

occasional showers of rain on its surface. In a day of hot sunshine, or mild rain, innumerable rills of pure and sparkling water run in icy channels along the surface of the glaciers, which in the night shrink, and come to nothing. They are often precipitated in bold cascades into deep fissures in the ice, and contribute together with springs to form torrents, which flow in tunnels at the bottom of the glaciers for many a league, and at length issue at their extremities from beneath beautiful caverns or arches. The waters of these streams are always densely charged with the finest mud, produced by the grinding of rock and sand under the weight of the moving mass.

The length of the Swiss glaciers is sometimes twenty miles, their width in the middle portion where they are broadest, occasionally two or three miles; their depth or thickness sometimes more than 600 feet. When they descend steep slopes, and precipices, or are forced through narrow gorges, the ice is broken up, and assumes the most fantastic and picturesque forms, with lofty peaks and pinnacles projecting above the general level. These snow-white masses are often relieved by a dark back-ground of pines, as in the valley of Chamouni; and are not only surrounded with abundance of the wild rhododendron in full flower, but encroach still lower into the region of cultivation, and trespass on fields where the tobacco-plant is flourishing by the side of the peasant's hut.

The cause of glacier motion has of late been a subject of careful investigation and much keen controversy. Although a question of physics, rather than of geology, it is too interesting to allow me to pass it by without some brief mention. De Saussure, whose travels in the Alps are full of original observations, as well as sound and comprehensive general views, conceived, that the weight of the ice might be sufficient to urge it down the slope of the valley, if the sliding motion were aided by the water flowing at the bottom. For this "gravitation theory" Charpentier, followed by Agassiz, both of whom added many valuable facts to our knowledge of the phenomena of glaciers, substituted the hypothesis of dilatation. The most solid ice is always permeable to water, and penetrated by innumerable fissures and capillary tubes, often extremely minute. These tubes imbibe the aqueous fluid during the day, which freezes, it is said, in the cold of the night, and expands while in the act of congelation. The distension of the whole mass exerts an immense force, tending to propel the glacier in the direction of least resistance — "in other words, down the valley." This theory was opposed by Mr. Hopkins on mathematical and mechanical grounds, in several able papers. Among other objections, he pointed out that the friction of so enormous a body as a glacier on its bed is so great, that the vertical direction would always be that of least resistance, and if a considerable distension of the mass should take place, by the action of freezing, it would tend to increase its thickness, rather than accelerate its downward progress. He also contended (and his arguments were illustrated by many ingenious experiments) that the slope along which a glacier can move, solely by the influence of gravitation may be ex-