

these loose masses, instead of accumulating on a stationary base, happen to fall upon a glacier, they will move along with it, and in place of a single heap, they will form in the course of years a long stream of blocks. If a glacier be 20 miles long, and its annual progression about 500 feet, it will require about two centuries for a block thus lodged upon its surface to travel down from the higher to the lower regions, or to the extremity of the icy mass. This terminal point remains usually unchanged from year to year, although every part of the ice is in motion, because the liquefaction by heat is just sufficient to balance the onward movement of the glacier, which may be compared to an endless file of soldiers, pouring into a breach, and shot down as fast as they advance.

The stones carried along on the ice are called in Switzerland the "moraines" of the glacier. There is always one line of blocks on each side or edge of the icy stream, and often several in the middle, where they are arranged in long ridges on mounds, often several yards high. The cause of these "medial moraines" was first explained by Agassiz, who referred them to the confluence of tributary glaciers.\*

All sand and fragments of soft stone which fall through fissures and reach the bottom of the glaciers, or which are interposed between the glacier and the steep sides of the valley, are pushed along, and ground down into mud, while the larger and harder fragments have their angles worn off. At the same time the fundamental and boundary rocks are smoothed and polished, and often scored with parallel furrows, or with lines and scratches produced by hard minerals, such as crystals of quartz, which act like the diamond upon glass. This effect is perfectly different from that caused by the action of water, or a muddy torrent forcing along heavy fragments; for when stones are fixed firmly in the ice, and pushed along by it, under great pressure, in straight lines, they scoop out long, rectilinear furrows or grooves parallel to each other.† The discovery of such markings at various heights far above the surface of the existing glaciers and for miles beyond their present terminations, affords geological evidence of the former extension of the ice beyond its present limits in Switzerland and other countries.

The moraine of the glacier, observes Charpentier, is entirely devoid of stratification, for there has been no sorting of the materials, as in the case of sand, mud, and pebbles, when deposited by running water. The ice transports indifferently, and to the same spots, the heaviest blocks and the finest particles, mingling all together, and leaving them in one confused and promiscuous heap wherever it melts. ‡

*Icebergs.*—In countries situated in high northern latitudes, like Spitzbergen, between 70° and 80° N., glaciers, loaded with mud and rock, descend to the sea, and there huge fragments of them float off

\* Etudes sur les Glaciers, 1840.

† Agassiz, Jam. Ed. New Phil. Journ. No. 54 p. 388.

‡ Charpentier, Ann. des Mines, tom. viii.; see also Papers by MM. Venetz and Agassiz.