III.—Analyses of Nova Scotia Coals and other Minerals. —By E. Gilpin, Jr., A.M., F.G.S., Inspector of Mines, Etc.

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The following analyses, for the most part hitherto unpublished, may be interesting for comparison. They have been made by the writer, and may be considered as representing fair averages.

The value of proximate analyses for commercial purposes has certain limits. By its means, in a properly averaged sample representing a bed of coal, the amount of moisture, of ash, and of sulphur, can be determined. The estimations of the amounts of volatile matter, and of fixed carbon, vary with the time of heating, amount of heat, bulk of sample, etc., so that they can be regarded only as approximate. For the same reasons, the gas values of coals are not satisfactorily determined in the laboratory by this method of analysis. The quality of the coke as left in the crucible after determination of volatile combustible matter, is not always found to correspond with that obtained in practice.

The time and cost of ultimate analyses of coal have prevented their adoption for general commercial purposes, and their value may be based principally upon the view, that as they give the total percentage of carbon present in the coals, they are in accord with the idea that the ultimate evaporative power of a coal is in direct proportion to the amount of carbon it contains. The determinations of sulphur and ash by proximate analysis are equally valuable for ordinary purposes.

It is remarkable that more attention is not paid by purchasers to the composition and comparative values of the fuels offered to them. The slight differences in prices which are sometimes allowed for coals generally acknowledged to be of lower grade are in many cases disproportionate to the differences really existing. To manufacturers, and other large consumers, the study of this matter would prove a considerable item of profit in balancing cost sheets.

In every metallurgical business ores are bought by the percentage of metal they contain, limits are fixed for the impurities, and within these limits the amount to be deducted from the value of the metal varies.

Thus, two coals, showing respectively —

Combustible matter	92.00	92.00
Water	.50	2.50
Sulphur	.50	.50
Ash	7.00	5.00

will not have the same values as fuels, nor equal adaptability for many metallurgical purposes. Now, assuming the amount of combustible matter to be suited to the purposes of the purchaser, and he wishes to make gas for lighting, the first fuel is worth more to him than the second; while to the purchaser for domestic purposes, the lessened amount of ash in the second coal would outweigh the amount of moisture he would have to purchase with it.

1. Coal from the Victoria Colliery of the Low Point, Barasois, and Lingan Mining Company.

Coal bright and compact, breaking into elongated blocks, and blocks having a cubical fracture. The deposition planes are well marked, and carry a good deal of mineral charcoal, and some of the primary planes have films of calcspar. Pyrites is sometimes visible in the deposition planes, and occasionally is presented in small nodules. The average specific gravity of the coal is about 1.3.

Composition:

	Slow Coking.	Fast Coking.
Moisture	.75	.75
Volat. Comb. matter	26.85	32.13
Fixed carbon	68.13	62.85
Ash	4.27	4.27
	100.00	100.00
Sulphur	1.286	
Theoretical evaporative power	9.3	8.6

From the above figures the coal is evidently of excellent quality, and should be found a good steam coal. Its percentage of volatile matter and moisture are lower than is usual in coals from this district, and approach those characterising the typical steam coals of the United States. The coal yielded during analysis a bright and fairly compact coke, and in practice would probably yield a merchantable article of good quality.

2. Coal from the Sydney main seam of the General Mining Association (Sydney Mines.)

This seam is considered the equivalent of the Victoria seam, referred to in Analysis No. 1. The actual connection has not yet been proved, although the levels of the Sydney Mines are being rapidly extended toward it under the harbor.

The coal is bright, and fairly compact, breaking irregularly. It shows little visible pyrites and spar. By fast and by slow coking the following results were obtained:—

	Slow Coking.	Fast Coking.
Moisture	·420	·420
Volatile combustible matter	34·962	37·110
Fixed carbon	59·993	57·845
Ash	4·625	4·625
	100·000	100·000
Sulphur	.95	.95

As compared with the analysis from the Victoria seam coal, it is decidedly more bituminous, and contains less sulphur. From its behaviour under analysis it should in practice yield a good volume of illuminating gas, of a fair candle power. The coals are alike in their moisture and ash contents. The coal yielded a bright and coherent coke. In practice, small amounts of coke are burned at this mine in beehive ovens, and the article produced is of good quality, which would be improved if its manufacture were carried on continuously.

I put here, side by side, two analyses of the ash of these coals,

one made by me some years ago, the other made by the late Dr. How:—

	Victoria.	Sydney.
Iron peroxide	56.543	51.33
Alumina	6.456	4.84
Insoluble residue	27.500	29.50
Manganese	1.930	....
Magnesia	.035	.23
Lime	2.598	3.05
Lime Sulphate	....	10.98
Sulphuric Acid	3.790	....
Phosphoric Acid	.690	Trace.
Alkalies	.150	Trace.
Chlorine	....	Trace.
	99.693	100.00

3. Coal from Mabou, Inverness County.

This coal was regarded as an Anthracite. I am not aware of the age of the rocks it occurs in. Color black, and lustrous. Breaks with uneven fracture into irregular shaped pieces. In the fire kindles slowly, and burns without flame, yielding a fair heat. The ashes left is white, and retains the shape of the original piece as put on the fire.

On analysis, it yielded:

Volatile matter	2.73
Fixed Carbon	43.71
Ash	53.56
Sulphur	Trace.
	100.00

From its composition and its behaviour in the fire, it may be classified as a highly carbonaceous shale.

A similar mineral found at Lepreaux, near St. John, New Brunswick, was analysed by me some years ago, and proved to contain an amount of ash nearly equal to that of the Mabou sample. As the percentage of ash in an ordinary commercial

Anthracite of fair quality should not exceed 10 per centum, it will be seen that these deposits are far below the standard.

Cumberland County Coals.

The following analyses are of samples of coal from seams opened out recently by Mr. E. Sharp, and others, of Amherst, at Stanley, a short distance east of the Styles' mine. The samples were all from the crop, and more or less covered with clay.

4. Sample No. 1, marked from "North" Seam. Hard and compact, breaking with a cubical fracture; color black, with a bright lustre; no visible pyrites, and no mineral charcoal on deposition planes. Its composition was:

Moisture	2.35
Volatile combustible matter	35.86
Fixed carbon	53.36
Ash	8.43
	100.00
Sulphur	.52

Coke moderately compact by fast coking. Sample kindled readily, and burned with a long white flame, and gave a moderate amount of smoke.

5. Sample No. 2. Marked "Bottle-Glass" Seam.

Coal fairly compact, hard, and breaking with a conchoidal fracture; color black and lustrous, with a few thin, dull layers; streak black. A few visible crystals of pyrites and a little mineral charcoal. The partings held a few films of rusted calcic carbonate. Composition:

Moisture	3.82
Volatile combustible matter	30.15
Fixed carbon	56.13
Ash	9.90
	100.00
Sulphur	.75

Coke slightly coherent by fast coking; sample ignited readily and burned with a moderate amount of smoke.

6. Sample No. 3. Marked "Canneloid Coal from upper part of Eight-feet Seam."

Coal hard and compact, with cubical fracture; color dull black, with brownish-black streak. Burned with clear white flame, and left an ash equal in bulk to the original fuel.

It yielded:

Volatile matter	36.50
Ash	63.50
	100.00

This composition represents a moderate amount of volatile combustible matter.

7. Sample No. 4, marked "Bench of Eight Feet Seam."

Coal fairly bright and compact, fracture uneven; a little mineral charcoal and a little visible pyrites.

Composition:

Moisture	4.10
Volatile combustible matter	29.85
Fixed carbon	59.13
Ash	6.92
	100.00
Sulphur	1.25

Coal burned readily with good flame.

8. Joggins Main Seam.

Coal bright and lustrous, breaking with little dust and a cubical fracture. The planes hold a few films of calcspar and pyrites. A sample representing both benches yielded:

	Slow Coking.	Fast Coking.
Moisture	1.115	1.115
Volatile combustible matter	32.582	34.050
Fixed carbon	60.013	58.565
Ash	6.290	6.290
	100.000	100.000
Sulphur	1.25	1.25

Some years ago, in a paper read before the Montreal meeting of the British Association for the advancement of Science, I gave the average composition of the coals of the Cumberland coal field as folllows:

Moisture	1.46
Volatile combustible matter	33.69
Fixed carbon	59.35
Ash	5.50
	100.00

From this it will be seen that the seams of coal represented by the analyses given in this paper compare favorably with the average.

9. Magnetic Iron Ore, from Kemptville.

Metallic iron	58.20
Silicious matter	11.50
Sulphur and Phosphorus	Traces.

The ore is said to occur in a vein three feet wide.

10. Sample of Red Hematite from Greener Mine, George's River, Cape Breton County.

Vein said to be from six to nine feet wide, and is situated on high ground, near deep water on the Bras D'or Lake. As will be seen from this analysis, the ore is of excellent quality. The rock in which it is found is, I believe, of Lower Silurian age. The slates, etc., composing this horizon are in this locality very full of finely disseminated peroxide of iron.

Moisture	1.10
Iron oxide	89.30
Silicious and clayey matter	7.82
Lime	.67
Magnesia	.88
Phosphoric Acid	.20
Sulphur	Trace.
	99.97

Metallic Iron	62.50
Phosphorus	.09
Sulphur	Trace.

11. Manganese Ores, Walton.

Soft Black Ore.

Manganese (available oxide)	90.15
Iron Oxide	2.55
Barytes	1.12
Moisture	2.05
Silica	2.80
Phosphoric Acid	1.02
Lime Carbonate	Tr.
	99.69

Hard Brown Ore.

Manganese Oxides	85.54
Iron Oxide	1.18
Barytes	.89
Silica	3.27
Phosphoric Acid	.34
Moisture	8.54
	99.76

12. Sample of Limestone, Pictou County.

Carbonate of Lime	85.25
Silcious matter	7.00
Water	.95
Sulphur	Trace.
Phosphorus	"
Iron, Manganese, Magnesia, Alumina	6.80
	100.00

The limestone may be considered as of fair quality, and adapted for use in the process of iron smelting.