

carry on their battle. On such beaches, when not too coarse, little ridges may be seen marking the limits reached by the breakers; little rills are furrowed in the sand or mud by the waters as they recede; irregular cracks, if the shore be muddy, are determined when such shores, during the retreat of the tide, are exposed to the drying action of the sun; even the pattering of drops of rain may leave their impress upon the surface to be overlaid and preserved by the deposits of the next tide; masses of floating seaweed may accumulate here and there, the borings and trailings of marine worms may be recognized, often in great numbers, or a shell may be found now and then, half buried in the sand. Such features are familiar characteristics of all beaches. They can be determined in no other way; and therefore when we meet them, we at once recognize their origin even though the locality where they are found be now quite above or it may be far removed from the action of the sea. Examples of this are to be seen in the immediate vicinity of St. John, where shell-fish and star-fishes may be gathered from the clays used in brick-making, though these are never now submerged, while both east and west of St. John are old elevated beaches two hundred feet or more above the level of the tide. But these are comparatively modern. We have yet to point out our *primeval* beach and to ascertain what it may reveal.

To reach it we have only to descend from the Park or from Mt. Pleasant into the valley already referred to as separating these from the main body of the city. In doing so we shall find, as along the Lily Lake road, that the crystalline rocks and limestones which meet the eye on every side in the park itself, are followed by rocks of quite a different character, viz., (1) a narrow band of somewhat ash-like and in reality semi-volcanic beds, and (2) a series of dark grey to black slates and sandstones. These are but hardened beds of sand and mud—therefore formed like all other beds of sand or mud—and in them or the similar beds which underlie most of the city, may be found all the evidences of beach origin which have been described above. We may note where beds of sand have been heaped up by winds or shifting currents; we may find rain prints, rill marks, shrinkage cracks, etc., just as on a modern beach. We can recognize the trailings of worms and we can gather, as on a

recent shore, fragments of seaweeds or of stranded shells and other animals.

Now the presence of a beach argues adjacent land, and, if the beds in question are what we have claimed them to be, there must have been some source near at hand from which their materials could be derived. We naturally suppose that source to have been the ridge against which they rest and which they partly cover, i. e., the ridge now adorned by the Park, and proof of this is not wanting, as rolled but easily recognized fragments of its crystalline rocks are contained in the conglomerates or pebble beds which at some points mark the junction of the two formations. What was the extent of that land and what was the condition of America as a whole in that remote period?

Before proceeding to answer these questions I may first observe that a study of the organisms found in the ancient beach last referred to, and which we shall presently consider more fully, shows that their character is essentially the same as that of a group of rocks found in Wales, the Cambria of the early Britons, and for that reason known among geologists as the Cambrian period. Evidently everything which can clearly be shown to antedate this period may therefore be appropriately designated as *Pre-Cambrian*, and by that name we may conveniently continue our study of the Pre-Cambrian rocks of Acadia and of the continent.

So far as New Brunswick is concerned the only rocks clearly referable to a period so remote—estimated by geologists anywhere from ten millions to twenty-four millions of years,—are confined to the southern counties, now forming a series of low parallel ridges near the coast, of which the Portland ridge, including the Park and Mt. Pleasant is one, the Kingston peninsula a second, and portions of the region north of the Long Reach of the St. John river a third. They are now separated by the troughs of Loch Lomond, the Kennebecasis and the Long Reach, and in each of these troughs fossil bearing Cambrian rocks are to be found. In Nova Scotia the rocks of the Pre-Cambrian system are still less extensive, being apparently confined to the island of Cape Breton, including there the bold and picturesque bluffs which overlook the sea just north of the entrance of Bras d'Or Lake. In Quebec and Ontario, however, they occupy vast areas, forming an extensive V-shaped tract extending from Labra-