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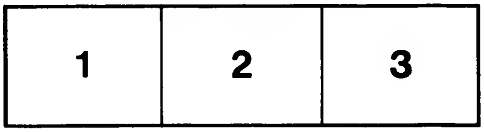

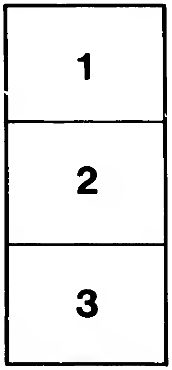

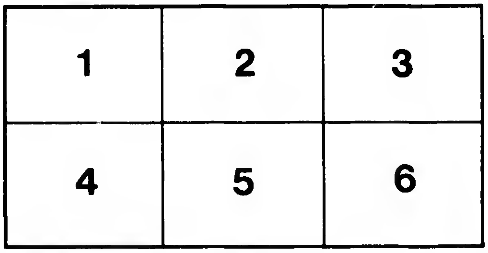

II.—*Notes on the Manganese Ores of Nova Scotia.*

By EDWIN GILPIN, Jun., A.M., F.G.S.

(Read May 22, 1884.)

In the following sketch I have endeavoured to bring together the information relative to the manganese ores of Nova Scotia. The only previous note now accessible, beyond the references in Dr. Dawson's "Acadian Geology," is one by the late Dr. How, of King's College, Windsor, published in the Transactions of the Nova Scotia Institute of Natural Science. The exceptional purity of some of the ores makes them interesting to the mineralogist, and valuable in certain operations of the manufacturer. The attention paid in Nova Scotia to the working of these ores is by no means proportionate to their value, and to the great extent of the geological formation to which they appear to be chiefly confined. The object of these notes will be obtained, if they serve to indicate that the ores of manganese may prove in the future an important addition to the mining resources of this province.

The least valuable but certainly the most common of the Nova Scotia manganese ores is wad. This ore is found as a superficial deposit in connection with every geological formation known in the province. Among the localities yielding it may be mentioned Jeddore, Ship Harbour, St. Margaret's Bay, Shelburne, La Have, Chester, Parrsborough, Springhill, Pictou, and Antigonishe. These ores exhibit the varying composition which characterizes their class, and have in some cases been used to a limited extent as paints. On Boularderie Island, Cape Breton, a bed of wad, several feet thick, was examined some years ago. The following analyses show this want of uniformity of composition: two analyses by Mr. Hoffman, of the Canadian Geological Survey, gave:—

	I.	II.
Manganese peroxide	25·42	11·04
Iron sesquioxide	—	12·49
Insoluble matter	—	57·76
Water	33·52	—

also, in the case of analysis II, traces of copper, cobalt, and nickel.

An analysis, by the writer, of a sample from a different part of the bed, gave:—

Manganese peroxide	44·33
Iron sesquioxide	35·50
Insoluble matter	10·00

At the Londonderry Iron Mines, Colchester County, in the great vein of brown hematite, associated with ochre, ankerite, sideroplesite, and calcite, in strata of Lower Silurian age, secondary changes have at some points enriched the iron ore with manganese peroxide up to fourteen per cent. of its total constituents. Some encrusting fibres are manganite, and part of the manganese is present under the form of wad, of which Mr. H. Louis gives the following analysis:—

Manganese peroxide	67·10
Manganese protoxide	10·67
Water	9·37
Copper protoxide	·88
Iron protoxide	4·09
Alumina	·67
Nickel and cobalt oxide	·65
Lime	2·49
Magnesia	trace
Silica	4·08
	100·00

The occurrence of this ore in the pre-carboniferous rocks is interesting, as showing its original wide distribution, and as possibly indicating the sources of part of the more recent ores of economic value. Pyrolusite is the only ore of manganese which has hitherto been mined to any extent in Nova Scotia, and it is known to occur in pre-carboniferous strata at several points. Between Halifax and Windsor, near Mount Uniacke, pyrolusite is found in small pockets and veins penetrating granite, and in quartzites of the auriferous Lower Cambrian of the Nova Scotia Atlantic coast. It occurs in veinlets in the granite of Musquodoboit, and as small irregular seams in the granite of Ship Harbour. In the hills south of Wolfville, in King's County, the same ore is found in quartzites and slates, presumably of Upper Silurian age. In the trias of the same county, the ore is met in a bedded form near Cornwallis and Wolfville, and in the triassic trap it is said to occur lining cavities, in association with zeolites, etc.

We, however, find these ores most abundantly in the Lower Carboniferous marine limestone formation. This horizon forms one of the widest spread, and most strongly marked of the divisions of the Carboniferous period. It is met in King's County, in Hants, Cumberland, Colchester, Pictou, and Antigonishe, and in the four counties of the Island of Cape Breton. The measures of this division, comprising sandstones, shales, grits, and limestones, with beds of gypsum and marl, sometimes rest directly on the pre-carboniferous strata, and at many points are separated from them by the lower, or false coal-measures, or by beds of conglomerate, according to the conditions of the period of accumulation. The limestones and gypsums occur, apparently, at no fixed horizon in this division. Dr. Dawson, in his "Acadian Geology", has divided the limestones into five groups, characterized respectively, so far as the subject has received attention, by a predominance of certain fossil forms. In his supplement to the second edition, he proposes to subdivide the lowest group by distinguishing a certain manganiferous limestone, which appears at many points to form the basis of the limestone formation, strictly so called. This limestone at Salmon River, Cape Breton County, Springville and New Laing, Pictou County, Chester, Maitland, Tenny Cape, Windsor and Onslow, seems to underlie the gypsum beds, and generally to be associated with manganese. The following analyses by the writer show the character of some of these limestones:—

	Springville, (Pictou Co.) I.	II.	Tenny Cape I.	Salmon River, C. B. I.
Lime carbonate	83·42	55·28	49·81	49·269
Iron carbonate	1·29	24·11	2·56	4·044
Magnesia carbonate	10·32	10·15	35·44	28·034
Manganese carbonate	1·38	1·83	4·58[1]	14·586
Insoluble matter	4·85	5·00	8·06	1·298
Moisture	—	·40	·37	—
	101·17	96·77	100·82	97·231

The limestone of Chester, on the Atlantic shore, presents a remnant of Lower Carboniferous measures, formerly without doubt co-extensive with those of our northern counties. The lower beds are described by the late Dr. How as compact, of a dark blue colour, and consisting principally of carbonates of iron, lime, magnesia and manganese, yielding umbers by weathering. These are the most highly magnesian and manganiferous limestones that I have yet met in the province. It is quite possible that there may be others higher in the marine limestone formation carrying notable percentages of the carbonates of these metals. In the case of the Pictou district, however, the overlying limestones, up to what may be termed the base of the millstone-grit, are decidedly non-magnesian; the inspection of a very complete set of analyses showing none carrying over four per cent. of the carbonate of magnesia, and usually little more than traces of manganese.

The following analysis, made at the Durham College of Science, of a limestone lying above the Springville gypsum, shows the usual composition of the purer grade of the limestones of the higher sections of the Pictou marine limestones :—

Lime carbonate	96·26
Magnesia carbonate	2·33
Iron peroxide	·57
Manganese peroxide	·55
Alumina	·10
Sulphur	·02
Phosphoric acid	·03
Silica	1·99
Moisture	·17
	101·02

In the northern part of Hants County, the carboniferous marine limestones and the underlying lower coal measures are found in a series of east and west folds, shifted and broken by transverse subordinate flexures. The presence of manganese in the upper of these divisions is first observable at the mouth of the Shubenacadie River, where a dark-coloured limestone underlies the gypsum, and is associated, a short distance east of the river, with red shales, carrying veins of red hematite, with manganese oxides and calcspar. The westward continuation of this horizon is noticeable again at Tenny Cape, where a series of these measures, extending to Walton and Cheverie, a distance of about fifteen

[1] As peroxide.

miles, contains several beds of limestone, which apparently underlie the gypsum, and may be called manganiferous. These measures carrying manganese re-appear again south of Windsor, and at Douglas, fifteen miles south of Tenny Cape, near the line of their junction with the pre-carboniferous rocks. In this range of measures the manganese of Tenny Cape appears to be principally connected with a compact red and gray limestone, which, from the analysis already given, may be called a dolomite. At the western end of the district it occurs as veins in conglomerates and sandstones, and also in limestones in places decidedly magnesian.

The Tenny Cape manganese ores were discovered about the year 1862, and have been intermittently worked since that date. The limestone band to which they seem to be principally confined is about 300 feet thick. The ore occurs in irregular nests, and in seams eroded on the bedding-planes and cross-fractures. It thus occurs that large masses almost entirely isolated have been met, also seams with occasional pockets, sometimes connected, but in no case, so far as I am aware, following any regular order of position or extent. The largest mass yet found was estimated to contain 180 tons of ore. Apparently, the ore has been deposited at irregular intervals of time, with the associated minerals, in the openings worn by the action of water on the limestones. Specimens may be obtained showing pyrolusite, cementing waterworn pieces of limestone, and surrounding nodules of the bed-rock which have resisted erosion. The ore is chiefly a fibrous pyrolusite, with splendent lustre, based on a compact or granular ore consisting of pyrolusite, of psilomelane, and of manganite, the latter mineral however not being present in large quantity. The quality of these ores, even after the slight hand-dressing they receive at the mines, is very high, and in some years they bring $125.00 a ton at the mine. They are prized by glass-makers for their freedom from impurities, especially of iron. This high grade of the pyrolusite from the Tenny Cape district will appear when, from numerous assays, it has been found to yield from eighty-eight to ninety-five per cent. of available oxide. The following analyses show the general character of these ores :—

	Douglas.[1]	Cheverie.[2]
Moisture	1·660	2·05
Water of composition	3·630	—
Iron peroxide	·603	2·55
Oxygen	7.035	—
Baryta	·724	1·12
Insoluble matter	1·728	2·80
Phosphoric acid	—	1·029
Manganese oxides	84·620	—
Peroxide of manganese	—	90·15
Lime	—	trace
	100·000	99·699

At Walton and Cheverie manganite is more common than at Tenny Cape. Its mode of occurrence is similar, and its general character is shown by the following analyses :—

[1] Contains some psilomelane ; analyst, H. Poole.
[2] E. Gilpin.

	Tenny.[1]	Cheverie.[2]
Manganese oxides	85·54	86·81
Iron peroxide	1·18	2.05
Baryta	·89	
Insoluble matter	3·27	1·14
Phosphoric acid	·34	—
Water	8·54	10·00
Available oxygen	51·54	47·73

The Tenny Cape manganite is compact, with partly fibrous structure, and submetallic lustre. It is not in much demand at present, but I am informed that considerable quantities could be got at several points. The following are the principal minerals found in connection with the Tenny Cape ores:—

Calcite. This, the most abundant accessory, occurs as low rhombohedral crystals implanted on the limestone, of reddish and bluish shades, frequently with the edges clouded symmetrically with impurities; and as a secondary deposit on the preceding crystals, in the form of snow-white grannular incrustations, frequently penetrated by the fibres of pyrolusite; and as a capping on isolated fibres of the ore. The pyrolusite also occurs encrusting wine-coloured crystals of dog-tooth spar.

Iron is present as an earthy red hematite, and as a fibrous and mammilated limonite. Iron sulphide is seldom visible.

Barite occurs in rounded nodules, and in tabular crystals in the ore, and mixed with the calcspar.

Selenite is sometimes noticed in fibrous form, and in thin transparent films.

Many very beautiful cabinet specimens of these minerals have been met at Mr. J. W. Stephens' mine, the natural beauty of the crystals being greatly increased by the setting of gleaming fibres of the black pyrolusite.

Lower Carboniferous limestones at Minudie, in Cumberland County, have yielded small quantities of a soft fine-grained pyrolusite, giving on analysis 97·04 per cent. of manganese binoxide. Ores similar to those of Tenny Cape are found at Onslow, and on the Salmon River, near Truro, Colchester County. Prospecting work has shown red shales and sandstones, and beds of dark-bluish limestone, covered by beds of gravel and clay holding nodules of compact sub-crystalline pyrolusite. The ore also occurs in veins, up to four inches in thickness, in the sandstones, and in irregular nests and layers in the limestone. Calcspar, barite, and selenite are found in the veins, which are filled with fibrous ore. The exact horizon of the beds holding these ores is not readily ascertainable, and it may be higher in the marine limestone formation than at Tenny Cape. The ore is of very good quality, some of it running as high as ninety per cent. of available oxide. In Pictou County, near Glengarry station, nodules of fibrous pyrolusite, containing eighty-four per cent. of peroxide, are found with crystals of dog-tooth spar, in a dark-blue limestone, similar to that at Springville already referred to, and exposed close to the junction of the marine limestone with pre-carboniferous rocks.

Boulders of a mixture of psilomelane with manganite occur lying on the limestone at Springville, of which an analysis has already been given, and on the associated red

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[1] Dr. How.
[2] E. Gilpin.

shales. At several points in this vicinity the limonite ores, found along the line of junction of the Upper and Lower Silurian with the Lower Carboniferous marine limestone are heavily charged with manganese. The ore is dull brownish-black in colour, with a black streak, and softer than the normal limonite. The percentage of manganese present in the iron ore varies. The general character of this ore, however, will appear from the following analyses by the writer:—

	I.	II.
Water of composition	—	12·530 (Water and Moisture together)
Moisture	1.450	
Insoluble residue	2·731	25·130
Alumina	2·880	trace
Iron sesquioxide	10·848	48·223
Manganese sesquioxide	62·950	—
Manganese peroxide	—	14·410
Magnesia	1·630	—
Lime	7·280	·015
Baryta	·670	—
Carbonic acid	—	—
Sulphur	—	·480
Phosphorus	—	·020
	90·439	100·808

In Antigonishe County similar ferriferous manganese ores have been found in drift at several places.

In Cape Breton deposits of economic value occur only in the western part of the county of the same name. Here, at the head waters of the Salmon River, the lower members of the Carboniferous are met in a valley between the felsites of the Mira and East Bay hills. The space is generally occupied by the millstone grit, beneath the edges of which the marine limestones occasionally crop out, or the latter are excluded by the basal conglomerates. The following notes are from a visit to the Moseley (iron) mine, and from information kindly furnished by Mr. Fletcher, of the Canadian Geological Survey.

The felsites of the Mira Hills form a series of bays along which are exposed carboniferous limestones, conglomerates, shales, and grits as they were accumulated subject to the varying conditions of the winds and currents of the period under consideration. At some points, the limestones rest on the felsites; at other localities, grits and shales intervene; elsewhere, the basal conglomerates are covered directly by the millstone grit. The manganese ores were discovered two years ago in one of these recesses where the felsites were succeeded by shales and grits, and finally by limestones, the later apparently extending from point to point of the ancient bay. The ores at the western mine are found in irregular bedded layers in a soft arenaceous reddish-coloured shale, which is in some places calcareous and coated with films of manganese oxide. The layers vary in thickness up to eighteen inches, and are frequently connected by cross stringers of ore. The shales when weathered present the ore in small nodules, and the disintegration of the former by water probably indicates the source of the beds of gravel manganese ore found lying on them. The ore at the eastern mine occurs as a bed immediately underlying a layer of black manganiferous limestone, with red and greenish shales and coarse grit. The thickness of the ore and limestone varies from two to eight inches, the average thickness of the two being about eight inches. The ore also occurs in this vicinity as lenticular pockets and irregular nests in conglomerate, etc., and sometimes forms the cementing material. This latter mode of occurrence is similar to that shown by the red hematites (sometimes highly manganiferous) found at various points in the lower Carboniferous conglomerates of the island near their junction with older strata. The analysis of the overlying limestone has already been given. The ore from this locality is generally a pyrolusite, soft, fine-grained, and sometimes sub-crystalline. It is at some openings mixed with manganite, and the latter ore is abundant at several places in the grits. The minerals associated with the ore are calcspar, barite, films of selenite, and limestone. Analyses by Mr. Hoffman, of the Canadian Geological Survey, show that the ores run as high as 88·9 per cent. of binoxide, and contain an admixture of ferric oxide as low as two-tenths of one per cent. On the Magdalen Islands, the manganese ores are found, according to Mr. Richardson (Geological Survey Report, 1879-80) associated with sand, clay, gypsum, and doleritic rocks of Lower Carboniferous age. From Mr. Hoffman's report, (*ibid.*) the ore is a purely crystalline manganite, yielding on analysis 45·61 of binoxide. I have, however, seen samples of pure pyrolusite from these islands. There do not seem to be any limestones directly connected with these ores, as surveyed by Mr. Richardson, and the locality appears to form an exception to the rule which, so far as my information goes, governs the presence of manganese ores in the Carboniferous of Nova Scotia, viz., the presence of limestone. Possibly in the case of these Magdalen Island ores they may have been derived directly from the dolerite.

From the preceding notes, which cover, I think, all the localities known to yield manganese in this province, it may be inferred that in Nova Scotia there appears to be ground for referring the principal deposits of the ores of manganese to an horizon low down in the Carbonifer[illegible] marine limestones, and certainly, in most cases, underlying the lowest gypsum beds [illegible] that limestones, magnesian and sometimes also manganiferous, appear to be associated [illegible]h them. I am not prepared to attempt any outline of the process which, in Nova Scotia, appears at some points to have deposited in these strata iron ores, sometimes manganiferous, and at other points ores of manganese frequently very free from iron. The source of the manganese may be looked for in the older strata bordering the Carboniferous sea, or, as Dr. Dawson suggests, its presence in these limestones may be due to the decomposition of volcanic debris proceeding from the contemporaneous igneous vents which produced the Carboniferous traps. Both the older bordering strata, and the limestones and associated strata may have been drawn upon for the deposits of this interesting and useful mineral. The action of magnesian thermal springs may have led to the alteration of the limestones more particularly referred to in the preceding notes. Such an action might lead to the deposition of manganese and iron oxides, as well as of lead and copper ores, all of which are frequently found in them.