

on the exact site of an equally vast accumulation of comparatively modern lavas and scoriæ is peculiarly worthy of notice as a general phenomenon observed in very different parts of the globe. It proves that, notwithstanding the fact in the past history of volcanoes that one region after another has been for ages and has then ceased to be the chief theatre of igneous action, still the activity of subterranean heat may often be persistent for more than one geological period in the same place, relaxing perhaps in its energies for a while, but then breaking out afresh with an intensity as great as ever.

We have still to consider the mode of origin of the higher volcanic mass, or the upper series of rocks with which the peculiar form of the Caldera is more intimately connected. The principal question here arising is this, whether the mass was dome-shaped from the beginning, having grown by the superposition of one conical envelope of lava and ashes formed over another, or whether, as Von Buch and his followers imagine, its component materials were first spread out in horizontal or nearly horizontal deposits, and then upheaved at once into a dome-shaped mountain with a caldera in its centre. According to the first hypothesis the cone was built up gradually, and completed with all its beds dipping as now, and traversed by all its dikes, before the Caldera originated. According to the other, the Caldera was the result of the same movements which gave a dome-shaped structure to the mass, and which caused the beds to be highly inclined; in other words, the cone and the Caldera were produced simultaneously. So singularly opposite are these views, that the principal agency introduced by the one theory is upheaval, by the other subsidence. The very name of "Elevation Craters" points to the kind of movement to which one school attributes the origin of a cone and caldera; whereas the chief agencies appealed to by the other school are gaseous explosions, engulfment, and aqueous denudation.

The favorable reception of the doctrine of upheaval has arisen from the following circumstances. Streams of lava, it is said, which run down a declivity of more than three degrees are never stony; and, if the slope exceed five or six degrees, they are mere shallow and narrow strings of vesicular or fragmentary slag. Whenever, therefore, we find parallel layers of stony lava, especially if they be of some thickness, high up in the walls of a caldera, we may be sure that they were solidified originally on a very gentle slope; and if they are now inclined at angles of 10° , 20° , or 30° , not only they, but all the interstratified beds of lapilli, scoriæ, tuff, and agglomerate, must have been at first nearly flat, and must have been afterwards lifted up with the solid beds into their present position. It is supposed that such a derangement of the strata could scarcely fail to give rise to a wide opening near the centre of upheaval, and in the case of Palma, the Caldera (which Von Buch called "the hollow axis of the cone") may represent this breach of continuity.

Among other objections to the elevation-crater theory often advanced