Art. IV.—The Geology of Cape Breton. The Minerals of the Carboniferous.—By E. Gilpin, Jr., F.G.S., Inspector of Mines, &c.—Part IV.

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In my last contribution I gave an account of the Coal Beds of Cape Breton, and purpose in this paper to attempt a brief description of the more prominent of the remaining minerals known to occur in the sub-divisions of the Carboniferous in this Island.

The gypsum is certainly the most conspicuous of these. It recalls the white cliffs of Old England, and may some day inspire a local muse. It is a first cousin of the chalk too, for here the coy oxide of lime has allied herself with the more stable and powerful sulphuric acid, instead of the etherial, volatile, and social carbonic acid. The former in the furnace parts readily from her consort, while the latter boils, drops a tear of water of composition, but does not dissolve partnership.

There is one notable geological fact connected with the gypsum of the Maritime Provinces, its occurrence in measures of palæozoic age, the marine limestone formation of the Carboniferous. In nearly all other countries it is of much later age. This led to much confusion in the earlier attempts to outline Nova Scotian geology, and it was, I believe, first placed in its true position, below the coal measures, through the researches of Mr. R. Brown, and Sir Wm. Dawson.

I have already described the marine limestone formation of the Island, and followed it, now skirting the Bras d'Or Lake, or mantling round the older hills, or filling the valleys of the numerous rivers of the Margaree, River Dennys, and Middle River districts. In it the gypsum is met rising like a ruined marble palace of Eastern climes from the waters of the Bras d'Or, or frowning in a cliff, hollowed into a thousand little caves and

recesses by the waves and ice. In the woods, from a distance, it recalls the tented homes of an army, or broods like a dismantled castle over some quiet valley.

Soft and friable the untiring finger of time plays many a rude prank with it, and the malice of the destroyer of all things even follows it below ground. Subterranean streams wear it away, and with equal power remove the adjoining marls and shales, until the cover of a hidden pool falls in a crash. The inborne earth is soon coated with grass and shrubbery, and these funnel-shaped depressions mark the passage of the gypsum beds when no outcrop is visible.

Thanks to the help of the microscope, and to our knowledge of the labors of marine insects the course of the formation of the limestones frequently associated with the gypsums can be readily followed. We are, however, at a loss to account in an equally satisfactory manner for the growth of the gypsum masses. No branching coral, or mild bicarbonate formed this mineral, one half of which is the strongest and most deadly of acids. We can now perhaps imagine that some faulting of the rocks poured out springs carrying free sulphuric acid, this meeting limestone would lead to the formation of gypsum. Other scientists account for its formation by the slow process of concentration and evaporation of inland seas. Certainly it is frequently accompanied by salts of magnesia, and of sodium, etc., more or less pronounced ingredients of the ocean. Interesting as this question is, I could not attempt to do justice to Cape Breton if I were to discuss it now.

The gypsum occurs in every variety of color. The prevailing color is white, which is shaded into blue, but it is noticed red, black and blue, and occasionally green. The anbrydrite variety is white, pale blue and gray. Both varieties occur massive, crystalline, and granular. The tabular translucent crystals, known as selenite, are frequently taken for mica. The beds of gypsum vary in thickness up to one hundred and fifty feet, and proximately continuous, extend often for miles. The minerals is frequently found in crystals and veins in marls, shales, and

limestone. I have frequently observed it in films coating the joints of the coal seams.

The precise effect of gypsum on soils is, I believe, still a matter of doubt, but unquestionably it and the limestone occur in the best farming districts in the Island. So far as I am aware no attempts have been made to practically test its effects on the poorer and colder soils of the Millstone grit or Devonian measures.

The principal market for gypsum is found in the United States, where it is ground for agricultural purposes, and boiled and ground for the house builders' use. The export of this mineral from Nova Scotia for a number of years past has varied between 80,000 and 150,000 tons a year. Little, if any, ground gypsum is exported to the United States, as there is a heavy duty imposed on it. Windsor and the surrounding villages form the principal point of export. The short transport via the Bay of Fundy, and the excellent position of the Nova Scotia quarries, close to shipping, have excluded the Cape Breton gypsum from the United States market.

Lennox Passage, Baddeck, and St. Ann's Harbor are the points in Cape Breton whence shipments have been made. The total amounts have, so far as my information goes, not exceeded 10,000 tons in any one year. All this, I believe, goes up the St. Lawrence, and it is to be regretted that the markets of the Gulf are not extensive enough to permit an output in some degree proportionate to the extent of the deposits.

The following analysis of a gypsum from a quarry opened some years ago, about four miles East of Baddeck, will serve to show the composition of an article of good quality :—

Gypsum (hydrated lime sulphate)	98.85
Lime Carbonate	1.07
Silica	.11
	100.03

The gypsum varies a little in hardness, the soft rock being generally preferred. The anhydrite is, as its name shows, the same mineral without water, it is seldom quarried, and forms

great part of the spoil. It has been experimentally polished, and yields a material adapted for in-door decoration. In the vicinity of the quarries I have seen it used for foundations for houses.

In the United States, Ohio and Michigan are the principal producers, the output being annually about 50,000 tons of land, and about 25,000 tons of calcined plaster. The imported stone is divided about equally between the land and the calcining mills. About three-fourths of the Nova Scotia gypsum goes to New York, where the prices vary from $2.50 to $3.50 a ton. The remainder is absorbed in the States nearer the Bay of Fundy. The Grand River, Ontario, plaster quarries send annually about 5,000 tons of medium grade rock into the Western States for agricultural purposes.

In England the annual production is about 80,000 tons, valued at from $3.00 to $4.00 per ton. The French deposits are very large, and its extensive use for fictile purposes by the ingenious artists of the capital of that country has gained for it the distinctive appellation of Plaster of Paris.

In many places salt and gypsum are closely associated, and usually include magnesian limestones in the surrounding strata. This conjunction is the basis of the theory that gypsum is a product of concentration. Taking the converse, in this Province the associated limestones are, so far as I have been able to investigate the subject, decidedly non-magnesian, and the presence of workable deposits of salt does not clearly follow.

Crystals of salt (chloride of sodium) are not uncommon in gypsum quarries, and at various points saliferous brines come to the surface. In our climate it would not itself be exposed as an outcropping stratum, but if present in our gypsum districts would exist as subterranean deposits, at a level below the surface drainage of the country.

It could be found only by boring, and if the calculations of the cost of mining it, etc., would permit of its competing with the Canadian and foreign article, the Government could present to the people of this Province no more acceptable gift than the

discovery of workable deposits of a mineral so necessary in the economic and domestic arts of the present day.

Among the better known mineral springs of Cape Breton may be mentioned the following :—

Springs half-way between Baddeck and Whyhogomah, on the shore road. These extend over several acres of ground, the largest discharging from 100 to 200 gallons per minute. An analysis by the chemist of the Geological Survey gave—in 1000 parts :—

Chloride of Sodium	50.6881
" Potassium	.1942
" Magnesium	.1593
Sulphate of Calcium	5.6810
Alumina	traces.
Silica	traces.
	56.7226

Salt has been made from this brine for local use, and at one time its systematic extraction was comtemplated.

At Deadman's Point, near Washaback, is a chalybeate spring. Mention may be made here of a mineral spring near Ben Eoin, East Bay, which is strongly saline, although said to issue from Laurentian rocks. Over twenty years ago, when it was first brought into notice, many resorted to it, but lately it has not been much visited. An analysis by the late Professor How gave, in grains to the imperial gallon :—

Iron and Phosphoric acid	traces.
Carbonate of Lime and Magnesia	.60
Sulphate of Lime	.94
Chloride of Sodium	343.11
Chloride of Potassium	4.55
Chloride of Calcium	308.90
Chloride of Magnesium	4.47
	662.57

No iodine was detected.

He compared the water to that of St. Catherines, Ancaster and Whitby, Ontario.

Mr. Fletcher, in his report on Richmond County, states that salt and sulphur springs are found on Rabbit Island, at Landry Lake, McMaster's Mill, Greenville, River Dennys, and River Tilliard. A sample of the McMaster's Mill Spring gave Mr. Hoffman, Chemist of the Survey, in 1000 parts :—

BASES.

Potassia	Trace.
Soda	Very large quantity.
Lime	Small quantity.
Magnesia	Very small quantity.
Ferrous Oxide	Small quantity.

ACIDS.

Sulphuric Acid	Rather large quantity.
Phosphoric Acid	Trace.
Carbonic Acid	Rather small quantity.
Chlorine	Very large quantity.

Neither bromine or iodine were detected.

Iron Ore. Clay Iron Stone. This ore is frequently met in the coal measures, in thin beds and layers of nodules, seldom, however, in deposits exceeding a thickness of a few inches This ore of iron forms the basis of the cheap pig iron of Great Britain, for it is frequently found so closely associated with the coal beds, that it is extracted at the one operation, and hoisted through the same shaft. When the coal is of good coking quality it is evident that cheap pig iron can be easily made.

So far the sections of the coal measures exposed in Cape Breton have not shown this ore in beds thick enough to be of economic value. But as a demand for it has not yet risen its presence may frequently have been overlooked. Such was the case with the celebrated "black band," a variety of this ore, which, neglected for many years, long formed the basis of the great iron industry of Scotland.

Some years ago I noticed the occurrence of the black band

ore in the Pictou coal field, where it had also been overlooked as valueless. Similar varieties of this ore may be found in the Cape Breton carboniferous when the analyst and iron smelter begin their search for furnace supplies. I am not aware of any complete analysis of this ore, from the Island, but samples I have seen would yield from 25 to 35 per cent. of iron.

The purest variety of this ore, known as siderite, does not occur in the coal measures, but in this Province is usually associated with the limestones. It occurs at Sutherland's Brook, Pictou Co,, in a large bed, and is found in a bed said to be three feet thick on Boulardarie Island. At this locality, according to Dr. B. Harrington, it yields 32.58 per cent. of metallic iron. It is also frequently met in veinlets, in various rocks.

At a point near Sydney Town, the limestone beds near the summit of the millstone grit, pass, in places, into beds of red hematite, carrying about 30 per cent. of iron. But the quality of the ore is such as hardly to warrant further exploration.

At numerous points where the lower carboniferous conglomerates rest on the Precambrian felsites, etc., deposits of red hematite are found. The ore occurs in pockets and veinlets, and encrusting films along the line of junction. The ore is usually of excellent quality, but irregular in amount. The following analysis of a sample from Loran, near Louisburg, will serve to show its quality:—

Peroxide of Iron	90.14
Lime and Magnesia	4.20
Sulphur	.10
Phosphoric Acid	.11
Silica	5.45
	100.00

As the ore frequently coats the heavy stones of the conglomerates, it often deceives the inexperienced miner, who finds, on breaking his ore, that he has lavished his affection and built his hopes on a very commonplace and valueless pebble.

Some attention has been paid to deposits of this nature at

East Bay, and considerable amounts of ore have been found. It is quite possible that deposits capable of yielding large amounts of ore do exist, and the working of these deposits may disclose the rules governing their location. I would suggest that the lines of junction of the marine limestones with the older rocks furnish better hunting grounds for the prospector, as the greater solubility of the limestones affords more opportunity for the seggregation of workable ore bodies. An instance of this is furnished by the occurrence near Loch Lomond of rich, red hematite ore, apparently in the limestone horizon; and a more widely known parallel is furnished by the limestones of Barrow and Furness, in England, which have supplied immense amounts of the purest red hematites, in many respects resembling those in Cape Breton, now under consideration.

Cape Breton is not without examples of the earliest step in the aggregation of this useful metal. Beds of bog iron ore are frequently met, and the large amounts of iron-bearing rocks and the presence of varying minerals aiding their formation make them perhaps more numerous in the Carboniferous than elsewhere. Frequently they occur in the sites of old swamps or bogs, as beds from a few inches to a couple of feet in thickness. This ore is good enough for local use in blast furnace practice for foundry iron, but is neither rich enough in metallic iron, or free enough from phosphorus to be sought after for steel making.

It not unfrequently happens that considerable amounts of manganese, a metal in many points resembling iron, become incorporated with these bog ores. They therefore graduate from bog iron ore, a hydrous peroxide of iron into a similar manganese ore. In this latter form it is not known in Cape Breton pure enough for exportation.

As I have insensibly passed from iron to manganese, I may remark here that throughout the Lower Provinces the limestones of the Carboniferous and their associated silicious shales form the habitat of a very valuable and pure variety of manganese ore. In a paper read a few years ago before the Royal Society of Canada I gave a full account of the manganese ores of Nova Scotia. In Cape Breton this crystalline pyrolusite is known

mineralogically at many points, but has been found in workable amounts only at Salmon River, in the East part of Cape Breton County.

Here the old coves of the precambrian shores were filled with carboniferous shales, conglomerates, and limestones. At the McCuish mine the ores are found in irregular bedded layers, in a soft arenaceous shale, up to 18 inches in thickness. At the Eastern mine, the ore occurs as a bed underlying a soft manganiferous limestone, the ore varying in thickness up to 8 inches.

The following analyses by Mr. Hoffman of the Geological Survey will show the character of the ores:—

Sample No. 1, Pyrolusite, with a little Manganite, gave—
Binoxide ..... 81.52 per cent.
Sample No. 2, Pyrolusite, gave—
Binoxide ..... 88.98 per cent.
Ferric oxide ..... 21 "

Ores represented by the above analyses would be adapted for all the uses to which the mineral is usually put, and especially for glass-making.

These deposits are worked by Mr. E. T. Mosely of Sydney, and it is to be hoped will form a permanent addition to the mineral resources of the island.

Of the more impure and at present valueless varieties of manganese ores, that occurring in surface layers, like the bog iron ore referred to, is the most common. This is usually presented as a loose friable earthy mineral, of a brown or black color. It is known at several points in Cape Breton, the largest deposit is perhaps that found near Big Harbor, Boularderie, which contained:—

Manganese ..... 25.42 p. c.
Water ..... 32.52 "

Other samples from this locality yielded me on analysis somewhat larger percentages of manganese. Another sample from Lewis Bay, Grand Mira, yielded Mr. Hoffman:

Manganese oroxide (available) ..... 44.96 p. c.
Insoluble matter ..... 12.25 "

Limestones.—Everywhere through the Island of Cape Breton, this mineral is exposed, and here as elsewhere its abundance has given the farmers division of the carboniferous its characteristic title. As distinguished from the same mineral in the older rocks, it is presented as oolitic, shelly, flaggy, grannular, etc., but never crystallized as marble. Its color, texture and purity vary continually, and the lime burner has little trouble in securing an article fit for any of his operations. In the coal measures there are numerous thin beds of limestone bituminous, and fossiliferous. I have seen no analysis of these beds, but it is quite probable that some of them may hold several per cent. of phosphoric acid, and be suitable for cheap local fertilisers. A limestone near St. Peters is said to be suitable for making hydraulic cement, but so far it is questionable if any bed of limestone has yet been found in Nova Scotia maintaining a composition, indicating hydraulicity, ever a distance large enough to secure uniformity in the cement.

At Lennox Passage a limestone has been quarried for a number of years, and it is said to be of excellent quality.

Silver and Lead.—The carboniferous limestones not unfrequently contain grains and veinlets of Galena. At a few points these indications have been decided enough to lead to exploratory work. As yet, however, the Galena has not been found either in quantity enough to form an economic ore of lead, or associated with silver in amount sufficient to warrant much attention being paid to it. Among the localities noticed as in this connection may be mentioned: South-west Margaree, and Middle River. At Pleasant Bay, near the mouth of McKenzie River, Galena containing gold and silver, and associated with copper pyrites, occurs in calcspar veins, up to three feet in thickness, in grits, sandstone, and bituminous limestone. Near the Head of Lochlomond, and on Salmon River, in Cape Breton Co., Galena occurs in a massive limestone, and in a dark manganiferous limestone, in small grains; and in veinlets in a dark breccia apparently of carboniferous age. Here the cementing matter of the stone is calcareous. A few tons have been taken

out, and on assay were found to yield a small per centage of lead, a trace of gold, and 2°879 ounces of silver to the ton.

In the Port Hood coal measures a small vein of galena was noticed in a sandstone bed between two coal seams. A similar case was noticed some years ago at the Joggins coal mines, in Nova Scotia, where, if I remember correctly, the lead ore was noticed in the coal bed where cut by a fault.

Copper.—In Cape Breton this ore occurs principally as pyrites. The conglomerates frequently show it in small quantities near their junction with older rocks. In the vicinity of Whycogomah it occurs in diorite dykes, cutting the lower carboniferous measures, and its occurrence at Port Bevis, under similar conditions, has been noticed.

At Cheticamp, a number of years ago, a good deal of money was spent in prospecting for Copper. The ores were green and blue carbonate of copper, gray and yellow sulphides, and chrysocolla. The deposits are in the vicinity of lower carboniferous traps and sandstones, but probably resemble in economic value ores frequently met in rocks of the same age in Pictou, Colchester and Cumberland Counties. Copper ore occurs under similar conditions at Jerome's Point, where native copper is found in trap. Copper pyrites is frequently met from this point as far as Cape North, and so wide spread are the traces of the ores of this metal in this part of Inverness County, that it may safely be predicted that workable deposits will be found either in the Pre-Cambrian rocks, or as derivative ore bodies in the adjoining carboniferous strata.

Celestite.—This mineral, the Sulphate of Strontium, is reported by Mr. Fletcher as occurring on the right bank of the Sydney River, about a mile and a half above the Coxheath Bridge, as a bed about a foot thick, of a bluish grey color, associated with limestone. This mineral is used largely for the crimson color of fireworks, and lately has been introduced in certain processes of sugar refining. The principal source of supply is, I believe, Italy, whence about 5000 tons are annually exported to England and

Germany. The mineral may be much more common here than is supposed, as it might readily be mistaken for a limestone.

Barytes. This mineral is largely used in paint making, and is found in Nova Scotia in at least two localities as a workable deposit, River John, Pictou County, and at Stewiacke. The River John mine is not being worked, but the Messrs. Henderson & Potts, of this city, took last year a large amount of the ore from the Stewiacke mine. Mr. Fletcher reports the mineral as occurring in Pine Brook, Loch Lomond, but does not consider the deposit of much importance. I have noticed it in small veinlets, with fluor spar in a clayey limestone near the Sydney River Bridge.

Building stones. As a rule Carboniferous measures of Cape Breton do not yield building stone of extra quality. Sandstones are quarried for local use at Margaree, Broad Cove, Cheticamp, Whyhogomah and Mabou. The limestone grit of Boularderie Island and Sydney Harbor yield a stone which is of fair quality. Generally speaking, however, the beds are too coarse, irregular in bedding, and frequently so impregnated with iron as to make them adapted principally for foundations and rough work. However, some of the upper beds of the limestone formation yield sandstones of firm and even texture, and good color which may be extensive enough to admit of regular quarry work.

In the construction of bridges and culverts on the railway now being built across the Island, a considerable amount of limestone has been used from contractors' quarries opened near the line. This rock when found in beds with suitable division planes forms an excellent and durable building material. Several thousand cubic yards were used for this purpose last year.

Oil.—A good deal of interest was shown in the so-called Lake Anslie oil fields a few years ago. This large lake occupies a portion of an extensive basin of lower carboniferous measures, flanked on all sides by older strata. At numerous points in the vicinity of the lake, petroleum is found in cavities in the

sandstones, and oosing from the shales, etc. A large amount of money was spent in putting down bore holes in this district, and on the Middle River of Baddeck, where similar indications were observed. All the exploratory work proved unsuccessful.

The source of these widespread signs of oil must be sought in the carboniferous measures, as they are probably immediately underlaid by the Laurentian. None of the bore holes were put down deep enough to settle whether or no there does exist an oil-bearing stratum before the older rocks are reached. No attempts were made to identify any bed or set of beds as probable oil-bearers, or to test any section systematically. From the nonsense talked about the identification in this district of certain beds with the first, second, etc. rocks of the United States oil fields, it was apparent that no system was recognised, and the money spent has done nothing to settle the question practically.