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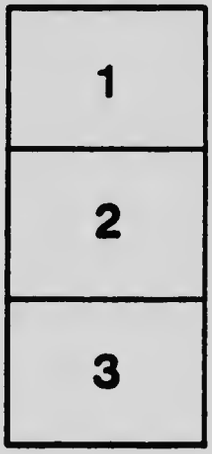

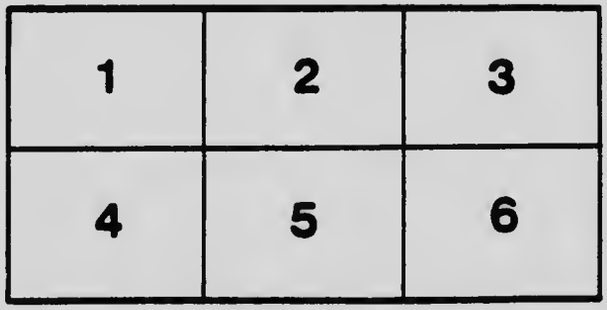

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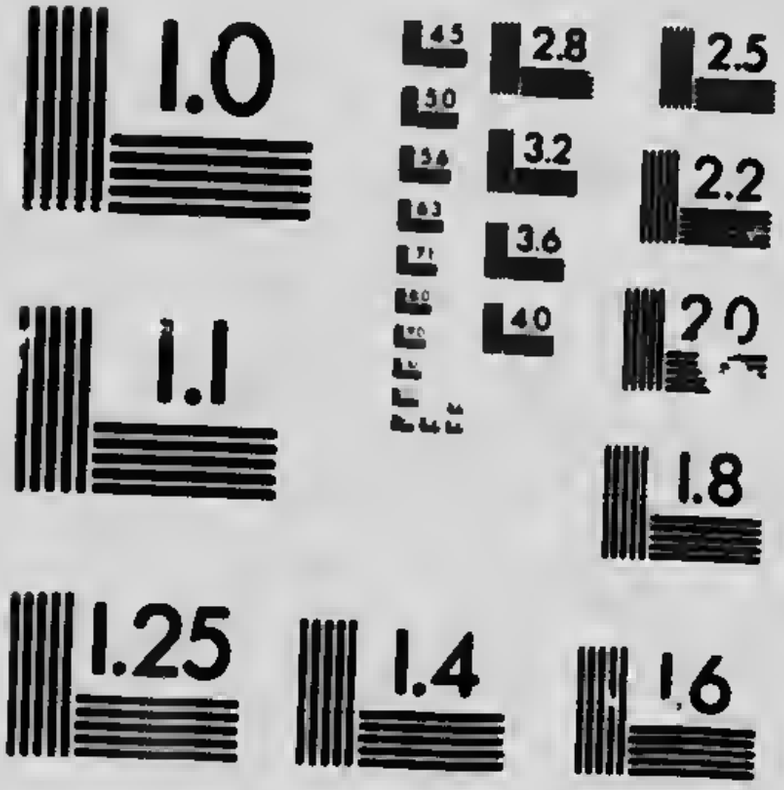

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PARTS L & M, ANNUAL REPORT, VOL. XI.

GEOLOGICAL SURVEY OF CANADA
G. M. DAWSON, C.M.G., LL.D., F.R.S., DIRECTOR

REPORTS

ON EXPLORATIONS

OF

THE COASTS OF HUDSON STRAIT AND UNGAVA BAY

BY

A. P. LOW, B.A.Sc.,
AND
ROBERT BELL, M.D., LL.D., F.R.S.

OTTAWA
PRINTED BY S. E. DAWSON, PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1901

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Price, Twenty cents.

UMIAK OR WOMEN'S BOAT, WAKEHAM BAY.

A. P. Low.—Photo. 1897.

ESKIMO IN KYAKS, WAKEHAM BAY.

GEOLOGICAL SURVEY OF CANADA

G. M. DAWSON, C.M.G., LL.D., F.R.S., DIRECTOR

REPORT

ON AN

EXPLORATION OF PART

OF THE

SOUTH SHORE OF HUDSON STRAIT

AND OF

UNGAVA BAY

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A. P. LOW, B.Ap.Sc.

OTTAWA

PRINTED BY S. E. DAWSON, PRINTER TO THE QUEEN'S MOST EXCELLENT MAJESTY

1899

No. 680.

G. M. Dawson, C.M.G., LL.D., F.R.S.,

Director Geological Survey of Canada.

Sir,—I herewith beg to submit my report on the exploration in the summer of 1897, of a part of the south shore of Hudson Strait and of the west and south shores of Ungava Bay.

I have the honour to be, Sir,

Your obedient servant,

A. P. LOW.

Ottawa, June 16th, 1898.

NOTE.—*The bearings in this report are all referred to the true meridian, and the elevations to mean sea-level.*

REPORT

ON AN

EXPLORATION OF PART OF THE SOUTH SHORE OF HUDSON STRAIT AND OF UNGAVA BAY.

Introductory.

This report is based on the observations made during July and August, 1897, on the geology and physical geography of the northern portion of the Labrador Peninsula bordering on Hudson Strait and of Ungava Bay. The area examined extended from Douglas Harbour, situated some 150 miles to the eastward of Cape Wolstenholme at the entrance of Hudson Bay, to George River in the south-east part of Ungava Bay, a distance by the coast of 750 miles. The work was chiefly confined to the coast, and except by a few trips extending a short distance inland, the interior was explored only along the lower portions of the larger rivers. Payne River was ascended thirty-five miles, Koksoak River thirty miles, Whale River ten miles and George River twenty-five miles. Mr. G. A Young, B.Ap.Sc., who had acted as my assistant during the previous season, again took charge of the topographical work, and, in addition, kept daily meteorological observations and made a collection of plants found growing along the coast. He proved most efficient and materially assisted in the success of the exploration. The rest of the party consisted of D. Burgoyne sailing-master and carpenter, J. Lantz, cook, and J. Greenland, sailor, all of whom filled their positions in a satisfactory manner. It had been expected that an Eskimo interpreter would have been secured on the Labrador coast, so that advantage might have been taken of the local knowledge of the natives met with, but heavy pack-ice completely blocked the Atlantic coast on our way northward, and prevented the ship from calling at any place where such an interpreter might have been obtained. As a consequence, we were unable to communicate intelligibly with the natives and doubtless missed much valuable information.

Area included in Report.

Members of the party.

Acknowledgments are due to Mr. C. C. Chipman, Commissioner of the Hudson's Bay Company, for a circular letter to the officers in charge of the several posts visited, and to Mr. Mathewson, Fort Chimo,

Acknowledgments.

Mr. John Ford, George River, and Mr. J. Edmunds, Whale River' officers of the Company, for kind hospitality and help ; also to Capt. A. Gray, of the Hudson's Bay Company's steamship *Erik*, for transporting the yacht and equipment to Nachvak and carefully storing it there for future use.

Investigations in Hudson Strait.

The Parliament of Canada, during the session of 1897, voted a sum of money to send a suitable ship to Hudson Strait in order to further test the period during which the strait is open to navigation. For this work the *Diana*, a Newfoundland sealing steamship, built specially for work in heavy ice, was chartered and placed under the command of Commander W. Wakeham, of the Department of Marine and Fisheries, the remainder of the officers and crew being natives of Newfoundland, accustomed to ice work. Advantage was taken of the transport afforded by the *Diana* to send two parties from the Geological Survey to explore the coast-line of both sides of the strait. Dr Bell was appointed in charge of the party on the north side, and to the writer was assigned the exploration of the southern shore. Two small yachts were built at Mahone Bay, Nova Scotia, for the use of the exploration parties. Their dimensions were similar, i.e., length 35 feet ; beam 10 feet ; extreme draught 3½ feet ; thickness of planking 1 inch, white pine. They were decked over, except a large watertight cockpit, and below deck had accommodation for two in a small cabin aft, while forward of a bulkhead was a store-room and a small galley, with close accommodation for four men in the bow. Sixty gallons of mineral oil was carried for fuel, in tanks under the seats of the cockpit, and a double burner Primus oil stove was used in the galley, answering its purpose admirably. The yachts were given a yawl rig, with a total sail area of 800 square-feet, sufficient to drive them along in light winds, and provided with wide reefs by which sail was easily reduced in heavy weather. A sixteen-foot skiff was towed as a tender, and was found very useful in landing along the coast. The yachts were found well adapted to the work, except that the pine planking was too soft and thin for rough usage amongst ice; and if the boats are again employed for similar work it would be advisable to sheath them with copper protected by longitudinal battens of hardwood.

Yachts used in explorations of Hudson Strait.

The yachts were placed on board the *Diana* at Halifax, securely lashed to the deck amidships, leaving only a narrow passage way between them, and were unfortunately the cause of much inconvenience, on board, especially when coal was being shifted from the main hatch to the bunkers.

The *Diana* sailed from Halifax on June 3rd, and passed through the Strait of Belle Isle, where the first heavy ice was encountered. On the way northward along the Atlantic coast, more or less delay was occasioned by the heavy pack drifting southward, and the eastern entrance of Hudson Strait was not reached until the 22nd of June. Further delays by ice, especially in the neighbourhood of Big Island, near the middle of the strait, prevented the *Diana* from passing into the open water of Hudson Bay until the 12th of July. Returning immediately, an attempt was made to land Dr. Bell's party in the vicinity of King Cape on the eastern side of the mouth of Fox Channel, but owing to the great quantity of heavy ice about Salisbury and Nottingham islands and to the northward, it was found impossible to do so, and the ship was headed east, to land my party at the first convenient place on the southern shore. Passage from Halifax to Hudson Strait.

Commander Wakeham, in his report of the voyage of the *Diana**, enters fully into the conditions and nature of the ice of Hudson Strait. My own observations and conclusions in regard to the ice coincide with those so ably set forth by him, and, consequently, it is unnecessary to allude further to them here.

PHYSICAL FEATURES OF THE SOUTH COAST OF HUDSON STRAIT.

Early on the morning of the 16th of July, the *Diana* reached the western entrance of King George Sound, and steamed slowly in between several islands and the mainland. The largest island is about six miles long by about three wide and had been poetically named the Maiden's Paps by some ancient navigator, from the outline of two rounded hills upon it; the other islands are much smaller, but all are high and rocky, the highest points on the large island being estimated at 700 feet above the sea. The mainland is also high, rocky and destitute of trees. It is broken by bold points into small irregular bays, with deep water close in shore, the only danger being due to the lumpy nature of the bottom, which in places rises into small islands, and in others to shoals indicated only by grounded ice. We anchored in a small cove on the west side of the mouth of a deep inlet, about five miles south of the western end of the Maiden's Paps, and a boat was sent to sound the channel into the inlet where a safer anchorage was sought, as the cove where the ship lay was open to the northward and full of ice drifting backward and forward with the tides. During the absence of the boat, preparations King George Sound.

* Report of the Expedition to Hudson Strait, etc., Marine and Fisheries Department, 1897, pp. 61-69.

were made for launching our yacht, and, owing to the absence of yards on the mainmast, considerably difficulty was experienced; but after two hours' work a successful launch was made and as the yacht took the water we named her the *Alle* after the hardy little auk.

Good ship anchorage.

The boat returned in the afternoon and reported a safe anchorage about five miles farther up the inlet, with the shallowest soundings of five fathoms at low-water on a bar at the entrance, and elsewhere from ten to fifteen fathoms. The ship then shifted to the inner harbour, towing the yacht with her, and a good holding ground of mud and boulders was found within a quarter of a mile of the shore on the west side of the bay. Four small rocky islands at the mouth of the inlet practically make the harbour land-locked. The best entrance is between the first and second islands from the west shore, and there is probably a sufficient depth of water for large ships between the other islands, but a narrow bar of large boulders, covered at high-water, extends from the western island to the mainland. The inlet was

Douglas Harbour.

named Douglas Harbour by Commander Wakeham, and it was subsequently found to be seventeen miles long, being divided into two narrow arms nine miles above the entrance. The main body varies from half a mile to a mile across. High hills rise abruptly from the water almost everywhere, with an altitude of about 700 feet near the entrance, increasing to 1500 feet towards the head of the arms. The next day was employed in rigging the yacht and in stowing the provisions and outfit. Much annoyance was caused by large cakes of heavy ice drifting about on the tide, which required constant watch to keep them from fouling the yacht tied to the side of the *Diana*. In the evening Commander Wakeham handed me a letter containing instructions to be at Fort Chimo on September 15th, when the *Diana* would call there for our party and take us to St. John's, Newfoundland.

Diana sails.

On Sunday July 18th, everything being properly stowed and the *Alle* completely rigged, we left the ship after breakfast and sailed with a strongly westerly breeze up the south-west arm. The *Diana* shortly after hoisted anchor and stood out of the harbour on her way to Big Island, where Dr. Bell's party was to be landed. We anchored at the head of the arm early in the afternoon and took a series of observation on the sun with the sextant and chronometer for latitude azimuth and time; later, the press was filled with arctic flowering plants which formed a brilliant carpet over the sandy and gravelly terraces in a continuation of the valley of the arm. A small river empties into the head of the arm, and at high-water its mouth was filled with trout from

WEST ARM, DOUGLAS HARBOUR, HUDSON STRAIT.

A. P. Low, Photo. 1897.

RAVINE ON BROOK AT HEAD OF WEST ARM DOUGLAS HARBOUR.

one to five pounds in weight. We had unfortunately omitted to bring a net, and as the fish were feeding on swarms of sand-shrimps they would not take other bait freely, so we caught only a few small ones. They proved to be the arctic trout or Hearne's salmon, quite distinct from the ordinary sea-trout of more southern waters. They are abundant in the tidal waters of all the rivers flowing into Hudson Strait and Ungava Bay. In the Koksoak River they have been taken up to fourteen pounds in weight, but ordinarily weigh from three to eight pounds. The bottom, in the shallow water at the head of the arm, was covered with numerous dead crabs of all sizes up to six inches diameter, which had been killed by the weight of heavy cakes of ice grounded there at high-water and left by the retreating tide. Arctic Trout.

Early the next morning an exploration of the country about the head of the arm was made. For a mile, our way led over a level terrace of sand and gravel, one hundred feet above sea level, to where the river divided into two equal branches. The valley of the stream from the sea to the forks varies from fifty to one hundred yards in width, and is cut into the terrace; its grade is steep and the stream in consequence is a continuous rapid over a winding, bouldery bed. The bank of the west branch was followed about half a mile, rising over terraces of thirty-seven and ten feet; crossing the stream further ascents of forty-five and one hundred and twenty feet brought us to the top of a well marked gravel terrace 313 feet above the sea, while behind it and flanking the steep rocky hills, were two other terraces at 375 feet and 506 feet respectively, above sea-level. These are not so clearly defined as the lower ones and are formed of coarser material with scattered boulders, but their tops appear to have been levelled by water, and they probably mark the extreme uplift of the land since the later-glacial subsidence. The stream has cleared the drift from its channel and rushes down a narrow rocky gulch in a beautiful cascade of 500 feet. Above this fall and below the next, there is a fine deep pool in which a number of large trout were seen, but having no means of catching them we could not tell the species, although they resembled the ordinary brook trout. From the pool, a steep climb of 850 feet over well glaciated, granitic rocks, led to a more gradual slope of the upper part of the hill, which was covered with innumerable boulders and blocks to its summit, 1,860 feet above the sea. The view from the summit is very desolate. Barren, rocky or boulder-covered hills on all sides, run in low rounded ridges separated from one another by small deep valleys filled with snow; the surface, wherever there is sufficient soil, was covered with lichens diversified with a few arctic flowers, but not in the beautiful abundance met with in the valleys. No trees and very little soil hide the bare rocks, scarred Country about Douglas Harbour. Brook Trout

Birds.

everywhere with huge blocks and boulders. A few birds, mostly snow buntings and Lapland longspurs were seen on the summit, evidently with young. Having examined the rocks and taken a number of photographs we returned to the yacht in time for a noon observation of the sun, and later on made observations for time to determine the rate of the chronometer. Towards evening it rained heavily and the weather remained dirty all night. The following morning we left the head of the arm and on the way down examined the rocks at several places on both sides. We then sailed to within a mile of the head of the south-east arm, where the water was only two fathoms deep at high-tide. The valley of this arm continues some miles beyond the sea, and is occupied by a large stream which has brought down the sand that forms the wide shoals at its mouth. An observation for latitude was taken at the edge of the shoal water, after which the whole afternoon was spent beating down the arm against a strong wind, the bay being covered

Floating ice.

with large cakes of ice blown into it by the wind. We anchored in a small cove on the west side, about a mile up the south-west arm, where there was good shelter from the ice. The hills about the head of the south-east arm appear to be higher than those ascended, the highest summits being probably about 2,000 feet above the sea.

It blew a gale during the night, and the wind continued so strong next day that we were unable to leave the anchorage, so Young and I climbed the prominent hill at the entrance to the arm. Its summit, by the aneroid, has an elevation of 1,600 feet, and consists of an immense dyke of rusty amphibolite. We experienced considerable difficulty in walking against the wind and several times had to take shelter behind large boulders during the more violent gusts. During the gale, a peculiar dark cloud remained stationary over the bay. A grand view of the entrance to Douglas Harbour was obtained from the summit, and also of the islands of King George Sound, while on the horizon Big Island was distinctly seen. Stringers of ice were observed in the sound, but beyond it clear water extended for fifteen miles,

Ice in Strait.

followed by loose pack to the horizon. On the way up and down the hill several new species of plants and three species of butterflies were added to the collection. Bird life is by no means abundant on the land the only species noted being the snow bunting, Lapland longspur, shore lark, a sparrow, raven and rock ptarmigan, the last still in about half-winter plumage.

On July 22nd, the wind moderated slightly towards morning, and we sailed for the mouth of the harbour under reefed jib only, and racing along with numerous small water-spouts soon reached the

islands at the entrance, where a landing was made. Outside the harbour the wind was steadier and lighter, gradually dying out and leaving us becalmed at noon near the western end of Prince of Wales Island. The distance between the mouths of Douglas Harbour and Fisher Bay is twenty-five miles, and the general trend is east-south-east. The coast between the bays is bold, and indented only by small coves, none of which afford harbours. The rocky shores rise abruptly, from 400 feet to 800 feet above the water, and are backed by higher hills that reach altitudes of 1,500 feet and more. The water appears to be deep close in shore, and only two small rocky islands were seen under the land. The islands to the eastward of the Maiden's Paps, four or five in number, extend in that direction about eight miles; they are much lower than the large island, and lie about ten miles off the coast. From the most easterly island there is an interval of eight miles to the west point of Prince of Wales Island. This island is about six miles long by three wide; it is high and rocky and lies diagonally to the coast, its south-west end being about four miles from the mainland. A smaller, high, rocky island lies immediately off the south-west point, and further eastward three rocky islands partly obstruct the channel between the large island and the mainland.

Coast between Douglas Harbour and Fisher Bay.

Fisher Bay is nine miles long and three miles wide at its mouth, being divided into two arms about half-way up. The bay opens to the north-east, and its western side is quite shallow, extensive boulder-covered flats being exposed at low-water on that side; but there is a good channel along the east side, which leads to a protected harbour behind two high islands near the head of the eastern arm, where we arrived at midnight. Prince of Wales Island is a favourite breeding ground for sea-pigeons, *Cepphus mandtii*, thousands of which were about the yacht while we were becalmed off the island.

Fisher Bay.

The early part of the next morning was spent visiting the mainland and islands at the head of the bay. A small stream falls in from the eastward near the head of the bay, being the discharge of a beautifully clear lake lying between high hills, which the Eskimos report is well-stocked with trout. We ran several lines of soundings through the harbour and the approach to it, and found from five to eight fathoms at low-water.

Towards noon we sailed to the east point, where five families of Eskimos were encamped, engaged in harpooning white porpoises and seals for their winter's supply of oil. The encampment consisted of five seal-skin tents situated on the side of a rocky hill, covered in places with coarse shingle; the tents were erected among the boulders, and

Eskimo encampment.

the only protection from the uneven rocky floor was a pile of hairy deerskins forming the bed in the back part of the tent. Blubber and meat were strewn about the tents indiscriminately, inside and out, and the smell of rancid oil and flesh was almost overpowering. The natives were all clothed in garments of deer-skin or seal-skin dressed with the hair on, and as most of them had apparently been worn a considerable time, they were far from clean. No articles of European manufacture were noticed, beyond guns, rifles, some iron in the spears and a few knives. Few of these people ever come in direct contact with the whites, as they send their winter hunt of furs by some picked men in the spring to Fort Chimo, the journey being made overland with dog-teams and occupying nearly three months. The skins of arctic foxes, bears and wolves are exchanged for guns, ammunition, needles and knives, while any credit remaining is used to purchase tobacco. The hunt had already gone to Fort Chimo before our arrival and as we did not want oil or sealskins, there was very little to trade with and what we did buy was all paid for in tobacco, of which these people are inordinately fond. We took several photographs of the group and also of the tents, and in exchange made a small present of tobacco to each man, woman and child. It was curious to see a mother take a short black pipe filled with rank, black tobacco, out of her mouth and pass it backwards to the small child in her hood; the youngster evidently relished it, as there was always a cry when the mother resumed her own smoke.

Coast between Fisher and Wakeham bays.

Having taken a noon observation on the sun, we stood eastward along the coast to the next large inlet, called Wakeham Bay, and ascended it to its head, arriving there at 10 p.m. The distance, from the eastern side of Fisher Bay to the entrance of Wakeham Bay, is eight miles. The coast between these bays is more rugged and broken than to the westward, with a few small islands along shore but no shelter sufficient for the yacht. The land rises abruptly from the shore and increases in altitude as Wakeham Bay is approached, where, on the east side of the entrance, a rounded hill rises 1,800 feet directly from the water, and must be a prominent mark from far to seaward; the other hills along this part of the coast vary in altitude from 800 feet to 1,500 feet.

Wakeham Bay.

Wakeham Bay is twenty miles long. At its mouth it is nearly two miles and a half wide, gradually narrowing to a little over a mile about three miles above the entrance. The water of the approach is deep, and the only obstructions to free navigation are two small islands, nearly covered at high-tide, one of which lies about two miles north-

east of the western head and the other about three miles due north of the eastern side of the entrance. There is plenty of room between them, and they should not be dangerous in approaching this, the safest and best harbour on the south coast of Hudson Strait. The eastern side of the entrance is formed by a rocky peninsula 600 feet high, joined to the mainland by a neck of sand and clay less than fifty feet high, with a small lake in the middle. Beyond the narrows the bay averages three miles in width for ten miles; the remainder of the upper end being less than a mile wide. A fine protected ship harbour, out of the run of the tide and consequently free from the danger of quickly moving ice, was found just inside the peninsula, with good anchorage in from fifteen to twenty-five fathoms opposite the low sandy neck. Of course when the bay is full of ice, a ship would be beset here, but there is no current in the cove and consequently the ice-pressure would be due only to wind. Excellent ship harbour.

The highlands on the west side continue about ten miles up the bay to the wide valley of a small stream, beyond which the immediate hills vary from 200 feet to 500 feet until near the head of the inlet, when they reach heights of 1,200 or 1,500 feet. On the east side, the general altitude of the hills ranges from 800 feet to 1,000 feet, and there are numerous wide, drift-filled valleys below the 300 foot level.

On July 24th, the yacht remained at anchor all day, and we busied ourselves examining the country and rocks about the head of the bay. The main valley continues a long distance inland, and is occupied by a small unnavigable river. Other wide valleys parallel to that of the inlet make the country more broken, but lower than that described about the head of Douglas Harbour. The hills are from 1,000 feet to 1,500 feet high, and being formed from diabase and schists are more abrupt in outline than those of the granite region to the westward. In the afternoon we examined the lower stretches of the river with the small boat, and later dredged from the yacht, securing a number of crabs and shrimps, which, with other dredgings taken later were preserved in alcohol, and given to Commander Wakeham. Two of the men went hunting, and although they saw many tracks of caribou, they did not come across any of the animals. Head of Wakeham Bay. Dredgings.

The next morning we beat down the inlet against a light head wind and reached the anchorage behind the peninsula at 1.30 p.m. The last five miles was made through large cakes of heavy ice, which the wind was rapidly drifting into the bay. This was exciting and somewhat dangerous work, as our boat with its inch planking would not

stand many hard knocks or pinches, and several times we had to force passages between large pans. From the summit of the peninsula the coast was found to be tightly packed with ice, while a constant heavy stream of it was pressing through the narrows into the bay As the cove in which the yacht was anchored still remained free from ice we determined to remain there. Later in the evening a family of Eskimos was found encamped on a point outside the bay.

Delayed by ice.

On July 26th, the wind continued from the north-east, causing the stream of ice to rapidly fill the bay with each flood tide, while little if any went out with the ebb;a circumstance probably due to the large body of ice outside preventing the rapidly flowing tide from carrying out the ice brought in on the preceding floods. In the morning we sounded the bottom of the open cove, where we were hemmed in, with the result previously stated; and then dredged, obtaining several species of shells, crabs, sea-urchin, shrimps, sponge, rock-cod and a sculpin. As the ice was encroaching on the yacht we beached her near high-water mark on a bed of gravel out of reach of the heavy cakes of ice which took the ground in much deeper water outside. In the afternoon we climbed the hills on the east side of the bay and obtained the barometric elevations of the terraces on the peninsula. We gave the Eskimo a rifle and sent him for caribou which he says are plentiful not far away. The following day the conditions remained the same, the ice pouring into the bay with the north-east wind. On the 28th the bay was full of ice, and fearing that a change of wind might block us in the cove for days we took the yacht in tow of the small boat and succeeded in moving her along shore about a mile, to the point at the narrows, where we were caught in the ice moving in contrary directions with the current and eddies and only with g . good luck escaped serious damage. Being unable to pass the point we returned to our former anchorage, where we remained until the evening of the next day, when we again tried to tow out of the bay and succeeded in passing the point on the slack water at high-tide, and then took the yacht into a small cove on the outer side of the neck where we were icebound until August 1st. During our enforced delay, the time was employed examining the surrounding country and rocks and in painting and cleaning the yacht. On the last day we were visited by a large party of Eskimos in three umiaks and seven kyaks. They were on their way from Stupart Bay to some place on the coast to the westward where they go inland to hunt caribou for their winter's supply of clothing. I took several photographs of the boats and people and made to all the customary present of a small piece of tobacco.

Eskimo visitors.

We started as soon as the yacht floated on August 1st and had considerable difficulty working out of the cove between the large pans of ice aground; when outside a light west wind carried us past Cape Prince of Wales to Stupart Bay where we anchored for the night. The course all the way was through loose ice, sufficiently open to allow the yacht to pass with little danger.

Wakeham Bay to Cape Prince of Wales.

The distance from Wakeham Bay to Cape Prince of Wales is twenty-four miles and the course is nearly east. A large island, which we called Doctor Island, lies about three miles off the coast, with its western end about fifteen miles from Wakeham Bay. Doctor Island is about five miles long and appears to be triangular in shape; it is much lower than the large islands to the westward, and from outside might be taken for a portion of the mainland. The coast is more indented than to the westward, but all the bays are wide and afford no shelter from northerly winds. The hills, for ten miles beyond Wakeham Bay, rise about 800 feet directly from the sea; they then become lower and less abrupt, and are broken by wide valleys, in which the drift is terraced to about 300 feet above the present sea-level. As Cape Prince of Wales is approached the hills gradually die out and about the cape do not exceed 300 feet in elevation. With the decrease in the height of the land there is a corresponding shallowing of the water, and to the eastward of Doctor Island there are numerous shoals, some of which are bare at low water and others marked by heavy ice grounded upon them.

Shallow water.

From Cape Prince of Wales, the course was south for five miles, to the entrance of Stupart Bay, where one of the government observation stations was situated in 1885-86. We found the dwelling-house still standing and in good repair, the other buildings having been broken up by the Eskimos. The house was closed with large blocks of cement from the pillars for the magnetic instruments. The inside of the house is used by the natives as a store-house for oil and the floor was covered with sealskins full of oil, the stench of which was overpowering. One room had been left locked by Mr. Payne, the observer, and the natives had never entered it, as we found, among other things, on forcing the door, a small mirror, two tin pails and some boots, all of which were of great value to these people. This is a proof that the Eskimos of the south side of Hudson Strait have not the thieving proclivities reported of the natives in other parts of the Arctic, and our own experience was wholly corroborative, for although no watch was kept of them while aboard the yacht none of the small articles lying about were ever missed.

Old observation station at Stupart Bay.

We left Stupart Bay early next morning with a light south wind, that freshened to a strong breeze, and sailed across Joy Bay to the south
Joy Bay. of Stupart Bay and up its south shore into very shallow water, with eight feet about a mile from the shore at high-tide. The head of the bay is blocked with sand brought down by the small river emptying into it. We were unable to enter the river on account of the sandy flats at its mouth, but it appeared larger than any stream yet passed, and the deep valley in which it flowed was flanked by sand terraces up to 200 feet.

This is probably the river in which the Eskimos are reported to have caught salmon and trout for the observation station. From the bottom of Joy Bay we beat out to near the end of the point separating it from Whitley Bay, and came to anchor in a good boat-harbour behind an island, being unable to proceed further on account of thick fog, rain and loose ice.

Joy Bay is nine miles wide and about the same in depth. Its shores are generally low, and greatly broken by rocky points, forming shallow irregular coves; a number of rocky islands are dotted over its surface. The water is nowhere deep and the bottom is irregular, so that it would be dangerous to enter with a vessel. The country in rear is broken, and the hills vary in altitude from 300 feet to 700 feet, but they rise more gradually than those along the coast to the westward, and appear to run in ridges parallel to the strike of the rocks, or north-west and south-east, with abrupt cliffs towards the south-west.

The rain and fog continued until 3 p.m. the next day, when a light southerly breeze enabled us to get into Whitley Bay, where we grounded for two hours, and finally made a harbour at dark in the upper end of the bay some eight miles from the point, and just outside a narrows between high rocky cliffs where the tide rushed through at a rate of
Whitley Bay. seven or eight knots an hour. Whitley Bay is even more shallow than the last, and like it completely dry at low-tide, when the bottom shows as mud-flats covered with many great boulders. Eider ducks in thousands feed on these shoals.

The following morning we landed Young on the west side of the narrows to sketch the adjacent coast from the summit of the hill, which he found to be 700 feet high. We then sailed through the narrows on the rising tide which caused a heavy rapid with a fall of three feet in fifty. Beyond the narrows, the bay widens to about a mile across and continues with this width for two miles, to its head, where a small river flows in through a deep narrow valley. On our way out we had considerable difficulty in stemming the rapid with a strong fair wind, and only

A. P. Low. Photo. 1897.

GROUP OF ESKIMO AT WAKEHAM BAY.

succeeded in doing so by crossing from side to side and so taking advantage of small eddies. Picking up Young at the point, we sailed into the next small bay, which is navigable only at high-tide; and remained there examining the rocks until after the noon observation for latitude.

We then ran eastward along the coast behind a large island and past several small bays open to the north and north-east, and anchored in a deep narrow inlet about three miles long, with a small river flowing in at its head, thirty miles from Whitley Bay. This is an excellent boat-harbour, but very deep, there being seven fathoms of water within a hundred feet of the shore. We saw only a few strings of loose ice about ten miles off shore. Last ice seen

After passing the large island, five miles long, at the mouth of Whitley Bay, the coast again becomes bold, with deep water close in shore and with only a few small islands under the land. The hills rise abruptly from 400 feet to 1,000 feet above the sea, and there are only small areas of terraced drift at the heads of the bays and coves and in the valleys between the hills; elsewhere only bare rock is seen.

On August 5th, we made only eleven miles on account of calms and very light winds. The coast passed was more rugged, with the hills rising directly from the water to heights varying from 700 to 1,000 feet. No good harbours were seen, but the coast is indented with small coves, all open to the sea, and without islands or points with shelter behind them. There are drift terraces in all the bays, and we measured a series of eight on the flank of conspicuous headland called Dyke Head. No ice was seen during the day, but there was an ice-blink to the north-east and a patch of fog to the eastward. The next day we had no wind until evening, when we ran until dark in search of a harbour, and found only an indifferent one behind a point near the head of a bay, open to the north-east, twelve miles east of our last anchorage. The coast passed was broken by three bays, the first being broad and the last two about five miles long and from one to two miles wide, with deep water to their heads and no safe anchorage from northerly wind. The coast continues bold, with sharp headlands about 1,000 feet high jutting out between the bays. Coast east of Whitley Bay.

We remained at anchor for the next two days, riding out a heavy north-east gale in a partly exposed position, where the yacht was subjected to the force of the heavy swell heaving into the bay from outside. Gale.

On August 9th we left this anchorage, and taking advantage of a strong north-west wind, soon passed eight miles of the same high broken coast, to the mouth of Diana Bay, which is sixteen miles wide Diana Bay.

and nearly twenty-five miles long. The western shore is high and rocky, but about the head of the bay and along the east side, the country is much lower, the highest hills not having an elevation of more than 200 feet; in the south-east corner, the general level is below 100 feet. The mouth of the bay is blocked by a high island about eight miles wide and extending eleven miles up the bay; good shelter for ships could be found among several other large islands that lie between the big island and the west shore. The head and eastern part of the bay are shallow with a lumpy bottom of rock and boulders.

Errors of the Chart.

This portion of the coast is not accurately mapped on the chart, there being two large islands marked at the entrance to Ungava Bay and no bay like the one here described. As the coast on the chart was laid down from observations made on ships sailing through the strait, it is very likely that the large island in the bay is the inside island shown on the chart, and that the point forming the east side of the bay is represented by the outer island, the land at the head of the bay being below the horizon of a ship passing through the strait. We anchored for the night in a small cove on the east side near the entrance to the bay.

Cape Hopes Advance

The next morning we sailed four miles, with a light wind from the north-east, to Cape Hopes Advance or Prince Henry Foreland, rounding which we proceeded south-east through a labyrinth of small rocky islands with shallow water between them, until we were stopped by thick fog at 3.30 p. m., when we had to feel our way to a harbour, being guided by the lead and by the noise of the breakers. Cape Hopes Advance is about 300 feet high and rises boldly from the water, but beyond it the coast is much lower and the irregular hills rarely exceed 200 feet in altitude. The islands were called the Eider Islands on account of the great numbers of these ducks found nesting upon them.

Thick fog covered the sea all next day, with light winds from south-east to north-west and consequently we were unable to sail. The fog appears to hang nearly constantly about Cape Hopes Advance, a circumstance caused perhaps by warmer currents of water and air from Ungava Bay meeting the colder currents of the strait. There was little fog inland, so we landed and took a series of observations for latitude and azimuth, and later, dredged between the islands, adding to our collection three new small fishes, a sponge, an anemone, a shrimp, some corals, and a few shells. Great quantities of kelp on the bottom seriously interfered with the dredging by blocking up the mouth of the dredge.

On August 12th, we started early and sailed south-southeast eleven miles, between low rocky islands that form a fringe about four miles wide along the coast. The water between the islands is very shallow, so that at low-tide many of them are joined together and to the mainland. Shallow water with shoals appears to extend outside the islands for several miles, rendering an approach with large vessels dangerous. The course was then changed to south-west, and we continued in that direction for twenty-eight miles, and were then forced to ground the yacht at high tide in a small rocky cove at the head of a wide shallow bay, in order to escape the dirty weather brewing with a north-east wind and a very low barometer. The islands gradually die out along this course after about ten miles, but the shallow water continues and the bottom being uneven is very dangerous on account of the great blocks and boulders scattered over it. The coast is low and broken only by detached, irregular hills never over 200 feet high. The country is covered with drift to a considerable extent and the flats are dotted with many small ponds, the breeding place of ducks and wading birds. There are no large streams, the ponds being drained by a network of brooks. Shallow water.

During the night, the wind increased to a gale which continued until the following evening, when it shifted to north-west and the weather cleared. The yacht remained on the beach and we passed the day making excursions over the peaty plains, passing over a hill 200 feet high, faced on both sides with boulders forming a ridge running nearly west inland to another hill about three miles away. The appearance of the bay at low-tide was startling. The bottom was entirely exposed for about three miles outside high-water mark and was formed of low rocky ridges with mud flats between them, while everywhere boulders of all sizes were strewn about. Stormy weather.

The next morning, at high-tide, we towed the yacht out of the bay, but made no headway until afternoon, when we sailed southward about five miles with a very light south-east wind, and then searched for upwards of an hour for a sufficient depth of water to anchor in. We finally found a hole between a number of small drift-covered islands with forty feet of water at high-tide. At half-tide the current between the islands was so strong that the yacht surged to and fro with the helm lashed hard over and we were in danger of breaking adrift, or dashing against the hummocks of boulders which formed the sides of the hole. Fortunately, as the tide became low, the shallows about became dry and the current slackened, so that when the yacht grounded for upwards of an hour it was in quiet water. This is an example of Great rise and fall of tide.

the great rise and fall of the tide in Ungava Bay, and of the danger in navigating its shallow waters, where the tide falls an inch a minute, and where, in consequence, if a boat grounds in falling tide it is impossible to release her until the water rises again. We named the islands in the neighbourhood the Plover Islands, on account of the great flocks of these birds met with here, together with thousands of gulls, sea-pigeons and eider ducks. The coast in the vicinity is low and flat like that previously described, and the shallow water extends several miles out from shore. We saw the loom of a large island some twenty miles to the eastward which we subsequently learned from the Eskimo was the western end of Akpatok Island. This changes the west end of the island thirty miles to the north of its position on the chart, making it conform with the position of the northern and eastern parts as laid down by the *Diana*.

Plover Islands

On August 15th we continued southward for twenty miles, passing among low islands formed of rock and drift, separated from one another and from the low shores by shallow water, and arrived at a rocky headland called Tuvalik, on the north side of Payne Bay. A band of Eskimos in four tents, was found at Tuvalik, and from these people we learned that a large river flowed into the bay. We sailed five miles up the bay, passing with shallow water over muddy flats, and anchored in a deeper channel, off the point at the entrance to a bay stretching to the northward, where it was thought the river might flow in. The coast passed during the day was very similar to that already described, being generally low and flat, broken only by occasional ridges of rocky hills never more than 300 feet high. These have an east-and-west trend, and thus come out to the shore in rocky points. The hills have the aspect of the Cambrian hills of the Koksoak River, and are formed of stratified rocks, the direction of the ridges conforming with the strike of the rocks, which dip northward at low angles and correspond to the hill-slopes in that direction, while towards the south the hills generally have abrupt cliffs.

Eskimos at Payne River.

The next morning we sailed to the head of the northern bay, but there found only a small stream discharging a lake some ten miles long, that lay in a wide valley to the northward. Some time was spent examining the rocks on the mainland and islands, which were found to contain large quantities of iron-ore. In the afternoon we worked out of the bay, (nearly dry at low tide), and anchored for three hours between the islands at its mouth, awaiting the flood-tide to enter the river. In the evening the river was ascended about six miles, on a very strong current, and the yacht was brought to anchor under the

A. P. Low. Photo. 1897.

VIEW OF PAYNE RIVER, THIRTY MILES ABOVE ITS MOUTH.

north shore in thirteen fathoms of water. After dark we were joined by a number of Eskimos in an umiak and seven kyaks, who pitched three tents on the shore opposite the yacht.

Payne River. The following morning we visited the encampment and arranged with two men to pilot us up the river. We started on the rising tide under treble reefs and raced up stream ahead of a gale, making over twenty-five miles in less than three hours. There were tremendous tide-rips at an island about fifteen miles up, which we successfully passed through and arrived at a second rapid, where the river is obstructed by a bar of huge boulders stretching diagonally across the stream near the head of tide-water. Beyond this obstruction the river was unnagivable for the yacht. In the afternoon I sent the Eskimos to kill a barren-ground caribou, these animals being plentiful about here, and with Young ascended the hills on the north side of the river, and took several photographs from the summit.

Country about Payne River. The country on both sides of the river is rough and rocky, with hills rising about 600 feet above the stream, and divided into ridges by deep valleys containing small tributaries. The valleys and sides of the hills are generally mantled with clay up to an elevation of 300 feet, while above that there is little fine drift, but plenty of scattered blocks and boulders. The hills are composed of granites, and consequently have the usual rounded aspect due to glaciated masses of this rock in the Laurentian country. The river stretches far to the westward, and about ten miles above the limit of tide the stream divides into two nearly equal branches, each with a deeply cut valley. The climate seems to be less rigorous than along the coast, as the willows grow to bushes several feet high, instead of only rising an inch or two from the ground as on the sea-shore.

Salmon and trout. The following morning an attempt was made to catch salmon and trout with a fly at the foot of the rapid, but without success, although a number of large trout were seen swimming about in the eddies. The Eskimos returned at noon with a part of a very large buck, which had been killed the previous evening; and on their arrival we started down stream. When the island was reached where the heavy tide-rips had been noticed on the previous day, we found that a ledge of rock extended from the island to both shores, causing a rapid with about six feet fall in two hundred yards. It was rather exciting to sail down with the yacht with only sufficient wind for steerage, but we got through safely and continued down stream eight miles, until met by the rising tide, when the anchor was dropped until the next ebb.

We got under way at three o'clock next morning and drifted down to the Eskimo encampment, where we paid off our pilots and

landed to photograph the natives. We bought a number of Arctic trout which had been taken in a net, and were informed that the Atlantic salmon were also abundant in the river. The natives were on their way to the caribou hunting grounds, some fifty miles above where we turned back on the river. They would remain there for a few weeks spearing the barren-ground caribou as they crossed the river in great bands during the autumn migration southwards to the edge of the wooded region.

Barren-ground caribou.

In the afternoon we continued down the river and along the south shore of the bay, coming to anchor among some islands nine miles beyond the south point of the bay.

Payne Bay.

Across its entrance, from Tuvalik to the south point, Payne Bay is fourteen miles wide. It gradually narrows to about three miles at the mouth of the river, which is eleven miles to the westward of Tuvalik. The bay is generally shallow and dotted with islands and bouldery shoals. There appear to be two deep channels leading from the mouth of the river towards the sea, one on either side of a group of five islands about three miles off the mouth. The deep water extends beyond the islands, but outside, in line with the capes, there appeared to be a number of low bars and shoals which practically block the entrance to the river for large vessels.

The river at its mouth is nearly three miles wide, but decreases rapidly to a point projecting from the south shore, three miles up stream, where it is about two-thirds of a mile across. Above the point it again widens, and varies from three-quarters of a mile to a mile and a half, for fifteen miles, to where it takes a sharp bend to the northward, two miles below the first rapid. The bend is a mile long, when the river again flows from the westward for six miles from the head-of-tide rapid. On the lower course the bays are shallow and are generally dry at low tide, presenting mud-flats covered with boulders, these being particularly thick along the outer margin of the flats where they have been shoved up by the ice. A number of shoal points and bars stretch out from both shores and there are also shoals dividing the deep channel of the lower part of the river. These bars and shoals are covered at high-tide and are then very dangerous owing to the large boulders scattered over them. As has been already mentioned, there is a reef of rock extending from shore to shore at the island above the bend, the heavy rapid caused by it is not more than ten feet deep and forms a practical bar to further navigation.

Dangerous entrance to Payne River.

Above the island, the channel appears to be uniformly of good depth for the next six miles, to the second rapid, where a line of boulders

stretches diagonally across the river and at low-tide causes a fall of about six feet over and between the boulders. The Eskimos report shallow water above this rapid, navigable only with small boats and very rapid everywhere, but without any direct fall. The river forks about ten miles above the rapid, and some distance further up the main branch again divides. The middle branch flows out of Payne Lake about a hundred miles to the westward of the mouth of the river, and it is near the outlet of the lake that the Eskimos go for caribou. The volume of the river is estimated to equal that of the Gatineau at Ottawa. The banks above high-water mark are generally rocky, except in the bays, where the drift terraces are faced with dry walls of boulders. The hills on both sides of the valley are continuous except where broken by the valleys of small tributaries; they gradually increase in height from the coast inland, being from 200 feet to 300 feet near the bay and about 600 feet at the upper rapid. There are considerable deposits of clay overlain by sand in the valleys, and these are terraced up to 300 feet above sea-level.

Drainage of the northern interior.

Payne River is the only important stream flowing into Hudson Strait between its mouth and King George Sound, none of the other rivers being sufficiently large to drain an area extending fifty miles inland. From this it would appear that the area along the coast must be higher than the interior portion of northern Labrador, and that the streams flowing into Hudson Strait and the northern part of Ungava Bay only drain a relatively narrow outer slope of coastal hills, the main drainage flowing first southward and then east or west into Ungava and Hudson bays. This is borne out by the description of the interior given by the Eskimos, who say that the country far inland from Payne River and southward is lower and flatter than the highlands of the coast, and that the extensive plains are dotted with lakes and covered with a much better growth of vegetation, affording excellent feeding-grounds for immense herds of caribou.

Low shores and shallow water.

On August 20th, we started at 3 a.m. with a light south-west wind and sailed southward along a low flat coast, being gradually forced off shore by the shallowness of the water, which never exceeded five fathoms and at times was less than three fathoms. For twenty miles we passed between a number of low rocky islands, lying from five to ten miles off the mainland, and arrived opposite a deep bay, about ten miles wide, with a long low point dividing it into two channels each about three miles wide. Highlands were seen about twenty-five miles to the westward, probably near the coast at the head of the bay. Eight miles south of this bay we landed for an observation on a rocky shore, having

isolated hills 200 feet high, but generally low and flat. From there the course was south-sou ast for seventeen miles to Cone Island, only 140 feet high, but very conspicuous among the surrounding low islands. We anchored in d er behind some small islands six miles to the south-east of C Island, arriving there at dark.

During the afternoon we followed the low shore on which we had landed for the observation, and were about eight miles off it at Cone Island, from the top of which a large bay with high shores was seen running north-we for about fifteen miles. While looking for a harbour we entered this bay and found it very shallow; it has a couple of smaller bays running northward from its upper end. The Eskimos at Fort Chimo say that this bay connects with the bays passed in the orning, the whole forming Hopes Advance Bay, which is consequently about twenty-fives mile wide at its mouth and about twenty miles deep; this being much less than the length given on the chart. The mouth of the bay is blocked by large islands with shallow channels between them, through which the tides rush in and out with great violence, rendering the bay quite unnavigable for large ships. A river nearly as large as Payne River is reported to flow into the head of Hopes Advance Bay.

Hopes Advance Bay.

Gale.

We passed an uncomfortable night, owing to the strong tide between the islands keeping the yacht broadside to the heavy sea. The wind was fresh in the morning and was accompanied with fog, while the barometer fell steadily and we decided to look for a more sheltered harbour. This was found between the islands and the mainland, but with the tide rushing through the channel like a mill-race. The wind increased to a gale in the afternoon and changed to the northward, forcing us to put out the second anchor. It blew very hard during the next night with heavy squalls of rain, changing to snow during the following afternoon, the hills becoming white while there was about six inches of snow on the deck. In the evening the wind shifted to north-west, and the weather partly cleared. On the morning of August 23rd, we worked for two hours getting up the anchors which had become fouled under boulders by the swinging of the yacht. We then sailed eight miles southward, through a labyrinth of islands which were named Gyrfalcon Islands from the number of those birds seen.

Gyrfalcon Islands.

The islands are formed by broken ridges of stratified rocks; the ridges lie south-east and north-west with which the length of the islands conform. They vary in height from 50 feet to 200 feet, and have cliffs facing the south-west, with more gentle slopes in the opposite direction conforming to the dip of the rocks. The water in

the channels between the ridges is deep, but in the cross channels it is liable to sudden changes and is often shallow. The mainland has the same character as the islands and is so broken by bays that it is very difficult to distinguish coast from islands.

From the southern limit of the islands we crossed a bay. This is called Leaf River Bay, and is about eight miles wide at its mouth, but narrows to three miles across some ten miles up. This we learned was the entrance to Leaf Lake, a body of salt water divided from the bay by a deep narrow strait walled in by high rocky cliffs. A small vessel called the *Fox* is sent annually by the Hudson's Bay Company from Fort Chimo to kill white porpoises in the lake. The captain of the *Fox* estimates the lake to be nearly fifty miles long and about ten miles wide. Its longer axis runs about north-northwest, and the outlet is situated about half-way up the lake. The Leaf River flows in on the west side almost opposite the outlet, and is a considerable stream having a volume about equal to Payne River, according to the estimate of the Eskimos. Salmon are not known to enter this river. Barren ground caribou are always plentiful on the plains inland along the course of the stream, where willows and arctic birches grow abundantly as large bushes and are the only trees of the region, the northern limit of the spruce and larch being still further south.

Leaf River Bay.

Porpoise fishery

We sailed eastward along the south shore of the bay for twelve miles to Stony Point, where we were obliged to anchor behind a rocky islet in a heavy swell, owing to the wind dying out. The south side of the bay being formed of granitic rock, is totally different in character from the north shore; there is an absence of islands and the water is shallower gradually deepening to about five fathoms a mile off shore. The shores are generally rocky at the small points, and elsewhere boulder-strewn, while the country behind gradually rises into long rounded hills never more than 200 feet high. A thick mantle of drift covers the slopes and fills the valleys, but owing to the gentle slopes the terraces are not well marked and were only indistinctly seen from the yacht. Stony Point is a rocky hill about 200 feet high, with a number of rocky knolls outside, which become islands at high-tide, with huge masses of rock scattered everywhere. The water is very shallow for two miles outside the point, and for five miles beyond the sea breaks upon a number of boulder shoals.

Coast south Leaf River Bay.

On August 24th, we started at 4 a.m. and sailed south-southeast for thirty-five miles along a low and almost unbroken shore to the mouth of the Koksoak or Ungava River. This part of the coast is low, with only three or four islands of shingle close to the shore and separated

Coast north of Koksoak River.

from the mainland by shallow channels dry at low-tide. The water deepens slowly to about five fathoms a mile off shore, and there appears to be very few shoals outside that limit except towards the mouth of the river, where a number of rocky islands and shoals extend outwards from the north point for more than a mile. Other shallow places in the mouth of the river render an entrance hazardous without the aid of a pilot. We stopped at the mouth of the river until 1 p.m., awaiting the rising tide which carried us to Fort Chimo, thirty miles up, where we arrived at 5.30 p.m. and found the Hudson's Bay Company's steamship *Erik* at anchor opposite the fort. She had arrived on August 20th from Churchill, this being the earliest arrival on record.

Arrival at Fort Chimo.

We remained at Fort Chimo until August 27th, making necessary repairs to the yacht and equipment, and then left for George River which empties into the south-east part of Ungava Bay about 100 miles to the eastward of the mouth of the Koksoak. Before leaving, arrangements were made with Captain Gray for the transport on the *Erik* of the yacht and equipment from Fort Chimo to Nachvak on the eastern Labrador coast, where the yacht would be available for another season's work in the Strait or Hudson Bay. This would not have been the case if the yacht had been laid up at Fort Chimo, owing to the impossibility of reaching that place until the end of August, too late for any effective work.

We dropped down the river and anchored in a small cove on the south side near the mouth, where we waited for the next morning tide, which carried us eastward fifteen miles, past a number of low shoals of rock and boulders stretching nearly ten miles off the south point, until we finally brought up against a line of reefs, bare at low tide, that extends northward from the islands at the mouth of Whale River to and beyond a large island called Saiglorsoak, that lies sixteen miles outside. This island is surrounded by a cluster of smaller ones, all high and rocky and forming good marks in steering for the Koksoak River. Saiglorsoak is about five miles long and should be kept well to the southward as the reefs continue some miles beyond it.

Islands off Whale River.

We turned south along the west side of the shoals and with the rising tide soon reached the channel between Big Island (Whale River) and the mainland. The channel narrows from a width of three miles at its entrance to less than a mile at the upper end of the island, seven miles farther up, where a sharp bend of a mile to the eastward leads to the true mouth of Whale River. The deep part of the channel is quite narrow and is bounded by extensive mud-flats on both sides

Whale River.

that are bare at low-tide. The current in the channel is very swift, and at several places breaks into rapids and tide-rips. At the bend we picked up an Eskimo, who was engaged setting salmon nets for the Hudson's Bay Company, and with him as guide reached the Hudson's Bay post, situated on the east bank eight miles above the mouth of the river, arriving there after dark. The channel up to the post varies from a mile to a mile and a half in width and is full to the banks at high-tide, but at low-tide, bare mud flats occupy over two-thirds of the width, with the deep channel considerably below their level. The post is situated at the head of navigation, there being shallow rapids only a short distance above it, where the influence of the tide ceases. The river has a volume about equal to that of Payne River and drains a large area of country to the southward, between the drainage-areas of the Koksoak and George rivers. It rises in large lakes about 200 miles inland, on one of which the Hudson's Bay Company formerly had an outpost, mentioned as Erlandson's Lake post in McLean's narrative.* The post at Whale River is merely a fishing establishment and small trading station for the natives in the vicinity, consisting of three small buildings. The salmon fishery in the lower part of the river was formerly a paying industry, but has been gradually decreasing and this year (1897) was almost a total failure, as were the fisheries in the Koksoak and George rivers.

Hudson's Bay Company's post.

The banks of the river are generally low, with terraced drift behind and highlands in rear of the post, where the hills rise about 500 feet and are partly wooded with small black spruce and larch, the woods extending nearly to the mouth of the river.

The coast between the mouths of the Koksoak and Whale rivers is generally low, with a range of hills extending from the mouth of the former stream south-east about the head of False River Bay to the mouth of Whale River. There is a shallow bay on the south side of the mouth of the Koksoak, between these hills and the end of a low bouldery point five miles to the north-east of them. Rounding this point, the coast trends to the south of east for ten miles, to the mouth of False River Bay, so called on account of having been often mistaken for the mouth of the Koksoak. This bay is several miles long and about three miles wide at its mouth, but is so shallow that it cannot be navigated even by small craft. A low point separates False River Bay from the west channel to Whale River which has been already described.

Coast between Koksoak and Whale rivers

* Notes of a Twenty-five years service in the Hudson's Bay Territory, London, 1849,

Coast east of Whale River.

Next morning we left the post on the top of high-water and sailed out by the channel to the east of Big Island which can only be used by small craft at high-tide. Then, with a fair wind, we continued north-east along the coast for forty-five miles and anchored at dark in a small rocky cove quite open to the sea. The coast passed is generally low with an occasional rocky point. The water is very shallow everywhere for two or three miles off, and we were obliged to keep that distance out to avoid striking. There are a few rocky islands scattered along the shore, but they are surrounded by water too shallow to afford harbours behind them. Two long bays were passed, which extend inland between the high hills that rise behind the low margin along shore. The natives say that three small rivers empty into the heads of these bays, one stream flowing into the western bay and two into the eastern. These bays are very shallow and at low-tide are nearly dry and quite unapproachable. The margin of low land varies from one to five miles in width; beyond it the country consists of rocky hills rising to altitudes varying from 500 to 1000 feet; the hills are broken by the deep valleys of the rivers mentioned and those of minor streams.

We got under way at four o'clock next morning and arrived at 7 a.m., at Beacon Island on the west side of the mouth of George River, seventeen miles from the starting point. The wind freshened to half a gale, blowing directly out of the river, and in consequence we only made six miles more by 11 o'clock when we were forced to anchor behind a large rocky island on the east side to await the next rising tide. This was the strongest wind in which we had sailed during the season and the tide against the wind raised a heavy short sea. The yacht behaved splendidly, however, working to windward with treble-reefed mainsail and reefed fore-staysail without straining and dry except for the flying spray. We remained behind the island until 4 p.m., and then made about six miles before dark, when we anchored under a point about two miles below the George River Narrows.

The coast from last night's anchorage to Beacon Island is higher and more rocky than to the westward; it is greatly broken by irregular rocky points, and is fringed with islands. The water unfortunately remains shallow.

We started early on August 31st, and succeeded in getting within a mile of the cove where the Hudson's Bay Company's post is situated before the change of tide. There we anchored until evening, when we worked the yacht into the cove.

The cove is on the east side of the river twenty-three miles from Beacon Island. The post consists of the usual three or four small houses, built on the side of a hill that rises about 700 feet above it. The opposite side of the cove is bounded by a similar hill, and the situation is very desolate, especially at low-tide when the bottom of slimy mud and boulders is bare out to the river a mile away. A few stunted trees grow along the banks of a large brook which flows into the upper part of the cove. The post is kept up chiefly for the salmon fishery and for the trade with about twenty families of Eskimos living along the eastern shore of Ungava Bay. Hudson's Bay Company's post at George River.

The George River is a large stream second only to the Koksoak; it drains a wide area of country to the southward, extending from the western slopes of the Atlantic range to the Whale and Koksoak drainage-areas on the west. It rises in large lakes of central Labrador, in the vicinity of the fifty-fifth parallel of north latitude, close to the head-waters of the North-west and Hamilton rivers which flow eastward into Hamilton Inlet. Beacon Island is the largest of a group lying off the western point at the mouth of the river, and is situated about two miles from Gull Island, which is connected with the shore at low-tide. From Gull Island to the large islands on the east side, the distance is three miles, and this constitutes the width of the main channel, as the channels between those islands and the east shore are dry at low-tide. Eleven miles above Beacon Island, the river takes a sharp bend to the east and contracts to about a mile across, with a small rocky island in mid-channel, just below it, the north channel is obstructed by a ledge of rock projecting some distance from shore and causing heavy rapids and whirlpools. The eastern bend is two miles long, and above it the river runs from the south for ten miles from Post Cove, above which its course is from the south-west. Above the narrows the width varies from one mile to two miles, with a long shallow cove on the east side four miles below Post Cove. There is a large rocky island opposite the post, with only a narrow channel separating it from the west shore. George River. Mouth of river.

The *Erik* anchors between the island and the northern point of the cove, lying about half a mile from shore, or within one hundred yards of the muddy flats extending from the point. All the goods are landed with boats at the post more than a mile away, and as this can only be done when the tide is more than half in, the ship always tries to be at George River near the time of highest tides. There is a great difference in the appearance of the river at high and low tide. When the tide is high the water reaches to the foot of the bold rocky shores Difficulty of landing goods at post.

generally without a beach, while at low-tide a wide margin of boulder-strewn mud intervenes between the channel and the rocky banks. Below the narrows are a number of shoals bare at low-tide, especially along the east side. The hills about the mouth of the river range in altitude from 100 feet to 400 feet. As the river is ascended there is a gradual increase in the general elevation, so that above the narrows the hills are from 500 to 1,000 feet high, and the general level of the country is close on 500 feet. Drift lies in considerable thickness in the valleys between the ranges of hills, and along the river, terraces are seen up to 300 feet above the present water-level. Small spruce trees are first seen a short distance above the eastern bend, and the forest becomes quite thick and continuous in the river valley about ten miles above the post.

Surrounding country.

The influence of the tide extends to a rapid some ten miles beyond the post, and above it the river varies from a quarter of a mile to a mile in width and is very swift, flowing in a shallow channel with nearly continuous rapids but no actual falls. It is navigable with boats for about forty miles above the post.

Return to Fort Chimo.

On the 1st of September we left the post and reached Beacon Island on the falling tide, where we remained until next morning, when we laid a course for Saiglorsoak Island, and anchored, in a calm, about nine miles off the south point at the mouth of the Koksoak River. Owing to calm weather we did not reach Fort Chimo until the afternoon of the 4th. The next few days were occupied in stripping the yacht and loading it aboard the *Erik* which left for George River on September 8th. From the 8th until the 17th we remained at Fort Chimo, anxiously awaiting the arrival of the *Diana*, which on the latter date steamed up the river in a heavy snow-storm. Fort Chimo was finally left on the 19th and after a quick passage we were safely landed at St. John's, Newfoundland, on the 25th. From St. John's, passage was taken in the *Ceylon* a tramp steamer partly loaded with iron ore, and after a very rough voyage we reached Halifax on the 30th, where the members of the party separated and I returned to Ottawa on the 2nd of October.

Return to Ottawa.

GEOLOGY.

General Observations.

General geological observations.

The rocks along the south coast of Hudson Strait and the west and south shores of Ungava Bay, present many interesting and complex problems. The occurrence of numerous quartz veins in the bedded rocks near to their contact with intrusive masses of greenstone and

granite are important, as such conditions are favourable to the presence of the more valuable minerals, and although no such minreals were found during the exploration, there is no reason why they should not be found with more detailed search, as many of the veins carry large quantities of pyrites. Bedded iron-ores were found, and although those examined were not of a very high grade, better bodies of ore might doubtless be found in the extensive areas of this iron-bearing series of rocks seen at a number of localities on the coast. Mineralized quartz veins. Bedded iron ores.

The long line of coast explored in the limited time at the disposal of the expedition, together with the difficulties of navigation in the shallow waters along the greater part of the coast, where the difference between high and low tide varied from twenty-five to forty feet, only allowed of a hurried examination each day of a few points on the shore, at considerable intervals, so that a thorough examination of the rocks was impossible, and consequently only such relations as could be made out from these isolated observations are here given. These northern coasts are ideal places for geological investigation, owing to the absence of trees and often of all vegetation, which leaves the rocks almost continuously bare; while below the 300-foot level the shores, as they have risen from the post-glacial subsidence, have been smoothed and polished by the pounding of floating ice, which has removed nearly all the drift from the points, leaving the solid fresh rock always exposed. Difficulties of detailed investigations.

The rocks met with are all of great antiquity, and all are more or less altered by pressure, induced by intrusions of igneous masses which has folded the bedded series and have produced foliation in much of the otherwise massive granites, gabbros, diabases and other greenstones. The foliation of the granites shows that the pressure was exerted from a direction varying from west to south-west. Where massive beds of cherts and quartzite have resisted the folding action, they, with their associated beds of softer shales or slates, have been shoved into ridges by over-thrust faults, giving the hills cliff-faces inland, while their seaward slopes conform closely with the dip of the beds. Ancient rocks.

Biotite-granite or granitite and biotite-gneiss, especially the latter, together occupy fully three-quarters of the coastal area. The granite and gneiss have commonly a medium texture, and vary in colour from light-pink to flesh-red, the light coloured varieties predominating. These rocks are usually very quartzose and often grade into impure quartzites, and in the gnessic rocks dark-red garnets are usually present. Masses of hornblende-biotite-granite are associated with the biotite-granite and in places appear to represent only more basic portions of Predominance of granite and gneiss.

the same magma. The gneisses seem to be metamorphic products of several rocks of different age and origin. Some of them are very ancient and probably represent part of the original Archæan complex. Others may represent granites of a somewhat later date, injected into the first, but still long anterior to the time of deposition of those sedimentary beds of Labrador that have been provisionally classed as Cambrian. A considerable part of the gneisses has, however, been formed from the alteration and quartzose infiltration of the bedded series of the Cambrian near the contacts of these rocks with great intrusions of later granites; and, finally, some of the gneisses are foliated parts of these later granitic intrusions. All these gneisses of different origin are very similar in appearance and composition, and often could not be distinguished from one another in the hurried examination given them, except in a few places where the contacts were clearly seen. These places are mentioned later in the detailed account of the exposures examined. Owing to the difficulty or impossibility of differentiating these gneisses of several ages and origins, they have all been classed together and no attempt is made to separate the so-called Cambrian bedded rocks from an older basement complex, except to state that in a number of places the bedded rocks appeared to rest unconformably upon rounded bosses of gneiss, which may represent an older series partly composed of clastic rocks, or may be masses of granite intruded below the newer bedded series, as, owing to the highly metamorphic condition of the newer rocks and their frequent intrusion by later granites it is exceedingly difficult to tell when a contact other than an intrusive one was found.

Probable different origins of gneiss.

Alteration of bedded series due to granite intrusions.

The bedded series occurs at intervals along the coast from Fisher Bay to the mouth of George River: its degree of alteration depending largely on its proximity to masses of newer granite and gneisses, which near the contact have broken, squeezed and metamorphosed the beds into highly crystalline schist, and gneisses.

There appears to have been an orogenic movement subsequent to the granitic intrusions, which has further altered the bedded series, throwing the beds into folds, or into repetitions of the series by a number of over-thrust faults. The rocks when least altered bear a close resemblance to portions of the unaltered series of bedded rocks classed as Cambrian and found in the interior of Labrador along the Hamilton and Koksoak rivers and also on the east coast of Hudson Bay.* They consist largely of black bituminous or graphitic shales, generally bearing considerable pyrite; gray micaceous slates, dark

Resemblance to rocks of the interior.

* Annual Report, Geol. Surv. Can., vol. VIII. (N.S.), pp. 261-282 L.

hornblendic slate, impure dark ferruginous chert, and dark siliceous ferruginous dolomite, the two last often carrying large masses of magnetic iron-ore. The great thickness of light-coloured, siliceous, dolomite found elsewhere with the series, was not seen along the coast. The rocks bear a close resemblance to that part of the Cambrian series found along the lower reaches of the Kaniapiskau and Larch branches of the Koksoak; and the presence of great sills or laccolites of gabbro, together with a peculiar light-green diabase and other greenstones, is a further point of resemblance to the rocks of the Koksoak. Sills of gabbro.

The intrusion of the granite appears to have greatly affected these clastic rocks, changing them into gneisses and schists, so that, for a considerable distance from the contact they resemble lithologically, the Grenville series of the Laurentian. The granites appear not only to have produced the schistosity, but to have caused infiltrations of heated waters carrying silica and silicates in solution depositing large quantities of quartz and felspar between the laminæ of the mica and hornblende-schists, changing these into typical gneisses, which, as well as the schists, usually carry large quantities of garnet often in very large crystals. When associated with gabbros, diabases and their decomposition-products, the bedded rocks are often ramified with quartz veins, generally holding considerable pyrite, these veins are most abundant near contacts with newer granites. Several samples from such veins have been assayed for gold with negative results, but as already explained these cannot be accepted as in any sense conclusive. Infiltrations of quartz. Negative assays.

Details of Rock Exposures Examined along the South Coast of Hudson Strait.

Douglas Harbour.

At the head of the South-west Arm, biotite-gneiss alone occurs in the hills forming the walls of the valley. The direction of the foliation varies from S. to S. 70° W. Similar biotite-gneisses were met with on both sides of the arm to within a mile of its mouth, where, on the north side, the rocks are coarse to fine, pink and red, very felspathic mica-gneiss. The fine-grained variety is usually pink in colour, the coarse-grained has in places an augen-gneiss structure and is red in colour. These gneisses are in contact with a mass of basic rock, about 200 feet thick, composed chiefly of very coarse-textured amphibolite, bearing considerable quantities of dark-red garnet and some light-green decomposed plagioclase. The dark mass has South-west arm.

the appearance of an ancient dyke injected into the gneiss before the foliation and tilting occurred, and was probably altered to its present condition by the same agencies that caused the foliation of the surrounding gneisses. The amphibolite is cut by veins of very quartzose pegmatite, resembling a graphic granite, composed of light-pink felspar, bluish quartz and scales of silvery biotite. In one of these veins near the contact of the gneiss and amphibolite, the lining of the vein next to the hornblende rock was made up of small crystals of dog-tooth spar and rusty-weathering rhombic dolomite, probably derived from the decomposition of the bisilicates of the amphibolite.

Amphibolite.

On the summit of the hill on the north side of the entrance to the South-west Arm, there are several large dyke-like masses of rock which vary in texture from very coarse massive amphibolite to fine-grained, well foliated hornblende-schist. These rocks seem to have been dykes cutting garnet-bearing biotite-gneiss; pressure on the thinner portions of the dykes having changed them into the foliated hornblende-schist. The massive rock is largely composed of coarsely crystalline black hornblende with many crystals of reddish-brown sphene and small spots of greenish-white plagioclase. A finer grained variety is almost wholly composed of black hornblende with little biotite, sphene and plagioclase. The foliated rock is chiefly composed of needle-like crystals of hornblende along with thin plates of greenish plagioclase and occasionally small red garnets. The adjacent biotite-gneiss is largely discoloured by iron rust from the decomposition of the dyke rock.

Garnet-bearing gneiss.

At the end of the point between the arms, pink and light-gray, fine- to medium-grained biotite-gneiss was seen, holding in many bands small red garnets, and including broken bands of blackish hornblende-mica-schist, evidently formed from ancient squeezed dykes greatly fractured; dip of gneiss S. 85° W. <70°.

On the western island at the mouth of the harbour, the rock is chiefly medium-textured, hornblende-mica-gneiss, very quartzose and weathering rusty. It is associated with finer grained, garnet-bearing, pink mica-gneiss, which appears to have been cut by the other. Both are cut by a dark basic dyke, one hundred feet wide, running N. 25° W. and seen cutting similar gneisses on the west shore of the bay. The dyke is very fine-grained near its contact with the gneiss and has only a medium texture in the middle. It is largely composed of hornblende with some sphene, many small garnets and some decomposed plagioclase. A number of very large dykes were seen cutting the gneisses in the hills along the coast between Douglas Harbour and Fisher Bay, but no stop was made to examine them.

The islands inside Prince of Wales Island are formed of rusty-weathering, greenish hornblende-mica-gneiss, very quartzose and holding broken bands of hornblende-mica-schist, all being cut by many dykes of pegmatite. Prince of Wales Island

Fisher Bay.

The rocks forming the high islands at the harbour near the head of the east arm of Fisher Bay, are medium- to coarse-textured, pink and yellowish mica-gneisses and mica-hornblende-gneiss usually very quartzose and holding shattered bands of dark hornblende-mica-schist. The pink hornblende-mica-gneiss is evidently an intrusion cutting the yellowish biotite-gneiss and dark bands of schist. All these rocks are cut by numerous dykes of red pegmatite. The general strike of the foliation is N. 30° E.

The point between the east and west arms shows a section, a quarter of a mile long, of dark schists and fine-grained biotite-gneisses. Mica-schist predominates and is usually dark in colour, the lighter coloured variety shading into a mica-gneiss with frequent partings of quartz. Hornblende-schists are interfoliated with the mica-gneiss and schist, and all the schists are very garnetiferous, with crystals varying from a quarter of an inch to one inch in diameter. Strike S. 80° E. A large vein of white pegmatite cuts across the bedding of the schists, and there are numerous veins of quartz, generally parallel to the foliation, the quartz being also garnet bearing. These rocks are probably altered clastics and associated dyke rocks, the clastics being represented by the mica-schists and gneisses and perhaps in part by the hornblende-schists, although most of the latter appear to have been dykes. The hornblende-mica-gneiss, previously described on the islands, appears to have been the cause of the metamorphism of the schists, and these appear to have been a patch of ancient sedimentary crust caught up by a granitic intrusion which occupies both shores of Fisher Bay. Bedded series

The rocks along the coast between Fisher Bay and Wakeham Bay appeared from a distance to be largely granite-gneisses cut by large dykes, but no close examination was made of them.

Wakeham Bay.

The rocks forming the shores of Wakeham Bay seem to be largely foliated granite, and it is impossible to state with the data to hand whether or not all the granite is newer than the series of metamorphic clastics found there. From the hurried examinations made about the Different age of granites.

bay, it seems probable that there are two foliated granites of different age both alike to the eye. One of these cuts and alters the bedded rocks and their associated irruptives, while the other is cut by the irruptives associated with the clastic rocks.

Metamorphic schists.

At the head of the bay, the rocks on the east side are well banded, dark-coloured mica-schists and hornblende-schists often full of garnets. The mica-schists are often rusty, owing to the decomposition of contained pyrite. Associated with the schists are beds of yellowish-white quartzite, from one to four feet thick, containing silvery mica in small scales along partings of the bedding. To the east of a small gully and about four hundred yards from the exposure of schists, the shore rises in abrupt cliffs of more or less squeezed and foliated decomposed diabase, much of which still shows the original diabase structure. These rocks extend for half a mile up the small river flowing into the head of the bay. No beds of mica-schist or other altered clastics were found associated with them. Hornblende-schist is most abundant and shades into a diorite-gneiss, and from that into a massive hornblende-rock with a diabase structure, there being little or none of the original augite remaining in the rock. Numerous small veins of quartz cut these rocks, and in a number of places small cavities and cracks were found filled with calcite probably from the decomposition of the bisilicates.

Granite.

The dark-coloured irruptives occupy the east shores of the upper part of Wakeham Bay for nearly ten miles, to the end of the narrow portion, except at one point about two miles below the head of the bay, where a mass of granite is protruded from the west shore and evidently cuts into the basic rocks. The west shore is all granite, from the schists at the head of the bay to the wide valley five miles below the narrows, beyond which the darker schistose rocks appear to be folded up with granite to the mouth of the bay. The irruptive granite is represented by coarse pink and gray biotite-gneiss, often of the character of an augen-gneiss and sometimes inclosing bands of mica-schist and mica-hornblende-schist, while hornblende is at times a constituent of the gneiss. At the small island near the mouth of the narrows, these gneisses were found associated with a finer grained mica-gneiss free from garnet and seemingly different from the garnet-bearing schists and gneisses.

On the peninsula on the east side of the mouth of Wakeham Bay, the rock is largely a medium-grained, gray mica-hornblende-gneiss with coarser red and dark schistose bands, in which mica and hornblende predominate. These rocks are generally very schistose. There is a

very prominent line of fault that crosses the peninsula diagonally and is continued in the cliff beyond the harbour to the eastward. The fault is marked by a trench, from ten to fifty feet wide and from five to twenty feet deep, filled with angular fragments of rock which near the fault has been greatly shattered with a development of chlorite and serpentine filling small cracks. Prominent fault.

Along the east side of the outer cove between the peninsula and the mainland, pink and red usually coarse-grained granitite-gneiss predominates. It is associated with gray, finer-grained, very quartzose mica-gneiss, usually holding small garnets, and with darker mica-schists. These appear to represent a bedded series and they are cut and twisted by the coarser red granitite-gneisses and also by many large dykes of red pegmatite. The pegmatite is chiefly orthoclase, with a good deal of quartz, and contains occasionally small crystals of biotite, magnetite, garnet and in one place a light-green crystal probably of beryl. Near the head of the cove the granitic rocks are cut by a large dyke of white pegmatite, which runs at a low angle up hill to the southward and directly across the strike of the foliation. The rocks along the shore are much contorted and faulted, the strike frequently changing abruptly. Contorted strata.

On the summit of the hill forming the point at the mouth of the cove, there is a huge dyke, from one hundred to four hundred feet wide, running nearly north-and-south. It cuts light-gray mica-gneiss which has a strike of S. 40° E. Both the gneiss and dyke rock are cut by red pegmatite which often holds fragments of the dyke. The dyke is formed of dark-coloured rock composed chiefly of hornblende, biotite and plagioclase, with many small garnets. The texture varies from medium in the interior to fine-grained and schistose near the edges of the dyke, where the direction of the foliation coincides closely with that of the walls. Great dyke.

Coast between Wakeham Bay and Stupart Bay.

From Wakeham Bay to the vicinity of Cape Prince of Wales, the rocks along the coast are very similar to those last described; the coarse granitites appear to predominate, but as the cape is approached the granitites give place to the bedded series and their associated basic irruptives. A landing was made on a small island about half way to Cape Prince of Wales, where the rocks were found to be chiefly coarse, red granitite-gneiss cutting and inclosing bands of gray, fine-grained, very quartzose, garnet-bearing mica-gneiss; both gneisses being in turn cut by large dykes of red pegmatite.

At Cape Prince of Wales, light-pink garnet-mica-gneiss is associated with bands of hornblende-schist which is also garnet-bearing in places. The schists are cut by small veins of white pegmatite which hardly penetrate the gneiss. The bedding is very regular, with the strike S. 10° W. Near the old station at Stupart Bay, gray and pink mica-gneiss is cut by red pegmatite. Some of the bands of gneiss hold a few small garnets.

Joy and Whitley Bays.

On the end of the long point in Joy Bay, dark-red, coarse-grained augen-gneiss, composed chiefly of biotite and red felspar in imperfect crystals or lumps, is interfoliated with thin bands of red pegmatite holding a little magnetite and brown sphene. Fine-grained pink mica-gneiss, holding a few garnets, occurs in thin bands with the above rocks. About five miles inside the south point of Joy Bay, a dyke from one hundred and fifty to two hundred feet wide runs N. 40° W. up the side of the hill and sharply cuts the gneisses. It ends abruptly at a line of fault on the summit, where the rocks are greatly twisted and the contorted gneisses inclose fragments of the dyke. The dyke is a decomposed diabase, now made up largely of green hornblende, biotite, chlorite and a little plagioclase, and for about three feet from the contact with the gneiss the dyke rock is schistose, the foliation forming a small angle with the walls. The gneiss is a more or less schistose, red and gray mica-gneiss holding considerable silvery biotite. On the summit it is much contorted and mixed with pegmatite and coarser light-gray, mica-gneiss, while at the foot of the hill the strike is regular and the fine-grained gneisses are interbanded with very quartzose layers and hornblende-mica-schists; strike N. 85° E.

Faulted dyke.

Near the end of the point there is a prominent knob of rock that rises abruptly about one hundred feet above the surrounding hills. It is of a dark basic material consisting chiefly of dark-green hornblende, biotite and plagioclase, with a number of quartzose bands that contain a considerable quantity of magnetite in grains and patches forming a magnetite-gneiss very similar to that found on the Stillwater and Manicougan rivers in Labrador. The whole is cut by small veins of bluish opalescent quartz. A number of similar knobs were seen stretching to the westward along the strike of the gneisses, and the iron-bearing beds and their associated altered basic rocks probably continue for a considerable distance. On the point there is a large quantity of fine-grained diorite, together with quartz-mica-diorite and pink granitite-gneiss; the last-mentioned cuts and incloses masses of the

Iron-bearing diorite.

more basic rocks. The diorites often contain large masses of coarsely crystalline green hornblende associated with garnet and also small segregations of yellow-weathering dolomite and dog-tooth spar. The iron ores were not noticed in these masses. The foliation of the diorite-gneiss coincides with that of the granitite-gneiss, and the granitite-gneiss appears to penetrate the more basic masses of diorite.

On the end of a small point four miles up Whitley Bay, well banded schists are seen, with light and dark mica-schists predominating. Some of the bands are charged with pyrite and in consequence weather rusty. The mica-schists are associated with bands of hornblende-schist and sericite-schist. All the bands contain garnets, most plentifully in the dark hornblende-schist and mica-schist, where the crystals are often very large, varying from one to two inches in diameter. Numerous quartz veins penetrate the schists, but generally run parallel to the foliation. The quartz is usually smoky and holds much garnet and yellow-weathering dolomite together with plates of light-green sericite and some pyrite.

Pyrites.

Large garnets.

On the low island lying off the point that divides the head of Whitley Bay into two arms, similar garnet-bearing dark mica-schists and hornblende-schists occur, with a very regular dip of N. 45° W. $<10°$ to 20°. In the northern arm of Whitley Bay, the dark, garnet-bearing schists appear to rest upon domes of medium-grained, pink granite-gneiss. In the south arm the rocks are all pink and gray granitite-gneiss and the coast appears to be largely composed of similar gneisses for the next six miles to the west point of Bourgoyne Bay, where schists are again seen intensely crumpled and folded. In this exposure black mica-schist with large garnets is most abundant, then follows a black carbonaceous schist full of small plates of graphite and containing small rhombs of dark-brown ankerite and a good deal of silica, the rock passing with excess of silica into a very fine-grained carbonaceous chert holding ankerite. The other schists are, gray siliceous mica-schist passing into a dark-gray quartzite, rusty-weathering mica-schist containing pyrite in minute grains, and dark-green chlorite-schists and hornblende-schists. A short distance up the bay from the point, the schists are less disturbed and appear to rest upon domes of light-gray granitite-gneiss. On the point in the middle of the bay, only the light-gray, medium to coarse granitite-gneiss is seen, with a strike of N. 35° E., but along the east side of the bay the schists again cap domes of gneiss, and within a quarter of a mile of the point a great fault drops the gneisses below the water-line leaving only schists on the point, where dark-gray, pearly mica-schist, greatly crumpled and faulted, holds much disseminated pyrites.

Contact between schists and granite.

Coast between Whitley Bay and Cape Hopes Advance.

Rocks largely granites.

For more than sixty miles to the eastward of Whitley Bay, or to the east side of Diana Bay, the rocks along the coast are chiefly granitite-gneiss which varies in texture from fine-grained schistose to coarse-grained massive, and often appears as augen-gneiss, with the strike of the foliation nearly parallel to the general trend of the coast, or east-and-west, and the dip toward the sea. Many large dykes of diabase and gabbro, more or less decomposed, cut these rocks and appear to have been greatly squeezed since their injection, as they change to chloritic and hornblendic schists wherever the dykes thin out. In many places the gneisses are very quartzose and in a number of the bold headlands the rocks are broken into huge rectangular fragments resembling blocks of thick-bedded sandstone.

Dark schists.

On the islands and along the east shore of Diana Bay, the dark mica-schists and mica-hornblende-schists are again found associated with the granitite-gneiss, which cuts and incloses masses of the schists; these latter predominate along the east shore of the bay and largely occupy the low land forming the wide point between Diana Bay and Ungava Bay. At Cape Hopes Advance and on the islands in the vicinity, coarse, red mica-augen-gneisses and mica-hornblende-gneisses are associated with bands and masses of finer grained similar rocks. All of these cut gray and pink, schistose mica-gneiss, in one place changing the strike from S. 80° W. to N. 40° W., and they also send off red pegmatite dykes, generally along the lines of foliation, into the schistose gneisses.

Cape Hopes Advance to Payne River.

Relations between intruded granite and gneisses.

Ten miles south of the Cape, on one of the Eider Islands, the masses of intruded, red hornblende-mica-gneiss were carefully traced, and were found generally to conform with the foliation of the light-coloured granitite-gneisses; but when followed along the contact, the red gneiss was found crossing the foliation in places and turning the lamina of the light-coloured gneiss close to the contact, as if by the flow of the intrusion. In many places there is a gradual passage from one variety of gneiss to the other. The irrupted masses when followed along the foliation were seen to pinch out at both ends and have evidently been intruded from below. In texture, the hornblende-mica-gneiss varies from fine-grained to a coarse pegmatitic rock, distinct from later pegmatites which cut all the rocks and hold crystals of tourmaline, biotite and hornblende. Most of the light-coloured granitite-gneisses are very quartzose and are interbanded with darker, more basic gneiss, made up

A. P. Low, Photo. 1897. MOUTH OF WAKEHAM BAY, FILLED WITH ICE

largely of chlorite and decomposed hornblende with greenish plagioclase and bluish opalescent quartz, very similar to that found in the squeezed diabase previously mentioned. This rock is taken to be such an altered diabase, rendered acidic by the accretion of quartz between the lamine of the bisilicates.

Ten miles south of this exposure, the rocks are dark-gray, mica-schist and hornblende-schist associated with coarser light-gray granitite-gneiss and coarse red granite. Dip. N. 10° E. < 70°. Five miles further south, the intrusive granite predominates and incloses broken bands of finer-grained garnet-gneiss. The next examination was made twenty miles further on, at the north side of Dry Bay where there is a prominent hill composed largely of light-gray granitoid-gneiss with interbanded medium- to coarse-grained, red granitite-gneiss and also bands of mica-schist and mica-hornblende-schist, usually thin and broken. At the south point of Dry Bay the rock is all gray and pink gneiss, varying from medium- to coarse-grained and at times having an augen structure. Strike N. 25° W. From there to the entrance of Payne River Bay, the same gneisses prevail, with an occasional large dyke, altered to hornblende-schist, and at times considerable areas of the mica-schists and mica-hornblende-schists. Intrusive granite.

At the north point of Payne River Bay, the rock is a coarse, red granitite-gneiss with little foliation. This rock continues about five miles up the bay, when a change is made to a metamorphosed series of clastic rocks which forms the hills and islands of the upper part of the bay and lower portion of the river. The following section was measured across the hills forming the outer point of the bay, on the north side of the river, five miles from its mouth: starting from gray granitoid-gneiss cut by pegmatite and pink granitite, the sequence is as follows, in descending order:— Section of rocks on north side of Payne Bay.

	Feet.
Light-grayish mica-schist often very quartzose passing into dark-gray quartzite with partings of mica.....	500
Light, yellow-weathering, blotched with brown, fine granular quartzite, with patches of ankerite and some lime. This rock towards the top shades to a dark, bluish-gray, from the presence of large quantities of magnetite in small grains, mixed with quartz, and at times occurring in larger crystalline masses	70
Dark-bluish, slaty quartzite, holding considerable magnetite, and shading upwards into barren, dark quartzite containing a small percentage of lime and lumps and veins of dark chert.....	350
Dark-gray arenaceous slate.....	35
Dark, massive, quartzite with a few partings of slate..	40

	Feet.
Dark mica-schist	20
Light mica-schist	10
Dark mica-hornblende-schist holding garnets and probably a squeezed dyke	8
Light-gray, schistose, biotite-gneiss	500

General dip of beds S. 80° E. < 30° to 60°.

The small islands in the north bay are formed of dark-gray, siliceous mica-schist, that weathers rusty from the decomposition of disseminated pyrite. At the mouth of the small river flowing into the bay, there is exposed, in the hillside to the east of the river, one hundred feet of light-blue, finely crystalline, siliceous limestone, greatly shattered and recemented by networks of small quartz veins, so that the rock closely resembles the siliceous limestones of other Cambrian areas of Labrador. The limestone is overlain by about a thousand feet of silicious, calcareous rock containing large patches of brown ferruginous dolomite interlaminated with black chert and also containing masses and veins of that mineral. The rock decays unevenly, leaving cavities where the carbonates have weathered away. Interbedded with these cherty rocks are bands containing much actinolite in large crystals radiating through a siliceous rock. The actinolite is light-coloured in the rock-mass, but there are veins containing dark steel-gray hornblende in masses of radiating crystals and others containing quartz and dolomite with sericite along the walls. The overlying rock is a rusty-weathering mica-schist similar to that met with on the islands of the bay, and it probably occupies the interval of swampy land between this hill and the range where the previous section was obtained. The islands at the mouth of Payne River belong to the same series, which is readily identified by the yellow-weathering dolomitic beds.

Hornblendic cherts.

These rocks occupy both sides of the river for about ten miles above its mouth, when they give place to granitite-gneiss. Along the river the clastic series is largely displaced by sheets of diabase, gabbro and hornblendic, chloritic and sericitic schists, which appear to have burst up between the bedding planes of the clastics like the great interflows of diabase and gabbro near the forks of the Kaniapiskau and Larch branches of the Koksoak River,* the only difference being that the pressure and metamorphism appear to have been greater about Payne River.

Sheets of decomposed gabbro.

The rocks of the upper part of the river are mostly pink and gray biotite-gneiss cut by many large dykes of diabase which are seen in the bare walls on both sides of the valley.

* Annual Report, Geol. Surv. Can., vol. IX. (N.S.), p. 33-34 L

Payne River to Gyrfalcon Islands.

To the southward of the mouth of the river the coast is chiefly occupied by light-coloured gneisses. At a stopping place fifteen miles from the river, there is an immense mass of amphibolite, at times containing violet plagioclase and cut by large veins of violet pegmatite. Owing to shallow water, no landing was made for thirty miles from here, to the large islands in the mouth of Hopes Advance Bay, where light- and dark-gray, very quartzose mica-gneisses are interbanded with garnet-bearing hornblende-schist. Dip N. 50 E. < 20° to 45°. These are cut by huge dykes of red pegmatite, and on the west side are cut off by a mass of coarse, dark, decomposed gabbro or diorite. Amphibolite mass.

On Cone Island of the Gyrfalcon group, the rocks are somewhat contorted and dip eastward; they consist chiefly of impure quartzite holding in places a good deal of garnet and small scales of biotite, and shade into a quartzose biotite-gneiss. Dark mica-diorite-gneiss, sometimes holding garnets, occurs with them, apparently interbedded. The Gyrfalcon Islands are arranged in a series of chains running north-west and south-east parallel to the strike of the rocks, and appear to have been formed by a series of thrust-faults, which have pushed the rocks into sharp ridges with perpendicular faces towards the south-east and gentler slopes in the opposite direction corresponding to the dip of the bedding of the rocks. Quartzites and very quartzose mica-gneisses predominate and are associated with a highly felspathic mica-diorite-gneiss which often resembles a decomposed crushed anorthosite. All the rocks contain more or less garnet. A few bands of rusty-weathering quartzite hold patches of ankerite and probably represent a more highly metamorphic phase of the rock met with at the mouth of Payne River. Crushed anorthosite.

Gyrfalcon Island to Koksoak River.

The rocks forming a small island on the south side of Leaf Bay, are chiefly dark-green amphibolite and hornblende-schist, together with bands of quartzose, schistose mica-gneiss cut by large dykes of light-pink pegmatite and coarse red granitoid-gneiss. The amphibolite is very coarse in texture near its contact with the pegmatite and granite. From this island to Stony Point, the shore is largely formed of light-coloured granite and gneiss. On the small islands off the point, a medium-grained, light-pink granitoid-gneiss predominates, and holds broken bands of light-gray biotite-gneiss often containing small garnets; both the granitite and the gneiss are cut by red pegmatite. The coast from Stony Point to the mouth of the Koksoak is low, with few rock-exposures, all of which appear to be similar to that last described. Amphibolite.

The rocks along the Koksoak to Fort Chimo have been described in a previous Report.* They consist of a bedded series of mica-schists hornblende-schists and gneisses cut by hornblende-granite and large veins of pegmatite, the irruptives predominating towards the mouth of the river.

Koksoak River to George River.

Gneisses and granites.

The coast between the Koksoak and Whale River is very low, with shallow water extending far out and quite unapproachable with the yacht until the channel on the west side of Big Island is reached, where the shores become higher and give an almost continuous rock exposure up Whale River to the Hudson's Bay post.

The rocks are all light-coloured gneisses and granites, being made up largely of irruptives containing shattered bands of a highly metamorphosed bedded series, now forming very quartzose, garnet-bearing biotite-gneiss and schist, with less hornblende-schist than to the northward. Between the mouths of Whale and George rivers, the wide flats and boulder-ridges which extend far out from the low shores rendered close examination of the rocks impossible, and only a few landings were made on islands and rocky points. Wherever an examination was made, however, gray biotite-gneiss with mica-schist and hornblende-schist were found, cut and shattered by red granites and pegmatite.

The same rocks occur on the islands along the east side of the mouth of George River and up that stream to the Hudson's Bay post. At Gull Island and along the west shore for ten miles above it, there are large exposures of dark basic rock, now chiefly diorite-gneiss, and evidently representing large masses of gabbro or diabase corresponding to the basic irruptives met with in the bedded series as previously described.

Glacial Geology.

Extent of ice-sheet.

The entire coast visited has at one time been covered by an ice-sheet sufficiently thick to over-ride the highest hills, and the movement of this ice caused the removal of the loose material leaving only large blocks and boulders strewn over the rocky surface of the rounded hills, which is everywhere grooved and striated by ice action. Little or no fine drift remains on any of the hills more than 400 feet high, and in the valleys between the higher hills there is

* Annual Report, Geol. Surv. Can., vol. VIII. (N.S.) p. 221 L.

usually not much fine material, the débris being mostly boulders and broken rock.

The list of glacial striæ given below, shows that the general motion of the ice was from the interior radially towards the coast, so that, as a rule, the striæ on the hills run nearly at right angles to the general trend of the coast. The direction of the ice-flow was, however, modified by that of deep valleys along the coast, the ice-stream accommodating itself to the valleys and pouring down these into the sea. The striæ are not well marked on the exposed points and islands along the coast below the 400-foot level, having been obliterated by the pounding of floating ice during the uplift subsequent to the main period of glaciation.

Radial flow of ice.

List of Glacial Striæ.

List of glacial striæ.

Douglas Harbour, on hills at head of S.W. Arm	N. 75° E.
" " at point between the arms	N.
" " 2 miles from point, W. side S. W. Arm	N. 25° E.
Fisher Bay, on top of island at anchorage	N. 50° E.
" " on side " "	N. 10° E.
Wakeham Bay, on island at mouth of narrows	N. 80° E.
" " on summit of the peninsula	N. 50° E.
" " on summit of east side at mouth	N. 25° E.
" " " "	N. 30° E.
Cape Prince of Wales, on end of cape	N. 35° E.
Joy Bay, 5 miles from S. point on summit of hill 500 ft. high	N. 85° E.
" on end of south point	N. 80° E.
Whitley Bay, on the long low island in the bay	N. 40° W.
10 miles east of Whitley Bay, on summit	N. 55° E.
25 " " "	N. 25° E.
Diana Bay, south-west point of the large island	N. 40° W.
Cape Hopes Advance	N. 60° E.
Eider Islands	N. 25° E.
" "	N. 40° E.
" "	N. 40° E.
Flat Bay, summit of hill on north side	N. 40° E.
" south point	N. 75° E.
Plover Islands	N. 65° E.
12 miles north of Payne River Bay	N. 45° E.
On summit of hills at end of exploration, Payne River	N. 40° E.
10 miles south of Payne River Bay	N. 20° E.
Cone Island Gyrfalcon Islands	N. 35° E.
Mainland at Gyrfalcon Islands	N. 30 E.
Leaf River Bay, small island on south side	N. 35° E.
15 miles west of mouth of George River	N. 5° W.
Island on the east side of " "	N.

Marine Terraces.

The greatest depth of submergence and the periods of rest during the uplift of the land toward the close of the glacial period, are marked

Terraces marking limits of subsidence of the land.

by a series of terraces cut into the drift occupying recesses between the rocky hills of the bold coast, or, in the lower country along the west side of Ungava Bay by flat plains that rise in steps from the present sea-level. The terraces were seen wherever sufficient drift material remained to form them, and their heights were estimated by eye, or, where convenient, their altitudes were obtained by means of the aneroid barometer. The highest terraces measured were found at the

Highest terraces.

head of the south-west arm of Douglas Harbour, and near Dyke Head, some thirty miles east of Whitley Bay, or more than one hundred miles east of Douglas Harbour. In both places the barometric height of the highest terrace was 405 feet and the tops were evidently an ancient shore-line under a rocky cliff, the surfaces being made up of moderately large, rounded boulders. This upper terrace is taken to represent the greatest depression of the land in this part of the Labrador Peninsula at this time, and is considerably less than that of the western portion, where the marine terraces are found to an elevation of more than 700 feet above sea-level in the vicinity of Richmond Gulf on Hudson Bay.* The amount of uplift along this part of Hudson Strait appears to have been constant, from the levels of the terraces cited above, and in Ungava Bay it seems to be somewhat less. Unfortunately no definite highest-level terrace was found there south of Payne River, where the highest terrace seen is only 325 feet above the sea. Those about the mouths of the Koksoak and George rivers are not higher. Along the Koksoak River the highest-level terrace is about 300 feet above the river near its mouth, and as the stream is ascended the terrace also rises so that at Stillwater Lake, 175 miles south-west of the mouth of the river and 520 feet above sea-level the upper terrace is 200 feet above the surface of the lake. This highest terrace is a well marked feature of the river-valley and is continuous from the mouth to Stillwater Lake. It is accompanied by marine stratified clays, so that its marine origin is undoubted.

Unequal uplift of Northern Labrador.

From the foregoing facts, it would appear that there has been an unequal uplift of the northern portion of Labrador, the maximum, more than 700 feet, having occurred along the coast of Hudson Bay in the vicinity of Richmond Gulf; and that this region of maximum uplift was continued inland, eastward, more than half way across to Ungava Bay: while from Stillwater Lake a gradual decrease occurs to about the southern part of Ungava Bay, where the uplift is only about 300 feet. Passing northward, however, the uplift again becomes greater, so that at the mouth of Payne River it reaches 325 feet and along the southern shore of Hudson Strait 405 feet.

* Annual Report, Geol. Surv. Can., vol. IX. (N.S.), p. 41 L.

At Douglas Harbour, terraces below the upper level were noted at 275, 212, 91, 46 and 37 feet. On the peninsula at the mouth of Wakeham Bay, well marked terraces occur at 180, 165, 150, and 65 feet, and at the head of the bay there is a broad terrace 90 feet high. About Cape Prince of Wales the lower terraces are persistent, and at the mouth of the river flowing into Joy Bay the drift deposits are terraced to above 300 feet. On the points of Joy and Whitley bays there is a continuous terrace at an elevation of 65 feet. The terraces at Dyke Head, lie in a small valley at the bottom of a cove facing the strait and afforded one of the best examples of terraced beaches seen on the coast, the heights being 405, 330, 275, 255, 220, 175, 90 and 85 feet, any lower terraces being lost by the scouring away of the drift from the rock. Between Cape Hopes Advance and the mouth of Payne River, the country is generally low and drift-covered, and is made up of flat-topped plains that rise in low terraced steps, as only isolated rocky ridges have an elevation above 200 feet, high-level terraces are not frequently seen. At Cape Hopes Advance there is one at 190 feet, and on the side of a rocky hill near the Plover Islands there are two beaches at 200 and 75 feet respectively. At the mouth of Payne River, the drift between the hills shows terraces at 323, 314, 304 and 184 feet besides others at lower levels. Along the river the valleys between the hills are filled with terraced drift up to 325 feet, the lower terraces are cut from stratified clay which rises about 150 feet above the level of the river, and is overlain by stratified sand nearly to the level of the highest terrace.

Douglas Harbour.

Dyke Head.

Payne River.

From Payne River to the mouth of the Koksoak, the low shores and slowly rising country in rear, gave only low terraces, seldom exceeding an elevation of 100 feet. The coast between the mouths of the Koksoak and George rivers is also low, and terraces are only seen along the flanks of the hills several miles inland. They appear to be continuous, with the highest estimated to be about 300 feet above the sea. Along the lower reaches of the George River to the Hudson's Bay post, the gullies and banks where drift is lodged are terraced to about 300 feet above the present level of the river, and the stratified clay appears to rise upwards of 100 feet above the water and is capped with stratified sand.

Koksoak and George rivers.

R. Bell, Photo., 1897.

NEAR BRUCE HARBOUR, LOOKING NORTH.
Showing band of white crystalline limestone.

GEOLOGICAL SURVEY OF CANADA

G. M. DAWSON, C.M.G., LL.D., F.R.S., DIRECTOR

REPORT

ON AN EXPLORATION ON

THE NORTHERN SIDE OF HUDSON STRAIT

BY

ROBERT BELL, M.D., LL.D., F.R.S.

OTTAWA
PRINTED BY S. E. DAWSON, PRINTER TO THE QUEEN'S MOST EXCELLENT MAJESTY
1901

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To G. M. Dawson, C.M.G., LL.D., F.R.S., &c.,

Director Geological Survey of Canada.

Sir,—The accompanying report on my field-work of 1897, on the northern side of Hudson Strait, contains fuller descriptions than the summary report, already published, as to the topography of the region surveyed or explored, together with all the details in regard to its geology, which are considered worth mentioning. Some general information on Baffin Land is also given. The appendix contains lists of the plants and insects obtained during the season. These will serve to supplement the published lists of similar collections which I made in Hudson Strait in 1884 and 1885, when many specimens were also secured in other departments of zoology and lists of the species published in my reports for those years. The illustrations are selected from my photographs as characteristic examples of the scenery of the coast. The topography and geology of the north side of the strait are reduced from my track-surveys, originally plotted on a scale of 4 miles to 1 inch, and which required only slight adjustment to bring them into correspondence with the numerous observed latitudes and longitudes.

I have the honour to be, Sir,

Your obedient servant,

ROBERT BELL.

Ottawa, December, 1900.

NOTE.—*The bearings throughout this report are given with reference to the true meridian.*

REPORT

OF AN EXPLORATION ON

THE NORTHERN SIDE OF HUDSON STRAIT

BY

ROBERT BELL, M.D., LL.D., F.R.S.

My summary report for 1897 contains a general account of my exploration of that year on the northern side of Hudson Strait, or in the southern part of Baffin Land, including a sketch of the geographical and geological results. The present report is intended to give a fuller description of the topography and geology of this comparatively new region, together with many facts which were observed in reference to its physical features, natural history, botany, climate and other matters which may be of interest or value. As stated in the above mentioned report, the opportunity for making this exploration was afforded by the sending out of the sealing steamer *Diana* by the Department of Marine and Fisheries to make investigations in the strait for other purposes.

Objects of this report.

Diana expedition.

I was provided with a small yacht at Halifax, which was carried on the deck of the steamer, and a crew of four sailors was engaged to accompany me to the field of operations, but I had no assistant. The *Diana* left the above port on the 3rd of June, and our course lay through the Strait of Belleisle, which was clear at that season, but owing to ice encountered off Hamilton Inlet, it was the 22nd of June before we entered Hudson Strait, which was found perfectly free of ice. Owing to the ship keeping too near the north shore in going through the strait, we became jammed in ice off Big Island, which stands out prominently like a great pier projected from that side and intercepts the drifting shore-ice. This contretemps delayed us considerably, and it was therefore not till the 12th of July that the *Diana* had completed her first voyage into Hudson Bay.

Enter Hudson Strait.

Enter Hudson Bay.

It was originally intended that I should be landed at a point in the vicinity of Kings Cape, or as near as possible to the junction of the north-east side of Hudson Strait with the east shore of Fox Basin,

but this was found to be impracticable at the time we happened to arrive near that point on account of a rapidly moving ice-floe. Eventually I commenced work at Ashe Inlet in Big Island. Before leaving the *Diana* the plan agreed upon was that I should proceed north-westward up the coast as far as possible, consistent with a tolerable certainty of being able to return to Ashe Inlet in order to meet the ship there on the 10th of September, so as to be taken to St. John's, Newfoundland, as arranged by the Minister of Marine and Fisheries. Had the captain of the *Diana* succeeded in landing me at Kings Cape, I could probably have explored about double the length of coast that was possible under the new arrangement. Owing to the very imperfect knowledge of the coast in the neighbourhood of Kings Cape and beyond it, and the absence of any chart showing the coast even approximately, it was impossible to appoint a place to meet the ship in that vicinity, otherwise I might have kept on till I fell in with her. Being therefore obliged to go twice over the same ground, to say nothing of the delay in getting to Ashe Inlet, I was able to accomplish little more than half of what could otherwise have been done. Still, I managed to complete a good track-survey as far as Chorkbak Inlet, over a length of 250 miles of coast, checked by many observations for latitude and longitude, in addition to a traverse all around Big Island, 30 miles in length and 16 in breadth, surveys of numerous inlets and of a route for 50 miles into the interior, to the shores of Lake Mingo, lying close alongside Lake Amadjuak, which was also seen and bearings taken to various points on its shores. Having completed the above, I returned to Ashe Inlet, which was reached ten days before the date appointed. The interval was filled up by an exploration around North Bay nearly to Icy Cape, which lies east of Big Island. On the return voyage the *Diana* passed close to the north end of Akpatok Island, which had heretofore been supposed to be a separate island to which the name of Green Island had been given. Having rounded the north-east point of this island, we coasted southward along part of its eastern side, stopping for a day at anchor midway down. This afforded me an opportunity of landing to examine the rocks, which were described in my summary report. It is unnecessary to repeat the notice of the remainder of my return journey to St. John's and Ottawa, which is given in the Summary Report for 1897.

Plan of operations.

Length of journey doubled.

Work accomplished.

Akpatok Island.

Dimensions and Area.

Baffin Land one island.

The territory, now known as Baffin Land was, until about 1875, supposed to consist of different islands known as Cockburn Island, Cumberland Island, Baffin's Land, Sussex Island, Fox Land, &c. It

seems to be now established that these are all connected and that there is but one great island, comprising them all, to which the name Baffin Land has been given. It forms the northern side of Hudson Strait, its southern extremity being in latitude 61° 42′, opposite Cape Chidley, and it extends in a north-westerly direction to latitude 74° 00′. It has a length of about 1,005 English statute miles with an average breadth of 305 miles, its greatest width being 500 and its least 150 miles. Its area approximates 300,000 square miles, and it therefore comprises about one tenth of the whole Dominion. It is the third largest island in the world, being exceeded only by Australia and Greenland.

Dimensions.

Area.

Discoverers.

The land around Frobisher Bay was discovered by Sir Martin Frobisher in 1576. Captain John Davis discovered Cumberland "Island," now known to form the eastern part of Baffin Land, in 1585. The northern part of the great island was discovered by Captain William Baffin, in 1616. It was, until recently, called Cockburn Island, although it had been named Baffin's Island or Baffin's Land by Lieutenant (afterwards Admiral) E. W. Parry, in 1821, 'out of respect to the memory of that able and enterprising navigator.' These lands therefore formed part of the British possessions in North America, by right of discovery, dating from periods of 143 to 183 years before the acquisition of Canada. They were formally transferred to the Dominion by Order-in-Council of the Imperial Government on the 1st September, 1880, together with all the islands of the Arctic archipelago lying to the northward of the mainland of the continent.

Discovery.

Transferred to Canada.

Narrative and General Description.

For a short narrative of my season's operations and a brief general description of the portions of the coast and interior examined, I cannot do better than quote the following from my summary report, written very soon after my return:

Narrative of operations.

The *Diana* brought me to Ashe Inlet on the 19th July, and my yacht was launched there on the 20th. The following day the wind blew too strongly for us to get out of the inlet and the time was spent in fixing its position relatively to other geographical features of Big Island, as a commencement of a track-survey of the coast. On the 22nd we made a start to windward, intending to pass up on the outside of Big Island. Before leaving the inlet, early in the morning, we

Land at Ashe Inlet.

Eskimo guide

fortunately found an Eskimo who had some knowledge of the English language and was acquainted with the south coast and the southern interior of Baffin Land, and I engaged him to go with us as guide and interpreter for the whole of our journey. He had slept near our anchorage and had nothing with him but a gun.

The hull of our yacht was made of one inch white-pine boards. She was, therefore incapable of contending with the ice, and our safety lay in avoiding it altogether. We had not gone many miles up the outer coast of Big Island, when we met an ice-pack lying in our course as far ahead as the eye could reach. Our Eskimo guide now advised us to try the passage between the island and the mainland, and accordingly we turned back and attempted to get round the south-eastern extremity, but on account of the wind failing us altogether we were able to make only about six miles to the south-eastward of Ashe Inlet. Here we discovered a much better harbour than Ashe Inlet, and I named it after Reeves, our sailing master. It is about a quarter of a mile in diameter, has two deep narrow entrances, a good bottom for holding and a depth of from five to fourteen fathoms at low water. The next day we rounded the south-eastern extremity of Big Island, which is about thirty miles long, but owing to a strong north-west wind we were obliged to anchor for the night among some small islands lying north-east of this point. It was fortunate that we took this route, as we found the family and relatives of our guide camped on the lower end of the island, and he was now able to make arrangements with them for his absence till September. He had not previously told us anything about his people.

Take inside passage.

Reeves Harbour.

At this season of the year there was continuous daylight in Hudson Strait during the whole twenty-four hours, and we sailed at two o'clock the following morning (24th) and made a track-survey of the inner side of Big Island as well as of a part of the main shore opposite. Two good harbours were discovered on this side of the island towards the northern end, and two more on the coast of the mainland in this vicinity.

Four harbours discovered.

In proceeding north-westward up the coast from Big Island the shore began to be fringed with innumerable rocky islands thickly clustered together. The breadth of the belt or archipelago increased as we advanced, until we approached the long inlet or fiord called Chorkbak, where our exploration ended. Here the islands became less numerous. The maximum breadth of the archipelago is about midway between Big Island and this inlet, and is about twenty-five miles. The islands vary in size from ten miles in length down to

Archipelago 25 miles wide.

mere rocks. The spaces between the large ones are filled up with smaller islands having a great variety of dimensions and form. As a rule, the largest and highest islands lie towards the mainland, while the outermost ones are smaller and lower. In sailing among these islands it was only when near the outer edge that we could see a clear horizon to the southward.

Mountainous coast.

The whole coast is rugged and for the most part mountainous. The innermost islands interlock with the bays and points of the mainland in such a manner that it is impossible to know without the aid of a guide whether one has reached the main shore or not. On ascending the higher hills or mountains of the outer ranges on the mainland, long channels of the sea can be seen running inland in different directions among the hills, which so closely resemble those among the adjacent large mountainous islands that only a person already acquainted with the geography could trace the coast-line of the mainland. The larger islands are equally hilly and rugged and the channels between them are usually not wide. Viewed from the top of a distant hill, so that the intervening channels cannot be seen, the eye fails to detect any difference between the general appearance of the islands and the mainland. The conditions may be best described if we imagine a rough mountainous country, rising as a whole gradually to the northward, to have been half submerged. The outer islands, which are also the smallest and most scattered, represent the more completely sunken hills, while as we proceed inward the progressingly larger and larger ones represent the less and less submerged areas and ranges, until, at last, we find only narrow channels of the sea running into the solid land. Besides these narrow and sometimes tortuous channels, numerous wide and tolerably straight fiords run inland. These generally have high hills on either side of them.

Many channels.

The islands.

Character of survey.

On leaving Big Island, it soon became evident that it would be impossible to make an instrumental survey of any considerable part of such a coast as this in the limited time that would be at my disposal, and that this time would be most advantageously spent in making the best track-survey possible under the circumstances, especially as it was necessary to devote a portion of the time to geological observation. I therefore determined to keep an accurate record of all the courses we followed among the islands or up the fiords, under the guidance of our Eskimo pilot, and also as good an estimate as possible of the length of each course, plotting them on diagrams as we went along. On these diagrams the relative positions of all the surrounding points, bays, islands, hills, &c., were also marked by the aid of many cross-bearings

Astronomical observations.

and estimated distances. Observations for the latitude and the variation of the compass were taken every day, and I also obtained numerous sights for longitude.

Good harbours.

The coast abounded in good harbours, and careful sketch-plans with soundings were made of all those that we visited. The heights of numerous hills, which I climbed, were ascertained by barometer.

Observations and collections.

A sufficient number of photographs for illustration were obtained: notes were recorded on all subjects that might be of interest in regard to this little-known region, whether from personal observations or from information supplied by the natives.

Weather.

From the time of our leaving Ashe Inlet, on the 21st of July, until we returned to it again on the 1st of September, the weather was mostly fine and bright, although cold upon the water, but we suffered

Calms

much delay from calms. The main obstacle to our progress, however, was the field-ice, which appeared to have come into the strait from the eastward during the winter or early spring, and to have insinuated

Field-ice.

itself into every channel and fiord. When not tightly packed, it was constantly moving hither and thither under the influence of the rapid and changeful currents generated by the high tides of the strait.

Tides of Hudson Strait.

The height of the mean tide at Big Island was ascertained by Mr. Ashe to be 30 feet, and the time of high-water at full and new moon to be 9h. 32m. Further west we could not determine the time of high or low water, which was irregular, on account, apparently, of the effect of the reflux from Hudson Bay upon the in-coming or out-going tide of the strait; while the local conditions, such as the directions, divisions, depths and widths of the channels still further complicated the problem. In trying to navigate our frail yacht in the open spaces, the heavy ice would set down upon us or run together and threaten to crush our little vessel in the most unexpected manner. Our undertaking was, therefore, constantly accompanied by great danger and anxiety, and it was only by constant vigilance night and day that we were fortunate enough to escape any harm during the entire trip.

Amadjuak Bay.

When we had reached a point a little beyond the entrance of Amadjuak Bay, we found the ice closely packed among the islands all around us. But the next morning the wind or tide had opened a lane up the fiord itself and I explored it to its extremity. The ice outside still remained packed, and in order to utilize the time most profitably, I determined to make an exploration into the interior of the country. Two seamen were left in charge of the yacht with instructions to make

Journey inland.

lines of soundings in the fiord, and with the other two and the Eskimo

guide, I started on a journey northward towards Amadjuak Lake, one of the bays of which was supposed to be at no great distance from this part of the coast. It proved, however, to be upwards of fifty miles inland. This journey occupied seven days, and the results will be described further on. When we returned to the head of the fiord, the sea was found to be open and we immediately set sail to continue the westward exploration of the coast.

Turn back from Chorkbak Inlet.

On the 22nd of August we had reached Chorkbak Inlet, and in case of being detained by calms or head winds on our return journey, I judged it prudent to turn back from this place in order to be sure of being able to keep our appointment to meet the *Diana* at Ashe Inlet on the 10th of September. In returning I followed a course which lay outside of that of the westward journey, so as to make a second line of track-survey among the island belt and of the outside of Big Island. We had fairly good weather and anchored again in Ashe Inlet on the 1st of September. In order to fill up the time with advantage till the 10th, I ran across to the main north shore opposite the island and explored it topographically and geologically nearly to Icy Cape. I then returned to Asle Inlet before the 10th, but owing to stormy weather, the *Diana* was not able to enter until the 12th. It only required two or three hours to transfer our outfit and surplus stores to the steamer and to dismantle the yacht and make her ready to tow across the strait to Fort Chimo, where I proposed to leave her, as it was not considered advisable to risk taking her to St. John's, Newfoundland, on the deck of the *Diana*. On the following morning we reached the northern extremity of Akpatok Island in Ungava Bay, and after coasting along the eastern side of the island we anchored close to the shore about half-way to the southern extremity. This afforded me an opportunity of landing in order to take photographs, examine the rocks, collect fossils and ascertain the heights of some of the cliffs and hills by the barometer. This was so far as I am aware, the first landing of a white man upon this island. Its position and general form and direction are erroneously represented upon the latest charts. The hypothetical "Green Island" of the charts corresponds with the northern part of Akpatok Island as determined by the observations of Captain Whiteley, and it is probable that this, seen from the northward, was mistaken for a different island.

Rejoin the Diana.

Land on Akpatok Island.

General Aspect.

General nature of the rocks.

Baffin Land has the usual sub-arctic climate and is destitute of trees. The rocks are principally Laurentian, not only in the portion which

I explored, but also all along the north-eastern coast, judging from the accounts of Dr. Franz Boas, who has travelled over the greater length of this side of the island, as well as from other evidence. The island has a generally mountainous, or hilly and barren aspect, but from the western shore bordering on Fox Basin a considerable area of flat Silurian limestone extends inland to Lake Nettilling and there are also areas of similar rocks in the northern parts of the island. In some districts comparatively level Laurentian areas occur. These level portions are the favourite haunts of the reindeer in summer. At this season the rocky Laurentian hills have generally a dark or nearly black appearance, owing to a growth of lichens upon them, but this sombre character is often relieved in valleys and on hill-sides by strips and patches of green, due to grasses and sedges in the lower parts and to a variety of flowering plants on sheltered slopes exposed to the sun. The landscape is further relieved by long banks and smaller patches of white where the last of the snows of perhaps several winters remain in shaded places.

Aspect.

Flat Silurian limestone.

Green portions.

Ice in valleys.

In two valleys of the interior I found accumulations of ice resembling small glaciers, but which had evidently been formed mainly by the constantly overflowing and simultaneous freezing in the winter of streams that in the summer run under the ice or in canyons they have cut through it.

Mountains and Glaciers.

Direction of ranges.

The mountains of Baffin Land may be grouped as three principal ranges, all running north-north-westerly nearly parallel to the eastern side of the island and the western coast of Greenland, the north-eastern or outmost range being the highest and the south-western the lowest.

Elevations of the high lands.

According to Dr. Franz Boas, the high interior of Baffin Land, lying just north of Cumberland Sound, is apparently all covered with ice like the interior of Greenland. Around the margins of this ice-cap the general elevation above the sea is about 5,000 feet, and it rises to about 8,000 feet in the central parts. Another area of smaller extent, but apparently equally high, lies a short distance to the north-west of the one just described. The high land, mostly ice-covered, lying north-east of Cumberland Sound and stretching over to Exeter Sound, is probably at least 5,000 feet high. Large portions of the northern interior are over 1,000 feet above the sea, often nearer 2,000 feet while the higher parts of these areas may be 3,000 feet or more. The mountainous region between Frobisher Bay and Cumberland Sound appears to have an elevation of between 2,000 and 3,000 feet. The

southern extremity of the island, between Hudson Strait and Frobisher Bay, is covered by the Grinnell glacier, between 70 and 100 miles in length from south-east to north-west, between latitude 62° and 63°, with a breadth of about 20 miles. The smooth summit of the glacier is distinctly visible from vessels in Hudson Strait in certain conditions of the weather. I have been told that one narrow stream of ice from its southern side reaches the water of the strait, but I was unable to verify this. The rough existing charts represent the northern side of the glacier as sending ice down at two or three places into the heads of inlets of Frobisher Bay. The Eskimos call the Grinnell glacier Ow-u i-to, and my guide, Twimi, knew of only one point at which it discharged into the sea. This place is called Pak-a-lui-a, and is not far to the north-west of Resolution Island. This man stated that all the icebergs which enter and pass up the strait, and which are well known to be of small size, come from Pak-a-lui-a. He also informed me that in the same neighbourhood, or at the second principal point north-west of Gabriel Strait, codfish are very abundant and many of them of large size. During my visit to these regions in 1884 and 1885 vague reports reached me of the existence of glaciers on some parts of the shores of Fox Basin, but as no icebergs have been seen in the basin nor any known to come out of it, should there be any land ice in that direction it does not appear to reach the sea. No glaciers, even of small size, are known to occur in Labrador, and there are probably none in southern Baffin Land or elsewhere to the west of the Grinnell glacier.

Grinnell glacier.

Codfish abundant.

In the southern part of the great island, or along the north-east side of Hudson Strait, the land is high all the way from Resolution Island to Fair Ness, the mountains near the coast rising from one to two thousand feet above the sea, but some of those which I saw in the interior at a distance of about one hundred miles north eastward of Fair Ness, appeared to be much higher and were capped with snow. The prominent point just named marks the termination of the outer high range on the north side of the strait and behind it is Markham Bay, with a breadth of fifteen miles. On the north side of this bay the land becomes much lower and, except in a few places, it continues so to beyond Chorkbak Inlet, but as we approach the vicinity of Kings Cape, or Sik-o-su-liat, the height again becomes a thousand feet or more. The Eskimos informed me that the high and rugged land, (Laurentian) of this promontory, continued northward up the east side of Fox Basin to the Koukdjuax River, which flows out of Lake Nettilling. Beyond this the shore of Fox Basin becomes low and flat for a considerable distance. This condition, as elsewhere explained, is

Character of coast.

believed to be due to the presence of beds of Silurian limestones lying almost horizontally.

Lakes.

Two great lakes.

Judging from what I saw of the interior of Baffin Land on my journey to Lake Amadjuak and on my return by a somewhat different route, the mountains are everywhere interspersed with lakes. Two of them are known to be of great size. Lake Nettilling is propably about 140 English statute miles in length, by 60 in breadth. Lake Amadjuak may exceed 120 miles in length by 40 in breadth in its central part, so that their united area must be very considerable. The greater diameter of each of these lakes lies north-west and south-east, or parallel to the mountain ranges.

Lake Mingo.

Lake Mingo, whose outlines and dimensions were sketched by the aid of numerous bearings and estimated distances, has a somewhat rounded or compact form and is at least 15 miles in diameter. It lies close to the south-western side of Lake Amadjuak and discharges into it by a very short river, which the Eskimos informed me has only a moderate current, adding that they paddle through it either up or down stream in their kyaks. I would therefore assume that the difference of level between these lakes does not exceed ten feet. Lake Mingo was found by barometer to be just 300 feet above the level of the sea, so that the elevation of Lake Amadjuak will be about 290 feet.

Koukdjuax River.

The natives, including my guide, who have seen the Koukdjuax River, which discharges this lake into Fox Basin, with a course of some fifty or sixty miles from its western bay, describe it as a very large stream with numerous rapids. This is only what might be expected, since the rate of descent is probably five or six feet per mile. Various reports reached me of a large lake lying not far from the head of Frobisher Bay, but these may refer to Lake Amadjuak, which extends in that direction. The lakes, of which sketches were made on my journey from Amadjuak Bay to Lake Mingo, are shown on the accompanying map, and they will be referred to further on in describing the geology of the routes followed in going and returning.

Origin of Hudson Strait.

Fox Channel or the southern part of Fox Basin is a continuation of Hudson Strait, and the deep submerged valley in which they lie has a straight north-westerly course of 700 miles. Hudson Bay is comparatively shallow.

Soundings.

The bottom is very even and from 70 to 100 fathoms in depth over great areas. Its outlet falls, at right angles,

into the channel of Hudson Strait, in which the soundings range from 200 to upwards of 300 fathoms. The origin of the straight and deep depression in which Hudson Strait and Fox Channel lie, is probably of very ancient geological date. In the great Archæan regions of northern Canada, I have elsewhere shown that the long straight channels of numerous narrow lakes and direct river courses are due to erosion commenced along decomposing dykes of igneous rocks, and that the depressions so formed have, in some cases, been subsequently enlarged from time to time by denudation. Sometimes a group of dykes or fissures produces the same effect as a single dyke. The depression of Hudson Strait and Fox Channel may have originated in this way. My first published suggestion of this is contained in a paper on Glacial Phenomena in Canada, printed in vol. I. of the Bulletin of the Geological Society of America, 1880, p. 300.

Ancient origin

Erosion along dykes.

In preglacial times, when the northern portion of the continent was elevated considerably above its present level, this valley was situated on the dry land probably as far down as the existing general line of the Atlantic coast, as its depth increases from north west to south-east or from the interior towards the ocean, and the ice-sheets of the glacial period moved from the high land on both sides directly towards and into it and then down the valley itself, as shown by the striation and the materials of the drift. The few soundings which have been taken eastward of the mouth of the strait would seem to show that its channel continues outward in the same direction, in the bottom of the sea, with comparatively shallow water immediately south of it. This latter section is overlooked by the mountains running in that direction from Cape Chidley. A preglacial river, exceeding in size any of those at present existing in North America and whose branches traversed the dry bed of Hudson Bay, coming together in its north-eastern part, probably flowed down this valley into the Atlantic.*

Direction of movement of ancient glaciers.

Geology of Baffin Land.

In the course of the voyage of the Canadian Government expedition steamer *Neptune* in 1884, and of the *Alert*, sent out on similar service in 1885, I made some notes on the geology of the northern side of Hudson Strait, principally in reference to Big Island and its vicinity.† The results of the work of 1897, embodied in the present report, and which are supplemented by the notes just mentioned, constitute the

Sources of geological information.

* On a Great Preglacial River in Northern Canada. Scottish Geographical Magazine. Volume XI., 1895, p. 368.

† Report of Progress, Geol. Surv. Can., 1882-84, pp. 1-62 DD, and Annual Report Geol. Surv. Can., vol. I. (N.S.) 1885, pp. 1-25 DD.

principal knowledge of the geology of Baffin Land available up to the present time. In Dr. Franz Boas's general description of this great island,* based on his own observations after a residence there of two years, a few notes are given in regard to the geology of some of its northern parts and of the region of its great lakes, which I shall quote, together with a few observations made by others, before proceeding to give the results of my own investigations in the southern part of the island in 1897.

Silliman's Fossil Mount.

A very small outlier of nearly horizontal beds of fossiliferous limestone, shale and marl occurs at the head of Frobisher Bay, in the form of a crumbling hill, resting on the northern flank of the Laurentian range on its south western side. It was discovered by Captain C. F. Hall and named by him Silliman's Fossil Mount.† Collections of fossils from this hill have been made by different persons. These have all been examined by Mr. Charles Schuchert and reported on by him in a paper on The Lower Silurian (Trenton) Fauna of Baffin Land, in which he gives lists of all the species.‡ They correspond with those which I obtained on Akpatok Island, determined by Dr. Whiteaves§ and Mr. Schuchert considers the rocks of both localities to belong to the Galena division of the Trenton group which also occurs on the lower part of the Nelson River, as well as at Stony Mountain and on the west side of Lake Winnipeg in Manitoba. Silliman's Fossil Mount is described as being in latitude 63° 44', longitude 68° 56' W., or three miles south of the (mouth of) Jordan River and one mile from tide water. It has a length of 1,000 yards from north-west to south-east, and was ascertained by Mr. R. W. Porter to be 340 feet in height.

Before the fossiliferous limestone at the head of Frobisher Bay was known to be confined to this hill, it was supposed by Dr. Franz Boas, that it might be an extension of the flat-lying limestone of the basin of lakes Amadjuak and Nettilling. It appears now, however, this is not only not connected with the latter, but, judging from the loose pieces which I found in abundance not far from the south side of the former lake, the rocks of the lake region are more probably of middle Silurian age. In 1885, I collected fragments of shaly marl and gray limestone containing fossils of the Trenton group on the surface of ice pans off Big Island. It was thought at the time that these might have come from Trenton beds in some of the bays on the north side of

* Dr. A. Petermanns Mitteilungen, Erganzungsheft, Nr. 80, November 1885.

† Narrative of the second Arctic Expedition by C. F. Hall, Washington, 1879. Appendix III., on the Geology of Frobisher Bay.

‡ Proceedings of the U.S. National Museum, Vol. XXII., pp. 143-177, No. 1192.

§ Am. Journ. Sci., 4th series, vol. VII. (1899) p. 433.

R. Bell, Photo., 1897.

NEAR BRUCE HARBOUR, LOOKING EAST

Showing characteristic coast scenery

the strait, but the examination of these bays in 1897 proved that no fossiliferous limestone *in situ* occurs there. The fragments referred to corresponded in character with the Trenton marl and limestone of Silliman's Fossil Mount. A good sized stream is described as running through and cutting off a portion of the mount, and this probably carries quantities of marl and limestone débris out upon the shore-ice in spring. As above mentioned, the small icebergs from Pak-a-lui-a on the south-west side of Frobisher Bay, are known by the Eskimos to float from thence through Gabriel Strait, and up the north-east side of Hudson Strait, and the shore-ice, when loosened, would naturally follow the same course. The above facts, taken together, would fully account for the presence of the Trenton fragments on the surface of ice-pans on the northern side of Hudson Strait.

Limestone of Fox Basin.

The scanty information we possess goes to show that Fox Basin is partly bordered on both sides by comparatively low land occupied by undisturbed fossiliferous Silurian limestone. Dr. Franz Boas ascertained the existence of these limestones on Lake Nettilling and he states that southward of the lake they rise into low hill-ranges. He also says: 'We will not be far astray if we connect this extensive Silurian district with the limestones which occur to the south of Igluling and which form the flat eastern half of Melville Peninsula.' Referring to those limestones in a letter to me in 1885, he says: 'The most interesting geological problem of the country is a study of the line of division between the Silurian plains and the eastern highlands. I suppose the Silurian rocks will be found either in the remotest corner of White Bear Sound, or close to it. Probably the strata will be found lying horizontally and then soundings in the lakes Amadjuak and Nettilling will be of great importance. It must be important for the problems of glaciation to survey the *inner* rim of the enormous basin formed by the chain of mountains of Davis Strait, the plateaus of Nugumit, Kingnait, Sikosuilat, Southampton Islands and Melville Peninsula.'

Southampton Island.

Limestones like those of the east and west shores of Fox Basin appear to occur also on the northern side of Southampton Island. I have obtained Devonian fossils from the limestone of the southern side of this large island. A high backbone of Laurentian rocks appears to run through its central part. Fox Basin therefore seems to lie in the middle of a very extensive flat trough of horizontal fossiliferous Silurian limestone, surrounded in a general way on all sides by high Laurentian hills. The Eskimo guide who accompanied me to Lake Amadjuak in 1897, informed me that he had passed round the

Lakes Amadjuak and Nettilling.

western end of the lake and had visited Lake Nettilling. This latter name means 'flat-floor,' and my guide said that flat-lying beds of rock similar to those around Nettilling extend to Lake Amadjuak, as well as to Fox Basin. The fossils which I collected from the horizontal limestones of Mansfield Island in 1884 indicate the Niagara formation,

Niagara formation.

while those occurring in the drift fragments of limestone of similar colour and character, which are abundant for a short distance southward of Lake Amadjuak, belong to the same formation. It is, therefore, probable that the great limestone trough of Fox Basin is chiefly, if not altogether, of Silurian age.

Northern Baffin Land.

Referring to the northern parts of Baffin Land, Dr. Franz Boas says: * 'Let us in conclusion cast a glance on the geological structure of the last mentioned territory [the northern part of Baffin Land]. The nucleus of the mountain masses appears to be everywhere gneiss, which I found especially at Kingnait and Panguirtung. In closest combination with the gneiss, granite also occurs, which especially large-grained, appears in the coast ranges and islands, Anarmtung and Newakdjuak in Cumberland Sound; Padloping, Kexertaxdjuin, Nudlung, Tupirbikdjowitjung and Siorartijung on Davis Strait.'

Cumberland Sound.

'In Cumberland Sound, as well as in the Naguimiut plateau, which latter is mostly composed of fine-grained granites, there are found at isolated places, diorites and trap-granulites which have broken through the granite. The occurrence of these to the south on Blunt Peninsula has been confirmed. In Cumberland Sound I found them at Panguirtung, and in a well-marked dyke in Akuliaxling eastward from Kexerten. The same diorite appears also in the mountain Kalingujang to the east of Kingnait.'

Other localities.

'The Silurian limestones overlying the old crystalline rocks, have been already mentioned. The same are found besides in [Cyrus] Field Bay, and they compose nearly the whole northern coast of Baffinland. Hall found sandstone at Lok's Land, which perhaps belongs to the Carboniferous formation. It is said to resemble that found by Parry at Antridge Bay [Fury and Hecla Strait.] Here may also be mentioned the samples of sandstone found by Bessels at Point Garry. From accounts by Captain Walker, of the ship Erik, coal is found in loose boulders in a stream at Eclipse Sound and on Aggidjeu [Durban Island.]'

Rocks of the east coast of Baffin Land.

In the Quarterly Journal of the Geological Society of London, vol. ix., 1853, p. 299, there is a note by Dr. P. C. Sutherland, on the

* Dr. A. Petermanns Mitteilungen Ergänzungsheft Nr. 80, Gotha, Nov., 1885, page 57.

geology of the eastern side of Baffin Land, in which he says the crystalline rocks occupy the whole coast from Cape Walter Bathurst, on the south side of Lancaster Sound to Cumberland Sound, and probably considerably beyond it, and adds: 'To this I believe there is one exception at Cape Durban, on the 67th parallel, where coal has been found by the whalers; and also at Kingnait, two degrees to the south-west of Durban, where, from the appearance of the land as viewed from a distance, trap may be said to occur on both sides of the inlet. Graphite is found abundant and pure, in several islands situate on the 65th parallel of latitude in Cumberland Strait [Sound] and on the west side of Davis Strait.'

Rocks from Cumberland Sound.

In November, 1887, Dr. Franz Boas sent me a small collection of rock-specimens* from the island of Umanaktuak and vicinity on the south-west coast of Cumberland Sound, all believed to have been taken from the rock *in situ*, with the exception of one specimen, which was from a boulder in the bed of a torrent at this island and consisted of 'compact limestone, almost black and somewhat argillaceous. It weathers dark-gray, and shows on the surface slightly projecting fine parallel lines of stratification from one-quarter to one-half inch apart. No trace of fossils can be detected either by inspection or microscopic sections. Under the microscope it is seen to consist of gray, rounded, fine calcareous grains with a few black ones, all apparently deposited from water.†' The other specimens in this collection included the following: 'graphite with rusty surfaces and holding drusy white quartz; a decomposing black crystalline rock, which on microscopic examination, proves to consist of graphite with hornblende, a triclinic felspar and a little quartz; hornblendic gneiss of a rather coarse "pepper-and-salt" appearance consisting of about equal parts of quartz and felspar forming the white portion and of black hornblende with smaller quantities of brown mica, the black; light-gray gneiss of medium texture, composed of about equal parts of orthoclase and quartz, with a subordinate portion of fine scales of black mica; gray gneiss, consisting of layers of mixed orthoclase and quartz, alternating with others composed of scales of brown mica; rusty mica-shist of medium texture, the quartz in small proportions; a very light-coloured variety of granite, apparently from a small vein.' There was also a specimen of foliated graphite with rusty surfaces and partings which had been found by an Eskimo about forty miles inland in a south-westerly direction from Umanaktuak. In connection with my exam-

* Science, vol. X., Dec., 1887, p. 287.

† This would correspond with the rock holding Utica fossils from Frobisher Bay, (noticed further on) as described to me by Professor B. K. Emerson.

ination of this collection, I stated that: 'These specimens indicate the ordinary Laurentian system of much the same character as on the north side of Hudson Strait, where the rocks appear to be allied to those of the lower Ottawa valley, and to be somewhat newer and more modified than the great mass of the Laurentian in the Hudson Bay territories.' My exploration of 1897 amply confirmed this determination of the horizon of the rocks of the north side of Hudson Strait.

Graphite.

On the occasion of the visit of the *Diana* to the whaling station called Black Lead in Cumberland Sound in 1897, specimens of graphite from the neighbourhood were obtained by members of our party. The occurrence of graphite in the various localities above mentioned around Cumberland Sound is interesting in connection with the abundance of the mineral at many places among the crystalline rocks on the north side of Hudson Strait and it is a fact tending to show that the rocks around that sound are also referable to the Grenville series.

Fossiliferous Rocks of Baffin Land.

Rocks from Frobisher Bay

In appendix III., to the 'Narrative of the Second Arctic Expedition made by Charles F. Hall,' (Washington, 1879,) Professor B. K. Emerson, of Amherst College, who examined the geological specimens brought by Hall from Frobisher Bay, enumerates granite, mica-schist, different gneisses, also crystalline limestone, magnetite, apatite, bornite and pyrite. He informs me that the specimens of crystalline limestone appeared to be loose pieces which had been picked up on the shore. They may have been carried from the interior to the bay by the ancient land ice coming from either side of the bay or down the valleys terminating at its head. In any case they indicate an extension in this direction of the crystalline limestones such as I found in great force along the north side of Hudson Strait.

Utica formation.

Silliman's Fossil Mount at the head of Frobisher Bay, already described, was so named by Captain Hall, who also brought Utica and Trenton fossils from localities to the eastward of the Mount and from the north shore of Frobisher Bay. These have been reported upon by Professor Emerson in the above mentioned narrative of Hall's expedition. Small collections of fossils have been brought since Hall's time from Silliman's Fossil Mount by various collectors. All of these, as well as the Amherst College collection, have been lately critically examined and reported on by Professor Charles Schuchert, of the United States National Museum.* In the last-named collection he finds seven distinctly Utica species in a 'flinty bituminous limestone,'

Fossils examined by Prof. Schuchert.

* On the Lower Silurian (Trenton) Fauna of Baffin Land. Proceeding of the U.S. National Museum, vol XXII., pp. 143-177. With plates XII-XIV.

which Prof. Emerson informs me weathers gray. The locality where these were collected is supposed to be Jones Cape in Frobisher Bay. Hall's collection also contains thirteen Trenton species from Cape Stevens (?) in the same bay. Prof. Schuchert's lists show that 72 species of fossils are now known from Silliman's Fossil Mount and that 28 of these are not known to occur elsewhere. The majority of all the species, or 57 per cent, correspond with those of the Galena or Trenton formation of the Minnesota and Manitoba region, while 17 are known to occur in the Trenton of the Ottawa valley and the State of New York. About 20 of the species are new to palæontology and most of these are described and figured in Prof. Schuchert's paper. He adds: 'The lithological similarities of the Minnesota Galena and Silliman's Fossil Mount, light-coloured shales predominating in both areas, may explain in a large measure the close identity of these widely separated faunas. This little fauna likewise brings out the fact that the corals, brachiopods, gasteropods and the trilobites are slow in their evolutional change, and the species can therefore spread over very large areas, while the cephalopods, and particularly the pelecypods, are more sensitive to change and are thus restricted to localities.... The Baffin Land fauna had an early introduction of Upper Silurian genera in the corals, *Halysites*, *Lyellia*, and *Plasmopora*. In Manitoba similar conditions occur in the presence of *Halysites*, *Favosites* and *Diphyphyllum*. Other Upper Silurian types do not appear to be present.'

Galena formation.

In Minnesota.

The Rev. Edmund Peck, a missionary in Cumberland Sound, obtained from the drift at Lake Kennedy (Nettilling) four species of fossils which may be considered as of Trenton age. They are probably from the eastern extremity of this large lake, which lies close to Cumberland Sound, and if the Trenton occurs *in situ* in that region, it is probably overlain by the Niagara towards the west end of the lake, since that formation would appear to occur there (see ante). Among the Arctic islands northward of Baffin Land large areas of Upper Silurian rocks are known to occur associated with strata of Lower Silurian age.

Fossils from Lake Nettilling.

Laurentian of the North side of Hudson Strait.

The rocks of the northern side of Hudson Strait examined by myself from North Bay to Chorkback Inlet and inland to Lake Mingo consist of well stratified hornblende- and mica-gneiss, mostly gray in colour, but sometimes reddish, interstratified with great bands of crystalline limestones, parallel to one another and conformable to the strike of the gneiss, which in a general way may be said to be parallel to the coast in the above distance. The direction, however, varies

General character of the rocks.

Strikes along the coast.

somewhat in different sections of the coast. On either side of North Bay it appears to converge to a central line running south-south-eastward. From the south-east point of Big Island to Fair Ness the strike is parallel to the shore or about N. 60° W. From Fair Ness to Edmund Bay on the mainland, 25 miles farther to the northward, the direction inclined a little more easterly or inland, being about north-northwest. Here an anticline or a line along which the strike changes, appears to run inland in a north-easterly direction and from this line to the east side of Amadjuak Bay the general strike is about west. Beyond Amadjuak Bay, as far as we went, the strike was pretty uniformly parallel to the trend of the coast or about N. 60° W.

Strikes in the interior.

In going inland from Amadjuak Bay to Lake Mingo, the strike which was at first about north-west gradually changed to about west, which it maintained for the greater part of the distance. A list is given further on showing the direction and amount of the dip together with the character of the rocks in a large number of places along the coast and inland to the north of Amadjuak Bay. It will be seen from this list that except when the strata are vertical, the dip is uniformly to the inland or northward side, except in one part of Markham Bay, and at Macdonald and Rawson islands, where it is in the opposite direction. The character of the rocks being given in each instance in this list no further remarks about them are required. In some instances where the dip was vertical as nearly as could be judged by the eye it is here given as 90°.

Dips of Laurentian Strata, North Side of Hudson Strait. (Astronomical Bearings.) Localities Arranged from South-east to North-west.

Dips of Laurentian strata.

1. West side of Glasgow Island in North Bay. Crystalline limestone and gray gneiss..... N 34° E < 45°
2. Bruce Harbour, opposite east point of Big Island. Gray gneiss with rusty bands..... N 16° W < 20° to 60°
3. Prominent hill on east side, Bruce Harbour. Gray gneiss..... N 16° E < 35°
4. Twimi Islands, in mid-channel between east point of Big Island and Bruce Harbour. Fine-grain reddish gray gneiss. N 40° E < 45°
5. Middle of north-east side of Big Island. Gray gneiss..... N 34° E 45°
6. East side Reeves Harbour. Gray gneiss..... N 10° W 90°
7. North-west side, Reeves Harbour. Gray gneiss..... N 10° to 50° E < 20° to 30°
8. North-east side Ashe Inlet. Dark gray gneiss rather finely ribboned with lighter streaks..... N 10° E 30°
9. East side Ashe Inlet. Gray micaceous gneiss..... N 45° E Mod'te
10. East side Ashe Inlet, 1 mile north-west of Station. Gray gneiss..... N about 25°
11. West side Ashe Inlet. Dark gray gneiss, composed of quartz and felspar in even beds (Rept. G. S. 1884, p 21 DD)..... N < 40°
12. East side North Bluff. Dark gray gneiss..... N low
13. West side North Bluff. Dark gray gneiss..... N 30° W < 10° to 20°

14. Group of islands 9 miles north of North Bluff. Reddish gray gneiss ..... N 56° W < 80° — Dips of Laurentian strata.
15. Main shore of Big Island 8 miles north of North Bluff. Red and gray gneiss. Disturbed. Average dip ..... N 30° W < high
16. The same. 10 miles north of North Bluff. Banded gray and red gneiss ..... N 10° W < 75°
17. North-east side Big Island near its north-west point. Gneiss and crystalline limestone ..... N 34° E < 40
18. Central part of Big Island. Common varieties of gray gneiss. (Rept. Geol. Survey, 1884, p. 21 DD.) General dip ..... N
19. Beaumont Harbour. (Opposite N. W. point of Big Island.) Light-gray crystalline limestone and red-weathering gray gneiss ..... } N 27° E < at diff't places 15° to 50
20. South point of entrance to Crooks Inlet. Rusty gneiss with white limestone ..... N 38° E < 90
21. South side Crooks Inlet, between entrance and a point midway up. Brown-weathering or rusty gneiss and light gray crystalline limestone. Average dip ..... N 40° E < 30
22. South side and upper half of same inlet. Gray fissile gneiss, stained reddish brown, but with yellow patches and associated with several thick bands of crystalline light colored limestone ..... } N 33° E Average < 45
23. Large promontory of north side of same inlet. White crystalline limestone ..... N 28° E < 30 to 45
24. 2 miles inland (N.) from head of same inlet. Gray gneiss ..... N 30° E < 90
25. 3 miles inland from, Do. Gray gneiss ..... N 23° E < 50
26. Bay opposite east end Strathcona Islands. White crystalline limestone and dark hornblendic gneiss ..... N 14° E < 25
27. Promontory at Red Islands, opposite middle of Strathcona Islands. Rusty gray gneiss with crystalline limestone ..... } N 14° E to N 34° E < 45
28. Island off south-east point of Glencoe Island. Gray gneiss. N 14° E < 30
29. Mainland opposite east end Glencoe Island. Rusty decomposing micaceous gneiss, also crystalline limestone ..... N 24° E < 25
30. Mainland, opposite west end of Glencoe Island. Gray gneiss. N 14° E < 25
31. Wharton Harbour. Great band of white crystalline limestone running E.S.E. up a valley ..... N 24° E < 60
32. Spicer Island. Light-gray quartzose gneiss, some of it holding light purple garnets ..... N 21° E < 90
33. Entrance to Akuling Inlet. Gray gneiss ..... 24° E < 60 to 80
34. West side Akuling Inlet. Gray gneiss ..... N 29° E < 60
35. First point south of Bedford Harbour. Gray gneiss ..... N 31° E < 45 to 60
36. Cape Montrose, Markham Bay. Gray gneiss ..... N 31° E < 45
37. Between Bedford Harbour and Fair Ness. Gneiss and limestone streaked with red ..... N 34° E < 45 to 60
38. East side of Bedford Harbour. Gray gneiss ..... N 34° E < 60
39. West side Bedford Harbour. Bedded felspar and quartz rock, with red rusty streaks ..... N 14° E < 75
40. Beds of white crystalline limestone and felspar alternating with gneiss or schist, weathering rusty red ..... } N 34° E < 40° to 70
41. Ta-muck-ta-may (or south bight of Markham Bay). Gneiss interstratified with crystalline limestone ..... N 30 to 40° E < 45
42. Around Blandford Bay. Crystalline limestones and associated red-weathering rocks ..... } N 35° E about 40
43. Near Point Robert, Markham Bay. Gneiss and crystalline limestone ..... } S 80° W Average < 45

Dips of Laurentian rocks.

44. Albert Bay, near centre of Markham Bay. Gray gneiss with white beds (limestones?) . . . S 80 W < 80
45. Island between Albert and Lubbock Bays. Gneiss and light gray limestone, much oxidized S 81 W < 80
46. Long Island at entrance of Lubbock Bay. Grey gneiss containing much light purple garnet as disseminated crystals. N 50 E < 90
47. Head of Lubbock Bay. Medium and fine-grained massive gray gneiss, hummocky and much oxidized . . N 14 E < 90
48. Northeastern of the Islands of God's Mercie. Gray gneiss. N 10 W < 45
49. Peck Island in Edmund Bay. (Next west of white Bear Bay.) Rather fine-grained light gray quartzose gneiss N 1 W 90
50. Point opposite (N.E. of) Macdonald Island. Gray gneiss N 10 W < 90
51. Macdonald Island. Gray gneiss. S 10 E < 25
52. Small island 5 miles north of Macdonald Island. Light reddish gray gneiss . . S 84 W 30
53. Top of knob 450 feet high at mouth of Alice River. Gray gneiss. N 34 E 90
54. Rawson (Harbour) Island. Gray gneiss N 6 W variable and high
55. Island 13 miles S.W. of Rawson Island. Gray gneiss. . S 17 W 70
56. Fairfax Harbour, near Tilted Hat Mountain. Gray gneiss. N 14 E 65
57. Geikie Point, near Chorkbuck Inlet. Gray gneiss. . . . N 34 E 60
58. Around Fort DeBoucherville on southern point of Nottingham Island. Gray and reddish gneiss. (Rept. Geol. Survey, for 1884, p. 28, DD.) Average dips . . N 45 W high

Between Amadjuak Bay and Lake Amadjuak.

59. Gertrude Lake, midway up. Gray gneiss . . . . N 80 E 90
60. Head of Gertrude Lake. Band of light crystalline limestone and felspar about 1000 feet thick immediately overlying rusty gneiss . . . . N 54 E 80
61. Orton Lake. White limestone. Local dip. . . N 12 E 70
62. White-streak Mountain, part of Franz Boas Lake. Band of white limestone of great thickness. General dip . N 56 E < 90
63. Foot of Greedy Lake. Gray gneiss N 19 E < high
64. East side Greedy Lake, opposite Boulder River. Gray gneiss. N 14 E < high
65. Portage between Stevenson and Gilbert Lakes. Gray gneiss N 11 W < 90
66. Between Gilbert and Walcott Lakes. Gray gneiss. General dip N 31 to 64 E < high

It will be seen from the above list that the dip is often vertical or nearly so and that in the great majority of cases it is inland or northward, being in the opposite direction at only two localities.

Crystalline Limestones.

The distinguishing feature in the geology of the southern part of Baffin Land is the great abundance, thickness and regularity of the limestones associated with the gneisses. At least ten immense bands, as shown on the accompanying map, were recognized, and it is probable that the two others, discovered in North Bay, are distinct from any

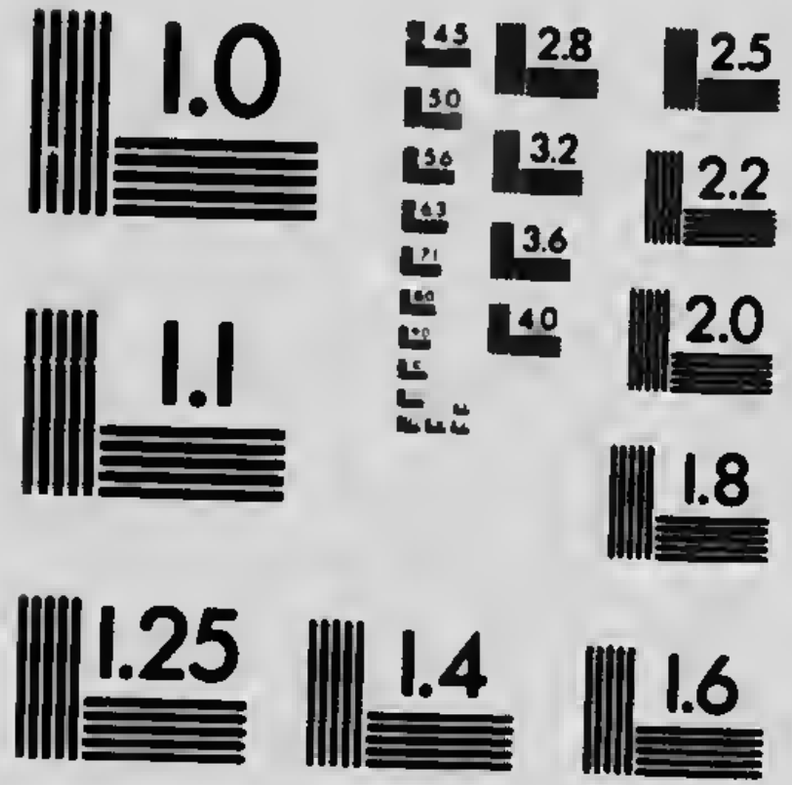
R. Bell, Photo., 1897.

FORKED FALL AT THE HEAD OF CANYON INLET, 468 FEET HIGH.

Crumbling white crystalline limestone on the left.

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



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of these. There would, therefore, appear to be twelve principal bands as far as known, to say nothing of numerous minor ones, between Icy Cape and Chorkback Inlet. The limestones are, for the most part, nearly white, coarsely crystalline and mixed with whitish felspars The individual crystals in some parts of the limestone masses would measure two or three inches in diameter and the crystallization of the felspar is occasionally equally coarse. The latter is generally somewhat irregularly disseminated, but sometimes it has a sort of parallelism with the bedding, although seldom entirely unmixed with the limestone. The limestones usually contain scattered grains of graphite and among the other minerals which commonly occur in the various bands are mica, garnet, magnetite, pyrite and hornblende. Serpentine of a dark colour was abundantly disseminated as grains and small irregular masses in a band which crosses the head of Cañon Inlet. Disseminated specks of bright green and blue serpentine were found in another band at White Bluff Harbour and similar specks of both colours occur in the eastern band at the head of North Bay The late Mr. Ashe gave me a crystal of sphene, an inch and a half in diameter, which had been brought to him by an Eskimo from North Bay—probably obtained from the limestone there.

Twelve bands.

Associated felspars.

Included minerals.

Although white is the prevailing colour of these limestones, this, in some localities is replaced by light-gray and occasionally by mottled varieties. The coarsely crystalline band which forms the (three small) Red Islands, opposite the Strathcona Islands, has a uniformly salmon-red or flesh colour. Some handsomely variegated kinds are to be found on the point just west of Glasgow Island in North Bay.

Colour.

The limestone bands have not suffered greater denudation than the gneisses, and they form hill and dale alternately with the latter. It is not easy to fully explain why the limestones have not been more deeply eroded than the gneisses, as is the case with the limestone bands in the counties of Ottawa, Labelle and Argenteuil on the north side of the Ottawa River, but the difference may be due partly to the limestone being more solid or having fewer joints and fissures than the gneisses, thus preventing the entrance of the surface waters which caused deeper decay in the latter during preglacial times, and partly to the fact that the dip is inland or northward from the strait, or directly towards the advance movement of the ice, and that this circumstance would shield every band from its denuding action. On the other hand, in the lower Ottawa region, just referred to, the run of the limestone bands corresponds to the direction of the glaciation and this has

No special erosion of the limestones.

Possible reasons.

favoured the wearing out of the valleys by the movement of the ice and its accompanying rock-débris.

Limestones are conspicuous.

Owing to the scantiness of the vegetation in Baffin Land, the white colour of the limestones on the sides and tops of the hills and ridges renders them very conspicuous in the landscape. Seen from a hill-top at a distance of fifteen or twenty miles they might be mistaken for glaciers. The débris of the decomposing limestones forms crumbling slopes resembling coarse salt on a grand scale. Among the localities where these limestone bands are well exposed, may be mentioned the head of North Bay, the north-east side of the upper part of Big Island and the adjacent islands as well as the mainland opposite, on both sides of Crooks Inlet, at the entrance to Cañon Inlet, on the Strathcona Islands and main shore opposite, around the northern and eastern parts of Markham Bay, at Wharton Harbour, Akuling Inlet, islands off Fair Ness, Aberdeen Bay, and along the shore southward of Amadjuak Bay; also along the route from this bay to Lake Amadjuak, at Orton Lake and White-streak Mountain at the foot of Franz Bons Lake. The high slopes about the north-western end of Big Island, were the first examples we saw of these white limestones, and at first sight we supposed the light colour to be due to snow on the hill-sides.

Localities of limestones.

Crooks Inlet.

Crooks Inlet is about twenty miles in length and it crosses the general strike at right angles. About half the total length of its shores appear to consist of crystalline limestones belonging to five different large bands. Owing to the shortness of the time at my disposal and the necessity of hastening to explore the coast to the north-westward, it was impossible for me to measure the width of these bands, but as the dips were at considerable angles and always in the same direction, (north-eastward), it was estimated that their total thickness may be 20,000 feet, if not more. The wide and conspicuous bed of coarsely crystalline whitish limestone and felspar, which runs from Wharton Harbour east-southeastward up a valley, afforded a better opportunity for estimating the thickness than any of the other bands we saw. It appeared to have a horizontal width of a mile and a quarter, or 6,600 feet. The dip is northward at an angle of about 60 and hence the bed would have a thickness of about 5,700 feet at right angles to the stratification.

Thickness.

As to the total thickness of the twelve bands of crystalline limestone which have been mentioned as occurring in this part of Baffin Land, the available data on the subject are not sufficient to form a correct estimate, but on adding together their probable approximate widths it seems to be no exaggeration to place their possible total volume, great

Total volume.

as it may appear, at about 30,000 feet, or an average of 2,500 feet for each of the principal bands, taking no account at all of the smaller ones.

Sedimentary origin.

It was stated in my summary report on the geology of this region that the series of rocks under consideration, including the limestones, seems to be made up of altered sediments. The enormous thickness, great length and regularity of the limestone bands would show that they have been precipitated evenly on the level bottom of the primeval ocean, and further that the sea must have been deep and the conditions uniform for great lengths of time. At the period when the limestones were formed, the temperature and the composition of the sea were no doubt very different from what they have been in the later geological times, and the precipitation of such vast quantities of carbonate of lime may have been due to such causes as the mingling of ocean currents with slight differences in the composition of their waters, the ebullition of gases from the bottom, or possibly from some change in the temperature of that part of the sea.

Concretionary action.

Thin, short and uneven layers of limestone consisting of lenticular and nodular forms along a certain plane in the stratification of large masses of crystalline rocks containing lime, may have been formed by concretionary action during or subsequent to consolidation, but in the present case, apart from the above reasons, the bands are too thick in proportion to the interstratified rocks to favour such an hypothesis, even if the minerals entering into the composition of the gneiss contained any considerable amount of lime in any form, which they do not.

South-east extension of limestones.

The ten large and parallel bands of limestone which have been described, in their extension to the south-eastward, probably continue to curve to the southward, eventually coming out upon the shore of the strait at various places between North Bay and the Middle Savage islands. In 1884, while seeking for a suitable place at which to establish an observatory station, the expedition steamer *Neptune* coasted as near as possible to the land, from the Middle Savage islands to Cape Best or Hattons Headland and we went ashore at some points. I had then an opportunity of seeing that the rocks in this interval of coast were Laurentian gneisses which showed considerable regularity in their stratification. It has been already mentioned that among Captain C. F. Hall's specimens from Frobisher Bay, crystalline limestone and apatite occur, and although these were probably picked up as loose fragments, they indicate the occurrence of these minerals *in situ* within the watershed of this bay and they are further evidence

Crystalline limestone at Frobisher Bay.

of the extensive development of the Grenville series in the southern part of Baffin Land.

Associated rocks.

The limestones are constantly associated with rocks which, in the fresh state, seem to consist of thinly laminated micaceous and graphitic gneiss, but which upon the surface generally appear as decomposed reddish brown ochrey masses with yellowish patches, the whole being the result of the action of the weather upon the pyrite which is abundantly disseminated throughout these strata. The hills formed of such rocks adjoining the limestone bands often look like great heaps of brownish ochre. By digging through the soft oxidized surface the partially decomposed pyritiferous rock containing much graphite can generally be reached at the depth of a few feet. Boulders are usually absent from these hills. The crystalline limestones of the Grenville series on both sides of the Ottawa River have decomposable rocks like the above associated with them and this constitutes an interesting resemblance pointing to a correspondence in age of the two sets of rocks. I have no doubt that a more detailed examination of the Baffin Land series would bring out other points of resemblance tending to prove their contemporaneity. If this were established it would be of great importance, since the rocks of the Grenville series are known to be elsewhere productive of a variety of economic minerals.

Ochrey covering.

Surface Geology.

Erratics.

In the portion of Baffin Land explored by myself, there is abundant evidence of the former existence of land-ice in the form of till and rounded and angular erratics. The latter are generally, but not universally, scattered in great numbers upon the surface of the rocks alike on the hills and lowest grounds. The rounded boulders are often thrown together in immense quantities, without any admixture of finer material, in the shape of ridges and heaps like small hills, especially along the sides and towards the bottoms of valleys. In some cases, as at Boulder River, Stevenson Lake, they are spread evenly and continuously over many acres, completely concealing the rock or ground beneath. They may generally be seen conspicuously perched on the flanks and tops of hills and on the brinks of precipices. Frequently they are gathered into groups in a variety of situations. With few exceptions the boulders at any place throughout the country consist of gneisses like those of the surrounding district and they have probably not been transported any great distance. Very large boulders are not common and few of extraordinary size were seen.

How they occur.

Osars.

Osars or dry heaps and ridges of sand and gravel without boulders

R. Bell, Photo., 1897.

LOOKING DOWN CANYON INLET FROM ITS HEAD.
A heap of glacial debris in foreground.

or even large stones were seen at several places on my journey to Lake Amadjuak, especially about the northern part of Stevenson Lake and west of Gilbert Lake. The till was nearly always much oxidized and it partook of a gravelly and sandy rather than a clayey character in the great majority of cases. It was present in considerable quantities at the head of inlets and on the slopes or the bottoms of most of the valleys examined. On our tramp to and from Lake Amadjuak we walked most of the way along the bottoms and sides of valleys, and here one of the characteristic features was the frequency with which our course was crossed by rivulets of perfectly transparent icy water, gurgling over stony bottoms in narrow channels cut through the till. Their flow appeared to be regular and constant and their supply of water seemed to be derived from the gradual thawing, during the summer weather, of the frozen ground along the numerous branches of the rivulets on the higher parts of the valley-slopes.

Till.

Many rivulets.

The general contours of the hills show that the country has been ice-swept at some period, but the other distinct signs of glaciation are not so strongly marked as they are along the eastern coast of Hudson Bay, or more particularly on the northern shores of Lakes Huron and Superior. The ochrey covering on many hills resulting from the superficial decay of certain rocks which accompany the great limestone bands has been already described. This is an evidence that these hills have not been recently glaciated. The frequent, if not general absence of boulders on such hills is an interesting circumstance in this connection. The surfaces of the gneisses exposed to the weather on the hills in various places where I went inland was considerably eroded, leaving the more resisting layers standing out several inches above the general surface.

Glaciation.

Distinct glacial striæ were seldom seen and then, as a rule, only near the level of the sea or of some lake. The bearings, in such cases as were observed, are given in the following list. In the interior, the general tendency of the striæ appears to be to follow the lowest levels towards Hudson Strait, while on the shore of the strait itself the glaciation has been south-eastward or parallel to its general course. On the southern side of the strait similar phenomena occur, that is, the glaciation runs from the interior northward to this great channel and on reaching it turns down its course towards the Atlantic. It would appear that before the advent of the glacial epoch this part of the continent stood at a considerably greater elevation above the ocean than the present, and that the bed of Hudson Strait and its continuation in the deep water of the southern part of Fox Basin, formed a straight land valley about 100 miles wide and 700 miles long, reaching

Glacial striæ.

Submerged valley of Hudson Strait.

from the Frozen Strait to the line of the present Atlantic coast of Labrador. This now submerged valley deepens as it goes towards the Atlantic, and as shown by the surroundings, its bottom is much lower than that of Hudson Bay. As I have elsewhere mentioned* the glaciation along the northern part of the present bottom of the eastern side of the latter was northward. The glacier which filled the valley now occupied by Hudson Strait would thus derive a portion of its ice from the bed of Hudson Bay.

Drift of Nottingham Island.

Before the discovery of direct evidence of the northward movement of the ice in the north-eastern part of the bed of Hudson Bay I suggested that the débris of rocks of the Manitounuck formation of the East Main Coast, which forms nearly half of the drift material on the southern part of Nottingham Island and embracing all varieties of the rocks of the series, might have come from somewhere to the west of this island†, but with our present knowledge on this subject, it appears more probable that the material has been derived from the eastern coast of Hudson Bay, as Nottingham Island would lie directly upon the course of the ice coming from this coast.

Terraces.

Wherever soft materials occur in the situations which were exposed to the action of the waves when the sea stood at relatively higher levels, or rather when the land was depressed, terraces may be seen marking periods of rest during the general uprising of the land which has been going on since the glacial epoch, and still continues. The time at my disposal did not permit of much attention being paid to this branch of the geology of the region explored, but a few facts were noted. At one mile north from the head of Crooks Inlet an ancient gravel and sand beach occurs at 360 feet above the sea, according to the barometer. A remarkable terrace with an inward semicircular curve stretches from side to side of a valley at a distance of about two miles from the shore, eastward of Glencoe Island. On a mountain side, half a mile west of Akpuk Inlet and one mile in from the entrance, old beaches or terraces, marked by gravel, sand and rounded stones occur at 378 and 528 feet above high tide as determined by the barometer. At Ta-muck-ta-may, a bay on the south side of Markham Bay, there are wide, sandy and gravelly plains behind the present sea-shore and overlooking the same small bay a remarkable set of terraces on a north-facing slope, occur at various elevations up to about 400 feet. Distinct terraces were seen at different heights around the lakes of the chain drained by Alice River, which

* On Glacial Phenomena in Canada, Bull. Geol. Soc. of Am., vol. I., 1890, p. 298. Report of Progress Geol. Surv., Can., 1882-3-4, p. 37, DD.

† Report of Progress, Geol. Surv., Can., 1882-3-4, p. 29, DD.

was followed on our way to Lake Amadjuak. In connection with this subject, Mr. Drinkwater of the *Diana* expedition, informed me that he had climbed the hills above O'Brien Harbour at Cape Chidley, and found a horizontal line of rolled stones, plainly marking a raised beach at an elevation of about 600 feet above the sea.

Pleistocene fossils.

Little could be done in the way of searching for fossils in the pleistocene deposits, but shells of *Saxicava rugosa* and *Mya truncata* were noticed in the till in a valley on the north-eastern of the Islands of God's Mercie at 200 feet from the sea, and at Lakes Gertrude and Greely *Saxicava rugosa* occurred in the drift at 110 feet above the same level in each case. At one place on the former lake the stony clay had been pushed and disturbed by ice since the shells were deposited. In all the harbours and sheltered places where we anchored we found a stiff stony clay and mud bottom at convenient depths.

Giant pot-holes.

Giant pot-holes in gneiss were observed on the west-facing slope at the east side of the narrow entrance to Cañon Inlet, of the following dimensions in the order of their occurrence from the extremity of the point southward: One between high and low tide, 8 feet in diameter; one of hollow spherical form and 15 feet in diameter, partly open at the side, whose top was 30 feet above tide; one between high and low tide, 20 feet in diameter, and one with top about 50 feet above tide, and about 18 feet in diameter

Glacial Striæ, North Side of Hudson Strait, Astronomical Bearings.

1.	Northern Inlet of North Bay	S. 27° W.
2.	Around Ashe Inlet (Rept. of Geol. Surv, 1885, p. 22, DD)	S. 65° E.
3.	Crystalline limestone ridge across entrance to Cañon Inlet, the striæ run up and over a steep slope	S. 34° W.
4.	West side Big Island, 9 miles north of North Bluff, about	S. 15° E.
5.	Entrance to Akuling Inlet	S. 57° W.
6.	North side Albert Bay, Markham Bay	S. 34° W.
7.	Amadjuak Harbour	S. 34° W.
8.	Gertrude Lake	S. 4° W.
9.	Foot of Franz Boas Lake	S. 3° W.
10.	Foot of Greely Lake	S. W.
11.	Walcott Lake	S. 59° W.
12.	Top of a mountain 1 mile S.W. of Mount Mingo and facing N.E.	S. 54° W.
13.	Rawson Harbour Island	S. 54° W.
14.	North-eastern of the Islands of God's Mercie, on vertical wall and rounded rocks	S. 44° W.
15.	Eastern sides of Islands of God's Mercie	S. 11° W.
16.	Long Island lying across entrance to Lubbock Bay, up steep slope and over the rounded ridge of the island	S. 59° W.
17.	Head of Lubbock Bay	S. 16° E to S. 24° W.
18.	Fairfax Harbour (on mainland 5 miles east of Hobart Island)	S. 54° W.
19.	North end of Jubilee Island	S. 49° W.

20. Geikie Point, near Chorkbuck Inlet..... S. 4 W.
21. Low southern extremity of Nottingham Island. Average of 20 situations around Port De Boucherville. (Rep. Geol. Survey, 1885, p. 29, DD) ..... S. 87° E.
22. In a valley at the head of Port De Boucherville. (Rep. Geol. Surv., 1885, p. 29, DD) about ..... S. 45 E.

APPENDIX I.

ASTRONOMICAL OBSERVATIONS.

LATITUDES in Baffin Land from observations by Dr. Robert Bell, in 18[illegible] used in the compilation of the accompanying map of Hudson Strait.

1.	Sun[illegible]y,	22nd August,	1897	Latitude	64° 14' 19"
2	Wednesday,	11th "	1897.	"	63° 57' 57"
3	"	18th "	1897.	"	63° 58' 07"
4	Monday,	23rd "	1897	"	63° 44' 33"
5	Saturday,	31st July,	1897	"	63° 17' 28"
6	Wednesday,	25th August,	1895	"	63° 08' 20"
7	Tuesday,	27th July,	1897		63° 00' 42"
8	Friday,	27th August,	1897.	"	62° 45' 35"
9	Friday	13th "	1897	"	61° 18' 35"
10	Saturday	14th "	1897	"	61° 25' 02"

Localities of the above Observations.

1. Point S. 4° E., 2½ miles from southwest end Diamond Island.
2 and 3.—In harbour, at head of Amadjuak Bay.
4.—Point N. 25° E., 4 miles from north end of Hector Island.
5.—On Spicer Island, 1 mile from north end.
6.—Point N. 60° W., 12 miles from northwest end Glenesse Island.
7.—Point on shore, N. 26° W., 5 miles from Cape Colmer.
8.—Point due south 1 miles from west end Emma Island.
9.—On Amadjuak Lake route, at north end of Gilbert Lake.
10. " " 1½ miles south of Mount Mingo

Longitudes in Baffin Land from observations by Dr. Robert Bell in 1897, used in the compilation of the accompanying map of Hudson Strait.

	Calculations by J. G. G. Kerry, McGill University.				Revised Results from Corrected Latitudes.		
Number.	Date.	Assumed Latitude.	Approx. Long.	Reduced Longitude.	Corrected Latitude	Long'de.	Difference with map.
	1897.						
1	Aug. 22	64° 10′	75° 00′	73° 29′ 39″	64° 06′ 10″	73° 33′ 29″	Abt. ½ mile E.
2	" 10	64° 20′	75° 30′	72° 26′ 49″	63° 50′ 22″	72° 56′ 27″	" ½ " W.
3	" 23	64° 00′	73° 00′	72° 52′ 57″	63° 49′ 23″	73° 03′ 34″	" ½ " W.
4	" 25	63° 10′	71° 00′	71° 33′ 49″	63° 00′ 11″	71° 43′ 38″	" 4½ " W.
5	" 27	62° 55′	71° 00′	70° 56′ 21″	62° 47′ 45″	71° 03′ 36″	" 5⅝ " W.

Localities of the above observations.

1.—Point N. 78° E. 3 miles from west end Chamberlain Island.
2.—Point N. 14° W. 4½ miles from north end McDougall Island.
3.—Point S. 4° W. 7½ miles from Rawson Harbour.
4.—Point S. 25° W. 3½ miles from northwest end Glencoe Islands.
5.—Point S. 28°. 2½ miles from west end of Emma Island.

APPENDIX II.

List of plants collected in Hudson Strait by Dr. Robert Bell in 1897.

The Phænerogams determined by J. M. Macoun, the Cryptogams by Prof. John Macoun.

The first column in the following list includes the species found around Prince George's Sound on the south side of Hudson Strait:

The second column the species collected in Baffin Land between Amadjuak Bay and Chorkback Inlet.

	I.	II.
Ranunculacea.		
Ranunculus nivalis, L.	*	
" pygmæus, Wahl	*	
" hyperboreus, Rottb.		*
" affinis, R. Br.		*
Papaveracea.		
Papaver alpinum, L.	*	
Cruciferæ.		
Cardamine pratensis, L.		*
" bellidifolia, Hook	*	
Draba nivalis, Lilj.	*	
" Wahlenbergii, Hartm		*
Arabis alpina, L.		*
Eutrema Edwardsii, R. Br.	*	
Caryophyllacea.		
Silene acaulis, L.	*	
Lychnis affinis, Vahl.	*	
" apetala, L.		*
Stellaria longipes, Goldie.		*
Cerastium alpinum, L.	*	*
Leguminosæ.		
Oxytropis campestris DC. var. cærulea, Koch	*	
" leucantha, Pers		*
Rosacea.		
Rubus Chamæmorus, L.	*	
Potentilla nana, Willd.	*	
Dryas integrifolia, Vahl	*	*
Saxifragacea.		
Saxifraga oppositifolia, L.	*	
" Aizoon, Jacq.		*
" cæspitosa, L.		*
" rivularis, L.		*
" cernua, L.		*
" nivalis, L.		*
" stellaris, L. var. comosa, Poir.		*
" Hirculus, L.	*	*
" tricuspidata, Retz.	*	*
" aizoides, L.		*
Onagracea.		
Epilobium latifolium, L.	*	*

	I.	II.
Compositæ.		
Erigeron uniflorus, L.	*	*
" eriocephalus, J. Vahl		*
Antennaria alpina, Gaertn.		*
Arnica alpina, Olin.	*	*
Chrysanthemum arcticum, L.		*
Artemisia borealis, Pall.		*
Taraxacum officinale, Weber. var. alpinum, Koch.	*	*
Campanulaceæ.		
Campanula uniflora, L.	*	*
Ericaceæ.		
Vaccinium uliginosum, L.	*	*
" Vitis-Idæa, L.	*	
Arctostaphylos alpina, Spreng.		
Cassiope tetragona, Don.	*	
Loiseleuria procumbens, Desv.		*
Bryanthus taxifolius, Gray.	*	*
Ledum palustre, L.	*	
Pyrola minor, L.		*
Plumbaginaceæ.		
Armeria vulgaris, Willd.	*	*
Scrophulariaceæ.		
Pedicularis Lapponica, L.	*	
" Langsdorffii, Fisch. var. lanata, Gray.		*
" hirsuta, L.	*	
" flammea, L.	*	*
Polygonaceæ.		
Polygonum viviparum, L.	*	*
Oxyria digyna, Hill.	*	*
Cupuliferæ.		
Betula glandulosa, Michx.	*	
" nana, L.	*	
Salicineæ.		
Salix arctica, R. B.		*
" glauca, L.	*	
" herbacea, L.		*
" reticulata, L.	*	*
" myrsinites, L. var. parviflora, Pursh.		*
" Uva-ursi, Pursh.		*
" Richardsoni, Hook.		*
Empetraceæ.		
Empetrum nigrum, L.		*

	I.	II.
Liliaceæ.		
Tofieldia borealis, Wahl.	*	*
Juncaceæ.		
Luzula spicata, Desv.	*	
Cyperaceæ.		
Carex misandra, R. Br.		*
" saxatilis, L.	*	*
Eriophorum Scheuzeri, Hoppe		*
Gramineæ.		
Glyceria vilfoidea, Fries	*	
Arctagrostis latifolia, Griseb		*
Hierochloa alpina, R. and S.	*	
Alopecurus alpinus, L.	*	*
Equisitaceæ.		
Equisetum arvense, L.		*
Lycopodiaceæ.		
Lycopodium Selago, L.		*
Musci.		
Ceratodon purpureus, Brid.		*
Racomitrium lanuginosum, Brid.		*
Barbula fragilis, Bruch and Schimp.		*
Amphoridium Lapponicum, Schimp.		*
Tetraplodon mnioides, Bruch and Schimp.		*
Webera nutans, Hedw.		*
Bryum arcticum, Bruch and Schimp.		*
Aulacomnium palustre, Schwaer.		*
Lichens.		
Cetraria islandica, (L.) Ach.		*
" nivalis, (L.) Ach.		*
Alectoria jubata var. chalybæiformis, Ach.		*
" ochroleuca var. rigida, Fr.		*
Umbilicaria proboscidea, (L.)		*
" hyperborea, Hoffm.		*
Peltigera aphthosa, (L.) Hoffm.		*
Solorina crocea, (L.) Ach.	*	
Placodium vitellinum (Ehrh.)		*
Placodium elegans (Link.) DC.		
Lecanora pallescens, (L.) Schær.		*
Pertusaria glomerata, (Ach.) Schær.		*
Stereocaulon paschale, (L.) Fr.		
" condensatum, Hoffm.		*
Cladonia rangiferina var. sylvatica, L.		*
Fungi.		
Scleroderma, sp.		
Lycoperdon Belli, Peck. Collected also at Digges Island, south side Hudson Strait.		

APPENDIX III.

List of Lepidoptera taken in Baffin Land by Dr. Robert Bell, in 1897.

Determined by Dr. James Fletcher Government Entomologist, Ottawa.

July 23.—Big Island:—
Argynnis Chariclea, Schneid, (4 specimens).
Colias Hecla, Lef. Female.

July 25.—Beaumont Harbour:—
**Chionobas Taygete*, Hub. Male.
Colias Hecla, Lef. Male.
Lycæna Aquilo, Bdv. (=*L. Franklinii*, Curtis).
Argynnis Chariclea, Schneid. (4)
Anarta Richardsonii, Curtis. Female.
Larva Rossii, Curtis, (Larva).

July 26.—Head of Crooks Inlet:—
Argynnis Chariclea, Schneid, male and female.
" *Polaris*, Bdv.
Colias Hecla, Lef. 3 males and female.
" *Pelidne*, Bdv. 3 males.

July 27. *Lycæna Aquilo*, Bdv.
Argynnis Polaris, Bdv. One male and one female.

July 29. Koong-neow Inlet:—
Chionobas Assimilis, But. Female.
Colias Pelidne, Bdv. Female.

August 12.—Route from Amadjuak Bay to Lake Amadjuak:—
Chrysophanus Hypophlæas, Bdv.
Lycæna Aquilo, Bdv.

August 14.—Near Lake Mingo:—.
Chrysophanus Hypophlæas, Bdv.
Colias Nastes, Bdv.
" *Hecla*, Lef. Male.
Anarta Richardsonii, Curtis.

Two species of bumble-bees were also collected which Dr. Fletcher has determined as *Bombus strenuus*, Cr. and *Bombus sylvicola*, Kirby.

* Although this species is quite within the range where it might be expected to be found, this, I believe, is the first actual Canadian record published.—J. F.

Geological S

GEORGE M. DAWSON

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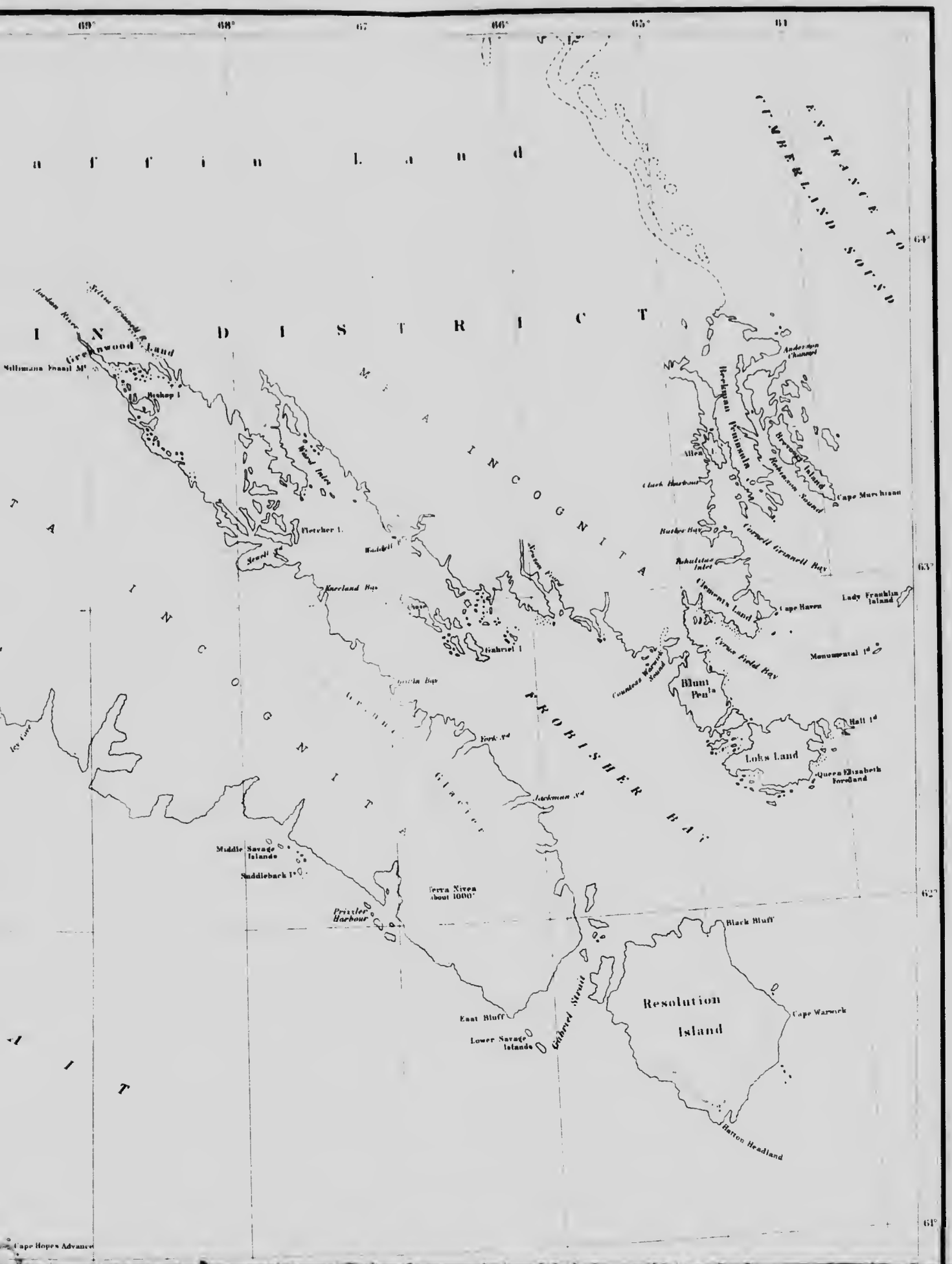
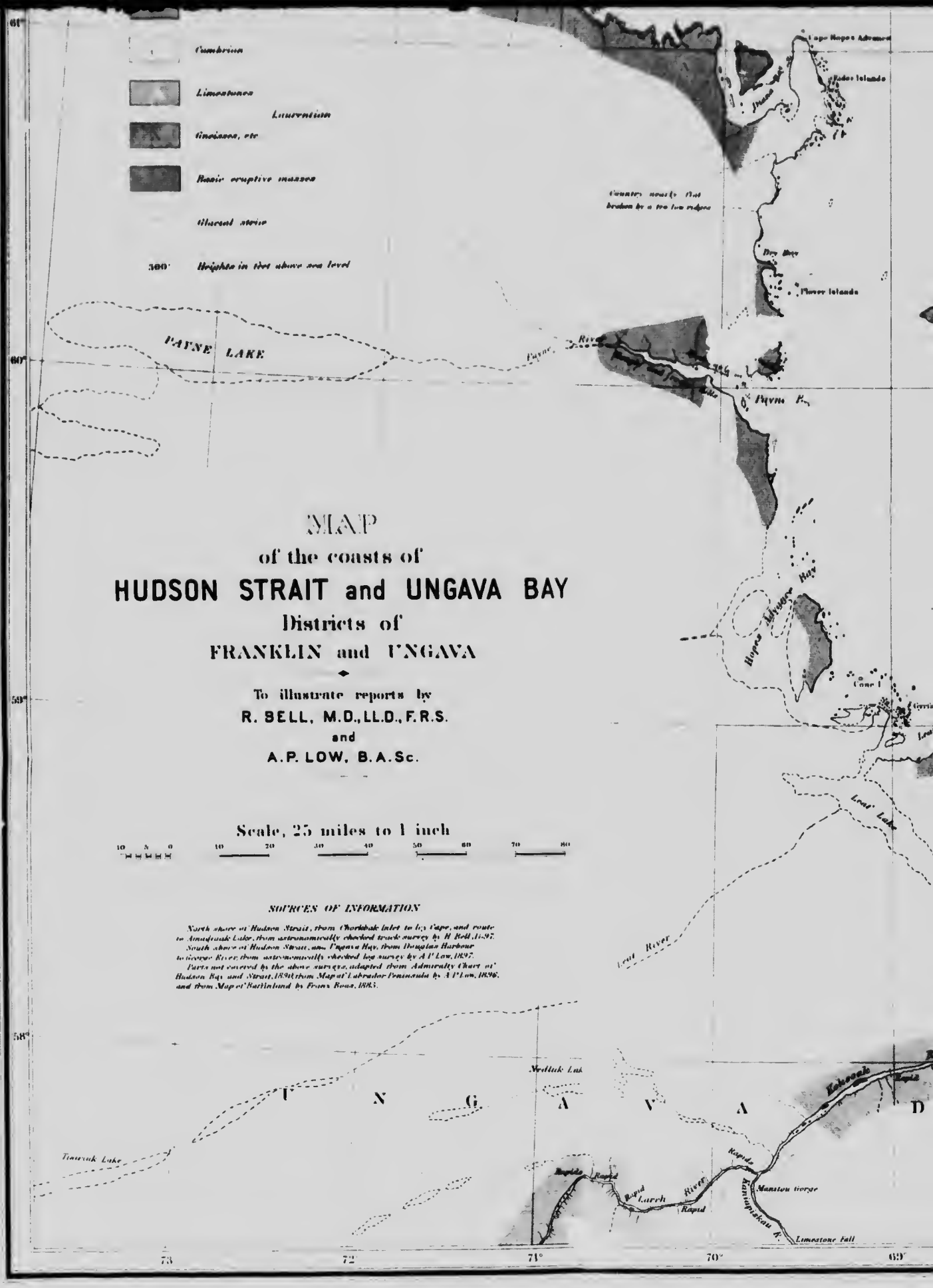
M. DAWSON, C.M.G., LL.D., F.R.S., DIRECTOR.

1909





MAP

of the coasts of

HUDSON STRAIT and UNGAVA BAY

Districts of

FRANKLIN and UNGAVA

To illustrate reports by

R. BELL, M.D., LL.D., F.R.S.

and

A.P. LOW, B.A.Sc.

Scale, 25 miles to 1 inch

10 5 0 10 20 30 40 50 60 70 80

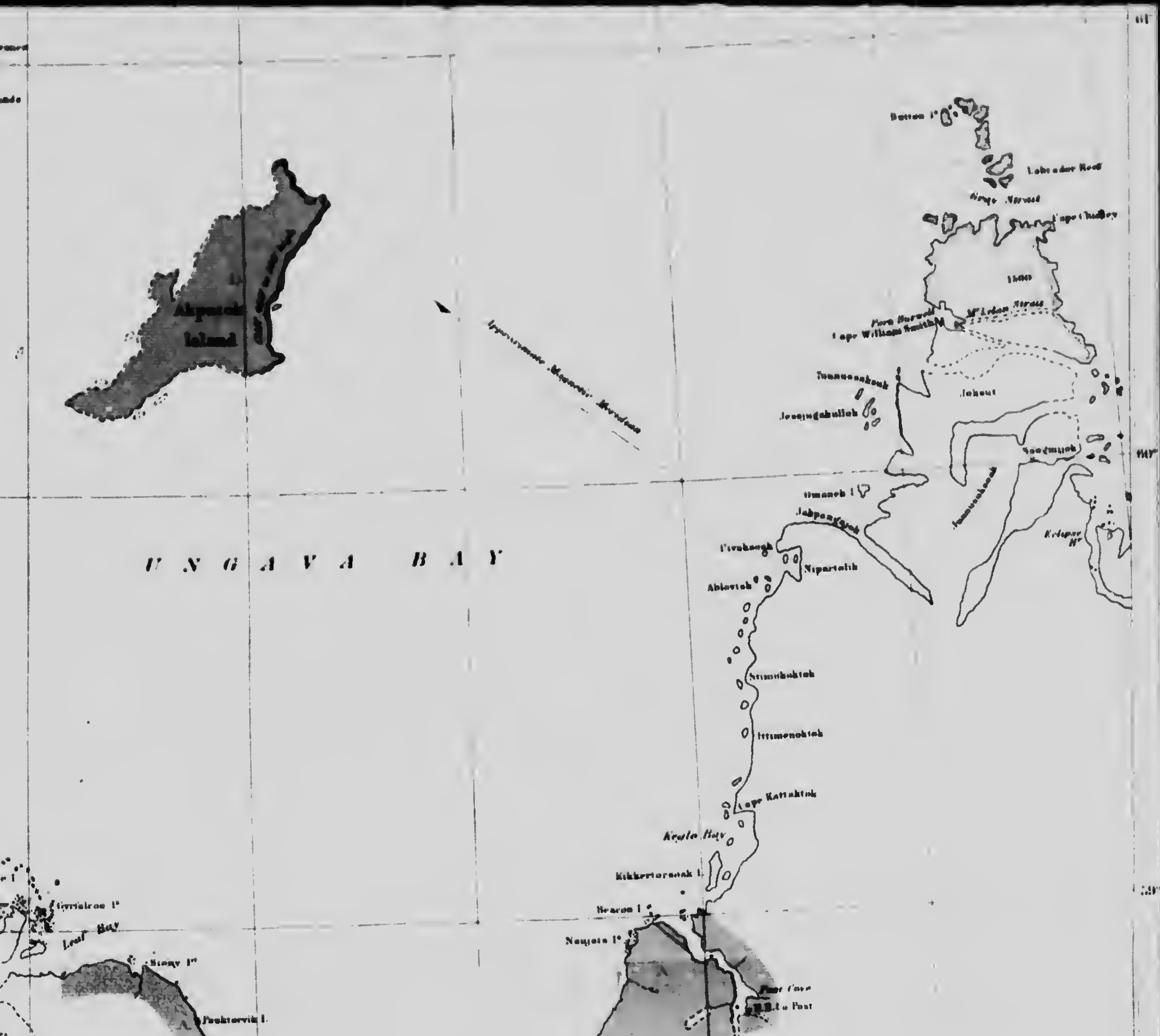
SOURCES OF INFORMATION

North shore of Hudson Strait, from Cherishak Inlet to Ivy Cape, and route to Amadjuak Lake, from astronomically checked track survey by H. Bell, 1897.

South shore of Hudson Strait, and Ungava Bay, from Douglas Harbour to George River, from astronomically checked log survey by A.P. Low, 1897.

Parts not covered by the above surveys, adapted from Admiralty Chart of Hudson Bay and Strait, 1894; from Map of Labrador Peninsula by A.P. Low, 1896, and from Map of Baffinland by Franz Boas, 1883.

C.O. Senecal, Chief Draughtsman
L.N. Richard and D.E. Prud'homme, Draughtsmen


Akpatok Island
U N G A V A B A Y
Button Is
Labrador Reef
Cape Chidley
Kikkertoronak I.
Beacon I.
Arvartik Is
Big Island
Whale River
George River
Fort Chimo H.B. Co. Post
D I S T R I C T
69°
68°
66°
65°