

searching for birds' nests, in some wild spot, I have suddenly come upon an adder basking in the sun, and one half the pleasure of a day's wanderings in search of specimens was always sacrificed to the fear of this serpent's bite. In the northern States of America, the dreaded rattlesnake swarms in some parts, the bite of which is frequently fatal in twenty minutes; while here, in our little half-island home, our children may ramble wherever they list, and meet with nothing more formidable than the bite of the common striped snake, which at the worst can only inflict a slight wound in no way dangerous to a healthy frame. Therefore, while in other climes which boast of the grandeur of their scenery, the beauty of their vegetation, or the vast area of their fertile lands, deadly foes are ever ready to spring upon the incautious, here in our northern home we may roam through the forests, scale our boulder ridges, or bathe in the limpid lake, without hindrance from any reptile form. Surely we ought, therefore, to consider how blessed we are in this respect, and while considering the blessing let us not forget the beneficent hand that has so blessed us; and as we roam in security amid Nature's pleasantest scenes, let us lift our eyes in gratitude to Him who has spared us the horrors of the serpent's fang.

ART. XIII. NOTES ON THE ECONOMIC MINERALOGY OF NOVA SCOTIA; PART II. THE ORES OF MANGANESE AND THEIR USES. BY HENRY HOW, D. C. L., *Professor of Chemistry and Natural History, University of King's College, Windsor.*

(Read May 2, 1865.)

A VERY interesting, and to all present appearances, valuable addition to the mining industry of the Province, has been made within the last three years by the working of the ores of manganese. Having been engaged in examining and reporting on the quality of these ores for those originally concerned, and having visited the scenes of operation, I requested and obtained permission to include such information I had gathered by these means in a general account of the manganese ores of the Province at present known to me. Having been, moreover, kindly furnished with sundry details of interest from various sources, I propose now to continue, on this subject, my Notes on the Economic Mineralogy of Nova Scotia, of

which the first part was published in the last volume of the Transactions of the Institute.

The only deposits of manganese mentioned in Dawson's Acadian Geology are an impure bed near Cornwallis bridge, that at Musquodoboit, and those in the iron veins of Shubenacadie and in the limestones of Walton and Cheverie, of which latter it is said (p. 239) "small quantities have been exported. I have no doubt that if the limestones can be profitably quarried on a large scale, the manganese might be separated and form a considerable additional source of revenue; but it seems doubtful whether mining operations for the manganese alone can be carried on without loss."

The ores of manganese found here in quantity are Wad or bog ore; Manganite, which may be called hard grey ore, and Pyrolusite, which may be distinguished as soft black lustrous ore, and is often mixed with psilomelane, a hard black ore not so lustrous as the last named.

Wad.—The first of these is a black earthy substance, which is found in rounded lumps and grains. It has been sent to me from Parrsborough, and from another locality, I believe to the east of Halifax, where it is found in lumps mixed with stones; the sample I examined contained a great deal of water, and, when dried, 56 per cent. of binoxide of manganese, with the traces of cobalt which are usually found in this species. Neither of these would be valuable as ores of manganese, but they would probably serve as paints. Bog manganese is often mixed with bog iron ore, and then forms deposits of a brown or chocolate colour, called ochres or mineral paints. The paints of Bridgewater and Chester furnish examples. In the first of these I found only 11 per cent., and in the second about 20 per cent. of binoxide of manganese. It is said to be useless to send to (the English) market ores containing less than 65 per cent. binoxide.

Manganite.—This is a very hard ore which is found in compact lumps of a steel grey colour and sub-metallic lustre, giving a reddish brown streak to a file. It is often found in the neighbourhood of the next mentioned; it occurs abundantly at Walton and Cheverie, and is met with at Douglas and Rawdon. At Walton I have picked it out of the stoneheaps in fields near the river, and was told that a bed of it crops out on the bank of the river near

the bridge. It is found at Cheverie in nodules on the beach about twenty rods above high water mark, and has been dug on the upland less than two miles from the beach; it was formerly shipped, but to what extent does not appear to be known. As it is very hard, and contains in its purest form only about 49 per cent. *binoxide*, this ore is not useful for the ordinary applications of manganese; but I was informed by a gentleman from Boston, dealing in these ores, that it answers for a certain secret process better than the rich soft ore, and that something like fifty tons were sold in the United States in 1863, and that it was hoped the demand would increase.

Pyrolusite.—This is the ordinary marketable ore, and is entirely composed of binoxide of manganese. It is so soft as to be easily scratched with a knife to a black powder, and is found in masses which are more or less glistening, and often very beautifully crystallized in black lustrous needles and prisms. It is met with near Kentville, King's County; near Pictou, Pictou County; near Amherst, Cumberland County; at Musquodoboit, Halifax County; and at Walton, and other places, especially at Teny Cape in the township of Kempt, in Hants County. These two latter are the only localities at which mining operations have been carried on, small quantities of ore having formerly been shipped from Walton, where, on one occasion, seven barrels were got out in cultivating a garden, and considerable returns, as will presently appear, having been made at Teny Cape. In 1861 Nicholas Mosher, Esq. junr., of Avondale, brought me samples from Teny Cape which I examined for him, and when he learned what the substance was he sought for it diligently and procured several fine specimens, some of which he sent to the International Exhibition of 1862. He found the ore to occur about a foot below the surface, in a bed of earth about a foot thick, in separate loose masses, generally flattened in shape, of all sizes, from that of a bean up to that of the lump of twenty-four pounds weight, which, as being the largest then met with, was sent to the Exhibition. In this mode of occurrence it was traced some fifty rods; subsequently it was found in thin veins in the rock under this earth, the rock being "brick-like" and easily detached with a pick, so as to leave sheets of the ore. In one place four veins were found in ten feet, the largest vein being about one and half inch thick. Diggings were

made to the depth of four or five feet, and the ore became more plentiful, but was so variable in amount that while on one occasion two and a half barrels were got by a man in one day, the average quantity obtained was about half a barrel per day per man. This variation arises from the ore occurring not in regular veins but in separate masses, often lenticular, in pockets of various sizes. The first considerable collection of ore sent from the mines was landed at Windsor in June 1863, for transmission to England. It consisted of thirty-three barrels, equal to about seven and a half tons English; it was picked ore and looked very rich and uniform in quality; the highest percentage of binoxide I know of from Teny Cape was found in a sample I put in the hands of Mr. D. Brown, a pupil of mine, who obtained 95 per cent., and when this lot of ore was sent to England, it averaged on analysis in Liverpool 91.5 per cent. binoxide, and gave less than half a per cent. iron: it sold there half for £8 10s., half for £9 sterling per ton, being disposed of to different buyers. Messrs. Tennant of Glasgow, great consumers of manganese, are reported to have said they had never seen ore so fine. In April 1864, what appeared to be a vein of five feet two inches thick was struck; I visited the mine in June, and saw many tons of ore piled up, and one huge mass of perhaps three tons weight laid bare *in situ*. Mr. John Browne, the manager of the mines, has obligingly furnished me with a report, dated February 16th, 1865, from which I give some extracts: after narrating the facts I had learned from Mr. Mosher, given above, he says: "On the south side of the ridge a large open cutting was brought in running nearly north and south, in which was discovered the first large deposit at a depth of only fifteen feet from the surface. It extended some twelve fathoms in length, varying in thickness from fourteen feet to as little as six inches. From this pocket we took from one hundred and twenty to one hundred and thirty tons, leaving nothing in the bottom but a few small veins. Upon these we sank our shaft, and at a depth of fifteen feet, making in all thirty feet from surface, we intersected pocket No. 2 immediately underneath the first deposit, and making in the same direction. The manganese in the second pocket is of far superior quality to that found nearer the surface, and we have returned from it some hundred and eighty tons. Up to the present time we have been

opening ground and prospecting. In conclusion, I beg to state that our prospects are daily improving, and I firmly believe that at no distant date the manganese mines of Teny Cape will hold a distinguished position in the list of *bona fide* and profitable mines of Nova Scotia.”

I have omitted a number of technical mining details, allowing the extracts to bring out the mode of occurrence, the richness and quantity of the ore yet obtained: it appears that upwards of three hundred tons have been got out. Two hundred tons more have since been taken out, and very fine ore of 93·8 per cent. has been found at 50 feet below the surface. As regards the quality, I believe all that has been sold in England has realized from £8 5s. to £9 stg. per ton* ; the beautiful specimens sent to the Dublin Exhibition this year, are, I apprehend, mostly from the second pocket, as I received the majority on February 4th ; the large mass, however, of about three cwt., which has so long lain at the door of the Halifax Reading Room, and is, by the liberality of Messrs. Nash and Co., also to be sent to Dublin, I imagine must be from the first pocket.

The second mine in operation at Teny Cape, was opened up by Messrs. Weeks & Co. In the spring of 1864 samples of ore were brought to me by O. Weeks, Esq., and J. W. Ouseley, Esq., which turned out to be sufficiently rich for working, as they gave, just as I received them, from 88 to about 92·5 per cent. binocide. In June I went with Dr. Weeks, of Brooklyn, and a party, to prospect the locality whence the samples were taken. It consisted of a considerable hill contiguous to the Mosher mine, and the indications of ore in various parts were very promising. Operations were soon after commenced, and during the year about eight tons, English, of ore were sent to Liverpool, where they realized £8 5s. stg. per ton.† One great advantage of this locality is, that the Basin of Minas is only about a mile and a half distant in a direct line, and the intervening country is such that a road can easily be made from the mines to the place of shipment.

Hants County possesses a variety of manganese ores in localities widely separate from each other ; it has been mentioned that seven

* About ten or twelve tons fetched £10 per ton.

† A third mine has been opened by Messrs. Hamilton & Duvar, and a good deal of ore has been raised.

barrels of ore were on one occasion dug up in cultivating a garden at Walton; of the quality of this I know nothing, but that valuable ore is found at Walton I am certain inasmuch as a party of which I was one extracted several pounds at a locality in the woods about seven miles from Teny Cape; one piece of this is sent to the Dublin Exhibition, and is quite as rich to all appearances as that from Teny Cape.* About twelve miles south of these places Mr. Mosher has met with large detached pieces of ore, one weighing thirty-five pounds was sent to the Exhibition of 1862 and remains in England; it consisted of *pyrolusite* and *psilomelane*; it gave to Mr. Poole, one of my pupils, about 84·5 per cent. binoxide; another large mass found in the same region weighed one hundred and eighty-four pounds. I do not know of what kind of ore it consisted. The rock holding the manganese at Teny Cape is a limestone containing a good deal of magnesia, and coloured either grey or red by oxide of iron; it is soft and easily detached from the ore; barytes is frequently seen crystallized through the ore, and carbonate of lime (calcite) is sometimes found beautifully crystallized in various forms encrusting the ore. At Walton the manganese is sometimes associated with iron ore (limonite), and occurs in limestone. Since nearly all the localities mentioned in a previous page as affording manganese are of lower carboniferous age, it is not improbable that many others may yet be found in the Province, where rocks of this age are so abundantly distributed. It is not, however, in such rocks only that manganese may be expected, since it appears by the Report on Mines and Minerals of New Brunswick, by Prof. Bailey, issued in 1864, that the deposits of manganese, with one exception, in that Province, are met with either in lower silurian or cambrian rocks (p. 71); the exception is a bed said to be alluvial (p. 33). As regards the mode of occurrence it is stated (p. 72), that manganese is generally found in quartz or barytes, especially the latter, the country-rock being slates; at one locality (p. 45) the slates enclose a bed of limestone, three or four feet thick, which contains the manganese; the alluvial locality is also said to have the manganese in limestone; in all cases the

* Five tons were afterwards taken out here by Mr. J. Browne.

† In a report issued in 1865, and received since this paper was read, I find that Professor Bailey places the manganese localities in New Brunswick at the base of the lower carboniferous series.

geological situation is different from that prevailing here. I may mention that the report gives twelve hundred and fifty tons as the amount of ore taken account of as raised and mostly sold; a large but unknown quantity besides is mentioned as having been raised and shipped, and much must have been used in the Province, since there were at one time large chemical works at the Hopewell manganese mines in Shepody mountain.

Canada, it appears, has not yet been found to possess manganese ores in sufficient purity or abundance to be of economic importance — (*Geology of Canada*, p. 751.) The chief supplies of these ores were till lately derived from Germany, but mines have been opened not only here and in New Brunswick, but in Spain and Vermont; and it was from Spain, according to a Report read before the British Association in 1863, that the richest ores were at that time mostly imported into England. A short extract from this report will probably be interesting as showing that Nova Scotia has richer and more accessible ores than Spain:—

“Manganese is imported from Germany and Spain; but it is chiefly from the latter country that the richest ores are now obtained, which are found in hills consisting of schistose rock, which sometimes rise to a height of eight hundred feet above the level of the plain; but it is also found in “pockets,” and, in the latter case, it is quarried by picks, and occasionally gunpowder is used. The quality of the ore varies from 50 to 90 per cent. peroxide, and to obtain the richer ore men and boys are employed to break and sort it, which is then put into sacks and carried a distance of twenty to thirty-five miles, on mules’ backs, to the ports of shipment in the Mediterranean. The richest ores are at Calanas, thirty miles north of the ancient Roman fishing town of Huelva. We are indebted to Mr. Gething for this information, who also informs us that he imported to the Tyne, in 1857, the first cargo of Spanish manganese.”

As regards Vermont, it appears from Dana’s Mineralogy that the ores are abundant at several places; whether they are worked at more than one I have not learned. The locality at which mining is prosecuted is Brandon; and from the following interesting information, communicated to me by Dr. W. H. Weeks, of Dartmouth, it appears that the mode of occurrence of the ore is very different from that at Teny Cape, and by no means so favourable for operations on a large scale:—

“My visit to Brandon, Vermont, was of very short duration; I spent only a few hours at the works, consequently had not time to study the locality. The manganese is taken out of a gravel bank; it exists in

very small pieces, varying in size from that of a pea to a small onion; it is compact, very black, and does not show the crystal as ours does. There is iron ore, said to be very pure, taken out of the deposit, and an ochre largely charged with oxide of iron. The process of obtaining and cleaning the manganese is slow and must be expensive; they wash it in pans by a process something similar to that adopted here for the separation of gold from powdered quartz. The quantity of manganese at the Brandon mines is very small in proportion to the amount of material operated on compared with ours. The Brandon manganese is very pure when thoroughly cleansed, but this is a difficult matter as the oxide of iron adheres tenaciously."

Uses of Manganese Ores.—These ores are employed for a variety of purposes in certain manufactures of purely chemical character, or in which the aid of chemistry is necessary, and according to the application to be made of them they are required of different degrees of purity: in most cases a tolerably high percentage of the particular oxide of manganese, called the binoxide, peroxide, or available oxide, is necessary, and for certain uses there must be little else in the ore, and especially iron must be either absent or present in extremely small proportion. The manufactures in which the ores are used are principally those of bleaching powder, glass, pottery, iron, some brown colours used in dyeing, and manganates and permanganates for certain oxidizing processes (as bleaching fats) and for disinfecting. The native oxide is used for making boiled oil, and has also been recommended as a deodorizer and purifier of water, and a cheap agent for extracting gold from quartz.

It is perhaps impossible to learn the total consumption of the ore for these purposes; we know, however, that Great Britain is the great seat of the chemical manufactures, and we have some facts to guide us to an estimate of the amount used there in the processes requiring the largest quantity; these I will now give, together with a rough estimate of the consumption in the United States. The most extensive use of the ore is in the making of bleaching powders (chiefly chloride of lime). According to the report previously quoted, the amount of manganese imported into the Tyne district alone for this purpose was then (1863) given as 11,400 tons per annum, at £4 stg. per ton. Although this district is a very considerable seat of chemical manufactures, there are other parts of the Kingdom where very large quantities of manganese are required, among which, the most important are Liverpool,

the seat of Messrs. Muspratt's, and Glasgow, of Messrs. Tennant's works. Accordingly, we find in the "Statistics of the Alkali Trade of the United Kingdom for 1862," that the annual consumption of manganese was then 33,000 tons for the manufactures depending on the products of the alkali trade, viz.: soap, glass, paper, cotton, woollen, linen, colour making, and all chemical manufactures of any magnitude. This estimate, however, takes no account of the ore used in making iron, and the demand for bleaching powder has been increasing of late years, partly owing to the use of grass, and perhaps of other materials, in the making of paper. The quantity of manganese ores used in the United States was, a year ago, estimated by a gentleman dealing in them in Boston, at about 500 tons per annum, by another gentleman, this year, at 1000 tons.

With regard to the quality of the ore required in certain cases, it is found that in making bleaching powder, the ordinary ores, containing perhaps from 65 to 75 per cent. binoxide along with water, oxide of iron, carbonate of lime, barytes, etc., answer so good a purpose, that the rich pure ores, such as that from Teny Cape, are not bought for this use, unless at a price far below that given by those who require only such ores. One of the firm of Tennant Co. (makers of bleaching powder), said, for example, that he could not afford to use Teny Cape ore, meaning, I suppose, at the high price it would fetch from glass makers, for, as J. Outram, Esq. junr., informed me, the Spanish ore of from 70 to 75 per cent. binoxide, sells for fifty-five to sixty shillings sterling per ton, and therefore the bleaching powder makers will give only about £5 10s. for Teny Cape ore, containing upwards of 90 per cent., while, as we have seen, this actually brought as much as £9 and even £10 stg. per ton. This high price was given by glass and pottery makers who require an ore as free as possible of iron; this at any rate is the case with the former who employ it to remove the stain of iron from the finest kinds of glass. Mr. Outram said that he thought even two or three per cent. of iron would interfere with the sale of ore at 93 per cent. binoxide for this purpose, and it was because the Teny Cape ore gave less than a half per cent. of iron, with 91.5 per cent. binoxide of manganese, that it brought the high prices obtained. The demand for these pure rich ores is comparatively

limited, perhaps a few hundred tons a year are fully as much as would find sale at the highest prices named. That there is always a steady demand for ore useful for making bleaching powder, is shown by the efforts made to restore to its original state the oxide employed: patents have been taken out for this purpose, and one is recommended by its owner as restoring the material to 52 per cent. and as being capable of bringing it up to 70 per cent. binoxide, which, as we have seen, is a very moderate percentage in the ores.

With regard to the other applications of manganese, the making of iron and steel is the most important. Manganese renders iron tough and steel better and more durable, in the latter case it acts by removing sulphur and silicon. Although the quantity of manganese actually imparted to the iron and steel is very small, in a manufacture of such enormous proportions the consumption must be large if continued. The making of manganates and per-manganates, which are used as oxidizing agents and in disinfecting, must also be extensive, a prize medal having been given to Mr. Condy in 1862 for the manufacture of such salts on the large scale.

As an illustration of the way in which the ores are sometimes treated in practice, I may mention the mode adopted by Mr. Hobbs, of Boston, who has had a great deal to do with the Upham and Shepody ores of New Brunswick. The ore is washed clean at the mines, boxed up, and sent to Boston, when it is selected into three good qualities and refuse; the three good sorts are ground in three mills till fine as flour, put up in barrels papered inside, and the contents of each barrel are assayed and sold according to assay.

The first quality free (?) of iron and containing about 98 per cent. of peroxide of manganese, is used for making the finest (flint) glass. The second quality (also no doubt pretty free of iron), containing from 75 to 80 per cent. peroxide, is used for making white phials. The third, containing about 70 per cent. peroxide, is employed for making common glass bottles; while the refuse, containing perhaps 25 or 30 per cent. iron, is used either in making clear amber coloured bottles for brandy, etc., or for carboys.

In conclusion I state together the quantities of binoxide of manganese contained in some of the Nova Scotian ores, as found by the experiments of my pupils or myself:—

	per cent. binoxide.
Manganite, from Cheverie, Hants Co., air-dry, gave.....	47·73
Wad, from Halifax Co. (?), dried at 212°, gave.....	56·00
Pyrolusite and } from Douglas, Hants Co., air-dry, gave...	84·62
Psilomelane	
Pyrolusite, Teny Cape, Hants Co., No. 1, air-dry, gave...	88·01
“ “ “ “ No. 2, “ “	92·69
“ “ “ “ No. 3, dried at 212°...	95·00
Pyrolusite, from Cumberland Co., dried at 212°, gave....	97·04

These results relate to the most important character of the ores; in the rich samples the amount of iron was generally very small; other analytical details are omitted, as this paper is perhaps long enough already. It is apparent, I think, that the ores of manganese are likely to prove of considerable importance in the economic mineralogy of the Province.

