

the charming July sun tempts you, you give way for the mouth of the basin, where the huge boulders of traps stem the Bay of Fundy tides, heaping great sand beaches at their bases. Your canoe grinds upon Indian beach, you run it up amidst dozens of other Indian canoes, and scan half way up the rocky barrier a shady spot for your bivouac. Here your Indian builds his fire, two parallel lines of stones eighteen inches high, with a trench between, picks and cleans his birds, and cutting branches from the nearest tree, impales a bird on every twig, resting the whole branch over his fire. Gravely he hands to each guest a branch with its roasted fruit, who, holding the branch in one hand pulls with the other the birds from the twigs. To one who has eaten of this Abyssinian banquet there is no need to tell of their tenderness and juicy delicacy. The rigor mortis has not yet stiffened the dead birds. This comes on after a few hours and then passes off after a day or two. If you cook the grouse shot upon your tramp for your night's supper, you are surprised how tough they are, but if you hang them in your camp for a day or two you find them tender. The Indian, like the Abyssinian, chooses the almost living flesh for his feast.

ARTICLE IX.—“THE NORTHERN OUTCROP OF THE CUMBERLAND COAL FIELD.” BY EDWIN GILPIN, A. M.,
F. G. S., F. R. S. C., ETC.

(Read May 8th, 1882.)

MY object this evening is to lay before you a brief summary of the work which has been done on the northern outcrops of the seams of the Cumberland Coal Field. Some of the information is new and of importance, but for much of the work done at an early date I have had recourse to official sources.

The Cumberland coal field was for many years an unknown and unpromising district. It was accessible by water at the Joggins only, to allow competition with the coals of Sydney and Pictou. The presence of coal seams was known at several other points, but the want of any means of transportation forbade an attempt to open them.

Under the influence of a temporary demand for coal in the United States, several mines were opened between Maccan and the Joggins; but they were abandoned as soon as the necessity ceased that called them into operation.

When, however, the long dreamt of Intercolonial Railway was opened through the centre of the field, a fresh and more lasting impetus was given to the coal trade. A large and flourishing mine was opened at Springhill, through the energy of some merchants of St. John, who have been well rewarded for their enterprise in taking hold of a property which was rejected by the people of Halifax. The demand for fuel at the Londonderry iron works has led to the opening of another colliery, and other properties are being prepared to meet the revival of business in the mineral we are now considering.

In view of this encouraging state of affairs, it may not prove uninteresting to you to learn not only what progress in development has been already effected, but to consider what additional stores of mineral wealth may be contained in the district treated of in this paper.

The key to the general structure of the Cumberland coal field is found at the Joggins, presented in a beautiful and unbroken section of the various divisions of the carboniferous system. This has been carefully studied and minutely described by Dr. Dawson and the late Sir Charles Lyell, and I shall refer to it so far as may be necessary to show its bearing on the distribution of the productive measures over a district 25 miles in length. On referring to Dawson's "Acadian Geology," we will find the Joggins' coal-measures bounded above (geologically speaking) by a set of massive sandstones (the upper coal measures), and below by a series of sandstones, grits and conglomerates (the Millstone grit). These massive covers, like the pasteboard of the book-binder's art, serve not to hide, but to preserve the material contained between them. The following summary, in descending order, will show the relative thickness of these great layers of sediments:

UPPER COAL MEASURES.

Upper part.....	650 feet.	
Lower "	1607 "	
	—————	2267 feet.

PRODUCTIVE COAL MEASURES.

Upper part.....	2134 feet.	
Lower ".....	2623 "	
	—	4757 feet.

MILLSTONE GRIT.

Upper part.....	2000 feet.	
Middle ".....	3240 "	
Lower ".....	640 "	
	—	5880 feet.

The lower part of the Upper Coal Measures is exposed at Ragged Reef, where it is made up chiefly of hard and massive gray and white sandstones, with occasional beds of a reddish colour, and red and gray shales.

The upper part of the Productive Coal Measures comprises about 1000 feet of gray sandstone, and nearly the same thickness of gray and reddish shale and fire clays. It contains 22 coal beds, all of which are thin and of poor quality as exposed on the shore, and will not be again referred to in this paper.

The lower part of the Productive Measures, holding all the workable seams yet known on the shores, is characterised by gray sandstones, and gray and dark coloured shales.

The Millstone Grit series forms an abrupt change in appearance to the measures holding the coal beds. It consists of reddish shales and red and gray sandstones, the latter passing into fine grits and conglomerates. It is, moreover, destitute of coal, and shows very few fossils beyond a few drifted pieces of wood.

The following section of the lower part of the Productive Measures shows the principal coal beds and their relative positions:—

	<i>Feet.</i>	<i>In.</i>	<i>Feet.</i>	<i>In.</i>
Strata.....	339	7	—	—
Main Seam.....	—	—	7	7
Strata.....	75	0	—	—
Queen Seam.....	—	—	4	10
Strata.....	968	0	—	—
Coal bed.....	—	—	4	0
Strata.....	18	—	—	—
New Mine Seam....	—	—	3	0
Strata.....	1160	—	—	—

Only two of the above seams, namely, the main and new mine are considered workable at the Joggins. We therefore have this vast thickness of strata, comprising 4757 feet, yielding in its upper half no seams worth mentioning, and in its lower part only four beds meriting the miner's attention..

In considering this great mass of sediments, with its alternating layers of coal, clay, sandstones and limestones, it must be borne in mind that the various changes chronicled at the Joggins did not necessarily extend over the whole of the Cumberland coal field. But, as Dr. Dawson remarks, had we visited the district during the coal period, we might, by changing our position a few miles, have passed from a sandy shore to a peaty swamp, or the margin of a lagoon. The evidence of similar districts at the present day, and the sections of their coal fields, show that, although these changes would be visible in passing over the ground, still the horizons of deposition, whether of vegetable matter or of sandstone, etc., vary very little, and that the persistence and regularity of the coal beds is greater than that of the associated measures. We thus find in Cape Breton coal seams preserving over considerable areas a uniform size and relative position while marked variations are observed in the thickness of the containing beds. Had we visited the district we are considering at a period coinciding with the formation of one of the coaly beds, we would have seen on all sides vast swampy plains covered with dense forests of strange shapes and unknown hues; calamite brakes and peaty bogs, traversed by sluggish streams and shallow lagoons, impeded and changed in their course by the luxuriant and encroaching vegetation. Again, a visit at the time of deposition of some of the great beds of barren sandstones would have shown us a wide and shallow sea filled with sandbars and low islands, on which grew straggling calamites, fighting for an existence amid the shifting sands.

We may now briefly pass in review the sections of the seams presented at the various mines which have been opened on the eastern extension of these strata.

Near the shore the Joggins main seam presents the following section recently measured by myself:—

	<i>Feet.</i>	<i>In.</i>
Coal.....	2	10
Coal and shale (holing).....	0	5
Shale.....	2	6
Coal.....	1	10
	—	—
Total.....	7	7

At the face of the most easterly workings, the parting has diminished to 4 inches.

The New Mine seam presents the following section :

	<i>Feet.</i>	<i>In.</i>
Coal.....	1	4
Coal and shale.....	0	4
Coal.....	1	1
Fireclay.....	0	4
Coal.....	0	3
	—	—
Total.....	3	4

At the Victoria Colliery, a section is presented which does not agree with any seen on the shore three miles distant, viz :—

	<i>Feet.</i>	<i>In.</i>
No. 1 Coal.....	1	10
Strata.....	15	0
No. 2 Coal.....	3	0
Strata.....	50	0
	<i>Feet.</i>	<i>In.</i>
No. 3 Coal {	0	6
Shale.....	1	4
Coal.....	1	2
Shale.....	0	10
Coal.....	1	4
	..	5
		2

A mine is being opened by the Minudie Coal Company, on a seam underlying those worked at the Victoria Colliery by about 900 feet. This seam presents the following section :—

	<i>Feet.</i>	<i>In.</i>
Coal.....	1	8
Shale.....	0	10
Coal.....	1	10
	—	—
Total.....	4	4

This seam is apparently the same as that shown in the preceding section, intervening between the Queen and New Mine seams.

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At the next colliery, the Lawrence, there are two seams, each 2 feet 6 inches thick, separated by 20 feet of strata.

At the Maccan Colliery there are three seams, presenting the following section :—

		<i>Feet.</i>	<i>In.</i>		
No. 1 Seam	Coal, coarse...	0	8	..	2
	Coal, good....	1	8		
Strata		100			0
No. 2 Seam		1			8
Strata		300			0
		<i>Feet.</i>	<i>In.</i>		
No. 3 Seam	Coal, good...	0	2	..	4
	Shale, ...	0	4		
	Coal, " ...	0	10		
	Shale, ...	1	6		
	Coal, " ...	1	2		

At the Scotia mine two seams have been worked. The upper one is 2 feet 9 inches thick. The lower one, separated from the other at the slope by 10 feet of rock, presents the following section :—

	<i>Ft.</i>	<i>In.</i>
Coal (impure)	1	3
Coal	0	11
Shale	0	4½
Coal	1	5
Shale	0	1½
Coal	0	11
Total		5 0

This parting of ten feet rapidly diminishes to the eastward, and the seams unite on the Chignecto area.

At the Chignecto mine, now being opened by the Steel Company of Canada, the same seam presents the following section :—

	<i>Ft.</i>	<i>In.</i>
Coal	1	0
Shale	0	2
Coal	1	0
Shale	0	1
Coal	0	6
Shale	0	1
Coal	0	3

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Shale.....	1	0
Coal	1	3
Shale.....	0	3
Coal	2	1
Shale.....	0	3
Coal	1	2
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Total.....	9	3

At the St. George mine the same seam presents a somewhat similar section, viz:—

	<i>Ft.</i>	<i>In.</i>
Coal (several thin partings).....	3	6
Shale	2	0
Coal	0	3
Shale	0	1½
Coal	1	3
Shale	0	2
Coal	1	9
Shale	1	10
Coal	0	11
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Total.....	11	9½

At the Styles' mine the following section of seams has been proved in ascending order, and is from information given me by Mr. James Hickman:—

1st Seam	2	0
Strata.....	12	0
<i>Ft. In.</i>		
2nd Seam {	Coal ..1 10	}
	Shale ..0 6	
	Coal ..1 2	
Strata.....	18	0
3rd Seam {	Coal ..3 6	}
	Shale ..0 10	
	Coal ..1 8	
Strata.....	30	0
4th Seam {	Coal ..2 0	}
	Shale .. 8	
	Coal .. 10	
Strata.....	8	0
5th Seam	1	10

This section represents the seams extending from the Styles

Brook to the St. George mine, a district about five miles in length. This end of the coal field will, from its proximity to the railway, and the regularity of the strata, prove an important future source of coal.

These sections differ widely, and in addition to this there are numerous faults known on the River Herbert areas. A heavy fault is also reported on the west line of the Styles area. We thus find that the seams cannot with any show of reason be correlated with either of the coal-beds worked at the Joggins, so far as their sections are concerned, and the presence of heavy faults prevents a satisfactory comparison between those of areas separated by a short distance.

Dr. Dawson considers the seams at the Victoria Colliery (already referred to) as representing the New Mine seam, the coal bed (given in the section) lying eighteen feet above it, and another coal bed 35 feet below it, containing three feet of coal and shale as represented in the Joggins section. He also compares the Chignecto seam with the bed lying eighteen feet above the New Mine seam, and he further suggests that the equivalent of the main seam is yet to be found in the eastern part of the district.

The work of the Geological survey has brought out new facts, which support his opinion as to the probable position of the Joggins main seam, while they oppose his correlation of the seams already given.

On approaching the Styles mine from the north a band of fine grained conglomerate is met, composed largely of syenitic, quartzite, and slate pebbles, the whole having a greenish and red colour. The thickness of this conglomerate and some associated beds of red shale is about 1,500 feet, and it is underlaid by about 1,000 feet of chocolate coloured shales and sandstones.

This bed of conglomerate has been traced from a point several miles east of the Styles mine nearly to the Maccan River, and throughout this distance it preserves the same characteristics, and appears to form the summit of the Millstone Grit. There is also, as mentioned by Mr. McOuat, another point supporting this view, that is, the underlying chocolate coloured shales are seldom

exposed, and have been eroded into a depression to the north of the conglomerate, recalling the great mass of soft strata lying between the upper part of the Millstone Grit and that section of it which furnishes the Joggins grindstones.

The Styles, St. George, Chignecto and Scotia seams all occur at a vertical distance above this conglomerate of 450 to 500 feet. We thus find ourselves provided with a clue at each end of this coal field, and the conclusions to be drawn from the facts I have endeavoured to give you in the briefest possible manner, are of considerable importance in their bearing on the coal values of the district.

On referring to the section of the Productive Measures, it will be noticed that the New Mine seam, which Dr. Dawson considered on the same horizon as the Victoria and Chignecto seams, is 1,100 feet above the Millstone grit. The equivalents, therefore, of the seams found at the Styles and other eastern mines must be sought for in the Joggin section, half way between the New Mine seam and the Millstone Grit.

There is a coal bed found at the Joggins 520 feet above the Millstone Grit, presenting the following section, viz:—

	<i>Ft.</i>	<i>In.</i>
Coal	0	4
Shale.....	1	6
Coal	0	6
Shale.....	1	3
Coal	0	1
	<hr style="width: 100px; margin: 0 auto;"/>	
Total.....	3	8

This may, so far as our data extend, be considered the equivalent of the eastern seams. It would then appear, that, if the conditions necessary for the formation of coal beds were as favourable in the eastern part of the district as they were at the Joggins, workable coal beds would be expected to exist on the horizons of the New Mine and main seams, respectively 1180 and 2289 feet above the Millstone Grit. Judging from the thickness of the seams known in the district east of the Maccan River, these conditions have been more favorable than at the Joggins; and there would, as the thickness of the measures and their characteristics.

remain practically unaltered, be reasonable ground for expecting to find the different seams better adapted for the miner's work than at the Joggins.

I have already spoken of the Ragged Reef sandstones forming the upper cover of the Productive Measures. This sandstone, occurring in massive beds, overlaid by red and gray shales and sandstones, has been traced into the eastern district. From the report of Mr. McOuat, already quoted, it appears that it crosses the Maccan River below Athol, and strikes the Little Forks River about a mile below the Styles Brook, and follows the course of the river to a point about a mile beyond the post road.

The vertical thickness of Productive Measures between the base of this sandstone and the Millstone Grit is, at the Joggins, 4757 feet; at the Styles Brook, 4500 feet, equivalent at the latter place to an interval of about a mile, measured horizontally. From the course of the conglomerate, which turns to the south about three miles beyond the Styles mine, it would at no great distance run under the sandstone. This is accounted for by the officers of the Survey on the supposition of a great fault, an upthrow to the east, probably of several thousand feet. There are other methods by which this apparent obliteration of the Productive Measures can be explained, but the discussion would make this paper too long.

This district affords a capital illustration of the principle that Nature never yields her secrets to the efforts of individuals confined to limited districts. Explorations had been carried on for years in ignorance of the fact that to the north of the Productive Measures the line of the Millstone Grit had been drawn clearly and distinctly; and that to the south an equally distinct barrier defined the area in which the prospector would legitimately exercise his skill and perseverance.

The work of the Geological Survey in this coal field, for some unexplained reason, was left incomplete, but so far as it has been carried in the Northern district, useful hints have been given to the prospector, which I have endeavored to place plainly before you.

We have seen that at the Joggins, the workable seams and the

most promising coal beds are confined to the lower part of the Productive Measures; while the upper half lying immediately below the Ragged Reef sandstones appears to be worthless. So far as I am aware, this set of rocks has not been systematically explored, and its coal contents east of the Joggins are problematical. However, as we have seen that the coal values of a certain horizon in the lower portion have improved to the east, we may anticipate that it is quite within the bounds of possibilities that conditions favorable to the accumulation of workable seams of coal have occurred through this long stretch of coal measures.

Having thus briefly discussed the known seams, and the possible future greatly enhanced value of the district, it remains for me to draw attention to the qualities and transportation facilities of the seams already noticed, with the proviso that any seams found in the future will be more favourably situated for outlet than those now proved.

The distance from the Intercolonial Railway to the furthest east point yet proved in the district is 3 miles. This distance gradually diminishes until the Railway enters the productive belt, and traverses it for a distance of about 1½ mile. By this road a ready outlet is furnished to shipping at Dorchester, 29 miles from Maccan.

The Maccan and Herbert Rivers furnish good shipping facilities for vessels up to 300 tons burden, and at the Joggins coal is loaded into vessels directly from the mines.

I regret to say that at the time I prepared for the Newcastle Institute of Mining Engineers, my paper on "Canadian Coals," I was unable to procure a set of samples of these coals for analysis. I give the following from Dr. Dawson's "Acadian Geology" and other sources, which show the general character of the seams :—

JOGGINS.

Moisture.....	2·50
Volatile Combustible Matter.....	36·30
Fixed Carbon.....	56·00
Ash.....	5·20

MACCAN.

Volatile Matter.....	37.00
Fixed Carbon.....	59.18
Ash.....	3.82

STYLES.

	<i>Fast coking.</i>	<i>Slow coking.</i>
Moisture.....	4.05	4.05
Volatile Combustible Matter	33.72	38.18
Fixed Carbon.....	55.83	51.37
Ash.....	6.40	6.40

The Dominion Government have made arrangements for surveying a line of railway from Maccan to Barnes' Creek, on the river Herbert, and thence to the Joggins, a total distance of about nine miles. This line of road would prove a valuable feeder to the Intercolonial Railway, and an important outlet to the whole Cumberland coal district. It passes across and skirts the productive belt nearly the whole way. By it, in winter, the Joggins, Minudie and other mines would find an outlet to New Brunswick and the Upper Provinces. In summer, the Maccan, and Springhill, and other mines, would find by this road an outlet to a shipping port much nearer than Dorchester and Parrsboro', and open for a longer portion of the year.

The Joggins coal, I presume almost unknown in Halifax, is when carefully prepared a good steam coal. During this year the company have contracted to supply coal for a line of steamers calling at St. John. I am not in possession of any data as to its qualifications for gas and coke making.

The coal from the Scotia and Chignecto seams has found a ready market as a good lasting house coal, and its adaptability for that important use, iron making and working, is shown by the selection of the Chignecto property by the Steel Company of Canada as a fuel supply. The coal from the Styles seam is also well adapted for domestic use, while from trials made on the Intercolonial Railway, it would appear to be a good steam coal. From its action while burning it should also possess good

cooking qualities. This point however can be settled satisfactorily only by practical tests.

I do not know that there is more that I can add to this brief sketch of an important, but still almost unknown district, but will feel satisfied if I have been able to convey to you, and ultimately to the general public, any information which will serve to draw attention to the resources of our Province, and to place on record data which may possibly be utilized by future explorers