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BRIG. & BVT. MAJ. GEN'L W. B. HAZEN,
CHIEF SIGNAL OFFICER OF THE ARMY.

BY AUTHORITY OF THE SECRETARY OF WAR.

WASHINGTON:
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National Oceanic and Atmospheric Administration

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FROM SEPTEMBER 16, 1881, TO AUGUST 25, 1882.

No. I.

REPORT OF MR. W. M. BEEBE:

RELIEF EXPEDITION TO LADY FRANKLIN BAY. GRINNELL LAND.

SAINT JOHN'S, N. F., *September 28, 1882.*

To the CHIEF SIGNAL OFFICER, U. S. A.,
Washington, D. C.

GENERAL: I have the honor to report that in obedience to orders contained in your instructions dated "Office of the Chief Signal Officer, Washington, D. C., June 18, 1882," I assumed charge of the men and supplies for Lieutenant Greely's party, Discovery Harbor, Lady Franklin Bay, Grinnell Land, upon their arrival, on the "Alhambra," from New York, on the morning of July 4th. These supplies, and those ordered to be purchased at Saint John's, were loaded on the "Neptune" with as little delay as possible, and the party sailed at 1.30 p. m. on the 8th.

Your instructions regarding observations to be taken on the voyage were duly turned over to Captain Sopp, of the "Neptune," but, as the instruments intended for this purpose could not be found, and as Captain Sopp evidently did not understand the nature of the observations ordered, I transferred the duty to Private Joseph Palmarts, Signal-Corps, U. S. Army; the results of his work with such instruments as the ship afforded, from the 13th of July until our return to Saint John's, are herewith submitted, marked "A." They are the means of eight observations taken each day.

During the first few days of the voyage, heavy winds and a rough sea were experienced, and our party were confined to their berths by sea-sickness. On the morning of the 12th, the weather moderated and the sea went down rapidly; since that time the health of all on board has been good. At 6.30 p. m. of the 12th, in latitude $55^{\circ} 3' N.$, longitude $51^{\circ} 25' 45'' W.$, we spoke the Hudson's Bay Company's steam-yacht "Diana," from London, England, to Ungava bay, Labrador, requesting to be reported by the first return vessel.

On the morning of the 13th of July, the first field ice was encountered 135 miles due west from Cape Farewell, latitude $60^{\circ} N.$, longitude $54^{\circ} 50' W.$

The fields, though not large, were very heavy and solid. Undoubtedly this was the heavy winter-ice, borne from the eastern coast of Greenland by the strong current which sets southward from about Iceland, turns to the westward and northward around Cape Farewell, and flows up the western coast of Greenland, until, in latitude (about) $67^{\circ} N.$, it meets and mingles with the current from Baffin's bay. These united currents set southward with great strength down the coast of Labrador, and trending eastward, pass around and down the eastern coast of Newfoundland and into the Gulf-stream, carrying with them the immense icebergs launched from the numerous glaciers of west Greenland and so much of the field ice as has survived the passage from Davis' strait.

Our passage during the 13th did not exceed three miles an hour, but the ship gave

evidence of her great strength, and her fitness for the work before her, breaking with ease and pushing aside the fragments of solid ice "pans." At 7.30 p. m., a dense fog having settled upon us, the ship was moored to a convenient ice-pan, to await clearer weather.

At 3 o'clock on the morning of the 14th, the lines were cast off, but it was evening of the 15th before the pack was finally cleared. During the day, a three-masted schooner was sighted standing in toward Holsteinburg, and at 9 o'clock in the evening we came up with the American schooner "Concord," of Gloucester, Massachusetts, at anchor, fishing for halibut, which are taken here in great numbers and are of superior quality.

We reached Godhavn at 5.30 on the evening of the 17th, and I went immediately on shore, accompanied by Doctor Hoadley and Captain Sopp, to pay our respects to the Inspector. I report with regret the death, on the 27th of May, of Inspector Smith, whose interest in all American expeditions to the Arctic regions is well known to you.

Mr. Kneuthsen, the acting inspector, and the governor of Disco, Mr. Djurh us, received us with great kindness, and during our stay did all in their power to aid us in securing such articles required by Lieutenant Greely as had not already been prepared in compliance with your request. The order for sleeping-bags had been received so late that material suitable for their manufacture could not be obtained, but through the courtesy of the officials, four (their individual property) were secured. All other articles ordered through the Danish Government had been collected in the quantities desired, with the exception of "matak," of which but sixty-four pounds could be obtained, and this, as it afterwards proved, had not been thoroughly cured, so that, notwithstanding the care given it, it soon became worthless.

I was unable to comply fully with your orders to pay for all stores purchased in Greenland, as I have explained in a former brief report.

We left Godhavn on the evening of July 20th, and on the morning of the 22d, again met field ice, neither so heavy nor so firm as that previously encountered; the ship worked her way through it readily at half-speed. The weather was disagreeable with rain and sleet, but it cleared sufficiently at noon to enable the captain to ascertain our position, latitude $73^{\circ} 4' N.$, longitude $58^{\circ} 39' W.$ During the afternoon, the ice became firmer and more closely packed. At 8 o'clock in the evening, a blinding snow-storm came on. This rendered it impossible to pick our way through the channels, and it was found necessary to again tie up to an ice-field, where we remained during most of the night.

Fair progress was made during the morning of the 23d, but at 1 o'clock p. m., we were again stopped by ice, through which the ship could not be forced; it extended in our front to the horizon. During the afternoon, a slight opening occurred, through which the ship worked with difficulty, but at 8 o'clock in the evening, we were again stopped and fairly "beset," being unable to move in any direction until midnight, when the strong north wind again freed us, and slow progress was made until 2.30 p. m. of the 24th, when, in latitude $75^{\circ} N.$, longitude $60^{\circ} W.$, we were again stopped. On the 25th, and until 7 o'clock a. m., of the 26th, we remained helplessly drifting with the tides, within plain view of Cape York, with its numerous glaciers, and the Crimson Cliffs of Beverly.

The weather had continued foggy, giving us only occasional glimpses of the sun, but on the 28th, it became clearer, and for the first time the sun was seen shining brightly at midnight.

Followed all day by half a gale of wind on the 28th, the ship made fair progress, passing Westenholm island at 8 o'clock in the morning, and Cary islands about 7 in the evening. At 3.30 on the morning of the 29th, Littleton island was passed, but half an hour later I was called by Captain Sopp and informed that we could go

no further. Going at once on deck, I found an unbroken ice-barrier, from twelve to twenty feet thick, extending from Cape Inglesfield on the west across the sound to Rosse bay and to the northern horizon, effectually checking our further progress. The ship was therefore turned southward, and looked in at Life-boat cove and at Port Foulke; a comfortable anchorage was at length found in "Pandora" Harbor. This harbor, named by Sir Allen Young, is a beautiful bay shut in by the Crystal Palace Cliffs upon the south, Cape Kenrick on the north, and by lower and less abrupt hills upon the eastward. During most weather, the anchorage would be a safe one, but during our stay there of a week, riding out a succession of southwesterly gales, much trouble was experienced, one anchor being lost, and two heavy hawsers, warping the stern of the ship to the rocks, were parted.

While here, Sir Allen Young's record of the "Pandora" was found, near the water's edge, where it had been washed down from the cairn upon the summit of a low point of rocks. This record, together with a copy of my own, which was left in the cairn is attached, marked "B."

Game was found in abundance. Arctic hares, the eider-duck, auks, and several varieties of gulls, of which a two week's supply for all hands was brought in by the hunting-parties, and proved a most acceptable change from the ordinary ship's fare. Several reindeer were seen, but none were taken.

On Monday morning, August 7th, the water-casks were filled, and at 10.45 we resumed our way northward. Heavy ice was soon encountered, but the fields which had been quite thoroughly broken by the southwest gales, were small and easily avoided, becoming larger and more compact, however, as we advanced, until at 9.45 p. m., we were compelled to stop and tie up to a large floe off the northern point of Bache island. The ice continued to close in upon us rendering movement in any direction impossible, and on the morning of the 9th, we found the ship fairly "beset" and helpless, twelve miles from Victoria Head, the nearest point of land. Toward evening the larger fields closed in more rapidly, rendering our position extremely perilous; the ship was raised bodily three feet, and the creaking of timbers and the grinding of the ice as it pressed upon her sides were ominous sounds. Had it not been for the smaller and softer ice immediately about us, and which, crushed by the solid fields as they closed us in, formed a cushion underneath the hull, the strong ship must inevitably have been crushed.

On Thursday, the 10th, we drifted a short distance northward, and reached the highest point attained, latitude $79^{\circ} 20'$. We were twelve miles from Cape Hawkes and seventeen from Cape Prescott, the intervening ice being impassible for even an unencumbered man. The season was still young and all on board were sanguine that a northerly wind would soon start the ice and that Discovery Harbor might yet be reached.

On the 11th, the ice closed in more firmly, piling the broken fragments as high as the bulwarks.

On the 12th, the wind subsided somewhat and the ship once more rode upon an even keel, but still three feet above the proper level.

At midnight I was on deck with the first mate, when a gentle crackling of the young ice attracted our attention, and, by the bright sunlight, we could see the water slowly trickling through. At 7 o'clock, a slight opening was observed between the large fields which had held us fast, and with great difficulty the ship was forced into open water to the southward. So great a power was found necessary to force our way that the boiler was overstrained and sprang a leak. This added greatly to our anxiety.

Your attention is respectfully invited to the accompanying chart (marked "C") made by Private Francis Thoma, 5th Infantry; it illustrates the movements of the ship in our search for a practicable route.

Upon reaching open water on the 15th of August, we stood across the sound to the eastern shore, but found no opening, and concluded to endeavor to secure an anchorage, from which to watch the movements of the ice, so that we might be prepared to take advantage of the first opportunity to reach Cape Hawkes, at least, where I had determined to establish, at once, the depot "A," and leave the whale-boat specified by Lieutenant Greely, which could be removed and taken further north should opportunity occur.

At one o'clock on the morning of the 18th, a comfortable anchorage was found in Payer Harbor, latitude $78^{\circ} 42'$ N., longitude $74^{\circ} 21'$ W., between Cape Sabine and Brevoort island, where the "Alert" and "Discovery" remained for a few days in 1875.

In a cairn on the summit of Brevoort island, Captain Nares's record was found; it accompanies this paper (marked "D,") and on a long, low, island near to and due west (true) from Brevoort island were found a small depot of provision left by the "Discovery," and the accompanying statement of Captain Stevenson.

The depot consisted of one barrel canned beef; two tins, forty pounds each, bacon; one barrel, one hundred pounds, dog biscuit; two barrels, one hundred and twenty rations each, biscuit: all in good condition; two hundred and forty rations, consisting of chocolate and sugar, tea and sugar, potatoes, wicks, tobacco, salt, stearine, onion-powder, and matches, all in fairly good condition.

Three small casks that had contained rum and high-wines were separated from the other packages, broken, and their contents evaporated or leaked out. There was also found the remains of an Esquimaux skin-boat, or oomiak, utterly destroyed, the frame broken and bearing marks of the teeth of some large animal, while the remnants of skin remaining fastened to the keel bore similar evidences of having been destroyed by bears.

The cache was rebuilt and made as secure as possible, marked by two oars, found with the depot, placed upright in the rocks, and a record of the "Neptune" placed in the cache. A description of this depot and its position was afterwards left with the depot established on Cape Sabine.

During the 21st and 22d, ice was observed in small quantities passing down the strait, but a visit to the summit of Cape Sabine, which was accomplished after severe climbing, did not afford much encouragement. However, as the ice, broken by the southwest winds, which had blown with considerable force for two days, seemed passing steadily down, I urged the captain to move out on the morning of the 23d. We started at 1.30 p. m., and found the western shore effectually blockaded above Cape Sabine, but standing to the eastward again found comparatively open water in mid-channel, through which we worked our way to a point nearly due east from Cape Prescott, where heavy, unbroken ice, extending as far as the eye could reach to the northward and from shore to shore, was encountered.

I now determined to turn all my attention to efforts to land supplies and whale-boats as far north as possible. Lest it should be found impossible to reach land with the boats, I caused a large sledge to be made, loaded with the boats and stores, which might be hauled by my party and volunteers from the ship's crew, over the ice if that should be found practicable.

Turning again to the westward, when our progress to the northward had been checked, we stood along the unbroken edge of the solid ice, and at 10 o'clock p. m. were again nearing Cape Sabine, without having found a crack in the solid pack, while the entrance to Payer Harbor was blockaded. It was now necessary to find an anchorage as the southwest wind, which had held in that quarter almost without interruption since our arrival in Smith's sound, was increasing in force, and the ship was headed for Littleton island. The captain was, however, not satisfied of the safety of the small harbor there, and, declining to take soundings and seek an anchorage in Foulke Fiord (which Captain Nares recommends as a winter harbor), continued

down to Pandora Harbor. There were already many evidences of approaching winter. The vegetation, bright and green on our departure on the 7th, was faded and brown, the flowers had disappeared, the ducks had taken their departure southward, and the summits of Cape Kenrick and Crystal Palace Cliffs were covered with snow.

Fully impressed with the great importance of establishing a depot as far north as Cape Hawkes, and fully satisfied that whatever was to be done must be accomplished quickly, we left Pandora Harbor at 3 o'clock on the afternoon of the 25th, but at half past nine were again brought to a check in the pack and compelled to tie up to an ice-floe.

During the 26th, a little gain to the northward was made, but we were again checked by an impenetrable pack forty miles from Cape Hawkes.

The edges of the heavy fields of intervening ice, crushing together with every change of wind and tide, were thrown up in huge, irregular rifts, impassable, even had they been stationary, by the trained seal-hunters who composed our crew; the idea of landing the stores by means of a sledge and boats was therefore abandoned.

On the 27th, we were able to move some distance to the northward, again reaching a position off Bache island, but no nearer land than we had been before. The wind freshening from the northwest, the ship was made fast to the floe to await the opening which was confidently expected. Notwithstanding the direction of the wind the larger fields, many miles in extent, moved westward against it, when, coming in contact with the land, their course was changed to the southward until checked again by Cape Sabine and Brevoort island.

All the ice in Smith's sound seemed drifting southward bodily, and it was determined to stand across once more to the eastern side, with the faint hope that a channel might be found where the fields had broken from the solid ice above, and by which the western shore might be reached.

The ice was close in shore, and our course was again changed to the westward, skirting the solid pack, the captain pushing the ship into every channel leading towards Cape Hawkes with all the energy that could be desired.

The western shore above Cape Sabine was unattainable, and fearing that Littleton island would soon be closed to us, I determined to establish the cache directed to be made there, while awaiting an opportunity to reach some point on the other side. New ice was forming every night and the captain became anxious for the safety of the ship; therefore, although determined to remain as long as there was the slightest hope of carrying out the letter of my instructions, and to retreat only when compelled by lateness of season, I was fully satisfied that we could stay but a few days longer in these waters.

On the 28th, there was a heavy southwest wind and snow. At 7.45 p. m., we anchored off Littleton island, and early on the morning of the 29th, the wind having subsided sufficiently to admit the landing of a small boat, I went on shore to select a place for the cache, when our presence was discovered by a party of Etah Esquimaux upon Cape Ohlsen. Crossing over I found it to be a hunting-party of six men and three women, who desired to accompany us on board the ship.

Regarding it unwise if not useless to land stores upon Littleton island while the natives remained in the vicinity, and thinking that a landing might be effected on the opposite or northern end of the island at night without their knowledge, we again stood across the channel, and at 1 o'clock on the morning of the 31st, succeeded in effecting a landing and establishing a cache upon Cape Sabine, the northernmost land that had been attainable by us. The stores and whale-boat were placed in a sheltered spot, well secured and covered by a tarpaulin. A tripod made of scantling, with an oar attached, to which pieces of canvas were well nailed,

was placed upon a prominent point, showing well from the northward and securely anchored with rocks, and in a cairn beneath was placed a record giving the bearings of the cache. A copy of this record is attached, marked "D."

A heavy northeast gale coming on, we took temporary refuge under the lee of Cape Ohlsen, a comfortable and safe anchorage in a north or northeast wind.

The Etahs paid us another visit and I determined, should it be necessary and as a last resort, to take them to Pandora Harbor and leave them.

The gale continued unabated during the 1st and until noon on the 2d of September, when we left our anchorage for a final effort to get further north.

Heavy field ice was met off Cape Sabine, increasing in size and thickness as we proceeded, until the captain positively refused to penetrate further, and, at 8 o'clock in the evening, made the ship fast to an ice-field. At 9 o'clock, new ice, cementing the broken floes, had formed to the thickness of three inches.

On Sunday, the 3d, we remained all day tied to the ice, shifting our position as safety from floating masses demanded, and on Monday, the 4th, finding it impossible to advance, the new ice having increased to four inches in thickness, and the engineers having reported a leak in the boiler, which up to that time had been kept from my knowledge, I determined to establish the cache on Littleton island without further delay. The natives still remaining on Cape Ohlsen, the stores were landed in a cove at the north end of the island, so well concealed as to be invisible from any point a few yards distance, and covered with a "paulin," securely anchored down with rocks, while copies of record, with minute directions for finding the stores, were placed, as directed in Lieutenant Greely's letter of last year,—two in the coal at the southern end of the island and one in Nare's cairn on the summit of the south-west part of the island. A copy of this record is attached, marked "E."

As a last resort, the remaining whale-boat was placed on Cape Isabella, and its location marked by a tripod showing well to the northward.

Should Lieutenant Greely's party reach Cape Sabine next year, before the arrival of the relief ship, they will scarcely fail to find this boat.

I then called a consultation, requesting an expression from Dr. Hoadley, Mr. Norman (the 1st officer), and Captain Sopp, who were unanimous in the opinion that further delay was useless and extremely hazardous; that everything had been done that could be done to carry out your orders; and that the safety of the ship and the lives of all on board demanded an immediate departure. At 11.40 on Tuesday night, I gave a reluctant assent and the voyage homeward began.

No field ice was seen after leaving Smith's sound, but icebergs in great numbers and of unusual size were encountered in the vicinity of the Cary islands, and for two days after passing that point.

We reached Godhavn on the evening of September 8th, and satisfactory arrangements were made for leaving the dogs, dog-food, and lumber. I made an unofficial request upon the acting inspector to have in readiness for next year's expedition, such additional dogs as may be needed, also skin-clothing, two or more dog-sledges, and two native drivers, stating that an official request would be made through the Danish government by the Chief Signal Officer of the Army.

A week's delay was found necessary by the captain for making repairs to the boiler, taking on of ballast, and such refitting as was needed for the homeward voyage.

Tiltcove, Newfoundland, was reached on the 23d, where I telegraphed you of our safe arrival and the failure of the expedition, and on Sunday, the 24th, at 10.30 p. m., Saint John's was reached.

Some delay was experienced in securing a store-house, where the supplies would be safe from frost and vermin; this was, however, finally secured, and the stores landed, but, transportation for all my party (including myself) having been ordered

by the "Alhambra," I was compelled to leave Saint John's without receipts. These will, however, reach Washington by next mail.

I take pleasure in earnestly recommending that the services of Doctor Hoadley should, if possible, be secured for the expedition to be sent next year. In addition to his professional fitness, he possesses physical strength and experience in travel, which eminently qualify him for the duty. I also take pleasure in testifying to the good conduct and cheerful performance of duty by the enlisted men of the party, and recommend that they all be allowed to accompany the next expedition.

I am, General, very respectfully, your obedient servant,

W. M. BEEBE, Jr.

REPORT OF LIEUTENANT JOSEPH S. POWELL:

RELIEF EXPEDITION TO POINT BARROW, ALASKA.

WASHINGTON D. C., *December 5, 1882.*

TO THE CHIEF SIGNAL OFFICER, U. S. A.

SIR: I have the honor to submit herewith, the following report relative to the relief expedition to Point Barrow, Alaska, placed under my charge:—

The schooner "Leo," of 150 tons burden, having been chartered by the government for the purpose, sailed from San Francisco, California, at 8.30 a. m., June 24th. We encountered head-winds and half gales during the passage over the Pacific. No incident of importance occurred until July 14th, when land was sighted, which proved to be the Shumagin islands, bearing ne. from Unimak pass, in longitude 160° W., latitude 55° N. After sighting these islands, the ship was tacked to the southwest, and on the 19th of July we reached the pass, but were prevented from clearing it by head-winds until the 20th. Our position in the pass on the night of the 19th, was rather dangerous. A heavy fog settled down toward night, turning into rain with a heavy sea, rendering it impossible to see land, and the only course left us was to beat forward and backward within the narrow limits of the pass, by the clock, until morning. The distance between the islands is but seven miles, and the land rises almost perpendicularly on each side. After clearing the pass on the 20th, the wind hauled to the southeast and blew a gale.

The cook having been taken seriously ill after the first ten days out, it became necessary to secure some one in his place, and with that end in view the master of the vessel endeavored to make Saint Paul's island, but we were not successful, owing to the gale before mentioned. I then directed that we proceed to Saint Michael's, a station of the Alaska Fur Company, with the hope of securing a native. We reached Saint Michael's July 26th, and after considerable persuasion, shipped a native named Kan-u-ark as cabin-boy. One of the principal objects I had in view in selecting this native was, in case we found it impossible on account of ice to reach Point Barrow, to have him act as interpreter and messenger.

Judging from the name, one would suppose that some sort of a colony was located at Saint Michael's, but such is not the case. The only whites at this place are the agent of the Alaska Fur Company, his wife and one assistant, together with the United States weather observer. As the vessel sailed into the harbor we were greeted with a salute by mountain-howitzers.

As before stated, considerable difficulty was experienced in securing a native. The news of the loss of the "Jeannette" had already reached the people and consequently they seemed loth to venture abroad in the white man's ships, which were thus liable to sail away and never return. The savage man all the world over is extremely prone to superstitious fears, and it is not at all to be wondered at that the simple native of these shores should be considerably impressed when he sees the mighty "Oomiaks" of the white man go away in the gloom of the mysterious north

and return no more. A jealous spirit seems to the poor native to reign over these gloomy solitudes, who will not permit the secrets of his realm to be explored with impunity, and when the mighty "Tungah" seizes upon the large vessels of the white man and dashes them to pieces in his anger, terror thrills through the poor savage, and he refuses to venture within the reach of the baleful power of the icy north, so potent for evil.

Kan-u-ark understood a few words of English and proved tolerably handy in waiting on the table, etc., although such employment must have been a new experience to him. We left Saint Michael's on the morning of the 27th and sailed for Golovin bay, directly opposite, where we took in a supply of water. Owing to heavy gales on the outside, we laid in this harbor two days and then sailed for Point Barrow. On reaching Behring sea we encountered a heavy gale from the north, with weather so thick as to prevent making any headway toward the straits. Finding it impossible to make northing and the gale increasing, I directed that the vessel proceed to Plover bay, having by this time become aware that with a sailing vessel we might be unable to make this point on our return. Weather still continued thick, and having proceeded in the direction of Plover bay as far as it should lie as registered by log, the vessel was hove to, waiting for the fog to lift that bearings could be taken. We laid there two days without a sight of land or of the sun, but on the morning of the third day it cleared sufficiently to distinguish the land, and we found ourselves about four miles from the entrance of the bay. On this morning, the wind, which had been blowing steadily from the north ever since we left Norton sound, lulled almost to a calm.

A steamer was sighted in the morning bearing down on us, and made out to be the U. S. revenue-cutter "Corwin;" to the captain, J. T. Healy, I am much indebted for courtesies. She came alongside and towed our vessel up the bay. Anchor was dropped at 1 p. m. At this hour the sky was clear, but the time too early for taking observations for rating chronometers in this latitude. At 2.30 p. m., I found the sky becoming overcast, with every appearance of another gale, and made all haste for taking such observations as could be had. It became foggy and cloudy in a short time, and but two observations of any value could be secured. The captain of the "Corwin" informed me that he would leave at 6 p. m. and would tow our vessel out if we were ready, and also that I could consider myself fortunate in securing the observations I had, as, at this season of the year, it was liable to be foggy or cloudy for a week at a time.

After considering the advantages of his offer, and there being every evidence of a long duration to the cloudiness, I accepted it. In order to check the observations taken on shore, I had comparisons made with the chronometer on board the "Corwin," believing that good results could be obtained, as this steamer was only three weeks out from San Francisco, and her chronometer properly rated.

The observations taken at Plover bay, though the number is small, are considered as very good, and are contained in an appendix to this report.

It became evident, after leaving Plover bay, that the opinion formed as to a lengthy continuance of cloudy weather was correct. Outside of the bay we laid in a calm until 8 p. m. August 7th. All this time the fog grew denser, to such an extent that we could not see a ship's length ahead. At the above-named hour a breeze sprang up from the south, and gradually worked itself into a gale. All day it continued, and increased in violence during the night, with no appearance of the fog lifting. The next morning, land could be distinguished through the fog, dead ahead, and not distant over two miles, and seemed to extend to the east and west. The master of the vessel imagined he was still on the Siberian coast, and the bluff we saw was the south head of Saint Lawrence bay, and that our position was due to a strong current moving to the northwest. The gale had so increased that it be-

came necessary to close-reef the sails. Then it became apparent that we were drifting ashore, and our only hope was to weather the point of land lying to the east, believing, if this could be done, we would find refuge in Saint Lawrence bay. It seemed an almost hopeless attempt, as we kept drifting nearer and nearer, but at last were successful in weathering it, though our distance from shore was less than one-half mile.

Our disappointment was great when we discovered that the land on the other side of the bluff trended toward the northeast, instead of to the northwest, as we expected it would. We kept on a course about southeast, until near dark, when low land was discovered right ahead. The chart and log-book were consulted, and it was clear to my mind that, owing to the foggy weather and a sailor's natural timidity of land, we had made more easting than should have been done, and the land we saw in the first instance, was a small bight between Cape Prince of Wales and Cape York, on the Alaska side, and the low land a portion of the spit at the entrance of Port Clarence.

It being considered impossible to again weather the bluff, we had been working around all day, I instructed the master to endeavor to make the harbor of Port Clarence, which was accomplished at 10 p. m., and anchor dropped. The making of this harbor I consider quite fortunate, for the gale increased in fury, and had we still been exposed to it, off a lee-shore, as we were earlier in the day, I am afraid the "Leo" would have ended her voyage then and there, and all on board gone to the bottom. The wind was estimated as blowing seventy miles an hour, and the sea running so high that had the ship struck, she would have been dashed to pieces in a few minutes, and no one could have reached the shore alive. The storm was a very extensive one, and continued till the 11th; the barometer in the mean time going down to 29.20. We remained at anchor three days, and then started on our way to Point Barrow. We passed through Behring strait on the morning of the 13th, and crossed the arctic circle at 12 m., same day.

Cape Lisburne, the northwestern point of America, was sighted on the 14th, and the next day a heavy gale struck us from the east, in the face of which we were unable to make more than ten miles in the next two days. At 12 m. August 18th, we were in a calm, in longitude $158^{\circ} 50'$ W., latitude $71^{\circ} 21'$ N. At 8 p. m., a breeze sprang up from the southeast and we headed for the station, only one point out of our course. At this time we were only forty-eight miles from Point Barrow, and in nearly the same latitude, and supposed with the four-knot breeze blowing we would be able to see the point about 6 a. m. next day. At that hour next morning, a sight was had of the sun and latitude approximated, and found to our surprise we were considerably to the northeastward of Point Barrow in longitude 155° or less (dependent upon latitude), and latitude assumed to be $71^{\circ} 30'$; though afterward it was determined it should have been much more. We were surrounded by ice-floes, and to the eastward could see the old ice-pack. Our position was determined to be the result of the action of a strong northeast current. This was verified by Lieutenant Ray, with whom I conversed about the matter, and who stated that there is a strong current moving past station to the northeast at a velocity of from two to three knots an hour, and that our vessel was in rather a dangerous position, for should it have become calm, we should have drifted to the northeast, beset with and crushed by ice; that vessels caught in this current move off to the northeast and not a piece of timber ever returns.

We came to anchor Sunday, August 20th, at 8 p. m., off the station at Ooglaamie. On the 21st, the wind blew so strongly, and the surf was so high that the landing of supplies, or even boats, was out of the question.

During the time we were landing supplies, all station instruments were compared with the standards I carried with me for this purpose.

Lying, as we were, in an open harbor, with every probability of a gale, which would have caused our weighing anchor and standing out to sea, and not knowing when we could ever return, I believed it to be my first duty to land all supplies. Officers, enlisted men, and natives performed their share of labor, and I believe it was owing to the energy displayed by the party at the station, that we were saved from a gale which commenced the morning after we sailed, and would undoubtedly have beached us or blown us so far to sea that the chances of returning would have been small. We began the work of unloading Tuesday, though the surf was still high. Wednesday and Thursday this work was continued.

On Thursday, the ice, in extensive fields, began moving rapidly to the south-west quite close to the vessel. Thursday night, ice came into contact with vessel, but no damage resulted save a bad shake up. Friday opened with a half gale, accompanied by snow. Saturday, same condition as on Friday. All work was suspended on these two days. Heavy ice closing around vessel and sharp lookout kept for the old pack, the approach of which, the fields and small bergs were sure indications. Sunday, the landing of supplies was finished, and after receiving mail on board, &c., we weighed anchor homeward bound at 2 p. m.

By reason of certain facts, which I have explained to the Chief Signal Officer, an official inspection of records of station was not made, so that a report relative thereto is not possible. From personal observation, and from conversations with Lieutenant Ray, I feel safe in asserting that the work is conducted in a highly creditable manner, and more accomplished than was considered could be, taking into consideration all the difficulties which had to be encountered and overcome. The success of this expedition is due solely to the energy, intelligence, and indefatigable labor of Lieutenant Ray.

The magnetic instruments in present use are the Unifilar (Declinometer) Dip-Circle and Bifilar, and all are properly adjusted.

The dip-circle has been used for absolute determinations, I presume, on "term" days, and weighted and used as a differential instrument the remainder of the month. The value of the weight, Lieutenant Ray informed me, is known. He also informed me that all readjustments have been computed and preserved.

All buildings about the station are substantial, and the dwelling-house is very comfortable. No sickness occurred during the winter; this, I believe, was due to the stringent rules enforced by Lieutenant Ray relative to exercise.

During my stay at the station, I had comparisons made daily, whenever landing could be made, with chronometers on shore. For this purpose, number 1692 was used as a "Hack." This instrument was handled carefully, and but small variations occurred by transporting it. There was but one day on which the sun shone sufficiently to make observations. On this day twelve sights were secured at different intervals. All observations and comparisons of chronometers going from and returning to San Francisco are embodied in a separate report. These observations and reductions were placed in the hands of Mr. Winslow Upton, computer, O. C. S. O., who has corrected all errors, and submitted a report of final result, which I embrace in this report as an appendix.

But little time was afforded me for familiarizing myself with the country or the customs and habits of the natives, and to Lieutenant Ray and Sergeant Cassidy I am indebted for valuable information, not only in this connection, but of the work performed during past year.

The winter had been long and severe, but hardly so much as had been expected. After the expedition arrived in September, 1881, a dwelling-house and observatories were at once erected, and on the 17th of October, hourly meteorological observations began, and hourly magnetic on the 1st of December, and from that time no interrup-

tions in the work have occurred. The magnetic work was especially trying during the very cold weather, for delicate instruments had to be manipulated and read in temperatures sometimes as low as -45° . At such times it was almost impossible to touch brass or other metals with the ungloved hand. From the 1st of December, 1881, to the 1st of August, 1882, over 90,000 readings of the magnetic instruments alone were taken and recorded. A corresponding amount of meteorological work was carried on at the same time.

The station is located on Cape Smyth, on a low ridge, about fifteen feet above water-level and about one hundred and fifty yards from the water's edge. The native village of Ooglaamie, containing about thirty "igloos" and one hundred and fifty inhabitants, is situated about half a mile distant to the southwest. Point Barrow is ten miles distant to the northeast. Cape Smyth is only a cape by courtesy, for there is scarcely a break in the coast-line, which runs uniformly in a northeast and southwest direction from Point Barrow to Wainwright Inlet.

The prospect from the station, even in summer, when it is at its best, is monotonous and uninviting, and in winter it must be dreary indeed. The tundra spreads away level and brown, relieved here and there by patches of sickly green, guttered in all directions by shallow water-courses, and covered with small shallow pools, while at no point within view does it reach an elevation of fifty feet above the level of the sea. Vegetation is very scanty, consisting chiefly of moss and lichens and other cryptogamous growths, with occasional patches of hard, wiry, grass and a few simple flowers. The only shrub to be found is the dwarf willow, which, instead of growing in an erect position, creeps along under the moss as if trying to hide from the inclement blasts, and in summer, it shoots forth its pretty rose-colored catkins and green leaves through its mossy covering in a timid and hesitating manner, as if aware of the uncongenial character of its surroundings.

During eight months of the year, the earth is frozen, and during the remaining four, it thaws to the depth of a foot from the surface, but below that depth it is permanently frozen to an unknown depth, probably one hundred and fifty to two hundred feet. It is a desolate land, interesting no doubt, but destitute of beauty, one in which the struggle for existence, both by animal and vegetable life, is of the hardest, where the aspects of nature are harsh without grandeur and desolate without being picturesque, and where the dead level of monotony everywhere prevails, the greatest variety being in the length of days and nights, which vary from seventy-two days to about as many minutes. The year is divided into seasons—a winter eight months long and a rather uncertain summer of four months. The latter season, if summer it can be called, is only such by contrast with the preceding winter, for the temperature rarely reaches 60° , and at any time a snow-storm may occur. Snow fell on every day we were at station. The lowest temperature experienced at station was 60° below zero. Luckily at such low temperatures the air is mostly still, and consequently people do not suffer so much as they do when the wind is blowing strongly, with the temperature considerably higher. Only two remarkable gales occurred, both in January—one continuing from the 11th to the 14th, and the other from the 21st to the 23d.

A description of the latter was given me. The wind reached a velocity of one hundred and four miles an hour, while for twenty-four hours the average velocity was over fifty miles. It is said the force of this gale was tremendous. Before its force the snow became impalpable powder and disappeared as if a sudden thaw had occurred. Sand and even coarse gravel were carried along in clouds and acted on exposed surfaces much the same as a sand-blast would. Wood and iron looked as if they had been subjected to a strong scouring process, and glass was ground so as to be almost opaque. One of the anemometers at station was broken long before the wind reached its highest velocity—the end of the spindle on which the cups

revolve being twisted off—but another stood the storm through without further damage than the blowing away of the wires which connect it with the self-register. The ice at sea, that previously seemed as immovable as the land, was broken up into fragments, as close in shore as half a mile, and when the storm abated was rushing away to the northeast with the velocity of a mill-race.

The sea at Point Barrow does not freeze to a greater depth than six or seven feet; the ice with which it is filled comes from a distance, and is generally a mixture of new and old worn ice. There is nothing in this sea approaching an iceberg, but still some very respectable masses are formed, especially near the coast, where the pressure of the moving floes from without is met by the resistance of the land, and huge fields of ice are driven over each other until they become grounded in water from fifteen to twenty fathoms deep and are piled up some forty or fifty feet. No doubt the grandeur and sublimity given to arctic scenery by the immensity of icebergs are here wanting, but the immensity of power displayed by the chaotic jumble of these enormous ice masses is more calculated to impress the mind than the mere bulk of lofty bergs that stud the seas on the eastern side of this continent. The broken floes are thrown together in every conceivable position, and at every possible inclination of surface, in a profusion of irregularity, of which no language can convey an adequate idea, and which must needs be seen to be appreciated.

Travelling over such a surface as this is next to impossible, and men without encumbrances could possibly advance eight or ten miles in a day, but if laden with food or otherwise, their progress would be far less than this—heavy ice-sleds would be almost impossible. Wherever there is land there is always an ice-foot—a narrow strip of level ice along the coast, over which sled-travel can be easily carried on, or in narrow channels without currents, when the ice may be comparatively smooth, but in the open sea, at a distance from land, such travel need never be attempted by any means now at our command, for nothing but failure will attend such attempts. The fringe of grounded ice along the Point-Barrow coast follows an irregular line, more or less distant from the shore, depending on the depth of the water, and varies from three to five miles in width.

Beyond the grounded line, the surface of the hummocks and floes is just as rough and uneven as it is anywhere else, but there is always more or less change going on—sometimes slowly and sometimes rapidly. Although to the eye the broad expanse of jumbled ice-hummocks seems as stable as the solid land, the stability is only apparent; a kind of vibratory motion takes place from time to time; the pressure increases and decreases alternately; currents set in, and the whole body of the ice seems to oscillate to and fro, so that it is seldom that the peculiar noises occasioned by the grinding and crushing together of the slowly moving masses cannot be heard. This song of the icy sea is a very peculiar one, and can scarcely be described so as to convey any clear idea of its nature. It is not loud, yet it can be heard to a great distance; it is neither a surge nor a swash, but a kind of slow, crashing, groaning, shrieking sound, in which sharp, silvery tinklings mingle with the low thunderous undertone of a rushing tempest. It impresses one with the idea of nearness and distance at the same time, and also that of immense forces in conflict. When this confused fantasia is heard from afar through the stillness of this Arctic zone, the effect is strangely weird and solemn—as if it were the distant hum of an active, living, world breaking across the boundaries of silence, solitude, and death.

The sun set on the 16th of November and did not rise again until the 22d of January, remaining below the horizon for seventy-two days, but there was no day during this long, dreary, period that there was not two to three hours of twilight—twilight sufficient to hide the stars. On the 16th of May, the sun ceased to set, and from that day until the 29th of July there was continual day.

During the latter part of winter and early part of summer, the ice-drift at Point

Barrow is almost always from the southwest to the northeast, but about October it begins to move in an opposite direction, and continues in November and December drifting in the same way.

A description of auroral displays, furnished me by members of the party, would lead me to suppose that no known portion of the globe surpasses Point Barrow, and few equal it in the intensity and brilliancy of these displays. The brilliancy of the displays bears no proportion to their number. It was only occasionally that great splendor and magnificence were reached, and the duration of the greatest brilliancy was only brief, compared with that of the display of which it formed a part. Individual auroras often lasted ten or twelve hours, or more, but the great bursts of splendor and motion seldom lasted more than thirty minutes, and often did not continue even so long; but while they lasted they were magnificent, indeed. On such occasions the sky became a gorgeous canopy of flames, all splendor, color, and motion; arch, column, and banner flashed and faded; silvery rays, with rosy bases and fringed with gold or emerald green, danced and whirled around the zenith, and broad curtains of light flung across the sky in every form of graceful curve and convolution, shook rainbow tints from every fold, until the beholder became bewildered and lost in the dazzling brilliancy.

In lower latitudes, the aurora is mostly seen as a luminous arch extending across the northern sky. At Point Barrow, the arched form, though common, was not the prevalent one, and the arches that appeared were seldom perfect, or if so, only for a few moments at a time, and the changes of form were so incessant that it was hard to decide which was the prevailing type. The curtain form mostly broken, but always convoluted and folded on itself like an immense scroll, was a common form, but whatever the form, the phenomena passed over the sky in a succession of waves, sometimes from north to south and vice versa. Intimately connected with the aurora was the disturbance of the magnetic needles—in fact, during the prevalence of the aurora, the magnets were in a state of chronic perturbation, especially during the great displays, when they were often so disturbed that some of them could not be read.

Lieutenant Ray informed me that upon one occasion he saw what he considered to be land, apparently elevated by mirage, directly north of the station. It seemed quite extensive and appeared like the rounded hill-tops of a large island rising above the horizon. Because of the existence of the strong current moving to the northeast at Point Barrow, which runs like a mill-race, it would seem probable that land should exist to the north, and the current between these two lands should be considerably increased according to well-known scientific principles, or possibly, no current, save that created by winds, would be found along the Point-Barrow coast unless there was land to the north. If the problem of the pole is ever solved, I venture to assert that land will be found at or near it, extending as a continuation of Greenland.

Lieutenant Ray also informed me that while making a trip to the southward in March last he discovered a large river flowing in a northeasterly direction, and emptying itself into Dease inlet, about forty miles to the eastward of the station. This river he named the Meade river, after the late General Meade. It is over one hundred yards wide in some places, and is deep enough to allow plenty of large fish to live in it during winter.

The Esquimaux race, to which the natives of Point Barrow and other places on the American side at which the vessel stopped belong, have already been pretty fully described by Arctic explorers; but the description of the Point-Barrow Esquimaux, as given me by Lieutenant Ray and Sergeant Cassidy, is very valuable. Very little has been written about the natives. They are called Innuits, from the word "Inuit," which means man in their language, the plural of which is "Innuine," meaning men

or people. Although there is great general resemblance between all the subdivisions of the Esquimaux race; yet, there is considerable disparity existing between the various families, both in language and manners, depending, no doubt, on the accidental circumstances of locality, surroundings, etc.

The language of the eastern Esquimaux would be entirely unintelligible to the natives of the western coast; and even the native of our side of Behring strait speaks a dialect differing considerably from that of the Siberian side. There are, in fact, many more points of similarity between all the natives of the eastern side of Behring sea, than there are between them and the natives of the opposite side; thus the natives of the Diomedes islands, in the middle of Behring straits, differ more in language and dress from the natives of East Cape, Asia, only twenty miles away, than the natives of Point Barrow do from those of Norton sound, nearly seven hundred miles to the southward. The natives on the American side are, on the whole, superior to those on the Asiatic,—better looking, more intelligent and cleanly, where cleanliness of course only means a less degree of filthiness,—and the natives of Point Barrow are a trifle superior to any of the natives I saw at any other point on the American side.

It seems to be the universal law that the savage deteriorates when he comes in contact with civilization, and the longer the contact the more abject he becomes; no one passing along the coasts of Behring sea and of the Arctic ocean to Point Barrow can fail to be struck by the clear exemplification of this law. There seems to be a strong tendency in savage man everywhere to acquire the bad habits of the civilized rather than the good, whenever the two races come into contact, and the Esquimaux is no exception to this rule. Thus the natives of Point Barrow, having had but little intercourse with the white man, have deteriorated less than the tribes to the southward, and are quite respectable people for savages. They are rather a good-looking people, with interesting but not handsome faces. In general their noses are too flat and the complexions too coppery for beauty. Their bodies are well formed and of average stature; their hands and feet are smaller and better formed than those of the average white man, and, if they had laid aside one or two rather nasty habits and learned to wash themselves occasionally, they might be considered tolerably handsome. The women are more intelligent and better looking than the men, and are treated with more consideration than among most savages. Still the man is the lord and master, and his wife or his daughters have no rights he is bound to respect by any code of law or morals existing among them. A woman cannot choose her husband, but is given away much the same as a cow or horse, and her husband can beat her, or put her away, or sell her, at pleasure, except she may happen to have more friends than he has, and then it may not be altogether safe for him to exercise his lordly prerogatives too freely. Self-interest, however, and the indolent, easy-going habits of these people, prevent the existence of much harshness between man and wife. The females of a marriageable age are seldom in excess of the males, and consequently there is but little choice allowed, besides it is imperative that every man shall have a wife if possible, because an Inuit without one is about as forlorn and helpless an individual as can well be imagined. Without a woman to cook his food, mend his boots and clothing, and attend to various other matters, the performance of which is considered to be beneath the dignity of the masculine nature, the man soon becomes ragged and out at the elbows, unless some sisterly relative takes him under her care. There is no such thing as marriage ceremony. The whole affair is a bargain and of no more importance than any other bargain. No morality, in the proper sense of the term, exists, nothing intrinsically right or wrong. Individuals have rights if they are able to maintain them, so that really might is the great arbiter of right, except in such cases where superstition steps in and exerts a regulating influence over conduct.

Notwithstanding all this, the social relations are carried on as smoothly, and with as little injustice as among civilized people. There are leading men whose influence depends on their wealth and the number of their relatives and friends, but no chiefs, hereditary or otherwise, whose behests any one is bound to obey. There are shamans or medicine-men who talk to the spirits of good or evil and whose interference is required in almost every relation in life. Before a man goes hunting, fishing, or on a journey, when any mishap befalls him, sickness, ill-luck or adversity of any kind, the shaman is called upon to deal with the spirit, which means to howl in the most discordant way imaginable, with an accompaniment played on skin drums or tom-toms. This office of shaman belongs to no one in particular, as any one who can howl with the proper amount of discordance can fill it, but if any one turns out more fortunate than the rest in bringing good weather, in effecting cures, and in bringing success in hunting or fishing, he will be most in demand for the time being. Every one seems to believe in spirits and plenty of them; some of them evil and some good, which may be conciliated or driven away by the shaman. There seems to be no belief in any other state of existence than the earthly one, and death is the end of all things to each and every one; when a man dies that is the end. It would seem that the poor savage treats life more philosophically than we do. To him there is neither reward nor punishment in the hereafter, and when the end approaches he passes away from this world as peacefully as an infant, with none of the terrors which possess many civilized persons when brought face to face with death.

Still, some trace in a belief of a future state that formerly did exist, and probably in some dim way exists still, is to be found in the habit of sometimes burying with the dead his bow and arrows, his knife, pipe, and other articles which he used while living, but curiously enough, nearly all of them are previously broken, and thus it might be considered as a mournful observance rather than an evidence of spiritual belief. Burial, of course, with the Innuits means simply exposure. The dead body is rolled up in a deer-skin or walrus hide and laid between the runners of a broken sled on some convenient knoll, where the winter winds and summer suns, aided by the wild foxes of the tundra, soon accomplish the work of disintegration.

The social habits of these people, although no worse than the rest of their race, are very repugnant to an ordinary civilized man. Squalor and filth are everywhere; dirt prevails in their food, in their living, and in all their personal surroundings. Indeed, some of their habits are unmentionably repulsive; and, I believe, there are no words in their language corresponding to our words dirt and cleanliness. I will, however, do them justice to say that they are entirely unconscious of their condition, and that they are simply dirty by the prescriptive right of ages of antecedent conditions, moving always in the conservative grooves of savage life. It seems that, if a savage man makes any progress toward civilization, cleanliness is about the last line in which he makes any advance.

As is well known, the food of the Innuits consists, mainly, of the flesh of the seal, the walrus, and the reindeer, with occasional variations of birds and fish. The mode of cooking is by boiling, which is done over a wood fire, in open air, during summer, and over their oil lamps in winter. The blood and intestines of bird and beast are carefully preserved and boiled with the rest of the animal, and any one who has seen the process in operation, must needs feel the stings of hunger pretty sharply before he can bring himself to partake of the resulting dish. The seal and the reindeer furnish by far the greater portion of their food, and should the supply of either of these animals fail, but more especially the former, starvation would ensue. Seals are caught during the winter in large numbers through their breathing-holes in the ice, either by spearing or netting. The reindeer are killed during the months of March, April, October, and November. During the winter months, food is often

very scarce, and many families have to depend for weeks on the little polar-cod, a fish about six inches long. No doubt since the advent of civilized man, there has been considerable change in the Inuit modes of living and obtaining food. The arrow and the sling, though still in use, have given place to the rifle and the shotgun; flint and ivory have been somewhat superseded by iron and lead, and their summer tents are now seldom made of anything but canvas, while cooking is done in iron pots and kettles instead of in the stone basins formerly in use.

Having turned over all supplies to Lieutenant Ray, Sunday, August 27th, and relieved from duty under my charge Sergeant Joseph E. Maxfield and Privates Charles Ancor and John A. Guzman, and receiving all mail destined for the United States, preparations were made to leave this dreary region—a region which seems to me to be one in which the bright sunshine of hope enters with a light so subdued that it is but the gleam from a far distant planet penetrating the cavern of ceaseless solitude and woe.

By reason of the severity of the climate, Sergeant James Cassidy was relieved by Lieutenant Ray from duty at Ooglaamie, and returned with me to San Francisco.

Anchor was weighed at 2 p. m. Sunday, and our homeward voyage begun in a snow-storm. Heavy drift-ice was moving rapidly to the southwest. This ice was of very peculiar construction and of varied tints, with height from three to thirty feet. Before the gale began, which was previously mentioned as occurring on the 24th, the ice began drifting from the northeast, in a contrary direction to its usual course, and I judged from the movement on Sunday, being identically the same, we would have another gale from the same quarter. My judgment was correct; for, on Monday, the gale commenced in earnest. We passed Point Belcher at 9 a. m., August 28th, and Icy Cape at 11 p. m.

During the day the temperature of the water changed in one hour from 36° to 31.5°, showing that there existed a warm current, which we crossed. We passed Cape Lisburne at 12 m., August 29th.

By the terms of the contract, the owner of the vessel was allowed to engage in any private enterprises he saw fit, after delivering supplies at Ooglaamie. Consequently, when we left station, I turned the vessel over to the master and ceased to direct its movements, but stipulated that we would return to Plover bay in order to obtain more observations.

We reached East Cape, Asia, Saturday, September 20th, and laid there Sunday and Monday. There is quite a large village located at East Cape, and the natives have a regularly installed chief—the only place we visited where we found a chief. We sailed from East Cape to the Diomedes islands, reaching there at 8 a. m. in a gale from the east. Left the Diomedes at 12 midnight, bound for Saint Lawrence bay, and anchored inside the harbor at 3 p. m. next day. This bay is full of historic reminiscences connected with the burning of the United States steamer "Rodgers," of the Jeannette Relief Expedition. The natives came on board clothed in some of the apparel left them by the officers and crew of this ill-fated vessel. Several had recommendations from the Rodger's party, and in compliance with requests made therein, each one was supplied with tobacco, bread, and molasses. One of the natives described to me the accident which befell Master Putnam of the navy, and stated that some time after the ice-floe, bearing Putnam, drifted out to sea, a southeasterly wind brought the floe back to shore, and he saw the remains of Putnam on it, his face and hands much discolored and the body swollen. The ice did not remain long, but floated out again, moving toward the Arctic.

We left Saint Lawrence bay on September 8th, and reached Plover bay on the 11th, at 2 p. m. Owing to cloudiness, I failed to get an observation of the sun on that day. On Tuesday the 9th, I left the vessel for shore at 7.30 a. m., but had to wait an hour for the fog to rise. Succeeded in getting two sights, but had to

suspend operations, as rain began to fall. It cleared up sufficiently by the afternoon to secure six sights through the clouds—three upper and three lower limb.

We sailed from Plover bay September 13th for Fort Saint Michael's, to return the native, Kan-u-ark, who shipped with us at that place. Shortly after leaving Plover bay a gale sprang up, which compelled us to alter our course and run to the south of Saint Lawrence island. At 5 p. m. of the 14th, the ship struck a reef of hidden rocks, not marked on chart, about six miles south of the island. For a while it looked as if we would winter in this region, or else go to the bottom. The heavy sea favored the vessel in getting off. The pumps were manned, and, to our satisfaction, we found but little water was making. Made Saint Michael's September 17th. While at this place I made informal inspection of the signal office. Left Saint Michael's on the 20th, and touched at Golovin bay same date. On the 28th of September, in Behring sea, the barometer commenced falling rapidly, and a fierce gale sprang up from the east, which soon blew with so much violence that we were obliged to take in all our canvas and heave to under a double reefed main-sail and foresail. We expected by the next day that it would have blown itself out and the worst be over, but it only increased in fury, and for the next day, and the next, and for full five, we were tossed to and fro, at the mercy of such a storm as I hope I shall never again experience. By the time the storm was over, the entire party were worn out, and the patience exhibited under such circumstances certainly became a virtue. We passed through Unimak pass on the 5th of October. Our voyage from thence across the Pacific to San Francisco was, on the whole, favorable, and we reached the latter place October 2d. It was three days before the vessel could be docked, and mail and freight forwarded to Washington.

I turned over to the United States Coast and Geodetic Survey, the chronometers for the purpose of rating. As the rates of the several chronometers have been determined, it would appear, from a careful examination of the record, that I was justified in using number 1683 (the standard) at Point Barrow without correction for rate, as the rate changed from losing to gaining during the voyage.

I regret that I am so pressed for time that I cannot embrace in this report any results deduced from the meteorological observations made during the voyage. Hourly meteorological observations were made without a single interruption. In this connection I desire to refer, with pleasure, to the great assistance given me by Sergeant James Cassidy and Private Frederic H. Clarke. These two men, on the return voyage, took all meteorological observations. These had to be made at all times, and the bravery shown by Sergeant Cassidy and Private Clarke in venturing on the deck of the vessel during storms, when heavy seas were pouring over her, is praiseworthy, and I earnestly commend them to the favorable consideration of the Chief Signal Officer.

Strong currents were found in Behring sea and in the Arctic. At some near date I hope to be able to make an additional report relating to these, and also submit certain theories relative to the movements of areas of low barometer across Behring sea. I am of the opinion that the theory of the ocean being the birthplace of storms is erroneous. But these matters will be investigated as soon as an opportunity presents itself.

Very respectfully, your obedient servant,

JOSEPH S. POWELL,
2d Lieutenant, Signal Corps, U. S. Army, Assistant.

APPENDIX.

Report of Mr. Winslow Upton, Computer Office of the Chief Signal Officer, on the longitude of the United States Polar Station at Ooglaamie, Alaska, from chronometer comparisons and observations made by the Expedition under Lieutenant Joseph S. Powell.

I. GENERAL DESCRIPTION OF THE EXPEDITION.

The Point Barrow supply expedition which visited the polar station in the summer of 1882, under the command of Lieutenant Powell, was instructed to determine the longitude of the station by means of chronometers. For this purpose the following chronometers were employed:—

- Negus 1683, mean time.
- Negus 1691, mean time.
- Negus 1692, sidereal time.
- Negus 1693, sidereal time.

Lieutenant Powell in his report (6805, Mis., 1882, App. A) states that these chronometers "were placed, still enclosed in the boxes in which they were sent from the manufacturers, in the state-room farthest removed from the companion-way and nearest the middle of the vessel. They were firmly secured to shelves." In addition, the ship chronometer, Harpur 396, was available for the daily comparisons.

The following was the plan of the expedition:—

1. Determination of the chronometer corrections and rates by the United States Coast and Geodetic Survey at San Francisco.
2. Daily comparisons of the chronometers during the voyage.
3. Determination of the chronometer corrections and sea rates from San Francisco at Plover bay, whose position is well determined.
4. Determination of the chronometer corrections at Point Barrow, and comparison with the local time as determined by Lieutenant Ray, in charge of the station.
5. Repetition of the observations at Plover bay on the return voyage, and at San Francisco after the return.

This programme was carried out faithfully, but, unfortunately, cloudy weather interfered seriously with the proposed observations. At Plover bay, but two settings with the sextant were obtained on the voyage to Point Barrow, and but eight on the return voyage, while at Point Barrow but three time determinations with the sextant were made, the first being incomplete. Lieutenant Ray had made but one time determination for six weeks preceding the arrival of the party, and therefore his chronometric corrections were unreliable. The daily chronometer comparisons were made without any omission, and the observations at San Francisco before and after the voyage were successful. On account of the partial failure of the observations, as above, it is impossible to obtain as good results as was hoped.

They have all been carefully reduced, and the following condensed account is given of the methods employed and results obtained:—

II. OBSERVATIONS BEFORE AND AFTER THE VOYAGE.

A copy of the observations and chronometer comparisons made at San Francisco has been furnished by the Superintendent of the United States Coast and Geodetic Survey. The observations were made at the Lafayette Park observatory, by

Messrs. Ferdinand Westdahl and Chas. B. Hill, with a Troughton & Simms Transit (U. S. C. S., No. 3.)

The position of the instrument is:—

Latitude	37° 47' 22.56'' N.	}	of Greenwich.
Longitude	122° 25' 41.23'' W.		
	or, 8 h. 9 m. 42.75 s. W.		

The observations before the voyage were made June 19, 20, and 21. These were reduced by the method of least squares, and the following corrections and rates furnished Lieutenant Powell by the observer:—

June 21, San Francisco mean time, ten hours.

M. T. Negus 1683, 6 h. 2 m. 38.1 s., fast of San Francisco mean time,
or, 2 h. 7 m. 4.6 s., slow of Greenwich mean time.
Approximate rate 0.6 s., losing daily.

M. T. Negus 1691, 2 h. 50 m. 59.5 s., fast of San Francisco mean time.
S. T. Negus 1692, 4 h. 26 m. 32.9 s., fast of San Francisco sidereal time.
S. T. Negus 1693, 4 h. 34 m. 43.7 s., fast of San Francisco sidereal time.

The observer's note states, "These were hastily computed from coincidences taken on the morning of June 21st, and without allowing for the rate of mean time, 4969, the 'Hack.'"

An examination of the observations showed that the separate results were somewhat discordant, but that the values given were probably reliable to a fraction of a second. The rate given for 1683 was evidently unreliable, as it was determined from observations not sufficiently accordant to give the rates for short intervals of time. It was thought unnecessary to make a new reduction of the observations, as the above is sufficiently accurate for the purpose of this computation.

After the return of the vessel, observations were made on October 27th and 28th, with the following results:—

M. T., Negus 1683, 6 h. 3 m. 2.5 s., fast of San Francisco mean time.
M. T., Negus 1691, 2 h. 53 m. 4.8 s., fast of San Francisco mean time.
S. T., Negus 1692, 4 h. 27 m. 47.8 s., fast of San Francisco sidereal time.
S. T., Negus 1693, 4 h. 33 m. 55.1 s., fast of San Francisco sidereal time.

The average daily rates of the chronometers from June 31st, to October 28th, 1882, are, therefore:—

M. T., 1683, gaining 0.1891 s.
M. T., 1691, gaining 0.9713 s.
S. T., 1692, gaining 0.5806 s.
S. T., 1693, losing 0.3767 s.

The rate for 1692 was modified during the computation as will be explained later.

III. OBSERVATIONS AT PLOVER BAY.

On the voyage to Point Barrow, a stop was made at Plover bay for the purpose of determining the local time.

On account of clouds, the following only were obtained:—

	August 6, p. m.	
<i>Observed 2 alt.</i>		<i>Chron. 1692.</i>
Sun's upper limb, 64° 18' 00''		8 h. 7 m. 52.5 s.
Sun's upper limb, 64° 32' 10''		8 h. 12 m. 21.5 s.
	Index corrections, zero.	

Reducing these readings separately, the following corrections were obtained, the position of Plover bay being regarded as lat. 64° 22' 0'', long. 11 h. 33 m. 26 s. (V, Bulletin of the Philosophical Society of Washington, vol. iv., p. 130.)

Chron. 1692, —4 h. 25 m. 57.4 s., on San Francisco sidereal time.

Chron. 1692, —4 h. 25 m. 58.4 s., on San Francisco sidereal time.

Mean, —4 h. 25 m. 57.9 s., on San Francisco sidereal time.

Combining this value with the chronometer comparisons made before and after the observations, we have the following corrections :—

M. T., 1683, —6 h. 2 m. 33.7 s., on San Francisco mean time.

M. T., 1691, —2 h. 51 m. 11.2 s., on San Francisco mean time.

S. T., 1692, —4 h. 25 m. 57.9 s., on San Francisco sidereal time.

S. T., 1693, —4 h. 33 m. 27.0 s., on San Francisco sidereal time.

M. T., 396, —7 h. 52 m. 7.9 s., on San Francisco mean time.

M. T., 887, —3 h. 11 m. 20.2 s., slow of Greenwich mean time.

Chronometer, M. T., 887, is the chronometer of the United States Steamer *Corwin*, which was at Plover bay on that day, its error was said to be 11 m. 20.4 s. slow of Greenwich mean time, which chances to be in almost absolute agreement with the result given.

On the return voyage, the following observations were made :—

September 12, a. m.

Observed 2 alt.

Sun's upper limb, $39^{\circ} 19' 30''$

Sun's upper limb, $39^{\circ} 27' 30''$

Index error $+ 4' 30''$.

Barometer, 29.75 ; thermometer, 40° .

Chron. 1692.

3 h. 52 m. 37.5 s.

3 h. 53 m. 27.5 s.

September 12, p. m.

Observed 2 alt.

Sun's upper limb, $27^{\circ} 43' 0''$.

Sun's upper limb, $27^{\circ} 34' 0''$.

Sun's upper limb, $27^{\circ} 28' 0''$.

Sun's lower limb, $27^{\circ} 19' 0''$.

Sun's lower limb, $27^{\circ} 12' 0''$.

Sun's lower limb, $26^{\circ} 59' 0''$.

Index error, $+ 4' 30''$.

Barometer, 29.71 ; thermometer, 40° .

Chron. 1692.

11 h. 33 m. 38.5 s.

11 h. 34 m. 18.5 s.

11 h. 34 m. 48 s.

11 h. 36 m. 3 s.

11 h. 36 m. 39.5 s.

11 h. 37 m. 38.5 s.

Lieutenant Powell's notes for the a. m. observation: "The above observations were taken under difficulties. The weather was partly cloudy, and raining slightly. They are, therefore, not considered good."

At the p. m. observation he says: "The same trouble in regard to clouds existed during the afternoon observations. The results are not considered good, but sufficient to act as checks."

In reducing these observations, it was assumed that "index error" should be "index correction," as the observer had so regarded it in his reductions, and as the original observations by which it was obtained are not recorded in the observer's note-book. It was also necessary to regard the observed altitudes in the last set of observations as 28° , instead of 27° , as recorded.

The following were the results obtained for the correction to 1692 :

4 h. 25 m. 32.7 s. a. m., first reading.

4 h. 25 m. 36.5 s. a. m., second reading.

4 h. 25 m. 37.6 s. p. m., first group.

4 h. 26 m. 7.4 s. p. m., second group.

Giving the first and second observations half weight, as they depend upon single readings only, we have :—

4 h. 25 m. 53.2 s.

Combining this with the chronometer comparisons made before and after the observations, the following corrections result:—

M. T. 1683,	—6 h. 2 m. 27.6 s.,	on San Francisco mean time.
M. T. 1691,	—2 h. 51 m. 42.9 s.,	on San Francisco mean time.
S. T. 1692,	—4 h. 25 m. 53.2 s.,	on San Francisco sidereal time.
S. T. 1693,	—4 h. 33 m. 9.1 s.,	on San Francisco sidereal time.
M. T. 396,	—7 h. 50 m. 31.3 s.,	on San Francisco mean time.

IV. OBSERVATIONS AT POINT BARROW.

The observations at Point Barrow were made at the observatory of the station at Ooglaamie on August 22d, a. m. and p. m., and August 26th, p. m.

They are given below with the reductions of each:—

		August 22, a. m.	
<i>Observed 2 alt.</i>			<i>Time by 1713.</i>
D	51 ^o 50'		7 h. 24 m. 15 s.
Sun's lower limb,	51 55		7 h. 25 m. 4 s.
	52 00		7 h. 25 m. 49 s.
R	51 50		7 h. 34 m. 0.5 s.
Sun's upper limb,	51 55		7 h. 34 m. 42.5 s.
	52 00		7 h. 35 m. 28 s.
MAXFIELD, <i>Observer.</i>			
D	53 ^o 25'		7 h. 49 m. 58 s.
Sun's lower limb,	53 30		7 h. 50 m. 45.1 s.
	53 35		7 h. 51 m. 19.5 s.
	53 40		7 h. 52 m. 17.5 s.
	53 45		7 h. 53 m. 9.5 s.
DARKE, <i>Observer.</i>			
		Index error, —1' 0".	

"Had great difficulty in getting contacts on account of variability in the refraction."

The observations were unsatisfactory and the reductions quite discordant. It was assumed that "index error" should be "index correction," as the observer had so regarded it, and as the record of August 26 has the word "correction." The reduction of the observations made by Mr. Darke differed ten minutes from those made by Sergeant Maxfield, the latter agreeing with those made in the afternoon. Assuming that the observed double altitude should be 54^o instead of 53^o, this discrepancy was removed and the resulting corrections of chronometer 1713 are:—

+ 1 h. 58 m. 53.6 s.,	on local mean time.
+ 1 h. 58 m. 15.7 s.	

		August 22, p. m.	
<i>Cover direct.—Observed 2 alt.</i>			<i>Chron. 1713.</i>
	47 ^o 40'		1 h. 7 m. 18 s.
	47 35		1 h. 8 m. 5.5 s.
	47 30		1 h. 8 m. 43.5 s., clear.
Sun's upper limb,	47 25		1 h. 9 m. 28.5 s.
	47 20		1 h. 10 m. 6.5 s.
	47 15		1 h. 10 m. 47.5 s.
<i>Cover reverse.</i>			
	47 40		1 h. 15 m. 43.5 s.
	47 35		1 h. 16 m. 27 s.
	47 30		1 h. 17 m. 4.5 s., partly cloudy.
Sun's lower limb,	47 25		1 h. 17 m. 48.5 s.
	47 20		1 h. 18 m. 27 s.
	47 15		missed.
		Index error, —1' 0".	MAXFIELD, <i>Observer.</i>

The reduction of these observations gives for the correction of chronometer 1713, on local time:—

+ 1 h. 59 m. 39.8 s.
 1 h. 59 m. 24.7 s.
 Mean, 1 h. 59 m. 32.2 s.
 August 26, p. m.

<i>Observed 2 alt.</i>	<i>Chron. 1713.</i>
Sun's lower limb, 48 ^o 36' 40''	12 h. 44 m. 48 s., cloudy.
48 28 20	12 h. 46 m. 14.5 s.
48 16 30	12 h. 47 m. 57 s., contact poor.
48 11 00	12 h. 48 m. 37 s.
48 3 50	12 h. 49 m. 40.5 s.
47 57 20	12 h. 50 m. 39.5 s.
Sun's upper limb, 46 31 40	12 h. 53 m. 43 s.
46 26 40	12 h. 54 m. 24 s.
46 21 00	12 h. 55 m. 11.5 s., contact better.
46 15 10	12 h. 55 m. 53.5 s.
46 7 50	12 h. 57 m. 3 s.
46 3 10	12 h. 57 m. 41.5 s.
Index correction, —1' 0''.	

Weather cloudy. Further observations stopped by clouds.

MAXFIELD, *Observer.*

The reduction of these observations gives the following corrections to chronometer 1713:—

+ 1 h. 59 m. 35.0 s.
 1 h. 59 m. 43.2 s.
 Mean 1 h. 59 m. 39.1 s.

Tabulating the results given above, we have for the corrections to chronometer 1713:—

August 22, a. m., + 1 h. 58 m. 53.6 s.	} Very uncertain.
1 h. 58 m. 15.7 s.	
“ 22, p. m., 1 h. 59 m. 32.2 s.	
“ 26, p. m., 1 h. 59 m. 39.1 s.	
Daily rate 1.73 s., losing.	

Observations made in this latitude, with the sextant under the best conditions, are subject to an uncertainty of several seconds.

A preliminary computation of the longitude made by using the observations of August 22d, p. m., and August 26th, p. m., with the rate given by them, showed for the daily comparisons a series of progressive values corresponding to the assumed rate. It was therefore evident that no reliance could be placed on the rate 1.73 s., given above.

Rejecting the morning observations of August 22d, and taking the mean of the others, we have for the chronometer correction of 1713:—

August 24, + 1 h. 59 m. 35.6 s.

Chronometer 1713 was one of those belonging to Lieutenant Ray in charge of the station at Ooglaamic. He furnished the following as its correction and rate:—

August 25, + 1 h. 59 m. 27.5 s., losing 0.1 s.

The records which were brought back from Lieutenant Ray do not show exactly how this value was obtained, but it apparently depends upon an observation made on August 16th with the sextant,

V. COMPUTATION OF THE LONGITUDE.

From the data furnished by the observations we proceed now to determine the longitude of Ooglaamie by several methods:—

(1.) By using the mean sea rates for each chronometer.

In section ii. are given the mean sea rates of the four chronometers, negus Nos. 1683, 1691, 1692, 1693, determined from the observations at San Francisco before and after the voyage.

The daily comparisons showed that the deviations from the mean rates were progressive, and characterized by no sudden changes, except in one instance. On September 14th, the ship was violently jarred by striking a rock. None of the chronometers seem to have been affected except No. 1692, which from that date, had a rate differing from its former rate by about 1.2 s.

Assuming that this change occurred at about the time of the comparisons on September 15th, we can determine its mean rate as follows:—

$$\begin{aligned} & 1692, \text{ correction.} \\ \text{June 21st, 10 a. m., 4 h. 26 m. 32.9 s.} \\ \text{Oct. 28th, 10 a. m., 4 h. 27 m. 47.8 s.} \\ & \text{Difference, 74.9 s.} \\ & 86 r + 43 (r + 1.2) = 74.9 \text{ s.} \\ & \qquad \qquad \qquad r = 0.1806 \text{ s., gaining.} \\ & \qquad \qquad \qquad r + 1.2 = 1.3806 \text{ s., gaining.} \end{aligned}$$

The former value is to be used from June 21st to September 15th; the latter from September 15th to October 28th.

The ship's chronometer, Harpur 396, was not compared with the others at San Francisco, but was included in the daily comparisons throughout the voyage; its rate can therefore be determined by using the mean rate of any of the other chronometers for a few days only at each end of the voyage. Using 1683 for this purpose, we have for the corrections and rate of 396 the following values:

$$\begin{aligned} \text{June 24th, —7 h. 53 m. 37.0 s.} \\ \text{Oct. 24th, —7 h. 50 m. 2.4 s,} \\ & \text{Difference, 3 m. 34.6 s.} \\ & \text{Daily rate, 1.7596 s., losing.} \end{aligned}$$

At Point Barrow, comparisons were made of the chronometers with those of Lieutenant Ray, on August 22d, 23d, 24th and 27th.

We have adopted in section iv, a correction for chronometer 1713, which is applicable to August 24th. A trial showed that the same result, within a few tenths of a second, was obtained by using August 24th alone, and by using all the comparisons, adopting the same correction for 1713, with no rate.

It is therefore sufficient to use the comparisons of August 24th as the reference point for the Point Barrow observations. The following table gives the chronometer corrections computed from the mean sea rates given above; and the resulting longitude expressed in time west of Greenwich:

August 24, 1882.		
<i>Chronometer.</i>	<i>Correction.</i>	<i>Longitude.</i>
1683	— 6 h. 2 m. 50.2 s.	10 h. 26 m. 32.9 s.
1691	— 2 h. 52 m. 1.8 s.	10 h. 26 m. 10.5 s.
396	— 7 h. 51 m. 47.5 s.	10 h. 26 m. 27.0 s.
1692	— 4 h. 26 m. 42.4 s.	10 h. 26 m. 3.7 s.
1693	— 4 h. 34 m. 19.5 s.	10 h. 25 m. 49.6 s.
		Mean 10 h. 26 m. 12.9 s.

(2.) By using the mean sea rates corrected for deviations of rate shown by the daily comparison.

No temperature observations were made during the voyage. In the cabin adjoining the state-room, a fire was kept burning, and probably the chronometers were not exposed to a very great range of temperature. But the daily comparisons show large deviations from the mean rates.

In order to examine these, the following table was prepared, which contains the observed relative rates of No. 1683 compared with each of the other chronometers in turn, and the deviations of the observed values from the mean relative rates. They are given for the mean of the five-day intervals contained in the column of dates.

Table showing the observed relative rates of the chronometers for five-day intervals, and the deviations from the mean relative rates:

1882.	1683. Relative rate.	1691. Devia- tion.	1683. Relative rate.	396. Devia- tion.	1683. Relative rate.	1692. Devia- tion.	1683. Relative rate.	1693. Devia- tion.
June 25-29.....	-.28 s.	-.50 s.	+1.02 s.	+.93 s.	+.52 s.	+.51 s.	+1.56 s.	-.99 s.
30 to July 4.....	-.56	-.22	+1.50	+.45	+.74	+.73	+1.26	-.69
July 5-9.....	-.24	-.54	+1.68	+.27	+.86	+.85	+1.76	-1.19
10-14.....	+.02	-.80	-2.06	-.11	-1.38	-1.37	-2.36	-1.79
15-19.....	-.28	-.50	-2.14	-.19	-.76	-.75	-1.72	-1.15
20-24.....	-.62	-.16	-2.20	-.25	-.60	-.59	-1.96	-1.39
25-29.....	-.66	-.12	-2.38	-.43	-.72	-.71	-2.04	-1.47
30 to Aug. 3.....	-.08	-.70	-2.50	-.55	-.60	-.59	-1.40	-.83
Aug. 4-8.....	-.32	-.46	-2.24	-.29	-.12	-.11	-.34	+.23
9-13.....	-.38	-.40	-2.24	-.29	-.02	+.03	+.38	+.19
14-18.....	-.50	-.28	-2.12	-.17	+.02	+.03	+.42	+.15
19-23.....	-1.08	+.30	-2.64	-.69	+.05	+.05	+.46	+.11
24-28.....	-1.10	+.32	-2.60	-.65	+.24	+.23	+.40	+.11
29 to Sept. 2.....	-1.30	+.52	-2.70	-.75	+.02	+.03	+.38	+.19
Sept. 3-7.....	-1.38	+.60	-2.64	-.69	+.10	+.11	+.22	+.35
8-12.....	-1.54	+.76	-2.24	-.29	+.50	+.51	+.04	+.61
13-17.....	-1.62	+.84	-2.04	-.09	+.64	+.17	+.18	+.75
18-22.....	-1.36	+.58	-2.38	-.43	-2.02	+.83	+.22	+.79
23-27.....	-1.36	+.58	-1.64	+.31	-1.76	+.57	+.28	+.85
28 to Oct. 2.....	-1.42	+.64	-.94	+1.01	-2.10	+.91	+.44	+1.01
Oct. 3-7.....	-.98	+.20	+1.50	+.45	-1.94	+.75	+.34	+.91
8-12.....	-.94	+.16	+1.16	+.79	-2.02	+.83	+.34	+.91
13-17.....	-.82	+.04	+1.10	+.85	-1.94	+.75	+.28	+.85
18-22.....	-.72	+.06	+1.26	+.69	-1.76	+.57	+.22	+.79
23-24.....	-.65	+.13	+1.70	+.25	-1.60	+.41	+.35	+.92
Mean relative rate	-.78.		+1.95.		+.01 to Sept. 15th.			+.57.
					-1 19 after Sept. 15th.			

It is evident, from this table, that the deviations from the mean rates are important, and that in general they follow the law of sines.

In the absence of any temperature observations, the best method of treating the deviations is to express them as a function of the time. There seems no reason for supposing that any one chronometer was poorer than the others; consequently we may select any one we please as a standard, and determine a series of corrections to its rate from the comparisons with the other chronometers. We have adopted 1683 as a standard, and have assumed that in the comparison with each, half of the respective deviations were chargeable to 1683 and half to the other chronometers. The mean of the four series of values thus obtained, with the opposite sign, gives the adopted corrections to the rate of 1683. They are as follows:

June 27 +.14 s.	Aug. 6 +.08 s.	Sept. 15 - .21 s.
July 2 .15 s.	" 11 .06 s.	" 20 .22 s.
" 7 .29 s.	" 16 .04 s.	" 25 .29 s.
" 12 .51 s.	" 21 .04 s.	" 30 .44 s.
" 17 .32 s.	" 26 - .06 s.	Oct. 5 .29 s.
" 22 .30 s.	" 31 .00 s.	" 10 .34 s.
" 27 .34 s.	Sept. 5 - .04 s.	" 15 .31 s.
Aug. 1 +.34 s.	" 10 - .20 s.	" 20 - .25 s.

If we now regard the period of one hundred and twenty days, from June 25th to

October 23d, as a circumference, we can express these corrections in terms of the sines of the intervals from June 25th, by the formula $a \sin \gamma =$ correction.

Our expression for the rate of 1683 then becomes :—

$$r = + 0.1891 \text{ s.} + a \sin \gamma.$$

By solution:—

$$r = + 0.1891 \text{ s.} + 0.41 \sin \gamma.$$

The value of the term $0.41 \sin \gamma$ summed for the period, June 21st to August 24th, is 15.8 s., which may, therefore, be applied with the opposite sign as a correction to the longitude deduced from 1683 with a mean rate. The resulting longitude is:—

10 h. 26 m. 17.1 s.

A complete discussion of all the chronometers would necessitate the determination of similar corrections to the others. But it should be noted that if we determine the correction to 1683 as above, by reference to all the chronometers, and then by subtracting the adopted corrections of the standard chronometer from the observed deviations, determine corrections to the other chronometers in turn, we simply reduce all the chronometers to the standard with its assumed corrections. The results from the separate chronometers will then necessarily be brought into close agreement with each other, the only difference possible being due to the effect of smoothing the residuals by the sine formula. The agreement obtained is fictitious, since all the readings are by the process adopted, brought into harmony with those of the standard chronometer, whose correction has been assumed. The result of reducing all the chronometers amounts simply to a check upon the numerical computation. In the case of the chronometers used on this expedition, a numerical check was obtained by summing the residuals for each chronometer, without applying the sine formula.

The above result, 10 h. 26 m. 17.1 s., may then be regarded as the final value of the longitude obtained from the mean sea rate, corrected for the observed deviations during the voyage.

(3.) By using the mean sea rate obtained from the two observations at Plover bay. In section iii. are given the chronometer corrections deduced from the observations at Plover bay on August 6th and September 12th.

The following table contains the resulting daily rates, the chronometer corrections on August 24th, and the deduced longitudes:—

<i>Daily rate.</i>	<i>Cor., Aug. 24.</i>	<i>Longitude.</i>
M. T. 1683, — .165 s.	6 h. 2 m. 30.7 s.	10 h. 26 m. 52.4 s.
M. T. 1691, + .857 s.	2 h. 51 m. 26.6 s.	10 h. 26 m. 45.7 s.
M. T. 396, —2.611 s.	7 h. 51 m. 20.9 s.	10 h. 26 m. 54.5 s.
S. T. 1692, — .127 s.	4 h. 25 m. 55.6 s.	10 h. 26 m. 50.5 s.
S. T. 2693, — .484 s.	4 h, 33 m. 18.3 s.	10 h. 26 m. 50.8 s.
		Mean, 10 h. 26 m. 50.8 s.

If we treat the observed relative rates given in the table on page 31 for the period, August 6 to September 12, and deduce the deviations from the mean, as was done in the case of the mean sea rates for the whole voyage above described, we have the following corrections to 1683:—

August 6, —.06 s.	August 26, —.05 s.
“ 11, —.05 s.	“ 31, .00 s.
“ 16, —.06 s.	Sept. 5, +.11 s.
“ 21, —.04 s.	“ 10, +.13 s.

These do not follow any law of sines, but indicate that from August 6 to August 24, a correction of +.05 per day should be applied to the mean rate of 1683. The resulting longitude becomes 10 h. 26 m. 51.5 s., which closely agrees with the above value determined from the uncorrected mean rates.

(4.) By using sea rates determined from San Francisco to Plover bay, or from Plover bay to San Francisco, this method gives the following rates, chronometer corrections, and longitudes:—

(a.) Sea rate from San Francisco to Plover bay.

<i>Daily rate.</i>	<i>Cor., Aug. 24.</i>	<i>Longitude.</i>
M. T. 1683, — .096 s.	6 h. 2 m. 32.0 s.	10 h. 26 m. 51.1 s.
M. T. 1691, + .254 s.	6 h. 51 m. 15.8 s.	10 h. 26 m. 56.5 s.
M. T. 396, —2.060 s.	7 h. 51 m. 30.8 s.	10 h. 26 m. 44.6 s.
S. T. 1692, — .761 s.	4 h. 25 m. 44.2 s.	10 h. 27 m. 1.9 s.
S. T. 1693, —1.667 s.	4 h. 32 m. 56.9 s.	10 h. 27 m. 12.2 s.
		Mean, 10 h. 26 m. 57.3 s.

(b.) Sea rate from Plover bay to San Francisco.

<i>Daily rate.</i>	<i>Cor., Aug. 24.</i>	<i>Longitude.</i>
M. T. 1683, + .759 s.	6 h. 2 m. 13.2 s.	10 h. 27 m. 9.9 s.
M. T. 1691, +1.780 s.	2 h. 51 m. 9.1 s.	10 h. 27 m. 3.2 s.
M. T. 396, — .743 s.	7 h. 50 m. 45.4 s.	10 h. 27 m. 30.0 s.
S. T. 1692, +1.370 s., before Sept. 15.	4 h. 25 m. 27.2 s.	10 h. 27 m. 18.9 s.
+2.570 s., after Sept. 15.		
S. T. 1693, +1.000 s.	4 h. 32 m. 50.1 s.	20 h. 27 m. 19.0 s.
		Mean, 10 h. 27 m. 16.2 s.

VI. FINAL RESULTS.

The values given in the preceding section may be grouped as follows, the results being taken to the nearest second only:—

- 10 h. 26 m. 13 s. from mean rates for whole voyage, uncorrected.
- 10 h. 26 m. 17 s. from mean rates for whole voyage, corrected.
- 10 h. 26 m. 51 s. from mean rates from Plover bay to Plover bay, uncorrected.
- 10 h. 26 m. 52 s. from mean rates from Plover bay to Plover bay, corrected.
- 10 h. 26 m. 57 s. from mean rates from San Francisco to Plover bay.
- 10 h. 27 m. 16 s. from mean rates from Plover bay to San Francisco.

In all these, the local time at Point Barrow has been adopted as given by the observations made there with the sextant. The chronometer corrections furnished by Lieutenant Ray would give values 9.2 s. greater than the above.

In deciding what should be done with these results, it is necessary to regard the accuracy of the methods by which they were obtained, as these are by no means equal. The two last results are the least reliable, as rates determined in the one case from San Francisco to Plover Bay cannot be fairly used for the remainder of the voyage to Point Barrow; nor can it be assumed in the other case that the rate on the return voyage, as determined from Plover bay to San Francisco, can be carried back to Point Barrow. The discordance between the rates thus obtained, as compared with each other and with the rates at the part of the voyage from Plover bay to Plover bay, shows that the rates were too changeable to give this method any reliability.

The result obtained by determining the mean rates from Plover bay to Plover bay, would be entitled to the highest weight if the observations at Plover bay had been more successful. The longitude of Plover bay has been quite well determined, and is probably known within a very few seconds of time, ("Bulletin of Philosophical Society of Washington," vol. iv.) But unfortunately, but little reliance can be placed on the observations, which were, on account of the weather, few and unsatisfactory. They may be in error by ten or more seconds.

The two results first given are subject to the uncertainties of rate due to the length

of the voyage. It is probably impossible to conduct a chronometric expedition of one hundred and twenty days and determine the longitude thereby with an uncertainty less than many seconds. The agreement in the results as determined by the separate chronometers is as good as can be expected, though their extreme range is 43 seconds.

On the whole it seemed best to adopt the second and fourth values of the series given above, giving them equal weight. We have then the results as below, according as we use the chronometer corrections at Point Barrow determined by special sextant observations, or as given by Lieutenant Ray:—

10 h. 26 m. 34.5 s.

43.7 s.

mean 10 h. 26 m. 39 s. final value of longitude.

This value, it need hardly be said, is uncertain by at least ten seconds, but it seems as accurate as can be obtained from the data at hand. The method of chronometers is not the best when the voyage is a long one, especially when a permanent party remains for months at the station whose longitude is desired. At the latitude of Point Barrow, the longitude can be obtained by lunar distances, or still better by lunar culminations, within 5 or 6 seconds at each observation. The permanent party can, therefore, by making sufficient observations, obtain their longitude to the nearest second, a degree of accuracy which cannot be looked for in the transportation of chronometers from the United States, under the most favorable circumstances.

No. III.

REPORT OF LIEUTENANT P. HENRY RAY:

WORK AT POINT BARROW, ALASKA,

FROM SEPTEMBER 16, 1881, TO AUGUST 25, 1882.

UNITED STATES SIGNAL STATION,
OOGLAAMIE, ALASKA, August 25, 1882.

TO THE CHIEF SIGNAL OFFICER, U. S. A.,

Washington, D. C.

SIR: I have the honor to report that, after the sailing of the Golden Fleece on the 16th of September, 1881, the whole energies of the party were devoted to securing the stores and instruments and erection of the buildings; the weather continued very stormy and inclement all during the month of September, so our lumber and material was wet and coated with ice, adding great discomfort to the labor of building, but the rapidly forming ice on the lakes and inlets showed we had no time to lose. By the 22d of September the building was so far advanced that we moved in all the stores that were likely to become damaged by the weather, and on October 3d it was so far completed that the whole party was enabled to move in. More or less snow had fallen during this time, and the ice was five inches thick on the inlet; the sea still remained open, with no heavy ice in sight. A strong current, setting continuously to the northeast along this shore, kept the young ice from becoming solid, but the sea was covered with loose pancakes of ice as far as the eye could reach. Storms of snow and sleet continued up to late in October; during that time we had several severe westerly gales, sending in a heavy sea on this shore. One on September 17th raised the water four and one-half feet above mean low tide, and, running clear over the long sand spit between us and Point Barrow, making the little patch of dry land on which the village of Noowook stands virtually an island, and showing us that there was not a single place between the station and the extreme point where it would have been safe to build the observatory, without carrying our stores a long distance back from the beach, which it was impossible to do with my small party. There was never a time after the Golden Fleece sailed, and before the sea was closed by ice, that it would have been possible for us to have landed with our stores. As it was, there was not a pound of stores lost or damaged, or an instrument injured. I send a map of the country in the immediate vicinity of the station, with plan of buildings.

The inside work on the main building was completed after the party moved in, and at the same time the meteorological instruments were placed and hourly observations in that department were commenced October 17th. The three magnetic instruments were mounted on wooden piers, the season being too far advanced to place masonry. Posts twelve inches square were set into the frozen earth to a depth of one foot, and cemented into their place by pouring water around them and allowing it to freeze. These piers answered every purpose, were perfectly solid and did not change their position in the slightest degree; and when the observatory was

taken down this summer, I found the ice around their base unmelted. As soon as the weather was warm enough, brick piers capped with stone were placed, and the instruments are now all in position on permanent piers.

On December 1, 1881, hourly observations were commenced in the three elements of magnetism, and were kept up uninterruptedly until July 22, 1882, when the work was suspended for seven days, while moving the observatory and placing the instruments on new piers, so as to be fully prepared for the year commencing August 1, 1882. The galvanometer was placed the latter part of July, and observations commenced August 11. The location of the observatory is such, that but one ground, the east, is on land, the south being in the lagoon, and the north and west in the sea (see map.) The east ground is in oil; all the others are held by a box of gravel strapped with iron, to which the plates are attached. It was impossible to place this instrument before, as the earth was frozen so hard the wires could not be laid, and there were no poles to be had to string the wires in the air.

There has been no tidal observations owing to the fact that no gauge was furnished the expedition, and it would be almost impossible to make any ordinary gauge, such as I might construct here, remain in place at this station. The inlet near the station is not affected by the tide, except when it is open to the sea, which is only about two months during the year. A gauge placed on the beach could not be made to stand when the sea is open, owing to the heavy sea during westerly gales, and in the early winter it would be disarranged by the ice. I believe though, I will be able to get observations for one term in each year, between the months of March and June, and I shall build a gauge if none is sent this year.

NATURAL HISTORY.

In this department every effort has been made to make the collection as perfect as possible. All of the spare time of every member of the party has been devoted to this work, and to Doctor Oldmixon, especially, the department of botany and ethnology. All collections made during the past year, I send by return vessel. In the ethnological department, we have had many difficulties to contend with, as not a single member of the party could speak a word of the language of these people when we landed, but as several of the party are acquiring it rapidly, I am in hopes to be able to make a satisfactory report upon our return.

The supply of fresh meat is limited, but sufficient can always be obtained for a party of this size. Reindeer and seal only can be depended upon. We have seen but one or two walrus. During the summer a few reindeer come as far north as the station, but cannot be found in any number this side of Dease inlet, or North Refuge inlet, and during the winter, they can not be found north of latitude 70° . Seal can be taken all through the winter, after the sea closes, by means of nets, set, after the manner of the natives, at their breathing holes. The meat of the white whale, I find to be excellent for food; have killed one this summer, and am in hopes to be able to take more, and also to get to the eastward and kill deer enough to last us through the winter, should the supply vessel reach us in time to permit me to make the trip after her departure. Last fall I purchased about five hundred pounds from the natives before the winter set in.

There is no fuel to be obtained in this vicinity, except drift; that which is indigenous to this country and comes ashore is a very inferior quality, being mostly of a species of cottonwood or balm. Even the natives can not make it burn without pouring oil over it. A few remnants of old wrecks are lying along the coast, but none of any importance near the station, and even where I have tried to get at them, they are so buried in the sand, that the labor was very great; what little timber I obtained would be of no consequence as fuel. I have utilized all I got in

building a bastion ten feet square, and two stories high on the corner of the main building, where I have mounted the Gatling gun, and stored the ammunition.

The natives have, as a rule, behaved in a friendly manner, and those belonging to Ooglaamic especially rendered valuable assistance at the time we landed, both in landing stores from the ship in their canoes and in carrying them from the beach to the site of the station. Some of the leading men from Noowook came down last winter and demanded presents which I refused to give. At the same time they made threats to come down and clean out the station, which they have not done. I have no fears of a general open attack; first, because no native has enough followers to be able to do anything serious; second, their struggle for existence keeps them too busy to make war upon any one. The spite of the disaffected ones is aimed principally at me, owing to the fact that they have been unable to obtain their usual supply of whiskey, arms, and ammunition from the whaling fleet this year. They think I am the cause of it, and I understand have made some threats in the matter; but I shall use every precaution against surprise. So far I have kept them at a distance; have never allowed any but a very few head men to come inside of the house, and do not permit my people to go into their villages or to meddle with them in any respect.

The safety of the station would be very much increased if the law relating to the sale of contraband goods by whalers and traders on this coast could be enforced. In the past there has been no check upon it in any way whatsoever, as we found them abundantly supplied with breach-loading arms and ammunition when we landed. The sending of the revenue-cutter into this sea a month or two after the fleet has entered is simply a farce, and from all I can learn, unless her course in the future should be different from that of the past, she had better stay away entirely. I believe the offenders in the fleet this year are confined to two or three ships. I met nearly all the masters when they first came up, and they all promised a strict compliance with the law. But in spite of all that the natives here have been drunk three different times during the last month.

I have made but two expeditions from the post during the past year. The first was made during the month of March, for the purpose of obtaining fresh meat. On the 23d of that month I left the post with a sled drawn by a team of eight dogs, accompanied by two natives with their families. We travelled along the coast on the ice southwest to the entrance of Woody inlet. We there left the sea and struck inland in a southerly direction and camped in a snow-hut, without fire, twenty-seven miles from the station, on the shore of what the natives told me was a large lake with an outlet leading into Woody inlet.

March 24th, broke camp at 5 a. m., weather cloudy, with light snow, wind southwest, very cold, traveled nearly due south, crossed during the day several large lakes and two streams flowing northeast, it being almost impossible to define their banks, as the whole country is nearly a dead level and covered with snow. I only knew when I passed from ice to land, as the natives told me. Travelled eighteen miles and went into camp at 1 p. m. Built a snow-hut to sleep in. The dry snow drifting with the wind made travelling very difficult, and it was hard work to make the dogs face the sharp wind. Camped on the left bank of a small stream flowing northeast, country along it more rolling and broken than that travelled over earlier in the day.

March 25th, broke camp at 6.30 a. m., weather still stormy, with light snow, wind southwest, travelled in a southerly direction. Very difficult to keep the course by the compass, as the guide and dogs were constantly getting out of their direction by the force of the wind, and the drifting snow hiding every landmark left us nothing to travel by, it being impossible to see but a few yards ahead of the team. After travelling about fifteen miles, came to a large river with high banks, as they were

swept clean by the wind, the river was well defined. It was two hundred yards wide at the point where I crossed it, and where the ice was exposed, seemed very winding. Its general course is northeast true. Named it Meade river, in honor of the late Major General George G. Meade, U. S. Army. A low growth of stunted willows, about four feet high, fringes its banks, it being the first growth of anything like timber seen since leaving the station. We traveled up the right bank three miles and came to the camp of a native deer-hunter named Mung-y-a-loo, who belongs at Ooglaamic. These natives, while hunting deer in the winter, never remain long in one place and live exclusively in snow-huts, which they construct very quickly whenever they wish to camp. They are simply oblong holes dug into the hard snow where it has drifted deeply, and covered with slabs of the same material, cut out with a large knife they carry for that purpose. I have never seen any of them build a circular hut, and they do not seem to know how. Camped with Mung-y-a-loo. Travelled eighteen miles.

March 26th. Broke camp at 5 a. m., travelled in a southwesterly direction along the right bank of Meade river seven and one-half miles, and crossed over to the left bank; channel two hundred and fifty yards wide at this point. At this place the trail left the river. I could see a large fork coming from the southeast, and the land was higher to the south, so I am of opinion it breaks into several forks a short distance above where I left it. Found several specimens of lignite coal among the drift on a sand bar. Natives told me that there is a large vein a few miles higher up the river. If so, it is the nearest to the station of any yet discovered. Continued to travel in about the same direction all day; saw several bands of reindeer for the first time. At 6.30 p. m., came into the camp of an Ooglaamic native named Nick-a-y-a-loo, on a small stream that, from what the natives told me, I judge flows into Wainright's inlet. Weather clear, but very cold, with strong southwest wind. The sun and the snow affecting the eyes of the whole party very much. Marched thirty-two miles.

March 27th. Laid over in camp. Purchased four reindeer, also a number of white fish. Natives tell me they caught them in Meade river. Weather very cold.

March 28th. Broke camp at 5.30 a. m. for return trip, having obtained all the venison I could haul. As the wind remained in the southwest, was enabled to use a sail on the sled, and made excellent time, reaching Mung-y-a-loo's camp at 4 p. m. Hired one native boy to return with me.

March 29th. Wind blowing a gale from the west. Native refused to travel; obliged to lay over; weather very cold.

March 30th. Wind fell during the night, but still blowing fresh from the west. Broke camp at 5 a. m., following my outward bound trail; marched twenty-seven miles, and camped in an abandoned snow-hut.

March 31st. Broke camp at 5 a. m., travelled on trail; wind fair for sailing; weather very much moderated; reached the station at 6 p. m. Travelled thirty-six miles.

On this trip, I did not carry any instrument but a compass and pocket chronometer, as the sun was too low to make observations of any value. The trip was made solely to obtain fresh meat, as I dared not allow the party to go any longer without it. I wished to test the question if I was able to travel with safety alone with these natives, and they treated me with the utmost kindness throughout the whole trip; was obliged to travel most of the time on foot to keep from freezing.

On the 28th of April, I left the station with one native and a dog-team to locate the mouth of Meade river; traveled east 23° south, forty-five miles; found that it emptied into the Arctic ocean by five mouths, in latitude $70^{\circ} 59'$, north; longitude $154^{\circ} 32'$ west; returned to the station April 30th. The wind being fair, I made the trip from the mouth of the river to the station in thirteen hours. Since then, I have been too busy with the more important work at the station to be able to leave.

The sea, after the night of November 21st, was closed without any sign of open water until the 23d of April, when a small lead was reported four miles out, northwest from Noowook. Whales were also reported, and the natives reported seeing them nearly every day during the month of May and up until the 10th of June. In January we saw what is commonly known as a water sky, extending along the horizon to the northwest. As it was very black and heavy, and seemed very near, I started out to it. After travelling between six and seven miles over the ice, the heavy cloud faded away from in front of me and was just as visible between me and the land. It was simply the moisture rising through cracks in the ice. This I found to be the case in every instance where a *water sky* was seen. There is a strong current setting along this coast to the northeast, except during a strong northeast gale, which will sometimes make a surface current to the southwest, but such a current is not of any duration, for invariably upon a change of wind to any other quarter the current returns again to its old northeast course. I tested it a number of times through the ice, when the sea was entirely closed, and always found it set to the northeast.

On June 25th, the steamer "North Star" hove in sight, working up through a small lead of open water, about nine miles from the station. When she got nearly abreast of the station, she became fast in the ice, the pack closing down upon her. Captain Herendeen and myself went off to her, and received our first mail since sailing. The ship at the time was suffering from a severe nip, and was considerably raised up. She remained in this position until July 7th, when the pressure slacked up, and she worked her way in to within three miles of the station, and again the ice closed upon her. She did not seem to suffer any until about 2 p. m. on the 8th, when suddenly we heard a great shout raised by the crew, and we could also hear her timbers breaking. In twenty minutes she was out of sight. I went off to their assistance at once with Captain Herendeen, taking our small boat to ferry across the open holes, and the crew, forty-seven all told, were all safely ashore and in camp at the station at noon on the 9th.

As they saved only a little flour and hard bread, I ordered an issue of such articles of the ration as was necessary for their subsistence. I was unable to communicate with the fleet, as the ice had forced them away to the south, but succeeded in getting the most of them on board the "Bowhead," which worked up near here on the 15th, and we sent off the last of them on the 25th.

To Captains Campbell, Cogan, Smith, Heppinstone, and Knowles, we feel we owe a special debt of gratitude in sending us fresh vegetables as soon as they could reach us, and to all the captains of the fleet we are indebted for many acts of kindness.

During the winter a shaft was put down thirteen feet for earth temperatures, (see table) and at that point a room was excavated of sufficient capacity to store 2,000 pounds of fresh meat. As the temperature is below freezing winter and summer, there is no limit to the time we can preserve it. Shall carry on the work in the coming winter.

I ship one box (twenty-four) negatives of scenes and natives in this vicinity. My short course of instruction, and want of experience, I hope will be sufficient excuse for the quality of the work, but hope they will be of some service. Would like to have some prints returned to me with an expert's advice as to the course to pursue where I have failed to make a good negative.

There are some parts of the work which I will be unable to carry out with a party so small as this; for instance, observations of the aurora from different points, also sketches of the same, as the display is never the same for two consecutive seconds.

Measurements of the ice formation taken each month on the inlet adjacent to the station, are entered on the meteorological reports. Six feet, two and a half inches was the greatest thickness attained. The heaviest ice seen was that which came

down from the north with the pack in November. Eight feet was the maximum. I am of the opinion that ice never forms beyond that depth in this sea, as we could not find that it increased in thickness perceptibly, even after the temperature of the sea fell below the freezing-point for sea-water. The ice accumulates in great masses under the pressure caused by the currents, and gales, so that it often grounds in thirty fathoms of water. These masses become so firmly cemented by frost in the winter that they do not break up until July.

There has been no sickness of any consequence in the party during the year, and all have performed their duties with commendable zeal and fidelity, and as the full work has been carried on so far with four observers, the work for the ensuing year will be lighter than that of the past.

The carpenter and cook began to show signs of breaking down, and as I was able to replace them by two excellent men from the whaling fleet, I have discharged them at their own request.

The "Leo," with Lieutenant Powell, reached here on the 20th of this month, and she was discharged by the 25th. Lieutenant Powell brought but one magnetic hut, and it is designed for pendulum observations. I shall put it up and use it for the new magnetic instruments, but I cannot be responsible for the results, as it is nailed with iron nails throughout. It is a disappointment to me that the vessel did not arrive earlier, so as to enable me to have the instruments in position for international work. It was a mistake in allowing her to stop at intermediate places with private freight. Had she not done so, she would in all probability have reached here in time. As it is, the ground is now covered with snow, and winter is upon us, rendering the work of putting up brick piers very difficult. If a vessel cannot be chartered for this service alone, it would be better to ship by the "Tender" of the whaling fleet, which sails from San Francisco in June, and generally returns early in September. I have retained all the men I have quarters for. Should more be sent next year, additional lumber should be sent to construct quarters, of which I have furnished Lieutenant Powell a memorandum. I send estimates of stores for the year ending 1884. For the errors which may be found in my work for the past year, I hope the Chief Signal Officer will take into consideration my want of previous knowledge and instruction in scientific work. I return Sergeant Cassidy by "Leo."

I am, sir, very respectfully, your obedient servant,

(Signed)

P. H. RAY,

1st Lieutenant, 8th Infantry, A. S. O.,

Commanding Post.



TRACK CHART OF STEAMER NEPTUNE,
 July 28 to September 2, 1882.
 IN ATTEMPTING TO REACH
 LADY FRANKLIN BAY, GRINNELL LAND.

Prepared under the direction of the Chief Signal Officer of the Army
 OCTOBER, 1882.
 Drawn by Private F. THOMA, 5th Infantry.

