

wards from the Poles. At first it was merely a thin, flexible rind on the viscous or liquid inner mass. Then the crust while still hot, and locally at a red glow, broke and tore; the first rains collected in the depressions, and systems of tensions and pressures were generated in consequence of the subsidence of crust-blocks. A more complete phase of movement was reached as the crust became gradually thicker; forces which had during contraction been acting vertically towards the centre were diverted in a tangential direction by the resistance of the crust, and produced the folds and wrinkles represented in our mountain-chains. Continents and oceans also formed, and the crust was in a state to sustain life. In the fourth or final phase, to which the present belongs, the crust has become very thick; cooling and contraction are now proceeding very slowly; the tangential pressures called forth by the sinking crust are relieved by horizontal compression of the rocks at zones and localities of crust-weaknesses. The work done by pressure and fragmentation is converted into heat; and it was by means of this transmutation that Mallet explained the origin of the earth's own heat, and of volcanoes.

Mallet's explanation was warmly contested by O. Lang and Julius Roth. Lang differed from most physicists and chemists in his opinion that an increase in volume and not a contraction took place during the transition of the earth's material from the molten into the solid state. He attributed the origin of volcanoes to the expansion of the outer rock-materials during their consolidation and the necessity of additional space.

Ries and Winkelmann published in 1881 a series of observations on the solidification of melted metals. Their results were so far favourable to Lang's hypothesis in that they proved that, with the exception of cadmium and lead, nearly all other metals are heavier in the molten condition than in the solid. At the same time, Bischof's experiments are contradictory, since they prove that the most important plutonic rocks, such as granite, trachyte, basalt, suffer considerable contraction in passing from the molten into the solid state.

Faye, whose principles of cosmogony were briefly referred to above (p. 155), also made an attempt to explain the origin and development of the earth in agreement both with the doctrines of modern astronomy and with those of geology and palæontology. Starting from his own standpoint that the earth and