

Neither the Government, the City, nor private gentlemen can make any mistake by encouraging in every way any branch of Natural Science; but pre-eminent above all I think to dwellers near the sea, is by a thorough study of marine fauna and flora, to feed our people by removing good fish from the list of luxuries, and to keep the balance of trade in our favor.

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ART. IV.—NOTES ON SPECIMENS OF IRON ORES, ETC., COLLECTED IN PICTOU COUNTY FOR THE PHILADELPHIA EXHIBITION. BY EDWIN GILPIN, M.A., F.G.S., ETC.

(Read February 14th, 1876.)

MY purpose this evening is not to enter upon an elaborate scientific discussion of the minerals found in the district, but to show the relation they bear to the industrial development of the county. The first resources of a new country and those most readily drawn upon are the products of the waters and the forests, and such minerals as are most easily extracted for exportation in a raw state. These alone are insufficient for the permanent development of a country, fishing towns and villages grow slowly, and the yield of the forest diminishes in an increasing ratio. The census, our most reliable teacher of political economy, shows the simple fact that wherever coal and iron exist together, there the most flourishing populations are concentrated; that the commercial prosperity of every country is in direct ratio to the quantity of coal employed within its territory for the smelting and working up of *iron* and allied minerals.

Bearing these facts in mind, we will now briefly pass in review the various ores of iron that surround one side of the Pictou Coal Field; first glancing at the earliest information we have on the subject.

The indications of iron ore in the vicinity of the East River of Pictou, attracted early attention, and the General Mining Association of London, in 1828, or shortly after they opened their Pictou Collieries, endeavored to turn it to practical account. They

quarried a considerable quantity of red hæmatite from the Blanchard bed, and collected many tons of drift limonite on the banks of the East River. A blast furnace was erected at the Albion Mines for the purpose of smelting these ores, but the experiment was not satisfactory.

I am unable to get precise information on the subject ; but it can be readily understood that at that date a man accustomed to English fuel and ores could easily fail in smelting, when introduced to fuels and ores of a totally different character. This is borne out by the appearance of the iron made before the furnace was closed by scaffolding. The failure of the Association to discover the limonite in situ, caused them to totally abandon the idea of repeating the experiment.

From 1830 up to 1870 several accidental discoveries of ore were made in the district, but no work was done to ascertain their value, and it was not until the recent expansion in the iron trade that the question of the profitable smelting of iron ore in Pictou County again came up.

In 1873 extensive explorations, extending from Glengary on the Intercolonial Railway to French River, were conducted under Dr. Dawson's superintendence ; while I was at the same time engaged in testing the property of the Albion Mines company at Springville, already mentioned as the scene of a former unsuccessful search. The following season I took up the work where Dr. Dawson left it, and the results of our explorations constitute all that is practically known about the district.

Beginning at French River, we have first to notice a large deposit of clay iron stone in strata of Lower Carboniferous age. The beds vary from one to eight feet in thickness, and occupy a vertical height of several hundred feet. I am not aware of any analysis having been made of this ore ; from its appearance and specific gravity, it is certainly equal to the average of its class. Phillips in his treatise on Metallurgy, gives the percentage of metallic iron in Yorkshire and Staffordshire clay ironstones, as varying from twenty-eight to forty per cent.

The Carboniferous Conglomerate at one or two places in this

locality contains large numbers of rounded pebbles of a hard jaspéous red hæmatite of a very pure quality. As yet, however, the parent bed has not been found, but probably exists in the underlying Upper Silurian strata, at this point almost immediately beneath the Conglomerate.

Passing to Sutherland's Brook, at a point about three miles distant from Merigomish harbour, we have to notice a valuable deposit of spathose ore, found as a bed among strata considered of the Millstone Grit age. The ore has been opened only on the property of the Pictou Coal and Iron Company. Spathose ore is considered valuable when met in quantity, and is chiefly valued for the production of spiegeleisen. The chief foreign localities are, in England, Perran and Marazion in Cornwall, and Weardale in Durham. The Rhenish provinces have furnished the greatest supply, but the ores there are controlled by Bessemer steel manufactures, which reduces the quantity offered in the open market. In the United States I am aware of only two furnaces, in New Jersey, using it. The limited occurrence therefore of this ore makes the fact of its discovery in strata so wide spread in Nova Scotia, of much importance. The ore opened at Sutherland's Brook varies in thickness from six to fourteen feet. The following is an analysis by Dr. S. Hunt :

Sesquioxide of Iron.	20.52
Carbonate of Iron	57.40
“ “ Manganese	8.29
“ “ Magnesia	4.02
Silica	2.38
Sulphur	undetected
Phosphorus	“
Moisture	1.43
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	99.70
Metallic Iron	42.00

Passing to the Upper Silurian district lying between Sutherland's and East Rivers, we come to an enormous development of hæmatite ore—the variety being that known as red hæmatite or anhydrous peroxide of iron.

There are three great lines of out-crop of this ore, belonging, as far as at present known, to one large bed, thrown into its present form by undulations of the strata. There is moreover a higher horizon of similar ores opened by myself during the two past seasons. The most northerly of these outcrops, beginning near the spathose ore, crosses to about the centre of the west line of the Wentworth grant, extending a long distance as shown by surface indications. No openings have yet been made on it, but from the associated strata its dip would be to the north. The rocks between this point and the summit of Webster's Mountain are much twisted into undulating forms, and the connection between this exposure and those to the south still requires examination. The Webster bed has been carefully trenched and traced for several miles. It is an enormous deposit varying in width from fifteen to thirty feet, and dips generally to the North, and is found at an elevation of four hundred feet above Sutherland's River. Its position allows of the extraction of millions of tons of ore above water level by the simplest operations of the miner; and it is worthy of the remark of an eminent engineer, who, when shown its extent exclaimed that it should be called the back bone of Pictou County.

We now pass to Blanchard, about two miles from the East River, and here we have the third outcrop of this ore, on what Dr. Dawson considers the opposite side of an anticlinal. This has already been referred to as the Blanchard bed, from which the General Mining Association formerly quarried ore, and is now the property of James Hudson, Esq. It has never been traced any considerable distance, but is known to extend about one half mile, varying in width from thirty to one hundred feet, and lies about three hundred and sixty feet above the East River at its nearest point.

The presence of fossils and of an underlying seam of limestone, affords room for an interesting sketch of the conditions under which it was accumulated, but it would pass the limits of this paper. All these ores resemble each other strongly, and are compact with uneven fracture—the colour varies from steel grey to red and brown. Their composition may be gathered from the following analysis of the Webster ore, by Dr. Stevenson Macadam :

Oxides of iron,	75.67
Oxide of manganese,	.52
Carbonate of lime,	2.44
Phosphoric acid,	.22
Sulphur,	.29
Silica,	19.43
Alumina and magnesia,	1.43

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106.00

Equal to metallic iron, 54.36

Overlying the Blanchard bed, at a vertical height of several hundred feet, are a series of beds, varying in thickness from three to fourteen feet, forming two sides and an end of a synclinal trough, as proved by my investigations during the past season. The ore is similar to those just described, and on assay gave 42.5 per cent. of metallic iron. The Pictou Coal and Iron Company own well selected areas in this district, covering large quantities of these ores.

Still passing to the Westward, the next ore that claims our attention is the Limonite, found in the valley of the East River. In 1873 I opened the vein on the property of the Albion Mines Company, already referred to, and found it to be twenty-one feet wide, and it was proved the same year one mile to the south. From the data thus acquired, the passage of the vein has been traced several miles up the river, and it finally crosses to the west bank, where immense surface boulders mark its presence on the property of the Messrs. Primrose of Pictou. As far as investigations have been carried, the ore has been found at the point of contact of Lower Carboniferous and Upper Silurian strata. It is of the finest quality, as shown by the following analysis, and varies in width from five to twenty-one feet.

Analysis of Limonite from area of the Pictou Coal and Iron Co :

Oxide of iron,	88.92
Oxide of manganese,	.78
Alumina,	.71
Carbonate of lime,	1.44
Carbonate of magnesia,	.82

Phosphoric acid.	.34
Sulphur,	.24
Titanic acid,	Trace
Silica,	2.14
Moisture,	4.61
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Percentages,	100.00
Percentage of Metallic Iron,	62.24

Parts of the vein contain notable percentage of Manganese. The Limonite has a very fine variety of the Red Hæmatite, mixed with it at several points, at one place the Limonite appears to be replaced by it for some distance. The ore is of a deep red colour and of the finest quality, containing but a small admixture of foreign matter. As yet it is known only in small quantity in the form of surface boulders, but would amply repay a careful search for it.

About one mile to the West of the East River we meet the Specular vein. This is a very pure anhydrous peroxide of iron, having a metallic lustre and steely black colour. This vein has been carefully examined and traced on the properties of the Pictou Coal and Iron Company, where trenches and pits have shown it to extend over two miles,—its width varies from five to twenty feet. The vein follows the course of a high hill and is accessible by levels at several points. At one or two points a side vein, two feet wide, contains Magnetic oxide? and Limonite of a nearly black colour. I believe Dr. Dawson considers this vein to belong to the same Geological horizon as that holding the Londonderry ores of Colchester County.

The following analysis is by Dr. Thorpe of Glasgow :

Protoxide of Iron,	.89
Peroxide of Iron,	96.63
Sulphide of Iron,	.06
Phosphorus,	none
Insoluble,	3.2
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	100.78
Percentage of Metallic Iron.	68.3

Following the strike of the vein to the westward the same company have opened a vein of Limonite near Glengarry Station. At this point the ore is more compact than that found on the East River but of equal purity. The range of ferriferous rocks continues into Colchester County, but no explorations have been made beyond this point, altho' small veins of specular ore are known to crop on the head waters of the Middle and West Rivers.

There are undoubtedly other ores of iron in the district yet undiscovered, for I have in my possession varieties of hæmatite and spathose ores the localities of which are unknown.

These brief notes show that from Glengarry to Merigomish, a distance of 40 miles, there extends a series of iron ore deposits of good quality and more than usual dimensions. No less than six varieties of ore are known, which in itself is of unusual occurrence in one district. Bands of clay ironstone are known to occur in the Pictou coal measures, but there is no information at present available with regard to their quality, etc.

In the manufacture of iron, the presence of a cheap flux is of great importance; in this district limestone is very abundant, nearly every farmer has his own limekiln. The quality of the limestone is as varied as the beds themselves. As far as my observations have gone, the lower part of the carboniferous marine formation, as developed at Springville, contains three horizons of limestone. The lowest a strong dark limestone frequently resting on metamorphic silurian slates and containing sometimes notable percentages of iron and manganese. Above this comes a set of beds of compact white limestone, containing crinoids and other characteristic lower carboniferous fossils. One of these beds on analysis at the Durham College of Science gave over 96 per cent of calcium carbonate. The third series consists of dark bluish and gray limestones, sometimes argillaceous and arenaceous, giving a total thickness of over one hundred and seventy five feet from actual measurement. Still higher in the formation are other beds, some highly valued for local uses. These beds of limestone extend in bands roughly parallel to the lines of crop of the iron ores, so that every road from the ore to the fuel must pass over them.

*Fire Stone.* Some of the metamorphosed Upper Silurian clay slates near the East River, have been used to some extent as furnace linings to boilers, cupolas, etc. and are found very satisfactory. Their cleavage is at right angles to the bedding, and the stones can be laid as evenly as brick work. These slates are of great thickness and can be cheaply quarried.

*Fireclay.* There are three geological horizons in Pictou county which yield this material: the Upper Coal Measures, the Middle or Productive Coal Measures, and the Lower Carboniferous. On the shores of Merigomish harbour, beds of fireclay are frequently found in the Upper Coal Measures. One of these beds, seven feet thick and overlaid by fifteen inches of coal, has been partially tested with success, and is free from pyrites and calcareous matter, and resists heat well. Several attempts on a rude scale have been made to manufacture fire brick from the Coal Measures clays; but owing to a want of proper system, they have not been successful. The supply is unlimited and cheaply extracted, and in many cases the clay is very free from deleterious ingredients. The following is a partial analysis of a fireclay from the Pictou Coal Measures:

Silica,	58.00
Alumina,	32.00
Iron oxide,	4.00
Lime,	1.00

There has as yet been no trial made of the Lower Carboniferous fireclays; two samples that have come under my notice, contain considerable quantities of calcareous matter, others again appear to be of good quality. Enough however has been done to show that the Pictou fireclays are valuable; the quantity of the material, and the cheapness of fuel, make it matter of surprise that no attempts have been made to manufacture an article that we are content to import at a heavy cost.

*Gypsum.* This mineral crops at several places through the county, but owing to the distance from shipment, in the presence of the large deposits in Cape Breton and on the Bay of Fundy, it is not probable that it will prove of much value. A very fine class of this mineral has been worked for local use, at Irish Mountain.



The outcrop is extensive; the best beds are two in number, and twelve feet each in thickness.

*Moulding Sand.* This adjunct to iron smelting is very abundant on the East River and its tributaries. The best known deposit is near the mouth of McLellan's Brook, and has supplied the local foundries for many years.

*Manganese.* The presence of the oxides of this metal were detected by me when examining the property of the Albion Mines Company, already referred to. No attempts have yet been made to see if the quantity be of economic importance. The age of the strata, Lower Carboniferous limestone shale, in which it occurs on the East River, is the same as that in which it is found on the shore of the Basin of Minas. It is stated by some to have a beneficial effect on certain ores during the process of smelting, and in this connection its presence among the iron ores is of importance.

Large and characteristic samples of all the minerals noticed above have been collected for the Philadelphia Exhibition; and it is to be hoped that when they are exhibited together, a favourable opinion will be formed of the district.

I have now briefly given you a list of the ores of the only district in Pictou County that has had its metalliferous wealth tested to any extent.

It may appear strange that in these notes reference is so frequently made to the Pictou Coal and Iron Company, and that the greater number of the specimens of iron ores come from their properties. The reason is that they are the only people who have practically looked into and prospected the ore district, and certainly their investigations have disclosed deposits better suited for the metallurgist's art, than any yet discovered in the Province; and as their operations will materially aid all the interests of the County, it is to be hoped that their own advantage will be commensurate with the importance of the undertaking.

Specimens of iron ore have been brought to me from every part of the County, and the evidence of such wide spread deposits of iron ore exhibiting every variety and condition of formation that characterize the more valuable combinations of iron, sanctions the

anticipation of a prosperous future for this part of the Province. Pictou Coal is now practically used with success for iron smelting, and is within four miles of some of the deposits, and is carried across the iron district by the Pictou branch of the Intercolonial Railway.

We must now regard Pictou County as possessing in abundance those gifts of nature, which, when properly combined are the foundation stones of empires. The future of Nova Scotia is limited and easily foreseen as long as we continue the present system of selling our raw material for bread. When we assume the position intended for us by nature, and manufacture and work up the treasures of the rocks, we enter upon a boundless career.

NOTE.—Hand specimens of the samples collected for the Philadelphia Exhibition, were shown by the writer, to illustrate the paper.

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ART. V.—THE INDIGENOUS FERNS OF NOVA SCOTIA. BY  
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(Read before the Institute, April 24, 1876.)

AMONGST the different branches of the study of Nature, none perhaps is more charming and edifying than Botany. It gives a wholesome and pure delight to those who have taste for it. And so generally inherent is this taste, that the botanist, or aspirant botanist, will usually find his own enthusiasm quite catching by the circle of friends amongst whom he moves, if he will only demonstrate it a little. And thus he will see that it only needs a greater active interest to be taken, in order to awaken the same in others; and by so doing promote the science, and give a pleasure, as truly *sui-generis*, as it is gratifying and lasting.

From its necessary tendency to call for walks and rambles into the country, in the woods and open fields, Botany is essentially a healthful study; and from the ardour with which it inspires its student, it gives an untiring interest. Everything green speaks to