ART. II.—NOVA SCOTIAN GEOLOGY. INTERCOLONIAL RAILWAY. By the REV. D. HONEYMAN, D. C. L., F. G. S., *Member of the Geological Society of France, Hon. Mem. of the Geologists' Association of London, &c., Director of the Provincial Museum.*

(*Read November* 9, 1873.)

LEAVING Truro by the Intercolonial Railway, and proceeding in a northerly direction, at the distance of about half a mile, we see a fine section of an extensive gravel-bank which has done good service in ballasting the line of Railway. This bank is of *Post-pliocene formation*. The material has been largely derived from the rocks of the Cobequid Mountains lying to the north. Before reaching the DeBert Station, we pass over a long level track which shows numerous sections of the same formation, and many beautiful sections of the Triassic formation. The latter are seen in the lower parts of the cuttings, and in the openings of the various tunnels cut for the drainage. I would observe that elsewhere we have intervening between the *Post-pliocene* and *Triassic* formations, the *Pliocene Miocene*, *Eöcene*, *Cretaceous*, *Wealden*, *Oolite* and *Lias*; so that in passing at once from the Post-pliocene to the Triassic. we have an enormous *break in succession* and unrepresented *lapse of geological time*. At Folly River Bridge we still have the Triassic. The strata are seen in a magnificent section on the eastern side of the River.

In the second cutting, before reaching Londonderry Station, there is a fine section of coarse conglomerate. This is the lowest member of the Triassic series. This conglomerate was originally *shingle*, formed of the debris of pre-existing formations accumulated on the shores of the Post-carboniferous Sea.

After an obscure interval occupied by a *filling*, we have another cutting of strata of the carboniferous period. If the prevailing opinion is correct, that what is sometimes called the new red sandstone of Nova Scotia is altogether of Triassic age, we have here another *break in succession*, the Permian formation being absent. The proof of absence, however, is altogether presumptive, so that it is quite possible that the new red sandstone is partly *Permian* as well as *Triassic*.

We have now a great stretch of cuttings, showing a series of sections of sandstones, clays, grits and conglomerates. The last form a very marked feature both in extent and coarseness. The walls of conglomerate are high and threatening. They are close upon the road, masses are easily detached, obstructing the Railway Trains. The great characteristics of our carboniferous formation are not apparent in these sections—coal, gypsum and limestone are absent. The flora of the period are occasionally met with. The coarse conglomerate extends a considerable distance beyond the overhead bridge. This also is formed of shingle derived from the pre-carboniferous rocks of the Cobequid Mountains accumulated on the shores of the seas of the carboniferous period.

The last exposure of the carboniferous formation occurs in the opening of a brook tunnel. The rocks are soft black and grey shales, with concretions. Rocks are now unexposed to a distance of 700 feet, and then we have exposures of grey, metamorphic and uncrystalline rocks to a width of 2150 feet.

I believe this band to be of Middle Silurian age; others may regard it as Upper Silurian or Devonian. We have no direct evidence to settle this question, it is only by analogy that any view can be supported. General analogy is in favour of the probability that the band is of Devonian age, as the rocks immediately underlie the carboniferous. Special analogy for many years seemed to favour this view. The reasoning was thus:—On the opposite side of the Cobequid Mountains are strata which are regarded as the anticlinal equivalents of the strata in question. At Earltown, in the County of Pictou, these equivalents contain *fossils* corresponding with those of the *Typical* series in Arisaig which were considered to be Devonian by Palæontologists. Before my examination of the Londonderry Mines, part of the band of our section in 1866 (*vide Transactions of the Institute* 1866–7) our views of the age of the Arisaig series of rocks had undergone a great change. Distinguished Palæontologists on either side of the Atlantic had so correlated the fossils of the Arisaig series that the

Devonian had altogether disappeared from Arisaig, and the series became divided into Middle and Upper Silurian.

In the part of the rocks of the Londonderry Mines corresponding with the rocks exposed in our *section*, I observed a supposed lithological resemblance to the lower part of the Arisaig series, and I designated it accordingly. I supposed that a higher portion which is obscured in our section, was the Upper Arisaig. Regarding it as possible that the band might have a wider geological range than the Arisaig series, I still considered that a higher part or the part next to the Carboniferous might be Devonian. In this case the succession was regarded as *unbroken*. Now, however, as the Devonian has almost, if not altogether disappeared from Nova Scotian Geology, there is none found even to suppose its existence in the *band of our section*. I expect that the farther examination of the section through the Cobequids will show that there is every probability that the rocks under examination are of Middle Silurian age. If this is the case, we have here another *break in succession*, caused by the *absence* of the Devonian and the *obscuration* of the Upper Silurian.

The Upper Silurian of the other parts of the band has been here denuded by the seas of the Lower Carboniferous period, and overlapped by the conglomerate already described, the consolidated shingle that accumulated on the wasted Upper Silurian strata. I observed nothing very marked in these Middle Silurian (?) strata. Leaving these we enter upon another band of rocks, these are exposed in a series of beautiful sections to a width of 10,400 feet. This series of rocks consists chiefly of diorites and quartzites. The diorites are of different shades of green, and are crypto-crystalline; the quartzites are often banded. Near the commencement there is a gneissic stratum—farther on there is a bed or vein of green calcite mixed with diorite. In one of the diorite sections there is a thick vein of quartz. The lithological characteristics of this band effectually separates it from the preceeding. There is no part of the "Upper Arisaig Series," either at Arisaig or elsewhere, that shows diorites similar to those of our section. The crystalline rocks of Arisaig or what I have elsewhere named the "Lower Arisaig Series," alone exhibits diorites of similar character.

The *green calcite* of our section indicates conditions which seem to correlate the rocks of our section with the "Lower" rocks of Arisaig. The intimate connection existing between this band and the next in order on the line of Railway, points in the same direction. I have already experienced considerable difficulty in correlating the corresponding rocks in Arisaig. There was no difficulty in showing that they were older than the "Upper Arisaig Series," *i. e.* that they are older than the Middle and Upper Silurian periods. The difficulty was in ascertaining—how much older they were. I considered that I had established their lithological resemblance to the metamorphic rocks of the Quebec period of the Canadian Survey. Assuming that the Lower Silurian age of the Quebec rocks had been established, I had considered that there was little doubt that the marble and associated rocks of Arisaig were also Lower Silurian.—*Vide Trans. of Institute* 1872–3. I find however, that the age of the Quebec rocks is still a *questio vexata*, and it is maintained that they are older than the *acknowledged* Lower Silurian.

Proceeding farther along the line of Railway we have another great band, having a width of 24,000 feet, or about 4½ miles. Of this 11,500 feet is in the County of Colchester and 12,900 feet in the County of Cumberland.

The sections of rocks of this band on the I. C. R., are comparatively few and low. The rocks are almost or altogether obscured by the great gravel and sand-banks. The rocks that are seen in the sections or openings of stream-tunnels are granitoid—grey and red syenites and diorites. There are also crypto-crystalline diorites and porphyries. The crypto-crystalline diorites are not distinguishable from those of the preceding band. The transition

---

NOTE.—Since I read my paper to the Institute, I have had an opportunity of examining the geological formations of New Brunswick. The resemblance existing between the great Limestone-bearing formation of St. John and the Marble-bearing formation of Nova Scotia and Cape Breton is so striking, that I have very little hesitation in regarding them as *identical*. The resemblance between the formation of St. John and that of Arisaig is even more striking than between Arisaig and Cape Breton. Profs. Hart and Bayley, and Mr. Matthews have proved satisfactorily that the New Brunswick formation is older than the Lower Silurian.

of diorite from granitoid to crypto-crystalline is readily seen in the bed and sides of a small stream which crosses the Railway at the south end of Folly Lake, and also in Rocky Brook on the north side of the same Lake.

In this brook the diorites are intersected by numerous small veins of red syenite. The red syenite, farther on, is seen to be penetrated by dark green cypto-crystalline diorite, in veins.

The sections between Jobe's and Higgin's Brooks are beautifully variegated. There are crypto-crystalline diorites of various shades of green with brown porphyries and bright red syenites. The structural aspect of these rocks is sufficiently perplexing, while they seem as a whole to be "indigenous" or metamorphic—some of the crypto-crystalline diorites and the porphyries seem to be "exotic" or igneous.

The gravel banks which obscure or partially cover the rocks of this band, seem to merit more than a passing notice. The sections on both sides of the Railway indicate the thickness and extent of the accumulations of gravel. An examination of the material, *e. g.* boulders, gravel and sand, shows that it is chiefly, if not wholly, derived from the surrounding rocks.

The extent of the accumulations, their breadth and depth, show that the waste of rocks must have been very great. The roundness of the material shows the amount of rolling to which it had been subjected, while its stratification indicates that water was the agency engaged in arranging the banks.

The formation of the material may largely belong to a period or periods anterior to the Post-pliocene, while its diminution and partial transportation southwards was the work of the agencies of the latter period.

It is possible that prior to the Post-pliocene period, Folly Lake occupied the greater part of the hollow that lies between the mountains that rise on the east and west, that it extended to the north as far as the carboniferous formation and was embanked by it, that it rose to a higher level than at present, and received the waters, with *debris*, of the streams that flow from the mountains on either side, which are now known as Wallace River and its tributaries. At this time the only outlet of the lake may have been Folly River which flows southwards and empties its waters into the Basin of Minas. The present limitation of Folly Lake, the formation of the beautiful valley on the north, the present watershed, the divergence of the waterflow, and the existence of Wallace River, may therefore be regarded as possibly Post-pliocene, while the gravel beds may be regarded as the representatives in formation and time, of these formations that occur between the Triassic and Post-pliocene, as well as the Post-pliocene itself. We thus give work and attributable results to these mountain agencies which we find now in operation and which we have no right to regard as quiescent from the Triassic to the Post-pliocene period.

Proceeding from Folly Lake we cross the Wallace River. Gradually an enchanting view opens up. On the right is the deep valley of Wallace River with the mountains rising on its eastern side and the river flowing along at their foot,—as it still opens up, it reveals a lovely panorama extending far and wide, which excites the admiration of all travellers. We have reached the apparent extremity of this granitoid band. Its last outcrop is seen in a small nameless brook on the left side of the road. I have already observed that this is 12,900 feet from the county line.

Since leaving Truro we have made an enormous *descent*, geologically, while topographically we have *ascended* 600 feet above the sea level, the height of Folly Lake. Since leaving Folly Lake we have descended topographically 124-45 feet, our position being now 485-55 feet above the sea level. We are now on the northern side of the Anticlinal. As we proceed farther we *descend* topographically and *ascend* geologically.

The band succeeding has a *width* of 8,300 feet. Its first exposure is in the opening of the Tunnel of Smith's Brook. The rock is crypto-crystalline diorite. The finest exposure is in the Railway cutting to the north of the brook. This cutting exposes equal sections of rocks on either side of the line, their maximum height along the road is 83 feet; the minumum 56 feet. The variety and beauty exhibited by the walls are very striking there are magnificent slickensides, the glistening of the rocks make them brilliant in the sunshine. There are red Porphyries, crypto-crystalline diorites of various shades of green—one band of diorite shows occasionally crystals of red feldspar, it is Porphyritic. There are also banded jaspideous rocks. The rocks seem to have a dip of 48° N. 30 E. The jaspideous rocks and the absence of granitoid rocks make me separate this band from the preceding, just as I separated the one preceding it on account of its quartzites and want of granitoid rocks. The diorites of either band and the porphyries of Smith's Cutting might readily be regarded as the associates of the granitoid rocks and a part of the central band.

Proceeding still further we observe on the side of the Railway outcrops of purple coloured grits, some of these having abundance of crystals of yellow felspar were for some time mistaken for porphyries. There are also massive boulders of very hard purple conglomerate, with inclosed pebbles of scarlet jasper. There are also outcrops of purple jaspideous rocks and crystalline diorites. Besides these there are other rocks which it is difficult to characterize. At the Wentworth Station there is an obscure interval which is probably the approximate position of a conglomerate of rather peculiar character. A little below the Station on the road to Wentworth are seen large and small boulders of this conglomerate. These are composed of diorites and jasper pebbles, firmly cemented together. Some of the diorite pebbles are amygdaloidal and amygdaloid — porphyritic. The *amygdals* are calcite and the crystals red felspar. I have seen nothing like this conglomerate in any other part of Nova Scotia. The whole of this band of rocks must have been formed under strange conditions. In many respects it seems to resemble the Cambrian Formation of H. M. Geological Survey of Great Britain. *Vide Ramsay's Geology of North Wales.* At a farther distance of 100 feet north of the Wentworth Station there is a remarkable cutting of rocks. This cutting is 1100 feet in length. The walls on either side of the track are equal, their maximum height is 28 feet. I give the section with approximate measurements.

Obscure.	*Feet.*
1. Dark green Crypto-crystalline Diorite..............	30
2. Black soft Shale..............................	20
3. Diorites with shale parting....................	8

4.	Black Shale	56
5.	Diorites with Pyrites and Crystals of whitish Felspar..	16
6.	Black Slates and Shales, very pyritous, cleavage and jointed, having abundance of Fossils, dip 45° 15′ N, 5 E	40
7.	Diorite—pyritous	24
8.	Black Slates and Shales with joints—of dip 41° N. 5 W	100
9.	Diorite pyritous	14
10.	Shale	140
11.	Diorite	60
12.	Shale	6
13.	Diorite	30
14.	Shale	10
	Vertical thickness of the whole	615

It will be observed that the Lithology of this section is singular from its alternation of very hard and very soft rocks. The familiar diorite of the former sections occur no fewer than seven times, but instead of the quartzites, granitoid rocks, porphyries, jaspideous rocks and conglomerates, we have substituted very soft slates and shales. The dip in the other bands described was either obscure or uncertain. Here the dip of the slates and shales is unmistakable and the slate beds are divided into blocks by cleavage joints, occurring at right angles to the dip. The occurrence of Diorite, No. 7, between slates 6 and 8, with so little variation of the dip together with the conformability of the other diorites, the softness of the shales and other considerations to which I shall afterwards allude, induce me to believe that the beds of diorite were contemporaneous in formation with the slates and shales of the section.

I would here observe in reference to this *form* of diorite that I have not elsewhere found it in Nova Scotia associated with uncrystalline rocks. The only other instance of its occurrence is at Arisaig, in the "Lower Arisaig Series," where it is seen associated with granitoid diorites, hornblende rock, limestone, ophites and ophiocalcites. Here as in the central band of our section of the Intercolonial Railway, the crypto-crystalline passes gradually into the granitoid diorite. *Vide Transactions* 1872–73. I have not found it in connection with the "Upper Arisaig Series."

In slates and shales, No. 6, I found abundance of fossils. The prevalence of *Lingula* and *Orthis testudinaria* led me at first to think that I had found a formation corresponding in age with my lingula beds in the County of Pictou, or the B. of my Upper Arisaig Series. The farther discovery of *Graptolites*, led me to suppose that we had the equivalent of the graptolite shales of Doctor's Brook, Arisaig Township, or the lowest part of B. of Arisaig, or the base of the Lower Clinton. One difficulty in the way of this correlation, arises from the absence of A. Arisaig or the Mayhill sandstone equivalent. Wherever the lower members of the Upper Arisaig Series are found in Eastern Nova Scotia this is always present. Supposing, however, that this case may be exceptional. With a few exceptions the fauna are different from the familiar forms of the Arisaig series. The exceptions are *Calymene Blumen bachii*, *Terebratula affinis*, *Strophomena de pressa*. These are Lower, Middle and Upper Silurian forms and indicate no particular Silurian horizon. *Orthis testudinaria* is a form of very frequent occurrence occurs in the B' or Upper Clinton of Arisaig, but it is also a Lower Silurian form. Diprionidean forms of graptolites, *e. g. Climacograpsus* occur in the Doctor's Brook shales, or the base of B. of Arisaig, Lower Clinton. The existence of *Climacograpsus* at Doctor's Brook was a palæontological difficulty, in the way of correlating the containing strata. Prof. James Hall in his work, "On the Graptolites of the Quebec Group," makes the Hudson River group the Upper limit of this form, Vide Table. This led me in my paper "On the Geology of Antigonish County," to regard B of Arisaig as of Hudson River age, and A as Utica State.

Subsequently, however, I came to regard the graptolites of Doctor's Brook as a colony from the Hudson River—Lower Silurian. I was led to this conclusion when I made a systematic and

---

NOTE.—This form of diorite occurs frequently in the Huronian rocks of St. John, N. B., and also associated with the Lower Silurian slates at the end of the Meispec Road near the old Episcopal Cemetry.

thorough examination of Arisaig in the summer of 1863. I then extended the graptolite and lingula shales of Doctor's Brook to the cove south of Arisaig Pier. Here I found the shales having a rich and varied fauna. They were in close contact with the slates and shales, whose characteristic fossil is the *Graptolithus clintonensis.* I found that while the two setts of strata were lithologically distinct, the graptolithus clintonensis passed downwards into the lower shales, and consequently I distinguished the latter B as Lower Clinton, the former B' as Upper Clinton, and so regarded the graptolites of Doctor's Brook as a colony. I regard the *climacograpsus* of the slates of the Intercolonial Railway as characteristic as the associated *Lingulàe* are forms different from those of the Upper Arisaig series. They strikingly resemble Trenton Limestone and Hudson River forms. The other fauna are all different from those of Arisaig, and are new to Nova Scotian Palæontology. I therefore distinguish this as the "Wentworth Group," and regard the formation as approximately Hudson River, U. S., or Bala, England. The position that I assign the group in Nova Scotian Geology, is between the Upper and Lower Arisaig series, *i. e.* between the fossiliferous and crystalline.

The Wentworth fauna of my collection are *Orthoceras* 2 sp. *Cyclonema*, *Avicula*, *Cyrtodonta*, *Modiolopsis*, *Strophomena*, *Leptaena*, *Chonetes*, *Camerella*, *Rhynchonella*, *Atrypa*, *Lingulae Discinæ*, *Cornulites*, *Tentaculites*, *Asaphus*, *Calymene*, *Dalmanites*, *Crinoidæ*, *Graptolithus*, *Climacograpsus*.

The *Graptolites*, *Lingulæ* and *Discinae* are beautifully preserved, many of the others have been *pyritized*, and the remainder are in the form of casts.

Preceding on the line of Railway we have, after the Wentworth section an obscure interval between Little Whetstone Brook and Big Whetstone Brook, and then two sections of metamorphic rocks having a width of 2000 feet.

NOTE.—Considering that rocks of the Intercolonial Railway have a greater resemblance to those of Saint John Co., N. B. than to the eastern part of Nova Scotia, with the exception of "Lower Arisaig," I am disposed to ally this part of the Cobequids with Saint John, and to regard the Wentworth slates and their *fauna* as the successors of the Saint John slates and their *Primordial fauna*

These rocks are exposed in the upper and lower openings of the Tunnel of Big Whetstone Brook; in the upper the rocks are brownish slates, in the lower they are massive diorites, similar to these already met with. In the beginning of the next cutting are slates with a bed of diorite, associated with a brown porphyry. These slates produced a large *lingula* of the *Middle Silurian* type,—the strata have a high southerly dip, being apparently synclinal to the "Wentworth" group. The stratification is obscure. The bed of diorite and porphyry is assumed as conforming with the possible dip of strata. There is an apparent physical division between the two, or a depression which extends into the mountains. Big Whetstone Brook flows through it. At the end of the cutting is another dark brown *porhpyritic rock.* After an obscure interval there is another cutting, having at its commencement a thick bed of green diorite and then slates, without any farther occurrence of crystalline rocks.

After another obscure interval we come to a cutting having on either side sections of lower carboniferous conglomerate with overlying sandstones. The conglomerate is largely composed of boulders of the preceeding crystalline rocks. One boulder of porphyry embedded, was remarkable on account of its size—its weight was estimated at two or three hundred pounds. In the overlying sandstones were found embedded several masses of red syenite. One of these which we detached was very large—at least two hundred pounds weight. It was surrounded by carboniferous *flora*, compressed *calamites* and *cordaites*, some of these remained adhering to the syenite (vide specimens in the Provincial Museum.) These syenites must have lain on sandy flats surrounded with vegetation, both having become simultaneously embedded in the sand, and intimately associated. These are the earliest *flora* of the Cumberland Coal Field. The nearest red syenite rocks are two miles distant. These *facts* were noted as remarkable.

Descending Big Whetstone Brook at the junction of the Lower and Middle Silurian, we pass from the massive diorites in the lower opening of the tunnel, and then through slates, and then we come to *grits* of Lower Carboniferous age—succeeding these are sandstones. In these sandstones I found abundance of *rain prints*, *rill marks*, *casts of ferns* and *reptilian foot prints* in abundance. These foot prints are of varying shapes and sizes, some of them are truly formidable. Some of the reptiles had walked over the rain-pitted mud in a soft state and left deep impressions: others had walked over it when less soft and left impressions less deep; others had traversed the mud when it was netted with shrinkage cracks and left faint impressions. One had set his foot on a fern leaf which lay in his path, another between two long series of right and left steps has left a continuous tail-trail. These are to be found in the Museum.

It was fortunate that the Intercolonial Railway took its present course after passing Smith's Brook. To the right, at the distance of half a mile, we find at a bridge of Wallace River, that the lower carboniferous conglomerate lies directly on the continuation of the rocks of Smith's Cutting, so that in this direction the conglomerate, diorites, fossiliferous shales, &c. have all been denuded by the lower carboniferous seas, and covered by their shingle (conglomerates.)

To the (left) west, at a distance of three miles, we find that the work of destruction has been more complete, as the lower carboniferous conglomerate lies directly on the syenite. The interesting pre-carboniferous rocks of the northern part of the Intercolonial Railway in the Cobequids, is only a remnant left to show what once existed, and to reveal facts in geological history altogether at variance with our hitherto received opinions of the geological structure of the Cobequid Mountains.

In my examination of this and other sections of the Cobequid Mountains, I was accompanied by Mr. Andrew Jack, and occasionally by Mr. Frank West and Mr. Robie Cogswell. These gentlemen added many interesting fossils to our Wentworth collection.

I am very much indebted to A. C. Archibald, Esq., C. E., for the use of the Intercolonial Railway working planes and sections, by which I am enabled to give accurate measurements of the various groups of rocks and sections.