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GEOLOGICAL REPORT,

For 1867-1868,

BY

SIR W. E. LOGAN, F.R.S., F.G.S.,

LATE DIRECTOR OF THE GEOLOGICAL SURVEY,

ADDRESSED

TO THE HONOURABLE JOSEPH HOWE, M.P.,

SECRETARY OF STATE FOR THE PROVINCES.

MONTREAL, 20th December, 1869.

SIR,

In May last I had the honour of presenting to the Government a Summary Report, 1868. Summary Report of the Progress made in the Geological Survey for the years 1867-1868, stating that there had just before that time been received from my various assistants detailed reports of their work, which would be transmitted after due study had been devoted to them.

Of these detailed Reports, I have now to transmit to you by the hands of Detailed Reports. my successor, Mr. A. R. C. Selwyn, the Report of myself and Mr. E. Hartley, on a portion of the coal field of Pictou, Nova Scotia; that of Mr. J. Richardson, on the Lower Silurian rocks occupying the south side of the St. Lawrence, between the Chaudière and the Rivière du Loup, in the Province of Quebec; that of Mr. H. G. Vennor, on the Laurentian rocks of the counties of Addington, Hastings and Peterboro, in Ontario; that of Mr. C. Robb, on the deposits of a region comprising chiefly the counties of York, Carleton and Victoria, in New Brunswick; and the Report of Dr. T. Sterry Hunt, on various points of geological and chemical economics.

To these Reports are added one by Mr. R. Bell, on the rocks of those islands of the Manitoulin group which are situated to the west of the Grand Manitoulin. This Report embodies the results of an exploration made in 1866, the mention of which was accidentally omitted in the Summary Report.

REPORT

ON A PART OF THE PICTOU COAL FIELD, NOVA SCOTIA.

Pictou coal
field.

It has already been stated in the Summary Report of May last, that the portion of the Pictou coal field to which the time of Mr. Hartley and myself was devoted in 1868, was that which lies southward of New Glasgow, and extends several miles on each side of the East River; and that while the examination of the west side was wholly committed to Mr. Hartley, that on the east side was undertaken by myself. During the season which has just passed however, Mr. Hartley has added many facts to those previously collected by myself on this side, and these will now be embodied with my own.

Acknowledg-
ments for as-
sistance.

All the more important collieries in active operation near New Glasgow, are situated on the west side of the river; and it will be observed by Mr. Hartley's Report that he has had to thank the managers of these collieries for the ready assistance they universally afforded him in facilitating his work, by pointing out facts of interest, and supplying him with plans shewing under-ground excavations and topographical details on the surface. I have to express my obligations also to many persons for information, both oral and documentary, on the east as well as the west side of the river, and among them are Mr. J. B. Moore, Mr. J. P. Lawson, Mr. R. G. Haliburton, Mr. L. R. Kirby, Mr. Alex. McKay, Col. R. B. Sinclair, and Mr. J. R. Jackson. Mr. J. Rutherford, the Provincial Inspector of Mines, amongst other important information, obliged us with written descriptions of the boundaries of the various coal areas which have been leased by the Provincial Government; Mr. W. A. Hendry, Deputy Commissioner of the Crown Land Department, was so kind as to present us with a manuscript map shewing the positions of these areas and their proximate relations to some of the topographical features of the country, and Mr. H. Y. Hind supplied us with chain measurements of some of the roads and rivers. We are indebted to Mr. Jno. Weir and Mr. Alex. McBean, practical colliers, for pointing out to us various local facts of an important character with which they had become acquainted in the course of their experience; Mr. Thos. Lawther, by permission of Mr. Daniels of the Marsh Colliery, supplied us with information of the same kind, and all the farmers and inhabitants of the country were found to be most ready to assist us as far as they could.

The structure of this part of the Pictou coal field is of a very complicated character. While it is much covered with drift, it is disturbed by

undulations and broken by important faults, and to acquire even a proximate knowledge of the arrangement of its strata it was found necessary to measure, by compass and pacing, almost all public and private roads, as well as footpaths and streams. In constructing a map of the district, these have been kept in place by their relations to such of the straight boundary lines of the areas as we have had an opportunity of following; which lines, as given by Mr. Rutherford, have been assumed to be correct both in bearing and length. We have taken the coast and the navigable parts of rivers, as given on the Admiralty charts; and with a view of further binding our work together, Mr. W. B. Leather, C. E., was employed to measure, by theodolite and chain, a line from the East River to Sutherland's River, the direction being from the New Glasgow bridge on the former, by the old Merigomish road over Fraser's Mountain, to the lowest bridge on the latter. Mr. Leather has further assisted us by furnishing other lines, which he has had occasion to measure by theodolite, on both sides of the river. From these elements we have endeavored to construct a map on the scale of twenty chains to an inch. This may be presented at some future time; in the meanwhile its place is supplied by a plan on the scale of an inch to a mile, for the purpose of explaining the structure.

Measurements
by Mr. W. B.
Leather, C.E.

In the limited district in which we have worked there appear to be rock masses of four distinct horizons, more or less proximate. These are in ascending succession:

Series of forma-
tions.

- 1.—Conglomerates, quartzites and compact slates, (Devonian.)
- 2.—Greenish-gray and red sandstones, with
conglomerates and impure limestones.
- 3.—Red coarse conglomerates.
- 4.—Productive coal measures.

(Carboniferous.)

1. CONGLOMERATES, QUARTZITES AND COMPACT SLATES.

On the east side of the East River, about four miles southward of New Glasgow, there rises a hill which runs eastward to Sutherland's River, and is transversely cut into two parts by the valley of McLellan's Brook. Of these the western is called Weaver's or McGregor's Mountain, while the other is termed McLellan's Mountain. Rocks of the series about to be described probably compose both hills, but it is in the last named that they have been observed by me. No exposure has been met with which gives all the members of the series in regular succession, nor is it certain which is the upper and which the lower part of what has been examined, the dip being always very obscure. On the north flank of McLellan's Mountain there is met with, belonging to this series, a dark leek-green slate, in some places compact, as on the south side of St. Mary's road, about 750

Pre-carbonifer-
ous rocks.

McGregor's
Mountain.
McLellan's
Mountain.

Green slates.

paces southward of the house of Mr. Donald McLean (John's son), on a small mountain stream. A similar green slate is seen on Sutherland's River, at Park's Mills, but much of it is of a scaly character; and it is conspicuous from the opaque white surface it presents when weathered.

Quartzites.

On the same side of the hill, light and dark gray or nearly black, as well as olive-green quartzites, occur in several places, and a good instance of them presents itself at the bridge over a tributary of Sutherland's River, crossing the road already mentioned about half a mile from McPherson's mills.

At the edge or brow of the hill, south of the house of Mr. Finlay McDonald (John's son), and near the mountain road, a rock of a greenish colour is composed of feldspar with fine grains of quartz; loose angular masses of an epidotic character lie about, and some of a porphyroid aspect, reddish in tint, holding epidote and disseminated small masses or crystals of white feldspar. Some angular fragments of the rock shew a purplish slate attached to them, and flakes of a bluish slate are enclosed in the rock in place. In some parts there appeared to be an obscure indication of stratification, the dip being N. 13° W. $<40^{\circ}$ *; but the beds are so closely soldered together as to be undistinguishable except by slight differences of colour on the weathered surface. The rock here has different planes of cleavage, the underlie of one set being S. 3° E. $<61^{\circ}$, and of another S. 63° E. $<69^{\circ}$.

Red conglomerates of McLellan's Mountain.

In several places between this and McLellan's Brook the ridge of the hill presents a firm reddish conglomerate, with an arenaceous-feldspathic base, enveloping pebbles of various sizes up to an inch in diameter, of white, reddish and yellowish quartz, with others of a Venetian-red jasper and indurated slate, and many of white feldspar. The rock is strong and hard, and does not disintegrate rapidly in the weather, but the pebbles are very distinct on weathered surfaces. The rock is of this character on the summit, behind the residence of Mr. Alexander McLean, sen. On the summit, about three quarters of a mile west, it is composed of the same materials; but it is somewhat paler in colour, from the presence of more feldspar, and it appears to be finer grained.

* The bearings in this Report are given in relation to true north, the variation for magnetic north being $23^{\circ} 15'$ to the west. Practical colliers and others accustomed to use compass bearings only are particularly requested to keep this in mind, as otherwise they may be perplexed at finding the bearings in the Report so different from what they might expect. Magnetic bearings are not adopted, because these change annually, the change at present being an increase of $0^{\circ} 7'$ a year.

It is to be regretted that the boundary lines of the coal areas have all been run by compass instead of astronomically; the consequence is that to follow them it is necessary to know not only the original bearing of the line, but the year when the survey was made. In old surveys the difference is such that without knowing the date, which is never stated on the plans in general use, it becomes a matter of great difficulty to trace the lines on the ground, particularly through swamps and parts encumbered with brush-wood.

At the western end of McLellan's Mountain, near the residence of Mr. Robert Campbell, much of the rock is a dark gray or blackish fine grained grit, with a rough exterior and trappoid aspect; while some of it is a fine grained pistachio-green altered sandstone, with a ragged earthy fracture and gritty surface. Associated with this is a mottled green and flesh-red felsite, holding epidote, and a granular feldspathic rock, opaque white and crumbling in weathered parts, while it is much veined with white quartz.

Beyond this, southward, the rock becomes a coarse conglomerate of a mottled red and green, in some parts reddish-black, and chocolate-red in others. Some of the inclosed masses are six inches in diameter, composed of moderately coarse grains of a reddish and white feldspar and translucent quartz, with brilliant points, which seem to be micaceous specular iron ore. Some of the pebbles weather to a brick-red and orange-vermillion, very brilliant when wet. The whole rock is cracked in all directions, in fact brecciated. The sides of the cracks and the surfaces of some of the quartz pebbles are unctuous from a coating of specular iron ore. Some of the cracks shew slickensides, and some are filled with a brown manganesian powder.

Not only was this conglomerate brecciated, but so was every mass of all the series wherever met with, and to such an extent that, after hundreds of attempts, not one specimen could be dressed into an oblong shape of four by six inches, some blow of the hammer always shivering it in unexpected directions into irregular fragments, from concealed cracks.

In the locality last named, the coarse brecciated conglomerate is followed on the south side by a south-dipping band of limestone, which has been quarried for 120 paces on the strike, near the house of Mr. Alex. Fraser. The limestone exhibits fossils, one of them being *Spirorbis carbonarius*, and belongs to the succeeding series; and there may be some doubt whether the coarse conglomerate should not be classed with it. But including this conglomerate, the older rocks have here a breadth of 650 yards, and are limited on the north by the productive coal measures, dipping northward.

No evidence was observed by me, on McLellan's Mountain, to shew to what epoch these older rocks belong; but masses somewhat similar are noticed by Mr. Hartley on the west side of the East River, in a position where they have been mentioned in his *Acadian Geology* by Dr. J. W. Dawson, who considers them to be of Devonian age, and on his authority they will be so distinguished.

2. GREENISH-GRAY AND RED SANDSTONES WITH CONGLOMERATES AND IMPURE LIMESTONES.

This series of deposits appears to constitute a part of those which in his classification of the section examined by me at the Joggins, on

Millstone Grit.

Bonaventure
formation.

the Bay of Fundy in 1843, and published in the first of the Canadian Geological Reports in 1845, Dr. Dawson, in his *Acadian Geology*, has called the Millstone Grit, corresponding, though somewhat different in aspect, to the Bonaventure formation of Gaspé in the Province of Quebec, and to the Millstone Grit of England. On this side of the Atlantic it might appropriately be termed the Grindstone grit, as at the Joggins it yields, in large abundance, the excellent grindstones for which Nova Scotia is celebrated.

Rocks at foot of
Fraser's Mountain.

The largest spread of it observed by me on the east side of the East River, occupies a triangular area, of which the western apex occurs near the house of Mr. John Jack, at New Glasgow. From this, one side of the triangle runs along the south foot of Fraser's Mountain towards Merigomish Harbour, while the other has its course near the houses of Messrs. J. Mackay, Murdoch Ross, William Love and Alexander Fraser, and crossing Olden's road would reach Sutherland's River, above Ross's bridge, where the extremities of the base would be about two miles apart.

Limestone with
fossils.

It was also observed on McLellan's Brook, south of the limestone mentioned as having been quarried near Mr. Alex. Fraser's. Of this band of limestone, which is shewn by its organic remains to belong to this series, the following is a descending section :

	Ft. in.
Red flaggy sandstone of a free grit.....	2 6
Red arenaceous limestone, spotted with small masses of greenish limestone	0 6
Reddish striped nodular limestone, resembling a conglomerate of greenish limestone gravel having its interstices filled up with fine red sand...	1 6
Reddish limestone of the same character, but holding more of the calcareous nodules, some of which contain <i>Spirorbis carbonarius</i>	3 2
Gray good limestone, in some parts mottled with red; it is compact in texture, and gives a conchoidal fracture. In a piece of limestone which had been quarried out of the bed, was observed a fragment of a spiral shell about half an inch broad at the base.....	11 0
Red arenaceous shale.....	1 0
	19 8

Limestone, Mc-
Lellan's Brook.

The dip of this bed is S. 2° W. <42°. As already stated it has been quarried for about 120 yards on the strike, which would be N. 88° W. On the left bank of McLellan's Brook, about half a mile from the quarry, and about ten or eleven chains north of the point where this bearing would reach a sharp elbow of the stream, there occurs an exposure of gray limestone, which, although at one part in contact with red shale or slate, does not afford the means of clearly deciding its attitude or associations. Being without fossils, it was not found possible to make out whether or not it was the same bed as the one above described or one enclosed in the older red rock. As far as I could judge, the dip appeared to be N. 22° E. <68°, and the thickness about seventeen feet.

Farther up the brook, about thirty-three chains in a straight line, there occurs another calcareous band, which, with its associated strata, dips S. 1° E. < 44° - 54°. A descending section at the spot is as follows:

Limestone McLellan's Brook.

	Ft.	
Red sandstone of free grit, interstratified with layers of red shale.....	15	Red sandstone.
Red sandstone of a free grit.....	15	
Red sandstone interstratified with thin bands of gray limestone, weathering to a straw-yellow.....	9	
Gray limestone with interstratified yellow-weathering calcareous layers.....	4	
Gray compact limestone with a conchoidal fracture.....	8	
Red sandstone and red shale.....	45	

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Though no fossils were observed, it is not doubted that these strata are Millstone Grit; but it is not so certain with what series to class the rocks between this calcareous band and the one farther down the stream. Of these intermediate rocks there are three exposures, with intervals of concealment. They all consist, more or less, of a brecciated red and green coarse conglomerate, similar to that north of the limestone near Mr. Alex. Fraser's. Some of the inclosed masses are a foot in diameter, and among the smaller masses was observed one consisting of reddish orthoclase feldspar, with cleavable faces of an inch in diameter. Some parts of the exposures consist of red jaspery, fine-grained, argillaceous sandstone, harder than the usual strata of the Millstone Grit series, and others appeared to be a jaspery slate. The brecciated character of all these exposures makes it extremely difficult to determine the dip; but that of a bed of slate within seven chains of the more northern band of limestone seemed to be N. 37° E. < 37°. If the brecciated rocks between these limestones, and the brecciated conglomerate north of the limestone near Fraser's both belong to the Devonian series, there would appear to be a dislocation running along the valley of McLellan's Brook in this part, the conglomerates of the brook being more to the south than those near Fraser's.

Brecciated red and green conglomerates.

At a bridge about a quarter of a mile above the southern band of limestone, red sandstones of a free grit, computed to be about eighty feet thick, and belonging to the Millstone Grit dip N. 61° W. < 20°, and show the irregular arrangement of the strata.

In the already mentioned triangular area of this formation, which is overlooked by Fraser's Mountain, the most continuously exposed mass of strata observed was in the channel of Pine-tree Brook, between the property of Mr. James A. Fraser and Pine-tree Gut. The total thickness of this mass may be about 1,000 feet. The lower part appears to be a greenish-gray sandstone of a grindstone grit, interstratified with several bands of nodular limestone, by the people of the country, from its impurity, called *bastard limestone*, none of which appeared to be fit for burning. There

Pine-tree Brook.

Impure limestones.

may also be interstratified, in concealed intervals, some bands of red sandstone, but no indications of these were observed.

Greenish-gray
sandstones.

As an example of this lower part, an exposure on Mr. Jas. A. Fraser's land may be taken, where, between two bands of impure nodular limestone, dipping N. 7° E. < 34°, the lower about eighteen inches and the upper about three feet, there is included 270 feet of greenish-gray freestone of an even grain, well suited for building purposes. The rock appears to be composed of fine grains of whitish quartz and whitish feldspar, with small disseminated grains of a black colour, the composition of which is uncertain. Some of the beds are marked by circular spots of different sizes up to a foot in diameter, which appear to be sections of sub-globular forms, containing a good deal of calcareous matter. These are of a lighter gray than the surrounding stone, and though much harder, yield more readily to the solvent power of the weather, and therefore present slight depressions, which wherever several small spots are together, give a fretted aspect to the surface. The proprietor calls them *bulls' eyes*. In the strike of the upper calcareous band a sink-hole was observed, the bottom of which, though dry, appeared to be lower than the level of the neighbouring brook.

About a third of a mile down the brook there is another exposure about ninety feet above this. It consists of the same sort of greenish-gray freestone, and with a thickness of about 130 feet is surmounted by another band of impure nodular limestone of eight inches, supported by a couple of feet of a light gray calcareous sandstone, similar in aspect to the material of the *bulls' eyes*. Farther down the brook, and about 100 feet higher in the series, there is another mass of greenish-gray freestone of about twenty feet, which has been quarried, to a small extent, for building stone. The whole of these beds, making about 600 feet, have in the distance of more than half a mile a pretty regular average dip of N. 20° E. < 33°, and occupy a breadth of about thirteen chains.

Pine-tree Gut.

At the junction of this brook with Pine-tree Gut, on the left side of the stream, what is called Pine-tree Bank, a wooded cliff of about fifty feet in height, presents at the base about fifteen feet of gray freestone in massive beds of from three to five feet thick. A quarry has been opened in it about seven feet above the level of the water. The quarry stone has a face of six feet, and there are eighteen inches in the middle which would yield good flagstones, while the remainder would furnish building stones of excellent quality. In the cliff above this, thick bedded red sandstones occupy twelve feet, and red shale or marl and red flaggy sandstones about twenty feet more. At the edge of the cliff, a few feet above this, there was pointed out to me by Mr. J. Weir a layer of about an inch thick, which it was supposed might be a coal seam; but observing it had beneath it a bed of sandstone, without any indication of *Stigmaria*, a

Gray and red
sandstones and
shales.

close examination shewed that it was only a layer of drift plants, the bark of which had yielded the coal. A band of impure nodular limestone was obscurely seen above it. The dip is here N. 33° W. $<14^{\circ}$. Drift plants.

What is supposed to be a continuation of the gray freestone at the foot of the cliff, occurs about twenty-five chains to the eastward, on the telegraph road, at the bridge over the south branch of the brook, where a flagstone quarry, formerly worked, became covered up in the construction of the road. A bed of impure nodular limestone underlies the rock a few feet, and it appears probable that the old quarry here may occupy the same horizon as that at the summit of the series of beds already described further up Pine-tree Brook.

North of the old quarry, and eighty or a hundred feet above it, the interval being made up apparently of the red rocks of the upper part of Pine-tree Bank, and additional strata of the same character, another band of greenish-gray freestone, fit for building purposes, occurs on the land of Mr. J. Weir. It is probably between twenty and thirty feet thick, and is succeeded by red sandstones and shales, which occupy the channel of Pine-tree Brook up to the dam of Weir's mills. These red strata, about 200 feet in thickness, are succeeded on the road, close by the mill-pond, by a few feet of greenish-gray sandstone, with another band of impure nodular limestone. The whole series of strata thus described on the lower part of the brook, occupies a breadth of about twenty-eight chains, with an average dip of N. 23° W. $<12^{\circ}$, giving a total thickness of about 400 feet. Pine-tree Brook.
Weir's mills.

Proceeding westward, these upper strata gradually assume a dip eastward of north, and at the distance of about a mile in a straight line from Weir's mills, some of the red sandstones are seen on the telegraph road, dipping N. 7° E. $<31^{\circ}$, conforming well with the lower mass of strata in the vicinity of Mr. J. A. Fraser's, the breadth they occupy being somewhat diminished from the increase of slope. Here the upper beds come close upon the flank of Fraser's Mountain, composed of the conglomerates of the third series, towards which they dip all the way to New Glasgow. On Mr. A. McGregor's land, one of the bands of impure nodular limestone is seen at the foot of the hill, about eighteen chains north-eastward of the telegraph road, and the conglomerates of the hill crop out only a short distance north of it. A. McGregor's
impure lime-
stones.

Farther westward, much drift covers the surface, but within a mile of New Glasgow the presence of red sandstone was ascertained by Mr. J. P. Lawson in a trial-pit sunk twenty-nine feet through red clay, about thirty chains north-eastward of the old straight road running S. 63° E. from the Scotch Church. About twelve chains on the same side of this road, but more than a quarter of a mile nearer the church, greenish-gray freestone, in a shattered condition, occurs. It is overlaid by a band of impure nodular limestone, and at the junction there is a layer holding drift plants, Trial-pit on red
sandstone.

chiefly *Calamites cistii*. But this exposure is on the south side of the narrowing triangular area, which comes to a point where another shattered exposure of the same freestone was met with at the foot of the rising ground on which the house of Mr. J. Jack is situated.

South side of
triangular area.

On the south side of the triangle, upwards of a mile from the apex, still another shattered exposure of the greenish-gray freestone occurs, where this side of the triangle crosses the telegraph road. After an interval of about a mile and three-quarters, the next observed indication of the strata on this side is near the house of Mr. Murdoch Ross, where red sandstones are exposed with an uncertain dip. Farther on, red arenaceous strata were met with by Mr. W. Love in sinking a well near his house. Red sandstones are again seen on what is called the Pent road to the Marsh, at the foot of the hill descending from the house of Mr. Alexr. Fraser; but here also the exposure is obscure and the dip uncertain, and it is only on approaching Sutherland's River, near Ross's bridge, that the dip can be clearly made out from natural exposures, though the occurrence of red sandstones in place, is known in various trial-pits sunk on the St. Lawrence area by Mr. Haliburton.

Red rocks.

Section Ross's
bridge.

At Ross's bridge the following descending section occurs, the upper part being above the bridge and the lower exposed in a cliff immediately below it:

	<i>Feet.</i>
Red sandstone.....	50
Measures concealed.....	90
Red and brownish-drab sandstone.....	60
Brownish-red sandstone.....	60
Red and greenish-yellow mottled sandstone.....	180
Greenish conglomerate, with pebbles of a whitish quartzite and greenish argillaceous sandstone, spangled with small flakes of mica; all the pebbles are green externally. This layer is of varying thickness, from three inches to.....	1
Red shale.....	7
Red sandstone.....	2
Green shale.....	2
Green crumbling sandstone in thin bands, separated by green shale or more crumbling sandstone.....	4
Red sandstone and red shale.....	16
Yellowish sandstone mottled with green and red.....	14
Red and green mottled sandstone.....	4
Greenish sandstone mottled with red.....	9
Red sandstone.....	9
Red shale.....	5
Red sandstone.....	6

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These strata occupy a breadth of nearly a quarter of a mile, with a dip which, upon an average, is S. 23° E. < 24°, and the same attitude may

extend some distance farther down Sutherland's River. The dip is the reverse of that at Weir's mills, and between these places there must thus be at least one anticlinal form, and possibly more; but whether any rocks lower than the Carboniferous are brought to the surface in the interval has yet to be ascertained. Anticlinal,

3. RED COARSE CONGLOMERATES.

At the bridge of New Glasgow is exposed a series of conglomerates, which, in general colour, are between a brick-red and chocolate or Indian-red, and whose inclosed masses, varying from the smallest pebbles to boulders of two feet in diameter, are, for the most part, unmistakably derived from the red and greenish-gray sandstones, red shales and impure nodular limestones of the rock last described, some of them containing the same vegetable organic remains. With these pebbles and boulders are associated a few from the rocks still lower down. The whole are inclosed in a matrix of the same mineral character, constituting an argillo-arenaceous cement, which is also calcareous, and in the interstices of the boulders and pebbles is often observed a network of white calc-spar aiding to keep them together. There are interstratified in the rock, bands, from a few inches to several feet in thickness, of fine red sandstone and red shale, which serve to give assurance of the dip, and these occur at such distances apart as to render the conglomerate beds thick and massive, their transverse measure varying from ten to some times nearly 100 feet. New Glasgow conglomerates.

To this rock Dr. Dawson has given the name of the New Glasgow conglomerate. From a point a short distance above the bridge, to one much farther below, these conglomerates have a breadth of very nearly a mile, with a dip, which on the average is N. 3° — 13° W., with a slope gradually diminishing from 50° in the lower to about 30° in the upper part, and giving a total thickness of about 1,600 feet. As already indicated, this great mass of conglomerate composes Fraser's Mountain, towards the south flank of which, presenting the outcrop escarpment of the inferior part, the red and gray strata of the Millstone Grit dip in such a way as, without other evidence, to induce the supposition that the one series overlies the other conformably. But on the west side of the East River Mr. Hartley has evidence to show that there is a want of conformity, at least in some places. Thickness.

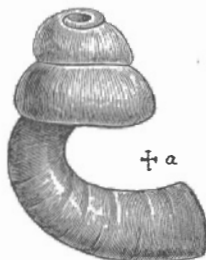
Three miles eastward of New Glasgow these conglomerates have a breadth, between their base, east of the house of Mr. A. McGregor, and their summit, on a property formerly belonging to Mr. William Fraser (Moose) of about fifty-four chains, and they are here immediately and conformably overlaid by the following ascending section: Moose Fraser's Concretionary limestone,

Section.		Fl. in
	Gray limestone which has been quarried for burning.....	20 0
	Measures concealed.....	10 0
	Bluish-gray slightly calcareous sandstone.....	5
Concretionary beds.	Bluish-brown concretionary limestone, the surface of which presents concentric botryoidal thinly laminated concretions, with grayish and red clay in the interstices and inequalities.....	10
	Gray and red clay.....	8
	Reddish concretionary limestone, with concentric botryoidal laminæ as before.....	1 0
	Whitish-gray limestone.....	1 0
	Gray and red mottled clay, resembling fireclay.....	1 4
	Gray flaggy sandstone.....	1 8
	Gray clay.....	6
	Whitish arenaceous limestone, holding abundance of <i>Spirorbis arietina</i> *.....	2 2
	Grayish-blue, spotted, slightly argillaceous sandstone.....	1 0
	Measures concealed, including several feet of underclay.....	24 0
	Coal and black carbonaceous shale, including about eighteen inches of good coal at the bottom, which used to be mined by Mr. W. Fraser, for the purpose of burning the limestone in the lower part of the section.....	4 5
		69 0

J. Small's
Concretionary
limestone.

The dip of these strata is N. 10° W. <47°, and very nearly on the strike this would give, they are again met with on a brook on the property of Mr. James Small, on the road to Little Harbour, Merigomish. The one locality is as much as three miles from the other; but the botryoidal concretionary limestone layers in both are so peculiar and so strikingly like in appearance, and in their relation to an overlying seam of coal, that no doubt can be entertained of their equivalence. At Mr. Small's the dip

* This is a new species, obtained by Mr. Hartley, who, with Dr. Dawson and myself, visited the locality in August, 1868, and the following is a description of it, kindly supplied by Dr. Dawson. The figure is magnified thirteen diameters, the natural size being shewn at a.



Spirorbis arietina.

Dawson's description of
Spirorbis arietina.

Spiral; sinistral; whorls four, the first three regularly spiral, and somewhat close, the last becoming irregular; cross section circular; shell thin, with delicate tubular structure, much finer than in *S. carbonarius*; surface uneven, with obscure wrinkles on the last whorl, and microscopic lines of growth on earlier whorls; apex flattened for attachment on first whorl only; length 1-10 to 1-8 inch (about 3 millimetres.)

of this limestone is about N. 23° W. <9°. The underlying conglomerate was not exposed; but there is no reasonable doubt of its occurrence beneath, and I have no evidence yet to shew that the mass is here of less volume than farther to the west.

The calcareous band with which these concretionary limestones are associated was not observed above the conglomerates on the East River, but immediately north of the position where they terminate, on the east side of the stream, after a concealed interval of 200 paces, they are succeeded by whitish sandstones, dipping north at an angle of 16°, which, a little way on, is reduced to 8°, and this low rate of inclination is maintained by the measures for a considerable distance toward Pictou, with an occasional flat undulation, reversing the dip. The apparent place of the limestone would be in the concealed interval in question.

Place of concretionary limestones on the East River.

4. PRODUCTIVE COAL MEASURES.

In the district which has engaged my special attention, the thick covering of drift so extensively concealing the strata, the dislocations which are known to affect these in some places, and the facts which suggest the probability of disturbances in others, while little has yet been revealed by crop workings, will make it difficult, for some time to come, to build up a column shewing a perfect series of the measures; and what is now offered is to be considered as only a distant approximation to the truth, to be improved hereafter as occasion may serve, and farther developments may occur.

Productive coal measures.

The most continuous exposure of the strata observed lies in the channel of McLellan's Brook, in which the rocks are bared, with short intervals of concealment, from nearly its mouth to the gap between McLellan's and McGregor's Mountains, and much farther beyond. But this section does not reach the highest strata, and some of the measures are repeated by an undulation. A portion of the beds, however, is seen nowhere else.

McLellan's Brook section.

The highest coal seam with which I have been able to connect the section, appears to me to be one of which the crop was ascertained by Messrs. McBean, on the dividing line between the first and second square mile of their three-mile area, going south-eastward, and about 250 paces from the stake at the south-western end of the line. Here there are five

The specimens described were found by Mr. E. Hartley, in limestone belonging to the coal formation, and immediately overlying the New Glasgow conglomerate. The occurrence of *Spirorbis* in this bed is mentioned in *Acadian Geology*, p. 326, but it is not distinguished from the ordinary *S. carbonarius*, from which, however, Mr. Hartley's specimens shew it to be very distinct. It is so regularly spiral that it might be mistaken for a gastropod shell; but its apex, flattened for attachment, and its microscopic structure, show it to be a worm shell. It was probably, like *S. carbonarius*, attached to submerged plants; but in the limestone above mentioned, it occurs loose in great numbers, having probably been drifted from its attachment. J. W. D.

Six-foot coal
seam.

small trial-pits and bore-holes in a distance of about eleven chains on the strike. In one of these, according to Mr. A. McBean, seven feet of coal were pierced under five feet of gravel, and in another five feet of coal under three feet of gravel, while the crop was touched in the others. The average strike of the crop is about N. 67° E., and the dip southward, but I am not able to state the rate of slope.

George McKay
four-foot seam.

A little to the west of north from this, at a distance of about twenty-two chains, reduced to a straight line, directly across the strata, Messrs. McBean sunk a trial-pit and bore-hole on the south side of St. Mary's road, not far from the house of Mr. J. McDonald (turner), penetrating, at the depth of twenty-feet, through four and a-half feet of coal. This they consider to be the same seam as that to which they sunk a pit about eighteen chains to the eastward of north from it, where it was four feet four inches in thickness, and identical with the seam which they worked by a slope about sixteen chains farther on the crop to the north-westward. This seam was previously worked by a slope about thirty-five chains still farther to the north-westward, by Mr. George McKay, for which reason it goes by the name of the George McKay four-foot seam. To the deep of McKay's slope, the Pictou Mining Company have sunk a shaft to this seam, at the Marsh Colliery, completed in October, 1868, and we thus have a section of part of the ground between McBean's six-foot and four-foot seams.

Marsh pit.

The inclination of the strata at McKay's slope is about 1 in 4, the dip at the mouth of the slope being N. 34° E., $<16^{\circ}$; but the measures appear to spread considerably, going round by the crop to St. Mary's road, and it is probable that the rate of dip there is not more than 1 in $4\frac{1}{2}$. This would give about 310 feet between McBean's six-foot and four-foot seams, and place the six-foot seam about ninety feet above the measures intersected in the Marsh pit. Combining these with what can be gathered from the Marsh Brook and McLellan's Brook, the following would be the series, as near as I can make it out from measurements by pacing, made by myself in 1868, and remeasurements by chain by Mr. Hartley in 1869.

Divisions and
sections.

For the convenience of comparison this whole series of deposits is divided into three parts or horizons—A, B, and C, and Sections under these are given in sequent numbers.

Division A, including Section 1.

Division B, including Sections 2, 4, 5, 6, 8.

Division C, including Sections 3, 7, 9.

SECTION 1. (DIVISION A.)

MEASURES INTERSECTED IN THE MARSH COLLIERY PIT.

Measures Marsh
pit.

	Ft.	In.	Ft.	In.	
Dark gray argillaceous shale.....	3	0	22	3	7
Gray impure fireclay.....	49	0	22	0	7
			52	0	
<i>Coal.—The Captain seam.</i>			171	7	3
Gray fireclay.....	4	10	16	8	7
Gray arenaceous shale.....	3	0	16	2	9
Gray solid sandstone.....	4	6	16	2	9
Gray argillaceous shale.....	8	9	15	6	3
			21	1	
<i>Coal.—A seam of inferior quality.</i>			147	6	1
Gray fireclay.....	4	0	14	5	10
Gray arenaceous shale.....	6	10	14	1	10
			10	10	
<i>Coal</i>			135	0	3
Gray fireclay.....	3	5	13	4	9
Gray arenaceous shale.....	7	10	13	1	4
Gray fireclay.....	2	0	12	3	6
Gray strong solid sandstone.....	24	4	12	1	6
Gray sandstone.....	18	6	9	7	2
Gray arenaceous shale.....	8	4	7	9	8
			64	5	
<i>Coal.—The Mill-race seam.</i>			70	4	
Cannel coal.....	0	9			
Mineral charcoal mixed with coal.....	0	3			
Good coal.....	2	1			
			3	1	
Gray soft fireclay, without divisions, holding occasional nodules of clay ironstone.....	17	6	67	3	
Gray flaggy sandstone, with thin black partings arranged in wavy layers.....	8	9	49	9	
Gray hard sandstone in one bed.....	6	0	41		
Gray shaly sandstone, with interstratified bands of gray hard sandstone of from one to four inches thick.....	19	6	35		
Dark gray argillaceous shale, with a few nodules of clay ironstone	11	9	15	6	
			63	6	
<i>Coal.—The George McKay seam.</i>					
Coarse shaly coal.....	0	3	23	7	
Good coal.....	3	6			
			3	9	
			223	7	

Mill-race seam.

George McKay
seam.

SECTION 2. (DIVISION B.)

MEASURES ON MARSH BROOK, FROM THE GEORGE MCKAY FOUR-FEET SEAM TO McLELLAN'S
BROOK.Measures Marsh
Brook.

	Ft.	In.	Ft.	In.
Gray fireclay, with great abundance of <i>Stigmaria</i>	3	0		
Measures not well ascertained, but supposed to consist chiefly of arenaceous shale and flaggy sandstone, with some black carbonaceous shale at the top.....	190	0		
			193	0

		<i>Ft.</i>	<i>In.</i>	<i>Ft.</i>	<i>In.</i>
Ten-inch seam.	<i>Coal.</i> — <i>The ten-inch seam.</i> A trial-pit has been sunk on the crop on the Marsh Brook.....				10
	Fireclay.....	2	6		
	Black carbonaceous shale, chiefly.....	90	0		
				92	6
Oil shale.	<i>Oil shale.</i> —A seam worked to a small extent in a trial-pit on Marsh Brook, sunk by Mr. Haliburton; the thickness is uncertain.			4	0
	Measures concealed.....	42	0		
	Black carbonaceous shale.....	5	0		
	Measures concealed.....	69	6		
	Light gray arenaceo-argillaceous shale.....	6	0		
	Black argillaceous shale not well exposed, there being many small intervals of concealment.....	72	0		
	Measures concealed.....	31	0		
	Dark bluish-gray argillaceous shale, not well exposed.....	20	0		
	Measures concealed.....	12	0		
	Black carbonaceous shale.....	16	9		
	Measures concealed.....	36	0		
	Black carbonaceous shale.....	10	0		
	Measures concealed.....	14	9		
	Black argillaceous shale.....	10	3		
	Measures concealed.....	26	8		
	Black carbonaceous shale.....	9	9		
	Measures concealed.....	2	9		
				384	5
Small coal seam.	<i>Coal, Cannel.</i>				3
	Gray fireclay.....	3	0		
	Light and dark gray fine grained flaggy sandstone.....	6	8		
	Yellowish-drab thick bedded sandstone, weathering rusty.....	8	0		
	Measures concealed.....	5	9		
	Yellowish-drab thick bedded rusty-weathering sandstone.....	4	8		
	Bluish-gray flaggy sandstone, with occasional carbonaceous partings.....	5	0		
	Measures concealed.....	38	0		
	Bluish-gray flaggy sandstone.....	1	0		
	Measures concealed.....	30	6		
	Yellowish-drab sandstone, in thin layers with false bedding, some parts weathering brownish-red.....	3	0		
	Measures concealed.....	4	5		
	Dark bluish-gray, brown-weathering sandstone, in some parts rust-brown.....	3	0		
	Dove-gray slightly arenaceous fireclay, weathering greenish-gray, and very soft when weathered.....	1	3		
				114	3
				0	0
Supposed coal seam.	<i>Coal.</i> —A seam supposed probable here.....				
	Measures concealed.....	7	5		
	Bluish-gray fireclay banded with dark gray, in layers from one-fiftieth to one-twentieth of an inch thick, the whole weathering dark brown or almost black.....	1	6		
	Measures concealed.....	13	0		
	Light bluish-gray argillaceous shale.....	0	6		
	Measures concealed.....	8	0		
				30	5
				819	8

SECTION 3. (DIVISION C.)

MEASURES ON McLELLAN'S BROOK FROM THE MOUTH OF MARSH BROOK TO
BLACK'S MILL-SITE.Measures Mc-
Lellan's Brook.

	Ft.	In.	Ft.	In.
Gray arenaceous shales and sandstones, some beds weathering purplish-brown or reddish.....	25	0		
Black carbonaceous shale.....	8	0		
Measures concealed.....	35	0		
Gray flaggy sandstone.....	3	8		
Measures concealed.....	79	0		
Very dark bluish-gray sandstone, extremely hard and fine grained and weathering brown.....	1	0		
Measures concealed, but there appears to be sandstone in the bed of the stream.....	32	0		
Black carbonaceous shale.....	28	0		
<i>Coal.</i> —A seam of hard coal but of fair quality.....			211	8
Very light gray fireclay, full of carbonized <i>Stigmaria</i>	2	6	7	Small coalseam.
Gray argillaceous-arenaceous shales and flaggy sandstones, passing into each other.....	16	0		
Whitish-gray very compact heavy bedded freestone.....	3	4		
Light and dark gray argillaceous shales.....	4	6		
Black coaly carbonaceous shale.....	2	0		
<i>Coal.</i> — <i>The Widow Chisholm seam</i> ,—off fair quality but hard.....			28	4
Yellowish-drab argillaceous-arenaceous very fine grained underclay with <i>Stigmaria</i>	2	3	1	0 Widow Chis- holm seam.
Dark gray compact sandstone, weathering rust-brown, full of <i>Stigmaria</i>	2	0		
Dark gray compact sandstone, weathering rust-brown, with occasional clay ironstone balls.....	3	7		
Dark yellowish-drab and brownish-drab sandstone, weathering rust-brown, in rather coarse thick beds.....	5	5		
Dark yellowish-drab and brownish-drab flaggy sandstones with very micaceous partings between some of the beds.....	25	0		
Measures concealed.....	14	6		
Dark yellowish-drab and brownish-drab flaggy sandstones shew- ing large casts of <i>Calamites cistii</i> , some of them four inches in width.....	2	0		
Measures concealed.....	2	3		
Dark yellowish-drab sandstones.....	9	6		
Dark yellowish-drab sandstones only partially exposed.....	49	0		
Dark yellowish-drab sandstones with false bedding and ripple- mark, and having black micaceous partings more con- spicuous towards the base.....	61	0		
Black semi-carbonaceous shale, with occasional clay ironstone balls.....	20	0		
Black highly carbonaceous shale, compact, with two sets of cleavage planes, dividing it into cuboidal blocks about one foot in diameter.....	5	0		
Purplish-gray fine grained sandstone.....	6	6		
Measures concealed.....	9	9		
Black carbonaceous shale.....	3	9		

	Ft.	In.	Ft.	In.
Measures concealed	15	0		
Black carbonaceous compact shale.....	8	3		
Measures concealed.....	8	6		
Yellowish-drab heavy bedded sandstone, weathering light drab...	11	4		
Measures concealed.....	8	10		
Yellowish-drab sandstone.....	9	6		
Measures concealed.....	16	6		
Yellowish-drab sandstone, generally flaggy, with wavy dark mica- ceous partings	34	6		
Brown arenaceous shale, weathering gray.....	5	6		
Gray argillaceous shale.....	1	6		
Black carbonaceous shale, very compact.....	4	6		
Light gray arenaceous shales and sandstones, with a few inches of gray argillaceous shale at the base, containing a band of clay ironstone two inches and a-half thick.....	15	9		
Ash-gray sandstone, very heavily bedded, one of the beds thirty- three inches thick, without any partings.....	12	2		
Grayish-drab coarse sandstones, with rust-stained partings.....	8	3		
Measures concealed.....	24	6		
Yellowish-drab sandstones, in thick beds, with wavy partings and much false bedding.....	10	0		
Yellowish-drab flaggy sandstones	6	6		
Gray rusty-weathering sandstone.....	0	8		
Bluish-gray argillaceous shale.....	2	6		
Yellowish-drab sandstone.....	49	6		
Measures concealed.....	26	3		
Yellowish-drab sandstone.....	2	0		
Measures concealed.....	3	2		
Yellowish-drab sandstone.....	9	0		
Measures concealed.....	3	2		
Black highly carbonaceous shale, very compact and not easily broken.....	29	0		
			547	10
Coal.....			0	3
Yellowish-drab underclay, full of <i>Stigmara</i> , and holding occasional disseminated clay ironstone balls from one-eighth to one- fourth of an inch in diameter	2	9		
Measures concealed.....	2	0		
Light gray compact rusty-weathering sandstone.....	0	6		
Light gray arenaceous shale, weathering of a greenish tinge, in coarse beds with dark partings.....	1	6		
Light gray fine grained arenaceous shale with dark partings....	2	9		
Light yellowish-drab sandstone.....	2	6		
Measures concealed.....	17	6		
Very light yellowish-drab sandstone, weathering red, with much false bedding.....	10	8		
Measures concealed.....	3	6		
Very light yellowish-drab sandstone with much false bedding ...	1	0		
Gray sandstone, weathering drab. At the bottom of this there is a fragment of an upright <i>Sigillaria</i> ; it is a sandstone core of about seven inches long, with a diameter of four inches and a-half; it is constricted towards the bottom, and then spreads out a little on a thin layer of shale beneath. No				

Small coal
seam.

Upright *Sigil-
laria*.

	<i>Ft.</i>	<i>In.</i>	<i>Ft.</i>	<i>In.</i>
roots were observed beneath, and the shale on which it is based passes just over the top of another upright <i>Sigillaria</i> , a few feet removed on one side.....	4	0		
Gray sandstone with three inches of shale on top.....	1	0		
Gray sandstone, weathering drab; the lower and upper parts of the bed are somewhat shaly, with two inches of soft clay on top	2	3		
Dark gray argillaceous shale, with nodules of clay ironstone. In this bed, in the distance of twenty-five feet, there are the remains of three upright <i>Sigillariae</i> . The largest of them is about eighteen inches in diameter; a length of forty-three inches of it remains. Towards the lower part it becomes constricted and then spreads out to a wider diameter on the bed beneath. It is a sandstone cast of the plant. The remains of the other two occur at the top of the bed, in the form of sandstone cores, each of them about seven inches long, one of them being five inches and the other seven inches in diameter; the former penetrates eleven inches into the layer of sandstone above, and the hollow semi-cylindrical mould of the other is visible in the upper bed for forty-five inches, from which the plant has been removed, while at the length of twenty-four inches in the sandstone the form is cut by two inches of soft shale. All the three plants probably had roots in the same bed of shale beneath, and these may have penetrated to a bed of sandstone still lower, which is marked by the presence of <i>Stigmara</i> , but no connection could be found between these roots and the upright plants	4	0		
Gray argillaceous shale.....	1	0		
Gray soft argillaceous shale or clay.....	0	3		
Gray flaggy sandstones in irregular layers, with remains of prostrate plants	1	6		
Gray sandstone in a single bed, marked by the presence of <i>Stigmara</i>	3	0		
Gray flaggy sandstones, weathering drab, with wavy surfaces, interstratified with argillaceous and arenaceous shales....	7	0		
Gray arenaceous shale and thin sandstones interstratified with beds of dark gray argillaceous shale.....	4	0		
Gray arenaceous shale, with beds of sandstone weathering to a mottled red and drab.....	6	0		
Measures concealed, probably flaggy sandstones.....	28	0		
Gray flaggy sandstone, weathering drab, with ripple-mark	16	0		
Gray argillaceous shale, with layers of gray flaggy sandstone, which are wavy and weather to a mottled drab and red..	5	0		
Gray flaggy sandstone interstratified with gray arenaceous shale.	7	0		
			134	8
			924	4

Three upright
Sigillariae.

This section terminates near the old mill-site belonging to Messrs. S. Black and A. Walker, where the measures appear to be interrupted by a fault. Evidences of a disturbance are plainly visible in the cliff overlooking the stream on the right bank; but I was unable to make out Black's mill-site.

clearly, from the cliff, which way the measures are thrown. In McLellan's Brook, all the way up to the mouth of Marsh Brook, the strata of Division C dip to the south-eastward. On the main stream, above the junction of the tributary, the same dip is maintained in the prolongation of the Marsh Brook series (Division B) to within twenty-six chains of the Fulling-mill bridge, the slope of the strata, all the way from Black's mill-site, varying from 8° to 20° . The measures are largely composed of sandstones, the strike of which is, of course, south-westward. From Black's mill-site downwards to the junction of McLellan's Brook with the East River, the measures are apparently all black shales, the chief part of them carbonaceous, giving a great thickness, with no sandstones observed. The dip of these shales is more or less north-eastward, at angles ranging from 8° to 24° . Their strike would be south-eastward, and in the prolongation of the strata in this direction, they would apparently come against the sandstones irregularly. The continuous contact of these two masses is concealed, but a line running about S.S.E. from Black's mill-site, crossing the old mill road a little north of the house of Mr. J. W. Turnbull, and coming on McLellan's Brook in the gap between McLellan's and McGregor's Mountains, would apparently have the sandstones on the east, while the black shales would be on the west, and it is probable that a dislocation, which may be called the Mill-road fault, more or less coincides with this line all the way. As no mass of arenaceous measures presenting the same characteristics as those of McLellan's Brook, is known below the black shales, the sandstones are supposed to be the higher in the series, and the dislocation would thus seem to be a downthrow to the eastward; but what may be the extent of the break, the evidence is not at present sufficient to decide.

As already stated, the south-eastward dip of the arenaceous measures on McLellan's Brook is maintained to within twenty-six chains of the Fulling-mill bridge. At this point, a seam of oil shale, formerly worked by Mr. Patrick, comes upon the brook. It is supposed to be on the same horizon as the oil shale on Marsh Brook, and the strata associated with it being more exposed on the main stream than on the tributary, we obtain additional details.

The measures here lie in the form of a synclinal, on the opposite sides of which, at the right margin of the stream, the two out-crops of the oil shale are about 200 paces apart. A fault runs in the brook in a bearing of $N. 36^{\circ} W.$ It appears to be a downthrow on the north-west side, producing on that side a greater separation of the out-crops. On the northern out-crop the evidences of the dislocation are in the middle of the stream, where black shales, on the south-east, come against sandstones on the north-west. Between the two there runs a thin vein of quartz, the underlie of which is $N. 54^{\circ} E. < 38^{\circ}$, and fragments of the quartz obtained from the vein, shewed well marked slickensides next the sandstone.

S. E. dip.

Black shales
McLellan's
Brook.

N. E. dip.

Mill-road fault.

Oil shale.

Patrick's work-
ing.

Synclinal.

Fault.

On the south out-crop, and on the north-west side of the fault, there are the remains of an old slope sunk by Mr. Patrick. The dip at the mouth of the slope is N. 22° E. $< 29^{\circ}$; and I was informed by Mr. A. McBean that in descending this slope the oil shale maintained a thickness of from two to six inches for about twenty feet; it then gradually thickened to five feet in descending sixty feet farther, while the dip gradually became N. 67° E. $< 52^{\circ}$; descending eight feet more, the deposit diminished to nothing; and in eight feet still further, the face of the fault presented itself, the strata becoming vertical. In the thickest part of the oil shale, a horizontal gallery was driven twenty yards to the left, and in this distance the seam thinned from five feet to fifteen inches, then again thickened and again thinned.

Patrick's slope on oil shale.

Variation of thickness.

From the description of Mr. McBean, and from the specimens shown me, the best and most typical parts of the oil shale appear to have a curly or felt-like structure. It is this part which varies so much in thickness, and while the bottom of the deposit remains even, the thinning arises from depressions in the upper portion, which are filled up with even layers of the more ordinary carbonaceous shale. The out-crops approach one another to the north-west, and the turn on the axis of the synclinal occurs about 300 yards from the margin of the brook. The measures associated with the oil shale on the opposite out-crops, as exposed on the brook, are as follows, in descending order, both sections belonging, of course, to the Division B:

Felt-like structure of oil shale.

Axis of synclinal.

SECTION 4. (DIVISION B.)

MEASURES ON THE SOUTH OUT-CROP FROM THE HIGHEST BEDS SEEN ABOVE THE OIL SHALE UP McLELLAN'S BROOK TO THE FULLING-MILL BRIDGE.

Measures on south out-crop.

	Ft.	In.	Ft.	In.
Brownish-gray fine grained sandstone, weathering brown.....	0	9		
Measures concealed.....	4	7		
Gray compact sandstone, with wavy micaceous partings.....	0	10		
Measures concealed.....	2	0		
Dark gray flaggy sandstone, weathering brownish-gray.....	1	0		
Measures concealed.....	5	3		
Bluish-gray argillaceous shale.....	2	3		
Measures concealed.....	2	0		
Bluish-gray argillaceous shale.....	1	6		
Black highly carbonaceous shale.....	13	6		
Measures concealed.....	13	8		
			47	4
<i>Oil shale</i> .—A seam varying in thickness from one inch to eight feet			4	0
Measures concealed.....	26	0		
Black argillaceous shale.....	8	10		
Black carbonaceous shale.....	3	5		
Measures concealed.....	164	0		
			202	3

Oil shale.

		<i>Ft.</i>	<i>In.</i>	<i>Ft.</i>	<i>In.</i>
Coal seam.	<i>Coal</i> .—A seam on which a pit has been sunk about 125 paces on the strike (S. 64° E.) from the margin of the brook.				
	Cannel coal.....	0	3		
	Bituminous coal	1	6		
					1 9
	Grayish-drab fine grained arenaceous underclay with <i>Stigmaria</i> .	3	0		
	Gray sandstone with wavy partings, and holding occasional clay-ironstone balls	2	4		
	Measures concealed.....	7	4		
	Dark gray arenaceous fireclay.....	7	0		
	Measures concealed.....	8	0		
	Light gray rusty-weathering sandstone, in thick beds	6	0		
	Measures concealed.....	2	3		
	Light gray soft-weathering arenaceous fireclay.....	1	8		
	Gray rusty-weathering sandstone	1	3		
	Measures concealed.....	2	0		
	Black semi-carbonaceous fireclay, slightly arenaceous, with a whitish-brown streak.....	5	0		
	Measures concealed.....	12	6		
Coal seam reported.	<i>Coal</i> .—A seam reported to be here.....				58 4
	Very dark gray fine grained fireclay, weathering very soft, with <i>Stigmaria</i>	1	10		1 0
	Light gray arenaceous underclay, with dark partings, holding <i>Stigmaria</i> and casts of <i>Calamites cistii</i>	1	6		
	Light gray sandstone, with occasional clay ironstone balls.....	4	3		
	Dark gray shaly sandstone	2	0		
	Dark gray sandstone in thick beds.....	12	0		
	Measures concealed, with one or two small exposures of dark semi-carbonaceous indurated shale.....	43	0		
	Dark gray, rusty-weathering sandstone, not well exposed.....	24	0		
	Measures concealed	9	0		
	Dark gray rusty-weathering sandstone.....				
	Measures concealed, but probably sandstone of the same character	25	0		
					122 7
					437 3

SECTION 5. (DIVISION B.)

MEASURES ON THE NORTH OUT-CROP FROM THE HIGHEST STRATA SEEN ABOVE THE OIL SHALE, DOWN McLELLAN'S BROOK.

	<i>Ft.</i>	<i>In.</i>	<i>Ft.</i>	<i>In.</i>
Measures on north out-crop.				
Brownish-gray fine grained sandstone in one bed, weathering brown.....	1	3		
Measures concealed	0	6		
Light gray compact sandstone	2	6		
Measures concealed.....	0	6		
Light gray flaggy sandstone.....	5	0		
Dark bluish-gray argillaceous shale.....	1	6		
Dark brownish-gray sandstone	4	6		
Measures concealed.....	22	0		
Black semi-carbonaceous shale.....	15	0		
				52 9

	<i>Ft.</i>	<i>In.</i>	<i>Ft.</i>	<i>In.</i>	
<i>Oil shale.</i> —A seam of black highly carbonaceous shale, containing lenticular masses of a substance like oil shale, as proved in a pit sunk to by the Pictou Mining Company.....				0 4	Oil shale.
Black carbonaceous shale.....	2	0			
Measures concealed.....	15	4			
Light bluish-gray argillaceous shale.....	1	6 1			
Black carbonaceous shale.....	9	0			
Measures concealed.....	46	0			
Black carbonaceous shale.....	5	0			
Measures concealed.....	17	6			
Black semi-carbonaceous shale.....	5	0			
Black argillaceous shale.....	6	8			
Black carbonaceous shale.....	5	0			
Black carbonaceous shale, very compact and tough.....	5	3			
Measures concealed.....	13	6			
Brownish-drab thick bedded sandstone, weathering rusty, with black micaceous partings.....	4	5			
Gray very fine grained sandstone, with clay ironstone balls....	4	9			
Gray very fine grained sandstone, partially concealed.....	6	6			
Very light gray fine grained sandstone, weathering rusty in the partings.....	1	4			
Gray sandstone, with black partings.....	27	6			
Brownish-drab flaggy sandstone, weathering brown.....	3	9			
Blackish-gray argillo-arenaceous shale, interstratified with light-gray arenaceous shale, with black partings.....	6	6			
Dark brownish-drab fine grained sandstone, weathering rusty...	4	9			
Dark bluish-gray arenaceous fireclay, weathering very soft in some beds.....	6	11			
			198	2	
<i>Coal.</i> —A seam supposed probable in this place.....			0	0	Supposed coal seam.
Dark bluish-gray arenaceous fireclay, partially concealed.....	7	5			
Measures concealed.....	20	0			
Gray sandstone, with black wavy micaceous partings.....	24	10			
Measures concealed.....	7	9			
			60	0	
<i>Coal.</i> —A seam supposed to be about this horizon.....			0	0	Supposed coal seam.
Measures concealed.....	80	0			
Black carbonaceous shale.....	9	7			
			89	7	
			400	10	

Both of these sections terminate at dislocations. That concluding at the Fulling-mill bridge comes against a break of considerable importance; its course appears to be N. 77° E., and it may be called the Fulling-mill fault.

The whole area of Productive coal measures belonging to that part of the Pictou field which has been under the examination of Mr. Hartley and myself, is included between two great upthrow dislocations, which may be termed the North and South faults. The former crosses the East River a little above New Glasgow bridge, where it brings the productive measures abruptly against the New Glasgow conglomerates. It thence runs to

Great South
fault.

Black shales.

Arenaceous
measures.

Three syncli-
nals.

South, Middle
and North.

George McKay
coal seam.

McBean's trial-
pit.

Trial-slope near
McGregor's.

Sutherland's River along the south side of the triangular area of Millstone Grit rocks which has been previously described, the bearing being about S. 82° E. for one-half of the distance, and S. 68° E. for the other. The South fault crosses the East River about three and a-half miles further up, skirts the north side of McGregor's Mountain, and intersecting McLellan's Brook about seventeen chains above the Fulling-mill bridge, passes along the north foot of McLellan's Mountain and strikes Sutherland's River about fifty chains below McPherson's bridge. This fault has on the south side the Devonian rocks of McGregor's and McLellan's Mountains, bringing those of the former mountain to abut against the great mass of black shales* lying west of the Mill-road fault, and those of McLellan's Mountain against the higher and more arenaceous deposits of the divisions A, B, and C.

Immediately east of the Mill-road fault these more arenaceous deposits appear to occupy the whole space between the North and South faults, in which space they are arranged in three synclinal forms, the axes of two of which, bearing eastward, are a little more than a mile and a-half apart; one of them, already alluded to, running in the vicinity of Patrick's old workings on the oil shale, and the other a little north of the pit sunk at the Marsh colliery to the George McKay four-feet coal seam. There is however a third parallel synclinal axis, over half a mile north of the latter, which passes along the upper part of Potter's Brook near the telegraph road, and comes obliquely against the North fault. These synclinals may be called the South, Middle (or Marsh), and North, the Middle one being the most important.

The out-crop of the George McKay seam on the south rise of the Middle synclinal is seen in the George McKayslope, and its course from this, as marked by the Pictou Mining Company's trial-pit, (thirty-six feet to the coal), and McBean's slope on the crop, is about S. 62° E. But farther on, as already indicated, it takes a more southward course, and folding over the axis of the anticlinal, which lies between the Middle and South synclinals mentioned, it reaches the St. Mary's road about 200 paces south-eastward of the house of Mr. Jas. McDonald, (turner), in McBean's trial-pit and bore-hole. It has not been tested by continuous trial-pits farther on, but between fifty and sixty chains to the south-west, in what appears to be the general strike of the measures, a trial-slope, about 230 paces outside of Messrs. McBean's south-western boundary, has been sunk on a coal seam on the left bank of a small stream running north-westward near the house of Mr. McGregor.

According to Mr. A. McBean, the thickness of this seam is three feet six

* It is supposed to be possible that a triangular area of Millstone Grit rocks may be interposed for part of the way between the South fault and one branching from it, and that towards the East River the black shales may abut against such rocks.

inches, and the dip at the mouth of the slope, which is about four feet above the stream, is $S. 16^{\circ} E. < 19^{\circ}$; but at nine feet down the slope the roof suddenly assumed an inclination of 70° . In another slope sunk at the level of the brook and a few paces to the north-east, the sudden increase of inclination occurred at a depth of about four feet; and by this it would appear that a fault is here present running about east and west, which would account for the irregularity of the strike at the mouths of the slopes. This seam is supposed to represent the George McKay four-foot seam. The dislocation may be called the McGregor fault.

On the right bank of the same brook, about a quarter of a mile further up, and a little within the south-western boundary of the McBean area, three small trial-pits have been sunk on a coal seam about four hundred paces from the south-west corner of the line between the first and second square miles. The thickness and character of the coal, I am not able to state with exactness, but the former appears to be from three to four feet, and the coal is covered by at least eight feet of black shale. The dip at the crop is $S. 43^{\circ} E. < 17\frac{1}{2}^{\circ}$; but according to Mr. McBean the inclination, after descending a short distance, suddenly increases to a considerable angle, and a crack in the coal at the bend is filled with shale similar to that of the roof. If the dip of the measures to the north-west be the same as that at the crop, this seam would appear to be about 160 feet over the George McKay seam, which is about the horizon of the Captain seam in the Marsh pit.

Several trial-pits and slopes have been sunk upon the south out-crop of the Captain and Mill-race seams in the vicinity of the Marsh pit, establishing the run of these seams, and shewing apparently a small divergence from the George McKay seam, going eastward, probably from some diminution of the inclination. Proceeding in an opposite direction from the George McKay slope, trial-pits which have been sunk on the crop of this seam, as pointed out to me by Mr. Lawther, exhibit the turn of the seam upon the axis of the synclinal about thirty chains westward from the Marsh pit, and the run of the Marsh pit group of seams on the north rise is indicated first by a slope sunk by Mr. Lawson on the Captain seam, for the Merigomish Company, near the north-west boundary of their area, about twenty-two chains from the south-west corner post.

The coal is here three feet thick, and the dip at the mouth of the slope is $S. 20^{\circ} E. < 17\frac{1}{2}^{\circ}$. This inclination continues for eighty feet down the slope, when a downthrow occurs about equal to the thickness of the coal, beyond which the inclination becomes 22° , and continues so for forty feet. In a bearing $N. 67^{\circ} E.$ from this, at a distance of about 850 paces, Mr. Lawson, by direction of Mr. Moore, has tested the whole of the Marsh pit group of seams, on a small stream which flows down the south slope of the

McGregor fault.

Coal seam supposed equivalent to the Captain seam

Captain and Mill-race seams.

Axis of Middle synclinal.

Captain seam, Merigomish area.

Marsh pit group tested by Lawson.

McPherson's
Brook.

hill from Donald McPherson's land. Here Messrs. McBean had sunk a small slope on the Captain seam, at a spot about six chains from the north-west and about twenty-four chains from the north-east boundary lines of their area.

According to Mr. A. McBean the thickness of the seam is here four feet, and the average dip of the measures is S. 28° E. < 45°. Agreeably to the measurements of Mr. Lawson, reduced to vertical thickness at right angles to the plane of the beds, the following is a descending section of the seams, with their distances apart :

		<i>Ft. In.</i>
Captain seam.	<i>Coal.—The Captain seam.....</i>	4 0
	<i>Intermediate measures.....</i>	21 0
	<i>Coal.....</i>	0 10
	<i>Intermediate measures.....</i>	85 10
Mill-race seam.	<i>Coal.—The Mill-race seam.</i>	
	Good coal, half of it being cannel.....	0 6
	Clay.....	0 8
	Good coal.....	1 0
	Shaly coal.....	1 10
		<hr/> 4 0
	<i>Intermediate measures.....</i>	52 2
George McKay seam.	<i>Coal.—The George McKay seam.</i>	
	Shaly coal.....	0 10
	Good coal.....	3 6
	Shaly coal.....	0 3
	Good coal.....	0 3
		<hr/> 4 10
		<hr/> 172 8

Increase of
thickness.

The same measures in the Marsh pit gave 171 feet 7 inches, by which it appears that though there is some difference in the intermediate thicknesses, the total difference is only thirteen inches, while three of the coal seams have increased in volume.

Coal seam
above the Cap-
tain seam.

A little over 200 paces down McPherson's Brook, from the slope on the Captain seam, another coal bed occurs, said to be about ten inches thick. It is exposed on the right bank of the brook, and is about 400 feet directly across the measures, from the out-crop of the Captain seam. Taking its inclination to be about 30°, which would be about the average of the angles in the trial-slopes on each side, its vertical distance over the Captain seam would be about 200 feet. On the Marsh Brook above the mill-pond, and about 600 paces from the north-west boundary of the McBean area, two trial-pits, about two chains apart, have been sunk by Messrs. McBean on the land of Mr. Jas. McDonald (Grayer). Mr. A. McBean describes the seam to be composed as follows :

	<i>Ft.</i>	<i>In.</i>	
Cannel coal.....	0	4	Four-feet seam above Captain seam.
Mineral charcoal mixed with coal.....	1	0	
Good brilliant coal	0	8	
Coal bored through.....	1	9	
	<hr/>		3 9

The level course between the two pits is very nearly north, with a slope to the west, said to be about 1 in 6, or 9°, the low angle and irregular bearing of the dip no doubt arising from the circumstance that we are here approaching to the axis of the synclinal curve. The southern of the two pits is about 300 paces from the assumed south crop of the Captain seam; but having no means of determining the law of the curve it is not possible to calculate the vertical distance of the one seam from the other, nor to state what may be the relation of the higher one to the coal bed in the lowest position on McPherson's Brook.

Axis of syn-
clinal.

Beyond McPherson's Brook the Captain seam appears to run along a dingle supplying a tributary streamlet, a quarter of a mile up which there is a red ferruginous spring,* which is supposed to give evidence of its presence at the foot of a steep rise on a farm road leading up into D. McPherson's fields on the top of the hill. Should this seam and those associated with it continue in the same course for half a mile farther, they would come against the great North upthrow fault, the effect of which, however, may possibly turn them a little south of west and continue their out-crop somewhat farther eastward; but of this there is as yet no evidence.

Red spring.

Contact of
seams with
North fault.

Somewhat over a mile south-west from the red spring, on the tributary of McPherson's Brook, and about thirty-three chains from the south-east boundary of their area, Messrs. McBean have sunk a trial-pit through eleven feet of drift and one foot of greenish-gray arenaceous shale, to a coal seam, of which the following is a section:

McBean's six-
feet seam.

	<i>Ft.</i>	<i>In.</i>
Cannel coal.....	0	1½
Good coal.....	0	4
Coarse coal and black carbonaceous fireclay.....	1	0
Good coal of rather coarse texture.....	2	6
Coal not so good, with hard shaly bands.....	2	6
	<hr/>	
	6 5½	

The crop of the seam rises in a small brook (the upper part of the Marsh Brook) about twenty feet to the south-westward, with a strike N. 37° E.; but a trial-pit sunk by Mr. Lawson on the crop about 160 paces north-eastward of the previous one, would appear to show the strike

Lawson's trial
pit.

* The proximity of coal seams to the surface is so often indicated by red ferruginous springs, that these springs, called by Welsh miners *the blood of the coal*, are sometimes taken as a guide in the search for out-crops.

between them to be N. 47° E. Another trial-pit, sunk by Messrs. McBean, about 210 paces still farther on the strike and some distance across the measures to the south-eastward, shews a seam, the strike of which, as represented by Mr. J. McBean, appears to be again N. 37° E. Constructing the distribution of the seams from these elements, the vertical distance between them would appear to be about fifty-seven feet. The seam is said to be composed of six feet of good coal.

These two seams, being on the south rise of the Middle synclinal, are conjectured to represent the Mill-race and the George McKay seams, which they resemble in character, though both are much thicker. But the inferences to be deduced from this equivalence are of so much importance, as will be seen by the sequel, that it ought not to be taken for granted until the presence here of the whole group of the Marsh pit seams has been proved by trial-pits in a straight line at right angles across the measures; which probably would not be a very expensive operation, seeing that the drift in the vicinity is by no means very deep.

At about 1450 feet across the measures, behind the lower of these seams, there occurs a bed of excellent coal of eight feet and a-half thick, on which Messrs. McBean have sunk a slope about five chains from the south-eastern and twenty-nine and a-half chains from the north-eastern boundaries of their area. The dip at the mouth of the slope is N. 55° W. < 33°, and as far as observed the measures seem to preserve this inclination all the way to the six-foot seam above. This would give a vertical distance between them, at right angles to the planes of stratification, of about 800 feet, and the following is a rude approximation to a descending section of the ground as far as we have been able to ascertain the facts:

SECTION 6. (DIVISION B).

MEASURES BETWEEN McBEAN'S SIX AND EIGHT FEET SEAMS.

Measures above
McBean's eight-
foot seam.

Upper conglom-
erate.

Seam of poor
coal.

	Ft.	In.	Ft.
<i>Coal</i> .—A seam conjectured to be equivalent to the <i>George McKay</i> seam			6
Black carbonaceous shale.....	40		
Greenish-gray conglomerate with silicious pebbles, varying in size from a quarter of an inch to two inches in diameter. This is not seen on the line of section, but at some distance to the eastward, and its true place may possibly be somewhat lower among the concealed measures.....	80		
Measures concealed.....	200		
Greenish-gray fine shaly sandstone.....	30		
Black carbonaceous shale only partially exposed.....	40		
			<hr/> 390
<i>Coal</i> .—Coaly shale.....	2	8	
Good coal.....	0	4	
			<hr/> 3

	Ft.	In.	Ft.	In.
Light yellowish fireclay with <i>Stigmaria</i>	20	0		
Measures concealed.....	28	0		
Dark brownish-gray argillaceous shale, with six inches of black compact carbonaceous shale at the bottom, holding many well preserved scales of <i>Diplodus</i> , half an inch in diameter.....	4	0	52	<i>Diplodus</i> scales.
Coal—Good coal.....	0	10		
Coaly shale.....	0	2	1	Coal seam small
Dark gray underclay with <i>Stigmaria</i> , and bluish-gray fireclay.....	4	0		
Measures concealed.....	60	0		
Drab-gray fine grained sandstone partially exposed.....	20	0		
Measures concealed.....	30	0		
Greenish conglomerate with quartz pebbles, associated with fine grained sandstone, only partially exposed.....	30	0		Lower conglomerate.
Measures concealed.....	45	0		
Black shale, a band of which at the top is carbonaceous and is said to burn with a bright flame like oil shale.....	54	0	243	
Coal.—A seam reported by Mr. A. McBean to be probably here but of uncertain thickness.....			1	Reported coal seam.
Measures concealed.....	95	0		
Bluish-gray arenaceous shale.....	15	0		
			110	
Coal.—The McBean eight-feet seam.....			8	McBean eight-feet seam.
			814	

Behind the McBean eight-feet seam Mr. Lawson has sunk several trial-pits on the McBean area, and Mr. Robert Mitchell has sunk a number of others on the Mitchell and Barton area which adjoins it on the south-east. By these pits the measures have been partially tested to a horizontal distance of about fifteen chains, in which the inclination of the strata gradually increases from 33° up to 55°, while they remain very parallel to one another on the strike, and a descending section of the ground, at right angles to the plane of the beds, is as follows, as nearly as has been ascertained :

Lawson and Mitchell's trial-pits.

Steepening of measures.

SECTION 7. (DIVISION C.)

MEASURES BENEATH McBEAN'S EIGHT-FEET SEAM.

	Ft.	In.	Ft.	In.
Greenish-drab underclay with <i>Stigmaria</i>	3	0		
Measures concealed.....	6	0		
Yellowish-drab shaly sandstone.....	14	0		
Black and dark gray argillaceous shale.....	14	0		
			37	0
Coal.—A seam of an inferior shaly character.....			3	0
Gray underclay.....	2	0		Seam of poor coal.
Measures concealed.....	8	7		
Yellowish-drab shaly sandstone.....	4	6		
Black argillaceous shale.....	4	6		
			19	7

		<i>Ft.</i>	<i>In.</i>	<i>Ft.</i>	<i>In.</i>
Small coal seam.	<i>Coal</i> .—Coal of inferior character.....	0	2		
	Good coal.....	0	1		
				0	3
	Brownish-drab fireclay, with <i>Stigmaria</i>	2	3		
Small coal seam.	Measures concealed.....	7	0		
				9	3
	<i>Coal</i> .—A seam of inferior quality.....			0	2
	Gray fireclay.....	3	9		
Seam of very good coal.	Brownish-drab compact sandstone.....	4	6		
				8	3
	<i>Coal</i> .—A seam said to be of remarkably good quality.....			2	6
	Gray compact fireclay.....	5	0		
Olden's seam.	Gray compact argillaceous shale, with some beds of fine arenaceous shale.....	10	0		
	Measures concealed.....	50	0		
	Gray argillaceous shale.....	4	0		
				69	0
Small coal seam.	<i>Coal</i> .—This is called <i>Olden's seam</i> . It appears to be a black shining flaky argillaceous shale. It is not seen on the line of section but somewhat to the eastward, and this would be its place provided no fault intervenes.....			0	2
	Gray fireclay.....	1	0		
	Measures concealed.....	68	0		
	Greenish sandstone, weathering drab.....	12	0		
Small coal seam.	Measures concealed.....	37	0		
	Gray sandstone, weathering to a brilliant orange or rusty reddish-yellow from peroxyd of iron.....	16	0		
				134	0
	<i>Coal</i> .—Shaly coal.....	0	2		
Crop of eight-feet seam to E.	Good finely laminated coal.....	0	1		
				0	3
	Light and blackish-gray sandstone, interstratified in alternating bands of about one-fourth and three-fourths of an inch thick	40	0		
	Light yellowish-drab rusty-weathering sandstones.....	14	0		
Crop of eight-feet seam to E.	Yellowish-gray and brownish-gray fine grained sandstone, weathering to an Indian-red.....	18	0		
	Yellowish-drab and dark gray red-weathering fireclay, crumbling into small fragments.....	32	0		
	Measures for the most part concealed, but two trial-pits show yellowish-drab brown-weathering or rusty-weathering sandstone, in wavy layers.....	247	0		
	Yellowish-drab arenaceous fireclay, weathering Indian-red.....	6	0		
Crop of eight-feet seam to E.	Measures concealed.....	80	0		
	Brownish-gray arenaceous shale, with dark brown bands in layers of from one to two inches.....	8	0		
	Black arenaceous very compact shale, with brownish-gray streaks.	3	0		
				448	0
				731	5

Mr. J. Weir has traced the out-crop of the McBean eight-feet seam for about eighteen chains in a bearing N. 45° E. from McBean's slope to the south-east boundary of the McBean area. Here it bends a little more to the eastward, and it partially crosses the corner of the Mitchell and

Barton area where it seems to be interrupted by a fault, but the seam may possibly be found ultimately to be the same as that struck in Haliburton's pit on the St. Lawrence area, somewhat less than half a mile beyond, where it apparently comes against the great North fault. In the other direction from McBean's slope Mr. Lawson has sunk a series of trial-pits on the crop, tracing it in a bearing S. 37° W. for thirty-five chains, whence it gradually bends to S. 22° W. for between five and six chains farther. Crop of eight-foot seam to W. By this it appears that the crop runs unbroken for very nearly three-quarters of a mile on the McBean area. At the south-western end of this, however, it meets with a serious interruption in the occurrence of a great dislocation. This appears to produce an upthrow on the south side, but what the extent of the break may be has not yet been quite determined. The position of this break having been ascertained by Mr. Lawson, it is Lawson fault. proposed to designate it by his name. In bearing it appears to be about S. 77° W., and in this direction it may have a connection with the Fulling-mill and the McGregor faults.

If the measures are not interrupted by other disturbances, the Lawson fault would permit a much farther extension westward to the out-crop of the overlying six-feet than to that of the eight-feet seam, and by a series of trial-pits along the out-crop of the six-feet seam for the purpose of proving this, the increased workable extension of the eight-feet seam beneath would be proved at the same time.

If by a proper transverse examination in the vicinity of the six-feet seam this should be found equivalent to the George McKay four-feet, or any one of the Marsh pit group, it would of course be immediately inferred that the eight-feet seam will occur some 700 or 800 feet beneath the bottom of the Marsh pit, and its out-crop might thus be sought for near the mouth of the Marsh Brook. Position of eight-foot seam on Marsh Brook

Although there are too many intervals of concealment on the lower part of the Marsh Brook, as well as between the six-feet on the upper part of the brook and the eight-feet seams, to permit an accurate comparison of details, yet it will be perceived by a reference to Section 2 (Division B), that at the depth of 789 feet beneath the George McKay seam there occur some bands of fireclay, and although no coal was seen associated with them, this would apparently be a favorable position in which a search for the eight-feet seam might be instituted. This spot is on the Pictou Mining Company's area, and the occurrence of the eight-feet seam here would establish its existence not only over the whole north-western part of the McBean area and carry it some distance on that of the company just named, but place it also under a considerable portion of the George McKay and other areas in the neighbourhood.

Red-weathering
sandstones.

In the 730 feet of arenaceous measures which have been partially examined beneath the McBean eight-feet seam, Section 7 (Division C), there occur in the lower half many bands of sandstone which weather to various tints of red, giving them externally the aspect of beds belonging to the Millstone Grit, and without careful examination they might be mistaken for such. There are beds on McLellan's Brook, in the lower part of Section 3 (Division C), which have the same peculiarity, though by no means to the same extent, the effect of the weathering being to give the surface of the rock merely a mottled red and green colour. An instance of this is very conspicuous in a flagstone quarry on the top of a narrow ridge formed by a sharp turn on the right bank of McLellan's Brook, a little above Black's mill-site; and it serves to assimilate the strata of the two localities.

Synclinal form.

Greenish con-
glomerates.

Four-feet seam.

Allusion has heretofore been made (p. 16) to five small trial-pits and bore-holes on the crop of a coal seam sunk by Messrs. McBean on the line between their first and second square miles (going south-eastward) about 250 paces from its south-western extremity. The dip is here southward; but at the extremity of the line it appears to be northward. There is thus a synclinal form in the interval; and through this interval is supposed to run the Lawson fault, throwing the measures up on the south side. In the vicinity of the stake at the extremity of the line there are obscure evidences of the occurrence of a series of greenish-grey conglomerates with silicious pebbles. These conglomerates are better seen near the residence of Mr. Alexander McLean junior, where, as I was informed, the rock was met with in excavating the cellar of the building; and it occurs in two very small ravines between 200 and 300 paces westward. Similar conglomerates in a lower stratigraphical place are well displayed near the residence of Mr. Alexander McLean senior, at the foot of McLellan's Mountain, where the rock is intersected by a mountain brook to the east of the house. On this brook, Mr. Haliburton has tested two coal seams; one above the lower conglomerates, by a trial-pit on what is said to be a four-feet seam, at the foot of the hill, and another a short distance on the rise of the hill, where a four-feet seam immediately under the conglomerates and their associated sandstones, is naturally exposed.

The dip of the conglomerates at the more northern position is about N. 43° W. < 13°; approaching the more southern conglomerates, it is about the same in direction, with an inclination of 19°, and at the out-crop, up the hill, the inclination increases to about 24°. Constructed from these elements as a guide, the following would appear to be a descending section of the ground, to which, of course, the amount of concealment must give some uncertainty:

SECTION 8. (DIVISION B.)

MEASURES INTERSECTED ON THE LAND OF MR. A. McLEAN, SEN.

	Ft.	Ft.	Measures on A. McLean's land. Conglomerates.
Greenish-grey conglomerates with silicious pebbles of various sizes up to two inches in diameter, many of them consisting of white quartz..	85		
Measures concealed.....	22		
		107	
Coal.—A seam of which the <i>wash</i> is seen about fourteen chains to the westward of the line of section.....		0	<i>Captain</i>
Greenish-grey sandstone with much false bedding, seen about nine chains to the eastward	20		
Measures concealed.....	290		
		310	
Coal.—A seam sunk to by Mr. Haliburton, near McLean's barn, said to be Measures concealed.....	25		4 Four-feet coal seam.
Greenish-grey conglomerate with silicious pebbles of various sizes up to two inches in diameter. This is not seen on the brook but to the westward of McLean's house.....	37		
		62	
Coal.—A seam is supposed to be probable here		0	Supposed coal seam.
Grey arenaceous underclay with <i>Stigmaria</i>	3		
Greyish-drab flaggy sandstone	12		
Black carbonaceous shale	13		
Greenish-drab coarse conglomerates with silicious pebbles of various sizes up to two inches and a-half in diameter, in an arenaceous cement .	30		Conglomerates.
Yellowish-drab and greyish-drab flaggy sandstones with partings shewing carbonized plants	18		
Black carbonaceous shale	3		
Greenish-drab flaggy sandstone.....	16		
Greenish-drab coarse conglomerate, as before.....	8		
Yellowish-drab flaggy sandstones and coarse conglomerates, partially concealed	55		
Dark greyish-drab moderately thick bedded sandstone with many impressions of plants.....	5		
		163	
Coal.—A seam opened by Mr. Haliburton at the crop. This may be called <i>The Mountain seam</i>			4 Mountain seam.
		650	

By comparing Sections 6 and 8, it will be seen that there are two series of conglomerates in each, with no great difference of distance apart, while there is nothing in the one section seriously contradicting the other, so far as known. Immediately beneath the lower conglomerates in Section 6, the measures are concealed, and these coarse beds may extend farther down; but the change in the sediments to carbonaceous shales a little lower would make the base of the conglomerates appear to be a position in which a coal seam might reasonably be expected. The discovery of such there would cause the parallelism of the two sections to be more complete, and render a search for the McBean eight-feet seam at the distance indicated between it and the conglomerates in Section 6, a reasonable undertaking in the

Supposed place of the McBean seam.

Contact of
Mountain seam
and South
fault.

vicinity of the Mountain seam. The vertical distance would appear to be from 150 to 200 feet. At an angle of 25° the horizontal distance would be between 350 and 500 feet. But within this distance behind the Mountain seam at McLean's, the whole of the productive coal measures are probably disturbed or perhaps cut off by the great South upthrow fault, very nearly to a contact with which, the Mountain seam can be traced westward. It would therefore be necessary to follow the Mountain seam some distance to the eastward to get the space required, and the most convenient place would be in the vicinity of the St. Mary's road, about half a mile from McLean's, where the measures do not appear to be greatly covered up with drift.

Equivalence of
conglomerates.

Should the coal seams which are above the summit of Section 6 prove, on proper examination, to be the Marsh-pit group, it would follow that the upper conglomerates beneath them would represent the sandstones which underlie the George McKay seam at the Marsh Colliery, and to these would also be equivalent the conglomerates at the summit of Section 8, by which it would appear that the break in the Lawson fault would exceed the distance between the George McKay seam and the one next above the Captain seam, or be over 370 feet.

Break in the
Lawson fault.

Widow McLean
seams.

Where the McBean eight-feet seam is interrupted by the Lawson fault, it abuts against strata associated with a series of coal seams which have been tested on McLean's Brook, where this brook runs through the land of Mrs. McLean, a widow lady; they are in consequence known as the Widow McLean seams. The coal which has been obtained from them is of inferior quality, and the seams are not known to have been met with anywhere else. There is little doubt that they underlie the McBean eight-feet, but at what vertical distance there appears as yet no clue to determine. They have been traced from the McBean area to that of Mitchell and Barton, where the highest of them crops out on the south side of St. Mary's road, about forty paces south-eastward from McBean's corner-post.

In their explorations, Messrs. Mitchell and Barton have not yet been able to find these seams beneath the McBean eight-feet on the east part of their area, nor the eight-feet above them on the west part. The vertical distance to which they have tested the ground by trial-pits in the former case is approximately given in Section 7 (Division C), where it appears to be about 730 feet, while that to which their researches have extended above and below the Widow McLean seams in the latter, as collected from the correlation of their numerous trial-pits, and of natural exposures, is presented in the following descending section :

YRABILL
YRABILL LACROO LACROO

SECTION 9. (DIVISION C.)

MEASURES INTERSECTED ON AND NEAR McLEAN'S BROOK.

	Feet. In.	Feet. In.	Measures Mc- Lean's Brook.
Light-grey very hard and tough underclay with <i>Stigmaria</i> ...	2 0		
Measures concealed	57 0		
Grey sandstone banded with dark brown streaks; the rock weathers rust-brown and holds <i>Stigmaria</i>	6 0		
Measures concealed.....	3 0		
Dark brown arenaceous shales, with carbonized impressions of <i>Cordailes borassifolia</i>	4 0		
Measures concealed.....	16 0		
Black argillaceous shale	5 0		
Measures concealed	35 0		
Grey arenaceous shales with ferruginous bands prevailing most towards the bottom, and weathering rust-yellow, while the rest of the beds weather a deep brown.....	6 0		
Dark grey arenaceous shale, with <i>Stigmaria</i> and <i>Cordailes bor-</i> <i>assifolia</i>	2 6		
Measures concealed.....	16 0		
Yellowish-drab fireclay, full of indeterminate <i>Calamites</i> casts, replaced by clay iron-stone	6 0 ^m		
Measures concealed.....	3 0		
Yellowish-drab fireclay, full of indeterminate <i>Calamites</i> casts, replaced by clay iron-stone	3 0		
Measures concealed	12 0		
Greenish-drab coarse grained sandstone, stained reddish-brown in the partings, which are full of carbonized comminuted plant-casts	4 0		
Measures concealed.....	20 0		
Light grey sandstone with argillaceous partings carrying in- determinate plants.....	5 0		
Measures concealed.....	32 0		
Black carbonaceous shale full of bivalve shells resembling <i>Modiola</i>	2 0		
<hr/>		239 6	
Coal or coaly shale.....			3½ Small coal seam.
Measures concealed.....	10 0		
Dark brown arenaceous shales, the colour passing into black.	3 0		
Measures concealed.....	7 0		
Grey underclay with <i>Stigmaria</i>	4 0		
Measures concealed.....	120 0		
Light grey flaggy sandstone with black carbonaceous partings, holding <i>Noeggerathia</i> , casts of <i>Calamites</i> and other inde- terminate plants.....	4 0		
Measures concealed	30 0		
<hr/>		178 0	
Coal.—The Widow McLean ten-feet seam (so called.)			Widow Mc- Lean ten-feet seam.
Bad shaly coal	6 8		
Good coal	1 6		
<hr/>		8 2	
Dark grey argillo-arenaceous underclay with <i>Stigmaria</i>	1 6		
Measures concealed.....	36 0		

	Ft.	In.	Ft.	In.
Light grey arenaceous shale.....	2	0		
Brownish-grey argillaceous and very ferruginous shale, ap- proaching to a clay ironstone; the exterior weathers off in curved scales, as if from some concretionary struc- ture, and the shale contains small indeterminate plant casts, resembling <i>Cordaites</i>	1	6		
Blackish-brown arenaceous shale with black plant-casts; this is followed by blackish arenaceous shale with black carbonaceous partings, containing specks of mineral charcoal and presenting large forms of <i>Stigmaria</i> and impressions of <i>Sigillaria</i> , too imperfect for specific determination.....	1	0		
			42	0
Widow McLean thirteen-foot seam.				
<i>Coal.—The Widow McLean thirteen-foot seam (so called.)</i>				
Coaly shale, in which occur interstratified laminæ of coal of from a twentieth to a quarter of an inch thick, with impressions of large forms of <i>Stigmaria</i> , with the stigmata or rootlet scars as large as a quarter of an inch in diameter.....	1	0		
Good coal, much laminated.....	1	10		
Dark fireclay.....	0	4		
Coal with many bands of finely laminated shaly coal; it breaks in cleavage joints at right angles to the plane of bedding and shows laminæ of from a twentieth to a hundredth of an inch thick, with a very brilliant lustre. The planes of deposition are slickensided, as if from great pressure, and then lateral movement, such as would result from corrugation.....	9	0		
			12	2
Light bluish-grey fireclay, full of black carbonized <i>Stigmaria</i> .	1	0		
Measures concealed.....	5	5		
			6	5
Widow McLean third seam.				
<i>Coal.—The Widow McLean third seam, said to be inferior coal.</i>				
Measures concealed.....			2	9
Widow McLean fourth seam.				
<i>Coal.—The Widow McLean fourth seam, said to be inferior coal</i>				
Measures concealed.....	254	0		
Yellowish-drab fireclay, having very distinct carbonized im- pressions of <i>Cordaites borassifolia</i>	6	0		
			260	0
Coal.—Black argillaceous shale and fireclay mixed with coaly matter.....				
Coal of a fair quality.....	3	3		
			4	0
Bluish-grey fireclay with <i>Stigmaria</i>	1	0		
Measures concealed.....	39	0		
Brownish very compact sandstone.....	0	8		
Very dark brown arenaceous shale, weathering blackish-brown.	0	8		
Greyish-drab arenaceous shale or sandstone, resembling a fire- clay, yielding readily to the weather and exfoliating in curved scales from the surface, as if from a concretionary structure.....	4	0		

	<i>Ft.</i>	<i>In.</i>	<i>Ft.</i>	<i>In.</i>
Greenish-drab conglomerate with a reddish tinge, perhaps from weathering; it holds pebbles of various sizes up to two inches in diameter, many of them of white and grey quartz and some of red sandstone	3	0		
Measures concealed	90	0		
Dark grey hard sandstone in even layers varying in thickness from one quarter to three quarters of an inch; they would be well suited for the purposes of tile-stones...	30	0		
Greenish-drab conglomerate with silicious pebbles.....	1	8		
			170	0
			941	0

While the general strike of the strata associated with the Mountain four-foot seam appears to be about S. 40° W., that of the Widow McLean group is S. 8° W., and this divergence makes it seem probable that the difficulty of the search for the McBean eight-foot seam between the two will be enhanced by a dislocation, the position and amount of which have yet to be discovered.

Probable fault.

The above section occupies a breadth of about 630 paces, in which the westward slope of the strata gradually increases from 30° at the summit to 58° at the base, and at a farther horizontal distance of about 280 feet across the measures to the eastward, in which the strata are concealed, there occurs an exposure of red conglomerate, more resembling beds belonging to the New Glasgow conglomerate or to the Mill-stone Grit than any seen interstratified with the workable coal seams. This mass, of which I could not determine the dip or strike, occurs on McLean's Brook, about 200 paces, following up the stream in a north-westerly bearing, from the pond of Mr. Finlay McDonald's saw-mill. From the head of the pond down to the mill there is a distance of about 200 paces in a direction nearly east, the strata in which are probably of the same character as the red mass farther up, and at the mill-dam coarse brick-red or Indian-red shales become exposed on the right bank of the brook, some of the beds of which display a few disseminated silicious pebbles of a couple of inches in diameter.

Red conglomerate.

Red shales.

In the bed of the stream under the mill a band of limestone makes its appearance. It is obscured by the refuse slabs ejected from the mill, but up in the cliff on the left bank it is again exposed, and here it has been quarried to a small extent. The limestone is brownish-grey in colour, and holds obscure fossils, some of which are probably *Spirorbis carbonarius*. This band of limestone, which is limited on each side by coarse red shales, is eighteen feet thick, and some small portions of it seem to be made up of hard masses of limestone surrounded by greenish shale. The dip of the bed is N. 87° E. < 55°.

Fossiliferous limestone.

About one hundred and twenty paces eastward another calcareous band runs up the cliff. It is about sixteen feet thick, and may be a

repetition of the previous one, either through an undulation or a dislocation, the dip being S. 72° W. $< 86^{\circ}$. The strike in each case would be nearly north and south, but that of the strata farther down the brook appears, with many irregularities, to run more with the trend of the valley, which is nearly east. Somewhat under a mile down the valley, and about three hundred paces north of the brook, there is still another exhibition of limestone near the house of Mr. Finlay McDonald (sawyer.) Here the band is eleven feet thick, in very regular layers, which are interstratified with thin partings of shale. A copious spring issues from it, and the band can be traced for one hundred and twenty paces to the westward of the spring, with a general dip of N. 30° W. $< 75^{\circ}$; while it is again met with in a bearing of N. 80° E., at a distance of about 250 paces from the same spot.

McDonald's
limestone.

Millstone Grit
rocks.

The rocks in the valley to the southward, judged of by two exposures on the north and one on the south side of McLean's Brook, are red shales, red sandstones, and red conglomerates, associated with greenish-drab sandstones and shales. Strata of a similar description are occasionally exposed in the valley all the way to Sutherland's River, and the whole bear a strong resemblance to the deposits of the Millstone Grit.

Strike of lime-
stones.

The strike of the limestone, near McDonald's house, points towards the exposures near his saw-mill, and notwithstanding the irregularities which the latter display, the whole may belong to one and the same band. Supposing this to be the case, it is very evident that the trend of the strata associated with the limestones diverges considerably from that of the measures accompanying the Widow McLean and the McBean coal seams. At right angles to the McBean seam, there is between it and McDonald's house, a distance of three-quarters of a mile, and in this there has yet been discovered no evidence of the emergence of the great mass of black shales, which it has been previously stated abuts against the Mill-road fault, notwithstanding that the Lawson fault is a considerable upthrow to the south in the interval. It cannot be supposed that the Mill-road fault suddenly annihilates these black shales, and this disturbance being a downthrow to the eastward, the inference is that the shales underlie the arenaceous coal measures to the east of it; and as the strata associated with McDonald's limestones probably belong to the Millstone Grit series, it follows that they must be brought to the surface by some very great fault running at an uncertain distance north of McDonald's house. The course of this fault has yet to be ascertained; but one point on it probably occurs at the exposure of red conglomerate above McDonald's mill-pond.

Absence of
black shales at
the surface.

Probable fault.

It will be seen by the sequel that the thickness of the black shales can scarcely be much less than about 2000 feet. According to Mr. Hartley, the workable coal seams which have been tested on the west side of

the East River, are interstratified in an additional thickness of measures, equal to about 500 feet, and below these he states the occurrence of a series of arenaceous and argillaceous beds, without any very valuable coal seams, but still belonging to the productive measures, of which the volume may be 1000 feet more. It thus appears possible that without allowing anything for the New Glasgow conglomerates the great break which brings the Millstone Grit rocks to the surface at the east end of the coal field, may be an upthrow of at least 3500 feet; it will probably run across from the South to the North fault and it may appropriately be termed the great East fault.

Great break.

East fault.

The relation of the Widow McLean seams to the McBean eight-feet seam not having been as yet ascertained with accuracy, it is a question how far they may be beneath the bottom of the Marsh pit in the Middle synclinal. But as their outcrop has not presented itself on McLellan's Brook, it seems probable that they are sufficiently deep seated to abut, in their south rise, against the black shales in the Mill-road fault. The Widow McLean seams can therefore scarcely be expected to come to the surface in any other place than south-east of the McBean eight-feet seam; but it would appear from a comparison of Sections 2 and 3 with Sections 6 and 7, that Messrs. Mitchell and Barton have as yet scarcely carried their researches far enough behind that coal seam to reach them.

Horizon of the Widow McLean seams.

It has been conjectured that the Widow McLean seams may be the eastern out-crop, in a deteriorated condition, of some of those workable seams which underlie the great mass of black shales. If such were the case, it would follow that the fault between them and the Mountain seam would be a much greater break than has been supposed by me, and the block of strata with which these seams are associated would apparently be a quadrangular mass limited by four great breaks, namely, the one just alluded to, the Lawson fault, the great East fault and the South fault. But until the search for the McBean seam behind the Mountain seam, and for the Widow McLean seams behind the McBean seam, has been exhaustive, it will be premature to speak with anything but doubt of the structure of this part of the coalfield.

On the St. Lawrence area, black shales appear to have been obtained in nearly a dozen trial-pits, embraced in a space of about one hundred acres, lying southward of Haliburton's main shaft. The shales are characterised by the presence of an abundance of *Cythere*, with many small scales and minute bones of fishes, but it does not appear probable that the shales will have any very great thickness. Their position seems to be on a continuation of the axis of the Middle synclinal, and the measures may be expected to preserve on the whole a moderate inclination. Indeed Mr. J. Weir, formerly employed as pitman by Mr. Haliburton, pointed out to me a trial-

St. Lawrence area.

Black shales.

Middle synclinal.

If it were the latter, its effect would naturally be to steepen the dip of the coal seam where in contact with it, and this dip, whatever its rate, would probably be northward. We see in the St. Lawrence pit that the effect of the North fault has been to produce a slope of the measures in an opposite direction, and it does not appear to me an improbable conjecture that the coal seam penetrated in that pit may possibly be the return of the eight-foot seam to the surface on the north side of a trough which lies between the two dislocations. It is possible also that the seam may abut against both these faults, and perhaps against the supposed great East fault, and thus shew no out-crop around the east end of the area which it may occupy, until it emerges near the St. Lawrence pit. After emerging, the out-crop gradually separates a little from the North fault in the neighbourhood of that pit; but as the fault gradually gains upon higher measures as it proceeds westward, the out-crop of the coal seam will again probably approach the fault and once more become concealed by it.

Possible equivalence of the St. Lawrence seam.

If the fault which interrupts the McBean eight-foot seam were an upthrow, the coal bed in the St. Lawrence pit could scarcely represent it, and further facts would have to be ascertained before the true structure could be given. It may be remarked, however, that the eastward strike of McBean's six-foot seam on the upper part of Marsh Brook, which is conjectured to be equivalent to the George McKay seam, appears to run such a course, that it will probably come against a mass of conglomerate which occurs south-eastward from Mr. William Grant's house in that neighbourhood. This conglomerate is supposed to be the same as that which underlies the coal seam in question, as stated in Section 6. The dip of the measures is there northwestward, and the presence of the conglomerate in such a relation would, in reality, indicate an upthrow on the east side of a disturbance. If the course which this disturbance may present, should point to the eastward interruption of the McBean eight-foot seam, the upthrow of this seam might be considered as established.

Upthrow fault.

About twelve chains from the north-east corner of the McBean area in a bearing N. 55° E. there is an exposure of greenish-gray conglomerate, dipping N. 43° W. < 40°. Were the fault an upthrow, this exposure would seem to represent the lower conglomerate of Section 6, and the crop of the McBean eight-foot seam would probably have the same relation to it on the east side of the disturbance, that McBean's slope has to the conglomerate on the west.

Conglomerate.

The Mill-road fault, as has been stated, runs about S.S.E. from Black's mill-site on McLellan's Brook, and its course can be pretty well seen in the line of demarcation which it presents between the arenaceous measures on the east and the black shales on the west. But what its precise course may be, northward, or what effect it may produce upon the distribu-

Mill-road fault.

tion of the measures in that direction, I have found no satisfactory evidence to determine. Arenaceous measures extend westward beyond the direct northern prolongation of the bearing given to the fault; but with a very little deflection westward the chief mass of sandstones would still keep on the east side, where they rise into a considerable hill, along the south-western foot of which the St. Mary's road runs to New Glasgow. The eastward prolongation of this hill appears to constitute the north-west limit of the Middle synclinal. The hill is supposed to have an anticlinal form, and rising on it to the north-eastward from Black's mill-site, we have some evidence of north-western dips on the land of Mr. Andrew Campbell. Near his house on the top of the hill is a well sunk through three feet of soil and thirteen feet of arenaceous shale and shaly sandstone; the dip, as explained to me by Mr. Campbell, was found to be N. 17° E. < 10°.

Farther north-eastward the rocks are so covered with drift that I have not been so fortunate as to meet with exposures shewing slopes in the same direction, but evidences of a synclinal, whose axis would run on the other side of the hill until cut off obliquely by the great North fault, are met with under three-quarters of a mile north-eastward, where several coal beds have been worked to a small extent on Potter's Brook. The ground, however, is here so broken by faults running in various directions, while the amounts of displacement are not known, and so affected by minor undulations, that it is next to impossible to correlate the seams with one another with any degree of certainty.

One of these seams occurs on the south side of the brook, where it was formerly worked by Mr. Alex. McKay, who informed me that the coal was of excellent quality, and who gave me the following section of the ground immediately beneath:

	Ft. In.
Coal—A seam of excellent quality.....	5 0
Ash-gray calcareous underclay, characterized by a great abundance of well-preserved forms of <i>Stigmaria</i>	1 6
Ash-gray fireclay, becoming mottled with red by exposure to the weather, and holding <i>Stigmaria</i>	7 0
Coal—A seam of which the thickness was not ascertained.....	0 6
	14 0

The strike of the out-crop, as determined by the work on it, is about N. 62° W., with a slope to the north-eastward, but I am uncertain of the angle of inclination.

About 300 paces N. 20° E. from this, on the north side of the brook, a horizontal gallery was opened many years ago (the colliery was visited by me when it was in work in 1841) by the late Mr. Alex. Fraser, in a seam of excellent coal from four and a-half to five feet thick. The mouth of the

Arenaceous
measures.

Anticlinal form.

N. W. dips.

Northsynclinal.

A. McKay's
five-foot seam.

Calcareous
underclay.

Fraser's five-
feet seam.

gallery is about fifteen feet over the brook and immediately under the south side of the telegraph road. The gallery in its general course is about N. 82° W., and it extends about 120 paces under ground, with a sudden turn southward about thirty paces in. The dip is northward, but as the natural out-crop on the face of the bank presents an arch, first rising southward towards the road and then falling again beyond to the level of the brook farther down, it is evident that the horizontal gallery would turn at some uncertain distance beyond the extent to which it has been carried, and come out again to the crop in the bank at the same height of fifteen feet above the brook, shewing by this a fold over the axis of an anticlinal form or roll in the strata. On the south side of the brook, nearly opposite to this point, a slope sinks southward in what is supposed to be the same seam, and a rise in this on the south side of a synclinal might be expected to bring the seam into junction with that worked by Mr. Alex. McKay; but a fault appears to run between the two positions on or near the axis of the synclinal and renders the identification less certain. According to Mr. Poole, however, a calcareous underclay of twenty-two inches supports the Fraser coal,* and further assimilates the two seams.

Small anticlinal form.

Fault.

Calcareous underclay

Immediately east of the mouth of Fraser's gallery a fault occurs, and vertical strata met with by Mr. George McKay, in a pit sunk about 135 paces southward, shew the bearing of the fault to be about S. 16° E. About 140 paces eastward of this fault, and on the south side of Potter's Brook, Mr. Lawson has sunk a slope for the Pictou Mining Company in a coal seam of which the following is a section:—

Fraser's fault

Lawson's coal seam.

	<i>Ft. In.</i>
Cannel coal, varying in thickness from three to nine inches.....	0 6
Mineral charcoal mixed with coal.....	0 2
Good bituminous coal, of which from four to six inches at the bottom appears to be of a friable character.....	3 0
	<hr/> 3 8

The bearing of the slope is S. 26° E., with an inclination of 20° for twenty feet; of 35° for eighty feet; of 20° for thirty-five feet, with a sudden diminution to 16° at the bottom, where a disturbance occurs running N. 52° W. This disturbance cannot, however, be a great one, as it produces little displacement at the out-crop of the seam; but at some distance farther to the deep of the seam (supposed to be about seventy paces from the mouth of the slope) a much more important dislocation probably occurs. Its position is inferred from the presence of about thirty feet of vertical sandstone about nine chains to the eastward of the slope, and a coal seam two and a-half feet thick, in a vertical attitude, about fifteen chains beyond; the

Small fault.

A larger fault.

* Transactions of the Nova Scotian Institute of Natural Science for 1863, p. 38.

bearing these would give to the fault is about S. 72° W. What displacement this fault produces has not been ascertained, but a subordinate one appears to run parallel with it about eighty-five paces north of it, the bearing of which would bring it about twenty or thirty paces behind the mouth of Lawson's slope. Entangled with these disturbances there appear to be two ten-inch seams of coal and several very small ones, in addition to the one of two and a-half feet just mentioned, the whole of which are supposed to be beneath the seam of Lawson's slope, and with it to lie in a narrow synclinal form north of the more important of the parallel faults.

Although the unknown amount of displacement produced by the fault at the mouth of Fraser's gallery prevents the stratigraphical relation of Fraser's and Lawson's seams from being accurately established, yet the character of the fuel in them has induced a comparison of the former with the George McKay seam and of the latter with the Mill-race seam. At any rate, it is but reasonable to suppose that these seams, with the rest of the Marsh-pit group, after cropping out on the north rise of the Middle synclinal, would, with the remainder of the measures, turn over to a northward dip and be found somewhere in connection with the synclinal of this part of Potter's Brook.

About thirty chains from the telegraph road, on the old straight road leading to the Scotch church in New Glasgow, a pit has been sunk on the East River area, close by its northern boundary. According to information given me, it penetrates fourteen feet of drift, then fourteen feet of rock, the character of which I could not ascertain, and finally intersects a coal seam eight feet thick. At the bottom of the pit a slope was sunk for fourteen feet in the coal, at an angle of 60° in a bearing about south, to a face of sandstone cutting off the coal. The bearing of this dislocation I was not so fortunate as to learn; but a fault, of which Mr. Hartley has detected the presence on the west side of the East River, will run a little south of this, if it be not the same one. If Lawson's and Fraser's seams may be compared with the Mill-race and the George McKay seams, this one may be compared with the McBean eight-feet seam.

The steepness of the seam here is no doubt due to the proximity of the great North fault, which passes about 120 paces behind it; but, after proceeding in this attitude for some distance westward, the strike of the measures appears to turn more south, while their slope diminishes. At a distance of about 700 paces from the pit, along the road near which it is situated, there is a descent in the surface, which runs about S. 30° W., and constitutes the north flank of a small but well marked ridge, which crosses the St. Mary's and telegraph roads just at their junction, and termi-

Still another fault.

Ten-inch coal seams.

Comparison of coal seams.

East river pit.

Eight-feet coal seam.

Fault.

Comparison with McBean's eight-feet seam.

North fault.

nates near the establishment of the Crown Coal, Brick and Pottery Company. The higher part of the ridge is composed of a brownish-drab sandstone of considerable thickness. This probably underlies the East River eight-foot seam, but at what vertical distance is uncertain.

Sandstone ridge.

At the Pottery works a pit was sunk to a three-foot seam of remarkably good coal by Mr. Jos. Richardson, and is hence called the Richardson seam, the measures intersected in the pit being as follows, with a dip of S. 57° E., < 19½°.

The Richardson three-foot seam.

	Ft.	In.
Drift.....	16	0
Gray argillaceous sandstone, gradually crumbling in the weather.....	24	0
Coal—The Richardson seam, of remarkable good quality.....	3	0
Grayish-drab fireclay, with abundance of <i>Stigmariu</i>	3	0
Light yellowish-drab fireclay.....	11	0
	57	0

These measures would underlie the mass of sandstone forming the ridge, and the out-crop of the coal seam would follow the foot of the rising ground up to the great North fault; where it crosses the road to the Scotch church there is a red ferruginous spring to mark its probable position; but in its south-westward course, the seam will probably be interrupted by a dislocation of which there is evidence at no great distance beyond the Pottery. The excellent quality of this coal gives it a resemblance to that of a bed two and a-half feet thick, which, as will be seen by Section 7, is about eighty feet beneath McBean's eight-foot seam.

Comparison of seams.

At Chisholm's mill-pond, on Potter's Brook, about thirty chains southward of the Pottery pit, an excellent seam of coal, said to be well suited for blacksmiths' purposes, and reported to have a thickness of three feet, was formerly worked by the Rev. Mr. Stewart, and is hence called the Stewart seam. The measures associated with it, as near as I could ascertain, are as follows, in descending order:

	Ft.	In.	Ft.	In.	
Black carbonaceous shale.....			10	0	
Coal.—The Stewart seam.....			3	0	Stewart's seam.
Gray underclay....	3	0			
Measures concealed, but probably black carbonaceous or argillaceous shale	120	0			
Gray sandstone, weathering drab	5	0			
			128	0	
Coal and black argillaceous shale.....			0	1	Small coal seam.
Gray soft fireclay.....	1	6			
Gray hard fireclay with indications of <i>Stigmaria</i>	3	6			
Grayish-drab sandstone.....	2	0			
Gray argillo-arenaceous shale.....	1	0			
Grayish-drab sandstone.....	4	0			

		<i>Ft. In.</i>	<i>Ft. In.</i>
	Gray arenaceous shale.....	0 6	
	Blackish argillaceous shale.....	0 6	
	Gray flaggy sandstone.....	36 0	
	Black carbonaceous and argillaceous shale, only partially seen..	50 0	
			99 0
Small coal seam.	<i>Coal</i> .—Cannel.....		0 11
	Gray fireclay.....	3 0	
	Black carbonaceous shale, only partially seen.....	105 0	
	Grayish-drab sandstone.....	25 0	
			133 0
			374 0

The sandstone at the base of the preceding section is seen on the west side of the New Glasgow road, at the bridge over Potter's Brook; and proceeding down the brook from this, the cliff on the right bank gives a continuous descending section, in which nothing is met with but black shales. These have been carefully examined by Mr. Hartley, and the direct breadth of them in the bearing N. 80° W. which is at right angles to the strike, is computed to be very nearly 475 paces, with angles of inclination varying from 33° to 47°. This would give a thickness of about 700 feet, and if to this be added 500 feet for what may be concealed to the middle of the river, the distance being fifteen chains and the supposed inclination 30°, the thickness would not be less than 1200 feet.

The strike of the Stewart coal seam across Chisholm's mill-pond and in the two or three crop-pits on the north side of it, is about N. 18° W., with an inclination to the eastward of about 30°; but a search for the seam in this direction, by trial-pits approaching the Pottery, has proved unsuccessful. In a cliff on the right bank of the East River, above the railway bridge, there is a considerable exposure of strata, which very probably underlie the seam at a considerable depth. About a quarter of a mile above the bridge, black shales, which are a part of the strata exposed, dip N. 40° E. < 23°—25°, and this dip is preserved on the strike for 300 paces; but approaching within 200 paces of the lower end of the bridge, the strata suddenly becoming arenaceous, plunge with a dip of N. 5° W. < 43°—45°, maintained for 150 paces measured directly across the strike, while close by the extremity of the bridge there appears to be a dislocation. This displacement, which may be called the Bridge fault, would seem to run a little south of the Pottery pit on the Richardson seam, and the sudden bend in the measures would carry the Stewart seam considerably out of its course to the westward, and thus, aided by the break, which is probably a downthrow on the north side, would bring it much nearer the river.

Southward from Chisholm's pond the measures appear gradually to assume a more westerly bearing, the strike becoming S. 20° W., and at

the distance of between 300 and 400 paces from the pond they are interrupted by another dislocation. The evidences of this were observed by Mr. Hartley on the right and left banks of Potter's Brook, about a quarter of a mile below the New Glasgow road, where the dip of the black shales becomes S. 5° E. < 60°. The course of this fault seems to be about west; it is a downthrow on the south side, supposed to be of about 200 feet, and on this side of it the black shales turn south-eastward and gradually conform with the arrangement which they present on McLellan's Brook.

The great mass of black shales which immediately succeeds the band of sandstone on the west side of the New Glasgow road at Potter's Brook seems to indicate that we have here the base of the arenaceous measures and the summit of the black shales, and the position and arrangement of the mass render it probable that it is to be considered an addition to the thickness which Mr. Hartley has found to exist at the highest horizon in them on the west side of the East River, less the 200 feet repeated in the Potter's-brook fault. Their volume over the Main coal seam (more particularly described in Mr. Hartley's Report,) is, according to him, 1128 feet. If to this we add the 1000 feet occurring on and near Potter's Brook, we have a thickness of 2128 feet.

Summit of
black shales.

Thickness of
black shales.

It has already been stated that McLellan's Brook, below Black's mill-site, presents a great body of these black shales, and on the East River, above the mouth of this brook, there are farther exposures, reaching to the out-crop of the Main seam, where a slope has been opened on it by the Pictou Mining Company. The whole will give to the series a transverse breadth of a little more than a mile and a quarter, with a north-eastward dip varying in inclination from 8° to 24°. Such a computation as can be made from these elements would assign to the black shales on the west side of the Mill-road fault, at Black's mill-site, a volume of 1740 feet. As this is 388 feet less than the total thickness stated above, it would follow that the displacement produced by the Mill-road fault would equal this, with as much in addition as the base of the arenaceous measures may be underneath the surface on the east side of the fault at that spot. As already stated, the precise course of this fault northward from Black's mill-site remains a matter of uncertainty; and whether it is deflected so far as to run for the black shales at Potter's Brook and come to the East River near the railway bridge must continue a subject for future investigation.

Break in Mill-
road fault.

Bearing of Mill-
road fault.

The out-crop of the Main seam, upon which the coal works of the General Mining Association are situated on the west side of the East River, crosses the New Glasgow road about a quarter of a mile above the turn to the Albion mines, and the slope of the Pictou Mining Company, which for the present is abandoned, is seen about 120 paces east of the road. As a detailed description of this seam, as observed by Mr. Hartley on the

Main seam.

Reference to
Mr. Hartley's
Report.

west side of the river, was necessarily to be a part of his Report, it was left to him to follow the investigation of it and the seams and ground associated with it to the eastward. I shall therefore refer to him for what is to be said of it and of a shaft sunk to it on Grant's farm, further to the eastward. The strike of the seam from the Albion mines to the slope is about S. 70° E. (or S. 47° E. Mag.), the dip at the mouth of the slope being N. 20° E. (or N. 43° E. Mag.) $< 19\frac{1}{2}^{\circ}$; but here the out-crop turns a little more southward, and a trial-pit has been sunk on it a quarter of a mile farther, in the bearing S. 45° E., thirteen chains beyond which it will come upon a fault, the course of which, as ascertained by Mr. Hartley on the west side of the river, is almost exactly east. About thirteen chains on the course of this fault a coal seam occurs on the south side of it, on the land of Mr. Donald McLeod. The following is a section of the seam, as given to me by Mr. Lawther, who sunk the trial-pit:—

	Ft. In.
Coarse coal.....	2 6
Coaly shale in very thin layers.....	3 0
Good coal, or the best part of the seam.....	2 6
	<hr/> 8 0

The crop has been traced a distance of about 190 paces, and the dip of the strata is about N. 76° E. $< 19^{\circ}$, black shale being above the coal seam, and sandstone supporting the underclay beneath. If this were the Main seam the displacement of the fault would be an upthrow of 286 feet on the south side; but the character of the seam is more like some of those lower down, and the upthrow, therefore, is probably much greater.

This is the only coal seam I could hear of that has been struck on the south side of the fault above mentioned. Between the trial-pit on the coal, however, and the great South upthrow, which appears to pass a little south of the house of Mr. Neil McKay, there is a space of a mile in breadth. The strata striking south would run across this nearly at right angles to the direction of the South fault. If the coal seams reach so far it is probable that they may be deflected somewhat to the west on approaching the upthrow; but as already stated, it is not impossible that a southern portion of the space may be occupied by rocks of the Millstone Grit series, brought into place by a fault subordinate to the great one. I have no facts, however, on the east side of the East River, to shew how much this may be.

About 200 paces less than a mile from the run of the coal seam on Donald McLeod's land, and at right angles to the strike, a pit has been sunk for water on the land of Mr. William McLeod. The pit is sixty-three feet deep; no water was obtained, and judging by the *débris* lying about the mouth of the pit, it penetrates nothing but black shale. A lump of asphaltum is said to have been obtained at the depth of twenty-five feet,

Strike of Main
seam.

McLeod seam.

South fault.

Black shales.

but I presume it may have been oil shale, or highly carbonaceous shale. The position of the excavation is on the road which crosses McGregor's Mountain, and it is about 800 paces north of the South fault.

About 1400 paces still farther east, but, as is supposed, on the east side of the Mill-road fault, there is an old gallery or level on a seam of coal said to be three feet thick, over which rises a considerable thickness of black shale. The mouth of the level is seen at a great bend of McLellan's Brook, about 240 paces above the Fulling-mill bridge, and a little over 300 paces north of the South fault. The dip of the strata appears to N. 54° E. $< 18^{\circ}$.

About 300 paces farther up the bend of McLellan's Brook, but not more than 300 paces on the road which runs southward from the Fulling-mill bridge, there is an exposure on the right bank of the brook, which would be on the east side of the Mill-road fault, and on the south side of the Fulling-mill fault, but it is uncertain to what division it may belong. The base of it reaches to within fifty paces of the Devonian rocks brought up by the great South fault. The following is a section of the strata in descending order:—

	Ft.	In.	
Greenish-drab arenaceous shale interstratified with layers of greenish-gray sandstone	22	0	
Black argillaceous shale with thin layers of sandstone.....	2	6	
Greenish-drab sandstone	0	6	
Black argillaceous shale.....	15	0	
Gray shaly sandstone	5	0	
Greenish-gray conglomerate with siliceous pebbles of various sizes up to an inch in diameter, in an arenaceous matrix..	1	6	Conglomerates
Black shale.....	1	0	
Greenish-gray conglomerate as before, with some sandstone	6	0	
Dark gray shaly sandstone	10	0	
Greenish-gray conglomerate as before.....	2	0	
Greenish-drab sandstone	1	0	
Black shale.....	3	0	
Greenish-drab sandstone	0	6	
Black flaky argillaceous shale weathering to a light gray clay...	0	6	
Greenish-gray sandstone with indications of <i>Stigmara</i>	0	6	
Greenish-gray conglomerate, as before	0	3	
Grayish-drab sandstone.....	3	0	
Coal	0	0½	Small coal seam
Greenish-drab sandstone with uncertain indications of <i>Stigmara</i> , with greenish-gray conglomerate at the bottom.....	2	6	
Black argillaceous shale with much iron pyrites.....	2	6	
Greenish sandstone, mottled with red, probably from weathering,	15	0	
Reddish sandstone, in some parts approaching to a drab; the reddish colour is perhaps due to weathering.....	20	0	Red sandstone.

The colour and character of some of the strata of this section induce the supposition that the mass may belong to a lower horizon than the neighbouring strata on the south side of the Fulling-mill fault, though still to be classed with the Productive measures ; and it may have been brought into the position which it occupies by some entanglement with the South upthrow fault.

No strata known of a certainty to belong to a lower subdivision of the Carboniferous group than the Productive measures have been as yet observed along the South fault, between these and the Devonian series, though it is supposed that some red rocks which Mr. Hartley has noticed on the west side of the East River may possibly be such. It is to be remarked, however, that these red rocks appear to have the same eastward dip as the undoubted Productive measures above them, in so far as the McLeod coal seam may be taken as guide ; and they may represent a deeper portion of the Productive measures than seen elsewhere in this coal field, with the exception of the New Glasgow conglomerate.

No rocks having the typical character of this conglomerate appear to have been brought to the surface by either the South or the East fault, or by Mr. Hartley's West fault. This does not, however, disprove their possible presence beneath the whole of the Productive area abutting against these faults and constituting the base of Dr. Dawson's Middle Coal formation, as inferred by Mr. Hartley.

This inference seems to be supported by the presence, immediately on the summit of the conglomerate, of the coal seam worked by Mr. William Fraser (Moose) for the burning of his limestone, and another said to overlie it ; and although the occurrence of these is not strengthened by the known existence of any of the larger workable coal seams in the Pictou synclinal, the deposits of which have yet to be examined by the officers of the Survey, it would not be surprising to find, in a country apparently so broken by great dislocations, that the absence of the larger seams may be due to a structure resulting from some of these faults, of as important a character as those affecting the productive part of the field above New Glasgow.

The total thickness of the Carboniferous rocks of Nova Scotia, as measured by myself at the Joggins in 1843 is about 14,700 feet. The Pictou series, in so far as our examinations have gone on the present occasion, is in ascending order as follows :

	<i>Ft.</i>	<i>Ft.</i>
Millstone Grit rocks, according to Mr. Hartley's Section 1, without any allowance for the East River series of Section 2, which may be an addition wholly or in part.....		3773
New Glasgow conglomerate, as measured on the east side of the East River.....		1600

Red rocks, west
of East River.

New Glasgow
conglomerate.

Coal seams
above conglom-
erate.

Total thickness
of Carboni-
ferous rocks.

	<i>Ft.</i>	<i>Ft.</i>
Productive coal measures:		
Measures on the west side of the East River, according to Mr. Hartley's Section 4.....		2453
Measures on the east side of the East River:		
Black shales above Mr. Hartley's Section 4....	<i>Ft.</i> 1000	
Arenaceous measures of this Report.		
Section 3, Division C.....	924	
Section 2, Division B.....	819	
Section 1, Division A.....	223	
Strata above A	148	
	<hr/> 2114	
		<hr/> 3114
		<hr/> 5567
		<hr/> 10840

When it is considered that in the sections above given on both sides of the East River we do not in any case, with the exception of the New Glasgow conglomerate, suppose that we have attained either the bottom or the top of the series to which it belongs, and that the subdivisions at the summit and at the base of the whole Carboniferous group are wanting, though deposits belonging to them are not far removed from the district examined, it seems probable that the volume assigned to the Carboniferous rocks at the Joggins will be fully maintained in the Pictou region.

I have the honour to be,

Sir,

Your most obedient servant,

W. E. LOGAN.

