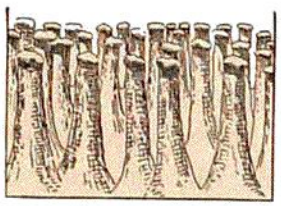
sion on soft earth or mud by denudation, which is circular or elliptical, according as the wind blows or not. These impressions, if they escape obliteration by succeeding drops and are soon covered by a layer of sediment, become "fossil rain-marks," and many surfaces so marked exist in the older rocks, bearing evidence as to former rains, and also as to the *above-water* level of the surface rained on. It may have been a mud-flat exposed between high and low tides. When the drops strike a gravel bed, stones in the gravel will protect the material directly beneath, while erosion around may cut away the material, and leave standing slender columns, each capped with a stone, as monumental evidence of the work done.

A miniature specimen of this work was observed by the author in 1887, alongside of the path leading down into Kilauea. It had been produced by drops falling from shrubbery, wet with the heavy mist of the night, to a bed of earth, three or four feet below. A portion of the scene is represented, natural size, in Fig. 158.

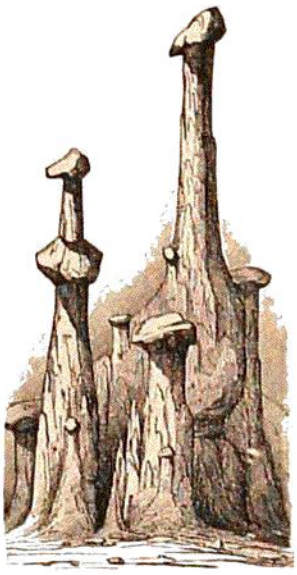
158.



Drop-made columns. D. '87.

Columns of 10 to 30 feet are often made out of beds of gravel, glacial drift, and the like. Fig. 159 represents a case near Antelope Park, on a small tributary of the Rio Grande, where a bed of tufa, over 500 feet thick, contains large stones. The waters of the rains descending along the surface of a vertical wall first made, beneath the stones, bas-reliefs of columns, and then the free columns; and, in the end, an area three miles long and half a mile wide was thickly covered with the columns, many 60 to 80 feet high, and some 400 feet (Endlich, 1875).

159.



Rain-made columns × ·04. Endlich, '75.

The power of water-strokes is well illustrated by the effects in gold-washings from a jet under a head of pressure derived from the water in an elevated reservoir, as in California hydraulic mining. The beds of compact auriferous gravel gradually return to their original condition of loose earth and stones, although struck only by a mass of pure water.

At Niagara, the spray made by the waterfall, carried forcibly into an open chamber behind the fall, causes the wear of the shales (James Hall).

2. *The excavation of valleys; Denudation.* — *Erosion*, excavation and denudation, or land-sculpture, are parts of one process. The simplest illustrations of the subject are afforded by the great, gently sloping, volcanic mountains, made up chiefly of stratified streams of basaltic lavas. In them, the slopes are but 5° to 10°, and conditions determining direction of drainage are in general reduced to two, the first and the last of those mentioned on page 177. The facts here presented are from the author's observations of 1839–1841, published in his Exploring Expedition Report, 1849.