Vesuvius, with its less liquid lavas, contrasts wonderfully in its way of working with the volcanoes of Hawaii. In the case of such lavas, the bubbles have to become large before the vapor can break through. Consequently, whenever the break occurs, the accumulated explosive force projects the fragments of the lava-shell, that is, the so-called volcanic ashes, or lapilli, to a height of hundreds or thousands of feet — even 10,000 in some Vesuvian eruptions.

Such high projections are the common fact at most volcanoes. Great viscidity, while leading to the production of large size in the vapor-made bubbles before they are ready for explosion, makes fewer of them form over a given surface of liquid lava; and in times of moderate activity the number may be but half a dozen, or only a single one, at a time, while on a like area, lavas with the Kilauea degree of viscidity would have scores or hundreds. When the author was at Naples, in May, 1834, there was at night an interval of 7 to 8 minutes between the explosions, or the throws (some hundreds of feet in height) of fiery cinders; on the ascent, the following day, the interval was 4 to 5 minutes; and on passing Stromboli, a fortnight later, June 16, it was 15 to 20 minutes, — the activity being less than usual, explosions every 2 or 3 minutes being common. As Spallanzani, Hofmann, and others have seen the rising bubble within Stromboli, the bursting, and, following this, the rush of vapor and the cinder projections, there is no reason to doubt that at Vesuvius, also, each throw of cinders had the same source. Mr. John Milne states that on his ascent of the Japan volcano, Oshima, in May, 1877, on approaching the top, successive explosions were heard every two seconds with occasional pauses, which explosions he found, on reaching the top, to be due to successive outbursts of steam, each outburst projecting to a height of nearly 6000 feet ashes and lava-fragments that descended vertically, unless wafted by the winds.

When the rains come down in torrents during such an eruption, the projected materials make the flowing mud (called *tufa* when it is dried and hardened) that buries fields and forests, and has made fossils of cities, of which Herculaneum and Pompeii are examples. Extensive tufa deposits are made by volcanoes of all kinds, but especially by those of the second and third kinds. Some accumulations, apparently from a single series of discharges, without intermediate streams of lava, have a thickness of 1000 feet or more, and cover thousands of square miles.

To the eastward of the Cascade summits, Oregon, Mr. Condon speaks of traveling over an area of tufa for 50 to 60 miles, and states that the volcanic ash was evenly laid over the whole surface, like a covering of snow; and where attaining its greatest thickness, the sharp features of the older surface ceased to show themselves through it. In many parts of the Rocky Mountain regions, the tufas contain silicified stumps and trunks of large trees (page 135).

(*b*) *Enlarging and vesiculating effects of vapors.* — The vapors also enlarge, by their expansion, the bulk of the liquid lava, and may thus increase the height of the lava-column.

They also make the *vesicles* or *air-cells* of lavas, producing its *vesicular* and *scoriaceous* varieties. These are their noiseless and unseen effects, while they are still inside of the lavas. The vesicular lavas contain relatively