Art. VIII.—Nova Scotian Geology, by Rev. D. Honeyman, D. C. L., F. G. S., &c.

(*Read April 13th*, 1874.)

COBEQUID MOUNTAINS, &c.

About three miles west from the Wentworth Station, of the Intercolonial Railway, (*vide, preceding paper by the author*) we find ourselves on the north side of the Cobequid Mountains, and on the road from Greenville to the Londonderry Iron Mines. Here we find the lower carboniferous conglomerate and the red syenite. Any intervention of the bands of rocks which occur on the Intercolonial Railway, between Smith's Brook and the carboniferous of Caldwell's Brook, as I previously noticed there, have been denuded and overlaped.

Near Purdy's Inn, West Chester, on the road from Amherst to the Londonderry Mines, we find the lower carboniferous conglomerate and the red syenite occurring in a similar manner. This position is six miles distant from the preceeding. The outcrops along both roads, southward to their meeting point, are of granitoid rocks: syenites and diorites. Between this point and the county line there are outcrops of granites. The granites are evidently massive, they are fine grained and of dark colour. South of the county line we have outcrops of the next band; these exposures exhibit much greater variety than was seen on the Intercolonial Railway. In one exposure the strata are beautifully banded. The dark green homogeneous diorites having interbedded red and green gneissoid strata; other exposures show massive homogeneous diorites; others show gneissio and quartzite strata, and the last exposures, a little below the bridge on the east side of the road, shows dark green diorite, which may readily be mistaken for uncrystalline rock, the hammer however shows that it is characteristically hard and crystalline. These are succeeded by uncrystalline rocks, as on the Intercolonial Railway. By exposures we find that the band in this direction is about half a mile wide. About the middle of it there is a great deposit of ankerite. At the time of my last visit, in 1866, this was not worked. It is now used as a flux instead of

the limestone formerly used. Besides being a flux it adds 25 per cent. of iron, the iron thus produced is adapted for *chilling*.

The extension of these strata, east and west, contains the deposits of limonite. The largest deposits lie to the west of the ankerite. In the same band there occurs a red hematite, which is used with the limonite and ankerite. These deposits all appear to be in the upper part of the band, and are probably of Upper Silurian age. The greatest width of the band is in the region of the red hematite, There it seems to be about a mile in width. Succeeding this band is the carboniferous of the Intercolonial Railway. The slates of the *ankerite* are overlaid by lower carboniferous conglomerate, those of the *red hematite* by lower carboniferous limestone. This difference of rock seems to account for the difference in width of the Silurian band in the bed localities, as conglomerate forming conditions are destructive, and limestone forming conditions conservative; the one being formed from the tear and wear of rocks on the shore, the other being formed in the depths by marine lime-forming invertebrates. This conglomerate and limestone may therefore be regarded as cotemporaneous. It is not unusual to find lower carboniferous limestones lying directly on pre-carboniferous rocks. The Pictou Coal Field furnishes many examples.—*Vide Transactures*, 1870—1–2 *Papers, by the author.*

Following the course of Great Village River, from the Londonderry Iron Works, we have a fine section of this carboniferous band, more distinct even than that of the Intercolonial Railway. In this, about three miles from the iron works, we have a quarry which once was the haunt of reptiles of the middle carboniferous period. *Dendrerpeton acadianum*, Owen, or his congeners. From this locality there is a sandstone slab in the Museum, which has three fine setts of casts of right and left reptilian tracks, one sett traversing it longitudinally and the others crossing and recrossing nearly at right angles. We have thus met with reptiles on either side of the Cobequid Mountains, of the same period, but in different geological horizens, the one being of the lower and the other of the middle carboniferous formation. Not far from the quarry we have the commencement of the new red sandstone, permian and trianic. This is also well exposed on either side of the river as

far as the Great Village, exhibiting the same characters as on the Intercolonial Railway. Beyond the Great Village all is obscure.

We would again traverse the Cobequid Mountains from the north, beginning at the county line, ~~two~~ 20 miles west of the Intercolonial Railway, and on the road to Five Islands. We are on the north side of the central band. The underlying rock, as shown by the outcrop, is granite. This granite is coarse and porphyritic, the mica is black, the felspar is reddish white; it is different from any other granite that I have met with in Nova Scotia—in position. I have found it frequently in boulders, and specimens have been brought to the Museum from Cape North, in the Island of Cape Breton. This granite is succeeded on the north by lower carboniferous conglomerate, in the same manner as are the syenites of West Chester and Greenville; the Silurians, of Wentworth, being still absent or overlapped. It is thus probable that forty square miles, at least, of crystalline and uncrystalline rocks have been denuded and obscured on this side of the Cobequid Mountains by the lower carboniferous seas. This lower carboniferous conglomerate is the southern base of the Cumberland Coal Field. Crossing the Mountains towards Five Islands for a long distance no outcrops are seen; the surface boulders and soil seem to indicate three or four miles of underlying granite, similar to that of the outcrop already noticed. Farther on we have frequent outcrops of granitoid rocks—syenites and diorites. About two miles from Five Islands the outcrops are of bedded crystalline rocks—gneisses and quartzites. The extension of these to the east, on North River, shows syenitic gneiss with crystalline limestone (marble). This marble is well known, it has been quarried to some extent with the expectation of obtaining masses fitted for sculpture, but without success.

The position of this marble and its associations are sufficient to indicate its relationship to the marbles and serpentines of Arisaig, N. S., and George's Mountain, C.B.—*Vide Transactions*, 1872-3. *Paper by the author.* The syenitic gneiss, in the vicinity of Bass River, seems to belong to the same band of rocks. This seems to overlie the strata which contain the *barite* veins of Five Islands. It will require still farther investigation to determine these points. The peculiar lithology of the barite containing-rocks, and their great

contortion, are difficulties in the way of settling this question, although these apparent difficulties may not amount to much in the face of systematic and thorough investigation. The *barite* has been somewhat extensively mined for the manufacture of white paint.

From the river below, the lofty, extensive and precipitous exposure of rocks, with its numerous pigeon holes, (adits) and shoots for conveying the mineral to the river, and picturesque surroundings, present a scene striking and imposing.

Returning to the mountain road we have, succeeding the crystalline, a band of uncrystalline rocks—slates and shales, an extension of the slates and shales of the Intercolonial Railway section and the Londonderry mines. These present no feature of importance.

At last we come to Harrington River, on the right side of the road, with its section of the carboniferous band of the Intercolonial Railway. Here we have a considerable thickness of slates, which very much resemble the slates of the preceding band. They are unconformable to the Upper Silurian. Many of the strata are beautifully ripple marked. These are succeeded by black strata, having shales with *modiola*, patches of scales of *palæoniscus* with *modiola* and *cordaites* (*?*) These are unmistakably lower carboniferous. The section of this formation extends onward to the mouth of the river, where it is overlaid by the new red sandstone. This band extending to the shore is terminated by Trap, an extension of that which constitutes a great part of the Five Islands and Gerrish Mountain. The trap of these Islands is celebrated on account of its minerals. That of Gerrish Mountain has a vein of *magnetite*—magnetic iron ore.

The trap at the end of the section has elevated the strata in this direction, and given the new red sandstone the form of a synclinal. On the road side, about a mile to the eastward, we find an exposure of the same band, having a southerly dip. This has received its direction from the trap of the Islands.

Gerrish Mountain is the eastern extremity of the trap which crosses the Bay of Fundy to Blomidon, and extends westward to Digby and Briar Island.

Intercolonial Railway.

On referring to the Section Book we get the following measurements:—

Folly Lake 602 feet above the sea level—

Crystalline rocks of Smith's cutting.....507.
Rocks of "Wentworth" cutting.....490.
Middle Silurian cutting, near Caldwell's Brook. 453.
Lower carboniferous conglomerate. .....450.

If we consider the conglomerate as having been formed on the approximate level of the sea, at the beginning of the carboniferous period, then the position of Folly Lake at that time was one hundred and fifty two feet above the sea level. The rocks of Smith's cutting fifty-seven feet, of Wentworth forty feet, and the Middle Silurian rocks, next the conglomerate, three feet. The Mountains of the Cobequids, which now rise to the height of eight hundred feet, were no higher than three hundred and fifty feet, and West Chester Sugar Loaf, the highest mountain in this range and in Nova Scotia, which now rises to a *reputed* height of one thousand two hundred feet, was elevated seven hundred and fifty feet above the surface of the waters. McNeil's Mountain, Arisaig, the highest in the east (one thousand and ten feet) rose to a height of five hundred and sixty feet; and the loftiest of the mountains of Cape Breton (nine hundred feet) were only four hundred and fifty feet in height.

Correlation.

I have already directed attention to the probable relationship of the crystalline, uncrystalline, and fossiliferous pre-carboniferous rocks of the Cobequid Mountains. From a Dominion point of view I would now turn to England.

On examining Prof. Ramsay's great work "on the Geology of North Wales," I find in page 90, fig. 20, a representation of an almost exact counterpart of the northern part of the Intercolonial Railway section. The Wales section runs thus:

1,—Syenite.
2,—Speckled felspathic and talcose flaggy beds, Llandeilo and Bala beds.

3,—Felspathic ashy conglomerate.
4,—Slate.
5,—Felspar porphyry.
6,—Blue slate.
7,—Felspathic trap.
8,—Blue slaty beds.

"In places the trap No. 7 is slightly hornblendic, and although probably intruded between the beds it may possibly be a regularly *interbedded lava flow*," *page* 96. In explanations on Plate 28, Section No. 3, the syenite, porphyries and greenstone are referred to the *Lower Silurian*.

The adding of a new *Fauna* to the Silurians of Nova Scotia seems to be a fitting time for making a few observations on the *Fauna* already known.

By common consent the fauna of Arisaig is regarded as typical of the Middle and Upper Silurian of Nova Scotia. All however are not agreed on the points of *range* and *relationship*.

With the aid and counsel of J. W. Salter, Esq., late Palæontologist of H. M. Survey of Great Britain, I made a subdivision of the Arisaig Series in 1863—Vide Paper by the Author "On the Geology of Arisaig." *Geological Journal*, 1863.

The division then made was *alphabetical* and British as follows:

A..... .....Mayhill Sandstone—Salter.
B. B'.....Lower Ludlow.
C.....Aymestry Limestones—Salter.
D.....Ludlow Tilestone—Salter.

After the lapse of 10 years and a great amount of labour and research, I consider that the alphabetical division is the only unobjectionable one that has been proposed, and that the only modification of the British division required is the omission of the "Lower Ludlow," which was not suggested by Mr. Salter. Previous to Mr. Salter's examination and correlation, I had correlated D. with the Upper Ludlow of Wales, and Dr. Dawson had at the same time correlated C. and D. with the Lower Helderberg, U. S., and B'. with the Clinton, U. S. D. and C. are farther distinguished by Dr. Dawson, Upper Arisaig, and B'. Lower Arisaig. Extensive observation has proved that Mr. Salter was correct in giving the Arisaig Series a greater range in time than that given by Dr. Dawson.

At Arisaig the Mayhill sandstone of Salter occupies the lowest position in the Series, and it has the same relative position in the several localities where it occurs in Nova Scotia. Its characteristic *fauna* is perfectly distinct from that of the others. Its *lithology* is also peculiar. While the other fossiliferous strata of the group are *argillaceous* this is highly siliceous—parts are *simply sandstone*. In one locality the strata are siliceous and the contained fossils are silicified casts. I have no difficulty whatever in recognizing the Mayhill sandstone strata from their relative position and lithology, when I find them, and the characteristic fossils appear as a matter of course. In previous papers I have given my reasons for distinguishing B. and B'. into Lower and Upper Clinton. I have followed the example of Hall in dividing the Arisaig Series into Middle and Upper Silurian. I have also been in the habit of correlating it thus :

England.		*United States.*
A.	Mayhill Sandstone	Medina Sandstone.
B.	.....	Lower Clinton.
B.'	.....	Upper Clinton.
C.	Aymestry Limestone.....	Niagara Limestone.
D.	Upper Ludlow.....	Lower Helderberg.
A. B. B'.....		Middle Silurian.
C. D.....		Upper Silurian.

In correlating the Arisaig Series with the United States divisions. I have found it difficult to correlate D. with the Lower Helderberg, notwithstanding that I had access to the best American authorities, and lists of figures. I am not surprised that Hall and others regarded the fauna of D. as Devonian, as they appear to have a greater resemblance to the Hamilton and Chemung than to the Lower Helderberg. The *facies* of the *fauna* of D. is strongly English, I experienced no difficulty in recognizing it in the Upper Ludlow of *Murchison's* Siluria. I believe that it is only through England that it can be correlated with the Lower Helderberg of the United States. C. is easily correlated with the Niagara limestone of the United States. B'. is with common consent admitted to be of Clinton age, United States. I have designated B. Lower Clinton, for reasons already given. I have not been able to correlate

A. Mayhill sandstone of Salter, directly with the Medina sandstone, United States. As it is distinct from B. and B'. Clinton and underlies it, it is reasonably regarded as the approximate equivalent of the Medina sandstone, United States. In addition it is also a sandstone. Sometimes I am disposed to subdivide and to make the metamorphosed part in conjunction with the trap of Arisaig Pier, and other parts of the shore—Oneida conglomerate, United States.

I have referred to another division of the Arisaig Series into Upper and Lower, the Lower Helderberg equivalent being the Upper and the Clinton the Lower Arisaig. There are two applications of the word Arisaig. There is the Arisaig Township and the locality Arisaig. In the former sense it is much too restrictive as it ignores a great part of the Arisaig Series—besides a typical series of crystalline rocks which I have elsewhere designated as "Lower Arisaig" and carboniferous rocks. In the latter sense it includes too much, as the "Lower Arisaig" of the Division *alone* lies in Arisaig, while the "Upper Arisaig" is in Moidart. On these grounds I consider this division as untenable.

From the considerations already stated I have long regarded the Silurian *fauna* of Nova Scotia as Anglo-American. When Mr. Salter examined my Arisaig collection at the London Exhibition of 1862, he marked particularly the English fossil *Grammysia Cingulata*. Upon the authority of Professor Dana,—this is a foreign form which has not been found elsewhere in America. In England this fossil occurs in the Ludlow tilestone. In Nova Scotia it occurs in the Upper Clinton of Arisaig. So that the Nova Scotian *Grammysia Cingulata* is older than the others, and may therefore at present be regarded as the *ancestral Grammysia Cingulata*.

In England and elsewhere Sir R. J. Murchison's division of the Silurian system into Upper and Lower, has been generally accepted. In America eminent Palæontologists, *e. g.* Hall and Billings, have divided the system into Lower, Middle and Upper. This is the division adopted by the New York and Canadian Surveys. Professor Ramsay in his *Geology of North Wales*, proposes a modification of Sir R. Murchison's division. Between the Upper and Lower Silurian he distinguishes an *Intermediate*

Series. This includes the Llandovery rocks, page 2. He adds: "The lists of the Geological Survey show that about ninety species of fossils are known in the Lower and Upper Llandovery strata of Wales and its neighbourhood. These, taken together, are, on the whole, so distinctive that it has been proposed to divide the strata in which they occur into a middle Silurian Series, page 231.

The difference between Professor Ramsay's Middle Silurian and our Nova Scotian Silurian is, he begins with the Mayhill sandstone (Upper Llandovery) and descends; including the Lower Llandovery. I begin with the Mayhill sandstone and ascend, including the Clinton.

Distribution of the Upper Arisaig Series.
Localities.

D. Upper Ludlow, England. Lower Helderberg, United States, Arisaig and Lochaber, Antigonish County. Springville, Irish Mountain, Blanchard, Merigomish, McLellan's Brook. Sutherland's River and Earltown, Pictou County.

C. Aymestry limestone, England. Niagara limestone, United States. Arisaig and Lochaber, Antigonish County. Springville, Pictou County.

B'. Upper Clinton, United States. Arisaig, East River, Blanchard, Irish Mountain, Sutherland's River, French River, Cobequids.

B. Lower Clinton, Arisaig. Barney's River, Sutherland's River.

A. Mayhill sandstone, England. Medina sandstone, United States. Arisaig, Lochaber, Marshy Hope, Barney's River, McLellan's Mountain, Sutherland's River.

It will be observed that the Counties of Antigonish and Pictou, include all the above mentioned localities where we find rocks containing Arisaig fossils. In the "Webster Collection," in the Provincial Museum, there is a small collection of fossils which appear to be of the Arisaig type, although these are not recognizable characteristic fossils. It is possible that they are from localities in the western part of the Province, mentioned, in "Dawson's Acadian Geology." These localities I have not yet examined.