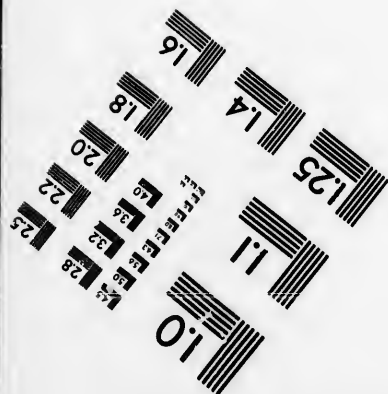
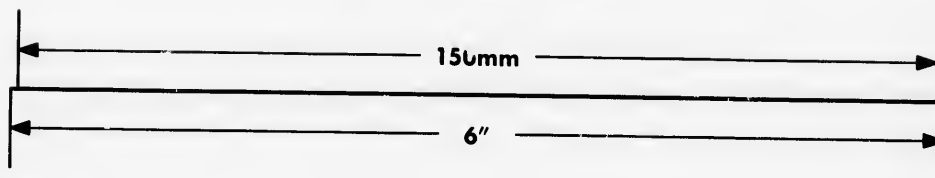
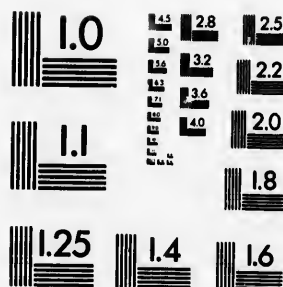
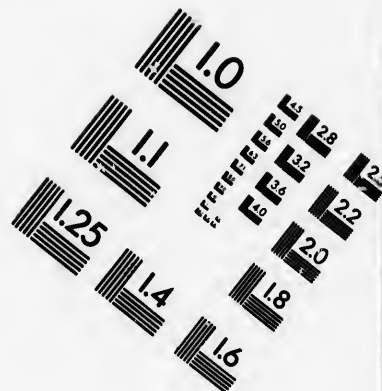
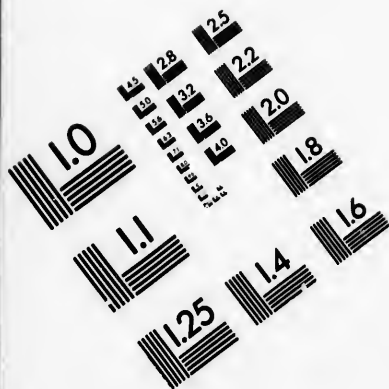
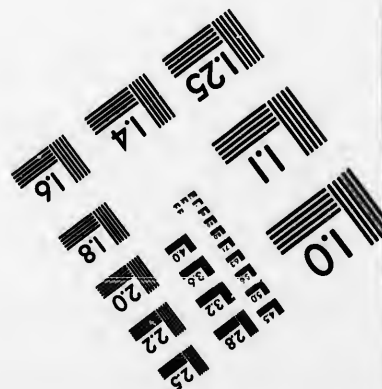


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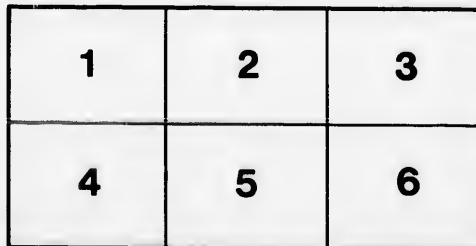
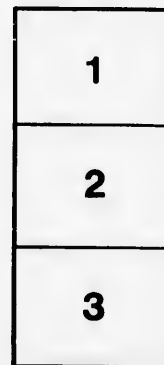
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REPORT
ON THE
GEOLOGY OF NEWFOUNDLAND

FOR 1865.

By ALEX. MURRAY, Esq.

WITH A

PREFATORY REPORT AND AN APPENDIX,

By SIR W. E. LOGAN, F.R.S., F.G.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

WITH A MAP OF BELVIE BAY.



MONTREAL:

JOHN LOVELL, PRINTER, ST. NICHOLAS STREET.

1866.

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GEOLOGY OF NEWFOUNDLAND.

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REPORT

OF

SIR W. E. LOGAN, L.L.D., F.R.S., F.G.S.,

ADDRESSED TO

THE HONORABLE E. CARTER, M.P.P., ATTORNEY GENERAL,
ST. JOHNS, NEWFOUNDLAND.

GEOLOGICAL SURVEY OFFICE,

MONTREAL, 1st May, 1866.

SIR,

Mr. Murray has submitted to me the results of his geological exploration in Newfoundland during the last two seasons ; and it gives me much satisfaction to observe the progress he has already made in developing the general structure of the eastern part of the island. Before he commenced his labors, Mr. Richardson, under my instructions, had already visited the western coast, with the view of ascertaining facts to elucidate points connected with the Geology of Canada. It was then ascertained that a trough of Lower Silurian rocks must underlie the northern part of the Gulf of St. Lawrence, gradually narrowing toward the Strait of Belleisle, one side of the trough rising on the coast of Labrador, while the other forms the western shore of Newfoundland from Bonne Bay to Cape Norman. On each side of the strait these rocks were found to rest on Laurentian gneiss ; and the mass of this ancient system, which presents itself in this part of Newfoundland, was ascertained to extend from the neighborhood of Bonne Bay to within twelve or fifteen miles of Hare Bay, but its breadth was not determined. Mr. Murray's investigations have since proved that this mass of Laurentian rocks spreads in breadth to the Atlantic coast of the great northern peninsula of the island ; that the base of the Lower Silurian strata, sweeping round the northern extremity of the gneiss, comes upon the coast near Canada Bay, and again strikes into the land at Coney Arm, in White Bay, where these Lower are overlaid by

Explorations of
Mr. Murray and
Mr. Richardson.

Lower Silurian
trough, Strait of
Belleisle.

Laurentian
rocks.

Upper Silurian,
Devonian, and
Carboniferous.

Upper Silurian, followed by rocks of Devonian age. Farther to the south-east, the Laurentian and Silurian series become partially and unconformably covered by rocks of the Carboniferous age, in two or three separate areas, which have heretofore been mentioned by Mr. Jukes. One of them is upon Grand Pond, and another on St. George's Bay. In his traverse last year, from Hall's Bay to St. George's Bay, Mr. Murray traced the western margin of the more northern of these, for about thirty miles, and observed the more southern at several points on the north and south-east shores of the bay which has last been mentioned.

Having thus ascertained the general position of these Carboniferous areas, it is important to determine with as little delay as possible what workable seams of coal may be associated with them; and Mr. Murray proposes to devote the chief part of his investigations during the ensuing season to this end, as well as to trace, as far as he can, the outcrop-course of any seams he may discover.

Coal beds at
Sydney.

The nearest known coal deposits to the Island of Newfoundland are the beds worked at Sydney, on the Island of Cape Breton; and it is not unreasonable to suppose it probable that there will be a general analogy in the character of the measures on the opposite sides of the water dividing them. At Sydney, between the base of the coal measures and the workable seams, there is a thickness of barren strata of between 3000 and 4000 feet; and if the same conditions exist in Newfoundland, it will depend upon the attitude of the strata whether we may expect the occurrence of coal beds there to become available to commerce. Mr. Murray observed a regular coal seam of six inches in thickness; but this would not be workable. Mr. Jukes has reported one of three feet; but at Sydney there are four workable seams, measuring altogether upwards of fifteen feet, in a thickness of 3000 feet, that at the bottom being three feet; and no time should be lost in determining such facts as will make it known whether these seams exist, or may be reasonably searched for by capitalists in the Carboniferous areas of Newfoundland.

Quebec group.

Mr. Murray's explorations on the east side of the northern peninsula, and Mr. Richardson's on the west, have shown that the Lower Silurian series in the northern part of Newfoundland is characterized by a great spread of that portion of it, which in Canadian Geology has been termed the Quebec group. This group may conveniently be separated into three divisions,* the middle one of which has proved rich in metalliferous deposits, in its course from the southern Atlantic States of the American Union to Canada, and through eastern Canada to Gaspé. The indications observed by Mr.

* The relations of this group and of its divisions are so important that I append a brief synopsis of them, in which the Lower Silurian strata of Newfoundland and the two basins of north-eastern continental America are compared.

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Murray are sufficient to authorize the expectation that the formation will prove productive of these metalliferous minerals in Newfoundland; and the Tilt Cove and Terra Nova mines, which are both in serpentine belonging to the middle division, are evidences that a detailed investigation of the distribution of the Quebec group is only second in importance, in an economic point of view, to that of the Carboniferous series. The occurrence of serpentine in the more southern part of Newfoundland has been pointed out by Mr. Jukes in various isolated places: and it appears to be probable that this rock will, in most, if not all of these, be found to belong to the Quebec group. The scattered facts already thus known, prepare us to expect a great development of the metalliferous division of the group in the southern, as well as the northern portion of the island, convincing me that a thorough knowledge of a great portion of the mineral wealth of the province will be vastly promoted by a careful and connected exploration and study of the Lower Silurian series.

Tilt Cove and
Terra Nova
mines.

Serpentine.

I have now the honor to transmit to you the accompanying Report of his first exploration, addressed to me by Mr. Murray while I was in England last year. The study of it required a reference to a collection of specimens which had been forwarded to the office of the Canadian Survey for examination; and the death of my brother, soon after my return, forced me to postpone the consideration of it longer than I wished.

I have the honor to be,

Sir,

Your most obedient servant,

W. E. LOGAN.

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REPORT
OF
ALEXANDER MURRAY, Esq.,

ADDRESSED TO

SIR W. E. LOGAN, F.R.S., &c.

LONDON, 11th April, 1865.

SIR,

In accordance with an arrangement made by yourself with the government of Newfoundland, by which I was selected to make a geological investigation of that province, I left Montreal, accompanied by Mr. H. H. Beckett as an assistant, on the 18th May last, and reached St. Johns, Newfoundland, on the 31st of the same month, when I immediately placed myself in communication with the Hon. H. W. Hoyles, Attorney General, to receive final instructions.

It being your desire that the great northern peninsula of the island, where most of the sea-coast is well exposed, should be examined as a commencement of the investigation, the Provincial Government were pleased, on my recommendation, to charter a schooner of twenty-seven tons burden, called the A. M. W. of Harbor Grace, with a crew consisting of a pilot commanding, and four seamen for the service. It was not, however, until the 22nd June that the vessel was refitted, and ready for sea; and during the interval, I employed my time in partially examining that portion of the peninsula of Avalon lying between St. Johns and Topsail Head in Conception Bay.

We finally left St. John's upon the 23rd June, and reached Twillingate, a port of some importance near the entrance to the Bay of Exploits, on the 27th of the same month, having been much detained on the voyage by fog and stormy weather. On the 30th June we reached Little Bay, where the examination was begun in earnest, at Terra Nova mine, and where advantage was taken of the opportunity to explore the coast and portions of the interior between that bay and Ming's Bight. After leav-

ing Little Bay, we proceeded to examine the northern peninsula, making excursions into the interior on every convenient occasion; and by the time this part of the work was accomplished, the season had advanced to the 3rd of October, after which we repaired to Twillingate to refit the vessel. Finally, a rather hurried excursion was made to Little Bay; and the Indian Brook, a large stream which falls into that bay, was ascended for a considerable distance, after which we sailed for St. Johns, and reached that port on the 3rd of November.

SEQUENCE AND DISTRIBUTION OF THE ROCKS OF THE GREAT NORTHERN PENINSULA.

Rocks of the
northern penin-
sula.

The rock masses observed in the great northern peninsula are recognized as belonging to the following geological divisions, which are given in ascending order.

1. Laurentian.
2. Potsdam group,
3. Quebec group } Lower Silurian.
4. Upper Silurian.
5. Devonian.

I. LAURENTIAN SYSTEM

Little Coney
Arm.

The rocks classed under this head occupy upwards of fifty miles of the eastern coast of the northern peninsula, extending from Little Coney Arm in White Bay, to within a few miles of Canada Bay. About four miles to the southward of the entrance to this bay, they strike into the land, and keeping to the westward of the bay, and of the Clouds Mountains, which are intermediate, they run a northerly course. The most northern exposure of them which was seen, occurred between three and four miles west of the Long Arm of Canada Bay, on a brook joining the arm, towards the upper end. Here the strike still continues northward; but there is little doubt that the limit of the series, beyond this, will soon turn gradually westward, to join the most northern position, where Mr. Richardson observed the hills composed of it on his visit to the western side of the peninsula in 1862.

Salt Water
Pond Brook.

In an exposure of the series met with a little more than two miles up Salt Water Pond Brook, the rock, which is of a reddish color, is fine-grained, and is composed chiefly of flesh-red orthoclase feldspar, with white quartz and brown or black mica. It is interstratified with layers consisting chiefly of fine black mica with grains of white quartz; and by these black bands it was easy to observe that the dip was to the eastward. In the two brooks which have been mentioned, there were no great exposures of the gneiss, but the loose blocks observed in the beds of the streams, and

Gneiss.

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GREAT NORTHERN

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on the banks on each side, derived, probably, from the formation not far off, made it evident that what is given above, is the general character of the gneiss in this part. Many blocks of greenstone were associated with those of gneiss, and on Salt Water Pond Brook, dykes of a similar description were seen intersecting the gneiss.

Greenstone
dykes.

In Hooping Harbor the general mass of rock is gneiss; but at the mouth of the brook, which flows in at the head of the north-east cove of the harbor, there are heavy bands of what cannot be distinguished from granite, some parts of them reddish and others gray, according to the color of the feldspar, which is sometimes in large tabular crystals, the quartz being whitish and in fine grains, while the mica is usually black, and in small scales. On the east side of the cove these bands of granite alternate very regularly with thick beds of coarse black mica-slate, clearly showing the stratified character of the mass, and giving a dip of $S. 88^{\circ} E. < 30^{\circ}$. Farther south, but on the same side of the harbor, there is a great amount of milk-white gneiss, deriving its color from opaque white orthoclase feldspar and white translucent quartz, but having well defined marks of stratification, in darker and lighter gray parallel streaks, deriving their color from the presence of more or less black mica. At the head of the western cove, or arm of the harbor, there is a great mass of a somewhat coarse flesh-red granite, in which no stratification could be made out, but it was overlaid by finely laminated beds of gneiss, and those upon the north shore of the cove appeared to be nearly horizontal. The cliffs on each side of the western arm, which rise almost perpendicularly to the height of between 650 and 700 feet, are all of gneiss, with bands of mica-slate, large tabular crystals of flesh-red feldspar being often observed in the strata. The dip at the head of the western arm is $S. 80^{\circ} E. < 25^{\circ}$, but there are numerous undulations and contortions which render it difficult to establish an average. In these cliffs, and generally, in the harbor, the gneiss is cut by many fine grained greenstone dykes, some of which are of great thickness. One of them, on the east side of the harbor, measured 130 feet across. These dykes appear generally to be about parallel to one another, their course being $N. 54^{\circ} E.$ and $S. 54^{\circ} W.$ Small veins of pegmatite, consisting of flesh-red orthoclase feldspar with some grains of quartz, are abundant in some places. At the extremity of the cape, on the east side of the entrance to Hooping Harbor, copper pyrites was observed disseminated in a small mass of quartz, constituting a nest in the white gneiss of that part. No visible vein was connected with the mass, and it is only worthy of remark as showing that the rock is not destitute of this ore, which may possibly be found in larger quantity in some other place in the neighborhood.

Hooping Har-
bor.

Granite and
mica slates.

Greenstone
dykes.

Copper ore.

Between Hooping Harbor and Bay Fourchette the rocks seem to be all very much of the same character as those above described; but the strata composing the cliffs between this bay, and the banks on either side of the

Bay Fourchette.

stream which falls in at its western extremity, appear to be less red in color than those farther north, and the contortions which they show are more numerous. The highest point seen from the anchorage on the north side of the bay, rose up almost vertically from the water's edge to the height of 904 feet.

Grandevache.

The gneiss at Grandevache is very much like that at Bay Fourchette. In some beds it is red and in others gray. It is in general fine grained, and frequent layers of whitish quartzite and black mica-slate are interstratified in it. The strata are cut by dykes of fine grained greenstone; numerous veins of pinkish feldspar reticulate through the rocks, intersecting both the strata and the dykes, and cracks and joints in the rocks are frequently lined with a pellicle of specular iron ore. The prevailing dip of the strata is here about S. 70° E. $< 40^{\circ}$ — 50° .

Specular iron ore.

Little Coney Arm.

Going southward, the limit of the Laurentian gneiss enters upon the land in a small bay about two and a half miles south of Devil's Cove, on the east side of White Bay; and between this recess and Little Coney Arm, a narrow strip of the succeeding formation separates it from the water. It is about a quarter of a mile from the water, at the head of Little Coney Arm, where the gneiss is red in color, and rather coarse in grain. It is interstratified with bands of black mica-slate, and a considerable mass of the latter rock, perhaps 500 feet in thickness, forms the eastern limit of the exposure. In the cliffs, a little back from the extremity of the arm, the strata are contorted, but the general dip of the gneiss is here nearly vertical, the strike being about north and south. At the mouth of a small brook, however, in the south-west corner of the arm, there are some beds of dark gray gneiss, which dip S. 46° E. $< 55^{\circ}$.

Gold Mine Cove.

From Little Coney Arm the limit of the Laurentian gneiss pursues a somewhat sinuous course southward, and the last exposures of it visited were met with about five miles westward of Gold Mine Cove, near the upper end of White Bay. Here the gneiss is of a dark gray color, and its constituents are grayish orthoclase feldspar and grayish quartz, with black hornblende and dark brown mica, usually in very minute scales. The strata are a good deal corrugated, and white quartz veins are numerous, some of them running in the strike of the rock, and others somewhat oblique to it, while the strata are intersected by many dykes of dark gray fine grained greenstone. The general trend of the strata, and of the hill-ranges, is here about south by west.

Bonne Bay.

From this spot to that at which Mr. Richardson left the Laurentian gneiss, in tracing its limit south-eastward near Bonne Bay, the distance in a straight line, a little south of west, is about thirty miles. It is extremely probable that the same rock composes the country the whole way; but where the opposite sides of this Laurentian mass, which forms the backbone of the northern peninsula, will ultimately join, in their trend southward, can only be determined by future exploration.

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The rocks which have thus been described are considered Laurentian, not merely from the lithological resemblance which they bear to the strata of that system in various parts of Canada, but also from the relation they are seen to have to the Lower Silurian strata, which unconformably cover them in the northern part of the peninsula. They there present an exact analogy with the conditions of the masses seen on the north side of the Strait of Belleisle, the gneiss of which is distant from the nearest part of that of Newfoundland, not more than forty miles, while it is uninterruptedly connected with the great continental spread of the system in Canada. In Canada the Laurentian gneiss is in some parts interstratified with enormous bands of crystalline limestone, and it is usually in these, or in the vicinity of them, that are met with the Laurentian minerals of economic importance; while the valleys that are underlaid by the limestones often give a considerable amount of surface capable of settlement. These economic minerals are the magnetic and specular ores of iron, the ores of lead and of copper, apatite or phosphate of lime, mica, and graphite or plumbago. None of these bands of crystalline limestone have yet been met with among the gneiss of the northern peninsula; but as it is only the rim of the 3000 square miles of it there spread out, which has thus far been examined, the calcareous bands may yet be found in the interior, should the examination at some future time be carried into greater detail. It will be seen by the description already given, that the only traces observed of any of the economic substances mentioned, were thin leaf-like veins of specular iron ore in Grandevache Bay, and a nest of copper pyrites at Hooping Harbor.

Strait of Belle-
isle.

Laurentian eco-
nomic minerals

II. POTSDAM GROUP.

Immediately east of the Laurentian gneiss, in the neighborhood of Canada Bay, the Clouds Mountains rise to a greater height than any part of the country for many miles around, and their bold and fantastic outline forms a picturesque and conspicuous feature, readily recognizable for a great distance. Three of the highest summits, on all of which the compass was affected by great local attraction, were found by triangulation to be 1173, 944, and 920 feet above the level of the sea. The first of these, called the Capped Mountain, is on the north side of Salt Water Pond Brook, and the other two on the south. The rocks composing these hills consist, at the base, of a great thickness of dark gray slates, not very well seen, but probably amounting to 1500 feet. These are followed by dark gray, and occasionally drab colored slates, with many interstratified conglomerate beds, not in general exceeding six inches in thickness, holding small quartz pebbles in the same slaty base. This mass, which may attain a thickness of about 500 feet, is surmounted by about forty feet of a dark purplish-gray diorite, apparently of an amygdaloidal character, containing nodules and numerous small masses of impure

Clouds Moun-
tains.

Slates and con-
glomerates.

Division A.

epidote, and jaspery peroxyd of iron, and is cut in many places by thin leaf-like veins of the same jaspery ore. The upper bed of this mass of strata, thus amounting to about 2000 feet, which we may designate as Division A, is seen at the summit of the more northern of the two hills which are south of Salt Pond Brook, from which the diorite slopes with the geographical surface, at an angle of about fourteen degrees, towards Canada Bay. The margin of the bay, however, from the point north of Weymouth Cove to Hell Mouth, a distance of about six miles, is composed of overlying rocks; while for miles farther, to the Gouffre, it consists of those of the Clouds Mountain range. Between the Gouffre and Canada Harbor, the coast is again composed of the overlying rocks.

In the bed of Salt Water Pond Brook, at their junction with the Laurentian gneiss, the strata of the Clouds Mountain range are vertical; farther removed from the gneiss, but somewhat to the north-west of the brook, they are highly tilted, with an inclination to the north-eastward; but descending the brook to within less than a mile from its mouth, the beds gradually present a moderate degree of regularity with a dip N. 26° W. < 18°. Between this and the pond, there is an interval of concealment, of about three-quarters of a mile, which is succeeded by exposures of higher rocks around the pond, and at the entrance to Long Arm. From these exposures, the following ascending series of deposits is gathered, the base being at the mouth of the brook, and the summit at the point on the north side of the entrance to Long Arm. These rocks we may designate as Division B.

Division B.

- | | Feet. |
|---|-------|
| 1. Yellowish and gray argillaceous and somewhat micaceous slate, and gray compact limestone, having a conchoidal fracture, interstratified with one another towards the middle, in beds of from two to three feet, with white and yellowish sandstone or quartzite in thin beds towards the top. | 300 |
| 2. Blue limestone, having a conchoidal fracture, in beds of from five to ten inches, with a one-foot bed of reddish variegated limestone towards the middle, almost made up of fragments of trilobites; among them <i>Olenellus Vermontanus</i> (Hall) occurs, and weathered surfaces of other calcareous beds in some parts show the remains of fucoids. | 400 |
| 3. Black and gray slate, in bands of from fifteen to twenty feet, interstratified with beds of white sandstone, of from five to seven inches thick, and of pale gray arenaceous limestone, weathering yellowish, and probably dolomitic, in beds of from five to ten inches thick near the base; the exposed surfaces of some of the calcareous beds are covered with small reddish nodules, which probably replace organic remains. These were observed at the entrance of Salt Water Pond. | 53 |
| 4. Black or dark gray slates, many bands of them hard and silicious, interstratified with beds of quartzite. Some of the slates contain many specimens of a <i>Lingula</i> , which appears, according to Mr. Billings, to be a new species, but allied to <i>L. prima</i> (Conrad). | 300 |
| 5. Blue and gray limestone in beds of eighteen inches and two feet. | 100 |

Fossils.

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upper bed of this mass of
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fourteen degrees, towards
from the point north of
at six miles, is composed
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Feet.
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The locality in which *Olenellus Vermontanus* was observed was at the Potsdam fossils.
entrance to Long Arm; and the presence of this trilobite in deposit 3,
with a brachiopod so nearly allied to *Lingula prima* in 4, leaves little doubt
that the strata in the above section belong to the Potsdam group, of
which the trilobite is peculiarly characteristic, both on the west side of
the gneiss in Newfoundland, and on the north side of the Strait of Belle-
Isle. Although the strata of the Clouds Mountain range were nowhere
seen in immediate contact with this recognized part of the Potsdam group,
yet as they apparently plunge beneath it, without any observed reason to
suppose a want of conformity, they will both for the present be classed
together.

The strata of the above section, in their strike south-eastward, come
against those of the two hills south of Salt Water Pond Brook, belonging
to the Clouds Mountain range, while the strata of the Capped Mountain
run against the Laurentian gneiss. By this it is evident that there is
here, on the south-east side of the valley of Salt Water Pond Brook, a
great fault, throwing the measures up on the eastward side. The course Fault.
of this fault is N. 53° E., and S. 53° W. The horizontal displacement
produced by it appears to be between two and three miles, but the data
are not sufficient to enable me to state with exactness the vertical amount.
This upthrow carries a portion of the strata of division B to the point
between Long Arm and Weymouth Cove; and the rocks already alluded
to as forming the coast from this point to Hell Mouth, and from the Gouffre
to Canada Harbor, belong to them. At Beaver Cove, which is inter- Beaver Cove
sandstones.
mediate between Weymouth Cove and Hell Mouth, the strata consist of
sandstones or quartzites, surmounted by dark gray somewhat calcareous
slates, with a dip S. 20° E. < 22°—33°, probably corresponding with the
upper part of B.3. The long point on the east side of Gouffre Cove is
composed of limestones, pale gray at the bottom, and white at the top,
exposed for about 100 paces across the measures, in a cliff of from 100 to
120 feet high. In this, the strata dip at various high angles, presenting
many cerrugations, which render it difficult to determine the exact thick-
ness, but it probably exceeds 200 feet. These limestones are supposed
to be equivalent to those of B.5, with an additional thickness, and they
are underlaid by a mass of disturbed and corrugated slates, which would
occupy the horizon of B.4. Similar rocks appear to form the promontory
on the west side of Canada Harbor. The limestones seen to be about
the same thickness; and the upper part of them, being pure white and fine-
grained, and capable of receiving a high polish, would afford a considerable Gouffre Cove
limestones.
amount of good material for ornamental marble. White marble.

At the head of Canada Harbor, these white limestones are brought
abruptly against slates, with quartzites and diorites, belonging to a higher Canada Harbor.
formation, by a great downth. w fault, running S. 31° W. The posi-

Fault.

Bide Arm.

Eagle Island.

tion of the fault is marked by the occurrence of several caverns in the limestone, from one of which there issues a beautiful stream of clear cold water. This fault, crossing the entrance to Canada Bay, strikes into a small cove, on the inside of the point separating Bide Arm from the Atlantic. Its effect upon the strata carries the strike parallel with it, and on the inside of the point they are exposed in a highly disturbed condition, and divided from the slates and diorites of the higher rock by a narrow belt of bog or low springy land, which marks the position of the fault. The fault here appears to run N. 19° E., keeping a little inland from the eastern shore of Bide Arm, and nearly parallel with it towards the northern extremity of the arm. The exposures on Eagle Island, which is immediately west of the point separating Bide Arm from the Atlantic, consist, on the west side, of the slates of B,4, and on the east, of the pale gray and white limestones of B,5. The dip on the island is about S. 76° E. < 25°—32°, and the whole of the strata, together with the limestones in the channel, up to the fault, have an estimated thickness of 1300 feet; of this about 400 feet would belong to the slates, and about 900 feet to the pale gray and white limestones, which is probably their total volume. As in the case of the limestones of Canada Harbor, of which they are evidently a continuation, with additional thickness, some of the beds are very white and compact, and would afford material available as ornamental marble; but the rock has a prevailing pale bluish tinge, and it is frequently streaked and spotted with pale blue and pale rose-red, which would probably be found an objection to its use in the higher works of art.

On leaving the north end of Eagle Island, the strike appears to make a sudden sweep to the north-westward; and at the point of the peninsula which divides Bide Arm from the main body of Canada Bay, a series of calcareous strata is exposed, which are considered an addition to the measures already given, and may be designated Division C. In ascending order they are as follows:

Division C.

Scolithus.

- | | Feet. |
|--|-------|
| 1. Bluish-gray, white-weathering compact limestone, in a few beds of two and three feet, showing fine lines of lamination on the out-cropping edges; the rock is penetrated by vertical forms resembling <i>Scolithus</i> , and on weathered surfaces there are scattered forms which appear to be obscure remains of fucoids..... | 7 |
| 2. Pale gray limestone in two massive beds, penetrated by numerous forms resembling <i>Scolithus</i> . The rock has a conchoidal fracture, and is probably suited for marble | 5 |
| 3. Pale blue hard limestone, presenting occasional obscure remains of fucoids on weathered surfaces..... | 1 |
| 4. Pale gray white-weathering limestone, in two massive beds, showing vertical cleavage lines..... | 8 |
| 5. Dark blue nearly black limestone, which weathers very white; it is penetrated by vertical forms, supposed to be <i>Scolithus</i> ; the weathered surfaces of beds are covered with brown or reddish patches, supposed to be remains of fucoid or corals..... | 6 |

ce of several caverns in the beautiful stream of clear cold Canada Bay, strikes into a rating Bide Arm from the the strike parallel with it, in a highly disturbed condition of the higher rock by a marks the position of the E., keeping a little inland ly parallel with it towards osures on Eagle Island, rating Bide Arm from the of B,4, and on the east, of dip on the island is about together with the lime- estimated thickness of 1300 tes, and about 900 feet to bably their total volume. rbor, of which they are ss, some of the beds are available as ornamental ish tinge, and it is fre- l pale rose-red, which the higher works of art. strike appears to make point of the peninsula Canada Bay, a series of d an addition to the vision C. In ascend-

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beds, show-	
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or reddish	
.....	6

	Feet.	
6. Gray limestone filled with silicified sub-globular forms, supposed to be organic remains.....	1	
7. Bluish gray compact limestone, in beds of from one to two feet thick, with scattered forms on weathered surfaces, supposed to be the remains of fucoids.....	11	
8. Brownish impure limestone, not well exposed.....	21	
9. Bluish hard limestone with a conchoidal fracture, in beds varying from one to four inches in thickness.....	18	
10. Pale bluish limestone in alternating thick and thin beds, varying from one foot to an inch. This forms the crest of a bold cliff facing the sea.....	30	
11. Blue white-weathering limestones in two massive beds.....	6	
12. Bluish-gray brown-weathering slates, interstratified with beds of bluish limestones, varying in thickness from ten to fifteen inches, the weathered surfaces of which are sometimes covered with obscure organic forms, supposed to be fucoids.....	66	
13. Bluish-gray white-weathering limestone in one massive bed.....	10	
14. Dark brown slates, and bluish and whitish limestones, in alternating beds, the uppermost bed of limestone weathers to a straw-yellow, and is probably dolomitic.....	50	
15. Blue and dark gray massive limestones interstratified with brown slates in equal quantities, the whole mass forming an undulating surface in the interior of the country. The limestone, at the summit, holds numerous nodules of black chert, weathering yellowish, which are arranged in layers parallel with the stratification.....	660	Chert.
	900	

At the base of the cliff, where the section commences, the dip is S. 44 E. < 26°, and at the top of the outer crest it is S. 44° E. < 34°; but in Bide Arm, some distance from the point of the peninsula, the inclination is irregular and sometimes approaches verticality, and the thickness of the latter part of the section may be understated.

Nearly the whole of the peninsula between Bide Arm and the main body of Canada Bay, is composed of the rocks of this division. The cherty limestone at the top is seen towards the extremity of the arm, on the west side, where the dip is S. 73° E. < 85°; while the rocks at the base of the division strike along the west side of the peninsula, gradually turning more north, and leaving room for a part of the white limestones of the previous division at two points on the coast included in the first three miles. The strike is nearly due north beyond this, for five miles, thence turning gradually more eastward towards the Salt Water Pond fault.

Following the formation northward from the section of Salt Water Pond, both sides of Long Arm seem to be composed of the Division B. In the beds of the brook flowing in near the upper end, on the west side, are seen the fucoidal limestones of B,4, and at the mouth of the brook there occur the limestones, whose surfaces are covered with the reddish nodules characterizing the base of B,5. The formation is not traced into the

Bide Arm peninsula.

In Long Arm.

country northward from this, and nothing of it was seen in Hare Bay though it is probable that the upper part of it approaches the coast somewhere near to West Brook, in the south-western part of the bay. The total thickness of the Potsdam group, as far as collected from the examination of Canada Bay, appears to be as follows:

	Feet.
A. Clouds Mountain bluish-gray slates, conglomerates, and diorite.	2500
B. Salt Water Pond bluish-gray, black, blue, reddish and white limestones, yellowish-gray and black slates, and gray and white sandstones, in some parts holding <i>Olenellus Vermontanus</i> , <i>Lin-gula</i> , <i>Scolithus</i> and fucoids.....	2000
C. Light and dark blue limestones, and brown slates with cherty limestone at the top.....	900
	5400

Between the cliff showing the cherty limestones in Bide Arm, and the recognized strata of the succeeding formation, there is a depression which appears to run all the way to North-east Arm. The rocks under this are concealed, and may add something to the volume of the Potsdam group.

In the neighborhood of Salt Water Pond, the strata of the Clouds Mountain range have a direct breadth of nearly three miles, but at the Gouffre the breadth is not more than about three-quarters of a mile. Whether this is to be wholly attributed to an increase of the dip, or whether it may be partly due to a thinning of the mass, is not quite certain. But in the next exposures southward, in which strata belonging to the Potsdam occur, the Clouds Mountain beds cannot be recognized with any degree of certainty. The localities of these exposures are at Great and Little Coney Arms. It has already been mentioned that the Laurentian gneiss, back from the extremity of Little Coney Arm, terminates in a considerable mass of black mica-slate. Between this and the succeeding exposure of rock, there occurs an interval of concealment, in which a depression runs in the strike, both northward and southward from the arm, forming on the south side, the valley of a small stream. On the east side of the depression there is seen another series of rocks, of which the following is an ascending section:

Little Coney
Arm.

Section.

	Feet.
1. Pale bluish-gray mica-slates with yellowish-brown iron stains, softer and more finely laminated than those of the Laurentian series, and more uniform both in color and texture.....	300
2. Pale bluish-gray iron-stained mica-slates, interstratified with bluish and blackish compact limestones, in beds of from one to three inches thick, and occurring at intervals of from two to four feet or more.....	430
3. Blue limestone in beds varying from ten to fifteen inches.....	50

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t approaches the coast some
rn part of the bay.
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follows:

	Feet.
erates, and dlorite.	2500
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<i>Vermontanus</i> , Lin-	
.....	2000
slates with cherty	
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.....	430
.....	50

	Feet.
4. Blue and gray compact limestone in beds varying from eight inches to two feet in thickness, with forms on weathered surfaces, supposed to be fucoids.....	30
5. Measures concealed.....	70
6. Pale gray black-weathering limestone in beds of from one to two feet, with cleavage joints in two directions, giving a brecciated aspect to the rock.....	110
7. Pale gray black-weathering compact limestone in beds of from four to five feet thick.....	80
8. Cream-white compact limestone, with a conchoidal fracture, in a single bed, probably fit for the purposes of marble.....	6
9. Pale blue drab-weathering limestone in beds of three or four inches thick, separated by thin layers of grayish-drab slate....	15
10. White very fine grained compact limestone, with a conchoidal fracture, in a single bed, with vertical cleavage joints running at right angles to the strike.....	15
11. White compact limestone, with a conchoidal fracture, in beds of from two to three feet, separated by thin layers of calcareous slate; the rock is probably fit for the purposes of marble....	35
12. Brown slates with interstratified white and yellowish fine grained compact limestones, in beds of from twelve to eighteen inches thick, with a two-foot band of darker, softer and more finely laminated slate at the top.....	75
13. Grayish-drab micaceous-calcareous slates, interstratified with pale blue and gray and whitish compact limestone, in beds of two feet thick and upwards.....	75
14. Blue compact limestone in a single bed.....	15
15. Pale gray fine-grained compact limestone, in beds of from one to three feet thick, parted by thin layers of gray slate.....	100
16. Pale gray black-weathering fine-grained limestone, in beds of from one to two feet in thickness, bordered by thin partings of blackish-gray slate.....	110
17. Grayish and bluish limestone in massive beds, separated by thin layers of slate.....	190
18. White compact hard limestone, in beds of from three to five feet, spotted yellow from decomposing iron pyrites.....	90
	1776

This section is obtained from the cliffs on the north side of Little Coney Arm, where the dip is E. $< 55^{\circ}$ — 70° , and where it extends across the measures for a distance of about 750 yards; at the eastward end of the line, the strata turn up again, with an opposite dip, forming a synclinal; *Synclinal.* the east side of which gives a repetition of most of the calcareous part of the section, before reaching the point at the entrance of the arm on the north side. A short distance along the coast from the corresponding point on the opposite side, the strata are seen to turn over again, forming an anticlinal, and, with an east dip, the limestones plunge under the surface *Anticlinal.* of Great Coney Arm. The character of the limestones of this section, and their relation to the Laurentian gneiss, render it pretty certain that they are a continuation of the calcareous rocks of Canada Bay, and therefore

belong to the Potsdam group. From the axis of the anticlinal which has just been mentioned, the water of Great Coney Arm is about seven-eighths of a mile wide, and on the opposite side there rises an escarpment composed of whitish, granitoid, very quartzose mica-slates. These have a breadth of about a mile and a quarter, and then sink beneath overlying uncomformable rocks. They present a somewhat uniform character for their whole breadth, as seen at the extremity of Coney Arm Head. They are somewhat corrugated, but generally dip to the eastward at a high angle. Supposing that the average inclination of forty-five degrees be given them, and that they are repeated by undulations, between two and three times, they would have a thickness of probably 1500 or 2000 feet. Whether they belong to the Potsdam group, it is difficult to say. No rocks like them have been anywhere found in this group, and they more resemble some of the strata of the metamorphosed Sillery series, as seen, but not in any such great volume, in the Eastern Townships of Canada. Should they prove to be of this series, then the intermediate strata of the Quebec group might be supposed to be buried beneath the waters of Great Coney Arm. But there is here scarcely room for them, and no certain traces of them have yet been met with in the run of the measures farther south in this neighborhood. It would therefore be necessary to allow the existence of a great downthrow fault to bring the Sillery series into the position occupied by these mica-slates.

The mica-slates gradually approach the limestones, in their southward trend, and about a mile up a considerable brook, which flows into Great Coney Arm at its southern extremity, the distance between them is about the third of a mile. This position is upwards of a mile west of Frenchman's Cove. At the extremity of Jackson's Arm, which is two and a half miles farther south, the mica-slates have a breadth of about a mile, in the western half of which they form high ridges inland, while the limestones rise about half a mile farther in, on the west side of the valley lying between them. These formations were here left trending southward, but they were not met with again in their southern distribution. The limestones are supposed to accompany the Laurentian gneiss in its course west of Sop's Arm, but the mica-slates did not appear on the coast at the extremity of it.

At Hauling Point, on the east side of White Bay, there is an exhibition of limestone. The color of the rock is for the most part white, but sometimes a pale rose-red; some parts of it weather yellowish, and these are occasionally dolomitic. It is coarsely crystalline, and mica is disseminated through it, and although probably a good material for burning into quick lime, it is inapplicable to any structural purpose. The dip of the rock is northward, and at the lower part it becomes interstratified with mica-slate. On the east side of a cove, inside of Hauling Point,

Granitoid mica-slates.

Coney Arm Head.

Probable fault.

Frenchman's Cove.

Jackson's Arm.

Sop's Arm.

Hauling point.

of the anticlinal which has
Arm is about seven-eighths
rises an escarpment com-
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Laurentian gneiss in its
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which would be beneath the previously mentioned rock, a coarse quartzose
granitoid mica-slate is met with, and a similar rock prevails along both
sides of the Western Arm up to its extremity, a distance of nearly three
miles across the measures. Here strong hard bands of micaceous gneiss
come in, bearing some resemblance to that of the Laurentian series. The
mica-slate which overlies them, strongly resembles that of Coney Arm Head.
If it be supposed that the gneiss of the Western Arm is Laurentian, it
would be fair to infer that the mica-slate of Coney Arm Head must be
older than the Sillery series, and be brought into place by an upthrow,
instead of a downthrow fault. The limestone of Hauling Point, notwith-
standing its very different crystalline condition from that of Great and
Little Coney Arm, might then be supposed to represent it; and the coarse
quartzose granitoid mica-slate on the opposite sides of White Bay to be
in the form of a trough, with the Potsdam group above it. It will be
necessary, however, that a great deal more should be ascertained of the
rocks to the eastward of White Bay, before such a question can be satis-
factorily determined.

Western Arm
gneiss.

Supposed syn-
clinal under
White Bay.

II. QUENEC GROUP.

Returning to Canada Bay, we find in the north-east corner of Bide Arm, a
series of gray and black limestones, many of them weathering yellow, and
probably magnesian. Between these and the cherty limestone at the top
of the previous formation, there intervenes the breadth of the arm; and as has
been already mentioned, a corresponding depression, under which the rocks
are concealed, runs from the north-west corner of Bide Arm to the North-
east Arm. Of this arm the east side is wholly covered with boulders; a
good deal of the west also is concealed; but near the mouth of the brook,
at the northern extremity, there are a few exposures of limestone, and it
is here that the base of the previous formation would strike the continua-
tion of the great fault of Salt Water Pond. On both sides of the North-west
Arm, but especially on the west, there are exposures of limestone, and near
the outlet of the brook, which falls into this arm at its northern extremity,
two massive beds of the rock are met with. The lower one is deep blue,
and weathers light yellow, being probably magnesian. It contains a num-
ber of gray blackish-weathering rudely sub-spherical concretions. Some
of them are of enormous size. One of them measures nine feet in diameter,
and several were observed measuring three feet. The upper bed is of a
pale gray on fracture, but weathers yellowish-brown, being probably mag-
nesian. The dip of these beds is N. 50° E < 10°; and about half a mile
farther up the stream, higher strata occur, consisting of about thirty feet of
gray and white limestones, in beds of from three inches to three feet, some
of them weathering yellow. The exposed surfaces of many are covered
with obscure remains of fucoids, and other fossils; and among the latter Mr.

Salt Water
Pond fault.
Limestone.

Concretions

Billings recognizes, in addition to fragments of trilobites and orthoceratites, *Maclurea canulata* (Billings), *M. Speciosa* (B.), and *M. Normani* (B.). These fossils belong to the Calciferous formation, which is the lowest of those that are classed under the designation of the Quebec group. It would thus appear that the base of the group stretches from Bide Arm to the North-west Arm, with a north-western trend; and it is probable that after running a few miles farther with this strike, it will turn up northward for Hare Bay.

Belvie Bay, which forms the south-western part of Hare Bay, has a very irregularly indented coast. It presents many deep coves, and many long sharp promontories, and it is studded with many islands. The exposures of rock are numerous, and a good transverse section was obtained extending from the neighborhood of the Southern Arm, on the west side of the bay, to Springs Arm, which is on the south side of Hare Bay, and somewhat behind the eastern limit of Belvie Bay, the distance being eight and a-half miles. The following appears to be the series of deposits which occur on it, as gathered from the exposures on each side of the line, and they are given in ascending order. The lowest deposit of the section, however, does not reach the base of the formation. How much is wanting is uncertain, but it cannot be less than some 500 feet.

Bide Arm.

Hare Bay.

Belvie Bay.

Section.

Fossils.

- | | Feet. |
|---|-------|
| 1. Gray yellow-weathering limestone, probably magnesian, in beds varying from three inches to one foot, with occasional thin partings of calcareous slate; on weathered surfaces there occur obscure remains of fucoids, with other fossils..... | 600 |
| 2. Black limestone in beds varying from six to twelve inches in thickness, followed by dark gray yellow-weathering, and probably magnesian limestone, in beds of from eight inches to one foot, separated by thin layers of greenish calcareous slate, which at the summit become of considerable thickness, and are interstratified with thin beds of dark gray yellowish-weathering limestone; the whole mass is terminated by a bed of brownish-black bituminous limestone. The limestones are for the most part fossiliferous, and among the fossils are <i>Murchisonia simulatrix</i> , <i>Maclurea Normani</i> , <i>Ptiloceras Wortheni</i> , <i>Orthoceras Allumettense</i> , and <i>Bathyrurus Nero</i> | 260 |
| 3. White compact limestone, with a conchoidal fracture, in beds varying from four to eight inches, aggregations of which alternate with beds of pale gray somewhat shaly limestone, of about the same dimensions. The gray limestones are fossiliferous, but the fossils are so fragmentary that it is difficult to determine them..... | 580 |
| 4. Dark gray yellow-weathering limestones, probably magnesian, in beds varying in thickness from three to eight inches, separated from one another by dark brownish yellow-weathering calcareous shales in thicknesses of from six to twelve inches..... | 180 |
| 5. Dark brownish yellow-weathering calcareous shales, with thin occasional bands of dark gray yellow-weathering limestone.... | 260 |

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6. Greenish calcareous shales interstratified, at considerable intervals, with thin bands of gray yellow-weathering limestone, exhibiting occasional faint traces of fucoids and other fossils, among which a <i>Holopea</i> was met with in Springs Arm. In several parts of the breadth from which this thickness is calculated, there are intervals of concealment.....	500	
7. Brownish conglomerate, holding pebbles of white quartz, and fragments of black slate and bottle-green diorite. The whole is studded with cubic crystals of iron pyrites, which cause the exterior to present a rusty brown color.....	20	Conglomerate.
8. Black slates with a cleavage independent of the bedding, and probably fit for roofing-slates in some parts of the thickness....	1100	Black slates.
9. Yellowish-white dolomite weathering brownish-yellow, in beds varying from two to three feet in thickness, separated by beds of gray yellow-weathering hard slates, of from three to five inches thick. The dolomite is very fully studded with cubes of iron pyrites.....	200	Dolomite.
	3700	

Above this there occurs a series of interstratified diorites, quartzites, and slates, with some bands of conglomerate having calcareous and other pebbles. The whole mass is very much corrugated; it is therefore difficult to estimate its thickness, but it probably does not exceed 400 or 500 feet. On the north side of Hare Bay, in How Harbor, a similar series of altered rocks is seen, overlaid by a mountain mass of serpentine. The hill in which the serpentine occurs has a vertical height of 500 feet above the sea, with a horizontal distance of half a mile from the outcrop of the base to the axis of the hill, and a dip towards the axis of twenty degrees: allowing for possible undulations, this would give 500 feet more, so that the volume of the serpentine may be 1000 feet.

The thickness from the base of the group to the summit of the black slates (8) would thus be about 4000 feet, and the dolomites, diorites and serpentine, 1600 or 1700 feet, making a total volume of 5600 feet. In the general Report of the Geology of Canada, published in 1863, the Quebec group series, on the west side of the northern peninsula, to the summit of a mass of black slates holding compound graptolites, to which the black slates of Belvie Bay are supposed to be equivalent, is given as about 4000 feet thick, while the diorites and serpentines are estimated at 1000 feet.

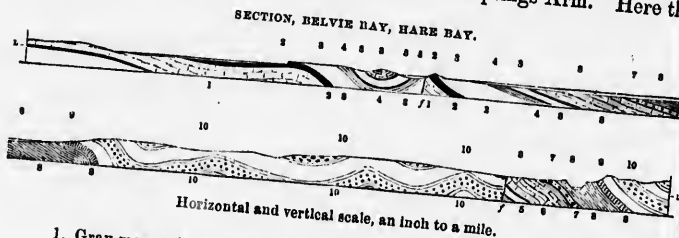
It will be seen from the accompanying plan and section how the measures are distributed on the coast and islands of Belvie Bay, and the general attitude they present in the exposures. Although the usual attitude of the beds shews but little disturbance, over the greater part of the area in the vicinity of Belvie Bay, there is nevertheless evidence of two dislocations of considerable magnitude. One of these was observed at the point between Shoal Arm and the main body of the bay, where the black limestone, sinking beneath the surface on the west side of the promontory, are

Plan and section.

Two faults.

Shoal Arm.

brought up again on the east side of a small synclinal, from a depth of about 200 feet. The other is on the west side of Springs Arm. Here the



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|------------------------------------|-------------------------------|
| 1. Gray magnesian limestones. | 7. Brownish conglomerates. |
| 2. Black limestones. | 8. Black slates. |
| 3. White limestones. | 9. Yellowish-white dolomite. |
| 4. Dark gray magnesian limestones. | 10. Diorites, dolomites, etc. |
| 5. Brownish calcareous shales. | 1. Sea level. |
| 6. Greenish calcareous slates. | f. Faults. |

greenish calcareous slates and gray limestones (6) are brought from beneath, on the east, and placed in juxtaposition with the diorites overlying the black slates (8), the amount of displacement being between 1500 and 2000 feet. These faults appear to be nearly parallel to one another, their course being about S. 23° W.

From the promontory south of the Western Arm to the Northern Arm, the coast of Hare Bay presents a beach, composed in general of sand and limestone gravel, with a flat wide-spread marshy country behind it, studded with innumerable ponds. There are no exposures of rocks along it, until on reaching a cove about a mile and a-half to the westward of the Northern Arm, where the limestones, of which a section has been given, are repeated, and compose the promontory and the island between the cove and the arm. The whole of the calcareous strata are comprehended in a distance of about a mile and a-half across the measures, and among the fossils obtained from them were *Murchisonia simulatrix*, *Maclurea speciosa*, *M. crenulata*, *Piloceras Canadense*, *Orthoceras* — ? and *Bathyrus* — ? with several other species of gasteropods and cephalopods, including a new species of *Lituites*, but all in a fragmentary condition. The dip is here eastward, with a somewhat regular slope of twenty-four degrees across the measures containing the limestones, giving a thickness of about 3000 feet. At the north-eastern end of the island which has been mentioned, the limestones are overlaid by a small amount of the black slates; but between the base of these, and a mass of diorites, which appears on the opposite side of the Northern Arm, there would be room for a thickness of the black slates equalling 1000 feet. The breadth and dip of the diorites, and their accompanying rocks on the east side of the arm, would give them a thickness of

Hare Bay.

Northern Arm.

Fossils.

Limestones.

Black slates.

Diorites.

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between 400 and 500 feet; and it is here that the serpentine mountain Serpentine. overlooking How Harbor, seems to show, as has already been stated, a thickness of about 1000 feet.

From the head of the Northern Arm the diorites run along the coast for seven or eight miles, apparently crossing the mouth of How Harbor in their course. It is probable that they then re-enter upon the land, and turn up to the north-east. In the north-western part of Hare Bay, the diorites thus appear to form the extremity of a trough, of which the serpentines Trough. constitute the centre. To the south of the south-eastern part of Pistolet Bay, Mr. Richardson observed mountains of serpentine, which probably Pistolet Bay. form the northern extremity of this synclinal range. In How Harbor, the black slates, interstratified near the summit with conglomerates holding numerous pebbles of limestone, greenstone and flat fragments of harder slates, rise from beneath the diorites in an irregular dome, and around the harbor the serpentine is arranged in several bold projecting mountain escarpments, while one mass, on the west side of the harbor, near the entrance, forms an isolated hill.

Within the harbor, the black slates were often marked by the presence of iron pyrites, and in some of the beds near the interstratified conglomerates, the quantity sometimes seemed almost sufficient to be made economically available. The diorites also often appeared to abound with the same mineral; and on the west side of the entrance to the harbor, there were some indications that copper pyrites occasionally accompanied it. Iron pyrites.
Copper pyrites.

On an excursion to the north-westward, extending between four and five miles from the cove at the base of the limestones, over a flat country, Interior flat country. studded with clumps of small spruce and balsam-fir, of which the trees seldom exceeded twenty feet in height, with moss and marsh and innumerable small ponds occupying the intervals, the strata met with were limestones, spread out in nearly horizontal layers. Bare surfaces of rock occasionally extended over areas of a square mile; these generally exhibited fragmentary fossils, of which, from the hardness of the rock, it was difficult to obtain specimens. They consisted, however, for the most part of convoluted shells, and orthoceratites, and much resembled the species already mentioned. The general surface seemed to be scarcely more than twenty or thirty feet above the sea, and only one exception to the dead level was met with, in a hill of limestone which rose to about 100 feet. As seen from the highest hill over How Harbor, a country of the same character appeared to extend northward to Pistolet Bay, rising over the water of which, four icebergs could be counted; whilst a little to the left, the mountains of Labrador Labrador. presented a faint blue undulating line over the horizon. A similar dead level extended to the westward as far as the eye could reach; but over this level, to the south-west, there arose in the distance, a range of mountains, the nearest point of which appeared to be from twenty

to twenty-five miles distant, being probably the most northern part of the area occupied by the Laurentian rocks.

Ireland Cove.

On the north side of Hare Bay there is a portion of the coast, between the point at which the diorites re-enter upon the land, and Ireland Cove, that has not been examined; but as seen from the deck of the schooner it presented an abrupt cliff to the sea, rising to a height of between twenty and thirty feet, maintained evenly for four or five miles; from this the surface in the interior gradually rose to a height of 150 or 200 feet, forming a valley running north-eastward between two parallel ranges of higher ground. It was supposed possible that the coast might here be occupied by the black slates. To the east of Ireland Cove the coast gradually becomes more bold, and an examination was made of it about two miles from the cove in that direction. The rock consists of a greenish hard splintery slate, breaking into long fragments; and in a small peninsula extending about 100 yards out from the main run of the shore, there was observed an exposure of about ninety feet across the measures, in which the slates appeared to have a nodular structure, presenting ovoid or reniform masses, pressed one upon another, which, in the four feet next the shore, were partially separated by thin whitish reticulating strings of calcareous matter, giving to the surface the aspect of marbled paper, and over this occurred a band of about forty feet of a purplish maroon color. The dip of the slate in this neighborhood was S. 57° E. < 45°; but going eastward it appeared to undulate, and the slate occupied the coast for a distance of three miles to the eastward of Swill Cove.

Swill Cove.

Goose Cove and Cape.

These slates continue along the coast, forming the point north of the entrance to Goose Cove, as well as the whole of the peninsula south of the Cove, forming Goose Cape; here they appear to have a north dip, as ascertained at the summit of the highest point of the peninsula, which is 380 feet above the sea, and stands directly south of the isthmus.

Green and grey slates.

North of the peninsula the rocks of Goose Cove are green and gray jaspery slates, and they are interstratified with many thin bands of quartzite. Among these are some thicker bands, which assume the character of fine conglomerates, from the presence of small pebbles of white translucent quartz. Epidote is associated with these slates, sometimes running in small patches with the slates, and sometimes running through them in small veins. White quartz cuts the slates and quartzites in thin irregular veins, and occasionally occurs in nests or bunches in the rocks, associated with copper pyrites. One of these bunches or patches, of a lenticular form, measured about three feet in length, with a breadth of a foot in the middle. The copper ore was irregularly disseminated in small masses, the largest of which was about two inches in length by a quarter of an inch thick. The rocks, here and elsewhere in the neighborhood, appear to be

Copper pyrites.

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very much contorted, rendering it next to impossible to determine their volume. The following sketch of some of the smaller convolutions was taken in the north-east corner of Goose Cove. It represents a mass of rock, which occurs in a cliff about fifty yards long by about twenty feet high.

CONTORTED STRATA.



GOOSE COVE, HARE BAY.

A footpath leads from the north-east corner of Goose Cove to Crevallière Harbor, running northward, the distance being about two miles. The summit of a hill 553 feet above the sea, to the east of the path, about half a mile from the cove, is composed of black hornblende slate; the breadth is about a hundred yards, and the dip is here S. 65° W. $<28^{\circ}$. The thickness of the mass would thus be about 130 feet. The summit of another hill, called the Sugar Loaf, distant about a quarter of a mile southward in the strike, appeared to be composed of the same rock; but what geological place it has, in relation to the Goose Cove rocks, is uncertain; it is probably beneath them. On the footpath, the rocks, seen every now and then for the whole distance, were green slates much resembling those of Goose Cove; but, arriving at Crevallière Harbor, a cliff of about twenty feet in height displayed a bed of quartzite at the bottom, surmounted by a band of black arenaceous very impure limestone, followed by a mass of green soft slates, which appeared to be chloritic; cracks and fissures in the rock were frequently filled with calcespar. The dip was S. 78° E. $<10^{\circ}$. The facts ascertained in the neighborhood of this part of Hare Bay, appear too scanty to determine the exact geological relation of the masses in the Quebec group; but the hard green slates, of which they chiefly consist, resemble in aspect the green diorite slates of the Eastern Townships of Canada; and the hornblende of Sugar Loaf hill would appear to favor the supposition that they are of a dioritic character here, and belong to the middle division of the group. They would thus belong to that part of the group which holds the serpentines, and is so often found rich in copper ores and other metalliferous minerals. No great mass of serpentine, however, was seen in the neighborhood, although it is probable that such may occur more in the interior.

On the south side of Hare Bay, about a mile to the east of the diorites of Springs Arm, where the section across Belvie Bay terminates, the dip of the measures is S. 25° E. $<60^{\circ}$, and a line across the measures running

Crevallière Harbor.

Hornblende slate.

Limestone.

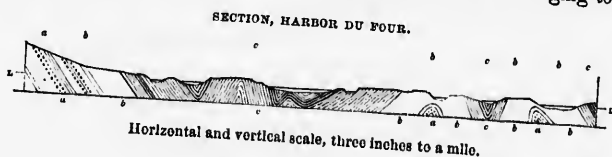
Diorite slates.

Maiden Arm
section.

from Hare Bay to Maiden Arm, gives the following section, reduced to vertical thickness:

Green slates.	1. Greenish hard jaspery slates.....	Feet. 500
	2. Pale sea-green quartzite. On the exterior it is opaque white from the effects of fire, but for the sixteenth of an inch beneath the surface, it is dark brown. This mass is divided into beds of from one to two feet by darker green hard slates, in beds varying from six to fifteen inches, and thin veins of white quartz run with the strike.....	150
	3. Blue, jaspery, very hard and compact slate.....	5
	6. Greenish hard compact slate.....	120
	7. Dark gray quartzites, including small rounded grains or pebbles of white quartz, giving it a speckled aspect; fine grains of iron pyrites are scattered through the rock, which is divided into beds varying in thickness of from ten to fifteen inches, separated by green hard slates of from one to three feet.....	70
Green slates.	8. Green hard slates interstratified at intervals of from one to a hundred feet by layers of greenish-gray brown-weathering diorite of from one to four feet in thickness.....	500
Black slates.	9. Black compact slates in layers of from twelve to eighteen inches, interstratified with dark gray slate weathering rusty brown. The measures beyond this become concealed, and the mass of black slates may be much thicker than given.....	30
		1375

Although the dip was all one way, it is not impossible that the beds 1 and 8 may be the same, from a break or an undulation, and the black slates may be those beneath the diorites. They occur again on the east side of the arm, toward the exit, where they have a thickness of 300 or 400 feet. It is probable that the green slates and diorites overlying the black slates, are kept at the surface by undulations, all along the coast to the Havre du Four, Fishot Island; and at Havre du Four a series of rocks belonging to this



- a. Quartzites and fine conglomerates.
- b. Sandstones and green slates.
- c. Black, green and brown slates.
- L. Sea level.

horizon, consisting of gray sandstones and conglomerates with pebbles of white quartz, interstratified with bands of green diorite slates and overlaid by a considerable mass of similar slates, showing brown and black bands

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in addition to green, present the folds illustrated in the accompanying transverse vertical section.

Similar rocks are displayed along the coast to St. Julien, but here there appears to be a change. The island of St. Julien, and the several promontories which divide the bay into the Great and Little Harbors, and Great Goose Cove, consist of coarse grayish or greenish sandstones and conglomerates, interstratified with green, purple and black argillo-arenaceous slates. The sandstones are composed of rounded grains of transparent, translucent and opaque white quartz, with others of white feldspar, held together by a sparing quantity of a gray or greenish argillaceous matter, with a very small amount of carbonate of lime. The same minerals compose the conglomerates, in which the pebbles, consisting of quartz, are in general about the size of peas, but in some bands, as in one which runs through the length of St. Julien Island, attain a diameter of between two and three inches. The strata in general dip nearly south-east at high angles, and stand in many instances in a vertical attitude. At the head of the eastern harbor, on the east side, a series of black and gray arenaceous slates, running parallel with the shore, have a general south-east dip, but display many twists and corrugations. Where the slates are crossed by streamlets of water, they present a rusty brown color, from the decomposition of iron pyrites, which is disseminated in the rocks, and they are cut by large white quartz veins, without the exhibition, however, of any metalliferous ores. Sandstones and fine conglomerates occur on the west side of the bay; and on this side, at a spot bearing N. 80° W. from the north point of St. Julien Island, the strata, consisting of conglomerate beds varying from eight to eighteen inches in thickness, parted by thin layers of green arenaceous slate, are cut by numerous quartz veins which run in various directions. One of these, traceable from the shore for between thirty and forty yards, is seen in the cliff, and holds yellow sulphuret of copper, while the rock is much stained with the blue and green carbonates resulting from the decomposition of the sulphuret. The ore is a nearly pure sulphuret, and it appears to be pretty continuously distributed in the vein, which in the cliff is rarely over three inches wide, though it seems to increase a little proceeding inland, before it becomes covered up.

On the promontory dividing the two harbors, a series of black slates is interstratified with bands of sandstone of between two and three feet thick, standing in a nearly or altogether vertical attitude, and from unequal wear of the sandstones, their jagged edges start up in prominent separate masses in the plane of the bed, many feet above the general level, and several of these, in succession, in some places, appear like colonnades. These sandstone pillars strongly resemble those at Tourette near Cape Chatte, on the St. Lawrence; and the rocks of the two localities have so much in common, that it is probable they belong to the same horizon. The St.

St. Julien.

Siliceous sandstones.

Copper ore.

Sandstone pillars.

- Julien sandstones would thus appear to belong to the Sillery series, which constitutes the upper part of the Quebec group.
- Croc Harbor. Croc Harbor is situated between four and five miles to the south-west of St. Julien. At the head of the harbor, and for a considerable distance up the brooks which fall into it there, the measures are chiefly black calcareous slates, with beds of limestone conglomerate, apparently near the top. These rocks are vertical, or highly tilted, with an inclination eastward; they have a breadth of more than a mile, within which distance, however, there may be more than one repetition. They are succeeded to the eastward by quartzites and diorite slates with beds of argillite passing into finely laminated micaceous slates. These rocks probably belong to the lower and middle divisions of the Quebec group. But near the mid-length of the harbor there are evidences of a fault running north-easterly, and slightly oblique to the stratification. It appears to be a downthrow to the south-eastward, and it brings in a series of rocks similar to those of St. Julien, consisting of sandstones and conglomerates interstratified with slates, which, in addition to green and purple, are in some places red, thus establishing a still farther resemblance to the Sillery series. The general bearing of the fault would carry it to the west side of St. Julien Bay, perhaps a little in from the shore, and it would thus run by the small vein of copper ore which has been described as occurring there. Though the quantity of the ore is not sufficient to be economically available, the vein might become of some significance should it be found to have any connection with the fault; for this being a displacement of some importance, it might possibly give an opportunity for a larger secretion of the ore.
- Fault. In Croc Harbor, the fault comes to the shore near the Genille fishing establishment, and on the opposite side it probably runs into Pelletier's Cove. In the peninsula of Cape Rouge, some six or seven miles to the southward, there occurs a fault, with a downthrow to the south-east, affecting a higher series of rocks, to be hereafter described. This is probably a continuation of the Croc Harbor fault, in which case it would come out upon the coast about five miles south of the harbor; and the coast that far probably belongs to the Sillery series. This series was observed by Mr. Richardson, some short distance to the east of Pistolet Bay, and from its trend in that part, it was supposed that its base would run into the Atlantic at St. Lunaire Bay.
- Sillery, Pistolet Bay. With the exception of the peninsula of Cape Rouge, and that of Cape Fox, the coast appears to be formed of rocks of the middle division of the Quebec group to the entrance of Canada Bay. It has already been mentioned that between Eagle Island, and the point at the northern side of the entrance to this bay, a fault brings the white limestones of the Potsdam group, on the west, against the diorites of the middle division of the Quebec group, on the east; and that the same condition of circumstances
- Faults.

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is observable in Canada Harbor, on the south side of the bay. From Canada Harbor, the bearing of the fault would carry it to a cove on the coast, between three and four miles to the southward, and here the fault ^{Faults.} brings the diorites of Canada Head, belonging to the middle division of the Quebec group, against the Laurentian gneiss, without the intervention of the lower division of the Quebec group, or any part of the Potsdam. From this it would appear that this dislocation must be here a downthrow to the eastward of about 8000 feet. It diminishes, however, towards Canada Bay, where the displacement appears to be about 4500 feet. From the convergence of this great dislocation, and that of Salt Water Pond, it is probable they would meet before reaching Hare Bay. The Salt Water Pond fault is a downthrow to the westward. Its influence, therefore, would diminish that of the Canada Harbor fault. We accordingly find that the dislocation near Springs Arm on Hare Bay, which is probably a continuation of the other two united, is only from 1500 to 2000 feet. Where the Springs Arm fault strikes into the land, on the north side of Hare Bay, has not yet been ascertained, but it will probably be somewhere near Ireland Cove. The study of these great breaks in the rocks of the country is a subject of great interest, since independent of the evidence they give of the great dynamic forces which have fractured the earth's crust, and the influence they have on the geographical distribution of the geological formations, they may be found to possess an economic value ; for they must originally have been connected with extensive fissures, and where they traverse rocks charged with metalliferous minerals, they may have given opportunity for the secretion of corresponding ores, and be found to hold valuable metalliferous lodes.

That part of the Quebec group which, in Canada, is rich in the more ^{Metalliferous part of Quebec group.} valuable metals, is the middle division, composed of dolomites, diorites and serpentines, such as those shown to extend, with a considerable breadth, for a distance of seventy miles on the east side of the northern peninsula ; and in this connection it may be remarked, that without having had an opportunity to thoroughly trace the structure in the localities where they occur farther east, similar rocks were observed in several places on the coast, between White Bay and St. Johns. One of these is Little Bay or ^{Little Bay.} Baie Verte, where serpentine rocks are pretty largely developed towards the head of the bay, in the neighborhood of the Terra Nova mine. Another is Ming's Bight, four or five miles to the eastward, where rocks of the same ^{Ming's Bight.} kind rise in a high hill-range, keeping the east coast of the bay, and striking inland in a south-western direction. Associated with the serpentines in this neighborhood, there are bands of anorthosite rock, diorite, dolomite, and a calcareo-magnesian rock stained green with oxyd of chromium ; and at Terra Nova mine the series was found to rest upon blackish or brownish finely laminated talcoid slate. These rocks are in some parts ^{Chromium.}

- marked with chromic iron, and in many with the sulphurets of iron and copper, occasionally in quantities economically available. Beneath the whole in Little Bay, a great mass of mica-slates strikes inland in a south-westerly direction from Coachman's Cove. They run up into the hills of the peninsula which divides Little Bay from White Bay, and may correspond with the mica-slates of the Western Arm already described. Near the central part of the peninsula between Little Bay and Ming's Bight, a considerable breadth of granitic rock occurs. It does not give much indication of gneissoid structure, but has a north-east and south-west trend, parallel with the other rocks on either side, and with the gneiss and mica-slate of the peninsula to the west, and may belong to the Laurentian series. From the distribution of the rocks in these two peninsulas, it would seem probable that there runs longitudinally through each of them, an anticlinal axis, and that rocks of the middle division of the Quebec group are arranged in a synclinal form in each of the bays, in which they rest on the Laurentian series, without the interposition of the lower division, or of the Potsdam group.
- Serpentines. Serpentine is also represented, or known, at Tilt Cove and Round Harbor on the peninsula, which terminates at Cape St. John, and farther south, rocks, which are probably of the same series, are exhibited on the islands of Hall's Bay, and again at Twillingate. In each of the latter cases, they appear to be related to a considerable volume of limestone; but all this section of country requires a great amount of careful examination before any detailed descriptions can be entered upon.
- Copper ore. Mention has already been made of the presence of copper ore in this middle division of the Quebec group, at How Harbor, Goose Cove, and the western side of St. Julien Bay; and although the quantities observed were not in any of these instances great, they yet serve to show that the ores of the metal accompany these deposits in their distribution, in Newfoundland as well as in Canada, and render it reasonable to expect the discovery of available quantities in those parts of the country hereafter. This is still farther confirmed by their occurrence in the rocks of the middle division, on both sides of Little Bay, and in considerable quantity at the head of the bay, in Terra Nova mine, and by indications observed on the west side of Ming's Bight; in several places in the vicinity of Twillingate, and on Sandy Cove Island at the entrance of Hall's Bay. At Tilt Cove and Round Harbor, copper ores are reported to be largely exhibited; but the plan of my exploration did not afford me time to visit these localities. Their value, however, has been made known by the enterprise of Mr. C. T. Bennett of St. John's, who has obtained from the government of the colony an exclusive right to the minerals, over a very extensive tract of the country, and has entered upon mining operations at Tilt Cove, with a fair promise of a profitable return.
- Terra Nova mine.
- C. T. Bennett.

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Iron pyrites was found to accompany the copper pyrites in most of the localities in which the latter occurred, but it was often met with disseminated in the rocks by itself, particularly in the black slates of the lower division of the Quebec group, where occasionally, as at How Harbor, it seemed almost sufficient in quantity to be made available for practical purposes. The largest deposit of it, however, that came under my observation, was in association with the serpentine of the middle division at the Terra Nova mine, which has been opened with the intention of working it for exportation to England. The Terra Nova mine is situated at the junction of two streams, whose united waters, flowing north-easterly for about a mile and a quarter, fall into the upper extremity of Little Bay. The deposit upon which the mine has been opened appears to be a stratified mass of iron and copper pyrites, with intercalations of hard clay slates, and it is interposed between a considerable volume of serpentine on the one side and chloritic slate on the other. The metalliferous band has a considerable breadth, probably thirty feet, or even more, and within that width there are strata of solid or nearly solid iron pyrites of from four to five feet thick. The general dip is about S. 80° E. < 80°. The upper part of it is chiefly iron pyrites, some of which is strongly magnetic ; but in the lower part, the yellow sulphuret of copper is pretty generally disseminated, in combination with that of iron, and in some spots in considerable proportion.

When first discovered, the exposure presented a mass of ore projecting along the bottom of the main stream, from the point of land separating the north-west and south-west brooks ; but the channels of both these brooks having been changed, near their junction, for the convenience of mining, the waters of the north-west brook alone now flow over it. To prove the mine, five shafts have been sunk, numbered from 1 to 5, in the order in which they were excavated. Two of these are upon the metalliferous band, while the other three, so far as they go, have been excavated in the rock of the country. The strike of the mineral mass naturally exposed, is about N. 20° E. and S. 20° W. true, (the magnetical variation being about N. 35° W.) A short distance from the natural junction of the two brooks, in what appeared to be the run of the metalliferous band, No. 1 shaft was sunk in hard clay-slate, without striking the band. No. 2 shaft was then sunk on the left bank of the main stream, in what appeared to be the run of the band northward. It was carried to a depth of twelve fathoms, through serpentine, without reaching the metalliferous band. From the bottom of this shaft, a drift was carried in a south-eastward direction a distance of between seventy and a hundred feet through serpentine all the way, passing beneath the main stream. Another shaft, No. 3, was then sunk to a depth of eight fathoms, about four chains from No. 2, in the bearing N. 80° E. This is also through serpentine, which was found to be cut by

Iron pyrites.

Terra Nova
mine.

No. 1 shaft.

No. 2 shaft.

No. 3 shaft.

No. 4 shaft.

numerous veins of calcspar, with frequent specks of copper pyrites, and small masses of native copper. No. 4 shaft is sunk on the metalliferous band close by the natural junction of the two brooks. At the time of my visit it had been excavated to a depth of twenty fathoms; from this a gallery had been driven along the band, northward, for about 100 feet in the strike, at a depth of ten fathoms, and another, from the bottom of the shaft, in the same direction for the same distance. Both these galleries pass under the north-west brook. At the termination of each of them there appears to

No. 5 shaft.

be a twist in the stratification. No. 5 shaft, called also Bell's shaft, is situated about a chain from No. 2, in the bearing S. 55° W. In it the metalliferous band was struck at the depth of ten fathoms. It is said that from the neighborhood of No. 4 shaft, the band separates into two branches going southward, and it is supposed that the reason why No. 1 shaft missed the band, is that the shaft is sunk in the rock between these two branches. The whole circumstances of the case induce me to think that we have here a short sharp twist, or overlap, in the stratification, and that the band will run more regularly southward from the eastward of the two branches, into which it appears to be divided at the junction of the streams, and more regularly northward from No. 5 shaft, in the general strike of the serpentine and the other rocks associated with it.

Sharp twist or overlap.

Chromium and nickel.

The investigations made by Dr. T. Sterry Hunt, the chemist and mineralogist of the Geological Survey of Canada, have shown that traces of chromium and nickel appear to be almost universally diffused in the serpentines of the Quebec group in Canada, and in the United States; and analyses made by him of several specimens from Pistolet Bay and Little Bay, indicate that the serpentines of Newfoundland will not be an exception. It is, therefore, reasonable to expect the occurrence of these metals in available quantities in the island. The ore in which the chromium of commerce usually occurs, is its combination with iron, and chromic iron has been obtained in Canada, in several places, in economic quantity. Although this ore was met with in Little Bay, the quantity was confined to mere crystals in the rock, but it strengthens the expectation of finding it in more abundance in other parts.

Serpentine.

Serpentine is a rock capable of receiving a high polish, and it is extensively used in commerce for architectural purposes of a decorative character; and for such purposes any amount of it might be obtained in How Harbor, Little Bay, Mings Bight, or wherever else it has been reported.

III. UPPER SILURIAN SERIES.

U. Silurian.

Proceeding southward along the coast of White Bay, from Coney Arm Head, which, as has already been stated, is composed of coarse quartzose mica-slate, possibly of Laurentian age, there accumulates on these mica-

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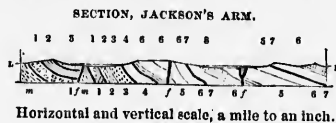
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slates a series of rocks traceable to Jackson's Arm. Jackson's Arm runs into the land, nearly at right angles to the strike; and here these upper rocks have a transverse breadth of about two miles. The following section of them, in ascending order, from the mica-slates, on which they are seen to rest, is taken from the north side of the arm, on which the measures appear to be broken by three considerable faults, causing what are supposed to be modified repetitions of some of the masses:

	Feet	Section.
1. Coarse conglomerates, with a light gray arenaceo-micaceous slaty matrix, which is slightly calcareous. The masses enclosed consist of pebbles and boulders of gneiss, large rounded fragments of whitish or light gray mica-slate, some of a darker gray greenstone, reddish-gray quartzites, and occasional smaller masses of limestone; among these there is a good deal of finer material of the same character, slightly calcareous, and mica-schist runs in irregular flakes and patches in the general direction of the stratification, but its cleavage often partially conforms to the rounded surface of the boulders and pebbles. The beds are very massive, and they appear to be divided by gray micaceous schist.....	400	
2. Sea-green slates, occasionally interstratified with dark gray, or blackish fine silky surfaced slates, some of which are harder than others.....	300	
3. Gray, coarse, rough arenaceo-micaceous schist, frequently passing into a fine conglomerate, with pebbles similar in mineral character to those of the coarse conglomerates beneath, but none of them exceeding the size of a hen's egg; the pebbles are sometimes arranged in regular layers, parallel to the stratification; bands of dark gray clay slate are occasionally interstratified in the mass.....	400	
4. Gray micaceous and arenaceous slates.....	250	
5. Green and black slates at the base, succeeded by gray arenaceous slate, which is interstratified with thin bands of sandstone.....	650	
6. Green, bluish, and blackish slates, interstratified with gray flaggy sandstones; the slates enclose nodules of pinkish calc-spar, and veins of the same cut the strata.....	250	
5. Grayish-blue limestone in a single bed.....	7	
8. Gray calcareo-arenaceous slates, interstratified with grayish sandstones, with a heavy mass of gray, white-weathering sandstone at the top.....	543	
	2800	

The above section can only be considered as giving an approximation to the truth. The three faults which dislocate the rocks, and are all considered to be upthrows on the east side, render it difficult to follow the sequence with exactitude; and some of the masses, which are supposed to be in a general way equivalent, on opposite sides of the faults, appear in different parts, to be modified in volume, and somewhat in lithological character, by different degrees of metamorphic action. The most western of the faults occurs in a small cove, upwards of half a mile from the upper end of the arm. It seems to be an upthrow of probably 1000 feet, and by it the coarse conglomerates 1, which rest upon the mica-slate at the upper end of the arm, are repeated on the other side of the cove. The fault appears to be coincident with a vein or dyke of granitoid rock, Dykes.

of which several occur, though they do not in every case greatly dislocate the measures. They are uniform in appearance; the rock weathers yellow, but when fresh broken, has a pale, yellowish-pink color; it is very



m Mica slate.

1. Coarse conglomerates.

2. Sea-green slates.

3. Slates and fine conglomerates.

4. Maceo-arenaceous slates.

5. Black and green slates.

6. Green, bluish and black slates.

7. Blue limestone.

8. Slates and sandstones.

L Sea level.

f, f, f Faults.

fine grained, and has a conchoidal fracture. Some of the veins or dykes run with the strata, and others intersect them, and they vary in thickness from one to thirty feet. They are cut by white quartz veins, which are confined to them, and do not run into the strata on each side. The second fault occurs upwards of two miles from the upper end of the arm, where the coast suddenly runs northward, for about half a mile, into a pretty deep cove. This fault does not seem to dislocate the measures more than 200 feet. The third fault occurs in the inhabited cove, about 400 yards from the outside point of the arm. It is supposed to be a dislocation of perhaps 1200 feet. On the west side of it, and of the cove, there is an abrupt low hill, formed of strong massive beds of quartzite, some of which appear to have a slaty cleavage; they are supposed to belong to the summit of the section, but would give a much greater volume to this part of it than the amount stated. On the east side of the cove there is a pale, pinkish-white splintery feldspathic rock, of which the relation to the others is not well understood; but it appears to be connected with the slates and sandstones of division 6, or to be intrusive. In addition to the granitoid compact fine grained veins or dykes, there are others in the upper part of the arm, which consist of a brown splintery, apparently feldspathic rock, which, like them, run in some places with the stratification, and in others, oblique to it.

Feldspathic
dykes.

Sop's Arm.

Sop Island.

These rocks run along the coast to the southward of Jackson's Arm, and extend to the upper end of Sop's Arm. As well as the coast, they form Sop Island and Goat Island, which is inside of it; and from their limit in Sop's Arm to the outside of the former island, they have a transverse breadth of upwards of five miles. In this neighborhood they seem to be even more dislocated, contorted, and disturbed than they are in Jackson's Arm, and much more altered. Their general identity, however, is sufficiently evident. At the upper end of Sop Island, on the west side, the strata are, in general, very highly tilted, often quite vertical, with a strike

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about S.S.W., and they consist of slates, quartzites, and conglomerates, Conglomerate. the enclosed masses in the last being quartz, slate, greenstone, and red feldspar, with a few scattered fragments of blood-red jasper. One band of rock has the aspect of a conglomerate which has been fused into a solid mass, in which the paste and enclosed fragments are so melted into one another as to make it difficult to define their respective limits. The slates, as at Jackson's Arm, are speckled with nodules, patches, and short veins of pink calc-spar, and the strata are intersected by veins or dykes of Pink calc-spar. pale yellowish-red or pink feldspathic rock, weathering to a faint sulphur-yellow. In these, small cubes of iron pyrites are abundant, and the felsite is cut by veins of quartz, which do not penetrate the rock on either side. From the northern extremity of the island, what appears to be a great porphyritic dyke, runs through it in the general strike of the stratification, Porphyritic dyke. and enters upon the south side of Sop's Arm, at a promontory, which is nearly two miles eastward of Spear Point. The dyke consists of reddish felsite, enclosing feldspar crystals of a pale flesh-red, with a yellow Felsite. tinge. On the surface it has a granitoid aspect, and its color is a light dull amber-brown, blotched with pale reddish, yellowish and whitish spots. Where it leaves the island on the south side, the rock has a transverse columnar structure; in it are disseminated many small crystals or Columnar structure. grains of transparent or translucent quartz, and occasionally many small cubes of iron pyrites. At the upper end of the island, on the east side, the dyke is lined with a mass of pale yellowish-pink felsite, weathering yellowish, making the relation of the great dyke and of the small one, already mentioned, sufficiently evident. In this part, the dyke has a breadth of about a quarter of a mile, and in mid-length of the island it apparently swells to a greater width, and comes out on the south side somewhat narrower than it is at the northern extremity, but accompanied on the west side by altered conglomerates, which it is sometimes difficult to distinguish from it.

At the upper end of Sop's Arm, there appears to be another mass of Sop's Arm. felsite porphyry, which, with a difference in color, has much the same character as the dyke of Sop Island. It is in general of a reddish or purplish-gray, with pale flesh-red and white grains of feldspar. The rock is intersected by innumerable white quartz veins, some of them pretty large, and some of them showing small quantities of specular iron ore. The mass forms a low range of bare hills across the extremity of a promontory, between two pretty deep coves in the northern part of the east end of the arm. The strike of the mass is about S. 30°—40° W., and there is more of the same kind of rock farther southward, in the point west of the brook which falls into the southern cove in this part of Sop's Arm. On the west side of the rock there are grass-green slates, which appear to be of a chloritic character, and they are mottled and irregularly marked with pea-

green epidote; but on the east it is followed by what are considered to be altered conglomerates, in which, however, the enclosed masses, some of which are very large, and other parts are seemingly so fused into one another, while the matrix so closely resembles the felsite of the porphyry, that it is really very difficult to say whether both the rocks should be classed as porphyries, or altered conglomerates, or the one be distinguished by a different name from the other.

Green slates.

Pink calc-spar.

Black fossiliferous slates.

Bartlet's Cove,

Spear Point.

Goat Island.

Quartz veins.

Copper ore.

Between the conglomerates of Sop Island and those of the eastern end of Sop's Arm, the rocks of the western part of Sop Island, of Goat Island, and of the main coast, appear to be slates of various shades of green, often marked by pink calc-spar in nodules, patches, and short veins; of occasional interstratified sandstones, sometimes fit for flagging, with calcareo-arenaceous bands; and occasional impure limestones, weathering brownish. East of Bartlet's Cove, which is an indentation on the south side of the south-western extremity of Sop Island, there was seen a thickness of fifty feet of black slates. These rocks are, in several places, characterised by fossils, which are somewhat obscure; but, though few of them could be specifically determined, they have yet, according to Mr. Billings, a general aspect allied to that of Upper Silurian types. It would, however, for the present, be impossible to say to what horizon in the series the different divisions of the rocks of Jackson's Arm and of Sop's Arm may belong; and it may be proper to remark, that while no doubt is entertained of the general equivalency of the rocks of the two localities, all the places in which organic remains were observed, occur in the neighborhood of Sop's Arm.

One of these localities is Bartlet's Cove. Here the fossils occur in calcareo-arenaceous flagstones, and the genera observed, in addition to numerous fucoids and crinoidal stems, were a *Murchisonia*, an *Orthoceras*, and a *Graptolithus*. At a point on the main coast, half way between Spear Point and the promontory occupied by the porphyry, which strikes from Sop Island, organic remains were met with in strata somewhat similar to those of Bartlet's Cove; they consisted of fucoids, crinoidal stems, and an *Orthoceras*. On the western side of Goat Island, still in the same description of strata, in addition to fragments of crinoidal columns, there were met with a *Syringopora*, and *Favosites Gothlandica*. Many of the specimens of coral were here replaced by white, and, in some instances, by pink calc-spar.

The rocks of Sop Island, Goat Island, and Sop's Arm, and the neighboring main coast, are intersected by many veins of white quartz, some of which contain specular iron ore, generally in small quantities, and others the yellow sulphuret of copper. One of the former is seen associated with the porphyroid rock described, at the east end of Sop's Arm. It presents druses, lined with six-sided terminated prisms of transparent and

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translucent quartz, and these are, in many places, invested with steel-gray specular iron ore, and, in others, with minute scales of red hematite. A vein of a similar character intersects green slates at the south side of the arm, about two miles from the upper end; a probable continuation of it, still in green slates, runs, parallel with the strike, through the eastern end of Goat Island, and is probably still continued across a point on the coast about two miles farther northward. Another occurs on Sop Island, on the opposite side of the narrows between it and Goat Island. In this are enclosed masses of bluish-green chlorite, which is penetrated by projecting prisms of transparent quartz; and peroxyd of iron, in steel-gray and red scales, is disseminated in small quantities in the vein. In Bartlet's Cove a somewhat similar white quartz vein occurs, which was marked by the presence of copper pyrites, sparingly disseminated; but on the east side of Sop Island, about a mile from the north end, there appears to be a fault or dislocation, constituting a lode, in which the yellow sulphuret of copper occurs in more abundance. The bearing of the lode is S. 56° W., and the mass between the walls is made up of crushed and broken fragments of the rock on either side, which belongs to the porphyritic dyke running through the island, with fragments of slate. The width of the lode varies from a few inches to a foot, and throughout this the yellow sulphuret is abundantly disseminated in small grains. It also appears to penetrate, in a smaller degree, the walls on either side of the lode, which are much stained by green carbonate. An average sample of the lode, however, has yielded to analysis only one per cent of metallic copper.

The limestones of the formation appear in general to be too impure for burning into quicklime, but there are several bands of the rock which might be very well adapted for building, and occasionally a good coarse sample of whetstone may be procured from slaty portions of the formation.

The eastern limit of the formation appears to run into the cove on the west side of Spear Point, where it is succeeded by rocks supposed to belong to a higher formation. The general dip of the strata is to the south-eastward, across the whole breadth; but the occurrence of the conglomerates on each side suggests that it may be arranged in the form of a trough between the parallel belts of porphyry, with an overturn on the south-east side. It seems probable, however, that the rise of the conglomerates on this side, perhaps occasioned by the intrusion of the porphyry, is only to be considered an undulation subordinate to a wider trough lying in White Bay.

V. DEVONIAN SERIES.

In describing the dislocation which crosses Croc Harbor, mention was made of the peninsulas of Cape Rouge and Cape Fox. These peninsulas are

Cape Rouge
Harbor.

Fault.

joined to the main coast by very narrow necks of land, and between the peninsulas is situated Cape Rouge Harbor. Both peninsulas are composed of the same rocks, the strata striking across the harbor, from the one to the other, in a general N.N.E. and S.S.W. bearing. The Cape Rouge peninsula, on the northern side of the harbor, gives the larger development of these rocks, and the coast along this part of the harbor was selected to obtain a section. The direct breadth across the measures, from the neck of the peninsula to the Atlantic on the outside, is just about two miles; but in this the strata are arranged in the form of a trough, with the dislocation, which has already been alluded to, running through it, nearly on the strike, at one-third of the breadth from the neck of the peninsula; and towards this dislocation the strata dip in opposite directions, at angles varying from 34° to 51° . A greater volume of strata crops out on the south-eastward side of the trough than on the north-westward; and as those at the base, on the latter side, do not make their re-appearance on the other, it is concluded that the dislocation is a downthrow on the south-eastern side, equal in amount to at least the difference in volume between the two. The base of the strata on the north-western side, approaches the diorites and quartzites of the middle division of the Quebec group, and it is supposed to rest upon them unconformably; the following is a description of the series in ascending order:

		<i>Feet.</i>
Ascending section.	1. Coarse conglomerates, of which the paste is a greenish-gray micaceous sand, and the enclosed pebbles consist chiefly of reddish-gray diorite, opaque white quartz, bluish quartzite, and occasional red jasper. The conglomerates are in massive beds, and are interstratified with greenish-gray micaceous sandstones.	93
	2. Greenish-gray micaceous sandstones, with ripple-mark on some of the surfaces, and occasional carbonized broken remains of plants.	8
	3. Coarse conglomerates, as before ...	18
Land plants.	4. Measures concealed.	40
	5. Black slates interstratified with thin beds of hard gray sandstone, followed by reddish slates at the top.	15
	6. Coarse conglomerates, as before in massive beds, interstratified with grayish slate bands.	29
Ripple mark.	7. Measures concealed.	60
	8. Reddish slaty micaceous sandstones, becoming blackish-gray at the top; the surfaces of the beds show coarse ripple mark.	11
	9. Measures concealed.	29
Crack-casts.	10. Dark gray dolomite in thin beds, some of which weather yellow; the surfaces of some of the beds are occasionally marked with reticulating crack-casts.	37
		340

These strata occur in the isthmus joining the peninsula of Cape Rouge with the mainland, and from the isthmus, the coast of the peninsula and

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the strike so nearly coincide, for upwards of a mile, that no additional strata can, for that distance, be safely gathered from it. Between this point and the fault, however, the shore becomes obliquely transverse to the measures. The direct breadth across them is about a quarter of a mile, and the average slope of the strata thirty-four degrees, which would give a thickness of about 750 feet. This consists of red and black slates interstratified with greenish-gray sandstones.

The section on the opposite side of the fault occupies the coast to the outside of the harbor, and gives the following strata in descending order :

	Feet.	Descending section.
1. Red, green, and black slates, with a mass of greenish-gray sandstone at the top	650	
2. Measures concealed in a valley, having a breadth of about thirty chains	1000 ?	
3. Red slates with beds of red and green sandstone	1450	
4. Red, black, and green slates interstratified with sandstones, and yellow-weathering bands, probably dolomites	450	
	3550	

The transverse breadth of the section is about ninety chains; the inclination near the fault is 36° , which gradually increases, and becomes 51° on the outside of the harbor. This would give about the same vertical thickness, in which, however, it is taken for granted that the strata concealed under the valley, 2, are not affected by any undulation or dislocation. It would appear from this, that with the conglomerates at the base, the whole thickness would be about 3750 feet, and that the fault may be considered a displacement of about 2500 feet.

Groais Island lies eastward from Cape Rouge about nine miles. The north end, and probably the whole island, consists of coarse quartzose mica-slate, like that of Coney Arm Head, and it is cut by white quartz veins carrying small quantities of copper pyrites. At the north-west corner, the mica-slate rise vertically up from the water for 350 feet, and the dip appears to be N. 35° – 45° W. < 37° – 45° . The small island north of this corner consists of strata belonging to the series displayed at Cape Rouge Harbor. They appear to unconformably overlie the mica-slate of Groais, their dip being S. 80° W. < 18° , and they consist at the base, in a cliff in which they are seen, of coarse conglomerates, with enclosed masses of the mica-slate in an arenaceous paste. The conglomerates are surmounted by about seventy feet of red and gray sandstones and red slates, which are capped by about thirty feet of conglomerates, interstratified with green arenaceous shales, and the surfaces of some of the sandstones display carbonized comminuted plants.

On submitting to Dr. J. W. Dawson, of McGill College, Montreal, so well known for his great skill in fossil botany, the plants belonging to this

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Groais Island.

Copper ore.

Conglomerates.

Land plants.

Dr. Dawson's
determination
of plants.

formation obtained here, and at Cape Rouge Harbor, he has favored me with the succeeding remarks. "Though all the specimens are obscure, there seem to be among them the following forms: 1. *Psilophyton*, like *P. princeps*; 2. *Lepidodendron*, decorticated, resembling *L. Chemungense*; 3. *Sigillaria*, a small portion of a stem not specifically determinable; 4. Striated stems, probably stipes of ferns; 5. *Sphenopteris*, a small and obscure leaflet. The supposed fossil wood and carbonaceous matter shew no structure. Though the collection does not afford sufficient material to warrant a decided opinion, I should be inclined to refer it to the Upper Devonian, rather than to any other period."

Gaspé sand-
stones.

The formation would thus appear to be equivalent to a part of what in the Geology of Canada, have been called the Gaspé sandstones. The rocks under description certainly bear a strong general resemblance to a portion of this group, but they also in some degree resemble the Bonaventure formation of Gaspé, equivalent to the Lower Carboniferous of Nova Scotia. Until more definite evidence is obtained, however, it will be convenient to class them provisionally as belonging to the Devonian series.

Petroleum.

From the Gaspé sandstones at the eastern extremity of Canada petroleum springs issue in many places; and as it is from the Devonian series that petroleum is obtained in such abundance in Pennsylvania and in western Canada, it seems reasonable to expect that available quantities of the substance will reward researches in Gaspé. No springs of petroleum were observed in the vicinity of Cape Rouge Harbor, but concentric nodules of irregular, and sometimes elongated forms, were occasionally met with in black hard argillaceous slates, towards the base of the formation, which, on fracture, were found to be charged with the oil; and the fact is one not to be lost sight of.

Spear Point,
White Bay.

In the deep cove west of Spear Point, in White Bay, red, green, and black slates strike into the land, a short distance east of one of the points mentioned as giving fossils allied to Upper Silurian types; and it seems probable that we have here the junction of the Upper Silurian and Devonian series. Similar red, green, and black slates form the west side of White Bay, from Spear Point to the entrance of Salt Water Pond,* on both sides of which, conglomerates occur, and contorted red and green slates, with gray sandstones and conglomerates, continue on the west side of the bay, on the way to Gold Mine Cove at its head. From the lithological character of these rocks, and the geographical relations they bear to the Upper Silurian near Spear Point, it is assumed that they are contemporaneous with those of Cape Rouge, and belong to the Devonian series; but as the few fossils that were obtained are too obscure to be in any way identified, the most satisfactory evidence is still wanting. The distur-

* This is another Salt Water Pond having no relation to that previously mentioned, on page 9.

bances of this part are very great, the strata being frequently dislocated by considerable faults, and frequently inverted or much contorted; so that to follow out the structure minutely would be a labor requiring much more time than I felt to be at my disposal. The general arrangement, however, exclusive of minor complications, seems to show that the formation here lies in a sharp narrow trough, supported by the Upper Silurian series, keeping the west side of White Bay to its head, and then including Northern Island. Farther inland, to the southward, the trough may lose its sharpness, and spread out in the valley of River Head Brook. Trough in White Bay.

The presence of small quantities of carbonaceous matter, occurring occasionally in the rocks at Cape Rouge, has given rise to rumours of the existence of coal seams there, and in other localities in the neighborhood, where the formation is exposed. One thin exceptional seam of coal is known to occur in the equivalent rocks of Gaspé (Geology of Canada, p. 394). Its thickness does not exceed one inch, and it is the only one which has been detected in a thickness of strata exceeding 7000 feet, belonging to the formation, which are nearly all exposed on the Gaspé coast of the Gulf of St. Lawrence. The formation is beneath the horizon of that series of rocks which, from the presence of workable coal seams in it, is truly called the Carboniferous, and nothing that we know of this lower formation elsewhere in America, or that I have observed on the coast of the northern peninsula of Newfoundland, would justify the expectation of discovering in it coal beds of any commercial importance.

On the north-west coast of Hall's Bay there occurs a conglomerate chiefly of a red color, with interstratified beds of gray and red sandstone. Similar rocks are partially exposed, resting on syenite, on the south-east side, towards the head of the bay. They form also the islands at the entrance to Indian Brook, and both sides of the brook as far as we ascended. These strata are usually only slightly tilted, while other apparently older rocks come up at intervals, considerably disturbed; but a great accumulation of drift, which is extensively spread over the valley of the stream, generally conceals the older rocks, and the junction of the two was nowhere observed. There is little doubt, however, that the conglomerate rests upon the disturbed rocks, unconformably, and it may possibly be of a later age than the Devonian; but the absence of fossils, without further evidence, must leave the matter in suspense. Small specimens of coal, which have been found near the upper rock in Hall's Bay, are no evidence of any weight on the point, as these are clearly a part of the ancient drift, and may have been derived from Carboniferous rocks farther north. Hall's Bay.
Indian Brook.
Drift coal.

VI. SUPERFICIAL DRIFT.

Superficial deposits, on the great northern peninsula of Newfoundland, may be said to have no existence, except in the shape of great erratic

Erratic blocks. blocks, with which the country generally, and the valleys particularly, are covered; nearly the whole of the finer material having been swept into the sea. The surfaces of the rocks are often smoothly rounded, and they sometimes exhibit the parallel grooves and scratches of glacial action. In
 Ice grooves. Beaver Cove. Beaver Cove of Canada Bay, and at the exit of this bay, they were observed bearing S. 25° E., which is just about the bearing of the valley, from the head of Long Arm to the exit of the bay. The most northern drift deposit of any
 Little Bay. consequence, that was met with, was at the head of Little Bay, near the Terra Nova mine, where there is a thickness of probably fifty or sixty feet of stratified clay, gravel, and sand, containing modern marine shells, at the height of about forty feet above the high-water mark. The surfaces of the rocks next the shore are here sometimes smoothly rounded and marked by parallel scratches. The bearing of the grooves is S. 56° W., which is the general bearing of the valley. Farther south, the drift becomes
 Stratified clay. more important, and it extends over a large area north-west of Hall's Bay, and up the valley of Indian Brook. The banks of this stream expose high sections of stratified clay, which is sometimes of a reddish, and sometimes of a drab or bluish color. It is usually surmounted by beds of sand or gravel, or an admixture of the two, and it gives, in many instances, a considerable extent of flat or gently undulating country, thickly covered by forest trees, such as white pine, balsam, fir, poplar and birch, some of which are often of large size. Considerable tracts through this part of the country seem to possess the ordinary requirements of agriculture, and would be eligible for settlement. The clays appear to be suitable for the manufacture of bricks; and the timber, in many places, is sufficiently abundant for the construction of dwelling-houses, and such like purposes.

I have the honor to be,

Sir,

Your most obedient servant,

A. MURRAY.

particularly, are swept into the rounded, and they of local action. In were observed, from the head deposit of any Bay, near the or sixty feet of brachiopod shells, at The surfaces rounded and is S. 56° W., drift becomes of Hall's Bay, n expose high and sometimes ds of sand or rances, a con- y covered by some of which part of the agriculture, and suitable for the s sufficiently ke purposes.

MURRAY.

APPENDIX.

LOWER SILURIAN ROCKS OF NORTH AMERICA.

As the Lower Silurian rocks will probably form a prominent feature in the geology of Newfoundland, it may be useful to state here the succession of deposits which constitute the series, according to our present knowledge. The sediments, which in the first part of the Silurian period, were deposited in the ocean surrounding the Laurentian and Huronian nucleus of the present American continent, appear to have differed considerably in different areas. Oscillations in this ancient land permitted to be spread over its surface, when at times submerged, that series of apparently conformable deposits which constitute the New York system, ranging from the Potsdam to the Hudson River formation. But between the Potsdam and Chazy periods a sudden continental elevation, and subsequent gradual subsidence, allowed the accumulation of a great series of intermediate deposits, which are displayed in the Green Mountains, on one side of the ancient nucleus, and in the metalliferous rocks of Lake Superior, on the other, but which are necessarily absent in the intermediate region of New York and central Canada.

At an early date in the Silurian period, a great dislocation commenced along the south-eastern line of the ancient gneissic continent, which gave rise to the division that now forms the western and eastern basins. The western basin includes those strata which extended over the surface of the submerged continent, together with the pré-Chazy rocks of Lake Superior, while the Lower Silurian rocks of the eastern basin present only the pre-Chazy formations, unconformably overlaid, in parts, by Upper Silurian and Devonian rocks. The group between the Potsdam and Chazy, in the eastern basin, has been separated into three divisions, but these subdivisions have not yet been defined in the western basin. In the western basin the measures are comparatively flat and undisturbed; while in the eastern they are thrown into innumerable undulations, a vast majority of which present anticlinal forms overturned on the north-western side. The general sinuous north-east and south-west axis of these undulations is parallel with the great dislocation of the St. Lawrence, and the undulations themselves are a part of those belonging to the Appalachian chain of mountains. It is in the western basin that we must look for the more regular succession of the Silurian rocks, from the time of the Chazy, and in the eastern, including Newfoundland, for that of those anterior to it. It is to be remarked, however, that in the great northern peninsula of Newfoundland, instead of undulations, great lines of fracture and dislocation are observed, while the strata are but little tilted, and it has not been decided precisely where the limit between the eastern and western basins is to be found in that island. It seems probable however that it will run on the east side of the Laurentian mountains, which form the backbone of the peninsula not mentioned.

The succession of Lower Silurian formations in North America may be thus tabulated, the paleontological evidence as to the relations of the Upper Calciferous and the Quebec group to the formations above and below them, having been determined by Mr. Billings.

ENGLISH SYNONYMS.	COMPLETE SERIES.	WESTERN BASIN.	EASTERN BASIN.	NEWFOUND- LAND.
Caradoc.....	{ 12. Hudson River.....	Hudson River.	.....	.....
	{ 11. Utica.....	Utica.	.....	.....
Caradoc?....	{ 10. Trenton group.....	Trenton group	.....	.....
	{ 9. Chazy.....	Chazy.....	.....	.....
Llandello....	{ 8. Sillery. } Quebec	.....	Sillery.....	Sillery.
	{ 7. Lauzon } group	.....	Lauzon.....	Lauzon.
	{ 6. Levis.. }	.....	Levis.....	Levis.
	{ 5. Upper Calciferous...	.....	.....	U. Calciferous.
Tremadoc...	{ 4. Lower Calciferous...	L. Calciferous.	.....	L. Calciferous.
	{ 3. Upper Potsdam.....	U. Potsdam...	.....	U. Potsdam.
Lingula flags.	{ 2. Lower Potsdam.....	L. Potsdam?..	L. Potsdam..	L. Potsdam.
	{ 1. St. John's group.....	.....	St. John's gr.	St. John's gr.

It thus appears that the lower portion of the series is complete in Newfoundland, and the upper in New York and Central Canada. Divisions 3, 4 and 5, have not yet been recognised in the eastern continental region.

The St. John's group, 1, is represented at St. John's, New Brunswick, by 3000 feet of black slates and sandstones, whose fauna, described by Mr. Hartt, was correctly referred by him to Etage C. of Barrande's primordial zone. It there reposes on older schistose rocks, as yet unstudied, but by Messrs. Hartt and Matthews designated as Cambrian. The slates of St. John, Newfoundland, and the Paradoxides beds of Brainerd, Massachusetts, also probably belong to the same horizon.

The Lower Potsdam, 2, is represented by several hundred feet of limestones and sandstones on the Straits of Bellefleur, and on White Bay, in Newfoundland, and by the slates of St. Albans and Georgia, Vermont.

The Upper Potsdam, 3, is that of Wisconsin and Minnesota, represented in the typical Potsdam of New York, which is overlaid by the Lower Calciferous, 4; while the Upper Calciferous, 5, is only recognized in the northern peninsula of Newfoundland.

The Quebec group, 6, 7, 8, is divided into three parts, named from localities where they are largely displayed. The first or Levis division embraces the limestones and black slates of Point Lévis, Orleans Island and Phillipsburgh, with their numerous fauna of trilobites and graptolites, for the most part identical with those of the Skiddaw slates. The second or Lauzon division was at first united with the preceding, but has been separated from it on account of its great mineralogical importance and distinctness, it being the metalliferous zone of the Lower Silurian in North America. Magnesian rocks, including dolomites, magnesites, serpentines, diorites, chloritic and steatitic beds, with micaceous and gneissic strata, characterize this Lauzon division; which is moreover rich in copper ores, chiefly as interstratified cupriferous slates, and is accompanied by silver, gold, nickel and chromium ores. The only fossils certainly recognized in it are an *Obolella* and two species of *Lingula*, at its summit. It is overlaid by the Sillery division, which consists of a great mass of sandstones and conglomerates, 2000 feet thick, interstratified with red and green slates, and so far as yet known, is destitute of fossils. In a large part of its distribution, the Quebec group is crystalline and metamorphic, but the characteristic mineral elements of the Lauzon division are to be found both in the altered and unaltered portions.

W. E. L.

tabulated,
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