

contemporary, Dr. Hutton, in his speculations as to the origin of granite.* According to him, the plutonic formations, as well as the crystalline schists, were substances precipitated from a chaotic fluid in some primeval or nascent condition of the planet; and the metals, therefore, being closely connected with them, had partaken, according to him, of a like mysterious origin. He also held that the trap rocks were aqueous deposits, and that dikes of porphyry, greenstone, and basalt, were fissures filled with their several contents from above. Hence he naturally inferred that mineral veins had derived their component materials from an incumbent ocean, rather than from a subterranean source; that these materials had been first dissolved in the waters above, instead of having risen up by sublimation from lakes and seas of igneous matter below.

In proportion as the hypothesis of a primeval fluid, or "chaotic menstruum," was abandoned, in reference to the plutonic formations, and when all geologists had come to be of one mind as to the true relation of the volcanic and trappean rocks, reasonable hopes began to be entertained that the phenomena of mineral veins might be explained by known causes, or by chemical, thermal, and electrical agency still at work in the interior of the earth. The grounds of this conclusion will be better understood when the geological facts brought to light by mining operations have been described and explained.

On different kinds of mineral veins. — Every geologist is familiarly acquainted with those veins of quartz which abound in hypogene strata, forming lenticular masses of limited extent. They are sometimes observed, also, in sandstones and shales. Veins of carbonate of lime are equally common in fossiliferous rocks, especially in limestones. Such veins appear to have once been chinks or small cavities, caused, like cracks in clay, by the shrinking of the mass, which has consolidated from a fluid state, or has simply contracted its dimensions in passing from a higher to a lower temperature. Siliceous, calcareous, and occasionally metallic matters, have sometimes found their way simultaneously into such empty spaces, by infiltration from the surrounding rocks, or by segregation, as it is often termed. Mixed with hot water and steam, metallic ores may have permeated a pasty matrix until they reached those receptacles formed by shrinkage, and thus gave rise to that irregular assemblage of veins, called by the Germans a "stockwerk," in allusion to the different floors on which the mining operations are in such cases carried on.

The more ordinary or regular veins are usually worked in vertical shafts, and have evidently been fissures produced by mechanical violence. They traverse all kinds of rocks, both hypogene and fossiliferous, and extend downwards to indefinite or unknown depths. We may assume that they correspond with such rents as we see caused from time to time by the shock of an earthquake. Metalliferous veins, referable to such agency, are occasionally a few inches wide, but more commonly 3 or 4

* Principles, &c., chap. iv.