

ART. VII.—GEOLOGY OF HALIFAX AND COLCHESTER COUNTIES
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PART II.

IN this and next paper I intend to adopt the plan of procedure which I proposed in my last paper on this subject—*Trans.* 1884. As I have already traversed with you the same region in my papers “On Superficial Geology”—*Trans.* 1881. I shall follow the same routes as formerly and with the same associates (the late) W. Sawers Stirling and Joseph Bell, and the Hon. Samuel Creelman.

HALIFAX CITY AND HARBOUR.

In the harbour to the east of Point Pleasant the only outcrop of rocks that appears is a small irregular patch of argillites, on the north end of McNab's Island. This and the other island—St. George's—show only drift accumulations. The argillites of the city cross over to the Dartmouth side, re-appearing below the ferry, and showing themselves on this side as far as the Narrows. Here they pass over from Richmond, I. C. R. Depot, associated with the succeeding quartzites. In Dartmouth the argillites are seen in fine sections at Black Rock, on the harbour, and in the Canal, and in frequent outcrops in the Town and on the Common. They appear on both sides of the First Lake; on the road, at the left side. At the Colored Settlement the argillites are associated with the quartzites and together cross at the top of the lake. The argillites then disappear, the quartzites only appearing as we proceed northward, as on either side of Bedford Basin to the north of Halifax.

ROUTE TO EASTERN PASSAGE.

From Dartmouth to Fort Clarence the only outcrop of rocks apparent is a patch of argillites. These are on the side of the

road and on the shore not far from the fort. Not far from the Cross Roads—Cow Bay and Eastern Passage Roads—there are fine exposures of strata from this onward, the last of them extending seaward and forming Devil Island. While the mass of these rocks are argillites I noticed among the first of the ledges a rock of a different character. It seemed to be a quartzite of appearance different from any that I had observed elsewhere in this formation. On applying an acid there was a brisk effervescence. There is about 18 per cent. of calcareous matter in the rock. I have called it a "Calcareo-quartzite," *vide* list in previous paper. The next noteworthy feature in some of the strata is the occurrence of the singular forms that I have noticed as occurring in the rocks below York Redoubt and called "Discinoid" forms. Returning to the Cross Roads, and taking the road to Cow Bay, a glaciated outcrop of argillites was noticed at the Episcopal Church, and a fine exposure in a brook crossed between the church and Cow Bay.

OW BAY.

There was only drift observed at the Bay. To this attention has already been fully given. Crossing over to the east of the bay, outcrops of rocks were seen. On the shore are interesting ledges. The rocks are generally argillites. Grey ones were observed, singularly hollowed by the action of the waves. These were found to be largely *calcareous*—"Calcareo-quartzite." The existence of these led me to expect fossils. I thought I had succeeded in finding them in a fine exposure of argillites. They were full of "discinoid" cavities, in layer upon layer, lying at right angles to the slaty cleavage. My associate, the late W. Sawers Stirling, and I collected specimens. In his collection were afterward found two specimens which were peculiar. One of these has concentric rings such as I have seen in *Discina*; the other is perfectly round and has an eccentric prominence, which I supposed to be the cast of the *foramen*. The finding of these led me to re-examine the rocks with the forms. I did not succeed in finding any resembling the two in question. I have still doubts of their organic origin.

COLE HARBOUR.

Then I traversed the region N. W. by Cole Harbour, the Lawrencetown and Dartmouth Road, and crossed over to entrance to the Preston Road, to the north of Dartmouth. All was rough and rocky. Quartzites only were observed until we reached the Dartmouth argillites. Quartzites solid. Stratified often in bold sections; are broken up in wildest confusion.

LAWRENCETOWN GOLD MINE.

Again and again the same rough region was traversed by the road from Dartmouth to Lawrencetown. (The "Lawrencetown" Gold Field occurs in this formation in the locality so named. This is one of the oldest of our gold fields and the least productive. A very fine specimen from it was a prominent object in the Government Collection at the Exposition de Paris, 1867.)

MONTAGUE GOLD MINES.

Proceeding to the north of Dartmouth along the lakes we cross the argillites already mentioned and enter upon the quartzites. At a distance of about 6 miles we come to the road that leads to the Montague Gold Mines. On one occasion we examined these with the Institute, when Mr. Lawson was working there successfully. Vide Appendix to Trans. 1870.

Still later I made a more particular examination with "Wong Kien Shoo." After examining excavations by prospecting, where much quartz had been broken up in search for gold, with apparently unsuccessful results, we came into the line of the old "Lawson Mines." Here we found a number of parallel quartz veins little disturbed. These had been evidently examined without success. The course of these was nearly E. and W. We found considerable excitement by a recent successful search for gold. A fine collection of rich quartz specimens were on exhibition in a miner's house and rich quartz at the Crushing Mill, erected on the old Mines. The vein from which these were extracted was examined and seen to advantage, as the excavation was only to a depth of 9 or 10 feet below the surface. A fine

collection from this mine was exhibited at a Halifax Exhibition and elsewhere. The proprietors of this mine sold it for a handsome sum. It was worked for some considerable time afterward with success. I understand that mines are still in operation in this gold field. [Still later there were other remarkable discoveries such as that of the Blue-nose Mine, afterwards called the Albion Mine. Vide Paper Trans. Feb. 1, 1856.]

WAVERLEY GOLD MINES (A.)

Proceeding northward we come to the Waverley Gold Mines. I directed attention to these in the paper which I read to the Geological Society of London in 1862—*Vide Quarterly Journal*. This was selected as the subject of my paper, on account of the peculiar character of the quartz veins—so-called Barrel quartz—and its proximity to the fine sections of the auriferous formation on the Intercolonial and Windsor Railroads. Operations in this field were afterwards extended as far as the junction of these roads. Here were situate the German Mines. We leave these mines at present, to return when we shall have noticed the remaining gold mines contained within the bounds of our area of observation.

OLD GUYSBORO' ROAD.

As formerly when we examined the "Superficial Geology"—Paper Trans. 1881-2—we traverse the Old Guysboro' Road as far as Meagher's Grant. On our way we noticed several outcrops of argillites. One of these is very ferruginous. It is near "Goff's Hotel." *Vide* "Walling's Map of Halifax County."

MEAGHER'S GRANT (A.)

Turning toward Musquodoboit Harbour we observed outcrops of argillites and then came to strata of Lower Carboniferous Limestones at "Seaton's Farm." These extend about a mile and are succeeded (geologically preceded) by Lower Cambrian quartzites without any intermediate formations. These quartzites extend to "Gibraltar," about a mile. Altogether unexpectedly we came to and traversed a great band of *granite*. This

was unexpected, as it was not indicated upon any geological map, or referred to in any geological work. Surveyors had spoken to me of the existence of granites at Preston, but I was not, until now, convinced of their existence or importance.

Granites (Archæan, Dana.)

This band was crossed after a traverse of 6 miles. It was seen to extend westward to Major's Lake, Preston, and the vicinity of the Waverley Mines. It was found also to reach at least as far as Ship Harbour, thus having a length of at least 25 miles. This lofty ridge of granite has a strike (?) conforming with that of the quartzites and argillites. This band was forthwith defined in my Centennial Map of Nova Scotia and exhibited at the ("Dominion Exhibition," Halifax) of the same year.

Leaving the band of granites we crossed a band of quartzites and argillites and reached the Mail Road, Musquodoboit Harbour. On this road we proceeded eastward to Clam Harbour, observing outcrops of quartzites and argillites and reached Clam Harbour. Here prospecting was in progress and some excitement caused by the finding of gold sights in quartz veins in the rocks of the locality.

Returning by the same road to Musquodoboit Harbour we found some excitement there by the discovery of gold at the east of Chezzetcook Harbor. The specimens exhibited were certainly very beautiful, and according to reliable reports the results realize expectations. [Mines are being worked and the production is satisfactory (1887.)]

From Musquodoboit Harbour we proceeded to Dartmouth. Outcrops of very ferruginous argillites were observed before reaching the road to East Chezzetcook. Beyond at Porter's Lake and Preston outcrops of quartzites were of frequent occurrence. Between Preston and the Dartmouth and Waverley Road there were outcrops of argillites.

MEAGHER'S GRANT (B.)

Returning to Meagher's Grant by the former route, we proceed to the Settlements—LITTLE RIVER and Middle Musquodoboit. At the Cross Roads Lower Cambrian quartzites with

in argillite. The source of the gold was thus made evident. At the Centennial Exhibition, Philadelphia, 1876, H. S. Poole, Superintendent of the Acadia Mine, Pictou, exhibited a collection of gold specimens with associate minerals. In this there were fine specimens of the gold containing conglomerate of Gay's River. One large specimen was particularly interesting. It is a large piece of greenish argillite upon which conglomerate has rested, leaving a small portion of itself and a striking display of small plates and scales of gold. On our last visit to the mines I found that a great amount of work had been done since my previous visit. The slates underlying the conglomerates had also been excavated. I did not find any conglomerate with gold, but I observed in the slates abundance of the *Discinoid* forms, which had attracted my attention on my first visit, and which I have already noticed elsewhere. These forms here are very regular, striking and puzzling. The specimens in the Museum with the gold containing conglomerate readily attract attention. The sea shore of the Lower Carboniferous Period extended to the position of Gay's River Gold Field.

The gypsums associated with the conglomerate are seen by frequent outcrops to extend westward to the neighborhood of the Gay's River and Shubenacadie Road. Beyond this all formations are obscured, except on the old road from Gay's River to Elmsdale. Here frequent outcrops of Lower Cambrian quartzites occur. Beyond the road to Milford these are seen to approach the Shubenacadie River to within the distance of $\frac{1}{2}$ a mile. Before coming to Elmsdale they retreat in the direction of the Oldham Gold Mines, giving place to a large extent of gypsums and gypseous deposits. Near the Enfield Station, on the other side of the Shubenacadie Bridge, on the road to the Oldham Gold Mines, argillites appear. About 2 miles farther we enter the mining region. I visited these in order to examine the position where our rich gold specimens had been found—the specimens which had been purchased by the Government for exhibition at the Centennial Exhibition, Philadelphia. I examined the position with interest. It was in the Oakes' Mine, at

no great distance from the road, and very near the surface. I also examined the other mines. Some of these were in operation and others at rest. The conviction was and is that the process which produced our 54 ounces, or \$1000 specimens, was capable of extensive production. This is from a scientific point of view.

Returning to Enfield Station, and proceeding along the line of railway towards the Waverley Mines, we find evidence of the existence of gypsums until we approach a creek on the left, where argillites appear in Grand Lake and continue associated with quartzites to the Grand Lake Station. Then we enter upon a broad band of argillites. These only appear in the cuttings. If, however, we take the road from the station and proceed a little distance we will observe in an opening in the bushes to the right a limited and isolated patch of another formation. This is a remnant of Lower Carboniferous Conglomerate, resembling that of Gay's River, with the exception of the seeming absence of gold. This is of considerable thickness and rests upon the upturned edges of the underlying argillites. It reaches to within a short distance of the railway. The glaciation of the argillite surfaces around shows the nature of the agency that has been at work in the isolation of this remnant of the Carboniferous Period.

Proceeding onward by the road or railroad we come to the Waverley or German Mines respectively.

WAVERLEY GOLD MINES (B.)

Age and Origin of the Gold.

From this position we proceed to the consideration of the two topics just indicated. The peculiarity of one of its gold deposits led us into a similar discussion 21 years ago. I now consider the questions with the advantage of observation and experience since made and acquired. At that time we knew nothing of the Gay's River Gold Field, and consequently any opinion that would extend the time of production of the gold into the Carboniferous Period might have been maintained. As far as our gold fields are concerned Gay's River Gold Field disposes of this view as altogether untenable. The gold existed in the Lower Cambrian rocks of Nova Scotia *before* the

beginning of the Lower Carboniferous Period. How far back in Pre-Carboniferous time is now the question. Another opinion has been advanced, viz., that the gold existed in the Archæan granite (Laurentian Gneisses) and that the gold deposits are beds derived from these granites with gold, converted into auriferous quartz by the metamorphism to which the strata has been subjected. This makes the auriferous quartz to be of Lower Cambrian age. This opinion has not met with much acceptance. The generally received opinion is that the *lodes* or *beds* are true veins, and therefore formed subsequent to the formation of the strata which contains them.

Our researches in the west—Annapolis and Digby—have led us to the conclusion that the metamorphism of the gold-bearing rocks was chiefly effected previous to the Middle Silurian Period, i. e., during Upper Cambrian and Lower Silurian time, and hence the term “Cambro-Silurian (Lower)” was applied to the rocks in question—Vide Paper Trans. 1884, This view of the age of the gold would still, in a sense, accord with the Murchinsonian view of the Age of Gold, or with another view that gold might be viewed in the light of a “Lower Silurian. Fossil.”

Thus much for the “age of the gold.”

When I examined the so-called “Barrel quartz,” 22 years ago, much of it lay exposed by the removal of the overlying quartzite bed. It lay in an almost horizontal position on a soft bed of unctuous green argillite, which much resembled a talcose schist. It lay like a number of branchless hemlock trunks, or as others described it like a “washing board.” The miners regarded it as an “overflow” of melted igneous rock, and expected some time to find the vent or dyke. It was never found, and after the “barrels” were removed the mining was done. The general opinion was that the veins were of igneous origin, and came up from the molten interior in the manner of lava. One difficulty in the way seemed to be that the rocks containing the quartz veins had not sufficient solidity to furnish open rents (vents) for the passage of molten material. If the veins had been in the granites the case might have been otherwise. Some of the most

important leads have been found to end, e. g., Hattie lead, Wine Harbour, and attempts to find a continuance downwards have been fruitless. There was no passage from the regions below.

I have yet to notice a very interesting locality in Colchester County. On the south branch of the Stewiacke River Cambrian quartzites are observed, having a very interesting gold vein. The quartzites are grey and contain numerous cubical crystals of pyrites. This is traversed by a vein of auriferous quartz, which measures one inch and upward. This vein is crystalline throughout. These crystals are often arranged in *geodes*. One in my possession has numerous long six-sided prisms with pyramidal terminations clear as crystal. Another has crystals with gold projecting from a crystal. There are no fewer than 7 sights of gold in a piece not more than an inch square where distinct crystals are seen crossing and recrossing from either quartzite wall. In another small specimen the vein goes into corners, the gold following. I cannot conceive anything more conclusive in support of the Hydrothermal Theory of the production of auriferous quartz veins. The veins seem to be too small for working.

ADDITIONAL OBSERVATIONS.

In our extensive collection in the Provincial Museum, which is representative of our principal gold fields, I find a specimen from Wine Harbor, which tends to confirm the view which I am illustrating. This is a piece of quartzite traversed by a quartz vein very rich in gold. This vein is so thin that it can scarcely be measured. It could only have been filled by capillary attraction. I find also several specimens of large size from Isaac's, in which the gold is in *calcite*, having shown (boidal) cleavage.

There seems to be no reason why every quartz vein in our Lower Cambria should not contain gold. Yet it is a fact that only certain veins, even in known gold fields, contain the precious metal.

In the Yarmouth and Digby great coast section there is any number of quartz veins, large and small, exposed in the best manner possible for observation. I have examined them care-

fully, but this is nothing to what has been done by prospectors. Yet only one vein has been found to be auriferous. This one has a peculiarity which the others do not possess. In the containing stratas there is abundance of arsenopyrite in beautiful crystals. The most productive veins at Montague are well known to have arsenopyrite in abundance. There are two fine specimens in our Museum Collection, which were presented by Mr. Lawson, as very striking. One is an unusually large piece of arsenopyrite, with a large sight of gold in the arsenopyrite. Another is a large piece of arsenopyrite, with the gold spread over it in a striking manner.

Other specimens are from Oldham, presented by Mr. Donaldson ; arsenopyrite rich with gold.

I shall give another illustration from Wine Harbor. Some years ago I went with Judge Henry and examined his mine. A large quantity of quartz was piled up at the top of the mine, which was said to be auriferous, although not visible. Looking about for minerals or other interesting objects among the rubbish, I noticed a piece of stone with a large piece of arsenopyrite. Striking it with my hammer, to break off the specimen, the stone broke into 8 pieces, all showing fine sights of gold. The principal pieces are in the Museum Collection. Specimens from Waverley and other gold mines show the same association of gold with arsenopyrite and other sulphites. When the latter occur in any quartz vein I generally recommend a search for gold and *vice versa*. Why this discrimination? I believe is one of the geological mysteries, which it is vain to attempt to elucidate.