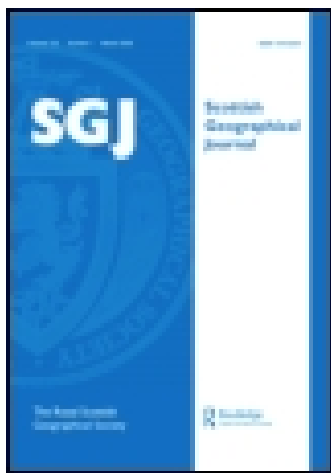


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The Kara sea and the route to the North Pole

Captain A. Hovgaard Danish Navy ^a

^a Hon. Corresponding Member, Royal Scottish Geographical Society ,

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hill. At 3 p.m. on the 7th I reached you, it having taken $4\frac{1}{2}$ hours of marching from the "Twin Cones."

I have the honour to be,

Sir,

Your obedient Servant,

W. E. STAIRS,

Lieut. R.E.

H. M. STANLEY, Esq.,

Commanding Emin Pacha Relief Expedition.

P.S.—The following are the generic names of the plants collected by me. Emin Pacha has kindly furnished them:—

1. Clematis.	14. Vaccinium.	27. Pteris aquilina.
2. Viola.	15. Erica arborea.	28. Asplenium.
3. Hibiscus.	16. Landolphia.	29. Aspidium.
4. Impatiens.	17. Heliotropium.	30. Polypodium.
5. Tephrosia.	18. Lantana.	31. Lycopodium.
6. Elycina. (?)	19. Moschosma.	32. Selaginella.
7. Rubus.	20. Lissochilus.	33. Marchantia.
8. Begonia.	21. Dracæna.	34. Parmelia.
9. Peucedanum.	22. Luzula.	35. Usnea.
10. Gnaphalium.	23. Carex.	36. Tree fern.
11. Helichrysum.	24. Anthistiria.	37. One fern.
12. Senecio.	25. Adiantum.	38. One Polypodium.
13. Sonchus.	26. Pellæa.	

} Unknown.

THE KARA SEA AND THE ROUTE TO THE NORTH POLE.

(*Read at Meeting of Society, Edinburgh, May 1889.*)

BY CAPTAIN A. HOVGAARD, *Danish Navy,*

Hon. Corresponding Member, Royal Scottish Geographical Society.

It is with great pleasure that I avail myself of the opportunity of reading a paper before this Society, of which I have been a Corresponding Member for some years.

It has been impossible of late years to organise an Arctic expedition in my country, so that I have no new information to give on the subject; but I believe that some remarks on the Kara Sea will have a special interest for a British audience, as some enterprising English merchants have taken up the idea of opening up communication with Siberia by this route.

Mr. Sewell recently read a paper on the last cruise undertaken by the indefatigable and energetic Captain Wiggins in the *Labrador*, which demonstrated that the Kara Sea is navigable. In 1882-83 I was in command of the only expedition which has wintered in that sea, and was thus able to study the movements of the ice for a year—my ship being beset by, and drifting with, the ice. I believe no one else has hitherto observed these movements; at least I have never seen them described, but only heard of immense hummocks formed on the coast of

Yalmal, and huge icebergs drifting down from the polar basin, which statements are quite inaccurate. The Kara Sea (by which I mean the sea between Yalmal and Novaia Zemlia) is just like an inland sea, having no communications with any polar basin, and almost all the ice found in it is formed and disappears there. This I will try to prove.

As member of the *Vega* expedition, I visited the Kara Sea in a year which was called exceptionally good, as no ice was visible during the voyage thither: this was in 1878. When I sailed up to these latitudes in the *Dijmphna* in 1882 we saw a good deal of ice, and all the Norwegian walrus-hunters agreed that 1882 was the most severe season they had experienced; 1883 was considered a bad year, but not so bad as 1882.

Though the meteorological conditions of these years have been held to differ considerably, we shall find on examination that the quantity of ice found in the Kara Sea during the last days of summer (the end of September) was the same in all three.

In speaking of a bad season, we always think of the circumstances in the neighbourhood of the straits leading to the Kara Sea, because it is there that vessels are prevented from entering it. These circumstances vary, of course, from day to day, for they are influenced by the slightest wind.

Looking at the map, you will find that the Kara Sea resembles a large sack, open to the north-east and having two narrow openings at the bottom. It is probable that this sack, at the end of the winter (*i.e.* the last days of April), is quite filled up with ice. Of course there are openings in the ice, as is proved by the fact that the wind is able to put the ice in motion, but still the maximum of ice is found at this time.

Before explaining how this ice disappears, we must consider what takes place during the winter. I must first inform you that the ice in the Yugor Strait was broken up very late in 1882, and it was only in the beginning of September that I succeeded in entering this channel. Here I had to wait a week until a southerly wind moved the ice from the shore. I then entered the Kara Sea, and found a lane of open water along the coast. Passing on towards the Yalmal coast, I saw to the north two steamers, beset by the ice and making signals of distress. Entering the pack, I succeeded in reaching one of them, the Norwegian steamer *Varna*, which had on board the Dutch expedition bound for Dickson's Haven. We were then both beset by the ice, the *Varna* for ever, the *Dijmphna* for a whole year. The other steamer, the *Louise*, succeeded in reaching open water, and returned to Europe the same year.

It was on the 18th of September 1882 that the *Dijmphna* and the *Varna* were beset by the ice, in $69^{\circ} 42'$ north latitude and $64^{\circ} 45'$ east longitude. A year later the *Dijmphna* was close to the north-east point of Waigatz Island, and during that time (with the exception of the last four days) we drifted with the ice.

Formerly it was stated that a current, marked also on several maps, followed the east coast of Novaia Zemlia, went round by the straits, through which it sent out branches, and, following the coast of Yalmal, again turned to the north.

This much is certain, that this current does not flow constantly, or we should have been driven to the north-east, but navigators spending a few days there in the summer months and finding that such a current then exists, owing to the powerful influence of the waters of the Obi in the north-east part of the sea and the effect of the north-east winds which blow almost constantly during that season, might be misled into supposing it to be permanent. But it is a mistake to suppose that these two circumstances can produce a regular current, as we shall see later on. From the meteorological observations made every hour all the year round on board the *Dijmphna*, the directions of the winds are on the whole as follows :—

From September to April, SW. $\frac{1}{2}$ W.

From May to August, NE.

During the winter the south-west winds drove the *Dijmphna* to the north, along the coast of Yalmal. As the ice near the coast was prevented from going exactly in the same direction as the wind, it became packed, and, every time we approached the coast, we were nipped. The worst spot was nearest the coast.

Here, on Christmas Eve, the *Varna* was completely crushed, and the immense floe on which we had placed our stores, in case we had to leave our ship, was also broken up, so that we had to jump from one piece of ice to another to save our sledges, boats, and provisions, while the ice was piled up in hummocks to a height of 30 feet. When the drift during a short calm set from the coast, we observed large openings in the ice, which were immediately frozen over again, the temperature during the long winter night having reached about 60° Fahr., but the next storm from the south-west piled it up into still more formidable hummocks. This process is continued all through the winter; every south-west storm forms hummocks by pressing the ice against the coast of Yalmal; the following calm permits the ice to spread and new ice to form, only to be piled up again by the next storm. In this way the ice goes on increasing in quantity, and in April we find the whole sea covered with hummocks.

In April we reached our most northerly point, and in May began to drift towards the Kara Straits under the influence of north and north-east winds. Later on the north-east wind was the predominant one, and the principal direction of the drift was south-west. At first it was slow, but became more rapid as the summer advanced, which proves that there was more open water. If any new ice was formed it was destroyed by the mutual friction and impact of the pieces. The north-east wind sweeps the ice towards the south-west shores of the sea straight towards the part where the two openings are found. But I do not consider that the quantity of ice in the Kara Sea is to any great extent diminished by part of it passing through these straits, of which the Kara is the more important, being broader and right in the direction of the prevailing wind, while the Yugor Strait is narrow and curved, though it also plays a special part in the hydrography of this sea. Only a small quantity of ice escapes through the straits, and the greater part of it disappears, where it is formed, in the Kara Sea itself. The whole mass is pressed

against the shores of Novaia Zemlia and Waigatz, where the weaker parts melt away, and the rapid drift wears away the under surface of the ice, while the exposed side has already become disintegrated to a large extent by the action of the rain, fog, and sun : the weaker parts burst, and the huge hummocks have room to move.

This pressure goes on continually ; the weaker piece of ice being forced over or under the stronger one, so that a larger surface is exposed to the direct action of the destructive powers—the rain, fog, and sun. The water trickles down the immense hummocks as they daily diminish, while at the same time the under parts are worn away by the swift eddying drift. The work of destruction proceeds at an incredibly rapid rate, even in the centre of the pack, but at the edge, nay, even several miles from it, the force of the swell is seen. The floes are rocked up and down, and in a short time completely broken up, partly by the friction between the fragments and partly by the impact of the water as it washes over and against their sides. No one who has not seen it can imagine the effect of the water's movements even in the smallest opening.

When, in the month of May, we began our drift to the south-west, we had about sixty miles between us and the coast of Yalmal entirely covered with hummocks, and while the ice to the west of us was being crushed to pieces, or was disappearing through the Kara Strait, we were drifting slowly away from the coast. The open water which was thus formed to the east of us could not freeze at that season of the year, but as it increased in extent the waves beat more violently on the eastern edge of the pack, and forced their way further and further into it. This disintegration went on with such astonishing rapidity that in the month of July the ice a few miles to the east of us was all broken up by the swell. Thus, in two months' time, the waves, with the assistance of rain, fog, and sun, had totally destroyed most of the ice that, at the end of the winter, had lain between us and the shore. During that period we had drifted 60 miles to the south-west, so that at the end of July a belt of over 100 miles of open water was found close to the west coast of the Yalmal peninsula. At the same time an equal amount of ice must have disappeared to the west of us, for a belt of open water, 60 miles broad, stretched across the whole sea in a north and south direction.

In August the circumstances were changed, as the ice was by that time broken up all round us, and we were no longer frozen up in the centre of a solid pack. It was broken up to a certain extent on the 11th of July, and, as time went on and the movement increased, the ice diminished in quantity, and what remained was enabled to drift more rapidly.

At the beginning of August we were about 20 miles away from Waigatz Island, and observed that the movement of the ice in our neighbourhood was not so regular as formerly ; it did not, as hitherto, invariably follow the direction of the wind. The idea struck us that the whole pack was trying to force its way through the Kara Strait, and, as this was too narrow an outlet for so huge a mass, there resulted a sort of conflict between the floes to the north of us and those to the south ; at one moment the former seemed to push everything before them, and the

next the latter seemed the more powerful, and forced their way towards the disputed passage. We were unfortunately situated just at the north-east of the point to which the ice converged, so that we were constantly squeezed by the ice. Every day our surroundings were so much altered that the floes, the forms of which we had become familiar with during the winter, were quite transformed and unrecognisable. It was here that we lost our propeller, and were reduced to the condition of a sailing vessel.

Even to the east of us everything was changed. At the beginning of August we had advanced rather faster than the ice to the north and south of us, which had closed up to the east in the wake of our track, and we were now far from the open water situated in that direction. The existence of the whirlpool, in which we were carried towards the Kara Strait, is easily explained. The constant NE. winds must increase the level in the Kara Sea; the narrow and shallow straits not permitting the water to escape as quickly as it enters from the NE., we have much the same phenomenon as would be presented by pouring water into a sack or tub with a narrow opening in the bottom; inside and near this opening a whirlpool would naturally be formed. This seems to explain the irregular movements of the ice above referred to. As regards the statement frequently made that there is an east-running current through the Yugor Strait, since the openings are not situated exactly in the bottom of the "sack," it is quite natural to infer a different movement of the water in each, or on either side of one, of them. The whirlpool causes a current through the Kara Strait, and, as the water flows directly through it from the north, the result is that the level of the south-eastern part of the Kara Sea would be reduced, were not this loss compensated for by the water which flows in through the Yugor Strait, and to a certain extent by a counter current which, hugging the shores of the Kara Strait, follows the coast of Waigatz Island. I myself have observed a similar current off the southern shores of Novaia Zemlia. This explains the fact that Norwegian walrus-hunters have in vain tried to force their way through the straits, though they found no ice to the west of Waigatz Island, whereas at the same time others entered the Kara Sea round the north of Novaia Zemlia without seeing ice, except when they approached the shore, and that only in the beginning of September was it possible to escape by the southern straits. The conditions outside the straits have nothing to do with the breaking up of the ice in the Kara Sea, very little ice escaping with the water which finds an outlet through them.

I will now proceed to show why the sea to the NE. has no effect in modifying the conditions of the ice within the Kara Sea. Though the "sack" is perfectly open in that direction, I do not believe the statement, so frequently repeated, that ice is driven by that entrance into the Kara. I myself never saw any in this inland sea, as I may term it, which was not formed within its limits, and the explanation of this fact is not far to seek. The ice on the river Obi breaks up while the Kara Sea is still blocked up by ice, formed on the spot during the winter, when SW. winds prevent any from entering from the NE. There is therefore at that time no room for the ice carried down by the river, which accordingly

finds another way of escape, probably the channel between Novaia Zemlia and Franz Josef Land, as I shall show presently. How otherwise can the presence of Siberian driftwood on the NW. shores of Novaia Zemlia be accounted for? It must, of course, be carried thither by the ice and water proceeding from the Obi and Yenisei. But it may be objected that Siberian driftwood is found also on the NE. shores of Novaia Zemlia. That is true, but it is carried there later in the season, when the ice of the Kara has receded to the SW., and none is borne down by the waters of the Obi and Yenisei. A considerable portion of the waters of these two Siberian rivers does find its way into the Kara Sea, a fact which I shall have occasion to refer to again in the latter part of my article, but it is at a season when, far from adding to the accumulations, they promote, in consequence of their higher temperature, the dissolution of the ice already existing there. We shall also find that the sea to the NE. of the Kara Sea proper is not subject to the influence of any polar basin, and that, if the name be employed to denote the whole sea from the Yugor Straits to Cape Chelyuskin (or North-East Cape), the whole area is essentially an inland sea.

Enough has now been said to explain the difficulties which all navigators encounter on the east coast of Novaia Zemlia. The waters of the Obi press the ice of the Kara Sea with great force against its shores, and, so far, exert an unfavourable influence, but, on the other hand, the stream by its great volume and comparatively high temperature prevents any ice from entering the sea from the NE. Moreover, the immense amount of mud carried down in the course of ages by the Obi and Yenisei, and deposited outside their estuaries, have formed a barrier which protects the Kara Sea on this side. There is yet another fact which tends to prove that the Kara Sea is unaffected by the adjacent Arctic regions. Weyprecht says that the low level of the Arctic Ocean during the winter gives rise to a current from the Atlantic, which enters along the bottom—a fact well established but difficult to account for. In the Kara Sea, however, we always found the temperature at a depth of from two to three fathoms constant (about 28° F.). A current of warmer water was observed on the surface to the west of the Kara Straits, but it did not cross the bar.

In the next place I shall endeavour to prove that the quantity of ice in the sea was very nearly the same in the three years I visited it, viz., 1878, 1882, 1883, though I am well aware that these years are considered to have differed considerably as regards the ice. On July 10, 1878, the ice in Yugor Strait lay in scattered sheets. In the Kara Sea it lay close to the north-east point of Waigatz Island, and thence extended to the south-east, east, and north-east to within 10 to 20 miles on an average from the coast. At 69° N. lat. the ice was so scattered that it was possible to approach the coast of Yalmal. Here the pack was so near to the land that a lane of open water could only be found close inshore, at a depth of 4 or 5 fathoms. Further north, at 73° N. lat., it was about 40 miles from the coast, and from this point its edge might be skirted, at the beginning of August, up to the north-east point of Novaia Zemlia. At that time there was no ice in the south-western part of the

Kara Sea, except small quantities on the east coast of Waigatz Island, and about 50 miles to the west and north-west of White Island, and the Yugor Strait was completely free, yet very little could have escaped by the Kara Strait, for none was visible to the west of it.

During the end of August and the beginning of September several walrus-hunters followed the eastern edge of the pack southwards from the north-east point of Novaia Zemlia. It extended to a breadth of 40 miles off Matthew Strait and blocked up the southern straits, but it was so scattered in the neighbourhood of Yugor Strait that the vessels were able to sail out of the sea by that channel. There was then no ice to the east, and a few days later it had again disappeared from the southern straits. It is evident, then, that even in this year, which has gained the reputation of having been exceptionally good, there was plenty of ice, though, in the position to which the wind drove it, it was no obstacle to navigation. Moreover, the absence of ice to the west of the straits would add to the apparent excellence of the season. In 1882 the sea to the west of the straits was in a very unfavourable condition, owing solely to the westerly winds, which during this summer prevailed in Barents Sea, and the *Varna*, *Louise*, and *Dijmphna* were the only vessels which succeeded in entering the Kara. The first two steamers entered by the Kara Strait, and were drifted with the ice along the coast of Waigatz Island, and then rapidly to the south-east. Captain Knudsen of the *Varna* always maintained that immediately after passing through the strait they were not far from open water, which lay to the north-east, but, as they were prevented by a dense fog from reaching it, they remained in the midst of the ice. The *Dijmphna* waited for a long time outside the Yugor Strait, until a southerly wind drove away the ice from its eastern mouth. This movement indicates that there must have been open water to the north-east. As I mentioned before, we found a lane of water along the shore, and we could, I feel sure, have reached the Yalmal coast the next day, had we not been obliged to enter the pack to assist the other ships. I did not, of course, dream for a moment of helping them out of the pack—this could only be done during some opportune movement of the ice, but I knew that they had neither clothes nor provisions, whereas I had enough for all. When, a few days later, the *Louise* gained the open water, which we had followed before, while the *Dijmphna* was drifted northwards with the pack, no ice was visible from her decks to the east and south-east. She was then about 10 miles distant to the south-west. These rapid movements of the ice prove that there could be no great quantity of it, and it is very probable that in 1878, if a ship had entered the pack, which, at the end of August in that year, lay off the southern straits, she would have passed through the same experience as we did in 1882.

In July 1883 a large open bay was found in the pack off Yugor Strait, and at the beginning of August a similar one was found off the Kara Strait. This was precisely at the time when we were drifting northwards. Later in the season the ice closed up to the straits again, while we drifted southwards. In the middle of September, when we got free, we had only to sail about half-a-dozen miles to reach the western edge of the pack. On approaching Waigatz Island we again met with a belt

of ice, but it must have been small, for we had to enter it for a short distance only in order to attain a position whence we might drift out with it through the strait. At the same time, a walrus-hunter at the north-west point of Waigatz Island saw no ice to the north-east.

The two years we have just been considering have been pointed out as particularly severe, and yet the rapid movements of the ice and other observed facts lead us to the conclusion that, towards the end of summer, the ice in the Kara Sea was restricted to a belt along the east coast of Novaia Zemlia and the coast of Waigatz Island, exactly as it lay in the good year 1878.

The next question is, Was the winter of 1882-3, the only one during which vessels have remained in the Kara Sea, a normal winter? I believe it was, and for the following reasons.

The depth of the sea in the southern part, off Yugor Strait, is considerable—more than 100 fathoms—and a deep depression lies also along the east coast of Novaia Zemlia; but in the middle, on the axis of the Kara Strait prolonged, we found a ridge ending to the north in a large bank, which I named, after our ship, the *Dijmphna* Bank. It will be remembered that the hummocks are formed by the ice being pressed against the coast of Yalmal during the winter, and probably many of the largest, which perhaps survive two winters, are formed near the coast, where they sometimes run aground. Here they pick up a quantity of clay which is distributed over the ice by subsequent compressions. Indeed, we always found, when the snow above had melted, that the ice was thickly covered with clay. Now in the summer, when the ice is borne towards the Kara Strait, it is precisely above the ridge just mentioned that the hummocks are subjected to the greatest pressure and are crushed to pieces, so that the clay falls to the bottom of the sea, and, since such is the origin of the ridge, it is evident that the movements of the ice must have been for many long years such as I have indicated.

This being so, the navigation of the sea becomes a very simple matter. It is only necessary to know the condition of the sea in the immediate neighbourhood of Yugor Strait, so as to choose the most suitable time for passing through it, after which the way to the Obi and Yenisei will present no difficulties. There is already a Russian settlement on the strait, which will no doubt at no distant time be placed in telegraphic communication with Archangel, so that the state of the ice may be made known by cable. I am quite certain that sooner or later a regular trade will be established by this route with Siberia, and that its abundant products will be carried to Europe at a far lower cost than at present.

It is for this reason that the Kara Sea is now attracting so much attention, but it has another claim to our interest, for it is the only route to the North Pole still left untried.

In 1882 I proposed in Denmark that an expedition should be sent out by this route to Cape Chelyuskin, for the purpose of searching for a passage to the North Pole from that point. I had then formed a theory of my own as to the distribution of land and water around the Pole, and the experience I have since gained is all in favour of the correctness

of that theory. Though I was prevented from carrying out my plan and may not succeed in organising another expedition, some one else may try it, and I am sure that at some future time this will be the route to the North Pole. The kind of route I mean is a coast line running north and south, for by no other is it possible to advance in those latitudes.

On looking at the map¹ you will find two pieces of paper attached to it. They mark out the areas which are no doubt occupied partly or entirely by land, while outside of them it is highly improbable that any land is to be found. The strait which separates them may lie more to the east or west, or there may be more than one. All I wish to indicate is that, somewhere in these regions, there must exist a connection between the Eastern Siberian Sea and the Palæocrystic Sea of Nares.

I shall now invite your attention to the threshold of the unknown regions, as Clements Markham so appropriately calls it, and set forth the various reasons on which my theory of the distribution of land and water round the Pole is based.

Turning first to Spitzbergen, we find that the Arctic Ocean probably extends far beyond these islands, for on their northern side a depression, more than 1300 fathoms in depth, runs in a northerly direction between Greenland and Franz Josef Land. Parry, at 82° 45' N. lat., saw to the north radiating ice-blinks, showing that the rough pack-ice on which he was travelling extended much further in that direction. The fact, that at this latitude he found the ice going to the south rather than to the west, would seem to imply that Franz Josef Land was its western boundary, as is indicated by the paper on the map. Payer found all the icebergs in Austria Sound drifting northwards, from which we may infer that the sound opens out in that direction; and, indeed, we may conclude that that part of Franz Josef Land, which lies to the west of this sound, consists only of a group of islands extending but a short distance to the north-west. Again, the comparatively warm northerly winds, which blew at the winter quarters of the *Tegetthoff*, seem to confirm the view that no large tracts of land exist in this direction.

With regard to Greenland, in the next place, there is every probability that this country does not extend much further north than 84° N. lat. The east coast has been thoroughly explored up to Cape Bismarck, and Lambert, in 1670, is said to have seen it two degrees further north. Lieutenant Lockwood, of the Greely Expedition, followed the west coast up to about 40° W. long., and the most northerly point he saw was at about 83½° N. lat. A comparison of the winds and currents from observations made on both coasts of Greenland leads us to the conclusion that the coast turns southwards near Lockwood's furthest point and trends towards Lambert's furthest and Cape Bismarck. Moreover, Professor Haughton found that the time which the tidal wave, after flowing northwards along the east coast of Greenland, took to reach the winter quarters

¹ Of the pieces of paper referred to by Captain Hovgaard, one, of an oval shape, extended from the North Pole to 75° N. lat. and ended in a point on the meridian of Wrangel Island (180°), and the other included Franz Josef Land and extended in front of the Kara Sea almost to Cape Chelyuskin. The strait was placed on the meridian of this Cape.

of the *Alert*, postulated a passage, which cannot be situated much further north than 84° N. lat., and Greely observed that the tide here came from the north, whereas at Melville Bay it comes from the south. Water therefore extends from the north of Spitzbergen along the north coast of Greenland, and the Atlantic is in uninterrupted connection with the Palæocrystic Sea of Nares.

The supposed extent of this sea has been enlarged from time to time. From the immobility of the ice masses, which Collinson noticed to the north of Behring Strait, and also from the slow drifting of the *Jeannette* during her first year, Sherard Osborne supposed that they floated on an Arctic Sea hemmed in on all sides, a northern prolongation of the Parry Islands being the boundary on that side.

But Belcher's observations in Northumberland Sound (Queen's Channel) indicated that large landless regions lay to the north and west, because, among other reasons, the water was violently agitated, and the ice was often broken up, by storms from these quarters. In late years, Captain Aldrich, of the Nares Expedition, and Greely, have shown that Cape Columbia is the most northern point of the American Arctic Archipelago, and that at 83° N. lat. the coast turns to the south-west. Petermann would limit this Arctic Sea by a prolongation of Greenland over the North Pole towards Wrangel Island, but this has been proved to be an erroneous idea, so that we have a broad arm of open sea extending down to Point Barrow.

How broad this arm is we cannot decide at present, but, judging from the nature of the ice and other circumstances, we must allow it a considerable breadth. To determine its northern and western limits we must continue our circuit of the Pole.

That there is a country north of Wrangel Island, the south-west coast of which extends towards Cape Chelyuskin, cannot be doubted for a moment. The circumstance that the northerly, and particularly the north-easterly, winds which we felt at the winter quarters of the *Vega*, were comparatively warm, indicates the existence of the expanse of open sea just mentioned, while the low temperature of the north-westerly winds was a sign that a considerable tract of land must have been situated in that direction. The almost trade-wind-like character of these winds confirmed the evidence of their temperature. Another proof is derived from the flight of the birds, which passed by our winter quarters in immense flocks of various species, for their destination could not possibly be Wrangel Island, seeing that the Americans, who visited it, noticed particularly the striking absence of animal life there during the summer. Again, the soundings taken at various points of the sea to the north of Wrangel Island attest still more strongly the existence of this land. Berry, in the steamer *Rodgers*, found that the depth increased as he sailed to the north-north-east from Wrangel Island, whereas, when he sailed due north, the depth decreased to 32 fathoms and, further on, to 20 fathoms. He did not actually see land, but he only reached $73\frac{1}{2}^{\circ}$ N. lat., so it might very well begin at 75° N. lat.

Supposing now that the southern point of this land is situated at 75° N. lat., the soundings and winds above mentioned show that the

eastern shore near this point must trend northwards. If we go further north, we must confine the land within the limits indicated on the map on account of the observations made by Belcher, and by Nares at his winter quarters. At a meeting of the Royal Geographical Society in London, shortly after the return of the expedition, Nares said: "Whether the sea, on the border of which we remained for eleven months, extends to the Pole, or across the Pole, we cannot be absolutely certain; but by reasoning we may safely predict that a very broad opening exists north of Cape Columbia, and I have reason to believe that it extends as far as the Pole." Greely was of the same opinion.

Now, going back to the southern point of this unknown land, which lies to the north of Wrangel Island, we shall find the course along which the *Jeannette* drifted an excellent guide whereby to determine its south-western limit. This vessel entered the pack in the vicinity of Herald Island, and was soon set fast in the ice, with which she was carried in an undeviating course to the north-west. The first winter the drift was so slow that by next summer she was in the neighbourhood of Wrangel Island. In the middle of the second winter, when the ship was at 73° north latitude, exactly to the south of the supposed point, the drift became very rapid, still tending to the north-west. At this point the vessel was evidently caught by a current, which came from the north along the east coast of the land in question, and swept round its southern point. The general direction, then, of the other coast must be north-westerly, following the direction of the current.

De Long, like Berry, found a depth of about 30 fathoms north of Wrangel Island, but, as he drifted during the third summer to the north-west, he found that the depth increased until it amounted to 80 fathoms to the north of the newly discovered islands northwards from the New Siberian Islands. We have, then, connecting this unknown country with Asia, a subaqueous ridge, the eastern side of which is marked by Wrangel Island, and the western by the New Siberian, Bennett, Jeannette, and Henrietta Islands. This, perhaps, was the route by which the Omokes, who are said to have disappeared to the north, found their way, by crossing from one island to another, to the mysterious country, where startling phenomena may reveal themselves to the inquiring explorers of Europe and America, who will certainly reach it sooner or later.

Let us now proceed westwards to Cape Chelyuskin. To the west of this point the water is shallow, whereas, when I was there in the *Vega*, we found 70 fathoms close to the shore immediately after rounding the point; and Pronchicheff, in 1736, found no bottom at 120 fathoms, further to the east. We must, therefore, conclude that this depression is not connected with the deep water already mentioned along the coast of Novaia Zemlia, but, more probably, with the basin near Henrietta Island.

We know that the *Jeannette* sank, in June 1881, at $77^{\circ} 15'$ north latitude, and 155° east longitude, and that some stores left by the retreating party on the ice were found three years later on the ice off the south-west coast of Greenland. We are well acquainted with the drift along the east coast of Greenland, round Cape Farewell, but how

did this ice reach the east coast? For various reasons, which I will give you presently, I do not believe that it passed between Cape Chelyuskin and Franz Josef Land, and therefore I have marked the strait as you see it on the map. Nares said that the ice near his winter quarters, for some reason he was unable to explain, set in from the north towards the coast, and it seems to me a very natural explanation that a communication exists between the deep basin north of Siberia and the deep basin north of Spitzbergen and Greenland. This is how I have fixed the north-western boundary of the unknown land north of Wrangel Island.

Finally, let us turn our attention to Franz Josef Land. Many circumstances show that it extends eastwards to within a short distance of Cape Chelyuskin. In the first place, Payer mentions the mighty Dove Glacier, on the eastern side of Austria Sound, the front of which extends in a northerly and southerly direction over more than half a degree of latitude. It must have its origin on extensive uplands, which would, most naturally, be sought for in a direction perpendicular to its front, that is, precisely in the direction of Cape Chelyuskin. Secondly, in 1878, a large flock of Brent or Barnacle Geese was seen at Cape Chelyuskin, evidently coming southwards from a country lying to the north. The constant north-east winds observed at the winter quarters of the *Tegetthoff*, and the depths in the northern part of the Kara Sea—by no means the least important indications—point to the existence of a large tract of land in this direction. The belt of deep sea passing between Franz Josef Land and Novaia Zemlia turns, as already stated, southwards along the east coast of the latter island, while further to the east, on the meridian of Lonely Island, no greater depth than 50 fathoms can be found, even as far north as 78° north latitude. In 1664, a Dutch whaler, Vlaming, found that, as he sailed to the north and north-east from Novaia Zemlia, the depth of the water decreased, and, when he had reached a distance of 280 miles from the north-east point of that island, he found a bottom of clay at a depth of 4 to 5 fathoms, so that he supposed himself to be near some unknown land. We may judge his position to have been at about $81\frac{1}{2}^{\circ}$ north latitude, and $79\frac{1}{2}^{\circ}$ east longitude.

We conclude from these facts that Franz Josef Land extends to within a comparatively short distance of Cape Chelyuskin. We should remember that the whole basin between the Yenisei and Novaia Zemlia was probably much deeper originally, but has been silted up by the rivers in the course of ages. Now, it would be very difficult to account for the sudden cessation of this filling up just at Cape Chelyuskin, if a wide sea existed to the north of this promontory, whereas, if it is only a strait with a current running north at its eastern extremity, the silting up will naturally be thus confined. The waters of the Obi and the Yenisei probably escape to the west between Novaia Zemlia and Franz Josef Land, as I have already mentioned, but if there were a broad opening to the north-east of them, it would be their more natural channel, considering the effect of the rotation of the earth.

Lastly, I shall allude to an old Dutch map of 1612, which is to be found in De Vee's book on the voyages of William Barents. It was drawn by Isaac Massa, and published by Hessel Gerard. Here we find

the Yalmal peninsula and White Island marked, and further to the east another, which may be Lonely Island, rediscovered in 1878 by the walrus-hunter Johannessen: to the north of this we find on the map a large country, which cannot be Novaia Zemlia, as this island is shown, quite correctly, more to the west. In several details this map is incorrect—the straits leading into the Kara Sea, for instance; but, for all that, many things which Massa says he heard from the Russians may be correct.

We are now come to the end of our examination of the threshold of the unknown regions, and have sketched roughly the outlines of the two countries which are supposed to be situated there.

If now we inquire by what way we can enter the unknown regions and advance as near as possible to the Pole, we must first, if our theory be correct, reject all former routes. Nordenskiöld's and Parry's experiences on the Spitzbergen route and those of Nares on the west coast of Greenland, render it probable that by these routes a latitude much higher than 84° N. lat. can never be reached. Comparing the experiences of De Long, Berry, and Hooper, with the results attained by Collinson, Maclure, and other discoverers, we must consider that the advantages of the route to the north of Behring Strait are at least very doubtful. There is, certainly, here more than elsewhere, a chance of finding a coast-line running approximately to the north and leading to high latitudes; but, on the other hand, there is but a slight prospect of reaching the southern termination of this shore. Finally, with regard to Franz Josef Land, the fate of the *Tegetthoff* and the *Eira*, as well as the experience of the *William Barents*, have shown us that it is very difficult to reach the western coast of that land, so that the practicability of this route is somewhat doubtful. On the other hand, the plan of reaching Franz Josef Land *via* Cape Chelyuskin is well worth trying, for I have proved beyond doubt that it is possible to enter the Kara Sea, even in so unfavourable a season as that of 1882; and I am quite sure that, had I not fallen in with the *Varna*, I should, as I said before, have been in open water close to the coast of Yalmal by the next day. If, then, Franz Josef Land really lies near this point, we are more likely to reach the base of our operations easily and safely by this route than by any other. When I conceived this plan, in 1882, it was said that in the strait north of Cape Chelyuskin the same currents would be found as between Franz Josef Land and Novaia Zemlia—that is, a current in the southern part running eastwards and another in the northern part running westwards—and that, therefore, the ice would prove as formidable an obstacle here as it was to the *Tegetthoff* north of Novaia Zemlia. This is, indeed, possible, but hardly probable. In the first place, the *Tegetthoff* no doubt drifted chiefly from the action of the wind: then again, even if such currents do exist to the north of Novaia Zemlia, it seems reasonable to expect that currents in the Kara Sea will act as in such inland seas as the Baltic and Kattegat, if there be only a shallow strait to the north of Cape Chelyuskin. Now we know that in the Skagerrack westerly currents flow regularly under the coast of Norway, and easterly currents under the coast of Denmark, and the same phenomenon may occur here, the currents being confined to the deeper parts of the sea.

If there were a current flowing west to the north of Cape Chelyuskin, it would probably be connected with the great current along which the *Jeannette* drifted, and it would, then, be much more perceptible north of Lonely Island and south of Austria Sound than it actually is. The fact seems to be that entirely local currents exist in both places. When the Austrians abandoned the *Tegetthoff*, they drifted for the first two months due north, that is, at right angles to the direction of the supposed current. Leigh Smith also observed that the ice drifted in a direction running north and south. Johannessen mentions a current flowing from the north near Lonely Island, which may with every probability be ascribed to a peculiar conformation of the fiords on the southern coast of Franz Josef Land. If such be the case, this land cannot be far off.

The current, however, with which the *Jeannette* drifted must, in consequence of the rotation of the earth, have a tendency to go eastwards, and, therefore, follow the western shore of the unknown land to the north of Wrangel Island, so that it is after all possible that an easterly current is to be found north of Cape Chelyuskin, and this, owing to the waters of the Obi and Yenisei, must be warm.

If the south-eastern point of Franz Josef Land be once reached, a coast will no doubt be found running approximately northwards, and, following this, the explorer may reach a strait where it will be possible to gain the opposite shore, which, as we have seen, leads to very high latitudes.

I have now arrived at the end of my paper, and have proved, I trust, that the Kara Sea is at present the most interesting part of the Arctic regions, leading as it does not only direct to the shores of Siberia, so important from a commercial point of view, but also to the richest field of scientific research. I tried myself to make use of this pathway in 1882, but it is very doubtful, as I have said, if I shall ever succeed in organising another expedition to these seas. I am quite sure, however, that other explorers will, sooner or later, try this route; and I believe that they will advance further towards the Pole from the Kara Sea than from any other point.

DISCUSSION.

DR. JOHN MURRAY, who presided, stated that he had spent a season in the Arctic Regions about twenty years ago, cruising between Spitzbergen and the ice off the east coast of Greenland, and had also landed at Cloven Cliff, one of the northern points of Greenland. They were frozen in the floe for three weeks in about lat. 76° , and were carried a long way south during that time. He had picked up many pine-trees frozen in the ice-floes, and had also found river detritus on some of the floes. He felt convinced that these trees had been carried over the Pole, having originally been brought into the Arctic Ocean by the Siberian and American rivers. He did not think that there was much land of any kind towards the North Pole. He never saw anything that could be called an iceberg in these northern waters: nothing in any way comparable with the icebergs from Davis Straits or with the huge table-shaped bergs they had seen in the Antarctic Ocean. He believed there

was a rather deep ocean towards the North Pole, and that the ice moved southwards from this ocean every season. In his opinion the proper way to reach the Pole was to follow the course the *Jeannette* had proposed to take. This, with a fair share of good luck, would bring the explorers out into the Atlantic probably in one or two seasons.

PROFESSOR COPELAND begged to point out a circumstance bearing on Captain Hovgaard's views which he did not recollect having seen in any book, viz.: that the vast current of ice, 50 or 100 miles in width, that moves incessantly southward down the east coast of Greenland, is originally composed entirely of sea-ice, and must consequently come from some large area of water to the north. From lat. 73° downwards indeed, large numbers of veritable icebergs of huge dimensions are thrown into the current by the glaciers in the larger fiords, as the second German Arctic Expedition, to which he was attached, had had opportunities of observing in 1870. This total absence of true bergs in the current north of 73° made it improbable that there was any continental extension of Greenland into unexplored regions towards the North Pole. The character and circumstances of the drift of the East Greenland ice were abundantly demonstrated by their unfortunate consort the *Hansa*, which was beset in lat. 74° , at the beginning of September 1869, and whose crew had eventually to seek shelter on a large floe, on which they drifted some 200 days before they succeeded in reaching the land near Cape Farewell, coasting the shores of which they eventually made their way to the settlements on the west coast. Had they but known, they might have remained quietly where they were, for the floe on which they had passed the winter actually rounded Cape Farewell under the action of the current, and proved a perfect godsend to the Eskimos, who found on its surface many articles of great value to them. In conclusion, he hoped that Captain Hovgaard would succeed in organising a Polar expedition, and might have the pleasure of leading it to the North Pole by the promising route from Cape Chelyuskin.

OBITUARY: 1889.

DOULS, CAMILLE.—France in the past year has had, like Germany, to mourn the loss of a young and intrepid African traveller; for Camille Douls, distinguished as the explorer of the Western Sahara, appears to have been treacherously assassinated while making his way across the desert to Timbuktu. M. Douls was born at Bordes in the department of Aveyron in 1864, and received his education at the Lyceum of Rodez, the capital of that department. In 1881 he visited the Antilles and Central America, and four years later, Morocco, where, during a residence of some length, he studied the language, manners, and customs of the Arabs. Here he conceived the bold idea of exploring the hitherto unknown western parts of the Sahara. In prosecution of this design he passed over to the Canary Islands, and there engaged the services of some fishermen to take him over to the desert coast, in the neighbourhood of