

festations of hypogene action are due directly to the more rapid contraction of the hotter internal mass of the earth and the consequent crushing in of the outer cooler shell. He pointed to the admitted difficulties in the way of connecting volcanic phenomena with the existence of internal lakes of liquid matter, or of a central ocean of molten rock. Observations made by him, on the effects of the earthquake shocks accompanying the volcanic eruptions of Vesuvius and of Etna, showed that the focus of disturbance could not be more than a few miles deep; that, in relation to the general mass of the globe, it was quite superficial, and could not possibly have lain under a crust of 800 miles or upward in thickness. The occurrence of volcanoes in lines, and especially along some of the great mountain-chains of the planet, was likewise dwelt upon by him as a fact not satisfactorily explicable on any previous hypothesis of volcanic energy. But he contended that all these difficulties disappear when once the simple idea of cooling and contraction is adequately realized. "The secular cooling of the globe," he remarks, "is always going on, though in a very slowly descending ratio. Contraction is therefore constantly providing a store of energy to be expended in crushing parts of the crust, and through that providing for the volcanic heat. But the crushing itself does not take place with uniformity; it necessarily acts *per saltum* after accumulated pressure has reached the necessary amount at a given point, where some of the pressed mass, unequally pressed as we must assume it, gives way, and is succeeded perhaps by a time of repose, or by the transfer of the crushing action elsewhere to some weaker point. Hence, though the magazine of volcanic energy is being constantly and steadily replenished by secular cooling, the effects are