

common; twelve inches corresponds to 365 feet a year, or one mile in about $14\frac{1}{2}$ years.

Forbes found for the maximum in July, at his upper station on the Bois Glacier, 52.1 inches a day, and in December 11.5 inches. In the large Muir Glacier, according to G. F. Wright, the average in August, 1886, was 20 feet per day; and according to H. F. Reid, in August, 1890, 10 feet.

The Greenland glaciers are rapid in movement because the outlets from the great interior mass are so narrow. At Disco Bay, the Jakobshavn Glacier moves in summer at middle 65 feet per day, and a fourth of a mile from the side, nearly 50 feet. Helland estimated the daily discharge of ice into the sea, as icebergs, at 432,000,000 cubic feet. Rates of 35.70 and 100 feet per day have been reported. The rate of 99 feet per day was observed in August, 1887, in the fiord east of Upernavik by the Danish Lieutenants, Ryder and Bloch. In glaciers of so great magnitude friction is reduced to a minimum.

In the summer the snow over the ice melts, sending streams and drippings down the crevasses and into all accessible cracks in the ice; as far within as the outside heat penetrates, the many air-cells inside warm up and melt the ice around them, and the dirt grains and all foreign substances absorb and use the heat in like manner. Moreover, the glaciers lose much at surface by evaporation.

4. *Intermittent advance.*—In glaciers the cycle of advance and retreat is many years in length. The meteorological conditions favoring maximum mass of *névé*, and thereby maximum rate of flow and elongation, are, as already explained: *first*, long and wet winters in the *névé* region, causing an extension of the *névé* area, which is that of the only permanent annual contributions, and which has great breadth compared with that of the trunk glacier below; *second*, short and dry summers, especially below the level of the *névé*. Thus come the largest gain and the smallest loss.

Observation has proved that the cycle of gain and loss is a long one, 20 to 50 years. Forel has reported that in the Alps there have been in this century five half cycles; 1800 probably to 1815, enlargement; 1815–30, diminution; 1830–45, enlargement; 1845–75, diminution; and that from 1875 to 1890 enlargement was beginning in different glaciers. He observes that the alternating periods correspond to that of a cold and rainy period, and that of a warm and dry, as meteorologically deduced by C. Lang (1886).

5. *Capability of flow in an ice-mass.*—Yielding to gravity in material so solid as the ice of a glacier, over uneven slopes and along valleys ever-varying in obstacles, is explained on the ground of the following qualities of ice and glaciers. (a) The fragility of ice, in consequence of which it breaks readily and so accommodates itself to obstacles; (b) the dissemination of much *water through the mass* of the glacier, which increases the fragility and approximates the condition to that of a viscid body; (c) *the plasticity of ice*, or the quality of molecular adaptation to conditions of pressure; (d) slipping along planes of bedding or stratification in the ice; (e) sliding of the