

Copper

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REPORT  
ON THE  
COPPER DEPOSIT OF GRAND MANAN,  
BAY OF FUNDY.

Having received instructions to examine the mineral property of Messrs. Gray and Company, on the western coast of the Island of the Grand Manan, I visited the spot in the early part of the present month (September, 1870), and made as careful an examination of the property as the nature of the ground would allow. The condensed statement, now submitted, embodies the general results of my investigation; but, in consequence of the present undeveloped state of the property, these results, it should be observed, are necessarily to some extent conjectural.

1. *General description of the Island*:—The Island of Grand Manan is situated near the Mouth of the Bay of Fundy, about ten or twelve miles east of the coast of Maine. It extends in a general NNE and SSW direction, its average length being about twenty-one miles. In breadth, it varies from three to four miles in some places, to seven or eight miles in others. A small strip at the extreme south of the island belongs to the State of Maine; but with this exception the whole of the island is included within the Province of New Brunswick. Saint Andrews, the nearest port of the Dominion of Canada, lies about thirty miles to the north-west.

The eastern coast of the island is comparatively low, and much indented in outline, offering several wide bays and more or less sheltered coves with good anchorage. This side of the island contains also one or two saw mills and a considerable number of detached settlements, chiefly occupied by fisher-

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men. Towards the central part of the island the ground rises abruptly, and the entire western coast presents an almost unbroken line of high basaltic cliffs, rising vertically to a height of from 200 to 250 feet above the sea level. Below this escarpment, with its slides and talus of heaped and broken rock, there is no true beach, but merely a narrow belt of coarse shingle, covered in many places by huge columns and angular masses of basaltic trap fallen from the cliffs above.

The western side of the island, more especially, is densely wooded, and would thus furnish a practically inexhaustible supply of good timber for mining purposes. Two or three small lakes occur also upon it, and streams emanating from these afford an unfailing supply of water. This point may be especially alluded to, as several valuable mining stations, situated on other islands of the Bay of Fundy, are greatly impeded in their operations by the want of fresh water for washing and dressing their ores. The property secured by the Company occupies a range of several miles along this western coast, and comprises altogether 800 acres. Part of it is held in fee simple, and the rest as regards mining rights, with full privileges as to roadway, water supply, cutting of timber, &c.

2. *Geological Features* :—The oldest rocks on the island are a series of metamorphic slates and conglomerates, probably of Palæozoic age. These are exposed chiefly on the north-east side of the island. They shew a general dip towards the south-west. In the accompanying sketch-section these metamorphic strata are denoted by the letter A. They are traversed in places by trap dykes, partly of an amygdaloidal character, and are covered here and there by beds of drift gravel. At the base of the island, on the western side, strata of buff-coloured sandstone crop out, and range along the shore throughout almost the entire extent of this part of the coast. These sandstone beds (lettered B in the section) are apparently of Triassic age. They dip at a slight angle towards the south-west, and must thus overlie the metamorphic strata, somewhat as depicted in the section ; but their extent in an easterly direction may be greater or less than is there shewn.



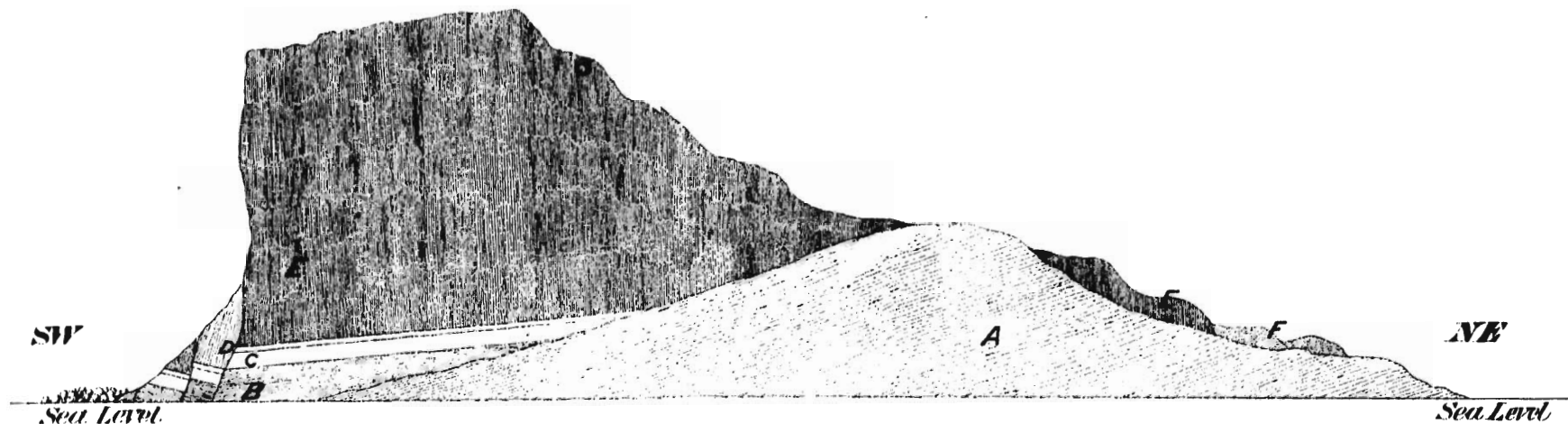
Here and there, below the boulders on the shore, they are seen on the other hand to extend in broad layers beneath the sea. A bed of white or pale grey tufa (C), averaging about seven or eight feet in thickness, rests conformably on these sandstones, and is succeeded by a thin layer of soft clay-like tufa (D), the two presenting, in many places, no clearly discernible line of separation. Finally, above the whole of these beds, a mass of columnar and sub-columnar trap (E), forms a huge overflow, its surface sinking down in step-like ridges towards the east, whilst on the western shore, as already stated, it forms a range of high precipitous cliffs, rising almost vertically from the sea.

3. *The Mineral Bed*:—The outcrop of light coloured tufaceous rock (C) referred to above, although covered up in many places by heaps of detrital matter fallen from the cliff, can be traced along the face of the western escarpment throughout a length of eight or nine miles, and it extends undoubtedly beyond this distance. It is shewn nowhere, however, in its true position; but only along the face of the slides or *éboulements* which rest against the base of the cliffs throughout the entire length of the island. As thus seen, it occupies a level much below the true position of the bed. The latter must be at least thirty or perhaps forty feet above high-water mark, whereas, on the face of the slides, the bed has been brought down in some places to within three or four feet of the water level, and in others to about fifteen or twenty feet. In these slides, also, the bed has been more or less broken up, and has been made to dip inwards or towards the east, as shewn in the accompanying sketch, whilst the true inclination is evidently in the opposite direction.

This tufaceous bed carries small patches and stains of earthy malachite or green carbonate of copper apparently throughout its entire length; and where the bed has been excavated to the extent of a few feet, these stains and earthy masses are seen to have arisen from the partial decomposition of small strings and bunches of copper glance or sulphide of copper, one of the richest ores of that metal. Only two excavations, however, have at present been carried into the bed, and neither

of these reach the solid or unfractured rock. But these excavations are about five miles apart, and here and there, on the intervening stretch of shore, pieces of the rock thickly charged with malachite, or shewing strings of copper glance, occur amongst the detrital matters dislodged from above. It may be fairly concluded, therefore, that the bed carries ore of this character throughout the entire length of its outcrop; but this cannot be absolutely proved without undertaking regular exploratory work, as a comparatively slight shock at the foot of the cliff is sufficient to bring down many tons of rock and stone. This tendency to fall is in great part due to the face of the cliff being composed of vertical columns of basalt, which separate readily at the partings. On the actual face of the outcrop, the show is in many places very poor. Here and there, for the space of a couple of fathoms or more, merely a few faint stains are observable, but in other places distinct patches of malachite occur. The ore appears to have been greatly decomposed near the face of the outcrop, partly, perhaps, by the action of sea-water; and it may thus, in course of time, have been gradually dissolved out or washed away. The water which infiltrates in places through the bed, holds evident traces of copper salts, as a film of metallic copper has been found on picks and hammers accidentally left in contact with it. The first three or four, or perhaps five feet of the bed (taken from the outcrop generally,) will not certainly give an average yield of one per cent. of metal; but at a distance of ten or twelve feet, if the present excavations may be taken as a criterion, a yield of at least five or six per cent. may be anticipated (see Assays in § 4). Copper glance contains normally 79·8 per cent. of metallic copper: the presence of a comparatively small amount is sufficient, therefore, to form a paying ore. Malachite, also, although a hydrated carbonate of copper, is comparatively rich in metal, as the copper in pure samples exceeds  $57\frac{1}{2}$  per cent.

4. *Results of Assays.*—A small sample showing faint stains, from the face of the outcrop, yielded in metallic copper only 0.21 per cent. Another sample, also from the face of the outcrop, but containing small specks of earthy malachite, yielded



SKETCH-SECTION ACROSS THE ISLAND OF GRAND MANAN: BAY OF FUNDY.

*A*—Metamorphic Slates and Conglomerates. *B*—Triassic Sandstone.  
*C*—Copper holding Tuff. *D*—Thin bed of clay-like Tuff shewing cupreous stains.  
*E*—Columnar and Sub-Columnar Trap. *F*—Beds of Drift Gravel.

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0.73 per cent. A sample taken from about 12 feet from the edge of the outcrop, and weighing nearly 5 lbs., gave 9.86 per cent. Two other samples gave respectively 4.63 and 6.15 per cent. Finally, a small sample from the same place, containing numerous strings of copper glance, yielded no less than 22.16 per cent. A piece of rock of about half-a-pound weight, picked up on the shore about a mile from the excavation which furnished the above samples, gave 4.58 per cent. metallic copper. Discarding the very rich and the very poor specimens, as exceptional examples, the results of these assays indicate an average yield of rather more than 6 per cent. But with the exception of the sample found upon the shore—and this may have been rolled there by the set of the tide, or dropped by some one passing the spot—these samples, it must be remembered, were obtained from a single spot of very limited extent, and hence they may not indicate in any way the true yield of the entire bed.

If the ore, allowing for loss, average 5 per cent. metal, each cubic fathom will contain about 2,020 lbs. of copper, and will weigh about 18 English tons. Taking the mean thickness of the bed at only six feet, and assuming it to extend eastward, with the same yield of metal, to a distance of ten fathoms only, each mile in length will comprise 8,800 cubic fathoms of copper-holding rock, and will carry 7,890 tons of metal, worth at the present low price of copper, about £580,000. In reference to this calculation, however, it must be observed that although the bed will probably be found to extend eastwards to a much greater distance than ten fathoms, its richness may not be constant throughout that distance; nor may the assumed yield be found to hold good, from fathom to fathom, along the length of the bed. On the other hand, the small strings of copper glance, as seen in the samples hitherto obtained, may thicken and form a network of ramifying veins, running in a general north and south direction—and in that case, the returns would be greatly in excess of the above estimate. It will thus be seen that in the present undeveloped state of the deposit, no definite conclusion can be arrived at respecting its true value.

5. *Proposed Exploratory Work.*—The extension of this copper-holding bed in a north and south direction may be regarded as fully proved; and it is equally certain that at particular spots the bed carries a profitable amount of ore. But the width of the bed, or its extent in an eastward direction, is altogether unknown; and it cannot consequently be predicted with certainty that the ore will be found in paying quantity throughout the bed generally. To determine these latter points, it will be necessary to carry a drift into the solid portion of the bed, the character of the ground precluding other modes of exploration. This drift should be run, in my opinion, from a point in the south side of the ravine which opens into Little Dark Harbour. The ravine in question cuts the strata of this western part of the island almost at right angles. If the drift, consequently, be started in this ravine at a sufficient distance from the shore, and at the proper elevation, it will prove the width or extension of the bed, to that distance at least, directly it strikes the solid rock; whereas, if started on the shore face of the escarpment, it will prove nothing until carried far into the bed; and the amount of tumbled rock and detrital matter, to be removed or passed through, will be about the same in either case. The distance of Little Dark Harbour from Sloop Cove, where the present excavation in the fallen rock matter has been opened, is about two-and-a-half miles. The cost of an exploration of this character would probably amount, on a rough estimate, to about two thousand five hundred or three thousand dollars—a certain outlay being required for preliminary expenses, in putting up shelter for the men employed, fixing forge and powder house, laying in provisions, &c.

6. *Working conditions of the Copper-holding bed, and general conclusions.*—The working conditions of this deposit are sufficiently favorable. The rock is comparatively soft, and is thus easily mined. The post and stall system would be employed in its removal. If the roof required additional support, plenty of suitable timber could be obtained on the property. The chief defect with regard to the ore, is the impossibility of concentrating it by dressing, without at least a very considera-

ble loss. It might be cobbled or hand dressed to a slight extent, but would otherwise have to be treated in bulk. The gangue is a silicate, free or nearly so from carbonate of lime. All things considered, a wet process for the extraction of the copper would give the most satisfactory results. If the ore be found to retain its present character, indeed, no other system could be profitably employed. It is also evident that the ore could not be exported, to be reduced elsewhere, but the extraction of the copper must be carried on at the mine itself. The necessary works could only be erected on the summit of the cliff, as the exposed shore presents no site for this purpose, and the intersecting ravine at Little Dark Harbour is apparently too contracted for the erection of suitable buildings. No difficulty, however, need be apprehended on this account. By the formation of slides on the cliff-face, the ore could be run up by various known methods, abundant water-power being available for this and other purposes.

In a word, the property in question may be regarded as a mineral location of more than ordinary promise; but the peculiar and to some extent uncertain character of the deposit demands further exploration. Until this be effected, the erection of reducing works, or expenditure of capital in fitting the ground for permanent mining occupation, cannot be legitimately recommended.

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