

THE QUESTION OF SUBSIDENCE AT LOUISBOURG, CAPE BRETON.—

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Engaged during a portion of the year 1901 in making surveys on the site of the old fortress of Louisbourg, Cape Breton Co., N. S., I incidentally took somewhat copious notes of topographical features, and although I made nothing in the nature of a contour survey, still I am satisfied that the result of my work is a plan, which, simply as a plan, is in some respects instructive.

During the current year, 1903, I received a letter from Dr. Henry S. Poole, on the reputed subsidence of land in the neighborhood of Louisbourg, and asking for my impressions on this question.

This being the first intimation I ever had that a recent subsidence of land in that region was regarded by anyone as a fact, I was under this disadvantage, viz., that my observations, although copious, were not made with a view to throwing light on this subject.

However, upon carefully scanning my notes taken on the ground, I find it difficult to surmise upon what observed facts the conclusion of subsidence could possibly be based.

In this connection, it will, of course, be understood that we are utterly waiving any discussion of the subsidences and elevations of the remote past, and that we are dealing with the hypothesis of a subsidence in present progress, and it is scarcely necessary to state that the question can only be decided, if at all, by a comparison of the present height above sea level of some portion of the shore which has neither been built nor worn away, with its elevation above tide level at some remote period.

I am of the opinion that there are some features of the fortifications at Louisbourg yet remaining, by which we can make a test of this point.

The peninsula upon which the fortress was situated has so frequently been described that I need not give any lengthened description of it, but it would appear necessary to note certain features of a topographical and geological character.

Extending from the historic White Point easterly to Black Rock, the whole shore is an alternation of beaches of rounded cobble-stones and of hard enduring rocky reefs, the remnants of redoubts belonging to an overpowered battle-front of the coast.

Inland along the same line there is an alternation of gravelly hills and low flat peat-covered swamps, almost wholly destitute of trees, and at a point nearly due south from the citadel of the fort there is a continuous stretch of swamp formed of peat of a depth varying from one to probably over six feet, and rising from an elevation but little above ordinary tide to a maximum height of twenty to thirty feet at the foot of the southern glacia.

Rochebort Point, the eastern extremity of the peninsula, is a rock about fifteen feet in height, thinly covered with soil, but from it along the harbour shore towards the west, bed rock, except in the sea ledges, disappears, and the northern portion of the ruined town and fortifications is evidently situated on a considerable depth of glacial drift, more of the nature of gravel than of clay.

On consulting a plan of Louisbourg,* dated 1745, by Lieutenant R. Gridley, of Pepperell's Artillery, we will observe a pond, with a beach of considerable extent, lying between it and the harbour. At the southeastern extremity of this pond was erected the Maurepas Bastion. It would be more correct to state that this bastion was built out in the pond, since the waters of the pond surround it on its front, its left flank, and its rear—and its

* A copy of Gridley's plan is in the Provincial Museum, Halifax, N. S., and a reproduction of it in *Trans. Roy. Soc. of Canada*, vol. ix (1891), sec. 2, plate 4.

position is such that the beach to the north of the pond might well serve it as a glacis.

From the Maurepas Bastion towards the south, a wall, a moat, and another bastion—the Bourillon—completely covered the neck of the isthmus at this point.

Although any argument based on a comparison of the heights of the pond and of ordinary high tide, must necessarily be inconclusive as to the question of subsidence, still the hypothesis does not derive support from the fact that the bottom of the sluiceway, at the western extremity of the pond, is now sufficiently high to carry away the waters of the pond at all but abnormally high tides.

At present, however, a barrier of sand and stones lies across the point of exit, and the drainage of the pond is by filtration through the gravel of the beach, and this latter fact gives rise to some reflections of a general character.

In the case of ponds along the ocean shore, separated from the ocean by a beach, and into which no brook of any considerable volume empties itself, this percolation through the sand is sufficient in the ordinary case to prevent the waters of the pond from overflowing the beach. We have frequently observed cases of this kind. And it may, too, be observed, that in the case of any particular pond of this class, a certain fixed relation exists, under normal conditions, between the height of the water in the pond and the mean level of the ocean water outside.

The waters of the Bras d'Or Lake as compared with the Atlantic Ocean, although a regular channel connects them, are subject to this very law, and the stone structure at the St. Peter's canal locks is arranged with regard to this condition.

The reasons for this state of things are to my mind so plain that I do not consider it necessary to explain them.

I trust I am not making too long a step in the reasoning process here introduced if I state that any elevation of the Atlantic Ocean with reference to the Island of Cape Breton, or

better to illustrate our case, any depression of the Island of Cape Breton with reference to the ocean, would have the effect of correspondingly submerging islands and promontaries in Bras d'Or Lake, provided, of course, that the rivers flowed as before, and the channel connecting Bras d'Or Lake with the ocean did not have an increased or a decreased capacity. Briefly, granting the conditions above stated, the relation of waters as to height would remain the same as before, even supposing the mean height of the lake water was some feet above the mean height of the ocean water in the first instance.

Let us now apply this law to the case of the pond at Louisbourg. The flow of water into the pond is small, and cannot have changed for centuries; its present way of egress is, at any rate, not *more* free than when a sluice-way connected the pond with the Atlantic Ocean; consequently any subsidence of the general area must be accompanied by a corresponding submergence of all objects standing out in the pond. Yet if my memory does not deceive me, the gorge of the Maurepas Bastion presents the same little pond in the plan by Lieutenant Gridley, made in 1745, that my notes present in the year 1901—there is no evidence of subsidence. We will now direct our attention to the neighborhood of the sluice-way, at the western extremity of the pond, and I will first state the facts as they appear: at this end of the pond, and extending for some distance along its northern shore, the land, instead of being a desert of sand and shingle as is the remainder of the beach, is covered with grass to the line of wave action, and there are still remaining, in its grassy swells, those characteristic zig-zags so puzzling to the unmilitary eye, and upon which French military engineers spent much thought one hundred and fifty years ago.

Carrying our investigations further towards the waters of the harbour we find a line of post-stubs, showing their ends above the rounded beach-rocks, and here, again, the characteristic zig-zag presents itself. Further investigation reveals the

fact that the intervals between posts were planked and walled with stones. If we have an unusually low tide, however, we can see a most interesting exposure. A structure of close-faced cribwork presents itself. I should prefer to call the structure cellular since the intersections of axe-hewn timber are at intervals of about three feet, and a ledge of concrete still remains in the beach overlying the timber structure.

The cribwork structure above referred to will be found to have two faces presented seaward forming an angle of about 125 degrees, and the apex of this angle is at present somewhat below the level of the lowest tide.

The lines of posts above referred to are continuations of these sides; and extending from the apex along the face of the structure towards the west is a row of piles of round timber driven as closely as possible to one another. This, in brief, is what remains of the "La Greve" or Beach Battery.

Turning again to the Atlantic coast we find a line of post-stubs similar to those existing at the site of the Beach Battery, lying between the Prince's Bastion and the sea, and continuing its zig-zags northerly towards the Bourillon Bastion, and for some distance southerly towards Black Rock; and opposite the extremity of the moat which fronts the Prince's Bastion are still to be seen in the beach the planks which formed the sluiceway by which the waters of the moat escaped into the Atlantic Ocean, and if the moat were in practical use today that sluiceway is sufficiently far above tide level to perform the service for which it was originally intended. Owing to the fact that the ground originally at the point referred to was quite low, and that the ground had evidently been taken from a distance to raise the glacis, it is obvious that there existed a necessity for leaving as *small a margin* as possible between the bottom of the sluiceway and *ordinary high tide* mark. ⁽¹⁾ This, to my

(1) The Vauban system of fortification used by the French, demanded a most pedantic and fixed proportion between heights and slopes of glacis and main work, so I suspect the moat was made at as low a level as possible. There is a similar French moat at Mauritius where there has been no subsidence.—Major O. C. Williamson, R. A.

mind, leaves but a *very narrow margin* of possibility for the truth of the hypothesis of subsidence.

Let us now return to the Beach Battery, and here we can anticipate the questions: Why does that battery appear partially submerged today? Why should the French engineers build batteries out in the sea when there was sufficient dry land upon which to build them?

To the first question we can easily reply, that the fact that a row of ordinary piles was driven along its northern face has in it more than a mere suggestion that the structure was originally placed out in the water. There is the additional fact that the timbers which constitute the cribwork structure do not lie horizontally, but wherever they are exposed they are found to have a seaward slope corresponding closely to the slope of the sea floor upon which they rest. If placed on dry land these timbers would in all probability be placed horizontally.

But as synthetic reasoning demands an hypothesis capable of embracing all the observed facts, I would in answer to the second question invite your attention to the supposition that the Beach Battery was built to combat another foe⁽²⁾ besides the British.

Reference to a present day plan of the harbour will show a conspicuous concavity in that portion of the beach lying southeasterly from the position of the battery and a prominence at the point where its remains are to be found which must strike the eye of the most casual observer.

These facts taken in concert with those already enumerated in this connection seem to justify the following retrospect:—The beach was gradually wearing away, and its drift caused by the eroding action of the ground-swell arising from easterly gales was constantly travelling along the shore towards the west. This must be stopped and the wisdom of the engineer who planned this structure has its monument in the fact

(2) In fact an ordinary "spur" for preventing denudation and not a fortification at all, in original intention at any rate.—Major O. C. Williamson, R. A.

that the grassy mounds raised on the shingly inner slope of the beach by the labor of man are today green, but are gradually wearing away as their artificial faithful protector yields to time and the warring elements.

In view of the considerations above stated it seems plain, to my mind, that the partial submergence of the Beach Battery today does not necessarily constitute an argument in behalf of subsidence.⁽³⁾

It seems to me not a partizan view of the case to say that the assertion that land on the eastern sea-board of Cape Breton had subsided, could much more easily go unchallenged were there no Louisbourg in the case with its ditches, its ruined curtain walls originally placed within easy reach of the ocean spray, and its batteries, as probable reference points to serve as data from which to judge of terrestrial stability or change,

(3) Such a "spur" would, if artificial, naturally subside in time.—Major O. C. Williamson, R. A.