Some Effects of Ice Action near Grand Lake, Cape Breton.—By W. S. Brodie, B. A.

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In the vicinity of Grand lake, about four miles from Sydney, as also near other lakes within a radius of fifteen miles from that spot, may be noticed some curious formations.

Roughly parallelling the shores of Grand, Waterford and Sand lakes are found mounds of considerable extent. These mounds vary in length, height, and width, running through swamp, forest and open ground. Sometimes they leave the lake shore distant hundreds of yards, at other places sloping to the water's edge. To consider the nature and origin of these mounds is the object of this paper. I will refer particularly to that at Grand Lake as being a type of all.

Size.—In length, I have traced this one in a fairly continuous line, though with frequent breaks, for over a mile.

Height.—Five or six feet above present lake level is their limit. Above the ground at base, the extreme height is about 4½ feet. The elevation of crest seems to bear no uniform ratio to distance from present shore line. I had no means of taking levels along the summit, but judging by the eye it is nearly level. There is at least no decided slope in either direction.

Width.—Where the mound is most pronounced, I found its base to measure about 15 feet in cross-section, its top about six. Allowing a height of five feet, this gives a side slope of 1 in 1.3. Generally, the slope is much less decided. I would judge that when first deposited the slope was sharp. Weathering, erosion, and plant growth has evidently flattened it to a large degree. I could not determine whether the side slopes differed in any uniform way on the same mound. Sometimes one side, some-

times the other was steeper, but for the most part they are almost as much alike as the two sides of a railway fill.

Structure —Physically the material is of all sizes and shapes from sand grains to boulders three and four feet in diameter. As a rule it is gravelly, containing more stones than the surrounding soil. There is no stratification, nor very marked assortment of material.

Mineralogically, the materials do not differ from those of the adjacent soil. All the stones show a weathered surface. Many are somewhat rounded, but this appears to be the result of weathering rather than of water action. I found no facetted surfaces, nor were there any glacial striæ; the stones, however, were not of sufficiently close texture to receive or retain such markings. A good deal of the soil in the mound seems to have resulted from the decay of boulders "in situ."

Age.—On the mound are trees growing many feet in height. One, which had recently been cut down, measured fifteen inches across the butt, 2½ feet from the ground. The roots of this tree, as of many others, spread out immediately at or below the surface, indicating that it had grown on the mound after it had been heaped up. This would show the deposit to be at least as old as the tree. For a birch to grow to that size on sterile soil and in a severe climate, would require 60 or 70 years at least, probably more.

From the weathering of the rocks contained, I would infer a much greater age for the mound than that.

Origin.—By the neighboring country folk, to whom these mounds offer convenient, if somewhat erratic foot-paths, their formation is readily explained. To the industrious beaver of bygone days is given the credit of building these extensive ramparts.

But the beaver, I believe, usually selects a spot on a stream flowing through a narrow gap, to make his work as light as possible in proportion to the increase of depth in water thus secured. These mounds, however, sometimes run through

nearly level country, and occasionally along hillsides, where, had they been absent, the hill itself would have served as a dam. Further, I have found no sticks of timber in any diggings or cuttings that I have examined.

Mounds somewhat resembling these are ascribed to glacial formation. Streams flowing beneath the ice of modern glaciers are loaded to the limit of carrying capacity with morainic material. This is deposited at the bottom of the ice tunnel, and on the final recession of the glacier there is left a sinuous heap of clay, gravel and boulders, to which the name of *esker* is given. Such mounds found throughout Canada and the northern United States are considered to be the work of Pleistocene ice.

But the sub-glacial stream seeking a lower level would scarcely bend upon itself in such fashion as shown in the accompanying blue print.

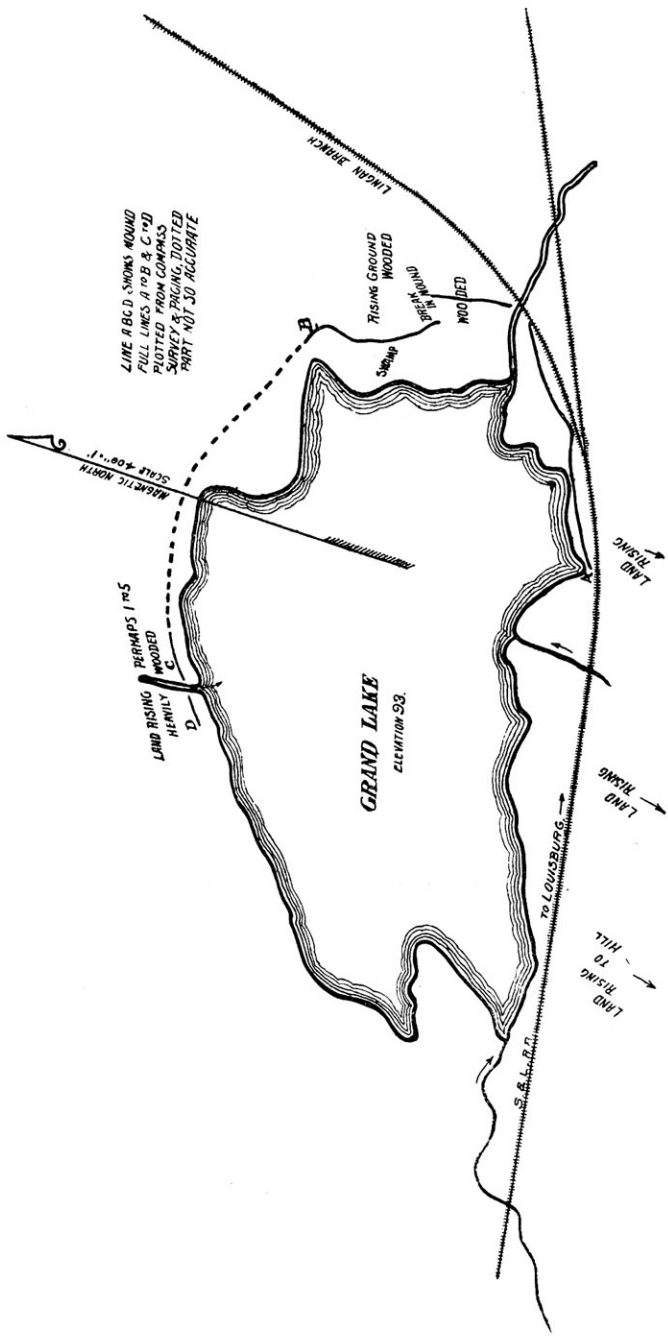
Further, in such a long stream it would surely enlarge its cavern at some points, say where it was obstructed by large boulders, and there spread its load in wide heaps. Although the mounds at Grand lake ramify for short distances, there are no such widenings as might be expected as above. Again the uniformity in height argues against the esker theory.

At the present margin of the lake there are narrow gravel beaches. On one occasion in midwinter, after a thaw of a few days' duration followed by sharp frost, I noticed that the ice in tne lake had pushed against this frozen mass of pebbles. The surface layer, cemented by frost, had buckled under the ice pressure in the form of a ridge, a few inches in height. I have a small photo attached showing this. The question arises, could the large mounds have been formed by the same agency as these small ones? I made several visits to the lake to observe any upbuilding comparable with the mounds in question. I could not find any effects of modern ice shove at all approaching in size the mound under discussion.

Salisbury, in his *Glacial Geology of New Jersey*, p. 98, makes mention of Endmoränes or Geschiebewalls. They have originated through marginal masses of ice becoming separated from the main body during a retreat, probably the final one, of the ice. Here we have a debris loaded iceberg melting where it stands and showering down around it gravel and boulders. These, heaped up in a ridge more or less circular in form, serve as a retaining wall for the water of the lake left at the final melting of the ice.

Or if this ice mass, instead of being entirely separated from the main body, projected as a lobe, we would again have conditions to form such a wall. If the lobe kept melting back as fast as it was pushed forward, its load would be discharged in a continuous line along a stationary front. Naturally where the lobe united with the main body of the ice, we would expect to find the wall missing.

I greatly regret that I was compelled to leave my investigations before completing the survey of the upper end of the lake, from which direction the glacial movement took place.


LINE ABCD SHOWS ROUND
FULL LINES A TO B & C TO D
PLOTTED FROM COMPASS
SURVEY & PACING, DOTTED
PART NOT SO ACCURATE
LINDEN BRANCH
RISING GROUND
WOODED
BREAK ROUND
MARSH
WOODED
MAGNETIC NORTH
SCALE 4 OR 5 CH.
PERHAPS 1 OR 5
WOODED
LAND RISING
HEAVILY
GRAND LAKE
ELEVATION 93.
LAND
RISING
LAND
RISING
LAND
RISING
TO
HILL
TO LOUISBURG
S.B. & L.R.R.