sides. As the forces both of pressure and propulsion are enormous, the sand, acting like emery, polishes the surface; the pebbles, like coarse gravers, scratch and furrow it; and the large stones scoop out grooves in it. Another effect also of this action, not yet adverted to, is called "roches moutonnées." Projecting eminences of rock are smoothed and worn into the shape of flattened domes, where the glaciers have passed over them.

Although the surface of almost every kind of rock, when exposed in the open air, wastes away by decomposition, yet some retain for ages their polished and furrowed exterior; and, if they are well protected by a covering of clay or turf, these marks of abrasion seem capable of enduring forever. They have been traced in the Alps to great heights above the present glaciers, and to great horizontal distances beyond them.

There are also found, on the sides of the Swiss valleys, round and deep holes, with polished sides, such holes as waterfalls make in the solid rock, but in places remote from running waters, and where the form of the surface will not permit us to suppose that any cascade could ever have existed. Similar cavities are common in hard rocks, such as gneiss, in Sweden, where they are called *giant caldrons*, and are sometimes 10 feet and more in depth; but in the Alps and Jura they often pass into spoon-shaped excavations and prolonged gutters. We learn from M. Agassiz that hollows of this form are now cut out by streams of water, which, after flowing along the surface of a glacier, fall into open fissures in the ice and form a cascade. Here the falling water, causing the gravel and sand at the bottom to rotate, cuts out a round cavity in the rock. But as the glacier moves on, the cascade becomes locomotive, and what would otherwise have been a circular hole is prolonged into a deep groove. The form of the rocky bottom of the valley down which the glacier is moving causes the rents in the ice and these locomotive cascades to be formed again and again, year after year, in exactly the same spots.

Another effect of a glacier is to lodge a ring of stones round the summit of a conical peak which may happen to project through the ice. If the glacier is lowered greatly by melting, these circles of large angular fragments, which are called "perched blocks," are left in a singular situation near the top of a steep hill or pinnacle, the lower parts of which may be destitute of boulders.

Alpine blocks on the Jura.—Now some or all the marks above enumerated,—the moraines, erratics, polished surfaces, domes, striæ, caldrons, and perched rocks, are observed in the Alps at great heights above the present glaciers, and far below their actual extremities; also in the great valley of Switzerland, 50 miles broad; and almost everywhere on the Jura, a chain which lies to the north of this valley. The average height of the Jura is about one-third that of the Alps, and it is now entirely destitute of glaciers, yet it presents almost everywhere similar moraines, and the same polished and grooved surfaces, and water-worn cavities. The erratics, moreover, which cover it, present a phenomenon which has astonished and perplexed the geologist for more than half a century. No conclusion can be more incontestable than that these