

Vast numbers of these occur in regions far removed from any modern volcanic action; generally upon lofty mountain ranges; as upon the Alps, the Pyrenees, the Caucasus, the Ozark mountains in this country, where are nearly seventy, in California, etc. Their temperature varies from about summer heat to that of boiling water. Nor can their origin be explained without supposing a deep-seated source of heat in the earth.

*Proof 4.*—*The existence of 400 active volcanoes, and many extinct ones, whose origin is deep seated, and which are connected over extensive areas.* If these were confined to one part of the globe, or if after one eruption the volcano were to remain forever quiet, we might regard the cause as local and the effect of particular chemical changes at those places, aided perhaps by electromagnetic agencies. But if the internal parts of the earth are in a melted state, that is, in the state of lava; and if this mass be slowly cooling, occasional eruptions of the matter ought to be expected to take place by existing volcanoes. Assuming the thickness of the earth's crust to be sixty miles, the contraction of this envelope one 13,000th of an inch, would force out matter enough to form one of the greatest volcanic eruptions on record. More probably, however, the percolations of water to the heated nucleus, or other causes of disturbance, more frequently produce an eruption than simple contraction.

Some geologists have proposed chemical theories to account for the phenomena of volcanoes. We will consider the two most important ones.

*Hypothesis of the Metalloids.*—This hypothesis, originally proposed, though subsequently abandoned, by Sir Humphrey Davy, supposes the internal parts of the earth, whether hot or cold, fluid or solid, to be composed in part of the metallic bases of the alkalies and earths, which combine energetically with oxygen whenever they are brought into contact with water, with the evolution of light and heat. To these metalloids water occasionally percolates in large quantities through fissures in the strata, and its sudden decomposition produces an eruption. Dr. Daubeny, the most strenuous advocate of this theory, has brought forward a great number of considerations which render it quite probable that this cause may often be concerned in producing volcanic phenomena, even if we do not admit that it is the sole cause.

Many of the phenomena of volcanoes may be explained upon this view, as the formation of vapor, the extrication of gases, and the sublimation of sulphur, salts, etc., and the connection of volcanoes with water. But it does not satisfactorily account for the constantly active vents. Moreover, silica, the most common chemical combination in lava, can not be produced by the union of silicium and oxygen under any heat known to chemists. Silicium is unaltered before the blowpipe, and is incombustible in oxygen gas. Aluminum also unites with oxygen very slowly, even under powerful heat.

*Modified Chemical Theory.*—Some geologists, as Lyell, have called in the