

RECORD OF OBSERVATIONS ON THE GEOLOGY OF NOVA SCOTIA, SINCE 1865. BY REV. D. HONEYMAN, D. C. L., F. G. S., &c., *Director of the Provincial Museum.*

IN the spring of 1869, I surveyed for the Geological Survey of Canada, Middle and Upper Silurian and Lower Carboniferous areas underlying the Pictou Coal Field. I commenced operations at Springville, East River, Pictou, where I had already spent no small amount of time. I now succeeded in extending the known area of Silurian rocks very considerably, and in developing the structure of this very interesting field. I advanced the Aymestry limestone rocks with their fossils into the river, and found them overlaid directly by black lower carboniferous limestone, as in Holmes' Brook: *vide* Acadian Geology, 1st ed., p. 243; 2nd ed., p. 316. Here we have the upper silurian and carboniferous limestone in contact, without any strata intervening, as at McAra's Brook, Arisaig, shewing that these upper silurian rocks were exposed at the bottom of the sea of the carboniferous era, when the limestone was formed upon it. I shall yet have occasion to notice other cases of a similar kind in this district. I have not observed similar occurrences in any other part of the Province. I also extended the same lower than formerly, by finding Arisaig Medina sandstone fossils in an old clearing N. of late Rev. A. McGillivray's, underlaid by a band of quartzite, which is possibly the Arisaig Oneida conglomerate. This is the only locality where I have succeeded in finding this formation out of Arisaig.

The extension (?) of this Oneida conglomerate and Medina sandstone underlies the ^{limestone} ~~limestone~~ (new ore) bed at Fraser's, one mile and three fourths above Springville Presbyterian church. The ore being included in the Clinton, between the formations just mentioned and the Niagara limestone equivalent. This series has been thrown into its present position by a great dyke of greenstone, which is seen outcropping largely a little farther up the river. On the other side of the river, S. side, are lower carboniferous strata, having a considerable breadth of gypsum funnels. These extend to McDon-

ald's Brook, a small branch of East River, where lower carboniferous sandstones outcrop. A continuation of these near Springville, opposite the Bridge above Springville, shew a considerable area of gypsum, with a continuation of funnels; all to the S. of this is lower carboniferous.

The greenstone is homogeneous and ferruginous. It lies in the axis of an anticlinal, which for convenience I shall designate anticlinal No. 1. On the opposite side of this anticlinal, I found the lowest strata highly metamorphic, and at the point of contact coalescing with the greenstone. The Clinton slates above these are well exposed in the Brook that passes immediately E. of the Presbyterian Church. I did not find any fossils in these slates. The other strata are covered by forest, until we get to Blanchard, in the vicinity of the bed of fossiliferous iron ore, referred to in Dawson's *Acadian Geology*, last ed., p. 591. In John McDonald's hill, I found lower Helderberg strata with their characteristic fossils. These appear to be the uppermost strata of this other side of the anticlinal, and corresponding with the lower Helderberg of Springville, which I have already noticed. Situate in Blanchard, and nearly opposite McDonald's hill, with its outcrop of fossiliferous lower Helderberg strata, is the bed of fossiliferous iron ore referred to. This evidently lies in Clinton slate, having a high dip. This series forms a synclinal with the preceding series; below the bed of ore are strata which I conceive to be the equivalent of the Medina sandstone. These are highly metamorphic,—the lines of stratification being occasionally exhibited by weathering, and by beautiful banded structure.

Below these is an outcrop of homogeneous and ferruginous greenstone. The preceding strata are finely exposed in a brook which, issuing from Blanchard, enters East River. The exposure forms a bold section, with a fine waterfall. The greenstone last mentioned proceeds onward parallel with the exposure of strata, and in the rear of it, widening as it proceeds, and ending in lofty mountains, having their termination at East River.

I would designate this greenstone as axis of anticlinal No. 2. Near the point of contact of the slates and greenstone, where they terminate near the river, is a considerable deposit of lower carbon-

iferous limestone, lying on the middle silurian slate, and coalescing with it, forming a breccia. Connected with this is a band of green pyritiferous marble, which is exposed on the bank and in the bed of the river, beside a bridge, and near the mouth of McDonald's Brook, which enters from the opposite side. I shall have occasion to refer to this brook again.

Proceeding farther up the river, I found at Kennedy's, on a road to Blanchard, a small outcrop of breccia, having limestone like a paste, with angular pieces of metamorphic argillite. This outcrop was about twenty paces in length, occupying an elevated position in contact with the greenstone of anticlinal No 2. Starting from the breccia and skirting the greenstone according to the course of the river, we come to Squire McDonald's, and find above his house the termination of the greenstone, and below his store, on the bank of the river, an exposure of a band of lower carboniferous limestone, which, above the bridge of Pleasant Valley, forms a wall on the opposite side of the river, and re-crosses the river, where we shall meet it again.

Returning to Blanchard, I find the bed of fossiliferous ore to be of considerable thickness—forty feet or thereabout—and extending the length of McDonald's property, but not beyond it;—a supposed extension of it northward being an outcrop of reddish slate. Passing over to the other side of axis No. 2, I found, beyond an interval between the greenstone on the other side of Squire Campbell's marsh, a fine outcrop of slate, with abundance of crinoids, and a *Dalmania* Sp? characteristic of the Clinton of Arisaig. Proceeding onward to East River from this point, I found another outcrop of similar slates. I saw several outcrops of slates, but did not particularly examine them. They extend to a brook which enters East River, near the bridge at Pleasant Valley. They outcrop at the mill dam and up the brook for some distance. I now come to notice the relation that the band of limestone which I described as forming a wall on the opposite side of the river, bears to the slates that underlie it. The river separates this wall from the strata of argillites which are finely exposed on the side of the river opposite to it; i. e. on the north side of the river. Proceeding along this side of the river I pass five exposures of slate, and at last come to

the place where the limestone re-crosses the river. Here I find them overlying metamorphic argillites, without any other rock intervening. These have all the appearance of lower Helderberg argillites, much altered. I found no fossils in them. Their cleavage joints glistened with micaceous iron ore.

These limestones extend to the bank at widow Chisholm's and disappear. The last outcrop of limestone occurs about a mile farther up the river, and above the road. This appears to be the extreme of the carboniferous formation in this direction. The band of silurian strata which underlies the limestone below Chisholm's, is underlaid by greenstone. The line of contact is cut by the road that leads from the Presbyterian church to the Blue Mountain. The greenstone is very long and wide. I do not know its boundaries. It extends up the river to the rear of the last outcrop of limestone. This greenstone belongs to an apparent monoclinial series. Farther up the river, at McPhee's, I found another outcrop of strata with greenstone. This may be called anticlinal No. 3. From this the silurian area becomes divided and bifurcates; one branch being what I have traversed on the one side of the river, and the other extending on the opposite side; the two being separated by the narrow lower carboniferous area, to which the limestones that I have already noticed belong.

I examined the skirts of the silurian formation on this the south side of the river. I found the first outcrop in the bed of the river, south of McPhee's. The strata exposed consists of black shale, which appear to be near the lowest part of the Clinton equivalent of Arisaig. Farther west the same strata are exposed in a brook at the dam of a saw-mill. Farther west they are again exposed in a brook at Pleasant Valley, with an underlying band of lighter colour and greater solidity, which appears to resemble the Medina sandstone equivalent of Arisaig. Still farther west we reach McDonald's brook, to which I have already called special attention. This is opposite the green marble, which I referred to as connected with anticlinal No. 2. In this brook there is a great exposure of the strata under examination, and in addition to these a series forming an anticlinal, which extends to the distance of two hundred and fifty paces from the river, making the greatest possible breadth of the

intervening carboniferous band very narrow. In this side of the anticlinal, I found strata containing Clinton fossils, which enabled me to determine the equivalency of the corresponding strata on the south side of the anticlinal, which include the *specular iron ore* at McDonald's. By this discovery, I was enabled to establish a geological connection between this ore of iron and the *fossiliferous iron ore* at Blanchard, and the *limonite* (iron ore) of Springville. In the axis of this anticlinal I observed a mass of greenstone on the left of the road which leads to McDonald's. These strata are farther exposed on the side of another brook below Archibald's. From the green marble the carboniferous area widens and expands as it proceeds westward; the silurian proceeding westward until we find it cut by the Pictou and Truro railway, by which the fine section of the strata is formed, which I have already compared with sections of the strata of the Gold Fields.—*Vide* Part preceding.

Returning to Springville, I proceed to describe my operations in extending farther the knowledge of the geology of this district. At McLean's I found the limestone separated from the lower Helderberg, by a band of lower carboniferous shale. This occupying the position which I have found limestone occupying in Holmes's brook; in the river at McPhee's, Springville; and in the river at Chisholm's, Pleasant Valley. This shews that clay was being deposited, as one might expect, on upper silurian strata; while limestone was being at the same time formed upon the same kind of strata; so that the two must be regarded as contemporaneous. I succeeded in extending the lower Helderberg to the north of McLean's, as far as the extremity of Irish Mountain. I found fossils of this horizon at McMillan's, and near McKenzie's, *in situ*. At the foot of Irish Mountain, at McMillan's, I found the lower Helderberg overlaid by lower carboniferous conglomerate. This outcrops in the drain on the side of the main road, and in the little stream below McMillan's. On the back of Irish Mountain I found fossils *in situ*, but not very distinct; and in Cross Brook, behind it, I found Clinton strata, with characteristic fossils. I followed these down the brook, where I found them extending to the north of Irish Mountain and its lower Helderberg, resting on the green-

stone, a continuation of axis No. 1, and overlaid unconformably by lower carboniferous grits and limestones. I found also the greenstone extending into the lower carboniferous formation, some distance beyond the silurian strata. The northern extremity thus ends in the lower carboniferous of McLellan's brook, while the southern ends at the southern carboniferous of East Branch, East River;—the length of the axis being six and a quarter miles. The 1st part giving direction to the series of silurian strata, as far as Holmes's Brook, Springville; the 2d giving a different direction as far as McLean's limekiln, or rather McIntosh's in the rear of McLean's; the 3d giving direction to the remaining strata of Irish Mountain and Cross Brook. Returning to the part of Cross Brook which is in my line of section, from the gypsum on the west side of Irish Mountain to Sutherland's river, I crossed the Clinton strata until I reached McDonald's, senr., where I found an outcrop of Medina sandstone, with its characteristic *petraia* considerably altered, resting upon greenstone of axis 1. Here the area of the outcrop of greenstone is considerable, being about two hundred paces across. Then comes a wide band of metamorphosed strata, corresponding with those of the other side of the anticlinal, but much altered, and to all appearance destitute of fossils. These extend lengthwise, and terminate partly on a mountain east of the northern extremity of the axis; part pass over McLellan's brook into the mountains, called McLellan's Mountain, forming the western side. Against the back of these silurian strata, lower carboniferous grits and limestone rest. The junction is seen in McLellan's brook, above Fraser's. In this lower carboniferous area lies the thick band of limestone on which the house of the late Rev. Dr. McGillivray is built, and also an outcrop of black limestone at the Cross Brook bridge, near McGillivray's. Some distance from this junction of lower carboniferous and middle Clinton (?) strata, or about three quarters of a mile, as the crow flies, is a fine section of strata, on the site of a saw-mill, having abundance of lower Helderberg fossils. I was rather taken by surprise when I came upon this fossiliferous outcrop, as the character of the underlying strata did not lead me to expect it. This fossiliferous band is exposed about the length of the eighth of a mile in the bed

and on the sides of the brook. It assumes the form of a syncline. Part of it, therefore, belongs to another series of silurian strata. This outcrop is doubtless an extension of the lower Helderberg of Blanchard, on McDonald's Mountain.

I sent a collection of fossils from this locality to the museum of the Survey. This new series of strata, of which the lower Helderberg part is exposed, enters into the formation of McLellan's mountain. Simon Fraser's mountain shews an outcrop of greenstone in the line of axis No. 2. This line then runs in a south east direction, having first one outcrop of greenstone with red porphyry, and then two other outcrops; and then it is possible that there is no other outcrop until Blanchard is reached. Parallel with this line is a fine exposure of Medina sandstone strata, overlaid by Clinton shales. On the side of the road ascending the mountain named, I was very fortunate to find a mass of rock having abundance of characteristic *petraia* and trumpet-shaped cornulites of Salter's Report, and an organism which I did not recognise, but which I considered to be possibly the pygidium of a trilobite. In similar positions I generally find the *petraia* in the form of casts—internal and external. Here I find the organism itself, as I get it on the shore between Doctor's brook and Arisaig. I also found other specimens throughout the outcrop, but they were by no means so abundant as my first success led me to expect. I did not find any in the Clinton strata of this band. These are doubtless an extension of the strata of Blanchard, containing the bed of *iron ore*.

I did not find fossils in any of the other strata between this and the fossiliferous lower Helderberg of McLellan's brook. However it is something to have characteristic fossils from the highest and lowest parts of a series. I found the greenstone of axis No. 2 also exposed in the church yard, near the Presbyterian church of McLellan's Mountain, and two considerable outcrops still farther north, having an extension of the Medina slate of Simon Fraser's mountain. West of these is a considerable outcrop of slates, which probably belong to the other side of the synclinal. These are succeeded in the same direction by conglomerates, containing a dyke of greenstone. It is quite possible that these may be a continuation of axis No. 2, farther north, as I have not examined in that direction.

Returning to the greenstone of axis No. 2, on the line of Simon Fraser's mountain, we ascend to the summit, and find outcropping the strata of the other side of the anticlinal. The numerous outcrops shew that this band is of considerable width. These outcrops also extend in a northerly direction, and run up against or to the east of Wier's mountain,—the most northerly outcrop being in David McLean's brook. The distance between the two extremities of this anticlinal being nine and a half miles. These strata are all metamorphic, being apparently destitute of fossils. To the north of the extremity of second anticlinal, lies the lower carboniferous, having an outcrop of limestone. This is situate on the north side of a little brook at the seat of a saw mill. The lower carboniferous strata are not seen in contact with the underlying silurian strata.

The general direction of the two anticlinals that I have described, is north-west. The next in order takes a different course. I have said that the last outcrop of the eastern side of anticlinal No. 2, lies to the west of Wier's mountain. This mountain is a great mass of greenstone, being apparently bounded on the north by carboniferous conglomerates, &c. The axial line of this mountain takes a direction north east; while the axis No. 2 has a north west direction. On the south east side of the mountain, not far from Mr. Wier's house, there is an outcrop of metamorphic silurian strata, which are undoubtedly the Medina sandstone equivalent. These have a north east strike; they are continued onward in the same direction, outcropping on the lower side of an old road, and then they terminate at Sutherland's river, forming a somewhat imposing fall, which has been made the seat of a factory. Overlying these, unconformably, are lower carboniferous strata, conglomerates and grits: these are well exposed in the river. The carboniferous formation comes up against the lowest part of the silurian strata. We have thus reached the extremity of the lower carboniferous of the Pictou Coal Field. Returning to the silurian outcrop at Wier's, we proceed south east to Cameron's brook, where I found soft argillaceous strata, like the Clinton of Arisaig, with abundance of characteristic fossils! These overlie the metamorphic of Wier's mountain. I found no appearance of higher strata connected with those. Where the brook enters Sutherland's river, in front of and above the falls,

there is a singular meeting of rocks. Above the fall strata in the river itself, there is an exposure of greenstone, which passes into the bank of the river. Between the river and Cameron's brook there is greenstone, which forms a considerable eminence over against the factory, on the side of the brook, and up the brook, until it comes up to the New Glasgow road. South of the falls are Medina sandstone strata, with their peculiar *petraia* and *lingulæ*. Passing along the New Glasgow road towards Sutherland's river, on the left of the road, the greenstone which originates above the falls on the right side of the road, and overlying the greenstone, are Medina strata, with lenticular beds of *orthids*, such as are found in similar beds in McDonald's cove, Arisaig; and also beds of *athyrus*, as at Lochaber. Overlying these at the old road, near where it is cut by Cameron's brook, are Clinton strata, from which I got a beautifully ribbed organism, which is in the Museum of the Geological Survey of Canada. Returning to the road I found, opposite the school house, Clinton strata: these overlie the Medina already mentioned, continued on to Sutherland's river and beyond it, which forms the site of McPherson's grist mill. Under the mill I found these Medina strata overlaid unconformably by lower carboniferous grits,—the latter butting against the former. Passing on towards the falls we find, in these sandstones in the bed of the river, a salt spring, the favourite resort of cattle; these may be seen congregating here from all quarters. Invalids may also be seen following their example, in the belief that the spring is, like quack medicine, omnipotent for the cure of all diseases. Overlying the Medina strata, and south of it, are Clinton strata. The former is exposed on either side of the bridge, and the latter above it,—both are fossiliferous. Farther south, up a branch of a small brook that enters Sutherland's river, above the bridge, is a considerable fall, (Fraser's.) The rock of the fall is Medina formation. Passing along the bridge towards Blue Mountain, my attention was turned to lofty banks on the left side of the road. As soon as I saw them I was struck with the resemblance they bore to the strata of my Barney's River *lingula* nodule bed. I made up my mind to collect similar nodules out of them, and they forthwith turned up in considerable abundance, of the same species as at Barney's

River. I crossed the fields until I came to Sutherland's river. I found a fine section of the shales on the river, with the nodules rolling out of them. In the shales were abundance of concretions, similar to those of the black grapolite and lingula shales of Doctor's brook, Arisaig. This is the only locality that I have found having shales identical with the lower Clinton of Arisaig. This resemblance of the river shales to those of Doctor's brook, and the striking resemblance of the banks on the side of the road to the lingula beds of Barney's River, enabled me at once to settle beyond dispute the horizon of the Barney's River lingula bed, which I had before done with some misgivings. The section of black lingula shales is a little below the place where a small brook that crosses the road enters the river. South of this exposure of shales, on the west side of the river, rises a hill, where there is an outcrop of greenstone porphyry. Still farther south, or about two miles in a straight line from the bridge at the mill, is a mountain of considerable elevation, called McDonald's mountain. The northern side of the mountain is porphyry, and the south is metamorphic slate,—the two terminate on the east side in a noble bluff, which is easily distinguishable from the bridge. I have not surveyed on the west side of Sutherland's river beyond this mountain. Entering Sutherland's river to the east of the mountain, and descending it a little way, I found lower Helderberg strata, with characteristic fossils. The river course is almost in the line of the strike. These rise in the bed of the river in magnificent forms, making rapids and waterfalls which made me somewhat tremulous when attempting to examine them. This is, without exception, the most imposing display that I have witnessed of lower Helderberg strata. I would advise every Geological student to make a pilgrimage to this Geological shrine. They can be seen to advantage by making a descent into the river directly opposite the first porphyry elevation, south of the lingula shale section. The strata under examination pass out of the river below the falls, crossing the little stream referred to when describing the lingula shale section, making in this strata a deep fall, a little below the Blue Mountain road. When I examined it there had been a clearing just made, and a mill was in process of erection. These strata then cross the road and

pass northward on the sides of the mountain, where I collected characteristic fossils. They continue their course until they terminate near a small lake which supplies a small stream which descends into Sutherland's river, below McPherson's mill. In this stream there is a section of rocks which deserves attention. Above the road it passes over a greenstone rock, and then crosses the bank on the right with an exposure of lingula shale, whose relation to the other rocks I was puzzled to understand. It is at all events the last of the silurians on the north of the Sutherland river silurian field. Farther up the greenstones rise in a gorge, making a nice little waterfall. This greenstone reaches to within a little of the lake, and then passes over in a northeasterly direction. On the north east side of this little lake is an outcrop of silurian strata, which is probably of Clinton age. Farther east we come to McBeath's, and find outcrops of lower Helderberg strata, with a low northerly dip. Every heap of stones around furnish lower Helderberg fossils. Passing on to the mountain that stands highest in the range, east of Sutherland's river, I found the ridge of strata on the summit to be lower Helderberg. South east of this are lower elevations, having lower strata, metamorphic, which terminate rather abruptly, with a steep descent; at the bottom of this runs a small brook, which appears to be the continuation of the small stream which enters Sutherland's river, near its falls, as I have already noticed. As I have got back to this point, I would turn attention to a singular arrangement of the silurian formations in this direction. The Helderberg strata of the river and of the fall of this small stream, are seen to be underlaid by dark shales with lingulæ. These are exposed on the side of the road, and in the bed of the stream: they are Clinton shales. Passing along the road toward the Blue Mountain, I found beyond Holmes's store an outcrop of strata, on the left side of the road. Here I collected, *in situ*, characteristic lower Helderberg fossils. Now this happens to be a continuation of the lower Helderberg strata of the lofty mountain last referred to. So that we have two sets of lower Helderberg strata, viz: the river strata and the mountain strata, both dipping in a westerly direction, but diverging northerly, having an older formation lying between them. The converging direction being

southerly, they would appear to have their centre east of McDonald's mountain, near the place where I met with the strata at first on entering the river.

The lower Helderberg outcrops that I have described in this quarter, appear to lie on the sides of a triangle, whose apex is opposite McDonald's mountain, which has the course of the river for one side, the continuation of the outcrop on the road, and the mountain strata for the other side, and the strata at McBeath's for the base, and Clinton strata situate in part of the area. This seems to show that there had once been a mesial fold in this area, that the crowning Helderberg had been removed by denudation, and that the underlying Clinton strata had been exposed as we now find them. I examined for a considerable distance to the south of the supposed apex, and found silurian strata outcropping all along, until I reached the site of McIntosh's saw mill. In this direction all the strata are metamorphic. The outcrop at the mill, forming a fine fall, appears to be of Medina strata. Descending the river, I reached metamorphic Clinton strata in the river and on the east bank of it, having abundance of veins of quartz,—one of the reputed gold fields that I have already referred to. This is evidently a continuation of the metamorphic strata which I have just noticed as underlying the lower Helderberg strata of the mountain.

I have yet to connect the lower Helderberg strata at McBeath's with the Clinton of French River, where it crosses the road between New Glasgow and Antigonishe, and to lay down the order of formation at the mouth of Marshy Hope, and draw the silurian boundary line from Mill Brook to the Marshy Hope, in order to complete the line between McNcil's brook, Arisaig, and McDonald's brook, East Branch, East River, and survey several important areas included within these boundaries, before I can map out satisfactorily the silurian systems of Antigonishe and Pictou.

It may seem strange that during my description of the area underlying the Pictou Coal Field, I have made no mention of the Devonian formation which is *so often spoken of* in connection with the strata underlying this coal field. The reason why is this: *there is no Devonian to be found there.*