GEOLOGICAL SURVEY OF CANADA
ROBERT BELL, M.D., Sc.D. (CANTAB), LL.D., F.R.S.

REPORT

ON THE

GEOLOGY AND PHYSICAL CHARACTER

OF THE

NASTAPOKA ISLANDS

HUDSON BAY

BY

A. P. LOW, B.Sc.

OTTAWA
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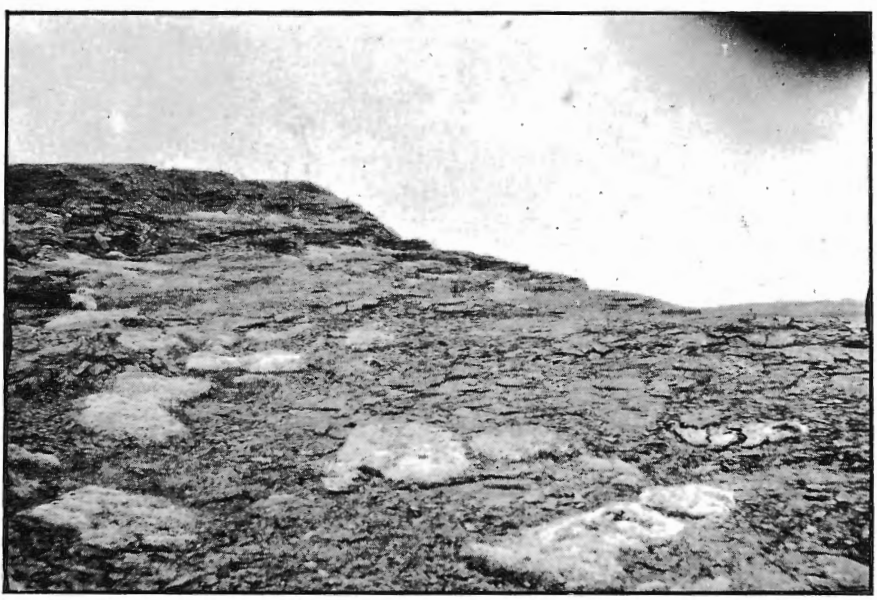
No. 819.

Nastapoka Fall on Mianland opposite Gordon Island.



Upper Iron Beds, on Gillies Island.

PORT HARRISON, HUDSON BAY,
November 20, 1901.

TO ROBERT BELL, M.D., LL.D., SC.D. (CANTAB.), F.R.S.,
Director Geological Survey of Canada.

SIR,—I beg to send you herewith my Report on the Nastapoka islands of Hudson bay. Acknowledgment is due to the President and Directors of the Dominion Development Company, for allowing me, while in their employ, to collect the material contained in this report and to send it to you for the benefit of the public.

The surveys required in this connection and their delineation, are the work of Mr. G. A. Young, M.Sc., to whom acknowledgment for his efficient and kindly assistance is here made.

I have the honour to be, Sir,
Your humble servant,

A. P. LOW.

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Introduction.

The present report is based upon observations made by the writer during the summer of 1901, while engaged in the location of mineral claims for a private company. This work called for a close examination of the ore-bearing measures and associated rocks on the Nastapoka islands, to determine the extent and value of the ores, and to gain a knowledge of the relations of the ore beds to the surrounding rocks, a matter of importance in connection with the laws governing the granting of mineral claims by the Dominion Government. These examinations resulted in the securing of considerable detailed information concerning the rocks.

The report is divided into two portions, the first part giving a general description of the islands as a group and a general idea of their geology, and the second part a detailed description of the physical features and geological formation of each of the larger islands.

The report was written at Port Harrison in N. Lat. 58° 30′ on the east coast of Hudson bay, during the winter following the exploration, and the writer has had to depend, while writing it, wholly upon his notes, and on the knowledge previously acquired of these and other areas of similar rocks in the Labrador peninsula, as no written information bearing upon the subject was available at the time.

The rocks of the Nastapoka islands were first reported upon by Dr. Robert Bell, who examined them in 1877, and whose report was published in the Report of Progress of the Geological Survey for that

year. The islands were again visited in 1898 by the writer, who made a hurried examination of them while passing southward along the east coast of Hudson bay; the results of the observations then made are published in the Annual Report, Geological Survey of Canada, vol. XIII. pp. 29D *et seq.*

PHYSICAL FEATURES OF THE NASTAPOKA ISLANDS.

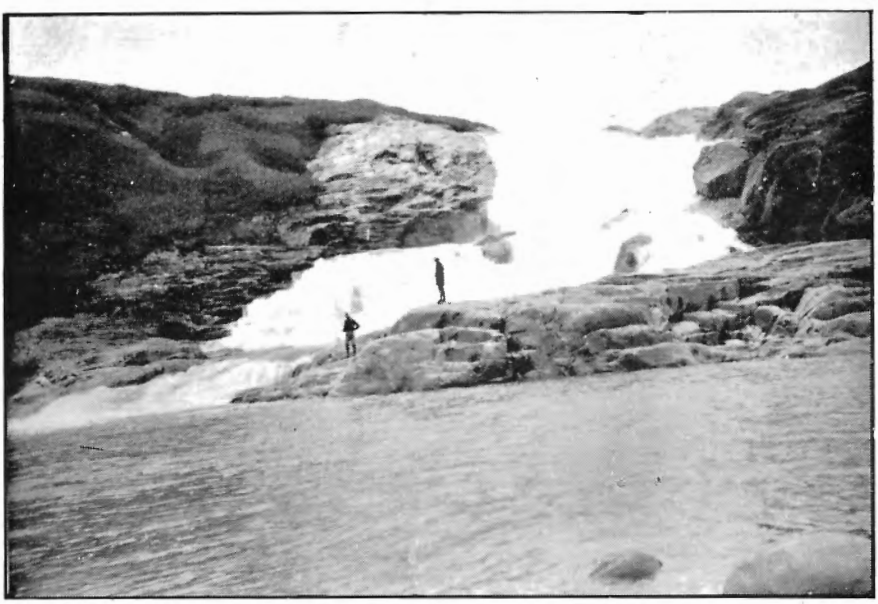
The Nastapoka islands lie close to the east coast of Hudson bay. They extend northward from five miles beyond the mouth of Little Whale river, to a point about twenty-five miles north of the mouth of Langland river, or, from N. Lat. 56° 5′ to N. Lat. 57° 50′, a distance of one hundred and twenty miles.

From their southern end to White Whale point in N. Lat. 57°, the general direction of the coast and islands is due north, while beyond that to the head of the chain the general direction is north-northwest. The islands form a chain roughly parallel to the coast and, with the exception of the distance between the two most northerly islands (which are nineteen miles apart) lie close together, the distance between island and island rarely exceeding a mile and usually being much less.

Nastapoka sound lies between them and the mainland, and varies from one to three mile across, the average width being somewhat over a mile. The sound so formed is like a broad river, and, except when the wind blows directly up or down, it is safe and easy to navigate with the smallest craft; while the depth of its channel will allow the largest ships to pass through it without danger. When the winds follow the channel, the strong currents caused by the tides raise an irregular sea.

The inner or eastern sides of all the islands are formed of abrupt cliffs with deep water close in-shore, while breaks in the cliffs form small bays with safe and unobstructed anchorages, easy of approach by large vessels. Towards the mainland the sound is also deep, but in places, especially about rocky points, reefs lie off the coast; and in the neighbourhood of the mouths of rivers there are shallows caused by the sand brought down by the streams and deposited outside. No safe or commodious harbours are found along the mainland, the mouths of Nastapoka and Langland rivers affording the only places of shelter for small craft on that side of the sound. The channel leading to Nastapoka river is narrow and crooked, and must be entered about a mile to the northward of the river and about half a mile from shore. It runs southward and gradually approaches the land until opposite the mouth

UPPER IRON ORE BEDS ON CHRISTIE ISLAND.



LANGLAND FALLS ON MAINLAND OPPOSITE BROUGHTON ISLAND.

of the river. The channel is from nine to twelve feet deep, with broad sandy shoals on both sides, where the water is less than a fathom deep. Inside the mouth of the river is a small, safe harbour in a basin below the rapids, which extend about one hundred yards to the falls, where the river descends perpendicularly one hundred feet. The entrance to Langland river is more dangerous, as the channel is less than fifty feet wide and very crooked with a bar across it at the mouth of the river, covered by less than four feet of water at low tide. The harbour inside is small but thoroughly protected and the only difficulty is in getting into it. The average rise and fall of the tide along the sound is about three feet.

The islands of the Nastapoka group vary in size from small wave-washed islets to one thirteen miles long and nearly three miles across in its widest part, known as Broughton island. Great and small, they number sixty-five in all, including the following larger islands in order from south to north: Flint, Belanger, Ross, Anderson, Lutit, Clarke, Gillies, Taylor, Miller, Gordon, Mowatt, Christie, Davieau, Nicholson, Broughton, McTavish and Cotter. The islands were named after officers of the Hudson's Bay Company who are or were connected with the company's posts situated on Hudson bay, and whose many kindnesses and willing aid extended to visiting members of the staff of the Geological Survey, have in a great measure ensured the success of the various explorations undertaken in the past through the vast northern regions practically under their control.

The physical character of the islands is similar throughout the chain; they are all formed from beds of stratified rocks, sometimes associated with flat sheets of trap. The rocks, although faulted, have a general dip towards the west; while, on their inner or eastern side, they are broken into sharp cliffs. The configuration of the islands conforms to the attitude of the rocks and consequently they all present sharp cliffs towards the sound, while on their western sides they slope gently and have low shores. The cliffs on the larger islands reach, in places, an elevation of upwards of 350 feet, but, as a rule, are between 100 feet and 200 feet high. They are broken into many small irregular bays and headlands, and the eastern shore is, as a rule, quite rocky, except in the bays where the lower cliffs are largely masked with sandy drift.

The surface of the islands, as before mentioned, has always a gentle slope westward, but this general slope is by no means regular, as the rocks have been thrown into roughly parallel ridges, similar in character, that is, each with a low cliff towards the east and a gentle slope westward, so that many of the islands are traversed by several low

rocky ridges, running north and south, each ridge somewhat lower than that next to it on the east. Narrow shallow valleys occupy the intervals between the ridges, their bottoms usually filled with sandy drift and dotted over with small lakes and ponds.

The drift on the islands is formed into terraces and old beaches at different elevations from the present sea-level to the summits of the highest islands, marking the various levels at which the islands rested during the uplift of the land at the close of the glacial period; and showing that during that period the present islands were below sea level. Similar evidence on the adjacent mainland shows that the total elevation of the land since the ice age has been upwards of 700 feet.

The outer or western shores of the islands are low, with rocky points and outlying reefs separating wide bays with sandy or boulder-strewn shores. A number of small harbours occur along the outer shores, but their entrances are usually obstructed by reefs and the whole of the outer shores are dangerous of approach to large ships, owing to shallow water broken by submerged reefs which extends a considerable distance from this side of the islands.

The channels between the islands are usually deep, but they are in places obstructed by reefs. An entrance to the sound with large ships should only be made between the larger and higher islands, as, where the islands are small and low the water between them is generally shallow and the bottom lumpy.

A few stunted spruce trees grow on the western side of Belanger island near the south end of the chain. These are the only representatives of the forest, the islands being elsewhere barren.

Small, northern willows grow a foot or so above the ground in protected gullies and everywhere else the sandy soil is covered with arctic lichens, mosses, sedges and flowering plants, which never rise more than a few inches above the ground. Notwithstanding the absence of trees the surface of the islands has far from a desolate appearance in summer, when it resembles a highly cultivated region in broken country, whose face is beautifully diversified by the flowers and foliage of these arctic plants, while little lakes nestling between low ridges of barren rocks add charm to the picture.

GENERAL GEOLOGY OF THE NASTAPOKA ISDANDS.

The Nastapoka islands are formed from unaltered sedimentary rocks consisting of dolomites, sandstones, shales, jaspilytes, cherts and

ferruginous shales. Associated with these rocks are sheets of dark green trap, which have been injected between the bedding of the stratified rocks or have been surface-flows contemporaneous with the formation of the sediments. A graywacke slate, which appears to have been formed by the deposit of volcanic ashes, is also associated with these rocks. The following is a general section of the rocks forming the islands; and is made from the measured sections, given in detail later in the report.

Descending order.

	Feet.
1. Rusty weathering, dark gray, siliceous rock containing ankerite (carbonate of iron and magnesia) and magnetite..	20 to 100
2. Dark-gray silicious rock containing magnetite with small quantities of ankerite	50 to 250
3. Red jaspilyte rich in hematite ore	10 to 100
4. Red jaspilyte poor in hematite ore	5 to 20
5. Purple, or greenish-weathering, dark-green, graywacke shales	10 to 70
6. Red jaspilyte poor in hematite ore	0 to 5
7. Light greenish-gray sandstone and shale	10 to 300
8. Fine grained dolomite	0 to 50

The rusty weathering, dark-gray silicious rocks of the first division (1) are found on all the islands from Flint to McTavish, being wanting only on Cotter island. The typical rock is a dark gray chert made up of finely divided silica showing under the microscope small grains of quartz filled in by later accessions of that material in a finely divided state. It contains minute crystals of magnetite scattered through the mass, and also patches of crystalline carbonates. At the southern end of the chain it is cherty and sometimes light green in colour. These rocks are usually in thin beds, the parting between the beds filled with brownish ankerite, which also occurs in flat lenticular masses inclosed in the cherts; many of these masses are several inches in thickness and several square feet in area, so that the rock usually contains from twenty to fifty *per cent* of ankerite. These ores are too much broken and too intimately mixed with the cherts for profitable mining. The rusty character of the rock is due to surface decomposition of ankerite to limonite. The beds increase in thickness as the islands are followed northward, and reach their maximum development on Davieau island and northward to McTavish island where they have a thickness of fifty feet. These measures can be traced southward from the Nastapoka chain in the outer islands lying along the coast for upward of 150 miles, being last seen on Long island just north of Cape Jones, where they are overlaid by a considerable thickness of trap.

The second division of the section is an arbitrary one, and was made to embrace all the beds containing important deposits of magnetite. The upper beds of the division grade into those of division I, while the lower pass gradually into division III.

The typical rock of these measures is a dark gray, fine grained variety of quartzite chert, containing considerable magnetite scattered through it in minute crystals; it also contains small quantities of carbonates of iron, magnesia and lime. The beds are usually thin (from one to twelve inches) and the partings between them are filled with a mixture of silica and magnetite with small quantities of ankerite. These partings vary in thickness, but are generally thin between the upper beds of the division, and quite thick (six inches to forty-eight inches) towards the bottom, where they form important ores of iron; as the beds of chert are often, quite thin between two or more thick partings of ore and might easily be neglected in mining. The mixture of silica and magnetite in the ore is an intimate one, with the silica usually in a finely divided state.

The proportion of these substances is not constant, so that the ores vary from a lean ferruginous chert, to a rich ore containing upwards of sixty *per cent* of iron. Large quantities of the better ores occur in the lower beds of the division. The occurence of these ores between the beds of gray silicious rock, and their intimate association with finely divided silica point to their deposition and enrichment from the infiltrations of waters carrying solutions of iron and silica which were deposited by the waters in cracks and between the bedding of the already-formed silicious rocks. This mode of formation has been described by Van Hise for similar ores in the Lake Superior region.

On the three southern islands of the chain, there is a gradual change in the nature of these measures. They pass into a brownish-black, silicious shale, rich in iron and containing considerable carbon as small scales of graphite. This is the form in which they are found to the southward of the islands as far as Long island. The thickness of the division is very constant on the islands northward to McTavish, but it does not occur on Cotter island.

The rocks belonging to the third division, as before stated, grade into the division above them and the line between them cannot be drawn sharply.

The typical rock of this division is fine-grained and very silicious, with minute particles of silica coated with red oxide of iron, forming a coarse impure red jasper.

These jasper rocks usually occur in thin broken bands with the partings between them filled with a finely-divided mixture of hematite, magnetite and jasper. The hematite is greatly in excess of the magnetite. The association of the iron ores and the jasper is intimate and they must have been deposited simultaneously from aqueous solutions probably leached from the cherty carbonate measures above. Microscopic sections from these rocks are almost identical with those of jaspilyte figured by Van Hise in his monograph on the iron-bearing rocks of the Lake Superior region; and they must have had the same origin as he has assigned to those rocks, namely; enrichments deposited by water subsequent to the formation of the bedded rocks in which they are found as partings, and filling the most minute cavities.

The amount of ore in this admixture of hematite and jasper varies greatly; where the ore is poor, the jaspery rock predominates and incloses lenses of hematite, while where the hematite is most plentiful it incloses similar lenses of jasper. The detailed description of these rocks, given later, shows that the measures of this division contain an immense amount of hematite. The rocks of the division do not occur on all the islands, being wanting on Flint, Belanger and Ross. On Anderson they are represented by a few thin beds not rich in ore, while on Clarke they form the summit of the section with a thickness of eighty feet. They reach their maximum development on Gillies and Taylor where their ores are richest and most concentrated; farther northward they become thinner and poorer in ore, being twenty feet thick on Davieau and only eight feet thick on McTavish, where they die out. No trace of these measures is found underlying the upper rocks on the islands south of the Nastapoka group.

The fourth division, consisting of red jaspilytes is an arbitrary one, of use only as a subdivision of the iron-bearing rocks. Wherever the jaspilytes are well developed, the richer beds are underlain with leaner measures, unfit for working and these poorer ores constitute this division. On Clarke island these beds are twenty feet thick; on Gillies they vary from ten to twenty feet in thickness, on Taylor ten feet, while to the northward, they merge into the overlying division, all poor in iron ores.

The rocks of the fifth division differ from those of the rest of the section, in that they are of volcanic origin, probably trap-ash, rocks contemporaneous with an outflow of trap, which, on the northern and southern islands, occurs at the same horizon.

The rock is a purple or greenish-weathering, dark green, fine grained graywacke, with a horizontal shaly cleavage. It is formed from finely

divided and partly rounded fragments of plagioclase, bisilicates (largely decomposed to chlorite) and rounded grains of quartz, which indicate a sedimentary character, while its other constituents point to an igneous origin, probably the ashes of a volcanic outburst deposited in a shallow sea.

In places the shales contain small partings of hematite; and at times portions of them are coated on the surface, so as to resemble metallic iron. These are not rich in iron ore.

These measures were first noted on Clarke island, where they have a thickness of seventy-five feet. On Gillies they are sixty feet thick; on Christie eighty-five feet; on Davieau less than fifty feet; on Broughton thirty feet; and on McTavish fifty feet. They disappear in the interval of nineteen miles separating McTavish from Cotter, being represented on the latter island by twenty feet of fine-grained trap, overlying the sandstone of the seventh division. Twenty five miles northward of Cotter, the trap is again seen in the Hopewell islands, where it overlies similar sandstones and attains a thickness of upwards of a hundred feet. On Belanger, Ross and Anderson islands sheets of traps, wholly or in part, occupy the horizon of the graywacke shales on the other islands. On Belanger thirty-five feet of graywacke shales rest upon three feet of trap, which latter overlies twenty feet of gray-wacke shale, resting upon twenty-five feet of trap.

On Ross and Anderson the trap underlying the iron-bearing rocks only rises slightly above sea level and its thickness is unknown. On Flint island, fifteen feet of trap rest upon beds of arkose sandstone which probably was largely formed from volcanic ashes.

The rocks of the six divisions are limited to Gillies, Davieau and McTavish islands. This jasper rock is in thin beds or flags without hematite ores. On McTavish island the jasper splits into thin flags, is nicely mottled and would prove effective for interior house decoration.

The sandstone and associated silicious shales constituting the seventh division are found in the lower portions of all the prominent eastern points of the islands. The sandstone is always light coloured, with generally, a greenish or pinkish tinge to the gray. A number of massive beds occur in the measures, but as a rule, the sandstone is thin-bedded and flaggy with the surface of the flags ripple-marked. It is essentially composed of quartz grains, but often holds considerable quantities of the carbonates of lime and magnesia, especially on the northern islands, where it is difficult to determine whether some of the beds are

silicious limestone or calcareous sandrock. Many of the beds contain small splotches of ankerite; and at times small garnets are found in the upper, massive beds. The shales form partings between the sandstone beds, indicating that the whole of the measures were deposited in shallow water. The shales are very silicious and usually of a light green colour.

The dolomites forming the eighth and lowest division are only met with at the eastern point of Belanger island. They are very much contorted and broken where seen; and the contact between them and the overlying sandstones is concealed by drift, so that it is impossible to state whether or not they conformably underlie the sandstone. The sandstone where last seen above the drift is undisturbed, in marked contrast to the dolomites below, and there may be a line of fault between them.

The rocks forming the Nastapoka islands have a general dip to the westward, or towards the sea; the angle of dip is generally low-from 5° to 15°. This general westward dip is by no means uniform and regular, as the rocks are thrown into roughly parallel ridges running north and south and separated by intervals varying from a few feet to several hundred yards across. These parallel ridges are the result of up-throws along lines of fault, the up-throw being always on the western side, and consequently the rocks on that side are always higher and have steeper faces than those on the opposite side of the fault. The amount of displacement at any of these faults is generally small and rarely exceeds one hundred feet. As a result of the displacements caused by these faults the surfaces of the islands always give one or more repetitions of the upper measures.

The stratigraphy is further complicated by another series of faults lying transverse to the first system. These two series of faults have broken the measures into huge blocks more or less rectangular in shape, and the unequal throw of the transverse faults has tilted these blocks so that they often dip diagonally to the northward or southward of west, resembling, on a gigantic scale, ice piled along shore by pressure from seaward. The present condition and position of the rocks must have been due to some such pressure acting from seaward, which forced them against the inert masses of granite and crystalline rocks forming the mainland, causing them to buckle along lines parallel to the coast and forcing huge cakes of rock to over-ride one another.

The buckling at these parallel faults, on the islands, represents on a smaller scale what took place along a great line of fault which extended fully three hundred miles along the east coast of Hudson bay, from

Cape Jones to Portland promontary, and caused the uplift of Long island, the outer islands between it and the Nastapoka islands and the Nastapoka and Hopewell islands, all of which belong to the same geological horizon. The uplift along this fault line must have been several hundred feet, while the horizontal movement of the rocks was much greater than the uplift. A second great line of fault and overthrust is indicated by the position of other unaltered rocks of this formation which lie upon the granites and other rocks of the mainland, from the north end of Richmond gulf to the vicinity of Cape Jones, a distance of nearly two hundred miles. The rocks of this division also exhibit a series of minor parallel faults like those described above. The Belcher and other islands stretch in lines parallel to the coast, from northward of Cape Jones to beyond Portland promontory, and are from forty to seventy miles off the land. These islands resemble in physical character to those lying close to the coast and have probably been thrown up from the sea bottom by a similar great overthrust along corresponding lines of fault. The rocks of the Nastapoka islands are not only faulted, but are also thrown into anticlinal and synclinal folds. These folds are always gentle and only on McTavish island does the angle of such a fold exceed 20° on either side, and even this moderate fold is broken along its crest. This slight folding before the buckling of the rocks shows that at the time the pressure, causing movements in them, was exerted, the rocks were at or close to the surface, and the lack of pressure from super-imposed strata allowed them to break rather than fold, as they would have done had they been deeply buried beneath newer formations.

The geological position of the rocks of the Nastapoka group is difficult to determine, owing to the great and minor faults which have displaced them and other measures of the formation to which they belong. The mainland, from opposite Flint island to Anderson island is occupied by a series of similar unaltered rocks belonging undoubtedly to the same formation. They are largely dolomites, limestones and sandstones, generally resting unconformably upon beds of arkose and arkose sandstone, but opposite Anderson island lying immediately upon granites. A great thickness of bedded trap overlies these stratified rocks. These unaltered rocks of the mainland dip gently west ward, and if no line of fault followed Nastapoka sound, the rocks of the islands would rest conformably upon them, and consequently would be newer and higher in the measures of the formation than the rocks of the mainland.

A study of the measures displayed in the southern cliffs of Richmond gulf, opposite Belanger island, was made in 1899. Here an unbroken series was found rising, from a coarse arkose rock, through arkose sandstones and shales into light coloured pinkish and greenish sandstones and silicious shales very like those of the bottom measures of the islands. Resting conformably on these sandstones and shales was a considerable thickness of lean jaspilytes mixed with graywacke shales having dark gray ferruginous cherts above them, while on top were dolomite, limestone and sandstone capped with trap. From this it is inferred that the Nastapoka group of rocks with their important iron-bearing measures belong to the middle portion of the so-called Cambrian formation of the peninsula of Labrador. Consequently they are older than the rocks of the coast and underlie them. Though, thrust up by a great fault, they seemingly overlie these rocks which form the summit of the formation along the east coast of Hudson bay.

Large areas of similar unaltered sedimentary rocks occur throughout the peninsula of Labrador, and are probably the equivalents of certain of the iron-bearing series about Lake Superior and of those to the westward of Hudson bay, hand specimens from these localities being undistinguishable, so closely do they resemble one another.

On former maps of portions of the peninsula of Labrador, the areas of rocks belonging to this formation have been coloured as belonging to the Cambrian formation, and in the earlier reports on this region, the rocks were thought to be a part of that system, owing to their unaltered condition, in contrast with all the other rocks of that vast area that were either crystalline granites and other irrupted rocks, or crystalline schists and gneisses, so completely metamorphosed as to have lost all trace of their original sedimentary nature, if any were sediments. These highly crystalline rocks were classed as Laurentian or Huronian and were considered to be much older than the unaltered rocks of the so-called Cambrian areas. More extended and closer study of both the unaltered and crystalline rocks and of their relations to one another has changed the views of the writer; and he now considers the unaltered, so-called Cambrian rocks to be the equivalents of many of the gneisses and schists classed as Laurentian (Grenville Series) and the Huronian areas of the Labrador peninsula to represent a portion of the unaltered rocks and their associated basic eruptives (traps, trap-ash, &c.,) altered by the irruption of granite and rendered schistose by pressure. The granites which have been classed as typical Laurentian, always cut and alter the bedded rocks wherever seen in direct contact with them and are consequently newer than the latter.

The above observed facts extending over large areas of the peninsula, the result of several years study of the rocks, have led the author to conclude that the term Cambrian as applied to these unaltered rocks is a misnomer, as considered in their relations with the surrounding areas classed as Laurentian and Huronian, they are of similar or greater age than the rocks so classed; and the term Cambrian is confined elsewhere, to rocks of more recent formation than the Laurentian or Huronian.

The age of these unaltered rocks is unknown, but is undoubtedly very great. No fossils have as yet been determined from them, but there appears to be evidence of low forms of life both animal and vegetable in them; as without them it is difficult to account for the deposition of the large quantities of carbon in the shales of this formation. The taking into solution of iron and its redeposition was possible due to the action of organic acids. Certain of the limestones contain concretions of alternate concentric layers of chert and limestone, which resemble fossils of low animal organisation. During the past season, very thin layers of carbon with some resemblance to organic forms were found in the sandstones of Cotter island; these have the appearance of lowly organized plant life. If there are fossils in these rocks they represent a low type of life, lower than the known fossils from the lowest beds of the Cambrian, and consequently this formation is older than the Cambrian. It is proposed, therefore, to class these so-called Cambrian unaltered rocks as Laurentian, as they represent the oldest, known sedimentary rocks in the North East of America and probably in the world.

DETAILED DESCRIPTIONS OF THE PHYSICAL FEATURES AND GEOLOGY OF THE NASTAPOKA ISLANDS.

Flint island is the most southern of the Nastapoka chain of islands, and lies about five miles to the northwest of the mouth of Little Whale river. The island is roughly triangular in shape, with each side nearly three quarters of a mile in length. The convex base faces northwest, or towards the open sea; the other sides are concave with very short angular points breaking the regularity of the curves. The island is rocky with a few areas of terraced drift at the heads of the small bays. The summit of the island rises less than fifty feet above the sea. The rocks dip at small angles towards the northwest and are the cause of low and abrupt cliffs along the southern and eastern shores, and of gentle slopes towards the west.

The total thickness of rock seen on Flint island is about one hundred feet and is as given in the following section :—

	Feet.
1. Fine-grained, greenish chert....	
2. Rusty-weathering, greenish and brownish, silicious, ferruginous shale, in places containing small cubes of pyrite.....	50
3. Compact, greenish trap-rock, containing a few veins of jasper and magnetite, too small for working.....	15
4. Coarse, reddish green, arkose sandrock.....	30
To sea-level. Total.....	95

A vein of quartz containing a high percentage of manganiferous siderite occurs on the island, although its exact locality was not determined. Fragments from the vein, show that it is from eight to ten inches wide, and that about fifty per cent of its mass is ore. The ore is valuable owing to the large quantity of manganese carried by it, but the vein is probably too narrow for profitable working.

Belanger island lies about a mile and a half north of Flint island. Its nearest approach to the mainland is just south of the entrance to Richmond gulf, where the sound is less than a mile wide.

The island is roughly triangular in shape, but unlike Flint island, its northwest side is concave and the others convex, each side being about three miles long. The rocks have a general, gentle dip towards the northwest and the surface of the island conforms to the slope of the rocks; consequently, on the inner, or south and east sides, steep cliffs rise abruptly from the sea. These cliffs at the inner angle have a maximum height of nearly 500 feet, and decrease gradually in elevation towards the west and north. On the outer or northwest face the coast is low with wide sandy bays separated by low rocky points. Deep water is found close under the cliffs on the inner side of the island, while on the outside a number of reefs lie parallel to the shore in the shallow water, which extends a considerable distance from the land, rendering an approach from seaward dangerous. A rocky sprit just south of the inner point forms a small boat harbour, good only for north and westerly winds, as it is too small to prevent the sea from throwing in a heavy swell when the wind is from the south or east.

The surface of the island is broken by rocky ridges caused by minor faults in the stratification of the rocks. There are considerable areas covered with sandy and coarser drift, especially on the western part of the island. Gravel and boulder ridges are seen at different levels, quite to the summit of the island, and indicate the rise of the land since the post-glacial subsidence.

The surface of the drift and many of the rocks are covered with arctic lichens, shrubs and flowering plants, which seldom grow more than an inch or so, above the ground. Arctic willows grow to heights of two or three feet in protected gullies, and a few small, stunted spruce trees are scattered over the western part of the island; on the mainland the trees extend along the coast some fifteen miles farther north to Fishing lake opposite Anderson island.

The following section was measured from the high cliffs near the little harbour on the inner side of the island and shows the measures of the Nastapoka series from its bottom to near the summit.

	Feet.
1. Dark gray, silicious dolomite, rusty-weathering from contained iron; holds large lenticular patches and broken bands of ankerite (a carbonate of iron and magnesia)	50
2. Concealed (probably No 3)	150
3. Rusty weathering, dark green, silicious shale, highly ferruginous, and apparently of pyroclastic origin	35
4. Fine grained, dark green trap	3
5. Dark green, brown-mottled, ferruginous chert; in flags with thin partings of oxide of iron; probably an ash rock	20
6. Very fine grained, dark green trap	25
7. Light and dark gray, sandstone and quartzite, splitting into large flags	50
8. Gray quartzite	4
9. Greenish, silicious shale	2
10. Light gray quartzite	1
11. Light green, silicious shale	5
12. White quartzite	3
13. Gray and greenish, shaly sandstone	26
14. White quartzite	3
15. Light greenish, silicious shale and sandstone	75
16. Greenish, silicious shale	10
17. Light greenish gray sandstone	6
18. Greenish, silicious shale	6
19. Light gray sandstone, with a few thin partings of green shale	27
20. Light greenish shale and sandstone in thin beds	20
21. Light gray sandstone	2
22. Light greenish, silicious shale	11
23. Light gray sandstone	1
24. Light greenish and reddish shales	5
25. Light gray sandstone	6
26. Fine grained, light greenish, very silicious dolomite	8
27. Light gray, friable sandstone	1·5
29. Greenish and pinkish, silicious shales	10
29. Light gray sandstone	1·5
30. Greenish, silicious shale	2
31. Light gray sandstone	8
32. Concealed	20
33. Light greenish weathering, very fine grained, greenish-gray limestone or dolomite with thin partings of quartzite holding garnets.	

		Feet.
	Some of the beds would afford good lithographic stone, but for the scattered grains of quartz in them	30
34.	Yellow-weathering, medium grained dolomite; with concretions of finer grained dolomite, from two to twelve inches in diameter. Associated and mixed with bands of light-green, very fine grained blue limestone; all much contorted	20
To sea level.	Total	643

In the above section, 3, 4 and 5 correspond with the rocks of Flint island, while 1, 3 and 4 are the equivalents of the iron-bearing rocks of the islands to the northward. In places on those islands other members of the section are met with to within a short distance above 33 which is nowhere seen excepting on Belanger island.

Ross island lies immediately north of Belanger, from which it is separated by a channel nearly a mile wide. This channel, being opposite the narrow entrance to Richmond gulf (a tidal lake some twenty five miles long by twenty miles wide), feels the sweep of the currents rushing in and out of the entrance. Consequently it is only during the most severe weather, and long after the rest of Nastapoka sound has frozen over, that this channel freezes. The Eskimos travelling along the coast during the early winter are obliged to pass outside Belanger and Ross islands in order to avoid this open water.

The longer axis of Ross island lies nearly north and south; its greatest length is two miles and its widest part never exceeds a mile across. In shape it roughly approximates a half moon with the horns directed westward. The island, on its eastern face, rises in steep cliffs from 200 to 300 feet above the sea, with deep water close to their base, so that it is impossible to anchor along the inner side. The outer shore forms a wide, flat bay, ending in low rocky points, the remainder of the shore being sandy.

A small island separated by a narrow channel lies, as a continuation of the cliff, off each end of the island. Beyond and close to the northern islet are two others, lying at right angles to its direction. Between these islands is an excellent harbour open only to the eastward.

The measures displayed in the cliffs are similar to those of Belanger island from the trap 6, upwards. Dark silicious shale predominates, with a thickness of nearly 200 feet. A few beds of dark gray chert are scattered through the shales, becoming more plentiful towards the top, where the shales pass into a cherty, ferruginous dolomite, or rather, a ferruginous, dolomitic, silicious rock of a dark gray colour. The beds of shale are often highly charged with oxide of iron; and minute

crystals of magnetite are met with throughout the measures. The dark silicious rock contains considerable magnetite and also concretions and thin, broken bands of ankerite. These measures, although quite ferruginous can not be classed as practical ores of iron as the percentage of contained iron is too low.

Anderson is the next large island north of Ross. Its greatest length, from south-west to north-east, is three miles and a half; while in its widest part it is about two miles across. The shape of the island bears a rough resemblance to the outline of a ham with the shank pointed towards the north-west.

The southern and about half of the eastern shores are exceedingly steep and rugged so that no landing can be effected along them. The cliffs rise nearly perpendicularly to heights varying from 200 to 350 feet. Near the middle of the eastern shore the cliffs end abruptly and the land trends sharply to the westward forming a bag which is nearly land-locked by two small rocky islands, and affords a very secure anchorage. The northern part of the inner or eastern shore is largely rocky, but the cliffs are lower and less abrupt than those to the south-ward.

The island slopes gently towards the west; and a second ridge of hills, the continuation of the northern cliffs, forms an escarpment across its southern half, a wide valley separating this ridge from that of the southern coast. This valley is filled with terraced drift, and dotted with small lakes. The outer or western coast is generally low and sandy with a few rocky points and reefs.

The rocks of Anderson island belong to the same horizon as those of Ross island. They differ from them in being more silicious so that the shales are in a great measure replaced by the dark gray silicious rock which occurs in thin beds with partings of shale very rich in magnetite. Some of these partings have a thickness of two feet and the percentage of contained magnetite is high. The dark gray silicious rock also carries considerable magnetite scattered through it in minute crystals. The lower beds of this rock are inter-banded with thin layers of an admixture of jasper, hematite and magnetite (jaspiltyte). They are all of low grade.

Lutit island is separated from Anderson by a channel about 200 yards wide at its narrowest part. The island is a mile and a half long, from south-west to north-east, while its greatest breadth is about half a mile. It has low cliffs along its south eastern face and the interior slopes gently towards its western shore, which is low and sandy. The rocks exposed in the cliff are similar to those of Anderson island.

Clarke island is next northward from Lutit, from which it is distant three miles, the channel between being broken by a few low, reef-like islands lying outside the line between the larger islands. The island, is roughly pear-shaped. It is two miles long and a mile and a half across at the broadest part, near the southern end. The inner cliffs are not much over 100 feet in elevation. Three small islands under the cliff form excellent small harbours, while two other small islands lying off the south-west point afford another harbour exposed towards the south. The island is rocky, but not very rugged; the rocks slope westward and are not much broken by small faults.

The following section was obtained from the rocks exposed in the cliffs of the eastern and southern sides of the island:—

	Feet.
1. Beds of red jaspilyte, usually lean, the ore occurring as a mixture of hematite and magnetite, in flat lenticular masses in the jasper. These masses of ore vary both in richness and thickness, the thickest mass in these measures being four feet	80
2. Red jasper in thin beds, very poor in ore	20
3. Reddish-purple and greenish weathering, dark greenish-gray, fine-grained graywacke shales, composed largely of fragmental plagioclase, with mica, chlorite and other bisilicates and also containing small grains of quartz, and small crystals of magnetite. This is probably an ash rock, but in some places on the islands to the northward it has the appearance of a squeezed trap	75
4. Red jaspilyte containing considerable hematite-magnetite ore with an aggregate thickness of probably three feet	10
5. Purplish-weathering graywacke shales	60
6. Light gray sandstone	5
To sea level. Total	248

The section shows a great increase in the jaspilytes, which on Ander-island were represented by a few thin bands in the lower part of the dark gray silicious measures. The amount of iron ore in the jaspilytes is very large and it is merely a question of time before they are worked.

Gillies island lies four miles north of Clarke, the intermediate space being partly occupied by three small islands. It has a length of twelve miles due north and south, but rarely exceeds a mile and a-half in breadth and in two places narrows to less than a quarter of a mile across. The eastern shore-line is broken by wide bays which form good harbours for all but easterly winds, the only perfect harbour being in a small bay about a mile from the southern end.

This side of the island is generally rocky with cliffs more or less abrupt. The highest of these rise nearly 300 feet above sea level though their general elevation is below 200 feet. Where the island

narrows, the shores are quite low and sandy, and they have a similar character about the heads of the bays. The western shore is low and covered with drift, with occasional rocky ridges extending into the sea to form low points and outlying reefs. There are a few small harbours so formed, but they are usually obstructed by reefs across their entrances and dangerous to approach in stormy weather.

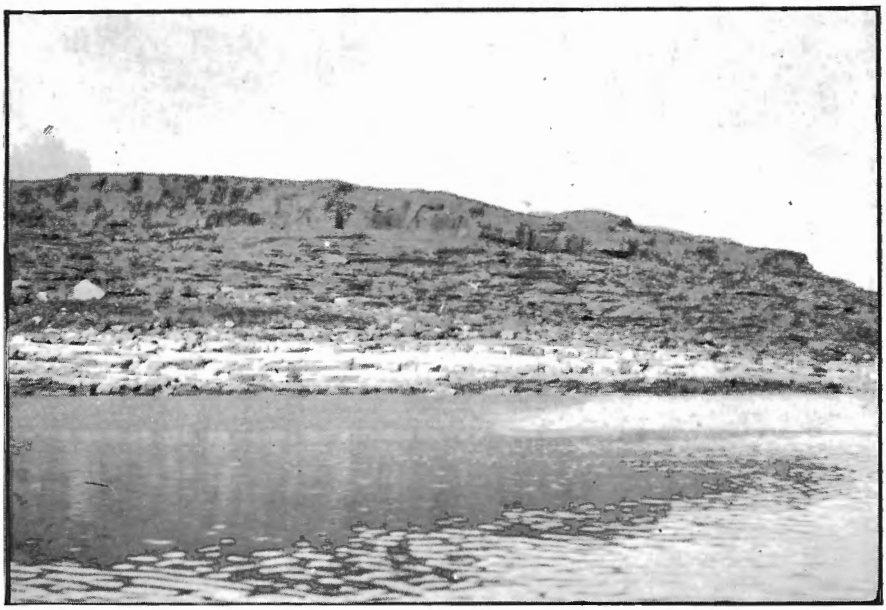
The surface of the island is nearly half-covered with drift cut into terraces with a display of ancient sea beaches at many levels extending to the summit of the island. The drift-covered areas are dotted by many small shallow lakes and ponds, the resorts of numerous aquatic birds. Several minor faults have thrown the rocks into low, roughly parallel ridges, that run in broken lines the entire length of the island.

The iron-bearing measures are well developed on Gillies island and constitute at least four-fifths of its rock-mass. At the southern end the dark-gray, ferruginous cherts, which towards their summit, contain much carbonate of iron, alone are seen. About a mile and a half from the south end the beds of jaspilyte appear from below sea-level in the eastern cliff. Northward for two miles, the strata slowly rise above the sea, and at the second bay, an east and west fault brings the measures north of it about 100 feet above those on its south side, and cause the lowest beds of jaspilyte to occupy the summit of the cliff on the north side, while they are only sixty feet above the water to the south of the fault.

The following section was measured down the cliff immediately to the north of the fault:—

		Feet.
1.	Red jaspilyte moderately rich in ore	18
2.	Red jaspilite lean in iron-ore	10
3.	Purple and greenish-weathering, dark graywacke shales	60
4.	Red jasper, containing very little iron ore	3
5.	Light green, thin-bedded silicious shale	5
6.	Light green, very silicious shales with thin partings of flaggy sandstone	25
7.	Light greenish, medium textured massive sandstone	80
8.	Light greenish gray sandstone (ripple-marked) in thin beds with narrow partings of light-green silicious shale	20
9.	Light gray, medium grained quartzite, containing some mica in small scales	6
10.	Light green sandstones and shales in thin beds (ripple-marked)	15
To sea level.	Total	242

Another section was measured on the south side of the fault from the summit of the cliff to the top of the graywacke shales (3) which



Cliff on east side Taylor Island, Iron Ores overlying Sandstone.

Cliff of Jaspilyte, east side Gillies Island.

occupy the lower portion of the cliff with the underlying sandstones just showing above the sea :—

	Feet.
1. Dark gray silicious rock (chert) in thin beds parted by thinner beds or layers of brown carbonate and oxide of iron. The chert beds contain flat lenticular masses of silicious carbonate of iron (ankerite) varying in volume from minute particles to masses with a surface of several square feet and a thickness of several inches. The chert also contains a considerable percentage of magnetite scattered through it in minute crystals..	20–60
2. Dark gray silicious rock, which becomes richer in magnetite and loses many of the carbonate inclusions as the measures are descended. The bedding is more massive and the partings are thicker and richer in ore. The thickest partings of nearly pure ore are four feet through, but they are usually less than a foot thick. Towards the bottom the magnetite is mixed with hematite and the cherts at the same time change gradually to jaspilyte.....	100
3. Red jaspilyte in bands, varying in colour from dark metallic blue to light red, and in composition from a nearly pure hematite to lean jasper. There is much good iron ore in these measures.....	80
4. Very lean red jaspilyte with a few thin partings of rich hematite.	20
To top of graywacke shale. Total.....	200

The measures of 2 and 3 contain the workable deposits of iron ore. The ores of the upper division (2) associated with the gray cherts are magnetite with usually a small quantity of associated hematite.

As mentioned above, the ore beds form partings between the beds of chert, and the thickest are about four feet through, while in places the thinner bands are separated by only thin beds of chert, and it might be found profitable to work two or more of them at the same time.

The magnetite of the partings appears to be different from the minute crystals in the chert and is probably largely formed by infiltration of iron solutions from above, which have been deposited in the horizontal cracks along the bedding planes of the cherts, and have also replaced the flat lenticular masses of ankerite found in the upper cherts, which, in the lower, are similarly replaced by magnetite. The jaspilyte beds appear to have been originally very similar in character to the upper carbonate-bearing cherts, and have been altered to their present state by enrichments of iron, by the same process of infiltration and deposition that occurred in the magnetite-bearing cherts above, the only difference being that the deposited iron is largely in the form of hematite with only a small proportion of magnetite. A close examination of the jaspilyte measures shows an intimate connection between the iron ore and the silica of the rock. The jasper, under the microscope, is seen to be formed of very small particles of silica coated with

red oxide of iron, to which is due the change from the gray chert to the jaspilyte. The rock appears to have been originally constituted largely of finely divided silica, and its present composition is due to infiltration of waters carrying silica and iron, both of which have been deposited in the minutest cavities of the rock, and as growth-rings on the surface of the original finely divided quartz. As a consequence of the ores being derived by deposit from silicious waters, there is always present, even in the best ores, a quantity of intimately associated silica. The jaspilytes in the section are seen to grade from a nearly pure iron ore, to a ferruginous chert, very poor in iron, as is the case with the beds of division 4 in the section above. Where the rock is poor in iron, the jasper is separated by thin partings of enriched ore, and also contains flattened lenticular masses of hematite. As the rock becomes richer, these lenticular bodies become larger and the ore partings thicker, so that in the better ores the mass of the rock is largely hematite, containing thin, broken bands of the jasper and in the richest ore, only small, flat, lenticular masses of jasper which are quite unimportant in relation to the mass of the ore.

The measures below the iron-bearing series occupy the cliff for two miles northward of the fault, the lower beds of jaspilyte being seen along the summit. A second transverse fault then causes the measures on its north side to be about sixty feet lower than those to the southward, and, the cliffs bending westward towards the direction of the gentle dip of the rocks, the lower measures slowly pass below the level of the sea, and a mile beyond the fault the lower jaspilyte appears on the shore at sea level. From here to the north end of the island, with the exception of the lower parts of a few prominent points, the cliffs are formed entirely of the iron-bearing measures. These measures appear to thicken towards the north end of the island and to include a greater amount of jaspilyte, reaching a thickness of over one hundred feet, with an upper band of jaspilyte, rich in hematite and eight feet thick, situated in the dark gray silicious rocks eighty-five feet above the summit of the lower jaspilyte.

The rocks have a general westward dip at low angles, seldom exceeding 20° from the horizontal and usually much lower. This western dip is not regular, as the rocks are broken by a number of faults, which are roughly parallel to each other and to the longer axis of the island. The disturbance caused by these faults is never very great, the vertical throw being from five to fifty feet, with a repetition of part of the measures at each fault. Along with this parallel faulting are several transverse breaks, the two largest of which have been already mentioned.

The result of the faulting causes the surface of the island to resemble on a gigantic scale, thick ice shoved against a shore by wind-pressure from seaward, where the pressure has been sufficient to cause a buckling in the ice-sheet along several lines parallel to the shore, and has forced the outer cakes to over-ride the inner ones, while transverse fractures have broken the mass into cakes of various sizes. This is the appearance of Gillies island, covered with roughly parallel, but irregular, low ridges of rock, all dipping in a westerly direction with low escarpments towards the east. All of the ridges are broken into large blocks by transverse faults, and some of the blocks have a northerly tilt, while others slope diagonally southward, closely resembling the cakes of ice piled along a shore.

The repetition of the measures by these roughly parallel thrust faults has caused the surface of the interior and western parts of the island to show always the upper middle, or lower measures of the iron-bearing series, notwithstanding their moderate thickness and constant westward dip. This fact will no doubt be valuable in future mining operations as the richer ores will be found throughout the island either directly on the surface or at depths of only a few feet below it.

Taylor island is separated from the north end of Gillies by a deep channel, upwards of a mile in length and about a quarter of a mile in width running north-west. The island is three miles long, from north to south, by a mile and a half broad at the widest part in its southern half, the northern part tapering off to a long point.

The south and east shores are high and rocky, while the western side, as usual, slopes gently to the sea with numerous rocky points joined by stretches of low sandy shore. The eastern shore is indented by a bay half a mile wide, which stretches inland from its capes for nearly a mile and affords a commodious and safe harbour. A second harbour is formed by two rocky islands nearly inclosing a smaller bay south of the north-east point.

Two high rocky ridges traverse the island from north to south. One of these forms the high eastern cliffs which in places have an elevation of upwards of 300 feet. The other ridge runs up the western half of the island, and has a sharp escarpment along its eastern side. A wide low valley lies between the ridges, and is largely occupied by small lakes, the largest of which is tidal and is connected with the eastern bay by a short channel, above the level of low tide.

The high cliffs of the south-eastern part of the island give a good section of most of the measures of the Nastapoka series of rocks. The

lower members are seen in the southern and eastern cliffs, while the iron-bearing series appears near the summit of these cliffs and in the western ridge, thus covering a greater part of the surface of the island. These iron-bearing rocks attain a maximum thickness on Taylor island, as is seen from the following section measured across the southern part from west to east :—

	Feet.
1. Rusty weathering, cherty rock ; contains much ankerite and splits into thin flags with thin partings and flat concretions of ankerite partly decomposed to brown oxide of iron	60
2. Dark grey silicious rock, or chert in thin beds with partings of ore, mostly in the form of magnetite along with some ankerite. The latter disappears as the measures are descended. The cherts hold small crystals of magnetite in their mass	55
3. Red jaspilyte, low in hematite ore	20
4. Red jaspilyte, rich in hematite ore	8
5. Red jaspilyte, low in hematite ore	20
6. Dark grey cherts with partings of magnetite-hematite ore from 1 in. to 30 in. thick	50
7. Red jaspilyte usually rich in hematite	20–50
8. Red jaspilyte lean in hematite	10
9. Purplish-weathering, dark green graywacke shales, less fissile than formerly and having a roughly columnar cleavage in the south cliff.	50
10. Light gray sandstone and light green shales. The sandstone is in five massive beds from 2 to 10 feet thick and numerous thinner beds	100
To sea level. Total	393–423

A chain of twenty-five small islands extends northward from Taylor island thirteen miles to Mowatt island. These islands lie in roughly parallel lines formed from the exposed portions of partly submerged rocky ridges. They are generally quite low; and the rocks seen in their cliffs are usually the purplish graywacke shale, or the overlying jaspilytes. The two largest islands are named Miller and Gordon, the latter being the larger, and a little over a mile long by half a mile wide. In its south-east cliff from twenty to forty feet of rich jaspilyte is seen above the graywacke shales. Elsewhere the low cliffs are formed of the dark gray cherts, never very rich in iron ore.

Mowatt island is roughly oval in shape; its longer axis lies north and south, and is two miles long; the shorter is slightly over a mile. The island is broken by low rocky ridges, with considerable drift in the intermediate valleys, which are dotted with small lakes and ponds. As usual, the eastern side has abrupt cliffs.

About twenty feet of sandstone rises above the sea in the south-east cliffs; elsewhere the lowest measures seen are the purple shales or the

beds of jaspilyte. The iron-bearing series is not only thinner but the amount of contained ore is less than on Taylor island. The lean jaspilyte resting upon the graywacke shales is six feet thick with fifteen feet of the richer jaspilyte resting upon it. This in turn is overlaid by nearly 200 feet of dark gray chert with, usually, thin partings of magnetite ore; the whole being capped with a considerable thickness (50 feet) of rusty-weathering chert containing considerable ankerite in lenticular patches or as partings between the cherty beds. Much of the surface carbonate has been decomposed to brown oxide of iron.

Christie island is separated from Mowatt by a narrow channel, which is only 100 yards across at its narrowest part. Two good harbours lie on the east side of the narrows, one in the bay at the northern end of Mowatt, the other to the south of Christie, where a long sandy point practically incloses a small bay. Another harbour is formed by a small island lying off the western entrance to the passage between the islands.

Christie island is roughly triangular in shape. The base is towards the south and is two miles and a half long, while from north to south the greatest length is three miles. The eastern cliff in many places rises upwards of 300 feet above the sea. The interior surface of the island is rocky and traversed by low scarped ridges running roughly north and south. The intermediate valleys are filled with drift and dotted with lakes.

The following section was measured from the cliff at the south-east point of the island and gives the total thickness of the measures exposed :—

	Feet.
1. Dark gray, rusty-weathering chert; containing considerable ankerite partly decomposed to limonite	50
2. Dark gray chert, with thin partings of magnetite, none sufficiently thick for working	115
3. Red jaspilyte, lean in hematite	15
4. Dark greenish and purplish-weathering graywacke shales	85
5. Light gray, compact sandstone, with bands holding small red garnets	18
6. Light green, silicious shale	5
7. Light gray sandstone, pitted with small spots of brown carbonate. Beds 6 in. to 24 in. thick	8
8. Light gray sandstone with partings of shale	5
9. Light gray sandstone	1·5
10. Light gray sandstone separated into thin flags by narrow partings of light green silicious shale	2
11. Light greenish silicious shale, with many partings of sandstone flags	10
12. Light gray sandstone	1

13. Light greenish silicious shale with partings of flaggy sandstone (ripple marked) 8
14. Light pinkish and greenish sandstone in beds from 6 in. to 30 in. thick..... 13

To sea level. Total..... ...336·5

At the summit of the outer cliff there is a sharp synclinal fold, the rocks dipping W $< 45°$ on one side, and E $< 30°$ on the other. The rocks at the axis of the fold are badly shattered. This is one of a few cases noted where the rocks of this series have folded, as in nearly every case where folding might have taken place the rocks have broken and slid over one another, before the fold was completed.

Between Davieau and Christie islands lies a channel nearly a mile wide, with straight walls of cliff on both sides. The cliffs lower gradually towards the western entrance of the channel where they die away in rocky points. The channel is called Tuksuit or "The Throat" by the Eskimos. It is a favourite stopping place for these people when travelling in winter owing to the number of seals frequenting the chan nel where they are killed with spears through holes or cracks in the ice.

Davieau is one of the larger islands of the chain, being ten miles long and in the widest part, two miles across, with an average breadth not exceeding a mile. Its longer axis, like that of the islands to the northward, lies north-northwest, or parallel to the general trend of the coast which changes from north to north-northwest at White Whale point opposite the southern end of the island.

The eastern coast is rugged and broken into a number of small bays, none of which afford good harbours for easterly winds.

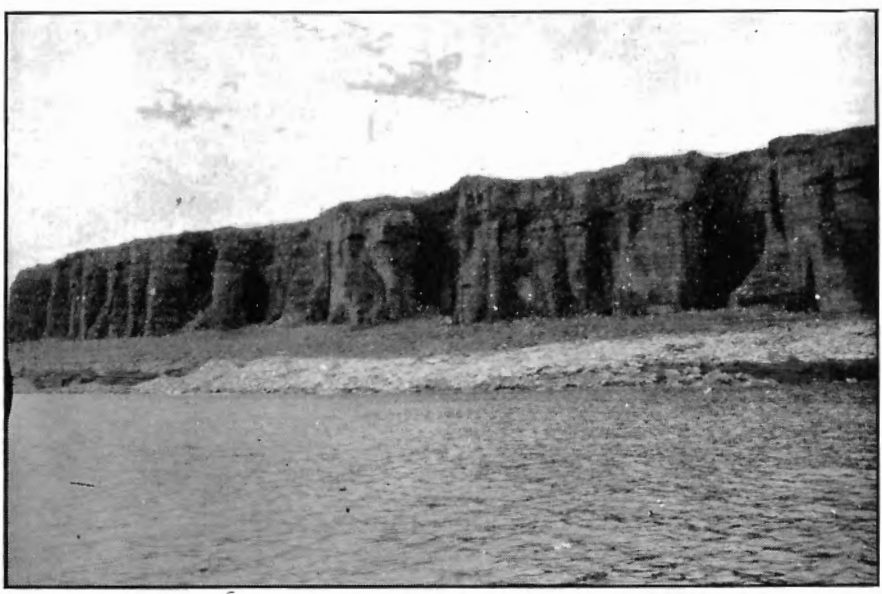
The interior and western portions of the island are largely covered with drift and these areas are dotted with many ponds and small lakes.

Near the south east end of the island the following section of the iron-bearing series was measured:—

Feet.

1. Rusty weathering, dark gray chert, containing considerable ankerite.... 50
2. Dark gray chert, lean in magnetite, and with thin partings of magnetite ore..... 115
3. Red jaspilyte, poor in hematite..... 20
4. Impure red jasper rock 5
5. Two purplish graywacke shales, compact with green splotches, towards the upper part containing thin bands (1 in. to 5 in. thick) rich in hematite, which stains the shales and gives them the appearance of polished metallic iron.

CLIFFS ON EASTERN SIDE OF BROUGHTON ISLAND.



CLIFFS OF LIMESTONE AND SANDSTONE ON COTTER ISLAND.

Towards the northern end of the island the dark gray cherts become thicker, especially the upper rusty portion carrying ankerite, while the underlying jaspilyte contains less hematite, and gradually thins out. The total amount of iron ore in these rocks appears to be less than in those of the southern islands and to be more evenly distributed through the measures, so that no part is sufficiently rich and concentrated to permit of the ore being mined profitably.

Nicholson island is separated from Davieau by a channel only a quarter of a mile across at its narrowest part. It is two miles and a quarter long, by nearly a mile across at its widest part. The southern third of the island forms a long narrow point, largely covered with drift. Lying off this portion are three small rocky islands. The cliffs begin on the east side near the northern end of this point and continue to the north end of the island. The interior is largely drift-covered and dotted with ponds, and the western shore is low. A very good boat harbour is situated on the east side about a mile from the south end, in a small bay behind a rocky islet.

The rocks are displayed in the cliffs from the greywacke shales upwards. The dark gray cherts have a thickness of about two hundred feet, and the jaspilyte beds have nearly disappeared. The amount of iron in the measures has decreased and is nowhere sufficiently concentrated to afford workable deposits. The carbonate ores descend much lower in the measures than they do to the southward and there appears to have been but little redistribution and concentration of the iron. The summit beds of the dark gray chert contain considerable light green chert in lenticular masses. They are overlaid by ten feet of a reddish-weathering basic rock of a greenish colour, arranged in thin horizontal layers. It is usually fine-grained, but sometimes is sufficiently coarse to show crystalline faces of plagioclase, of which it is largely composed. The rock appears to be a very fine-grained trap injected between beds and foliated by vertical pressure.

Broughton island is the largest of the Nastapoka chain, being thirteen miles long, and upwards of two miles across, to the northward of its mid-length, where it attains its greatest breadth. High cliffs rise at its northern and southern ends with a long stretch of low sandy shore between them on the eastern side. Two good harbours are situated on the east side near the southern end of the island, where shelter is afforded in small bays covered by small islands lying a few hundred yards off shore. The northern part of the east shore is deeply indented by small bays, all of which afford excellent harbours. The interior of the island is mostly covered with drift with many lakes,

some of which are fairly large, and are the breeding places of numerous ducks and geese.

The southern part of the eastern cliff is largely formed of the dark gray iron-bearing cherts resting upon a thin band of graywacke shales which in turn are underlaid by beds of sandstone. The amount of iron ore in the dark gray cherts apparently continues to decrease in quantity, the richest bands of magnetite seldom exceeding six inches and never attaining eighteen inches in thickness. They are always separated by wide beds of barren rock, so that two or more bands of ore could not be worked to advantage at the same time. The northern cliffs give a more extended section with a greater thickness of the underlying sandstone.

McTavish island lies two miles north of Broughton with a small island in the channel about midway between the large islands. McTavish is a long narrow island, its length being eight miles, while it rarely exceeds half a mile in breadth. Its eastern shore is nearly straight and consequently without harbours. The highest part of the eastern cliff does not attain an elevation of two hundred feet, and rarely rises more than one hundred feet above the sea. The interior surface is like that of all the other islands—largely drift and lakes. Low ridges of rock outcrop in places and there is a general easy slope towards the eastern shore.

The following section was measured down the eastern cliff near the middle of the island:—

	Feet.
1. Rusty-weathering, dark gray chert, holding considerable ankerite	50
2. Red jaspilyte, poor in hematite ore	8
3. Dark green, graywacke shale, showing, on weathered surfaces a semblance to metallic iron	34
4. Dark purple-weathering graywacke shale containing a few thin bands or veins of bright red hematite from one to six inches wide.	50
5. Impure red jasper	4
6. Massive, light gray sandstone	10
7. Light gray sandstone in beds from two to six inches thick separated by much light green silicious shale, all containing a small quantity of dolomite	50
To sea level. Total	175

Cotter island is the most northerly of the Nastapoka chain; it lies nineteen miles beyond McTavish and is twenty-six miles south of the Hopewell chain of islands, and so constitutes an intermediate link between them. The island is four miles long and averages half a mile in breadth. It is lower than the islands to the south and its eastern cliff

rarely attains an elevation of one hundred feet. The shore-lines are nearly straight and afford no harbours. The surface of the island is generally rocky with a few patches of drift towards the southern end, while the northern end is covered by a sheet of trap.

The eastern cliff is formed largely of a light bluish, calcareous sandstone which is split into huge blocks by vertical cracks; many of these cracks are wide and form deep caves near the sea level and give to the cliff a very picturesque castellated appearance.

The following section was measured down the eastern cliff at a point about one mile from the north end of the island:—

1.	Highly decomposed, fine grained trap	20
2.	Light greenish shales, with partings of light bluish, arenaceous limestone	35
3.	Light greenish and bluish calcareous sandstones (ripple-marked). Some of these beds have on their surfaces curious irregular markings, made by very thin deposits of black carbonaceous matter which may be the fossil remains of some low organism	50
To sea level.	Total	105

The measures given above appear to represent those underlying the iron-bearing series of the southern islands, the shales and sandstones being very similar to those of McTavish island, except that they contain a larger quantity of limestone, or dolomite. The overlying trap may be closely related to the graywacke shale, as the latter contains much igneous matter, and, as before stated, was probably a trap-ash. These rocks are also continued in the Hopewell islands to the northward, where the trap attains a much greater thickness and overlies sandstones almost identical in appearance with those of Cotter island. The trap caps all the Hopewell islands and consequently the iron-bearing series is not represented in the rocks of those islands.