1 'TE PLEISTOCENE OSCILLATIONS.

tica "now only ces Centigrade the mouth of ing Portlandia in the vicinity portion of the el, the highest tioned locality in the sandy is many of the ompared with amelioration ie lower clays 75 feet above

fossil shells. In the sandy of the upper considerable small forms d characteris absent ...

clays have y at depths the vicinity ast 510 feet to 275 feet ve stood at n the lower the lowest tudes were have been r they are

" Geol. Surv ..

overlain by the upper clay, and the occurrence of abundant remains of Macoma Balthica in the littoral deposits in the district at altitudes of 470 feet and lower, and of Mytilus edulis Lin. at an altitude of at least 325 feet above the sea, shows that the climate was not high-arctic during the time of emergence of the land as Mytilus edulis on high-arctic shores is not a littoral shell and Macoma Balthica is more characteristically boreal than arctic.¹ The occurrence of the clays at high altitudes far up the Ottawa and Gatineau valleys also shows that the ice-sheet had retreated a considerable distance before emergence of the land had taken place to any great extent. Both the physical character of the clays, and the character of the fauna, therefore, seem to show that the sea must have risen on the land as the ice-sheet withdrew; that at first it stood at about 300 feet or possibly lower and later rose considerably higher.

This is exactly what has been shown by Brögger to have taken place in southern Norway. Brögger has held that the oscillation of sea-level was due to a depression of the land. Wright,² however, has pointed out that it is more probable that the sea rose on the land owing to the return to the ocean of the water which had been bound up in the ice-sheets, for the depression of the sea-level was "an absolutely necessary result of glaciation," as has been shown by the investigations of Penck, Woodworth, and Daly.

The rise of the sea on the land which, apparently, took place in the Ottawa valley was preceded by uplift whicl' affected the Great Lakesregion; for the Ottawa valley must have been, in part at least, occupied by the ice-sheet during the existence of Lakes Iroquois and Algonquin and at least a small amount of uplift affected the region at the foot of ake Ontario during the life of Lake Iroquois.³ Uplift also affe d the northern portion of the Great Lakes region and probably included the upper portion of the Ottawa valley near Mattawa during the existence of Lake Algonquin and while the ice-sheet still occupied the upper

¹ Brögger, W. C., *Ibid*, p. 693. ² Wright, W. B., "The Quaternary Ice Age."

Coleman, A. P., "The Iroquois Beach in Ontario," Bull. Geol. Soc. Am., vol. XV, 1903, pp. 347-368.