

33. *Lycoperdon gemmatum*, *Fr.* In fields and pastures
Common. Aug., Sept.

ART. IX.—NOVA SCOTIAN GEOLOGY.—NOTES ON A NEW GEOLOGICAL PROGRESS MAP OF PICTOU COUNTY. BY THE REV. D. HONEYMAN, D. C. L., F. S. A., *Hon. Member of the Geol. Assoc., London, &c.; Curator of the Provincial Museum, and Professor of Geology in Dalhousie College and University.*

(Read May 10, 1880.)

INTRODUCTION.

THE map exhibited is the first of a series which I have been engaged for some time constructing.

They are all on a scale one inch to the mile. Church's county maps are generally used for topography. Occasionally the Admiralty charts are used in the delineation of harbours and portions of coasts of geological importance. From these and railway section books elevation measurements are largely obtained.

The various papers that I have submitted to the Institute and these maps may be regarded as mutually illustrative.

Additional notes, however, seem to be required, in the case of some maps, for the following among other reasons :

1st. Railways have been, or are being, constructed which are of more or less geological importance. These, in their nature, could not be referred to in papers already communicated.

2nd. New facts may have come to light.

3rd. Certain old facts may have to be brought into connection with these new facts for specific purposes.

The following notes on the progress map of Pictou county seem to be required on considerations as above.

GREAT COAL FIELD.

A prominent feature of our map is an irregular polygon colored black. This is the Pictou coal field as defined by Sir W. E. Logan and E. Hartley. I have simply transferred it from the map

accompanying the Report of Progress of the Geological Survey of Canada, 1868-9.

EASTERN EXTENSION RAILWAY.

I am indebted to M. Murphy, C. E., Government engineer, for the correct delineation of this line of railway on my map. Passengers cannot fail in observing the great scarcity of rock cuttings along the line from New Glasgow to the eastern boundary of the county. Still it has been the means of reaching many points of interest to the geologist, and it has rendered of easy access a district of great interest, whose geology has been imperfectly comprehended and partly misunderstood.

Leaving the New Glasgow station, we start from the northern side of Sir W. Logan's coal area, traverse the lower carboniferous conglomerate of New Glasgow and succeeding grits. Turning eastward we proceed through drift cuttings and occasional sandstones while crossing Sutherland's River and French River. We continue to traverse the Lower Carboniferous through Piedmont Valley. Entering the basin of Barney's River the geology begins to be somewhat obscure. In fact, we are taking a great geological leap. When we pass from the Barney's River strata to the siding at Dewar's furniture factory, we find that we have descended from the Lower Carboniferous to the Middle Silurian period. The geological gap between represents Devonian and Upper Silurian time. We have just crossed the Western branch of Barney's River. Proceeding a short distance we cross a bridge over the middle branch, descending lower in Middle Silurian time. Still farther on we cross the eastern branch of Barney's River. Here strata are seen partly covered by a *dump*. These are the bottom strata of this Middle Silurian series of the several branches of Barney's River. The Middle Silurian series here, as elsewhere, includes A, B and B' of the "Upper Arisaig series." A is equivalent to the "Mayhill Sandstones" of Wales, according to Salter. B' is of Clinton age, U. S., according to Hall, and B intermediate, according to my own determination, of the typical series in Arisaig Township of Antigonish County. I may state that B' is the "Lower Arisaig series" of "Acadian Geology." Still proceeding on the line of railway, we pass from the base of

the Middle Silurian to a base of strata of Lower Carboniferous age. We thus take a greater leap upwards than was done downwards on our entering upon the Barney's River Basin. The difference is measured by our descent geologically in passing through the Middle Silurian series. Proceeding onward we pass from the Lower Carboniferous into a great Metamorphic series, which enters largely into the constitution of the mountains through which passes the remarkably picturesque "Marshy Hope."

Through this pass flows the eastern branch of Barney's River, and proceeds the line of Railway, in two sub-parallel lines.

A beautiful section of a part of the metamorphic strata is seen on the side of the railway. The latter proceeds onwards through the Valley without any other rock exposures being apparent. About a mile from the County line, strata A. (Middle Silurian) are observed on the side of Barney's River. These extend onward into the County of Antigonish, and are cut by the railway before it reaches the county line. We discontinue our journey until I read notes on the map of Antigonish County.

GENERAL SECTIONS.

On the map.

Section line, No. 1.—This section commences on the Pictou and Antigonish Co. line, 2 miles from Northumberland Strait and the same distance from the N. west corner Arisaig Township, the county line being the western boundary of the township. The portion indicated is 3 miles distant from the top of the uppermost member (D) of the typical "Upper Arisaig Series," situate near the mouth of McAra's Brook in the county of Antigonish, and on the Northumberland Strait. This line is *zigzag*, consisting of three straight lines, which I shall designate respectively 1, 2, 3.

Line 1.—Beginning at the starting point proceeds in a direction S. 25 W. to Sutherland's Mountain, *Kenzieville*, a distance of 9 miles. In its course it traverses, 1st. The metamorphic rocks of the Antigonish, and Pictou Mountains. 2d. A carboniferous band of rocks of the same mountains. 3d. A. B. & B. of eastern and middle branches of Barney's mountains, and ends at strata with Diorite, of Sutherland's mountain at the west branch of

Barney's River. I have already incidentally referred to some of the rocks of this section. Having recently made a thorough examination of the Basin of Barney's River, I shall give the results.

Traversing the line of railway, I was led to make Dewar's Furniture Factory siding my halting place. Here I was kindly welcomed and hospitably entertained by the proprietor of the Factory. Examining the dam and race which are situate on the west branch of Barney's River, I was interested to find *silurian strata* where I had expected to find Carboniferous rocks. From cursory observations I had been led to infer that this was a Carboniferous area, and that the Silurian of the east was bounded by the eastern branch of the River. I had supposed Cameron's mountain which was on the right of the road entering the Marshy Hope, which is formed of lower carboniferous conglomerate, to be a continuation of the carboniferous mountains which run on the south of Piedmont Valley. I had also supposed that the Middle Silurian strata (A) which occur on the left side of the same road was a continuation of other strata, occurring in the Marshy Hope at the county line. *See the railway traverse proceeding.*

Accompanied by A. Dewar, I examined the fields to the south of the factory onward to the New Glasgow and Antigonish road in search of the supposed connection of the Carboniferous Mountains without success. We then observed Silurian strata in the middle branch, which led us to follow its course northward to the railway bridge. We found Middle Silurian strata (B) all the way, and, therefore, *no connection* between the Marshy Hope Carboniferous Mountain and the Mountains of the west. We then ascended McPhee's Mountain on the north side of the entrance of the Marshy Hope and found that it also was formed of Lower Carboniferous Conglomerate, like Cameron's, on the south. We afterward examined rocks in the east branch of Barney's River and found that they were the connection between the two mountains, being also conglomerates with the addition of *igneous* rocks. The latter were found to occupy a *central* position, by comparison with the other passage conglomerate outcroppings on the road. The continuation of these mountains on the north was also found to be of Lower Carboniferous age, Cameron's moun-

tain is there connected with the Carboniferous of Merigomish, on the north rather than on the west. It then appears that the metamorphic rocks of the Antigonish and Pictou mountains are *altogether* bounded on the west by Carboniferous rocks of mountains. It at the same time appears that the Middle Silurian (A) strata, on the left side of the road, are completely disconnected with the similar strata (A) toward the county line. These are two note-worthy considerations.

I shall now direct attention to the disconnected Silurian strata. They are brownish quartzose slates, much metamorphosed. They are fossiliferous. The fossils are the usual ones of A of the "Upper Arisaig series." *Petraia*, *Athyris*, *Cyclonema*. They are all casts—external and internal. On the east branch of Barney's River, where the railway enters the Marshy Hope, I have referred to similar strata partly covered by a *dump*. These lie to the north of the preceding, and are also cut off from any connection with Eastern Silurian strata by the carboniferous conglomerates and igneous rocks of the same branch of Barney's River. We are thus led to follow a northern course, i. e., down the river. We find them proceeding in this direction, crossing the river at McPhee's, and apparently terminating $3\frac{1}{4}$ miles from the entrance to the Marshy Hope. I collected fossils in part of these at the road before reaching McPhee's. Two of the specimens lie before me. I shall describe them. The one is a quartzose rock, coloured brown with iron oxide. It has a sharp cast of the exterior of a good sized *Cyclonema*. One side of the specimen has crystals of quartz. The second specimen is of the same character, being from the same mass of rock. It is larger, having a vein of quartz with beautiful quartz crystals. On a corner is exposed a large *Cyclonema*, showing the internal cast entire, also a considerable part of the surrounding external cast. The shell space is entirely vacant. The last specimen is a beautiful and convincing illustration of *rock formation*.

Examining the high ground south of the Marshy hope road, and west of Cameron's mountain of lower carboniferous age, referred to above, we found the southern continuation of our Silurian (A) strata outcropping extensively; after a time it ceases to appear.

We proceeded onward to Mr. McIver's at the back of Cameron's mountain, no outcrops appeared. We then descended McIver's Brook proceeding northward, no strata were seen for a considerable distance, at length strata appeared in great mass, which were found to be our Silurian (A) strata succeeded by B, crossing the brook to proceed westward as mountain strata, including Sutherland's mountain of our section. Their boldness, and hardness of A, have constituted them mountain rocks. Sutherland's mountain strata are tilted; fossils abound in them, such as Arisaig, and quartz veins are also abundant.

A great proportion of the mountain consists of Diorite. It is well exposed on the back of the mountain reaching nearly to its summit. This is the usual association in Nova Scotia, east and west. In Antigonish, Pictou, Annapolis and Digby counties, strata A of the upper Arisaig series are invariably associated with intrusive Diorite. Succeeding this band are B. & B' strata, these contrast strikingly with the preceding. They are generally very soft furnishing the *pencil stone* of *How's Mineralogy of Nova Scotia*, when exposed they become clay. The lower strata contains my "Lingula nodule bed." As usual at my last visit I extricated a great number of nodules from its two exposures. These contain beautiful *lingulæ* of several species. B strata as usual furnish a great variety of genera and species peculiar to our Clinton period. They will be found included in our *lists of fossils* in the sequel. The west branch of Barney's River is the approximate boundary of this Middle Silurian area. The Carboniferous begins in the river at the mill north of McPhee's Silurian (A) strata. At Dewar's Furniture Factory strata B extended beyond the river. Between Robertson's and the Rev. Mr. McKeehan's, the carboniferous mountains south of Piedmont Valley, have their extremity on the east. This apparent intrusion into the Middle Silurian originally led me to infer a connection with Cameron's mountain already referred to.

ANTIGONISH AND PICTOU MOUNTAINS.

From McPhee's extremity of A (Middle Silurian strata) I crossed the Middle Silurian and then the Carboniferous, and reached the old mountain road at Bailey's Brook. At the bridge and

fulling mill ruins, Igneous rocks were observed, of lower carboniferous age.

A short distance above the bridge I examined a mass of limestone of lower carboniferous aspect. J. McLellan who pointed it out to me, assured me that similar limestone had been quarried in the high ground to the east of the mountain road and used for building purposes. Farther on the road side and mountain sides and summit, outcrops of metamorphic rocks appear, they are quartzites and argillites. No member of the Upper Arisaig series has thus far been seen on the side of this metamorphic series. The carboniferous bands along it from the Antigonish county line to the Marshy Hope road. We shall now examine the south on Marshy Hope side. On the road below W. Robertson's and at the watering place for horses, the felsites of the mountains appear after the carboniferous outcrops, on the left side of the line of railway opposite. At Pushie's is an interesting section of a steep side of the mountain, the rocks of this section are felsites and argillite, the felsites containing *micaceous hematite with pyrite*. Beyond this there do not appear any rock exposures until we come opposite the Marshy Hope station. Here at a bridge over Barney's River, of the road entering the Sutherland settlement, Middle Silurian strata (A) outcrop. Entering the settlement we find argillites with quartzites on the side of a tributary of Barney's River. On the summit of the mountain at Sutherland's Argillite outcrops. These resemble the James River Fall rocks. The latter are in Antigonish county—9 miles east, from the Sutherland mountain outcrop. The Middle Silurian (A) strata of the bridge extend into Antigonish county as far as Lindsay's stables. At McLean's they are cut by the line of railway, after this the railway passes them on the south. I discovered these many years ago with them. *Lingulæ, Petraia and Cornulites* were also found in them from time to time. I was accompanied by the Rev. Mr. Goodfellow and son, when I made my recent examination. We found *Petraia forresteri* (Salter) in the strata at Lindsay's stables. At McLean's we found abundance of *Cyclonema, Orthis and Lingula* associated with the characteristic *Athyris* (casts) and *Crinoidea*. From the moun-

tain side above, Mr. Goodfellow brought a piece of rock which was found to be a conglomerate of peculiar character. It is almost identical with the dioritic conglomerate which I found at Wentworth, I. C. R., with other conglomerates and rocks, which led me to proper views of the age of rocks of the Arisaig mountains, and to distinguish them from the "Lower Arisaig series," (Archæan Dana) and "Upper Arisaig series," (Middle and Upper Silurian,) by making a "Middle Arisaig series" and correlating it with Professor Ramsay's "Cader Idris" (Lower Silurian). The distance from the north side of Bayley's Brook to the south side McLean's is 5 miles.

Other Mountains.

My attention was also directed to the mountains on the south side of the Marshy Hope railway. Opposite the Middle Silurian (A) strata last examined, is a Brook (Bryan Daley's) which penetrates these mountains. Ascending this brook the first rocks that I met with were apparently carboniferous strata consisting of clayey shales and conglomerates. Succeeding these are exposures of metamorphic slates—argillites. I shall have to investigate these before I can arrive at any satisfactory conclusion regarding their age. In the meantime I regard them as a continuation of whatever rocks may form the mountains at McIver's, and, therefore, as underlying the strata A, B of the Barney's River Middle Silurian area. The same doubtless extend farther west behind Sutherland's Middle Silurian Mountain of our section, so that they may be regarded as *Pre-Middle Silurian* and, therefore, *Lower Silurian*.

Section line 1, division 2 extends from Sutherland's Mountain to French River—a distance of 6 miles. Its course is N. 80 W. It begins in the diorite of Sutherland's mountain, crosses A strata of the mountains, passes through B strata with its *Lingula nodule bed*, traverses B' south of Cooper's and at Turner's with its *Graptolithus clintonensis* (priodon), *Dalmanites*, *Lepto-coelia*, *Strophomena*, etc., and ends at an igneous rock in French River (a Lower Carboniferous rock).

This Middle Silurian area is intersected diagonally by the line of section. It is bounded on the north by the Carboniferous

mountains—these have been already referred to as on the south of Piedmont valley and the line of railway. The mountains on the south are an extension of the strata of Sutherland's mountain. Strata B and B' lie between.

Division 3 extends from French River to the west side of Irish Mountain, a distance of twenty-seven and a half miles. Its course is S. 55 W. It traverses first an area of Lower Carboniferous rocks, then the Middle and Upper Silurian of Sutherland's River, McLellan's Mountain and Brook, and Irish Mountain, terminating in the Lower Carboniferous of East River.

The Silurian formation retreats after it reaches the west branch of French River, and forms the compound curve which connects the Silurian area of the Barney's and French basins with those of East River basin. The connection is very complicated, consisting of Anticlinals, Synclinals and Monoclinals; yet there is no great difficulty experienced in resolving the complications in consequence of the constant recurrence of well known characteristic fossils and obvious structure. Vide Papers in Transactions 1870-1-2.

Section 2nd.

This section begins where the preceding section ends. Division No. 1 proceeds S. 19 E., a distance of 4.3 miles to Fraser's (sadler). Beginning in the Gypsum it passes through the Lower Carboniferous to the Limestone of McLean's Lime Kiln at Springville, a little farther it enters D strata, with abundance of characteristic fossils. At the late Rev. Angus McGillivray's pasture, it enters C strata with fossils characteristic of this horizon. It then passes through an obscure region, in which we may presume that B' (Middle Silurian) strata are to be found according to the analogy of the preceding section (No. 1). We then come to a hill having fossils, which show that C strata have been left behind. Reaching Fraser's (sadler) we come to the *first discovered outcrop* of the iron ore of this division, or series, which we would, for future reference, name *Iron Ore, No. 1*. Division No. 2 of the section running N. 59 E., 0.6 of a mile, passes through the lowest strata of this series, which we shall, in the meantime, designate A strata. It then traverses a wide dyke of igneous

Diorite. Division No. 3 runs N. 82 E., a distance of 2.2 miles to John McDonald's Hill, Blanchard, passing through Middle Silurian strata A. At McDonald's hill it cuts an intersecting outcrop of D strata (Upper Silurian) with characteristic fossils. Division No. 4 passes N. 59 E., a distance of 0.6 of a mile, at its termination it cuts the Blanchard Iron Ore. This is a bed of fossiliferous red hematite 30 feet thick. The ore and the containing strata have fossils characteristic of A (Middle Silurian). I will call this *Iron Ore No. 2*. Division No. 5 runs S. 45 E., a distance of 3 miles. The half of this distance, 2.5 miles, it passes through Middle Silurian strata and then it reaches crystalline metamorphic rocks of Archæan age (Lower Arisaig). It traverses these a distance of 2.5 miles to McPhee's, still on the north side of East River division. It continues in the same direction S. 45 E., a distance of 0.6 of a mile, crossing the river and passing into a band of black metamorphic Middle Silurian strata. These have an east and west strike. At a farther distance of 6.8 miles, west, we reach the first outcrop of Iron ore at McDonald's, due south of Blanchard. I shall name this *Iron Ore No. 3*.

REMARKS ON THE DIVISIONS OF SECTION LINE NO. 2.

Division 1.

The series of Silurian rocks of this division might be regarded as a typical series, if Arisaig did not put in a prior and superior claim. I shall consider the series of Springville in the order of its development. D. strata at McLean's have received the most attention on account of the abundance of fossils. The fossils and their order of occurrence correspond in a striking manner with the typical D at Moydart, Arisaig Township.

The fossils are, with a few exceptions, of the same orders, genera and species; the mode of their occurrence and association remarkably corresponds. A ledge on the height at the back of McLean's and to the north of David's lake, has precisely the same fauna as a corresponding ledge at Moydart. The fauna are *Cornulites flexuosus*, *Homalonotus dawsoni*, *Spirifer subsulcatus* and *Avicula honeymani*, associated and in abundance. The only difference is in the degree of metamorphism and in the state of preservation. All the strata of the series of Springville are more highly

metamorphic than in the type, and the fossils, generally, are less perfectly preserved. C strata here correspond and differ in like manner when compared with the typical strata at Knoydart, Arisaig Township. The *Cephalopoda* are as large as in the type. An orthoceras at Springville is the largest found in Nova Scotia. Similar species appear in groups, as in the type. They occur in the same relative position. Remarkable forms are also found in the two localities. Here the strata are more highly metamorphic. This action has also affected the state of preservation of the fossils. They are generally casts. Strata D may be regarded as extending from the north end of Irish Mountain to Holmes' Brook. Before reaching McLean's, however, they seem to break and their course to change. At Macintosh's brooklet they make a sort of a water-fall, near their junction with the Carboniferous Sandstones that underlie McLean's Limestone. From this brook to Holmes' brook we have the D strata of division (1). Their width is considerable. Their outcrop, with fossils, was followed to some distance behind David's Lake. At the back of Irish Mountain C strata possibly exist among the strata of the abrupt descent to Cross Brook. They were not detected from want of fossils. At Holmes' brook their upper part becomes distinct in closest contact with Lower Carboniferous Limestone. Their immediate contact forms a breccia. Here the water sinks, leaving the remainder of the brook dry in summer. The water that has disappeared after a subterranean flow, reappears at Holmes' sluice and flows *sub diu* to the river. Limestone and C strata are seen in approximate contact at the opening; in the strata east of the sluice the large orthoceras was found and other characteristic fossils. In an outcrop not far from the road crossing, on the same side of the sluice, other characteristic fossils were found. The *same strata* are found in contact with the limestone on the river side at McPhee's. These strata passing along N. E. on the N. side of the river form mountains of steep ascent and considerable elevation. In some places the strata are bare, especially toward the mountain summit, resembling a house top of *high pitch*. The lower strata of McGillivray's pasture continue their *rampart* course with a depression on the left onwards to the end of the

mountain, having the same characteristic fossils at the end as at the beginning; limestone is seen here in the river as at McPhee's, although not in contact with the strata.

A RED LETTER DAY IN THE HISTORY OF PICTOU AND GEOLOGY OF
DIVISION C.

On the top of a hill at the end of the C strata mountains, on the line of the depression of the mountain summit already observed, on the right of the McGillivray strata I found an exposure of strata lithologically distinct from D. & C. These so much resemble the B' strata of Doctor Brook, Arisaig Township, that I was led to search in them for fossils. This happened on a day ever to be remembered in Pictou, when H. R. H. the Prince of Wales was in Pictou *en route* to Prince Edward Island. Few were in the country that day who could find the ways and means of getting to the town, these not being available I continued my search for fossils and found them. I collected 4 specimens belonging to a new species of *Homalonotus* which is known in my collection as *Homalonotus Siluriae Principis*—Prince of Wales *Homalonotus*, two large *lingulae* were discovered, also a *discina* and a form *Incertae sedis*.

DESCRIPTION.

C and D strata as at Arisaig have each their characteristic *homalonotus*. The number of specimens of a species of *homalonotus* found in our new strata of the mountain seems to form a characteristic. *Homalonotus dawsoni* is characteristic of D. *Homalonotus salteri*, *M. S.* is characteristic of C.

This was considered by Salter from the appearance of the pygidium to be *Homalonotus delphinocephalus*. When examined by him the head of the form was unknown. Specimens of the head were afterwards found which showed that it is not *delphinocephalus*. I have regarded it as a *new species* and named it after the late distinguished Palæontologist of H. M. Geological Survey of Great Britain.

The thorax and pygidium are all that is known of the *Homalonotus Siluriae Principis*. The thorax has the character of the genus, being *level backed*; the pygidium is different from that of *Homalonotus salteri* in not having a terminal spine. From

this and *Homalonotus dawsoni* it differs in being distinctly *trilobate*; the others have their furrows deep and continuous from side to side; this has the side *furrows* coming opposite to the *ridges* of the axis. It is much stouter than the others. The specimens are more or less distorted by metamorphism, the containing strata being highly metamorphic.

The first appearance of homalonotus in the typical Arisaig series is in B', where it is associated with casts of *pentamerus oblongus*.

This leads me to refer the strata in question to B'. The association of the large *lingulæ* seems to indicate the same horizon, as they are found in the same position at Arisaig. These are the only *lingulæ* found as far as I know at East River. *Discina* is larger than *discina* of D Springville; it more resembles the *discina* of B', French River. The form referred to *incertæ sedis* resembles the valves of a *pholas* open. It is finely striated across.

These considerations led me to consider the mountain strata as the upper part of B' of the series.

On the McLellan's mountain road, at the back of McGillivray's is a deserted farm, succeeding an obscure forest area. Here I observed strata which resemble fossiliferous A strata highly metamorphic. I did not succeed in finding fossils in them. I found a *petraia forresteri* in the bed of Holmes' Brook which might have come from a part of these strata, as this brook passes not far from the said *old farm*. The strata of this farm extended in the line of strike, cross the section line, near the position of *Iron Ore No. 1*.

This Iron ore is now an old acquaintance. It is 25 years, less six weeks, since I was first introduced to it by the late Rev. A. McGillivray. Then it was scattered all around his mountain farm. Every cairn of stones had its large masses and small pieces of beautifully crystallized brown Hematite. This led Mr. McGillivray naturally enough to suppose that the vein of ore was situate within the bounds of his farm, and that its discovery would add to the value of his property, especially as the General Mining Association was supposed to have no reservation except for *Gold, Silver, and Lapis Lazuli*. Every year, about the same

season, we had a search for the hidden treasure. In 1869, after a freshet, I considered that I had found unmistakable evidences of its position, near the upper outcrop of strata C. In apparently the same position, I came upon the trenches of the General Mining Association, at the end of the C. Strata Mountains, with a great accumulation of masses of ore on the sides of the road, near the bridge that crosses East River.

This led to the conclusion that the vein traversed *Aymestry Limestone* strata. In 1864, when making a preliminary Geological survey for the N. S. Government, *vide Blue Book*, Fraser's ore was pointed out to me in a small brook. There was not the least difficulty in recognising this as approximately *in situ*. Mr. E. Hartley, of the Geological Survey of Canada, sank a pit here and found the ore *in situ*. Considering the strata of Fraser's site as Middle Silurian I was only perplexed by the indications, and led to the conclusion that we must wait until the vein was traced from Fraser's onwards.

I am just waiting for an opportunity of examining the course of Mr. Gilpin's excavations, to satisfy myself in reference to the course of the vein, so as to indicate its geological relations on the map.

The carboniferous approaches the river on the south side opposite Fraser's, as is indicated by limestone or gypsum pits. It likely overlaps, or otherwise joins the ferriferous Middle Silurian as it does the C strata farther down the river.

DIVISION (4.)

Iron Ore No. 2.

This ore corresponds very closely in character and age, with the *red ore* of Nictaux, both are fossiliferous and siliceous. In the ore under examination, *Athyris* is found, which is elsewhere only found in A strata. Its geological horizon has therefore been indicated on the map as Middle Silurian. Mr. Gilpin's explorations seem to confirm this view, as he found its extension at Ross'. Its course is therefore approximately in the strata, outcropping in Squire Campbell's marsh, in which I found a pygidium of *Dalmanites* of B' Arasaig and other fossils (Crinoidea). The extension of these at Ross's also produced fossils. They were

sent in my collection of fossils to the Museum of the Survey, Canada.

DIVISION (4.)

Archæan.

I found and examined these rocks outcropping in all directions along the road which leads to Blue Mountain. I have examined them to a distance of two miles. These are separated from the river by a band of Middle and Upper Silurian? strata, which borders on the north side of the river, and comes into contact with a considerable bed of Lower Carboniferous Limestone.

The archæan rocks are felsites. In some places they have appearance of copper and micaceous iron ore. An outcrop of these appears at McPhee's giving the series a width of 2.5 miles. This may be the west side of the *archæan* of the Keppoch and Ohio, Antigonish County. I have not had an opportunity of tracing a connection between the two areas of crystalline rocks.

DIVISION 5.

Iron Ore, (No. 3.)

The rocks of this division contain the specular Iron ore at McDonald's on the south side of the river and S. of Blanchard's. This ore *in situ* was first shown to me by Mr. Donald Fraser in 1861, when I collected specimens of the various ores of the district for the London Exhibition of 1862. It seemed to indicate a deposit of economic importance, subsequently in 1869 when I investigated its geology the outcrop was obscured by an enormous pile of stones on its top, and it was with difficulty that I secured a passable specimen of the ore for our Museum collection. I examined the containing strata and found them to be dark coloured metamorphic strata. On emerging from the woods on my return to the river, crystalline rocks were observed in a field on the right. The outcrop of these is of considerable extent. The rocks are igneous and intrusive, like other rocks of the section on the north side of the river. We had thus the *appearance* of a monoclinal, the dip being southerly and the strike east and west. The extreme metamorphism of the rocks and the general aspect gave no encouragement for the search for palæontological evidence of age in the rocks themselves. I therefore searched for other

exposures on the line of strike. I found the rocks exposed in the course of an adjoining brook. I followed these towards Springville until I came to lower carboniferous rocks, which separate the strata under examination from the strata of Iron Ore (No. 1) on the north side of the river. Afterwards I examined the strata of the division 5 of the section which I found in the river without any carboniferous intervention between north and south, and in proximity to McPhee's *archæan outcrops*. In this way the areas of pre-carboniferous rocks having Iron ore on the *one* side of the river, were connected directly with the fossiliferous and pre-carboniferous rocks on the south side. This seemed to be one important element in correlation. Proceeding westward, down the river on its south side, I found one brook with a mill-dam; here is another exposure of the strata under examination. Still farther at Pleasant Valley another brook occurs having a mill-dam, and an exposure of the same strata. In addition I observed strata of lighter colour and greater compactness, I readily recognized a lithological feature of frequent occurrence at mill seats on Sutherland's river and its branches, where palæontology is available for the solution of difficulties. There I had to refer the corresponding strata to A and B B', middle silurian. If lithological evidence is worth anything in correlation, it surely is of some weight in the same district even at the distance of 9 or 10 miles.

The next exposure is in the brook east of the *situs* of Iron ore, (No. 3,) McDonald's brook. Here we have the best exposure of the strata. Along this brook I examined the strata to a considerable distance southward in search of a continuation of the Iron ore without success. Returning I reached an old mill-dam having strata of the same lithological character as the preceding, indications of A, B and B', middle silurian. Proceeding still along the bed of the brook, I found, after a considerable interval of obscurity, compact strata, having a southerly dip. These strata are hard and jointed *with films of micaceous oxide of iron in the joints*. Succeeding these at the bridge which crosses the road running up the south side of the river, I found black slates having obscure fossils, but which I have little doubt are of

Clinton age, farther on where the brook enters the river is a green marble of lower carboniferous age, and on the north side of the river opposite, in close connection with an igneous dyke is the continuation of the Blanchard strata, middle silurian, having lower carboniferous limestone in contact, I have no doubt whatever that there is a connection of the strata of the north and south areas of fossiliferous rocks under the bed of the river. The extension of the igneous rocks observed on the road to the Iron ore, No. 3, would occupy the obscure interval in the brook between the two sets of strata forming a *complete anticlinal* instead of the apparent monoclinical.

All this seems sufficient to determine the approximate age of the strata containing Iron ore, No. 3. This is consequently indicated on the map as middle silurian, which may be called the "upper series of the Cobequids." Geologists have had to call in the aid of the iron divisions of section No. 2 of our map, and to regard the former as devonian, upper or middle silurian, according to the views entertained regarding the age of the latter.

PALÆONTOLOGY OF THE REGION MAPPED.

The sign ff is of frequent occurrence on the map, in A, B, B', C, D of the "Upper Arisaig series" having fossils, that belong

1st to the Middle Silurian period.

2nd to the Upper Silurian period.

3rd We have ff occurring in limestones of the Lower Carboniferous period.

4th In the south and north side of the coal measure polygon.

I shall briefly collate and examine the Middle and Upper Silurian Faunas; and then examine the fauna of the Carboniferous period.

Regarding the Silurian series of the Springville division of section ten as representative of the Typical series. I shall group the scattered fauna around its members. Our passage will thus be direct into the lower and into the middle carboniferous age.

FOSSILS OF A. FROM THE PICTOU AND ANTIGONISH COUNTY
LINE AND DIVISIONS OF SECTION I.
Nos. 1, 2, 3 and Sutherland's river.

Coelenterata.

Petraia forresteri.

Petraia, sp.

Annuloida.

Crinoidea.

Annulosa.

Cornulites.

Cornulites, trumpet shaped., Salter M. S.

Trilobita.

Calymene, sp.

Molluscoidea.

Brachiopoda.

Strophomena corrugata.

Orthis, species.

Athyris, species.

Spirifer, like striatus

Spirifer, sp.

Rhynchonella, sp.

Lingulæ.

Mollusca.

Gasteropoda.

Cyclonema.

FOSSILS B.

Section No. 1. Division No. 1 & 3.

Lingulæ of several species chiefly in nodules.

FOSSILS B'.

Section No. 2. Div. No. A, Springville and e Blanchard
Sect. No. 1. Division No. 3, 6.

Coelenterata.

Graptolithus.

Graptolithus clintonensis, (priodon).

Crinoidea.

Cornulites.

Tentaculites.

Crustacea.

Beyrichia.

Trilobites.

Homalonotus Siluriæ Principis.

Dalmanites. several species.

*Molluscoida.**Brachiopoda.*

Strophomena depressa, abundant.

Leptæna, sp.

Orthis elegantula, abundant.

Leptocœlia intermedia, abundant.

Spirifer, sp.

Lingulæ, species large.

Lingulæ, sp. small.

Discina, sp. large.

do. sp. intermediate.

do. sp. small.

*Mollusca.**Cephalopoda.*

Orthoceras, small.

Conularia.

Incertæ sedis.

FAUNA OF C. SPRINGVILLE.

*Mollusca.**Cephalopoda.*

Orthoceras large

Orthoceras, sp.

Orthoceras, sp.

*Molluscoida.**Brachiopoda.*

Strophomena, sp.

Strophomena, sp.

Strophomena, sp.

Strophomena, sp.

Rhynchonella saffordi, abundant.

Rhynchonella wilsoni.

Rhynchonella, sp. abundant.

- Rhynchonella, sp.
 Meristella didyma, abundant.
 Atypa reticularis, coarse.
 Spirifer crispus ?
 Crania, sp.
Crustacea.
Trilobita.
 Calymene blumenbachi.
 Homalonotus salteri.
 Sutherland's river in boulders,
 Homalonotus Salteri.
 Crinoidea.
 Cornulites, large species.
 Coelenterata.
 Favosites fibrosa.
 Stenopora.
 Mollusca.
Cephalopoda.
 Ascoceras.
 Ormoceras, sp.
 Orthoceras, sp.
Heteropoda.
 Bellerophon, trilobatus.
Gasteropoda.
 Holopoea.
 Pleurotomaria.
 Acroculia haliotis.
Lamellibranchiata.
 Clidophori.
 Avicula honeymani.
 Modiolopsis.
Brachiopoda.
 Spirifer subsulatus.
 Chonetes, nova scotica.
 Crania acadiensis.
 Rhynchonella, various.
 Discina, sp ?

Crustacea.

Calymene blumenbachii.

Homalonotus dawsoni.

Dalmania logani.

Phacops stokesii?

Proetus stokesii?

Entomostraca.

Beyrichia.

Crinoidea.

Cornulites flexuosus.

Tentaculites.

The greater part of the organisms of D Springville are identical with those of D Arisaig. Still only a very small proportion of the species in the type have yet been found here. The same may be said of C, the other Upper Silurian member of the "Upper Arisaig series." When I make notes on my new map of Antigonish County this will be made manifest. It is evident however, even from the Springville series, that the fauna of Nova Scotia silurian had in C and D attained their maximum development especially in cephalopoda, pteropoda, heteropoda, gasteropoda, lamellibranchiata, brachiopoda of certain genera trilobites and crinoids. The exceptions are as follows, viz: *Brachiopoda*, *orthis*, *athyris*, *spirifer*, these have their beginning and climax in A, *lingulæ* in A and B', are rare in B' and very rare in C and D. The trilobite, *dalmanites*, is characteristic of B', *Calymene* is in A, C and D. The graptolithus expires in B'. The pteropod *conularia* is peculiar to B'. *Petraia* have their beginning, climax and end in A.

Marine vertebrates do not appear; all are invertebrates. The cephalopoda are of the highest order, and at the same time carnivora of the period.

CARBONIFEROUS (ff.)

The fauna of the Lower carboniferous limestones succeed the Upper Silurian, in the County of Pictou and elsewhere in Nova Scotia as far as is known. This makes a large break in the succession of life. To fill up the gap the Devonian or Old Red Sandstone is required, with its fishes, crustacea, mollusca, &c.

The Carboniferous formation may be seen from the map to come into contact again and again with every member of the Upper Arisaig series, and even with the intrusive rocks that give strike and dip. It is found overlying these strata and intrusive rocks, and overlapping them *a latere* and *a tergo*. The Carboniferous strata in these positions are respectively conglomerates, sandstones, claystones and limestones. These have been formed simultaneously by mechanical and organic agencies, in various conditions of formation. We then have alternations of conditions, and sandstones and claystones are made to succeed limestones, and limestone to succeed sandstone and clays.

The oldest limestone at Springville is that which is in contact with the strata of C. in Holmes' Brook and River. This is as far as seen non-fossiliferous; the next is that of McLean's quarry and Lime brook. Sandstone strata intervene between this and D strata; this is fossiliferous. the fossils are corals of the genus *Lithostrotion*. At Grant's factory on the river are limestones with clayey strata; these are next in order; they have a richer fauna. Others on the river farther down and on the West Branch are also fossiliferous. In the last the *pteropod*, *conularia* is found. This *genus* has already been recognized in B' Clinton of French river.

The collated fauna of the Springville limestones, are:

Localities.	<i>Cœlenterata.</i>
	<i>Actinozoa.</i>
Lime brook.	<i>Lithostrotion pictoense.</i>
Factory, E. river.	<i>Crinoidea.</i>
	<i>Molluscoïda.</i>
	<i>Producta cora.</i>
	do. <i>martini.</i>
Black Teeth.	<i>Spirifer, sp.</i>
	<i>Lamellibranchiata.</i>
Factory.	<i>Nucula?</i>
	<i>Gasteropoda.</i>
	<i>Genus?</i>
	<i>Heteropoda.</i>
	<i>Bellerophon decussatus.</i>

Pteropoda.

Conularia.

W. B., E. River. *Cephalopoda.*

Orthoceras.

Pisces.

Cochliodus sp. Salter.

In my London Exhibition collection, Mr. Salter recognized two teeth of *Cochliodus*. I was puzzled to know what they were. He at the same time detected specimens of *Bellerophon decussatus*. I believe this is the first recognition of Fishes of so early date in Nova Scotia, and the first identification of *Bellerophon* in the Lower Carboniferous Limestone.

The Silurian Fauna have totally disappeared. As far as Nova Scotia is concerned, this is no great marvel, when we consider the character of the agencies that were at work during the lapse of the Devonian Period, and their stupendous operations. Thus and then Nova Scotia became largely subærial, had its form well defined, and its mountain systems established. Its coasts presented to the seas of the Lower Carboniferous period rock arrangements to a large extent corresponding with those now existing. Hence we have the carboniferous rocks directly on Archæan, Cambrian and Silurian systems, just as the marine accumulations of shingle, sand, clay, dead shells, and their debris now rest, or are in process of formation. We should take this into account, as explanatory of rock arrangements which are readily by some referred to fault occurrence. Faults there are of course, and enough of them, without an unnecessary multiplying of their number.

The conditions of the Carboniferous Period were greatly different from those of the Periods preceding, the character of life differed in accordance. The preceding were invertebrate, now it is vertebrate, Cephalopoda are rare, reptiles appear, fishes became associated with such as do occur, to regulate the number of the mollusca that now begin to exist, increase and multiply.

The *Cochliodus* of Springville is akin to the Port Jackson Shark, which is also a cochliodont. The *Cochliodus* is palatal, forming a mouth pavement adapted to the grinding of mollusca.

or molluscan shells. The *Cochliodus* of East River does not seem to have been a large species; the teeth are not over a half of an inch in size. Our *Cochliodus* seems to have been an approximate cotemporary of the *Gyracanthus magnificus* of Cape Breton. A formidable and predaceous race of fishes, that pervaded the Nova Scotia seas of the Lower Carboniferous Period. Whence they came we are unable to discover. The Ichthyodorulite of Cape Breton in the Provincial Museum is regarded as unique; its length is about 22 inches, it is stout in proportion.

MIDDLE CARBONIFEROUS.

The last fauna is found in the coal formation polygon.

The localities are:

1. Turnbull's mine, McLellan's Brook.
2. Deacon McKenzie mine, New Glasgow.
3. Crown Pottery mine, New Glasgow.

At 1 and 2 I found, a number of years ago, a number of teeth of *Diplodus*. They are so-called from their form which is double, one lanceolate is upright the other is recurved, both are crenulated. The root has a heart-shaped prominence on its front. They belong to fishes of the shark family (*Hybodont*).

The localities where I found them are situate on the south and north sides of the area; from No. 3 mine I received about the same time from a miner the cast of a tooth of large size, with its owner a *Holoptychius*.

The teeth of *Diplodus* are of various sizes, showing a graduation as in the mouth of the shark. Associated with these, at MacKay mine were large and small ganoid scales and beautifully striated spines. The late Professor John Phillip of Oxford, seeing these specimens in my London Exhibition collection of 1862, remarked upon the coincidence between the Nova Scotian and British *faunas* in both having *diplodus*. He also observed that the N. S. teeth were much larger than the British. I would refer to another coincidence; the late Professor How of Windsor, N. S. had just discovered a trilobite in the Lower Carboniferous limestones of Kennetcook, N. S. and forwarded me a specimen for identification. I showed it to Professor Phillips as his *name-sake* (*Phillipsia Howi*; Billings). He also remarked upon the

coincidence of the N. S. Carboniferous faunas with that of the mountain limestone of G. B.

We have thus examined the *marine fauna* of the formations of Pictou County, and found an interesting and beautiful succession of life, with only one serious break, from, the Mayhill Sandstone, Intermediate Silurian—of Salter, to the Middle Carboniferous—Coal measures, i. e.

Beginning with Upper Arisaig A. Mayhill Sandstone, or the possible equivalent of the Medina Sandstone, U. S., we have proceeded upwards through B Arisaig, where equivalence (British or American) is doubtful; then B' Arisaig (which is considered by Hall as of Clinton Age, U. S.) next we have passed through the C. Arisaig Aymestry Limestone, (according to Salter) Upper Silurian; then the Upper Ludlow (Salter) or the Lower Helderberg and "Upper Arisaig" of Acadian Geology. We have bridged the Devonian Gap succeeding, and passed through the Lower Carboniferous into the Middle.