

In order to give a general delineation of the causal connection of geognostical phenomena, we will begin with those whose chief characteristic is dynamic, consisting in motion and in change in space. Earthquakes manifest themselves by quick and successive vertical, or horizontal, or rotatory vibrations.* In the very considerable number of earthquakes which I have experienced in both hemispheres, alike on land and at sea, the two first-named kinds of motion have often appeared to me to occur simultaneously. The mine-like explosion—the vertical action from below upward—was most strikingly manifested in the overthrow of the town of Riobamba in 1797, when the bodies of many of the inhabitants were found to have been hurled to Cullca, a hill several hundred feet in height, and on the opposite side of the River Lican. The propagation is most generally effected by undulations in a linear direction,† with a velocity of from twenty to twenty-eight miles in a minute, but partly in circles of commotion or large ellipses, in which the vibrations are propagated with decreasing intensity from a center toward the circumference. There are districts exposed to the action of two intersecting circles of commotion. In Northern Asia, where the Father of History,‡ and subsequently Theophylactus Simocatta,§ described the districts of Scythia as free from earthquakes, I have observed the metalliferous portion of the Altai Mountains under the influence of a two-fold focus of commotion, the Lake of Baikal, and the volcano of the Celestial Mountain (Thianschan).|| When the circles of commotion intersect one another—when, for instance, an elevated plain lies between two volcanoes simultaneously in a state of eruption, several wave-systems may exist together, as in fluids, and not mutually disturb one another. We may even suppose *interfer-*

* [See Daubeney *On Volcanoes*, 2d ed., 1848, p. 509.]—*Tr.*

† [On the linear direction of earthquakes, see Daubeney *On Volcanoes*, p. 515.]—*Tr.*

‡ Herod, iv., 28. The prostration of the colossal statue of Memnon, which has been again restored (Letronne, *La Statue Vocale de Memnon*, 1835, p. 25, 26), presents a fact in opposition to the ancient prejudice that Egypt is free from earthquakes (Pliny, ii., 80); but the valley of the Nile does lie external to the circle of commotion of Byzantium, the Archipelago, and Syria (Ideler ad Aristot., *Meteor.*, p. 584).

§ Saint-Martin, in the learned notes to Lebeau, *Hist. du Bas Empire*, t. ix., p. 401.

|| Humboldt, *Asie Centrale*, t. ii., p. 110–118. In regard to the difference between agitation of the surface and of the strata lying beneath it, see Gay-Lussac, in the *Annales de Chimie et de Physique*, t. xxii., p. 429.