Geology of King's County." *Trans.* 1877–8. In my paper "On the Superficial Geology of Halifax and Colchester Counties," read last session, I recorded other investigations. In the present paper is a record of the last steps which I consider necessary for the solution of the problem. By going *beyond* Nova Scotia, I have done more than I expected to accomplish.

ART. V.—AN ANALYSIS OF A PICTOU COAL SEAM.

By EDWIN GILPIN, JR., A.M., F.G.S., M.R.S.C. *Inspector of Mines.*

(Read April 9, 1883.)

THROUGH the courtesy of Mr. H. A. BUDDEN, Vice-President of the Intercolonial Coal Mining Company, I am permitted to lay before you the following analysis of a seam of coal, recently opened by them at Westville, Pictou County. Through the kindness of Mr. ROBERT SIMPSON, General Manager of the Company, who furnished me with a complete column of the seam, I was enabled to make a very careful and exact measurement of the various layers comprising the seam.

The following is the section of the seam in inches and tenths of an inch, beginning at the top:—

	INCHES.		INCHES.
Coal, coarse and shaley	....	....	5·4
" good, with two thin layers of shale, each 1-20th of an inch thick	4·4	....	....
" good, but coarse	6·7	....	....
Shale	....	....	·2
"	....	....	1·7
Coal, good	6·3	....	....
" shaley, with nodules of iron pyrites.	·5	....	....
" good, with four bands of shale, up to one-half inch thick	1.4	....	....
Shale	....	....	6

	INCHES		INCHES.
Coal, with bands of shale	....	....	·9
" good	4·7	....	....
" coarse and shaley	·8	....	....
" coarse	·8	....	....
" good	2.8	....	....
" " with several fine layers of shale	1·2	....	....
" "	5·6	....	....
Shale, with films of calcspar	....	....	.2
Coal, good	4·8	....	....
" with layers of shale	....	....	.9
" coarse with nodules of iron pyrites.	....	....	2·8
" good, with films of calcspar	4·0	....	....
" with layers of shale	....	....	1·8
Shale	....	....	·1
Coal, good	6·0	....	....
" shaley, with films of calcspar	....	....	3·0
" coarse, with spirorbis, etc.	....	....	1·0
" shaley	....	....	·2
" good	9 8	....	....
" coarse, a few layers of shale	2·0	....	....
" good	2·0	....	....
" good, with films of calcspar, and a few nodules of iron pyrites	7·1	....	....
Shale	....	....	·1
Coal, good	13·2	....	....
" " with layers of shale	.2	....	....
" " with a few nodules of iron pyrites	13·0	....	....
TOTAL.....*Coal*	97·3	*Shale*	19·0

This succession of layers presents some points of interest on which I would say a few words.

In no point do coal seams differ more than in the number and size of the included layers of shale. The Vale seam, in Pictou County, presents, at numerous points through the mine, a section in which no bands of shale can be detected. Other seams

contain them in varying proportions, sometimes to such an extent that the coal is rendered valueless for economic purposes. Almost the only value these bands of shale possess, is their record of the progress of growth of the associated coal. Applying the record of the numerous small bands of shale and shaley coal found in the seam under consideration, we learn that the growth of this deposit was not an uninterrupted one. Scarcely had the vegetation for a few inches of coal been accumulated, when a change took place, and it was covered by a layer of mud.

It is useless, perhaps, now to speculate how this covering was formed, perchance the shelter of some bar was broken, and for a season the tides could deposit their burden, or some nameless river of bygone days became obstructed and flooded the swamps, in which grew the weird vegetation of the carboniferous era.

Then, again, the vegetation accumulated to be once more interrupted. The presence of layers of coarse and shaley coal shows that the transition from a flourishing vegetation to a mud-laden flat was, in some cases, a gradual one, due, perhaps, to periodic inundations. Similarly the return to the conditions favourable to the growth of the coal plants was sometimes a slow one, as the struggle between land and water was year after year more and more in favour of the vegetation.

Thus grew our coal deposits, subject to the fluctuations of the district, and when the miner's pick thus reveals page after page of this wondrous history, it is not unreasonable to hope that some time they will be deciphered even more readily and with greater certainty than the changes now progressing around us.

So far as I am aware, it is noticeable that in all seams these layers are composed of very fine material, that never have the conditions of growth been so abruptly altered as to allow gravel or conglomerate to intervene. Such intercalations might, however, be observed in seams formed on the edges of productive districts where changed physical conditions held sway. So strongly marked were the general conditions of wide spread levels of vegetation during the productive period, that we find, even when oscillations permitted

streams to cut through coal beds, they carried only the finest sediments. An illustration of this recently came under my notice in the Cumberland district, where a brook of the carboniferous period had eroded the coal down to and partly through the underclay, the "want" being filled with a fine laminated gray shale. This is also interesting, for from the abrupt passage from coal to shale it is apparent that even at that early date in the history of the future coal bed it must have acquired a certain amount of coherence, enough to form the banks of even a sluggish stream.

There is another interesting point in connection with coal seams which I have not yet seen referred to in any books on this subject. That is the influence of the water and land surrounding the coal producing district upon the purity and homogeneity of the resulting coal bed. It is frequently found by the miner that, as he follows the seam, it changes its character. At first he was proud of the absence of "bands and balls" and of the facility with which he could supply pure coal. Gradually he finds that the bands of shale grow larger with ominous persistence. At last he awakens to the fact that his coal is getting "boney;" finally it proves unmarketable, and he turns his levels in another direction.

Sometimes trial-pits and bore-holes in advance prove that the coal has become a mere mass of carbonaceous shale, or that the seam has ceased. These changes may frequently be explained by the proximity of the vegetation to an arm of the sea or to a river, so that the deposition of mud from floods, etc., at first slight, becomes greater, both in the form of bands, and of a general addition of clayey and silicious matter. Finally a point is reached where the conditions of coal deposition ceased. In some cases the proximity of land covered by sand, which was carried by prevailing winds upon the accumulating vegetation, may explain the presence of an excessive amount of ash in seams not holding bands of shale. It may also have been possible that both these causes united to the deterioration of seams of coal.

This would show that some of the beds were formed in what might be termed broad shallow basins, in the centre of which is

found the purest coal, and that it gradually deteriorates each way. The presence of "barren" intervals is of importance, for much money has been spent in examining and proving these marginal districts, when a step further might have resulted in the discovery of workable beds.

The coal from this seam presents a finely-laminated appearance, with a fairly bright lustre, and breaks readily along the deposition planes, which are of a dull black colour, and hold a good deal of mineral charcoal. It is strong and forms little dust or slack. The coal is divided by two cleavage planes, obliquely inclined toward each other, causing it to break into rhomboidal pieces. It is comparatively free from iron pyrites, which is present in small nodules in several divisions of the seam.

The following proximate analyses were made by me on the fresh mined coal carefully sampled as it came from the face. The seam was divided into two portions,—the top comprising 34·4 inches, the lower 89·9 inches.

	Top Coal.	*Low'r Coal.*
Moisture	1·24	·95
Volatile combustible matter.—Fast coking	31·00	23·31
" " " Slow "	27·56	20·52
Fixed Carbon.....Fast "	46·23	60·29
" " .....Slow "	49·67	63·08
Ash	21·53	15·45
Sulphur (from pyrites)	·63	.939
Specific gravity	1·50	1·390
Theoretical evaporative power—Fast coking	6·35	8·28
" " " Slow "	6·83	8·66

The ash from both divisions is the average of two determinations, and is silicious, and of a light gray colour. The specific gravity is from the average determined for each larger layer of coal. The coal in each division did not coke by slow heating, that from the lower division was fairly coherent by fast heating. It may be remarked that an opinion as to the economical coking values of coals formed on their action in the crucible cannot be relied upon for a guide as to their yield in practical coking.

It will be noted that the percentage of ash in the top coal

injures its use for general purposes; it can, however, be utilized for colliery work, to the economy of the better coal. The coal from the lower portion is equal to the average of that mined in Pictou County. The theoretical evaporative power compares favorably with that of the coals from the various counties of the Province, as will appear from the following table:

Pictou Co'y, average of	5	coals.	Theoretical evaporative power		8·66
Cumberland Co., "	3	"	"	"	8·32
Cape Breton " "	12	"	"	"	8·56
Inverness " "	2	"	"	"	7·60

The average evaporative power of the lower part of the seam under consideration is 8·47. All the evaporative powers are calculated by REGNAULT'S formula, for comparison with the admiralty coal trials, although later researches have somewhat altered the values determined by him. The table is taken from the analysis given in my paper on "Canadian Coals," published in the transactions of the North of England Institute of Mining Engineers, for the year 1878.

ART. VI.—ON THE RESISTANCE TO THE PASSAGE OF THE ELECTRIC CURRENT BETWEEN AMALGAMATED ZINC ELECTRODES AND SOLUTIONS OF ZINC SULPHATE. BY PROF. J. G. MACGREGOR, M.A., D.Sc., F.R.S.E.

(Read April 9th, 1883.)

AFTER attention had been directed to the measurement of resistance by the establishment of OHM'S Law, the question was raised whether or not there was at the surface of separation of conductors of different substances a special resistance to the passage of the current, such that the current was weakened by the mere transition from the one conductor to the other. POGGENDORFF* settled this question for metals by so arranging two circuits

* Pogg. Ann. LII (1841).