

ART. XXIII.—*On the Glacial Lake St. Lawrence of Professor Warren Upham*; by ROBERT CHALMERS, of the Geological Survey of Canada.

IN an article in this Journal for January, 1895, entitled "Late Glacial or Champlain Subsidence and Re-elevation of the St. Lawrence River Basin," Mr. Warren Upham continues his discussions respecting hypothetical glacial lakes and glacial dams, and in endeavoring to account for the raised beaches in the region of the Great Lakes, etc., postulates still another glacial lake in the St. Lawrence valley between Lake Ontario and Quebec, held in by a glacial dam at or near the latter place. To this sheet of water he gives the name of the St. Lawrence Lake. Permit me to offer a few facts and inferences touching the question of this ice-dam and lake.

(1.) There is no evidence of a thick mass of ice having occupied the St. Lawrence valley at Quebec in the Pleistocene period. For the last ten years the writer has, at intervals, been investigating the glacial phenomena and the post-glacial shore lines, etc., of the south side of the St. Lawrence valley, especially between Mètis and the Chaudière river. During the past summer the work was revised and extended to the higher grounds of the Notre Dame Mountains in Quebec, and also to northern New Brunswick and northeastern Maine. The results do not afford any proofs of the movement of a great ice-sheet over this region at any time during the glacial period; on the contrary, the glacial phenomena on the slopes and higher grounds seem to be entirely due to local sheets of land-ice, of greater or less extent, moving in different directions, the course, on the slope facing the St. Lawrence, being mainly northward. In the bottom of the St. Lawrence valley, however, a northeast and southwest set of striæ occurs, which seems referable to the action of floating ice.

The theory that the later ice movements obliterated the earlier striæ does not find any support from the facts obtained on the south side of the St. Lawrence, so far as my examinations have extended. The glaciated surfaces everywhere exhibit criss-cross striæ, in fact these are the rule rather than the exception. The later sets, whether made by separate glaciers, or by succeeding portions of the same sheet conforming more closely to the minor topographical features as it decreased in thickness, show that the earlier striæ have not been effaced by later ice, except, perhaps to a very limited extent on exposed bosses.*

* In Mr. Upham's review of the third edition of "The Great Ice Age" by Prof. James Geikie (Am. Geologist, Jan., 1895, p. 52), he states that "the northward

The glaciation of the southern flank of the Laurentide Range on the north side of the St. Lawrence river at Quebec seems to be of much the same character as that of the south side of the river. Mr. A. P. Low, of this survey, who has examined this district in some detail, gives a list of striæ in the Annual Report of the Geological Survey of Canada, vol. v, page 48L, from which it appears that the ice movements were quite divergent in that particular locality. The Laurentide ice-sheet does not seem to have descended into the St. Lawrence valley there, unless as broken, detached glaciers. The smaller river valleys and the slopes have also influenced the ice-flow on the north side of the St. Lawrence as well as on the south side. Some of the narrow valleys between the ridges which trend along the foot hills, and are parallel thereto, have caused local glaciers to move northeastwardly in certain places, in others southwestwardly. No single dominant course was observed.

(2.) In Mr. Upham's map (Plate I) he gives the direction of the striæ on the south side of the St. Lawrence below Quebec as northeastward. Has he examined this region himself? If not, on whose authority has he reversed the courses of the striæ there, these being shown on Sir Wm. Dawson's map (*The Canadian Ice Age*, page 150) as pointing southwestward, and are supposed to have been produced by floating ice moving up the valley? The author's information in regard to these striæ, from whatever source it may have been obtained, is incorrect. No general sheet of land ice flowed to the northeastward in that part of the St. Lawrence valley. All the striæ *in the bottom of the valley* trending northeast and southwest are regarded as due to floating ice, and were produced in the last stage of the glacial period when the land stood at a lower level. In a few instances the southwest sides of the bosses are stossed by this floating ice as it moved down stream but the principal movement was up stream. This system of striation is traceable along the St. Lawrence valley from Metis, or lower down, westward to Montreal.

(3.) No lacustrine deposits have been found anywhere in the St. Lawrence valley beneath the Leda clay, as far as investigations have been made.

glacial flow from northern New England towards the St. Lawrence, as suggested by Chalmers, appears to have belonged only to a very late stage when the melting of the ice in the St. Lawrence valley, proceeding faster than on the mountainous area at the south, left there a large isolated remnant of the departing ice-sheet." I have nowhere stated that I regard the northward ice-flow referred to as belonging to a very late stage of the glacial period; on the contrary, I hold that wherever the northward ice-movements occurred they belong to the maximum stage of the ice age as well as to the melting or later stage; but my own observations have not extended further west than Lake Megantic.

All the facts taken together, therefore, show that the hypothesis of an ice dam at Quebec holding in a lake in the St. Lawrence valley between that point and Lake Ontario, as set forth by Mr. Upham, is untenable.

The glaciation of the St. Lawrence valley is exceedingly complex, and cannot be explained by *à priori* theories. The problems it presents must be solved by actual field investigations. The region is a most interesting one, however, and I invite glacialists to come and see the facts for themselves before propounding any grand generalizations respecting its Pleistocene geology.

Ottawa, Jan. 16, 1895.