ART. XIII. ON THE GEOLOGICAL FEATURES OF THE LONDONDERRY IRON MINES. BY REV. D. HONEYMAN, D. C. L., F. G. S.

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THESE mines are situate on Great Village river on the south side of the Cobequid mountains. Their history, previous to 1855, and the opinions until then entertained by the geologist as to the character, age and origin of the iron deposits, are fully given in Dr. Dawson's *Acadian Geology*. The following observations may be regarded as a sequel to the history just referred to. They are the result of two visits which I made to those mines in preparing illustrations of the resources of the Province for the London International Exhibition of 1862, and Paris Universal Exhibition of 1867. On my first visit I found in operation one blast furnace and several puddling furnaces. The ores employed were brown hematite and specular. The flux used was a limestone derived from a lower carboniferous deposit, existing about three miles west of the mines, and the fuel used was charcoal màde from the hardwood of the neighbouring forest. A massive Nasmyth hammer was constantly at work forming bars of charcoal iron, which were chiefly exported to England. The specular ore was derived from a bed about three feet thick, and the hematite from a bed of variable thickness and of unknown depth. In order to ascertain the depth pits had been sunk, but without any definite result. My last visit was of a much more satisfactory character, and the information acquired is of the most interesting and singular description. I found the works considerably extended by an increase of the number of puddling furnaces, and by the addition of rollers for the manufacture of bars and rods of iron. An attempt had also been made to manufacture cast steel, with the most satisfactory result. So that now there are here manufactured,—

Pig iron of the finest quality,
Charcoal iron,
Puddled steel,
Cast steel.

Dr. Percy's analysis shows the character of the Pig iron.

A suite of specimens, forwarded for the Paris Exhibition consist of:—

Pig iron,
Charcoal iron,
Puddled steel,
Cast steel,

Which satisfactorily illustrate the variety and completeness of production of the Acadian iron works. I have no doubt that they will confirm in Paris the character that has been gained in the Exhibitions of London 1851–1862, and Dublin, 1865.

The brown hematite is now the only ore available for the production of iron, the specular ore, already referred to, having been apparently exhausted. The supply of ore, however, has not been affected by the failure of the specular ore, as another great bed of hematite has been discovered of dimensions nearly equal to the bed already referred to. These two beds are now distinguished respectively as the north and south. The strike of the beds is east and west, their dip is 80° south. At Martin brook, they appear about thirty feet apart. The maximum thickness of each of the beds is twenty feet, and the average of the north is five feet and of the south four. Very often the beds are interrupted and disappear. The unequal thickness of the deposit and interruptions are marked by the inequality of excavation at Martin brook. Their length has been ascertained as at least twelve miles.

In the vicinity of Martin brook, where the hematite has been chiefly extracted, the course of the beds was found to be west by south. The cause of this deviation was a subject of conjecture. A level was driven obliquely to the strike for drainage in the meantime, and ultimately for the extraction of the ore. When this level reached the hematite beds at about one hundred feet below the surface, it was found that a great slip had occurred, that the beds had been cut off, that during the process a stratum of clay had been formed between the upper and lower part, the inclination of this stratum being about 20° south-west. This interesting revelation explains the mystery of the deviation already referred to, and at the same time shews that the deposits extend downward to the extent indicated by the level. As the

beds at the point of section have not degenerated in thickness or quality, they may be regarded as only an interruption.

Another level is being formed some feet under the other, and at right angles to the strike of the strata. This is expected to reveal the existence, or non-existence of the hematite beds, and it is reasonably expected that if they shall be recovered, they will be found in regular position, and more advantageously situated for mining purposes. It was supposed that the hematite was an altered ankerite, and that it would only be found in the top of the vein. Whatever may have been the original character of the ore when deposited, it is certain that the hematite extends to a depth of at least one hundred feet, and that its character in the level is precisely the same as it is in the excavations near the surface. I found cavities with butryoidal crystalizations of hematite in the roof of the level, as well as in the excavations above. The hematite of these beds is chiefly amorphous and friable, with numerous masses porous and compact, and mamillary butryoidal, and stalactitic crystalizations of striking variety of form.

Often the ore has an unmistakeable *cokelike* aspect, being specular and intermixed with slate, reminding me of the coke made from the fine coal, with intermixed slate, at the Acadia coal mines. This, and numerous other appearances in the ore, can only be satisfactorily accounted for by the supposition of metamorphism, by igneous agency. If, again, we are to suppose that the hematite is metamorphosed ankerite, the rarity of the occurrence of this mineral in the excavations at Martin brook, shew that the metamorphism has been complete. I shall now direct attention to the geological relations of these hematite beds.

The section represents the several geological formations existing in the Cobequid mountains, and also to the south of these, from the centre of the Cobequid mountains, to the Cobequid bay. In ascending order, the formations are silurian, devonian, carboniferous, and triassic. These are severally included in the ten miles represented in the section. The line of section is along a portion of the new Amherst road, the Great village river, and the shore from Great Village to

the Cobequid bay, one and a half miles. The north of the section represents the rocks from the centre to the bridge above the mines, a distance of one and a half miles. The extreme rock is syenitic, and is situate about three miles west of what is called the sugar loaf, which is considered to be the highest mountain of the range. In this part of the section we have altered strata, which bear a striking resemblance to the altered silurian near Arisaig pier, county of Antigonish. These are quartzite ore, with slaty cleavage, breaking readily into rhomboidal forms. These are sometimes divided by true granite. I was astonished at finding granite associated with these rocks, as I have not met with it elsewhere similarly associated. On referring to the *Acadian Geology*, I find that granite occurs elsewhere in the Cobequids, and in the same geological position. I was equally surprised about five years ago in finding granite in the Baddeck mountains, Cape Breton, where I had expected to find syenite, as in the Antigonish and Cobequid mountains. Still I believe the two cases are not analogous, and that the geological relations are different. I consider the Baddeck granite as identical with that of our lower silurian of Guysboro' county, &c., and I regard the auriferous slates of Wagamatcook, associated with the granite, as also of lower silurian age. The granite of our section has also connected with it as intrusive rocks, several dykes of dark pyritous trap, which have forced themselves up between the siliceous silurian strata, converting them, as at Arisaig, into porcelaneous jasper, obscuring the stratification. This trap appears in one case crowned with these strata, having failed to force its way to the surface.

I have assigned to these strata a silurian age, in consequence of their resemblance to the strata of Arisaig, of which the Frenchman's barn is a part. They also bear the same relation to the argillite here, as the supposed equivalent do to the argillite of the Antigonish, Ohio, and Merigomish mountains. I consider that it is not at all likely that we shall have any evidence more satisfactory than this to determine the geological age of the strata in question, at least in this locality, as the proximity of the trap must have destroyed organic remains as

in the case of Arisaig pier and the Frenchman's barn. It is possible, however, that an examination of the Arisaig equivalents at Earltown, on the north side of the Cobequid range, with their fossils, may enable us to determine the precise age of the strata under examination. Succeeding these, and toward the south, we have a thick series of strata, which in the line of section form a mountain of considerable elevation. These are readily distinguishable from those already described, and are divisible into three members. Members 1 and 2 are separated by the beds of hematite already referred to—1 being the underlying and 2 the overlying rocks. It has ever been supposed that these are the first tokens of the different geological periods—1 being supposed to be silurian, and 2 and 3 devonian—1 is found to be much harder than 2 and 3. The miners distinguish 1 and 2 by their difference in hardness. The thickness of the series may admit of a separation into periods, which may not be admissible on lithological grounds so slightly distinctive. 3 is more readily distinguished from the two preceding, by its darkness of colour and softness. The latter property gives depression to the surface of the ground which these last strata underlie, as the superior hardness of the former gives a corresponding elevation. Succeeding the devonian strata are conglomerates and sandstones of the carboniferous period. Preceding the formation there must have been an elevation of the strata already described, and that, too, at the same period as the corresponding strata elsewhere—that is, at the close of the devonian period. It is probable that the rocks then formed had not undergone the metamorphosing process by which they assumed their present character. I consider that in the manner of their deposition and in the time of upheaval, the sedimentary rocks resemble their Lochaber equivalent.—*Vide Geology of Antigonish County*. On the shore formed the shallow seas of the carboniferous period accumulated the shingles which now constitute the conglomerate, and afterward the series of sand stones, shales and clays, which are found reposing on these. The limestones are not found resting on the conglomerate as in Antigonish county, but limestones are found elsewhere in their usual position on the side of the Cobequids; and I have already mentioned

the limestones used in the manufacture of iron, occurring about three miles west of the mines. I was informed by Mr. Jones that these limestones succeed the devonian slates without the intervention of the conglomerate. This lower carboniferous conglomerate of our section now occupies an elevated position, more so indeed than the 3 members of the devonian series and a part of the sandstones resting on these conglomerates dips in the same general direction as the older rocks. I consider that the upheaval of these lower carboniferous strata and the metamorphorsis of the silurian and devonian formations were simultaneous, and that both were caused with similar operations at Polson's Lake. *Vide Geology of Antigonish.* The upheaving and altering agency appears to have been the trap which I have already referred to as in connection with the silurian strata of our section. To this period and agency I may therefore ascribe the metamorphic and igneous phenomena of the iron beds to which I have already alluded, and to the disturbing influence of the trap eruption I would attribute the great slip by which the rocks and iron beds at Martin brook have been divided. Succeeding these silurian, devonian and lower carboniferous strata, we have a broad band of carboniferous strata in the opposite direction, or synclinal to those already described. Succeeding these again we have another broad band of strata of triassic age, dipping in a direction opposite to those immediately preceding, the anticlinal axis being situate between the two formations. This triassic series is composed of a coarse conglomerate of considerable thickness, with interstratified sandstone which had been formed of and deposited on the carboniferous sandstone on the shores of the triassic sea. These again are succeeded by coarse red sandstone of the same period. This conglomerate and its sandstone now rise, with the strata immediately beneath, to a considerable elevation, and dip with a high angle in the same proportion as do the carboniferous strata of which they form the anticline. I have not been able to ascertain the nature of the elevating cause. There can be little doubt that it is trap, apparent or concealed, such as is to be met with at Two Islands, Five Islands, &c.

The new line of railway being constructed between Truro

and New Glasgow, furnishes a noble section of the band of strata which we are now considering. Leaving the West river station, on the way to Truro, we see on either side of the road fine specimens of argillite which flank Mount Tom on the west, succeeding the basal felspathic rocks. These exposures continue for several miles. The argillite of these cuttings appear to be very little, if in any degree, altered, and it it quite possible that fauna might be found in them which may more directly indicate the age of the altered or unaltered pre-carboniferous strata of the band, than even the Earltown group, already referred to. When we leave the section of argillite strata on the Truro side of Georgetown, there appeared to be some obscurity for some distance, and then succeeding are magnificent cuttings of carboniferous strata, showing a dip apparently synclinal to that of the older strata. Somewhere in these strata must be situate the manganese limestones of Salmon river. Succeeding these carboniferous strata cuttings are cuttings equally imposing of triassic sandstone, which reach nearly to the town of Truro.

I would observe, in conclusion, that the lines of railway from Halifax to Windsor, and from Halifax to Truro, now reveal and make accessible to the observer the great geological features of the Province. Proceeding from Windsor to Mount Uniacke, we pass through the granite which may be regarded as the basal rock of the Province; passing on to the junction of the Windsor and Truro lines we rise into the quartzite and argillite of the metamorphic lower silurian, which includes Mount Uniacke gold field. Proceeding from the junction to Truro, we pass from quartzite through argillite and quartzite, all lower silurian. Leaving Elmsdale, and approaching Shubenacadie, we reach the lower carboniferous limestones with their gypsum. Leaving Truro for Pictou, we pass through the series that I have already described, descending geologically through triassic, carboniferous, devonian and upper silurian, this last being, in all probability, the immediate successor of the auriferous lower silurian. From West river station to Pictou harbour we probably ascend through the extension of the silurian series of Springville, East river, through the lower carboniferous of Hopewell, then the middle and upper carboniferous. In various localities we pass through drift and alluvium, and thus we have a synoptical representation of the Geology of Nova Scotia.