difference does not amount to more than a fraction of a minute, and in arc of great circle it is only a fraction of half to one-third of a minute; hence, the accuracy of the longitudes on the charts may be regarded as sufficient for all practical purposes of navigation. The latitudes on the charts would appear to be generally correct, so far as the results set forth above can serve for their verification.

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8. Advent Baj.

Paa Odden, ved den vestre Bred af Indløbet til Advent Baj, der gaar i sydostlig Retning ind fra den indre Del af Isfjorden paa Spidsbergens Vestkyst, tog jeg den 20de August 1878 to Rækker Solhøjder til Bestemmelse af Bredden og Længden af det Punkt, der var Udgangspunktet for Iagttagelserne til Constructionen af det Kart, som Capt. Wille optog over Bajen med Omgivelser.

Omstændighederne vare ikke meget gunstige. Luften var tildels meget taaget, saaat Blændglassene ofte maatte vexles, ja kunde stundom endog undværes. En Følge af

8. Advent Bay.

On the tongue of land jutting out from the western shore of the entrance to Advent Bay, which extends in a south-easterly direction from the inner part of Ice Sound on the west coast of Spitsbergen, I took on the 20th of August, 1878, two series of solar altitudes, to determine the latitude and longitude of the point at which were commenced the observations for the survey made by Capt. Wille of the Bay and its environs.

Circumstances were anything but favourable, the atmosphere being so hazy at intervals that the coloured glasses had to be frequently changed, nay could now and again

disse Omstændigheder var det desværre, at jeg ikke kunde faa nogen brugbar Bestemmelse af Indexfejlen. Denne har jeg senere søgt at finde saaledes:

be dispensed with. As a consequence of these atmospheric conditions, I failed to obtain a trustworthy determination of the index-error. This I sought subsequently to find in the following manner: —

I Hammerfest den 9de Juli 1878 ved en Temperatur af + 8° C. var Indexfejlen *(Index-error)* + 2′ 7″
„ — „ 10de „ — „ „ — „ + 10 „ „ — — + 2 3
„ Christiania „ 11te Decb. — „ „ — „ — 3 „ „ — — + 2 27

Under Observationerne i Advent Baj var Luftens Temperatur + 3°, hvortil, efter grafisk Interpolation, svarer en Indexfejl af + 2′ 16″, der er benyttet til Beregningen af Højderne.

Den benyttede Solradius er den, som er udledet af Sammenligning mellem Observationerne af øvre og nedre Solrand.

Observationsuhr var mit Lommechronometer, der før og efter sammenlignedes med Hovedchronometret Reid ombord.

Reid	19ʰ	4ᵐ	0.ˢ0	0ʰ	55ᵐ	0.ˢ0
Lommechron.	19	53	58.6	1	44	57.2
Corr. t. Reid	—	49	58.6	—	49	57.2

Efter de timevise meteorologiske Iagttagelser ombord var

ved Morgenobs. Kl. 9 a. m. Barom. = 755.ᵐᵐ1 Temp. = 3.°0
„ Efterm.obs. „ 1 p. m. — 755. 0 — 2. 6

During the observations taken at Advent Bay, the temperature of the atmosphere was + 3°, to which, as found from diagrammatic interpolation, corresponds an index-error of + 2′ 16″, that assumed for computing the altitudes.

The apparent semidiameter of the sun taken for the computation, is that determined from a comparison of the observations of the upper and lower limbs.

On this occasion, I observed with my pocket-chronometer, which, before and after the observations, was compared on board with the chief timekeeper (Reid).

Reid	19ʰ	4ᵐ	0.ˢ0	0ʰ	55ᵐ	0.ˢ0
Pocket-chron.	19	53	58.6	1	44	57.2
Corr. to Reid	—	49	58.6	—	49	57.2

According to the hourly meteorological observations on board, the temperature and barometric pressure were as follows: —

9 a. m. Barometer 755.ᵐᵐ1 Temp. 5.°0
1 p. m. — 755. 0 — 2. 6

1878. August *(August)* 19—20.

Lommechron *(Pocket-Chronometer)*	2 h′	Δ
20ʰ 35ᵐ 59.ˢ6	☉ 40° 50′ 0″	— 7″
37 13. 0	55 40	— 1
39 18. 4	41 4 55	0
44 43. 2	☉ 42 31 40	+ 11
50 37. 2	42 56 10	— 2
55 52. 0	43 17 50	+ 1
57 20. 0	43 23 45	— 1
59 43. 2	43 33 15	— 4
21 6 32. 0	☉ 42 57 10	+ 3
7 37. 6	43 1 20	+ 3

Lommechron. *(Pocket-Chronometer)*	2 h′	Δ
0ʰ 29ᵐ 55.ˢ	☉ 47° 8′ 50″	+ 1″
33 50	☉ 48 5 5	— 7
34 40	48 3 50	— 4
35 40	☉ 46 59 10	— 5
37 28	46 56 10	+ 1
41 55	☉ 47 51 5	+ 5

Ved de mindste Kvadraters Methode har Hr. Åstrand fundet, idet der sættes $\varphi_0 = 78° 14′ 48″$, $\lambda_0 = 1^h 2^m 15.^s9$, og Reids Correction til Greenwich Middeltid ved Formiddagsobservationerne + 16ᵐ 0.ˢ0,

By the method of the least squares, putting $\varphi_0 = 78° 14′ 48″$, $\lambda_0 = 1^k 2^m 15.^s9$, and the Reid correction to Greenwich mean time for the a. m. observations = + 16ᵐ 0.ˢ0, Mr. Åstrand found

$$\delta = \pm 3.''3$$
$$\Delta\varphi = + 0.''4 \pm 1.''1, \quad \Delta\lambda = + 0.''3 \pm 7.''8 = + 0.^s02 \pm 0.^s52.$$

En sandsynlig constant Fejl af 10″ i alle Højder bevirker en Fejl af 11.″6 i den beregnede Bredde og af 0.′90 i den beregnede Længde. Resultatet bliver saaledes

$\varphi = 78^\circ\ 14'\ 48.''4 \pm 11.''6$
$\lambda = 15^\circ\ 33'\ 58.''5 \pm 16.\ 7 = 1^h\ 2^m\ 15.'9 \pm 1.'11$

I Kgl. Svenska Vetenskaps-Akademiens Handlingar, 13de Bind No. 9, findes en Afhandling af Dr. Aug. Wijkander: "Astronomiska Observationer under den Svenska Arktiska Expeditionen 1872—73. I. Tids- och Orts-Bestämningar." I Fortegnelsen over Bredder og Længder findes her, Side 54, ogsaa Punkter ved Advent Baj, nemlig "Rysstugen" og "Mynningen af elfven", begge bestemte efter Observationer af Prof. Nordenskiöld.

Ved Hjelp af det af Capt. Wille tegnede Kart over Advent Baj kan jeg med Lethed reducere mine Bestemmelser for Odden til de to nævnte Punkter. Jeg finder

"Odden"	Br.	78°	14′	48.″4	L. $1^h\ 2^m$	15.′92
Red. til "Russestuen"			— 1.	9		— 2.31
Russestuen		78	14	46. 5	1 2	13.61
do. efter Svenskerne		78	15	2.	1 2	31.5
Forskjel			— 15.″5			— 17′ 9.
Red. t. "Mund. af Elven"				29.″5		— 2.′85
Mund. af Elven		78°	14′	18. 9	$1^h\ 2^m$	13.07
do. efter Sv. Exp.		78	14	11.	1 2	31.0
Forskjel			+ 7.″9			− 17.′ 9

Medens Bredderne stemme, i Middel, indenfor den af den sandsynlige Fejl betegnede Grændse, ere de Svenske Expeditioners Længder c. 18′ mere østlige end mine. Da Længden af Punkterne ved Advent Bay af Svenskerne er henført til Længden af Sabine's Observatorium paa Indre Norskøen, og der — som af Dr. Wijkander i nævnte Afhandling Side 48—49 fremhævet, — er flere Grunde tilstede, der gjøre det sandsynligt, at Sabine's Længde er for stor østlig, 16 til 30 Tidssecunder, saa tør jeg anse den af mig fundne Længde for Advent Baj for at være nær den rigtige, og de 18 Tidssecunders Forskjel fra de Svenske Expeditioners som Correction til Sabines Længde af Observatoriet paa Indre Norskøen.

A probable constant error of 10″ in all the altitudes, will entail an error of 11.″6 in the computed latitudes and of 0.′90 in the computed longitude. The result is thus —

$\varphi = 78^\circ\ 14'\ 48.''4 \pm 11.''6$
$\lambda = 15^\circ\ 33'\ 58.''5 \pm 16.''7 = 1^h\ 2^m\ 15.'9 \pm 1.'11$

In Kgl. Svenska Vetenskaps-Akademiens Handlingar, Vol. 13, No. 9, Dr. Aug. Wijkander has furnished a paper entitled "Astronomiska Observationer under den Svenska Arktiska Expeditionen 1872—1873. I. Tids- och Orts-Bestämningar." The List of Latitudes and Longitudes, p. 54, includes those of two points at Advent Bay, viz. "Rysstugen" and "Mynningen of elfven," both determined from the observations of Professor Nordenskiöld.

By referring to Capt. Wille's map of Advent Bay, I could easily reduce my determinations for the tongue of land to those of the Swedish observer for the two points. The results were as follows: —

Tongue of land	Lat	78°	14′	48.′4	Long. $1^h\ 2^m$	15.′92
Red. to "Russian Hut"	—		— 1.	9	—	— 2. 31
Russian Hut		78	14	46.5	1 2	13.61
Do. Swed. Observ.		78	15	2	1 2	31.5
Difference			— 15.″5			— 17.′ 9
Red. to "Mouth of River"				29.″5		2.′85
Mouth of River		78°	14′	18.″9	$1^h\ 2^m$	13.′07
Do. Swed. Observ.		78	14	11	1 2	31.0
Difference			+ 7.″9			— 17.′ 9

Whilst the mean of the latitudes agrees within the limits of the probable error, the longitudes determined on the Swedish Expeditions are about 18′ farther east than mine. The longitude of the points at Advent Bay being referred by the Swedish observers to the longitude of Sabine's Observatory on "Inner Norway Island," and several reasons — as adduced by Dr. Wijkander in the above-mentioned paper, pp. 48, 49, — rendering it highly probable that Sabine's longitude is too far east, — from 16 to 30 seconds in time, — I may regard my longitude for Advent Bay as very nearly correct, and the 18 seconds in time by which it differs from that determined on the Swedish Expeditions, as a correction for Sabine's longitude of the Observatory on Inner Norway Island.

9. Jan Mayen.

Den 30te Juli 1877, om Eftermiddagen, da "Vøringen" befandt sig i Mary Muss Bugten paa Vestsiden af Jan Mayen, brød i korte Stunder Solen igjennem Taagen, og der observeredes to Solhøjder, netop som vi lettede fra Ankerpladsen.

9. Jan Mayen.

In the afternoon of the 30th of July, 1877, — the "Vøringen" lying at anchor in Mary Muss Bay on the west coast of Jan Mayen, — the sun broke at intervals through the mist, and two solar altitudes were taken, just as we were getting under weigh.

Den følgende Dag, den 31te Juli, laa Expeditionen til Ankers i den store Rækved-Bugt paa Jan Mayens Østside. Da Søgangen hindrede os fra at komme i Land, toges fra Skibsborde en Række Solhøjder, med forskjellige Sextanter, dels af Capt. Wille, dels af mig. Omstændighederne vare ikke gunstige. Skyer og Taage tog jevnlig Solen eller Horizonten bort.

Den 1ste August var Vejret noget gunstigere, og der observeredes om Formiddagen en Del Solhøjder fra samme Ankerplads, førend vi lettede.

I den nedenstaaende Tabel betegner G Capt. Grieg og M Mohn; E betegner den Expeditionen tilhørende Sextant og S en Skibet tilhørende Sextant.

Hver Iagttager bestemte sin Indexfejl. Jeg fandt den for Troughtons Sextant den 31te Juli ved Solen + 1′ 38″ og ved Horizonten + 1′ 35″. Benyttet er den første Værdi.

De fleste Observationer gjordes fra Hyttedækket. Øjets Højde regnedes her til 18 norske Fod eller 5.6 Meter.

I Beregningen er benyttet Solradien efter Nautical Almanac. Som det vil sees nedenfor, er den af Observationerne udledede Solradius større.

Som Observationsuhr benyttedes dels Lommechronometer, dels Lommeuhre, der umiddelbart før eller efter hver Observationsrække sammenlignedes med Hovedchronometret Reid. Hr. Tornøe, vor Chemiker, assisterede mig ved flere Observationer, idet han noterede Uhret. Reids Correction til Greenwich Middeltid beregnedes for Observationerne

Juli 30	Juli 31	Aug. 1
til + 8^m 28.′6	+ 8^m 29.′2	+ 8^m 30.′2

Efter foreløbige Beregninger sattes for Ankerpladsen paa Østsiden $\varphi_0 = 70^\circ$ 58.′0 og $\lambda_0 = 0^h$ 33^m 48.′3 W. Greenwich.

Beliggenheden af Ankerpladsen paa Vestsiden er ret nøje bestemt trigonometrisk i Forhold til Ankerpladsen paa Østsiden. Ved Hjelp af Stormastens Højde, 18.6 Meter, der fra en Baad af Capt. Wille maaltes i Vinkel til 4° 20.′3, fandtes Baadens Afstand fra Skibet = 245 Meter. Fra Baaden og fra Skibet (Mohn) sigtedes samtidig til Toppen af "Fugleberget", en fremtrædende let kjendelig Fjeldtop paa Øens Vestside ved Mary Muss Bugten. Vinkelen Fugleberg—Skib, seet fra Baad, var 86° 3.′7, Vinkelen Fugleberg—Baad, seet fra Skibet, var 90° 13.′3, hvoraf beregnes Afstanden fra Skibet til Fugleberget til 2.′03. Fuglebergets Azimuth fra Skibet fandtes efter 3 Compas-Pejlinger paa 3 forskjellige Kurser = N. 25° W. Derefter ligger Fugleberget 1′ 50.″4 nordligere og 2′ 38.″0 vestligere end Ankerpladsen paa Østsiden. Fra Fuglebergets Fod maalte jeg den 29de Juli Masthøjden til 0° 55.′5, hvilket giver en Afstand af 0.′62. Skibets Azimuth fra Fugleberget var her omtrent 70°. Heraf beregnes, at

The following day, July 31st, the Expedition anchored in Great Wood Bay, on the east coast of the island. The swell preventing us from landing, Capt. Wille and myself took a series of solar altitudes on board, with different sextants. The atmospheric conditions were not favourable, cloud and mist repeatedly blotting out the sun or the horizon.

On the 1st of August the weather cleared a little, and in the forenoon a few solar altitudes were observed from the same anchorage, shortly before we got under weigh.

In the Table given below, G signifies Capt. Grieg, and M, Professor Mohn; E signifies the sextant belonging to the Expedition, and S a sextant belonging to the vessel.

Each observer determined his index-error. For the Troughton sextant, I found the index-error, on the 31st of July. to be + 1′ 38″ by the sun, and + 1′ 35″ by the horizon. The first of these values was applied.

Most of the observations were made from the deck of the roundhouse, where the eye of the observer was assumed to be 18 Norwegian feet, or 5.6 metres, above the sea-level.

For these computations, the sun's semidiameter was taken from the Nautical Almanac. As will appear in the sequel, that deduced from the observations was somewhat greater.

We observed with the pocket-chronometer and ordinary watches, each timepiece being compared, immediately before and after a series of observations, with our chief chronometer, the Reid. Mr. Tornøe, chemist to the Expedition, assisted me in several of the observations, by noting the indications of the watch. The Reid correction to Greenwich mean time was computed for the observations taken —

July 30	July 31	Aug 1
at + 8^m 28.′6	+ 8^m 29.′2	+ 8^m 30.′2

For the anchorage on the east coast of the island, I put, as the result of preliminary computations, $\varphi_0 = 70^\circ$ 58.′0 and $\lambda_0 = 0^h$ 33^m 48.′3 W. Greenwich.

The position of the anchorage off the west coast of the island relative to that of the anchorage on the east side, was determined trigonometrically with tolerable exactness. Taking the height of the mainmast, 18.6 metres, which, as measured from a boat by Capt. Wille, gave an angle of 4° 20.′3, the distance of the boat from the ship was found to be 245 metres. From the boat and from the ship (Prof. Mohn), we simultaneously observed the summit of the "Fugleberg" (bird-cliff), a conspicuous mountain-top on the west side of the island, in close proximity to Mary Muss Bay. The angle Fugleberg—ship, as determined from the boat, was 86° 3.′7; the angle Fugleberg—boat, as determined from the ship, 90° 13.′3; and with these results the distance from the ship to Fugleberg was computed at 2.′03. The azimuth of Fugleberg from the ship, we found from 3 compass-bearings on 3 different courses = N. 25° W. The Fugleberg should accordingly lie 1′ 50.″4 farther north and 2′ 38.″0 farther west than our

Ankerpladsen paa Vestsiden ligger 10.″9 nordligere og 1′ 49.″1 vestligere end Fugleberget. Ankerpladsen paa Vestsiden ligger altsaa 2′ 1.″3 nordligere og 4′ 27″ vestligere end Ankerpladsen paa Østsiden. Er for den sidste $\varphi_0 = 70^0\ 58.'0$ og $\lambda_0 = 0^h\ 33^m\ 48.'3$, saa bliver for Ankerpladsen paa Vestsiden $\varphi_0 = 71^0\ 0'\ 1''$ og $\lambda_0 = 0^h\ 34^m\ 6.'1$.

Efter de mindste Kvadraters Methode beregnede jeg de sandsynligste Correctioner til φ_0 og λ_0.

Naar jeg derefter grupperede Differentserne (hvis Kvadratsum er Minimum) mellem de observerede (reducerede) Højder af Solcentret og de efter de fundne sandsynligste Værdier for Bredden og Længden beregnede, efter de observerede Solrender, viste det sig, at Middeldifferentsen for øvre Rand var + 0.′295 og for nedre Rand — 0.′282. Den observerede Solradius er saaledes gjennemsnitlig 0.′3 større end den til Beregningen benyttede. Corrigeres med denne Størrelse, faaes de i den følgende Tabel anførte Værdier af Differentserne Δ mellem observeret minus beregnet Solhøjde. I Tabellen ere alle Uhrtider reducerede til Reid, og alle maalte Solhøjder corrigerede for Indexfejl, Kimmingdaling, Refraction, Parallaxe og Solradius (Naut. Almanac's). *o* betegner øvre Solrand, *n* nedre Solrand. Aflæsningerne paa Sextanten ere gjorte i Secunder og Reductionen udført med Secunder, men da den sandsynlige Fejl af en enkelt Højde er over et halvt Minut, opføres i Tabellen Tiendedels Minut, ligesom Beregningen efter de mindste Kvadraters Methode er ført med femzifrede Logarithmer.

anchorage off the east coast. From the foot of the Fugleberg, the height of the mast, as measured by myself on the 29th of July, gave an angle of $0^0\ 55.'5$, which corresponds to a distance of 0.′62. At this point, the azimuth of the ship from the Fugleberg was about 70°. Computing with these results, our anchorage off the west coast should lie 10.″9 farther north and 1′ 49.″1 farther west than the Fugleberg. Hence, the anchorage off the west coast lies 2′ 1.″3 farther north and 4′ 27″ farther west than the anchorage off the east coast. Assuming for the latter $\varphi_0 = 70^0\ 58.'0$ and $\lambda_0 = 0^h\ 33^m\ 48.'3$, for the anchorage off the west coast $\varphi_0 = 71^0\ 0'\ 1''$ and $\lambda_0 = 0^h\ 34^m\ 6.'1$.

By the method of the least squares, I computed the most probable corrections of φ_0 and λ_0.

Then, on grouping the differences (the sum of the squares of which is a minimum) between the observed (duly corrected) altitudes of the sun's centre and those computed with the most probable values found for latitude and longitude, according to the observed solar limbs, the mean difference for the upper limb proved to be + 0.′295, and for the lower — 0.′282. On an average, therefore, the observed semidiameter of the sun is 0.′3 greater than that taken for the computation. Corrected with this quantity, we get the values given in the following Table for the differences, Δ, between the observed and the computed solar altitudes. In this Table all chronometer-times are reduced to those of the Reid chronometer, and all observed altitudes corrected for the index-error, the dip of the horizon, refraction, parallax, and the sun's semidiameter (from Naut. Almanac); *o* signifies upper solar limb, *n* lower solar limb. The readings of the sextant were noted in seconds, and their reduction computed in seconds; but the probable error of a single altitude amounting to more than half a minute, tenths of a minute have been given in the Table. The computation by the method of the least squares is made with five decimals in the logarithms.

Ankerplads paa Vestsiden. 1877. Juli 30.

(Anchorage on the West Side. 1877. July 30.)

Chron. Reid.	Obs. Højde. *(Obs. Altitude.)*	Rand. *(Limb.)*	Sext.	Obs.	Δ
$5^h\ 47^m\ 28^s$	$20^0\ 57.'2$	*n.*	*E.*	*G.*	+ 0.′9
5 48 1	20 56. 4	*n.*	*S.*	*M.*	— 1. 3

Ankerplads paa Østsiden. Obs. Capt. Wille.

(Anchorage on the East Side.)

Chron. Reid.	Obs. Højde. *(Obs. Altitude.)*	Rand. *(Limb.)*	Sext.	Δ
Juli *(July)* 31. $0^h\ 38^m\ 59.'$	$37^0\ 11.'2$	*n.*	*S.*	— 1.'1
$0\ 59\ 18.5$	$37\ 2.4$	*n.*	*S.*	— 0.4
$1\ 11\ 56$	$36\ 51.6$	*n.*	*E.*	— 0.1
$1\ 28\ 42.5$	$36\ 30.3$	*n.*	*E.*	— 0.7
$22\ 42\ 17$	$34\ 32.2$	*n.*	*E.*	— 2.1

De 4 første er givet dobbelt Vægt, da de bero paa flere Observationer hver. Man ser, at den observerede Solradius er større end min, sandsynligvis paa Grund af, at der er benyttet svagere Blændglas.

To the first 4 altitudes is attached double weight, each being the mean of several observations. The observed semidiameter of the sun is greater than mine, probably from lighter coloured glasses having been used.

Ankerplads paa Østsiden. Troughton's Sextant.

(Anchorage on the East Side.)

Iagttager *(Observer)*: Mohn. 1877. Juli *(July)* 30—31.

Chron. Reid.	Rand. *(Limb.)*	Obs. Højde. *(Obs. Altitude.)*	Δ
$22^h\ 35^m\ 37.'9$	*n.*	$34^0\ 31.'4$	+ 0.'6
$37\ 58.6$	*n.*	37.4	+ 0.4
$0\ 22\ 54.0$	*n.*	$37\ 11.5$	— 1.0
$37\ 37.5$	*o.*	14.9	+ 1.7
$40\ 18.3$	*n.*	11.3	— 0.8
$42\ 39.0$	*n.*	11.0	— 0.5
$48\ 25.5$	*o.*	10.4	+ 0.4
$58\ 39.6$	*n.*	4.0	+ 0.5
$1\ 0\ 19.5$	*o.*	2.7	— 0.1
$13\ 18.0$	*n.*	$36\ 49.1$	— 1.4
$15\ 9.9$	*o.*	50.0	— 1.2
$19\ 23.6$	*o.*	46.0	+ 1.9
$20\ 57.4$	*n.*	41.9	+ 0.4
$22\ 11.2$	*n.*	39.3	— 0.6
$23\ 41.1$	*o.*	38.5	— 0.1
$25\ 5.0$	*o.*	36.7	— 0.1
$26\ 23.0$	*n.*	34.5	+ 0.1
$27\ 31.9$	*n.*	32.7	0.0
$29\ 18.7$	*o.*	30.4	— 0.4
$29\ 44.6$	*o.*	28.2	— 2.0
$32\ 36.5$	*o.*	26.4	+ 0.6

Chron. Reid.	Rand. *(Limb.)*	Obs. Højde. *(Obs. Altitude.)*	Δ
$1^h\ 33^m\ 58.'3$	*n.*	$36^0\ 22.'4$	— 0.'7
$46\ 23.3$	*o.*	2.2	— 0.1
$47\ 23.2$	*o.*	0.2	— 0.3
$48\ 37.0$	*o.*	$35\ 58.7$	+ 0.6
$49\ 21.0$	*o.*	56.3	— 0.5
$49\ 55.0$	*o.*	55.3	— 0.3
$50\ 39.0$	*o.*	54.0	— 0.3
$51\ 20.4$	*o.*	53.9	+ 1.3
$52\ 32.8$	*n.*	50.1	+ 0.4
$53\ 29.2$	*n.*	47.9	+ 0.1
$54\ 22.1$	*n.*	46.4	+ 0.2
$55\ 7.6$	*n.*	45.3	+ 0.7
$56\ 47.5$	*n.*	41.9	+ 0.7
$58\ 35.4$	*n.*	37.6	+ 0.3
$2\ 0\ 29.7$	*n.*	35.4	+ 2.1
$22\ 41\ 38.0$	*o.*	$34\ 33.2$	+ 0.5
$43\ 57.5$	*o.*	39.0	+ 0.4
$48\ 13.0$	*o.*	49.6	+ 0.5
$23\ 19\ 19.6$	*n.*	$35\ 54.9$	+ 0.6
$22\ 34.0$	*n.*	59.2	— 0.8
$23\ 59.8$	*n.*	$36\ 2.9$	+ 0.4

Af alle Observationer findes $\delta = \pm\ 0.'57 = \pm\ 34''$.

$\Delta\varphi = +\ 0.'07 \pm 0.'09 = +\ 4.''5 \pm 5.''5.$
$\Delta\lambda = -\ 2.'35 \pm 0.'66 = -\ 2'\ 20.''9 \pm 39.''8 =$
$-\ 9.'39 \pm 2.'65.$

All the observations taken together give $\delta = \pm\ 0.'57 = \pm\ 34''$.

$\Delta\varphi = +\ 0.'07 \pm 0.'09 = +\ 4.''5 \pm 5.''5.$
$\Delta\lambda = \quad 2.'35 \pm 0.'66 = -\ 2'\ 20.''9 \pm 39.''8 =$
$-\ 9.'39 \pm 2.'65.$

En constant Fejl af 10″ i Højderne vil forandre den beregnede Bredde saa meget som 10.″02 og den beregnede Længde saa meget som 0.ˢ52. Resultatet bliver saaledes for Ankerpladsen paa Østsiden

A constant error of 10″ in the altitudes will change the computed latitude as much as 10.″02, and the computed longitude as much as 0.ˢ52. Hence, the result for our anchorage off the east coast is —

$$\varphi = 70^{\circ}\ 58'\ 4.''5 \pm 11.''4$$
$$\lambda = 8\ 24\ 43.^{s}7 \pm 41.^{s}0 = 0^{h}\ 33^{m}\ 38.^{s}9 \pm 2.^{s}73 \text{ W. Greenwich.}$$

og for Fuglebergets Top

and for the summit of the Fugleberg —

Bredde *(Latitude)* 70° 59′ 55″ ± 11.″4
Længde *(Longitude)* 8 27 22 ± 41.ˢ0 = 0ʰ 33ᵐ 49.ˢ5 ± 2.ˢ73 W. Greenwich.

Scoresby's Kart[1], paa hvilket Fugleberget let kan identificeres, lægger dette 1.′6 nordligere og 31′ (10 Kvartmil) østligere end min Bestemmelse. Scoresby's Observationer gjordes den 3die og 4de August 1817. I 1878 fandt den hollandske Expedition med Skonnerten "Willem Barendsz", at Jan Mayen ligger vestligere end paa Scoresby's Kart. Efter min Bestemmelse er Øen aflagt paa det af Capt. Wille og mig over samme udarbejdede nye Kart, der følger senere i denne Generalberetning.[2]

Scoresby's Map,[1] on which the Fugleberg may be easily found, places that mountain 1.′6 north and 31′ (10 miles) east of my determination. Scoreby's observations were taken on the 3rd and 4th of August 1817. In 1878, the Dutch Expedition, with the schooner "Willem Barendsz," found the Island of Jan Mayen to lie farther west than it does on Scoresby's map. For the new map of Jan Mayen constructed by Capt. Wille and myself, — to be subsequently published in the General Report,[2] — the position of the island was laid down from my own determination of latitude and longitude.

[1] An Account of the Arctic regions.

[2] Ogsaa publiceret i Petermann's Mittheilungen f. 1878 Taf. 13 og i den nye Udgave af Stieler's Hand-Atlas.

[1] An Account of the Arctic Regions.

[2] This Map has already appeared in Petermann's Mittheilungen for 1878, Pl. 13, and in the new Edition of Stieler's Hand-Atlas.

C. Wille. Magnetiske Observationer.

Efter den for Nordhavs-Expeditionen lagte Plan skulde der søges udført Observationer til Bestemmelse af Jordmagnetismens Elementer saavel i Land som i Søen. Til dette Øjemed anskaffedes og medbragtes følgende Instrumenter:

Et Unifilar-Magnetometer, No. 38, af Elliott Brothers i London. Instrumentet blev verificeret og dets Konstanter bestemte ved Observatoriet i Kew.

En liden Theodolit af Olsen i Kristiania, laant af den geografiske Opmaaling.

Et Inklinatorium af John Dover, Charlton, Kent, undersøgt i Kew.

Et Admiralitets-Standard-Kompas, verificeret ved Kompas-Observatoriet i Deptford.

Flere Azimuth-Kompasser.

En Fox-Cirkel No. 30 af John Dover, med Hjælpeapparater og Slingrebord.

Flere Kronometre og Sextanter.

Et Observationstelt fra Bergens Arsenal, velvillig udlaant af Armé-Intendanten.

Jeg skal nu særskilt behandle Observationerne paa Landstationer og Observationerne i Søen.

A. Observationer paa Land-Stationer og deres Resultater.

a. Deklination.

Begge til Magnetometret hørende Magneter var Kollimations-Magneter, med Skalaer i Objectivglassets Brændplan. Da Instrumentet ikke var forsynet med Plan-Spejl til Deklinationsbestemmelse, men kun havde et Hulspejl til at

C. Wille. Magnetical Observations.

The Scheme of Work approved for the Norwegian North-Atlantic Expedition, was, if possible, to comprise observations for determining the elements of terrestrial magnetism, alike on shore and at sea. With this object in view, the following instruments were provided.

A Unifilar Magnetometer, No. 38, made by Elliott Brothers, of London. This instrument was verified, and had its constants determined, at the Kew Observatory.

A small Theodolite, by Olsen of Christiania, obtained on loan from the Geographical Survey.

A Dip-Circle, by John Dover, of Charlton, Kent, examined at Kew.

An Admiralty Standard-Compass, verified at the Compass Observatory, Deptford.

Several Azimuth-Compasses.

A Fox-Circle, No. 30, by John Dover, with auxiliary apparatus and gimbal-table.

Several Chronometers and Sextants.

A Tent, kindly lent from the Bergen Arsenal.

I will now pass on to the observations, describing separately those taken at the land-stations and those made at sea.

A. Observations at Land-Stations, and their Results.

a. Declination.

Both of the magnets belonging to the magnetometer were collimator-magnets, with the scale in the focal plane of the object-glass. The instrument not being provided with a plane mirror for observing the declination, but

belyse Magnetens Skala, maatte en særskilt Theodolit anvendes til Bestemmelse af Azimut. Theodoliten opstilledes i 1876 paa sit eget Stativ med sin Kikkert i samme Højde som Magneten og saa nær denne som muligt. Da dette voldte meget Bryderi, lod jeg forfærdige paa Hortens mekaniske Verksted et Underlag af Messing, der kunde lægges paa Magnetometret og fæstes til dette ved Hjælp af de samme Indretninger, som anvendtes ved Deflektionsstangens Befæstigelse. Paa den ene Side af dette Underlag anbragtes Theodoliten, med Fodskruerne i smaa dertil afpassede Huller, og paa den anden Side en Modvægt af Bly. Det var med denne Indretning altid let at faa se og kunne indstille Magnetskalaens Midtstreg paa Theodolitens Vertikalfilament. Observationerne udførtes i Regelen paa følgende Maade:

Ophængningstraadens Torsion ophævedes. Theodoliten nivelleredes, og indstilledes med Filamentet paa Skalaens Midtstreg i Magneten, hvorefter Theodolitens Nonier aflæstes (Magn. I).

Theodoliten drejedes, saaledes at dens Kikkert pegede lidt vestenfor Solen, i Solcentrets Højde, og fastklemtes. Tidspunkterne for Overgangen af forangaaende og efterfølgende Rand af Solen over Vertikalfilamentet noteredes efter Kronometer. Denne Iagttagelse gjordes enten med Blændglas foran Okularet eller ved at projicere Solens og Filamentets Billede paa en hvid Skjærm. I mange Tilfælde var der to Iagttagere, af hvilke den enè observerede Solrandenes Passage og raabte "Nu" i det Øjeblik, de tangerede Filamentet, medens den anden observerede og noterede tilsvarende Øjeblikke efter Kronometret. Nonierne aflæstes.

Kikkerten lagdes om gjennem Zenit (Nadir), drejedes 180° om Vertikalaxen og begge Solrandes Passage observeredes i denne Stilling efter Kronometret, ligesom Nonierne aflæstes.

Magneten omlagdes, idet den drejedes 180° om sin Længdeaxe, og Filamentet i Theodolitkikkerten indstilledes atter paa Magnetskalaens Midtstreg, og Nonierne aflæstes. (Magn. II).

Naar Omstændighederne tillod det, observeredes atter Magneten i Stillingen I. Stundom blev den omlagt flere Gange.

Ligesaa flyttedes, ved saadanne Lejligheder, Theodoliten ved den følgende Sats saaledes, at Fodskruerne kom hver i andre Huller, hvorved dens Cirkels Nulpunkt forandredes 120°. Det viste sig imidlertid, at dens Delingsfejl ikke var saa betydelige, at denne Vexling af Stilling var nødvendig for at opnaa den forlangte Nøjagtighed af c. 1 Minut.

I flere Tilfælde bestemtes Azimut af en Mire, til hvilken Observationen af Magneten i begge Stillinger blev knyttet.

Kronometrets Stand blev i de fleste Tilfælde bestemt ved Solhøjder tagne med Sextant paa Observations-

having only a concave mirror by which to illuminate the scale of the magnet, the azimuth had to be determined with a separate theodolite. In 1876, the theodolite was mounted on its own stand, with the telescope facing the magnet, and as near it as possible. This, however, proving excessively troublesome, I procured from the Horten Mechanical Works a brass support, which, when placed upon the magnetometer, could be attached in the manner adopted for fixing the deflection-rod. On one side of this brass support was mounted the theodolite, with the foot-screws fitting into holes made for the purpose, the other side being given a counterpoise of lead. With this arrangement, the scale of the magnet could be easily sighted, and the middle division bisected by the vertical wire of the theodolite. The observations were generally taken as follows: —

The torsion of the suspension thread having been first removed, the theodolite was levelled, and the wire made to bisect the middle division of the scale of the magnet, after which the verniers of the theodolite were read off (Magn. I). The theodolite was then moved in azimuth and altitude till its teloscope pointed a little to the west of the sun, at the altitude of the sun's centre, and clamped in that position. The times for the transit of the preceding and following limbs of the sun across the vertical wire, were noted by a chronometer. This observation was taken either with a coloured glass before the eye-piece or by projecting the image of the sun and the wire on a white screen. Frequently, there were two observers, in which case one observed the transit of the solar limbs, calling out at the moment they were tangent to the wire, while the other observed and noted the corresponding readings of the chronometer. Then, after reading off the verniers, the telescope was turned through the zenith (nadir), moved 180° on its vertical axis, and the transits of both solar limbs observed in that position by the chronometer, the verniers being also read off.

The magnet was now inverted, being turned 180° about its longitudinal axis, and the wire of the telescope of the theodolite again made to bisect the middle division of the scale of the magnet, after which the verniers were read off (Magn. II).

Circumstances permitting, the magnet was again observed in position I. Occasionally, it was inverted several times.

Moreover, on such occasions the theodolite was so moved previous to the following set of observations, that the foot-screws should correspond with different holes, and change the zero of its circle by 120°. Its errors of division, however, did not prove so considerable as to render imperative such change in position for attaining the desired accuracy of about one minute.

In several cases, the azimuth of a mark was determined from the observations of the sun, and the observations of the magnet, in both positions, connected with the direct observations of the mark.

As a rule, the error of the chronometer was found from solar altitudes, taken with the sextant at the place

stedet. Herom kan jeg henvise til den foranstaaende Afhandling af Professor Mohn. Kronometrenes Gang bestemtes efter Sammenligning med det ombord værende Normalkronometer, hvis Stand og Gang var bestemt væsentlig efter telegrafiske Tidssignaler fra Christiania Observatorium[1]. Paa et Par Steder toges Kronometrets Stand efter dets Stand for Greenwich Tid og Længden af Observationsstedet efter Kystkartet.

Observationerne af alle Elementer gjordes i Teltet. Ved Observation af Solen aabnedes Teltet netop saavidt i Rum og Tid, som var nødvendigt.

of observation. For details on this head, I can refer to the foregoing Memoir, by Professor Mohn. The rate of the chronometer was determined by comparison with the standard chronometer on board, the error and rate of which were found chiefly by means of the time-signals telegraphed from the Christiania Observatory[1]. At one or two points, the error of the chronometer was taken from its error on Greenwich time and the longitude of the place of observation on the coastal chart.

The observations of all the elements were made in the tent. For observations of the sun, the tent was opened to just the necessary extent in space and time.

b. Horizontal Intensitet.

Observationerne og Beregningerne udførtes efter Instruktionerne i "A Manual of Scientific Enquiry"; Fourth Edition, 1871 Side 96 til 101. Unifilar-Magnetometrets Konstanter var ved Kew-Observatoriet bestemte saaledes:

Correction for Delingsfejl ved Afbøjningsstangen
ved 1 Foot. = + 0.00002 Foot.
„ 1.5 — = + 0.00004 —
} ved 62° F.

Svinge-Magnet, Værdi af 1 Skaladel = 1.′9.

Afbøjningsmagnetens Correction til 35° F = $0.000130\ (t_o - 35) + 0.00000056\ (t_o - 35)^2$.

Induktionskoefficient $\mu = 0.000195$.

Log π^2 K ved 60° F = 1.69708.

Der er desuden givet forskjellige Hjælpetabeller, blandt hvilke en for Værdierne af Log. π^2 K og Log $^1/_2$ r^3 for forskjellige Temperaturer:

b. Horizontal Intensity.

The observations and computations were made in accordance with the instructions contained in "A Manual of Scientific Enquiry;" Fourth Edition, 1871, pp. 96—101. The constants of the Unifilar Magnetometer had been determined at the Kew Observatory, as follows: —

Correction for errors of division of Deflecting Rod
at 1. Foot = + 0.00002 foot
„ 1.5 — = + 0.00004 „
} at 62° F.

Vibration Magnet, value of 1 division of Scale = 1.′9.

Deflecting Magnet, correction to 35° F = $0.000130\ (t_o - 35) + 0.00000056\ (t_o - 35)^2$.

Coefficient of Induction $\mu = 0.000195$.

Log π^2 K at 60° F = 1.69708.

Moreover, divers auxiliary Tables are annexed, one of which gives the values of Log. π^2 K and of Log. $^1/_2$ r^3 at different temperatures.

Temp. F	Log. π^2 K	Log. $\frac{1}{2}$ r^3 $r_0 = 1.0$	Log. $\frac{1}{2}$ r^3 $r_0' = 1.3$
30	1.69690	9.69859	0.04041
40	696	872	054
50	702	885	067
60	708	898	080
70	714	911	093
80	720	924	106
90	1.69726	9.69937	0.04119

Som Exempel paa Observationernes Udførelse og Beregning hidsættes følgende, efter de fra Kew erholdte trykte Blanketter udfyldte, Skemata.

To show the mode of taking and computing the observations, copies of the printed forms in use at Kew Observatory have been filled out, and here subjoined.

[1] Se den citerede Afh. Side 2.

[1] See Professor Mohn's Memoir, p. 2.

Observations of Deflection, 2nd of October 1876.

Station Christiania; Lat. 59° 54′ 43″, Long. 10° 43′ 37″.
Mean Time at Station; commencing 0^h 36^m p. m., ending 1^h 20^m p. m.
Magnet (A) deflecting; (B) suspended.

Deflecting Magnet: Distance	N. End.	Temp.	Readings of Verniers	Mean of Verniers	Corrected Circle Reading	Means and Differences	
East							
1 Foot	E.	53.°4	143° 17′ 40″	143° 17′ 30″	143° 17′ 30″	143° 13′ 40″	
			17 20		143 9 50	90 23 40	
1 „	W.	53. 4	90 21 0	90 21 10		52 50 0	Diff.
			21 20		90 21 10		
1.3 „	E.	53. 3	128 13 20	128 13 20	26 10	26 25 0.	u_o
			13 20				
1.3 „	W.	53. 2	105 7 40	105 7 50			
			8 0				
West							
1 Foot	W.	53.°4	90° 26′ 0″	90° 26′ 10″	128° 13′ 20″	128° 17′ 45″	
			26 20		22 10	105 10 25	
1 „	E.	53. 4	143 9 40	143 9 50		23 7 20	Diff.
			10 0		105 7 50		
1.3 „	W.	53. 0	105 13 0	105 13 0	13 0	11 33 40	u'_o
			13 0				
1.3 „	E.	53. 0	128 22 0	128 22 10			
			22 20				

Mean t_o = 53° 26 − 8 = 52.°5

Observed Angles of Deflection $(u_{,o})$ $r_o = 1.0 = 26° 25′ 0″$; $r'_o = 1.3 = 11\ 33\ 40$

$\frac{m_o}{X_o} = \frac{1}{2} r^3 \sin u_o$; $\frac{m'}{X'} = \frac{m_o}{X_o}\left\{1 + \frac{2\mu}{r_o^3} + q\,(t_o - t)\right\}$; $\frac{m}{X} = \frac{m'}{X'}\left(1 - \frac{P}{r_o^2}\right)$.

	$r = 1.0$	$r' = 1.3$		$r = 1.0$	$r' = 1.3$
			$\frac{1}{2} r^3$ Log. =	9.69888	0.04070
$1 + \frac{2\mu}{r_o^3}$ =	1.00039	1.00086	Sin. u_o Log. =	9.64826	9.30193
$+ (t_o - t)\,q$ =	0.00244	0.00244	$\frac{m_o}{X_o}$ Log. =	9.34714	9.34263
$1 + \frac{2\mu}{r_o^3}(t_o - t)\,q$ =	1.00283	1.00330	Log. =	0.00123	0.00143
			$\frac{m'}{X'}$ Log. =	9.34837	9.34406
			$1 - \frac{P}{r_o^2} = 0.97618$ Log. =	9.98953	9.99384
			$\frac{m}{X}$ Log. =	9.33790	9.33790
			mX Log. =	0.41767	
			$mX - \frac{m}{X} = X^2$ Log. =	1.07977	
			$3.4664 = X =$ Log. =	0.53988	
			$0.7547 = m =$ Log. =	9.87779	
			Red. to Metr. Un. Log. =	9.66378	
			$1.5983 = X =$ Log. =	0.20366	

Observer *Carl Wille.*

Observations of Vibration, 2nd of October 1876.

Station Christiania; Lat. 59° 54′ 43″, Long. 10° 43′ 37″.
Chronometer. Error at Station = $0^h\ 42^m\ 38^s$ Daily Rate (s) = 4.″5 Accl.
Magnet (A) suspended.
Effect of 90° of Torsion = 2.26 Div. = 4.″29. One Div. of Scale = 1.″9.
At Commencement / At End: Mean Time at Station $1^h\ 50^m$ / 2 2 p. m.; Semiarc of Vib. 76′ / 22.8; Temp. of Magnet 55.°0; $t_o = 55.°0$ / $t_o = 55.0$

Scale moving apparently to the Right					Scale moving apparently to the Left				
No. of Vib.	Time of Centre passing wire	No. of Vib.	Time of Centre passing wire	Time of 100 Vib.	No. of Vib.	Time of Centre passing wire	No. of Vib.	Time of Centre passing wire	Time of 100 Vib.
0	$2^h\ 33^m\ 21.''7$	100	$40^m\ 38.''1$	$7^m\ 16.''4$	5	$2^h\ 33^m\ 43.''5$	105	$41^m\ 00.''0$	$7^m\ 16.''5$
10	34 5.3	110	41 21.7	16.4	15	36 27.1	115	41 43.5	16.4
20	34 49.0	120	42 5.5	16.5	25	35 10.7	125	42 27.1	16.4
30	35 32.7	130	42 49.2	16.5	35	35 54.5	135	43 11.0	16.5
40	36 16.3	140	43 33.0	16.7	45	36 38.0	145	43 54.5	16.5
50	37 0.0	150	44 16.5	16.5	55	37 21.7	155	44 38.3	16.6
Diff.	3 38.3			.30	Diff.	3 38.2			29
100 at	2 40 38.3		Mean (1) =	7 16.5	105 at	40 59.9		Mean (2) =	7 16.48

$$T_{,} = T_o \left\{ 1 - \frac{s}{86400} - \frac{\alpha\alpha'}{16} \right\} \qquad T^2 = T_{,}^2 \left\{ 1 + \frac{H}{F} - q\,(t_o - t) + \mu \frac{X_o}{m_o} \right\} \qquad mX = \frac{\pi^2 K}{T^2}$$

$1 - \frac{s}{86400} = 0.99995$ — Mean (1) = $7^m\ 16.50$
$- \frac{\alpha\alpha'}{16} = 0.00001$ — „ (2) = 7 16.48
$1 - \frac{s}{86400} - \frac{\alpha\alpha'}{16} = 0.99994$ — T_o = 4.″3649 Log. = 0.63997
$1 + \frac{H}{F} = 1.00079$ — Log. = 9.99997
$- q\,(t_o - t) = 0.00282$ — $T_{,}$ Log. = 0.63994
0.99997
$+ \mu \div \frac{m_o}{X_o} = 0.00088$ — $T_{,}^2$ Log. = 1.27988
$1 + \frac{H}{F} - q\,(t_o - t) + \mu - \frac{m_o}{X_o} = 0.99885$ — Log. = 9.99950
T^2 Log. = 1.27938
μ Log. = 6.29003 — $\pi^2 K$ Log. = 1.69705
$\frac{m_o}{X_o}$ Log. = 9.34714 — $mX = \frac{\pi^2 K}{T^2}$ Log. = 0.41767
$\mu \div \frac{m_o}{X_o} = 0\ 00088$ Log. = 6.94289 — $\frac{m'}{X'}$ Log. = 9.34837
$mX - \frac{m'}{X'} = X'^2$ Log. = 1.06930
$X' = 3.4249$ Log. = 0.53465
m'^2 Log. = 9.76604
$m' = 0.76387$ Log. = 9.88302

Observation of Torsion.

Circle turned		Scale	Mean	Diff.
0°	=	40		
+ 180°	=	44.3	39.75	4.55
0°	=	39.5		
— 180°	=	35.5	40. 0	4.5
0°	=	40.5		4.5
			90° = 2.26	= 4.″29

Observer *Carl Wille.*

c. Inklination.

Det Doverske Inklinatorium havde tre Naale. Aflæsningen af Naalespidsene sker ved Mikroskoper. Nonierne angiver Minutter. Observationerne udførtes og beregnedes efter Instruktionerne i Manual of Scientific Enquiry Side 103—105. Følgende Skema benyttedes:

c. Inclination.

Dover's Dip-Circle had three needles. The ends of the needles are observed with microscopes. The verniers read minutes. The observations were taken and computed in accordance with the instructions in "A Manual of Scientific Enquiry," pp. 103—105. The printed form was as follows:

Magnetic Dip.

Station Christiania. Date 2nd of October 1876.
Needle No. 1.
Setting of Azimuth Circle 64° 49′ + 64° 28′ = 64° 38′.
Remarks . . . . . Magnetical Pillar in the Park of the Observatory.
Time 10^h 55^m a. m. to 0^h 5^m p. m.

Face of Needle to face of Instrument	Face of Instr.	Poles direct B dipping: Readings of Needle — Lower end	Upper end	Mean	Poles reversed A dipping: Readings of Needle — Lower end	Upper end	Mean
	EAST	71° 5.′5	71° 6.′0	71° 5.′7	71° 10′	71° 12′	71° 11.′0
		4.5	5.5	5.0	9	12	10.5
		4.0	4.0	5.0	9	11	10.0
		Mean = a		71 5.2	Mean = b		71 10.5
	WEST	71 0	70 58	70 59.	71 1	70 58	59.5
		0	59	59.5	1	58	
		0	71 0	60			
		Mean = a'		70 59.5	Mean = b'		70 59.5
Face of Needle reversed.	WEST	71 17	71 14	71 15.5	71 21.5	71 20	71 20.7
		16	14	15	21	19	20.0
		15	13	14	20	19	19.5
		Mean = a''		71 14.8	Mean = b''		71 20.1
	EAST	71 7	71 10	71 8.5	70 41	70 43	70 42 0
		3	6	4.5	41	43	42.0
		5	8	6.5	40	43	41.5
		Mean = a'''		71 6.5	Mean = b'''		70 41.8
			a''	71 14.8		b''	71 20.1
			a'	70 59.5		b'	70 59.5
			a	71 5.2		b	71 10.5
				4 26.0			4 11.9
		Mean of Means = 71° 6.′5			Mean of Means = β		71° 2.′97
					Do. Do. = α		71 6.5
					$\frac{\alpha + \beta}{2}$ Dip		9.47
							71 4.74

Observer *Carl Wille.*

1. Bergen.

Ved Observatoriet paa Nordnes. Bredde $\varphi = 60^{\circ}\ 23'\ 54''$, Længde $\lambda = 5^{\circ}\ 24'\ 0''$ E. Greenwich.

Horizontal-Intensitet.

1876, Ma 22.

Afbøjnings-Observation Kl. 12 til 1,30 Min. Eft.

Temperatur $t_0 = 62.^{\circ}5$ F. Afbøjningsvinkel, for Afstanden $r_0 = 1$ Fod, $u_0 = 28^{\circ}\ 58'\ 55''$. Iagttager C. Wille.

Svingnings-Observation Kl. 2,6 Min. til 2,18 Min. Eft.

Temperatur $t_0 = 65.^{\circ}5$ F. Observeret Svingetid $T_0 = 4.'4919$. Kronometret vinder daglig 3'. Halve Svingebue ved Begyndelsen $\alpha = 77.'9$, ved Enden $\alpha' = 24.'7$. Torsion for en Dreining af 90°, $u = 11.'78$. Iagttager C. Wille.

Resultat. Med P = 0.02300 faaes $m = 0.76660$ og Horizontalintensitet X = 3.2238.

Inklination.

Kl. 3,0 til 4,30 Min. Eft. Naal No. 1. C. Wille.

Resultat. $\theta = 72^{\circ}\ 24.'3$.

1. Bergen.

Observatory at Nordnes; latitude $\varphi = 60^{\circ}\ 23'\ 54''$, longitude $\lambda = 5^{\circ}\ 24'\ 0''$ E. Greenwich.

Horizontal Intensity.

1876, May 22.

Observation of Deflection: 12 a. m. to 1,30 p. m.

Temperature $t_0 = 62.^{\circ}5$ F.; angle of deflection for the distance $r_0 = 1$ foot, $u_0 = 28^{\circ}\ 58'\ 55''$. Observer C. Wille.

Observation of Vibration: 2,6 p. m. to 2,18 p. m.

Temperature $t_0 = 65.^{\circ}5$ F.; observed time of one vibration $T_0 = 4.'4919$; chronometer gaining daily 3'. Semi-arc of vibration at commencement $\alpha = 77.'9$, at end $\alpha' = 24.'7$. Torsion for a twist of 90°, $u = 11.'78$. Observer C. Wille.

Result. — With P = 0.02300, m will be = 0.76660 and the horizontal intensity X = 3.2238.

Inclination.

3,0 p. m. to 4,30 p. m. Needle No. 1. Observer C. Wille.

Result. — $\theta = 72^{\circ}\ 24.'3$.

2. Husø.

$\varphi = 60^{\circ}\ 59.'6$; $\lambda = 4^{\circ}\ 37'$ E. Greenwich.

α. Teltplads paa Øen, hvor Hr. Lexaus Hus staar.

Deklination. 1876, Juni 10, fandtes ved korresponderende Højder af Prof. Mohn[1] Kronometret Mewes 575 at være $0^h\ 28^m\ 30'$ foran Stedets Middeltid og dets daglige Acceleration 5.'93.

Samme Dags Eftermiddag bestemtes fra Teltpladsen Azimut af "Poldetind", en Fjeldtop med Varde paa Indre Sulen, der ligger i en Afstand af 18.57 Kilometer fra Husø. Der observeredes i 3 Satser (I, II og III) med Cirkelens Nulpunkt i 3 forskjellige Stillinger, og i hver Sats Omlægning af Kikkerten gjennem Zenit (1 og 2). O = Object = Poldetinds Varde. ⊙ = Cirkelaflæsning for Solens Centrum. Ch. = Kronometertid. ⊙| = Forangaaende Solrand. |⊙ = Efterfølgende Solrand. U = Uhrkorrektion. M. T. = Middeltid. E = Tidsjevning. t = Sand Soltid. δ = Solens Deklination. φ = Bredden. a = Solens Azimut. N. P. = Cirkelens Nordpunkt. A = Azimut af Objektet.

[1] H. Mohn. Astr. Obs., Side 5.

2. Husø.

$\varphi = 60^{\circ}\ 59.'6$; $\lambda = 4^{\circ}\ 37'$ E. Greenwich.

α. Tent on the main island, where Mr. Lexau's house stands.

Declination. — On the 10th of June, 1876, Professor Mohn[1] found the error of the chronometer, Mewes, No. 575, from equal altitudes, to be $0^h\ 28^m\ 30'$ fast on local mean time, and its daily acceleration 5.'93.

In the afternoon of the same day, the azimuth of "Poldetind," a mountain-top with a trigonometrical signal, on the island of Indre Sulen, distant from Husø 18.57 kilometres, was determined from the tent. We observed in three sets (I, II, and III), with the zero-point of the horizontal circle in three different positions, and for each set reversing the telescope through the zenith (1 and 2). O = object = Poldetind signal; ⊙ = reading of limb corresponding to the sun's centre; Ch = time by chronometer; ⊙| = preceding solar limb; |⊙ = following solar limb; U = error of chronometer; M. T. = mean time; E = equation of time; t = apparent solar time; δ = declination of sun; φ = latitude; a = azimuth of sun; N. P. = circle reading corresponding to the astronomical meridian (North Point); A = azimuth of object.

[1] H. Mohn. Astronomical Observations, p. 5.

	I			II			III		
	1	2	M.	1	2	M.	1	2	M.
O.	165° 7.′1	7.′5	165° 7.′3	44° 55.′5	55.′0	44° 55.′25	284° 32.′0	31.′25	284° 31.′6
⊙	46 16.5	67.5	46 42.0	289 52.5	104.5	290 18.5	173 15.0	71.25	173 43.1
Ch. ⊙	7^h 3^m 0.′5	7^m 3.′5	7^h 5^m 2.′0	7^h 21^m 26.′0	25^m 32.′5	7^h 23^m 29.′2	7^h 39^m 31.′5	44^m 9.′0	7^h 41^m 50.′3
„ ☉	5 38.3	9 41.5	7 39.9	24 4.2	28 9.4	26 6.8	42 7.0	46 43.7	44 25.3
Ch.		7^h 6^m 20.′95				7 24 48.0			7 43 7.8
U.		— 0 28 31.53				— 0 28 31.6			— 0 28 31.7
M. T.		6 37 49.4				6 56 16.4			7 14 36.1
E.		+ 44.0				+ 43.9			+ 43.9
t		6 38 33.4				6 57 0.3			7 15 20.0
δ		23° 4′ 20″				23° 4′ 20″			23° 4′ 20″
φ		60 59 36				60 59 36			60 59 36
a		N 70 18.′0 W				N 66 28.′7 W			N 62 41.′0 W
⊙		46 42.0				290 18.5			173 43.1
N. P.		117 0.0				356 47.2			236 24.1
O.		165 7.3				44 55.2			284 31.6
A.		N 48° 7.3 E				N 48° 8.′0 E			N 48° 7.′5 E

Azimuth of Poldetind = N 48° 7.′6 E.

Samtidig maaltes Horizontalvinkelen mellem Poldetind og Gavlen af et Hus med Theodoliten og fandtes = 130° 50.′1. Altsaa bliver Azimut af Gavlen = N 178° 57.′7 E eller S 1° 2.′3 E.

The horizontal angle between Poldetind and the gable of a house, was measured at the same time with the theodolite, and found to be 130° 50.′1. Hence, the azimuth of the gable = N 178° 57.′7 E, or S 1° 2.′3 E.

Klokkeslet. *(Hour.)*	Magnet I.	Gavl. *(Gable.)*	Diff.	Magnet II.	Gavl. *(Gable.)*	Diff.	M.	Decl.
3^h 20^m p. m.	278° 39′	295° 44′	17° 5′	278° 27′	295° 46.′5	17° 20′	17° 12.′5	18° 14.′8
7 30 „ „	218 13	235 22	17 9	217 49	235 22	17 33	17 21.0	18 23.3
5^h 25^m p. m.								18° 19.′

Den 13de Juni tog Prof. Mohn følgende Observationer til Bestemmelse af Deklinationen, paa samme Tid som jeg svang Skibet for at bestemme Compassernes Deviation. Stativet med Theodoliten rykkedes 0.75 Meter mod Sydsydost fra den forrige Plads. Herved bliver Azimut af Poldetind fra den nye Plads 0.′1 mindre, eller N 48° 7.′5 E.

Magnetometret opstilledes paa sin Plads og der gjordes følgende Observationer, med Instrumentets egen Kikkert, for at bestemme Magnet-Axens Collimation.

On the 13th of June, Professor Mohn took the following observations to determine the declination, whilst I swung the ship for deviation of compass. The theodolite and stand was now moved 0.75 metre south-south-east from its former position. Taken from this point, the azimuth of Poldetind will be 0.′1 less, or N 48° 7.′5 E.

After mounting the magnetometer, he took the following observations, with the telescope of the instrument, to determine the collimation of the axis of the magnet: —

Magnet I.	Magnet II.
79° 27′ 20″	79° 6′ 35″
28 35	7 30
27 35	
M. 79° 27′ 50″	79° 7′ 2.″5

½ Diff. = 10′ 24″ = 10.′4

Med Theodoliten toges følgende Observationer.

With the theodolite he took the following observations: —

Klokkeslet. (*Hour.*)	Magnet II.	Poldetind.	Declination.
22^h 34^m	266° 33′	153° 19′	18° 28′ W.
54	43	19	18
23 11	41	—	20
53	40	19.5	20
0 28	48	17.5	12
31	44.5	—	16
53	51	18	9
1 5	48	17	11
32	44	—	15
51	42	—	17
3 55	44	17	15
4 17	46	17	13
27	47	17	12
54	48	17.5	12
5 5	49	—	10
22	50	—	9
37	49.5	17	9
59	50	—	9
6 16	51	17.5	9
49	53	—	6

Ved grafisk Udjevning findes følgende Værdier for Deklinationen.

Computed from diagramatic interpolation, the following values were found for the declination: —

22^h 30^m	18° 25	1^h 30^m	18° 15′	4^h 30^m	18° 12′
23 0	22	2 0	17	5 0	11
23 30	19	2 30	19	5 30	10
0 0	17	3 0	18	6 0	9
0 30	13	3 30	16	6 30	8
1 0	12	4 0	15	7 0	7

og saaledes i Middel for Kl. 2.45^m Deklination = 18° 14.′7 W.

and thus, as a mean for 2.45 p. m. the declination is 18° 14.′7 W.

Horizontal-Intensitet.

1876, Juni 10.

Afbøjnings-Observation. Kl. 5.5 Min. Eft. til 6.0 Min. E.

$t_0 = 50.°5$; $r_0 = 1$, $u_0 = 29°\ 30'\ 47''$; $r_0' = 1.3$, $u_0' = 12°\ 49'\ 35''$. C. Wille.

Svingnings-Observation. Kl. 4.3 Min. Eft. til 4.15 Min. Eft.

$t_0 = 52.°1$, $T_0 = 4.'52585$; $s = 4.'88$; $\alpha = 76'$; $\alpha' = 19'$; $u = 12.'82$. C. Wille.

Resultat. $P = 0.022999$; $m = 0.76534$; $X = 3.1732$.

1876, Juni 15.

Svingnings-Observation. Kl. 12.15 Min. til 12.27 Min. Eft.

$t_0 = 56.°8$; $T_0 = 4.'53062$; $s = 4.'9$; $\alpha = 50'$ $\alpha' = 31'$, $u = 12.'51$. H. Mohn.

Afbøjnings-Observation. Kl. 1.20 Min. til 1.45 Min. Eft.

$t_0 = 56.'2$; $u_0 = 29°\ 29'\ 40''$; $u_0' = 12°\ 48'\ 35''$. H. Mohn.

Resultat. $P = 0.02462$; $m = 0.76500$; $X = 3.1751$.

Svingnings-Observation. Kl. 2.4 Min. til 2.16 Min. Efterm.

$t_0 = 57.°2$, $T_0 = 4.'52815$; $s = 4.'9$; $\alpha = 72'$; $\alpha' = 22'$, $u = 10.'87$. H. Mohn.

Efter den foregaaende Afbøjnings-Observation beregnes $X = 3.1750$.

Svingnings-Observation. Kl. 6.6 Min. til 6.17 Min. Efterm.

$t_0 = 54.°8$, $T_0 = 4.'52880$; $s = 4.'9$; $\alpha = 57'$; $\alpha' = 19'$; $u = 9.'03$. H. Mohn.

Efter den foregaaende Afbøjnings-Observation beregnes $X = 3.1746$.

1877, Juni 4.

Afbøjnings-Observation. Kl. 4.0 Min. til 4.55 Min. Efterm.

$t_0 = 52.°9$; $u_0 = 28°\ 37'\ 12.''5$; $u_0' = 12°\ 27'\ 27.''5$. C. Wille.

Svingnings-Observation. Kl. 6.57 Min. til 7.8 Min. Efterm.

$t_0 = 48.°8$; $T_0 = 4.'5902$; $s = 2.'8$; $\alpha = 74'$; $\alpha' = 26'$; $u = 3.'99$. C. Wille.

Resultat. $P = 0.02433$; $m = 0.74415$; $X = 3.1761$.

Inklination.

1876, Juni 12. Kl. 10.30 Min. til 11.45 Min. Form. Naal No. 1. C. Wille.

$\theta = 72°\ 43.'35$.

Samme Dag. Kl. 1.30 Min. til 2.5 Min. Eft. Naal No. 2. C. Wille.

$\theta = 72°\ 40.'96$.

Horizontal Intensity.

1876, June 10.

Observation of Deflection: — 5.5 p. m. to 6.0 p m.

$t_0 = 50.°5$; $r_0 = 1$; $u_0 = 29°\ 30'\ 47''$; $r_0' = 1.3$; $u_0' = 12°\ 49'\ 35''$. C. Wille.

Observation of Vibration: — 4.3 p. m. to 4.15 p. m.

$t_0 = 52.°1$, $T_0 = 4.'52585$; $s = 4.'88$; $\alpha = 76'$; $\alpha' = 19'$; $u = 12.'82$. C. Wille.

Result. — $P = 0.022999$; $m = 0.76534$; $X = 3.1732$.

1876, June 15.

Observation of Vibration: — 12.15 p. m. to 12.27 p. m.

$t_0 = 56.°8$; $T_0 = 4.'53062$; $s = 4.'9$; $\alpha = 50'$, $\alpha' = 31$, $u = 12.'51$. H. Mohn.

Observation of Deflection: — 1.20 p. m. to 1.45 p. m.

$t_0 = 56.°2$; $u_0 = 29°\ 29'\ 40''$, $u_0' = 12°\ 48'\ 35''$. H. Mohn.

Result. — $P = 0.02462$; $m = 0.76500$; $X = 3.1751$.

Observation of Vibration: — 2.4 p. m. to 2.16 p. m.

$t_0 = 57.°2$; $T_0 = 4.'52815$; $s = 4.'9$; $\alpha = 72'$; $\alpha' = 22'$, $u = 10.'87$. H. Mohn.

Computed from the preceding observation of deflection $X = 3.1750$.

Observation of Vibration: — 6.6 p. m. to 6.17 p. m.

$t_0 = 54.°8$; $T_0 = 4.'52880$; $s = 4.'9$; $\alpha = 57'$; $\alpha' = 19'$; $u = 9.'03$. H. Mohn.

Computed from the preceding observation of deflection $X = 3.1746$.

1877, June 4.

Observation of Deflection: — 4.0 p. m. to 4.55 p. m.

$t_0 = 52.°9$; $u_0 = 28°\ 37'\ 12.''5$; $u_0 = 12°\ 27'\ 27.''5$. C. Wille.

Observation of Vibration: — 6.57 p. m. to 7.8 p m.

$t_0 = 48.°8$; $T_0 = 4.'5902$; $s = 2.'8$; $\alpha = 74'$; $\alpha' = 26'$; $u = 3.'99$. C. Wille.

Result. — $P = 0.02433$; $m = 0.74415$; $X = 3.1761$.

Inclination.

1876, June 12: — 10.30 a. m. to 11.45 a. m. Needle No. 1. C. Wille.

$\theta = 72°\ 43.'35$.

Same Day: — 1.30 p. m. to 2.5 p. m. Needle No. 2. C. Wille.

$\theta = 72°\ 40.'96$.

Samme Dag. Kl. 6.15 Min. til 7.5 Min. Eft. Naal No. 1. C. Wille.

$\theta = 72^\circ\ 43.'9.$

1876, Juni 15. Kl. 10.55 Min. til 11.53 Min. Form. Naal No. 1. H. Mohn.

$\theta = 72^\circ\ 46.'02.$

Samme Dag. Kl. 7.7 Min. til 7.32 Min. Eft. Naal No. 2. H. Mohn.

$\theta = 72^\circ\ 45.'05.$

1877, Maj 23. Kl. 5.0 Min. til 6.45 Min. Eft. Naal No. 1. C. Wille.

$\theta = 72^\circ\ 43.'35.$

Same Day: — 6.15 p. m. to 7.5 p. m. Needle No. 1. C. Wille.

$\theta = 72^\circ\ 43.'9.$

1876, June 15: — 10.55 a. m. to 11.53 a. m. Needle No. 1. H. Mohn.

$\theta = 72^\circ\ 46.'02.$

Same Day: — 7.7 p. m. to 7.32 p. m. Needle No. 2. H. Mohn.

$\theta = 72^\circ\ 45.'05.$

1877, May 23: — 5.0 p. m. to 6.45 p. m. Needle No. 1. C. Wille.

$\theta = 72^\circ\ 43.'35.$

β. Et Skjær paa Østsiden af Havnen.

Deklination. Juni 16. Iagttager: Professor Mohn.

Fra det Punkt, hvor Theodoliten var opstillet foran Magnetometret, kunde Poldetind ikke sees paa Grund af, at et nærmere liggende Fjeld kom i Vejen. Men fra et nærliggende Punkt paa Skjæret, i SSE for det første, var Poldetind synlig. Paa Øen, hvor Teltet stod, saaes Poldetind i samme Vertikal som Observationspunktet paa Skjæret, naar Theodoliten flyttedes, lodret paa Synslinien til Poldetind, 41.4 Meter mod SE fra Observationspunktet i Teltet. Heraf beregnes, at Azimut af Poldetind, seet fra Theodolitens Plads paa Skjæret, var

$48^\circ\ 7.'6 - 7.'7 = 47^\circ\ 59.'9$ E,

Fra den søndre Ende af Skjæret saaes en anden fjern Fjeldtop 10° 25′ nordenfor Poldetind. Fra Observationspunktet paa Skjæret saaes Varden paa Husø 182° 27′ til venstre for den nævnte Fjeldtop. Vinkelen mellem Husø Varde (i SW) og Poldetind (i NE) regnet over Nord var følgelig 192° 52′. Da Poldetinds Azimut var N 48° 0′ E, bliver Azimut af Husø Varde:

β. An Islet at the east side of the Harbour.

Declination. June 16. Observer Professor Mohn.

From the point at which the theodolite was mounted in front of the magnetometer, Poldetind could not be sighted, a mountain in the vicinity intercepting the view in that direction. Poldetind was visible however from an adjacent point south-south-east of the former. From the island on which was pitched the tent, Poldetind could be sighted in the same vertical as the point of observation on the islet, after moving the theodolite, perpendicular to the line of vision, 41.4 metres south-east of the point of observation in the tent. Hence, the azimuth of Poldetind as observed from the position of the theodolite on the islet, was —

$48^\circ\ 7.'6 - 7.'7 = \text{N}\ 47^\circ\ 59.'9$ E

From the southern extremity of the islet could be seen another distant mountain-top, 10° 25′ north of Poldetind. Sighted from the point of observation on the islet, Husø signal was 182° 27′ to the left of that summit. The angle between Husø signal (bearing SW.) and Poldetind (bearing NE.) reckoned through the north, was accordingly 192° 52′. The azimuth of Poldetind being N 48° 0′ E, that of Husø signal is —

$192^\circ\ 52' - 48^\circ\ 0' = \text{N}.\ 144^\circ\ 52'\ \text{W} = \text{S}\ 35^\circ\ 8'\ \text{W}.$

Kl. 11,15 Min. Form. gjordes følgende Observationer:

At 11.15 a. m. the following observations were made: —

Magnet	I	159°	31′	II	339°	3′	I 159° 4′	II 158° 50′
Husø Varde *(Husø Signal)*		213	30		393	30	213 30	213 30
Vinkel *(Angle)*		53	59		54	27	54 26	54 40
Middel *(Mean)*							S 54° 8′ W	
Azimut af Husø Varde *(Azimuth of Signal)*							S 35 8 W	
Declination							19° 0′ W	

Om Eftermiddagen opstilledes Instrumenterne paa Skjæret paa en anden Plads, i Nærheden af den forrige. Da Solen var synlig, benyttedes den til Azimutbestemmelse.

In the afternoon the instruments were set up at a point on the islet near to that previously selected. The sun being visible, the azimuth was found from solar observations.

Ch. ⊙	$7^h\ 41^m\ 50.'$	$46^m\ 17.'5$	$7^h\ 44^m\ 3.'75$
„ ⊙	44 23.5	48 52.7	46 38.1
			7 45 20.9
U.			— 0 29 6.1
M. T.			7 16 14.8
E.			— 31.3
t			7 15 43.5
a			N 62° 26.'8 W.
⊙			143 18.5
N. P.			205 45.3

Magnet I	7° 23.'75	
— II	57.0	
— I	37.0	
Magnet	7° 43.'7	
Magnet	187° 43.'7	— 180°
N. P.	205 45.3	
Decl.	18° 1.'6 W.	

Horizontal-Intensitet.

1876. Juni 16.

Afbøjnings-Observation. Kl. 12.5 Mm. til 12.37 Min. Eft.

$t_0 = 53.^08$; $u_0 = 29^0\ 30'\ 52.''5$; $u_0' = 12^0\ 50'\ 25.''6$. H. Mohn.

Svingnings-Observation. Kl.1.0 Min. til 1.10 Min. Eft.

$t_0 = 60.^05$; $T_0 = 4.5331$; $s = 4.'9$; $\alpha = 33'$; $\alpha' = 7'$; $u = 5.'21$. H. Mohn.

Resultat: $P = 0.02075$; $m = 0.76655$; $X = 3.1686$.

Afbøjnings-Observation. Kl. 2.0 Mm. til 2.20 Mm. Eft.

$t_0 = 53.^08$; $u_0 = 29^0\ 25'\ 1''$. H. Mohn.

Beregnet efter foregaaende Svingnings-Observation faaes $m = 0.7654$ og $X = 3.1734$.

Inklination.

1876. Juni 16.

Kl. 6.10 Min. til 6.49 Min. Eft. Naal No. 1. H. Mohn.

$\theta = 72^0\ 44.'8$.

Horizontal Intensity.

1876. June 16.

Observation of Deflection: — 12.5 p. m. to 12.37 p. m.

$t_0 = 53.^08$; $u_0 = 29^0\ 30'\ 52.''5$; $u_0' = 12^0\ 50'\ 25.''6$. H. Mohn.

Observation of Vibration: — 1.0 p. m. to 1.10 p. m.

$t_0 = 60.^05$; T_0 4.5331; $s = 4.'9$; $\alpha = 33'$; $\alpha' = 7'$; $u = 5.'21$. H. Mohn.

Result: — $P = 0.02075$; $m = 0.76655$; $X = 3.1686$.

Observation of Deflection: — 2.0 p. m. to 2.20 p. m.

$t_0 = 53.^08$; $u_0 = 29^0\ 25'\ 1''$. H. Mohn.

Computed from the preceding observation of vibration $m = 0.7654$ and $X = 3.1734$.

Inclination.

1876. June 16.

6.10 p. m. to 6.49 p. m. Needle No 1. H. Mohn.

$\theta = 72^0\ 44.'8$.

3. Reykjavik.

$\varphi = 64^0\ 8'\ 30''$; $\lambda = 21^0\ 54'\ 8''$ V- Greenwich.

Den grønne Plæne ved Konsul Simons Hus.

Deklination. 1876. Aug. 1ste fandt jeg ved corresponderende Højder af Solen, at Kronometret Kullberg viste $2^h\ 6^m\ 55.'6$ foran Stedets Middeltid ved Middag[1]. Kronometret vandt daglig 0.'60.

Den 29de Juli om Eftermiddagen bestemte jeg Azimut af en Mire.

[1] Se H. Mohn. Astr. Obs. Side 6.

3. Reykjavik.

$\varphi = 64^0\ 8'\ 30''$; $\lambda = 21^0\ 54'\ 8''$ W. Greenwich.

The grass-plot adjoining Mr. Simson's house.

Declination. 1876. Aug. 1st I found the Kullberg chronometer, from equal solar altitudes[1], to be at noon $2^h\ 6^m\ 55.'6$ fast on mean local time; chronometer gaining daily 0.'60.

On the 29th of July, after noon, I determined the azimuth of a mark.

[1] See H. Mohn. Astronomical Observations, p. 6.

	1	2	M.
O.	95° 10.′0	9.′5	95° 9.′75
⊙	149 54.0	150 42.5	150 18.25
Ch. ⊙	7h 32m 5.′5	35m 46.′0	7h 33m 55.75
„ ⊙	34 41.5	38 19.5	36 30.50
			7h 35m 13.′1
U.			— 2 6 54.2
M. T.			5 28 18.9
E.			— 6 10.7
t			5 22 8.2
a			N 90° 5.′4 W.
⊙			150 18.25
N. P.			240 23.65
O.			95 9.75
A.			N 145 13.9 W.

	5h 30m p. m. Magnet.	Mire. (*Mark.*)
I	21° 34.′0	95° 9.′5
II	22 34.5	95 10.0
I	21 37.5	95 10.0
	22° 5.′1	95° 9.′8
A	= N 145° 13.′9 W	
Mire	= 95 9.8	
N. P	= 240 23.7	
Magnet	= 202 5.1 — 180°	
Decl.	= 38° 18.′6 W.	

Horizontal-Intensitet.

1876. Juli 31,

Afbøjnings-Observation. Kl. 10 til 11 Form.

$t_0 = 55.^{0}0$; $u_0 = 36^0\ 26'\ 45''$; $u_0' = 15^0\ 31'\ 55''$. C. Wille.

Svingnings-Observation. Kl. 12.6 Min. til 12. 18 Min. Eft.

$t_0 = 57.^{0}5$; $T_0 = 5.'0050$; $s = 0.'60$; $\alpha = 76'$; $\alpha' = 23'$; $u = 10.'4$. C. Wille.

Resultat: P = 0.02231; $m = 0.76147$; X = 2.6141.

Svingnings-Observation. Kl. 3.57 Min. til 4.10 Min. Eft.

$t_0 = 57.^{0}8$; $T_0 = 4.'9810$; $s = 0.'60$; $\alpha = 76'$; $\alpha' = 23'$; $u = 8.'5$. C. Wille.

Afbøjnings-Observation. Kl. 5.10 Min. til 6.10 Min. Eft.

$t_0 = 57.^{0}0$; $u_0 = 35^0\ 59'\ 22''$. C. Wille.

Resultat: Med P = 0.02231; $m = 0.7612$; X = 2.6407.

Inklination.

1876. Juli 28. Kl. 5.0 til 6,35 Eft. Naal No. 1. C. Wille.

$\theta = 76^0\ 28.'5$.

1876. August 1. Kl. 1.20 Min. til 2.20 Min. Eft. Naal No, 2. C. Wille.

$\theta = 76^0\ 26.'3$.

Horizontal Intensity.

1876. July 31.

Observation of Deflection: — 10 a. m. to 11 a. m.

$t_0 = 55.^{0}0$; $u_0 = 36^0\ 26'\ 45''$; $u'_0 = 15^0\ 31'\ 55''$. C. Wille.

Observation of Vibration: — 12.6 p. m. to 12.18 p. m.

$t_0 = 57.^{0}5$; $T_0 = 5.'0050$; $s = 0.'60$; $\alpha = 76'$; $\alpha' = 23'$; $u = 10.'4$. C. Wille.

Result: — P = 0.02231; $m = 0.76147$; X = 2.6141.

Observation of Vibration: — 3.57 p. m. to 4.10 p. m.

$t_0 = 57.^{0}8$; $T_0 = 4.'9810$; $s = 0.'60$; $\alpha = 76'$; $\alpha' = 23'$; $u = 8.'5$. C. Wille.

Observation of Deflection: — 5.10 p. m. to 6.10 p. m.

$t_0 = 57.^{0}0$; $u_0 = 35^0\ 59'\ 22''$. C. Wille.

Result: — With P = 0.02231; $m = 0.7612$; X = 2.6407.

Inclination.

1876. July 28: — 5.0 p. m. to 6.35 p. m. Needle No. 1. C. Wille.

$\theta = 76^0\ 28.'5$.

1876. Aug. 1: — 1.20 p. m. to 2.20 p. m. Needle No. 2. C. Wille.

$\theta = 76^0\ 26.'3$.

4. Namsos.

$\varphi = 64° 28' 12''$ $\lambda = 11° 31' 33''$ E. Greenwich.

Ved Bunden af Bugten nordenfor Byen, c. 7 Meter fra Stranden, strax søndenfor Stien, der fører videre til en Grind.

Declination. 1876. August 19 fandt Prof. Mohn ved corresponderende Højder af Solen[1] Kronometret Frodshams Korrektion til Stedets Middeltid lig + $0^h\ 31^m\ 47.'85$. Kronometret vandt daglig 5.'12.

Den 18de August om Eftermiddagen gjorde vi begge i Forening Observationer til Bestemmelse af Azimut og Deklination.

4. Namsos.

$\varphi = 54° 28' 12''$ $\lambda = 11° 31' 33''$ E. Greenwich.

At the head of the bay, north of the town, about 7 metres from the shore, and directly south of the pathway leading to a gate.

Declination. 1876. Aug. 19 Professor Mohn found, from equal solar altitudes,[1] the error of the Frodsham chronometer on mean local time = $0^h\ 31^m\ 47.'85$; chronometer gaining daily 5.'12.

On the 18th of August, in the afternoon, Professor Mohn and myself took observations to determine the azimuth and declination.

Ch. ⊙	5^h	47^m	54'	51^m	53'	5^h	49^m	53.'5	Magnet I	98°	26'	
„ ⊙		50	18		54	17		52	17.5	— II	99	0	
							5	51	5.5	— I	98	26	
U.						+		31	51.'7		98°	43'	
M. T.							6	22	57.2	Magnet	278°	43.'0	— 180°
E.						—	0	3	29.2	N. P.	292	25.9	
t							6	19	28.0	Decl.	13°	42.'9	W.
a						N	80°	2.'9	W.				
⊙							212	23.0					
N. P.							292	25.9					

Horizontal-Intensitet.

1879. Aug. 18.

Afbøjnings-Observation. Kl. 11.30 Min. Form. til 12.50 Min. Eft.

$t_o = 67.°3$; $u_o = 31° 29' 42''$; $u_o' = 13° 35' 40''$. C. Wille.

Svingnings-Observation. Kl. 1.51 Min. til 2.3 Min. Eft.

$t_o = 70.°7$; $T_o = 4.'7183$; $s = 5.'12$; $\alpha = 76'$; $\alpha' = 24'$; $u = 4.'1$. C. Wille.

Resultat: P = 0.02671; $m = 0.75760$; X = 2.9639.

Inklination.

1876. August 19. Kl. 10.30 Min. til 11.30 Form. Naal No. 1. C. Wille.

$\theta = 74° 2.'3$.

Samme Dag. Kl. 5.0 Min. til 6.0 Min. Eft. Naal No. 2. H. Mohn.

$\theta = 74° 2.'3$.

[1] H. Mohn. Astr. Obs. Side 7.

Horizontal Intensity.

1876. Aug. 18.

Observation of Deflection: — 11.30 a. m. to 12.50 p. m.

$t_o = 67.°3$; $u_o = 31° 29' 42''$; $u_o' = 13° 35' 40''$. C. Wille.

Observation of Vibration: — 1.51 p. m. to 2.3 p. m.

$t_o = 70.°7$; $T_o = 4.'7183$; $s = 5.'12$; $\alpha = 76'$; $\alpha' = 24'$; $u = 4.'1$. C. Wille.

Result: — P = 0.02671; $m = 0.75760$; X = 2.9639.

Inclination.

1876. Aug. 19: — 10.30 a. m. to 11.30 a. m. Needle No. 1. C. Wille.

$\theta = 74° 2.'3$.

Same Day: — 5.0 p. m. to 6.0 p. m. Needle No. 2. H. Mohn.

$\theta = 74° 2.'3$.

[1] H. Mohn. Astronomical Observations, p. 7.

5. Bodø.

$\varphi = 67°\ 17'\ 14''\ \lambda = 14°\ 24'\ 51''$ E. Greenwich.

I Nærheden af Stranden, noget østenfor den østligste Landgangsbrygge.

1877. August 13 observerede Prof. Mohn Solhøjder samtidig med at jeg tog de magnetiske Observationer[1]. Ved de første fandtes umiddelbart Standen af Kronometret Frodsham for Stedets sande Tid (U').

5. Bodø.

$\varphi = 67°\ 17'\ 14''\ \lambda = 14°\ 24'\ 51''$ E. Greenwich.

Near the shore, a little to the east of the most easterly landing-pier.

1877. Aug. 13 Professor Mohn observed altitudes of the sun, whilst I took magnetic observations[1]. By direct computation from the altitudes, he determined the error of the Frodsham chronometer on apparent local time (U').

Deklination. *Declination.*

1877. August 13.

Ch.	⊙	5^h	59^m	5.'5	6^h	4^m	22.'0	6^h	1^m	43.'75	Magnet I 80° 41.'5
„	☾	6	1	27.0	6	46.0			4	6.50	— II 80 13.6
								6	2	55.1	80 27.55
U'								— 0	1	57.8	
								6	0	57.3	Magnet 260 27.55 — 180°
t											N. P. 272 8.7
a								N	84°	4.'5 W.	Decl. 11° 41.'2 W.
⊙									188	34.2	
N. P.									272	8.7	

Horizontal-Intensitet.

1877. Aug. 13.

Svingnings-Observation. Kl. 12.10 Min. til 12.23 Min. Eft.

$t_o = 77.°6$; $T_o = 4.'9275$; $s = 3.'4$; $\alpha = 76'$; $\alpha' = 25'$; $u = 3.'4$. C. Wille.

Afbøjnings-Observation. Kl. 4.30 Min. til 5.30 Min. Eft.

$t_o = 72.°7$; $u_o = 32°\ 46'\ 20''$; $u_o' = 14°\ 6'\ 35''$. C. Wille.

Resultat: P = 0.02445; $m = 0.74020$; X = 2.7854.

Inklination.

1877. August 13. Kl. 9.45 Min. til 11.10 Min. Form. Naal No. 1. C. Wille.

$\theta = 75°\ 21.'4$.

Horizontal Intensity.

1877. Aug. 13.

Observation of Vibration: — 12.10 p. m. to 12.23 p. m.

$t_o = 77.°6$; $T_o = 4.'9275$; $s = 3.'4$; α 76'; $\alpha' = 25'$; $u = 3.'4$. C. Wille.

Observation of Deflection: — 4.30 p. m. to 5.30 p. m.

$t_o = 72.°7$; $u = 32°\ 46'\ 20''$; $u_o' = 14°\ 6'\ 35''$. C. Wille.

Result: — P = 0.02445; $m = 0.74020$; X = 2.7854.

Inclination.

1877. August 13: 9.45 a. m. to 11.10 a. m. Needle No. 1 C. Wille.

$\theta = 75°\ 21.'4$.

6. Tromsø.

$\varphi = 69°\ 39.'1\ \lambda = 18°\ 59.'3$ E. Greenwich.

Ved Stranden, nogle hundrede Skridt nordenfor Bryggen ved Storstennes, paa Østsiden af Tromsø-Sundet.

Bredde og Længde efter de norske Kystkarter. Krometrets, Frodshams, Stand for Stedets Tid er beregnet efter dets Stand for Greenwich Tid og Kartets Længde.

[1] H. Mohn. Astr. Obs. Side 8.

6. Tromsø.

$\varphi = 69°\ 39.'1\ \lambda = 18°\ 59.'3$ E. Greenwich.

On the beach, a few hundred paces north of the landing-pier at Storstennes, on the east side of Tromsø Sound.

Latitude and longitude from the coastal charts. Error of chronometer (Frodsham) on local time computed from error on Greenwich time and the longitude of the chart.

[1] H. Mohn. Astronomical Observations, p. 8.

Deklination. *Declination.*

1877. Juli *(July)* **11.**

Ch.	⊙	6^h	24^m	4.′0	29^m	56.′5	6^h 27^m	0.′25	Magnet I 80° 10.′25
„	⊙		26	36.0	32	28.0	29	32.0	— II 80 20.5
							6 28	16.1	80 15.4
U.						+	22	56.0	Magnet 260° 15.′4 — 180°
M. T.							6 51	12.1	N. P. 270 33.1
E.						—	0 5	14.5	Decl. 10 17.7 W.
t							6 45	57.6	
a						N	71°	30.′9 W	
⊙							199	2.2	
N. P.							270	33.1	

Horizontal-Intensitet.

1877. Juli 11.

Svingnings-Observation. Kl. 4.2 Min. til4.16 Min. Eft.

$t_o = 56.°4$; $T_o = 5.'0459$; $s = 3.'4$; $\alpha = 74'$; $\alpha' = 21'$; $u = 5.'7$. C. Wille.

Afbøjnings-Observation. Kl. 5.35 Min. til 6.13 Min. Eftm.

$t_o = 56.°6$; $u_o = 35°\ 0'\ 35''$; $u_o' = 14°\ 59'\ 37.''5$. C. Wille.

Resultat: $P = 0.02142$; $m = 0.74260$; $X = 2.6365$.

Inklination.

1877. Juli 11. Kl. 11.40 Min. Form. til 12.45 Min. Eft. Naal No. 1. C. Wille.

$\theta = 76°\ 21.'85$.

Horizontal Intensity.

1877. July 11.

Observation of Vibration: — 4.2 p. m. to 4.16 p. m.

$t_o = 56.°4$; T_o 5.′0459; $s = 3.'4$; $\alpha = 74'$; $\alpha' = 21'$; $u = 5.'7$. C. Wille.

Observation of Deflection: — 5.35 p. m. 6.13 p. m.

$t_o = 56.°6$; $u_o = 35°\ 0'\ 35''$; $u_o' = 14°\ 59'\ 37.''5$. C. Wille.

Result: — $P = 0.02142$; $m = 0.74260$; $X = 2.6365$

Inclination.

1877. July 11: — 11.40 a. m. to 12.45 p. m. Needle No. 1. C. Wille.

$\theta = 76°\ 21.'85$.

7. Hammerfest.

$\varphi = 70°\ 40'\ 11''$ $\lambda = 23°\ 40'\ 26''$ E. Greenwich.

Paa Fuglenes, i Nærheden af Meridianstøtten. Tidsbestemmelse ved Solhøjder af Prof. Mohn den 9de og 10de Juli 1878.[1]

Deklination.

1878. Juli 9 om Eftermiddagen bestemte vi Azimut af Kirkespiret. Observationsuhr Lommekronometer, hvis Korrektion til Stedets sande Tid var funden = + 51^m 20.′4.

Den 10de Juli Kl. 12.35 Min. Eft., bestemte jeg Deklinationen.

[1] H. Mohn. Astr. Obs. Side 12—14.

7. Hammerfest.

$\varphi = 70°\ 40'\ 11''$ $\lambda = 23°\ 40'\ 26''$ E. Greenwich.

At Fuglenes, near by the arc of meridian terminus column. Error of chronometer found from altitudes of the sun, taken by Professor Mohn on the 9th and 10th of July, 1878.[1]

Declination.

1878. July 9, in the afternoon, we determined the azimuth of the church spire, observing with the pocket-chronometer, for which the error on local apparent time was found to be + 51^m 20.′4.

On the 10th of July, 12.35 p. m., I determined the declination.

[1] H. Mohn. Astronomical Observations, p. 12—14.

	O.	229°	9′		10.′0		229°	9.′5	Magnet.	Mire. (*Mark.*)
	⊙		18	41.5	19°	27.0		19	4.25	I 80° 4.′0	48° 51.′5
Ch.	⊙	6h	14m	26.′4	17m	46.′0	6h	16m	6.′2	II 79 36.7	48 52.0
	⊙		16	50.0	20	15.0		18	32.5	79 50.35	48 51.75
							6	17	19.35	A = N 143° 32.′75 E.	
U′						+		51	20.4	Mire	48 51.75
t							7h	8m	39.75	N. P.	265 19.0
a						N	66°	32.′5	W	Magnet	259 50.35 — 180°
⊙							19	4.25		Decl.	5° 28.′6 W.
N. P.							85°	36.′75			
O.							229	9.5			
A.						N	143°	32.′75	E.		

Horizontal-Intensitet.

Svingnings-Observation. 1878. Juli 9. Kl. 5.40 Min. til 5.52 Min. Eft.

$t_o = 55.°7$; $T_o = 5.'0660$; $s = 7.'0$; $\alpha = 76'$; $\alpha' = 19'$; $u = 2.'49$. C. Wille.

Afbøjnings-Observation. 1878. Juli 10. Kl. 12.45 Min. til 1.30 Min. Eft.

$t_o = 64.°9$; $u_o = 37°\ 22'\ 9''$; $u_o' = 15°\ 54'\ 10''$. C. Wille.

Resultat: P = 0.01896; $m = 0.7627$;[1] X = 2.5484.

Inklination.

1878. Juli 10. Kl. 10.45 Min. til 11.55 Min. Form. Naal No. 1. C. Wille.

$\theta = 76°\ 54.'25$.

Horizontal Intensity.

Observation of Vibration. 1878. July 9: — 5.40 p. m. to 5.52 p. m.

$t_o = 55.°7$; $T_o = 5.'0660$; $s = 7.'0$; $\alpha = 76'$; $\alpha' = 19'$; $u = 2.'49$. C. Wille.

Observation of Deflection. 1878. July 10: — 12.45 p. m. to 1.30 p. m.

$t_o = 64.°9$; $u_o = 37°\ 22'\ 9''$; $u_o' = 15°\ 54'\ 10''$. C. Wille.

Result: — P = 0.01866; $m = 0.7627$;[1] X = 2.5484.

Inclination.

1878. July 10: — 10.45 a. m. to 11.55 a. m. Needle No. 1. C. Wille.

$\theta = 76°\ 54.'25$.

8. Vardø.

$\varphi = 70°\ 22'\ 24''$ $\lambda = 31°\ 7'\ 51''$ E. Greenwich.

Paa Fæstningen Vardøhus's Glacis, 170 Meter Nord for Fæstningens Midtpunkt.

Horizontal-Intensitet.

Svingnings-Observation. 1878. Juni 26. Kl. 1.4 Min. til 1.13 Min. Eft.

$t_o = 50.°4$; $T_o = 5.'0418$; $s = 8.'0$; $\alpha = 72'$; $\alpha' = 28'$; $u = 4.'08$. C. Wille.

Afbøjnings-Observation. 1878. Juni 26. Kl. 5.10 Min til 6.5 Min. Eft.

$t_o = 47.°8$; $u_o = 37°\ 11'\ 12''$; $u_o' = 15°\ 48'\ 30''$. C. Wille.

Resultat: P = 0.02259; $m = 0.7616$ X = 2.5737.

Inklination.

1878. Juni 26. Kl. 10.40 Min. til 11.37 Min. Form. Naal No. 1. C. Wille.

$\theta = 76°\ 52.'4$.

[1] Magneten var i 1878 opmagnetiseret.

8. Vardø.

$\varphi = 70°\ 22'\ 24''$ $\lambda = 31°\ 7'\ 51''$ E. Greenwich.

The glacis of Vardøhus, 170 metres north of the centre of the fortress.

Horizontal Intensity.

Observation of Vibration. 1878. June 26: — 1.4 p. m. to 1.13 p. m.

$t_o = 50.°4$; $T_o = 5.'0418$; $s = 8.'0$; $\alpha = 72'$; $\alpha' = 28'$; $u = 4.'08$. C. Wille.

Observation of Deflection. 1878. June 26: — 5.10 p. m. to 6.5 p. m.

$t_o = 47.°8$; $u_o = 37°\ 11'\ 12''$; $u_o' = 15°\ 48'\ 30''$. C. Wille.

Result: — P = 0.02259; $m = 0.7616$; X = 2.5737.

Inclination.

1878. June 26. 10.40 a. m. to 11.37 a. m. Needle No. 1. C. Wille.

$\theta = 76°\ 52.'4$.

[1] The Magnet had been re-magnetised in 1878.

B. Observationer i Søen og deres Resultater.

Ved Expeditionens Udrustning var det paatænkt, at der skulde gjøres fuldstændige magnetiske Observationer ombord, naar man var i Søen. Hertil havdes fuldstændigt Apparat i Admiralitets Standard-Kompasset og Fox-Cirkelen. Med denne sidste foretog jeg i 1876, under Skibets Udrustning, paa Bergens Observatorium de nødvendige Afvejninger. Under Expeditionens Ophold i Husø fra den 10de til 19de Juni samme Aar gjordes alle de fornødne Basis-Observationer. De magnetiske Elementers Størrelse bestemtes, som ovenfor vist, i Land ved absolute Maalinger. Deviationen bestemtes saavel for Styre-Kompasset som for Fox-Cirkelens Plads og med Fox-Cirkelen maaltes Inklination og Intensitet under forskjellige anlagte Kurser, idet Skibet blev svunget ved Hjælp af Trosser. Der toges Svingnings-Observationer til Bestemmelse af Coefficienterne μ og λ.

Ved Beregningen af de med Fox-Cirkelen ombord maalte Inklinationer og Intensiteter, fandt Prof. Mohn, at disse ikke kunde bringes til indbyrdes Harmoni, med mindre Indexfejlen for Fox-Cirkelens Naal sattes hele 19 Minuter større, end den fandtes af de Observationer, der var gjorte i Land paa samme Sted og til samme Tid med Fox-Cirkelen og med Inklinatoriet.

Da vi den 22de Juni 1876 i meget roligt Vejr og rolig Sø forsøgte Observationer med Fox-Cirkelen, viste det sig, at Skibet, vel nærmest paa Grund af det langsomt virkende Styreapparat,[1] ikke kunde holdes paa Kurs med den Støhed, som udfordredes til at Observationerne kunde gjøres med nogenlunde Nøjagtighed, ligesom Skibets vertikale Bevægelser uagtet den rolige Sø viste sig yderst hindrende i samme Retning. Beregningen af Observationerne gav ogsaa et utilfredsstillende Resultat. Kun en Gang senere forsøgtes, nemlig under Sejladsen ind til Thorshavn, Observationer med Fox-Cirkelen. Det yderst urolige Vejr, som Expeditionen havde i 1876, forbød alle videre Forsøg i dette Aar.

I 1877 hindrede saavel Vejret, som den Omstændighed, at jeg maatte gaa fra Husø til Bergen for at faa indsat ny Mellemaxel i Maskinen, mig i at foretage Basis-Observationer. I 1878 var Expeditionen under Rejserne saa ganske optagen af andre mere nødvendige Gjøremaal, at der ikke levnedes Tid til at tage andre magnetiske Observationer ombord end til Bestemmelse af Misvisningen.

Saaledes forenede sig Skibets magnetiske Konstitution, om jeg saa maa kalde det, dets langsomtvirkende Styreapparat, dets Letbevægelighed og ringe Bredde, uroligt Vejr, Reparation af Maskinen og Hensynet til Expeditionens Hovedarbejder, Lodninger, Temperaturmaalinger og Skrabninger, til absolute Hindringer mod Fox-Cirkelens

[1] C. Wille. Apparaterne og deres Brug. Side 4.

B. Observations at Sea, and their Results.

The Scheme of Work approved for the Expedition included complete series of magnetic observations at sea, for which we had the Admiralty standard compass and the Fox circle. With the latter instrument, I undertook in 1876, at the Bergen Observatory, whilst the ship was fitting out, the necessary weighings. During the stay of the Expedition at Husø, from the 10th to the 19th of June, same year, were taken all necessary base-observations. The deviation was determined alike for the steering-compass and the position of the Fox circle, and inclination and intensity were observed with the Fox circle on different courses, the ship being swung the while by means of hawsers. Observations of vibration were taken to determine the coefficients μ and λ.

In his computations of inclination and intensity observed on board with the Fox circle, Professor Mohn could not, he found, attain satisfactory agreement for the respective results unless the index-error for the needle of the Fox circle were put as much as 19 minutes greater than the error found from the observations taken on shore in the same place and at the same time with the Fox circle and with the dip circle.

On taking a few preliminary observations with the Fox circle, June 22nd 1876, in very fine weather and a calm sea, it was found impossible, chiefly no doubt owing to the tardy action of the steering-apparatus,[1] to keep the ship sufficiently steady on her course for observing with comparative accuracy; moreover, the vertical motion of the vessel, calm as was the sea, proved a serious obstacle to the attainment of anything like trustworthy determinations. The computed results, too, were not to be relied upon. Only once afterwards, viz. when nearing Thorshavn, did we try to observe with the Fox circle; indeed the boisterous weather encountered by the Expedition throughout the summer of 1876, precluded any further attempt on the first cruise.

In 1877 I had no opportunity of taking base-observations, both by reason of the weather and the discovery, on arriving at Husø, of a defect in the engine-shaft, necessitating our immediate return to Bergen to get a new one put in. In 1878 the prosecution of other and more important exploratory work left no time for magnetic observations save those required to determine declination.

Thus, the ship's magnetic properties, so to speak, the slow action of her steering-apparatus, her great mobility and trifling breadth of beam, rough weather, time lost in repairing the engine, and regard to the main objects of the Expedition, viz. sounding, determining temperature, and dredging the bottom, — proved one with the other in-

[1] C. Wille. The Apparatus, and How Used, p. 4.

Anvendelse i Søen. Betingelser for dens heldige Anvendelse er et bredt Fartøj, en let Styring, roligt Vejr og tilstrækkelig Tid, samt fremfor alt en saadan Plads for Instrumentet, at de med samme tagne Bestemmelser af Inklination og Intensitet harmonerer.

Det er saaledes kun Misvisnings-Observationerne, der have ledet til brugbare Resultater.

Førend jeg gaar over til at beskrive den i Søen anvendte Fremgangsmaade og give de beregnede Resultater, maa jeg først omtale Resultaterne af de Observationer, som gjordes i Husø til Bestemmelse af Kompassets Deviation.

Den 13de Juni 1876 svang jeg Skibet paa Husø Havn for at bestemme Kompassets Deviation. Svingningen udførtes ved Trosser, fastgjorte i Land. For hver anlagt Kurs (16 forskjellige Streger), paa hvilke der observeredes, pejledes med Kompasset Varden paa Poldetind. Samtidig observerede paa Teltpladsen i Land Prof. Mohn, paa givet Signal, Magnetometret til Bestemmelse af den absolute Deklination. Fra Teltpladsen var, som ovenfor Side 8 anført, Azimut af Varden paa Poldetind N 48° 7.′5 E. Da Fartøjet (Standard Kompasset ombord) under Svingningen laa meget nær i Vertikalplanet mellem Teltpladsen og Poldetind, bliver Azimut af Poldetind for Standard-Kompasset ombord N 48.°1 E. Poldetinds Afstand fra Husø er 10 Kvartmil, saa at en Forrykning lodret paa Sigtelinen mellem begge Steder af 0.°1 svarer til 32.4 Meter, en Afstand, der er meget større end Forrykningen af Kompassets Plads under Svingningen.

Trækkes Azimut af Poldetind — 48.°1 — fra Pejlingen af Poldetind, faar man det sande Azimut af Kompasnaalens Nordende eller den devierende Misvisning. Den følgende Tabel indeholder Observationerne og de deraf beregnede Værdier for devierende Misvisning.

superable obstacles to the use of the Fox circle at sea. The conditions for successful observation with the instrument are a vessel broad in the beam and easy to steer, calm weather and sufficient time, and above all such a position for the instrument as will admit of satisfactory agreement in its determinations of inclination and intensity.

Hence, the only observations attended with trustworthy results, were those taken to find the declination.

Before proceeding to describe the method adopted at sea and give the computed results, I must first set forth the results of the observations taken at Husø for determining the deviation of the compass.

On the 13th of June, 1876, I swung the ship in Husø harbour, by means of hawsers, to obtain the deviation of the compass. For every course by compass (16 different points) on which I observed, the bearing of the Poldetind signal was taken with the compass, Professor Mohn, at a given signal, simultaneously observing the magnetometer in the tent on shore, to determine the absolute declination. As previously stated, page 8, the azimuth of the Poldetind signal from the tent was N. 48° 7.′5 E. Now, as the ship (standard compass on board) lay when swinging very nearly in the vertical plane between the tent and Poldetind, the azimuth of Poldetind for the standard compass on board will be N. 48.°1 E. The distance of Poldetind from Husø is 10 miles; and hence a change in position of 0.°1 perpendicular to the line of vision between both places, corresponds to 32.4 metres, a distance much greater than is that corresponding to the change in the position of the compass during the swinging of the ship.

If the azimuth of Poldetind — 48.°1 — be subtracted from the bearing of Poldetind, we get the true azimuth of the north end of the compass-needle, or the deviating variation. In the following Table are given the observations, and the values computed from them, for deviating variation.

Klokkeslet. (*Hour.*)	Anlagt Kurs paa St. Kompas. (*Ship's Head by Stnd. Compass.*)	Pejling af Poldetind. (*Bearing of Poldetind.*)	Devierende Misvisning. (*Deviating Variation.*)
$10^h\ 34^m$ a. m.	S 0.°2 E	N 66.°0 E	N 17.°9 W
10. 55	S 21. 6 E	75. 1	27. 0
11 58	S 45. 0 E	82. 3	34. 2
0 28 p. m.	S 67. 4 E	85. 4	37. 3
0 49	E	85. 0	36. 9
1 5	N 67. 5 E	82. 7	34. 6
1 29	N 44. 9 E	77. 7	29. 6
1 32	N 22. 5 E	72. 5	24. 4
1 51	N 0. 2 E	67. 0	18. 9
4 15	N 22. 7 W	61. 5	13. 4
4 32	N 45. 3 W	56. 3	8. 2
4 52	N 67. 5 W	51. 9	3. 8
5 21	N 89. 7 W	48. 6	0. 5
5 40	S 67. 2 W	48. 3	0. 2
5 58	S 45. 3 W	50. 5	2. 4
6 15	S 22. 8 W	57. 1	9. 0
6 45	S 0. 7 E	66. 0	17. 9

Tallene i den sidste Rubrik, den devierende Misvisning, afsattes som Ordinater paa Rudepapir, med Tallene i den anden Rubrik, anlagt Kurs paa Standard-Kompas, som Argument. Paa grafisk Vej droges mellem de afsatte Punkter den sandsynligste Kurve, og af denne Kurve udtoges følgende Værdier: C = Anlagt Kurs efter St. Kompasset. D = Devierende Misvisning.

The figures in the last column, the deviating variation, were set down as ordinates on ruled paper, with the figures in the second column as abscissæ. A free hand curve was then drawn as nearly as possible through all the marked points, and from this curve were deduced the following values (C signifies "course by compass;" D, "deviating variation"): —

C	D	C	D	C	D	C	D
N	18.°8 W	E	37.°0 W	S	17.°8 W	W	0.°4 W
N 10° E	21. 3	S 80° E	37. 4	S 10° W	13. 8	N 80° W	1. 6
20	23. 8	70	37. 3	20	10. 0	70	3. 3
30	26. 1	60	36. 6	30	6 6	60	5. 2
40	28. 4	50	35. 2	40	3. 8	50	7. 2
50	30. 8	40	33. 0	50	1. 6	40	9. 4
60	33. 1	30	30. 0	60	0. 6	30	11. 8
70	35. 0	20	26. 5	70	0. 1	20	14. 0
80	36. 4	10	22. 1	80	0. 0	10	16. 5

Medium af de devierende Misvisninger i denne Tabel er

18.°68 West.

The mean of deviating variation in this Table is

18.°68 W.

Ifølge Side 7 var Middel-Misvisningen paa Teltpladsen paa samme Tid 18° 14.′7 = 18°.24.

Paa Skjæret østenfor Havnen fandt Prof. Mohn (Side 11) den 16de Juni Misvisningen om Formiddagen = 19° 0′, om Eftermiddagen 18° 2′, i Middel 18° 31′ = 18°.52. Da Fartøjet under Svingningen laa mellem Teltpladsen og Skjæret, turde det være rigtigst at sætte Misvisningen paa Skibets Plads lig

18.°38 West.

Dette Tal er kun 0.°30 mindre end *Middeltallet af de devierende Misvisninger ombord. Det sidste giver saaledes den sande Misvisning med en Nøjagtighed af mindst en halv Grad.* Efter dette Princip udførtes Misvisningsbestemmelserne i Søen. Til Bedømmelse af Skibets magnetiske Forhold hidsættes de beregnede Værdier for Konstanterne i Deviations-Formelen.

As previously shown, page 11, the mean declination simultaneously found at the tent was 18° 14.′7 = 18.°24.

On the islet east of the harbour, Professor Mohn found the declination in the forenoon of the 16th of June = 19° 0′, in the afternoon 18° 2′, giving a mean of 18° 31′ = 18.°52. Now, as the vessel lay when swinging between the tent and the islet, the declination for the ship's position may be put at

18.°38 W.

This value is only 0.°30 less than *the mean of the deviating variations observed on board. Hence, this mean gives the true variation within half a degree.* On this principle was determined the variation at sea. To show the magnetic influence of the vessel, the computed values of the constants in the deviation formula are here given. —

$$A = 0.°0;\ B = -18.°47;\ C = -0.°45;\ D = +2.°47;\ E = +0.°23.$$

Deviationen er 0 for anlagt Kurs Nord og Syd, Maximum, 18.°5, for Ost og West.

Misvisnings-Bestemmelserne i Søen udførtes paa følgende Maade. Skibet blev, i roligt Vejr og under Solskin, ved Maskine og Ror bragt til at ligge an forskjellige, i Regelen 16, Kurser, saa jevnt som muligt fordelte over hele Horizonten. For hver af disse anlagte Kurser bestemtes Vinkelen mellem Diametralplanet og Solens Vertikal-

The deviation is 0 with the ship's head due north or south, its maximum with the ship's head due east or west being 18.°5.

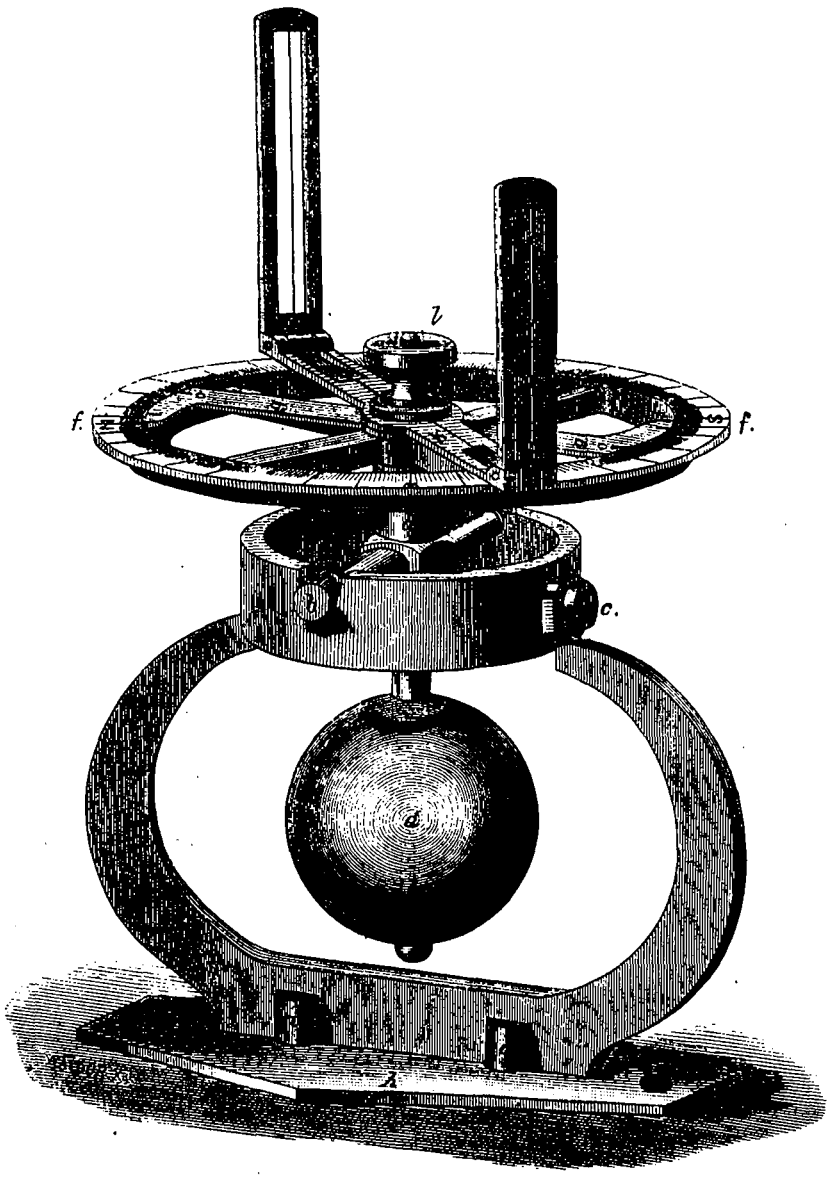
The determinations of declination at sea were performed as follows: — In calm, bright weather the ship's head was brought upon different points of the compass, as a rule 16, as regularly distributed round the circumference as possible. For each of these points was determined the angle between the midship line and the vertical circle of

cirkel. Dette gjordes en enkelt Gang (i 1877) ved Hjælp af Kompassets Pejlapparat, men i Regelen (i 1878) paa nedenfor beskrevne Maade.

Da enhver Pejlings Nøjagtighed væsentligst beror paa, at Kompasnaalen er i Ro og rigtig indstillet i den devierende magnetiske Meridian, og da Naalen let kan bringes i Svingninger ved Manipulationen af Pejlapparatet, naar dette er anbragt direkte paa Kompasdaasen, anvendtes til Pejlinger Wille's Azimuth Pejlskive, et Instrument, som jeg konstruerede i 1869 og som siden har været reglementeret i den norske Marine. Instrumentet er fremstillet i hosstaaende Figur, og vil lettelig forstaaes af Tegningen.

the sun. On one occasion (1877) this was done by means of the sight vanes on the standard compass, but subsequently without exception in the manner described below.

As the accuracy of every bearing is mainly dependent upon the compass-needle being steady, and parallel to the deviating magnetic meridian, and as the needle will be easily caused to vibrate when manipulating the bearing apparatus, if the latter be fixed direct to the compass-box, — all bearings were taken with Wille's Azimuth Dumb-card, an instrument devised by the author in 1869, and which has since been officially adopted for the Norwegian Navy. The instrument is represented in the Figure.



Paa Grund af Bevægeligheden om Tapperne *b* og *c* vil Kuglen *d*, der er af Bly, altid holde Tappen *a* vertikal, og Ringen *f*, der med sit Centerstykke kan drejes om den øvre Del af Tappen *a*, vil saaledes indtage en horizontal Stilling og bibeholde denne under Skibets Bevægelser. Ringen er inddelt i 360° og er tillige mærket med de 8 Hovedstreger N, NO, O, SO o. s. v. Til Overkant af Tappen *a* er fastskruet Tverstykket *g*, paa hvilket er an-

The ball *d*, which is of lead, moving readily on the pivots *b* and *c*, will always keep the pivot *a* perpendicular; and the ring *f*, which along with its centre-piece can be made to revolve about the upper part of the pivot *a*, will accordingly take a horizontal position and keep it during the motion of the vessel. The ring is divided into 360 degrees, with separate marks for the 8 cardinal points, N., NE., E., SE., &c. To the upper edge of the pivot *a* is

mærket to diametralt staaende Nulpunkter (Indexer), og Beslaget *h* skal være saaledes placeret, at naar Pejlskiven nedsættes i dette med sine to Tapper *i i*, saa skal Linjen mellem de to Nulstreger paa det faste Tverstykke *g* være parallel med Skibets Diametralplan. Om en tyndere Fortsættelse af Tappen *a* bevæger sig Diopterlinealen *k* med sine Dioptere, og kan fæstes i en hvilkensomhelst Vinkel med *g* ved Hjælp af Skruen *l*.

Pejlingen foregik altsaa saaledes: En Observatør passede Styringen og aflæste nøjagtig anlagt Kurs i Observationsøjeblikket, en anden havde Kronometret og Noticebogen, og en tredie stod ved Pejlskiven. Naar Skibet gik støt, uden Giringer, og Kompasnaalen var i Ro, pejltes Solen enten direkte eller, naar den var højere paa Himlen, ved Hjælp af Skyggen af den vertikale Traad og Diameterstregen paa Linealen *k*. Naar disse var nøjagtig overet, raabtes "Nu!" og Kronometrets Visende noteredes; derefter opgaves anlagt Kurs, der ligeledes noteredes, og Ringen *f* drejedes saaledes, at den samme Kursstreg kom overet med Nulpunktet paa *g*. Inddelingen paa Ringen havde da nøjagtig samme Stilling til Diametralplanet som Inddelingen paa Kompasrosen havde i det Øjeblik, da der blev raabt "Nu", hvorpaa Pejlingen aflæstes paa Ringen i Aabningen og ligeud for Diameterstregen paa Linealen *k*, som om den var aflæst direkte paa Kompasrosen. Dersom Linealen *k* under en forlig eller agterlig Pejling dækker Nulstregen, benyttes de to Hjælpestreger, der er anbragte et vist Antal Grader til Siden af den egentlige Nulstreg.

Kronometrets Stand for sand Tid ombord bestemtes enten efter dets Stand for Greenwich Tid og Skibets beregnede Længde eller, naar Dagstiden var gunstig, det er Solen ikke for nær Meridianen, ved at tage nogle Solhøjder og deraf beregne Solens Timevinkel.

Af den saaledes fundne Uhrkorrektion, den efter Kronometret noterede Tid, Bredden og Solens Deklination beregnedes Solens Azimut. Forskjellen mellem Solens sande Azimut og Pejlingen af Solen gav de til de forskjellige anlagte Kurser svarende Værdier for den devierende Misvisning. Efter den ovenbeskrevne grafiske Methode bestemtes derpaa Middeltallet af de ækvidstante Værdier for denne, hvilket antoges som den sande Misvisning.

De følgende Tabeller indeholder Observationerne og de deraf udledede Resultater. t = Klokkeslettet efter sand Soltid, S Pejling af Solen, a Solens Azimut.

screwed a cross-piece, *g*, marked with two diametrically opposite zero-points (indices), and the frame *h* must be so placed that, on inserting into it the dumb-card with its two pivots *i i*, the line between the two zero-points on the fixed cross-piece *g* will be parallel to the middle fore and aft line of the ship. On a thinner continuation of the pivot *a* moves a cross-piece, *k*, with sight-vanes, which admits of being fixed at any required angle with *g* by means of the screw *l*.

The bearings were taken accordingly as follows: — One observer looked to the steering, and read off the exact compass course at the moment of observation, another had charge of the chronometer and noted the time, and a third observed the azimuth dumb-card. Now, when the ship kept steady on her course without yawing, and with the compass-needle at rest, the bearing of the sun was taken either direct or, for greater altitudes, by the shadow of the vertical wire and the diameter-line on the cross-piece *k*. The moment the shadow of the thread and the line were exactly coincident, observer No. 3 called out to his colleague with the chronometer, who noted and entered the time, after which the direction of the ship's head by the compass was given, and entered in the note-book, the ring *f* being then moved in such manner that the division corresponding to the direction of the ship's head by compass was made coincident with the zero-point on the cross-piece *g*. Hence, the division-lines on the ring had precisely the same position relative to the midship line as the division-lines on the compass-card at the moment observer No 3 called out, and the bearing was then read off through the open space in the centrepiece *k*, the extremities of the diameter-line being the index, exactly as though it had been read off direct from the compass-card. Should the piece *k* when taking a bearing in or near the direction of the fore and aft midship line cover the zero-point, recourse is in that case had to the two lines drawn a certain number of degrees from the true zero-point, one on either side.

The error of the chronometer on apparent time on board was found either from its error on Greenwich time and the ship's computed longitude, or, at a favourable hour of the day, i. e. with the sun not too near the meridian, by taking a few solar altitudes and computing the hour-angle of the sun.

From the error of the chronometer thus determined, the observed chronometer-time, the latitude, and the sun's declination, was computed the azimuth of the sun. The difference between the true azimuth and the bearing of the sun gave the values for deviating variation corresponding to the different compass courses. By the diagramatic method described above was found the mean of the equidistant values for the deviating variation, which we assumed to be the true declination.

In the following Tables are set forth the observations and their computed results: t signifies apparent time; S, bearing of sun; a, azimuth of sun.

I. Vestfjorden. *(The West Fjord).* 1877. August 10.

$\varphi = 68° 5'$ N. $\lambda = 14° 30'$ E. Greenwich.

No.	*C*	*t*	*a*	*S*	*D*
1	SE	$4^h\ 48^m\ 50^s$	N 100° 42′ W	N 71° 40′ W	29.°0 W
2	SE	49 53	100 27	71 20	29. 1
3	SSE	57 28	98.6	77 30	21. 1
	S	5 2 3	97.5	86 30	11. 0
4	S 0° 20′ E	2 47	97.3	86 10	11. 1
	S 1° W	4 11	97.1	87 0	10. 1
5	SSW	9 44	95.8	S 84 40 W	0. 5
	SSW	10 36	95.6	84 30	0. 1 W
6	SW	15 29	94.4	79 0	6 9 E
	SW			78 30	
7	WSW	20 34	93.2	76 0	10.6
	WSW			76 20	
8	S 88° W	23 4	92.6	76 40	10. 6
	W			77 5	
9	N 69.°5 W	27 19	91.6	81 20	7. 1
	N 67 W	27 56	91.4	81 40	6. 9
10	NW	31 25	90.7	87 0	2. 0 E
	NW			87 30	
11	N 24° W	33 50	90.1	N 85 30 W	4. 6 W
	N 21 W	36 33	89.5	84 20	5. 2
12	N 1.°5 E	42 51	88.0	76 20	11. 8
	N 1. 5 E			76 0	
13	NNE	47 45	87.0	68 40	18. 2
	NNE			69 0	
14	NE	51 30	86.0	61 30	24. 4
	NE			61 40	
15	ENE	55 46	85.0	55 30	29. 6
	ENE			55 20	
16	E	58 59	84.3	51 10	33. 0 W
	E			51 20	

$A = 0.°0$; $B = -\ 21.°92$; $C = -\ 0.°25$; $D = +\ 2.°50$; $E = +\ 0.°62$.

Ved denne og alle de følgende Bestemmelser var den forreste Jollebom om Bagbord svunget ud; i Husø var den svunget indover.

For this and all subsequent determinations, the foremost port davit was swung *out*, excepting at Husø, where it was swung *in*.

C	*D*	*C*	*D*	*C*	*D*	*C*	*D*
N	11.°6 W	E	33.°1 W	S	10.°5 W	W	10.°5 E
N 10° E	14. 7	S 80° E	33. 6	S 10° W	5. 8	N 80° W	9. 3
20	17. 6	70	33. 4	20	1. 3 W	70	7. 6
30	20. 5	60	32. 4	30	2. 6 E	60	5. 4
40	23. 1	50	30. 3	40	5. 7	50	2. 9
50	25. 7	40	27. 5	50	8. 3	40	0. 2 E
60	28. 2	30	24. 0	60	10. 0	30	2. 5 W
70	30. 3	20	20. 0	70	11. 0	20	5. 4
80	32. 0	10	15. 4	80	11 1	10	8. 3.

Middel af D = Misvisning = 11.°2 W. Mean of D = variation = 11.°2 W.

2. Bergen. Byfjorden. *(Bergen. The Byfjord.)* **1878. Juni 14.**

$\varphi = 60°\ 23.'9$ N. $\lambda = 5°\ 54.'0$ E. Greenwich.

No.	*C*	*t*	*a*	*S*	*D*
1	N 29.°5 E	$5^h\ 25^m\ 47'$	N 85.°2 W	N 61.°0 W	24.°2 W
2	S 79. W	37 49	82.7	82.0	0.7
3	S 58. W	41 10	82.0	80.5	2.5
4	S 37. W	44 0	81.4	75.5	5.9
5	S 17.5 W	47 11	80.7	69.0	11.7
6	S 1.2 W	49 13	80.3	62.7	17.6
7	S 8. E	51 20	79.8	53.7	26.1
8	S 68.5 E	54 52	79.1	42.5	36.6
9	N 88. E	57 20	78.6	43.0	35.6
10	N 58. E	6 0 17	77.9	47.3	30.6
11	N 35.7 E	2 16	77.5	52.0	25.5
12	N 9.7 E	4 29	77.1	56.7	20.4
13	N 3. W	6 18	76.7	59.8	16.9
14	N 36.5 W	9 53	75.9	67.0	8.9
15	N 68.7 W	13 42	75.2	74.0	1.2
16	N 89.5 W	17 8	74.5	72.8	1.7
17	N 69.5 W	19 52	73.9	70.5	3.4
18	N 55.2 W	22 19	73.4	67.2	6.2
19	N 48. W	25 26	72.8	64.8	8.0
20	N 20.5 W	28 14	72.2	59.0	13.2
21	N 11. W	30 21	71.7	57.0	14.7

$A = +\ 0.°0$; $B = -\ 17.°48$; $C = +\ 0.°50$; $D = +\ 2.°33$; $E = +\ 0.°24$.

C	*D*	*C*	*D*	*C*	*D*	*C*	*D*
N	17.°6 W	E	36.°0 W	S	18.°2 W	W	1.°0 W
N 10° E	20.1	S 80° E	36.7	S 10 W	14.5	N 80° W	2.0
20	22.5	70	36.7	20	10.9	70	3.3
30	24.7	60	36.0	30	7.7	60	4.8
40	26.9	50	34.7	40	5.0	50	6.6
50	29.0	40	32.4	50	3.0	40	8.6
60	31.1	30	29.4	60	1.7	30	10.7
70	33.0	20	25.8	70	0.8	20	13.0
80	34.6	10	22.0	80	0.6	10	15.2

Middel af D = Misvisning = 18.°2 W. Mean of D = Variation = 18.°2 W.

3. Øst-Finmarken. *(East Finmark.)* 1878. Juni *(June)* 25.

$\varphi = 70^\circ\ 45'.8$ N. $\lambda = 30^\circ\ 6'.6$ E. Greenwich.

No.	*C*	*t*	*a*	*S*	*D*
1	S 45.°5 E	6h 20m 41s	N 77.°0 W	N 58.°6 W	18.°4 W
2	S 63.75 E	23 12	76.5	54.8	21.7
3	S 78.5 E	24 37	76.2	54.2	22.0
4	N 88.5 E	27 7	75.6	54.0	21.6
5	N 74.5 E	28 54	75.2	55.2	20.0
6	N 59. E	30. 42	74.8	57.9	16.9
7	N 43.25 E	32 47	74.4	62.0	12.4
8	N 25.6 E	34 23	74.0	66.8	7.2
9	N 9.3 E	37 47	73.2	71.3	1.9 W
10	N 2.3 E	39 45	72.8	73.6	0.8 E
11	N 11. W	41 13	72.4	78.2	5.8
12	N 23.6 W	42 58	72.0	80.0	8.0
13	N 40.3 W	44 19	71.7	84.8	13.1
14	N 54.6 W	46 19	71.2	N 87.2 W	16.0
15	N 69. W	48 18	70.8	S 89.2 W	20.0
16	N 83.3 W	49 44	70.5	87.9	21.6
17	S 80. W	52 21	69.9	87.9	22.2
18	S 65.3 W	53 58	69.5	S 89.2 W	21.3
19	S 52.6 W	56 15	69.0	N 89.1 W	20.1
20	S 40.3 W	58 6	68.6	86.1	17.5
21	S 30.3 W	7 0 20	68.1	82.2	14.1
22	S 16.6 W	2 37	67.6	75.2	7.6
23	S 1.5 W	4 30	67.2	67.2	0.0
24	S 10.3 E	6 6	66.8	62.3	4.5 W
25	S 19. E	8 9	66.3	57.3	9.0
26	S 26.5 E	11 18	65.6	54.0	11.6
27	S 34.5 E	13 b	65.2	49.5	15.7 W

$A = + 0.°05$; $B = - 22.°22$; $C = + 0.°43$; $D = + 2.°30$; $E = + 0.°22$.

C	*D*	*C*	*D*	*C*	*D*	*C*	*D*
N	1.°2 E	E	21.°9 W	S	0.°1 W	W	22.°1 E
N 10 E	2.2 W	S 80 E	22.4	S 10 W	4.5 E	N 80 W	21.2
20	5.4	70	22.2	20	9.3	70	19.7
30	8.6	60	21.3	30	13.6	60	17.7
40	11.6	50	19.5	40	16.8	50	15.3
50	14.5	40	16.8	50	19.4	40	12.6
60	17.1	30	13.5	60	21.0	30	9.9
70	19.3	20	9.5	70	22.0	20	7.1
80	21.0	10	5.0	80	22.3	10	4.3

Middel af D = Misvisning = 0.°2 E. Mean of D = Variation = 0.°2 E.

4. Vest-Finmarken *(West Finmark)*. 1878, Juli *(July)* 13.

$\varphi = 71^{\circ}\ 7'$ N. $\lambda = 21^{\circ}\ 11'$ E. Greenwich.

No.	C	t	a	S	D
1	N 89.°0 W	$5^h\ 2^m\ 26^s$	N 96.°2 W	N 112.°2 W	16.°0 E
2	N 71 W	4 49	95. 6	108. 8	13. 2
3	N 43 W	7 52	94. 9	100. 8	5. 9
4	N 24 W	9 21	94. 6	96 5	1. 9 E
5	N 2 E	11 56	93. 9	90. 1	3. 8 W
6	N 22.5 E	14 39	93. 3	82. 4	10. 0
7	N 45.5 E	16 35	92. 8	74. 0	18. 8
8	N 65 E	20 5	92. 0	67. 4	24. 6
9	E	22 8	91. 5	64. 0	27. 5
10	S 67.5 E	25 51	90. 6	63. 5	27. 1
11	S 45 E	28 9	90. 1	66. 1	24. 0
12	S 23 E	31 34	89. 2	72. 4	16. 8
13	S	33 55	88. 7	82. 0	6. 7
14	S 0.5 W	35 15	88. 3	82. 0	6. 3 W
15	S 22.5 W	37 44	87. 7	93. 0	5. 3 E
16	S 43.5 W	39 20	87. 4	101. 0	13. 6
17	S 67 W	41 46	86. 9	103. 0	16. 1
18	N 89 W	45 55	85. 9	102. 0	16. 1 E

$A = 0.^{\circ}0$; $B = -22.^{\circ}17$; $C = +0.^{\circ}22$; $D = +2.^{\circ}78$; $E = +0.^{\circ}05$.

C	D	C	D	C	D	C	D
N	5.°0 W	E	27.°6 W	S	6.°5 W	W	16.°3 E
N 10 E	8. 0	S 80 E	28. 0	S 10 W	1. 3 W	N 80 W	14. 9
20	11. 0	70	27. 8	20	3. 6 E	70	13. 0
30	14. 1	60	26. 7	30	8. 2	60	11. 2
40	17. 2	50	25. 0	40	11. 8	50	8. 5
50	20. 2	40	22. 5	50	14. 4	40	6. 0
60	22. 9	30	19. 4	60	16. 3	30	3. 5
70	25. 1	20	15. 6	70	17. 0	20	0. 7 E
80	26. 7	10	11. 3	80	16. 9	10	2. 1 W

Middel af D = Misvisning = 5.°6 W. Mean of D = Variation = 5.°6 W.

5. Det norske Hav. *(The Norwegian Sea.)* **1878. Juli** *(July)* **20.**

$\varphi = 75°\ 3'$ N. $\lambda = 5°\ 13'$ E. Greenwich.

No.	C	t	a	S	D
1	S 45.°5 E	$4^h\ 19^m\ 19^s$	N 109.°1 W	N 66.°7 W	42.°4 W
2	S 69.3 E	21 31	108.6	61.0	47.6
3	S 89 E	23 55	108.0	61.5	46.5
4	N 68.3 E	26 13	107.3	64.2	43.1
5	N 42.6 E	29 47	106.4	69.7	36.7
6	N 18 E	32 15	105.8	80.2	25.6
7	N	34 2	105.4	85.2	20.2
8	N 27 W	40 5	104.0	94.8	9.2
9	N 46.3 W	41 47	103.6	99.7	3.8 W
10	N 65 W	43 22	103.1	103.2	0.1 E
11	N 89.3 W	44 55	102.7	107.3	4.6
12	S 68 W	46 50	102.2	107.2	5.0 E

$A = +\ 0.°02$; $B = -\ 26.°42$; $C \leqq 0.°0$; $D = +\ 2.87$; $E = +\ 0.°48$.

C	D	C	D	C	D	C	D
N	20.°2 W	E	46.9 W	S	20.°0 W	W	4.°8 E
N 10° E	24.1	S 80°. E	47.3	S 10 W	13.8	N 80° W	3.8
20	28.0	70	47.0	20	8.2	70	0.2 E
30	31.5	60	45.9	30	3.6	60	2.0 W
40	35.0	50	43.9	40	0.0	50	2.9
50	38.2	40	40.8	50	2.6 E	40	5.6
60	41.0	30	36.9	60	4.4	30	8.9
70	43.5	20	32 0	70	5.3	20	12.5
80	45.5	10	26.3	80	5.3	10	16.1

Middel af D = Misvisning = 20.°5 W. Mean of D = Variation = 20.°5 W.

6. Sydkap, Spidsbergen. *(South Cape, Spitzbergen.)* **1878. August** *(August)* **5.**

$\varphi = 76° 27'$ N. $\lambda = 17° 0'$ til $17° 10'$ E. Greenwich.

No.	C	t	a	S	D
1	N 89.°3 E	$7^h\ 48^m\ 47^s$	N 59.°9 W	N 20.°0 W	39.°9 W
2	N 68.3 E	51 47	59.2	23.1	36.1
3	N 45.6 E	58 23	57.6	29.7	27.9
4	N 18.3 E	8 0 52	57.1	39.9	17.2
5	N 23 E	2 58	56.6	37.3	19.3
6	N 2.3 W	6 7	55.8	49.2	6.6
7	N 2 E	9 41 45	33.1	23.8	9.3
8	N 24.3 W	44 8	32.5	31.5	1.0 W
9	N 50.3 W	46 19	32.0	40.5	8.5 E
10	N 70 W	48 25	31.5	44.2	12.7
11	N 88.6 W	51 22	30.8	45.1	14.3
12	S 88.3 W	56 21	29.6	45.3	15.7
13	S 65 W	10 0 13	28.7	43.8	15.1
14	S 43.6 W	3 32	27.9	37.2	9.3
15	S 24.3 W	7 8	27.0	28.2	1.2 E
16	S 0.3 W	9 57	26.4	15.2	11.2 W
17	S 22.6 E	13 11	25.6	N 1.9 W	23.7
18	S 47.3 E	15 48	24.9	N 9.7 E	34.6
19	S 71.6 E	20 38	23.8	15.1	38.9
20	N 85.3 E	25 34	22.6	N 16.2 E	38.8

$A = +$ 0.°02; $B = -$ 27.°67; $C = +$ 0.°62; $D = +$ 2.°47; $E = +$ 0.°49.

C	D	C	D	C	D	C	D
N	10.°5 W	E	39.°7 W	S	11.°5 W	W	16.°0 E
N 10 E	14.4	S 80 E	40.2	S 10 W	5.8	N 80 W	14.8
20	18.3	70	39.7	20	0.7 W	70	13.1
30	22.0	60	38.1	30	4.0 E	60	10.5
40	25.7	50	35.5	40	8.0	50	7.6
50	29.5	40	31.9	50	11.4	40	4.4
60	33.1	30	27.5	60	14.0	30	1.0 E
70	36.2	20	22.5	70	15.7	20	2.5 W
80	38.3	10	17.0	80	16.3	10	6.3 W

Middel af D = Misvisning = 11.°4 W. Mean of D = Variation = 11.°4 W.

7. Grønlandshavet. *(The Greenland Sea.)* 1878. August 9.

$\varphi = 76° 27'$ N. $\lambda = 0° 56'$ W. Greenwich.

No.	C	t (a. m.)	a	S	D
1	S 56.°3 E	$10^h\ 41^m\ 53'$	S 21.°5 E	S 32.°0 W	53.°5 W
2	S 35 E	45 30	20.5	24.9	45.4
3	S 17.3 E	48 40	19.6	15.8	35.4
4	S 2 W	51 6	19.0	S 6.3 W	25.3
5	S 23.3 W	53 14	18.4	S 3.2 E	15.2
6	S 50 W	55 46	17.7	14.4	3.3 W
7	S 64.3 W	57 16	17.3	18.5	1.2 E
8	N 89 W	59 11	16.8	20.6	3.8 E
9	N 71 W	11 2 14	15.9	15.4	0.5 W
10	N 51.3 W	8 40	14.2	S 7.7 E	6.5
11	N 17.6 W	10 39	13.6	S 6.2 W	19.8
12	N 2 E	13 13	12.9	14.9	27.8
13	N 15 E	19 16	11.2	21.0	32.2
14	N 51.3 E	22 6	10 5	35.0	45.5
15	N 64.6 E	26 0	9.4	39.0	48.4
16	N 87 E	28 6	8.8	44.5	53.3
17	S 72.3 E	30 1	8.3	45.8	54.1
18	S 48.6 E	32 16	7.6	41.4	49.0
19	S 68.6 E	37 26	6.2	S 46.8 W	53.0 W

$A = -$ 0.°32; $B = -$ 28.°17; $C = -$ 0.°33; $D = +$ 2.°30; $E = -$ 0.°80.

C	D	C	D	C	D	C	D
N	26.°7 W	E	53.°7 W	S	26.°7 W	W	3.°6 E
N 10° E	30.5	S 80.° E	54.3	S 10° W	21.5	N 80° W	2.0 E
20	34.3	70	54.0	20	16.5	70	0.5 W
30	38.0	60	52.7	30	11.7	60	3.5
40	41.5	50	50.2	40	7.3	50	6.8
50	44.8	40	46.6	50	3.3 W	40	10.6
60	47.8	30	42.3	60	0.2 E	30	14.7
70	50.4	20	37.3	70	2.6	20	18.7
80	52.4	10	32.0	80	3.8 E	10	22.7 W

Middel af D = Misvisning = 25.°9 W. Mean of D = Variation = 25.°9 W.

Oversigts-Tabel. *(Synoptic Table.)*

Station.	Nordl. Bredde *(North Latitude)*	Længde fra Gr. *(Longitude)*	Datum *(Date)*	Klokkeslet *(Hour)*	Declination	Horizontal-Intensitet *(Horizontal Intensity)* Brit. Un.	Metr. Un.	*m*	Inclin. *θ*
Bergen	60° 23.′9	5° 24.′0 E	1876 Mai 22	1—2 p. m.		3.2238	1.4864	0.7666	
—				3—4½ p. m.					72° 24.′3
Husø	60 59.6	4 37.0 E	1876 Juni 10	4—6 p. m.	18° 19′ W	3.1732	1.4631	0.7653	
—			— „ 12	10½—12 a. m.					72 43.4
—			— „ „	1½—2 p. m.					72 41.0
—			— „ „	6—7½ p. m.					72 43.9
—			— „ 13	10½ a.m.—7 p.m.	18 15 W				
—			— „ „	11—12 a. m.					72 46.0
—			— „ 15	12¼—1¾ p. m.		3.1751	1.4640	0.7650	
—			— „ „	2¼ p. m.		3.1750	1.4640		
—			— „ „	6¼ p. m.		3.1746	1.4637		
—			— „ „	7¼ p. m.					72 45.5
Do. Skjær *(Islet)*			— „ 16	11¼ a. m.	19 0 W				
— —			— „ „	12—1 p. m.		3.1686		0.7666	
— —			— „ „	2¼ p. m.		3.1734	1.4632		
— —			— „ „	6½ p. m.					72 44.8
— —			— „ „	7½ p. m.	18 2 W				
Husø			1877 Mai 23	5½ p. m.					72 43.4
—			— Juni 4	4—5 p. m.		3.1761	1.4644	0.7442	
Reykjavik	64 8.5	21 54.1 W	1876 Juli 28	5—6½ p. m.					76 28.5
—			— „ 29	5½ p. m.	38 19 W				
—			— „ 31	10—12¼ p. m.		2.6141	1.2053	0.7615	
—			— „ „	4—6 p. m.		2.6407	1.2176	0.7612	
—			— Aug. 1	1¼—2¼ p. m.					76 26.3
Namsos	64 28.2	11 31.5 E	1876 Aug. 18	11½—2 p. m.		2.9639	1.3666	0.7576	
—			— „ „	6 p. m.	13 43 W				
—			— „ 19	10½—11½ a. m.					74 2.3
—			— „ „	5—6. p. m.					74 2.3
Kristiania	59 54.7	10 43.6 E	1876 Oct. 2	11 a. —2 p. m.		3.4664	1.5983	0.7547	71 4.7
Bodø	67 17.2	14 24.9 E	1877 Aug. 13	9¾—11¼ a. m.					75 21.4
—			— „ „	12¼—5½ p. m.		2.7854	1.2842	0.7402	
—			— „ „	6 p. m.	11 41 W				
Tromsø	69 39.1	18 59.3 E	1877 Juli 11	11¾—12¾					76 21.9
—			— „ „	4—6¼ p. m.		2.6365	1.2155	0.7426	
—			— „ „	7 p. m.	10 18 W				
Hammerfest	70 40.2	23 40.4 E	1877 Juli 9	5¾—24 p. m.		2.5484	1.1750	0.7627	
—			— „ 10	10¾—12 a. m.					76 54.3
—			— „ „	12½ p. m.	5 29 W				
Vardø	70 22.4	31 7.8	1878 Juni 26	10¾—11½ a. m.					76 52.4
—			— „ „	1—6 p. m.		2.5737	1.1867	0.7616	
Bergen *(Bergen)*	60 23.8	5 17.1 E	1878 Juni 14	6 p. m.	18.°2 W				
Vestfjorden *(West Fjord)*	68 5	14 30 E	1877 Aug. 10	5½ p. m.	11.2 W				
Vest-Finmarken *(West Finmark)*	71 7	21 11 E	1878 Juli 13	5½ p. m.	5.6 W				
Øst-Finmarken *(East Finmark)*	70 45.8	30 6.6 E	— Juni 25	7 p. m.	0.2 E				
Norske Hav *(Norwegian Sea)*	75 3	5 13 E	— Juli 20	4½ p. m.	20.5 W				
Sydkap Spidsbergen *(South Cape Spitzbergen)*	76 27	17 5 E	— Aug. 5	10 p. m.	11.4 W				
Grøndlandshavet *(Greenland Sea)*	76 27	0 56. W	— „ 9	11 a. m.	25.9 W				

H. Mohn. Nogle Bidrag til de nordlige Landes Geografi og Naturhistorie,

sammenstillede efter Iagttagelser,

gjorte paa den norske Nordhavs-Expedition 1876—78.

Med 6 farvetrykte Billeder og 9 Træsnit
samt 2 Karter.

Ved Nordhavs-Expeditionens Ophold i Havn eller under Kysten af de af det nordlige Atlanterhav og Ishavet beskyllede Lande og Øer, søgte man, saavidt Lejligheden tillod det, at anstille forskjellige Slags Iagttagelser paa Land. Disse Iagttagelser og deres Resultater har jeg, forsaavidt de antages at indeholde nye Oplysninger af Interesse, sammenstillet i de følgende Blade. De medfølgende Billeder, der samtlige ere udførte efter Originaltegninger, tagne paa Stedet, ville i mange Henseender give en langt fuldstændigere Forestilling om Gjenstandene end den vidtløftigste Beskrivelse.

I. Vestmanna-Øerne.

Fra Reden udenfor Havnen, hvor "Vöringen" laa fra den 22de til den 26de Juli 1876, ser man mod Nord Heima-Øens højeste Fjeld, *Heimaklettur*, og mod Nordost Forbjerget *Ystiklettur*. Det er dette sidste, vi se paa Billedet, til hvilket Maleren, Hr. Schiertz, har benyttet sin fortrinlige, paa Stedet tagne Farve-Skitse. De vulkanske Bergarters Forvitringsformer i dette fugtige Klima illustreres udmerket vel paa dette Billede. *Ystikletturs* stejle Vægge med sine smale Afsatser gjør det til et Fugleberg, hvor den hvide fra Fuglene hidrørende Farve smukt vexler med den naturlige brune, og oventil ser man paa mindre og større Partier den for Nordvest-Europas Ølande ejendommelige saftige grønne Farve af Græsset. Ved Klettens

H. Mohn. Contributions to the Geography and Natural History of the Northern Regions of Europe,

derived from observations made on the Norwegian North-Atlantic Expedition (1876—1878).

With 6 Chromo-lithographs, 9 Wood Engravings,
and 2 Maps.

The time passed by the Norwegian Expedition on the coast of such continental tracts and islands as border upon the North-Atlantic and the Arctic Ocean, was devoted, circumstances permitting, to the prosecution of exploratory work on shore. Those of the observations, and their results, that are fraught, it is presumed, with new and interesting data, have been set forth in the following pages. The accompanying illustrations, all of which are from sketches taken on the spot, will convey, in many respects, a much livelier impression of the natural objects they represent than any mere verbal description, however graphic and precise.

I. The Vestmanna Islands.

From the roadstead, without the harbour, where the "Vøringen" lay at anchor from the 22nd to the 26th of July 1876, is seen, looking north, Heima Island's loftiest summit, *Heimaklettur*, and north-east, Cape *Ystiklettur*. It is the latter we have depicted in the plate, for the original of which Mr. Schiertz, artist to the Expedition, made good use of his admirable water-colour sketches, taken on the spot. The rugged forms assumed in this humid climate by the disintegrated volcanic rocks are faithfully rendered. *Ystiklettur*, with its precipitous walls and long, narrow ledges, exhibits the salient features of a fowling-cliff, where the white colour characteristic of bird-haunts is picturesquely blent with the natural brown of the rock; and here and

Fod sees en Hule i Havbrynet; den benævnes *Klettshellir,* og er et af de mange Vidnesbyrd om Havets Virkninger paa Kysterne, paa hvilke Færøernes og Islands Klippestrande ere saa rige. Taagen ligger over Havet og stenger Udsigten til Island selv, med de store Jøkler.

Vende vi fra Ankerpladsen Blikket rundt, saa se vi mod Syd eller Sydvest den lille, men regelmæssige, nu udslukte Vulkan *Helgafell.* Den 23de Juli 1876 gjorde jeg, i Følge med Distriktslægen, Thorsteinn Jonsson, en Tur til Toppen af Helgafell. Vejen gik først over en udstrakt Lava-Mark, *"hraun"*, der skraaner nedad fra Vulkanens Kegle. I denne Lava findes flere Huler. En af dem er sine 20 Meter lang og 10 Meter bred; ovenfra kommer man ned i den gjennem et lidet Hul, gjennem hvilket man kan hoppe ned paa Bunden. I en Højde af omtrent 124 Meter over Havet ophørte Lavamarken og afløstes af den øverste Vulkan- eller Aske-Kegle. Denne bestaar af udkastede løse Masser, tildels af større Dimensioner, som Lavablokke af indtil 1 Meters Længde, men hovedsagelig af mindre, aflangt runde, rødlige Slaggestene og endnu mindre, mørke Smaasten og Sand.

Paa Toppen af Helgafell er der en kraterformet Fordybning. Den største Højde af Krater-Randen ligger mod Sydost, den laveste mod Nordvest. Forskjel i Højde c. 12 Meter. Kraterets Bund ligger igjen omtrent 12 Meter lavere end Randens laveste Parti. Keglens ydre Skraaning har en Heldning af c. 35°. Den er kortest paa Sydsiden, hvor de løse Materialier ikke række saa langt ned som paa Nordsiden, og fra hvilken Side derfor ogsaa Bestigningen er lettest.

Højden af det Punkt, hvor Keglen rækker længst ned paa Nordsiden og hvor Lavamarken begynder, samt Højden af den højeste Kam paa Helgafells Krater er beregnet efter Observationer med Aneroidbarometer. Dette sammenlignedes med Observationerne ombord (der udførtes hver Time), idet jeg aflæste det ved Havfladen før og efter Opstigningen. Desuden anbragtes de ved Undersøgelsen paa det meteorologiske Institut bestemte Correctioner for forskjellige Højder. Luftens Temperatur maaltes med Slyngethermometer. Ved Stranden var den 0.°2 til 0.°3 højere end ombord i "Vøringen". De til Normalbarometer og Normalthermometer reducerede observerede Værdier vare:

there at the summit the eye rests refreshed upon grassy patches of the rich bright-green tint peculiar to the island herbage of north-western Europe. At the foot of the cliff we see a cave, called *Klettshellir;* it is one of the striking proofs given by the sea of its action on coasts, of which so many are to be met with along the rocky shores of the Færoes and Iceland. A mist lies over the ocean, shutting out from view the main land of Iceland, with its great glaciers.

Bearing south, or rather south-west, from the anchorage, we have the small, but in form regular, and now extinct volcano *Helgafell.* On the 23rd of June, 1876, I made an excursion to the top of this mountain, in company with the surgeon of the district, Mr. Thorsteinn Jonsson. The way led at first over a broad expanse of lava, *hraun,* shelving down from the cone of the volcano. In the lava are a number of caves. To one of these, measuring 60 feet in length by 30 in width, access is gained from above through a narrow opening, down which you can leap to the bottom. The field of lava reaches about 370 feet above the sea, as far as the upper cone of the volcano. This cone consists partly of loose ejected masses, for instance blocks of lava measuring as much as 3 feet in length, but chiefly of reddish oval-shaped cinders, along with dark-coloured pebbles and sand.

At the summit of Mount Helgafell there is a crater-like excavation. The height of the edge is greatest towards the south-east, least towards the north-west, the difference being about 40 feet. The bottom of the excavation lies about 40 feet beneath the lowest part of the edge. The outer slope of the cone inclines at an angle of circa 35°. It is shortest on the south-side, where the loose debris do not extend so far down as on the north, and up the southern acclivity the ascent of the mountain is therefore easiest.

The altitude of the lowest point to which the wall of the cone descends on the north side, viz. where the field of lava begins, as also of the loftiest ridge of the crater, was computed from observations with the aneroid barometer. The readings of the instrument at the level of the sea, which I noted before and after the ascent, were compared with the observations on board, taken every hour, and the corrections found at the Meteorological Institute for different altitudes duly applied. The temperature of the atmosphere was taken with the sling thermometer. Along the shore it was from 0.°2 to 0.°3 higher than on board the "Vøringen." The observed values reduced to those of the standard barometer and standard thermometer, were as follows: —

1.	Foden af Keglen *(Foot of Cone)*	Kl. 7^h 6^m p. m.	Bar. reduc.	736.^{mm}7	Temp. 8.°5 C.
	Havfladen *(Sea-level)*	„ „ —	— —	747. 9	— 9. 5
	Resultat. Højde *(Result. Height)* = 124 Meter *(Metres).*				
2.	Toppen af Helgafell *(Summit of Helgafell)*	Kl. 7^h 22^m p. m.	— —	726. 35	— 6. 7
	Havfladen *(Sea-level)*	„ „ —	— —	747. 9	— 9. 4
	Resultat. Højde *(Result. Height)* = 240.5 Meter *(Metres).*				

2. Jan Mayen.

Den 27de Juli 1877, om Aftenen, kom vi, paa Vejen fra Tromsø til Jan Mayen, ind i Polarstrømmen. Temperaturen i Havets Overflade, der hele Dagen tidligere havde været 8° og derover, gik hurtig ned til mellem 4° og 5° og en Temperatur af 0° fandtes allerede i 17 Favnes Dyb. Dette var 15 geografiske Mil øst for Jan Mayen. Den følgende Nat og Formiddag dampede vi, under jevnlig Lodning, videre vestover og fandt Dybder paa 829, 968, 796, 1060 og, Kl. 1 Eftm. den 28de, 654 Favne. Endnu viste Jan Mayen sig ikke. Med det kolde Vand havde Polarhavets Taage indfundet sig og taget bort saavel Solen som al Udsigt til Land. Imidlertid tydede, foruden Dybdens Aftagen, den stadig tiltagende Mængde af Søfugl, navnlig Lunder, som saaes flyvende østover, paa at Landet ikke kunde være langt borte. Med Kursen fremdeles ret mod Vest dampedes fra Pladsen for det sidste Lodskud videre Kl. 1.40 Min. Kl. 2 hørtes pludselig første Styrmands Raab "Jeg ser Isbræen forud". Farten standsedes, Loddet kastedes og viste en Dybde af 144 Favne. I Horizonten, under den lavt liggende Taage, skimtedes en vældig nedoverhængende Isbræ mod den mørke Fjeldvæg. Det var Østsiden af Jan Mayen. Med Loddet i Bund bleve vi liggende paa samme Plads et Par Timers Tid. Taagen lettede noget, og vi kunde se nordover til Ostkap og sydover til Sydostkap. Vi laa ligeudenfor den sydligste af Østsidens fem store Isbræer (Petersens Bræ). Afstanden fra Land bestemtes, ved Ekkoet af et Kanonskud, (10.'4 Mellemtid) til en liden Kvartmil (1750 Meter).

Da Søgangen kom fra Nordnordost og der saaes Brændinger paa Stranden, besluttedes det at søge en Ankerplads paa den anden Side af Øen. Vi tog da Loddet ind og dampede nordover. Vejret holdt sig fremdeles taaget, og i det Øjeblik, vi vare naaede til tvers af Nordostkap, lagde Taagen sig saa tæt over Havet, at Landet og Horizonten blev taget ganske bort. Kursen sattes en Stund senere mod Vest, derpaa mod Syd og endelig mod Sydost. Taagen holdt sig hele Tiden over Havet og hindrede al Udsigt. Med korte Tidsmellemrum observeredes Havoverfladens Temperatur som et muligt Varsel om Is i Nærheden. Vi fandt jevnlig over 3°, og ikke lavere end 2.°3. Da vi Kl. 7 om Aftenen efter Bestikket nærmede os Mary Muss Bugten, begyndte vi at lodde, og fortsatte hermed under Farten ind mod det usynlige Land, for paa denne Maade at finde en Ankerplads, til Kl. 10. Kl. $10^1/_2$ begyndte imidlertid heldigvis Taagen at løfte sig, saaat de nedre Dele af Landet bleve synlige. Vi kunde nu orientere os og vælge vor Ankerplads, og Kl. 11 faldt Vøringens Anker i Mary Muss Bugten paa 20 Favne Vand, en god halv Kvartmil fra Stranden.

2. Jan Mayen.

In the evening of the 27th of July, 1877, on our passage from Tromsø to Jan Mayen, we entered the Polar current. The temperature at the surface of the sea, which throughout the day had not been lower than 8°, sank rapidly to between 4° and 5°, and 0° was registered at a depth of 17 fathoms, the position of the ship being then 60 miles east of Jan Mayen. During the night and the forenoon of the following day we steamed on westward, sounding repeatedly, and found the depth to be successively 829, 968, 796, 1060, and, at 1 p. m. on the 28th, 654 fathoms. Still, nothing was to be seen of Jan Mayen. With the frigid water had come the Arctic fog, shrouding both the sun and the land. Meanwhile, divers species of sea-birds, more especially puffins, seen flying eastward in steadily increasing numbers, could not fail to announce, apart from the observed decrease in depth, our comparative proximity to the island. Steering due west as before, we steamed on from where the last sounding had been taken (1.40 p. m.), and at 2 p. m. we suddenly heard the first mate shout "Glacier ahead!" The ship's way was immediately deadened, and on heaving the lead, the depth was found to be 144 fathoms. On the horizon, under the low-lying fog, could be descried against the dark mountain-wall a huge, beetling glacier. It was the eastern shore of Jan Mayen. With the lead at the bottom, we remained in the same spot for a couple of hours, when the fog began to clear a little, and looking northward, we could sight Cape East, southward, Cape South-East. The vessel lay right off the most southerly of the 5 large glaciers (Petersen's glacier) on the east coast of Jan Mayen. The distance from land was determined by the echo of a cannon-shot (interval 10.'4), and found to be something under a mile (5742 feet).

The swell coming from the north-north-east, and observing the sea breaking on the shore, we determined to seek a sheltered anchorage on the other side of the island. The lead was accordingly hoisted in, and we steamed northward. The weather still continued thick; and just as the vessel had got abreast of Cape North-East, the fog became all at once so dense that nothing could be seen of the land and the horizon. Shortly after, the course was set west, then south, and finally south-east. Meanwhile, there was no break in the fog, which still hung over the sea, excluding the prospect on every side. At brief intervals we noted the temperature of the surface-water, as a possible indication of the proximity of ice. This was generally found to be 3°, and in no case under 2.°3. At 7 p. m., as, according to our reckoning, we were approaching Mary Muss Bay, we heaved the lead, and continued sounding till 10 o'clock, as we bore down on the fog-shrouded coast to find anchorage for the ship. Fortunately, however, at half-past ten the dense mist began to rise, disclosing the lower parts of the land. We could now look about us and choose our anchorage; and at 11 o'clock the "Vøringen" dropped her anchor in Mary Muss Bay, in 20 fathoms of water, a little more than half a mile from the shore.

Den følgende Morgen var Havet aldeles roligt. Taagen laa fremdeles over Landet, saaat kun de lavere Dele vare synlige, til en Højde af 150 til 200 Meter. Foran os laa det maleriske Fugleberg (Fig. 1), hvis bratte, mørke Vægge mindede om Ystiklettur paa Vestmannaøerne. Ved

The next morning the sea was quite calm, but a thick fog, at the height of 500—600 feet, still hung over the island, only the lower range of coast being accordingly visible. In front towered the "Fugleberg," or fowling-cliff (Fig. 1), which with its dark, precipitous rocks vividly

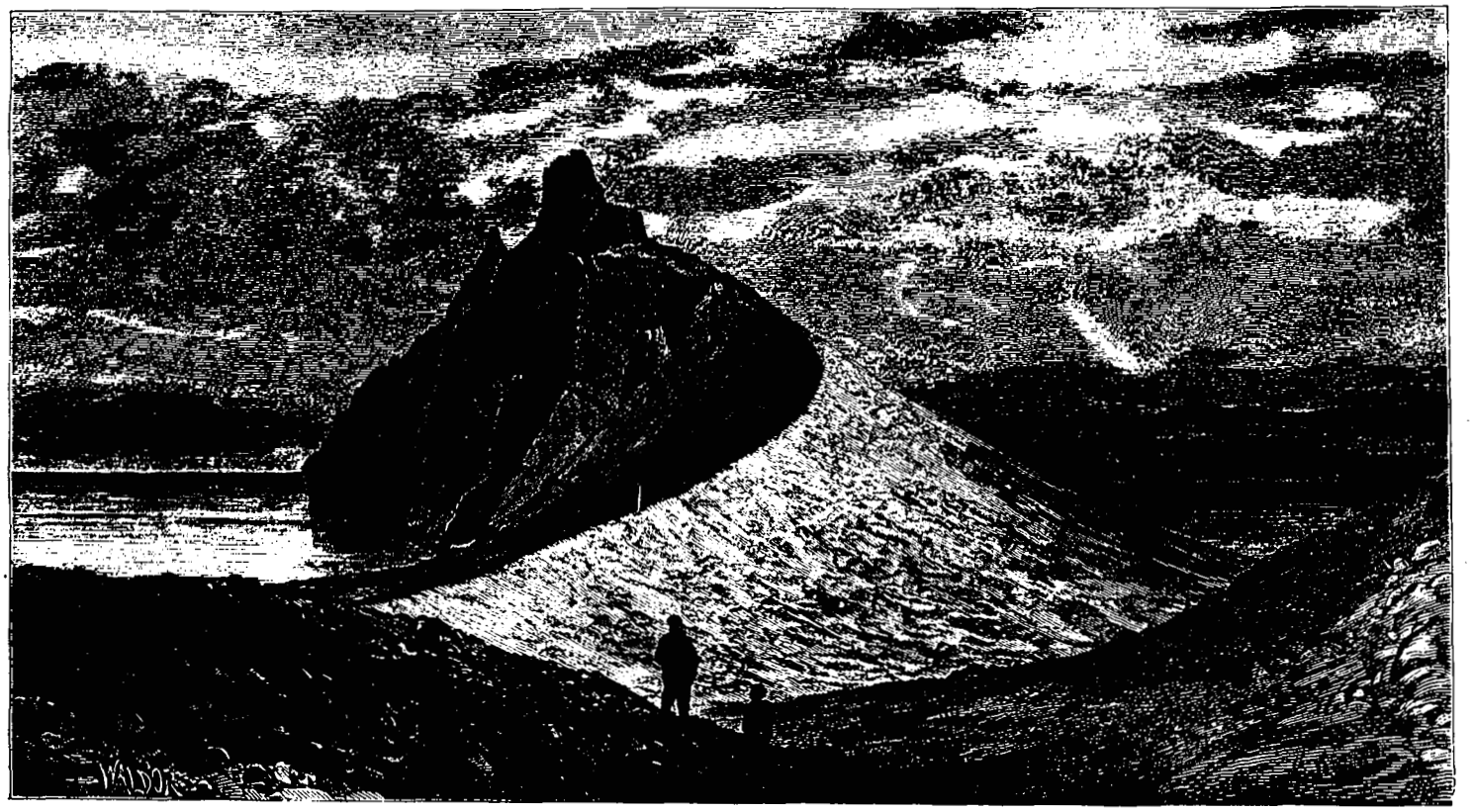


Fig. 1. Fugleberget. — The Fugleberg, or Fowling-Cliff.

Siden af Fugleberget, længere mod Syd, laa en flad Sandstrand, tæt bestrøet af Rækved. Her gik vi i Land uden den ringeste Vanskelighed. Stranden bestod af sort Sand. Den største Del af Rækveden laa paa en fra Havbredden noget tilbagetrukket Slags Terrasse, hvis horizontale Flade fandtes 5 til 6 Meter over Havets Niveau. Den mindre Del laa paa den foranliggende Skraaning mellem Terrassen og Stranden. Derfor ser det i Frastand fra Søen ud, som om Rækveden laa opstablet i regelmæssige Lag paa Stranden.

"Fugleberget" viste sig at være — som det sees af Figur 1 — Østsiden af et Krater, hvis vestlige Del er styrtet i Havet. Det er bygget af Lag af Tuf, fast Lava, udkastede Masser af Slakker og Aske. Paa den søndre Side af Mary Muss Bugten hævede sig, nær Søen, et mindre kegleformigt Krater (Krater Blytt), og indenfor dette, nærmere Øens Midte, et noget større af samme Form (Krater Danielssen), hvis Top nu ragede op i Taagen, men som

reminded us of Ystiklettur on the Vestmanna Islands. Stretching south of the Fugleberg, lay a flat sandy beach, bestrewn with driftwood. Here we landed, without the slightest difficulty. The beach was of black sand. Most of the driftwood lay on a terrace-like ledge, the level surface of which extended from 15 to 20 feet above the sea; the remaining portion was scattered over the gentle slope between the ledge and the beach. Thus, from the sea the driftwood appears at some distance to be piled along the shore in regular layers.

The "Fugleberg" (see Fig. 1) was found to be the eastern side of a crater whose west part had toppled down into the sea. It is built up of stratified tuff, compact lava, discharged masses of cinders, and ashes. On the south shore of Mary Muss Bay, in close proximity to the sea, rose a smaller, conical-shaped crater (Blytt's crater), and farther inland, towards the middle of the island, another of similar form, but somewhat larger (Danielssen's crater),

en af de følgende Dage saaes klart fra Øens Østside. Ved at stige op saa højt som Taagen tillod mig (175 Meter), fandt jeg Keglen bestaaende af lutter løse, udkastede, afrundede røde Stene samt sort Aske.

Ved Opstigningen fra Mary Muss Bugten naaede jeg, mellem Fugleberget og de to nævnte Kratere, meget snart op til Højderyggen af Øen, der her er paa sit laveste og smaleste. Fast lysgraa Lava, jevnlig blæret i Overfladen, dannede her Bergarten. Denne er, ifølge en senere Undersøgelse,[1] i meget ringe Grad, næsten umerkelig, magnetisk, medens en tættere, mørkere Lava, med indesluttede større Krystaller af indtil flere Millimeters Gjennemsnit og af basaltisk Udseende, der fandtes paa flere Steder, er tydelig polar magnetisk. Det laveste Parti af denne Højderyg fandtes efter Maaling med Aneroidbarometer at være 66 Meter. Højderyggen afluttedes paa den anden Side, mod Sydost, af en brat Styrtning. Under denne laa et udstrakt lavt Forland, der danner den indre Begrændsning af den lange, østlige Lagune. Mod Øst saaes fra Højden

its summit shrouded in mist, of which however we got on one of the following days an excellent view from the east side of the island. On clambering up as far as the fog would admit (570 feet), I found the cone to be exclusively composed of reddish, rounded, cindery stones ejected from the crater, and ashes.

Making the ascent from Mary Muss Bay, I soon reached — between Fugleberg and the two above-mentioned craters — the chief mountain ridge of the island, where its breadth and altitude are least. Here, compact light-grey lava, cellular at the surface, constitutes the outer stratum of rock. According to a subsequent examination,[1] this substance is very slightly, nay well-nigh inappreciably magnetic, whereas a denser, darker-coloured lava containing large crystals, — some of which measure several millimetres in diameter, — and of basaltic appearance, that occurred in several localities, has a perceptible magnetic polarity. The least elevated section of the ridge was found, from observations with the aneroid barometer, to reach an altitude of 217 feet. The ridge terminates on the opposite side of the island, towards the south-east, in a

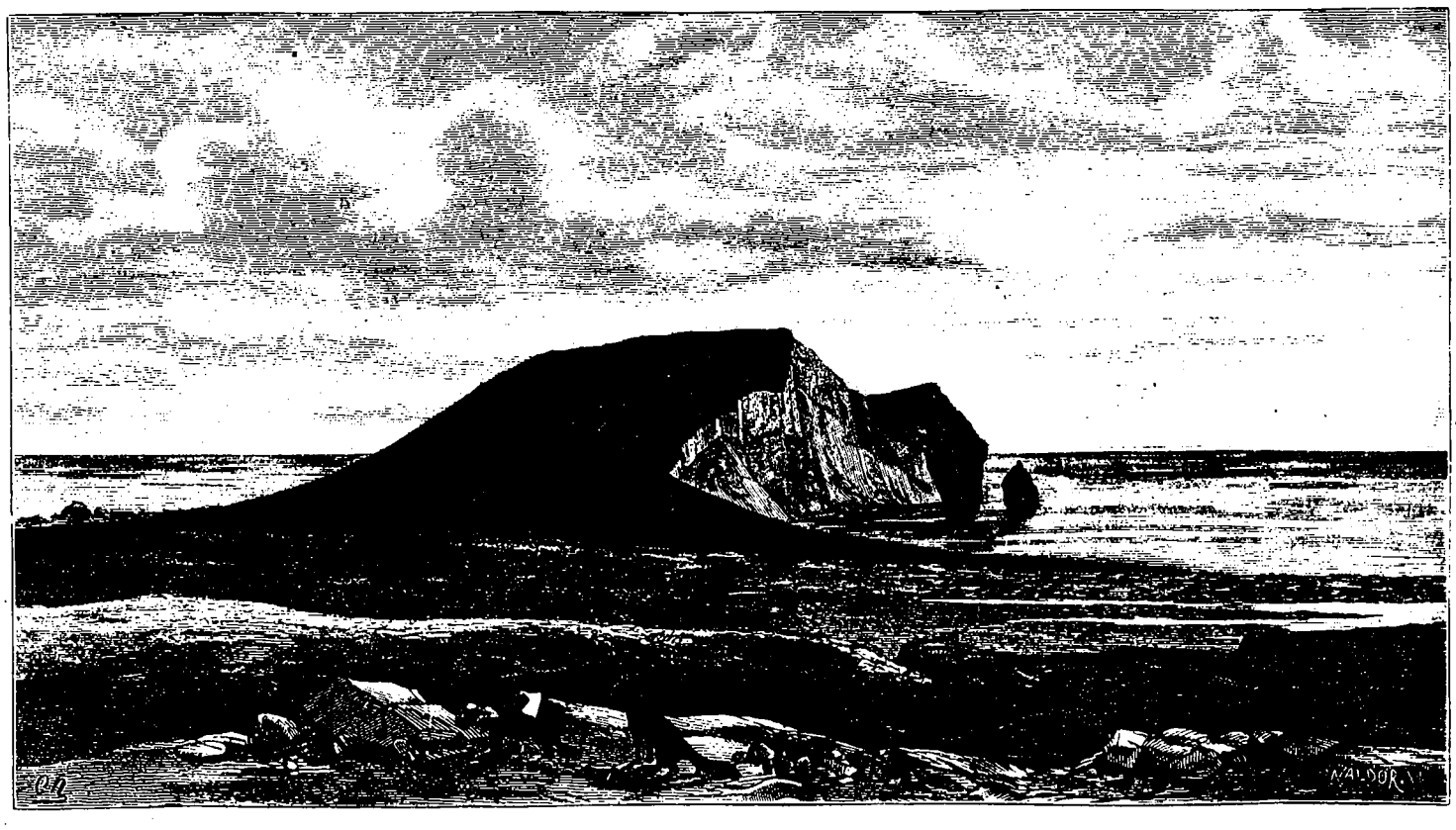


Fig. 2. Ægoen. — Egg Island.

[1] Foretaget af Prof. Schiötz.

[1] By Professor Schiötz, of Christiania University.

den i Havet udstikkende Halvø "Ægøen" med sin "Kalv" (Fig. 2). Mod Sydost saaes under Taagen Jan Mayens Syd-Lands Østkyst, med Lagunen og dens Vold, og de frit staaende af Havet opragende Bergknauser "Lodsbaaden" og det fjernere "Fyrtaarnet". Hr. Schiertz's Billede giver en udmerket Forestilling om dette Parti. Til Grund for samme ligger en Skitse taget fra Højderyggen. Da Taagen, som nævnt, denne Dag dækkede Højderne, ere disse tilføjede efter de fra Ankerpladsen paa Østsiden et Par Dage senere tagne Skitser.

Mod Nord kunde ingen fremtrædende Træk i Landskabet sees under Taageranden. Paa Tilbagevejen til Landingspladsen fulgte jeg en liden Bæk mellem de to nævnte Kratere i Syd for Mary Muss Bugten. Den forsvandt i Sandet førend den naaede Havet. Fra dette Punkt tegnede jeg Skitsen til Fig. 1, der viser "Fugleberget" fra Siden, til Venstre af samme Havet, til Højre den vestlige Lagune.

Samme Formiddag samlede Dr. Danielssen Planter paa Højderyggen og paa Skraaningen af det større Krater (Krater Danielssen) i Syd for Landingspladsen. En Polarræv, der blev opjaget paa Højderyggen eller Ejdet, blev skudt med Expressrifle af Lieutenant Petersen.

Det rolige Vejr vedvarede om Eftermiddagen, og nye Excursioner foretoges i Land. Fra Landingspladsen gik jeg først over den indre og ydre Skraaning af Fuglebergets Affald mod Sydost, og derpaa tilvenstre i Dalen indenfor Fugleberget, indtil jeg naaede den vestlige Lagune. For at komme fra Lagunens sydlige Strand hen til den Tange, som skiller den fra Havet, maatte jeg passere en Ur af tildels store skarpkantede Lavablokke, der her danner Overfladen af "Fuglebergets" mod Lagunen vendende Fod. Lagunen har ferskt Vand. Den er saa dyb, at Bund ikke kunde sees paa en kort Afstand fra Stranden.

Tangen, som skiller Lagunen fra Havet, var 200 Skridt (140 Meter) bred. Dens højeste Ryg laa, efter Maaling med Aneroidbarometer, 8 à 9 Meter over Havets Niveau. Lagunvandets Niveau laa 5 à 6 Meter under Tangens Ryg, eller omtrent 3 Meter højere end Havets Niveau. Paa Tangen laa megen Rækved og mange Hvirvler og Kjæver af Hval. Der fandt jeg ogsaa et Flotholt, c. 10 Cm. langt, 7 Cm. bredt, 2 Cm. tykt, af Bark. Forskjellige Stykker bredbladet Tang laa opskyllede paa Yderkanten af samme Vold. Dennes Længde ansloges til en Kvartmil og Lagunens Bredde til henimod det samme. Der saaes Rækved liggende ogsaa paa Lagunens søndre,

steep declivity, beneath which stretches a broad expanse of low-lying foreshore, forming the inner boundary of the long eastern lagoon. Looking east from the heights above, I had before me the "Ægøen" (Egg-Island) peninsula, with its "calf" — small detached islet (Fig. 2). In the south-west, we could sight beneath the fog the east coast of the southern part of Jan Mayen, with the lagoon and its barrier, and, rising abruptly from the sea, two isolated rocks, known as "Lodsbaaden" (the pilot boat) and "Fyrtaarnet" (the light-house). Mr. Schiertz has given in the plate an excellent view of this fine coastal scenery, sketched from the ridge overlooking the sea. The mountain summits having, as previously remarked, been wrapped in clouds on our arrival, that part of the picture was filled in from sketches taken a day or two later from our anchorage on the east side of the island.

North, no prominent feature of the scenery could be discerned below the fog. On my way back to the landing-place, I followed the course of a rivulet between the two craters south of Mary Muss Bay. Before reaching the sea, this little stream was lost in the sand; and here I sketched the "Fugleberg" — a side-view, to the left the ocean, to the right the western lagoon (Fig. 1).

The same afternoon Dr. Danielssen collected specimens of the insular flora on the mountain ridge and on the slope of the great crater (Danielssen's crater), south of the landing-place. A polar fox, roused, I believe, among the rocks of the mountain ridge, or on the isthmus, was shot by Lieutenant Petersen with an "Express" rifle.

The weather still continuing fine, further excursions were made in the afternoon. From the landing-place I took a south-easterly direction, crossing the south-western ridge of the Fugleberg, and then, turning to the left, struck off down the valley on the shore-side of the cliff, till I came to the western lagoon. In making my way from the south shore of the lagoon to the strip of land stretching between it and the sea, I had to pass an incline of debris over part of which were dispersed large, sharp-edged blocks of lava, that hereabouts form the base of the fowling-cliff on the side facing the lagoon. The water of the lagoon is fresh, and apparently of considerable depth, since the bottom could not be discerned at a short distance from shore.

The barrier separating the lagoon from the sea measures 200 paces (460 feet) across. Its highest ridge, as determined from observations with the aneroid barometer, attains an elevation of 28 feet above the level of the sea. The surface of the water of the lagoon lies 18 feet lower than the ridge of the barrier, or about 10 feet above the level of the sea. On the barrier there was a good deal of driftwood, along with the vertebræ and jaws of whales. There, too, I found a float of bark, about 4 inches long, 3 inches broad, and $^3/_4$ inches thick. Divers fragments of broad-leafed seaweed had been washed on to the outer slope of the barrier. The length of the latter

indre Strand. Luftens Temperatur var 4° og Vandet i Lagunen var + 4.°3.

Under Tilbageturen sad min Ledsager, der havde Hagelgevær med, og jeg og hvilede i Uren ved Lagunens Bred. En Ræv kom frem af Uren, betragtede os nysgjerrig, gik oven om rundt om os og saa udover Lagunen. Paa mit Vink havde imidlertid min Ledsager ladet Geværet og rakt mig det. Blandt de fra denne Excursion medbragte Specimina var et i Uren skudt Exemplar af *Canis lagopus*. Det 3die Exemplar blev skudt af Capt. Wille samme Eftermiddag paa Stranden i Mary Muss Bugten, hvor Matroserne havde opgjort et Baal af Rækved, der syntes at hidlokke Rævene.

Hr. Tornøe gik samme Eftermiddag langs den indre Side af Lagunen. Ved dens nordøstre Hjørne fandt han

I estimated at an English mile, and took the breadth of the lagoon to be about the same. Driftwood lay scattered over the southern (inner) strand of the lagoon. The temperature of the air was 4°, that of the water in the lagoon 4.°3.

On our way back to the boat, as I and my companion, who carried a fowling-piece, were resting on the tract of debris that borders the shore of the lagoon, a fox made its appearance among the stones, and, after regarding us a moment with evident curiosity, passed quietly on, within good range, in a circuit above us, and looked out across the lagoon. I motioned my companion to load and hand me the gun. Among the specimens collected on this excursion was an example of *Canis lagopus*. Another specimen of this animal was shot the same afternoon by Capt. Wille on the shore of Mary Muss Bay, where the sailors had lighted a pile of driftwood, which seemed to attract the foxes.

Mr. Tornøe strolled along the land-side of the lagoon,

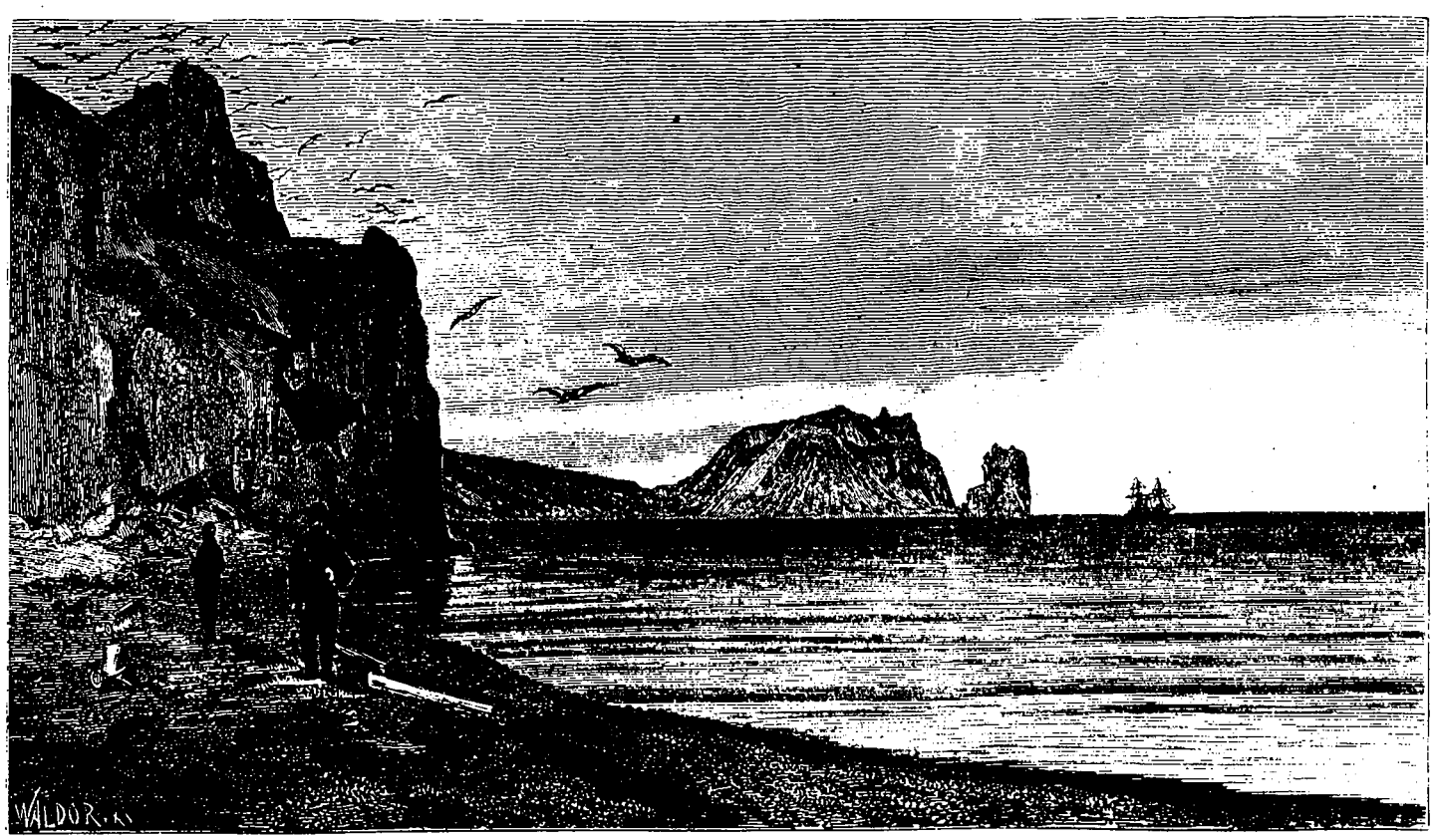


Fig. 3. Det Brielske Taarn. — Brielle Tower.

en Bæk (Tornøes Bæk), der løb ud i Lagunen. Fra den søndre Strand af Lagunen førte en lavtliggende Dal, kanske det laveste Ejd paa hele Øen, ham over til Østkysten, hvor han steg ned ad den bratte Skraaning og vandrede hen til

flowing into which, at the north-eastern extremity, he found a small stream (Tornøe's rivulet). From the south side of the lagoon, a deep-lying valley, perhaps the lowest part of the island, took him across to the eastern shore, whence, descending the steep incline, he made his way to the long

den lange Lagune. Ogsaa her var Vandet ferskt, men Lagunen var meget grundere end Vestsidens. Der laa Rækved, saavel paa Lagunvolden som paa den indre Strand.

Den følgende Dag arbejdede Zoologerne med Skrabning fra Baad i Mary Muss Bugten. Fra vor Ankerplads toges Skitser, navnlig af Landet mod Vest. Disse ligge til Grund for Fig. 3, der viser Udseendet af det Nes, der begrændser Nordostsiden af Nord-Baj eller English Bay. Yderst ser man den isolerede høje Klippe, som af de gamle Hollændere er kaldt "Brielle-Taarnet" og som danner et udmerket Sømerke. Mellem "Taarnet" og Landet indenfor er en dyb Kløft, som paa de ældste Karter kaldes "Walrusch Gat". Billedets Synspunkt er tænkt paa den vestlige Laguntange, strax i Nordost for Fugleberget, hvis bratte Skrænt sees til venstre i Forgrunden. Brielle Taarnet ligger tre Gange saa langt borte som "Vøringen".

Da vi om Eftermiddagen gjorde os istand til at gaa i Land for at undersøge Landet længere sydpaa, rejste sig en frisk Bris af Nordvest, der satte saa megen Sø, at Landgang blev vanskelig. Det besluttedes da at sejle om til den anden Side af Øen. Under Letningen kom Solen et Par Gange frem i Vest, saa at dens Højde kunde maales. Paa den anden Side, mod Nordost, rev Vinden enkelte Gange Hul i Taagen, og Toppen af Beerenberg viste sig i nogle Secunder, ophøjet og vidunderlig skjøn i sin blændende hvide Snekaabe. Dens Højde blev maalt med Sextant. Vi styrede NNV. over. Saa ofte som Beerenberg var synlig, benyttedes de korte Stunder til at fæste dens Udseende i Skitsebøgerne. Efter disse Skitser er Fig. 4 tegnet. Forholdet mellem de verticale og horizontale Udstrækninger er det rigtige og stemmer med Kartet. Store sorte Flekker, paafaldende mørke ved Contrasten med den blændende hvide, af Solen oplyste Sne, viste bratte Styrtninger paa den øvre Kegle, hvor Fjeldet var ganske bart. Da vi kom længere frem, stak to Afsatser, den ene udenfor (nordenfor) og nedenfor den anden, sig frem mod Nord → se Fig. 4 — saa kom Taagen og tilhyllede atter alt undtagen det laveste af Landet til 90 à 100 Meters Højde.

Under hele Farten denne Eftermiddag og Aften rundt Øens Nordende toges stadig Pejlinger med Compasset til alle synlige Pynter og andre merkelige Gjenstande, og der maaltes Vinkler med Sextant. Ogsaa til Punkter paa Sydlandet, der under den første Del af Farten saaes helt nede indtil Hoyberg, toges Sigter. Kursen styredes og beregnedes med Nøjagtighed og Loggemaskinen observeredes hvert femte Minut. Der toges ved Siden heraf en Række Skitser. Det saaledes indvundne Materiale er i fuldt Maal

lagoon. Here, too, the water was fresh, though the lagoon was much shallower than that on the west side. Driftwood lay scattered alike on the barrier and on the inner strand.

On the following day our zoologists dredged from a boat in Mary Muss Bay. Sketches were made from the anchorage, chiefly of the land stretching west; and these have furnished the subject of Fig. 3, which gives a view of the headland forming the north-eastern extremity of North or English Bay. In the distance is seen the lofty isolated rock called by the early Dutch navigators "Brielle Tower," and which serves as an excellent land-mark. Between the "Tower" and the main land extends a deep ravine, that bears on the earliest maps the name of "Walrusch Gat." The point of view in the figure is supposed to be on the barrier of the western lagoon, north-east of the Fugleberg, which, with its steep acclivity, rises boldly in the left foreground. The distance of Brielle Tower from the point of view is thrice that of the "Vøringen."

In the afternoon, as a party of us were getting ready to go ashore, with a view to explore the island farther south, a fresh breeze sprang up from the north-west, and soon made so rough a sea that landing was out of the question. We determined therefore to steam round to the opposite side of the island. While getting under weigh, the sun broke out twice in the west, and we managed to take a couple of altitudes. Now and again, on the other side, in the north-east, the wind tore a rent in the clouds, and for a few seconds disclosed the dazzling, snow-capt summit of Beerenberg, in matchless grandeur and beauty. The height of the mountain was measured with the sextant. We steered north-north-west. So often as any part of Mount Beerenberg became visible for a moment, the brief opportunity was eagerly seized to fix some new feature of its fleeting aspect. Fig. 4 is from these sketches. The proportion between the vertical and the horizontal extent of the mountain is true to nature, and agrees with the Map. Huge black patches on the upper cone, rendered doubly conspicuous by contrast with the dazzling white of the sun-illumined snow, showed the position of the steepest inclines, where the mountain was entirely naked. Farther on, two rocky ledges, the one beyond (north of) and below the other, could be seen projecting northward (Fig. 4); — and then came the fog, blotting out everything from view, save the lowest strip of coast, that was still visible for about 300 feet above the sea.

During the whole of that afternoon and evening, as we steamed round the northern extremity of the island, bearings by the compass were successively taken of all visible headlands and other salient landmarks; and angles were measured with the sextant. Of points on the south part of Jan Mayen, that for some time after starting could be seen as far as Hoyberg, bearings were also taken. The ship's course was accurately computed, the water-log being observed every five minutes. Moreover, a series of sketches

giver et meget vildt Skue. Vi passerede i en Afstand af $2^1/_3$ Kvartmil.

glaciers on the north side as they appeared to us. In the foreground lie prodigious rampart-like masses of debris;

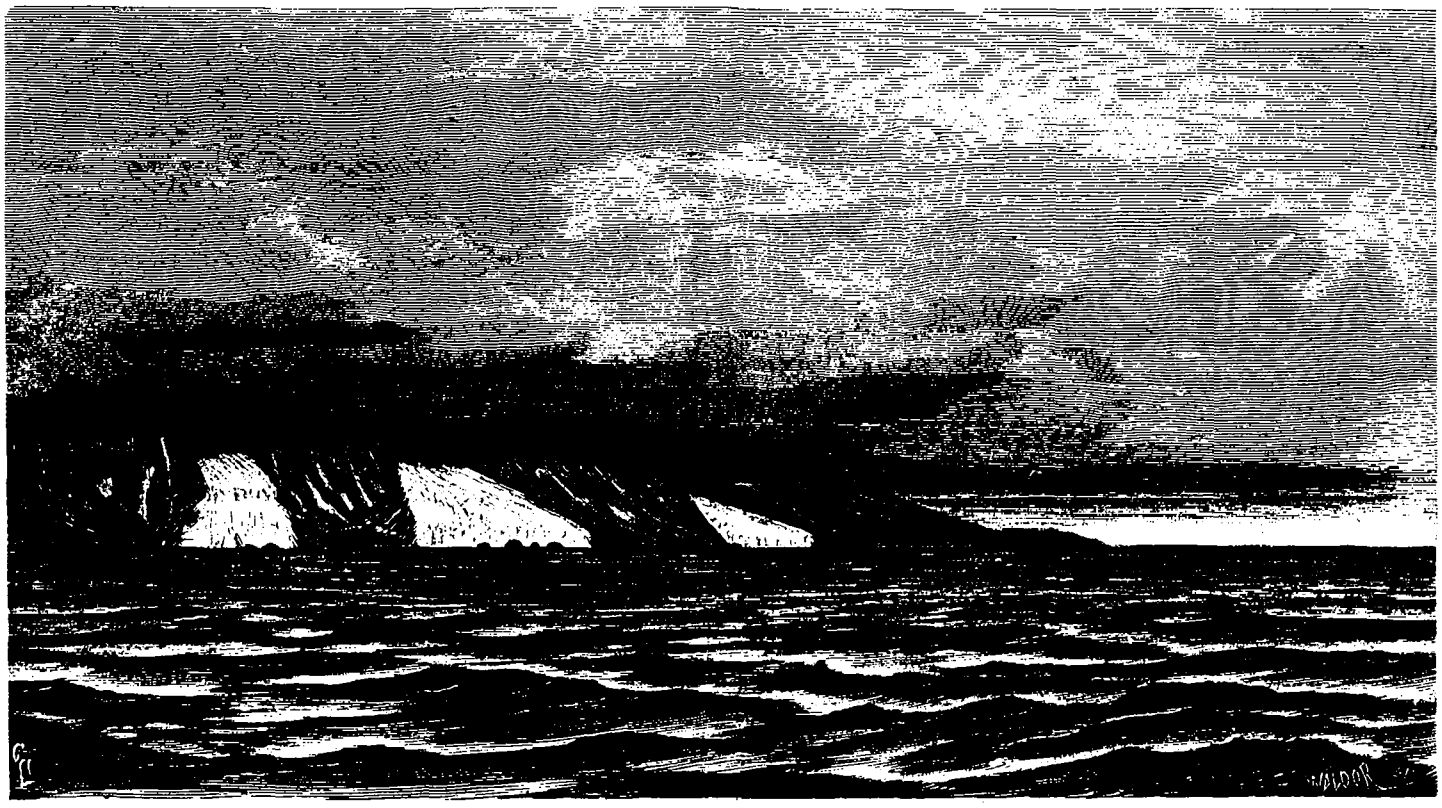


Fig. 5. Nordsidens Bræer. — The Glaciers of the North Coast.

Kl. 9 om Aftenen passerede vi Nordostkap. Vi kunde nu se Rækken af de stejle Bræer paa Østsiden. Der var ikke flere end 5 saadanne, som naaede Havfladen. Deres indbyrdes Beliggenhed bestemte jeg ved at notere de Øjeblikke efter Uret, da hver af dem observeredes tvers paa Kursen, der holdtes uforandret og med jevn Fart. Kl. 12,45 Min. om Morgenen ankrede vi i den store Rækved-Bugt paa 12 Favne Vand, udenfor Lagunen, i Vest for Ægøen.

Denne Dag, den 31te Juli, bleve vi liggende paa vor Ankerplads. Taagen fordelte sig noget, saa noget mere af Landet blev synligt; men Beerenberg var fremdeles tilhyllet. Derimod var Solen jevnlig fremme om Formiddagen og en Del af Eftermiddagen. Da Søgangen hindrede Landgang, toges Solhøjder fra Skibet.

Om Eftermiddagen forsøgtes Landgang med to Baade, men Brændingen var for svær til at man turde vove Forsøg paa at bringe Instrumenter i Land. Vi roede langs Lagunthe glaciers, too, are jagged and riven, and discoloured with dirt; altogether it is a wild scene. We passed at the distance of two and one-third miles.

By 9 o'clock in the evening we had rounded Cape North-East; and now the series of precipitous glaciers on the east side of the island came in sight. Only 5 of these reached to the water's edge. Their relative position I determined by noting, watch in hand, the exact moment at which each was observed abreast of the vessel, keeping the same course and speed. At 12.45 a. m. we cast anchor in Great Wood Bay, in 12 fathoms, off the lagoon lying west of Egg Island.

The rest of the day, July 31st, we passed at our anchorage. The fog dispersing a little, more could be seen of the land; Mount Beerenberg, however, was still wrapped in clouds. Meanwhile, we had the sun out most of the fore part of the day, and at intervals in the afternoon. The swell being too heavy to admit of landing, a series of solar altitudes was taken from the ship.

In the afternoon two boats put off for the shore; but there was too much surf to risk landing the instruments. We rowed along the barrier of the lagoon to Egg Island,

giver et meget vildt Skue. Vi passerede i en Afstand af $2^1/_3$ Kvartmil.

glaciers on the north side as they appeared to us. In the foreground lie prodigious rampart-like masses of debris;

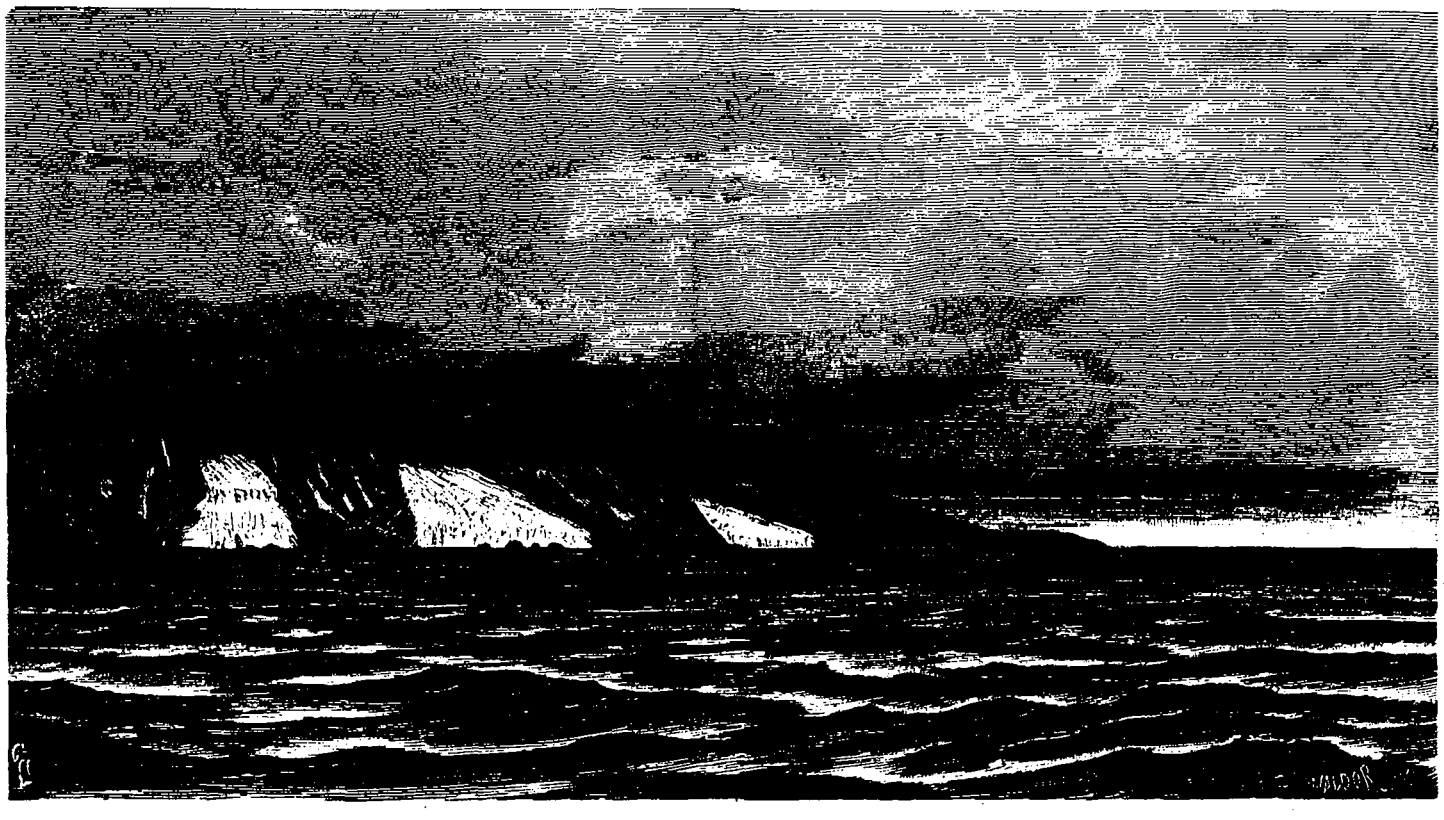


Fig. 5. Nordsidens Bræer. — The Glaciers of the North Coast.

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volden, hen til Ægøen og udenom denne. Der, hvor Lagunvolden støder til Foden af Ægøen, saa vi Snelag, dækkede af sort Sand. Vi fik den følgende Dag, som det nedenfor vil sees, en simpel Forklaring paa dette Forhold. Ægøens Sider ere overalt mod Søen ganske stejle. Paa Sydvestsiden saaes i den tverbratte Væg et udmerket tydeligt Profil af de Aske- eller Tuf-Lag, hvoraf Øen, eller nu rettere Halvøen, er dannet. Ved svage Vindstød ramlede Dele af Asken løs og styrtede som Ras ned i Fjæren eller i Havet, eller hvirvledes af sterkere Vindstød op til høje Røgskyer. Ægø-Kalven er et løsrevet eller tilbagestaaende Stykke af Ægøens Krater, bestaaende ligesom hele Øen af sort Tuf, der indeslutter større og mindre Stene. I Ægø-Kalven saaes Stene af indtil en Meters Tvermaal. Ægøens Krater er nu aabent mod Sydost, den ydre Del er begravet i Havet. Et Snit gjennem Ægøen fra NW—SE viser paa den mod Land vendende Side Lag af Aske, der, parallele med Overfladen, helde mod NW. Henimod Krateret derimod helde Lagene ned mod dette, mod SE, og inde i Krateret ser man paa dettes bratte Vægge det udgaaende af disse Lag som horizontale Belter.

Da vort Forsøg paa at komme i Land havde vist sig frugtesløst, skred vi til at bestemme Beliggenheden af vor Ankerplads i Forhold til fremtrædende Punkter paa Land ved trigonometriske Operationer. Ved Ægø-Kalven maalte jeg med Sextant Højden af Stortoppen paa "Vøringen". Da vi vare komne tilbage til Fartøjet, rejste Capt. Wille ud i Baaden, hvorfra han, liggende i en passende Afstand og Retning, maalte Vinkelhøjden af Stormasten, og derpaa Horizontalvinkelen mellem Stormasten og det Punkt, hvis Beliggenhed skulde bestemmes, i samme Øjeblik som jeg, staaende ved Stormasten, paa givet Signal maalte Horizontalvinkelen mellem Captein Wille og Punktet. Paa denne Maade bestemtes Afstandene til Ægø-Kalven, til Fugleberget paa Vestsiden, hvis markerede Top (se Fig. 1) var synlig over det lavere Ejde, og til Klippen "Lodsbaaden". Fuglebergets Azimut bestemtes af Skibets Officierer ved 3 Compaspejlinger paa 3 forskjellige Kurser, og Horizontalvinklerne mellem dette Punkt og de øvrige observeredes. Fra Fuglebergets Fod havde jeg den Dag, vi vare i Land, maalt Stormastens Vinkelhøjde og Skibets omtrentlige Azimut. Saaledes vandtes et efter Omstændighederne godt Grundlag for Øens Kartlægning. Samme Dag toges mange Skitser. Sydlandets Udseende kunde nogenlunde opfattes; dog vare de højeste Partier hverken nu eller senere under vort Ophold fri for Skyer. Vort store Billede med Lagunen viser Sydlandets Østside meget nær saaledes som det saaes fra Ankerpladsen.

and some distance round. Where the barrier of the lagoon abuts on Egg Island, we saw layers of snow covered with black sand. The next day, as will appear below, a simple explanation was obtained of this phenomenon. The sides of Egg Island are exceedingly precipitous towards the sea. On the south-west side, the well-nigh perpendicular wall of the cliff exhibited with remarkable distinctness the strata of ashes, or tuff, of which the island, or now rather the peninsula, is composed. A puff of wind brushing the surface sufficed to loosen and blow about the ashes, some falling on the beach or into the sea, while a violent gust would whirl them aloft in clouds. The Egg Island calf (detached islet) is a disrupted fragment of the Egg Island crater, consisting, as does the whole of the main island, exclusively of black tuff, in which are imbedded larger and smaller stones. In the tuff of the islet were seen stones measuring as much as 3 feet across. The Egg Island crater is now open towards the south-east, the outer portion lying buried in the sea. A vertical section through the island from NW. to SE. exhibits on the land side layers of ashes, which, running parallel to the surface, incline towards the north-west, but, as they approach the crater, turn off towards it, dipping in a south-easterly direction, and within, on the precipitous walls of the cavity, make their appearance as broad horizontal bands.

The attempt to land having proved abortive, we now set about determining the relative position of our anchorage and that of salient points on shore, by means of trigonometrical observations. Off the Egg Island calf, I measured with the sextant the height of the main mast of the "Vøringen." On our return to the ship, Captain Wille put off in a boat, from which, in the proper direction, he first measured the angle of elevation of the main mast, and then the horizontal angle between the main mast and the point the position of which had to be determined, whilst I, stationed beside the main mast, at a given signal, simultaneously measured the horizontal angle between the boat and the point. In this manner were determined the respective distances of the Egg Island calf, of the Fugleberg, on the west side, the conspicuous summit of the cliff (see Fig. 1) being visible above the low-lying isthmus, and of the "Lodsbaaden," or pilot-boat rock. The azimuth of the Fugleberg was taken by the officers of the vessel, from 3 compass-bearings on 3 different courses, and the horizontal angles between that point and the other landmarks were observed. From the foot of the Fugleberg, I had taken the day we were on shore the angle of elevation of the main mast, together with the approximate azimuth of the ship. We thus, considering the circumstances, succeeded in obtaining a fair collection of data for constructing a map of the island. The same day numerous sketches were made of the coastal scenery. The contours of the southern land could be discerned with tolerable distinctness; but neither on this nor any subsequent occasion during our stay were its loftiest tracts visible. The large plate with the lagoon shows the east side of the southern land very nearly as it appeared from the anchorage.

Den følgende Dag, 1ste August, fik jeg om Formiddagen nogle Solhøjder fra Ankerpladsen. Vi lettede og stod sydover, loddede og skrabede paa 70 og 95 Favnes Dyb (se Kartet). Bunden var sort vulkansk Sand og Slik og Dyrelivet rigt; Vandet ved Bunden havde en Temperatur under 0°. Over Jan Mayens Sydland laa Taagen fremdeles og skjulte de øverste Dele, men over Nordlandet spredte Skyerne sig efterhaanden, saa at vi hele Eftermiddagen og Aftenen havde det herlige Syn af Beerenberg i fuld Solbelysning. Selvfølgelig vare alle Tegnere i fuld Virksomhed. Fra den nordligste af de paa Kartet med 95 Favnes Dyb betegnede Stationer tog jeg en Række Maalinger af Beerenberg: Horizontalvinkler og Højdevinkler med Sextant, Heldningsvinkler med det til mit geologiske Compas hørende Klinometer, samt flere Skitser. Dette Material er benyttet til Tegningen af mit Billede af Beerenberg.

Til Venstre ser man den sorte Ægø i lidt over 6 Kvartmils Afstand, det nærmeste Object. Havhorizonten ligger i lidt over 4 Kvartmils Afstand fra Øjet, og alle Strandpartierne dukke følgelig under denne. Til Højre for Ægøen sees Kraterne Esk og Vogt, begge med sine kløftede Kraterrender. Mellem Krater Vogt og det spidsere Fjeld (Scoresby's Berg) til venstre for samme, der ligger lige op for Østkanten af Ægøen, synes en Dal med en Bergmasse, der skraaner mod Vest og hvis Fod var synlig fra Ankerpladsen, maaske en Lavastrøm. Dens Farve var mere blaalig, medens Kraternes er rødlig. Østenfor Krater Vogt saaes, mindre tydelig, nogle Højder under Beerenbergs Fod, indtil man kommer til den store Sydbræ, der i en Bue gaar ned fra Snegrændsen til Havet. Partiet mellem Sydbræen og Sydostkap frembød i den betydelige Afstand, 9 til 12 Kvartmil, ikke mange Detaljer. Lige øst for Sydbræen kunde jeg se en Højde eller en Højderyg, der syntes at ende i et Fremspring i Havet, Scoresby's Cape Fishburn. Som man ser af Billedet, kunde Snegrændsens gjennemsnitlige Beliggenhed bestemmes med en ikke ringe Nøjagtighed. Dens Højde beregner jeg efter mine Maalinger til 706 Meter over Havet. Over Snegrændsen sees Beerenbergs Snekaabe, der dækker hele den øvre Del af Fjeldets Basis. Denne Basis er en flad Kegle; dens Skraaning maaltes paa Vestsiden til 8° og paa Østsiden, ned mod Sydostkap, til 10°.

Over Basiskeglen, der rækker op til en Højde af c. 1400 Meter, hæver sig Beerenbergs Askekegle med en ydre Skraaning af 42°. Denne fremtræder ren paa Vestsiden, medens der paa Østsiden skyder frem fra Keglen nogle Ribber, antagelig Lavagange gjennem Keglen, der reducere den apparente Skraaning til 32°. Paa Vestsiden maaltes, fra den 8° heldende Basis af, et længere Stykke med 15° Heldning, derpaa et kortere Stykke med 28°

On the following day, August the 1st, I took in the forenoon a few solar altitudes from the anchorage. We then got under weigh and stood south, sounding and dredging in 70 and 95 fathoms (see Map). The bottom consisted of black volcanic sand and ooze; and there was abundance of animal life. The bottom-temperature was below 0°. Over the southern part of Jan Mayen the fog still lay heavy, obscuring the most elevated tracts; but over the northern part the clouds were gradually dispersing, and throughout the afternoon and evening we had a magnificent sun-lit view of Beerenberg. All who could draw were now of course fully engaged in sketching the scenery. From the most northerly of the observing-stations at which the depth, as indicated in the Map, was 95 fathoms, I took a series of measurements of Mount Beerenberg, — horizontal and vertical angles, with the sextant, angles of inclination, with the clinometer belonging to my geological compass, and made besides several sketches. The material thus acquired has been carefully worked up for my prospect of Mount Beerenberg.

On the left-hand side, distant upwards of 6 miles, the black wall of Egg Island, the nearest object in the picture, is seen boldly projecting. The distance of the horizon being a little more than 4 miles from the point of view, all parts of the shore dip beneath it. To the right of Egg Island are seen the Esk and Vogt craters, with their jagged edges. Between Vogt's crater and the somewhat acuminate mountain to the left (Mount Scoresby) rising behind the eastern acclivity of Egg Island, extends a valley filled with a rocky mass, — possibly a current of lava, — the base of which was visible from the anchorage. This mass had a bluish tint, whereas the craters are of a reddish colour. East of Vogt's crater loomed a few summits at the foot of Mount Beerenberg, and farther on was seen the great southern glacier shelving down in a curve from the snow-limit to the sea. At so considerable a distance as 9 to 12 miles, the tract between the southern glacier and Cape South-East did not present many prominent details. East of the southern glacier, I could distinguish a summit or mountain-ridge terminating apparently in a headland, — Scoresby's Cape Fishburn. As will be seen from the plate, the snow-line could be determined with very considerable accuracy. Its elevation I computed from my measurements at 2316 feet above the sea. At that height commence the snows of Beerenberg, which cover the entire upper portion of the base of the mountain. The base has the form of an obtuse cone, that on the west side was found to incline 8°, on the east, towards Cape South-East, 10°.

Above the lower cone, which attains an altitude of nearly 4600 feet, towers the cone of ashes, with its outer slope shelving at an angle of 42°. On the west side the slope has the surface smooth, but on the east exhibits a few prominent ribs, probably dykes of lava, which reduce the apparent incline to 32°. On the west side, from where the base of the mountain shelves at an angle of 8°, the slope for a good way up was found to be 15°, then for a

Heldning, og endelig selve Keglens Heldning paa 42°. Paa Østsiden sees Underdelens Skraaning paa 10° at skyde sig foran de fjernere, i Skygge liggende Partier, der staa ud som Ribber fra den geometriske øvre Kegle. Solen stod, da Kraterets Konturer og Skygger skitseredes, i Vest, i Papirets Plan.

Den stejle Kratervæg er paa mange Steder snefri, og den sorte Aske viser her store Flekker af ofte bizarre Figurer. Kraterranden er tagget, men Sneen, der dækker den, giver Randen med dens Tagger ejendommelig bløde Omrids. Kraterranden er højest paa Vestsiden; der maaltes en gjennemsnitlig Heldning af den øverste Linie af $2^1/_2$ Grad. Det højeste Punkt af Beerenberg ligger saaledes (nu) paa Kraterets Vestside og, som Fig. 4 viser, noget mod Nord. Det er dette Punkt, hvis Højde vi have søgt at bestemme med et rundt Tal til 1950 Meter.

Fra Loddestationerne toge Officererne Pejlinger til Øens nordlige og sydlige Del. At bestemme Skibets paaværende Plads efter Pejlingerne og Scoresby's Kart, viste sig omtrent ugjørligt, da dette, i Overensstemmelse med de ældre hollandske Karter, giver Sydlandet for langt og for smalt.

Medens vi vare paa Søen, havde vi Anledning til at iagttage de voldsomme Hvirvelvinde, der kunne blæse under Beerenberg. For et Sejlskib maatte disse være yderst generende med de pludselige Omslag i Vindens Retning under sterke Byger. I disse maaltes en Vindhastighed af 15 Meter pr. Secund, den største Vindhastighed vi iagttog under 1877 Aars Rejse. Fra Søen saa vi, hvorledes det fine Tufsand fra Ægøen reves løs og førtes højt op i Luften som en mørk Røgsky med de sterke Vindbyger. Med den vulkanske Ø for Øjne skulde der ikke nogen sterk Indbildningskraft til, for at man kunde tro at se Ildsluer bryde ud fra Ægøen og saaledes komme til at medbringe Efterretning om at have været tilstede ved et vulkansk Udbrud. Heldigvis havde vi Dagen før havt Anledning til at overbevise os om Sagens sande Natur. Om Aftenen ankrede vi i den store Rækvedbugt et Par Kvartmil i Sydvest for den forrige Ankerplads.

Næste Morgen, den 2den August, var Beerenberg fremdeles synlig. Vi lettede og stod østover, passerede Ægøen og loddede i 195 Favne udenfor Sydbræen. Paa Veien saa jeg tydelig inde paa Underlandet under Krater Vogt det af Carl Vogt i 1860 observerede og beskrevne lave Krater Berna. Fremdeles saa jeg, at Sydbræen gik lige til Stranden, men at dens nederste Del var bedækket med Smuds. Efter Lodningen gjorde vi et Forsøg til Bestemmelse af Højden af Beerenberg. Efter et godt Med (Ægøens Kant over et markeret Punkt inde paa Land) sejledes i en nøjagtig udmaalt Tid, medens Skibets Fart hvert 5te Minut observeredes efter Loggemaskinen. Ved Begyndelsen og Enden af dette Tidsrum maalte med Sex-

short distance 28°, the incline of the upper cone itself reaching, as previously stated, 42°. On the east side, the slope of the lower cone, that shelves at an angle of 10°, was seen extending before the more remote parts of the upper declivity, which lay in shadow, and like huge ribs project from the upper cone. When sketching the contours and shadows of the crater, I had the sun in the same plane as the paper.

The precipitous walls of the crater being in many places bare of snow, large patches of the black surface make their appearance, many of them grotesque in form. The ridge of the crater is extremely rugged; but the snow covering the jagged edges imparts a wonderful softness of outline. The ridge of the crater is highest on the west side; and its average incline was found to be $2^1/_2$ degrees. The most elevated point of Mount Beerenberg is accordingly (now) on the west side of the crater, and, as shown in Fig. 4, lies a little towards the north. It is this point the altitude of which we have approximately determined at 6400 feet.

From the sounding-stations, the ship's officers took bearings of points in the northern and southern parts of the island. To determine the ship's position from bearings and Scoresby's map proved well-nigh impossible, since the latter, based as it is on the earlier Dutch maps, gives the southern part of the island at once too long and too narrow.

Whilst engaged in sounding, we had opportunity of observing the violent whirlwinds that are often encountered on passing east of Beerenberg. To sailing-vessels they must prove a serious annoyance, owing to the sudden changes in the direction of the wind during heavy squalls. On one such occasion the velocity of the wind was found to reach 15 metres a second, the greatest velocity observed on the cruise in 1877. In the strong eddying gusts the fine tuff-sand of Egg Island would be caught and whirled aloft like a dense cloud of dust or ashes. With the volcanic island in immediate proximity, it required no great stretch of the imagination to fancy you saw flames bursting forth from the crater, and thus bring away the erroneous impression of having witnessed a volcanic eruption. Fortunately, we had had on the previous day opportunity of ascertaining the true nature of the phenomenon. In the evening we cast anchor in Great Wood Bay, a couple of miles south-west of our former anchorage.

Next morning, August the 2nd, Mount Beerenberg was still visible. We got under weigh, steering east, past Egg Island, and sounded in 195 fathoms, off the southern glacier. As we steamed along the coast, I could plainly distinguish on the low-lying tract beneath Vogt's crater the low Berna crater, observed and described by Carl Vogt in 1860. Moreover, I could follow the direction of the southern glacier to where it reaches the sea: its lower extremity was covered with dirt. After sounding, an attempt was made to determine the altitude of Mount Beerenberg. Selecting a good bearing (the base of the outer wall of Egg Island in a line with a salient inland point) we steamed ahead in this direction for a given time, accurately measured, the

tant, paa givet Signal, en Iagttager Vinkelen mellem Medet og Toppen, og en anden Iagttager Toppens Højde over Horizonten. Resultatet af Beregningen var 1945 Meter.

Om Eftermiddagen loddedes 340 Favne udenfor Sydostkap. Kursen sattes nu nordover. Taagen begyndte at omhylle Beerenberg og vi saa dens Top og Skuldre for sidste Gang. I Nordost for Nordostkap, 7 Kvartmil af, fandtes en Dybde af 1040 Favne. Dette giver en midlere Heldning af Havbunden udenfor Nordostkap af 8 Grader, hvilket er noget brattere end Heldningen af Beerenbergs Basis henimod Nordostkap (efter Kartet 6.°6), men mindre brat end Heldningen mod Sydostkap (10°). Paa Skraaningen ned mod Nordostkap saaes en Eruptionskegle (Krater Sars), som findes i ældre Tegninger, naar man ser nøje efter, saaledes i Vogt's Rejse og paa Lieutenant Ring's Tegning Fig. 7. Paa Nordsiden af Øen saaes de 3 Isbræer trædende frem af dybe Dale foran den bratte, 60° heldende, 300 Meter høje Fjeldvæg, Fig. 5. Hvad der laa højere, var dækket af Skylaget. Vi fik saaledes desværre ikke se Beerenberg og dens Grundstykke fra Nordsiden, og de store Bræers Udspring fra Snegrændsen gik ligeledes vor Iagttagelse forbi, da Taagen efterhaanden sænkede sig.

Efter at have taget en Række Lodskud i Nord og Nordvest for Jan Mayen, og fundet over 1000 Favnes Dyb paa vort vestligste Punkt, hvor Luftens Temperatur om Natten var kun lidt over Frysepunktet, men ingen Is var at se, styredes tilbage mod Øens Vestside. Da vi om Formiddagen den 3die August nærmede os Mary Muss Bugten, var Vejret fremdeles meget taaget. Vi styrede videre langs Landet sydvestover og spejdede opmerksomt efter en Lejlighed til at komme i Land paa Sydlandet, men forgjæves. Ofte tog Taagen Udsigten til Land ganske bort, og overalt saa vi Brændingen paa Stranden lige sterk som da vi forgjæves prøvede at lande paa Østsiden. Vi stoppede paa et Par Stationer og loddede — se Kartet — 98 og 156 Favne. Fra disse Stationer og fra flere andre Punkter fik vi gode Skitser af enkelte Partier af de lavere Dele af Sydlandet. Efter disse er saaledes Fig. 6 gjengivet. Man ser den regelmæssige Eruptionskegle Hoyberg ude mod Stranden. Længere inde, ved Guinea Bugten, dukker et lidet, men meget regelmæssigt kegleformigt Krater (Høsaaten) op af Lavlandet. Den lave Sydpynt vender lige mod Tilskueren. Bagenfor det foranliggende Lavland løfter sig med bratte Vægge Sydlandets Højfjeld. Oppe paa dette sees et kegleformet Fjeld (Krater Vøringen), et Krater efter al Sandsynlighed. De bratte Styrtninger mod Havet fortsætte lige til Cap Sydvest. Her er en naturlig Port i Fjeldet, gjennem hvilken Havet gaar. Udenfor Nesset sees de Syv Klipper med sine fantastiske Former.

speed of the ship being read off every five minutes on the scale of the water-log. At the beginning and the end of this interval, at a given signal, one observer measured with the sextant the angle subtending between the bearing and the summit of the mountain, and another the height of the summit above the horizon. The result of the computation was 6380 feet.

In the afternoon we sounded in 340 fathoms off Cape South-East, and then steered northward. Clouds had now begun to gather round Beerenberg, and we had our last view of the summit and upper part of the mountain. North-east of Cape North-East, 7 miles from land, the depth was 1040 fathoms. This shows a mean incline of the sea-bed off Cape North-East of 8 degrees, which slightly exceeds that of the base of Mount Beerenberg towards Cape North-East (according to the Map 6.°6), but is somewhat less than the slope towards Cape South-East (10°). On the north-eastern declivity was seen a parasitic cone (Sars's crater), which may be found in earlier views of the island if carefully looked for, for instance in a prospect in Vogt's Travels, and in one by Lieutenant Ring, Fig. 7. On the north side of the island the 3 glaciers could be seen jutting out from deep valleys beyond the precipitous mountain-wall, which is here 900 feet high and shelves at an angle of 60°, Fig. 5. Whatever lay at a greater elevation was wrapped in clouds. Unfortunately, therefore, we got no view of Mount Beerenberg from the north side of the island, and the origin of the glaciers at the snow-limit likewise escaped our observation, the fog having gradually descended.

After having taken a series of soundings to the north and north-west of Jan Mayen, and found a depth of more than a thousand fathoms at the most westerly station, where the temperature of the atmosphere at night was only a little above the freezing-point, though no ice was to be seen, we steamed back to the west side of the island. In the forenoon of August the 3rd, when bearing down on Mary Muss Bay, the weather was exceedingly foggy. We steered thence in a south-westerly direction along the coast, carefully watching for an opportunity to land, — but in vain. The fog frequently shut out the land; and a line of breakers was everywhere observed along the shore, the swell being no less heavy than on the occasion of our unsuccessfull attempt to land on the east side of the island. We stopped twice and sounded (see Map) in 98 and 156 fathoms. At these stations and several other points we succeeded in sketching the scenery of the low-lying tract in the southern part of Jan Mayen. Fig. 6 is from these sketches. Near the shore we see the parasitic crater Hoyberg; and farther inland, in the vicinity of Guinea Bay, a conical crater, — the "hay-cock," — small but regular in form, rises from the low-lying tract around it. The Low South Point projects in a line with the point of view. Behind the low tract in the foreground of the engraving, towers with its precipitous walls the plateau of the southern part of Jan Mayen. Here may be seen a conical-shaped mount (the Vøringen crater), in all probability of

Fig. 6. Hoyberg.

Det var det sidste, vi saa af Jan Mayen. Taagen indhyllede atter alt. Vi fik Intet at se af Sydkysten eller Sydostkysten, idet vi styrede videre sydvestover.

Billedet, Fig. 7, der viser Jan Mayen i Vinterdragt, seet fra Nordvest, skyldes en Tegning af Lieutenant i den norske Marine S. Ring, der som Fører af Sælfangeren "Capella" har havt Anledning til at se Jan Mayen klar fra denne Kant. Man ser paa Skraaningen ned mod Nordostkap Krater Sars, man øjner de store Isbræer paa Nordsiden, Cap Nordvest og Muyens Korsnes vende mod Tilskueren, den lave Del af Øen paa Midten og Sydlandets Højder træde klart frem. Beerenbergs Krater viser sig med indsunket Rand paa Nordsiden, og derunder en vid Dal eller Kjedel, hvorfra de store Nordbræer tage sit Udspring.

eruptive origin. The precipitous declivities facing the sea extend to Cape South-West. Here there is a "gate," or natural excavation, in the mountain-wall, through which the sea passes. Off the promontory rise the Seven Rocks, with their rugged, fantastic contours.

This was the last we saw of Jan Mayen. The fog had again begun to thicken, and soon shrouded everything from view. Nothing could be seen of either the south or the south-east coast as we steamed ahead on a south-westerly course.

For the prospect (Fig. 7) of Jan Mayen in its winter garb, as seen from the north-west, we are indebted to a drawing from the pencil of Lieutenant S. Ring, R. N., who, when commanding the sealer "Capella," sketched this part of the island on a clear day. We have Sars's crater, on the slope shelving towards Cape North-East; we see, too, the great glaciers on the north side, also Cape North-West and Muyen's Cross Cape, in a line with the point of view; and the low tract of the island, with the heights of the southern part, are boldly defined in the picture. The crater of Beerenberg, with its sunken edge on the north side, is also seen, and lower down a huge, cauldron-shaped depression, from which the great northern glaciers take their origin.

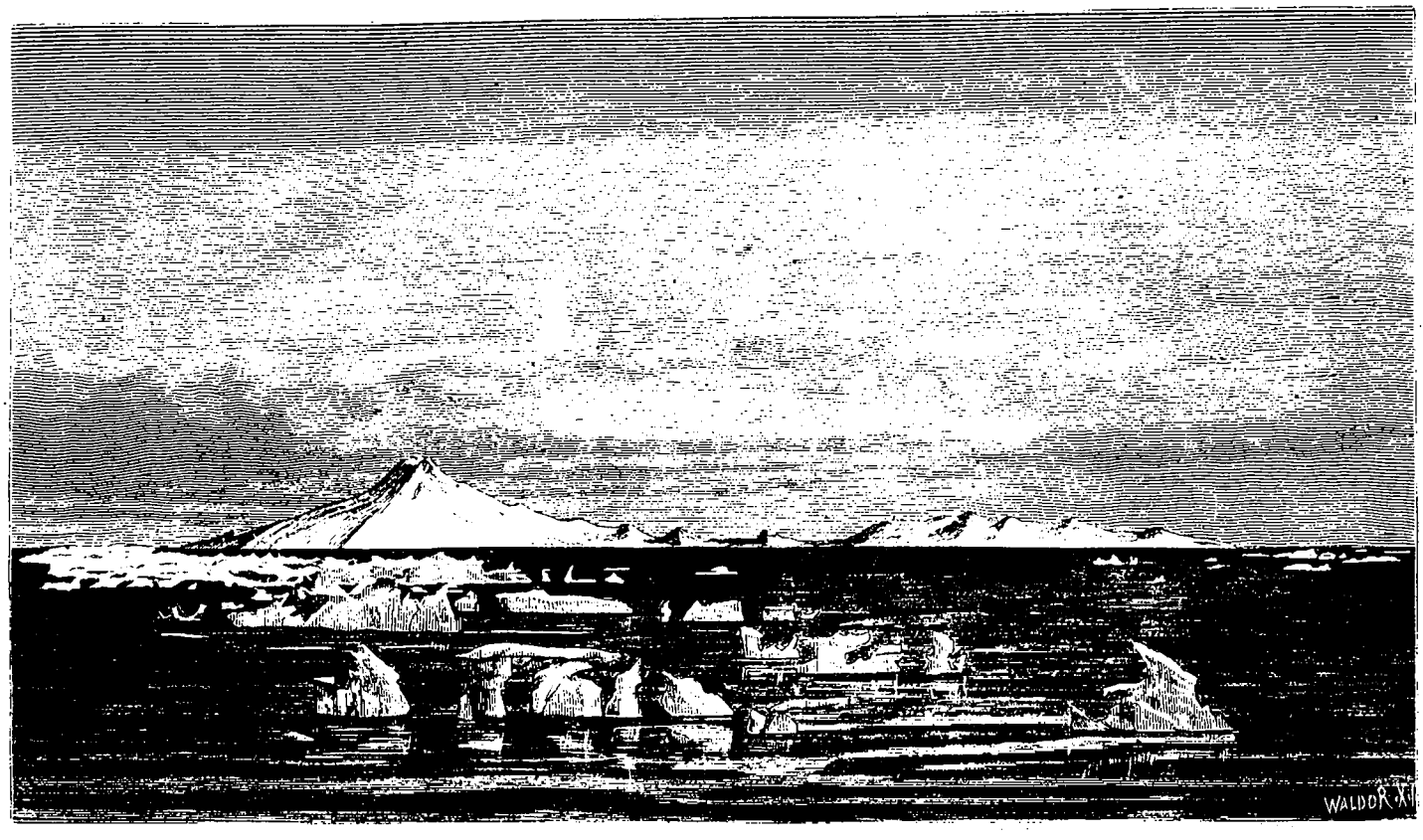


Fig. 7. Jan Mayen i Vinterdragt, fra Nordvest. — Winter View of Jan Mayen, looking South-East.

Af den foranstaaende Rejsebeskrivelse vil man se, hvorledes vor Expedition samlede det Materiale, vi have benyttet til at forbedre Kartet over Jan Mayen. Da Expeditionens Hovedformaal var at undersøge Havet, kunde vi anvende kun en kortere Tid til Undersøgelsen af Jan Mayen. og de Iagttagelser, som vi hertil kunde samle, maatte blive udførte lejlighedsvis, eftersom Omstændighederne tillod det. Vi kunde saaledes ikke afvente de gunstigere Omstændigheder, der vare nødvendige for en mere gjennemført Undersøgelse, men vare nødte til at combinere de erholdte Observationer og deres Resultater paa bedste Maade indbyrdes og med ældre Undersøgelsers Resultater. Dette har kostet ikke lidet Arbejde, og det af Captein Wille og mig udarbejdede Kart er Frugten af en Række gjentagne Forsøg paa at tilfredsstille alle de spredte Iagttagelser, der foreligge. Som man vil se, vare vi under vort Ophold ved Jan Mayen ikke særdeles begunstigede af Vejret, men vi vare heller ikke særdeles uheldige, — dog var der liden eller ingen Lejlighed til at anstille *systematiske* Iagttagelser.

Af ældre Literatur vedrørende Jan Mayen er til Kartet og Beskrivelsen benyttet følgende:

1. De Nieuwe Groote Zee-spiegel, inhoudende Eene Beschryvinghe der Zee-Kusten van de oostersche en noordsche Schip-vaert. Amsterdam 1662. Beskrivelsen af Jan

The foregoing account of our exploratory work will show in what manner data were collected on the Norwegian Expedition for constructing a new map of Jan Mayen. The main object of the Expedition being to investigate the physical conditions of the sea, the time we could devote to the exploration of Jan Mayen was of course comparatively short; and the observations we succeeded in obtaining had to be taken occasionally, according as opportunity offered. Thus it was not in our power to carry out a complete investigation; we could only combine in the best possible manner our observations and their results, collating them with those of earlier explorers. To do this has cost considerable labour, and the Map constructed by Captain Wille and myself is based on a series of re-iterated attempts to combine all the scattered data before us. As previously shown, the weather during our stay at Jan Mayen was neither particularly favourable nor exceptionally bad; but we had little or no opportunity of instituting *systematic* observations.

Of earlier works on Jan Mayen, the following have been consulted: —

1. — De Nieuwe Groote Zee-spiegel, inhoudende Eene Beschryvinghe der Zee-Kusten van de oostersche en noordsche Schip-vaert. Amsterdam 1662. To this account is

Mayen ledsages af et "Pas-caert van Jan Mayen Eylant". I den benyttede Udgave mangler desværre et Blad, paa hvilket Beskrivelsen af Øens Nordside skulde være at finde. En noget forkortet Oversættelse af denne Beskrivelse til Tysk, som Professor Buijs Ballot i Utrecht har havt den Godhed at sende mig, slutter imidlertid med den Bemerkning, at Beskrivelsen af Nordsiden mangler. Forøvrigt beskrives i dette gamle Verk Østkysten helt fra Nordostkap sydover og Vestkysten fra Sydkap nordover indtil Nordvestkap. Kartet, der aabenbart er det som ligger til Grund for alle de senere Karter over Jan Mayen, forekommer mig i sine Hovedtræk at være lige saa godt som disse.

2. C. G. Zorgdragers alte und neue Grönlandische Fischerei und Wallfischfang, . . . ausgefertiget durch Abraham Moubach. Leipzig 1723. For Jan Mayens Vedkommende har jeg i dette Verk ikke fundet noget mere end i det foregaaende, der aabenbart er Kilden.

3. An Account of the Arctic Regions, . . . by W. Scoresby Jun. F. R. S. E. Edinburgh 1820. Til Grund for Scoresby's Kart ligger Zorgdragers, der aabenbart igjen har til Kilde det gamle Kart i "Zee-spiegel". Hele Øens Beliggenhed er rectificeret af Scoresby, men i Detaljerne er det gamle Kart fremdeles det paalideligste.

4. Letters from High Latitudes, being some account of a voyage, in 1856, in the schooner-yacht "Foam," to Iceland, Jan Mayen, & Spitzbergen. By Lord Dufferin. Fourth Edition. London 1858.

5. Nord-Fahrt, entlang der Norwegischen Küste, nach dem Nordkap, den Inseln Jan Mayen und Island, . . . unternommen während der Monate Mai bis Oktober 1861 von Dr. Georg Berna, . . . Erzählt von Carl Vogt. Frankfurt a. M. 1863.

Det Kart, som ledsager Vogt's Beskrivelse, er en Copi af Scoresby's Kart. Det indeholder en Del Forbedringer, men er paa den anden Side, navnlig i hydrografisk Henseende, mindre fuldstændigt og correct end de ældre Karter. Derimod have de Billeder af Partier af Jan Mayen, der ledsage Vogt's Verk, været mig af overordentlig stor Nytte, og for deres store Paalidelighed kan jeg indestaa. Endog mindre Træk i Landskabet har jeg efter disse Billeder kunnet identificere.

Til Grund for Constructionen af vort Kart er lagt Scoresby's. Efter de af os foretagne Pejlinger og andre Vinkelmaalinger har Capt. Wille gjort et Udkast til Kystens Form, og anbragt derved de hydrografiske Detaljer fra vore Iagttagelser, saa langt de rak, og fra Scoresby. Efter det Material, som stod til min Raadighed, heri indbefattet en Række Skitser af Hr. Schiertz, vor Tegner, Professor Sars og mig selv, har jeg forsøgt at aflægge yderlige hydrografiske Detaljer, dels efter "Zeespiegel", idet jeg fandt, at Beskrivelsen og Kartet i dette var rigtigere end i de senere Verker, dels ved Hjelp af Skitserne, efter hvilke jeg kunde bestemme noget sikrere enkelte Partiers indbyrdes Beliggenhed, navnlig i Forbindelse med de verticale Dimensioner. Situationen

annexed a "Pas-caert van Jan Mayen Eylant." In the edition I have consulted, the leaf on which an account of the north coast of the island might have been looked for, is unfortunately missing. A somewhat abridged translation of this work into German, which Professor Buijs Ballot of Utrecht had the kindness to send me, closes, however, with the remark, that no account has been given of the north side. For the rest, in this old volume the east coast is described from Cape North-East southwards, and the west coast, from Cape South northwards to Cape North-West. The map, which is manifestly that on which all later maps of Jan Mayen are based, would appear in its main features to be quite as correct as any of these.

2. — C. G. Zorgdragers alte und neue Grönlandische Fischerei und Wallfischfang, . . . ausgefertiget durch Abraham Moubach. Leipzig 1723. As regards Jan Mayen, I found nothing in this work that is not contained in the foregoing, whence the author has evidently drawn his information.

3. — An Account of the Arctic Regions . . . by W. Scoresby Jun. F. R. S. E. Edinburgh 1820. Scoresby's map is based on Zorgdrager's, which in turn is evidently derived from the old map in the "Zee-spiegel." The position of the island has, indeed, been rectified by Scoresby; but in all details the old map is still the most trustworthy.

4. — Letters from High Latitudes, being some account of a voyage, in 1856, in the schooner-yacht "Foam," to Iceland, Jan Mayen, & Spitzbergen. By Lord Dufferin. Fourth Edition. London 1858.

5. — Nord-Fahrt, entlang der Norwegischen Küste, nach dem Nordcap, den Inseln Jan Mayen und Island, . . . unternommen während der Monate Mai bis Oktober 1861 von Dr. Georg Berna, . . . Erzählt von Carl Vogt. Frankfurt a. M. 1863.

The map annexed to Vogt's account of the Island is a copy of Scoresby's. It is, indeed, in some respects more correct, but in others, more particularly as regards the hydrographical details, less complete and trustworthy than the earlier maps. On the other hand, the views of the Island accompanying Vogt's work have rendered me the greatest service; and for their accuracy, which is remarkable, I can personally vouch. Even minor features of the scenery, I have been able to identify from these excellent illustrations.

Our map of Jan Mayen is based on Scoresby's. From the various bearings and other measured angles, Captain Wille has figured the contours of the coast, and set down, so far as possible, the hydrographical details, from our own observations and those of Scoresby. After a careful study of the material collected, including numerous sketches by Mr. Schiertz, artist to the Expedition, Professor Sars, and myself, I have sought to fill in further hydrographical details, partly since I find the account and map in the "Zeespiegel" to be more correct than are any of those given in later works on Jan Mayen, and partly with a view to determine, by means of the sketches, with greater accuracy the relative position of divers parts of

paa Kartet, der er fremstillet ved Højdekurver for hver 100 Meter, beror paa vort fælles Arbejde, saaledes at de store Træk ere udkastede af Capt. Wille, medens jeg har nærmere udarbejdet Detaljen. Herved er stadig taget Hensyn til, at Skitserne gjerne, som ogsaa de udførte Vinkelmaalinger vise, overdrive de verticale i Forhold til de horizontale Dimensioner. Efter mange gjentagne Forsøg er det i det Hele taget lykkets mig at tilvejebringe en god Overensstemmelse mellem Skitserne og de tagne Vinkelmaal.

Øens geografiske Beliggenhed er aflagt efter vore astronomiske og geodetiske Observationer.[1]

Ved Sammenligning mellem de ældre Karter og vort vil man finde adskillige Afvigelser. Jeg skal her vise de vigtigste af disse.

Scoresby's Bredder stemme gjennemgaaende godt med vore. Efter Udmaaling af 19 Punkter finder jeg, at Scoresbys Bredder i Gjennemsnit er et halvt Minut større end vore, og den største Forskjel er 2 Minuter. Scoresby's Længder ere derimod gjennemsnitlig 28 Bueminuter mindre end vore. Afvigelserne variere mellem 20 og 33 Minuter. Med andre Ord, Jan Mayen ligger efter vor Bestemmelse lidt over 9 Kvartmil længere Vest end i Scoresby's Kart og i de hidtil brugte Søkarter. Da vor Længdebestemmelse ikke er usikker paa mere end nogle faa Tidssekunder, bliver Jan Mayens geografiske Beliggenhed at rette i Karterne. Ogsaa den hollandske Expedition med Skonnerten "Willem Barendsz" i 1878 fandt Jan Mayens vestlige Længde større end Karterne angive. Scoresby's Bestemmelse er fra August 1817; han havde da været i Søen fra Vaaren af, og det er ikke at undres over, at hans Chronometers beregnede Stand kunde afvige betydeligt fra den rigtige.

"Zeespiegel" lægger Jan Mayen mellem Bredderne 71° 0′ og 71° 30′, altsaa en 15 Minuter for langt mod Nord, og Øens Midte paa Meridianen af Cap Landsend, eller 5° 40′ Vest for Greenwich, det er næsten 3 Grader for langt mod Øst.

Den nordlige Del af Øen og den midterste lave Del stemme i sine større Omrids vel overens paa alle Karter. Den sydlige Del derimod have vi fundet kortere og bredere end paa de ældre Karter, et Resultat, der fremgaar saavel af vore Vinkelmaalinger som af de, med Loggemaskinen bestemte, udsejlede Distancer.

Efter alle vore Vinkelmaalinger, saavel horizontale som verticale, og efter alle Skitser ligger Beerenbergs Kegle og Krater mere centralt paa Nordlandet end hos Scoresby og Vogt. Vi fandt Højden af Beerenberg den 3die August at være 1945 Meter, medens Scoresby angiver den til 6870

[1] Se H. Mohn. Astronomiske Observationer Side 23.

the island, in particular as regards their vertical extent. The relief of the land — shown on the Map by contour lines for every 100 metres, — is the result of our joint labours, Capt. Wille having laid down the general features while I worked out the details. Regard has been everywhere had to the tendency exhibited in the sketches, as confirmed too by the trigonometrical measurements, of increasing the vertical and lessening the horizontal extent. After numerous re-iterated attempts I at length succeeded in attaining satisfactory agreement between the sketches and the trigonometrical measurements.

The geographical position of the island is that found from our astronomical and geodetical observations.[1]

On comparing the earlier maps of Jan Mayen with that we have now constructed, ours will be found to differ in many respects. I will point out the most important.

Scoresby's latitudes agree on the whole satisfactorily with those determined by ourselves. By direct measurement of 19 points, I found Scoresby's latitudes on an average to exceed ours by half a minute; the greatest difference is 2 minutes. Scoresby's longitudes, however, are on an average 28 minutes of arc less than ours. The difference varies between 20 and 33 minutes. In short, Jan Mayen, according to our determination, lies a little more than 9 miles farther west than it does on Scoresby's map and the charts in use up to the present time. As the error of our determination of longitude does not amount to more than a few seconds in time, the geographical position of Jan Mayen on maps and charts will henceforth have to be rectified. The Dutch Expedition, too, despatched in 1878 with the schooner "Willem Barendsz," found the west longitude of Jan Mayen to be greater than that given in the charts. Scoresby's determination dates from August 1817. As captain of a whaler, Scoresby had then been at sea since the spring of the year; and hence it is not surprising that the true error of his chronometer should have deviated considerably from that computed.

The "Zeespiegel" places Jan Mayen between the parallels 71° 0′ and 71° 30′, thus 15 minutes too far north, and the middle of the island on the meridian of Land's End, or 5° 40′ west of Greenwich — nearly 3 degrees too far east.

The northern part of the island and the low-lying central tract agree well in their general contours on all the maps. The southern part, on the other hand, we found to be shorter and broader than it is given on the earlier maps, a result derived alike from our trigonometrical observations and the extent of the coast as determined by the water-log.

According to all our trigonometrical measurements, both horizontal and vertical, as also the numerous sketches, the cone and crater of Mount Beerenberg should have a more central position in the northern part of the island than has been given them by Scoresby and Vogt. We found

[1] H. Mohn. Astronomical Observations, p. 23.

engelske Fod eller 2094 Meter. De Højdemaalinger, som jeg fik fra Ankerpladsen i Mary Muss Bugten og fra Loddestationen No. 224 paa Østsiden (Side 12) stemme meget vel med en Højde af 1945 Meter, idet de give, Distantserne tagne efter Kartet, respective 1968 og 1944 Meter.

Paa alle de ældre Karter findes paa Vestsiden af Beerenberg, ved Havet, mellem første og andet Korsnes, et Sted betegnet som en Isbræ. Det hedder i "Zeespiegel": *Heynste Ysbergh,* hos Scoresby: *Iceberg,* og hos Vogt er vist en fra Beerenbergs Side til Havet udgaaende stor Isbræ. Da vi besøgte Jan Mayen, fandtes her paa denne Kant ingen Isbræ, der gaar til Havet. Vi saa kun enkelte Sneflækker paa den lavere Del af Øen. Scoresby og Vogt, der begge kun saa Jan Mayens Østkyst, have aabenbart hentet denne Bræ fra det gamle hollandske Kart. Er Bræen forsvunden siden Begyndelsen af det 18de Aarhundrede? Zorgdrager har den, og den staar nævnt i Beskrivelsen i "Zeespiegel". Eller foreligger en Forvexling med Bræerne paa Nordsiden?

De 3 store Isbræer paa Nordsiden af Jan Mayen findes ikke angivne paa Kartet i "Zeespiegel", og heller ikke hos Zorgdrager, Scoresby eller Vogt. Nordsiden er, som tidligere nævnt, ikke beskrevet i "Zeespiegel", men paa Zorgdragers Kart findes angivet Trankogerier i østre Korsbugt, saa at man maa antage, at denne Kyst i tidligere Tider var vel kjendt. Have disse Bræer først siden Midten af forrige Aarhundrede naaet den nuværende Udstrækning?

Paa Østsiden af Beerenberg saa vi fem store Isbræer, der med en brat Heldning gik lige ned til Havet. Flere end dette Antal kunde med Bestemthed ikke anføres. "Zeespiegel" har saavel i Kartet som i Beskrivelsen kun 3 Isbræer her, i Beliggenhed svarende til de tre nordligste, ligesaa Zorgdragers og Scoresby's Kart, hvilket sidste dog grupperer dem noget anderledes, idet de to sydligste ere lagte paa noget nær samme Plads, som vore to sydligste. Scoresby's Billede derimod viser flere end 5 til Havet nedrækkende Bræer paa denne Kyst, hvilke det er vanskeligt at identificere med de af os sete. Paa Kartet i Berna's "Nordfahrt" kan jeg ikke gjenfinde vore fem Bræer, men vel paa Billedet af Østkysten i samme Verk. Ere de stejle Isbræer paa Østkysten med Hensyn til Antal og Betydenhed vexlende med Tiderne?

Sydbræen findes ikke paa Karterne i "Zeespiegel", hos Zorgdrager og Scoresby, omtales heller ikke i disses Beskrivelser. Den forekommer først hos Vogt, hvis Kart, Billeder og Beskrivelse stemme godt med vore Iagttagelser. Kysten udenfor er, efter de ældre Beskrivelser, meget uren, saa at Bræen maaske ikke havde nogen hydrografisk Inter-

the altitude of Beerenberg — August the 3rd — to be 6380 feet, whereas Scoresby's determination is 6870 feet. The altitudes I succeeded in taking from our anchorage in Mary Muss Bay and from Sounding-station 224, on the east side of the island (page 12), agree very well with a height of 6380 feet, corresponding as they do to 6457 and 6377 feet.

On the west side of Beerenberg, in close proximity to the sea, between the first and second Cross Capes, there is in all of the earlier maps a point marked to denote a glacier. In the "Zeespiegel" it bears the name of *Heynste Ysbergh;* Scoresby calls it *Iceberg;* and in the map accompanying Vogt's work on Jan Mayen a large glacier is here seen extending down the slope of the mountain to the sea. When *we* visited the island, there was no glacier reaching out to the sea on this side. We merely saw a few patches of snow scattered here and there over the lower tract of the coast. Scoresby and Vogt, both of whom saw only the eastern shores of Jan Mayen, have manifestly followed the old Dutch map. Can the glacier have disappeared since the beginning of the 18th century? Zorgdrager has it, and it is mentioned in the account given in the "Zeespiegel." Or has there been some mistake connected with the glaciers of the north side?

The 3 great glaciers on the north coast of Jan Mayen are not to be found on the map in the "Zeespiegel," nor on those by Zorgdrager, Scoresby, or Vogt. As previously mentioned, no account is given of the north side in the old Dutch work; but on Zorgdrager's map we have given the position of factories established in East Cross Bay for boiling down blubber; and hence that coast must have been well known in former times. Possibly, the glaciers in question did not attain their present extent till the middle of the last century.

On the east side of Beerenberg, we saw 5 large glaciers shelving abruptly down to the sea. A greater number could not be clearly distinguished. Only 3 glaciers are to be found here on the map in the "Zeespiegel," corresponding in position to the three northernmost of ours, as also on the maps by Zorgdrager and Scoresby, though the latter groups them somewhat differently, the two lying farthest south having almost the same position as the two most southerly of those observed by ourselves; but on the other hand, in Scoresby's view of the coast more than 5 glaciers, which can hardly be identified with those we observed, extend down to the sea. On the map in Berna's "Nordfahrt" I cannot find our 5 glaciers; in his view of the east coast, however, in the same work, they are easy to identify. Do the precipitous glaciers on the east coast, as regards number and extent, possibly undergo some change in the course of centuries?

The Southern Glacier is not to be found on any of the earlier maps of Jan Mayen, nor is it mentioned in the accounts of the island given in the "Zeespiegel" and by Zorgdrager and Scoresby. The first to call attention to this glacier was Vogt, whose map, views, and general account of the island closely agree with our own observations.

esse for de gamle Hvalfangere i det 17de Aarhundrede, men paafaldende er det unegtelig, at Scoresby, der roede langs denne Kyst den 4de August 1817 og var iland paa Toppen af Krater Esk samme Dag, ikke omtaler denne betydelige Bræ, der danner et saa fremtrædende Træk i Landskabet. Se Vogt's Beretning og vort Billede. Er ogsaa den en nyere Tids Dannelse?

Med Hensyn til Krater Esk og Krater Vogt maa jeg bemerke, at jeg efter nøjagtig Gjennemgaaen af Scoresby's og Vogt's Beretninger er kommen til det bestemte Resultat, at disse Forskere have besteget forskjellige Kratere. Vogt beretter nemlig, at han besteg Scoresby's Krater Esk. De ældre Karter give ingen Vejledning, da disse Gjenstande ikke ere af nogen hydrografisk Interesse. Scoresby siger (I, Side 162), "at han fra Krater Esk saa ved Foden af Bjerget paa Sydostsiden, i Nærheden af en vældig Lavastrækning, et andet Krater med Rand som en Murtinde, af lignende Form som det ovenfor beskrevne (Esk)." Begge Kratere ere angivne paa hans Kart, det vestligste betegnet "Esk Mount, a Volcano". Vogt saa fra det Krater, han besteg, nede paa det lave Forland det lave Askekrater "Berna", der neppe hæver sig over Sletten, og paa Vogt's Kart er Scoresby's andet Krater udeladt og "Berna" sat istedet. Efter hvad jeg, som ovenfor nævnt, til forskjellige Tider kunde se, findes alle 3 Kratere, saaledes som paa vort Kart angivet. Der er i Vogt's Beskrivelse, saavidt jeg kan se, Intet i Vejen for at antage, at det Krater, Scoresby saa tydelig fra Toppen af "Esk", er det, som Vogt har besteget. Jeg har ogsaa tilladt mig at give dette Krater Navn efter denne Forsker, hvis Rejse til Jan Mayen i saa høj Grad har udvidet vor Kundskab om denne Ø, og hvis Beskrivelse deraf havde orienteret mig i Forvejen i den Grad, at jeg under vort Besøg der havde en Følelse, som om det var en tidligere kjendt Egn, jeg var kommet til.

Ægøen er i "Zeespiegel", hos Zorgdrager og hos Scoresby fremstillet som en fra Hovedlandet ved et Sund adskilt virkelig Ø. Vogt's Kart forbinder den med Land ved en ganske smal Tange. Vi saa den som en fuldstændig Halvø. Man se Fig. 2 og Kartet. Scoresby's Cape Brodrick, Pynten indenfor Sundet, er saaledes forsvundet mellem 1817 og 1861, idet Øen er bleven forbundet med Land. Landtangen, der nu er lige saa bred som Ægøen selv, ligger adskillige Meter over Havspejlet.

Lagunen paa Vestsiden omtales i "Zeespiegel" og forekommer paa Kartet saavel her som i Zorgdrager's og i Scoresby's Verker. Paa Vogt's Kart er den bleven udeglemt. Den korte Beskrivelse i "Zeespiegel" stemmer godt med mine Iagttagelser paa Stedet. Den lange Lagune paa Østsiden derimod findes ikke i nogen af de ældre Beskri-

Off the coast, the navigation is here, according to the earlier accounts, a good deal incumbered with rocks and shoals; and hence, possibly, the old whalers of the 17th century did not attach any hydrographical importance to the glacier. It is however undeniably strange, that Scoresby, who on the 4th of August rowed along this part of the coast, and the same day ascended to the summit of Mount Esk, should not have mentioned so considerable a glacier, forming as it does a prominent feature of the scenery (see Vogt's account and our view). Can this, too, be a later formation?

As regards the Esk crater and the Vogt crater, I feel convinced, from a careful perusal of Scoresby's and Vogt's accounts, that the said explorers must have ascended different craters. According to Vogt's statement, he ascended the Esk crater (Scoresby's). The earlier maps afford no assistance in deciding this doubtful point, since such details, being without hydrographical interest for the navigators of that time, were not laid down. Scoresby, who had ascended the Esk crater, states (page 162), that "at the foot of the mount, on the south-east side, near a stupendous accumulation of lava, bearing the castellated form, was another crater, of similar form to the one above described." Both craters are to be found on his map, the most westerly of the two being designated "Esk Mount, a Volcano." Looking down from the crater he had ascended, Vogt saw beneath him, on the low-lying foreland, the low Berna crater, which hardly rises above the surrounding tract; and on Vogt's map Scoresby's second crater has been left out and the Berna crater substituted in its place. As previously stated, according to what I observed at different times, all 3 craters are to be found, in the respective positions given them on our map. In Vogt's account there is nothing, so far as I can judge, to oppose our assuming that the cone which Scoresby distinctly observed from the summit of Mount Esk is that ascended by Vogt. I have likewise made free to give this crater the name of the explorer whose voyage to Jan Mayen has so largely contributed to extend our knowledge of that interesting island, and whose accurate account had rendered me so familiar with its topography, that during our sojourn there I had frequently the impression of being in a country I had visited before.

Both in the "Zeespiegel" and in the maps by Zorgdrager and Scoresby, Egg Island is represented as a veritable island, cut off by a sound from the main land. On Vogt's map, an exceedingly narrow strip of land connects, it with the main island. As *we* beheld "Egg Island," it was in every respect a peninsula; see Fig. 2 and the Map. Scoresby's Cape Brodrick, the point lying within the sound, must accordingly have disappeared some time between the years 1817 and 1861. The isthmus, which is now equal in breadth to Egg Island itself, rises a score or so of feet above the sea-level.

The lagoon on the west side is mentioned in the account of the island given in the "Zeespiegel," and may be found on the map accompanying that work, as also on the maps by Zorgdrager and Scoresby. On Vogt's map it has been left out. The brief description in the "Zeespiegel" agrees closely with my own observations. On the other

velser eller Karter. "Zeespiegel" har paa dette Sted to lange Bugter, Store og lille Rækved-Bugt ("Groote Hout bay" og "Cleyne Hout bay"), adskilte ved en til Havet gaaende Bergmasse. Denne er aabenbart den samme som vi kaldte "Støtten", og som sees saavel paa vort Billede af Lagunen som paa det tilsvarende Billede Side 282 hos Vogt. I Bugten har "Zeespiegel" en flad Fjære af Sand, dækket med Rækved, og i Havet udenfor er der temmelig grundt, 6, 7 og 8 Favne indtil $1^1/_2$ Kvartmil fra Stranden. Zorgdrager og Scoresby har det samme. Scoresby fortæller, at, da han var paa Toppen af "Esk", "var, mod Sydvest, hele Øens Udstrækning synlig", men nævner ikke et Ord om Lagunen, og har den heller ikke paa sit Kart. Fra Toppen af sit Krater beretter Vogt, at han saa Lagunen i hele dens Udstrækning, og fra "Esk" skulde den være lige saa godt synlig. Man tør herefter med Vogt trygt slutte, at Lagunen er dannet mellem begge Forskeres Besøg, mellem 1817 og 1861. Jeg tror snarere, at den er dannet ved at den lave Sandvold, som adskiller den fra Havet, efterhaanden er opkastet af Brændingen, end, som Vogt antager, at Lagunens Flade tidligere var dækket af "Bankisen". Ægøens Forbindelse med Land staar aabenbart i nøjeste Forbindelse med Lagunvoldens Fremkomst over Havspejlet; thi Ægøens Landtunge udgjør den directe Fortsættelse af Lagunvolden. En Hævning af Landet her er ikke utænkelig, men paa den anden Side af Øen, ved den vestre Lagunes Vold, er der, naar "Zeespiegel"s Beskrivelse fra Midten af det 16de Aarhundrede sammenholdes med mine ovenfor nævnte Iagttagelser, ikke noget Tegn til nogen merkelig Hævning. Paa vor Kundskabs nærværende Standpunkt kunne Gjætninger lige saa lidet hjelpe os her som ved Spørgsmaal om Jan Mayens Isbræers Forandringer.

De af Havet opragende Klipper "Lodsbaaden" og "Fyrtaarnet" ligge efter vore Maalinger og Tegninger som paa vort Kart angivet. De findes begge omtalte i "Zeespiegel" og afsatte paa Kartet deri som "Klip als een Seyl". Deres Beliggenhed er rigtigere paa det gamle hollandske Kart end hos Scoresby, der lægger "Lodsbaaden" for langt mod Syd og "Fyrtaarnet" for langt fra Land.

Guinea-Bugtens nordligste Pynt stikker, ifølge vore Skitser, mere frem end paa Scoresby's Kart. Heri stemme vi bedre overens med "Zeespiegel".

Vogel-klip ligger ifølge "Zeespiegel" lige udenfor Vestpynten af Syd-Bay, ikke som hos Scoresby i Sydvest for denne. "Naar man ligger paa 15 Favne Vand i Syd-

hand, the long lagoon on the east side is not mentioned in the earlier accounts of Jan Mayen, nor does it appear on any of the annexed maps. In the "Zeespiegel," this part of the coast exhibits two long bights, — Great Wood Bay and Little Wood Bay ("Groote Hout bay" and "Cleyne Hout bay"), disconnected by a rocky mass stretching between them down to the sea. It is evidently this cliff to which we have given the name of "Søjlen" (the pillar), and which appears both in *our* view of the lagoon and in that given on page 282 of Vogt's work. In the "Zeespiegel," the bay has a flat sandy beach covered with driftwood, and the water is shallow — 6, 7, and 8 fathoms — to the distance of a mile and a half from the shore. The same details are given in the maps by Zorgdrager and Scoresby. Scoresby states, that from the summit of Mount Esk, "towards the south-west the utmost extent of the island was visible;" but he does not say a word about the lagoon, nor is that prominent feature of the coast to be found in his map. From the top of the crater bearing his name, Vogt could overlook the lagoon in its full extent, and the same should be the case from the summit of Mount Esk. Hence, it would be reasonable to infer with Vogt, that the lagoon has been formed between the visits of the two explorers, or some time during the interval extending from 1817 to 1861. Meanwhile, the origin of the lagoon must, I think, be ascribed to the low sand-barrier stretching between it and the sea having been gradually thrown up by the action of the surf, rather than, as Vogt surmises, to the possible fact of its surface having in former times been covered with "bank-ice." The conversion of Egg Island to a peninsula is beyond doubt closely connected with the appearance of the lagoon barrier above the sea-level, since the Egg Island isthmus constitutes the direct continuation of the said barrier. True, there may have been a rise along this part of the coast; but on the other side of the island, if the account given in the "Zeespiegel" from the middle of the 16th century be compared with the results of my own observations, there can hardly have been a perceptible rise at the barrier of the western lagoon. At the present stage of research, hypothetical deductions are as futile here as in questions bearing on a presumptive change in the number and position of Jan Mayen's glaciers.

The two rocks rising abruptly from the sea called respectively the "pilot-boat" and the "light-house," have, according to our observations and drawings, the position given them in the annexed Map. They are both mentioned in the "Zeespiegel," and laid down on the map accompanying that work as "Klip als een Seyl." The old Dutch geographer has placed these rocks more correctly than Scoresby, on whose map the "pilot-boat" lies too far south and the "light-house" too far from the shore.

The most northerly point of Guinea Bay projects, according to our drawings, farther out than it does on Scoresby's map. In this detail we agree better with the "Zeespiegel."

Vogel-klip lies according to the "Zeespiegel" just without the west point of South Bay, not as on Scoresby's map to the south-west of that bight. "When anchored in

Bay, saa ser man ud mellem Vogel-klip og Landet."

Et Stykke fra Hoepstock's Bay "finder man et Nes, tvers af hvilket der ligger nogle Klipper, som kaldes *de Rudsen*"[1] ("Zeespiegel").

"Walrusch Gat" kaldes Kløften udenfor det Nes, som skyder ud paa Nordsiden af English Bay, og udenfor hvilket det "Brielske Taarn" staar. Se Fig. 3.

Strax vestenfor Mary Muss Bugt staar paa "Zeespiegel"s og Zorgdragers Kart en af Havet opragende Klippe. Nogen saadan saa vi ikke, men vel et Skjær, over hvilket Søen brød. Klippen er styrtet i Havet.

Paa Kartet i "Zeespiegel" stikker Fugleberget frem som et langt Nes mod Nord. I Beskrivelsen hedder det: "Fra Østpynten af Mary Muss Bay skyder en Bergfod fra Landet ud i Søen, meget stejl og høj ved sin Vest-Strand. Nu er der intet saadant udskydende Nes. Men der ligger en Boe udenfor Fugleberget.

Af Sidekratere paa Jan Mayen have vi observeret flere end der er aflagt i de ældre Karter. Jeg henviser til Rejsebeskrivelsen ovenfor og Kartet samt Billederne. De paa Kartet som Kratere betegnede Fjeldtoppe, der ikke ere omtalte i Rejsebeskrivelsen, ere aflagte efter Tegningerne og ere antagne, paa Grund af deres Form, der er eller nærmer sig den koniske, for at svare til dette Navn.

15 fathoms in South Bay, you look out between Vogel-klip and the land."

A short distance from Hoepstock's Bay "there is a noss, or promontory, off which are seen a few rocks, called *de Rudsen*"[1] ("Zeespiegel").

"Walrusch Gat" is the name given to the chasm lying without the promontory that juts forth on the north shore of English Bay, and beyond which rises "Brielle Tower" (see Fig. 3).

A little west of Mary Muss Bay, both on the map in the "Zeespiegel" and on that by Zorgdrager, there is a rock projecting abruptly out of the sea. We could discover no such rock; but we saw a shoal over which the sea was breaking. The rock in question must at some later period have toppled down into the sea.

On the map in the "Zeespiegel," the Fugleberg projects towards the north as a long noss, or headland, described in the account as follows: — "From the east point of Mary Muss Bay, the base of a mountain, very lofty and precipitous on its west side, juts out from the land into the sea." *Now* there is no such projecting promontory. A sunken rock, however, lies off the Fugleberg.

Of parasitic craters on Jan Mayen, we observed a greater number than are given in the earlier maps of the island. For further information on this head, the reader is referred to the above account of our exploratory work, as also to the Map and the illustrations. The mountain summits marked on the map as craters, though not mentioned in the account of the island, have been laid down from sketches, and are, by reason of their form, which is more or less conical, presumably entitled to the name.

Adskilt ved dybe Have fra alle nærmeste Lande ligger Jan Mayen ensom ude i Grønlandshavet. Mellem Norge og Jan Mayen er Havet 1760 Favne dybt, mod Spidsbergen over 2000 Favne, mod Grønland over 1300 Favne og mod Island over 1000 Favne dybt. Øens Retning er fra NE. t E.—SW. t W., den peger mod Danmarkstrædet og ligger parallel Heklas Vulkanlinie. Den er efter alt hvad derom er blevet observeret, bygget udelukkende af vulkanske Bergarter, og disse synes alle at tilhøre den moderne Vulkanisme. Den er saaledes yngre end Færøerne og Island, hvor ældre vulkanske Bergarter ere eneraadende eller danne Grundvolden. Dens Længde er lidt over $7^1/_2$ geografisk Mil. Den dannes af to større Dele, den nordlige og den sydlige, der ere forenede ved en lavere og smalere Landstrækning. Den nordlige Dels største Bredde er lidt over 2 geografiske Mile, den sydliges $1^1/_2$ geografisk Mil, og paa det smaleste Sted er Bredden $1^1/_2$ Kvartmil

[1] Rudsen = fr. roche = Klippe.

Cut off on all sides by extensive ocean tracts from the nearest land, the Island of Jan Mayen occupies an isolated position in the Greenland Sea. Between Norway and Jan Mayen the depth reaches 1760 fathoms, towards Spitzbergen upwards of 2000 fathoms, towards Greenland upwards of 1300 fathoms, and towards Iceland upwards of 1000 fathoms. The direction of the island is from NE. by E. to SW. by W.; it points towards Denmark Strait, and lies parallel to the volcanic line of Mount Hecla. As previously stated, Jan Mayen is built up of volcanic rocks, all of which would appear to belong to the modern group. Hence the island is probably a later formation than are the Færoes and Iceland, where the old volcanic rocks prevail either exclusively or in greater part. Its length slightly exceeds $7^1/_2$ geographical miles. It consists of two large parts or divisions, a northern and a southern, connected together by a lower and narrower tract. The greatest

[1] Rudsen: Fr. roche: rock.

(0.4 geogr. Mil), Lagunen medregnet. Øens Fladeindhold er 7.32 geogr. Kvadratmil.

Den nordlige Del er den største og mest fremtrædende. I dens Midte troner det 1950 Meter høje Beerenberg, en udslukt Vulkan; Krateret har en Bredde af 1330 Meter. Den øverste Kegle har en ydre Skraaning af 42° og en Højde af omkring 600 Meter. Den synes, at dømme efter de sorte Flekker, der navnlig paa Vestsiden ere saa fremtrædende, at være dannet af Aske. Den Basis, hvorpaa denne Kegle hviler, skraaner til alle Kanter udad med en Heldning af 8 til 10 Grader, en Heldning der mod Nord og Øst fortsætter under Havet til mindst 1000 Favnes Dyb. Kraterets Rand viser sig takket og den højeste Tinde ligger paa Vestsiden. Mod Nord er Kratervæggen tildels indstyrtet paa en Højde af et Par hundrede Meter. Den saaledes dannede Dalsænkning fortsætter nordover ned imod Nordsiden af Øen, begrændset paa begge Sider af divergerende Bergrygge, der tildels skyde sig frem terrassevis. Dette er Beerenbergs *val del bove,* der danner Firnmulden for dens største Isbræer, som skyde sig ud paa Nordsiden. Paa Østsiden findes ogsaa fremstaaende Ribber, der dele Østsidens Gletscherfelter, men mod Syd og Vest synes den øvre Kegles Yderflade at være meget jevn, kun oppe ved Kraterranden furet af smaa Indsænkninger mellem Kratertakkerne. Beerenbergs Basis gaar mod Vest, Sydvest og Nordost med temmelig jevne Skraaninger helt ned til Havet eller Lavlandet, men mod Nord og mod Øst danner den særdeles stejle Kyster, der frembyde Præcipicer paa 300 Meters Højde. Paa flere Steder er Basisen gjennemfuret af dybe Indskjæringer, gjennem hvilke Isbræerne finde sin Vej til Havet.

Sydlandets Højde naar ikke paa langt nær op til Nordlandets. Sydlandet danner et Højplateau, der mod Sydost og Syd har mange bratte Styrtninger mod Havet, men mod Nordvest har foran sig et lavt Forland, hvis Højde ikke rækker 100 Meter over Havet. Højden af Sydlandets Plateau anslaar jeg til omkring 300 Meter. Ovenpaa dette hæve sig nogle større Højder, af hvilke den højeste, der synes at frembyde en konisk Spids og saaledes muligens er en vulkansk Kegle, neppe rager over 500 Meter op over Havfladen.

Den lavere midterste Del af Øen, der er bygget af faste Lavamasser og rigelig besat med Eruptionskratere, naar paa sit laveste en omtrentlig Højde af kun 66 Meter eller maaske mindre, medens Kratertoppene naa op til

breadth of the northern part is a little more than 2 geographical miles, that of the southern $1^1/_2$ geographical miles, and the connecting tract (including the lagoon) measures at the narrowest point $1^1/_2$ English miles across (0.4 geographical mile). The area of the island is 7.32 geographical square miles.

The northern part of Jan Mayen is larger and more elevated than the southern. From its central tract towers the monarch of the island, Mount Beerenberg, an extinct volcano, rising in regal majesty to the height of 6400 feet. The crater measures 4360 feet in diameter. The upper cone, which shelves at an angle of 42° and attains an altitude of about 2000 feet, would, to judge from the black spots so conspicuous on its western declivity, appear to be composed of ashes. The base supporting the cone slopes out in every direction at an angle of from 8 to 10 degrees, and this incline is retained towards the north and east to a depth of at least 1000 fathoms beneath the sea-level. The edge of the crater has a jagged appearance, and the loftiest peak lies on the west side of the mountain. Towards the north, the wall of the crater has partially given way down to a height of from 600 to 700 feet. The depression thus formed extends northwards towards the north coast of the island, bounded on either side by diverging mountain ridges, that here and there project ledge-like one above the other. This is Beerenberg's *val del bove*, which constitutes the snow-field for the largest of its glaciers, that jut out from the north side of the mountain. On the east side, too, are seen prominent ribs, all of which intersect the nevés of the east side; towards the south and west, however, the surface of the outer cone would appear to be remarkably smooth, at the edge of the crater only being furrowed with shallow depressions between the jags. The base of Mount Beerenberg shelves towards the west, south-west, and north-east with a comparatively gentle incline, either to the water's edge or the low-lying shore; towards the north and east, however, the descent at the coast is very abrupt, exhibiting precipices 1000 feet high. In several places the base of the mountain is intersected by deep ravines, through which the glaciers find a passage to the sea.

The height of the southern part of the island cannot be compared to that of the northern. The southern land constitutes a wide plateau, which, in a south-easterly and southerly direction exhibits numerous precipices along the coast, but, towards the north-west, has extending before it a low-lying foreland, less than 300 feet above the sea. The height of the plateau I estimated at 1000 feet. Rising above this table-land are seen several summits; the loftiest, which has apparently a conical form, and may therefore be of eruptive origin, can hardly attain an altitude of 1600 feet above the sea-level.

The low middle tract of the island, which is built up of compact masses of lava and bears numerous eruptive craters, has at its lowest point an elevation of only 200 feet, or perhaps even less, whereas the crater summits

150 à 200 Meter. Fugleberget er maalt til 150 Meter; Ægøen anslaaet til c. 150 Meter.

Beerenbergs Basis er, som paavist af Carl Vogt, bygget af Lavalag og tildels Tuflag, der synes at have flydt eller være kastet ud af det store Central-Krater, sandsynligvis førend dette havde opbygget den øvre Askekegle. Af lignende Bygning er Øens Midtparti og efter Udseendet at dømme ogsaa den sydlige Del. Ovenpaa denne store sammenhængende Lavamasse staa en Mængde smaa Sidekratere, der for en stor Del have bevaret en udpræget konisk Form. Saadanne ere Krater Sars, Krateret øst for Sydbræen, Kraterne Esk og Vogt, Kraterne Danielssen og Blytt og Kraterne ved Guineabugten. Forstyrrede i sin Form ere Fugleberget paa Vestsiden og Ægøen paa Østsiden, idet begges ydre Kraterrand er opslugt af Havet. Nogle af Sidekraterne ere byggede af Lava og have udsendt betydelige Lavastrømme, som Vogt, Esk, nogles Top er bygget af løse udkastede Masser, Slakker og Aske, Rapilli, som Kraterne ved Mary Muss Bugten, ved Guineabugten, andre af Tuflag, Tufconglomerater og faste Lavalag, som Fugleberget, og atter andre af Aske alene, som Ægøen og Berna.

Den vulkanske Hovedspalte, hvorpaa Jan Mayen er bygget, gaar aabenbart efter Øens Længderetning, efter Heklalinien. Men Sidekraternes Gruppering synes at give en Antydning af, at der har været Tverspalter i Retningen WNW.—ESE. Vi have nemlig i denne Retning, som det synes, flere Rader af Sidekratere, saasom Esk—Vogt—Berna, Fugleberg—Egø, Hoyberg—Krater ved Fyrtaarnet (?). Er det et Tilfælde, at Endekrateret mod SE. i de to første Rækker, Berna og Ægø, kun have udkastet Aske?

Af Dale gives der paa Jan Mayen ingen af større Længde; de større Dale paa Nordlandet ere fyldte af Bræerne og Sydlandet synes at være meget lidet indskaaret af Dale. Af Bække ere kun faa iagttagne.

Karakteristiske for Jan Mayens Kyst ere de paa mange Steder opstaaende Klipper i Havet, hvoraf vi ovenfor have nævnt flere. De ere vistnok for største Delen Rester af Lavastrømme, der ere gaaede ud i Havet.

Jan Mayens Kyster ere, som ovenfor berørt, paa mange Steder meget bratte og høje. Paa andre Steder er der et lavt Forland, bestaaende af Lava, dækket tildels med Sand. Dette Forland, som paa Kartet har sin særegne Betegnelse, ligger tildels saa lavt, at det er dækket med Rækved. Lave Strender, af Sand, ere ogsaa mangesteds tilstede, og indeholde store Mængder af Rækved, Kjæver og Hvirvler af Hval, Vraggods og opkastet Tang.

reach a height of 400 to 600 feet. The altitude of Fugleberg we found by observation to be 490 feet; that of Egg Island was estimated at 400 to 500 feet.

As shown by Carl Vogt, the base of Mount Beerenberg is composed partly of layers of lava, and partly of layers of tuff, that would appear to have flowed or been discharged from the great central crater previous to the formation of the upper cone of ashes. The middle tract of the island exhibits a similar structure, and to judge from its appearance, also the southern part. Above this stupendous mass of lava rise a number of small parasitic craters, the greater part of which have retained a conical form. Such, for instance, are Sars's crater, the crater east of the southern glacier, the Esk and Vogt craters, Danielssen's and Blytt's craters, and the craters in the vicinity of Guinea Bay. Fugleberg on the west coast and Egg Island on the east, are no longer conical, the outer edge of the crater having given way and fallen into the sea. Some of the parasitic craters are built up of lava, and would appear to have sent forth considerable currents, as the Vogt and Esk craters; the summit of others consists of loose erupted masses, cinders, and ashes (rapilli), as the craters in the vicinity of Mary Muss Bay and Guinea Bay; others are composed of layers of tuff, tuff-conglomerate and compact masses of lava, as the Fugleberg, and others again of ashes alone, as Egg Island and the Berna crater.

The chief volcanic fissure in which Jan Mayen Island is built, must obviously extend in the longitudinal direction of the land, parallel to the volcanic line of Mount Hecla. Meanwhile, the grouping of the parasitic craters would seem to intimate the existence of transverse fissures running from WNW. to ESE.; for in that direction there are, apparently, several rows of parasitic craters, as the Esk, Vogt, Berna, the Fugleberg and Egg Island, Hoyberg and the crater in the vicinity of the "pilot-boat" (?). Must we regard it as mere accident that each of the terminal craters towards the south-east in the two first rows should have discharged ashes alone?

Jan Mayen has no valleys of considerable extent; the large ravines in the northern part of the island are filled with glaciers, and the southern land would appear to be but little intersected by vales or ravines. Of brooks or rivulets, very few have been observed.

A characteristic feature distinguishing the coast of Jan Mayen, are the fantastic-shaped rocks that in many places rise abruptly from the sea, of which we have mentioned several. They are no doubt in greater part fragments of lava detached from currents that had flowed into the sea.

The coasts of Jan Mayen are, as previously stated, in many places lofty and precipitous. In some localities, however, there is a low expanse of foreshore consisting of lava, partially covered with sand. This foreshore, which is separately marked on the Map, lies so low in places as to be covered with driftwood. Some localities, too, exhibit a low sandy beach, bestrewn with large quantities of driftwood, the jaws and vertebræ of whales, bits of wreck, and sea-weed.

Intetsteds paa Øen findes en Havn, der kan yde et Skib eller en Baad Ly i alle Slags Vejr.[1] Landgang paa Øen er derfor mulig kun naar Søen er forholdsvis rolig, men dette er vistnok en Sjeldenhed, undtagen naar Havisen ligger rundt om Øen.

Merkværdige ere de to Laguner, der ere adskilte fra Havet ved Volde af sort Sand, kun nogle faa Meter høje, et Par hundrede Skridt brede, som føre ferskt Vand og hvis Spejl kun ligger ubetydeligt højere end Havet. Vestsidens Lagune er saa dyb, at den vilde kunne give en god Havn, om Tangen blev gjennembrudt i tilstrækkelig Dybde. Østsidens Lagune er mindre dyb.

Jan Mayen ligger ganske i den østgrønlandske Polarstrøm. Under 10 til 20 Favne er Havets Vand hele Aaret igjennem iskoldt. Om Vinteren er der ofte aabent Vand ved Jan Mayen; navnlig passere Sælfangerne jevnlig vesten-om Øen. Sommeren er kold, en naturlig Følge af det iskolde Vand.

Den nordlige Del af Jan Mayen er dækket af evig Sne indtil en Højde af omkring 700 Meter. Beerenbergs Kegle er snedækt undtagen paa de bratteste Steder, hvor den sorte Fjeldvæg træder frem. Beerenbergs Basis er dækket af en udstrakt Snekaabe, hvorfra vældige Isbræer skyde sig ned, af hvilke 9 store Bræer naa helt til Havet.

Sydlandet synes ikke at være glacieret. Store Sneflekker findes om Sommeren overalt paa Øen i Nærheden af Havet.

Jan Mayens Flora er fattig. Men det Grønne mangler ikke, tvertimod danner Mosernes grønne Teppe, der dækker store Partier, en udmerket malerisk Contrast til Bergarternes sorte, brune og røde Farver. De af Dr. Danielssen paa Ejdet i Syd for Mary Muss Bugten samlede Planter ere, ifølge Bestemmelse af Professor *A. Blytt*, følgende:

Saxifraga cæspitosa, L.
— *nivalis*, L.
— *oppositifolia*, L.
— *rivularis* L.
Ranunculus glacialis, L.
Halianthus peploides, Fr.
Cerastium alpinum, L.?
Draba corymbosa, R. Br.
Cochlearia officinalis, L.
Oxyria digyna, Campd.
Catabrosa algida, Fr.

Af *Pattedyr* findes Fjeldrakken, *Canis lagopus*, i ikke ganske ringe Antal paa Jan Mayen. Den synes at nære sig af Søfugl. Af Fugle har Hr. Friele noteret følgende Arter:

[1] Lille Sandbugt synes efter Beskrivelsen i Zeespiegel at afgive en god Baadhavn, dækket af udenfor liggende Skjærgaard.

Nowhere on the shores of Jan Mayen has a harbour been found that could afford a ship or a boat shelter in all kinds of weather.[1] Hence, to land is possible only with the sea comparatively smooth, which it rarely is save when drift-ice encompasses the island.

Specially noteworthy are the two lagoons, cut off from the sea by barriers of black sand, only a few feet high and a couple of hundred paces broad. They both contain fresh water, the surface of which lies but very little above that of the sea. The lagoon on the west side of the island is deep enough to afford a good harbour were the barrier cut through to a sufficient depth. The lagoon on the east side is comparatively shallow.

Jan Mayen lies wholly within the Greenland Arctic current. At a depth of from 10 to 20 fathoms, the temperature of the sea is all the year round below zero. In the winter there is frequently open water off the coasts of Jan Mayen, sealers often passing to the west of the island. The summer is naturally cold, from the presence of ice-cold water so near the surface of the sea.

The northern part of Jan Mayen rises, at a height of about 2300 feet, into the region of perpetual frost. The upper cone of Mount Beerenberg is snow-capt, save on the steepest parts of its declivity, where the black mountain-wall is seen protruding. The base of Beerenberg is girt with a belt of snow, from which prodigious glaciers take their origin, 9 of the largest reaching down to the water's edge.

The southern part of the island would not appear to be glaciated. Large patches of snow are everywhere observed throughout the summer in the vicinity of the sea.

Jan Mayen has but a meagre Flora. Bright herbage, however, is not wanting; the green carpet of moss, in places of considerable extent, forms a striking and pleasant contrast to the black, brown, and red of the surrounding rocks. The plants collected by Dr. Danielssen on the isthmus south of Mary Muss Bay, are, according to Professor *A. Blytt*, as follows: —

Saxifraga cæspitosa, L.
— *nivalis*, L.
— *oppositifolia*, L.
— *rivularis*, L.
Ranunculus glacialis, L.
Halianthus peploides, Fr.
Cerastium alpinum, L.?
Draba corymbosa, R. Br.
Cochlearia officinalis, L.
Oxyria digyna, Campd.
Catabrosa algida, Fr.

Of mammiferous animals, the Polar fox, *Canis lagopus*, is by no means rare on Jan Mayen. Of birds, Mr. Friele has noted the following species: —

[1] Little Sand Bay would appear, according to the account in the "Zeespiegel," to be a good harbour for boats, protected as it is by an outlying chain of islets.

Somateria mollissima, Leach. Sjelden.
Larus glaucus, Brün. Almindelig.
Fulmarus glacialis, Lin. Overordentlig talrig.
Grylle Mandti, Licht. Talrig.
Uria arra, Schlegel. Talrig.
Mergulus alle, Lin. Talrig.
Tringa maritima?

Er Landets Fauna fattig, er derimod Havets desto rigere, hvorom Vidnesbyrd vil foreligge i samtlige zoologiske Afhandlinger i denne Generalberetning.

Bemerkninger til Kartet.

Kartprojectionen er Mercators. Maalestokken 1:200,000. Navnene paa Kartet ere alle paaførte af mig. Jeg har for det første beholdt alle de gamle hollandske Navne, i Originalsproget eller oversatte. Dernæst har jeg beholdt alle de af Scoresby og Carl Vogt givne Navne. Og endelig har jeg tilføjet en Del nye Navne. Disse ere: *Weyprechts Bræ,* til Minde om den fremragende Polarfarer, hvis store Plan til Undersøgelse af Polarlandenes fysiske Forhold nu bliver realiseret; *Kjerulfs Bræ,* efter den berømte norske Geolog; *Foyns Bræ,* efter Capt. Svend Foyn, der var den første Nordmand, som gik i Spidsen for de Norskes Sælfangst ved Jan Mayen; *Krater Sars,* efter Expeditionens Medlem, Prof. G. O. Sars; *Clandeboye Creek,* det Punkt, hvor Lord Dufferin var i Land (efter velvillig skriftlig Meddelelse fra Lord D.; se ogsaa "Letters from High Latitudes", Side 165); *Lord Dufferins Bræ; Frieles Bræ, Griegs Bræ, Willes Bræ, Petersens Bræ, Schiertz's Top,* efter Deltagerne i vor Expedition; *Krater Vøringen,* efter Expeditionens Skib; *Høsaaten,* det lille Krater i Nærheden af *Hoyberg* (et Navn, der betegner et Tag over en Høstak, der minder om den regelmæssige Kegleform[1]); *Krater Danielssen,* efter Expeditionens Medlem, Dr. Danielssen, der botaniserede her; *Krater Blytt,* efter Prof. A. Blytt, der har bestemt de paa Jan Mayen indsamlede Planter; *Tornøes Bæk,* efter Expeditionens Medlem, Chemikeren H. Tornøe, som fandt denne, ret vandrige Bæk; *Scoresby's Berg,* efter den berømte Hvalfanger, hvem Jan Mayens Geografi skylder saa meget.

[1] Meddelelse af Dr. Snellen i Utrecht.

Somateria mollissima, Leach. — Rare.
Larus glaucus, Brün. — Common.
Fulmarus glacialis, Lin. — Exceedingly abundant.
Grylle Mandti, Licht. — Abundant.
Uria arra, Schlegel. — Abundant.
Mergulus alle, Lin. — Abundant.
Tringa maritima?

If the land Fauna of the island is meagre, that of the sea is proportionately rich, a fact which the numerous zoological Memoirs published in this General Report will sufficiently attest.

Remarks on the Map.

The Map is on Mercator's projection, scale $\frac{1}{200,000}$. All of the names are selected by myself. First, I have chosen to retain the old Dutch names, either in the original language or translated. Secondly, I have kept all the names given by Scoresby and Carl Vogt. And finally, I have added new names, viz. *Weyprecht's Glacier,* in memory of the renowned traveller, whose comprehensive plan for the investigation of the physical conditions of the Arctic Regions is now in course of realisation; *Kjerulf's Glacier,* after the celebrated Norwegian geologist; *Foyn's Glacier,* after Captain Svend Foyn, the first of his countrymen who started a Norwegian sealing fishery off the coasts of Jan Mayen; *Sars's Crater,* after Professor G. O. Sars, member of the Expedition; *Clandeboye Creek,* the spot where Lord Dufferin landed (as kindly communicated by that nobleman from Constantinople; see, too, "Letters from High Latitudes," p. 165); *Lord Dufferin's Glacier; Friele's Glacier, Grieg's Glacier, Wille's Glacier, Petersen's Glacier, Schiertz's Peak,* after gentlemen who took part in the Expedition; the *Vøringen Crater,* after the name of the vessel; *Høsaaten* (haycock), the small crater in the vicinity of Mount Hoyberg (Hoyberg is a Dutch word signifying the roof of a haystack[1] that in form has some resemblance to a volcanic cone); *Danielssen's Crater,* after Dr. Danielssen, member of the Expedition, who botanised on its slope; *Blytt's Crater,* after Professor A. Blytt, who has determined the specimens of plants collected on Jan Mayen; *Tornøe's Rivulet,* after Mr. H. Tornøe, chemist to the Expedition, who on one of our excursions found this for Jan Mayen copious spring of water; *Mount Scoresby,* after the enterprising British whaler to whom the geography of Jan Mayen is so greatly indebted.

[1] Communicated by Dr. Snellen of Utrecht.

Fra Hr. *H. Reusch,* Assistent ved den geologiske Undersøgelse, har jeg modtaget følgende Meddelelse om hans mikroskopiske Undersøgelse af nogle Bergarter fra Jan Mayen.

De Haandstykker fra Jan Mayen, som De velvilligen har tilstillet Universitetets Mineralkabinet, har jeg efter Professor Kjerulfs Opfordring undersøgt mikroskopisk. Der foreligger *Basalter* (Rosenbusch's Definition). Herved er dog at bemærke, at Olivinen, idetmindste tildels, er tilstede i noget ringe Mængde, og at Plagioklasen, i Modsætning til, hvad der for det meste finder Sted hos de ægte Basalter, for en Del forekommer porfyrisk indsprængt i større Individer. Alligevel har jeg ikke kunnet beslutte mig for Navnet Augitandesit.

Fire af Haandstykkerne, No. 4, 5, 6, 7, var temmelig ens; med blotte Øjne betragtet foreligger en temmelig rigelig, af smaa tomme Blærerum opfyldt, tæt, mørkegraa Bergart, hvori man ser fremskinne fine Feldspatlister og enkelte større Feldspatkrystaller, samt ogsaa bemærker en eller anden Augitkrystal, undtagelsesvis endelig ogsaa et lidet Korn grønlig Olivin.

Under Mikroskopet ser man en forholdsvis lidet finkornet Grundmasse af langstrakte Plagioklaskrystaller og mere rundagtige Augitindivider, fremdeles mørkt slaggeagtigt Glas og Korn af en mørk Jernerts. Udskilt i større, porfyrisk indsprængte Krystaller forekommer Plagioklas og Augit, hvilken sidste som Grundmassens er lys brunlig-grøn, meget svagt pleochroistisk. Hist og her i Præparaterne opdager man indsprængte større Olivinkrystaller, der er saagodtsom aldeles friske og for en stor Del omgrændsede af distincte Flader.

I de større Krystaller af de sidstnævnte tre Mineraler sees gjerne Glasindeslutninger og Jernertskorn, i Olivinen tillige Picotit (?).

De som No. 2 og 3 mærkede Haandstykker var ikke porøse og indeholdt talrigere samt mere fremtrædende porfyrisk udskilte Krystaller end foregaaende. I Grundmassen var Augiterne meget smaa; Jernerts var rigelig tilstede; lidt Biotit bemerkedes; Glas saa man kun lidet til. Derimod indeholdt de udskilte større Plagioklaskrystaller Indeslutninger af saadant som ogsaa af Grundmassen i vakkert rectangulært omgrændsede Partier. En paafaldende Finkornethed udmærkede den Olivinkrystallerne nærmest omgivende Del af Grundmassen, i hvilken forresten i dette lige saa lidt som i foregaaende Tilfælde Olivin bemærkedes som egentlig Bestanddel. Olivinen var dels omgrændset af Flader, dels havde den ujevne Omrids, dels endelig trængte Grundmassen med ujevnt conturerede, undertiden udpræget sækformede Forgreninger ind i dem. Disse Forgreninger var finkornede eller vel oftere et slaggeagtigt Glas, hvilket ogsaa gjerne optraadte i den til Krystallerne ellers allernærmest stødende Del af Grundmassen. Hosstaaende tre Figurer, der er tegnede ved 360 Ganges Forstørrelse, illustrerer nøjere dette Forhold. For Tydelighedens Skyld har jeg undladt at indtegne de Sprækker og Jernertskorn,

Mr. *H. Reusch,* Assistant to the Norwegian Geological Survey, has sent me the following results of his microscopical examination of divers rock-specimens from the island of Jan Mayen.

The rock-specimens from Jan Mayen which you kindly forwarded to the Mineralogical Museum of the University, I have, at Professor Kjerulf's request, submitted to microscopic examination. They are *basalt* (Rosenbusch's definition). I must, however, observe, that in some cases olivine is present in no great proportion, and that plagioclase, as an exception to the general rule in true basalt, occurs here and there porphyrically imbedded in crystals of considerable size. Nevertheless, I cannot decide for augite-andesite.

Four of the specimens, Nos. 4, 5, 6, and 7, are comparatively uniform in appearance. To the naked eye, their aspect is that of a dark-grey rock exhibiting numerous empty vesicles, together with glistening lines of feldspar and several large crystals of that substance; one or two crystals of augite may be likewise observed, and finally minute isolated granules of greenish olivine.

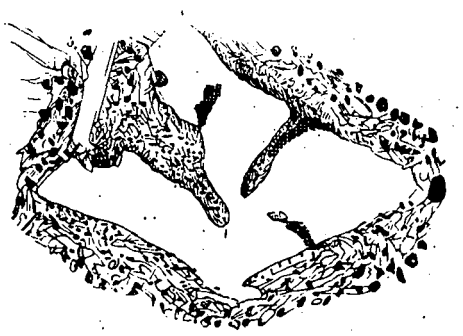
Viewed under the microscope, is seen a comparatively coarse base of elongated plagioclase crystals, along with crystals of augite, rounder in form, dark slaggy glass, and grains of a dark-coloured iron ore. Plagioclase and augite occur imbedded in comparatively large crystals, the latter having, in common with that of the base, a brownish-green tint; it is, too, to a very slight extent pleochroistic. Every here and there in the prepared specimens are observed comparatively large imbedded crystals of olivine, with scarcely a trace of decomposition, and having on all sides well-defined facets.

In the three last-mentioned minerals are seen cavities containing glass and grains of iron ore; in the olivine also picotite (?).

Specimens No. 2 and 3 are not porous; moreover, they differ from those described above in having a greater number of porphyrically imbedded crystals, which are also more obvious. In the base, the grains of augite are exceedingly minute; iron ore is present in great abundance; a little biotite, too, was observed, but only traces of glass. On the other hand, the large plagioclase crystals exhibited numerous cavities containing the latter substance, as also that of the base, in beautifully formed rectangular spots. The part of the base immediately surrounding the crystals of olivine exhibits a remarkably fine granulation, though for the rest, neither in these nor any of the foregoing specimens does olivine occur as a true basic constituent. The crystals of olivine have some of them plane surfaces, others irregular outlines, and some are pierced by the substance of the base with irregular, and possibly also sac-like, ramifications. These ramifications are either finely granular, or, more frequently perhaps, consist of slaggy glass, which often occurs too in the part of the base contiguous to the crystals. The three figures given below, showing the object as it appeared under the microscope

som tildels sees i Olivinkrystallerne. Det mørke med korsvise, hvide Linjer, som sees indtrængende i Olivinen er urent, slaggeagtigt Glas, det sorte Mineral i Omgivelsen er Jernertskorn.

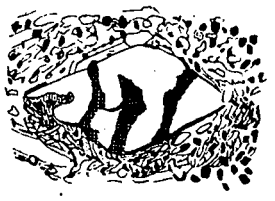
(magnifiing 360 diameters), will supplement the verbal description. To avoid complexity in the drawing, I have left out the fissures and the grains of iron ore that are seen in some of the crystals of olivine. The dark substance, with intersecting white lines, seen piercing the olivine, is discoloured, slaggy glass, the black particles lying around, grains of iron ore.



Olivinkrystal i Basalt. — A Crystal of Olivine in Basalt, magnified.

Den omgivende Bergart er paafaldende finkornet indved Krystallen og trænger i sækformede Forgreninger ind i denne.

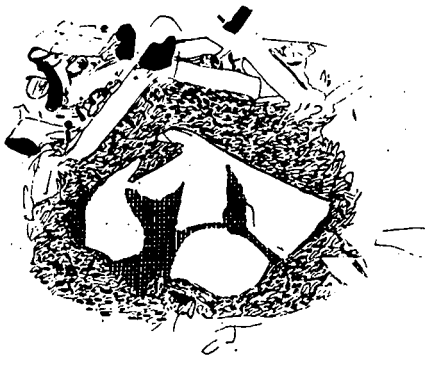
The surrounding rock exhibits a remarkably fine granulation in immediate proximity to the crystals, which it pierces in sac-like ramifications.



Olivinkrystal i Basalt. — A Crystal of Olivine in Basalt, magnified.

Urent Glas indtrængende fra den omgivende temmelig finkornede Bergart.

Discoloured glass is seen piercing the crystal from the surrounding rock, which has a fine granulation.



Olivinkrystal i Basalt. — A Crystal of Olivine in Basalt, magnified.

Den omgivende Bergart er finkornet. Øverst paa Tegningen sees Basalt af den herskende Kornighedsgrad. Urent Glas trænger ind i Krystallen fra Omgivelsen.

The surrounding base is finely granulated. — At the top of the figure is seen basalt of the dominant degree of granulation. Discoloured glass pierces the crystal from the rock surrounding it.

Disse mikroskopiske Forhold minder unægtelig om Eruptiver, som bliver finkornede paa sine Grænser og sender finkornede Forgreninger ud i de omgivende Bergarter. Hvorvidt her foreligger et Afkjølingsfænomen er dog tvivlsomt; maaske Olivinen allerede ved sin Udkrystallisation har paavirket Grundmassen, saa den i dens umiddelbare Nærhed har stivnet hurtigere. Lignende Forhold som disse ved Olivinen beskrevne iagttages, om end mindre karakteristisk, ved de udskilte Plagioklas- og Augitkrystaller.

Haandstykket No. 8 er porøst, af en forholdsvis lys, rødliggraa Farve og indeholder udskilte Augitkrystaller. Under Mikroskop ser man, at Bergarten, som er forholdsvis lidet grovkornet og lidet rig paa mindre Augitindivider, indeholder en hel Del Olivin. Dennes Individer udhæver sig ikke synderlig i Størrelse fremfor de øvrige Bestanddele; den er ikke som i de foregaaende Tilfælde frisk, men underkastet en begyndende Serpentinisering ledsaget af Udskillelse af Jernoxyd, som er det, der gjør Bergarten rødlig. Slaggeagtigt Glas er temmelig rigelig tilstede. Nogle lange fine Naale i Feldspaten formodes at være Apatit.

Haandstykket No. 1 udmærker sig fra de beskrevne makroskopisk derved at det ingen porfyrisk udskilte Feldspatkrystaller indeholder, men derimod en Mængde smukke gulagtiggrønne Olivinkrystaller, som er indtil 0.5 cm. store.

Under Mikroskopet ser man, at Hulrummene gjerne er omgivne med en Zone af Glas. I Olivinen, der synes at være udkrystalliseret efter en anden Typus end foregaaende, bemærkes hyppig det som Picotit tydede Mineral. Den mørke Jernerts er tilstede ikke alene i rundagtige Korn, men ogsaa i stavformede Legemer. Disse forekommer som Regel nær Olivinkrystallerne og har en bestemt Stilling til disse, uanseet Bergartens øvrige paa kryds og tvers liggende Bestanddele. De staar, saavidt jeg har kunnet iagttage det, lodret mod Olivinernes Hovedakse, parallelt deres lange Biakse; de staar nemlig lodret mod deres bedste Gjennemgangsretning. Man faar Indtrykket af, at Bergartens først udskilte Bestanddele, Olivinen og Jernertsen, i den endnu plastiske Masse har ordnet sig i et bestemt Forhold indbyrdes.

These microscopic details are undeniably suggestive of eruptive rocks that exhibit a fine granulation at their limits and send forth finely granulated ramifications. Whether we have here the result of some cooling process is doubtful; possibly, the olivine acted in the course of its crystallisation upon the basic substance, thereby causing the latter in its immediate vicinity to harden sooner. A similar feature, though less characteristic than in the olivine, distinguishes the imbedded crystals of plagioclase and augite.

Specimen No. 8 is porous, of a lightish ruddy-grey colour, and contains imbedded crystals of augite. Viewed under the microscope, this rock, which, comparatively, has not a coarse granulation and exhibits but few particles of augite, contains a good deal of olivine. The crystals of the latter substance are not very large as compared with its other constituents; the olivine is not as in the foregoing specimens undecomposed, but exhibits distinct traces of serpentinisation, along with the formation of oxide of iron. This it is which gives a red colour to the rock. Slaggy glass occurs in comparative abundance. A few long thin crystals in the feldspar would appear to be apatite.

Specimen No. 1 is distinguished macroscopically from those described above, by its not containing imbedded crystals of feldspar; it exhibits, however, an abundance of beautiful yellowish-green crystals of olivine, measuring up to 0.5 cm.

Viewed under the microscope, the hollow cavities are found to be encompassed by a zone of glass. The olivine exhibits a type of crystallisation different to that observed in the other specimens, and contains a greater proportion of picotite than usual. The dark iron ore occurs not only in roundish grains, but also in rod-shaped corpuscles. These corpuscles are as a rule observed in immediate proximity to the crystals of olivine and have a definite position towards them, irrespective of the other constituents of the rock, that run in all directions. They are placed, so far as I could determine, perpendicular to the vertical axis of the crystals, and parallel to the macrodiagonal, being perpendicular to the most perfect cleavage. The first-formed constituents of the rock, olivine and iron ore, would appear to have taken up a definite position one towards the other while the surrounding mass was yet plastic.

Olivinkrystal i Basalt. — A Crystal of Olivine in Basalt.

Den i stavformede Legemer forekommende Jernerts har en bestemt Stilling i Forhold til Olivinkrystallen. Tegnet ved 360 Ganges Forstørrelse.

The iron ore occurring as rod-shaped corpuscles has a definite position towards the crystal of olivine. — Microscope magnifying 360 diameters.

3. Beeren Eiland.

Den 4de Juli 1878 kom Expeditionen tidlig om Morgenen op under Beeren Eiland. Taagen, som laa over Øens højere Dele, spredte sig efterhaanden, og om Formiddagen blev Vejret ganske klart. Vi ankrede udenfor den saakaldte "Russestue", et forfaldet lidet Hus, der dog tidligere skal have været Bolig for et overvintrende Parti. Gjennem "Borgermester-Porten"[1] roede vi ind i den lille Bugt, ved hvis inderste Bred Russestuen ligger. Vi medhavde fra Bergen en Post til den hollandske Expedition med Skonnerten "Willem Barendsz," hvilken efter den af den hollandske Consul meddelte Anvisning nedgroves, indlagt i en dobbelt Kasse, i Nærheden af Huset. Stedet merkedes med et Flag, hvorpaa stod malet: "'Vøringen' til 'Willem Barendsz'." Vi havde senere paa Sommeren den Tilfredsstillelse at erfare, at Hollænderne havde fundet sin Post.

Vort af stormende Vejr og Modvind forlængede Ophold i Østhavet tillod os ikke at offre mere end en halv Dag til et Besøg paa Beeren Eiland. Jordbunden bestod omkring Russestuen af lutter forvitret Sten, en ren "Forvitringshud," der i Frastand gav Landet et aldeles "graaskaldet" Udseende. Om Morgenen toges Skitser af Beeren-Eilands Sydvestpynt. Billeder af denne findes i Beretningerne om de Svenske Spidsbergen-Expeditioner 1861 og 1864. Da vi vare i Land om Formiddagen, og efter at være kommen ombord igjen, tog jeg Skitser af Øens højeste Fjeld, Mount Misery. Fig. 8 er skaaret efter en Tegning, der er gjort efter disse Skitser. Man ser her Beeren-Eilands Sydostpynt til Højre. Udenfor viser sig Drivis, der kommer fra Nordost. Gjennem Mount Misery gaar et horizontalt Lag af en ejendommelig fremtrædende Bergart med, som det synes, verticale Afsondringsflader. Forsaavidt man kan dømme af Udseendet alene i Frastand, synes denne Bergart at være den af Nordenskiöld benævnte Hyperit, der forekommer paa aldeles lignende Maade paa Spidsbergen og hvis Forekomstmaade sees af flere Billeder i Beretningerne om de Svenske Spidsbergens-Expeditioner.

Højden af Mount Misery's øverste Top bestemte jeg paa følgende Maade. Fra et Punkt i Land, hvor der var oprejst en liden Stenvarde, maalte jeg med Sextant Vinkelhøjden (0° 50′ 0″) af Vøringens Stormast (der efter et nøjagtigt taget Maal udgjorde 21.39 Meter). Dette giver en Afstand mellem Stenvarden og Ankerpladsen af 1470 Meter. Ved Stenvarden var Lufttrykket 744.^{mm}0, medens det ombord, i Havets Niveau var 750.^{mm}7. Luftens Temperatur var 5° C. Stenvardens Højde over Havet beregnes herefter til 73 Meter. Endvidere maalte jeg med Sextanten Vinkelen mellem "Vøringen" og Toppen af Mount Misery

[1] Se "Svenska Expeditionen till Spetsbergen År 1864 ombord paa "Axel Thordsen," under Ledning af A. E. Nordenskiöld", Side 16.

3. Beeren Eiland.

On the 4th of July, 1878, early in the morning, the Expedition reached the coast of Beeren Eiland. A thick fog, which lay over the loftiest parts of the island, gradually dispersed, and in the course of the forenoon the weather became quite clear. We anchored off the so-called "Russian Hut," an old, neglected cabin, which is said, however, to have once served as a winter abode for a party of sailors. Passing through the "Borgermester-Porten"[1] (burgomaster's gate), we rowed into the small bay at the head of which stands the Russian Hut. We had with us from Bergen a bag of letters for the Dutch Expedition with the schooner "Willem Barendsz," which, in accordance with directions given by the Dutch Consul, was now buried near the cabin, after being laid in a double case. We marked the spot with a flag, on which had been painted the words: "'Vøringen' til 'Willem Barendsz'." Later in the season we had the satisfaction of learning that the Dutch explorers had found their letters.

The boisterous weather and the succession of contrary winds that had protracted our cruise in the Barents Sea, would not admit of our devoting more than half a day to an excursion on Beeren Eiland. The ground in the vicinity of the Russian Hut consists exclusively of disintegrated stones, -- in the strictest sense a "weathered crust," which at some distance gives to the land a grey, bald appearance. In the morning we sketched the south-western promontory of Beeren Eiland. Views of this headland are given in the accounts of the Swedish Spitzbergen Expeditions in 1861 and 1864. When on shore in the forenoon, and after returning to the vessel, I sketched the highest summit of the island, Mount Misery. The view in Fig. 8 is from these sketches. To the right, we have the south-eastern headland of Beeren Eiland. Beyond, is seen drift-ice bearing down upon the island from the north-east. Traversing Mount Misery, we observe a layer of a peculiar conspicuous rock, having apparently a vertical columnar structure. To judge from its aspect at a distance, this rock would appear to be of the kind designated by Nordenskiöld as hyperite, that occurs under precisely the same conditions on Spitzbergen, and the structure of which is illustrated in several of the figures accompanying the accounts of the Swedish Spitzbergen Expeditions.

The altitude of Mount Misery was determined as follows. From a point on shore, at which a mound of stones had been erected, I measured with the sextant the angle of elevation (0° 50′ 0″) of the main mast of the "Vøringen," which, according to accurate measurement, had a height of 21.39 metres. The said angle corresponds to a distance between the mound and the anchorage of 1470 metres. At the mound, the barometric pressure was 744.^{mm}0, whereas on board (at the level of the sea) it was 750.^{mm}7. The temperature of the air was 5° C. From these data, the height of the mound above the sea-level was computed at

[1] See "Svenska Expeditionen till Spetsbergen. År 1864 ombord paa 'Axel Thordsen,' under Ledning af A. E. Nordenskiöld," p. 16.

(111° 22′) og Toppens Vinkelhøjde over Horizonten (8° 40′). Horizonten bestemtes ved Hjelp af Wredes Niveller-Spejl, med hvilket jeg merkede mig et tydeligt Punkt paa Fjeldet ret under Toppen, i Stenvardens Niveau. Kommen ombord maalte jeg Vinkelen mellem Stenvarden og Toppen af

73 metres. Moreover, I measured with the sextant the angle subtending between the "Vøringen" and the summit of Mount Misery (111° 22′), as also the angle of elevation of the latter above the horizon (8° 40′). The horizon was determined by means of Wrede's levelling-mirror, with which

Fig. 8. Mount Misery.

Mount Misery (48° 9′) samt Toppens Højdevinkel over Horizonten (7° 56′, corrigeret for Kimmingdaling). Herefter beregnes Afstanden Stenvarde—Top til 3914 Meter, Afstanden Skib—Top til 3131 Meter, og Højdeforskjellen mellem de to første Punkter til 472 Meter, mellem de to sidste til 541 Meter. Lægges hertil de respective Standpunkters Højde over Havet, 73 Meter og 3 Meter, faaes som Resultat 545 og 544 Meter. Den sidste Bestemmelse har jeg antaget som den sikreste, og sætter saaledes Mount Miserys Højde til 544 Meter eller 1785 engelske Fod. Dette er et større Tal end den paa Søkarterne, formentlig efter et Skjøn, angivne Højde af 1200 Fod.

I marked a point on the mountain, in the vertical plane of the summit, and level with the mound. On returning to the vessel, I measured the angle subtending between the mound and the summit of Mount Misery (48° 9′), as also the angle of elevation of the latter above the horizon (7° 56′, corrected for the dip). The distance between the mound and the summit was then computed, and found to be 3914 metres, that between the ship and the summit 3131 metres, and the difference in altitude between the two first-mentioned points 472 metres, between the two last-mentioned 541 metres. Now, if to these figures be added the height above the sea of the respective standpoints, viz. 73 metres and 3 metres, the result will be 545 and 544 metres. The latter determination I regard as the more trustworthy of the two, and have therefore put the altitude of Mount Misery at 544 metres, or 1785 English feet above the sea-level. This exceeds the height given in the charts — 1200 feet, the result probably of estimation.

Den 1ste August 1878 laa Expeditionen under Nordostsiden af Beeren Eiland for at have Ly for den paa Havet blæsende Sydvest Storm. Da Vejret om Aftenen syntes at bedage sig, forsøgtes at lande paa Øen. Dette lyktes ogsaa. Vi kom i Land ved Mundingen af Engelsk-Elven, der ved sit Udløb i en liden Bugt danner en Fos. Vi steg op paa Beeren-Eilands flade Plateau, der fandtes at ligge omtrent 34 Meter over Havet, og vandrede en Mils Vej nordover. Kysten er overalt ganske brat, flere Steder helder Fjeldvæggen udover. Den er dannet af horizontale Lag, der som bekjendt tilhøre Stenkulperioden. Fra Søen af ser Kystlinien temmelig ret ud, men fra Land viste den sig at bestaa af fremspringende Nes afvexlende med indgaaende Bugter. Brændingen arbejder uafladelig paa at udgrave de lavere Lag. De overliggende Lag miste sit Underlag, brydes af og styrte i Stranden, hvor de søndermales af Bølgeslaget. Paa Land saa vi, indenfor Plateauets Rand, gabende Sprækker, der havde dannet sig ved de undergravede Lags begyndende Synkning. I Fjæren saa vi, hvorledes Bølgerne tumlede vildt med det nedrasede Lands Rester. Ved enkelte Nes staar igjen Stabber eller Søjler, adskilte fra Landet, ogsaa som Vidnesbyrd om Havets Magt. Disse Stabber, med sine horizontale Lag, frembyde søgte Hækkepladse for talløse Søfugle, der her kunne være i Fred for Fiender. Saaledes skrider Beeren-Eilands Ødelæggelse frem. Den grunde Banke, der strækker sig fra Øst-Spidsbergen til Beeren-Eiland, er sandsynligvis for en stor Del Resterne af dette Land. Nu kommer hertil det faste Materiale, som Drivisen fører med sig og afsætter ved sin Smeltning.

Vort Billede viser denne Kyst med de udoverhængende Lag, de fremstikkende Nes, de af Bølgerne udhulede Bugter, i hvilke Brændingen arbejder, og to af de fritstaaende Stabber.

Inde paa Sletten passerede vi, i en Afstand af et Par Kilometer fra Kysten, en Række smaa grunde Ferskvandsøer, hvis Vand havde en Temperatur af 9° C., og som syntes at være et yndet Opholdssted for talrige Søfugle. Overfladen af Fjeldet bestod af lutter løse Stene, dels som løs Ur, dels som mindre Stene med Jord imellem, der frembød en Smule Vegetation. Hist og her fandtes sammenhængende Mostepper.

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4. Spidsbergen.

Den 5te August 1878 fik vi for første Gang Øje paa Spidsbergen. Ved Middag saaes Syd-Spidsbergen forud, et skydækket Land med Sne og Isbræer. Udenfor Sydkap ligge nogle ganske lave Øer. Vi sejlede søndenom disse og

On the 1st of August, 1878, the "Vøringen" rode at anchor off the north-east coast of Beeren Eiland, during a heavy gale from the south-west. In the evening, the weather having somewhat abated, an attempt was made to land on the island. It proved successful. We landed at the mouth of English River, which forms a cataract where it disembogues into a small bay. We ascended to the plateau of Beeren Eiland, that attains an elevation of about 110 feet above the sea, and strolled for a few miles in a northerly direction. The coast is everywhere precipitous, in several places with beetling cliffs. It is built up of horizontal strata belonging to the true carboniferous era. As seen from the sea, the coast appears to extend in a comparatively unbroken line; but on landing, it was found to form numerous headlands and bays. The ceasless action of the surf gradually wears away the lower strata. The upper layers being thus deprived of their support, give way, and topple down into the sea, where they are broken up by the lashing of the waves. Near the edge of the plateau were seen yawning rents in the surface, showing that the subjacent layers were about to give way. On the beach, we could observe the action of the waves in tossing about the fallen masses. Stumps or columns of rock still remain off some of the headlands, — another proof of the marvellous power of the waves. These columnar rocks afford favourite breeding-haunts for sea-fowl, where they have nothing to fear from their enemies. Thus proceeds the gradual demolition of Beeren Eiland. The bank extending from East Spitzbergen to Beeren Eiland, is probably in greater part the remains of this land, along with the solid matter deposited on the melting of drift-ice.

Our view of this coast shows the beetling stratified cliffs, the bold projecting headlands, the bays and creeks hollowed out by the sea, in which the surf is for ever engaged in its work of destruction, and two of the isolated columnar rocks.

On the plateau, about a mile from the coast, we passed a chain of small freshwater lakes, apparently the favourite resort of innumerable wild-fowl; the temperature of the water was 9° C. The surface of the island consisted exclusively of loose materials, in part dry gravel, in part small stones embedded in earth exhibiting traces of vegetation. Here and there was seen a carpet of moss.

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4. Spitzbergen.

On the 5th of August, 1878, we got our first view of Spitzbergen. About noon the "Vøringen" bore down on South Spitzbergen, a cloud-capt land, with snow-fields and glaciers. Off South Cape are seen a number of small,

aflagde et kort Besøg i Storfjorden. Det var en ejendommelig smuk Aften. Foran os laa, som Billedet viser, Sydkap med sine Sne- og Isbræer, af hvilke en næsten naaede Havet. Fjeldtoppene vare paa Vestsiden indhyllede i Skyer, fremkaldte af den herskende Vestenvind. Paa Østsiden derimod, imod Storfjorden, var Himmelen klarere, og ude i Horizonten mod Øst var der aldeles klart Solskin. Men Himmelen var ikke blaa, den havde et forunderligt sterkt gult Skjær, som først i Sydost gik over til det vante blaa. I Nord for det egentlige Sydkap saaes "Keilhaus Fjeld", og mellem dette og Sydkap fremtraadte Billedets interessanteste Gjenstand, en Isbræ, der fra det Indre af Landet med sagte Skraaning steg ned til og langt ud i Havet, hvor den endte med en tverbrat Væg, kanske sine 30 Meter høj, og hvis horizontale Udstrækning kunde maales med Kvartmile. Ved Synet af denne Ismasse, paa hvis Overflade Solens Straaler fremkaldte et blændende hvidt Lys, medens den bratte Endevæg laa som en lang, mørk Rand eller Skygge langs Havbrynet, med den sterkeste Modsætning til hin, kunde jeg forstaa, hvorfor vore Fangstfarere kalde Isbræerne for Is-*Fjelde*. Et saadant Fjeld gjør, som det her træder frem, den samme Berettigelse gjældende paa at deltage i Rækken af de Masser, der bygge den faste Jord, som den massiveste Granit. Vort Billedes Forgrund danner det spejlblanke, kun nu og da af en svag Bris krusede, men dog altid gyngende Havspejl, med sit gjennemsigtige, grønne Vand, i hvilket Isflag og Isblokke af de mangfoldigste og forunderligste Former ligge omstrøede. Her sees et fladt Stykke, ovenpaa dels blændende hvidt af Sne, dels tilsmudset af jordagtige Stoffe, med blaa Sprækker og smukt blaagrønt under Vandet — det er Vandets egen Farve. Hist et Stykke som en Svane med sin lange Hals, en hyppig Fremtoning hos Polarisen.

low-lying islands. We passed to the south of these islets, and steamed a short distance up the Stor Fjord. It was a lovely night. Before us, as shown in the prospect, lay Cape South, with its snow-fields and glaciers, one of which reached almost to the water's edge. The summits on the west coast were wrapped in clouds driving before the westerly wind. On the east shore, in the direction of the Stor Fjord, the atmosphere was considerably clearer, and on the eastern horizon the sun shone brightly. The sky, however, was not azure; it had a strange yellowish tint, that extended to the south-east before merging into the wonted cerulean hue. North of the promontory forming Cape South, was seen "Mount Keilhau;" and between this summit and the headland lay, boldly defined, the most interesting object in the view, a stupendous glacier, which, with a gentle declivity, extended from the inland tracts to the shore and far out into the sea, where it terminated in a perpendicular wall, at a rough estimation not less than 100 feet high, and horizontally stretching for miles. Regarding this prodigious mass of ice, from the surface of which the rays of the sun were reflected in dazzling brightness, whereas its terminal wall extended, in striking contrast, as a dark line or shadowy limit along the surface of the ocean, the name of "Is-Fjelde" (Ice Mountains), given by our seamen to these Spitzbergen glaciers, was seen to be singularly appropriate. One of these glacial bergs is equally entitled to rank as a component part of the masses that constitute the land as granite itself. In the foreground of the picture, curled here and there by a gentle wind, the ocean expands its ever restless bosom, on which floes and fragments of ice of every conceivable form lie scattered around. Here, we have a huge flat block — its surface covered partly with snow of a dazzling whiteness and partly with some dark earthy substance — exhibiting blue fissures, and having under the water a beautiful bluish-green tint, the colour of the surrounding ocean. There, is seen a fragment resembling a swan, with its long extended neck, a form frequently assumed by the Polar drift-ice.

Den 15de og 16de August 1878 laa Expeditionen til Ankers ved *Norsk Øerne* paa Nordkysten af Vestspidsbergen. Der indtoges en Del Ballast, til hvilken Stene af passende Størrelse kunde hentes i Fjæren lige ved Sundet mellem Norskøerne. I dette var der en sterk Tidevandstrøm, der førte Ismasser østenfra ind i Sundet og siden med skiftende Strøm tilbage. Vort Billede Fig. 9 viser Udsigten fra Ankerpladsen mod Nord. Til Højre Ydre Norskø, fra hvis Top man i klart Vejr kan se østover helt til Verlegenhuk. I Billedets Midte se vi Toppen af Øen "Cloven Cliff," der i vest-østlig Retning har en Klov eller Kløft. Vi se paa Billedet, hvorledes Lyset falder ind gjennem denne. Til Venstre er Øen Vogelsang. Udenfor Øerne

The 15th and 16th of August, 1878, the Expedition passed at anchor at the *Norway Islands*, on the north coast of West Spitzbergen. Here we took in ballast, stones of suitable size forming the beach of the sound that extends between the islands. In this sound there was a strong tidal current, that brought with it, when setting from the east, considerable quantities of drift-ice, but which, on the turn of the tide, carried it back again. The view in Fig. 9 is from the anchorage, looking north. To the right we have Outer Norway Island, from the summit of which, in clear weather, you can see in an easterly direction as far as Verlegen Hook. The middle part of the picture shows the summit of the island, "Cloven Cliff," a

ligger Taagen over Havet. I Sundet sees et Par Fartøjer tilankers. Det er norske Torskefiskere, der her gjøre et rigt Fiske. Sluppen er den bekjendte "Isbjørn", der i

rocky mount that from west to east exhibits a long rent or chasm. In the view, we see how the light falls into this ravine. To the left, rises the island of Vogelsang. Off

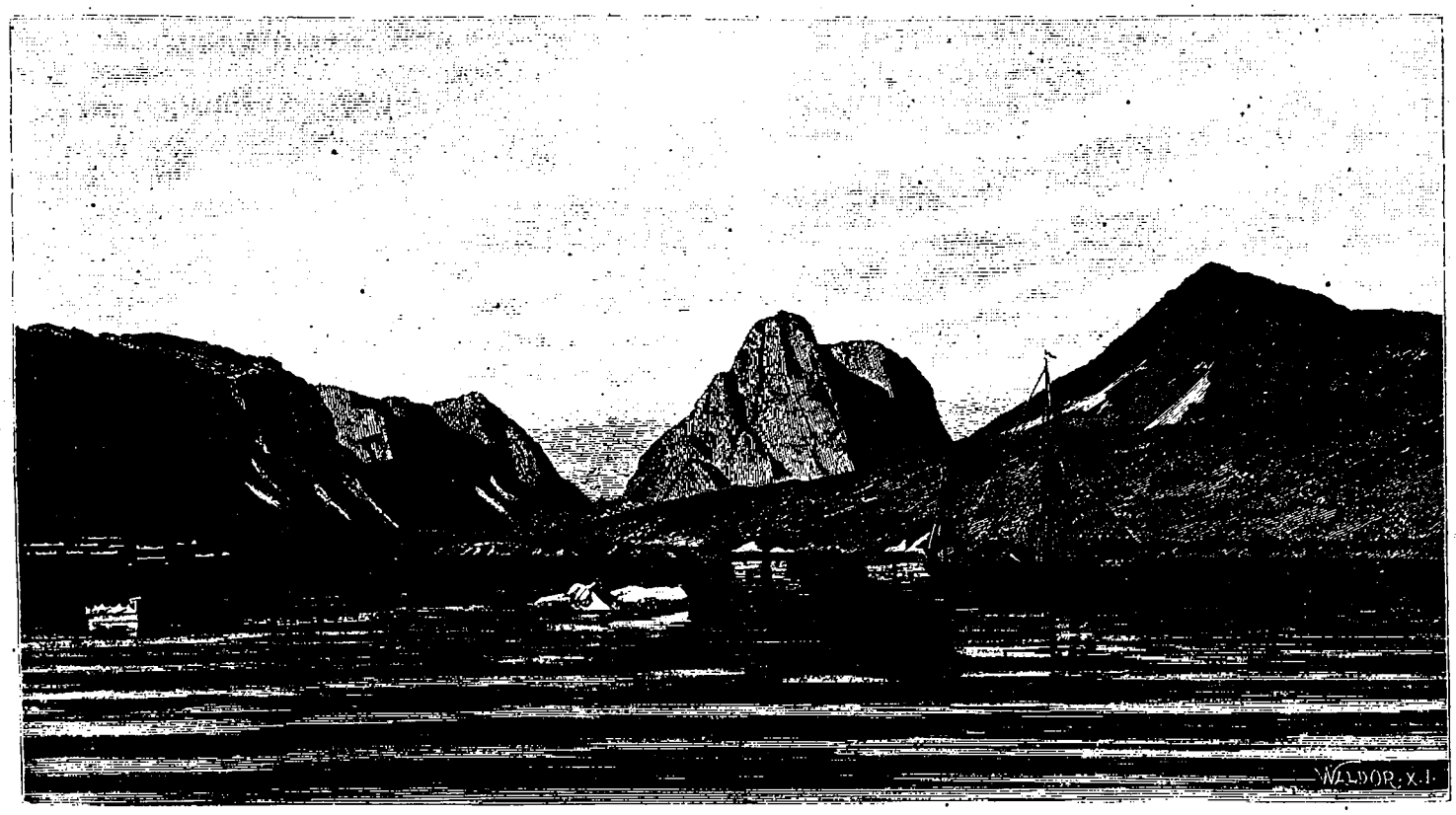


Fig. 9. Cloven Cliff.

1871 førte Weyprecht og Payer og i 1872 Grev Wilczek paa deres Polarfærder til Spidsbergen og Østhavet.

the islands, a dense fog lies over the sea. In the Sound, one or two vessels are seen riding at anchor. They are Norwegian ships engaged in the Spitzbergen cod-fishery, which hereabouts is very productive. One of the vessels is the "Isbjørn", the well-known cutter that in 1871 took Weyprecht and Payer, and in 1872 Count Wilczek on their exploratory voyages to Spitzbergen and the Barents Sea.

Om Aftenen den 16de August sejlede Expeditionen ned gjennem Smeerenberg-Sundet, hvor vi saa vort største Isberg, c. 23 Meter højt, staaende paa Grund der hvor South-Gat begynder. Vi passerede South-Gat efter det i 1818 af Beechey og Franklin optagne Kart, og ankrede ved Midnat i Magdalena Bay, indenfor "Begravelsespladsen".

Magdalena Bays storartede Glacialnatur er udmerket

In the evening of the 16th of August, the Expedition steamed through Smeerenberg Sound, and we had a fine view of the largest iceberg seen on any of our cruises. It had grounded in the inner part of South Gat. Its elevation was estimated at about 70 feet. We steered through South Gat by the chart constructed in 1818 by Beechey and Franklin, and cast anchor in Magdalena Bay, within the "burial ground."

The grand glacial scenery of Magdalena Bay is ad-

vel gjengivet i Plancherne til Gaimards Rejse med "la Recherche". Vort Billede, der viser Sydsidens Bræer, er taget fra den fremspringende Landtunge "Begravelsespladsen". I Forgrunden sees, hvorledes det ser ud paa en Campo santo paa Spidsbergen. Til Venstre se vi Landtungen, der forbinder Begravelsespladsen med Land, og udenfor denne den saakaldte Gully's Glacier. Dennes Ende hviler for en stor Del paa Fjæren, langs hvilken jeg passerede foran den, men i Midten gaar Bræen ud i Havet og her løsner stadig Stykker af den. Jeg blev Vidne til et saadant Skuespil. En høj Issøjle løste sig med et Brag fra Bræens yderste Væg. Den heldede udover og begyndte sit Fald med en svingende Bevægelse, støttet paa sin underste Ende. Jeg ventede at se den falde med hele sin Sideflade i Vandet, men dette skede ikke. Da den havde svunget udad en 30 Grader fra Verticalen, sank hele Issøjlen med Et sammen med en gjennemgaaende Verticalbevægelse, knustes og strøedes som mindre Stykker over Søen, der ved Faldet sattes i sterk Bølgegang. — Jeg var oppe paa Bræen paa dens Nordside; den var uden større Sprækker og havde en meget jevn Overflade.

I det indre Basin af Magdalena Bay gjenfandt jeg de af Charles Martins i 1839 maalte lave Dybtemperaturer. Bundtemperaturen var her — 2.°1, den laveste Temperatur i Havet, jeg havde fundet paa hele vor Expedition. Og her var et rigt arctiskt Dyreliv.

Fra den 19de til den 22de August laa Expeditionen tilankers i Advent Bay, Isfjorden, Spidsbergen, medens Maskinen eftersaaes. Denne Anledning benyttede Capt. Wille til at optage et nøiagtigt Kart over Advent Bay, der ofte besøges af norske Fangstfartøjer. Eftermiddagen den 19de benyttedes til en Recognoscering, og der opsattes nogle Signaler. Den 20de om Morgenen tog jeg paa Odden (Basis A) en Række Solhøjder. (Se H. Mohn. Astronomiske Observationer Side 19). En Grundlinie blev udstukket og merket med Teltpinde paa det flade og jevne Terræn langs Stranden. Grundlinien er i Kartet optrukket mellem Punkterne A og B. Horizontalvinklerne til de nærmeste Signaler maaltes med Theodolit. Ved Middagstid bestemtes Azimut af Linien A C med Theodolit og Solen af Capt. Wille og mig i Forening. Derpaa fik jeg atter nogle Solhøjder. Om Eftermiddagen rejste Capt. Wille med Baad rundt den indre Del af Bugten og maalte med Sextant Horizontalvinklerne mellem de opsatte Signaler. Samtidig hermed maalte jeg Grundliniens Længde. Jeg benyttede hertil 3 Træstænger, af tilsammen 9.112 Meters Længde, ret afskaarne for Enderne. Disse lagdes af mine Assistenter, Baadsmanden og en Matros, fra Basis B af paa Jorden,

mirably rendered in the Plates annexed to Gaimard's voyage with "la Recherche." Our view of the glaciers of the south-coast is taken from the tongue of land termed "the burial ground." In the foreground, we have the aspect of a Campo Santo on Spitzbergen. To the left stretches the isthmus connecting the burial-ground with the main land, and off the former rises the so-called Gully's Glacier. The terminal portion of this glacier rests in greater part on the beach, along which I strolled below it; but the middle section projects into the sea, and here large fragments are continually breaking off. I was myself a witness of this gradual dismemberment. A lofty column of ice parted with a loud crash from the outer wall of the glacier. Supported at its lower end, the fall commenced with a slow, swaying movement. I expected to see it strike the water with the whole of its lateral surface, but in this was mistaken; having swung some 30 degrees out of the perpendicular, the entire column suddenly collapsed, taking a well-nigh vertical direction, and was smashed to pieces, the fragments being scattered over the sea, which became violently agitated by the shock. I had ascended the glacier from the north side; its surface was remarkably even and exhibited no considerable fissures.

In the inner basin of Magdalena Bay I observed the low deep-sea temperatures found by Charles Martins in 1839. The bottom-temperature was —2.°1 C., the lowest temperature I at any time observed in the water of the sea on the cruises of the Expedition. And yet these depths disclosed an abundance of animal life.

From the 19th to the 22nd of August, the "Vøringen" lay at anchor in Advent Bay, Ice Sound, Spitzbergen, her engines having to be cleaned and examined. Capt. Wille took advantage of this opportunity to construct a map of Advent Bay, a locality which is frequently visited by Norwegian fishing vessels. The afternoon of the 19th was devoted to reconnoitring in the vicinity of the Bay, and a few signals were erected. On the morning of the 20th, I took from the tongue of land (Base A) a series of solar altitudes (See H. Mohn. Astronomical Observations, p. 19). A base line was marked out with tent-pegs along the flat, beachy strand. On the Map, the base line extends between the points A and B. About noon, Capt. Wille and myself determined with the theodolite the azimuth of the line A C by the sun. I then succeeded in taking another series of solar altitudes. In the afternoon, Capt. Wille rowed round the inner shore of the Bay, and measured with the sextant the horizontal angles between the signals. Whilst he was thus engaged, I measured the length of the base line. For this purpose, I made use of three wooden rods, cut straight off at the ends, measuring together 9.112 metres. These rods were placed on the ground by my two assistants, the

i Numerfølge, I, II, III, og indsigtedes ved Øjemaal i Linien. Det blæste en liden Bris tvers paa Linien og. Operationen gik let ved at commandere "luf" og "fald". Naar Stængerne flyttedes, satte jeg Foden paa den sidste Stang, indtil den næste var sat til dens Ende og orienteret. Maalingen kunde saaledes paa det flade Terræn blive ret nøjagtig. Grundliniens hele Længde fandtes ved Hjelp af Stængerne og et Metermaal at være 299.11 Meter. Nogen merkelig Reduction for Stængernes Heldning har jeg ikke fundet det praktisk nødvendigt at anbringe. Metermaalet, der anvendtes som Normalmaal, er et i Paris kjøbt, med Regjerings-Stempel forsynet Træmaal til at lægge sammen. Det er henimod en Millimeter længere end et Par andre herværende Meterscalaer af omhyggeligere Construction. Dette Overskud kan regnes at gaa op imod den ved Maalestængernes Heldning og unøjagtige Orientering fremkomne Fejl. Efter Afslutningen af Grundliniemaalingen opsatte jeg Signalerne Y, T og videre vestover.

Den 21de August beregnedes Gaarsdagens Observationer og afsattes i Kartet. Capt. Grieg foretog Lodninger i Advent Bay. Om Eftermiddagen maalte jeg Vinkler fra de Signaler, jeg havde opsat den forrige Eftermiddag.

Den 22de fortsatte Capt. Wille Kartarbejdet. Capt. Grieg loddede om Formiddagen, og Capt. Wille om Eftermiddagen. Kl. 6 Eft. lettede vi og sejlede ud Isfjorden.

Kartet over Advent Bay er tegnet af Capt. Wille. Det originale Kart i 1:30000 er gjengivet her i 1:50000. Kartet beror, som af ovenstaaende Beskrivelse vil sees, paa en fuldstændig Triangulation. De trigonometriske Punkter ere paa Kartet merkede med de latinske Bogstaver. Azimutbestemmelsen, der orienterer Kartet, antages sikker paa et Minut, og Længdeudstrækningerne sikre paa en totusindedel af samme. Angaaende den absolute Bredde og Længde henvises til min Afhandling om de astronomiske Observationer Side 19.

Forresten indeholder Kartet selv de nødvendige Oplysninger.

boatswain and a sailor, so as to extend one after the other (I, II, III) from Base B, and as nearly as the eye could determine in the true line. There was a light breeze blowing at right angles to the base line, and the operation could be easily performed by commanding "luff" and "off." When the rods were being moved, I put my foot on the last of them, keeping it there till the next had been placed end on against it, and properly adjusted. In this manner a pretty accurate measurement could be made on the flat ground. By means of the rods and a metre-measure, the whole length of the base line was found to be 299.11 metres. Any appreciable reduction for the inclination of the rods, I have not thought necessary to apply. The metre-measure, which I used as the standard measure of length, had been bought in Paris; it is of wood, furnished with the government-stamp, and made to fold up. This instrument is about a millimetre longer than two other metre-scales, of more accurate construction, that we have here. The excess in length may be regarded as compensating the error arising from the inclination and imperfect adjustment of the rods. After measuring the base line, I erected the signals Y, T, and others farther west.

On the 21st of August, the observations taken the day before were computed and laid down on the Map. Capt. Grieg sounded in the Bay. In the afternoon I measured angles from the signals I had erected on the previous day.

On the 22nd, Capt. Wille went on constructing his map. Capt. Grieg took soundings in the forenoon and Capt. Wille in the afternoon. At 6 p. m. we got under weigh, and steamed out of Ice Sound.

For the Map of Advent Bay we are indebted to Capt. Wille. The original map was on a scale of $\frac{1}{30,000}$; the scale of that annexed to this Memoir is $\frac{1}{50,000}$. As will appear from the above description, the Map of Advent Bay is based on a complete triangulation. The trigonometrical points are denoted by capital letters. The azimuth determination, on which is based the direction of the meridian of the Map, may be regarded as true to a minute, and the longitudinal extent as correct within the two-thousandth part of the actual length. As regards the absolute latitude and longitude, the reader is referred to my "Astronomical Observations," page 19.

For the rest, all necessary information is given in the Map.

Billederne, Fig. 1—9, ere tegnede af Landskabsmaler *Carl Nielsen,* efter Skitser tagne paa Stedet af Hr. F. W. Schiertz, Prof. G. O. Sars og Prof. H. Mohn.

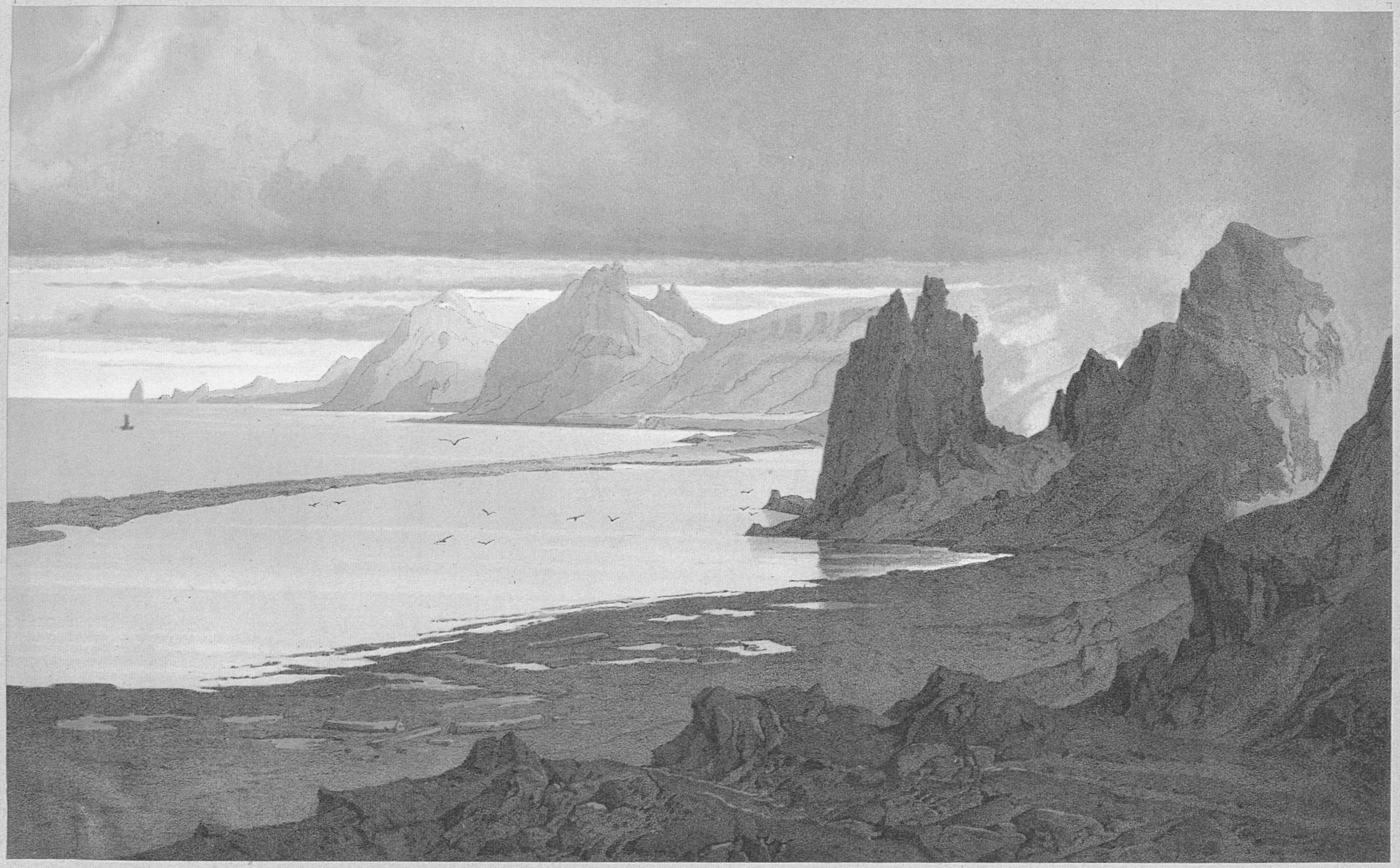
Figs. 1 to 9 are drawn by *Carl Nielsen,* artist, from sketches taken on the spot by F. W. Schiertz, artist to the Expedition, Prof. G. O. Sars, and Prof. H. Mohn.

Translated into English by **John Hazeland.**

Tegnet af F.W. Schiertz. Lith. af F. Larsen.

Hoffensberg & Traps Etabl. Kjöbenhavn.

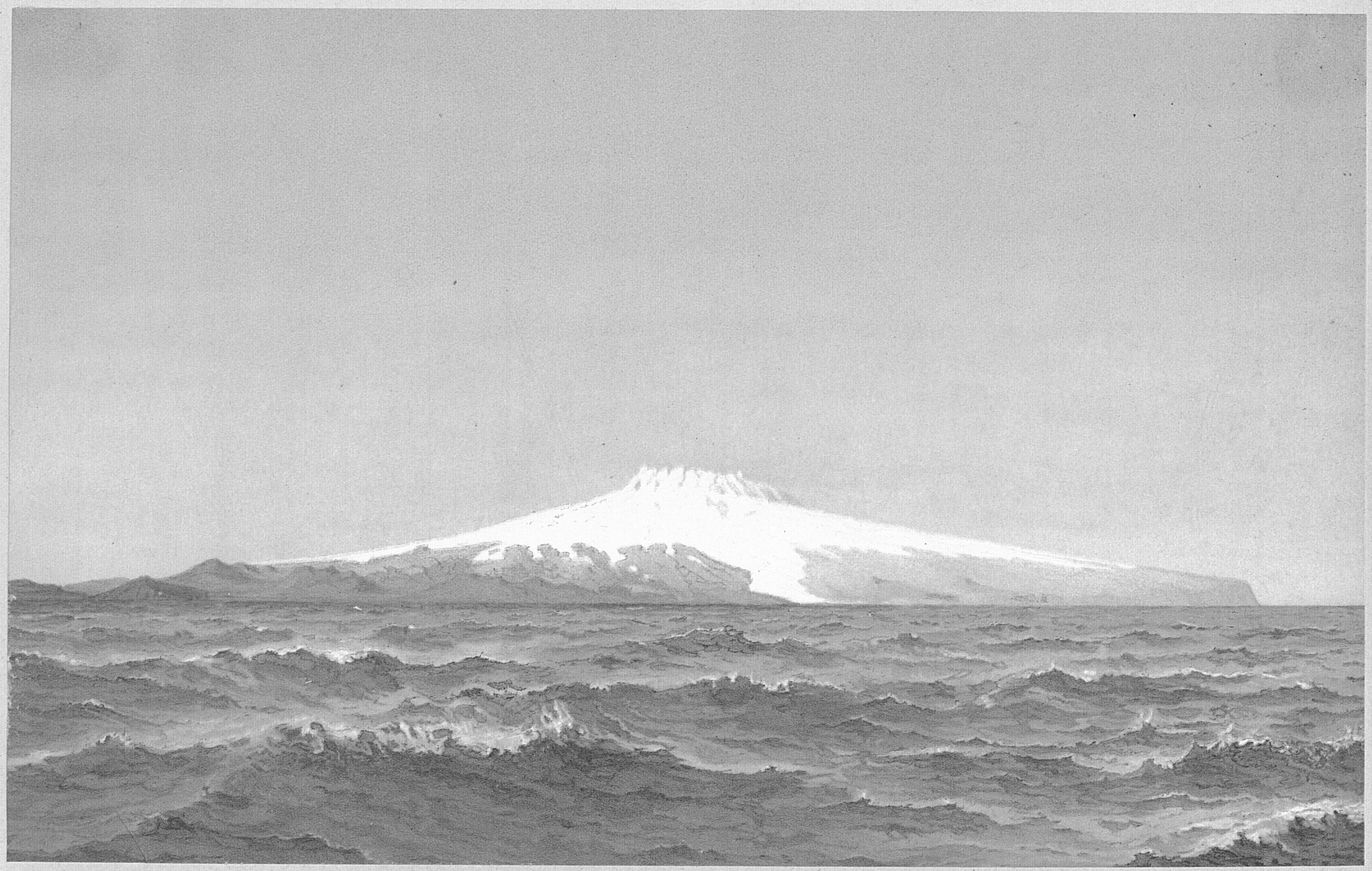
FRA VESTMANNA-ÖERNE. ISLAND.



Tegnet af F.W. Schiertz. Lith. af F. Larsen.

Hoffensberg & Traps Etabl. Kjöbenhavn.

LAGUNEN PAA ÖSTSIDEN AF JAN MAYEN.



Tegnet af H. Mohn. Lith. af F. Larsen.

Hoffensberg & Traps Etabl. Kjöbenhavn.

BEERENBERG. JAN MAYEN.

Tegnet af F.W. Schiertz. Lith. af F. Larsen.

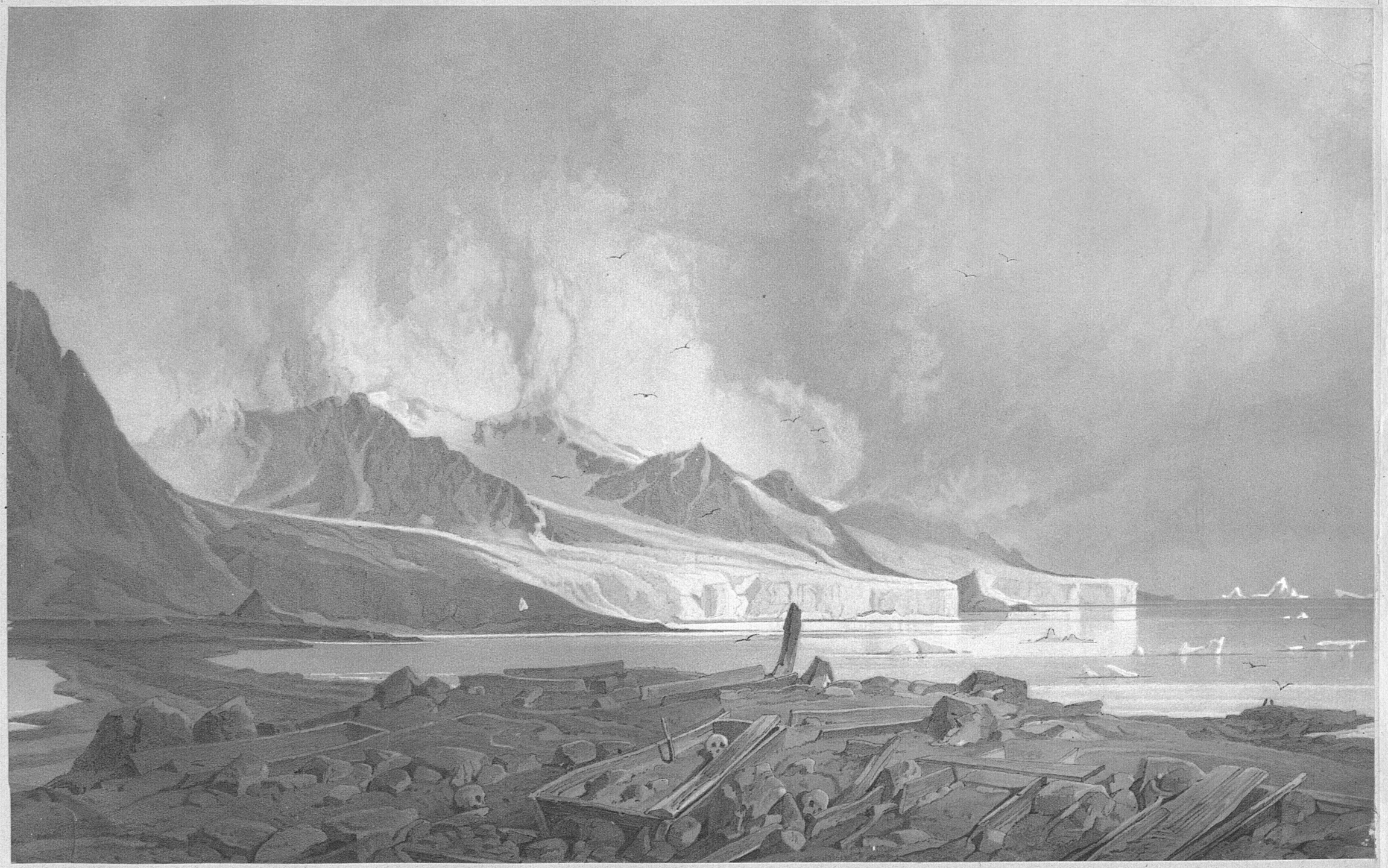
Hoffensberg & Traps Etabl. Kjöbenhavn.

ÖSTSIDEN AF BEEREN-EILAND.

Tegnet af F.W. Schiertz. Lith. af F. Larsen.

Hoffensberg & Traps Etabl. Kjöbenhav

SYDKAP. SPIDSBERGEN.



Tegnet af F.W. Schiertz. Lith. af F. Larsen.

Hoffensberg & Traps Etabl. Kjöbenhavn

MAGDALENE-BAI. SPIDSBERGEN.

KART
over
JAN MAYEN

EFTER ÆLDRE KARTER
(de ZEESPIEGEL, SCORESBY, C.VOGT)
og den Norske Nordhavs-Expeditions
Undersögelser 1877.
Udarbejdet af
C. WILLE og H. MOHN
Kaptejn i Marinen. Professor
1882.

Maalestok 1: 200,000.
1 ½ 0 1 2 3 4 5 6 7 8 9 10
Kilometer.

JAN MAYEN
ISLAND

FROM EARLIER MAPS
(de ZEESPIEGEL, SCORESBY, C.VOGT)
and the Survey made in 1877 on
the Norwegian North-Atlantic Expedition.
Constructed by
Capt. C. WILLE, R.N. and Prof. H. MOHN.
1882.

Scale 1: 200,000.
1 ½ 0 1 2 3 4 5
Nautical miles.

Youngs Forland
Cap Nordost
Ostcap
Kr. Sars
Cap Nordvest
Vestre Korsbugt
Mayens andet Korsnes
Clandeboye Creek
Lord Dufferins Bræ
Frieles Bræ
Griegs Bræ
Willes Bræ
Beerenberg
1945
Første Korsnes
Pedersens Bræ
Cap Neill
Cap Sydost
Scoresby's Berg
Kr. Esk
Kr. Vogt
Kr. Berns
Lille Sandbugt
Cap Hope
Cap Fichburn
Sydl. Bræ
Misv. 33° N.W.
Brielle Taarne
Walrusch Gat
Mary Muss Bugt
Kr. Blyth
Kr. Danielsen
Nord d. Engelske Bugt
Rudsen
Tømmer Bugt
Hoepstock Bugt
Roeberg
Vogel Klip
Syd-Bugt
Guinea Bugt
Lave Sydpynt
Høsahten
Høyberg
Kr. Vøringen
Syd Klipper
Cap Sydvest
Cap Syd
Pyrtaarnet
Schiertz's Top
Beeren Gat
Lodsbaad
Cap Traill
Stötten
Østre Laguner
Ægöen
Kjøl-Kalven
Turnbugt
Jameson Bugt
Ræk ved Bugt
Vestre Laguner
Tornøes Bræ
Fuglehorg
Weyprechts Bræ
Kjendlis Bræ
Østre Korsbugt
Sø. Foyns Bræ

Længde Vest for Greenwich.

Höjder i Meter, Dybder i Favne	Height in Metres, Depths in Fathoms
Höjdekurver for hver 100 Meter	Contour Lines for every 100 Metres
Kegleformet Krater (Kr.)	Crater of Conical Form
Isbræer (Bræ)	Glacier
Lav Strand af sort Sand	Low Beach of Black Sand
Lant Forland af Fjeld	Low Foreland of Rock
Boer i Vandfladen	Rocks
Undervandshoer	Sunken Rocks
Ankerplads	Anchorage

A. Aarnes lith.
Den private Opmaalings lith. Anstalt, Kristiania.

KART over ADVENT BAY

i Isfjorden paa Spidsbergen.

optaget af Kaptejn i Marinen C. F. Wille

med Assistance af

Professor Dr. H. Mohn og Skibskaptein J. Grieg, 1878.

Punkt A ligger paa { *78° 14' 48" Nord Bredde* / *15° 34' 14" Længde Öst Gr.*

Azimuth af Linien A C er 3° 15,'5 S. ad Ö.

Kompassets Misvisning 1878 - 12°,25 vestlig

Lodskud i Favne.

ADVENT BAY

Spitzbergen; Icefjord.

Surveyed by Capt. C. F. Wille R.N.

with the assistance of

Prof. H. Mohn and Capt. J. Grieg, 1878.

Point A { *78° 14' 48" N^th Lat.* / *15° 34' 14" Long. E. Gr.*

Azimuth of line A C = S 3° 15,'5 E.

Variation in 1878 = 12,°25 West.

Soundings in fathoms.

Maalestok 1: 50,000.

0 5 10 Kabl.

0 1 2 3 4 Kvartmil. (Naut. miles)