SECOND SUPPLEMENT

TO THE

PAPERS ON THE EASTERN AND NORTHERN EXTENSION

OF

THE GULF STREAM.

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PAPERS ON THE EASTERN AND NORTHERN EXTENSION OF THE GULF STREAM.

[From Dr. Petermann's "Geographische Mittheilungen," 1872, p. 101 *et seq.*]

THE NORWEGIAN DISCOVERIES NORTHEAST OF SPITZBERGEN IN 1871.

Other cruises, besides the reconnaissance of Lieutenants Weyprecht and Payer, to the eastward of Spitzbergen in the season of 1871, in which valuable observations were made by the masters and important data for the correction of the charts of that region obtained, were briefly noticed in a previous publication. (See the "First Supplement to the Papers on the Eastern and Northern Extension of the Gulf Stream, published by the Hydrographic Office in January, 1872.) The following accounts of the two more important are from the diaries of the masters, which were kept in conformity with the instructions of the Norwegian Meteorological Institute at Christiania.

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I.

THE CRUISE OF SMYTH AND ULVE, JUNE 19 TO SEPTEMBER 27, 1871.

This expedition, undertaken by an English gentleman, Leigh Smyth, started from Tromsö at about the same time as that of Weyprecht and Payer, and it was agreed upon by the two expeditions to make all observations in the same manner. The vessel employed was the schooner "Samson," of eighty-five tons, with a Norwegian crew under command of the well-known Erik A. Ulve, Mr. Smyth not being a seaman.

The "Samson," leaving Tromsö June 19, followed the Norwegian coast as far as Sorö, and then steered north. At first, northerly winds prevailing, the temperature of the air was quite low, 35°.6 to 37°.4; on the high sea, however, it rose June 23 and 24, with that of the sea, to 41° and 42°.8.

Two days after leaving the coast, on the 25th of June, in latitude 74° 5′ N., the ice was encountered, and the temperature of air and water fell rapidly to and below the freezing point, as is always the case in the vicinity of ice. The schooner sailed for a day to the northeast in loose drift-ice, up to the border of thicker ice, in latitude 74° 48′ N., longitude 26° 20′ E.; thence she was kept along that border around Bear Island toward Spitzbergen, which was the first object of the cruise.

This border of thicker ice to the east of Bear Island trended E. N. E., in about the same latitude, (74½° N.) On the 30th the schooner was in latitude 74° 00′ N., near Bear Island, while Weyprecht and Payer, who had pushed directly into the ice, were beset on the same day only 20 miles to the north of the same place, (in latitude 74° 20′ N., longitude 21° 00′ E.) The same heavy ice prevented Smyth and Ulve from making Bear Island, and compelled them to round it to the south.

After a quick passage the latitude of the South Cape of Spitzbergen was made on the 6th of July, Prince Charles Foreland on the 8th, and the northwest end of Spitzbergen on the 13th. The highest temperature of the surface of the sea, 44°.6, was observed 50 miles S. W. of Bear Island, in latitude 74° N.; 42°.8 were carried beyond latitude 75° N., 41° beyond latitude 77° N., 39°.2 up to latitude 79½° N., and 37°.4 were observed even beyond the northwest extreme of Spitzbergen. Throughout this time (June 30 to July 13) fogs prevailed, and the temperature of the air was, on the average, 1° ower than that of the surface of the sea.

There was no ice seen from July 1 (when south of Bear Island) to the 14th, when the vessel had reached within two miles of Amsterdam Island. Now, however, it lay to the West, East, and North, as far as could be seen from the top of the highest mountain of that island, with the exception of a small strip of navigable water along the coast through which the vessel penetrated, from the 17th to the 28th of July, with short interruptions, to Shoal Point, (latitude 80° 17′ N., longitude 17° 40′ E.,) when thicker ice compelled her to enter Sorge Bay.

The temperature of the air along the north coast of Spitzbergen, from the 27th to the 28th of July, had been, with prevailing easterly winds, in the mean 36°.9, and that of the surface of the sea 34°.3. In Sorge Bay, with calm weather and sunshine, the temperature of the air rose on the 29th and 30th to 55°, the mean of the two days being 50°, while that of the sea remained at 37°, thus illustrating the power of insolation in bays and near the land. On the 16th of July, in Kobbe Bay, the temperature of the air had risen to 47°. In the Hinlopen Strait, into which the vessel proceeded southward on the 31st of July, both the temperature of air and sea fell to 32°. In Lomme Bay, where she lay at anchor on the 1st and 2d of August, the air showed in the mean 42°.3, the water 39°.2, the bay being, like Sorge Bay, entirely free from ice. Here one of the glass balls* was found which is used in the Norway fisheries, proving that the Gulf Stream, following the north coast of Spitzbergen, extends also into Lomme Bay.

The vessel remained in the southern part of Hinlopen Strait throughout August; first in Augusta Bay, where she lay from the 5th to the 11th, on account of ice to the southward and eastward, thick fogs and stormy weather. The mean temperature of the air, during that week, was 35°.6, and that of the surface water 32°.2.

On August 12 the vessel sailed south to William Island, where she anchored, first at Cape Breusing, the N. W. point of the island, and then at Thumb Point, the east point of it. At the latter anchorage she staid from the 15th to the 30th, waiting for the ice to the eastward to clear; it remained, however, so thick that no sailing craft could attempt to push through it toward King-Charles Land, which was seen repeatedly to the E. S. E., as also open water beyond the ice, in the same direction. On the 31st the anchor

* Torrell's expedition in 1861 had also found there some of these balls. (See Passarge, *Die schwedischen Expeditionen*, p. 229.)

was lifted and the vessel again turned north. The temperature of the air during this time had been, in the mean, 35°.2, and of the sea, 31°.6.

The southeast end of the Hinlopen Strait is evidently a very favorable locality for sealing in the ice which, drifting in from the E. and the N. E., accumulates there, the only outlet to the N. W. being, so to say, a funnel, as the strait narrows more and more in that direction.

Although the strait was still full of drift-ice, the vessel passed it very quickly, making 100 miles in one day, up to noon of September 1, when she was in latitude 80° 20′ N., close to the northern cape of Low Island, where but little drift-ice was found. Thence she followed the entire northern coast of the Northeast Land, first on a N. E., and, after doubling the North Cape, on an easterly course, making, to September 5, 90 miles in an air-line, or 100 miles on her courses, a distance which, in this high latitude (80½° N.) and on a northern coast, is quite considerable.

The average temperature of the air in these five days was 37°.2, that of the sea 32°.9, decidedly higher than that observed 1½ degrees farther south in Hinlopen Strait. The drift-ice was everywhere navigable; there appeared to be a thicker border about 20 miles to the north of the coast, between the Seven Islands and Charles-XII Island.

Smyth and Ulve penetrated in this region four degrees farther east than the Swedish expedition, or any observer before them. At their easternmost point (latitude 80° 27′ N., longitude 27° 25′ E.) there was, on September 6, "*open water before them, to the eastward and southward, as far as they could see,*" and that there must have been also considerable open water beyond their horizon, to the S. E., would appear from the abundant rain, with southeasterly winds, experienced during the following two days, the 6th and 7th of September.

That easternmost point of Smyth and Ulve is distant less than 200 miles, or only about a day's run of a good steam-vessel, from the northernmost point reached by Weyprecht and Payer only five days previous, on the 1st of September. It is of especial interest as regards the solution of the Polar question, that the navigability of this part of the Arctic Ocean, proven by the latter to latitude 78¾° N., was thus shown by Smyth and Ulve to extend two degrees higher north and, a little farther to the westward, even nearly three degrees, to 81° 24′ N.

On returning south the vessel made the Seven Islands and followed the chain to the northernmost (Ross) island, in latitude 80° 48′ N., where a landing

was effected on September 10. There was some drift-ice along the vessels track up to the Seven Islands and around the latter, but none whatever north of Ross Island to latitude 81° 24′ N., longitude 18° 35′ E., the northernmost point reached in this cruise, on September 11. There the ice was again encountered, but in so small pieces as not to be any obstacle to the further progress of even so small a craft as the "Samson." The lateness of the season, with violent gales from the westward, however, made the return advisable.

The above position is by logging, referred to an astronomical observation obtained in latitude 81° 20′ N., longitude 18° 42′ E. An observation of deep-sea temperature at the same time (September 11) showed 42° at 300 fathoms depth, while the surface-water was at 34°—a surprising result. The color of the water was blue.

From there the vessel sailed first on a S. W., and then on a S. by E. course to Wijde Bay, where in the evening of September 12th she anchored off Cape Petermann, the southern head of the bay, in latitude 79° 13′ N. Although it had during these two days blown quite strong, at times increasing to a gale, from the W., W. N. W. and N. W., the direction of the great East-Greenland Ice-stream, no indication of ice was seen throughout this stretch; it must consequently have laid at this time considerably to the west of it. The temperature of the sea averaged in these two days 35°, that of the air 26°.6.

From the 12th to the 16th the vessel remained in Wijde Bay, catching shark, and then sailed again north until in sight of Moffen Island, when, after anchoring off Welcome Point, she started homeward on the 19th of September. From that day to the 23d, she made nearly 600 miles, from latitude 80° 00′ N., longitude 13° 14′ E. (at noon of the 19th,) to 71° 26′ N., 20° 25′ E., (her position at noon of the 23d.) There was a little ice only at the N. W. cape of Spitzbergen, and nowhere else throughout that distance any trace of it; the mean daily temperatures were: September 19, water 36°.5, air 29°.5; September 20, water 35°.1, air 29°.5; September 21, water 36°.5, air 33°.8; September 22, water 38°.3, air 35°.6; September 23, water 45°.5, air 36°.9. The lowest temperature was observed off the southern cape of Spitzbergen on September 21, water 33°.5, and air 32°.0. Between latitudes 73⅓° N. and 70° N., the water had, from September 22 to 24, still a temperature of 42°.8 to 47°.1. There was also no trace of ice on September 22 off Bear Island, which was passed quite close.

On September 27 the vessel entered Tromsö, finding there a temperature of the air of 36°.

The following are the deep-sea temperature-observations made by Smyth and Ulve:

June 26.

Latitude	74° 38′ N.
Longitude	26° 57′ E.
Surface	32°.7.
Thirty-five fathoms	34°.0.
One hundred fathoms	35°.4.

June 26.

Latitude	74° 11′ N.
Longitude	28° 57′ E.
Surface	37°.6.
Two hundred and twenty-five fathoms	33°.1.

June 30.

Latitude	74° 00′ N.
Longitude	21° 20′ E.
Surface	37°.4.
One hundred fathoms	38°.5.
One hundred and sixty fathoms	33°.1.

July 1.

Latitude	73° 27′ N.
Longitude	20° 21′ E.
Surface	40°.1.
One hundred fathoms	35°.1.
Two hundred and fifty fathoms	33°.1.

July 5.

Latitude	75° 00′ N.
Longitude	13° 15′ E.
Surface	42°.3.
One hundred fathoms	33°.4.
Two hundred and sixty-five fathoms	34°.8.

July 6.

Latitude	75° 46′ N.
Longitude	12° 58′ E.
Surface	42°.8.
One hundred fathoms	34°.0.
Two hundred and fifty fathoms	33°.1.

July 7.

Latitude	77° 15′ N.
Longitude	13° 10′ E.
Surface	40°.8.
One hundred fathoms	35°.1.
Three hundred fathoms	32°.7.

July 10.

Latitude	78° 48′ N.
Longitude	10° 00′ E.
Surface	38°.8.
Fifty fathoms	30°.6.

July 10.

Latitude	78° 49′ N.
Longitude	9° 39′ E.
Surface	38°.8.
Seventy-five fathoms	30°.6.

September 11.

Latitude	81° 20′ N.
Longitude	18° 42′ E.
Surface	34°.0.
Three hundred fathoms	42°.1.

These observations are of the highest interest, especially on account of the remarkable difference between those obtained to the south and west of Spitzbergen and those north of it; the latter show, (in latitude 81° 20′ N.,) on the 11th of September, a considerable rise of the temperature of the sea downward, while the former, between 73° and 79° N. from the 26th of June to the 10th of July, with a single exception, when the lower surface temperature surely resulted from the more compact drift-ice, shows a decided fall of the temperature downward, thus coinciding with the general results of Weyprecht's observations. Possibly the remarkable and comparatively very great increase of the temperature of the sea down to 300 fathoms north of Spitzbergen may be caused by the immense depth of the sea in that region, the Swedish expedition of 1868 having obtained 1,340 fathoms near the spot where Ulve observed in 300 fathoms.

II.

CAPTAIN T. TORKILDSEN'S CRUISE FROM TROMSÖ TO SPITZBERGEN, JULY 26 TO SEPTEMBER 26, 1871.

The meteorological journal, only, of this cruise was sent in by the master. The observations are very valuable, the more so as they were made on the same system as those of Weyprecht and Ulve in other parts of that sea.

On leaving the coast of Norway, July 27, the temperature of the air in latitude 70° 15′ N. was still as high as 62°.1, and that of the surface-water 48°.9; from there to latitude 71° 30′ N., the latter fell to 44°.6 and to latitude 73° 00′ N. to 42°.8, and that of the air respectively to 47°.3 and 42°.8. From the latter position to Bear Island, where drift-ice was still found on the 30th of July, the temperature of the sea fell to 33°.8, in 76° 00′ N. near the southern cape of Spitzbergen to 32°, that of the air remaining a few degrees above the freezing-point. From there to 78° 26′ N. the temperature of the sea, however, rose again to 44°.2.

In Peter Winter Bay on the eastern coast of Prince Charles Foreland, (latitude 78½ N.,) the mean temperature of the sea between the 5th and 8th of August was 41°.5, that of the air 47°.1.

From the latter place, Torkildsen proceeded to Cross Bay, in which he remained from the 10th of August to the 15th of September, the first week in Ebeltoft Harbor, latitude 79° 08′ N., the mean temperature of the sea during these six days being 42°.3, and that of the air 45°.5, with about the same difference in the temperature of the sea and the air in all the observations; considerable ice was sliding from the glaciers into the sea. The other part of his stay in Cross Bay, Torkildsen spent in Julia Regina Bay, (latitude 79° 21′ N., longitude 11° 45′ E.,)* the northern extreme of Cross Bay. The mean temperatures there were: August 17 to 31, surface of the sea 37°.6, air 43°.2; September 1 to 15, surface of the sea 37°.4, air 40°.5. The highest temperature of the sea during this time was observed on August 20, with 41°, the lowest on September 15, with 31°.3; the highest temperature of the air on August 21, with 50°, the lowest on September 12, with 26°.2.

We find in the journal the following records: August 22: "No more icebergs; they have all drifted out to sea." August 31: "Small flakes of ice drift out of the fjord." September 11: "Great fall of snow; two feet."

* On the Swedish and English charts, the northern limit of this bay is 79° 16′ N.

On September 16 the vessel started homeward. The temperature of the air on that day was in the mean 30°.9, and that of the sea 34°.5, remaining about the same to the latitude of the South Cape, (76° N.,) and thence steadily increasing toward the south, in analogy with the observations of Ulve and Smyth. In latitude 73½° N. the temperature of the sea was, as the latter found it, 42°.8; on the 23d of September, down to latitude 72½° N. 44°.6.

The following deep-sea temperature-observations were made:

August 1.

Latitude	76° 34′ N.
Longitude	15° 52′ E.
Surface	37°.0.
Thirty-nine fathoms	35°.2.

August 1.

Latitude	76° 38′ N.
Longitude	15° 49′ E.
Surface	36°.0.
Thirty-nine fathoms	35°.2.

August 1.

Latitude	76° 39′ N.
Longitude	15° 43′ E.
Surface	35°.2.
Twenty-six fathoms	35°.2.

August 2.

Latitude	76° 45′ N.
Longitude	15° 36′ E.
Surface	37°.4.
Fourteen fathoms	35°.6.

August 2.

Latitude	76° 45′ N.
Longitude	15° 40′ E.
Surface	37°.4.
Fourteen fathoms	36°.0.

August 2.

Latitude	76° 44′ N.
Longitude	15° 40′ E.
Surface	37°.4.
Twelve fathoms	36°.1.

August 2.

Latitude	76° 51′ N.
Longitude	15° 25′ E.
Surface	36°.7.
Thirteen fathoms	37°.0.

August 2.

Latitude	76° 54′ N
Longitude	15° 20′ E
Surface	36°.7.
Eighteen fathoms	37°.0.

August 2.

Latitude	76° 53′ N.
Longitude	15° 04′ E.
Surface	37°.4.
Forty-seven fathoms	35°.6.

August 4.

Latitude	78° 08′ N.
Longitude	12° 39′ E.
Surface	44°.1.
Forty-seven fathoms	39°.6.

August 8.

Latitude	78° 32′ N.
Longitude	11° 26′ E.
Surface	41°.7.
Eighteen fathoms	29°.3.

August 8.

Latitude	78° 32′ N.
Longitude	11° 26′ E.
Surface	42°.1.
Eighteen fathoms	30°.6.

August 8.

Latitude	78° 32′ N.
Longitude	11° 26′ E.
Surface	42°.8.
Seventeen fathoms	29°.8.

August 9.

Latitude	78° 59′ N
Longitude	11° 20′ E.
Surface	41°.9.
Twenty and one-half fathoms	37°.8.

III.

SMYTH AND ULVE'S DISCOVERIES.

As to the discovery and survey of new land, the results of Smyth and Ulve's cruise are more important than those of any cruise between East Greenland and Siberia in the last decades.

The Northeast Land of Spitzbergen has been found by them to extend across 10½° of longitude instead of the 7½°, between which it has been shown heretofore on all charts, and a single glance at the new chart (compare that of the Arctic Ocean between Greenland and Nova Zembla, published by the United States Hydrographic Office, January 1872) will show how much the Spitzbergen group has been changed by this.

The recent examinations of the Kara Sea by the Norwegians, though important, did not result in changes of the configuration of the land; the reconnaissances of Mack, Johannesen, Carlsen, and Derma, on the northeastern shores of Nova Zembla, merely restored their outlines to the shape which was given them by the Dutch three hundred years ago; the exploration of the Nova Zembla Sea by Weyprecht and Payer added no new land to the chart; the discovery of King-Charles Land, by Von Heughlin and Count Zeil, is only a confirmation of the old Wiche-Land of Pellham; none of the Swedish expeditions to Spitzbergen brought discoveries of land, neither did the otherwise unsurpassed cruise of Parry to latitude 82¾° N. in 1827; the coast of East Greenland, surveyed by the German expedition to 77° 01′ N., was shown on charts, as early as 1670, to extend to latitude 78½° N., longitude 20° 00′ W.; and Daines Barrington, one of the best authorities for Arctic geography, records that in 1775 East Greenland had been ascertained to extend to 79½° N., and thence probably still farther to the N. N. E.*

The Northeast Land had been circumnavigated before Smyth and Ulve's cruise, but no observations were obtained to fix its limits; its great extent, ascertained by Smyth and Ulve, was entirely unknown, and on all the charts the coast was represented as turning, beyond Dove Bay, directly to the southward, while it actually extends fully three degrees farther to the east.

On the Arctic charts, from those of Keulen to those of Scoresby, Northeast Land is shown as a narrow island, about 6° of longitude in width. On

* Compare Barrington and Beaufoy: "The possibility of approaching the North Pole." London, 1818, p. 160.

Barrow's chart, published in 1847,* it is 1½° wider, and so it was generally represented after Torrell's surveys in 1861. This incorrect representation is the more remarkable, as, otherwise, East Spitzbergen has been pretty well known for centuries. Keulen's chart, for instance, shows William Island as well as the Bastian Islands and Bismarck Strait quite correct, and it was probably only through inadvertence that the former was represented on the Swedish chart as a promontory of the main, and thus copied into the British Admiralty chart.

The extension of the Northeast Land 3° farther east has been ascertained by Smyth and Ulve on the southern coast as well as on the northern. Having ascended, on the 9th of August, the summit of the heights near Cape Torrell, Captain Ulve saw that the land does not turn at Cape Lindeman (the foot of the Rosenthal glacier,) to the N. E., but that it forms there a bay; and beyond, a long stretch of low land protruding considerably to seaward, another bay, (the third on that coast,) with glaciers over its head, then finally terminating in a promontory which bends to the N. E. This was verified on the 19th of August, from a mountain of William Island, 1,300 feet high, near Thumbpoint—its eastern cape—and is also fully corroborated by bearings obtained by Von Heughlin, in 1870, at Cape Heughlin on Edge Island.†

The Bastian Islands, according to Ulve, are 20 in number, (not eight, as heretofore represented,) of various size and lying nearly in a circle; the northern are higher and greater than the southern, and at greater distances from each other; the three southwesternmost are close in shore, nearly midway between Cape Weyprecht and Thumbpoint.

Captain Ulve repeatedly saw King-Charles Land, and took bearings to its peaks.

The easternmost point reached by Torrell's expedition north of Northeast Land was in latitude 80° 25′ 52″ N., longitude 23° 35′ 15″ E. Smyth and Ulve came 4° farther east; the northeast point of Northeast Land they ascertained to be in latitude 80° 10′ N., longitude 28° 08′ E.

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* Barrow: "Arctic Voyages of Discovery." London, 1847.

† Von Heughlin says, in his "Spitzbergen," Vol. I, p. 190: "On Cape Heughlin I again took azimuths, especially toward north, where unluckily the horizon was very foggy. Far behind the three northernmost high and steep peaks on the eastern coast of Barents Island, between which glaciers extend to the sea, I believed I could distinguish land shaped like an insular promontory. If I was not deceived, *there must be high land east of Cape Torrell, and of the Mary and Rosenthal glaciers, to nearly the 25th degree of longitude.*" Ulve's Cape Mohn is exactly on that meridian, and thus Von Heughlin is really the discoverer of this great extension of Northeast Land.

IV.

THE SEA NORTH OF SPITZBERGEN, AND THE MOST NORTHERN METEOROLOGICAL OBSERVATIONS.

The discovery by Weyprecht and Payer of an open and navigable sea east of Spitzbergen has caused astonishment, and was even doubted in some quarters, where it was firmly believed that as low as in latitude 75½° N. impenetrable ice—"an icy bulwark built for eternity"—bars all progress.* How Weyprecht and Payer happened to push farther, will be seen from their preliminary report, and fully from their extended account, soon to be published.

Lamont, on the 6th, 7th, and 12th of July, 1871, in his excellent screw-steamer, off Amsterdam Island at the northwestern end of Spitzbergen, (latitude 79¾° N.,) records in his diary, "I find here the ice worse than ever; * * it seems to me that there must be a sort of permanent settling down of the northern ice against the banks of Spitzbergen of late years." But notwithstanding this bad ice, Smyth and Ulve came in their frail sailing craft with ease to 81° 24′ N. and 17 degrees of longitude to the eastward of Amsterdam Island, and found there open and navigable water.

These are, indeed, strange contradictions. We meet such, however, in geographical research frequently, not only beyond the Polar Circle, but also in the Tropical Zone and other parts of the globe. Scoresby's "Account," for instance, is justly considered one of the best authorities for the Arctic regions; but to follow it blindly, without regard to other authorities, would be folly. He speaks of the climate of Spitzbergen (Vol. I, p. 135), in 1820, as follows: "The climate of Spitzbergen is no doubt more disagreeable to human feeling than that of any other country yet discovered. Extending to within ten degrees of the Pole, it is generally intensely cold, and even in the warmest months, the temperature not averaging more than 34½°, it is then subject to a cold, occasionally, of three, four, or more degrees below the freezing-point." The Swedes, by no means optimists in regard to the Polar question, on the contrary, say on the same subject in their report of the expedition of 1864: † "It may be boldly stated that there exists on the globe no healthier, and, to

* "The ice, the main ice, lies there (east of Hope Island) forever," is the expression used by Lamont.

† Passarge. The Swedish Expedition, p. 432.

the human body, more beneficial summer climate than that of Spitzbergen. Throughout the three summers in which the Swedish expedition visited it, not a single case of catarrh, diarrhœa, fever, or any other sickness, has occurred on the ships of the expedition. * * * We would not be astonished if physicians should send their sick high north in order to regain health and strength." Further, in their report on the expedition in 1868, they state:* "The cruises, for pleasure and sport, of the English to Spitzbergen during the hot summers of European latitudes, may shortly become so frequent that we may see, each summer, steamer excursions into that region, and the building of a summer hotel in Spitzbergen is not less probable than of one on the summit of the Alps. For some sick, a summer sojourn in Spitzbergen may even be pleasant and advantageous; we have observed, for instance, our breathing to be far more free and unrestrained than in central and southern Sweden, complaints of the chest not occurring at all; and there occurred among our crew not one case of cold, cough, or catarrh."

It is certain that we now know the climate of Spitzbergen far better than Scoresby did; the results of Smyth's, Ulve's, and Torkildson's temperature-observations, moreover, differ from the description of Scoresby, which refers more to the icy border west of Spitzbergen than to that of the island itself. It may therefore be well to review briefly its temperature relations, and more especially those of the northern coasts lying in about latitude 80°, as near the Pole as observations have been obtained.

From their high latitude and northern exposure, these coasts are extremely unfavorable for the development of warmth. Although washed at times by a weak branch of the Gulf Stream, they lie directly in the throat of the Polar stream, setting at all times against them and carrying there uninterruptedly the drift-ice of the Central Polar Basin. But notwithstanding these icy relations, the power of insolation is there very great and wonderful in its results. The observations of Torrell's expedition of 1861, which had for its especial object the exploration of this northern coast, and is therefore the most reliable authority for its climate, bears evidence of this. We find the following statements in the narrative of this expedition:†

* Compare the letters from the Swedish Expedition dated Seal Bay, August 27, 1868, communicated in the Geographische Mittheilungen for 1868, p. 434.

† Passarge. Die schwedischen Expeditionen, pp. 106, 172, 174, 188, 200, 240, *et seq.*

"The summer was setting in rapidly (in Sorge or Treurenberg Bay), June being the spring month of Spitzbergen. The sun rose higher, and his rays were by no means powerless. The snow first softening, then saturated with water, disappeared in places entirely. The water-pools changed to sweet-water lakes. On the hill crowned with the Æolus cross and on the low promontory near the graves, the only places free of snow on our arrival, *Cochlearia fenestrata* and the Polar willows began to open their buds on the 11th of June. On the 22d we had the first flowers of *Saxifraga oppositifolia* as a sign that the sun of high summer had conquered the winter. On the 26th, *Draba alpina*, *Cochlearia*, *Cardamine bellidifolia*, and *Saxifraga cernua* flowered, as also here and there *Oxyria* and willows, and in the beginning of July, *Cerastium alpinum*. But it was not alone that snow, ice, and plants showed the increasing influence of the sun; animal life also began to appear. Small *podures* jumped lively over the snow; as early as on the 7th we found on Mount Hecla, more than 1,500 feet above the level of the sea, a great number of mosquitoes; and on the 21st we caught, near the Æolus Cross, butterflies which, however, dared to rise only a few feet above the ground. Here and there small spiders were seen, and in the wet mud a species of worms of the shape of our grubs.

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"During our stay in the bay the thermometer remained mostly at the freezing point; after the 22d of June it never fell below it; at one time it rose in the sun even to 59°. The average temperature in June, inclusive of the cold days at the beginning of the month, while beating off Red Bay, from 305 observations, was 35°. The increasing temperature of the air, the resurrection of vegetable and animal life, the melting of the snow, the parting of the ice in the bay and on the coasts and its melting at the edges, all resulted from the never-setting sun rising, at noon, over 30° above the horizon. The water also, although replete with huge masses of ice, showed unmistakably a rise of temperature. While in the first week it remained below the freezing-point, and even fell to 29°.3, it now often rose above the freezing-point, and at times even to 36°.5, melting the flakes of ice swimming about, which thus again decreased its temperature.

* * * * * * *

"In the beginning of June the summer set in with that astonishing rapidity of which the inhabitant of southern regions can hardly form a per-

ception. The snow, in the last days of June, still covered hills and valleys, and the ice in the interior of the bays appeared to be able to defy the little strength of the Arctic sun; but we soon witnessed how, even in the 80th degree of latitude, the latter possessed the power to call sleeping nature to life, as if with a magic wand. The borders of the icy masses, undermined by the swell, broke and tumbled into the sea; then the ground-ice, attacked alike by the waves and by the sun, parted into immense blocks and followed. One could see the naked spots on the slopes and in the plains growing in size from hour to hour; where we had but just been sliding with snow-shoes, torrents of water descended, carrying along the earth and *débris* of the terraces and slopes. The water accumulations in the plains extended more and more; they made excursions difficult, and gave many of us an unwelcome icy bath. Plants began to show and to grow rapidly into leaves and flowers; in short, spring had turned into summer. The temperature now rose at times to 52° in the shade, the sun's powerful light affected the eye, the heat became oppressive, and from the rising vapors the lower air lost its transparency.

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"The promontory near which our ship lay ascends in terraces to Mount Hecla. Disrobed of its winter cover the ground, with its surface of loose slate, hyperit, and lime-stone fragments, looked like a plowed field, with some *Saxifragæ*, *Drabæ*, *Cardimine bellidifolia*, and *Cerastium alpinum*, now in full bloom, interspersed over it. On the sweet-water ponds the *Fjäreplytt* (*Tringa maritima*) could be seen in small groups hunting worms, and now and then also the beautiful *Phalaropus* picking *algæ* (*Nostæ commune*), of which there were plenty, but still undeveloped. The eider-geese had already laid their eggs in their simple nests. On the strand, especially at the mouths of the small creeks, there were great numbers of *Kryckiæ* (*Larus tridactylus*), with "sea-horses" and sea-swallows (*Sterna arctica*), always in motion and noisy, devouring *Limacinæ*, muscles abounding in this season on the coasts of Spitzbergen, especially in the fiords and in the vicinity of the glacier-water, and always keeping on the surface.

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"The firm ice was (on the 15th of July) so weak that we frequently sunk to the armpit, when believing it perfectly firm."

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"All of the ice which to the 17th had been west of Low Island (latitude 80½° N.), and which had caused us so much trouble, had completely disappeared two days after.

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"On Parry Island (80⅔° N.), nearly every day, from the 28th of July, we had rain; much open water must consequently have been in the vicinity, notwithstanding the high latitude. The mountains also now began, for the greater part, to be free of ice and snow, and even in Lomme Bay, in Hinlopen Strait, which is considered to be among the most unfavorable regions as regards the climate, the results of the sun became very marked. We found that bay to be an excellent place for hunting; nine reindeer were killed in a short time, and these animals were now so fat as to be a heavy load for our boat, proving how quickly and powerful vegetation and animals develop during the Arctic summer.

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"Parry saw no ice in September between Treurenberg Bay and Cloven Cliff; he believed that it would not be difficult to penetrate north of the Seven Islands to latitude 82° N. Captain Haugan, of the brig Jan Mayen, stated to me (Torrell) that the ice disappears there in August, no one knowing how or where to; and we also had occasion to see how rapidly the shore-ice melts, the strong current being probably the principal cause of this, as well as of the rapid decline of the sea-ice. The temperature of the water is highest in the latter part of the summer; we found it never below 35°.6; the blocks of ice, as soon as surrounded by open water and a warm current, must diminish rapidly; from all this it may readily be assumed that a steam-vessel could, in that season, circumnavigate Spitzbergen and obtain important results. All the previous expeditions have remained there only to the beginning of the autumn, and the attempt was therefore never made. The whalers leave this region usually in the first part of the summer, the Greenland whale ascending higher north with the drift-ice, in the vicinity of which it generally keeps. It was our intention to attempt the circumnavigation of Spitzbergen, but the Æolus, not being a good sailing craft, the crew were averse to it, as they feared they might be compelled to winter in the ice. It was, therefore, finally concluded to return west and to resume the exploration of the western coasts. We lifted anchor on the 29th. There was a light breeze from the southeast, with a strong swell from the northeast, indicating the ice to be at a great distance in that direction."

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In addition to these important statements, we find in the Transactions of the Swedish Royal Academy the following passage from a discourse delivered by Torrell before that institute: "All the bays on the north coast of the Northeast Land are, about this time (August 15), either already free of ice or bridged by a weak shell, which probably will disappear before the winter sets in. *Firm ice, remaining throughout the summer, is not found on the coast of the Northeast Land, and a vessel would have to go high north in order to find ice which remains firm throughout the year.*"

Some have ventured the opinion that the sea explored by Weyprecht and Payer was only accidentally, or for the time, open and free from ice, the firm border having receded somewhat to the north or melted off; but in the above statements we have the proof that there is no permanent ice even in latitude 80½° N., in the very throat of the Polar current, on a coast against which all the year the icy masses of the Central Polar Basin press. It might be said that these observations are only for two years, 1864 and 1871, but for the latter we have more observations than for any previous year from the beginning of explorations in the Arctic. There was no firm, impenetrable ice off Eastern Greenland, none around Spitzbergen, in the Nova Zembla Sea, around Nova Zembla and in the Kara Sea; and even as far in the Siberian Arctic Sea as longitude 82½° E., no indication of ice was encountered by Mack.

Ulve and Smyth met loose drift-ice in the very Polar Stream north of Spitzbergen, not lower than latitude 81° 24′ N., on the 11th of September; all the ice, against which they had to battle some weeks before, on the parallel of latitude 79° 50′ N., extending then as far as the eye reached, had completely disappeared; and at that highest point the temperature of the air was 32°, and of the sea it was 36°, while Kane observed at Rensselaer Harbor (his winter-quarters), in latitude 78° 37′ N., nearly three degrees more south, a mean daily temperature on September 11, 1853, of 16°.7 (highest 19°.8, lowest 14°.2), and on September 11, 1854, respectively 10°.4, 19°.0, and 2°.3.

It is true, that in the same direction as that followed by Smyth and Ulve, Parry, in 1827, fell in with ice drifting S. W. with the great and powerful East Greenland current, but he met nowhere with firm or even connected ice, and by no means with the icy bulwark built for eternity, which, in the fancy of some, lies fully six degrees farther south, off East Greenland.

The importance of these northernmost temperature observations will be seen by everybody. There are only $7\frac{1}{4}°$ of latitude from Parry's highest point to the Pole. If the sun acts thus powerful from latitude 80° to $82\frac{3}{4}°$ N., how extraordinary must be the result of its action where it remains for six months uninterruptedly above the horizon.*

In the high north, however, the difference between eastern and western coasts, which we find farther south, must never be lost sight of. There is, especially north of Spitzbergen, an important dividing line between the warm southern (the Gulf) stream and the northern or Polar stream with its drifting ice. The result of all the observations thus far confirms the extension of these two streams into the highest latitudes, exactly in the shape in which they were shown on the charts published previously (with the papers on the extension of the Gulf Stream). A warm stream, comparatively free of ice, runs to the north, on the eastward of a cold stream, constantly carrying more or less ice southward.

Ulve's observations are striking also in this respect: As long as he remained off the eastern coasts of the Northeast Land the temperature of the air never fell below the freezing-point; when, on the 9th of September, he came within reach of the westerly winds, resulting from the Polar Stream, it fell below the freezing-point, marking lowest with W., W. N. W. and N. W. winds.

Previous cruises in these high latitudes also confirm this, even the northern cruise of Scoresby, whose observations are limited to the region west of Spitzbergen. On the 24th of May, 1806, he had penetrated to latitude 81° 30′ N., longitude 19° E., where he found the ice trending E. N. E., while there was open water in a semicircle from E. N. E. to S. E. as far as the eye could reach.

The narratives of older date also record open water to the north of Spitzbergen, in an easterly direction, or at least indications of such. Captain Wheatley, for instance, came, in 1766, to latitude $81\frac{1}{2}°$ N., and found there open water and a heavy swell from the N. E., indicative of open water to a great distance in that direction. Captain Clark, in 1773, reported the same. Others found frequently a similar state at the Seven Islands, and all

* Compare the paragraphs "Climate of the Pole" and "The question of an open Arctic Sea," in Meech, "on the relative intensity of the heat and light of the sun upon different latitudes of the earth." (Smithsonian Contributions to Knowledge, November, 1856.)

who have been off the coasts of Northeast Land (as now Smyth and Ulve) assert that they have seen only open water, some adding, conscientiously, that they could not say how far it reached, as no one had yet followed it.*

The following notes, referring to the same question, were received by Dr. Petermann from British whalers:

1. From Captain William Willis, at Hull, master of the whaler Sarah Elizabeth: "In the beginning of May, 1848, I had penetrated to latitude 82° N., longitude 15° E., and found there to the north and to the west a complete barrier of ice; *but to the east there was but open water, as far as I could see in clear weather.*"

2. From Dr. Whitworth, surgeon of the whaler Truelove, of Hull: "In 1837 we came to latitude 82½° N., between the meridians 12 to 15° E., where there was to the northeast an open sea, completely free from ice."†

This also appears to have been early in the season. In the narrative of the Swedish expedition it is stated that the Norwegian hunters penetrate to the Northeast Land as early as April.

From the above reports it is evident that this part of the Circumpolar Sea also is navigable from April to September, for fully six months. At Fruholmen, the northernmost station for regular observations of the temperature, the sea has the highest temperature from June to December.

Another important experience made by Weyprecht and Payer last summer—the less heavy quality of the ice east of Hope Island and its sudden and complete disappearance—has also been observed previously; for instance, by Captain I. Gravill, master of the whaler Abram, who reported as follows: "While whaling in June, 1845, east of Spitzbergen, I came within 30 miles E. N. E. of Hope Island, and found the ice to be there thinner than farther westward, being but 4 to 5 feet thick. Walrus hunters of Hammerfest told me that in September the ice had disappeared east of Spitzbergen, and that the sea there was open."

All the observations of the Swedes, Norwegians, British, &c., among them such authorities as Scoresby, senior and junior, are in harmony with the results of the cruises of the last year, and by combining all of them the wonderful contrasts between the eastern and western sides of the North Atlantic Ocean can be followed to Spitzbergen and far beyond. When Parry,

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*Barrington and Beaufoy. The possibility of approaching the North Pole, pp. 65, 67, 159, 239.

†Athenæum, December 3, 1853.

in 1827, could, even in the Polar Stream, penetrate to latitude 82¾° N., it is evident that a properly built steam-vessel must be able to reach in the navigable Eastern Sea a much higher latitude. Practical navigation is pressing there, every year, higher and higher. The journals of not less than thirteen cruises of last year have been sent to Dr. Petermann, of which the following is a short extract:

1. James Lamont (steam-yacht Diana), to the Greenland Sea and Spitzbergen, from May 1 to August 15, 1871.

2. Master W. Simonson (schooner Sleipner), to Nova Zembla and the Kara Sea, from May 13 to September 14, 1871, when the vessel was lost by striking a bank on the homeward passage.

3. Master E. Carlsen (sloop Solid) starts from Hammerfest May 19, 1871; circumnavigates Nova Zembla; finds Barent's winter-house (159⁶/₇); traverses the Kara Sea September 15 to October 5; passes through Kara Strait October 6; returns to Hammerfest November 4, 1871.

4. Captain F. C. Mack (schooner Polarstjernen) starts from Tromsö May 22, 1871; circumnavigates Nova Zembla, penetrates in the eastward to 82° 20′ E. in latitude 75° 25′ N. (on September 12); traverses Kara Sea September 16 to 25; passes Yugor Strait September 26, and returns to Tromsö October 7, 1871.

5. Master I. N. Isaksen (schooner Skjön Valborg) leaves Tromsö June 6, 1871; off the northeast coast of Nova Zembla in August; returns to Tromsö October 6, 1871.

6. Master Hans Chr. Johannesen (yacht Lydianna) leaves Tromsö June 9, 1871; arrives off the northern end of Nova Zembla June 27; in Matotschkin Scharr August 8, 1871.

7. Master Ed. H. Johannesen (schooner Nordland) leaves Tromsö June 10, 1871; reaches the northeast Cape of Nova Zembla July 7; passes Kara Strait August 26; returns to Tromsö October 3, 1871.

8. Captain Sören Johannessen (yacht Cecilia) leaves Tromsö June 10, 1871; reaches Russian Harbor June 30; on returning passes Kara Strait August 28; after traversing the Kara Sea off White Island, September 6; makes the northeast cape of Nova Zembla September 16; northeasternmost point reached on September 9 (latitude 77° 02′ N., longitude 76° 34′ E.), no ice there; traverses Kara Sea a second time; passes through Yugor Strait September 28; arrives back at Tromsö October 27, 1871.

9. Captain S. Tobieson (yacht Freya) leaves Tromsö June 11; reaches the northeast cape of Nova Zembla June 27; in Matotschkin Scharr July 31; traverses the Nova Zembla Sea; highest point reached August 11: latitude 78° 07′ N.; longitude 41° 55′ E.; at Hope Island August 16; remains off Spitzbergen to September 7.

10. Captain E. A. Ulve and Leigh Smyth (schooner Samson). See account, page 4, *et seq.*

11. Weyprecht's and Payer's expedition. See first supplement.

12. A. Rosenthal's expedition (steamer Germania) leaves Tönsberg July 8; returns to Bremerhaven November 3, 1871.

13. Captain T. Torkildsen (yacht Ellida) leaves Carlsö July 26; returns September 26. See account on page 9.

V.

GILLIS LAND AND KING-CHARLES LAND.

There are in the Central Polar Basin islands and greater aggregations of land which have been sighted long ago but not yet reached.

Gillis Land, seen as far back as 1707, has become shrouded in a kind of mystery, as was formerly Baffin Bay, in which, in 1818, scarcely any one would believe, its discovery in 1616 not having been verified to that time.

On charts of older dates Gillis Land is placed as a promontory between the parallels of latitude 80° 00′ and 80° 10′ N., about 5 degrees to the eastward of Northeast Land. We find no authoritative record of it between 1707 and 1865. In August of the latter year the Swedish Expedition under Nordenskiöld having ascended White Mountain, 3,000 feet high, on the east coast of Spitzbergen, reported: "The view from this peak is probably the grandest to be found on Spitzbergen. To the east, at a distance of about 80 miles, we saw high land with two peaks overlapping mountains behind them, apparently the most westerly salient of a great and heretofore well-nigh unknown Arctic continent which, although discovered as early as 1707 by Captain Giles, has been forgotten, and is not shown on the more recent charts."* On the chart published by the expedition† that land is represented as a promontory 13 miles in width, between the parallels of latitude 78° 50′ and 79° 03′ N., in longitude 28½° E., and named Gillis Land, although there is a difference of 75 miles between the latitude assigned to the latter by Captain Giles and that of the Swedish Expedition. This identification of the two discoveries, or their representation as a connected land, is hardly justifiable; the less so as another discovery east of Spitzbergen stands on record, that of Wiche Land, said to have been seen before Giles's time, in 1617, by the English whaler Wiche, and represented on Pellham's chart between latitude 75¾° and 78⅓° N., more in accord with the Swedish discovery.

Several Norwegian masters, as Carlsen, C. H. Johannesen, Mattilas, Tobiesen, Aström, &c., have also seen the Swedish Foreland, but no land to

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* Passarge. *Die schwedischen Expeditionen*, p. 473.

† Karta öfver Spetsbergen, hufvudsakligast enlight jakttagelser under de svenska expeditionerna åren 1861 och 1864. Af. N. Dunér och A. E. Nordenskiöld. Stockholm, Maj 1865. (K. Vetensk, Handl. Bd. VI.) Republished by the British Admiralty, 1865, and now published, with corrections from the late explorations, by the United States Hydrographic Office.

the north of it, although such probably exists, as would appear from the reports of Birkbeck and Newton in 1864.

In August, 1870, Count Zeil and Heuglin saw the Swedish Foreland from Middendorff Peak, 1,500 feet high, near Freeman Strait, and determined its position more accurately (making it about 2° to the westward of the Swedish position), and they also saw to the east of it, plainly, more extensive land, with numerous peaks stretching southward from the parallel of latitude 79° N., to about 78° N., as far as the eye reached. (Compare "Papers on the Gulf Stream," p. 188). This discovery has been doubted by some, but the two gentlemen are fully convinced that they were not deceived; they named the land after the King of Würtemberg—King-Charles Land.

As that land appeared to terminate north with the parallel of latitude 79°, it cannot be identified with Gillis Land, which was reported 70 miles farther to the north. It is unfortunate that the chart of Gerard Van Keulen has been selected to base upon it the more recent charts, as it is but mediocre, and, as regards correctness, surely not so reliable as some charts of older date. According to the best data we possess of the discovery of Captain Giles, Gillis Land will have to be placed, not as on Van Keulen's chart, 55 miles E. S. E. of Cape Smyth, *but* 100 *miles northeast of that cape, in about latitude* 81½° *N., longitude* 36° *E. of Greenwich.**

There are arguments and indications supporting this. William Baffin, in 1816, two years before he discovered Baffin Bay, penetrated northeast of Spitzbergen, to latitude 81° N., and there believed that he saw land extending to latitude 82° N.†. Russians who have wintered in the northern part of Spitzbergen have always observed in the spring (April) numerous wild geese, ducks, and other birds flying toward the north, and in September returning south.‡ This is confirmed by observations of Torrell's Expedition: "On the 23d of May, 1861, while off the northwestern coast of Spitzbergen, great flocks of geese (*Anser bernicla*) were seen flying in a northeast direction, probably *to a more northern land than Spitzbergen.* The walrus-hunters are convinced of the existence of such land, as they have, even in the highest latitudes, seen birds pursuing their route in rapid flight in that direction." §

* Barrington and Beaufoy: "The possibility of approaching the North Pole," pp. 144 and 145.

† The same, pp. 40 and 41. See also Dr. I. R. Forster's chart of the land around the North Pole, of 1783.

‡ Barrington and Beaufoy, pp. 144 and 145.

§ Passarge. *Die schwedischen Expeditionen*, pp. 37 and 38.

The most northern land north of Spitzbergen, known with certainty, is the small group of the Seven Islands; the walrus and Polar bears, found there in great numbers, are indications of land beyond that group, probably to the northeast. In 1862 Norwegian hunters killed there many walrus; in 1863 none were found, but instead of them, numerous bears, of which 25 were killed. The Polar bear never goes far from the land; there are at present but few on Spitzbergen; the great number seen in 1863, north of Spitzbergen, is at least very remarkable.

VI.

THE POLAR EXPEDITIONS NOW PREPARING.

An expedition is now being fitted out for the further exploration of the Arctic Ocean, from which great results may justly be expected: an Austrian expedition, to be commanded by Lieutenants Weyprecht and Payer, the principal explorers of the last year. About $87,000 have been collected for it in the short time since the return of these gentlemen from their late reconnaissance. The purpose of the expedition, as stated by Lieutenant Weyprecht in a letter to the chamber of commerce at Triest, is: "To follow the open sea, found last summer, to the north and to the east and to extend the explorations into the sea north of Siberia." The expedition will leave Bremerhaven, where the vessel, the "Admiral Tegethoff," is building, toward the end of June, and it is expected to pass the first winter at Cape Chelyuskin (Sieveri Vostochni Noss), the northernmost point of Asia, to continue in the second summer the exploration of the Central Polar Sea, and to push, during the third summer, to Behring Strait; the expedition to be provided for fully three years.

The "Admiral Tegethoff" is a steamer of 220 tons, 118 feet long, 25¼ feet beam, and 13½ feet depth of hold, three-masted schooner rigged, with an engine of ninety-five horse-power, giving a speed of five to six knots. She will carry coal for forty days. Besides Lieutenants Weyprecht and Payer, there will be two other Austrian naval officers, Brosch and Orel, a surgeon, a machinist, two Tyrolese glacier-guides, and sixteen seamen, all Quarneroli, reputed to be the best sailors of the Mediterranean.

A Count Wilscheck, who subscribed $15,000, intends, also, to accompany the expedition during the summer months, in a yacht which he is fitting out, and which will be commanded by Captain Spaun, of the Austrian navy. With him will be Mr. Höfer, the director of the Klagenfurt mining-school, as geologist.

There is also a Swedish expedition fitting out under Professor Nordenskiöld, who intends to winter at one of the Seven Islands in latitude 80½° N., and to proceed from there in the spring of 1873 in reindeer sleighs.

Among the private undertakings, combining research with sport, the most important will be those of Captain G. Jensen, of Drammen, in the steamer "Cap Nor," and of Captain Svend Foyn, a renowned whaler, also with a steamer.