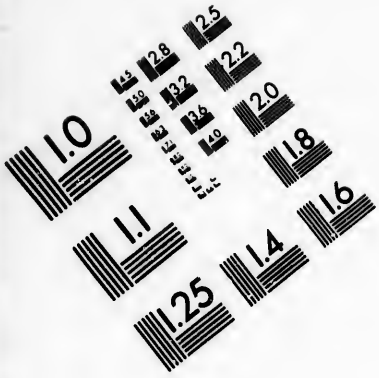

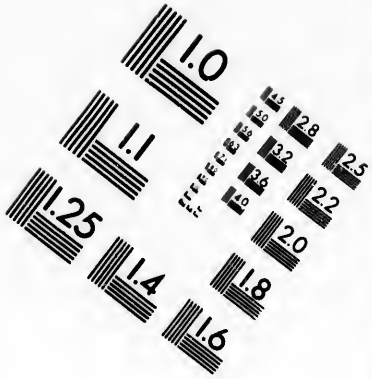

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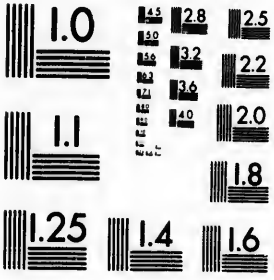

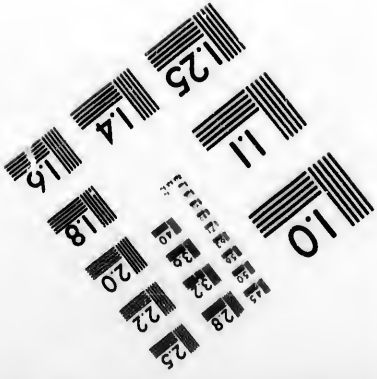

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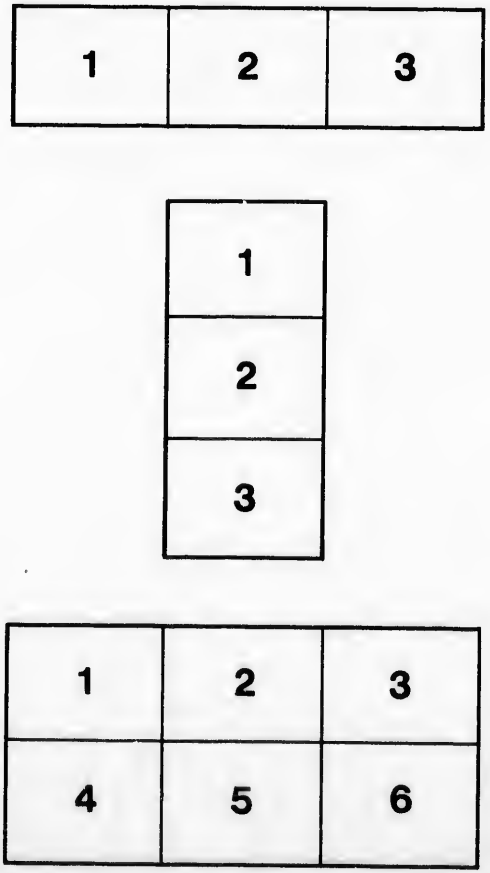

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[TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING ENGINEERS.]

THE IRON ORES OF PICTOU COUNTY, NOVA SCOTIA.

BY E. GILPIN, JR., A.M., F.G.S., F.R.S.C., INSPECTOR OF MINES, HALIFAX, N. S.

(A Communication to the Secretary, read at the Chattanooga Meeting, May, 1885.)

THE following notes may serve to bring before your Institute an idea of the iron-ore resources of Pictou County. Enough work has been done to permit an estimate to be formed of their quality and probable extent. As yet the systematic mining and smelting of iron-ore in Nova Scotia is confined to the operations of the Steel Company of Canada, in Colchester County.

Although the locality I am about to describe appears, in many respects, well adapted to iron smelting, etc., no attempts have yet been made to begin work. Nova Scotian capital is more readily turned to lumbering, fishing, and shipping ventures; and such an investment appears equally foreign to the rest of the Dominion. I need not, however, go further into this part of the subject, and can only hope that my notes may prove serviceable as indicating a probable field for future development.

The accompanying map shows the position of the harbor of Pictou relative to the coal and iron-ore fields, and to the railways which intersect them. The branch of the Intercolonial Railway, running from Truro to Pictou, forms the western boundary of the iron-ore district, which extends beyond the point where the New Glasgow and Cape Breton Railway crosses the French River. The iron-ore district may be roughly described as a triangle formed by the ore-outcrops and the two railways, the former making the base, and the latter the sides of the triangle, the apex resting on the coal-field at New Glasgow.

The drainage of the country is toward the Gulf of St. Lawrence, through the Middle, East, Sutherland's, and French rivers; and the surface is undulatory, seldom exceeding two hundred feet above the sea-level, except in the district lying between Glengarry and the upper waters of the French and Sutherland's rivers, where a maximum height of about five hundred feet is reached at several points.

Geologically speaking, the district embraces two divisions, the Carboniferous and the Silurian, the latter resting on strata provisionally considered to be of pre-Cambrian age. As no geological survey has yet been made of this county, except in the coal-field, the boundary lines of the various horizons cannot be indicated with absolute accuracy.

From New Glasgow northward to Pictou are met the measures of the Upper Carboniferous (embracing the upper part of the productive measures). These strata are considered by geologists to mark the transition from the Carboniferous into the Permian, and the term Permo-Carboniferous has been applied to them. The town of New Glasgow lies on the northern outcrop of the coal-measures, which extend from Sutherland's River to Middle River, and are bounded by heavy faults, bringing the different Carboniferous subdivisions into close contact with each other. The Millstone-Grit occupies an irregular tract of country lying to the south of the coal-field. The sections which have come under my notice do not show any clearly defined boundary to this formation, which appears to pass insensibly into the coal-measures above and the Marine limestone beneath.

The latter formation, which is of interest in this connection, as it holds numerous beds of limestone, iron-ores, etc., is presented in an irregular band, extending from Glengarry to Sutherland's River, and projecting to the south up the East River in a narrow tongue. The lowest division of the Carboniferous, represented elsewhere in the Province by dark-colored bituminous shales or by heavy beds of conglomerate, does not appear in this district.

The various members of the Carboniferous system rest on two divisions of the Silurian. The upper division has for its western boundary the East River, and occupies the highlands, already referred to, as extending from that point to the eastward. The beds making up this series are gray and olive slates, in places passing into coarse grits and sandstones, and containing a few calcareous bands. The fossils they yield are considered by Dr. J. W. Dawson to be the equivalents of those characterizing the Lower Helderberg of United States geologists. Passing downwards, underlying strata are met, which, in the absence of the Niagara limestone may be regarded as of Clinton age. These ferriferous strata are now presented in synclinal folds, irregular in shape, and frequently broken by faults, and rest on nacreous and chloritic schists with immense masses of an indurated slaty breccia, rising into prominent hills.

On the west side of the east branch of the East River the Carboniferous rests on strata, composed largely of black and gray slates and quartzites, older than any met on the east side of the river, except possibly the hills of indurated breccia. At several points patches of strata, perhaps representing the lower beds exposed on the east side of the river, intervene between the Carboniferous and the older strata. These slates and quartzites are considered to be the eastward extension of the axial measures of the Cobequid Mountains, which they strongly resemble, and have been termed Siluro-Cambrian. As yet, however, the work of mapping out these horizons has been incidental to the exploratory work on the various iron-ore deposits, and much remains to be done.

Although the presence of a few of the iron-ore beds about to be described had been known for many years, no attempts were made to prove their value until 1873. In this year Dr. Dawson, assisted by his son Mr. George Dawson, determined the position and extent of some of the more important deposits, and their work was continued by the writer for several seasons over a district embracing three hundred square miles.

Taking the ores in ascending geological order, they occur as follows:

Cambro-Silurian.		Specular magnetite.
Upper Silurian.		Red hematite.
Carboniferous	Marine limestone.	Spathic ore. Red hematite.
	Millstone grit.	Nodular clay ironstone.
	Coal measures	Clay-ironstone. Blackband.
	Upper coal measures.	Clay-ironstone.
Recent.		Bog-ore.

The iron-ore district of the Cambro-Silurian series begins about six miles to the northwest of Glengarry station, where there are several veins of specular ore in Gairlock. These veins, as exposed naturally near the farm of James McKay, of Mill Brook, vary in thickness up to 2 feet, but no work has been done to test their extent. About two miles west of Glengarry a large vein crosses the railway, and is composed chiefly of ankerite with sideroplesite, and a little calcspar, and carries several veins of specular ore. One of these has been opened by a short drift and shows 3 feet of excellent ore.

From this point eastward to Drug Brook on the west branch of the East River traces of specular ore are frequently met, but no veins have been observed. Here a natural exposure shows three beds of limonite, the thickest being about 30 inches in width. It is not known with certainty that these ores represent the specular

already referred to, and they have been considered to belong to a second ore-range, lying to the south of the specular. From this point, surface-signs of specular ore mark the passage of the vein for about three miles, to an opening made by Mr. Watson on a vein of specular ore 7 feet wide. A few yards from this is a bed of a dark-colored magnetic ore, about 18 inches wide; but no details are known as to its extent and value.

The specular vein has been traced about four miles further to the east, and shafts have been sunk on it at several points. On the Weaver property, enough work has been done to show that the vein is about 100 feet wide, and carries several bodies of specular ore from 1 to 15 feet thick. About one-half a mile east of the Weaver property, where the vein begins to skirt the river-valley, it appears to be associated with limonite. The vein has not yet been searched for in the wooded district lying east of the river.

This vein is, strictly speaking, a stratum-vein, and maintains a course very closely agreeing with that of the slates, and a nearly vertical dip. During a great part of its course, as sketched above, it runs on elevated ground, which would facilitate mining. There are indications of a similar parallel vein lying further to the south, but hitherto it has not received attention. The alternation of specular and limonite ores in these veins has also been observed at Londonderry, Colchester County, where the earlier workings at several points yielded considerable quantities of the former ore, while at greater depths limonite alone is found.

The ore is compact and foliated, and its quality is shown by the following analyses:

Composition.	Specular Ore.			Limonite.
	I. Weaver.	II. Weaver.	III. Watson.	IV. Drug Brook.
Iron oxides,	92.01	97.52	93.80	81.902
Manganese oxide,	2.16	....	....	.068
Alumina,	.21	....	....	1.019
Lime carbonate,	1.27	....	....	.313
Magnesia carbonate,	.43	....	....	.052
Phosphoric acid,	.08	....	trace.	....
Phosphorus,	....	none.	....	.431
Sulphur,	.16	trace.	.68	.046
Titanic acid,	trace.	....	....	....
Silica,	3.68	3.20	3.40	6.350
Moisture,	....	....	....	9.462
Metallic iron,	64.41	68.33	65.60	57.718

I. Dr. Stevenson Macadam. II. Dr. T. E. Thorpe. III. E. G., Jr. IV. Geol. Sur., Canada.

The Upper Silurian district is marked by the occurrence of beds of red hematite, some of which reach large dimensions. Allusion has already been made to the basin-shaped synclinals presented by these strata. One of these synclinals in Blanchard settlement has a width of one and a half miles, and a length of about three and a half miles. Owing to the wooded character of much of the ground at this point, the exact thickness of the basin cannot be given. Its western apex rests on a mass of the indurated slaty breccia, already alluded to, and has been for a short distance a good deal broken by faults.

On the southern side of this basin, a bed of ore from 3 to 5 feet in thickness has been traced for about three miles, and maintains a moderate dip to the north. The reverse outcrop, or southerly dip, of this bed has been observed at several points on the north side of the basin, and several beds of ore are believed to occur between them in the flat-lying band of measures forming the axis of the synclinal. About 700 feet below the northern outcrop of this bed is an exposure of a bed of red hematite, commonly known as the Big Blanchard bed. This bed stands nearly vertical, and varies in width from 30 to 100 feet. No attempts have yet been made to trace it beyond its natural exposure, which is about half a mile in length.

At a vertical distance below the southern outcrop of the upper bed, corresponding closely to the distance between it and the big bed on the north side, are strong surface indications of the reverse outcrop of the big bed. Should this bed be proved to extend over the area indicated it would yield an immense amount of ore. The northern end of this synclinal is broken by faults bringing up lower measures; and a little further north the Webster red hematite is met with a strike nearly at right angles to that of the beds just described, and a northerly dip at angles of 15° to 50°.

The exact relationship of the Webster ore to that of Blanchard has not yet been clearly made out, but it may be taken to represent one of the outcrops of the big bed brought up by a transverse folding. It has been traced for about four miles, and varies in thickness from 15 to 40 feet. The best ore extends for about one mile each way from Sutherland's River, and the bed then becomes poorer by degrees from excess of silicious matter, until it passes into a ferruginous quartzite. At several points, beds of quartzite are found intercalated in the ore, but do not pass into it, being sharply defined by smooth partings. This ore is not fossiliferous, and may be con-

sidered a segregation of iron oxide around minute grains of silica, giving the ore in places a sub-oolitic structure. Its color is steel-gray, with a metallic luster in some of the layers. The ore is very favorably situated for mining as it runs on the crest of a high hill.

About three miles to the north, after several small synclinal folds are passed, the Fall Brook ore is met. It has a southerly dip and resembles the Webster ore, but is of an earthy red color. It has been opened by Mr. Watson at Fall Brook, and is known to extend about five miles to the eastward, nearly to the spathic ore on McLarens Brook. Its thickness is about 15 feet, and it preserves the quality, shown by an analysis of the ore from the opening in Fall Brook, over the greater part of its course. To the south of the spathic ore deposit it becomes more siliceous, and freer from sulphur and phosphorus.

There are several other smaller areas of this class of ore in the district under consideration, but they have not yet been examined. The measures of this horizon continue with a few breaks from Springville to Arisaig, on the east line of the county, a distance of forty miles. They have been examined at several points, and have yielded indications of the presence of red hematites. At Arisaig a bed of red hematite similar in appearance and structure to that found at Webster's, and 4 feet in thickness, has been traced for some distance.

The following analyses will show the character of these ores:

Composition.	I. Webster.	II. Webster.	III. Fall Brook.	IV. Arisaig.
Iron oxides,	75.67	65.26	63.451	74.77
Manganese oxide,	.52	traces.	....	trace.
Alumina,	.45	5.59	.205	....
Lime carbonate,	2.44	1.88	3.992	8.76
Magnesia carbonate,	.98	1.05	.120	
Phosphoric acid,	.22	....	.450	....
Phosphorus,	....	none.	....	.08
Sulphur,	.29	none.	trace.	trace.
Titanic acid,	trace.	....	....	....
Silica,	19.43	23.68	27.735	16.10
Moisture,	....	2.54	2.995	....
Metallic iron,	54.36	43.40	44.400	52.34

I. and II. Drs. Macadam and Thorpe. III. E. G., Jr.

It may be remarked that the amount of phosphorus in these ores appears to be connected with the presence of fossils at certain places.

When they are absent or present in small numbers, as is usually the case, the beds yield an ore very free from both sulphur and phosphorus.

Although the grade of these ores may not be equal to that of the specular, they are evidently in enormous quantity and can be very cheaply mined; and the more northerly beds are close to the coal-field.

The ores next to be noticed are the limonites of the East River valley. From Springville to Sunny Brae the Lower Carboniferous Marine limestones rest on the Upper Silurian and lower strata, the points of junction presenting at several places interesting sections of the deposition of the limestones on the clay-slates and other pre-Carboniferous rocks. The line of junction is at many points occupied by deposits of limonite, varying in thickness from 3 to 20 feet. At some points the ore-bearing ground appears from surface indications to be several hundred yards broad. At several openings the ores are highly manganiferous, and specimens of pyrolusite of good quality have been found. The limestones connected with these ores at Springville and Black Rock are, in some instances, rich enough in carbonate of iron to be available for furnace-use.

The source of these bodies of ore may be sought for in the oxidation and concentration of the iron in the limestones, and from the beds of red hematite in the Upper Silurian already referred to, several of which are in the immediate vicinity of the limonite.

The ores are compact, mammillated, and fibrous, and their quality is shown by the following analyses:

Composition.	I.	II.	III.	IV.
Iron oxides,	88.92	93.09	81.19	48.223
Manganese oxide,	.78	1.10	.20	14.410
Alumina,	.71	....	....	....
Lime carbonate,	1.44	....	....	.5
Magnesia carbonate,	.82	....	....	traces.
Phosphoric acid,	.34	....	.15	....
Phosphorus,	....	none.	....	.020
Sulphur,	.24	.04	traces.	.480
Titanic acid,	trace.	....	....	....
Silica,	2.14	4.80	4.26	25.130
Moisture,	4.61	....	13.60	12.530
Metallic iron,	62.24	65.20	56.83	33.826

I. Dr. S. Macadam. II. Dr. T. E. Thorpe. III. J. H. Huxley. IV. E. G., Jr.

Passing to the Sutherland's River district, an opening has been made on a bed of spathic ore which occurs in red marl, associated

with limestone and gypsum. Its width varies from 6 to 10 feet, and from surface indications it appears to extend over a considerable tract of country. The bed in places is highly manganiferous, and is a typical spathic iron, granular and crystalline in texture, and of a light-gray color. The following analyses will show its character:

	I.	II.
Sesquioxide of iron,	20.52	——
Carbonate of iron,	57.40	82.11
Carbonate of manganese,	8.29	4.70
Carbonate of lime,	4.02	2.37
Carbonate of magnesia,	5.66	9.06
Silica,	2.38	1.69
Moisture,	1.43	——
Sulphur,	none	.10
Phosphorus,	none	none
Metallic iron,	42.07	39.64

I. Dr. T. S. Hunt. II. J. H. Huxley.

Indications of spathic ore have been found on Sutherland's River, McLellan's Brook, etc., under similar conditions, and this ore may prove a widespread and important addition to the ores of the county.

Still further east on French River, at a horizon apparently several hundred feet higher, and considered to represent the upper part of the Marine limestone formation, there are several beds of a nodular red hematite, varying in thickness up to 4 feet. These beds have been recognized as extending for several miles. They appear to be the weathered outcrops of carbonate ores, but they have only been examined superficially. Samples taken from the outcrop of a 4-foot bed on French River yielded 35 per cent. of metallic iron.

In the productive coal-measures, clay-ironstones and black-band ore have been noticed at several horizons. It may be questioned if any of the ores hitherto casually exposed in shafts and stone tunnels are present in quantities large enough to warrant the expectation of independent workings, although in some cases they could be worked in connection with the coal-beds. The horizon yielding these ores most abundantly appears to be that embraced between the Albion main seam and the McGregor seam. Old records show several beds included in these strata which contain layers of ironstone up to 3 feet in thickness, and on further examination they may prove of economic value.

The following analyses by the writer will serve to show the quality of some of these ores:

	I. Clay-ironstone.	II. Black-band.
Moisture,	2.132	——
Sulphur,	.612	.214
Phosphoric acid,	trace	.586
Manganese oxide,	——	4.450
Lime,	trace	3.780
Magnesia,	1.655	.783
Alumina,	16.962	3.180
Silica,	.780	16.546
Carbonic acid,	——	27.589
Iron protoxide,	45.361	36.000
Metallic iron,	35.000	28.000

Although no attempts have yet been made to find iron-ore in the coal-districts, the indications observed up to the present date may fairly be considered to show the probable presence of a large and cheap supply of ore.

In the Upper Carboniferous measures lying to the north of New Glasgow there are several thin layers of clay-ironstone, not apparently of economic value.

In the surface-drift there have been beds of bog iron-ore observed at numerous points. These deposits have nowhere been observed of large dimensions, but would probably be utilized for furnace purposes in the vicinity of the iron-ore districts more particularly alluded to above. River John, French and East rivers may be mentioned as localities yielding this ore; and the following analysis is of ore from a small bed exposed in a cutting of the Glasgow and Cape Breton Railway in Merigomish, near French River:

Moisture,	5.500
Water of composition,	6.100
Sulphur,	.208
Phosphoric acid,	.384
Manganese oxide,	5.886
Lime,	trace
Magnesia,	trace
Alumina,	3.106
Silica,	12.325
Iron peroxide,	66.510
Metallic iron,	46.557

These notes may serve to give a general idea of the iron ores of Pictou County, and considering the wooded condition of nearly all the Silurian and Cambro-Silurian districts, and the little inducement that has as yet existed to stimulate search, it must be admitted that the discoveries hitherto made, almost exclusively of natural

exposures, are of good promise. It is anticipated that the work of the Canadian Geological Survey will shortly be extended into this county, and their mapping of the divisions of the pre-Carboniferous rocks will undoubtedly facilitate the prospector's work.

In this connection a brief reference to the two important accessories to iron smelting—fuel and fluxes—may not be out of place.

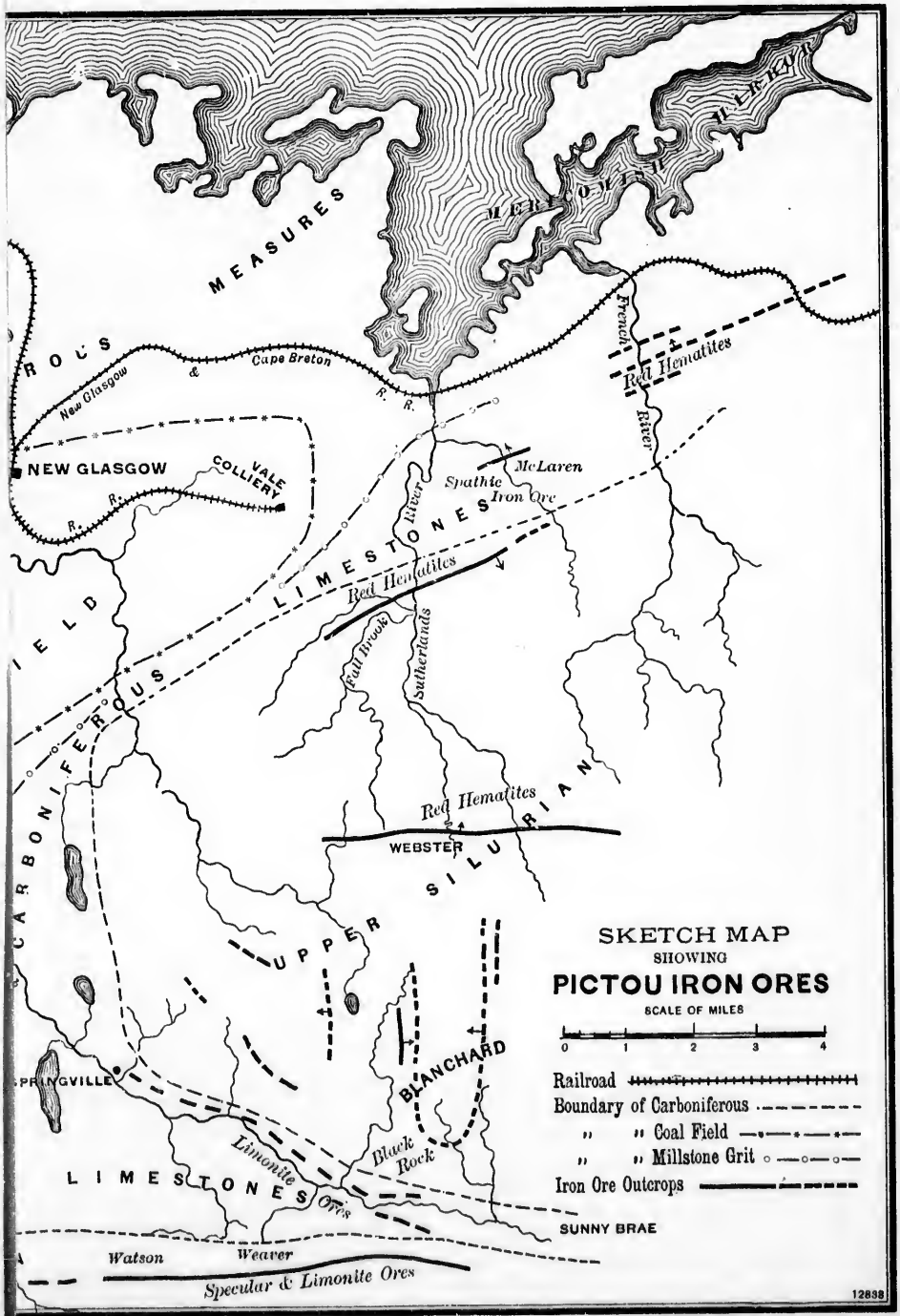
The coal of Pictou County may be described as bituminous and free-burning. Several of the seams now worked have not been found to yield a good coke, but answer well in the furnace when used with about twice their weight of coke. Other seams, however, yield a coke which makes a good furnace-article, and has been successfully used at Londonderry. The coke is cellular, and extremely resistant, resembling in appearance that from the north of England. The following average of several analyses, made some years ago by the writer, will serve to show its character:

Moisture,	.96
Carbon,	83.85
Sulphur,	.52
Phosphoric acid,	.01
Ash,	14.50

Limestone is abundant in the county, and forms an irregular band between the iron-ores and the coal-field. On the East River, and on its western branch, it is at several places close to the iron-ore. The lowest beds hitherto found rest on the pre-Carboniferous rocks, and are generally highly ferriferous and manganiferous. They form a horizon which I have described in a paper read before the last meeting of the Royal Society of Canada as presenting itself at the base of the Marine limestone formation in Nova Scotia, and at many points yielding ores of manganese, iron, and lead. The higher beds are frequently very pure and uniform in quality. They vary in thickness up to 75 feet, and are often continuous for long distances.

The following analysis will show the character of one of the better-known beds:

Carbonate of lime,	93.90
Carbonate of magnesia,	2.45
Peroxide of iron,	.59
Peroxide of manganese,	.56
Alumina,	.12
Sulphur,	.03
Phosphoric acid,	.03
Silica,	2.10
Moisture,	.18


MEASURES
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ROUS & Cape Breton R. R.
New Glasgow
NEW GLASGOW
VALE COLLIERY
R.
R.
French River
Red Hematites
McLaren
Spathic Iron Ore
LIMESTONES
Red Hematites
River
Fall Brook
Sutherlands
IELD
CARBONIFEROUS
Red Hematites
WEBSTER
SILURIAN
UPPER
BLANCHARD
PRINGVILLE
Black Rock
Limonite Ores
LIMESTONES
SUNNY BRAE
Watson
Weaver
Specular & Limonite Ores
SKETCH MAP
SHOWING
PICTOU IRON ORES
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Boundary of Carboniferous
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Iron Ore Outcrops
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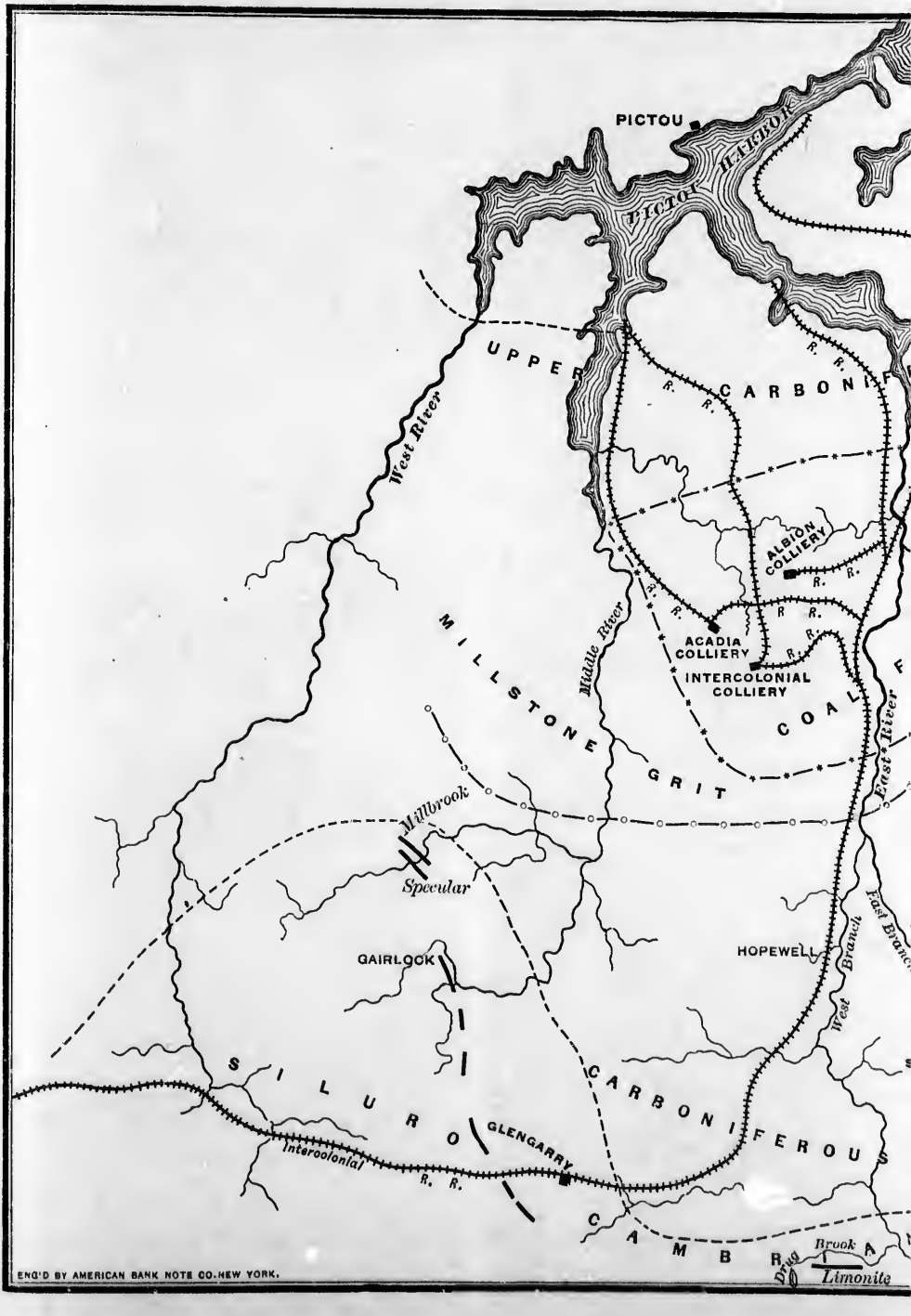
PICTOU
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ACADIA COLLIERY
INTERCOLONIAL COLLIERY
MILLSTONE GRIT
COAL
Middle River
East River
Millbrook
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GAIRLOCK
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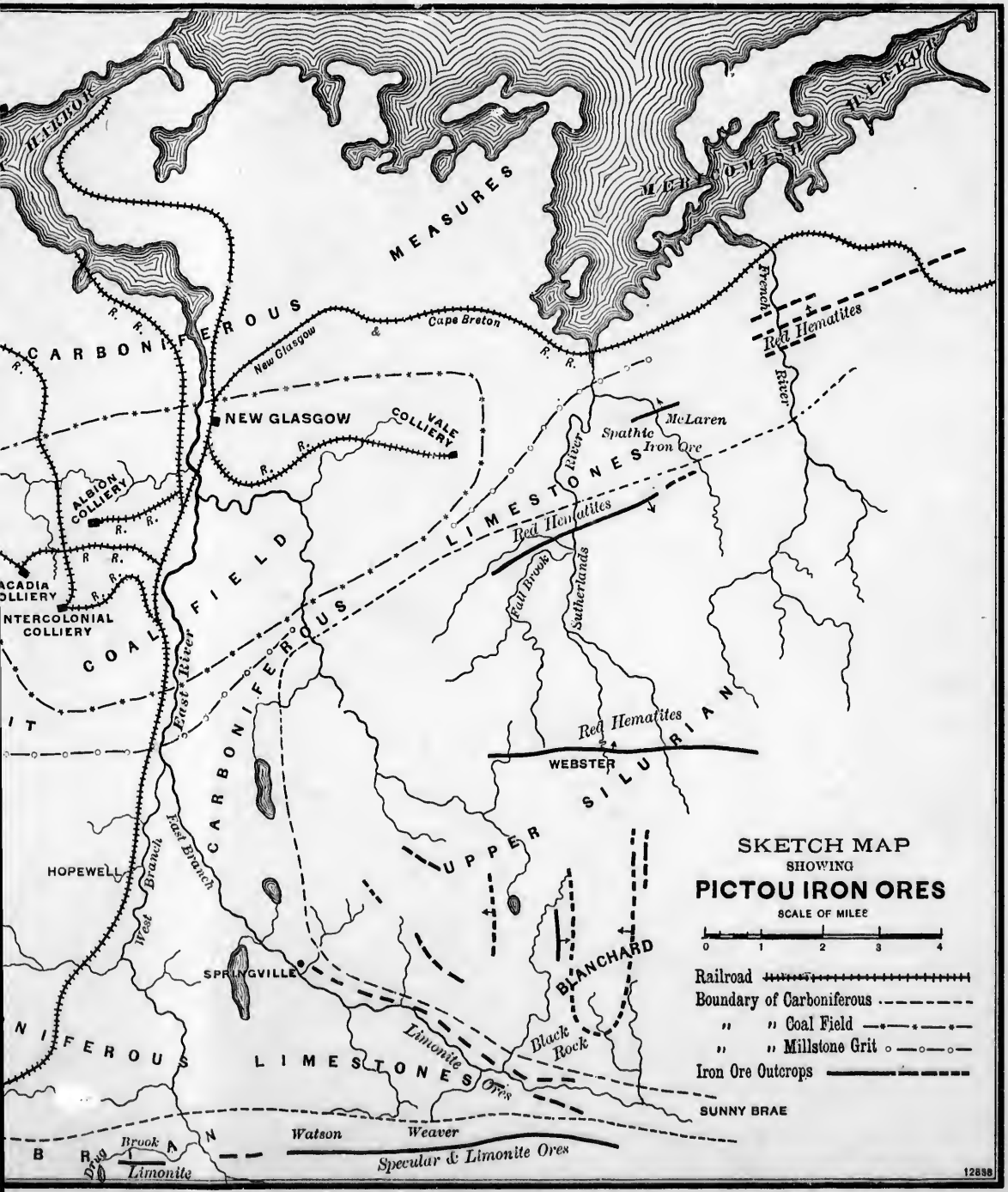
MEASURES
CARBONIFEROUS
Cape Breton
R. R.
NEW GLASGOW
VALE COLLIERY
ALBION COLLIERY
INTERCOLONIAL COLLIERY
COAL FIELD
LIMESTONES
East River
French River
Red Hematites
McLaren
Spathic Iron Ore
Fall Brook
Sutherlands
WEBSTER
SILURIAN
UPPER
HOPEWELL
West Branch
East Branch
SPRINGVILLE
BLANCHARD
Black Rock
Limonite Ores
SUNNY BRAE
Watson
Weaver
Specular & Limonite Ores
Limonite
SKETCH MAP
SHOWING
PICTOU IRON ORES
SCALE OF MILES
0 1 2 3 4
Railroad
Boundary of Carboniferous
" " Coal Field
" " Millstone Grit
Iron Ore Outcrops
12838