WILEY

Journey across the Inland Ice of Greenland from East to West

Author(s): Fridtjof Nansen

Source: *Proceedings of the Royal Geographical Society and Monthly Record of Geography*, New Monthly Series, Vol. 11, No. 8 (Aug., 1889), pp. 469-487

Published by: [Wiley](#) on behalf of [The Royal Geographical Society \(with the Institute of British Geographers\)](#)

Stable URL: <http://www.jstor.org/stable/1801325>

Accessed: 14/06/2014 02:05

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at <http://www.jstor.org/page/info/about/policies/terms.jsp>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.

The Royal Geographical Society (with the Institute of British Geographers) and Wiley are collaborating with JSTOR to digitize, preserve and extend access to Proceedings of the Royal Geographical Society and Monthly Record of Geography.

<http://www.jstor.org>

PROCEEDINGS
OF THE
ROYAL GEOGRAPHICAL SOCIETY
AND MONTHLY RECORD OF GEOGRAPHY.

Journey across the Inland Ice of Greenland from East to West.

By Dr. FRIDTJOF NANSEN.

(Read at the Evening Meeting, June 24th, 1889.)

Map, p. 524.

SINCE Greenland was discovered about nine hundred years ago, the interior of that continent has remained a mystery to Europeans as well as to the Eskimos, and many are the opinions and suggestions which have been put forth as to its real nature. Our forefathers, the old Vikings, who first discovered Greenland, maintained that it was only the land near the coasts which was not ice- and snow-clad, whilst the interior was covered with a sheet of ice so thick that only in some few places could you see the ground underneath. This is, indeed, a fairly correct view, and until quite recently nobody knew more of it than this.

Many attempts have been made to penetrate into this mysterious interior. I shall here only briefly mention a few of them.

The first expedition known of was one undertaken in the middle of last century by a Dane, Paars, who was major in the Danish army, and the first, and last, Governor of Greenland. He was sent by the Danish Government, with an escort of about twenty soldiers, with wives and children, twelve horses, guns, &c., and was ordered to cross Greenland on horseback from the west coast, and when he reached the east coast to build a fortress, found a colony, and take care of the old Norsemen who were thought still to survive. I need not tell you that this expedition only reached the inland ice, and returned filled with horror. Major Paars wrote a very vivid description of the fearful dangers that would be encountered on an expedition on the inland ice. The impossibility of crossing Greenland was at once settled. Notwithstanding this there have been a great many attempts since that time.

Another Scandinavian, Dalager, who also lived in the last century, was more fortunate, and really walked over the ice several miles. Several Norwegians and Danes have also made the attempt this century, but did not succeed. In 1867 two well-known Englishmen, the famous

No. VIII.—Aug. 1889.]

2 I

alpinist, Whymper, and Dr. Robert Brown, also tried to penetrate into the interior, but were unfortunate. They met with very difficult ice, and were obliged to return when some few miles from the coast.

More fortunate were the following expeditions:—that of Baron Nordenskiöld in 1870; the Danes, Captain Jensen, Kornerup, and Groth, 1878; Nordenskiöld again in 1883; and the American Peary with the Dane Maigaard in 1886. These last reached about 100 miles from the coast, and a height of about 7500 feet.

All those attempts were made from the west coast, but from the little-known east coast nobody had tried so far as is known.

How the plan of my expedition across Greenland was ripened in my youthful brain I shall not try to explain here. I got the idea one day in 1882, whilst on board a Norwegian sealing ship; we were ice-bound for twenty-four days near the still unknown part of the east coast of Greenland, and from that time I could not get it out of my mind.

My opinion was that if an expedition was fitted out in a proper way it was not at all an impossibility to cross Greenland, and that the very men for such an expedition would be Norwegian "ski-runners." The Norwegian snowshoes called "ski" are just the thing for traversing snow-fields, and that snow would be found in the interior of Greenland I never doubted. But there was another thing which also in my opinion was of the greatest importance, and that was the place from which to start. If we started from the west coast of Greenland I was quite sure we should not be able to cross, for then we should have the flesh-pots of Egypt behind us, and in front of us would be the ice-desert and the east coast, which is not much better, and when we reached this coast we should have to cross again to the west coast to be rescued. Even if one could keep up his own spirit to this he might not be able to force his men forward when the food began to decrease.

I thought the only certain way was to penetrate the floe-ice and land on the desolate and ice-bound east coast between 65° and 66° N. latitude, and make that the starting-point for the inhabited west coast; in that way we should, as it were, burn all bridges behind us, and it would not be necessary to force the men forward, for they would certainly have no temptation to return, whilst in front of us we should have the west coast inviting us with all the comforts of civilisation. The men had no choice, only forward. Our order was death or the west coast of Greenland. In this way was it accomplished.

When I first put forth my plan to cross Greenland most people said I was either mad or tired of life. Neither was, however, the case, and, notwithstanding all warnings, more than forty men offered to accompany me. I selected three Norwegians, viz. Captain Sverdrup, Lieut. Dietrichsen, and a peasant, Kristian Kristiansen Trana. From Lapland I got two Lapps, Samuel Balto and Ole Ravna, who I hoped would in various respects be of use to us, but I was rather

disappointed; they were good and strong men, but Norwegians would have done just as well, and in dangerous positions they were easily frightened.

I must here acknowledge the liberality of Mr. Gamél, of Copenhagen, who contributed largely to the expenses of the expedition.

In the first days of May last year the expedition started from Christiania, and sailed viâ Scotland and the Faroe Islands to Iceland, where we on the 4th of June embarked on board the Norwegian sealing ship *Jason* for the east coast of Greenland.

The coast of Greenland was not, however, so easily reached as we had expected, the floe-ice occurring in larger quantities than it generally does. For six weeks we had to wander about in the ice between Iceland and Greenland before we could approach the coast near enough to induce us to leave the ship.

It was on the 17th July that we left the ship in the ice near Cape Dan, outside the Sermilik fjord. A salute from the guns of the *Jason* announced to the solemn and silent ice-world that we were burning our last bridge and bidding farewell to civilisation and comfort. From this moment we had to take our own way. It was with strange feelings that we six men parted from our friends on board the ship and steered our two boats into this desolate ice-world, which now was going to be our home for a long time. We had, however, all of us the best hope of succeeding; that dangers and hardships were coming we knew, but we felt sure that we should overcome them.

The first thing we had to do, and a very important thing indeed, was to reach land. But before we could do this, we had to force our way through an ice-pack of about ten or twelve miles' breadth, and this was one of the most difficult parts of the whole journey. I had originally hoped to penetrate the ice in one or two days, but we met quite unexpectedly with a strong and dangerous current which pressed the ice-floes against each other, and we had to take great care that our boats were not crushed; to make it more difficult we got for some time fog and heavy rain. In spite of all this we advanced for about twenty hours rather rapidly towards land. I could see the stones on the shore, and was already quite sure of reaching it within a short time, when we had the misfortune of getting one of our boats crushed during an ice-pressure; it could not float, and we were obliged to take it up on a floe to get it mended. This required several hours, and in the meantime we were swept southwards by the rapid current; the distance from the land grew rapidly, and the speed with which we were swept along was so great that it was in vain to try to struggle against it. We had nothing left but to take leave of the beautiful mountains and the glaciers round the Sermilik fjord, and to look out for another landing-place, or perhaps meet destruction in the floe-ice, with its capricious currents, which soon carried us towards land, but soon again towards the open

sea. To make the position still more awkward, we got heavy rain which wet us through to the skin. We could do nothing better than pitch our tent on the ice-floe and creep into our sleeping bags to take a sleep, which, after twenty hours' constant hard work in the ice, was rather welcome.

I shall not tire you with a description of our drift along the east coast of Greenland; how we dragged our boats over the ice-floes, how we worked hard and tried to force our way towards land, how, in the nights, with those charming Arctic sunsets which call forth in your mind all your most tender feelings and dreams of your childhood, how we could then be seen casting longing looks towards that wild and beautiful coast, from which we were parted only by some few miles of vexing ice.

I will not tire you with a description of how often we hoped to land, how often we were disappointed, and how often we were nearly wrecked in the ice; the worst of it was, that the precious summer-time was passing away, and we were not able to use it; the difficulty of carrying out our plans grew greater every day.

That you may get an idea of what risks one runs in such ice-currents, I will tell you our experiences of one day and night only. One morning we observed that we were being rapidly carried by a strong current towards the open ocean, where a heavy sea was coming from east down upon us; it was in vain to try to drag our boats over the floe-ice against this current; it was inevitable that we must come into the dangerous breakers at the margin of the ice, where it was impossible to stick to the ice. The ice-floes were smashed to pieces all around us; our own floe was broken into several pieces, we had nothing to do but select the strongest ice-floe we could find in the neighbourhood and to prepare with our utmost determination for a hard struggle for life. We got a strong floe, brought all our things and provisions into our two boats, which were standing on the ice-floe, only our tent and two sleeping bags were still left for use on the ice. Towards night all was ready; we were then some thousand yards from the open sea, we could only too distinctly see how the ice-floes were washed over by the heavy breakers so that everything was swept away, how they were broken to pieces and then almost crushed into dust; within a few hours we should be at the outside margin, there would be nothing left but to try to get our boats through the breakers and enter the open sea; but as it was best to face this struggle with as fresh energies as possible, all the men were ordered to sleep except one, who should keep watch and call us when it would no longer be possible for us to maintain our position. While Captain Sverdrup took the first turn, we crept into our sleeping bags, and, as we were tired—all of us—we fell fast asleep within a few minutes. Even the Lapps slept well though they had been dreadfully anxious all the day, and were quite sure they had seen the sun setting

for the last time; one of them, who did not find the tent safe enough, slept in one of our boats, and did not even awake when the breakers very nearly had swept the boat away, so that Sverdrup was obliged to hold it.

After some time I was awakened by hearing the breakers roar just outside the tent; I expected to hear Sverdrup call, or to see the tent swept away, but Sverdrup did not call and the tent stood; I heard the thunder of the breakers for some time, but then I do not remember anything more. I fell asleep again and did not awake until next morning, when I was most astonished to discover that we had again approached land, and were far distant from the open sea.

Sverdrup told me now that our position had been rather awkward for some hours in the night; we had had a large mass of ice on our side, which threatened to crush our floe every moment, and the breakers swept over our floe on all sides, only the spot where the tent was standing was spared. Once he came to the tent door to call us, he unfastened one hook, but then thought he would still look at the next breaker coming; this was worse than the former one, he returned to the tent, unfastened one hook more, but thought it best to wait and watch what the next breaker would be like. He did not unfasten any more hooks. Just at the decisive moment the current turned and we were again carried towards land, away from the dangerous breakers.

On the 29th of July we landed at Anoritik, which is, however, not very far from the south point of Greenland, and is situated in $61\frac{1}{2}^{\circ}$ N. lat., consequently about 250 miles south of the place where we intended to begin our journey across the continent. It was now very late in the season; the best time of the short Greenland summer had passed away, there was but little left. It would have been very easy to reach the Danish settlements on the west coast near Cape Farewell, and northwards the floe ice was pressed tightly against the coast all the way. We had to choose here between certain rescue in the south and the accomplishment of our plans or perhaps death in the north. If I had asked my two Lapps I was sure of the answer, it would have been southwards on any condition; but if I had asked my brave Norwegians I was just as sure that the answer would be "northwards," we must not on account of any risk give up our plans. None of them were, however, asked; arrived inside the ice, the boats were steered northwards without any order, there were no thoughts of giving up our plans yet, there was still left time enough to cross Greenland if we did our best. I shall never forget the sensations that possessed us when we passed the last floe which parted us from land, it was as if we had escaped a long and dreary prison and saw life lying bright and gay before us.

And certainly life was bright, but I will not say we had much comfort, or rather much time to enjoy it; the order of the day was to sleep as little as possible, eat as little and as quickly as possible, and to

work as much as possible. Our food was water, biscuits, and dried meat—for cooking or procuring fresh meat we had no time, though there was game enough. The ice was very difficult, we often had to break our way through it by help of axe and poles. It often looked almost hopeless; it would take us hours to advance some few feet, but we advanced, and that is always better than to go backwards, and I had five brave companions who did not give it up. On the way we met with several encampments of heathen Eskimos living on this desolate coast. We hoped to get some help from them, but they could not advance through the ice so well with their skin boats as we could with our wooden ones, and we were obliged to leave them.

At last, on the 10th of August, we reached a place called Umivik, where I thought it convenient to begin our overland journey. After having examined the glaciers in the neighbourhood and found a good way, and after having made everything ready, we left our two boats on the coast and started on our journey across the unknown interior of Greenland. Our destination was the Danish settlement Christianshaab, at Disco Bay.

We had five sledges; the load on four of them was about 200 lbs. each, and on the fifth about double as much. The last was pulled by Captain Sverdrup and myself, who took the lead, the other four members of the expedition following, each pulling one sledge. Our food consisted principally of dried beef, pemmican, meat-biscuits, dried bread, butter, pâté de foie gras (not the Strasburg luxury), meat-chocolate, common chocolate, tea, &c. Besides provisions, we had on our sledges scientific instruments, guns, Norwegian snowshoes (called *ski*), Canadian snowshoes, alpine axes and walking-sticks, alpine ropes, one tent for all six, and two sleeping bags of reindeer skin; as we slept three men in each bag, they were very warm, and we could stand the very low temperatures experienced, sleeping directly on the snow.

Notwithstanding the very steep slopes we had to climb, and the many crevasses, &c., we advanced rather rapidly for two days, then we were stopped by a storm from the north, with heavy rain, and we had to stay in our tent lying down in our sleeping bag for three days, while the ice melted rapidly under us, and the rain poured down above.

At first the snow was very uneven, but hard and good for sledge-pulling. There were plenty of dangerous crevasses, so that we had to be vigilant; no accidents happened, however; occasionally some one fell up to the arms through the snow-bridges by which we had to pass over the large crevasses, but by help of the alpine axes a deeper fall was prevented.

At some distance from the coast the snow became, however, very soft, and bad for pulling, and our difficulties went on increasing, the snow became looser, and the pulling was very hard work, even if we had not had a continuous snowstorm blowing against us. I hoped that it would soon become better, but each day it became worse. It was only too clear

that if it continued in this way we should not be able to reach Disco Bay till the middle of September, when the last ship would be leaving for Europe. We should thus have no hope of returning home this year (1888) if we continued our way to Christianshaab. We should probably have a better chance of reaching a ship at Godthaab, situated further to the south, on the west coast; and as I thought this direction to be of more scientific interest, I changed our route and turned towards Godthaab, though I expected to find more troublesome ice in this direction, and though it would be much more difficult to reach the Danish settlements for rescue after leaving the inland ice. That was on the 27th of August. We had then reached about $64^{\circ} 50'$ N., about 40 miles from the coast, and a height of about 7000 feet. By this change of direction the wind became so favourable that we could use sails on the sledges, and thus they became less heavy to pull. In this manner we advanced during three days, then the wind went down, and we were obliged to lower our sails.

In the beginning of September we reached a quite flat and extensive plateau, which resembled a frozen ocean. Its height was between 8000 and 9000 feet, though towards the north it seemed to be considerably higher. Over this plateau or highland we travelled more than two weeks. The cold was considerable. I am not, however, able to give an exact statement of the temperature, as our thermometers did not go low enough. I believe that on some nights it was between -45° and -50° Centigrade (between 80° and 90° below freezing-point, Fahrenheit). In the tent where we (six men) slept, and where we cooked our tea and chocolate, it was even less than -40° Centigrade (72° of frost, Fahrenheit). During one month we found no water. To get drinking water we were obliged to melt snow either in our cooking apparatus or by our own warmth in iron bottles, which were carried inside our clothes on our bosoms. The sunshine on these white snow-fields was bad for the eyes, but no case of snow-blindness occurred.

To give a description of the scenery during the day in this region is easy. We saw only three things: that was snow, sun, and ourselves. One day was quite like another. But still even this part of the earth has its beauties, and I shall never forget the glorious sunsets and the nights on the snow- and ice-fields of Greenland, when the ever changing northern lights were scintillating perhaps brighter than anywhere else. I shall never forget the strange impressions, as from another world, we got in this solemn, silent nature, as we saw the lights spreading like a terrible fire over the whole sky, then gathering again in the zenith, as if swept together by a storm, always flitting, burning, and scintillating, and then at once disappearing, leaving the monotonous snow-fields in darkness as they were before.

Another more soothing and peaceful impression came upon us when the moon appeared and made its silvery way over the limitless snow-

fields over which the stars were sparkling with a brightness unknown in other latitudes; indeed I am certain that none of us will ever forget our night wanderings over the snow-fields of Greenland.

The landscape was not always, however, so peaceful as here described, sometimes we met snowstorms, and we often saw nothing but drifting snow. One day, the 8th of September, we were even obliged to remain in our tent, whilst it was nearly torn to pieces by the storm; the next day, when we wanted to continue our journey, we found that the tent was almost quite buried in the snow. We had to dig ourselves out and hunt for our sledges, which had quite disappeared; this, however, was very often the case in the mornings.

As to our daily life in these not very hospitable surroundings, with a temperature of 70° to 90° below the freezing-point Fahr., I shall not tire you with a particular description of that. I shall only say that we stood it pretty well.

The worst thing was to turn out in the morning. It sometimes happened that I found my head in the sleeping bag surrounded by a crust of ice and rime caused by the freezing of the breath. To turn out an hour before the others to cook, and be obliged to touch iron articles and get spirits of wine on your fingers, was not very agreeable. I had this pleasant work every morning, as the others, when they tried it, generally used too much fuel, and we had to be careful in that respect, as we should not be able to get any water without fuel.

As to cleanliness, we could not afford to indulge much in that luxury. I am afraid you may consider me a thorough barbarian when I tell you that we did not wash ourselves from the time we left the ship *Jason* until we reached the west coast, that is during two months and a half, and in the same time we were never out of our clothes. That we did not wash had, however, its peculiar reasons: on one hand we had no water; but, on the other hand, even when we had it, washing was strictly forbidden, as the washing of the face is very bad on snow-fields, where the sun is constantly shining, the skin is easily blistered, and the sun can cause you dreadful pains.

Our cooking was not always of the tidiest character, we had no water to wash our cooking vessel, and when we had cooked pea-soup in the night, we had to cook tea or chocolate in the same vessel next morning, with the remains of pea-soup in it. It was, however, rather good, as we could not afford to throw away anything belonging to food, neither were we very particular about what we got to eat. I remember one night our cooking apparatus was upset, and all our precious pea-soup was poured out over the canvas floor of our tent, but we did not hesitate; we immediately took hold of each side of the floor, lifted it up, and sucked the pea-soup out of the middle. No drop was lost. We were compelled, in fact, to live like natives. Mashers, I fear, would not succeed in the interior of Greenland.

On the 19th of September we got a favourable sailing wind, so that we could use sails on our sledges. We had only to stand on our *ski* and hold on to our sledges, while we rattled down the slope towards the west coast, sometimes with a quite astonishing speed. Certainly that was the most delightful ski race I ever had in my life.

Towards night, when it was getting dark, and when we just went on with a good speed, I observed a dark spot in front of us. I did not understand what it was, and let it go ahead. At a distance of some few steps I discovered, however, that it was a broad crevasse; the sledges were immediately turned just at the right moment, we were already on the margin of the crevasse, a second longer and the three first of us with two sledges would have disappeared, and none would have heard of us any more.

We had to be more vigilant after this. The night came, but we would use the favourable wind as long as possible, and as we got moonlight we could sail on for a very long time. I went in front examining the ice, and the sledges came sailing afterwards. We had to pass many crevasses, but no accidents happened. Once, however, a snow-bridge over a very deep and broad crevasse fell down just when we had passed, and had very nearly taken with it two men and two sledges. In the middle of the night we were at last stopped by ice so filled with crevasses that we could not advance any longer, and we had to pitch our tent and go to sleep. We were now very near the coast, but met with ice so difficult and uneven and filled in all directions with immense crevasses, so that we could advance only very slowly. At last, on the 24th of September, we reached land at a small lake to the south of Kangarsunek, a fjord where a large glacier issues.

On the 26th of September we reached the sea at the inner end of the Ameralikfjord, in $64^{\circ} 12'$ N. lat. I shall never forget what a pleasure and enjoyment it was to get water again, so that we could drink as we liked—no wine could have tasted better, and what a comfort it was to have any quantity of fuel—willow and heather—so that we could make an open fire in the night and cook as much as we liked.

We had now reached our destination—the west coast of Greenland. The distance we had passed over the inland ice was about 260 miles. The interior of Greenland was explored at all events in one direction, in spite of the general opinion that it was impossible to accomplish it. We had now only one thing left, and that was to get into communication with other human beings. This it was desirable to do as soon as possible, as we had not very much food left—we had plenty of dried beef, but we suffered from want of fat; but Godthaab, the nearest place where people lived, was still a distance of 50 miles away. As I saw that it would be no easy task to reach this place by land, the mountains being too difficult to pass, I thought it better to go by sea,

and determined to construct a boat. The next day three of us made the boat out of the canvas which formed the tent floor, of the bamboo rods used on the sledges, and willow boughs found near the shore. Towards night our boat was ready.

Next day, September 28th, Captain Sverdrup and I started with this boat for Godthaab. The first portion of the way we had to carry it, as the fjord is filled with glacier mud. This was a rather heavy task, as we often sank into the mud to the knees. Next day we reached open water and went out of the Ameralik-fjord. During some days we got contrary wind, and the boat was very heavy to pull against wind and sea, it being too broad as well as short. On the 3rd of October we reached Godthaab and were heartily welcomed by the population. Two boats were sent to bring the other four members of the expedition to Godthaab. Being stopped by a heavy storm, these boats were, however, obliged to wait for several days. At last, on the 12th of October, they arrived, and all our party were gathered in Godthaab. The expedition was finished, and Greenland was crossed for the first time.

My hope to find a ship for Europe in Godthaab was disappointed. I, however, learned that at Ivigtut, about 240 miles south of Godthaab, there was still a ship, the *Fox*, which in the middle of October was to leave for Denmark. I sent immediately a messenger (an Eskimo in his small skin-boat or kajak) to the *Fox* to ask the captain to come and take us home. As the season was very late and as the captain of the *Fox* did not know how much ice there was towards Godthaab, he dared not come, and we were obliged to spend the winter in Greenland. Strange to say, this ship, the *Fox*, which brought the message to Europe that we were safely arrived at the west coast of Greenland, is the same ship which Sir Leopold M'Clintock commanded on his famous expedition in search of Franklin.

To spend a winter in Greenland was not very disagreeable to us. We had a pleasant time of it; there was plenty of shooting, sea birds, ptarmigans, and reindeer; there was snow enough to enable us to use our *skis*. But the most fascinating of all was the life in the kajak, or small Eskimo skin-boat, only capable of holding one man, which certainly has not its equal, and is the best one-man vessel in the world. It is propelled by a paddle, and when you have learnt to manage it properly, you may go against the heaviest stern. If you are capsized by a sea and can manage your oar, you can rise again and need not be afraid of anything. A good Eskimo can, in his kajak, go even 80 miles in one day.

For one who cannot manage his kajak easily it is rather a dangerous sport, and many Eskimos die in the kajak every year; in Godthaab and neighbourhood six died this winter, but that is one of the reasons, perhaps, why kajak sailing is so fascinating.

On the 15th of April this year the Danish steamship *Hvidbjørnen*

came to bring us home, and we left Greenland almost sorry to part with its happy people, these children of nature, who have no experience of the miseries of civilisation, and who do not know real poverty. Sometimes they are in want, but generally they have plenty of food and are always happy and content.

The voyage homewards was as pleasant as possible.

The scientific results of the expedition cannot at present be stated, the many observations not having been worked out by the special *savants* to whom they have been submitted. There are, however, some points which, especially in geological and meteorological respects, even at present are prominent; and though I am no geologist and no meteorologist, I shall mention some of those which according to my view are of much interest.

At first I think the shape of the inland ice is of importance.

Many geologists have suggested that the interior of Greenland is ice- and snow-clad, but there have been others who were of the opinion that it was not snow-clad. Amongst the latter I will here especially mention the famous Nordenskiöld.

This prominent explorer of Arctic regions, who has seen more of ice- and snow-fields than most people, held the opinion that we are not entitled to conclude that the ice-covering extends throughout Greenland from coast to coast, notwithstanding that nobody had seen the boundaries of the "ice-desert." He even believed "that it in most cases is a physical impossibility, that the interior of a large continent should be completely covered with ice under the climatic circumstances which occur on our planet south of 80° latitude." As to the interior of Greenland, he says that it is even easy to prove that the conditions for the forming of glaciers cannot occur there if the surface of the land does not gradually and regularly rise from the east coast as well as from the west coast towards the centre. But such a shape has in Nordenskiöld's opinion no continent, orographically known, on our earth. Greenland he supposes to have an orographical construction very much like Scandinavia, that is, it consists of mountain ranges and peaks separated by deep valleys and plains, and in such a country most of the rain and snow must fall in the neighbourhood of the coasts, whilst only dry and warm winds reach the interior, so that there cannot be moisture enough to form a glacier here.

I will not here criticise Nordenskiöld's theories. The expedition from which I have just returned has, in my opinion, fully proved that they cannot be right as far as concerns Greenland. It has, I believe settled the fact that this part of Greenland is not only ice- and snow-clad, but has a mighty shield-shaped covering of snow and ice, under which mountains as well as valleys have quite disappeared, and where you cannot even trace the configuration of the land and mountains. Whether this is also the case in the most northern parts of

Greenland I dare not yet say; this must be decided by a new expedition, and I think the question to be of the highest interest. At present we will only consider the southern parts of Greenland.

The ice-covering has here, as already mentioned, the shape of a shield. Rather rapidly, but regularly, it rises from the east coast, reaches a height of 9000 to 10,000 feet, is rather flat and even in the middle, and falls again regularly towards the west coast. Considering this peculiar and regular shape of the ice, the first question which must force itself upon us is, What has occasioned this regular shape? what is the configuration of the land underneath?

I have heard geologists say that, judging from what has been observed by us, it is clear that Greenland is a tableland, the exterior parts of which are only excavated by the glaciers, so that fjords and valleys are formed, whilst the interior evidently has the shape of a high plateau, where no considerable valleys or mountains can be present, here being no glaciers to excavate the ground. But I think this conclusion is entirely false. I think that the shape of the surface of the inland ice is not at all caused by the configuration of the land underneath.

Nordenskiöld is certainly right when he says that the configuration of Greenland is very like that of Scandinavia, and especially that of Norway, and let us also say that of Scotland.

In the interior of Greenland there must be mountains and valleys, as well as near the coast. That there are on the coasts deep fjords and lofty mountains very like those of western Norway, and that they have just the same wild and prominent character in some places, we already know; they are perhaps even wilder than I ever saw them in my own country.

If we entertain the opinion that these fjords are excavated by the ice, we must also conclude that the same ice has been able to excavate valleys and form mountains in the interior of the continent; to this subject I shall, however, return a little later. At present I will only state that we have no right to seek the reason of the shield-like shape of the ice in the configuration of the land underneath; the surface of the ice must have a shape of its own, which is given not by the land but by the meteorological circumstances. Nobody can deny that the ice must in some places have a quite enormous thickness, as it fills the valleys and covers up all the mountains, and its thickness must evidently be regulated by the quantity of snow falling. This quantity must be largest towards the coasts, gradually diminishing towards the interior, it is consequently very likely that the ice has not its greatest thickness just in the middle of the continent, but rather on both sides towards the coasts. We might thus already *a priori* have expected to find a shape of the ice just like that observed.

I have already mentioned that the surface of the snow-field in the interior is quite even and as it were polished. It has a striking

resemblance to the undisturbed surface of a frozen ocean, the long but not high billows of which rolling from east to west are not easily distinguishable to the eye.

The principal factor which makes this surface so remarkably even is the wind. The levelling influence of the wind may easily be studied in our own mountains in the winter; there it may be seen how its prevailing effect is to remove every prominence, the snow being carried from the mountains into the valleys to fill them and make the mountains disappear.

This has of course also been the case in Greenland, only to a much higher degree, when its present glacial period commenced. The snow grew annually, gradually the valleys were filled up, the mountains disappeared, and the snow-field was produced which we now see. The work of the wind now is to level and polish the surface of this vast field and make it as smooth as the surface of a lake in quiet weather, where you find no spot to fix the eye upon or where you can let it rest; where you have to use your compass just like you do at sea.

The surface of the snow-field in the interior consists of soft, loose and dry snow, which is easily moved by the wind. Even in midsummer there is no snow-melting of importance in this interior. Even with the six feet long sticks we use for *ski*-running, I could not reach hard ice or snow underneath the soft layer. At intervals of six to ten inches quite thin ice-crusts occurred, between them there was, however, soft snow like that of the surface. These thin ice-crusts are evidently formed by the direct influence of the sun during midsummer. The sun is then in the middle of the day able to bring the surface of the snow to melt a little; in the night, however, it freezes again. Whether these ice-crusts at certain intervals indicated annual layers of snow, or whether they only indicated heavy snowfalls during the summer, I am not able to decide; I am, however, inclined to be of the latter opinion, at all events to some extent.

I previously mentioned that we had snowfall almost every day; when we compare this with the just stated fact that there is no real snow-melting in the interior, it would seem as if we were obliged to conclude that the quantity of snow is still increasing in the interior of Greenland. This cannot, however, easily be the case, at all events, not in any considerable degree, for if it was so, the quantity of ice and snow must also increase towards the coasts.

Judging from the observations and measurements which during several years are made on the west coast of Greenland, it seems, however, as if the ice varies a little from one year to another, but that upon the whole its quantity keeps very nearly on the same level. We are not thus entitled to assume that the quantity of snow is increasing in the interior.

But what is the reason why it does not increase?

As already mentioned, the snow-melting cannot be of any importance. The evaporation from the snow-surface cannot, in my opinion, be of much more importance, as it must be quite a trifle with such a low temperature of the air, and where on most days a little snow falls.

A factor of more importance is, I think, the snowdrifts occasioned by the wind, which most likely has a tendency to blow from the cold and high interior towards the lower and warmer coasts. In the middle of the continent the winds blow, however, in all possible directions, and thus I think even this factor is of no great importance. The principal factor to keep the level must in my opinion be the pressure which is produced within this immense layer of ice and snow. On one hand this pressure forces the ice downwards along the sloping sides of the mountains, through the valleys and towards the sea, into which it falls in form of ice-streams or glaciers, and is carried away in form of icebergs or is melted.

To a great many people it does not seem necessary that the ice must force its way to the coast in this manner, but I think that if we said that the interior of Greenland was filled or covered by an immense layer of pitch nobody would doubt that this would find its way to the sea; but there is really in that respect no great difference between these two materials; by the immense pressure the ice is probably made even more fluid than melting pitch.

But the pressure brings the ice to the sea not only in the form of ice, but also, and certainly in larger quantity, in the form of water. As is generally known, ice has the peculiarity that by pressure it can be transformed into water at temperatures lower than its common melting-point—in other words, pressure lowers the melting-point of the ice. I do not think, however, that it is principally in this manner the pressure contributes to the melting of the snow, as such a high pressure and consequently a very considerable quantity of snow and ice is necessary to lower the melting-point of the ice only one degree. I think that the most important factor is the warmth produced by the pressure and friction. When such immense quantities of ice and snow as those in Greenland are in constant movement, it is evident that the pressure must give rise to a quite enormous friction, and in this way a considerable warmth must be produced. There is thus much reason to conclude that the deeper we come in the ice the higher temperature we will find, and at a certain depth the temperature of the ice must be about its melting-point, which consequently is somewhat lower than the ordinary freezing-point (i. e. zero of Centigrade).

Even if we do not think of the fact that the temperature of the earth's crust rises everywhere when we penetrate towards the depth, it seems thus to be likely that in the depths of the inland ice of Greenland, especially where the ice touches the ground underneath, there is a considerable melting going on. It may be objected that nobody has

observed this melting or even a rising of the temperature of the ice downwards. This is quite true, but a good proof that a melting really goes on in the interior are the rivers, which, even in the middle of the cold Greenland winter, run out under the glaciers at the margin of the inland ice. I have observed such rivers myself; they were even large where there was no possibility of a melting on the surface of the inland ice.

For glacialists I think the observations made on this expedition must be of great interest. I think they must contribute largely to confirm many of the glacial theories.

The careful observation of a snow and ice covering like that of Greenland is, in my opinion, of great importance for the theory of the formation of valleys and fjords by the ice. The ability to excavate the ground underneath must be considerable in quantities of ice like those observed there. To me it seems indeed natural that the more we study Greenland, its coasts, and its inland ice, the more convinced must we feel of the great ability of the ice to form fjords and valleys to a great extent. Indeed, if we attentively study on one hand the fjords and valleys of Greenland, with their many evidences of glacial influence, and on the other hand the inland ice, we can be in no doubt whatever that these are in a near relation to each other; and if we from Greenland turn our eyes to Norway and Scotland, we must grant that there are here quite similar formations.

In meteorological respects there are some observations of great interest. The very low temperature met with in the interior will be astonishing to most meteorologists; it does not seem to agree with the received meteorological laws, at all events not at the first glance. The radiation of warmth from this immense snow-field, in such an altitude where the air is consequently very thin, must evidently have a great influence in lowering the temperature. The interior of Greenland must indeed be the coldest place on earth hitherto known; it must be a kind of cold pole from which the winds blow towards the coasts and the sea.

I think that this low temperature may throw a good deal of light on the much discussed question, the cause of the great cold of the Glacial Period in Europe and North America, which at that time were covered with an ice-sheet similar to that we now see in Greenland. I think that the best way of solving the problems of the great Ice Age is to go and examine the places where similar conditions are now found, and no better place can be found than Greenland. But Greenland is a vast region; our expedition was the first to cross it, but I hope it will not be the last.

The following discussion ensued on the reading of the foregoing paper:—

Sir LEOPOLD MCCLINTOCK expressed his admiration of the feat which Dr. Nansen had performed. For a very long time he (Sir Leopold) had devoted much attention to the improvement of sledge equipments. In exploring a new country, of course, a

baggage wagon was a most important article, and in Arctic regions the sledge was the baggage wagon. It should be strong but light, because the baggage animals were the men. Sledges might be divided into two classes—the flat sledge and the runner sledge. The flat one was an extremely thin plank, 12 feet long, turned up at the fore-end. Where the snow was very soft and deep no other could be used. In the runner sledge the platform, on which the baggage was secured, was raised a few inches on runners or skates. These runner sledges were used in the English Arctic expeditions, and with them about 40,000 miles had been travelled in the search for the Franklin Expedition. In Greenland the runner sledge was used almost exclusively. Where the depth of snow was not great the runners cut down through it on to the ice. The sledge Dr. Nansen had used was a combination of the two kinds. It was, strictly speaking, a runner sledge, but the runners were simply enlarged Norwegian snowshoes, and were admirably adapted to the nature of the surface travelled over by his expedition. Next in point of importance to the sledge were the Norwegian snowshoes, 8 feet long and 3½ inches wide. In the Franklin searching expeditions they were not unknown, but the circumstances were not favourable for their use; the snow was seldom deep enough or smooth enough. On one occasion he thought the time had arrived when he might achieve a triumph. There had been a fall of snow, and a beautiful little white fox came near; so he started off in snowshoes to catch him, but after a few miles he was convinced there was no chance of doing so, as he was not a born Norwegian and familiar in the use of them. Dr. Nansen had given them a graphic description of his ice navigation; but he dwelt sufficiently upon the remarkably low temperature, and had barely mentioned the intense snow-glare. For six or seven weeks not a speck of black was to be seen anywhere. Nothing could be more trying to the eyes. Of course they wore smoke-coloured glasses and veils, and Dr. Nansen found, contrary to English experience, that red veils were more efficacious than blue or green ones. None but those trained to snowshoes could have performed such a feat as Dr. Nansen had done, for he found the snow to be uniformly soft and deep. After crossing Greenland Dr. Nansen had to construct a boat, without any other means than his own equipment afforded; out of his sledges he formed a framework and covered it with the canvas of his tent, and in this frail structure this worthy descendant of the hardy Norsemen sailed some fifty miles; this is a most remarkable instance of resource and power of adaptation in overcoming difficulty. Every one could appreciate his heroic determination at the outset, to leave himself no retreat. Other leaders who had burned their boats behind them had an inhabitable country before them; but Dr. Nansen had only a glacier before him and he depended solely on what he carried on the sledges. He started with sixty days' provisions, and he was between seventy and eighty days in crossing the glacier. Greenland was 1400 miles in length, and therefore crossing it only in one place did not satisfy the requirements of science; its eastern coast was almost unknown, it was even uncertain whether any human beings existed there; in the year 1826 a few Esquimaux were met with by an English expedition, but none have been seen by any subsequent visitors. He hoped that on a future occasion Dr. Nansen would not be unwilling to pay another visit to Greenland, and if he did, he would be sure of receiving a hearty welcome from this Society, on his return.

Sir ALLEN YOUNG indorsed Sir Leopold M'Clintock's opinion as to Dr. Nansen's wonderful performance. In 1860 he commanded the *Fox*, the very ship that Dr. Nansen had mentioned, on an expedition intended to survey a route by way of the Faroe Islands, Iceland, and Greenland to Labrador. He was accompanied by Dr. Rae, who crossed the Faroe Islands and Iceland, and surveyed the routes for the telegraph. On September 12th, after passing through 100 miles of ice, they arrived at the coast of

Greenland, about 63° N. The sight of the coast was simply appalling, with precipitous peaks and cliffs, and glaciers running down to the sea. He was about one mile off the land, and could have landed a party; but feeling that he could not keep his ship in her position, he thought it better to report in favour of carrying a cable round the south into one of the western fiords. Afterwards, on the western inland ice, he accompanied Dr. Rae for two days, but heavy snow intervened, and he had great difficulty in getting back to his ship. That was in the middle of November. He wished to ask Dr. Nansen if he thought it would be possible to land a telegraph cable on the east coast and carry it across to the west coast.

Dr. RAE begged to express his admiration, and to re-echo the words of previous speakers, at the manner in which Dr. Nansen had carried out the arduous work he had undertaken in the crossing over Greenland, although, owing to unforeseen detention, the crossing was not made in a locality so far north, or at so wide a part as he had hoped to do. But he evidently, and for obvious good reasons, started from the right side (the east). Dr. Nansen's sledges were evidently superior in many ways to those used by the great English Government Arctic expeditions, the runners of the former being proportionally much broader, and therefore having a much greater bearing-up power, in proportion to the lading, than the latter, which the sailors (who hauled them) said buried themselves in the deep, soft snow lying between the ice hummocks, giving immense trouble and labour in extricating them; whereas the flat sledges in the form of the Indian "toboggan," with runners five-eighths of an inch deep, used by his (Dr. Rae's) parties, could not sink in the snow, and when having run down one hummock, it by its own impetus went half-way up the next. With these sledges, heavily laden, each man hauling one, some journeys of over 1000 miles were performed at a daily rate of 20 miles; and that of 1851, aided by three half-starved dogs, at the rate of 25 miles, the leader of the party hauling a sledge lightly loaded with 60 lbs. Regarding the *Fox* Telegraph Expedition, of which Sir Allen Young spoke, and of the overland part of the work, of which he (Dr. Rae) had been placed in charge by Colonel Schaffner, the crossing of Greenland, although it was talked of, there was not the slightest intention of its being attempted, not the smallest preparation of any kind having been made for such an arduous piece of work; and if there had been any such preparation, the lateness of the season (November) would have been a fatal hindrance. All that was desired or expected to be done was accomplished by getting a few miles inland on the glacier, and by reaching a deep and wide crevasse that effectually stopped further progress; and showing that to bring a telegraph wire across the ice would be very difficult, if not impracticable, and in his (Dr. Rae's) opinion useless. Moreover, by some curious mistake, the provisions for the four Eskimo women that formed the crew of the boat (only one sailor could be obtained from the *Fox*) had not been put on board, so that during the detention of the party by a severe and long snowstorm, they would have been on very short commons, but for there being a good many ptarmigan, of which a number were shot by the leader of the party, owing to which he acquired the character of being a very expert sportsman indeed, because the crew saw these fine birds shot down two or three at a time (pot-hunting with limited ammunition) with a double-barrel and small shot, whilst the Eskimo hunter had to use a very inferior rifle and single ball for the same purpose. The party, as soon as travelling was possible, went to an Eskimo's house (built of wood) at the north side of the fjord, where they stayed until the ice became strong enough to be walked upon, and men with a boat were sent from the *Fox* to assist them. From this Eskimo a very fine sheep was bought, which produced as excellent mutton as could have been got in London, and full rations were served out to all. On arriving at Julianshaab a ball took place, at which Dr. Rae was courteously

No. VIII.—Aug. 1889.]

2 K

invited to dance a polka with each of his dusky but blithe boat's crew, and the little lasses performed extremely well.

Admiral Sir E. OMMANNEY hailed with joy the presence of Dr. Nansen at this Society, the first man that ever crossed the continent of Greenland from sea to sea. In traversing the White Continent he had performed as glorious a feat as the man who had walked across the dark continent of Africa. He did not know which to admire most, the courage which Dr. Nansen had shown when cast adrift with his party on the loose floes of ice, drifting about at the mercy of the currents and winds, in hourly peril of destruction, or the fortitude which he exhibited during his remarkable march across the elevated icy plateau of Greenland. Of naval Arctic explorers, he (Sir Erasmus) had now become a veteran, for he had served under Captain James Ross, in 1836, on an expedition to Baffin's Bay, and had landed at several points on the West Coast of Greenland. He then wondered whether it could be possible for any human being to traverse the interior ice of that glacial country, and he was happy in having lived to see the man who had accomplished the feat, which must stand on record as one of the grandest achievements in the history of Arctic travel and discovery. The mode of travelling and sufferings experienced by Dr. Nansen were in some degree similar to what were encountered on the sledge journeys during the search after Franklin's ships. The audience would therefore form some idea of the noble work which our gallant seamen performed in sledging over many thousand miles of ice in pursuit of that ill-fated expedition. It was important to point out an exceptional feature in this very remarkable journey as compared with previous Arctic explorations. Dr. Nansen's track lay far south of the Arctic circle, and he travelled late in the season, consequently he had to contend with the inconvenience of some darkness during the twenty-four hours, and suffered an intensity of cold quite unprecedented; whereas the English sledge journeys had to be performed in a far higher latitude under continuous daylight, having the sun always above the horizon. In congratulating Dr. Nansen on his great success, he (Sir Erasmus) would desire to see him attempt the exploration of the Antarctic regions, where a far more glorious field for research was open to his power and skill than he could find in the Arctic.

Dr. NANSEN heartily thanked the speakers for the flattering words which they had used with regard to him. He thought it quite impossible to carry a telegraphic cable across Greenland and keep it there, on account of the movement of the glaciers. No place would be found in which to fix the poles, and it could never be certain that the cable would not be broken. He agreed with Sir Allen Young that it was better to carry the cable along the coast to Cape Farewell, and then across to Labrador.

The PRESIDENT tendered in the name of the Society their most cordial thanks to Dr. Nansen for the very interesting paper with which he had favoured them. It was the record of a most extraordinary achievement, boldly planned, resolutely undertaken, and most skilfully carried into effect. At the age of twenty-seven to have taken a foremost place amongst northern travellers, was to have done enough for fame, but he was sure that Dr. Nansen's energy would be stimulated by what he had already done, and the reception which he had met with that night would only be the first of many recognitions of good work done. It was in the fitness of things that this most interesting expedition should have been carried out by the subjects of that accomplished and able monarch, who so wisely and well governed the two northern Scandinavian countries, and by the presence of whose much respected representative the present meeting was honoured. But he was convinced that it must have been very agreeable to Dr. Nansen that Denmark shared in the honour. A well-known and public-spirited Danish merchant, Mr. Gamel, found the principal part of the funds

that were required for the expedition. If he were not misinformed, Dr. Nansen, although a Norwegian, had Danish blood, and in his remarkable enterprise he was only emulating in peace the spirit which had been manifested by his kindred in war. One of Dr. Nansen's Danish connections was a hero of Danish naval story. A hundred and eighty years ago the relations between Sweden and Denmark were not altogether so pleasant as they now were, and in the year 1709 a sea-fight took place between them, in the course of which the vessel commanded by a connection of Dr. Nansen, Captain Hvitfeldt, took fire. She was to windward of the Danish fleet, and he saw that there was imminent danger that she might be driven against the other vessels. He took his resolution, and calmly blew up his vessel, thereby sacrificing himself, but saving his friends. Not a little of Captain Hvitfeldt's energy and self-sacrifice seemed to have passed into the veins of his descendant. In conclusion, he wished all prosperity to Dr. Nansen, and to all who took part in the expedition.

Dr. NANSEN returned his most cordial thanks for the words which the President had spoken, and for the welcome which he had received from the Society.

The Local Distribution of the Tribes inhabiting the Mountains of North-west Morocco.

By WALTER B. HARRIS.

Map, p. 524.

So little is known of the fanatical tribes of the north-west mountains of Morocco, that a few facts I was able to gather during a visit to their country in March and April of this year (1889) may not prove useless.

I had returned from Fez by the "upper" road to Wazan, but was unable to stay more than two days there, owing to some of our party—having been detained by the rainfall of early February—being pressed for time. However, short as was my visit then, it enabled me to renew my acquaintance with H.H. Mulai Mohammed—Sherif of Wazan—who pressed me very much to return on a visit to him as soon as I was able after my arrival in Tangier. Ten days after arriving there I set out once more "up country," accompanied by only three Moors, one the Selim who led me to Sheshuan last year, the other two men I knew well and could trust.

Much rain fell during my journey, and I did not reach Wazan till six days after my departure, in spite of rather stiff travelling. I was cordially received by H.H. as usual, and given a house to live in and all my wants supplied during my whole stay of one day less than a fortnight.

My journey to Sheshuan last year had immensely interested me in this portion of Morocco, and its inhabitants. So I determined to take advantage of my stay at Wazan in finding out as much as I possibly could about the tribes situated to the east of that town, and inhabiting a district stretching from Tetuan on the north to Fez on the south.

2 K 2