

## TRANSACTIONS.

ART. I.—GLACIAL GEOLOGY OF CAPE BRETON\*. BY THE LATE REV. D. HONEYMAN, D.C.L., F.R.S.C., &c., *Provincial Geologist*.

In our walks around STRATHLORNE the abundance of boulders of Archæan rocks attracted attention. Fortunately recent rains had washed and brightened them, rendering their characters very obvious. A collection of them would be readily mistaken for one of our representative collections made in and around Halifax. I at once recognized a relationship. The boulders are Syenites, Syenitic Gneisses, Diorites and Porphyrites. The Pre-Cambrian, or Archæan, Mabou Highlands, extending West, N. West and South-West, and corresponding with the N. S. Cobequid Mountains, were suspected to be their source, and action similar to that established in Nova Scotia was suspected to be the efficient cause of their distribution.

Referring to Mr. Fletcher's Map, still in sheets, I observed on the margin 'glaciation signs,' which seemed to have a bearing on the distribution. Locating these I found one position at Green Point, near the mouth of Mabou Harbour, about a mile to the West of the South-western extremity, and another on the West side of Lake Ainslie, near the reputed oil region, and opposite McLean's Point, *vide* Fletcher's Map. We now purposed to adopt the method of investigation which had led to such good results in Nova Scotia.

Having mounted Fletcher's Map and extended on a wall, we extended the courses of the glacial grooves of Green Point in a S. E. direction as far as Craigneish Mountains of Archæan age. We then drew another parallel to this, so as to include the locality of the other glaciation at Lake Ainslie. This hypothetical

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\* This paper was found among Dr. Honeyman's MSS. after his death. It describes observations made a few months before his death, and was probably not revised for publication.

parallel, commencing at McIsaac's Pond, north of the Mabou Highlands, passes through Loch Ban and along the major axis of Lake Ainslie, proceeding onwards to St. Patrick's Channel it avoids the Archæan areas on either side of Lake Ainslie, passes over an extension of the Malloch area at the foot of the Lake, goes through a pass of Archæan on the Channel and proceeds to the Great Bras d'Or.

We now proceed to work along and between these two parallels.

The Presbyterian 'Manse' of Strathlorne is our headquarters. It stands on the front of a range of low hills of sand and boulders, or moraine, which covers and *completely* obscures the underlying *Lower Carboniferous*. These extend north and south, to the north of our station one and six-tenths of a mile, and south of it about half a mile. Here it is terminated by a mountain with rocks outcropping on the sides. It extends towards Loch Ban and a range of Lower Carboniferous mountains which begin on the north of Loch Ban and terminate with *Dioritic* mountains. The length of this range is about two miles. The width of our sand hills is half a mile (E. and W.) Extending to the west, north and south is a broad and fertile valley, through which a river flows. This is bounded on the west by the Mabou Highlands. These extend between our parallels having a N. E. and S. W. trend, and reach to the Gulf of St. Lawrence. These are  $9\frac{1}{2}$  miles long. Their width E. and W. is 6 miles. Towards our Mabou Parallel the width is 8 miles. The formations of the Highlands are Archæan and Lower Carboniferous. The extreme width of the former is  $4\frac{1}{2}$  miles. Over this extensive area we have to search closely for outcrops of rocks. All is covered with drift and soil. We have to be guided largely by the contour in defining the lines of the several formations. The Geological Survey distinguishes the Lower Carboniferous of our hills and mountains as 'Metamorphic' Lower Carboniferous. We do not appreciate this distinction. As usual we divide the Carboniferous of the District including the Coal Measures, into Lower and Middle. Our previous examinations of the district in 1851 and 1861 were confined to the Mabou Harbour and Coal

Mines and Cape Mabou on the shore. The greater part of it is therefore to us a new field. In this paper we do not follow the order of examination as recorded in our diary. We take the shortest mode of recording the results.

We enter the Highlands by a road which turns from that to the Broad Cove Coal Mines at the Strathlorne Post Office. Crossing a brook we ascend. Red Clays with Archæan boulders large and small are exposed in the deep ruts made by recent rains. Next we see among the boulders chocolate coloured sandstones outcropping. These show that the front (?) hills are Lower Carboniferous. We come to an extensive valley having farms. Traversing this for some distance we come to the second and last outcrop of sandstones. Farther on we again ascend. On our right we have the first outcrop of the Archæan rocks. They are hornblendic. Onward we observe other outcrops on the road and sides. These are illustrated by the varied character of the boulders on the road. We have got to a considerable height, commanding an extensive and lovely view. The object of special interest is Lake Ainslie, which we can see as far as McLean's Point opposite our *second* glacial striation. We take an observation. Our station now is in the middle of what we may call the Strathlorne division of the Archæan, (taking McAuley Brook as the dividing line.) A S. E. magnetic course passes through the middle of Loch Ban and across Lake Ainslie. We continue our ascent. Outcrops still appear on the road. An extensive table land is now reached. This is largely occupied by extensive farms. We have now a guide leading us to the summit of Cape Mabou. We reach the watershed where White Brook and McAuley's Brook are only separated by the road. Here are outcrops of Gneisses, Hornblendic Schists, etc. Of these we collect specimens. We proceed and reach the summit. We take a specimen of the highest rock or rather boulder as no outcrops are to be seen. Descending, we re-examine the various outcrops and the grand supply of boulders on the road, which would furnish a glacier with a goodly freight of prepared material, as the ancient glaciers have found a like plentiful debris of the past, ready made for transportation. This and other Archæan ranges which largely

constitute the island, and give it direction, were doubtless raised above the waters from the earliest periods, furnishing material for the subsequent Formations, Carboniferous and Post-Pliocene as well as Recent. Entering upon the Strath we find Archæan boulders on all sides. We again reach the Post Office. Before the examination of the Highlands we had traversed the roads in all directions in courses sub-parallel to the mountains, from first to second parallel, from McIsaac's Pond to Mabou Harbor, with S.E. offsets. We shall now direct attention to the last. A. From the Presbyterian Church we crossed the Moraine already described to Loch Ban, and collected choice specimens of Archæan boulders. Reaching the top of the Loch we took the road to the right. For some distance boulders were absent, until we began to proceed southerly. Then they re-appeared in abundance. Coming to the extremity of the Lower Carboniferous mountains with Diorites already noticed, we observed our first outcrop of this Formation; we turned off, and for the purpose of examining it, proceeding along the road, we observed Archæan boulders in our way. Ascending toward the outcrop, boulders were still observed. We reached the outcrop. The rocks are chocolate coloured sandstones. They are raised to a high angle—70°—with a southerly dip. We collect specimens. Archæan boulders, large and small, are seen on the top of the outcrop. Of these we also take specimens. We ascend the mountains still higher. Archæan boulders are seen at the summit. We take a level and find it corresponding with that of the summits of the Lower Carboniferous elevations of the Highlands already observed. We descend on the west side of this mountain, and come to a considerable outcrop of coarse L. C. conglomerate. As this is the first observed, we also take a specimen. We also collected specimens of the Diorites on the other extremity of the range, *e. g.*, of the summit rock, which we found to be of equal elevation, with summits of the Archæan rocks of the Highlands. The elevation may be realized when (?) we noticed that the summit of this mountain is illuminated by the setting sun when all the surrounding mountains are in the shade, and the edges of the table land of the Highlands are distinctly visible from the out-

crop of Diorite. The specimens are amorphous and Porphyritic, with distinct crystals of Feldspar. On the sides of the mountain are outcrops and *debris*. In the latter we collected Amygdaloids; some of these are vesicular. Among them we observed several Archæan boulders.

We continue our course along Loch Ban (S. Easterly) as far as its end. We observe Archæan boulders all the way. Turning off the main road we descend into the hollow of a Moraine and ascend. Here we have very large Archæan boulders, and boulder clay, etc. Farther progress S. E. is intercepted by Lake Ainslie and the outlet. The bed of the lake is doubtless the place of boulders.

B. We make a second S. E. offset. To the South of the Lower Carboniferous Mountain which seems to terminate our Strathlorne Moraine and beyond McAuley's Brook that bounds the Strathlorne division of the Mabou Highlands, we turn off on the Black River Road. Ascending a hill we observe Archæan Boulders on our way. We now come in sight of Loch Ban and Lake Ainslie. Following the road we descend. On our left is a deep hollow, in which runs a brook. We continue and cross the brook, which now runs through bogs, swamps and thicket, which terminate in Loch Ban, in the distance. Black River, which runs into the Loch, stops farther progress. We have to return to our main road. Archæan Boulders were observed as far as we proceeded. The point reached was South of Loch Ban and 4 miles distant from the mountain on the north side, having the L. C. outcrop and Archæan Boulders. We hope to be able to report farther progress along this Parallel at a future time. McAuley's Brook having reached the road is now the Strathlorne River. At the Bridge where it turns northward there is an interesting section of the drift. In the bed of the river is a bed of red clay with boulders. Above it is the clay with sand and boulders. Above is a thick stratum of Archæan boulders. This is covered with a thick coat of soil with vegetation.

The boulders in the river bed are beautiful and instructive. High on the sides of a lofty mountain we observe an outcrop of rocks. We ascend to examine them. They are Syenites and

Gneisses. This is the only outcrop. Up to the summit is vegetation. Beech trees, &c., almost cover the top. There is no undergrowth. The view is extensive and beautiful. Loch Ban and Lake Ainslie and the region of Black River, which we had previously examined, are beautifully defined.

We would now proceed to work on our First Parallel.

On our way to Mabou, beyond the Black River Road, Archæan Boulders appeared the greater part of the way, then become rare or disappeared altogether, and then reappeared in abundance as we approached Mabou. We afterwards found, when we reached the Mabou terminus of the Archæan Mountains, that lofty Carboniferous Mountains intervening had intercepted or diverted transportation. Our first station was Mabou. Here I first proceeded along the road toward the extremity of the Archæan of the Highlands. Archæan Boulders, Syenites, Syenitic Gneisses and Diorites appeared in usual abundance all along the road until we were beyond the Carboniferous Mountain. We then walked some distance along a road that intervened between the Archæan and the Carboniferous, with like results. Satisfied thus far we returned to Mabou. Next we observed a Glacial Moraine section at Mabou. In this we also found Archæan boulders. I followed this drift below the Bridge until I could go no farther on account of a turn of the river. Archæan boulders were found all the way. Our next station was Donald McDonald's, at the extremity of the Archæan of the Highlands near the Harbour. Here we saw an outcrop of Archæan rocks where the road to the Pasture crosses a Brook. The rocks were syenitic. All the rocks of the Mountains are obscured with deep soil and luxuriant vegetation. The summits are covered with forest.

From this we proceeded westward to Green Point, on the shore of the St. Lawrence. We were surprised at meeting with Archæan boulders on our way, as the Formation traversed was Lower Carboniferous—Gypsiferous. This seemed to indicate a northern transportation. The apparent anomaly was explained when we reached Green Point. Our first objects of search were glacier-grooved rocks. The unusually coarse conglomerates be-

fore us were certainly not at all reassuring. After a diligent search we found a number of glacier grooves beautifully parallel, having a course S. 10 E. We failed in finding others. We were, however, satisfied. The grooves were on a comparatively smooth stratum close to the drift bank. We now examined the conglomerate itself and found it very largely composed of Archæan boulders. Here was a northern transportation effected by the seas of the Lower Carboniferous period, and a secondary source of Post-Pliocene transportation. Following the course of the grooves in a southerly direction we crossed the conglomerates, which we saw exposed in bold cliffs on the shore, as we proceeded and landed in the Mabou Harbour. Then, walking along the foot of the exposed covering of drift and conglomerates on the right side of the Harbour, we observed Archæan boulders in the drift and on the shore until we approached the Gypsums, where the apparently anomalous occurrence of boulders was observed. We have therefore a duplex transportation on the south of Macdonald's Archæan mountain. This is certainly a very striking phenomenon.

The occurrence of the grooves on the verge of the sea, like corresponding phenomena observed in Nova Scotia (*vide* Transactions of the Nova Scotian Institute of Natural Science), unmistakably show that an impulse was communicated from *beyond* Nova Scotia and Cape Breton, and that the glaciers of both are only members of a great glacier system which comprehended both Nova Scotia and Cape Breton.

Fletcher's excellent map shows that the glacier courses of Lake Ainslie and Mabou Harbour, and a third appearing north of Lake Ainslie, along Margaree and Middle Rivers, and through an intervening break in the Archæan Mountains, are parallel to the Strait of Canso. A like parallelism of the latter with the harbours (Fjords) of the Atlantic coast of Nova Scotia and our hypothetical parallels, led me to regard the Strait as, to a certain extent at least, formed by glacial action. This view seems to be farther supported by the occurrence of "glacial grooves," having a north and south course, observed by Fletcher at Eddy Point, Guysboro County, N. S., in the mouth of the Strait of Canso. On our way

to Halifax, on Friday, August 2nd, we were fortunately detained at the Railway Terminus, Port Mulgrave. Here we observed a section of heavy Drift, with Archæan boulders in abundance. We had sufficient time to collect a good representation of these for our Provincial Museum. The specimens are identical with those collected at Strathlorne and Mabou. Looking at Fletcher's map, we find that this section of Drift lies southeast of the Archæan area of Cape Porcupine, and about a mile distant. We regard this as conclusive evidence of the glacial action *Hypothesis*.

This seems to remove a difficulty in the way of introducing the *Mastodon ohioiticus* into Cape Breton, in consequence of the intervention of the Strait of Canso. We have only to refer the introduction to *pre-glacial* times, when the Strait of Canso may have had no existence.