

But the theory adopted in this work of the subterranean origin of the hypogene formations would be untenable, if the supposed fact here alluded to, of the appearance of tertiary granite at the surface was not a rare exception to the general rule. A considerable lapse of time must intervene between the formation, in the nether regions, of plutonic and metamorphic rocks, and their emergence at the surface. For a long series of subterranean movements must occur before such rocks can be uplifted into the atmosphere or the ocean; and, before they can be rendered visible to man, some strata which previously covered them must usually have been stripped off by denudation.

We know that in the Bay of Baïæ, in 1538, in Cutch in 1819, and on several occasions in Peru and Chili, since the commencement of the present century, the permanent upheaval or subsidence of land has been accompanied by the simultaneous emission of lava at one or more points in the same volcanic region. From these and other examples it may be inferred that the rising or sinking of the earth's crust, operations by which sea is converted into land, and land into sea, are a part only of the consequences of subterranean igneous action. It can scarcely be doubted that this action consists, in a great degree, of the baking, and occasionally the liquefaction, of rocks, causing them to assume, in some cases a larger, in other a smaller volume than before the application of heat. It consists also in the generation of gases, and their expansion by heat, and the injection of liquid matter into rents formed in superincumbent rocks. The prodigious scale on which these subterranean causes have operated in Sicily since the deposition of the Newer Pliocene strata will be appreciated, when we remember that throughout half the surface of that island such strata are met with, raised to the height of from 50 to that of 2000 and even 3000 feet above the level of the sea. In the same island also the older rocks which are contiguous to these marine tertiary strata must have undergone, within the same period, a similar amount of upheaval.

The like observations may be extended to nearly the whole of Europe, for, since the commencement of the Eocene period, the entire European area, including some of the central and very lofty portions of the Alps themselves, as I have elsewhere shown*, has, with the exception of a few districts, emerged from the deep to its present altitude; and even those tracts, which were already dry land before the Eocene era, have almost everywhere acquired additional height. A large amount of subsidence has also occurred during the same period, so that the extent of the subterranean spaces which have either become the receptacles of sunken fragments of the earth's crust, or have been rendered capable of supporting other fragments at a much greater height than before, must be so great that they probably equal, if not exceed in volume, the entire continent of Europe. We are entitled, therefore, to ask what amount of change of equivalent importance can be proved to

* See map of Europe and explanation, in Principles, book I.