

and again without the plates, each measurement being preceded and succeeded by tests of the electrical similarity of electrodes and plates. Without the plates the current had to pass across two surfaces of contact between amalgamated zinc and electrolyte. With the plates it had to cross ten such surfaces. If there had been any transition resistance, therefore, the measured resistances in these two cases should have been different. In no case, however, was I able to detect any difference greater than could be accounted for by the mere insertion of the plates. In some experiments in which I used a connecting tube so small that the resistance of the cell was about 4,000 ohms, I could detect no difference at all. In others in which I used a tube of larger bore, so that the resistance was about 1700 ohms, differences were noticeable, but they were not such as to necessitate the assumption of a transition resistance to account for them.

The apparatus which I used enabled me to measure resistances accurately to .1 ohm. It is therefore clear that the transition resistance which the current meets in passing eight times across the bounding surface between amalgamated zinc electrodes, of the area mentioned above, and solution of zinc sulphate, does not amount to one-tenth of an ohm, and that therefore the transition resistance at one such surface is not so much as .0125 ohm.

This result was sufficient for the purpose for which I made the experiments.

The above experiments were made in the Physical Laboratory of the University of Edinburgh. I am indebted to Prof. TAIT for his kindness in furnishing me with the necessary apparatus.

ART. VII. NOVA SCOTIAN GEOLOGY—HALIFAX AND COLCHESTER COUNTIES. BY Prof. D. HONEYMAN, D.C.L., &c.

(Read 14th May, 1883.)

By looking at the Map of Nova Scotia it will be observed that the Counties of Halifax and Colchester are large. Halifax County extends from Lat. 62 deg. 13 min. to 64 deg. 5 min. The

eastern side of Colchester is in 62 deg. 47 min. The southern line of Halifax County is the Atlantic Coast. It is bounded on the north by the counties of Hants, Colchester and Guysboro'. A large part of the County of Colchester, which includes part of the Cobequid Mountains, is separated from the County of Halifax by the County of Hants. In this Paper, Parts I., II. and III., I intend to confine attention chiefly to the parts of Halifax and Colchester included between the meridians 62 deg. 55 min. and 63 deg. 41 min.

To the Geology of this region I have devoted considerable attention during the past 20 years. The results of my first work were communicated to the Geological Society of London during the time of the London Exhibition of 1862, by request of the Nova Scotia Commission. Quarterly Journal of G. S., 1862. Paper "On the Nova Scotia Gold Fields." The results of an examination of the Gays River Gold Field, were communicated to the Institute in 1866, *Transactions*. When I read my Paper "On the Geology of Nictaux, Annapolis Co.," to the Institute on Nov. 12, 1877, my new views on the Geology of Nictaux suggested and was followed by the reading of a paper "On the Geology of Halifax County." The latter Paper was not printed, as I considered it proper to defer the publication of views advanced on the age and foreign relations of certain formations, until I had further investigated the character and relations of the Nictaux formations. Since then I have investigated these formations thoroughly and communicated the results to the Institute in a series of Papers. I have also investigated thoroughly the Geology of the region now about to be examined. I have already, in three Papers, traversed the same field, *vide* Papers on the "Superficial Geology of Halifax and Colchester Counties." Localities and names to which I may now refer may be presumed to be familiar.

SECTIONS.

I would define the general geology in three transverse sections following certain meridians of longitude, so that each can easily be located on any map of Nova Scotia. The map on which I have already defined my work is Mackinlay's Map, Geologically coloured, which I exhibited at the Centennial Exhibition, Phila., 1876, and the Nova Scotia Government departments of the Dominion Exhibitions, in Halifax 1881, and Kingston 1882.

SECTION A, LONG. 63 deg. 35 min.

From Cape Sambro the Archæo-Cambro Silurian (lower) extends 34 miles, 1½ miles of Lower Carboniferous succeeds when we reach the Schubencadie River. North of this is Hants County.

SECTION B, LONG. 63 deg. 20 min.

From Three Fathom Harbour the Archæo-Cambro Silurian (lower) extends to Gay's River Road, a distance of 28 miles, the Lower Carboniferous succeeds and extends a distance of 20 miles to the vicinity of Truro, then comes the Triassic. Beyond are the Carboniferous, Silurian and Archæan of the Cobequid Mountains which do not come within the scope of our Paper, as the Pictou Railway line is our boundary in this direction.

SECTION C, LONG. 62 deg. 55 min.

From Clam Bay the Archæo-Cambro-Silurian (lower) extends 47 miles to Cox's Brook, a tributary of the Stewiacke River. Succeeding this are 12 miles of the Lower Carboniferous, before we reach the Pictou Railway.

The composite term Archæo-Cambro-Silurian (lower) of the above sections, was first used in my paper "On the Geology of Digby and Yarmouth Counties." *Trans.* It was there explained that *Archæo-Cambro* refers to *Formation*, and Silurian-lower to *subsequent metamorphism* with the introduction of gold and associate accidental minerals. The term "grossly cotemporaneous" has been used to characterize this. It seems to me that this is too indefinite and unscientific. My use of the term "Archæan" is that of DANA in his Text Book of Geology, where it is equivalent to the old term Azoic, and includes the Laurentian and Huronian formations. The Huronian seems to include the Lower Cambrian of certain English Geologists, SALTER and others. H. M. Geologocial Society does not recognize this sub-division of the Cambrian. I explained, *Loc. cit.*, that I used the term Cambrian as it is used by H. M. Survey. In my Paper I was led by *fossiliferous* evidence and sequence to regard the auriferous rocks of Yarmouth as of Pre-Silurian age, Cambrian in Formation, and to give them a lease of a portion of subsequent time for alteration, metamorphism and the acquisition of Gold and Gems, &c. The associated granites were prefixed to these and made participants

of the same metamorphosing influence, hence the whole complex system was named Archæo-Cambro-Silurian (lower). In my paper, on the Geology of Nictaux, I showed that Geologists had heretofore been mistaken in regarding certain strata as of Devonian age on supposed palæontological evidence. Those views as I have subsequently shown, were confirmed by the palæontological evidence of the Digby cognate formation, which had rightly been regarded as equivalent to that of Nictaux. I also showed that the Middle and Lower Silurian, fossiliferous-strata of Nictaux had not been affected by the *underlying* granite. I showed that the gneisses, which *seemed* to have been affected by the granite, belonged to an entirely different series of rocks, in short, that the granite and associated metamorphic gneissoid rocks were Archæo-Cambro-Silurian (lower) and a continuation of the Yarmouth Series.

In my paper "On Metalliferous Sands," read last session, I showed the correspondence of auriferous rocks in Wyoming, in lithology and minerals, with our own auriferous and the virtual coincidence of age. The only difference is that the Wyoming rocks are regarded as *Huronian*, and therefore Archæan. As our Cambrian is on the border of Azoic, with only doubtful life, there seems to be no formidable obstacle in the way of regarding our gold fields as closely Archæan. However, in the meantime we may characterize our gold fields as Archæo-Cambro-Silurian (lower.)

While I consider that we have little (if any) interval or break between the auriferous and succeeding formations, in Annapolis, Digby and Kings Counties, the case is much different in Halifax and Colchester. This will be seen by referring to sections "A," "B" and "C." It will be there observed that the Archæo-Cambro-Silurian (lower) is succeeded by the Lower Carboniferous. If one were thus to infer the age of the former from that of the latter, it would be concluded to be of Devonian age. This irregular sequence, and the want of distinct fossiliferous evidence, has always been a difficulty in the way of the satisfactory correlation of the formation of our gold fields. In my paper read before the Geological Society of 1862, I illustrated the geology of the gold fields by an examination of the railway

sections, especially from the Windsor Junction to Windsor, in connection with the Waverley gold fields and its barrel quartz. (*Vide* paper [with illustration] in "Quarterly Journal," 1862.) I reasoned thus: The rocks are widely different from any member of the Arisaig series, at Arisaig, or elsewhere, in the eastern part of the Province, which ranges from the Devonian to the Middle Silurian. They are extremely metamorphic, more so than any of the preceding. Gold has now been found in them in sufficient quantities to be of economic importance. These considerations seem to warrant the conclusion that the formation in question is Lower Silurian. The author of "Acadian Geology" had, on other considerations, come to the same conclusions. In the discussion that followed the reading of my paper, two eminent geologists, only, took a part. The one considered the rocks of our gold fields to be of Devonian age, the other agreed with me in the views that I had taken. In a subsequent conversation which I had with the former, the granites were referred to, which had been noticed as occurring at Mount Uniacke, but had not been taken into account in the discussion. It was *then* agreed that they were of igneous origin, and might be of Devonian or any age.

Among all the interesting exhibits of gold at the London Exhibition of 1862, there was one which was to me peculiarly interesting. This collection stood at the entrance to the Eastern Annex, in which was the wondrous economic mineral display of Great Britain. The exhibit was from the Dolgelly gold field in North Wales. Here were a magnificent bar of gold, rock specimens and gold in its matrix. Accompanying this was a map by Mr. T. A. READWIN. A pamphlet was distributed, entitled, "Notes explanatory of a map of the faults of the Dolgelly Gold District, undertaken for Mr. T. A. READWIN, by J. W. SALTER, F. G. S., &c." I was fortunate to secure a copy of this pamphlet, which I have carefully preserved as a memento of pleasant intercourse had with its illustrious author, and pleasant walks among the various departments of the exhibition, where any thing relating to "Silurian" was to be found. I looked upon this gold collection as intimately related to that of the gold fields from Nova Scotia, although there seemed to be a difference

in age,—the Dolgelly gold being of Cambrian age, while the other was considered to be of Lower Silurian age. The researches and discoveries in the palæozoic geology of old Acadia—New Brunswick, Nova Scotia and Cape Breton—during the past 20 years, have added Primordial or Upper Cambrian, Upper Lingula, Flags, Hudson and Trenton, with their characteristic forms of life. Every effort has been made, especially by diligent study, of the rocks Saint John and Halifax, to correlate our gold fields with the most ancient of the Palæozoic series. The old Igneous rocks have, to a great extent, been resolved into Archæan Metamorphic rocks—Laurentian and Huronian—so that the Lower Cambrian, or Dolgelly, auriferous period seems now to be the only resting place for our own auriferous series of rocks. The want of life, or its existence in low and doubtful forms, seems to indicate this. This view accords with the conclusion at which I had arrived by the lithology, sequence and palæontology observed in the Western Counties, especially of Digby and Yarmouth.

CORRELATION.

Previous investigations in Kings and Annapolis Counties, and especially at Nictaux in the latter, had *re-conducted* to Dolgelly and led to a correlation with the *auriferous* formation of Halifax County. In my unpublished paper, read at the same meeting, on the 12th of November 1877, that I read my published paper, “On the Geology of Nictaux,” I made use of SALTER’S notes on READWIN’S Map and compared the Halifax Quartzites and Argillites with the “Lower Cambrian,” “Barmouth and Harlech Rocks of Prof. SEDGWICK.” “The Dolgelly Gold district comprehends the upper part of the Lower Cambrian or Barmouth Rocks, and the lower part of the Upper Cambrian or Lingula Flags (Primordial), which range all along the Barmouth estuary and thence northwards to Festiniog.” The whole series of these rocks (Barmouth) consists of a very hard sandstone with beds of purple slate, which occur chiefly in the middle and lower portions of the series, but the upper sandstone beds are frequently interstratified with bands of green slate which distinguish it readily from the overlying formation, viz:—The Lingula Flags or Upper Cambrian. This is a triple formation measuring about 6000 or 7000 feet in thickness, according to Professor RAMSAY. It has been divided

by my own research, into a *lower* group of black slate and trap-pean shale, a *middle* group of sandstone, and a thin upper group of very black shale, which in North Wales is rich in fossils."

"Of these formations we have only to deal with the lower, for in that only, at present, are the gold veins worked in the district, but the gold is not confined to these lower members, for the productive mine at Castell Carn Dochan is in much higher rocks. Indeed it is at the junction of this formation with the underlying Cambrian grits (quartzites) that the principal bearing lodes are found." Pp. 1, 2.

SALTER'S description of the Barmouth rocks might with very little change be employed in describing our quartzites (grits) and argillites the only difference existing between the English series and our own seems to be accidental. *Their* metamorphism may have taken place in Upper Cambrian time, which seems to correspond with our Lower Silurian which is meant to include the Primordial of Saint John, N. B., the Lower Lingula Flags and the Mira ridge, C. B., *Olenus* and *Agnostus*, Upper Lingula Flags of SALTER'S Appendix to RAMSAY'S Geology formation of North Wales.

ARCHÆO-SILURIAN (LOWER).

This is a term which I use to denote the granites of the series. At Nictaux these were considered to be igneous rocks of Devonian age and were considered as having so metamorphosed the supposed Devonian fossiliferous rocks, as to have converted them into gneissoid rocks. The inclusion of portions of these gneissoid rocks was also regarded as conclusive evidence of the igneous origin of the granite. The old view is that the granite is of igneous origin and that it is an intrusive rock, the new and orthodox view is that granites are generally metamorphic rocks, and not necessarily intrusive rocks, and that remetamorphism may account for the apparent fusion and intrusion. At Nictaux I found, *first* that the supposed Devonian rocks having fossils are of Middle Silurian age, *second* that the rocks by which they are intruded and metamorphosed are igneous diorites; *third* that in positions where granite and the fossiliferous rocks were in actual contact, the latter were very little metamorphosed and certainly not converted into gneissoid rocks. The granite

appeared to be an underlying rock. It had evidently been granite when the other rock was formed upon it. It is therefore at least of pre-Middle or Lower Silurian age.

The gneissoid rocks are identical with those on the west side of the N. W. Arm, Halifax, the granites are identical, except that the variety is greater at Nictaux, the inclusions are similar to those which are of frequent enough occurrence in the vicinity of the line of junction of the granites and gneissoid rocks. There is, therefore, no reason why we should regard the granites of Halifax and county as of different origin and age from those of Nictaux.

ARCHÆAN.

In our field there are three granitic areas corresponding with the three sections. The area of section 1 extends from Halifax Harbour, westwards to St. Margaret's Bay, a distance of 20 miles, and from the Atlantic coast northward to Hammond's Plains, a distance of 18 miles.

The area of section 2 on the E. side of Fletcher's Lake beyond the Windsor Junction, I. C. R., its extent has not yet been ascertained.

The area of section 3 extends from Lake Major to Ship Harbour, and beyond, a distance of 27 miles. Where I have examined it between Meagher's Grant and Musquodoboit Harbour it commences about one mile north of the main road, Musquodoboit Harbour, and extends 6 miles.

It is thus evident that this formation occupies a very large portion of our field and is entitled to greater consideration than is generally conceded to it.

The part of this formation that is most accessible is the area of 1st section, this is admirably exposed on the west side of Halifax Harbour, the N. W. Arm, and the road at water works and there is little difficulty in traversing it in any direction. I have conducted the Institute over the most exposed portion from Purcell's Cove to York Redoubt Point. This has also been an interesting field study to my students in geology during the past 10 years, so that by this time I am pretty familiar with its details and can dispense with my field-book generally in giving an account of it.

The granites of the region are generally coarse in structure. It is only on the ground of use and wont that they are entitled to the name. Their constituent minerals are, as usual, Orthoclase, Muscovite and Quartz, the two first minerals generally prevail. They are not quartzose and consequently are not first-class building stones. They polish well however and *easily*, and are favorites with workers, (more so than the granites of Shelburne, which are truly granites—quartzose granites). The orthoclase is white, often very white, the mica is black and grey, the quartz is often hyaline and often smoky. In some places the mica of the granite is black, in others it is grey, sometimes both occur. The rocks are largely porphyritic with large crystals of orthoclase, especially the very white variety. Some years ago I found in one of the cuttings of the water works, granite with deep red orthoclase, this has a green foliated mineral in place of the mica. A Museum polished specimen of this rock is very beautiful. The polishing has removed the green mineral, so that the surface is singularly marked. It was thought that the stone would be adapted for ornamental purposes, its extent was found to be small.

MINERALS.

In some places the minerals of the granite are segregated, one of the constituents being found without the other, mica is thus found and also feldspar. Here the mica may be said to constitute the rock, and there is no difficulty in securing specimens of any size. Around these the mixed rock is so coarsely constituted that it would pass for a gneiss in acknowledged Archæan regions. In one place, under a bridge at Long Lake embankment, nothing but feldspar is seen of clayey colour. In this black tourmaline abounds in large crystals. A specimen which was brought to the Museum is very singular, it is composed of feldspar and quartz and mica, the feldspar and quartz are very marked, long and large tourmaline crystals pervade, passing indiscriminately through the quartz and feldspar indicating simultaneous crystallization of the three. Another large specimen from the same quarter is sub-conical in form, it is composed of feldspar and mica plates, the latter are arranged so as to give shape to the whole. In some places the quartz is snow-white, in this crystals

of jet black tourmaline are often found prevailing in clusters. Specimens of those in the museum collection are very striking. There is a specimen in our Webster Collection, it is probable that it has come from the granite region of Paradise, Annapolis County, where white quartz with groups of black tourmaline is of frequent occurrence. The specimen is a crystal of beautiful smoky quartz (cairngorm) with long crystals of black tourmaline permeating the interior. Crystals of tourmaline are of frequent occurrence in our granite area. Groups are sometimes arranged in stellar forms. Small crystals of colourless quartz are often found in the granite under examination. I have a large crystal of opaque smoky quartz which is said to have come from the Queen's granite quarry, where black tourmaline is also found.

CAMBRO (SILURIAN).

The rocks of this series are, 1, gneissoid (ironstone).

2, micaceous.

3, Argillites, slates.

4, " shales.

5, Quartzites (grits).

6, " banded.

7, " calcareo-

(The line of the granite is generally N. E. and S. W. while the line of strike of the formation that succeeds or *abuts* is generally E. and W.)

While all the members of this series are readily recognisable no line can be drawn as a separating line, they all pass into each other insensibly, gneissoid into micaceous and argillites, argillites into quartzites and quartzites into calcareo-quartzites, e. g., Examining the Queen's quarries on the W. Side of the N. W. Arm, we first find the two formations in contact. Abutting against the granite we have a micaceous-schistose rock with distinct bedding, E. and W. strike and North dip, I generally try to secure a specimen at a junction of this kind so as to illustrate it, I did not succeed here, the granite and the schist always separated. This rock passes into the hard gneissoid (ironstone) of the quarry. On the East side of the Arm, at Point Pleasant, we have the same becoming a coarse ferruginous and argillaceous

rock with the same strike and dip. The ledges on the east side of Point Pleasant are a continuation, these are generally argillites.

2. At Pleasant street, not far from the Park, there are beautiful exposures of argillite strata. Coming to the shore on the opposite side we find a great ledge of similar strata. At the side and back of these are argillite shales and massive quartzites with veins of quartz, all the three pass into each other insensibly. In the gold fields argillites are seen when mining where the surface would lead to the expectation of only quartzites.

3. The Calcareo-quartzites are a striking illustration. I first observed these on the shore between Cow Bay and Cole Harbour. When walking along the shore, I was surprised to find certain rocks singularly worn, as I have seen Lower Carboniferous Limestone worn on the sea shore, by the action of the waves, while other parts of the same rock had the usual appearance of the hard quartzites exposed to similar action. I found in subsequent chemical examinations that 18 per cent of the highly worn parts of the rock was calcareous, while the other parts were quartzite. The acid only can indicate the passage with precision, which is gradual, the sea indicates it approximately. Similar rock and indications are observed on the Eastern Passage, opposite Lawlor's Island. The constitution of the original sediment and accident are doubtless the causes of the variation. The series, therefore, is not divisible into subordinate members or groups.

SYNCLINAL.

On the East side of Pleasant Park, at Steele's Pond is a point where there was in olden times a Three Gun Battery. The rocks of this are exposed on the shore, and exhibit interesting structure. They are seen to dip on the right to the South and on the left to the North. In the centre the strata are bent so as to display a series of parabolic curves. A photograph of this taken by the photographer of H.M.S. Challenger for Sir C. WYVILLE THOMSON, is a very striking picture.

SECTION.

On the right or north of the Syncline the argillite strata become confused, they then become shaly. In the shales I found forms which at first sight seemed to be graptolite stipes but

turned out to be chistolites. In this band all is confusion, dip being at different angles and strike in all directions. At length the strata become slaty having a distinct southerly dip and cleavage at right angles to the dip. The extension of these westerly outcropping in a field has similar structure. Proceeding in the same direction along Pleasant street, splendid outcrops are seen dipping in the same direction, opposite the last of these we have again a fine outcrop on the shore; here the dip is also southerly and the strike nearly East and West. This outcrop was referred to above, as exhibiting slates and shales, passing into quartzites with veins of quartz. These outcrops are an interesting study, not merely on account of the transition just referred to, but also on account of the metamorphic phenomena which are beautifully striking and instructive. The last, street section, shows beautiful wavy lines of bedding with a southerly dip, slaty cleavage at right angles, joints and other striking features, e. g., concretions? around which the wavy lines are seen to curve and then return to their original course. Some years ago I examined similar argillites exposed in blasting the foundation of the Young Men's Christian Association Building in the City, these were seen dipping in the same direction with similar cleavage. A specimen in my rock collection in the museum, shows pyrite in flat rhomboid crystals which might be mistaken for ganoid scales. If the arrangement from this to the syncline were to be regarded generally regular, it would indicate a great thickness of argillite strata. There may be doubt, however, on account of obscuration of the intermediate strata, as well as the probable causes of the existing arrangement of strata, lateral pressure, non-intrusion. Returning to the syncline and proceeding to the left, south, we have first an obscuration of strata, then a point with confusion of strata, again, obscuration and then a ledge with crumpled bedding of argillites and a northerly dip. Here too there is cleavage and joints with glaciation and scooping in the line of joint, showing beautiful lines. The glaciation is S. 38° E. A ledge to the south of this and next to the fort at the *Point*, is composed of quartzite strata with overlying slaty strata, an arrangement similar to that observed at Cranberry Head, Yarmouth. (*Vide* Paper on the "Geology of Digby and Yarmouth Counties." *Trans.* 1881-2).

On the quartzite *stratum* are seen *markings* when the shaly strata are removed, these are considered to be *Helminthites* (worm tracks). I have pointed out these again and again to members of Institute, to students and others for several years. Every season there are new exposures. I have tried to secure specimens for the museum but without success, on account of the great hardness of the *stratum*.

On the west of the syncline, the confused strata on the right, the obscuration and confused strata on the left, is the road succeeded by confusion. Steel's Pond and Miller's Field, with wonderfully crumpled strata on either side; Pine Hill, the seat of the Presbyterian College, beautiful country residences and the Penitentiary. We have now reached the North West Arm. Crossing to the opposite side we come to the Sugar Refinery. Here we find the argillites of the syncline continued. The rocks of which these are a part, are exposed in a beautiful and instructive section which I would now describe. The stratified rocks—argillite and gneissoid—extend a considerable distance to the right, N. W. and left. In the latter direction they extend to the Point, at the entrance to the Arm where we have the Ironstone (gneissoid) Quarries. In the section succeed the granite of the Queen's quarries. The gneissoid rocks have the northerly dip of the Point Pleasant extension and of the previous section. On the road to the Queen's Quarries they are seen butting against the granite as a distinct micaceous schist. At the Junction the two are so loosely coherent that I found it impossible to secure a *specimen* which would indicate the Junction. We now come to Purcell's Cove, where the gneissoid rocks succeed the granite in section and butt against the granite and maintain a northerly dip. The granites again come forward to the section and continue as far as Falkland Village, where they are again succeeded by gneissoid rocks. On the shore the first of the latter is seen to *overlie* the granite. At the Junction they are so firmly coherent that there is no difficulty in securing a Junction specimen. From this point to York Redoubt point, the stratified rocks are seen in the section., while the granite retreats, forming a bay which is occupied by the gneissoid rocks. These have an east and west strike and a northerly dip,

up to York Redoubt Point. As the granite retreats on the north side of Falkland Village, the gneissoid rocks dip toward it, *seemingly* into it, not away from it. There is no anticline. On the shore the rocks are very ferruginous. Pyrite is found in them in large crystals. Some of the strata are very andalusitic. The mineral is in slender, pearly prisms. These are often arranged in stellar forms. One stratum is covered with these. In York Redoubt, the strata which is seen to overly the granite which rises on the south side of the fort, have a northerly dip and are very andalusitic. The extension of the shore andalusitic strata in the granite bay, are schists without andalusite. This is their character near the Junction with the granite. In the section south of the Redoubt pier, is another kind of rocks which are hard to characterize; they might be called a quartzite. In these are abundance of *discinoid* forms. I am very doubtful regarding their character. I find them in three other localities to which I will yet refer. The inclination of strata is low and its direction doubtful until it is decidedly westerly, and towards the associate granite. The granite then comes into the section and alternates with the stratified rocks. At the Point the latter make their exit, and then the granites are the only shore rocks. I have reason to suppose that the stratified rocks appear again at Portuguese Cove. At the Point the stratified rocks have a slight easterly inclination. The junction of these with the granite is very interesting. The two are seen dove-tailing, but not blending. A museum specimen shows this in a striking manner. The stratified part is banded with a right angled termination; another piece is pointed. The granite seems to have been inserted by fusion. In the *discinoid* part there are long veins of quartz with mica. I regard these phenomena as having been induced by *re-metamorphism*.

I am here reminded of an observation which I made on the Nepisigit river, on the Bay des Chaleurs, New Brunswick. *Vide* Paper *Trans.*, 1875-6: "A month among the Geological Formations of New Brunswick."

At the "Rough Waters" we have the junction of the granite and the Bonaventure formation (Lower Carboniferous), granite,

granite *debris*, and sandstone or grit. I became aware of the existence of a distinct stratum of debris when I was trying to find the junction of the solid granite with the sandstones, in order to secure a representative specimen. The debris had been previously observed by Sir W. E. LOGAN'S Geology of Canada. It has also been noticed by Mr. ELLS, in his recent report, and by him *united* with the Lower Carboniferous, as the lowest bed of the series. I cannot help believing that if metamorphism were induced in this region, of the intensity to which the Halifax rocks have evidently been subjected, phenomena similar to those under examination would be the result.

Returning to the N. W. Arm part of the section, I would again notice the junction of the Queen's Quarry granite and the gneissoid and schist strata. Dr. WARREN and I investigated thoroughly the extension of this line of junction, and defined it as exactly as possible on the Admiralty map of the harbour as we proceeded. We were able to do this on account of the scantiness of the vegetation, the contrast between the white granite and the black stratified rocks, and the minute exactness of the contour lines of the map. The east and west penetrations of the strata into the granite were numerous, some of these were too small for indication on the map, but the larger ones were defined, until we reached the vicinity of the Coal-pit lakes, where the rankness of the vegetation obscured the lines of junction. Afterwards I resumed the investigation, when I examined and observed the strata of the syncline in and around Williams' lake. On the road at the top (west) end of this large lake, the stratified rocks and the granites were again observed in junction. The two were very intimately connected, so as to be inseparable, yet there was no blending. The stratified rocks, in considerable width, proceeded onward, crossed the York Redoubt ^{point}, and seemed to terminate abruptly in the bushes on the west side, —low, swampy ground, extending beyond, to Long Lake. I referred to this extension in my paper of last session, when describing the rocks on our way to the Rocking Stone. We encountered it after a tramp over granites, extending from the vicinity of Melville Island. I therefore recognized it as an old

acquaintance. Their occurrence between two sets of granites would doubtless be perplexing to any one but myself, who am the only one that has investigated its true relation to the associate granites. These are thus divided into two by their intervention. The second granites in great force cross easterly, and are beautifully exposed on the SANDFORD FLEMING road and property, and also in the N. W. Arm section. In the latter they are seen in junction with the gneissoid (ferruginous) rocks, as well as in the heights which intervene between the road and section. In this locality pieces of gneissoid rocks are also seen imbedded in the granite in like manner as at Nictaux. From this one might be led to infer the existence of the gneissoid rocks prior to that of the granites, as has been done in the case of the Nictaux gneissoids. Here, as at Nictaux, we attribute the phenomena to re-metamorphism of the granite during the metamorphism of the stratified rocks. In the section on the arm we find argillites succeeding the granites and gneissoids. In these I found numerous crystals of chiastolite. These are prismatic, and of considerable size, larger than the Falkland and York Redoubt andalusite crystals. The granites appear on the side of the road, opposite Melville Island, and then retreat into the elevated and woody region to re-appear on the St. Margaret's Bay road, at the Water works. Here, again, they are seen in junction with the gneissoid. They again retreat, and after proceeding onward, advance to Birch Cove, on Bedford Basin, where they are quarried for ornamental purposes. Their mode of occurrence in Hammond's Plains is well described by Mr. HARE. For information regarding their junction with the stratified Cambrian rocks, I would refer to his paper. *Transactions* 1880-1.

END OF PART I.