auspices and brightest prospects. As we cherish these and apply to them our powers of body and mind, so shall we aid the accomplishment of our destiny and become at length what God and nature have manifestly designed us to be—the chief nation of the western hemisphere, perhaps the leading nation of the world.

Art. II. — Geological Notes of Excursions with Members of the British Association, and others.

By Rev. D. Honeyman, D.C.L., F.R.S.C., F.S.A., &c.
Curator of the Provincial Museum.

(*Read December* 8, 1884.)

When accompanying our visitors of the British Association, I made several observations which seem worthy of record.

JOGGINS SECTION.

We first examined the South Joggins Section—the middle carboniferous division. This section is always interesting, as every season makes a renovation. We were, however, too late. Any fossil trees which had been exposed in the early part of the season, had been removed by Mr. Barnhill and others. A part that is always striking had thus disappeared. Interesting specimens of stigmariae, with rootlets, lepidodendra, sigillaria and calamites, were observed among the *debris* of the cliffs and in the ledges. Seams of coal and shales with *anthracosia* and *entomostraca* were also examined and specimens collected. Want of time prevented us from visiting aud examining the grindstone grits of Lower Cove.

Interesting sections of trees, sigillaria and lepidodendra, were also examined at the Superintendent's residence, with small collections of fossils, containing large scales of rhizodus and other ganoids, with ferns and other flora. These had been secured by Prof. Richards, of the Massachusetts Institute of Technology.

SPRING HILL AND PARRSBORO' RAILWAY.

Beginning at the Springhill Mines Station, we were in the

middle carboniferous" formation and of the synclinal to the Joggins section. Proceeding, we passed into the red sandstones of the lower carboniferous. At a distance of about 11 miles, we seemed to come to the end of this. I expected as much, from the proximity of the line to a road and river section that I made from Spring Hill to Five Islands. *(Vide Paper, year 187–.)*

From this onward, to a distance of about four miles, all is obscured by drift. From the analogy of the section just referred to, as well as for reasons which I shall adduce in the sequel, I consider that the underlying rocks are Archæan. In the other section, lower carboniferous conglomerates come in contact with the granites without the intervention of other pre-carboniferous formations. The I. C. R. section has the Wentworth series, which I consider to be of lower silurian age, intervening between the lower carboniferous and archæan. *(Vide Paper* 1870.*)*

Proceeding I observed outcrops of rocks to the east of the railway, and masses of rock even on the line, which are evidently metamorphic. On the other section, near Five Islands, we have 2½ miles of metamorphic rocks, which I regard as silurian, and as probably the extension of the Londonderry ferriferous series. Underlying Parrsboro', we have probably the extension of the Harrington river rocks (Five Islands), which produced carboniferous *flora* and *fauna*.

PARRSBORO' AND PARTRIDGE ISLAND.

In a walk along the road I had an opportunity of examining a carboniferous series, which is considered to be synclinal to the preceding. The upper beds of these, which are thin sandstones, and grey and black shales, have a northerly dip in 75° and an east and west strike—they are seen crossing the road below Parrsboro. They are, therefore, synclinal to the Parrsboro' series. The outcrops on the road farther on seem to have the same high dip. The shore sections east and west of the pier, are evidently of the same character. In some of these—a red sandstone—Mr. Gilpin found carboniferous fossils,—*shells*. I was surprised to find them where I expected to find Triassic Sandstones. On the shore section east of Parrsboro', these were seen

and distinguished by their bright red colour. These were also observed to the west of Cape Sharp. The intervening part of the formation has been evidently obscured by glacial and post glacial marine denudation.

PARTRIDGE ISLAND.

This island, or rather peninsula, is very interesting. Walking over the rocks, we found the tide conveniently low, so as to enable us to compass it. The east side is basaltic and bold, —some of it having a "causeway" aspect. Numerous veins are seen permeating the basalt. These are generally jaspideous or chalcedonic; some appear to be magnetite,—a specimen was found among the basalts. At the point the rocks are split, so as to form an easy passage to the western side, when the tides are rising. On this side the rocks are more interesting to the collector. They are amygdaloids, &c., and other traps, replete with minerals in veins, gledes and amygdules. Here we collected beautiful specimens of minerals and amygdaloids—the latter for the purpose of comparison—with boulders, in the drift of Halifax and other places. Coming to the north side, we saw a fine section of triassic sandstones. They were seen to dip towards the eruptive rocks, and at the junction to be overlaid by them. They were thus dipping in a direction contrary to the carboniferous of the shore. This may be considered a continuation and a termination of our section.

PASSAGE FROM PARRSBORO' TO WINDSOR.

On board of the steamer "Hiawatha," we made further observations. Clearing Partridge Island, we observed Cape Sharp, with its triassic and eruptive rocks. Easterly in the distance was seen Cape d'Or, having an insular appearance in consequence of a mirage. Succeeding was Cape Split, with its fantastic peaks, and the grand ridge of eruptive rocks ending in Cape Blomidon. The day was exceptionally clear, so that distant objects could be seen with great distinctness. Blomidon was beautiful, with its great stretch of underlying bright red triassic sandstones, overlaid and crowned with dark basaltic and other trappean rocks. Rounding the cape, we admired its

noble profile; proceeding, we viewed its triassic sections onward to Grand Pre, without difficulty. These sections represent the triassic formation of Cornwallis and Annapolis Valley. From the occurrence of the same formation on either side of the Basin, and to the eastward, as well as from the sections just referred to, we can safely infer that this formation extended, or yet extends, from Parrsboro' to Grand Pre,—a distance of 15 miles. The sections on the shore may therefore be added to our section. Approaching the estuary of the Avon, attention was directed to the interesting section of lower carboniferous strata called Horton Bluff. Great outcrops of gypsum were observed on the right, and Cheverie triassic and lower carboniferous on the left.

WINDSOR.

Reaching Windsor we examined the interesting lower carboniferous section above the old Avon Bridge. Attention was first directed to the fossiliferous limestones, and the outcropping gypsum. Here very fine masses of selenite were found. Dr. Blanford observed the abundance of trappean boulders, and supposed that there must be a dyke in the neighborhood. Being assured that these amygdaloidal and otherwise were transported, he regarded Partridge Island as the source of supply. The abundance of associated boulders of crystalline rocks confirms the supposition. I will give the reason why.

I had not examined these since I commenced my investigations in glacial transportation. I did not remember of the occurrence of any other than amygdaloid boulders. I had observed amygdaloid at Blomidon, and had referred the amygdaloids in the drift of Halifax, &c., to Blomidon.

The boulders of other crystalline rocks, such as syenites, diorites, &c., now observed at the Avon section, associated with the amygdaloids, basalts, and other trappean rocks, shew transportation from the Cobequid Mountains, beyond Parrsboro'. Partridge Island, being in their course, could not escape a levy any more than Blomidon, so that we may consider both as sources of supply of amygdaloid and other trappean boulders. The glacier may thus be credited with facilitating the construction of the

Springhill and Parrsboro' Railroad by excavating in part the passage through the Archæan and other formations, and also with furnishing ballast by the deposit of the obscuring drift. In this connection, I would observe that it may have had something to do with the formation of the great Boar's Back of Hebert River. This deposit is 7 miles in length.

GYPSUM QUARRIES.

We were conveyed to the extensive Gypsum Quarries, east of Windsor. The exposure of gypsum is truly magnificent. How or by what process these and similar deposits came into existence has certainly yet to be discovered. There is a large amount of Anhydrite, as well as hydrous gypsum. The first is bluish in color—a use for it is yet to be ascertained. The useful gypsum is white, and is principally used as Plaster of Paris.

The borates (mineral) is a discovery of the late Professor How in these quarries. Specimens were collected. His representative collection is in the Provincial Museum.

On our way boulders of amygdaloids, crystalline rocks of the Cobequids, were observed on the road side.

We left Windsor by the Railway Train at night and travelled to Halifax. As the rock sections of the Railway could not then be observed, I will describe them in inverse order from my Paper "On the Geology of the Gold Fields of Nova Scotia."—*Quarterly Journal of Geological Society, 1863.*

We have (1) the Newport Gypsum (of the quarries visited); (2) half a mile of Lower Carboniferous Sandstone (underlying the Gypsum). This is unconformable to (3), quartzite (Cambrian of our Gold Fields), which extend 2½ miles. Then come (5) Argillites (of the same formation). These extend 2½ miles. Following (6) are cuttings of Quartzite to about a distance of 2½ miles. We next have (7) Granites of Mount Uniacke; these extend to a distance of about 4 miles. In this there is a quartzite parting. A farther distance of 1½ miles are quartzite cuttings. We have now reached 12 miles from the Junction. At Beaver Bank, the station next the Junction, are Slate Quarries. At the Windsor Junction the Quartzites appear in great promi-

nence. Here we have the extreme of the Waverly Gold Field. From this to Halifax Station we have Quartzites with Argillites The latter connect with the Quartzites at Richmond. These Argillites extend beyond the Station through Halifax City to Point Pleasant.

MONTAGU GOLD MINES.

At Halifax our Party received large additions by the arrival of several other members. We next visited the Montagu Gold Mines, near Halifax. On our way a subject of conversation with Dr. Blanford and Mr. Topley. was the age of the gold bearing rocks. When the Gold was first discovered the geology of Nova Scotia and New Brunswick had not attained to its present state of development. The only fossiliferous rocks with which they could be compared were the Middle and Upper Silurian rocks of the "Arisaig Series." The high metamorphism of the gold bearing rocks when compared with that of the others, and the fact of the existence of gold in quantity seemed conclusive of their Lower Silurian age. *Vide* my Paper "On the Geology of the Nova Scotia Gold Fields."—*Journal of the Geological Society, 1863.*

Since then the *Archæan* and *Hudson River* of Arisaig have come to light, as well as the *Archæan* and *Cincinnati or Hudson River*, of Wentworth, of the Cobequid Mountains, the *Archæan and Upper Lingula Flags* of Cape Breton, and the *Archæan and Lower Lingula Flags* or Primordial of Saint John, New Brunswick, and yet no *obvious* equivalent of the gold bearing rocks have appeared. We have consequently been led from this and other considerations to look to Wales for their equivalent, and consider that we have found at least an *approximate* equivalent in the gold bearing rocks of the Dolgelly district, *i. e.*, the Cambrian or Pre-Lower Lingula Flags. In this, as at Arisaig, we would adopt the late Mr. Salter's advice, in consequence of distance, to use the qualifying term *approximate*. *Vide* Paper "On the Geology of Halifax and Colchester Counties, Part I."—*Trans. Institute, 1882-83.*

One of the Mines, the Bluenose, or New Albion, was particularly examined, the position of the auriferous vein, its char-

acter, its gold and mode of occurrence, as well as the process at the mill by which the gold is extracted. Gold was seen occurring in a striking manner in a collection of pieces of quartz taken from the mine. Of these the visitors received a liberal share, as *mementoes* of Nova Scotia Gold Fields.

POINT PLEASANT.

Dr. Blanford, Messrs. Bauerman, Topley and Merrit, the geologists of the party, and Mr. Morrow, the President of the Nova Scotia Institute of Natural Science, went to Point Pleasant to examine interesting glacial phenomena. As the weather was unfavorable, we could only examine a few of the more striking of these.

1. We first examined a ledge of the Cambrian rocks on the east side, near the Point. This projects into the harbour. The strata have a northerly dip of 20°. The rocks are hard and crumpled. They have been scooped, grooved and rounded. The course of striation produced passes through the harbour, touching Thrum Cap, a remarkable glacial deposit which was examined in company with Col. Akers, R. E. I have characterized this as "The *ultima thule* of Glacial Transportation in Eastern Canada."—(*Vide* Paper "On the Geology of Halifax Harbour," read at the meeting of the British Association at Montreal.) It was suggested that the glaciating agency might have come from the south. Another glaciated surface to be yet examined was referred to as shewing the direction.

2. The section of a deposit of glacial drift at the west side at the entrance to the N. W. Arm was next examined. Numerous boulders were observed. These were syenites, diorites and porphyrites, from the Cobequid Mountain, Archæan series of rocks, and of the Springhill and Parrsboro' Railway. Attention was then directed to an enormous boulder of quartzite of Bedford Basin or beyond. This is furrowed, rounded and striated in a remarkable manner—two sets of furrows forming a series of various angles. This was at once recognized as part of the plowing machine which had furrowed, striated and polished the rock surfaces of Point Pleasant. The boulders of our section is still partially imbedded in the drift.

3. I next directed attention to a sizeable boulder which Prof. Richardson had taken out of the drift with his pick-hammer.

Dr. Blanford at once recognised it as a Partridge Island Amygdaloid. The boulder is replete with beautiful Amygdules of the Zeolites, Heulandite, Stilbite, &c. The remains of it will be found in our Museum Collections, where it is treasured as a memento of pleasant intercourse with British and American Geologists.

PRINCE OF WALES' TOWER.

Our next and last object was the very remarkable, unique, and instructive, I may say classical, glaciated rock area at the Prince of Wales' Tower. This has called forth the admiration of every Geologist who has examined it. Here we have a rock surface generally smoothed, polished, striated and rutted in the Glacial Period after having been tilted "wonderfully crumpled and faulted," in the very remote Lower Silurian past.

The most striking and instructive part of it are its ruts. These convincingly reply to the question asked on the Harbour ledge (1). A series of these are seen beginning at the northern side of the area. After rutting the edges of the striata, in the manner of a nail drawn across the lines of growth of a pine board, they come to a close set line of crumples. Here the ruts terminate, only a few short scratches pass beyond the crumples, diverging from the regular course S. 20 E. mag., at various angles. This convincingly shows that points of the graving machine making the ruts had been fractured in their southerly course. This testimony corresponds with that of the transported Amygdaloids. The rut course produced in a northerly direction passes the line of Blomidon, and crosses to Cape Sharp. A parallel glaciation, course S. 20°, E. mag., from Gore and Shubenacadie, on the east, includes Partridge Island and Two Islands. The two still farther produced pass through the Cobequid Mountains, including the depression through which the Spring Hill and Parrsboro Railway passes, and terminate in Nova Scotia at the South Joggins Section, the latter two miles west of the Joggins Mines' Coal Seams, the former 12 miles farther west at Sand River. Produced farther they pass into New Brunswick, including the "Pre-cambrian" mountain, Shepody.

Previous to the meeting of the British Association I had the pleasure of examining the phenomena of Pleasant Park with the other members of the Association. Mr. Blair, of Oakshaw, Paisley, and the Rev. Father Kavanagh, S. J., now of Quebec. As the weather at this time was more favourable a more extensive and minute examination of the locality was effected. The "Geology of the Harbour" was pretty fully discussed with these Geologists in anticipation of the reading of my Paper on this subject, forwarded to the Secretary of the Association, Prof. Bonney. Specimens of rocks and glacially transported boulders were collected. One boulder was of a beautiful Diorite-Porphyry, from the Cobequid Mountain Archæan series of rocks. Of this Father Kavanagh has made an exquisite section and forwarded it to me for examination with the Polariscope and Microscope.

DESCRIPTION.

The ground mass consists of Hornblende with microscopic Plagioclase. The latter is amorphous with minute crystals, which are often in twins. Some parts of this mixture is beautifully pleochroic with the dichroism of the hornblende and the trichroism of the feldspar. Other parts are darkened with opacite which the microscope with direct light shews to be chiefly magnetite. The Plagioclases separated from the ground mass so as to make the rock porphyritic is strikingly pleochroic. There are only two rocks which I have previously examined, one from Sundy Point, Yarmouth, another from St Peter's Canal, Cape Breton, that exhibit an equal variety of colours, bands and striae. Some of these crystals include magnetite. The Feldspar in this and the other sections has a different spectrum from that of the Labradorite of the Blomidon Basalts and the *albite* of the Arisaig Archæan Diorites and the Nictaux and Wentworth igneous diorites. I have *supposed* this form of Plagioclase to be *oligoclase.*

I have derived much pleasure and profit from this intercourse with "Brother Hammerers,"