

the ice pressed southeastwardly over the state line into Massachusetts. Pressing southward through the Hudson valley the Highlands must again have profoundly influenced the movement of the ice both in its retreat and in its advance. The ice passed through the Highland gorge leaving a characteristic glaciated topography in the smoother northern slopes of the high ridges which overlook the river and plucking out boulders from their southern slopes, thus giving the frowning cliffs which meet the eye as one ascends the river. The extension of the lowland developed over the soft Hudson slates to the southwest along the northern side of the Highlands would have afforded a passage for the ice in that direction. The ice passing through the Highlands and at the maximum of glaciation over the highest ridges, must have had a relatively rapid motion through the lower Hudson valley. The axis of this flow passed; as Salisbury has shown by detailed mapping of the striae, to the west of the Palisade border of the gorge over the Hackensack lowlands of New Jersey. On the west of this line the ice moved southwestwardly over Newark N. J., and on the east of the line southeastwardly over New York city to the moraine on Long Island.

The form of the valley and the Hudson gorge must have influenced strongly the retreat of the ice, and many of the glacial deposits, described in the following pages, demonstrate this point so clearly that, in view of the light which they throw on the several stages of the melting ice as it dwindled away from a complete covering of the eastern part of the State to long tongues of ice comparable to a valley glacier, it becomes possible to outline the history of the retreat in relation to the varying cross-section of the Hudson valley and in regard to the control which the distribution of the ice mass exerted on the character and order of arrangement of deposits made either by the ice in moving debris to its margin, or by the streams which built deposits along that margin.

#### THEORETIC MODE OF RETREAT OF REGIONAL GLACIER FROM A VALLEY

Enough is now known of regional glaciers such as that which spread from the region north of the St Lawrence into New England and New York to enable us to depict the general mode of retreat of the ice sheet in different districts, having deep meridi-