

No liquid lavas are in any way directly concerned, and hence the eruptions are only semi-volcanic. Their violence may cease in a few hours.

The eruption at Bandai-san, Japan, in July, 1888, was probably of this kind. The volcano had been extinct for 1000 years. In an hour after it burst out the ash-shower had mostly passed, the pitchy blackness changing so soon to dim twilight; and in 5 hours all was ended. Kikuchi, who describes the eruption, states that no evidence appeared that liquid lavas contributed to the ejected material, or to any of the results.

The blowing off of the summits of volcanoes has been attributed to explosive eruptions. Steam has little expansive power after it escapes into the open air. It expends its energies in work where generated, as in a steam-boiler. Where large open craters exist, the volcanic peaks about it would be little moved by the explosion, except through undermining and a collapse. But if the old mountain had been much denuded, and was essentially solid to its summit, an explosion within it might widely scatter the fragments, besides making great excavations at the center. The stones hurled from Bandai-san are said to have struck the trees, on descending, at an angle of about 30°.

4. Work of the Spent Vapors and Waste Heat of the Volcano: Fumaroles, Ovens, Solfataras.

While the chief part of the spent vapors and heat of the volcano go directly from the boiling or discharged lavas into the air, a portion escapes through fissures about a volcano or a volcanic region. They thus make (1) *fumaroles* (so named from the Latin *fumus*, *smoke*), the greater number of which open upward directly into the air, but some into cavernous places in the crater or in lava-streams; (2) *solfataras* (so named from the Italian *solfo*, *sulphur*), which are made up of a combination of steaming fissures, and cover large areas with the results of decomposition and deposit from the escaping gases. Fumaroles are common about the walls of active craters and the courses of lava-streams, and the escaping vapors may have all temperatures from nearly that of the liquid lava to 212° F. and below. But solfataras are usually more remote from the center of volcanic action, and may occupy regions of long-quiet or essentially extinct craters; and consequently the vapors have a lower temperature.

Vesuvius has its *fumaroles*; but the *solfataras* of the region is to the west of Naples, over the extinct volcanic region of the Phlegrean Fields. Kilauea has fumaroles or steaming fissures along its walls and some of large size just west of the Volcano House; and but a few rods northwest of the same house there is a solfataras region. Both fumaroles and solfataras derive accessions to the vapors from descending waters supplied by rains, and some of the fissures afford only odorless steam.

The rocks (solidified lavas), acted upon by the volcanic vapors, consist mostly of silica, alumina, potash, soda, lime, magnesia, and iron oxide; the presence of potash with little or no soda distinguishes those of the third class (p. 273), and the near absence of potash, those of the second and first classes.

The chief vapor or gas coming directly from the lavas is, in all volcanoes, sulphurous acid (SO₂); and with it may be hydrogen and nitrogen. At Vesuvius, chlorine is given