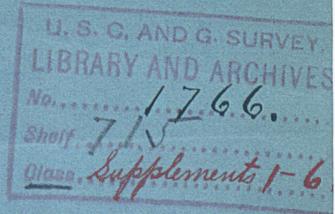


81



FOURTH SUPPLEMENT

TO THE

PAPERS ON THE EASTERN AND NORTHERN EXTENSION

OF

THE GULF STREAM.

PUBLISHED BY

THE UNITED STATES HYDROGRAPHIC OFFICE,

WASHINGTON, D. C.

NOVEMBER, 1873.

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[From Dr. Petermann's "Geographische Mittheilungen," vol. for 1873, p. 337 et seq.]

THE FIFTH SWEDISH NORTH-POLE EXPEDITION, UNDER PROFESSOR NORDENSKIÖLD, 1872-'73.*

The purposes of this expedition, its outfit and progress in the first three months, have been briefly stated in the "Third Supplement to the Papers on the Northern and Eastern Extension of the Gulf Stream," p. 54. After the autumn of 1872 no tidings came of it for nearly nine months, and fears began to be entertained for its safety, when, on July 5, the supply-steamer *Uncle Adam* arrived at Tromsø, bringing quite cheerful accounts of the health of the members of the expedition, but not so satisfactory as to its success, and dreadful regarding the fate of the crews of the Norwegian fishing-vessels which were blockaded in Spitzbergen by the ice of the last winter. A few days after her the brig *Gladan* also arrived at the same place with official reports of the commanders of the two vessels of the expedition, Captain Palander of the steamer *Polhem*, and Captain Krusenstierna of the *Gladan*, as also with letters of the head of the scientific department, Professor Nordenskiöld, to Mr. Oscar Dickson, of Göteborg, the principal promoter of the expedition. Their contents were immediately published, and are as follows:

All attempts to reach Parry Island, (north of Spitzbergen, in latitude $80^{\circ} 40' N.$), where it was originally intended to pass the winter, having failed, Mossel or Half-Moon Bay, in latitude $79^{\circ} 50' N.$, was selected instead, and was reached by the three vessels, the *Uncle Adam* included, on September 3; but on the 6th, before the two vessels, which were to return home, could depart, the bay was blockaded by drift-ice, so that, instead of twenty-one men, for which number, only, sufficient provisions for the winter had been laid in, sixty-seven depended upon them; and the prospects became still more gloomy when the reindeer brought from Norway for the sleigh-expedition, which was to start in the spring for the North, broke away through the negligence of the Laplanders to whom the care of them was intrusted.

Nevertheless there was no despondence; the necessary steps for providing

* Compare the chart of the Arctic Ocean, published by the United States Hydrographic Office, with the second Supplement of the "Papers on the Northern and Eastern Extension of the Gulf Stream."

winter-quarters were promptly entered upon, and the commodious house brought from Göteborg landed and put together. Then came a most unexpected call for aid from fifty-eight men, the crews of six Norwegian fishing-vessels, which were also blockaded by the ice in the vicinity, at Grey Point, and had hardly provisions enough to last them until new-year. The commander of the expedition, pointing out to them that his sixty-seven men were already on short rations, advised them to go to the Ice-fiord, where, for the intended Swedish colony for working the phosphate-fields, a house had been built, and considerable quantities of flour, peas, grit, potatoes, meat, and other necessities stored. Eighteen of these men adopted the advice, and started October 7, in their boats, south, for the Ice-fiord; the others remained at first in their vessels, intending to avail themselves of the offer made them by the commander that he would allow them to join his party under the condition of the strictest obedience to the regulations which he should be compelled to establish. But before they had moved into winter-quarters a gale opened the ice around two of the vessels, which thus became free and sailed on November 4. Thirty-eight of the men started on them for their home, which they happily reached after a long and dangerous passage. They attempted in vain to enter the Ice-fiord, in order to take in their companions who had gone there. Two of the Norwegians, an experienced arctic fishing-master, Mattilas, a Finlander by birth, and his cook, remained with the vessels still frozen in at Grey Point, the former not willing to leave his uninsured vessel. They were, subsequently, found dead in a boat, in which they appeared to have made an attempt to reach the Swedish winter-quarters. The vessels were destroyed by the ice.

The fate of the eighteen men in the Ice-fiord has been described by the Christiania paper *Dagbladet*, from the diary kept by the unfortunate men from October 7, 1872, to April 19, 1873, and recovered by the Norwegian fishing-master, Fr. Mack, who found their corpses. Want of discipline and the incapability of making the proper use of the means at hand, appear to have been the main causes of their dreadful fate. The diary records hardly any bodily labor or exercise, and the place showed no evidence whatever of it. The conveniences which the house offered were not taken advantage of; instead of dividing themselves in two or three rooms, all the men crowded into one, in which everything gave evidence of a great degree of uncleanness. Of the preserved vegetables, such as potatoes, &c., only very little was used,

but a great quantity of salted meat which is so very apt to cause the scurvy. No party wintering North had ever been so well provided; perhaps these men would have fared better if there had not been so much at their command.

Having left their vessels at Grey Point, October 7, they arrived, after suffering the many hardships to which they were exposed in their boats, October 14, at the Swedish establishment in the Ice-fiord. They made there but two hunting excursions, from which they returned with two polar bears, two foxes, and several reindeer. The diary records, November 7, "The hunting excursions ceased on account of the darkness." The thermometer was carefully observed five times each day, at 4 and 8 a. m., at noon, and at 4 and 8 p. m. In October it stood lowest ($-2^{\circ}.2$) on the 21st; it then rose steadily to the 31st, when it showed 32° . In the first days of November the temperature remained high, the thermometer reading, at noon of the 8th, $35^{\circ}.6$; it then fell steadily to $-7^{\circ}.6$ in the morning of the 16th, the coldest day of the month. On the 22d it showed again as high as $28^{\circ}.4$. In December the temperature was still more changeable, the thermometer reading lowest ($-7^{\circ}.6$.) on the 19th, and highest ($24^{\circ}.8$) on the 5th, at 5 p. m. In the beginning of January, from the 2d to the 5th, the days were mild, but on the 12th the thermometer fell to $-23^{\circ}.8$. In the latter part of the month it rose again, standing, from the evening of the 21st to noon of the 22d, at 32° . February also had mild days, viz, $30^{\circ}.2$ on the 2d and 3d. In the middle of the month was the lowest temperature observed in the winter, viz, $-25^{\circ}.6$ at 4 p. m. of the 14th. The recorded observations ceased March 3.

Although the diary does not state of what sickness the poor men died, there is no doubt that it was that dreadful scourge, the scurvy. The first notice of sickness is recorded on December 9th in the words, "All well, except one of the crew who has not been well for the last eight days." From that day the diary repeats uniformly, "No improvement in health." On December 19th it is stated, "Two men always on the sick-bed;" on the 24th, "State of health very bad; nearly all hands sick;" on the day following, "No improvement;" and on the 31st, "On Christmas eve the sick were placed all in one room by themselves, where two men nurse them day and night." Thus the sickness increased steadily to January 19th, when the record reads: "Tønnes G. Pedersen, who fell sick January 5th, died this morning at 3.30 a. m., after much suffering; in the afternoon he was followed by Hendrik Hendriksen Hestnäs, of Balfstjorden, sick since December 19th." Sunday,

February 2d, it is stated, "The sickness rages; only three men are well." Thereafter each day, "No change in health for the better;" to which is added on the 20th, "This day we saw the sun for the first time in 1873." On the 21st it is stated, "At 6 o'clock this afternoon the Lord took away one more of our comrades, Nils Christian Larsen Kjöto, after a sickness of eighty-two days." From February 23d the diary is written by another hand. On the 25th it says, "There is only one man remaining well, who has to look after everything; may it please the Lord to help us in our wretchedness;" and on Friday the 28th, "This evening one more of our comrades died." From that day nothing but deaths are recorded; the last was that of Martin Hansen on April 19th. The last of all the records, in still another hand, and evidently penned in the delirium of fever, is: "Peder Andreas Nilsen, Balsfjorden, en Rödhue, (a red cap,) en Strynhue, (a straw cap,) Har T. Mitterhuk." What followed may be imagined. Their fate is the more dreadful as these men evidently succumbed, without displaying the least energy, to the enervating influences of idleness and darkness, while at home the greatest exertions were made to relieve them, but in vain. (See Third Supplement, pages 54 to 57.)

In strong contrast with this are the Swedish winter-quarters at Mossel Bay. The men were kept there by their officers always active and at hard labor, which prevented scurvy altogether. Only one of the men died, of consumption, and one perished on the ice; while all others enjoyed the best health. A telegram sent by Palander and Nordenskiöld through the *Uncle Adam*, and forwarded from Tromsö, states: "The winter has passed very happily. Full reports of unexpectedly interesting scientific observations, proving the abundance of animal and vegetable life in the sea during total darkness, and observations on the aurora borealis, climatic relations, refraction, &c., have been sent by the vessel. The attempts to reach a higher degree of latitude failed through mishaps and the heavy ice at Phipps, to which a sleigh-expedition started on April 14th."

In addition to this, Nordenskiöld and Palander, with fourteen men, undertook an expedition to the east, around the little-known Northeast Land, from Cape Platen to the eastern point, and thence over the inland-ice back to Mossel Bay, a journey of sixty days in constant fog or snow-storm, and on the inland-ice frequently interrupted by deep ravines, hidden under a thin snow-cover which broke under the feet of the travelers, so that mishaps could only be prevented by the strictest attention and discipline. Palander, with two

men, returned on the 14th; Nordenskiöld, with the others, not until the 29th of June, shortly before the departure of the *Uncle Adam*. An attempt to push north in another direction than Phipps Island failed also, the provisions falling short. No mention is made of attempts to reach Giles Land, (King Charles Land.) Shortness of provisions compelled the expedition to start back for Norway in July; but it was the intention that the *Polhem* should first penetrate in a northwestern direction as far as the ice would permit.

The report of Captain Palander, the commander of the *Polhem*, to the Swedish Navy department, dated Mossel Bay, September 15th, 1872, reads, with a few unimportant abbreviations and omissions, as follows:

After sending my last report, dated Green Harbor, Spitzbergen, August 4th, 1872, I started in the *Polhem*, with the brig *Gladan* in tow, from that place north, through Charles Foreland Sound, passing, August 5th, its shallowest part, ($2\frac{3}{4}$ fathoms,) between two sand-banks. The same afternoon, in the latitude of the northernmost point of Charles Foreland, I dropped the *Gladan*, after appointing, in accord with Professor Nordenskiöld, the Seven Islands (Parry Islands) as place of rendezvous, where winter-quarters were to be taken and the house, brought from Göteborg and consisting of six apartments besides kitchen and store-rooms, to be landed by the *Gladan*. On the route the *Polhem* was to stop at the southernmost Norway Island, off the north-west coast of Spitzbergen, in order to ascertain the error of the chronometers, General Sabine having established the position of that island at a small observatory which he had erected there in the summer of 1823. I arrived at it August 7th and left again the next day, after obtaining good sights. In the afternoon I saw the *Gladan* lying in diffused ice, with a very light breeze, and took her in tow, proceeding on our course for the Seven Islands, first through thin ice which, however, thickened so much that progress became impracticable and I was compelled, in latitude $80^{\circ} 02' N.$, longitude $13^{\circ} 19' E.$, to turn back in order to try and feel my way along the coast. In this I at first succeeded, but after reaching, on the 9th, Welcome Bay, progress was again barred by the ice, and Norwegian fishermen, whom I met there and who had been beset by the ice for the last three weeks in Liefde Bay, assured me that there was no possibility of proceeding farther north or east; I therefore concluded to turn south and wait for more favorable ice-relations and at the same time for the supply-steamer *Uncle Adam*, she having for us reindeer, reindeer-moss, and coal for fuel in the winter. In the evening of the same day I came to anchor in Fair Haven, south of the Norway Islands.

The *Uncle Adam* arrived on the 13th. The stay was taken advantage of for zoological dredgings, observations, surveys, and other labors of scientific interest. On the 15th the three vessels weighed their anchors and started again; but the ice had become still more impenetrable, and in latitude $80^{\circ} 00' N.$, longitude $13^{\circ} 27' E.$, we had to turn back for the Norway Islands, where we anchored the evening of the same day. The reindeer and their food were landed there, and the *Uncle Adam*, on the 18th, departed to the Ice-fiord for the coal which was to be brought there from Tromsö by the steamer *Mimer*.

Another attempt to push north was made on August 28, but in vain. September 1, seeing from a mountain that the ice had diffused, I again tried, leaving a boat of the *Gladan*, with Lieutenant von Holten and four men, with orders to wait for the *Uncle Adam* and to meet us with her in one of certain harbors on the north coast of Spitzbergen. The southerly winds had driven the ice north, causing an open channel along the coast of from 12 to 15 miles in width. We passed through it, arriving in the afternoon of the 2d off Brandywine Bay, on the Northeast Land, but there the ice, extending from the shore to a distance of about 20 miles and of a thickness of 20 to 30 feet, prevented us from proceeding farther. In latitude $80^{\circ} 14' N.$, longitude $17^{\circ} 47' E.$, we had to turn back, and make for the southwestern extremity of Shoal Point, beyond which, in Murchison Bay, we expected to find a good harbor for the *Polhem*, which had been selected as the second choice for winter-quarters. But this, also, we could not reach, on account of uncommonly thick ice, and we proceeded to Mossel Bay, on the eastern side of the mouth of Wijde Bay, where we arrived in the forenoon of September 3, and concluded to stay.

These winter-quarters are situated on an islet on the eastern side of the inner part of Mossel Bay, in latitude $79^{\circ} 53' N.$, longitude $16^{\circ} 15' 05'' E.$, according to the observations made by me. The islet and some small rocks form a pretty good harbor for vessels of light draught, the depth at low tide being $11\frac{1}{2}$ feet, and the bottom fine sand.

A part of the provisions, the house, three small observatories, and the coal brought by the *Uncle Adam* were landed, and the house put together and placed in position. Two of the observatories are built; magnetic and meteorological observations have begun, and will be made every hour as long as we remain in Spitzbergen.

In the beginning of October, before the new ice forms, and when the sea is

free of the old, through the autumnal gales which at that time generally prevail, Professor Nordenskiöld wishes me to go in the *Polhem* to Whale Island, in Murchison Bay, as also to the Parry Islands, in order to establish there depots of provisions and reindeer-moss for the sleigh-expeditions in the spring of 1873, as also to make an attempt to push north as far as practicable, and then return to Mossel Bay for the winter. It is proposed to make in the spring two sleigh-expeditions, one toward the east to Giles Land, for which the depot at Whale Island is intended, and the other to the Parry Islands, and thence directly north as far to the pole as will be possible; either both at the same time, or first the eastern and then the northern.

Three boats were built for the purpose at Kopenhagen, the largest weighing about 350, the smallest 130 pounds. They will be placed on low, light sleighs, and will be drawn by the men, after being loaded with the provisions, reserve-clothing, sleeping bags and tents, a photogen kitchen, arms and medicine. The 33 reindeer, now on shore, are not intended to draw the boat-sleighs, but smaller sleighs loaded with their own food; they will be killed in succession for meat. The northern expedition will consist of from 8 to 10 persons, who will be provided with provisions for 90 days inclusive of the reindeer.

During all the time the *Polhem* has been in Spitzbergen waters, with the exception of the few days in Mossel Bay, the weather has been, contrary to all previous experience, quite stormy, and the sky almost constantly overcast. There was an uncommonly great quantity of drift-ice, which prevented the progress of the expedition north.

The highest temperature observed in the last days was $46^{\circ}.4$; the lowest, (September 11.) $17^{\circ}.6$.

The state of health on board is at present (September 15) excellent, and it is a pleasant duty for me to report that all have behaved admirably, and have shown the liveliest interest for the success of the enterprise for which they have ventured their lives.

Captain Palander's report, dated Mossel Bay, January 29, 1873.

I could not forward my last report of September 15, 1872, as the *Gladan* was detained by a gale and drift-ice and, with the *Uncle Adam*, finally beset.

In the night of October 1 a number of Norwegian fishermen came, to our great surprise, on foot over the ice, some from Grey Point, distant about 18

miles, and others from Welcome Point, distant about 24 miles, where six fishing-vessels were beset by the ice during the gales of September 16, 17, and 18. They asked for provisions for themselves and their companions, being provided, at the utmost, only to December 1, and also for permission to stay with us. The following answer was given them in writing:

“Regarding the mishap which is threatening the crews of the Norwegian fishing-vessels, at present beset by the ice on the north coast of Spitzbergen, the undersigned are compelled to state that the Swedish expedition, which has only provisions for 21 men, consists now, after the unexpected detention in Mossel Bay by the ice of the brig *Gladan* and the steamer *Uncle Adam*, of 67 men; that, consequently, the rations have already been shortened considerably, and it will, therefore, be entirely impossible to support 58 persons more to the time when the water may be expected to open next summer. But there has been built, by a Swedish company, at Cape Thordsen in the Ice-fjord a substantial house of four to six rooms with fire-places, where the agent, according to a statement made by him to us, has left, besides fuel and material for another house, a stock of provisions consisting of 20 or 30 bags of flour, peas, and grit, several barrels of preserved potatoes, meat, &c. There a part of the crews might attempt to go should your vessels not be able to free themselves this fall. We are, however, should it become necessary, willing to afford you room and fuel in our vessels, as also to aid you, as far as compatible with the purpose of the expedition, with the most indispensable provisions for six months from the 1st of December, of which, however, you cannot expect more, at the utmost, than one-half the ration which is now allotted to our own people, under the following conditions:

“1. That the masters of the fishing-vessels bind themselves in the name of their owners to pay any indemnity which the King may find proper to demand.

“2. That the crews of the fishing-vessels find their own rations to the 1st of December.

“3. That they promise to endeavor to provide for themselves as much as possible by diligent hunting, and would also use such auxiliary nourishment as may be furnished or indicated to them.

“4. That, as long as they were furnished with provisions by the expedition, or lived on the vessels of the same, they should be under the direct command of the chief of the expedition, and of the commander of the vessel on which they lived.

"5. That they would, during that time, willingly and without asking compensation, execute all orders which might be given them for the promotion of the purposes of the expedition."

When the *Gladan* was beset, with provisions only to the middle of December, the rations were shortened so that the provisions on hand would last to September 15, 1873, at which time we might surely expect to obtain a new stock; but when the 58 fishermen were to be added, I prepared a telegram, which I sent by the two fishing-vessels which subsequently became free, asking for a supply of provisions by a vessel to be dispatched as early in the spring as possible.

From the time of our arrival at Mossel Bay (September 3) to the 16th of that month the temperature was very mild, with hardly any wind, but on the 16th, when the *Gladan* was to sail, the weather changed, a westerly snow-storm detaining the *Gladan* as well as the *Uncle Adam*, and bringing drift-ice down in such quantity, that not only Mossel Bay, but also the sea, was completely filled by it as far as the eye could reach. The temperature also grew colder, and on the 29th the thermometer stood at $-20^{\circ}.2$. All prospects of the vessels leaving disappeared, and a change in the distribution of the rations became necessary.

On the 1st of October the crew of the *Polhem*, with all the persons connected with the expedition, moved into the new house.

Several parties were sent in October in various directions to search for the reindeer, which had escaped and which were so essential for the intended sleigh-expeditions, but they were not found at a distance of 30 miles.

October 20 the sun sunk below the horizon, having disappeared from our eyes on the 13th, as the southern horizon was covered by high mountains, measuring 3° ; but twilight still remained for several hours, until, in the last half of November, it was completely dark even at noon.

October 22d I started with five men on a sleigh-expedition, partly to try the boat, to ascertain how much provisions would be required daily, and to examine the practicability of the outfit; partly to see, myself, the condition of the fishing-vessels beset at Grey Point. I selected the shortest route over the ice, but this was so much pressed together that we could proceed with our heavy load only with the greatest difficulty, each of the men having to draw nearly 200 pounds. We made daily, on an average, 7 miles.

I reached the vessels at Grey Point October 24th, and was informed there

that 17 of the men had gone westward over the ice, in two boats, in an attempt to reach from the Norway Islands, where they expected open water, along the west coast of Spitzbergen the Ice-fiord, to stay in the house of the intended Swedish colony should they not find there a vessel in which they could return home. The following fishing-vessels were beset: at Grey Point the yacht *Ellida*, master Mattilas, 10 men; the yacht *Dragedukker*, master Andersen, 10 men; the yacht *Svanen*, master C. Johansson, 6 men; the yacht *Helene*, master Myra, 11 men; at Welcome Point the sloop *Frederika*, master Knudsen, 11 men, and the sloop *Pepita*, master N. Johansson, 10 men; together, 58 men. Their provisions could not possibly be made to last, as they had stated, to the 1st of December; they had hardly sufficient until the middle of November; they begged that we should permit them to come to us on November 10th, promising that they would leave us the earlier. Humanity prompted me to comply, but I warned them again that I could not grant them other conditions than those I had promised them in my letter of October 1st. There was at that time hardly any prospect that they might become free before the winter set in, as the ice surrounding them was very strong, thicker ice of 3 fathoms having pushed in many places over the thinner, especially on the shallows.

October 26th I returned to our house in Mossel Bay, having made the trip of 36 miles, both ways, in five days, there being but eight hours' light. The air-line between Mossel Bay and Grey Point measures only 10 miles.

On two of these five days the temperature had been $-18^{\circ}.4$; the cold was, however, by no means oppressive, neither when on the march nor at night in a tent on the ice. The only difficulty we experienced at night was that our breath changed into snow which adhered to the inner side of the tent and fell in our faces whenever the wind moved the canvas. We saw no open water either way.

During November a strong northeasterly wind prevailed, often increasing to a gale which, in conjunction with the current, especially in flood-tides, carried away the ice, and we could see from our islet, in the beginning of the month, some open water. On the 30th the ice broke in the harbor and was carried away by the ebb-tides, so that the *Gladan* lay in perfectly open water. December 8th the ice broke away around the *Polhem*, when I caused steam to be got up to tow the *Gladan* farther into the harbor, but the rudder-pintle of the *Polhem* broke and I had to desist.

As there were on the *Gladan* several cases of sickness and no adequate quarters for a hospital, I took the sick people into the back saloon of the *Polhem*, where Quartermaster Svan died, December 20th, of pulmonary disease.

In December the harbor was sometimes open, sometimes frozen over. It was then my intention, in accordance with Professor Nordenskiöld's wishes, to go to sea with the *Polhem* in the latter part of the month, in order to dredge and to ascertain the border of the ice to the northward which, in our opinion, could not be at any great distance; but when the *Polhem* was ready to start, the harbor again froze over.

In January the harbor was repeatedly more or less free, once entirely so; and even when full of drift-ice, or covered by new ice, there was always open water at some distance outside. This circumstance, so little to be expected in this high latitude, is evidently the cause of the comparatively high temperature which prevailed throughout the winter, contrary to the experience of the previous expeditions. In January the thermometer rose on two successive days to $33^{\circ}.8$; on the 22d of the same month it stood at $38^{\circ}.8$; and the lowest temperature observed was but $-26^{\circ}.3$.

The weather was in general stormy, with but little precipitation. The prevailing and strongest wind blows in this region from the southeast. It is coldest with northeasterly and north-northeasterly winds, mildest with north-westerly winds; it never blew any length of time from the north.

Considering this state of the ice, and the temperature relations, as also the fact that in 1868 the *Sofia* was able in the month of October to penetrate as far as latitude 82° N., and that some fishermen, especially Mattilas, who has visited this region forty-two summers, have frequently not left the north coast of Spitzbergen before the middle of October, the besetting of the *Gladan*, the *Uncle Adam* and the six fishing-vessels must be deemed an exception which could not be foreseen.

As the trial-trip has shown that the sleigh-expeditions will require a more numerous crew than at first believed; furthermore, as the difficulties which may be expected on these expeditions will be increased by the loss of the reindeer, and especially by the greater distances to be made on account of the more southerly position of the winter-quarters; and, lastly, because I cannot now leave the *Polhem* without a crew, as she lies in open water exposed to the ice-drift of a stormy region, instead of being frozen in, I have, according

to section 7 of my instructions, concluded to retain the four of the *Polhem's* crew who were to return in the *Gladan*, even if the latter should be able to sail before the expeditions start. The men are satisfied with this arrangement.

It is our intention to go with the *Polhem* north as soon as an occasion offers. After her return the expeditions will be placed on foot, on the plan which has been explained in my last report.

I am glad to be able to report that no one has been sick on the *Polhem* since she left Karlskrona; all are in the best spirits, the more so as they anticipate that the greatest difficulties have been overcome with the daylight now just setting in.

Captain Palander's report, dated Mossel Bay, March 15th, 1873.

On January 29th, when the *Gladan* was just ready to sail, she was prevented by a strong wind which, on the 30th, increased to a storm, creating so high a sea in the harbor that the *Polhem* could not be kept at her moorings even by the aid of her engine. The *Gladan*, which had been lying outside of the *Polhem*, was driven past the latter toward the shore, and we failed in our attempts of throwing her a hawser by rockets. At last a boat succeeded in carrying to her the strongest which the *Polhem* had, but this parted and the *Gladan*, after touching the bottom several times, was driven on a shoal where her rudder unshipped and broke. I could not go with the *Polhem* to her assistance before 7 p. m., when I dragged her off and towed her to the other shore of the harbor under the lee of some shoals and islets. In letting go the tow-line, the latter became foul of the *Polhem's* propeller; she had to come to, and, in swinging, grounded upon a shoal near the islet on which the winter-quarters stand. After the turn of tide, however, and after taking off a part of the provisions and coal, she floated off again.

On the following day the storm increased to a hurricane from the north and northwest, and, as the propeller was not yet clear, both vessels would probably have stranded, if the harbor had not been filled suddenly with floes of ice which freezing together, formed a bridge of from 3 to 6 feet in thickness.

The *Gladan's* boats were recovered without damage; the starboard boat of the *Polhem*, however, which had fouled with the propeller, had broken to fragments.

February 1st was cold with quiet weather. The propeller of the *Polhem* was cleared and the rudder of the *Gladan* repaired and shipped again.

Since then the weather has changed, the winter setting in earnestly.

Although the harbor opened again on February 8th the weather was too bad to go to sea. Northerly and northeasterly winds caused severe cold, and covered the harbor and the sea outside of it with ice. It remained severely cold all February, the thermometer falling as low as $-36^{\circ}.7$, and the mean temperature of the month being $-8^{\circ}.9$.

The ice in the harbor grew two feet in thickness, but the sea remained free, so much so that from the nearest mountain, 800 or 900 feet in height, open water was seen extending from the northern part of Hinlopen Strait, along the northwest coast of the Northeast Land toward the north, and thence in a narrow belt on the parallel of latitude of the Moffat and Norway Islands. The distance between Verlegen-hook and the Norway Islands was frozen to the shore. Ice was also seen north and northwest of the above belt.

The latter part of February was quiet and fair. On the 28th we saw, for the first time in 1873, the sun over the mountains. At present the daylight lasts from 12 to 14 hours.

The ice relations preventing the vessels from going to sea, we have concluded to make two sleigh-expeditions to the eastward, for the survey of the unknown east coast of Northeast Land, and for the exploration of Giles Land, (King Charles Land,) not visited heretofore.* Both expeditions will start on March 16, first in company over the inland-ice to Lomme Bay, and thence through Hinlopen Strait to Cape Torell where they will separate. Professor Nordenskiöld and myself, with 6 men, provided with a boat and provisions for 42 days, will go to Giles Land, and Lieutenants v. Krusenstierna and Parent, with 10 men, a sleigh and provisions for 30 days, will go north along the east coast of the Northeast Land.

After our return to Mossel Bay we will start on the northern expedition. It will depend on circumstances whether we start directly with sleighs, or whether the *Polhem* will carry the expedition as far north as possible, and then leave us on the ice. We estimate the time of our absence at 60 days. After returning, about the middle of July, we will go south in the *Polhem*, and visit some harbors on the west coast of Spitzbergen, for instance, King Bay, the Ice-fiord, Bell and Horn Sound, &c., for scientific researches.

I hope to arrive in Tromsö in the first days of September. All hands are well; there has not been thus far a single case of sickness among the crew of the *Polhem*.

* King Charles Land had been visited, July and August, 1872, by three Norwegian fishing masters, Johnson, Nilson, and Altmann; see the third supplement to the papers on the northern and eastern extension of the Gulf Stream, p. 41, and the chart accompanying it.

The sleigh-expeditions in 1873.—Scientific labors.—Captain Palander's report, dated Mossel Bay, June 29, 1873.

The sleigh-expeditions toward the east were not carried out by Professor Nordenskiöld, the weather having been too unfavorable. But Lieutenant Parent and myself, with 10 men, started April 17 in a sleigh-boat for Verlegen-hook, where we left the boat and provisions at a depot for the northern sleigh-expedition. We returned on the 19th, having camped two nights in a tent with a temperature of -31° , which did not affect us.

The sleigh-expedition toward the north pole started April 24, consisting of Professor Nordenskiöld, myself and 14 men, with three sleighs and two boats. But arriving at Verlegen-hook with a broken sleigh, we found that we were too few; I therefore returned to Mossel Bay in order to change the disposition, and strengthen the sleighs, which labor absorbed six days.

In the mean time a dog had come to Mossel Bay, which I believed I had seen in October with the Norwegian fishermen at Grey Point. It occurred to me that some of these men might have remained there through the winter, and might now be in distress; I went, therefore, April 30, accompanied by Quartermaster Stjernberg, with medicine, to that place; but could discover neither persons nor vessels. The search became difficult on account of snow-squalls, and as I had only provisions for one day with me, and the ice at the mouth of Wijde Bay, which we had to repass, had proved very bad, I returned May 1.

On the 3d I left with the repaired sleighs for Shoal Point, where I joined the party of Professor Nordenskiöld on the 5th. In my absence, when the party crossed Hinlopen Strait, on their way to Shoal Point, Quartermaster Snabb had perished on the ice while attempting, with Landsman Öman, to go in a heavy snow-drift, without orders or permission, over the drift-ice to the nearest shore for some drift-wood. Öman had turned back when he found that it might become difficult to rejoin the party, but Snabb, not minding the warnings of Öman, insisted and nothing was afterward seen or heard of him; he probably died from hunger or cold. This occurred seven days before I joined the party; the searches I caused to be made were in vain.

I started with the party again on the 6th, proceeding through Brandywine Bay, and over the valley back of it to the Parry Islands, where we arrived, after several days' hard travel over the drift-ice, on May 16. There six of Professor Nordenskiöld's men, who had transported our provisions, returned

to the ship. Leaving at the Parry Islands a depot of provisions for 7 days we started from thence with 11 men, with provisions for 45 days, and reached, on the 28th, the northeastern point of Phipps' Island, in latitude $80^{\circ} 42' N.$ There, however, we saw, from a high mountain near the point, that the drift-ice to the northward was in such condition that, with the heavily-loaded sleighs, (280 pounds per man,) it would be impossible to reach a much greater latitude, and we concluded, therefore, to go to Cape Platen, and thence along the entirely unknown north coast of the Northeast Land and across the inland-ice, a route of great scientific interest.

We were extremely sad at being thus obliged to relinquish the programme of penetrating to the northward, but necessity compelled us to do so. Our subsequent experience in marching over the drift-ice showed that we often could not push in a day farther than half a mile, sometimes even less. Assuming that we could have made 2 miles a day, had we continued on the northern route for 25 days longer, and retrace the same way in 20 days, (having provisions only for 45 days,) we should not have gone farther than latitude $81^{\circ} 42' N.$, as far only as several fishing-vessels have been in the summer, while the brig *Sofia*, in 1868, reached latitude $81^{\circ} 42' N.$, and Parry, in 1827, in boats, $82^{\circ} 32' N.$ All hopes of pushing farther, or only as far as the latter, had vanished, while on the route which we now chose we could at least attain some results. I am convinced that we would not have been able to penetrate farther north, even if we had not lost our reindeer. On the lower and more readily passable drift-ice between Marten Island and Cape Platen we had to climb over walls of packed ice 36 feet in height, and we could do so only by cutting a road, it requiring often one to two hours to make 50 to 100 feet.

We entered the inland-ice of the Northeast Land, on June 1, and remained on it 15 days. The greatest elevation ascended by us on it was 1,600 to 1,720 feet. The ice was, on the average, even, but there were in many places clefts from 50 to 80 feet in width, and so deep that we could not see the bottom.

On June 15 we reached the valley back of Wahlenberg Bay. From there we proceeded, partly on the ice, partly on the land, and partly also over glaciers, along the east shore of the Hinlopen Strait to Shoal Point, where we arrived on June 23. In the night of that day I crossed, in a boat with 2 men, Hinlopen Strait, and arrived on the 27th at Mossel Bay after an absence of 52 days.

During the expedition astronomical and magnetical observations were made each day, the weather permitting. The distance made both ways was about 350 miles.

On my arrival at the winter-quarters I was informed that they had been visited, June 12, by Mr. Smith, of London, in the yacht *Diana*, who has cruised around Spitzbergen several summers, and had this year made an attempt to penetrate toward the north pole. He had left for the expedition a very valuable present of preserved provisions, lemon-juice, rum, &c.

The Norwegian fishing-craft *Finmarken*, Master Mattiesen, was wrecked on June 22, in Hinlopen Strait. All hands were saved, and are now with us, to go home in the *Uncle Adam*.

The open water is now so close that the vessels are able to go to sea. The brig *Gladan* leaves to-day, but the *Polhem* will not start home before the middle of July, as she is fully provisioned to August 1 and Professor Nordenskiöld desires to make soundings and dredge north of latitude 80° N. I hope to arrive at Tromsø about the 1st of August.

Professor Nordenskiöld returned with the sleigh expedition June 29. The health of the crew of the *Polhem* is at present satisfactory, the few cases of scurvy, which have occurred during the last months, having been cured.

First letter of Professor Nordenskiöld to Mr. O. Dickson, in Göteborg, dated Mossel Bay, February 23, 1873.

(This, and the following letters, contain some statements, which having been made also by Captain Palander in the above reports, are omitted, and such omission is indicated by asterisks.—HYDROGRAPHIC OFFICE.)

* * * Only one of the strayed reindeer returned after some weeks with a large wound on its back, caused either by a fall from the rocks, or by the paw of a polar bear. The wound has healed, and the deer fattened. Although tied to a pole, without shelter, it is evidently in good health, and relishes the moss which was brought out from Lapland. The apprehensions entertained in regard to the feasibility of supporting the reindeer through the winter, with moss brought out for them, has thus proved causeless. * *

The northern coast of Spitzbergen is, generally, as late as the beginning of October, quite free from ice. But this year severe cold has set in by the middle of September, with northerly and northwesterly winds, which drove the ice toward the north coast of Spitzbergen, and caused the sea to freeze as far as could be seen from the mountains surrounding Mossel Bay. We, there-

fore, expected a very cold winter, but to the present it has not proved so, as will be seen from the following table of monthly temperatures :

	Mean.	Maximum.	Minimum.
September, 1872,	+ 6.08	+ 27.68	— 7.96
October, 1872,	+ 9.32	+ 30.92	— 16.96
November, 1872,	+ 17.24	+ 36.88	— 3.10
December, 1872,	+ 5.90	+ 25.88	— 15.88
January 1 to 26, 1873,	+ 11.66	+ 38.48	— 26.32

Thus the winter has, so far, not been colder on the north coast of Spitzbergen than it is generally at Gefle, in Southern Sweden, 20° of latitude farther to the southward. From the beginning of September no daily variation of temperature has been observed; that is to say, a difference of temperature between the several hours of the day, as a rule, does not exist here during the dark season. Sudden changes of temperature, however, are very common, and frequent severe storms, especially from the southward.

The sea outside of the harbor became free of ice in the beginning of November, and since then the ice in the harbor has broken repeatedly, but always under circumstances, such as cold, gales and darkness, which would not permit the vessel to go to sea.

* * * * *

Drs. Erwall, Kjellman, and Wijkander will remain at the winter-quarters, in order that during our absence there may be no interruption in the magnetic and meteorological observations, which thus far have been made every hour, day and night; the former from the 13th of October, the latter from the 12th of September. Magnetic observations will also be made every minute on the 1st and 15th of each month, according to an agreement with the Physical Institute at Upsala. As no polar expedition has wintered so high north as ours, (Dr. Kane's winter-quarters lie in 78° 38' N.; those of Dr. Hayes and of the British polar expeditions still farther south,)* a series of magnetic and meteorological observations, embracing nearly an entire year, at our quarters, in latitude 79° 53' N., will be of great benefit to science, especially as they will be the first winter observations made in the European part of the polar region by naval officers or by savans.

Lieutenant Parent and Dr. Wijkander have also observed diligently the aurora borealis and its spectrum, and have determined seven lines of the latter, which in this region agree minutely with the spectral lines of the lower, less shining part of the flame of a light, (Mozzen's coal-spectrum.) This ob-

* The United States Expedition in the *Polaris* wintered 1871-72 in latitude 81° 37' N., and 1872-73 in latitude 78° 23' N., but the records of all the observations were unhappily lost by the wreck of the vessel.

ervation is an important addition to the knowledge of a great and still enigmatical phenomenon pointing to a probable connection between it and the meteors which contain coal, iron, and other matter. Even the fact, thus far not accounted for, that the spectra of this beautiful light-phenomenon have been found to vary according to the region or circumstances, may be founded, perhaps exclusively, on the differing nature of the matter which descends and burns with the electric discharge.

In the winter months the aurora appears to be permanent with southerly winds, but it is less resplendent than an intense aurora in more southern regions. It is in the Arctic zone altogether of a different character, probably because its source lies there nearer to the surface of the earth. I shall investigate this more fully.

Various other researches have been instituted by the members of the expedition: by Dr. Wijkander into the electricity of the air, (with an apparatus constructed for the expedition by Adjunct Holmgren in Lund, the ordinary instruments having proved to be not sufficiently sensitive in the polar regions,) and into the temperature of the earth; by Captains Palander and Von Krusenstierna into the tides; further zoological and botanical labors, inquiries into the formation of the ice, into the influence of the aurora borealis upon upon the magnetical constants, &c.

Dredgings were made almost every day throughout the winter, in the open water whenever there was such, but mostly beneath the ice. Their proceeds prove that animal life by no means ceases in the long winter nights; on the contrary, it is probably then at its highest stage, although the temperature of the water decreases nearly to $28^{\circ}.4$. This discovery of vigorous animal life in the absence of light, and with the decreased temperature of the Polar Sea is entirely unexpected. It even appears that several animalcula, surely not possessing the means of increasing their inner temperature above that of the surrounding medium, retain life at as low a temperature as 14° to 5° . On walking in mid-winter along the strand, on the snow getting wet at high tide, an intense bluish-white bright matter spreads around the feet, which, when examined under the microscope, proves to be caused by millions of microscopic crustacea living in the snow-mud and in the drift-snow. Snow saturated with salt-water is evidently the proper element of these animalcula, and I found that they retained their brightness when the temperature of the snow was $13^{\circ}.6$ and that of the air $-27^{\circ}.8$. It impresses the mind strangely, when,

walking in the cold winter-night through this mixture of snow and sparks, the latter scatter at each footstep in all directions, so that one might fear to burn his shoes or clothes.

By the detention of the vessels Dr. Kjellman, the botanist, was also compelled to remain with the expedition, and to this the latter is indebted for remarkable and highly important results in this field. It had been expected that the algæ flora would cease or benumb during the winter for the want of warmth and light, which heretofore have been considered indispensable conditions of vegetable life; but the examinations of the algæ, obtained in the winter by dredging, proved such not to be the case; it was, on the contrary, established that, notwithstanding the uninterrupted total darkness through four months and the then low temperature of the sea-water, a perennial rich vegetation of algæ exists, corresponding minutely, as regards quantity and quality, with the summer vegetation, and of very remarkable vigor, especially as regards all the stages of fructification. This leads to the conclusion that the algæ, compared with seed-plants, require but very little light, a temperature of from 28° to 30° being sufficient for the development of a rich flora, as also that increased light and temperature contribute very little to it. These conclusions, which are based upon a great number of observations carried on uninterruptedly during the winter-nights, will be of great importance for the physiology and geography of plants.

Among others the dredge brought up a few specimens of phosphorescent annelidæ. From their existence at the bottom of the sea a conclusion might perhaps be drawn that the organic matter deposited there may possibly develop a light which, although undetectable by the eye, may act chemically as a substitute, in physiological respects, for the direct light of the sun; experiments by Dr. Envall, however, proved this not to be so. He lowered an hermetically closed colorless bottle, containing iodized glass-plates which had been exposed in a silver-bath, to the bottom of the sea at a depth of about two fathoms; after remaining there for twelve hours they had as little changed as they would have after remaining for the same time in a dark room.

Hardly any game was obtained by hunting in the winter. In the autumn a few reindeer, a number of birds, and about one hundred grouse, of a large and very fat species, with delicate flesh of a taste like that of geese, were killed. This bird is here in great abundance, living especially beneath the

stone piles on the cliffs. With the winter it disappeared entirely, although it is evidently not a bird of passage. Quartermaster Rhoden killed a young mountain-owl, (*Strix nyctæa*), which evidently prey upon the grouse, which they resemble in colors. Only a few seal and one polar bear were seen during the winter nights, but the voice of sea-birds was frequently heard near the ice-border.

* * * * *

The sun disappears in Mossel Bay October 20th, not to rise again until the 21st of February. A mountain-chain bordering the bay to the southward however, prolonged the night 14 days, so that it lasted from October 13th to March 1st. The moon appears every fortnight and remains above the horizon two weeks, ten days of which time she is circumpolar. Whenever the moon did not shine, in December and January, it was total darkness, even at noon, but now the twilight is at noon strong enough to read large type without difficulty.

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Second letter of Professor Nordenskiöld, dated Mossel Bay, March 13th, 1873

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The latter part of the winter was more severely cold than was expected from the experience in December and January, as will be seen from the following table of temperatures:

	Mean.	Maximum.	Minimum.
January, 1873,	+ 14°.2	+ 38°.5	— 22°.7
February, 1873,	— 8°.9	+ 34°.9	— 36°.8
March, 1873,	+ 0°.3	+ 31°.3	— 37°.5

In April the temperature varied, to the 20th, between —4° and —31°.

* * * * *

(*A letter of Doctor A. Wijkander, dated Mossel Bay, June 22d, 1873, also published in the "Mittheilungen," contains nothing in addition to the above except the following passages.—HYDROGRAPHIC OFFICE.*)

There were a few cases of snow-blindness during the march of the sleigh-expedition, but these were easily cured.

After Professor Nordenskiöld had left with the sleigh-expedition, the temperature remained uninterruptedly low until the middle of May, when the weather grew milder. At present the sea is open, and all the fishing-masters, whom we lately saw, agree in stating the ice relations of this year to be

an exception. The observations are continued diligently, although the number and energy of the co-laborers have decreased by some cases of scurvy and through the influence of the long winter and the shortened rations.

* * * * *

From a letter of a member of the expedition, probably the surgeon, published in the Aftonbladet of July 21st, 1873.

* * * * *

The thermometer-observations, which were uninterruptedly continued, result, for the

	Mean.	Maximum.	Minimum.
Month of March, 1873,	- 0°.3	+ 31°.3	- 36°.4
April, 1873,	- 0°.6	+ 32°.4	- 33°.7
May, 1873,	+ 17°.2	+ 38°.5	- 2°.9

* * * * *

There were, in my opinion, several causes for the scurvy. The cases were severest and most numerous among those who remained on board-ship. On shore the character of the sickness was mild. It is remarkable that the crew of the *Uncle Adam*, who used more salt provisions than the others, were not attacked until March. The less healthy living on board, the changes necessarily caused by the Arctic winter even on healthy and strong persons, and the short provisions, which amounted only to two-third rations, were probably the main sources of the disease. * * * * * On board of the *Polhem* there are at present four scurvy-cases and one convalescent. Some are very near being attacked, and others complain of rheumatic pains and bad digestion. Two of the cases are of recent date and still mild. On the *Gladan* eight fully-developed cases of scurvy of a serious character have occurred, besides a number of cases of rheumatism and other complaints. Some showed symptoms of an attack, but the development was prevented. Of the eight attacked, three are convalescent and two still under treatment. One attack occurred in June. Of the crew of the *Uncle Adam* all, except the commander, were attacked more or less, the greater number of them very severely. Five are now convalescent and seven are still very seriously sick. Although, in general, all hands are so weak that it can hardly be agreeable to the commander to go with them to sea, I nevertheless believe that the relief, which they will feel in leaving this prison, will have a very beneficial effect. The present of Mr. Leigh Smith was a godsend for the expedition, as through it the salt provisions could be dispensed with for four days of the week.

* * * * *

From a letter of another member of the expedition, dated Mossel Bay, April 21st, 1873, published in the Ny illustrerad Tidning.

The *Polhem* left Göteborg July 4th, 1872. In Refö Fiord the *Gladan* was taken in tow, and both vessels continued together one day and one night. On the 14th we reached Tromsö, where we met the Austrian expedition just starting. After completing our outfit we also started July 21st. Crossing over to Spitzbergen we had fair weather and a favorable fresh breeze, enabling us to use sail and economize our valuable stock of coal. The snowy peaks and mighty glaciers of Spitzbergen came in sight on the 25th. It was our intention to make a stay of a few days at the South Cape, the southernmost point of Spitzbergen, in order to determine its position more accurately and examine it physically more thoroughly than had been done, but the commander deemed it wise to shorten our examinations on shore to an hour, for fear of the numerous shoals and reefs, surrounded by breakers, which showed their heads at ebb-tide.

On the 27th we arrived in the Ice-fiord and anchored in Advent Bay, the comparatively rich and inviting shores of which were known from previous expeditions; there we met the *Gladan*, which had arrived seven days before us. We remained in the Ice-fiord until August 4th, visiting the inner and heretofore unknown part of Dickson Bay, the new colony of the "Ice-fiord Company" at Cape Thordsen, Green Harbor, Coal Bay, Cape Staraschtschin, and other points, at all of which we made, as far as the allotted time would permit, astronomical and physical observations and collections of animals and plants. The petrified remains of the sub-tropic plants belonging to the Chalk formation, found at Cape Staraschtschin, deserve special attention. This new and, for geology, important discovery was made in the immediate vicinity of a place where already plant-petrifications had been found belonging, however, to a more recent period, and pointing to a more temperate climate as a transition to the present ice-period. There are thus found, in the strata of the polar Chalk formation, ferns, a great number of species of resinous woods showing types which we now find in the tropics, with the entire absence of leaved woods, while the Tertiary strata over them, of a more recent time, contain most remarkable remains, for instance of a taxodium found at present in Texas, of trees of the same genus as the *Sequoia californica*, of plane-trees, of large-leaved linden-trees, oaks, beech-trees, &c., nearly all giants when compared not only with the largest tree now occurring in Spitzbergen, the dwarf-

birch, of which we found some one foot in height at Coal Bay, but also with the trees of the Scandinavian woods.

In Fairhaven dredgings were made daily with two boats, and the examination and preservation of the great number of specimens obtained by them kept the scientific gentlemen very busy. Everybody had occasion to see how rich the sea surrounding Spitzbergen is with animals of the lower orders. Although this fact is well known through the previous expeditions, the variety of peculiar forms of mollusks, craw-fish, worms, &c., does not fail to cause surprise and astonishment in one who for the first time sees them brought up from the depths of water which is almost always at the freezing-point.

Fairhaven is also interesting for its algæ, as they differ in this region remarkably from those of Southern and Western Spitzbergen. The Spitzbergen sea-fauna has heretofore been considered, although rich in numbers, poor in species; but it proved directly the contrary. The cause of the small number of algæ does not appear to lie in the climatic relations, as the species found here are well developed and of luxurious growth, and endure even the strong cold and the total darkness of the winter; it is the geological structure of Spitzbergen, the prevalence of loose, sedimentary and therefore hard mountain crystal. Everywhere the mountains consist of slate and sandstone strata, as for instance at the South Cape, and in several parts around the Ice-fiord, the bottom of the sea is clay, mud, gravel and smooth rock, on which algæ cannot thrive; while in regions where, as for instance on the Norway Islands, granite or gneiss prevails, the bottom of the sea is covered by larger blocks and stones, affording, by their hardness and roughness, to the roots of such sea-plants a firm footing and protection against the commotion of the waves and ice-blocks. In regions of the latter description a comparative rich growth is met. But the algæ of Spitzbergen consist by no means exclusively of the luxuriant species; there are also some very small and delicate, which could hardly be expected in these regions; they were found in abundance in the sweet-water ponds near Fairhaven, which are formed by the melted water of the glaciers in the vicinity and melted snow, and even on the remaining snow. The red, green, and greenish-brown coloring which was seen, extending often over great areas, was caused by innumerable microscopic algæ which appeared to possess, on the snow illuminated by the sun, all the conditions required for life.

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The picture developed before our eyes on entering Mossel Bay, on the morning of September 3, was truly inviting. There was not the smallest cloud in the sky, which possessed all the clearness and purity peculiar to the high north; the shallow bay lay in the blinding sunlight, as bright as a mirror. A beautiful green covered the, for Spitzbergen, uncommonly wide bottom-land stretching between the shores and the mountain-chain which encircled the bay, broken only in the background by a deep valley. A water-basin of considerable extent was visible at the mouth of the latter, and here and there in the bottom-land small sweet-water ponds. Far back, leaning against a rock, were seen the remains of a Russian hut, as generally all the ruins of small huts built by either Russian or Norwegian fishermen are thus termed. A great number of birds of passage surrounded the ship, and from a distance the confused, dull noise was heard, indicating their breeding-resort.

* * * * *

For the dredging, which was mostly done by the Laplanders under the direction of the Quäne Kristian, the reindeer, which had returned to the camp, was very useful; it had become as tame as a dog and carried the apparatus, such as ice-axes, poles, hawsers, and nets. The dredging was for the greater part done under the ice, in the following manner: A number of holes were cut in it at certain distances; a hawser, to the middle of which the dredge had been fastened, was then drawn through them beneath the ice by means of a large pole, and by hauling first at one end and then at the other the bottom was scraped by the dredge. A great variety of animals living there in uninterrupted darkness, in water of a temperature considerably below the freezing-point, were thus brought up: many-chambered rhizopods, in detecting which among the scrapings the sharp eyes and the patience of the Laplanders were of great aid; various species of worms, craw-fish, fish-spawn, and hatched fish; sometimes, also, a grown fish; and beautiful sea-tang, with well-developed fructification, as, for instance, the well-known *Laminaria* and *Fuci*, with other algæ of variable forms and colors.

(The writer then speaks of the hardships in making observations in the cold days; of the difficulty of out-door exercise in total darkness; of the occupation of the crew in the winter, and their entertainments, especially at Christmas time, &c.)—Hydrographic Office.

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The beautiful weather of Spitzbergen, extolled by previous visitors, was experienced by us only during the first half of September. The summer was

wet, cold, foggy, and stormy, but the winter milder than we had expected. The mercury never actually froze, although it came near it. The cold term did not set in before the re-appearance of the sun, when the weather changed entirely. The storms ceased, and with the quiet air or the light northerly breeze the cold increased, and the temperature remained low throughout March and April. The mild weather during the dark season must probably be ascribed to the southerly gales, which then prevailed and were mostly very violent. In quiet weather a temperature of -22° could be readily borne, and one of the quartermasters, who fell into the water at a temperature of -34° , did not suffer from it; but the least wind made the cold unbearable, and at a few degrees below the freezing-point it was harder to bear than a temperature of -40° with a quiet air.

* * * * *

The report of the commander of the brig *Gladan*, Lieutenant G. von Krusenstierna, dated Tromsö Sound, July 13, 1873, published in the "Post och Inrikes Tidningar," and also republished in the "Mittheilungen," refers mainly to the causes of the detention of the *Gladan*, stated more briefly in the reports of Captain Palander, and in the above letters. There is hardly anything in addition in it, besides the statement that the tidal hour in Mossel Bay was found to be 2 hours 21 minutes, and the following table, the result of the meteorological observations made on board the vessel:

Month.	Thermometer, F.	Barometer.	Direction and force of wind.	Days.
		<i>Inches.</i>		
October, 1872...	lowest, $-18^{\circ}.8$	29,843	Variable	6
	mean, $+10^{\circ}.0$		SSE., fresh top-gallant-sail breeze	16
	highest, $+31^{\circ}.6$		SE., gale	1
November, 1872.	lowest, $-3^{\circ}.1$	29,769	Variable	8
	mean, $+17^{\circ}.2$		SE., top-sail breeze to reefed sails	22
	highest, $+36^{\circ}.5$		—
December, 1872.	lowest, $-15^{\circ}.9$	29,814	Variable	3
	mean, $+5^{\circ}.9$		SE., top-gallant-sail breeze	26
	highest, $+25^{\circ}.9$		NW., top-sail breeze	1
January, 1873...	lowest, $-26^{\circ}.3$	29,555	Variable; fresh top-sail breeze	7
	mean, $+14^{\circ}.2$		SE. to SW., top-gallant-sail breeze to storms	19
	highest, $+38^{\circ}.5$		N. to NW., top-gallant-sail breeze to storms	5
February, 1873..	lowest, $-36^{\circ}.8$	29,694	Variable; top-gallant-sail breeze to storms	11
	mean, $-8^{\circ}.9$		SE. to SW., light breeze	13
	highest, $+34^{\circ}.9$		NW. to W., strong top-sail breeze	4

Month.	Thermometer, F.	Barometer.	Direction and force of wind.	Days.
March, 1873	lowest, $-36^{\circ}.4$	Inches. 29,794	Variable; top-gallant-sail breeze.....	4
	mean, $+0^{\circ}.3$		Calms.....	11
	highest, $+31^{\circ}.3$		SSE. to NW., Top-gallant-sail breeze to Double-reefed top-sail breeze	16
April, 1873	lowest, $-26^{\circ}.7$	30,015	Variable; fresh top-sail and light top-gallant- sail breeze	12
	mean, $-0^{\circ}.6$		Calms.....	4
	highest, $+32^{\circ}.4$		SSW. to NW., top-sail breeze.....	14
May, 1873	lowest, $-2^{\circ}.9$	30,350	Variable; top-gallant-sail breeze.....	12
	mean, $+17^{\circ}.2$		Calms.....	5
	highest, $+38^{\circ}.5$		NW. to SSE., top-sail to top-gallant-sail breeze.	14

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The principal vessel of the expedition, the steamer *Polhem*, returned to Tromsø August 6, 1873; and the following telegram was sent from there by Professor Nordenskiöld:

“Just arrived, all well. After the return of the sleigh-expedition I intended to attempt another, but was prevented by the failure of provisions. Extensive deep-sea dredgings, however, were made, as also magnetic and geological investigations. I bring home extensive collections of Miocene plants from several places, richer than any heretofore known in the polar regions, as also specimens from two places, belonging to an older; and until now entirely unknown; geological period. These collections will shed important light upon the beautiful flora and the climate of the geologic period. I hope these scientific results of the expedition will indemnify for the failure of reaching a higher latitude.”

[From the "Geographische Mittheilungen" for 1873, p. 444 et seq.]

THE SLEIGH-EXCURSIONS OF THE SWEDISH EXPEDITION IN THE NORTHEASTERN PART OF SPITZBERGEN, APRIL 24 TO JUNE 15, 1873.

The following is the report in detail of Professor Nordenskiöld on the sleigh-excursions of the expedition, the outlines of which were given in the several letters published above.

The unfavorable ice-relations of the autumn of 1872, which prevented us from wintering on the Seven Islands, the loss of the reindeer, and other circumstances, made it evident that the attempt to reach a high parallel of latitude would not be so successful as had been expected on starting from Norway; we, nevertheless, hoped that this part of our programme might not fail altogether, the more so as the otherwise unfortunate detention of the vessels in Mossel Bay by the ice increased considerably the available force.

It was my intention that two smaller parties should accompany the party which was to push north—one, consisting of three Laplanders and three Norwegians, under the direction of Mate Christenson, to carry provisions to the Seven Islands and then to return; the other, furnished from the crew of the *Gladan*, under the command of Lieutenant von Krusenstierna, to accompany us a distance farther, and then also to return.

The two parties from the *Polhem* started together April 24 with two boat-sleighs, taking the route over the mountain-ridge, of about 1,000 feet in height, which separates Mossel Bay from Treurenberg Bay. All hands aiding in drawing the sleighs over the gradual slope of the ridge and the hills terminating it, we made good progress, notwithstanding the unevenness of the road and the heavy burden.

On the heights those of the crew who had accompanied us left for the ship, and we proceeded toward Verlegen Hook.

While going down the heights our largest sleigh broke and, meeting Lieutenant von Krusenstierna, we learned that one of his men had fallen sick and had returned. One of our own party was also attacked very severely with scurvy.

I intended to replace the broken sleigh by that of the party from the *Gladan*, but found on examining it that it was also damaged. There was now no doubt that the sleighs built at Copenhagen from a British pattern were not strong enough for carrying a weight of from 2,000 to 3,000 pounds on the ice and over broken ground. It became necessary, before proceeding farther, either to build new sleighs from the scanty material at our command at the winter-quarters, or to strengthen the old sufficiently. Lieutenant Palander returned with a part of the men for the purpose, and I determined to avail of the detention for the establishment of depots in the direction of the Seven Islands.

I left Verlegen Hook on the 25th with Mate Christenson, four marines, one Norwegian, and three Laplanders for Shore Point across Hinlopen Strait. Four men carried the smallest boat, *Louisa*, on their shoulders, while the provisions, the tent, and other stores were packed on two small sleighs and a reindeer-sleigh drawn by the only reindeer left. I followed the latter, watching it with especial interest, in order to ascertain the fitness of these animals for such excursions. My expectations were surpassed; although the Laplanders said that it was not one of the best, it drew without difficulty the sleigh burdened with 200 pounds weight, was as easily directed as an old cart-horse, took eagerly the moss brought along, and furnished afterward, when killed, excellent meat. With forty of such reindeer we could have penetrated a great distance north of the Parry Islands, even with the ice-relations existing this year north of the Northeast Land.

The distance we traveled from Mossel Bay to Verlegen Hook was, inclusive of the deviation we made, nearly 2 Swedish (13 nautical) miles; we made this the first day, although we had to cross a ridge of 1,000 feet in height; but it took us, on account of the roughness of the ice, three days to cross Hinlopen Strait, which is there only 3 Swedish miles wide. The weather was at first favorable, but the second day thick fog enveloped the mouth of the strait, preventing us from picking the way for our small sleighs, and when it lifted with easterly and southeasterly winds, the latter brought fine snow which in a few minutes filled holes six inches deep. The upper air remained so clear that not only the sun, but also numerous parhelia and halos, created by the refraction of the rays in the ice-needles were seen; but everything near the horizon was hid by the fog. Some high peaks, distant several miles, showed with so clear and sharp contours that they appeared to be very close to, while objects closer

to the ice could not be distinguished at all at some distance. (The report states now all the circumstances connected with the loss of Cockswain Snabb see page 14, which caused a delay of some days.)

On the 2d of May six men were sent to Verlegen Hook. I remained with three men at Shoal Point, where, on the 5th, Lieutenant Palander arrived with the repaired sleighs. While the greater number of the men had taken the route along the ice-border, Lieutenant Palander had availed himself, for the transport of the boats with the provisions, of an opening in the ice caused by the late gale, thus avoiding the ice, which had detained my party, and crossing the mouth of the strait in 17 hours. But Lieutenant von Krusens-tierna was compelled to abandon the project of accompanying us with a part of his crew, so that the number of days for which provisions could be taken along for the principal party was considerably lessened.

The parties were now arranged in the following manner: 1. The principal party, consisting of Lieutenant Palander, myself, and 9 men, taking along a boat, tent, the necessary clothing and night equipments, guns, instruments, medicine, cooking-apparatus, tallow, fuel, and provisions for 50 days. This outfit was packed on two sleighs which, after the changes made by Lieutenant Palander, proved strong enough. 2. A party consisting of Mate Christenson, two Norwegians and three Laplanders, to accompany us to the Seven Islands with enough provisions to supply the parties to that point, and leaving there a stock for the return.

Our manner of living was as follows: Two hours before starting the cook was called to make the coffee, all hands taking their turn in this by no means pleasant duty. For fuel drift-wood was used, and, when none was to be found, tallow. As the latter had to be economized, the stove had then to be moved into the tent, which soon was filled by a thick smoke coloring our skin to an even black, so that we almost resembled the people of the African desert. As soon as the coffee was cooked, it was divided into tins which served as well for cups as for plates; then a pan was placed over the fire with half a pound of pemmican for each man, in addition to which each received, in the morning, one-quarter pound of bread and one-tenth pound of butter. Immediately after the breakfast we started. On the march we rested after each one and a half hours a quarter of an hour, and after five hours one hour for dinner, for which each received one-fourth pound of bread, a piece of bacon, and some brandy. After another five hours' march, the tents were

pitched for the night, when again some brandy, one-fourth pound of bread, and one-half pound of pemmican were distributed to each man. The latter made an excellent soup which, if it could have been accompanied with some vegetables two or three times a week throughout the winter, would surely have protected the expedition altogether against scurvy. Coffee was then taken, each crept into his päsik, (fur-coat,) a woolen blanket was spread over all in common, and in a few moments all were in sound sleep. There were no night-watches.

May 6th we started early, and, favored by a fine wind, permitting us to use the sleigh-sails, we reached, before evening, after a march of eight miles, the southern point of Low Island. On the following day snow fell thickly; the wind increased and brought so strong a snow-drift that we were compelled to halt and seek shelter in our tents. The wind and snow-drift continuing the two following days, with a temperature of -3° , we had to remain in our tents, in which we were greatly annoyed by the snow-dust driven by the wind through the texture of the cotton canvas, and by the snow, into which the breath of the men changed after settling on the canvas, and which was constantly shaken down upon us by the gale. We were glad when, on the 10th, we could resume our march, with beautiful weather at a temperature of $0^{\circ}.5$, taking our route past Cape Hansteen, over Brandywine Bay and the low peninsula which separates the above bay from Extreme Hook, to the Castrén Islands which we reached May 12th.

One of the Laplanders had become so completely snow-blind that we had to leave him with a tent on the islands. In hopes of reaching the Parry Islands from here in one day, we left also the greater part of the outfit of the party which was to return. To complete these arrangements we remained on the Castrén Islands a day, sending out two of the Laplanders to hunt. Although they did not find reindeer, they saw numerous tracks of them.

Early on the 14th we resumed our march to the Parry Islands, the southern point of which was distant from our camp on the Castrén Islands 10 miles. The ice on the sea between these islands was not smooth like that over which we had traveled thus far, but so densely packed that the distance took us nearly three days. At noon of the 16th we reached the Parry Islands, on the shores of which we again found smooth ice. The day was one of the few beautiful experienced on our expedition. Drift-wood, so necessary for comfort in the tents, lay in abundance on the strand, and a reindeer, which we saw the moment we reached the southeastern shore of the island, was

killed. Numerous tracks revealed the fact that even this island, situated near the 81st parallel of northern latitude, is the home of large animals living on herbs. Bear-tracks also were found, showing that this greatest enemy of the deer lives there in great numbers. Whalers generally believe that the polar bear hibernates, but this is by no means certain. He feeds principally on the seal; but, as the number of seal-holes were not in proportion to the tracks of the polar bear, it would seem that the latter would be compelled to take also moss and lichens.

After the establishment of a small provision-depot covered by large stones, Mate Christenson and the two Norwegians were sent back to the vessel, and we started again on the 15th, taking our route over the sound between Phipp's and Marten's Islands, bridged by smooth ice which permitted us to reach the southeastern point of the former in five hours. Here we ascended a mountain, from the top of which we saw that the sea north of the Seven Islands was covered with great masses of ice packed over each other to great heights, with no open water or smoother ice between them which would offer a possibility of penetrating farther with our heavily-loaded sleighs. This was the more unexpected, as on two previous occasions I had seen, from high elevations, this part of the polar basin covered by smooth ice, with no greater obstructions than, perhaps, now and then a place more difficult to pass, which was also the experience of Parry and Scoresby, and of the Swedish expedition in 1868. What we saw now showed the utter impossibility of penetrating even a degree farther north.

Had we succeeded in establishing our winter-quarters on the Parry Islands instead of Mossel Bay, we might have been able, even with the present ice-relations, to have found, by reconnoitering in various directions, a more favorable ground, without shortening our rations too much. What now remained would hardly have been sufficient for penetrating a considerable distance to the northward, even with the most favorable ice-relations. Under the existing circumstances I saw no alternative but to drop at present the attempt, hoping however to find later in the summer, but still early enough, a new starting-point, perhaps even to the northward of the Seven Islands, from which I could renew the attempt with full provisions.

In order not to allow the great undertaking to remain altogether without result, I chose for the return not the direct route, but that around the Northeast Land, which offered a chance to determine the eastern extent of the latter

and to explore its geology, the condition of the inland-ice, the position of the islands east of the Northeast Land, &c. We were in hopes to reach, by that circuitous route, our winter-quarters in 20 to 30 days, early enough for the renewal of the attempt to penetrate to the northward. It took us however, 40 days, although the route, as originally planned, was shortened, and brought far greater hardships, difficulties and dangers than had been anticipated, but the scientific results were also greater than expected, especially as regards the condition of the inland-ice of Spitzbergen, which differs in many respects from that of the inland-ice of Greenland on the parallel of latitude 20 miles farther south.

Leaving the boat with other not absolutely necessary effects at Phipp's Island, we started, on May 18th, by the south of Marten's Island, for Cape Platen. At first the ice was favorable for our progress; but when we had reached the parallel of the southern point of Marten's Island, we met with packed ice, over which our progress was slow. This difficulty continued until, on the 23d, we reached Cape Platen, the distance of which from Phipp's Island is only 20 nautical miles. The ice over which we passed was formed of blocks packed loosely into pyramids or ice-walls 30 feet in height, so close to each other that there was often no room for our tent between them. The sides of the blocks were covered with magnificent ice-crystals an inch in diameter, which detached as soon as the blocks were touched. Between the blocks lay snow which, where the ice had formed this winter, was not deep or loose, and did not retard much our progress; in other places, however, where the ice-blocks were older, it was deep but not firm enough to bear the weight of a man, and, therefore, difficult to pass over. Axes and shovels had to be worked constantly to make a road for the sleighs; and some days we could not make, with the greatest labor, more than a mile. In addition there was always, at least near the horizon, so thick an ice-fog that it was impossible to select the route; and thus it occurred several times that we traveled over very difficult ground, when, with an accidental clearing off, we discovered that close to us were smooth ice-fields.

We saw a great number of polar bears and the ice showed almost everywhere their tracks, although we saw no animals on which they could prey. It was interesting to observe how carefully the polar bear selects the least difficult path, avoiding ice-edges and deep drift-snow if not firm enough to bear its heavy body. Whenever the fog prevented us from selecting the

path, we followed, often for great distances, the track of this animal, and were never misled. In killing bears we were at first quite unsuccessful, although anxious to obtain them for meat and fuel. Our hunters were not cautious enough in approaching them. Watchful and shy, the animals were always able to retreat in time, generally slowly and in many curves, but rapid enough not to allow the hunter to come within rifle-shot distance; and the deceived hunter returned, after a long tramp over ice-hills and through deep drift-snow, panting and fatigued, without the game. The method was then changed. As soon as a bear was seen, if we had time to spare, all hid in the tent or behind the hunter; the bear, inquisitive or eager to inspect dark objects which had been thrown on the ice, and which he probably took for seal, to ascertain the nature of the object by scent, came, with many windings, so near that he rarely escaped the ball of Captain Palander.

East of Cape Platen the ice was, in general, of good condition, permitting us to proceed quite rapidly, only detained by deviations from the direct route for topographical purposes. The weather also was quite favorable. Some days the temperature was so high as to melt the snow and cause sweet water to accumulate in holes and ravines. This was welcome to us, as we had been compelled, since the 29th of April, to melt snow for drinking-water, which not only took fuel and time, but gave us also but a small ration of a mixture of water, grounds of coffee, reindeer-hair and soot. In many places the fiords were surrounded by beautiful mountains, the steep upper slopes of which swarmed with millions of sea-birds, though there was not as yet any open water in the vicinity, while the foot of the ridge consisted of immense stones richly covered with black lichens. In some places, where the winter-gales had prevented the snow from accumulating, the foot of the mountains appeared as a richly green grass or moss meadow. Such spots, never yet disturbed by a huntsman, offered an excellent pasture for the reindeer; and there were very numerous tracks of these, as also of polar bears, especially along the shore and off the points. One morning, when camping near such a track, we saw a bear approach in a slow trot, following the accustomed path without its wonted vigilance. He ran directly against the mouth of the Remington which finished him. A number of reindeer were shot, and all proved to be in better condition than those killed in the spring in the southern part of Spitzbergen. The delicious meat gave a welcome change to the vigorous but uniform pemmican diet.

The travel along this coast took the remainder of May—a considerably longer time than we had calculated. It was, however, very interesting, partly as respects geography and geology, partly because we saw the low points just freed from the icy cover and could examine into their geological structure which in similar places of the more southern regions is hid by luxurious vegetation. A full report in regard to this and other discoveries can only be made after a more thorough inquiry into the material. I will only state here that our geographical determinations confirm the reports of Mr. Leigh Smith regarding the considerable eastern extension of the Northeast Land; and that the existing charts will have to be extensively corrected in the configuration of the land, the number and position of islands, points, fiords, &c., which previously were only located by bearings obtained on board of vessels.

In the last few days a dark cloud had shown to the eastward and northeastward, which seemed to indicate open water on the eastern side of Spitzbergen. To examine this and the condition of the sea and inland ice farther east and south, Palander and myself ascended, May 31st, a peak on one of the eastern most islands off the north coast of the Northeast Land, and saw that there was along the latter coast a considerable stretch of open water extending as far as Broch and Foyne Islands, but inclosed by ice. No land was seen to the northeast.

Before discovering this open water I had been in doubt whether I should choose the route over the sea-ice, along the east coast, or over the inland-ice, in the direction of Cape Mohn or Cape Torell. On the former I would have been able to ascertain the extension of the inland-ice to the eastward, which observation, repeated after a number of years, would demonstrate the rapidity with which this ice progresses or recedes; while on the latter route the nature of this, in physical and geographical respects, so very interesting formation could be more fully investigated. The open water which I saw left no choice. If it extended, as was to be expected, even in a narrow furrow, to the vertical edge of the glacier, it would have been a barrier to all further progress, as we had left the sleigh-boat behind. The inland-ice, on the contrary, appeared even, without any clefts.

The Northeast Land, across which we now concluded to travel, is the northernmost of the four great islands into which Spitzbergen is divided by several sounds and fiords. It extends 75 miles north and south, and about 70 miles east and west. The entire interior of this great island is covered by

ice to a height of 2,000 to 3,000 feet, to which the precipitation adds in the summer as well as in the winter, and which, therefore, would constantly increase, if not, as is the case with all glaciers, the mass would slowly but uninterruptedly flow off into the sea, causing ice-discharges similar to the mouths of rivers in more southerly regions. The principal direction of the ice-stream is in the Northeast Land to the eastward, and the east coast is, therefore, for the greater part, a steep ice-wall inaccessible from seaward—the broadest glacier known, much broader than the Humboldt Glacier in Western Greenland, described so vividly by Kane. Toward the north the inland-ice of the Northeast Land terminates generally in a gradual slope, extending, in some places, to the sea, but mostly leaving along the coast a narrow strip of land free from ice. No steep declivities prevent penetrating there into the interior.

After remaining a day at our last camp for geographical determination and short excursions in various directions, we started, June 1st, southward, in the direction of a hill in which the inland-ice terminated seaward, sloping gradually enough for our sleighs; but, after having made a few hundred paces, we were suddenly interrupted by a dangerous adventure, teaching us that we now had entered grounds with greater dangers than we had expected.

Like the glaciers of Scandinavia, Switzerland, Greenland, &c., those of Spitzbergen are also interlaced by perpendicular clefts through the entire mass of ice. They are caused by the motion of the ice, and occur only rarely where the glacier descends from a height to an extensive plain. We therefore were justified in assuming that we would not meet with them on the route we had chosen; and should there be any, I had hoped that they would be filled with snow by the snow-gales of the winter. In general this proved to be the fact. They were, at least, not so numerous or of such dimensions as in the part of the inland-ice of Greenland visited by Dr. Berggren and myself in 1870; but there were still quite a number, some almost bottomless, and many of them large enough to swallow our sleighs. They were the more dangerous as they were covered by a thin layer of snow so completely that they could only be detected by boring into the snow with a cane, and were frequently detected only by falling into them.

Before we had drawn the sleigh 100 feet we met a wide but not deep uncovered cleft, which we readily crossed on a bridge of snow strong enough to carry us and the sleighs, and, as we could not see other clefts, I thought

that the flat ice would be continuous and secure, at least until we should reach the other coast. But we had scarcely passed a thousand paces, when one of the men disappeared under the perfectly flat ice so suddenly that he had no time to cry for aid. Looking down, terror-struck, into the hole made by his body, we saw him hanging to the reindeer gear over a deep abyss, which had been covered by a thin layer of snow. In a few moments he was drawn up by a stout rope thrown to him. Had he slipped the gear, or had it broken, he would surely have been lost.

We now changed the gear so that it was less apt to slip; the leader was provided with a boat-hook, with which he was directed to examine each suspicious spot, and thus we proceeded. We passed innumerable clefts, the greater part of which were detected only when the snow-cover sunk before our feet, or when one or the other fell into it with his foot or half the body, which occurred so often, that soon it was hardly minded. Generally the leader succeeded in planting the other foot in time on the firm ground, or in grasping a sleigh or one of his companions; but there was many a fall, and I cannot commend sufficiently the intrepidity of the men.

The first day of our passage over the inland-ice the air was quite clear, permitting a good view, which showed that the strip of open water in the east and northeast had extended, but no land was discovered in that direction. The inland-ice widened to the southward and westward over mountain-ridges, (so-called glacier-holms,) rising gradually to an immense plateau 2,000 to 3,000 feet above the level of the sea, on the surface of which each puff of wind caused a fine snow-dust as troublesome as the desert-sand to the travelers over the Sahara. This dust polished the upper stratum of the glacier, consisting of hard-packed snow, not of ice, as in Greenland, in such a degree that it appeared as if we traveled over faultless white marble. At a depth of 2 to 3 yards the snow changed into ice, forming first into a stratum of beautiful great ice-crystals, then into granulous ice, and, finally, into hard and compact glacier-ice, the origin of which could only be detected by numerous bubbles filled with dense air.

During the remainder of the passage, June 1 to 15, either snow-drifts were prevailing which, when the wind blew strong against us, compelled us to remain for days closely packed in our canvas tents, or so thick a fog that we could see only a few yards. The ice, however, being at first very smooth, with exception of the few clefts referred to above, the fog did not retard much

our progress, as we were traveling by the compass; but soon the ice proved to be interlaced by broad channels, the walls of which were, in most places, too steep for our sleighs; and then the fog not only prevented us from selecting the least broken ground, but caused also an uncommon refraction of the light, so that we could not see whether a deep ravine or only one of a few yards in depth was before us. We were frequently compelled to lower one of the men by a rope to ascertain the depth. In many instances he did not reach the bottom; but sometimes a cleft, on account of which we had deviated considerably from our route, was thus proved to be only a few feet deep. The light was so very strange that on one occasion we mistook an ice-gull for a polar bear, and made preparations for hunting the latter.

We traveled an entire week over this difficult and dangerous ground at a height of 1,500 to 2,000 feet above the level of the sea; and just before leaving it, on the 15th of June, we narrowly escaped a great danger, a snow-bridge over a very deep cleft breaking the very moment we were to cross it.

It was originally our intention to proceed to Cape Mohn, thence along the coast to Cape Torell, from the latter over Hinlopen Strait to Thumb Point, and again over the inland-ice, past Chydenius Mountain, to Mossel Bay; but, beyond Cape Mohn, in the vicinity of Thumb Point, this route was barred by very difficult ground which we dared not enter, choosing the route to Hinlopen Strait by Wahlenberg Bay.

In the valley back of the latter bay, named after the celebrated botanist and geologist, we saw, June 15, the first flowers, a beautiful red *saxifraga*, as also the greatest glacier moraines I met in Spitzbergen. We reached Shoal Point in the night of the 23d of June. There a small boat, the *Sofia*, had been left, in which Captain Palander crossed, with three men, Hinlopen Strait. The weather was bad and the sea high. He arrived the following day in Mossel Bay. I remained with the rest of the men at Shoal Point to wait for the *Polhem*, or for a boat large enough for us and our effects, but before the latter reached us I engaged a fishing-sloop of Tromsø which arrived near our camp and brought us to Mossel Bay. From the master, who just had delivered to the *Polhem* provisions sent us from Norway, we not only heard the news from our little polar world, but also from the greater one, to the southward, from which we had now been absent a full year.

The ground over which we have passed in the Northeast Land furnishes, like the inland-ice of Greenland, an image of the condition of the Scandina-

vian peninsula and similar countries during the geological period which preceded the present, and in which men first appear. The study of these deserts throws therefore light, not only on the present physical condition of great regions of the earth, but also on the causes which have produced the present condition of the most advanced parts of the world. Thus there are here living documents for investigating the most recent period of the history of our globe; and I hope that, after a thorough examination of my observations, this our journey over the inland-ice will add to the knowledge of the latter many new and interesting data, perhaps of greater importance to science than those which we might have gathered if we had succeeded in reaching a parallel of latitude a few minutes higher than Parry's highest, which we could not have attained after our mishaps, even if the ice farther north had been more favorable than in the vicinity of the Seven Islands. In stating this, however, I by no means concur in the arguments which are advanced in some quarters against the expeditions to the north pole itself. On the contrary, I am convinced that there are, beyond the present limit of the part of the polar basin known to us, many highly important problems, the solution of which should be aimed at even if it can only be reached by the greatest exertions. I hope that our failure will not discourage further attempts to reach the pole in sleighs. Notwithstanding our failure, I am convinced of the correctness of the assumptions upon which our programme was based, and I will state my reasons in a separate paper. Even the most opposed views may combine in this simple question in an earnest but friendly discussion.

When we started on our northern trip I had hoped that the open water would soon extend to our anchorage, so that the *Gladan* and the *Uncle Adam* could start home in May, but I found them, on my return, still at the winter-quarters, just about to leave by a channel sawed through the ice.

This unexpected detention of all three vessels had shortened our provisions so much that it was impossible to remain with the *Polhem* until the autumn for a new attempt to push north. Instead of it, I concluded to make use of the remainder of the summer for deep-sea dredgings along the north coast of Spitzbergen, and for a geological examination of the Ice Fiord and the Bell Sound.

[From Dr. Petermann's "Geographische Mittheilungen" for 1874, pp. 65 et seq.]

COUNT WILTSCHECK'S EXPEDITION TO SPITZBERGEN AND NOVA ZEMLA IN 1872.

The purpose of this expedition (which was briefly noticed in the Third Supplement to the Papers on the Northern and Eastern Extension of the Gulf Stream, pp. 40 and 53) was to establish in the Arctic Sea a coal and provision depot for the Austrian expedition under Weyprecht and Payer, as far east as possible, and to avail of every circumstance for meteorological observations, geological researches, and geographical reconnaissances. The programme was to leave Tromsö in the middle of June for Spitzbergen; to ascend the Horn Sound Fiord, and leave there a maximum and minimum thermometer; then to cross over, in the middle of July, on the most direct possible course, to Nova Zemla; to establish the depot in the vicinity of Cape Nassau; and to sail for the mouth of the Petchora, whence the party was to travel home overland through Russia, while the vessel was to return with the collections to Tromsö.

The *Isbjörn*, which had been used the last summer by Weyprecht and Payer for their reconnaissance, was again selected, and refitted in Tromsö. The party, consisting, besides Count Wiltscheck, of Rear-Admiral Doblebsky v. Sterneck and Ehrenstein, of the Austrian navy, the geologist H. Höfer, Wm. Burger as photographer, Mühlbacher of Ebensee as hunter, and the Alpine guide Paierl, arrived at Tromsö June 17, and found the yacht ready for starting. The *Isbjörn* is a schooner of 65 tons, 63 feet long, with 18 feet beam, and was manned by six sailors and a boy under command of Master Kjölden. Her accommodations were very scant; there was a small cabin with only two berths, and two additional berths had to be fitted forward.

We left Tromsö on the 20th in tow of a tug, and, favored by wind and weather and without meeting ice, reached the South Cape of Spitzbergen on the evening of the 25th. The following night, however, the wind

increased so much, creating a heavy swell from the westward, that we were compelled to seek shelter under the lee of the eastern coast, where we saw the first drift-ice extending along the coast, and to the eastward and southward of it. After lying to for a day, we again doubled the South Cape, and resumed our course toward Horn Sound.

At the South Cape we did not find the strong easterly current observed by Weyprecht and Payer in 1871. South of the cape the drift was south-eastward, and in the opposite direction north of it. I must state here that in general we could not gather on our cruise data for the establishment of a system of currents. They corresponded in the open water with the direction of the wind, and in the ice they changed frequently in short distances. The wind also was very unsteady, evidently under the influence of the density of the ice and the direction in which it extended.

After we had passed the South Cape, the wind was mostly ahead, compelling us to beat. On the night of the 29th we saw the breakers off the entrance of Horn Sound, and, after entering the latter on the following day, found an excellent anchorage in a small bay, named by us Isbjörn Bay, on the north side of the sound. We made a survey of the bay and its vicinity, and some excursions over the glacier, in which we gathered some valuable geological, botanical, and zoological specimens. A hill, named by us Bird Mount, was the breeding-place of many thousand birds, which were so tame that they could readily be caught with the hand. As the Horn Sound Fiord was enveloped in thick fog, and remained so during our stay, we did not dare to ascend it, to leave on it, according to the programme, a maximum and minimum thermometer. The hunters also were not very successful; the Horn Sound is known not to have much game, and is, therefore, rarely visited.

The grandeur of the icy landscape, here as almost throughout the Arctic region, impresses the mind deeply and bears hardly any comparison. The glaciers which surround the sound extend to great distances, filling the valleys between the naked mountain-heads and ridges, and reach with their feet to the shore. Immense ice-blocks detach from them, with a noise as sharp as the roar of thunder, before the eye of the beholder, and fall into the water, to drift around in the open sea, clad in fog. But there are, notwithstanding the destruction caused continuously by the cold and the ice, and in strange con-

trast to it, small green oases in the protected places on the slopes on the sunny side of the mountains.

We left the Horn Sound July 5th, sailing back to the South Cape, which, on account of contrary winds, we were able to double only after three days' beating. We met now but little ice drifting south, and, therefore, concluded to take a northerly course for the ice-border north of Hope Island, in order to cross the basin between Spitzbergen and Nova Zemla as high north as possible. This route offered not only occasion for completing Weyprecht's observations of last year in this thus far only very little explored part of the Arctic Sea, but also a chance of meeting, at the ice-border or near Cape Nassau, with the Tegetthoff, which had taken the direct route from the North Cape to the Barento Islands. At first we were favored by the winds and by the ice relations, but about 20 miles northeast of Hope Island we encountered heavy ice through which we failed to break, even southeast of the island. We were compelled to pass to the southwest of the island in order to seek a channel through the ice in a lower latitude.

We passed the island, brightly illuminated by the sun, close to. To the southward of it we met two Norwegian fishing-vessels, which reported that very bad ice had prevented them from reaching Nova Zemla, and soon we encountered the same obstruction. On the evening of the 13th of July the rapid decline of the temperature of the water indicated its vicinity, the weather being heavy and a thick fog enveloping the entire horizon. While sitting at supper we were suddenly frightened by a heavy shock of the vessel, and, after reaching the deck, we found that we were in the midst of the ice. Colossal blocks of it were driven by the waves against each other; the little vessel was pushed and pressed from all quarters, and might have fared badly had we not succeeded in pushing, with a heavy press of sail, through the drifting masses into a comparatively open channel.

From that day we relinquished altogether the idea of attempting to reach higher latitudes in the open sea, the more as the ice-border, along which we had pushed through the drift-ice, trended more and more in a southerly direction; the Norwegian fishermen had found it reaching down to the parallel of 72° N. Nothing remained for us but to cling to the ice-border, working along it as close as possible for fourteen hard days, often

beset-entirely, until, on the morning of the 27th, we reached Nova Zemla, near Cape Britwin.

There we met a Norwegian yacht, the master of which informed us that there was considerable heavy ice to the northward of Cape Suchoi, where several Russian and Norwegian vessels were at anchor awaiting better ice-relations, and that he would endeavor to enter the Kara Sea from the southward. Under these circumstances we concluded to visit the Matotschkin Shar, and ascertain from there the best manner of reaching our object.

Nova Zemla, a spur or continuation of the Ural, does not contain as many high mountain-ridges as Spitzbergen. At the first glance no distinct ranges can be distinguished; numerous ice-clad peaks, confusedly grouped, appear sometimes close together, sometimes separated by extensive glaciers and snow-fields. From this white background, the mountains closer to the coast and more under the influence of the warm stream and the rays of the sun, and, therefore, like the strand, bare of snow, set off in dark forms. No glaciers reach to the coast southward of Matotschkin Shar; the vegetation is, therefore, advanced, and extensive areas, with a green juicy cover, furnish pasture for numerous reindeer.

The coast along which we sailed, with fair wind and beautiful weather, was picturesque, with varying scenery. The drift-ice, through which we had sailed until the morning before reaching Cape Britwin, had disappeared; the sea from north through west to south, as far as the eye could reach from the cross-trees, was as smooth as a mirror, and completely free from ice; there was not even any refraction of ice on the horizon, which had accompanied us thus far whenever there was no fog.

These sudden changes, which can only be caused by the influence of the direction of the wind, by the strong currents, the high temperature of the water, and by the sun, are strange and almost enigmatical. A vessel may be beset by the ice, surrounded by ice-fields extending as far as the eye can reach, and enshrouded in thick, dark fog; in a short time the ice-fields break, and channels open between them; a moment later the rays of the sun dissolve the fog, and the clearest horizon appears, with a most magnificent refraction of the ice, and but small remains of the latter lie singly on the vast surface.

On the morning of the 29th we entered Matotschkin Thar, and anchored

off the mouth of the Tschiravina, in company with four other vessels, two Russian schooners and the yachts of the brothers Ulve. The few days of recreation, which had become necessary, passing but too quick, were used for excursions into the interior. The examinations of Count Wiltscheck and Doctor Höfer furnish important data for the geological structure of this part of the island; the collected specimens will probably prove the connection of the island with the Ural range. A maximum and minimum thermometer was placed on the highest peak of the Matotschkin Shar, at an elevation of 4,000 feet above the level of the sea. A number of geodetical determinations were made and views obtained in pencil and by the photographer. The hunters added to the zoological, and especially to the ornithological, collection some new and interesting specimens. The results of these excursions show that many statements made by previous visitors regarding the island and the sea surrounding it are very unreliable.

The information of the state of the ice which the fishermen gave us was not encouraging. Half the Shar was still frozen, and the ice north of it was said to be quite compact. The vessels were waiting here for a chance to enter the Kara Sea either through the Shar or from the southward.

Thus there was only a slim prospect of meeting the Tegetthoff; the only chance being by pushing onward as rapidly as possible. We therefore left the Shar on the 5th; but the following morning, finding the ice drifting against us, we could only continue on our course close to the coast. At Suchoi Noss, the channel, between the extensive reef making out from the cape and the ice, was so narrow that we had to use great exertion and all our skill in passing it. To the northward of the cape, however, the channel widened to two miles on the average, allowing us to sail unmolested to the Admiralty Islands, which we reached on the 9th.

The difference in the formation of the mountains north and south of Matotschkin Shar is striking. The trend of the ridges in the northern part of the island is also difficult to distinguish; the numerous peaks overtopping the mass of snow and ice appear isolated, connected only by the grand glaciers which fill all the valleys to immeasurable distances and reach to the sea, the numerous bays and bights of which were all covered with firm ice.

North of the Admiralty Peninsula we met the Norwegian schooner *Eliaser*, Master Imbrigsen, who informed us that north of the Hump Islands

the ice was very unfavorable, heavy gales having driven it close to the shore; that these gales had caused the wreck of two Norwegian vessels; and that he had escaped the same fate only by anchoring in time in Cross Bay, from whence he had been able to rescue the crews of the two vessels and their cargoes. Nevertheless, we continued on our course, although we soon came to great masses of ice, through which we worked with much difficulty.

On the 10th the watch on the cross-trees thought that he could distinguish a three-masted vessel, the image greatly distorted by the refraction caused by the ice; and on the following day, after reaching the Hump Islands, we saw distinctly the three masts and the smoke-stack of the Tegetthoff lying northwest of us in the ice. We hoisted our flag and fired several signal-guns with our small cannon; but in vain, the little vessel could not be distinguished against the islands and the coast, from the Tegetthoff, and at noon we saw smoke ascending from her stack. I will not describe the hours of anxiety and doubt which followed. We strained all our energies in efforts to push through the ice, which was closing more and more, using the small channels between the islands, some of which we had to retrace after laboring through them for hours. On the 12th, after 24 hours of the greatest anxiety, we were at last recognized by the Tegetthoff, which still lay fast, about six to eight miles distant from us, and we found clearer water, permitting us to approach her. At 2 o'clock in the afternoon we boarded her in a boat. Taking advantage of a fresh southwesterly breeze, which sprung up, and of the lee of the land, the two vessels pushed on until on the following morning the heavy ice created a new barrier, compelling both vessels to make fast to the shore-ice of the Barento Islands.

Changing the original programme, according to which the provision-depot was to be established at Cape Nassau, we determined to place it between two natural rocky walls which we discovered on an excursion. We were still distant from Cape Nassau 20 miles, and would hardly have found there, for the depot, as good a protection against the attacks of the hungry polar bear. The unfavorable state of the ice, moreover, rendered any attempt to push farther north dangerous, as we were by no means prepared for wintering; the ice appeared to be impenetrable to a distance of five or six miles, the opening in which we anchored being hardly a mile in diameter, and even in this the vessels were beset completely several times; we had to be pre-

pared for slipping the ice-anchor at any moment, our only protection being a tongue of the shore-ice, against which the drift-ice continuously drove; had it been demolished, the masses of ice would have drifted directly upon us, and probably crushed the vessels against the shore-ice.

During our sojourn at the Barento Islands, to the 21st of August, we were thus prevented from excursions in the interior for examinations of the geological nature of the land. The vessels were separated from the Barento Islands by firm ice about two cables in width; this was used for exercising, for the first time, the dogs of the Tegetthoff with sleds. They rendered good service in landing the provisions and in carrying on board the drift-wood found on the shore.

Count Wiltscheck and Doctor Höfer availed themselves of every occasion for completing their geological researches; they added to their collection a number of petrefactions, proving the connection of Nova Zemla with the Ural. The botanist, however, found but a poor field; there were no spots of vegetation besides the summits of the Barento Islands, on which only a few crippled species of polar plants grow.

On the 28th the barometer stood quite low, continuing to fall the following days slowly but steadily; the sun had disappeared, the wind was unsteady, and the commotion of the masses of ice great. It had been agreed that the vessels should separate as soon as bad weather set in. There was for the Tegetthoff no chance of pushing east as far as Cape Tschelinskin to winter there. Captain Weyprecht, however, hoped to be able to double Cape Nassau, and reach, for winter-quarters, a harbor on the east coast of Nova Zemla, from where he could explore the regions east or north.

On the 22d the low barometer and a heavy NNW. wind gave the signal for starting. The Tegetthoff fired up; both vessels got under way, she steering North, and we WSW., looking for a channel through the ice. Shortly after, a snow-drift set in, and we lost sight of the Tegetthoff. About 5 p. m. the weather cleared; we were surrounded by ice, and could not distinguish the many summits of the land from the icebergs around us; a small channel of open water, trending northward, could be traced from the cross-trees. A boat lowered to hunt a polar bear, which was killed, was in great danger, and only with difficulty drawn over the ice.

A violent northerly gale prevailing the following days compelled us to

relinquish our intention of touching, homeward-bound, at some points of Nova Zemla. The night of the 22d we passed inside of Cross Island; on the 23d we doubled Suchoi Noss; on the 24th Cape Britwin; and anchored, after a stormy night, at noon of the 26th, with fair weather, behind the southern cape of Gooseland, at the entrance of the Kostin Shar. This part of the cruise had no interesting incidents; on account of thick fog and the stormy weather we saw the land but rarely. Off Matotschkin Shar we saw the last firm ice, extending close under the coast to the Shar. Beyond the Shar swimming icebergs came in sight, heralding free water and our delivery from the heavy masses of ice through which we had worked so many weeks. Our two days' stay at anchor off Gooseland gave us evidence that this region had been very little explored. There were none of the indications of visits from fishermen and hunters, which are found numerous elsewhere. The bays and islands, washed by quiet waters, are swarming with ducks; we saw also seal and reindeer, besides a splendid hawk and a few swallows; no animals, however, were killed. Doctor Höfer found here some interesting petrefactions.

We left our anchorage on the 28th, and sailed, with very fair weather and a fresh northwesterly breeze, through the Kostin Shar. At 11 p. m. we doubled the southern cape of Meshdusharski Island, from whence we shaped our course for the mouth of the Petchora Bay. By a storm in the night of the 29th we were, however, compelled to keep away from the low sandbanks off that river, resuming our course at noon of the 30th. In the night of that day we sighted Matwejen Island, and came to anchor, on the morning of September 1st, off Warandai Island.