

and portions of the continents, as in the collapse and submergence of larger and smaller areas of the land. Athanasius Kircher gave circumstantial descriptions of sunken islands (Atlantis), and of lands raised from the ocean-floor. In the eighteenth century, De Maillet and Buffon ascribed changes of surface conformation to gradual diminution of the ocean volume, while Lazzaro Moro tried to explain the double aspect of emergence of land and ascent of the water-level by means of volcanic catastrophes. The Swiss investigator, J. G. Sulzer, in 1746 suggested the possibility that the position of the earth's centre of gravity was affected by the variable distribution of surface material; and Justi, in 1771, believed in "wanderings" of the Pole.

In 1702, the Swedish physicist Hjärne had introduced the method of direct observation by having marks hewn on the rocks of the coast, and thus paved the way for the definite knowledge obtained in the case of the Scandinavian movements. Scientific opinion then wavered between two chief parties, the one believing with Celsius in the lowering of the ocean-level; and the other and stronger party following Hutton, Playfair, Buch, Lyell, and others in ascribing the relative changes of level to upheaval of the land associated with subterranean volcanicity. Bischof, although he expressed in the chapter on "Heat" his agreement with the Huttonian Theory of Expansion, afterwards attributed secular movements more especially to alternating expansion and diminution of volume produced in deep-seated rocks by chemical transformations. Following this direction of thought, Volger, Mohr, and Vogt thought that the originally sedimentary rocks of Scandinavia had been transformed into crystalline rock, and had undergone an expansion of volume during the process of crystallisation.

The French mathematician, Adhémar, was the first scientist who, in seeking an explanation for crust-movement, considered the earth in its cosmogenetic relations. He regarded the influence of the earth's internal heat as quite irrelevant to the climatic conditions at the earth's surface; these he attributed wholly to the action of the sun's heat, and investigated the varying positions of the earth relatively to the sun, with a view to explaining the recurrence of Ice Ages and also the associated periodic rise and retreat of the ocean. Research in this direction thirty years later was greatly advanced by James