

course of about 25° to 30° . The narrow lake trends about S. by W., not far from the direction of movement in the ice-sheet over the region.

Over Manitoba, the following courses of scratches are reported by S. B. Tyrrell : About Lake Manitoba, S. to S. 13° E. ; about Lake Winnipegosis, S. 13° E. to S. 58° W. ; about Swan Lake, west of Winnipegosis, S. 48° - 53° W. ; on Red Deer River, S. 68° - 78° W. ; Grand Rapids on the Saskatchewan, S. 2° - 62° W. ; at Roche-rouge, S. 12° W. ; Cedar Lake, S. 19° - 39° W. The southward and southeasterly course is evidently due to a valley movement along the lakes. For others, over the interior of North America, see Upham's paper on Lake Agassiz, *Can. Geol. Rep.* for 1888-1889, and other Reports of the Canada Geological Survey.

In the use of scratches to determine direction of flow, the directions on page 942 should be observed. When scratches having different courses occur at the same locality, it is also to be remembered that direction of general movement in the ice-mass depends on the slope of the *upper surface*, as is true for any liquid ; and therefore that the thinning of the ice from melting may change the direction of movement at bottom. But where thinning has diminished the slope of the ice-surface below the angle required for flow, the ice is that only of a dead glacier.

Boulders were observed in Northampton and Monroe counties, Pa., by Lewis and Wright, which must have come from the Adirondacks. One of them of "labradorite syenite," $2\frac{1}{2}'$ in diameter, was found in Upper Mount Bethel just south of Kittatinny Mountain ; another, similar, measuring $4' \times 3' \times 3'$, on the moraine near Taylorsburg, between Kittatinny Mountain and Pocono Mountain ; and another, of gray Adirondack granite, containing magnetite, near Fork's Station, in Paradise, 5 miles north of Pocono summit, at a height of 1550' ; and boulders of gneiss are abundant over the Pocono plateau, 2000' above sea level. (*Geol. Rep. Pa.*, vol. Z, *On the Terminal Moraine in Pa. and N. Y.*, by H. C. Lewis, 1884, with an Appendix on the Terminal Moraine in Ohio and Kentucky, by G. F. Wright.)

General direction of flow. — From the Laurentide ice-plateau, or that which covered the Canada watershed and extended westward and northward, the flow was not only eastward and westward, but also northward, from its northern part toward the Arctic seas ; and along the great eastward bend in the plateau over Canada south of Hudson Bay to Labrador, it was south-westward on the western part, and farther east, southward and southeastward. The observed courses of transported stones and lines of abrasion are the means of locating the summit region of the ice-plateau.

High mountains outside the plateau also influenced the flow, for they are regions of greatest precipitation. The White Mountains, Green Mountains, and Adirondacks, combined into a common plateau by the ice, was one of these mountain regions, apparently determining southeastward directions of movement over New England and southwestward over Pennsylvania and much of New York. In western New York and over the higher parts of Ohio the flow was again east of south ; but beyond Indiana to Dakota the direction was in general southward and southwestward, as if from an ice-plateau in the Lake Superior region.

But above these plateaus, and farther north, dominated the higher Laurentide ice-plateau, which appears to have been the chief source of movement southward for the region during the time of maximum ice, although there were many subordinate sources.