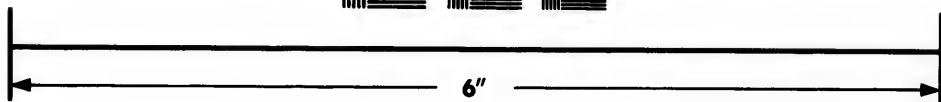
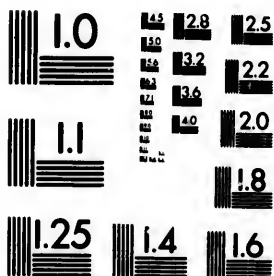


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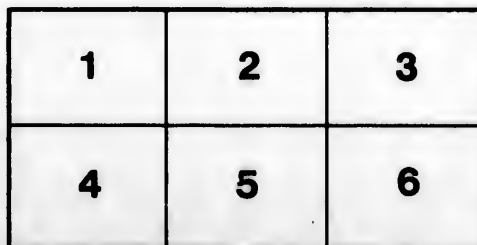
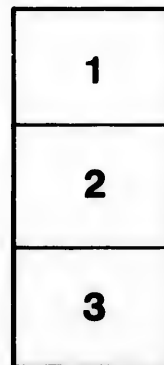
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# REPORT

ON THE

# GEOLOGY OF MANITOULIN ISLAND,

BY

**ROBERT BELL, C. E., F. G. S., F. C. S.,**

PROFESSOR OF CHEMISTRY AND NATURAL HISTORY IN QUEEN'S  
UNIVERSITY, KINGSTON, CANADA.

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ADDRESSED TO SIR W. E. LOGAN, PROVINCIAL GEOLOGIST.

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# REPORT

OF

MR. ROBERT BELL,

ADDRESSED TO

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

DIRECTOR OF THE GEOLOGICAL SURVEY.

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SIR,—

In the month of April, 1865, I had the honor to receive your instructions from London, directing me to visit the Manitoulin Islands, which had already been geologically examined by Mr. Murray, in 1847, and described in his Report for that year, pages 99-106; the object of my visit being to trace out, with greater detail the various rock formations of the group. Being directed to do carefully, whatever was done, I found it impossible to go over more than the Grand Manitoulin Island, and the smaller islands immediately adjacent, so that the following report has reference to these alone.

## GEOGRAPHICAL DESCRIPTION.

The Grand Manitoulin Island is the largest of the Manitoulin Geography. group, in the northern part of Lake Huron. It is eighty-five miles long, from east to west, and thirty miles broad in the middle, and contains fifteen or sixteen hundred square miles—equal to about one million of acres. A striking feature in the geography of the island is the numerous deep bays indenting its outline, chiefly on the northern side, and the comparatively large lakes which are scattered through the interior. Both of these have been caused by slight transverse undulations of the strata, affording facilities for the cutting out of the depressions by glacial denudation. The most eastern of these anticlineals runs from Wequamekongsing Bay, on the east end of

the island, through South Bay. The next passes through Wequamkong Bay, and the enlargement at the head of Manitowaning Bay. This latter bay is not far from twenty miles long, and its main body, together with the eastern expanse of Lake Manitou, lies upon a third anticlinal. Lake Manitou, which is in the centre of the broadest part of the island, is the largest of the lakes. It measures eleven miles in length, from east to west, and although quite narrow in the middle, is, near each end, about seven miles broad from north to south, the western expanse, like the eastern, corresponding with one of the transverse anticlinals. Close to the west of this lake is another, called Lake Mindemooya, six miles long from north to south, and three miles wide. It lies upon a continuation of the anticlinal running down Honora Bay. Still farther west is Lake Kagawong, very much resembling Lake Manitou in outline, and having its features similarly disposed with regard to direction, each of the broad portions, as in the case of Lake Manitou, lying upon a north and south anticlinal. A little more than half way from its east end, the island is cut almost in two by Lake Wolsey, which has the same level as Lake Huron, and communicates with it by an outlet a quarter of a mile wide. In size, form and direction, this lake is almost a counterpart of Lake Mindemooya, while Lakes Manitou and Kagawong may each be considered as the doubles of these. In this way we have six inland sheets of water, in precisely the same geological situation, each one being due to a slight north and south anticlinal running through its centre. In addition to this chain of lakes, Gore Bay, Helen Bay, and a smaller one between it and Lake Wolsey, Elizabeth Bay, the western part of Bayfield Sound, and Cemetery and Mildrum Bays in the western portion of the island, occupy the same geological position with regard to these lakes, and to one another, and have all been produced by the same geological causes. The anticlinals thus indicated are fifteen in number. The regularity in the arrangement of the lakes and bays is very striking, as will be perceived by an inspection of the accompanying map. While the shore-lines to the northward, are thus indented, those which, look southward are very uniform, and nearly straight in their general outline. A good example of this is seen in the whole south coast of the island, which has no bays corresponding with those on the north side; what is called South Bay being rather a lake, fourteen miles long, and having an outlet only about two hundred yards broad. For the same geological reasons, the southern shores of Barrie and La Cloche Islands, and the northern sides of Lakes Manitou and Kagawong, are nearly straight.

In addition to the lakes already mentioned, smaller ones, varying from a quarter of a mile to four miles in length, are very numerous.



The lakes are generally studded with picturesque islands, and from the larger ones, streams of considerable size flow into Lake Huron. The rivulets which enter the three larger lakes are quite insignificant in size, and few in number, yet the River Manitou, which flows from the south-eastern extremity of the lake of the same name, into Michael Bay on the south side of the island, is from fifty to one hundred feet broad, and has a swift current. It is said to be navigable for canoes, with the exception of a fall of about eight feet near Michael Bay. The Mindemooya River, running from Lake Mindemooya to Providence Bay on the south side, and the Kagawong River, flowing from Lake Kagawong into Mudge Bay on the north side of the island, are each nearly equal in size to the Manitou River. The Mindemooya is navigable for canoes throughout, but the Kagawong is interrupted near its mouth, by falls, equal in all to about sixty feet, above which it is navigable to the lake. Each of these rivers is capable of driving a number of mills. Streams large enough to be available for milling purposes also occur at the following places: Wequemakong; on the north-west side of South Bay, one at five and one at eleven miles from the head; on the west side of Manitowaning Bay, six miles from the head; at the head of She-gua-an-dah Bay; at the head of West (or Honora) Bay; at the west end of Bayfield Sound; and at the head of Cemetery Bay. Some of the other streams represented upon the map, might also be found available during the greater part of the year.

No mountains, properly speaking, occur on the Manitoulin Island. The geological structure being similar to that of the western peninsula of Upper Canada, the island presents a series of even plateaux, having their abrupt edges facing to the northward. The surface of each, beginning at the north, slopes gently southward with the dip of the strata, till it meets the escarpment of the next higher, the last one dipping under the waters of Lake Huron.

*Soil.*—Only some portions of the island are covered with soil fit for cultivation—much of the surface being either greatly encumbered with boulders, or consisting of almost bare flat rocks. The distribution of the soil was found to be dependent on that of the geological formations, so that knowing the geology of the island, the extent and distribution of its soil are also known. The island is almost equally divided longitudinally, by the conspicuous escarpment of the Niagara formation, which faces northward, and runs in a zig-zag course from one end to the other. In a general way, this escarpment forms the grand dividing line, in regard to the quality of the land, the good soil lying mostly to the north of it, while the rocky land occupies the area to the south. There are numerous exceptions to this

general rule, on both sides of the line, which thus divides the island, as it were, into halves. In the northern half, the boulders which have been transported from the country on the north shore of Lake Huron, will constitute in some places a serious obstacle to agriculture, and in other places the solid rock comes almost to the surface. On the other hand, considerable tracts of good soil are to be found in the southern half, and even on this side of the island, except in the worst portions, a shallow soil covers the flat rocks, affording land suitable for pasturage.

*Trees.*

*Trees.*—The trees of Manitoulin Island are hard and soft maple, elm, bass-wood, white and yellow birch, iron-wood, white and red oak, beech, white and black ash, poplar, aspen, mountain ash, plum, cherry, balsam-fir, red and white pine, spruce, hemlock and white cedar. Although the number of species is thus very considerable, the more valuable kinds, such as oak, elm, and pine are not in sufficient quantities to render the island of importance as a lumbering region. The pine and other kinds of coniferous trees, which are very generally scattered over the island, will be found of great value to the settlers for the purposes of construction. Hard maple is the prevailing timber, more particularly in the northern parts of the island, and every spring, large quantities of sugar are manufactured from its sap by the Indians.

*Climate.*

*Climate and Productions.*—The climate of the Manitoulin Island is said, by those who have lived many years upon it, to be in most respects similar to that of the western peninsula of Canada. This would also be inferred from the vegetation of the island. Although lying to the northward of the western peninsula it has the advantages of being surrounded by the waters of Lake Huron, and of being sheltered by the Huronian hills to the northward. The spring appears to be quite as early as at Toronto, and the fall no earlier than there. The heat of summer is tempered by breezes from the surrounding lake, and the sheets of water so thickly scattered in the interior also exert a modifying influence.

*Agriculture.*

The island having hitherto been in the hands of the Indians, no extensive agricultural operations have been carried on, but at the settlements of Wequemakong and Manitowaning, established more than twenty years ago, sufficient experience has been gained by white men, in addition to that of the Indians, to prove the climate very well suited for growing all the usual crops of the other parts of western Canada. Both fall and spring wheat have been successfully raised, as well as all the coarser grains. Maize is grown in considerable quantities by the Indians. Potatoes succeed well, both with regard to size, quantity and quality, and the potatoe disease has

so far been unknown upon the island. Timothy and clover grow luxuriantly, and peas are an abundant crop; we observed them fully ripe at the end of June. In the gardens at Manitowaning, excellent cucumbers, musk-melons and water-melons are grown in the open air. The melons are said never to fail to ripen in good time. In these gardens, tomatoes in large quantities, were ripe in August and September, and a few apple trees were laden with fruit. Plums and cherries also succeed well.

*General Remarks.*—The government having just thrown open for settlement, the recently surveyed lands on Manitoulin, and but little being generally known regarding this island, the following observations may be found useful at the present time. In 1836, Sir Francis Bond Head, then the governor of Upper Canada, set this large island apart, as a place to which all Indians might resort when they had disposed of their lands in other parts of the province. It was believed that in this way the Indians might be got together in considerable numbers, and the government attempted, by means of instructors, to teach them agriculture and various trades. But the Indians, failing to carry out this scheme, an agreement was effected with them by the Hon. Mr. McDougall, in 1862, by which the island, with the exception of the portion lying to the east of the isthmus separating Manitowaning and South Bays, could be made available for the use of white men. After a preliminary exploration, six townships have been surveyed, which are now thrown open for settlement. The soil of most of the lots in these townships appears to be well suited for farming purposes, and the timber upon them will not be difficult to clear. Every part of the island is easily accessible from some point upon the shore, and the interior lakes will probably be found of advantage for the purposes of transportation. Several leading roads have been laid down in the original surveys, and these are to be constructed out of the funds to be realized from the sale of the lands. The good land of the island derives an additional value from the fact that its agricultural productions will probably be required to supply mines on the north shore of Lake Huron. The poorer lands may be very profitably employed for sheep-farming. The facility with which they may be cleared of their timber, and their suitability for this purpose, have been demonstrated at Manitowaning, where between two and three thousand acres are under grass. The valuable fisheries around the island will prove of advantage during its first settlement. Large quantities, especially of white-fish and salmon-trout, are sent to market every year by the Indians, who are very skilful in the manufacture of nets and barrels. The interior lakes also abound in

Settlement.

Fisheries.

white-fish, salmon-trout, fresh-water herring, black bass, perch, pickerel, pike, dog-fish and speckled trout, and several of them are much resorted to for fishing by the Indians. Bears and caribon are the principal quadrupeds of the islands. The beaver has been completely exterminated. Ducks are plentiful during their spring and fall migrations, but very few of them remain all summer. Both the spotted and ruffed grouse, or common partridge, are met with, the latter in some abundance. The economic minerals of the island will be described further on. Should the petroleum be found to exist in large quantities, it will prove a great stimulus to the rapid development of the resources of the island.

#### GEOLOGICAL DESCRIPTION.

Geology.

The general geological features of the Manitoulin Islands as determined by Mr. Murray, will be found in the *Geology of Canada*, pages 194, 216, 320 and 333. As there shown, the rocks of the island, with the exception of a few ridges of Huronian quartzite at the head of She-gua-an-dah Bay, consist of unaltered and nearly horizontal strata of Lower and Middle Silurian age. The general dip is to the southward, with slight variations to the east and west of south at each of the fifteen low anticlinals already referred to, which traverse the island in a general course a little to the west of south. The positions of these anticlinals have been mentioned as corresponding with those of the larger interior lakes, and the bays along the north shore. At the west end of the island, their direction is more nearly north and south than at the eastern end, the variation to the westward of south increasing constantly in proceeding towards this end. The channels separating Manitoulin from Cockburn Island, on the west, and from Horse Island, on the east, are caused by similar anticlinals, which also partake of the direction of those nearest to them.

Chazy formation.

*Chazy Formation.*—The chazy formation is represented by red marls, interstratified with bluish-drab bands of the same, and a few layers of fine quartzose sandstone, in the northern part of La Cloche Island.

Trenton group.

*Trenton Group.*—The greater part of La Cloche Island, and of the other principal islands between the north shore of Lake Huron and the Manitoulin Island, consist of dolomites and thin bedded light grey and somewhat argillaceous limestones, of the Trenton group. The upper portion of this group, of a somewhat more massive character, occurs on Manitoulin, forming the northern part of the peninsula between Wequema-kong and Manitowaning Bays, and skirting the northern extremity of the island for six miles from Little Current to West Bay. In the former area there may be

about eighty, and in the latter forty feet of strata belonging to this group, counting from the lowest bed which comes to the level of Lake Huron.

*Utica Formation.*—This is the next in ascending order, and forms the northern part of Cape Smyth, a belt about a mile broad, running southwestward across the peninsula between Wequemakong and Manitowaning Bays, part of Heywood or Rat Island, the whole of Strawberry Island, and a strip sweeping round from the head of She-gua-an-dah Bay to West Bay. It occurs again on the southern part of Clapperton Island, and on the smaller islands adjacent to it, and probably also at Maple Point, on the opposite side of Clapperton Channel. The total thickness of this formation on Manitoulin Island is probably about sixty feet. It consists entirely of massive black bituminous shale, weathering to a very light drab color.

*Hudson River Formation.*—Above the Utica succeeds the Hudson River formation, consisting of soft marly bluish drab colored shales, interstratified with numerous beds of fine grained grey sandstone, and grey fossiliferous limestone, all capped by about thirty feet of dark grey limestone, holding *Stromatopora concentrica* and *Beatricea unilulata*.

The fact of this formation diminishing in volume as it runs westward is referred to in your General Report of 1863. Its thickness at Cape Rich, on the southwest side of the Georgian Bay, is there given as 500 feet. At Cape Smyth you give the thickness as 300 feet, and the explorations of last summer tended to confirm the correctness of this estimate. To the south of She-gua-an-dah Bay, and of Little Current, the thickness appears to be about 250 feet, and at Maple Point 220 feet. About 145 feet are exposed on Barrie Island, and 137 at Cape Robert, but the base of the formation being under the level of Lake Huron at both of these localities, the figures mentioned do not give its total thickness. The following is a descending section of the cliff on the west side of Cape Robert:

Brown-weathering, drab and bluish grey argillo-arenaceous limestone—mostly thin-bedded, or when thicker, breaking away in irregular lumps. This band forms the perpendicular and overhanging portion of the cliff, and is here, and elsewhere on the island, characterized by a large concentric coral ( <i>Stromatopora concentrica</i> ) . . . . .	17
Crumbling calcareo-arenaceous shale of a bluish drab color . . . . .	10
Hard grey calcareous beds, interstratified with bluish grey shale . . . . .	3
Bluish grey clayey shale . . . . .	25
Hard grey calcareous beds . . . . .	2
Bluish grey arenaceous crumbling marl . . . . .	30

87 ft.

The remaining fifty feet below this, consisted, wherever exposed, of marls or clays like the last, interstratified occasionally with a thin bed of harder rock. Probably a few feet of hard rock, like the first, intervene between the top of the cliff and the summit of the formation.

## Fossils.

Fossils, mostly well preserved, are more abundant in the marls or shales and limestones of the Hudson River formation at Cape Smyth than at any other known locality of this formation in Upper Canada. The following species collected there are enumerated in the General Report of the Survey, (page 218.) *Tetradium fibratum*, *Stenopora fibrosa*, *Favistella stellata*, undetermined species of *Petraia* and *Stromatopora*, *Leptæna sericea*, *Strophomena alternata*, *S. filitexta*, *Orthis lynx*, *O. occidentalis*, *O. insculpta*, *Rhynchonella modesta*, *R. recurvirostra*, *Modiolopsis modiolaris*, *Avicula demissa*, undetermined species of *Orthonota* and *Cyrtodonta*, *Pleurotomaria Americana*, *P. Helena*, *Cyclonema vilix*, an undetermined *Murchisonia*, *Orthoceras bilineatum*, *O. crebriseptum*, and an undetermined *Asaphus*.

On the east side of Metch-ke-wed-enong village, at the head of West Bay, the following species, as determined by Mr. Billings, were collected in grey, somewhat arenaceous limestone, belonging to the upper part of the Hudson River formation: *Stenopora fibrosa*, *Fenistella stellata*, *Heliolites interstincla* (Wahlenberg,) *Strombodes pentagonus*, *Zaphrentis bilateralis*, *Cyathophyllum* ——? *Tetradium fibratum* (Safford), *Orthis occidentalis* Hall), *Orthis* ——? *Rhynchonella modesta* (Say), *Ambonychia radiata* (Hall), *Ctenodonta* ——? *Cyrtodonta* ——? together with a small *Athyris*, and a cystidean.

On the east side of the same bay, and half a mile from Metch-ke-wed-enong, were found *Stenopora fibrosa*, *Favosites Gothlandica*, *Favistella stellata*, *Zaphrentis bilateralis*, *Strophomena planumbona*, *S. rhomboidalis*, *Orthis lynx*, *Orthis* ——? *Rhynchonella modesta* and *Atrypa plano-convexa*.

The fossils from the two localities last mentioned, belong partly to the Hudson River, and partly to the Clinton formation, and the strata in which they were found would, therefore, appear to constitute beds of passage between the two formations. On the same side of West Bay, and three miles from Metch-ke-wed-enong, the following were collected: *Stenopora fibrosa*, *Favistella stellata*, *Petraia* ——? *Rhynchonella recurvirostra*, *R. capax*, *Orthis lynx*, and *O. occidentalis*, with some undetermined species of Lamellibranchiata and Gasteropoda. These are all proper to the Hudson River formation, and the beds from which they were derived are situated near its summit.

Fossils belonging to the same formation, some of which are

silicified, are plentiful in the arenaceous limestone forming the top of a bank about forty feet high, at the south-eastern extremity of Manitowaning Bay. These beds are not far from the summit of the formation. They hold *Stromatopora concentrica* and *Beatricea undulata*, and probably constitute the same band in which these species occur on Club and Rabbit Islands, and at the top of the cliffs at Cape Smyth. The Hudson River formation, near its northern boundary, is everywhere marked, except at the heads of bays, by a steep and elevated bank of the clayey strata, usually capped by the limestone band.

On the south-west side of the Georgian Bay, a red marl, representing the Medina formation, overlies the Hudson River formation, coming between it and the Clinton formation. In proceeding northward towards the Manitoulin Island, this marl is last seen at Cabot's Head, and no trace of it has been found upon the island, where the Clinton rests directly upon the Hudson River formation.

*Clinton Formation.*—This consists of from 125 to 150 feet of buff-weathering purplish-grey magnesian limestone, surmounted by a band of red marl, which may average twenty feet in thickness. This limestone is generally thin-bedded, and holds silicified fossils. The lower beds are characterized by the prevalence in them of the heads of small cystideans about the size of peas. In some places soft white nodules, similar to those found in the Clinton formation in the county of Grey, are met with in considerable numbers. The escarpments formed by the outcropping edges of these beds, have a dentated or zig-zag outline, caused by the cleavage joints, which divide the beds vertically into rectangular blocks. These cleavage planes run almost due north and south, and east and west, and from their constancy in regard to direction, are of service in assisting to follow out the distribution of the formation. Near the north-eastern extremity of South Bay, the following fossils were collected, the species having been determined by Mr. Billings: *Stenopora fibrosa*, *Favosites Gothlandica*, *Strombodes gracilis*, *Stromatopora concentrica*, *Strophomena pecten*, *Orthis Davidsoni*, and two undetermined species, *Atrypa plano-convexa*, and a species of *Orthoceras*. The cystidean already referred to, which has not been specifically determined, occurs here in abundance. All of the fossils are silicified. From this part of South Bay the base of the formation sweeps round, with a northward curve, to the eastern shore of the island. The formation occupies a considerable area on the north side of South Bay, and round the southern part of Manitowaning Bay, forming the cliffs to the west and south of the village of the same name. At the southern extremity of the bay the usually thin-bedded character of the formation is interrupted by a massive

section, forming the prominent part of the escarpment, known as Gibraltar Rock. Continuing to the westward, these limestones form the northern and north-western shores of Lake Manitou. Along the latter they rise in a cliff, which in some places is upwards of seventy feet high. They cap the cliffs on both sides of West and Mudge Bays, form the northern shore of Lake Kagawong, and probably underlie the drift deposits at the north end of Lake Mindemooya. They are again seen along the northern side of Bayfield Sound, and upon Hone Island, from which they cross Cape Robert, and are once more exposed on the islands at the entrance of Cemetery Bay.

Red marl.

The overlying red marl, already referred to as belonging to this formation, probably corresponds with the iron ore band known to exist in the Clinton further south. Although its thickness may not, on an average, exceed twenty feet, it appears to be very persistent throughout the island, at the base of the succeeding limestone formation. The red marl is mingled with bluish-green layers and patches, and interstratified with an occasional thin hard seam of the same color. The finest soil of the island is found along the outcrop of this marly band, and numerous Indian gardens are situated upon it.

Niagara formation.

*Niagara Formation.*—The higher limestone mentioned above, is referred to the Niagara formation, although some of the silicified fossils which abound in its lower beds are common to the Clinton. These fossiliferous beds generally form the lower part of the cliff which marks the geographical base of the Niagara formation, and as there is no means of drawing a line between them and the undoubted Niagara strata; they are, for convenience, classified with these, in the same way as are a few similar beds, which occur in a like position on the mainland, to the southward. By a reference to your General Report of 1863, it appears that the Niagara formation gradually increases in thickness in proceeding northward, from about 100 feet, where it leaves Lake Ontario, to 160 where it strikes the Georgian Bay, and to 200 or 250 on the west side of Colpoy's Bay. It is also shown to continue increasing in volume as it follows the Indian Peninsula to Cabot's Head. It runs through the whole length of Manitoulin Island, occupying the southern half, with the exception of some patches of the overlying Guelph formation, which will be described further on. Its average breadth is nine miles, which, with a dip of forty feet in a mile, would give 360 feet as the thickness of the formation. At fifty feet in a mile it would be 450 feet. The mean of these is 405 feet, which is probably not far from the actual thickness.

The northern boundary of the formation, rendered conspicuous by



a limestone cliff varying from 20 to 200 feet in height, has the following course: After crossing the peninsula between the east end of the island and South Bay, it runs northward from Rocky Point on the north-west side of the same bay, to the eastern extremity of Lake Manitou, and thence follows its southern and western shores. It then runs out in a long point between the west end of Lake Manitou on the one side, and West Bay and Lake Mindemooya on the other. Starting from the north-west corner of this lake it sweeps round in another promontory to the north-east corner of Lake Kagawong, and follows round its southern shore. From the west side of Lake Kagawong it crosses to Lake Mudgee-manitou, and after forming another promontory towards the north, runs southward to Lake Wolsey, reaching its east shore about the middle, from which point it continues round the southern part of the lake to the outlet. From Lake Wolsey it follows the south shore of Bayfield Sound to She-she-qua-ning, where it strikes across Cape Robert, and continues thence all along the shore to the western extremity of the island.

Niagara formation.

The upper beds of this formation, as well as the Guelph strata, dip into Lake Huron at so small an angle, that they produce a low shore, and shallow water all along the south side of the island. The coast line is very much broken by shallow bays and straggling points, rendering navigation somewhat dangerous.

The whole formation consists of thick-bedded and thin-bedded limestones of various shades of light and dark grey. Wherever the surface has been exposed to fire, by the burning of the timber, it weathers white, but when not thus scorched it is generally dark-colored or almost black, from the growth of small lichens upon it. The high promontory of Niagara limestone between Lake Manitou and West Bay suggested to the Indians the name, Metch-ke-wed-enong or The High Hill, for their village at the head of the bay. The following is an approximate descending section of the escarpment overlooking the west side of Lake Manitou:

	Feet.
Very massive light grey magnesian limestone. In some places smooth walls, which had once formed the sides of joints, extend, without a break, nearly from top to bottom. No fossils are recognizable.....	60
Thin bedded-grey limestone, some portions holding silicified corals.....	40
Limestone similar to the last, but often projecting in a separate terrace below the other. A three-foot bed, near the centre, is full of silicified corals.....	50
Talus.....	30
	180

Fossils.

Mr. Billings has recognized the following among the fossils collected in the forty feet band, the species marked thus \* being new: *Stenopora fibrosa* (Goldfuss), *Favosites Gothlandica* (Goldfuss), *F. favosa* (Goldfuss), *Halysites catenularius* (Linn), *Syringopora junceiformis* (Hall), *S. Dalmani* (Billings) *Heliotites macrostylus* (Hall), \* *Eridophyllum Huronense* (Billings), *Zaphrentis bilateralis* (Hall), \* *Cyathophyllum Vennori* (Billings), *Ptychophyllum Belli* (Billings), *Strombodes pentagonus* (Goldfuss), *S. Murchisoni* (Edwards and Haime), *Stromtopora concentrica* (Goldfuss), *Orthis Davidsoni* (Verneuil), *Pentamerus oblongus* (Sowerby), *Euomphalus* — ?, *Orthoceras Bayfieldi* (Stokes), together with several species of crinoids.

In places, the massive band at the top recedes to a short distance from the general line of the cliff, thus leaving exposed the fossiliferous beds below. On the surfaces thus formed the silicified corals, distinctly weathered out, are strewn about in great numbers. On the south side of Bayfield Sound the rocks of this formation rise in a bold escarpment overlooking the lake. It is particularly conspicuous between Helen and Elizabeth Bays, and is separated by a step into two portions, the top of the lower being about 100 feet, and that of the upper between 200 and 250 feet above the level of Lake Huron. In crossing the island from north to south, after passing the brink of the main escarpment, smaller ones, making up the higher portion of the formation, are met with at intervals all the way to the south shore. They consist mostly of light grey, sometimes almost white compact limestone, rather fine grained and crystalline in texture. Some of the upper beds, being those on the south side of the island, are dark grey in color.

Guelph formation.

*Guelph Formation.*—This formation occurs on both sides of the entrance to South Bay. The beds are mostly very massive, soft, finely crystalline, and of a light greyish-buff color. They weather to a very uneven, pitted or spongy looking surface, blackened by the growth of minute lichens. At this locality, fossils are plentiful in some beds, but very obscure. Among those collected, Mr. Billings has recognized *Favosites Gothlandica*, a species of *Zaphrentis*, and two small spiral Gasteropods, similar to those found elsewhere in the Guelph formation. Besides the patches of this formation which occur on either side of the entrance to South Bay, there is a third, on the west side of Michael Bay, extending towards Providence Bay, with apparently a fourth on the south-east extremity of the island, and a fifth, forming the south end of Horse Island. The total thickness of this formation on the main island is probably about 100 feet.

A section from north to south, across the middle of Manitoulin Island, would give about the following ascending section: General section.

	Feet.
1. Trenton formation (upper part, above level of Lake Huron).....	40
2. Utica formation.....	60
3. Hudson River formation.....	250
4. Clinton formation.....	157
5. Niagara formation.....	405
6. Guelph formation (to level of Lake Huron).....	100
Total.....	1012

*Superficial Geology.*—The glacial phenomena of the drift period have evidently had much to do with the production of the present features of the island. Glacial striæ are everywhere seen upon the top of the solid rock, except where its surface has been exposed to defacing agencies. Along the south side, the upper beds of limestone, sloping into the lake, are always strongly grooved or furrowed. A strip of bare and almost flat rock, several hundred feet broad, frequently intervenes between the forest and the water, and in such places the grooving is very strikingly displayed. On the west side of the entrance to South Bay, the Guelph dolomites are cut into a remarkable series of long straight and parallel hollows, in which the water is deep enough to admit sail-boats. The ridges between these furrows vary from one to ten feet in height. Their course is about S. 50° W., and they dip under the lake at an angle of two or three degrees. At the west end of the island, the course of the striæ is more nearly south than at the other end, where it is considerably to the west of south, the direction changing gradually with that of the depressions which hold the interior lakes and the bays on the north side. From the west end to Elizabeth Bay, the course is about S. 9° W.; on the south shore, nearly abreast of Lake Wolsey, it is S. 17° W., at Providence Bay, S. 36° W., and on the shores of South Bay, from S. 50° W. to S. 55° W. The northern sides of the interior lakes generally present low sloping and ice-grooved shores, corresponding with the south shore of the island, while cliffs or steep banks rise from their southern margins, corresponding with its abrupt northern coast. The flat top of Gibraltar Rock, at the head of Manitowaning Bay is worn into numerous large pot-holes. Some of these are upwards of ten feet deep, and six feet in diameter. Hard rounded boulders and stones were observed in the bottom of each, and out of some of them small trees had grown. Their elevation is about 200 feet over Lake Huron. Rounded boulders, derived from the hard Huronian rocks of the north shore of Lake Huron,

are scattered more or less thickly over the whole island. They are sometimes perched on the brinks of the cliffs, from which they may be easily dislodged. No stratified clay, and but little stratified sand, was noticed upon the island. Well marked lake-terraces were observed around Wequemakong Bay, but their levels were not ascertained.

#### ECONOMIC MATERIALS.

Building  
stones.

*Building Stones.*—Some bands of the Trenton limestone, at and near Little Current, would afford good building stone for houses. Most of the upper half of the Niagara formation consists principally of light grey dolomite, in both thick and thin beds. It would make a durable and handsome building-stone. At the northwest point of the island, there are some beds in the lower part of the same formation, of a light greyish-buff color, quite soft and easily worked. Judging from the natural exposures, it is evident that the stone is very durable. Some portions of the Guelph dolomite, along the southeast part of the island can scarcely be distinguished from the stone from the same formation, which is so highly prized for building purposes, in the neighbourhood of Guelph.

Flagstones.

*Flagstones.*—The lowermost stratum of the Niagara formation, or that immediately overlying the red marl, is very thinly and evenly bedded, and the joints are far apart. Many of the beds have smooth surfaces, and appear well adapted for flagstones.

Whetstones.

*Whetstones.*—The fine grained sandstone layers in the Hudson River marls at Cape Smyth, like those in the same formation in the county of Grey, are suitable for making whetstones.

Cement.

*Hydraulic Cement.*—Some of the harder beds near the top of the Hudson River formation, and some of those belonging to the Trenton in Manitowaning Bay, weather yellow, and appear as if they would make water-lime.

Quartzite.

*Quartzite for Glass-making.*—The Huronian quartzite, forming the bare ridges at She-gua-an-dah Bay, is white, and apparently free from impurities, and there is an unlimited quantity of it for this purpose.

Gypsum.

*Gypsum.*—This mineral is said to occur in promising quantities on the east end of the island, about three miles south of Wequemakongsing, but as this information was only communicated to me as we were leaving the island, it was found impossible, to visit the locality. In the same geological position, on the east side of West Bay, about a mile and a half from Metch-ke-wed-enong, small quantities of gypsum occur in the limestone, near the junction of the Hudson River and Clinton formations.

*Salt.*—Springs of salt water are reported as occurring upon *Barrie Island*, but they may probably be only such bitter saline waters as are generally met with in these lower rocks.

*Bituminous Shales.*—Some years since, as described in the *Geology of Canada*, page 784, attempts were made at Collingwood to manufacture oils by distilling the bituminous shale of the Utica formation, and it was then found that oils could be profitably made from it, when the refined illuminating oil brought seventy-five cents a gallon. On the Manitoulin Island this rock appears to be more bituminous than at Collingwood, and in the event of mineral oils reaching a comparatively high price, it may be found valuable for their manufacture.

*Petroleum.*—Springs of petroleum have been found on the south side of Wequemakong Bay, where three or four wells are now being sunk. One of these is now (7th May, 1866,) upwards of 500 feet deep. It starts upon the Hudson River rocks, probably about the middle of the formation, and passes through the Utica and Trenton strata. A hard quartz rock (probably Huronian) has now been reached. Oil, accompanied by gas, was found at various levels, and up to the present time, it appears that seventy-two barrels of oil have been dipped up by the sand-pump, during the progress of the boring. Surface oil is said to have been found at Bob's Portage, on the east side of Manitowaning Bay, and also in She-gua-an-dah Bay, and upon Strawberry Island. A petroleum spring, on one of the islands north of Maple Point, is referred to in your General Report of 1863.

In the General Report, pages 523 and 790, there are notices of a bituminous dolomitic limestone, a specimen of which had been brought from Grand Manitoulin Island, containing about eight per cent. of solid bitumen or mineral pitch. It was there pointed out that this might be used, like the similar asphaltic limestones of Switzerland and of Italy, for the preparation of mastic pavements. The precise locality of this bituminous limestone has not, however, as yet been discovered.

I have the honor to be,  
Sir,  
Your obedient servant,

Queen's University,  
Kingston, 7th May, 1866.

ROBERT BELL.

