REPORT

ON A TOPOGRAPHICAL SURVEY OF PART

OF THE

Cumberland Coal Field,

WITH NOTICES OF THE

COAL SEAMS,

AND THEIR RELATION TO THE

IRON DEPOSITS OF THE COBEQUIDS,

BY

HENRY YOULE HIND, M. A.

(Geologist to the Canadian Red River Expedition of 1857.—In charge of the Assiniboine and Saskatchewan Expedition of 1858.—Author of Narrative of the Canadian Expedition to the North West.—Explorations in the Interior of the Labrador Peninsula.—Report on the Geology of New Brunswick, &c.—Reports on Waverly, Sherbrooke, Mount Uniacke, Oldham and Renfrew Gold Districts of Nova Scotia, &c., &c.)

HALIFAX, N. S.

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REPORT.

THE HONORABLE DANIEL MACDONALD, M. P. P., COMMISSIONER OF WORKS AND MINES:

SIR,—I have the honor to report the result of the survey of that portion of the County of Cumberland in which Licenses to search, Licenses to work, and Leases of Coal property have been granted by the Department of Mines.

According to the instructions received from the Department, the object of the survey was to ascertain the exact distance between the known boundaries of certain leases whose position was fixed, in order that in the future granting of Licenses to search or to work, no discrepancies might arise between the theoretical boundaries assigned on the plan in the Mines Department and the actual boundaries when surveyed and staked out on the ground.

The several points whose distances it was desirable to ascertain, were furnished to me by Mr. Kelly, the Assistant Commissioner, and are as follows:

1st. The distance between the post marking the limits of the General Mining Association's tract at Springhill, and the post marking the limits of the Joggins Colliery on Chignecto Bay.

2nd. The distances between the post marking the limits of the New York and Acadia Company's property (now the Scotia), and the post marking the limits of the Joggins

Colliery on Chignecto Bay and the General Mining Association's tract at Sprignhill.

3rd. The distance between the Culvert on Black River and the south-east corner of the General Mining Association's tract at Springhill.

4th. The distance between the post marking the limits of the New York and Acadia Company's property on the Lower Macan, and the centre of the bridge over the Macan at Southampton.

5th. The distance between the bridge over the Lower Hebert River near the Victoria Colliery, and the bridge over the Upper Hebert near Fullerton's Lake.

I was desired also to collect information respecting the course and continuity of the Coal seams between the Joggins Colliery and Styles pit, and any other information which might be of use to the Department.

My instructions embraced as a leading feature the securing of the services of a thoroughly competent Civil Engineer to make the topographical survey, and map the results for the Department of Mines.

On the 27th June I made arrangements with Mr. John E. Oram, C. E., Professor of Mathematics, Natural Philosophy and Astronomy in King's College, Windsor, to conduct the required survey, who, a few days afterwards, started for Cumberland with his assistants.

Professor Oram has had considerable experience in the kind of work required by the Department of Mines, having spent some years in Central Europe making surveys for, and superintending works on, an important line of railway in the Austrian dominions. His report of the method adopted in conducting the survey is herewith transmitted, together with a field book containing the details of each observation made. The field book is in fact a book of reference in case any dispute should arise respecting the position of the points determined and laid down on the plans accompanying his report. These plans are three in number:

No. 1. A plan of the area surveyed on a scale of 40 chains or half a mile to an inch.

No. 2. A plan on a scale of 60 chains to the inch, this being the scale hitherto adopted by the Department.

No. 3. A plan on a scale of ten chains to the inch, showing the relation of the seams on the Scotia, Chignecto, and St. George Collieries. This plan contains the exact position of the dips of the strata on the line of railway connecting these Collieries with the Macan River. Although the information therein embodied was not required by the Department, yet, as it settles an important point in the geological structure of this part of the Coal Basin, Professor Oram kindly undertook to accompany me in the examination and to lay down the precise position of each observation for dip and strike of rock which it was essential to plot in order to elucidate the structure on these properties.

It was formerly supposed that a great fault occurred between the Macan Colliery and the St. George, by which the seams were thrown a considerable distance to the north. The survey shows that the position of the shafts had not been correctly laid down, and although a fault or faults occur between the Chignecto and St. George, they are by no means of the magnitude previously supposed.

The position of a fault or faults is shown on the plan, and the effect is to change the mean strike of the strata from N. 85½ E. to S. 55½ E., a difference or divergence of 39 degrees.

The construction of the Intercolonial Railway has established a connection between the magnificent Coal seams of Springhill and the Londonderry Iron ores at the Acadia

Charcoal Iron Works. The discoveries which have been made during the past two years with regard to the distribution of the Iron ores in the Cobequid range of mountains, invest these extensive mineral deposits with unlooked for importance.

Nova Scotia is the only Province in the Dominion where Iron and Coal are in comparatively close proximity, or in other words, where the conditions necessary for the manufacture of cheap and good Iron prevail. The development of the Cumberland Coal mines will be greatly stimulated by the simultaneous development of the Iron deposits of the Cobequids, and a new industry may now rapidly spring into existence in Nova Scotia which will greatly enhance its prosperity.

I have endeavored to reproduce in this report reliable information on the Iron ores of the Cobequids, and their commercial relation to the Cumberland Coal, under the conviction that the time is not far distant when Nova Scotia will be able to supply the Dominion, not only with abundance of cheap and good Coal, but also with cheap and good Iron.

I have the honor to be,

Your obedient servant,

HENRY YOULE HIND.

Windsor, December 23rd, 1872.

I.—GENERAL RESULTS OF THE TOPOGRAPHICAL SURVEY.

Some of the differences between the results of the present survey and the Departmental map, are given further on, but the following may be here mentioned as illustrating the necessity of an accurate delineation of the ground over which licenses to search or work are granted by the Department.

A License to search was applied for on Oct. 10th, 1871, and described in the following terms:—"Beginning on the west bank of the Hebert River forty chains below the point at which the northern boundary of area No 61, West Brook crosses, thence," &c., &c.

According to Professor Oram's survey, the northern boundary of area No. 61 does *not* cross the Hebert River, although it is so represented on the Departmental map. Numerous other Licenses to search have been taken out, the descriptions of which have been based upon the supposed position of area No. 61. All of these are consequently affected by the topographical error. The mean distance of the River Hebert west of the Macan, is at least one mile greater by the present survey than represented on the Departmental map, and the area of land at the disposal of the Department is in reality considerably greater in this part of the Coal field than appears on the map.

On the other hand, the distance between the Scotia Lease and the Macan Bridge at Athol is less than represented on the Departmental map. As a consequence of this error, the License to work taken out by the Mineral Exploration and Mining Company, No. 68, instead of being one square mile, is reduced to about half a mile. Minor discrepancies will appear when the boundaries of the Leases, Licenses to Work, and Licenses to Search are laid down according to the descriptions filed in the Mines Department.

The following list shows the leading differences between the results obtained by the present survey and the plan in the Mines Department. These, it will be readily acknowledged, are quite sufficient to warrant the execution of the work at the present time, and will afford an opportunity of remedying the discrepancies, before the granting of Licenses to Work, or Leases, in certain parts of the Coal field gives a real or supposed value to particular areas.

The result in general terms may be thus expressed: Proceeding from north to south, say from the Scotia Company's property to the Upper Macan River, there is less land than is represented on the Departmental map; whereas, proceeding from east to west, say from the General Mining Association's tract to the Joggins wharf, there is considerably more land than is represented on the Departmental map. On the whole, there is a considerable area of land which may be located, especially between the Hebert and Macan Rivers, the Departmental map showing less than the surface of thecountry presents.

The position of the seams of Coal, now for the first time correctly laid down, exhibits a remarkable parallelism, and a belt or zone of Coal crops, not exceeding 44 chains, or little more than half a mile in breadth, as far as known, extends for a distance of seventeen miles on the north side of the Basin, or from the Joggins to Styles' seam.

Table Shewing some of the differences between the Departmental Map and the Present Survey.

		Distance in Chains.
No. 1.	*Present Survey*—East to West. From the south-east corner of the General Mining Association's area at Springhill to the wharf at Joggins Mines, on Chignecto Channel, Bay of Fundy..	1525
	Departmental Map.......................... Difference 58 chains. Or 58 chains *longer* by the present survey.	1467
No. 2.	*Present Survey*—North to South. From the south west corner of the New York and Acadia Lease (now the Scotia) to the centre of the bridge over the Macan at Southampton................	718
	Departmental Map.......................... Difference 30 chains or 30 chains *shorter* by the present survey.	748
No. 3.	*Present Survey.* From the centre of the bridge over the Macan at Southampton, to the Hog's Back on the River Hebert on a course north seventy degrees west................	412
	Departmental Map........ .... Difference 127 chains or 127 chains longer by the present survey.	285
No. 4.	*Present Survey.* From the north east corner of the General Mining Association's area to the centre of the bridge over the Macan at Southampton....................	777

		Distance in Chains.
	Departmental Map........................	795
	Difference 18 chains or 18 chains less by the present survey.	
No. 5.	*Present Survey.*	
	From the bridge over the Forks River at Athol to Junction of Roads on west side of Hebert River, near the mouth of Mi l Creek.......	650
	Departmental Map........................	570
	Difference 80 chains or 80 chains longer by the present survey.	
No. 6.	*Present Survey.*	
	Centre of bridge on the Lower Macan, near the south west corner of the New York and Acadia (now Scotia) Co.'s Lease to the centre of the bridge across the Hebert River near the Victoria Mine..	480
	Departmental Map.........................	480
	Difference 0.	
No. 7.	*Present Survey.*	
	From the centre of the Lower Hebert River Bridge to the centre of the Upper Macan River Bridge at Southampton...	724
	Departmental Map........................	710
	Difference 14 chains or 14 greater by the present survey.	

II.—THE NORTH SIDE OF THE COAL BASIN.

The north side of the Cumberland Coal Basin is now tolerably well determined as far as Styles' pit, about seventeen miles from the Joggins' loading wharf.

The course of the seams opened by different companies indicates considerable uniformity in the rim of the productive measures. If a line be drawn from the Joggins slope to Styles' pit, the greatest distance any one of the shafts sunk by the different companies from this line does not much exceed half a mile (44 chains.)

The following table shows this relation. It is, however, to be observed that the occurrence of "steps" produced by faults are numerous, and some of these are mentioned in the excellent work of the former Inspector of Mines, Mr. John Rutherford, M. E., on "*The Coal Fields of Nova Scotia.*"

Table of the courses, dips, distances apart, and distances from a datum line of the known seams on the north side of the Cumberland Coal Field.

Name of Seams.	Course.	Dip.	Distance of shafts apart.	Distance fm. datum line in chains.
Joggins.......	S. 64° E.	19 S.	0	0
Victoria......	S. 80° E.	17 S.	220 chains.	44 South.
Lawrence......	S. 81° E.	22 S.	104 "	40 "
Macan........	E. and W.	35 S.	322 "	8 "
			(West Shaft.	
Scotia........	S. 84 E.	38 to 40 S.	376	40 North.
Chignecto......	S. 74 E.	42	22	—
St. George....	S. 60 E.	45	85	12 North.
Blight........	S. 74 to 80 E.	—	—	—
Styles........	N. 80 E.	45	350	0

The datum line is supposed to be drawn through the Joggins' Slope and the Style's Pit on a course south eighty degrees east.

Distance in an air line between the Joggins' Slope and the Styles' Pit, 1364 chains or 17 miles and 4 chains.

THE JOGGINS SEAMS.

The general course of the Main or King's Seam is south seventy-four degrees east, with a southerly dip of 19 degrees.

In 1866 the seams had the following face*:

KING'S SEAM.

	Ft.	In.
Coal	0	6
Do. with partings	0	7
Coal	2	1
Fire Clay	1	6
Coal	1	6
Total	6	2

HARD SCRABBLE SEAM.

	Ft.	In
Coal	1	3½
Do. Coarse	0	4½
Coal	1	1½
Fire Clay	0	3½
Coal	0	3
Total	3	4

NEW MINE SEAM.

Coal..........................4 feet, 8 inches.

In 1872 the worked portion of the main seam was stated to consist of—

Coal	3 feet	
Fire Clay	1 "	10 inches
Coal, good	1 "	10
Total Coal	4 "	10

This appears to show a considerable improvement in the seam.

*Report of the Inspector of Mines,

VICTORIA SEAMS.

Course of Seams—

Angle of dip 17 degrees southerly.
Depth of shaft 135 feet.

	Foot	inches.
No. 1.—Upper Seam........................	1	10

Depth from surface 66 feet.

	Feet	inches.
No. 2.—Middle Seam........................	2	0

Depth from surface 82 feet.

	Feet	inches.
No. 3.—Lower Seam.		
Coal..	0	6
Fire Clay..................................	1	4
Coal..	1	2
Fire Clay..................................	0	9¾
Coal..	1	4
Total	5	1¾

Depth from surface 135 feet.

THE LAWRENCE SEAM.

Course of Seams S. 81 E.

Angle of Dip 22 degrees southerly.
No. 1.—Thickness.....................2 feet 6 inches.
No. 2.—Thickness.....................2 feet 6 inches.
Distance apart, 20 feet of strata.

THE MACAN SEAMS.

Course of Seams, East and West.

Angle of Dip 35 degrees southerly.
No. 1.—West face.

Coarse Stony Coal..............	8 inches.
Good Coal.........................	1 foot 8 "
Total.........................	2 feet 4 inches.

East face 1000 feet to the eastward.

Coarse Stony Coal	0 feet 8 inches.
Fire Clay	0 " 1 "
Good Coal	1 " 7½ "
Total	2 " 4½ "

No. 2.—Coal .... 1 foot 8 inches.

No. 3.—The "Big Bed."

Coal	0 feet 2 inches,
Shale	0 " 4 "
Coal	0 " 10 "
Shale	1 " 6 "
Coal	1 " 2 "
Total	4 " 0 "

No. 2 is 100 feet in thickness of strata below No. 1, and No. 3 is 300 feet below No. 2.

SCOTIA'S SEAMS (formerly New York and Acadia).

Course of Seams, south 84 degrees east.

Dip south, from 38 to 40 degrees.

The Scotia, Chignecto, and St. George Companies work the same seam, but there is considerable difference in the composition of the seam at different points.

On the Scotia and Chignecto properties there are three Seams, as follows:

No. 1, the lowest.
No. 2, 12 feet above No. 1.
No. 3, 5 feet above No. 2.

On the Chignecto property No. 3 is separated from No. 2 by 15 inches of strata; and at the St. George shaft No. 3 and No. 2 come together. Here in fact the three seams form but one seam with partings.

No. 1.—Coal with partings of clay	2 feet 10 inches.
Coal	2 " 2 "

No. 2.—Impure Coal	1 foot	3 inches.	
Coal	0 "	11	
Hard Band	0 "	4½	"
Coal	1 "	5	"
Slaty Band	0 "	1½	"
Coal	0 "	11	"
Total	5 "	0	"

CHIGNECTO SEAMS.

750 feet east of Shaft.

	Ft.	In.
Coal (coarse)	2	6
Shale	0	10
Coal	3	6
Shale	1	3
Coal	5	0
Total	13	1

CHIGNECTO (SAME SEAM.)

	Ft.	In.
Coal (coarse)	2	2
Shale	0	6
Coal	2	1
Slaty Band	0	1½
Coal	1	5½
Do. coarse	0	4
Shale	1	3
Coal	1	2
Slaty Band	0	2
Coal	3	6
Total	12	9

This Seam on Pugsley's Brook, east of the Chignecto property, has the following section according to Mr. Patrick;

	Ft.	In.
Coal	1	4
Slate	0	½

	Ft.	In.
Coal	0	5
Slate	0	1
Coal	0	2
Slate	0	1
Coal	2	3
Slate	0	2
Coal	0	5
Slate, thin parting.		
Coal	1	0
Slate, thin parting.		
Coal	0	10
Slate	0	1
Coal	0	8
Slate	0	4½
Coal	0	6
Slate	1	2
Coal	0	6
Slate	0	2
Coal	1	2
Slate	0	2
Coal	0	7
Slate	0	2
Coal	3	0
Slate	2	11
Coal	1	4
Total thickness	20	4
Total Coal	14	4
Slate	6	0

ST. GEORGE SEAM.

This seam is the same as at the Chignecto Mine, but its composition is different (1.)

	Ft.	In.
Coal, with partings	3	6
Fire Clay	2	0
Coal	0	3
Shale	0	1½

(1) Inspector's Report for 1866.

Coal	1	3
Shale	0	2
Coal	1	9
Fire Clay	1	10
Coal	0	11
Total	11	9½

THE SAME SFAM (1).

	Ft.	In.
Coal	3	6
Shale	2	0
Coal	3	10
Shale	1	10
Coal	0	11
Total Feet	12	1

STYLES' SEAM.

Course of Seam........................N. 80 E.
Angle of Dip............................45.
Thickness of Seam....................7 feet 8 inches.

With a band of carbonaceous shale in the middle 6 inches thick. (2)

These with the "Blight Seams," lying between the St. George Colliery and the Styles' Seams, comprehend all the known workable seams on the north side of the Basin.

(1) The Coal Fields of Nova Scotia. By John Rutherford, M. E., 1872.

(2) The Coal Fields of Nova Scotia. Rutherford.

III.—THE BLACK RIVER SEAMS.

The south branch of Black River is crossed by the Intercolonial Railroad, about six miles south-east of Styles' seam. A quarter of a mile up the stream, and south of the culvert, the following seams have been exposed on the banks of the stream, beginning at the lowest.

	Ft.	In.
No. 1.—Black Shale and Coal	1	0
No. 2.—Blue Black Shale with three inches of Coal	3	0
No. 3.—Black Shale with ten inches of Coal	2	0
No. 4.—Two inches Coal, twelve inches Shale, fifteen inches Coal—total	2	5
No. 5.—Coal	1	6
No. 6.—Coal	0	3
No. 7.—Coal	2	6
No. 8.—Shale and Coal	1	0
No. 9.—One foot Coaly Shale	1	0

These seams occur in a horizontal distance of 950 feet, and are inclined to the north at a mean angle of 36 degrees.

From the structure of the rocks on the line of the Intercolonial it is very probable that these seams represent the south side of the basin, and that continuity may eventually be established between the group represented by the Styles' Seam and those on Black River.

IV.—THE SPRING HILL SEAMS.

The Director of the Geological Survey of the Dominion states in the Report of Progress for 1870–71, as follows respecting these important seams:

"The evidence, so far as it goes, appears to show that in a distance of about eight hundred yards horizontal measurement across the strike of the measures, there are eight seams of workable thickness, as under, in ascending order:

		Ft.	In.
No.	1	13	6
"	2	6	0
"	3	2	4
"	4	12	3
"	5	2	6
"	6......A crop—thickness uncertain.		
"	7—shaly Coal	4	0
"	8	2	0
	Total	42	7

"The average dip is supposed to be about thirty degrees, which would give a vertical thickness of measures from the 13′ 6″ seam to the 2′ seam of about 1200 feet."

The course of this important group of seams is (commencing about the middle of the General Mining Association's area, and close to the south-eastern line), north fifty degrees east for about one mile; thence north ten degrees east for seven-eighths of a mile; thence north forty degrees west for about three-eighths of a mile, beyond which point explorations do not appear to have been carried.

There is a disturbance near the church at Springhill, and the seams on the south-west side of the Road tend more to the south in the westerly prolongation of the crop, supposing that the seams here observed are continuations of the group just enumerated. The structure of the rocks would indicate, in the absence of faults, that the crop of these seams sweeps round to the head waters of the Macan, and then turning sharp round, pursues a course down the valley of the Macan River towards Southampton.

In 1869, the late Mr. Edward Hartley, F. G. S., of the Canadian Geological Survey, presented a brief report to Sir W. E. Logan, on the Springhill Coal of the Main Seam, including also some remarks on this portion of the Cumberland Basin. All information of a reliable character on the peculiarities of the Springhill Main Seam is important, hence it will be advisable to re-produce Mr. Hartley's report without abbreviation:—

EXAMINATION OF MAIN SEAM COAL. *

"The samples of coal examined were taken from the Main seam of the Spring Hill coal-field, and were obtained at the Black Mine. The sample box contained about sixty pounds of coal (round and slack.

"An examination of the external character of this coal shows it to be a bituminous coal of a moderately compact texture, and not inclined to fall to pieces, or *slack*. Its color is a bright brownish black, brilliant, except on the faces of the *partings*, which show a few patches of mineral charcoal. But a small proportion of the sample shows a shaly lamination, or tendency to break with the planes of deposition. It has a tendency rather to break with the cleat and cleavage-planes which are inclined to the deposition-planes at angles varying from 65° to 75°, and occasionally 80°, giving irregular surfaces, known technically as *crystalline* faces.

Four samples were taken for analysis:—I and II were two averages of the whole box:—III was a picked sample of the best (most compact) coal, and IV was a specimen of the coal showing a shaly texture. The results of proximate analysis in the laboratory were as follows;—

	Hartley.			
	I.	II.	III.	IV.
Hygroscopic moisture.........	1.21	.98	.58	1.28
Volatile combustible matter..	33.08	35.52	33.27	35.66
Fixed carbon.....................	61.49	59.23	63.85	58.53
Ash (perfectly white).........	4.22	4.08	2.30	4.53
	100.00	100.00	100.00	100.00
Coke.............................	65.71	63.50	66.15	63.06

"Sample I was carbonized by a slow and careful application of heat; but in treating II the heat was suddenly applied, and the carbonization effected as rapidly as possible. Analysis I thus shows the smallest amount of volatile matter obtainable from the coal, and

* Notes on Coal from Spring Hill Coal Field, County Cumberland. Nova Scotia, by Edwd. Hartley, F. G. S.

II the largest. Determinations were made of the sulphur in sample I, with the following results ;—

	Per cent.
Total amount of sulphur in coal	0.225
Amount of sulphur in ash (as gypsum)	0.108
" " as iron pyrites, by difference	0.117

"The analyses show this coal to belong to the class known as highly bituminous, or *fat* caking coals, in character very similar to those of the North of England, known as North Country, or Newcastle-Hartley coal.

"The high rate of volatile to fixed combustible matter should render this coal, in common with the Newcastle coals, which it resembles, an admirable gas-coal, while in the amount of sulphur it falls much below the average of Newcastle coals (which contain about nine-tenths of one per cent, as determined by the Admiralty steam coal trials) ; therefore the gas obtained from it should be very easily purified.

"The coke of this coal appears in every way well adapted for iron smelting, as it is firm, and rather compact, and in content of ash and sulphur will compare most favorably with that from any coal from the Provinces. This coke is much more easily formed, and of a better quality than from the greater number of Provincial coals. As the amount of ash is a most important point in iron-smelting, it may be well to give the following data concerning the ash content of other coals for comparison. They are taken from Professor W. R. Johnson's Coal Trade of British America (page 126), in his comparison of the Reports of the British American Commissions, on coal trials :—

		Per cent.
Average of ash in 39 British coals	laboratory analysis	5.76
" " 35 American coals	" "	7.76

"Showing in favor of average Spring Hill coal as compared with British coals, a balance of 1.61 per cent. and of 3.61 per cent., as compared with American in ash-content. For comparison with coals of the other districts of Nova Scotia, it may be stated that Pictou coals average from 7 to 9 per cent. of ash ; Sydney (so far as published analyses show), from 5 to 7 per cent., and Cumberland (Joggins) coal from 5 to 6 per cent.

"With regard to the use of this coal as a steam-producer, I would refer the reader to the article "Remarks on the trials of steam-coals," in my recent report on the Coals and Iron ores of Pictou

County. (See Report, page 426 et seq) in which it is shown that coals of this class are now burnt with an evaporative power equal to that of the Welsh semi-anthracites, or free-burning steam coals. The remarks there made, calling attention to the importance of these trials to the Pictou coal trade, apply with greater force to the coal under consideration than to Pictou coals, on account of the nearer approach in character of the Spring Hill coal to those of Newcastle. At the date of my original Report on the Spring Hill Main-seam coal, I was not possessed of any result of ultimate analysis, but attention was then called to the resemblance of the coals in proximate constituents, and the following analysis given: A—is an analyses of Hartley coal from Newcastle-on-Tyne. B—an average of a number of analyses of Newcastle coals (both A and B from the appendix to Richardson's, Knapp's Technology); and C—an average of analysis I and II of this paper; being of the Black Mine samples.

	A	B	C
Volatile matter, water included	35.50	37.60	35.39
Fixed Carbon	60.50	57.00	60.46
Ash	4.00	5.40	4.15
	100,00	100.00	100.00

"Since the circulation (in manuscript) of the original Report, I have received an ultimate analysis of this coal, by Dr. John Percy, F. R. S., of the Royal School of Mines. This analysis was made by Dr. Percy, some years since, for parties interested in the Spring Hill coal-field, the specimen analysed being a sample from the outcrop of which the following proximate analysis is given:

	PERCY.
Coke	64.94
Volatile matter	31.08
Water	3.98
	100.00

"The small amount of volatile matter, and the large amount of water present in this small sample, would lead me to believe that its quality was not equal to that of the coal examined by me.

"The following table gives Dr. Percy's analysis, and also analyses of the Newcastle coals used in the late British experiments on North Country coals, as noticed in the Report on Pictou coals, already referred to, the analyses of Newcastle coals being on the authority of the Reports of the British Commissioners in the Admiralty steam-coal trials. In these analyses no account of the moisture in the coals appears, and it is to be presumed that the samples of coal analysed were either dried before being treated, or that the amount of moisture was exceedingly small. Therefore I have added a re-calculation of Dr. Percy's anylyses, based on the supposition that the sample of the Spring Hill coal was dried, (or disregarding water.) Analysis 7, of the following table is by Dr. Percy, of the coal from Spring Hill, including water, and 8 is the calculation from this analysis of the ultimate constituents of the dry coal.

Name of Coals.	Carbon.	Hydrogen.	Oxygen and Nitrogen.	Sulphur.	Ash.	Coke.
Newcastle Coals.						
1. West Hartley Main..........	81 85	5 29	9 22	1 13	2 51	59 20
2. Hastings Hartley............	82 24	5 42	8 05	1 35	2 94	....
3. Davison's West Hartley....	83 26	5 31	4 22	1 38	5 84	59 49
4. Original Hartley	81 18	5 56	8 75	1 44	3 07	58 22
5. Cowpen and Sydney's Hartley........................	82 20	5 10	9 65	0 71	2 33	58 59
6. Derwentwater Hartley......	78 01	4 74	12 15	1 37	3 73	54 83
Spring Hill Coal.						
7. Main Coal, (outcrop) including 3.98 p.c. of water..	75 51	5 00	9 37	1 09	5 05	64 94
8. Main Coal (dry)	78 51	5 19	9 66	1 12	5 20	....

V.—THE IRON ORES OF THE COBEQUIDS IN RELATION TO THE CUMBERLAND COAL.

Mr. Hartley calls attention to the importance of the Spring Hill Seams in their relation to the Iron Ores of the Cobequid range of Mountains:

"About thirty miles to the south of Spring Hill, the Intercolonial railway will pass through the property of the Acadian Iron Company, about two and one-half miles from the Acadian Iron Mines at Londonderry, thus connecting this important district with the coal-field. The Acadian Mines are so well known, from many published reports and descriptions, that it seems unnecessary to give any description of them here, and in this connection it will suffice to say that the supply of iron ore of remarkably good quality thus brought in connection with a coal well adapted for smelting and puddling, seems from all descriptions, to be practically almost inexhaustible. The main vein (on the authority of Messrs. Woodhouse and Jeffcock, Mining Engineers, of London,) has been traced for a distance of twelve miles from east to west, and it is stated that did the trade admit, numerous workings might be located thereon. The ore at the Acadian Ironworks is at present smelted with charcoal, the iron produced being of the best quality, taking a rank in the English market second only to the better brands of Swedish charcoal iron."

The high price of charcoal involves a costly and excellent quality of iron, but of comparatively limited production. The connection now established between the Londonderry Iron works and the Spring Hill Coal seams, will permit of the manufacture of a much cheaper iron, and in far greater quantities than hitherto possible.

The recent discoveries at the Acadia works of the true character of the limonite or brown vein ore with which this furnace is supplied, renders the supposition advanced by Mr. Hartley more than probable, that the ores are almost practically inexhaustible over a considerable area, longitudinally, of the Cobequids. A brief description of these ores may not be out of place, as they will doubtless exercise great influence upon the demand for the Coal of the Spring Hill seams:

At and near the juncture of the Carboniferous rock and older Metamorphic strata, on the south side of the Cobequid range of mountains, a great fracture or rather a series of fractures appear to have occurred, which are the seat of the veins holding the ore. These fractures have been traced for a distance exceeding thirty miles, and they vary in breadth from thirty to one hundred and fifty feet. The vein stone chiefly consists of the mineral ankerite, a mixture of the carbonate of iron, lime and magnesia. The ankerite contains from 16 to 25 per cent. of carbonate of iron. It is used in the smelting furnace as a flux.

The ore itself occurs chiefly in the form of brown hematite or limonite, in the botryoidal, stalactitic and compact forms. It is from this ore that the furnace is in the main supplied.

Red hematite is also of no uncommon occurrence, and is used to mix with the brown ore in certain proportions. Specular ore is found in small masses and scales; it is used for fetling in the puddling furnace.

It was formerly supposed that the brown ore was most abundant near the surface, but recent discoveries have established the fact that this ore may exist at any accessible depth in the great fractures on the Cobequid range.

At one locality about two miles from the furnace, at the Acadia Charcoal Iron Works, adit levels have been driven on the course of the vein (east and west nearly), which, in a vertical depth of about 350 feet, expose upwards of twenty thousand tons of ore, with an increase of thickness of the deposit as the depth becomes greater. The thickness of the veins of ore is here at some points over twenty feet. Masses of the country rock or "horses" are numerous in the vein stone and occasionally in the brown ore. Sometimes the mass of veinstones assumes the form of a breccia whose angular particles are cemented by the mineral ankerite. In the brown ore veins "horses" are not uncommon, and the whole mass of the vein is so honeycombed and vesicular; that surface water rapidly penetrates from the highest to the lowest adit level in a vertical attitude of 350 feet.

About half a mile north of the great vein is another vein, but little is known of its capabilities, the stores of ore in sight being sufficient for several years' consumption.

Throughout the extent of the property, a distance of thirteen miles, the brown ore has been traced at the surface, and in many places it has been quarried, but systematic mining has only been commenced on the western section.

The vein, as proved two miles to the west of the works, appears to establish the important fact that this extraordinary distribution of iron ore is not generally confined to the surface in a wedge-shaped form as formerly supposed but extends downwards to great depths, being in fact a true fissure vein or series of fissure veins of vast extent and depth.

The average cost of mining the ore, exclusive of "dead work," &c., is one dollar or 4s. stg. per ton, delivered at the mouth of the level. The ore has to be carted to the furnace, a distance of two miles from one point and three miles from another, at a cost of 60c. or 2s. 6d. and 84c, or 3s. 6d. stg. per ton respectively, in the absence, to the present time, of rail or tramways. The total cost of the ore at the furnace, with the addition of the "dead work," &c., is about two dollars and fifty cents, or 10s, 6d. a ton.

The ankerite or flux is found in abundance close to the furnace, and when limestone is required it is brought a distance of three miles from beds which appear to be nearly parallel to the course of the veins, or about due East and West magnetic, the variation being 21 degrees West.

The mean elevation of the country where the ore is obtained is 680 feet above the sea level, and the mountain range is intersected by profound narrow valleys or gorges at right angles to the course of the vein, and cutting it to the depth of from 300 to 380 feet, so that every facility is afforded for driving levels on the vein at different depths, and mining any quantity of ore that may be desired. Arleady a level has been driven to the vein at a depth of 350 feet from the surface, and a breadth of ore of the highest class has been intersected, averaging from nine to twenty-three feet.

The Spring Hill coal, from the fine 11-foot opened by the Spring Hill Company, which has been shown by experiments and analysis to be of the best quality, can be laid down at the works on completion of the short branch line to the Intercolonial, now in course of construction, at a cost of £2.16 or 9s. stg. a ton. The requirements of the Iron Works will reach 40,000 tons of coal per annum, on completion of the second-blast furnace; and their influence will necessarily be immediately felt, to the advantage of the coal proprietors.

There are several other localities in the Cobequid range where Iron ores have been found to exist considerably nearer to the Spring Hill seams than the Acadian works, and their junction with the Coal of Cumberland by short mineral lines of railroad is merely a question of time. The future importance of the Iron and Coal industry of Nova Scotia in various parts of the Province is already foreshadowed by the new commercial relations which have dawned upon the Acadian mines of Londonderry.

VI.—DR. DAWSON'S DESCRIPTION OF THE COBEQUID ORES.

A very comprehensive description was given by Dr. Dawson in 1849 of this great mineral deposit, and is reproduced in the second edition of his Acadian Geology. As this beautiful work is not likely to be very generally distributed, although it ought to be in the hands of all who are interested in the mineral wealth of Nova Scotia, it is desirable to reproduce here the exhaustive description of the great Acadian vein, with the additional information afforded by experience, that the brown ore, as stated above, has been found at a depth of 350 feet from the surface, averaging from the surface to the lowest level from nine to twenty-three feet of ore.

"I shall begin by describing the vein as it occurs on the west branch of the Great Village river, at the site chosen by C. D. Archibald, Esq., for the furnace and buildings of the "Acadia Mine," and as seen in 1849. In the western bank of this stream, and at the junction of the carboniferous and metamorphic series, a thick series of grey and brown sandstones and shales of the former system, dipping to the south at angles of 65° and 70°, meet black and olive slates, having a nearly vertical position, and with a strike N. 55° E. The dip of these slates, where apparent, is to the southward, and the strike of the slaty cleavage and of the bedding appears to coincide. Near the falls of the river, a short distance northward of the junction just noticed, the slates give place to grey quartzite, which, with some beds of olive slate, occupies the river section to, and for some distance beyond, the iron vein.

The vein is well seen in the bed of the stream, and also in excavations in the western bank, which rises abruptly to the height of 327 feet above the river bed. In the bottom of the stream it presents the appearance of a complicated network of fissures, penetrating the quartzite and slate, and filled with a crystalline compound of the carbonates of lime, iron, and magnesia, which, from its composition and external characters, I refer to the species ankerite. With this mineral there is a smaller quantity of red-ochrey iron ore, and of micaceous specular iron ore.

In ascending the western bank of the stream, the vein appears to increase in width and in the quantity of the ores of iron. In one place, where a trench was cut across it, its breadth was 120 feet. Though its walls are very irregular, it has a distinct underlie to the south, apparently coinciding with the dip of the containing rocks. As might have been anticipated from its appearance in the river bed, it presents the aspect of a wide and very irregular vein, including large angular fragments of quartzite, and of an olivaceous slate with glistening surfaces. These fragments are especially large and abundant in the central part of the vein, where they form a large irregular and interrupted rocky partition.

That the reader may be enabled to understand the description of this singular deposit, I give the composition of the various substances contained in it, as ascertained by my own analysis and examinations.

1. *Specular Iron Ore*, or nearly pure peroxide of iron, in black crystalline scales and masses.

2. *Magnetic Iron Ore*, a compound of the peroxide and protoxide of iron. This and the first mentioned ore, as they occur intermixed in this vein, are capable of affording from 60 to 70 per cent. of pure Iron. Both of these ores have been introduced into the vein by igneous fusion or sublimation.

3. *Ochrey Red Iron Ore.* This is the most abundant ore in the vein, and is of great value on account of its richness and fusibility. It is also the material of which the mineral paint produced by this region is manufactured. It varies somewhat in quality, but the purest specimens are peroxide of iron, with scarcely any foreign matter.

4. *Ankerite*, or carbonate of iron, lime and magnesia. This is the most abundant material in the vein, and is usually of a grayish-white color, though sometimes tinged red by the peroxide of iron. A specimen of the reddish variety, containing small scattered crystals of specular iron, gave on analysis—

Peroxide of Iron	33.0
Carbonate of Lime	46.0
Carbonate of Iron	19.5
Carbonate of Magnesia	0.8
Silicious Sand	0.4
	99.7

The white variety consists of—

Carbonate of Lime.........,........	45.0
Carbonate of Iron..........,......	23.2
Carbonate of Magnesia..............	22,0
Silicious Sand....................	0.5
	99.7

With this mineral is found a variety of spathose Iron, or sparry carbonate of Iron, containing about 20 per cent. of carbonate of magnesia. It is of a light yellow color, and runs in little veins through the ankerite. I have no doubt that all these substances have been molten by heat, and injected from beneath into the irregular fissures in which they are now found. The ochrey red ore, previously mentionedd, appears to be the result of the subsequent action of heat on the spathose Iron. The ankerite and spathose Iron may become valuable for mixing with the other ores, affording lime for a flux and much Iron.

5. *Yellow Ochery Iron Ore.* This is found in great quantity on the surface of the vein, and has resulted from the rusting of the ankerite, which soon becomes covered with a yellow rusty coat when exposed. The yellow ochre is a peroxide of iron combined with water, and when calcined it affords a good red pigment. On analysis it gave—

Peroxide of Iron................	74,52
Alumina "	4.48
Carbonate of Lime and Magnesia..	0.40
Silica and Silicates " ..	6.20
Water, mostly combined........	14.40
	100.00

6. *Brown Hematite* occurs in large balls along the out-crop of the vein. It has been produced by the solvent action of acid water on the carbonate of iron, and the subsequent precipitation of iron from these solutions. It is a valuable ore, but is probably most abundant near the surface of the vein.

7. *Sulphate of Barytes* occurs in small crystals lining fissures, and in compact veins in the ankerite. Though quite insoluble, this substance can be decomposed by heated solutions of alkaline carbonates; and when these are cooled it is reformed and deposited.* It hasprobably been introduced in this way into this vein.

* Bischoff quoted by De la Becbe. Geo Obs. p. 669.

I shall endeavor in the following remarks to state the manner in which these minerals occur in the complicated mixture which fills this vein, and their probable origin. Let the reader then imagine that he is standing on the side of the deep ravine of the Great Village River, looking into a rocky excavation in which the minerals above mentioned appear to be mixed together in the most inextricable confusion, in great irregular cracks of the slaty rocks, and he will be able perhaps to wade through the following description.

The ankerite should evidently be considered the vein-stone, as it surrounds and includes all the other contents of the vein, and greatly exceeds them in quantity. Where not exposed, it is white and coarsely crystalline. On exposure, it becomes yellowish; and near the surface, as well as on the sides of the fissures, it is decomposed, leaving a residue of yellow ochery hydrous peroxide of iron. In some parts of the vein, the ankerite is intimately mixed with crystals and veinlets of yellowish spathose iron. The red ochery iron ore occurs in minor veins and irregular masses dispersed in the ankerite. Some of these veins are two yards in thickness; and the shapeless masses are often of much larger dimensions. Specular iron ore also occurs in small irregular veins, and in disseminated crystals and nests. At one part of the bank there appears to be a considerable mass of magnetic iron ore, mixed with specular ore; this mass was not, however, uncovered till after I had left the ground.

The whole aspect of the vein, as it appears in the excavations in the river bank, is extremely irregular and complicated. This arises not only from the broken character of the walls, the included rocky fragments, and the confused intermixture of the materials of the vein; but also from the occurrence of numerous transverse fissures, which appear to have slightly shifted the vein, and whose surfaces usually display the appearance named "slickenside," and are often coated with comminuted slate or iron ore. In some places these are so numerous as to give an appearance of transverse stratification. One of them was observed to be filled with flesh-colored sulphate of barytes, forming a little subordinate vein about an inch in thickness.

The general course of the vein, deduced from observations made by Mr. Hayes and myself at the Acadia Mine and further to the eastward, is S. 98° W. magnetic, the variation being 21° west. At the Acadia Mines this course deviates about 33° from that of the containing rocks. In other localities, however, the deviation is much smaller; and in general there is an approach to parallelism between the course of the vein and that of the rock formation of the hills, as well as that of the junction of the carboniferous and metamorphic systems. The vein, for a space of seven miles along the hills is always found at distances of from 300 yards to one-third of a mile northward of the last carboniferous beds, and always in the same band of slate and quartzite.

Westward of the Acadia Mine the course of the vein over the high ground is marked by the color of the soil, as far as Cook's Brook, about a mile distant. The outcrop of the ore was not exposed in this brook, but large fragments of specular ore have been found in its bed, and a shaft, sunk on the course of the vein, has penetrated more than forty feet through yellow ochre containing a few rounded masses and irregular layers of ankerite. At this point the decomposition of the ankerite and spathic iron has extended to a much greater depth than usual, and is so perfect that a specimen of the yellow ochre was found to contain only .4 per cent. of the carbonates of lime and magnesia; the remainder being hydrous peroxide of iron, alumina, and silicious matter.

Still further west, in Martin Brook, I observed indications of the continuation of the vein. Beyond this place I have not traced it; but I have received specimens of specular iron ore and ankerite from the continuation of the same metamorphic district, as far west as the Five Islands, twenty miles distant from Acadia Mine,

On the east side of the west branch of the Great Village River, the ground does not rise so rapidly as on the western bank, and the vein is not so well exposed. On this side, however, a small quantity of copper pyrites has been found in or near the vein, but it does not seem to be of any importance. Indications of the vein can be seen on the surface as far as the east branch of the river. In the east branch, red and grey conglomerates, dipping to the south, and forming the base of the carboniferous system, are seen to rest unconformably on olive, black and brown slates, whose strike is S. 75° W. The continuation of the iron vein was not observed in the bed of this stream.

Further eastward, on the high ground between the Great Village and Folly Rivers, indications of the ores of iron have been observed; especially near the latter river, where in two places small excavations have exposed specular and red ores, and where numerous fragments of brown hematite are found scattered on the surface.

The ravine of Folly River affords a good natural section of the quartzite and slate of the hills, as well as of the carboniferous beds of the lower ground. This section, as far as the base of the hills, is described in chapter XV. The lowest carboniferous bed is a thick, coarse, grey and brownish conglomerate, dipping S. 20° W. It rests uncomformably on a bed of slate, very similar to that seen in a like position at the Great Village River, and which differs considerably in appearance from most of the slates of these hills. The strike of the slate is S. 70° W.; and that of the bedding and slaty structure appear to correspond. In a layer of graywacke included in this slate, I observed small and well-rounded pebbles of light-colored quartz. This slate is succeeded by thick beds of gray quartzite and hard olivaceous slates. These occupy the river section for about 700 yards, or as far as the "Falls," where the river is thrown over a ridge of quartzite fifty-five feet in height; a small rill pouring in on the eastern side from a much greater elevation. Between the conglomerate and the waterfall the quartzite contains a few narrow strings of ankerite, and at the fall there is a group of reticulating veins, some of them six inches in thickness. They contain a little iron pyrites. These are the only indications of the iron vein observed in this section; and as the group of beds in which it should occur is well exposed, it is probable that it is represented here only by these small veinlets distributed over a great breadth of rock. Above the fall the quartzite and slate continue to alternate for a considerable distance, the dip being generally to the southward, in one place at as low an angle as 55°. About a quarter of a mile above the fall they are traversed by a dyke or mass of fine grained hornblendic igneous rock.

On the elevated ground east of Folly River the vein is again largely developed, and two excavations exposed a part of its thickness on the property of the Londonderry Mining Company. The excavations nearest to the river showed a thickness of 190 feet of rock on the south side of the vein. This consists of gray quartzite, olive slate, and about three feet of black slate. These beds are traversed by a few small strings of ankerite, which increase in dimensions on approaching the broken and irregular wall of the vein. About seventeen feet of the south side of the vein consist principally of ankerite. Adjoining this on the north is red iron ore, with nests of specular ore, veins and blocks of ankerite decomposed in part to yellow ochre, and fragments of rock. Ten feet in thickness of this red ore were seen without exposing the north wall of the vein.

On the surface in this vicinity are large fragments of brown hematite, which mark the course of the vein. In the eastern excavation, this mineral was seen in places near the surface, and occupying fissures in a fragment of quartzite. In this second excavation the red ore was more largely mixed with the micaceous specular variety; and also included large rounded blocks of ankerite and angular fragments of rock. The width exposed here was thirteen feet, and neither wall was seen.

The ankerite is decomposed to the depth of eight feet. The same appearance of transverse vertical layers seen at the Acadian Mine is observed here, and is probably due to the same cause.

Still further east, on the property of C. D. Archibald, Esq., and on ground equally elevated, three excavations have shown a still greater development of the vein. A trench of fifty-three feet in length, and nearly at right angles to the course of the vein, showed in its whole length a mixture of red and specular ores with ankerite. Another excavation, ninety-five feet to the northward of the first, exhibited ankerite tinged of a deep red color, by peroxide of Iron, and traversed by reticulating veins of red Iron ore. A third opening, 365 feet south-eastward of the first, showed white and gray ankerite, having some of its fissures coated with tabular crystals of white sulphate of barytes. The walls of the vein were not seen at this place; but 150 paces south of the first trench a thick dike of greenish igneous rock, apparently a very fine-grained greenstone, appears, with a course of S. 102 W. This dike was not seen westward of this place, but it can be traced for a considerable distance to the eastward. In the Mill Brook, two miles east of Folly River, it appears in connection with a bed of black slate near the margin of the metamorphic system, and probably a continuation of that seen in a similar position in the Folly and Great Village Rivers, At the Mill Brook the dike is about 100 feet in thickness.

In the bed of the Mill Brook, the vein is seen in the form of a net work of fissures, chiefly filled with ankerite, and in its eastern bank it attains a great thickness. In a bank of another brook still further to the eastward, and in the same line of bearing, it appears to be of large dimensions, and contains abundance of red Iron ore and red ankerite. I have not traced it further to the east, but I have no doubt of its continuance to a great distance in that direction.

The geological history of this deposit embraces the following occurrences:—1s. The formation of a wide irregular fissure, along a great part of the length of the Cobequid Mountains. 2ndly. The filling of this fissure with a molten or softened, and partially even sublimed mass of ferruginous and calcareous matter, presenting, as I think, an evident illustration of the igneous formation of a vein of calcareous, magnesian and ferruginous carbonates. 3rdly. The breaking up of the vein thus formed by cross fractures and faults. 4thly. The partial roasting of its contents by heat, so as to produce the red ores, which are obviously the result of the heating and oxidation of a part of the carbonate of Iron, and this process may be seen, on minutely examining the vein, to have extended itself from the walls of the smallest fissures. 5thly. The action of heated waters passing through its crevices, and depositing sulphate of barytes and brown hematite. 6thly. The influence of the air and surface waters in changing large portions of the superficial contents of the vein into ochrey hydrous peroxide of Iron.

It is, however, to be observed that this deposit might be accounted for on the supposition that a bed of Iron ore and carbonate of lime and magnesia, similar to those occurring elsewhere in the upper silurian, had been so softened and altered by heat as to penetrate in vein-like forms the surrounding rocks. Sir W. E. Logan has shown that phenomena of this kind occurs in the Laurentian regions of Canada.

This deposit is evidently wedge-shaped, being largest and richest on the surface of the highest ridges. It contains, however, an immense quantity of valuable ores of Iron, though its irregular character opposes many difficulties to the miner. Difficulties have also been found in smelting the ore to advantage; but these are often incident to the first trials of new deposits, to which the methods, applicable to others, of which the workmen have had previous experience, do not apply. It is believed, however, that these preliminary hindrances have been overcome, and that the mine has now become highly profitable to its proprietors. I quote the following estimate of the value of the deposit from the elaborate report of J. L. Hayes in 1849. It has been fully confirmed by experience :—

"From the descriptions which I have above given, it is evident, that although the unlimited extent of the ore at any particular point can only be determined by working the deposits, yet an immense field is open for explorations and working.

"Although it is quite probable that an abundant supply of ore will be found upon the west bank of the river. at a price which will not exceed two dollars to the ton of iron ; if this should not be the case, an ample supply can be furnished from the other localities at an expense which, including raising and hauling, could not exceed four dollars to the ton of iron. I would advise the opening of the veins at different points upon the line, to determine the cheapest point for mining, and the ores which can be used most advantageously. If this is done, the price of the ore cannot be fairly set down at the sum for which it can be obtained from the nearest locality, but at an average of the prices of the ores from different localities, delivered at the point selected for the furnace. This may be estimated at three dollars to the ton of iron.

"The value of this locality with respect to ore may be judged of by comparing it with establishments in the United States. In Berkshire County, Massachusetts, at some establishments which have been successfully conducted, the price of ore is between five and six dollars to the ton of iron. In Orange County, New York, ore yielding between 40 and 50 per cent. costs between four and five dollars to the ton of iron. At one locality in New York the ore costs ten dollars to the ton of iron. At some establishments on Lake Champlain, ore costing one dollar per ton at the mine, is carried twelve miles to the furnace. The ore at the Baltimore furnaces costs over seven dollars to the ton of iron. This is about the average cost of the ore at the furnaces in Pennsylvania. Estimating the cost of the ore even at four dollars to the ton of iron, there will be advantage over the average American localities.

"The cost of ores at some of the Swedish and Russian furnaces is still greater. In certain parts of the Ural Mountains the minerals are carried by land to the forests, a distance of from 40 to 80 miles. Some of the forges of Sweden are supplied with minerals from Presburg and Dennemora, which are transported by land-carriage, the lakes, and the sea, to distances exceeding 370 miles.

"There is no trace of sulphur, arsenic, or any foreign matter which can deteriorate the quality of the iron, or of titanium or chrome, which would render the ores refractory. The red ochrey ore, the most abundant variety, being sufficiently porous to present large surfaces to the reducing gases in the blast furnace, and yet sufficiently compact not to choke the furnace, but to allow the free passage of the blast, can be used with peculiar advantage. The daily make of iron from these ores will be large, and the consumption of combustible comparatively small.

"I have no doubt that iron of the first quality for purity and strength, and which will demand the highest prices in the market, can be made from these ores. If Mr. Mushet's opinion, based upon his own experiments, that these ores will furnish steel iron equal to the best Swedish marks, should prove correct, these ores possess a rare value; for, of the many charcoal iron establishments in the United States, I know but one which furnishes iron suitable for making the first quality of steel."

In addition to the use of the ores of Iron in these deposits as sources of the metal, mineral paints and artificial slates of excellent quality are manufactured from the Iron ochres of the Folly mountain, and are extensively used for protecting wooden buildings, &c."

Dr. HONEYMAN'S DESCRIPTION OF THE GREAT VEIN IN 1866.

The following extract is from a paper read before the Nova Scotia Institute of Natural Science, in January 1867, by Dr. Honeyman.

"These mines are situate on Great Village river on the south side of the Cobequid mountains Their history previous to 1855, and the opinions until then entertained by the geologist as to the charcter, age and origin of the iron deposits, are fully given in Dr. Dawson's Acadian Geology. The following may be regarded as a sequel to the history just referred to. They are the results of two visits which I made to those mines in preparing illustrations of the resources of the Province for the London International Exhibition of 1862, and the Paris Universal Exhibition of 1867. On my first visit I found in operation one blast furnace and several puddling furnaces. The ores employed were brown hematite and specular. The flux used was a limestone derived from a lower carboniferous deposit, existing about three miles west of the mines, and the fuel used was charcoal made from hardwood of the neighboring forest. A massive Nasmyth hammer was constantly at work forming bars of charcoal iron, which were chiefly exported to England. The specular ore was derived from a bed about three feet thick, and the hematite from a bed of variable thickness and of unknown depth. In order to ascertain the depth pits had been sunk, but without any definite result. My last visit was of a much more satisfactory character, and the information acquired is of the most interesting and singular description.

The brown hematite is now the only ore available for the production of iron, the specular ore, already referred to, having been apparently exhausted. The supply of ore, however, has not been affected by the failure of the specular ore, as another great bed of hematite has been discovered of dimensions nearly equal to the bed already referred to. These two beds are now distinguished respectively as north and south. The strike of the beds is east and west, their dip is 80° south. At Martin's Brook they appear about thirty feet apart. The maximum thickness of each of the beds, is twenty feet, and the average of the north is five feet, and is the south four. Very often the beds are interrupted and disappear. The unequal thickness of the deposit and interruptions are marked by the inequality of excavation at Martin's Brook. Their length has been ascertained as at least twelve miles.

In the vicinity of Martin's Brook, where the hematite has been chiefly extracted, the course of the beds was found to be west by south. The cause of this deviation was a subject of conjecture. A level was driven obliquely to the strike for drainage in the meantime, and ultimately for the extraction of the ore. When this level reached the hematite beds at about one hundred feet below the surface, it was found that a great slip had occurred, that the beds had been cut off, that during the process a stratum of clay had been formed between the upper and lower part, the inclination of this stratum being about 20° south-west. This interesting revelation explains the mystery of the deviation already referred to, and at the same time shews that the deposits extend downward to the extent indicated by the level. As the beds at the point of section have not degenerated in thickness or quality, they may be regarded as only an interruption.

Another level is being formed some feet under the other, and at right angles to the strike of the strata. This is expected to reveal the existence or non-existence of the hematite beds, and it is reasonably expected that if they shall be recovered, they will be found in regular position, and more advantageously situated for mining purposes. It was supposed that the hematite was an altered ankerite, and that it would only be found in the top of the vein. Whatever may have been the original character of the ore when deposited, it is certain that the hematite extends to a depth of at least one hundred feet, and that its character in the level is precisely the same as it is in the excavations near the surface. I found cavities with butryoidal crystallizations of hematite in the roof of the level, as well as in the excavations above. The hematite of these beds is chiefly amorphous and friable, with numerous masses porous and compact, and mamillary butryoidal, and stalactitic crystal izations of striking variety of form.

Often the ore has an unmistakable coke-like aspect, being specular and intermixed with slate, reminding me of the coke made from the fine coal, with intermixed slate, at the Acadia Coal Mines. This, and other numerous appearances in the ore, can only be satisfactorily accounted for by the supposition of metamorphism by igneous agency. If, again, we are to suppose that the hematite is metamorphosed ankerite, the rarity of the occurrence of this mineral in the excavations at Martin Brook shew that the metamorphism has been complete. I shall now direct attention to the geological relations of these hematite beds."

In Dr. How's "Mineralogy of Nova Scotia," the history of the discoveries of the true vein character of the brown ore is continued up to 1868. Mr. Jones, the manager of the works, writing to Dr. How, says:—

"The veins of ore, which are now (1868) pretty well defined, are two in number, and continue as we go deeper with our workings, much *the same as they were found at the surface*. We have now one adit 250 yards in the ore at a depth of 40 yards below the surface, and another 169 yards across the measures towards the ore at a depth of 80 yards"

In a subsequent paper by Dr. Honeyman (March, 1870), entitled "Notes on Iron Deposits on East River, in the County of Pictou,"* Dr Honeyman presents additional facts especting the true vien character of the Brown Hematite of Londonderry, and announces the proving of the ore to the depth of 200 feet:

"Theorists have advanced the same opinion as has been done in regard to the hematites of Londonderry Mines. This opinion is that it must necessarily be confined to the depth of a few feet. I met this view of the matter in a former communication to this Institute, by the fact that a level cutting the Londonderry beds at a depth of 100 feet from the surface shewed the ore as still hematite. In addition to this, Mr. Jones, the manager of the Londonderry iron mine, in answer to inquiries has informed me that he has proved the beds to the depth of 200 feet, and found the ore still hematite, so that any theory of this band implying limited depth at East River is completely untenable."

The further proving of the hematite at a depth of 350 feet from the surface, as stated on page 29, sufficiently establishes the character of the deposit, and its probable persistency in depth as far as mining the ore is commercially practicable.

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* Proceedings and Transactions of the Nova Scotia Institute of Natural Science, 1869-70, p.p 72.

ANKERITE.

It has been stated on page 30 that the flux now exclusively used at the Acadia mines with the brown ore is the Mineral Ankerite, which follows the vein stone. Ankerite consists of carbonates of lime and magnesia with a variable admixture of carbonate of iron. Its primary crystalline form is a rhomebohedron. In addition to the analysis of this important mineral given on page 33 the following have been made by Dr. Jackson and Dr. How. (*)

	Jackson. Yellow.	Jackson. Brown.	How. Brown.
Cabonate of lime...... ....—	43·80	49.20	51 61
Carbonate of iron......	23.45 }	20 30	19 59
Carbonate of Manganese............	0.18 }		....
Carbonate of Magnesia...........	30.80	30.20	28 67
Siliceous sand	0·10	....	0.13
	98.15	99 70	100.90

Ankerite bears no resemblance to clay iron-stone, which is an ore chiefly found in the carboniferous and cretaceous series, and contains a considerable percentage of alumina. Clay iron-stone is essentially an argillaceous ore, while ankerite may be described as a ferruginous dolomite, and is mentioned by Dana under the head of dolomite or magnesian carbonate of lime. As a flux it is a very important mineral, and especially adapted to the smelting of the Brown ores of Cobequids.

Overman, in his "Treatise on Metallurgy,' says:—"One of the first maxims in selecting flux, should be that it contains an admixture of iron; and if such can not be obtained, which is most frequently the case with limestone, an impure is preferable to a pure limestone, The leading principle in all smelting operations is, to smelt by as low a heat as possible."

Ankerite satisfies this condition admirably; it contains the necessary admixture of iron, and being found as the vein stone of the ore, its association in this respect is of great economic importance in the smelting of the Cobequid ores. The name given to this mineral is in honor of the Austrian Mineralogist, Professor Anker. By its decomposition it gives rise to variously-colored ochres, which form the basis of pigments, and in the vicinity of Folly Mountain deposits have been mined and manufactured into mineral paints.

(*) How's Mineralogy of Nova Scotia.

VII.—GEOLOGICAL SECTION OF THE NORTH SIDE OF THE CUMBERLAND COAL FIELD.

In 1843 an elaborate section of the measures exposed on the coast of Chignecto channel was made by Sir William Logan, and published in the first Report of the Canadian Geological Survey, in 1844.

This section has justly been regarded, not only as one of the most remarkable illustrations of geological structure extant, but also as exhibiting in its description singular powers of observation, deduction and analysis. It extends over a horizontal distance of ten miles, from Minudie to near the centre of the great Cumberland trough of carboniferous rocks near the West Ragged Reef, thus comprising the greater portion of the north side of the trough or basin, and including all the known coal-bearing groups of beds. The south side of the trough, extending from the Shoulie River to a short distance south of Apple River, has not been described.

THE NORTH SIDE OF THE BASIN FROM MINUDIE TO SHOULIE.

Sir William Logan's measurements comprehended 14570 feet in vertical thickness, of the carboniferous rocks of the Cumberland trough. He divided this series into eight groups, of which the following is the resume, beginning with the highest group:

	Thickness in Feet.
Group No. 1,........	1617
" " 2,..................................	650
" " 3,..	2134
" " 4,..	2539
" " 5,..	2082
" " 6,..	3240
" " 7,..	650
" " 8,..	1658
Total thickness...............	14570 feet.

Groups one and two do not contain any seams of Coal, and as far as this important mineral is concerned, they may be regarded as barren.

Group No. three contains twenty-two seams of Coal.
Group No. four contains forty-five seams of Coal.
Group No. five is barren.
Group No. six contains nine seams of Coal.
Groups No. seven and eight are barren.

The entire section contains seventy-six seams of Coal; many of these are but rudimentary, as they appear on the coast section, but in the interior of the Basin they may acquire very considerable dimensions, as is shown by the Spring Hill seams, which are of a magnitude and purity no where recognized in the coast section. There is, however, no certain evidence that any one seam found on the coast can be identified with seams discovered far in the interior, and it is probable that local conditions may have favored the accumulation of Coal in one locality, which did not obtain in another.

Of the eight groups of bed before enumerated, three are characterized by numerous beds of Coal, but this is not the only mineral of economic importance which gives value to the Cumberland Coal Fields. Sir William Logan in his comprehensive section and analysis of the same, has included the beds of clay iron stone, the beds fit for grindstones and for flagging. He has also enumerated the various beds of limestones, which are valuable as a source of lime, and especially on account of the large per centage of phosphoric acid they contain, which may render them important as sources of special manures.

ANALYSIS OF SIR WILLIAM LOGAN'S SECTION.

GROUP NO. I.

From the neighborhood of West Ragged Reef to a few hundred feet beyond the north branch of Two Rivers.

	Feet.	Feet.
Grenish gray or drab colored Sandstones, with conglomerate beds and large carbonized Drift plants........................	947	
Dark Red or chocolate argillaceous and argillo—areneceous shales....................	670	
Total thickness	———	1677

A few beds fit for grindstones and waterstones; (large grindstones). No clay ironstone beds, no coal seams. This group forms part of the upper barren measures, and is characterized by beds of conglomerate.

GROUP NO. II.

From a few hundred feet north of the north branch of Two Rivers to a short distance beyond Ragged Reef Point.

	Feet.	Feet.	Feet.
Drab colored Sandstones without conglomerate beds..............................	219		
Gray Sandstones........................	81.		
Reddish Yellow Sandstones...............	28		
	———	328	
Red, green, and greenish gray argillaceous and arenaceous shales....................	.. ..	322	
Total thickness....	.. ..	———	650

GROUP NO. III.

From a short distance beyond Ragged Reef Point to Dennis River Point.

	Feet.	Feet.	Feet.	Feet.
COAL in 22 seams..........	5 ft. 5 in,			
Carbonaceous shales associated with the Coal Seams and in one instance without coal......	3 10			
		9ft. 3iu.		
Underclay or understone being beds of various material immediately subjacent to the Seams of Coal and carbonaceous shale, and universally penetrated by the branches and radiating leaves of *stigmaria ficoides*.				
Every one of the Coal and carbonaceous seams rests upon a bed of this description, and in two cases stigmariæ beds exist without superincumbent coal. The material constituting the stigmariæ bed is as follows:				
Sandstone, gray. 23ft. 3in.				
Greenish gray or drab ......43 0 "				
	66 3			
Argillaceous and arenaceous shale,				
Gray	58 4			
Greenish gray...........	7 0			
Red and occasionally green	42 0	107 4	173 7	
Sandstone—				
Gray........................	82 0			
Greenish gray, chiefly fit for grindstones..	657 0			
Reddish of various shades..................	204 0			

	Feet.	Feet.	Feet.	Feet.
Shale—				
Gray—Argillaceous....	92 6			
Arenaceous......	44 0			
Red and Green	———	136 6		
Argillaceous........	564 0			
Arenaceous...........	104 9			
	———	668 9		
		———	805 3	
Measures concealed, supposed to chiefly shale	....		203 0	
			———	
Total thickness..		....		2134 1

This Group of Beds forms the upper coal-bearing group in the Cumberland Basin. None of the seams as they appear on the coast, are of workable thickness, but there are indications in the interior that some seams belonging to this group are of economic value.

The grindstone beds of North Ragged Reef and of South Ragged Reef lie within the limits of the group. About six hundred feet in thickness of rock in separate beds fit for grindstones show the importance of this group without regard to Coal. Beds of shale containing clay-ironstone balls are numerous.

GROUP NO. IV.

Extending from Dennis River Point to the south western extremity of Lower Cove.

COAL in forty-five seams	37 9½			
Carbonaceous shale, associated with the above coal seams and in one instance without coal..	36 4			
Gray argillaceous shale interstratified with the coal seams in 8 cases, in two of which the shale is one foot and upwards thick, without exhibiting any remains of stigmariæ	4 4½			

	Feet.	Feet.	Feet.	Feet.
Black and Gray bituminous limestone, touching the coal and carbonaceous shales, often interstratified, and containing the remains of fishes, shells, and occasionally stigmariæ. In one instance the limestone has no coal with it, in 16 cases it is associated with the coal seams......................	23 3			
		101 9		
Underclay or understone, being beds of various material, immediately subjacent to the seams of coal and carbonaceous shale and bituminons limestone, and invariably penetrated by the recumbent branches or radiating leaves of the *stigmaria fiocides*. Every one of the seams of coal and carbonaceous shale rests upon a stigmariæ bed with the exception of one instance, where 4 feet of gray argillaceous shale, destitute of the plant, is interposed between the stigmariæ bed and the coal, and one instance where the stigmariæ are doubtful.— There are 12 instances of stigmariæ beds without superincumbent coal. The material constituting the stigmariæ beds is as follows:				
Ganister, a hard silicious stone.........	4 6			

	Feet.	Feet.	Feet.	Feet.
Sandstone—				
Gray and crumbly, sometimes a doubtful fire clay	72 10			
Greenish gray	4 0			
		76 10		
Arenaceous shale, often fit for fireclay—				
Gray	189 0			
Greenish gray	25 6			
Red	6 0			
		220 6		
Argillaceous shale sometimes fit for fireclay—				
Gray	99 4			
Greenish gray	28 0			
Green	12 10			
Red and Green	45 0			
Red	17 3			
		202 5		
Sandstone—				
			504 3	
Gray in color, and much of it of a crumbly nature, resembling the quality in which the remains of Stigmariæ are found		259 2		
Greenish		4 6		
Greenish Gray or Drab coloured, some of it fit for grindstones, and patches of it containing carbonized drift plants		232 6		
Red and green, less durable in quality than the drab colored stone		69 0		
Reddish, similar to the preceding in durability		67 3		
Red, or chocolate colored, easily yielding to the influence of weather		15 6		
			647 11	
SHALE—Arenaceous.				
Gray	91 0			
Gray with *ironstone* balls	13 0			
		104 0		
Greenish gray		5 0		
Green		18 6		
Reddish		15 8		
Red and green	42 0			

	Feet.	Feet.	Feet.	Feet.
Red and green with *ironstone* balls..........	4 0			
SHALE—Argillaceous.		46 0		
Gray......................	224 8		189 2	
Gray with *ironstone* balls	199 4			
		424 0		
Greenish gray	32 0			
Greenish Gray with *ironstone* balls.........	17 0			
		49 0		
Green		38 6		
Red and Green.........	153 6			
Red and green with *ironstone* balls.........	118 6			
		272 0		
Red, or chocolate-colored	230 6			
Red, or chocolate-colored with *ironstone* balls.....................	82 0			
		312 6		
			1096 0	
Total thickness..				2539 1

This important group of beds contains

Coal Seams........ .... 37 feet 9½ inches.
Bituminous Limestone........... 23 feet in thickness.
Fireclay, say........................100 " "
Sandstone, fit for grindstones—— " "
Shale, with Ironstone Balls.. 433 " "

GROUP NO. V.

From the south-westerh extremity of Lower Cove, to Upper Cove Point.

SANDSTONE.				
Greenish gray, with occasional Drift plants carbonized	28 0			
Greenish gray, with concretionary Limestone, having the aspect of conglomerate.................	20 0			
		48 0		

	Feet.	Feet.	Feet.	Feet,
Reddish gray, with occasional drift plants carbonized	104 0			
Reddish gray, with concretionary Limestone...	16 0	120 0		
Reddish green..............	24 0			
Reddish green with concretionary limestone . .	37 0	61 0		
Red and green		6 0		
Red		233 0		
Shale—			408 8	
Red Argillaceous...........	640 0			
Red Arenaceous.............	230 0	870 0		
Green Argillaceous.........		4 0		
Measures not well exposed, but probably composed of Red Shale and Sandstone ....——........			874 0	
			740 0	
Total thickness...				208 2

This group is altogether barren as far as the exposures on the coast permit conclusions to be drawn. One-third, however, of the section is concealed by drift, but the general composition of the Rocks is such as to render it doubtful whether any coal seams or any layers of ironstone balls exist. The prevailing red color of the beds shows that on the coast at least, the conditions for the accumulation of vegetable matter were wholly unfavorable. Coal is generally associated with gray-colored rocks, and clay ironstone with coal, or accumulations of vegetable remains. The prevailing red color of the beds belonging to this group is preserved far into the interior, and may be seen on East Brook, which appears to flow over these beds for a space of several miles. The presence of concretionary limestone in thicker beds indicates the existence of deeper seas during the period of the deposition of this group.

GROUP NO. VI.

From Upper Cove Point to a few hundred feet beyond Dog Fish Reef.

	Feet.	Feet.	Feet.	Feet.
Coal in nine seams........	0 10			
Carbonaceous shale, associated with coal, and containing remains of shells	7 4			
Bituminous limestone with remains of fish and calcareous beds, associated with the coal and carbonaceous shale seams in one instance, and in six instances independent........	4 10			
Greenish and gray argillaceous shale, associated in some instances with the coal and carbonaceous seams.........	9 1			
		22 1		
Underclay or understone being beds of various materials, immediately subjacent to the seams of coal and carbonaceous shale, and invariably penetrated by the recumbent branches and radiating leaves of the *stigmariæ ficoides*. Every one of the coal seams rests upon a stigmariæ bed, and there is one instance of the stigmariæ bed without superincumbent coal. The materials of which the stigmariæ beds consist is as follows:—Sandstone of a gray color and crumbly quality	5 0			

	Feet.	Feet.	Feet.	Feet.
Shale.—Gray argillo-arenaceous, frequently fit for fire-clay	50 0			
Green argillo-arenaceous..	21 0			
Red and Green Argillo-arenaceous................	17 0			
		88 0		
			93 0	
Sandstone — Greenish Gray or drab colored, of which much is fit for the purpose of good grindstones, and it is in it that the chief quarries of the Joggins exist. Of this mass 350 feet in various parts are filled with vast collections of drift plants, coated with crystalline coal. The plants are in great confusion, and are in general prostrate. Spherical concretions some four feet in diameter, with a rusty black exterior, occur in 51 feet of it......		1886 6		
Greenish........................		2 0		
Yellow, of a finer but less durable quality than the drab.........................		25 0		
Reddish gray................		19 6		
Red and green..............		15 0		
Red and chocolate-colored		95 6		
			2043 6	
Limestone of a concretionary character, very much resembling conglomerate, generally of a greenish color, and in very irregular layers...			43 8	
Shale. — Greenish gray arenaceous and argillaceous......................		136 0		

	Feet.	Feet.	Feet.	Feet.
Gray arenaceous and argillaceous, with a few small beds containing ironstone balls..........		234 0		
Red and green variegated		77 0		
Red and chocolate colored		592 2		
Total thickness.....		———	10392	3240 9

This group is the lowest coal-bearing group of beds in the Cumberland Basin.

The most important grindstone quarries belong to this group. The ironstone beds are few in number.

GROUP NO. VII.

From Dog Fish Reef to half way between Downing's Cove and Mill Creek.

SANDSTONE. — Greenish gray........ , ...	1 0			
Reddish........................	7 0			
Red and green........	20 0			
Red	65 0			
	———	93 0		
Red with white streaks....		51 0		
		———	144 0	
Conglomerate with red, white gray and yellow quartz, and black Lydian stone pebbles, in a matrix of red sandstone			148 0	
Limestone in concretionary nodules placed in a matrix of greenish sandstone and shale, occasionally associated with carbonized fragments of plants...........			16 0	
SHALE — Deep red and chocolate red, arenaceous....		62 0		

	Feet.	Feet.	Feet	Feet.
Measures concealed, but supposed to be of the same quality..............		280 0	342 0	
Total thickness.....				650 0

This group appears to be barren. It contains neither coal, sandstone fit for grindstones, nor ironstone balls. It is, however, noteworthy that Sir William Logan mentions the occurrence of a regular vein of sulphate of Barytes, 3 inches wide.

GROUP NO. VIII.

From the boundary of the last named group to Seaman's brook, Mill Creek, Minudie.

SANDSTONE. — Greenish gray, occasionally holding carbonized remains of plants, and in four instances the plants (underlying the sandstone) are replaced by gray sulphuret and green carbonate of copper	206 0			
Reddish.........................	13 0			
Deep Red.................	213 0			
		432 0		
Concretionary limestone, associated with the greenish gray sandstone. The concretions are held in an argillo-arenaceous matrix. In one instance the whole of the bed is calcareous, and there occur nine beds altogether...........		20 0		
SHALE.—Red arenaceous, sometimes more and sometimes less argillaceous.........	1186 0			

	Feet.	Feet.	Feet.	Feet.
Reddish, black and gray, with calcareous septaria and nodules................	20 0			
		1206 0		
Total thickness........			1658 0	

Plaster and a heavy bed of Limestone occur at the base of this group.

RECAPITULATION.

Group No. 1.........	1671	Barren—Conglomerates.
" No. 2.........	650	do. "
" No. 3........	2134	22 Coal Seams—UPPER COAL-bearing Group.
" No. 4.........	2539	45 Coal Seams—MIDDLE COAL-bearing Group.
" No. 5.........	2082	Barren.
" No. 6.........	3240	22 Coal Seams—LOWER COAL-bearing group.
" No. 7	650	Barren—conglomerates.
" No. 8.........	1658	Barren—Plaster.
Total thickness.....	14570	

It is not to be inferred that the characteristics presented by the rocks in this elaborate coast section are maintained throughout the extension of the strata eastwards far into the interior. Local conditions which prevailed during the periods of deposition have greatly modified the composition of the beds and of the seams of Coal. Towards the interior of the Basin many beds which show no signs of coarse materials on the coast become grits or conglomerates in the interior. Many beds die out while others thicken, and what is true of the strata holds good with regard to Coal seams. The collection of seams at the Scotia, Chignecto and St. George is an instance of this thinning out of certain beds and the thickening of others.

EXPLORATIONS FOR COAL.

The greater portion of the Cumberland Basin is deeply covered with drift clays and gravels, consequently explorations for the crop of the seams are both tedious and expensive.

An expeditious method of proving the seams in their extension from a point where their existence is known, or in searching for seams where the structure of the country indicates their position is very desirable. The ordinary method pursued in boring for coal is troublesome, expensive and unsatisfactory. A method which will not only bore expeditiously but at the same time shew with certainty the kind of rock and its character, and the precise thickness of the seam of coal, is very desirable. This method is claimed to have been perfected by the application and use of the Diamond Drill, which is not only very expeditious but enables a core of the strata bored through to be brought to the surface.

Diamond Drills have been for some years in operation in Europe and more recently in America. In England the Diamond Rock-Boring Company has been recently established, while the American Diamond Drill Company has been for some time in successful operation.

The French engineer, Rodolphe Leschot, first conceived the idea of using black diamonds for drilling purposes, and his invention was tested in 1863 during the construction of the Mont Cenis tunnel, and was found to give very satisfactory results.

The American Diamond Drill Company work under Leschot's patents, and profess, while retaining the principle of the inventor, to have introduced new methods and various improvements on the details of the machinery used.

The report of the Commission at the Paris Exhibition on Leschot's Drill is very satisfactory, and is well worthy of introduction here, in view of the wants of the mining public with respect to some expeditious and consequently cheap boring apparatus which enables the prospectors to determine with accuracy the nature of the materials through which the borings are passing.

Referring to Leschot's Drill, the Commissioners say:

"The imperfections that Mr. Leschot, civil engineer and pupil of the Central School, had recognized in the employment of iron and steel in the boring of hard rocks or metals, the drills softening rapidly, and often producing only an advance of Om. .07 to Om. .10 per hour, gave him the happy idea of applying a rotating tool, acting in the manner of an annular cutter, and in which steel teeth should be replaced by diamonds. To accomplish this, he set into a tubular washer or ring, about Om. .005 or Om. 006 thick, black diamonds, projecting Om. .0005 at the most, some from within, some from without, and some in front.

"It is understood that after this ring has been attached to the perforating shaft, it is rotated at the rate of about two hundred revolutions per minute, and the black diamonds brought in contact with a softer substance will cut and wear it to an extent which will depend upon the pressure exerted, and the hardness of the rock. By continuing this action the groove can be made to a great depth, and the cylindrical core which remains attached to the rock enters the hole through the axis of the tool-carrier. When the operation is terminated, the core is taken out in the shape of quite a regular cylinder, which only breaks when the rock is of a brittle nature, or has been previously cracked. It is evident that the use of this cutting-ring saves considerable powder, since a part of the rock is not pulverized. In the example we have given in describing the Leschot perforator, the effort was only 61 441 tons per hour, while it would have been 204.5 tons if the entire matter had been pulverized.

The ring employed by Messrs. De La Roche-Tollay and Perret (exhibitors of the Leschot Drill at the Exposition), is only Om. .035 outside diameter, and the core worked was Om. .014 in diameter.

"*Cost of Tools.*—We will now reply to an objection which has been raised as to the price of this tool. It is true that when the ring was first used, a difficulty existed in the selection of diamonds, which from the nature of their cleavage, would be the most serviceable. The setting was not always performed as solidly as could be desired; but these difficulties have disappeared. We have examined two rings which were worked for seven months at the Expositions, and which have perfectly resisted. We believe we can affirm that in a hard stone, like granite, a ring properly worked will cut holes to an aggregate depth of 150 metres (over 490 feet). A ring for boring holes Om. 036 diameter, costs about 150 francs, but as the black or opaque diamonds used in its construction are ordinarily employed in the shape of dust for polishing transparent diamonds, and as their wear during the act of performation is very light, they can be extracted from the socket in which they are set, and be returned to the trade with a depreciation proportionate only to the diminution of weight.

The diamonds extracted from the worn-out ring generally fetch seventy or eighty francs—that is to say, about one half of their first cost.

"The following are the results of the experiments made during the Exposition, the speed of rotation varying from two hundred and fifty to two hundred and eighty revolutions per minute ;

"Advance per minute in the Mont Cenis quartz, Om. 054 (2⅓ inches): in granite, Om. .050 (about 2 inches); in very hard calcareous dolomite, Om. .080 (3 3-16 inches).

"The holes were perfectly regular, and being so, were well adapted to the use of powder cartridges, which are much less dangerous than the ordinary powder.

"The hydraulic engine (by which the tool on exhibition was operated) and the perforator have worked four hours every day for a period of seven months, without necessitating any serious repairs."

The American Diamond Drill Company claim that by long practical experimenting they have greatly improved upon the machines which Messrs. De La Roche-Tollay & Perrett manufacture under Professor Leschot's patent in France. While their machines rotate the annual ring (or diamond boring head) only 200 to 280 revolutions per minute, the American rotate the same from 400 to 800 revolutions per minute, according to the style and application of the machine. This increased speed, with improved mechanical devices for adjusting and applying the tool, is said to greatly economize time, and enable bores to be made in sandstone, limestone, slate and marble at a uniform rate of fifteen to twenty (15 to 20) feet per hour. and in quartz, flint and granite from six to eight (6 to 8) feet per hour.

The simplicity of American machines is said to render unnecessary the employment of expensive skilled labor in their operation, and since the drill points never require sharpening, only two workmen are needed to keep the same in steady operation, and make all necessary repairs.

This drill is said to penetrate rock faster than by any other known method, to perform a greater amount of work more cheaply than it can be otherwise done, to make perfectly cylindrical holes, to bore at a depth of five or six hundred feet as rapidly as when near the surface, to bore in any direction or angle, (a very important consideration), and lastly to bring out a solid core of the rock through which the drill is passing.

The following is a description of the American Prospecting Diamond Drill. It consists of an upright boiler, to one side of which is firmly bolted the case iron frame which supports the engine and swivel drill-head, gears and screw-shaft with the drill passing through it. The engine may be an oscillator of from five to seven horse-power. The screw shaft is made of hydraulic tube from five to seven feet in length, with a deep screw cut on the outside; it also carries a spline, by which it is feathered to its upper sleeve-gear. This gear is double, and connects by its lower teeth with the beveled driving-gear, and by its upper teeth with the release gear. The release gear is feathered to the feed-shaft at the bottom of which is a fractional gear, fitting to the lower gear on the screw-shaft, which has one or more teeth less than the frictional gear, whereby a differential feed is produced. This frictional gear is attached to the bottom of feed shaft by a friction nut, thus producing a combined differential and frictional feed, which renders a drill perfectly sensitive to the character of the rock through which it is passing, and maintains a uniform pressure upon the same. The severe and sudden strain upon the cutting-points incidental to drilling through soft into hard rock with a positive feed is thus avoided. The drill-rod (passing through the screw-shaft) consists of a tubular boring-rod, made of lapweld tube, with the bit or boring-head screwed on to one end.

The Annular or Hollow Boring-Bit is a steel thimble about four inches in length, having three rows of black diamonds in their natural rough state firmly embedded therein, so that the edges of those in one row project forward from its face, while the edges of those in the other two rows project from the outer and inner periphries respectively. The diamonds of the first mentioned row cut the path of the drill in its forward progress, while those upon the outer and inner periphery of the tool enlarge the cavity around the same, and admit the free ingress and egress of the water, as hereafter described. As the drill passes into the rock, cutting an annular channel, that portion of stone encircled by this channel is of course undisturbed; the drill-rod passing down over it preserves it intact until the solid cylinder core thus formed is withdrawn in the drill rod in sections.

The sides of the hollow bit are one-fourth of an inch thick, and the diamonds of the inner row project about one-sixteenth of an inch, so that the core or cylinder produced by a two-inch drill (the ordinary size of testing and blasting) is one and a quarter inches in diameter.

Inside the bit is placed a self-adjusting wedge, which impinges upon and holds fast the bore when the action of the drill is reversed—thus breaking it off at the bottom and bringing it to the surface when the drill is withdrawn. In order to withdraw the drill it is only necessary to throw out the release gear by sliding it up the feed shaft to which it is feathered, when the drill runs up with the same motion of the engine which carried it down, but with a velocity sixty times greater; that is, the speed with which the drill leaves the rock, bringing the core with it, is to the speed with which it penetrates it as sixty to one—the revolving velocity in both cases being the same. The drill-rod may be extended to any desirable length by simply adding fresh pieces of tubing, the successive lengths being quickly coupled together with an inside coupling four inches long, with a hole through the centre to admit the water.

The steam pump is connected by rubber hose with any convenient stream or reservoir of water, and also with the outer end of the drill-pipe by a similar hose having a swivel joint. Through this hose a stream of water is forced into the hollow drill-rod, from which it escapes only at the bottom of the bit, and passes rapidly out of the hole at the surface of the rock, carrying away all the grit and borings as fast as produced.

With this machine a core is said to be easily brought to the surface from any depth within a thousand feet.

VIII.—THE BASIN WEST OF SPRING HILL.

South-west of the disturbance near the church at Spring Hill mentioned on page 23, several seams have been discovered, having a course varying from south forty degrees west near the bottom of the hill to south twenty degrees west at the summit. The crops of the seams appear to be affected by an anticlinal, whose axis lies to the south of the lowest seams, or those at the summit of the hill. At the Hibbard Pit a large seam has been intersected by a shaft which is supposed to be the continuation either of the main seam or of the thirteen foot seam. It is alleged that this seam has been found near fifteen chains south-east of the boundary of the General Mining Association's tract and about seventeen chains southwest of the Hibbard Pit. According to the structure of the rocks the crop of this seam should pursue a gently curving course towards the junction of the Mountain Road and the Upper Maccan Road, and in the absence of faults it would then trend more to the west and sweep down the valley of the Macan towards Southampton. Numerous bore holes have been put down for a distance exceeding a mile to the north-west of the prolongation of the General Mining Association's tract without striking this seam. Further trial holes to the rise will probably be attended with successful results.

The smaller seams near and upon the summit of the hill will curve more sharply to the south, being nearer the axis of the anticlinal, and probably take an easterly course before returning towards the valley of the Macan. From the Mountain Road all the way to Southampton, a distance of seven and a half miles, the rocks are regular, dipping towards the north-west at a low angle as far as the Etta Road, where they take a more northerly dip.

Small seams of coal have been found in this portion of the valley of the Macan, but no recognized representation as yet of the great seams at Springhill. It is only by natural exposures that these could have been found, for it does not appear that any trial bore holes have been put down in this part of the basin. The discovery of one of the large seams in any part of the Upper Macan valley would be of great importance, for the uniformity in the structure of the rocks for many miles would indicate great regularity in their continuity over a very large area.

From Southampton towards Athol the dips of the strata trend slightly to the east of north, thus showing a trough-shaped form, and giving strength to the supposition that the Springhill seams occupy a superior horizon to that of the Joggins seams, or the seams on the north side of the Basin.

A spur of conglomerates forming the base of the Coal measures appears on the west side of the road leading from Fullerton's Lake to Southampton, and takes a northerly direction down the valley of the Hebert River. The west flank of this spur crosses the Halfway River about five miles from Fullerton's Lake, and its outcrop has been traced in a north-easterly direction for nearly two miles. In a westerly direction it has been traced from the place where it crosses Halfway River for three and a half miles, or beyond the outlet of Gaspereau or Welton's Lake. This mass of conglomerates appears to penetrate the Coal Basin in the form of an elongated dome. From Welton's Lake the Coal measures take a general course towards the head waters of Apple River, and terminate on the coast of Chignecto Channel at Spicer Cove, where they may be seen in close juxtaposition with the metamorphic series of the Cobequids, and where also, on the authority of Mr. Patrick, small seams of Coal are visible at low water.

IX.—SECTION ON THE COAST SOUTH-WEST OF THE SHULEE RIVER.

Near the mouth of the Shulee River on Chignecto Channel the rock dips to the north-east at a low angle, and here is probably the axis of the main synclinal in the Cumberland Coal Basin. Proceeding south-westerly along the coast, an easterly dip is seen at Clam Cove, and about two miles further down the coast a south-westerly dip occurs at Sand Cove, and continues to Sand River.

This structure points to the existence of a subordinate anticlinal which has been recognized on Mill Creek about three miles from its junction with the Hebert River.

The axis of this subordinate anticlinal has a course nearly due east and west magnetic, and it is not improbable that it may have an important bearing upon the depth of workable seams of Coal in this part of the Basin. South-west of Sand River the dips are all nearly due south as far as Carron Cove within a mile and a half of Apple head. At the head waters of Mill Creek and for four miles down that stream the strata dip north, showing the existence of a trough or synclinal nearly parallel to the anticlinal before mentioned.

The view which has hitherto been entertained regarding the Cumberland Coal basin in the vicinity of Chignecto Bay, namely that the whole series represented in the section on the north side of the basin is reproduced with northerly dips on the south side of the synclinal axis passing through the Shulee River, is not borne out by the result of exploration. A great undulation in the southern part of the basin gives rise to a subordinate anticlinal and a subordinate synclinal. Near Spicer Cove and on the east branch of Apple River, Coal seams have been observed, showing that there the Coal measures approach the older metamorphic series very closely. The country between Fullerton's Lake and the coast is very little known; the last house west of Parrsboro' river is William Harrison's, distant five miles in an air line west from Fullerton's Lake. Between Harrison's and the head of Sand River Harbor, a distance of nine miles, there is but one habitation. Between Harrison's and Porter's Mill on the Herbert river in an air line about nine miles, and between Harrison's and Shulee River harbor, about eight miles, there is not a single house or cabin. This part of the country is a complete wilderness, in which extensive barrens are numerous.

The highest land in this part of Cumberland County is about six miles due west of William Harrison's on Half-way river. From an extensive swamp, which occupies an elevated table land, the following rivers take their rise: Half-way River and Fox River, flowing into the Basin of Minas; Mill Creek, flowing into the Hebert River; East Branch of Apple River, Sand River and Shulee River, flowing into Chignecto Channel. Mill Creek traverses a vast and gently undulating plain, resembling in many particulars the level country through which East Brook, rising near Spring Hill, takes its course.

It appears probable that workable Coal seams will be found near the Sand River road; these supposed seams being the continuations of seams known to exist at Spicer Cove and on the East Branch of Apple River. North of the upper portion of Mill Creek, and along the crown of the subordinate anticlinal workable seams may be sufficiently near the surface to admit of economical exploration. The outlet for these coals on the anticlinal would be Shulee harbor; while those in the valley of Mill Creek could be conveyed by tramway to Half-way River, thence by the proposed railway from Spring Hill to Parrsboro' to the last-named place for shipment.

X.—PROFESSOR ORAM'S REPORT.

KINGS COLLEGE, WINDSOR, N. S ,
December 9th, 1872.

DEAR SIR,—

I beg to transmit to you, for the information of the Commissioner of Mines, a detailed report of the mode of operation adopted in my survey of part of the Cumberland Coal Field.

The whole of this survey has been effected by means of a Troughton & Simm's 5 inch Ordnance Theodolite and a Gunter's Chain, the latter having been carefully tested at frequent intervals during the survey.

The plan I adopted was the following; First carefully selecting a suitable site for a base line, which in a country like Springhill is not an easy matter. I found the spot best adapted for this was a prominence called Boss's Hill, from which the best view of the country can be secured; the longest base I obtained was somewhat short of half-a-mile.

I then took accurate observations from each extremity of base, of conspicuous objects, houses and barns, situated on or near the line of survey. The information as to locality of houses, &c,, I obtained from Mr. Miller, a resident at Springhill.

My next step was to connect this base, by means of a Traverse Survey, with the objects already noted, and in every instance when possible, I took back-sights on a flagstaff erected on Mr. A. Mill's barn, which is situated on the base line; this method has the effect of completely tying in the survey, and rendering the detection of any inaccuracy in plotting at once simple.

The different lines in the Traverse were measured between flagstaffs placed as far apart as the sinuous course of the road would permit; the relative and compass bearings of these lines were both carefully registered, a plan absolutely necessary for accuracy, as in some instances, in crossing railways, I found the needle deflected as much as 4°, and in one case having to carry the line of survey for some distance along the Intercolonial R. R., I found the indications of the needle quite valueless.

The elevations and depressions of the lines are all carefully noted in the Field Book, thus giving a rough approximation to the profile of the country; these lines reduced to a horizontal base have been plotted. In making the plan I first plotted the positions of the objects observed from the base line, and then proceeded with the traverse joining these points, thereby giving a crucial test of the accuracy of the work. The positions of all objects situated at any distance from the line of survey are obtained from at least three angular observations from extremities of lines in the traverse.

All the observations and measurements mentioned above I herewith transmit in the Field Book, which book forms a complete record of the entire survey and supplies a means of testing the accuracy of the whole, or any part of the traverse.

For instance, should at any future time, a doubt arise as to the correctness of the plan with regard to the relative distances, or positions of any points marked on it, nothing can be easier than to take the Field Book on to the ground, commence at the nearest bench-mark described in the notes, and test the accuracy of bearing and length of each consecutive line between the desired points, as every B. M. is fixed by a stake driven at the side of the road, in a position where it is likely to remain undisturbed. This system of conducting a survey, besides giving accuracy of detail, offers facilities for testing and confirmation, and can, at any future time, be supplemented or incorporated with any other survey, either previously or subsequently effected,

I remain,

Yours truly,

JOHN E. ORAM.

H. Y. HIND, Esq.,
Windsor, N. S.