Fam. COCCINELLIDÆ.

Gen. Coccinella.

1. *Coccinella trifasciata*, Linn.
C. perplexa, Muls.
Common.

2. *Coccinella bipunctata*, Linn.
Adalia bioculata, Say.
Extremely abundant.

Gen. Hippodamia.

Hippodamia 13 *punctata*, Linn.
H. tibialis, Say.

Rare. Taken by Mr. A. Silver at River Bank, Preston. This species has a wide range over British America, being found at Lake Superior, and as far to the north-west as Great Bear Lake in lat 69° N. long 120° W.

Gen. Mysia.

Mysia 15 *punctata*, Muls.
Coccinella 15 *punctata*, Oliv.
Anatis mali, Say.
A. labiculata, Ibid.
I have only taken one specimen of this insect.

Art. XIII. Explorations in the Pictou Coal Field, in 1867 and 1868. By R. G. Haliburton, F. S. A., *Sec'y of Nova Scotia Coal Owners Association.*

(*Read Dec.* 14, 1868.)

Since my paper appeared in the Transactions for 1866–7, explorations in the Pictou coal field have been somewhat limited in consequence of the temporary depression which has taken place in the coal trade, the result of the heavy duty imposed by Congress upon our coal, and the low price of fuel in the United States.

On the Montreal and Pictou Company's property, on the west

side of East River, expensive explorations were carried on, to thoroughly test the seam, for the purpose, if possible, of identifying it with the main or the deep seam of the Albion Mines. A level was driven one hundred yards westerly on the seam. As we worked westerly the partings gave out, and the benches united in one seam of 25 feet thickness, which improved in quality the farther west we worked. In Professor How's work on the Mineralogy of Nova Scotia, he gives to coal tested by him, which came from this seam, a high rank as a steam producer.* Dr. Dawson has also spoken to me of specimens which he has examined, as being unsurpassed by any which he had elsewhere met with in the Pictou coal field. The whole seam was not equally good, the fault having caused it to be disturbed, but it was rapidly becoming uniform in quality, as the levels were driven away from the fault which was found where the pit was sunk. At the end of our west level, we drove a level northerly through the underlying strata, and found them undisturbed. The Intercolonial Company also traced the crop of our seam nearly a quarter of a mile westerly into their area.

The general appearance of the Montreal and Pictou seam resembled greatly the Campbell seam, the main seam of the Middle River district; but there was a great difficulty in finding room for these seams as they approached the conglomerate, so we could only solve the difficulty by imagining that some faults would be found near New Glasgow.

In July, 1868, Dr. Dawson examined a large portion of the Pictou coal district, and among the rest the areas belonging to the East River Company, which adjoin the Montreal and Pictou Company's property, and extending back nearly three miles to "the Marsh," embrace the Geo. McKay or Marsh coal within their

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* Professor How gives the following analysis of this coal:

"No. 2 sample from second bench gave—

Moisture	5.47	
Volatile combustible	19.93	
Fixed carbon	68.55	Coke—74.60
Ash	6.05	
	100.00	
Evaporative power	9.41	

"This was an extremely bright and clean coal. Its very high evaporative power, even making allowance for the difference between the power shown by analysis, and that which could be actually obtained by practice, makes it occupy a good position among British and American Coals for Steam."

limits. The following extracts from a report by him may be of interest here :—

"The area of the East River Coal Company extends to the south-eastward from the town of New Glasgow, about three miles, with a breadth of about a half a mile, and lies in the northern and central portion of the Coal basin of the East River of Pictou, on the east side of that river.

"The workable seams contained in the property, consist of certain upper seams not known on the west side of the East River, together with the equivalents of the lower seams which have long been mined on the west side, though their extension on the east side of the Coal field has only recently attracted attention. In this report I shall notice these two groups of beds separately, and shall then refer to the extent and quantity of the Coal contained in them, and the most profitable means for its extraction.

"I.—Upper Coal Seams.

"These upper beds crop out on the west end of the area with easterly dips. One of them, the "Stewart seam," has been opened in the adjoining property of the "General Mining Association," though the works are now abandoned. It is stated to be about three feet in thickness, its coal being of excellent quality. Its dip, as ascertained by examination of the associated beds exposed in the bed of "Potters Brook," is east at an angle of 40°. The strike of the "Stewart seam" carries it into the area of the East River Company; and following its direction a shaft has been sunk in the overlying measures, which has penetrated a bed of 2 feet 9 inches thick, known as the "Richardson seam."

"This may possibly be the continuation of the "Stewart seam," but is more probably an overlying bed. The "Richardson seam" is now worked on a small scale in connection with a bed of fireclay, which forms its floor. The dip at the Richardson mine is to the south-east, shewing that the measures turn somewhat rapidly to the eastward in the space between it and the old workings on the Stewart seam. Following the outcrop to the eastward, there are indications of a further bend of the measures to the east; but the coal is not seen for a mile, where a bed known as the "Foster seam" is exposed on an old adit, a short distance to the northward of the property of the Company. This bed is 4 feet 4 inches thick, and dips at a small angle to the north-east. In a short space, however, the dip of the measures changes, and a little to the northward a slope has been sunk by the Montreal and New Glasgow Company on a bed 4 feet thick, dipping south 5 degrees east, at an angle of 34°. This bed differs from the Foster seam in its character and accompaniments, and is probably an overlying seam. It has 6 inches of cannel in its upper part, and a larger per centage of ashes than the Foster seam, which is a good Coal of uniform quality. Trial pits opened in this vicinity, both in the Montreal and New Glasgow and East River areas, indicate that the beds have been subjected to an anticlinal fold, producing considerable disturbance in this part of the area, and probably dividing it into two subordinate basins. Beyond this place the coal outcrops have not been traced along the northern side of the area, but on the

adjoining property and near the eastern end of the area, now under consideration, a bed of Coal has been struck by Mr. Kirby. It is stated to be 4 feet thick, and dips to the south, which would carry it in a short distance into the East River area. This bed is no doubt a continuation of one of those mentioned above, probably of the upper or Lawson seam.

"Returning to the south side of the area at its western end, the strike of the "Stewart" seam would carry its outcrop to the southward, and it does not appear on this property for some distance to the eastward.

"On the eastward end of the area, however, the outcrop of the upper seams again crosses the boundary of the area, and one of the beds 4 feet 4 inches thick has been opened, under the name of the "George McKay" seam, and a considerable quantity of excellent coal has been extracted from it. It has a high reputation as a steam coal, which, as will appear in the sequel, is borne out by its composition. It dips north 60o east at an angle of 12° to 15°. From this place the extension of the bed has been traced about 1104 feet, and a shaft has been sunk upon it by the "German Company." At the time of my visit, this shaft had penetrated three small seams of coal, and I was subsequently informed that it had also passed through a bed corresponding in size and quality with the Lawson seam before reaching the McKay bed, which would thus appear to be the Foster seam.

"The McKay bed would appear to be the lowest bed of the upper series, with the exception of a seam of 9 inches in thickness; but at a distance of 400 yards to the rise of the measures, corresponding to a vertical thickness of about 300 feet, there occurs a bed of oil coal 7 feet thick, of which 4 feet have been found to yield at the rate of 60 gallons per ton, and the remaining three at the rate of 40 gallons per ton.

"II.—Lower Seams.

"The equivalents of the "main seam" and other beds of the Albion Mines, occur on this property at a depth of about 1000 feet below the upper beds above mentioned; on the northern side of the area, and near its boundary, one of these beds has been opened in a trial pit, which was full of water at the time of my visit, but I was informed that it had exposed a bed of Coal six feet thick, S. 20° W. at an angle of 60°. This opening cannot, however, be considered sufficient to test this portion of the property, as the lower seams must, if one may judge from their dimensions elsewhere, be much more extensive than the above statement would indicate.

"On the north side of the area, the lower beds have not yet been removed, but the characteristic black shales which overlie them appear in several places, and they could, no doubt, be easily reached by a shaft sunk in the south-eastern part of the property. From my knowledge of other parts of the Pictou Coal field, I have no hesitation in affirming that these lower beds underlie the greater part of the area, and though they have not been proved, yet their ascertained value both to the west and east of the area, renders it certain that their amount of coal must greatly exceed that of the upper series above mentioned.

"III.—Amount and Quality of Coal.

"It is not at present determined how many workable beds occur in the upper series; but it is certain that there are at least two: (1) The Kirby or Lawson seam, worked on the slope of the Montreal and New Glasgow Company, and which may be identical with the Richardson seam and with one of the beds on the shaft of the German Company. (2) The Foster seam, which I regard as identical with the George McKay, and possibly with the "Stewart" seam.

Samples of these Coals gave on assay, the following results:

Name of Coal.		*Volatile matter.*	*Coke.*	*Fixed Carbon.*	*Ash.*	*Color of ash.*
1. Kirby or Lawson, 4 feet thick.	coal.....	25·4	74.6	50	24·6	whitish.
	cannel...	34.8	65.2	47.6	17.6	reddish.
2. George McKay, 4 ft. 4 in.	1 sample	31·4	68·6	63·6	5	grey.
	2 "	31·2	68·8	62.6	6·2	grey.
3. Foster Coal, 4 ft. 4 in.		29	71	53·4	17·6	reddish grey.

"Of the above coals, that of the George McKay seam is decidedly the most valuable, whether for gas or steam purposes. In the small amount of earthy matter contained in it, it compares favourably with any coal hitherto shipped from the Pictou mines.

"The coal of the Foster mine, in general quality, resembles that of the George McKay, bnt contains much more earthy matter. If as above conjectured, these two exposures belong to one and the same bed, then the quality of the coal must improve in its extension eastward.

"The Kirby or Lawson coal affords a large amount of ashes; but the layer of cannel at the top is very valuable as a gas coal, and affords a good coke.

"I had no opportunity of obtaining samples of the lower coals on this property. The nearest exposure to the opening already referred to on the north side of the area, is that of the Montreal and Pictou Company on the west side of the river, where the beds are stated to contain 37 ft. 6 in. in thickness of good coal in four beds. The nearest exposure to the eastward is that on the McBean area, where the thickness is believed to be sixteen feet in two beds.

"With regard to the actual quantity of coal on the area, the facts are not sufficiently well ascertained to enable a definite calculation to be made, I consider it palpable, however, that the upper seams will be found to extend over about one square mile of the area, and that after making all reasonable deductions, they may afford about 4,000,000 tons of coal at a very moderate expense for extraction and transportation. The lower seams must extend over nearly the whole extent of the property, and must be capable of yielding several times the above quantity."

Having had some experience of the difficulties which meet the geologist, and the practical miner in the Pictou coal field, from the remarkable features which it exhibits, I addressed a letter to the Secretary of State for the Provinces, and while in Ottawa in February 1868, had an interview with Sir John Macdonald, respecting

the importance of having a geological examination of that district, as soon as possible by the Geological Survey of Canada. It was represented that the complicated nature of the coal formation there, as indicated in my last paper, was a source, not only of scientific uncertainty, but also of great difficulty and of a heavy loss in an economic point of view. This correspondence which has been published *in extenso* in our local papers, resulted in an assurance from the government that arrangements were being made for a Geological Survey of Nova Scotia, and that everything would be done to secure an early and a thorough investigation of the coal fields of Pictou county.

In the course of a few months, Sir Wm. Logan, accompanied by a very able assistant, Mr. Edward Hartley, visited Pictou county, and spent the summer and autumn in making a most careful and painstaking examination of that locality, and of its geological structure. The brief summary report of his survey which has appeared, will be of interest here :—

"The attention of Mr. D. Honeyman was applied in Nova Scotia to an examination of various parts of the townships of Maxwelton, Arisaig and Antigonish, in the counties of Pictou and Antigonish, especially those extending along the sea coast for a few miles inland, embracing rocks of the Silurian and Carboniferous eras. Belonging to the latter on both sides of Antigonish harbor, there are important deposits of gypsum, well situated for the purposes of trade; and the recent investigations of Mr. Honeyman apppear to have cousiderably extended the surface under which the mineral was previously known to exist.

"In Nova Scotia I availed myself also for a short time of the services of Professor H. How of King's College, Windsor, whose attention was directed to various parts of the County of Digby, where the ores of iron with some indications of copper and lead seem to be the chief substances of economic interest.

"About three months of my own time have been occupied in the investigation of the structure of that part of the Pictou coal field in Nova Scotia, which lies southward of New Glasgow, and extends several miles on each side of the East River. In this I was aided by Mr. E. Hartley, and with the view of hastening the examination as much as possible, we divided the work into two parts. That on the west side of the river was wholly committed to Mr. Hartley, that on the east was undertaken by myself.

"The true structure of a coal field, in which valuable seams of the fuel exist, being a matter of great commercial importance, no pains should be spared in making it out; but where as in the present instance it is of a

* The report appeared subsequently to the paper being read, but before publication of this volume of Transactions. It has therefore been added to the paper

complicated character, while natural exposures and crop workings are but few, it will demand much time to accumulate the number of facts required to arrive at a satisfactory conclusion. We do not pretend that in three months we have been able to accomplish our task, but it appears to me that we have added considerably to what was previously known and at a future time we hope still further to elucidate the subject.

"The New Glasgow productive coal measures appear to lie between two great up-throw faults, which are about three miles apart on the East River, and run nearly parallel to one another in a bearing northward of west. The coal field is about ten miles long between Middle and Sutherland Rivers, and it is broken by several obliquely transverse faults. The measures suffer some undulations, and in several parts the coal seams abut against the one bounding side fault or the other.

"On the west side of the East River, the principal coal bed, being the one on which are established the Albion, the Acadia, the Intercolonial and the Nova Scotia collieries, is called the main seam. It is about thirty-five feet thick at the first named colliery, and about twenty feet at the others. Beneath this there is a seam of twenty-four feet, one of five feet and one of eleven feet, all in a thickness of about 500; besides which about 200 feet lower, there is a four feet seam made up partly of coal and partly of a species of carbonaceous shale, yielding much oil by distillation, and formerly giving it great value.

"On the east side, besides an oil-shale seam of about four feet, on a different horizon however from the one just mentioned, there are among other coal seams of minor importance, one of four feet, one of six feet and one of eight feet, all of good quality, with others of inferior quality but greater thickness beneath. The most important of the whole is the eight feet seam, which exposed is of excellent quality, in its whole thickness. It has been only lately opened by Messrs. McBean on their three mile area, much of which it will underlie: the crop of it, having already, since I left Nova Scotia, been traced three quarters of a mile, running obliquely transverse between the two great upthrown faults mentioned.

"To elucidate the structure of this coal field a map is in preparation, but not yet completed, and when transmitted to the Government, it will be accompanied by reports, giving such details of structure as we have been able to collect, and in which we shall take the opportunity of thanking many persons for the information and assistance they have afforded. The reports will be accompanied by an appendix, giving in a tabulated form, analyses of various coal seams of this field, some of the analyses recently made, and others collected from different official sources, not now readily accessible, as well as information which could not be conveniently introduced into the body of the reports."

The heavy fault, detected by Sir Wm. Logan, is the key to the whole district. Its discovery was due to most exact and careful explorations, accompanied by an equally careful topographical survey, both of which were carried on by Sir Wm. Logan and Mr. Hartley. The enormous labour of pacing all the roads, and measuring and fixing all the localities where important exposures

of strata occur, must be apparent to all. The maps of the country and the previous topographical surveys had been altogether unreliable, and the geological survey had therefore thrown upon it the toil of the pedestrian and of the land surveyor, with the mental labours of the geologist and the man of science.

The occurrence of the conglomerate at New Glasgow had been the *bête noir* of geologists. How it got there and to what age it belonged was a puzzle. The mystery was solved by Sir Wm. Logan discovering that an enormous fault of some thousands of feet, passes close to the conglomerate at New Glasgow, running a few degrees east of south for miles. It passes through the northern angle of the East River property, traversing the Montreal and New Glasgow, and the Merigomish areas, passing a short distance to the eastward of the pit at Sutherland's River, where it meets the older rocks of the McLennan's Mountain range, and terminates the limits of the coalfield in that direction. It is a very remarkable fault, as it has brought up rocks which are, I believe, looked upon as possibly silurian, and has placed them in immediate contact with the coal seams of the district, the latter in many cases running against or being cut off by the fault. This interesting discovery solved not only the problems as to the conglomerate, but also the practical difficulties we had met with, in determining the course of the coal seams on the Montreal and Pictou Company's property. The seams instead of bending to the eastward, and crossing the river, run northerly until they are cut off by the fault. This discovery will greatly increase the value of that property, and its extent of coal, which had been previously under-estimated. I have been urged by Mr. Hartley to sink a shaft, or a trial pit on the seam found close to the river bank, which was seven feet thick at the outcrop. But it now seems probable that it must be the main seam. If this is the case, the seam worked by us must be the deep or the Cage Pit seam. A seam of seven feet so near the river, must prove very valuable, but the discovery of the main seam within a few yards of a shipping place, and of the railway, would be of still greater importance in an economic point of view to those interested in the property—and would be of much geological interest in determining the position of the upper set of seams.

The discovery of the northern edge of the basin on the Montreal

and Pictou Company's property, proves to be most interesting, for excepting in that locality, the northern crops have been cut off by the line of the fault. In that place the edge of the basin must have originally curved further towards the south than anywhere else, and hence has escaped from the effects of the line of fault which has elsewhere cut off the crops, and probably a large extension of the basin to the northward. By a fortunate chance we searched for the northern edge in the only place where there was the slightest chance of finding it. No amount of skill or capital expended elsewhere would have been of any avail, in searching for the northern outcrops of the Pictou basin. The discoveries made to the eastward have been mainly confined to explorations on the McBean area, on which several seams have been found. The 8 foot and 6 foot seam were discovered a short distance from the western boundary of the St. Lawrence area, and have been traced to that property. It is difficult to pronounce positively as to these seams. The 6 foot seam is by a very competent judge, supposed to be the "George McKay seam"—and I have been urged to sink a trial pit on the George McKay area, in which I am interested, to see if the 8 foot seam does not occur below the George McKay or Marsh seam; although the discovery of the McBean seam on that property would materially enhance its value. At present there are but few inducements to invest much money in boreholes and trial pits. A revival of trade will lead to renewed energy in explorations, and will contribute alike to the cause of science and of commerce.

The great depression caused by the duty on our coal imposed by the Congress of the United States, was very nearly ruinous to all owners of undeveloped properties, as it was impossible to sell or to realize even at a sacrifice. Hence those who had already spent large sums in developing and testing their mining areas, were precluded from doing anything further, until a revival of trade should give renewed confidence in mineral property in Nova Scotia. There are, however, indications of a speedy revival, in spite of the heavy duty, which amounts to almost the price of the coal at the pit's mouth, as the price of fuel is rapidly rising in the United States. If this continues it must once more throw open an almost unlimited market to our coal, while a reduction of the duty, which

cannot be far distant, will make coal mining in Nova Scotia one of the most profitable branches of business on this side of the Atlantic.

We may therefore look forward to extensive operations in the Pictou coal field before long, that will throw much light on the geology of the district.