42. Influence of Helmholtz's speculations in England.

It does not seem that Helmholtz's speculations were much taken up abroad; in this country, however, they fell on more fruitful soil:[1] they led first of all to

[1] It is a remarkable fact that the country which produced the great theory that finally destroyed the older vortex theory of Descartes, was the one in which, a century after Newton, the modern views on vortex-motion were first and almost exclusively developed. Notably the scientific atmosphere in which Thomson and Tait moved was, *inter alia*, charged with the bold ideas and the suggestive nomenclature of Macquorn Rankine. He owes his permanent place in the history of science to being side by side with Lord Kelvin and Clausius, one of the three founders of theoretical thermodynamics. But he was in addition to this perhaps the earliest and purest representative of the kinetic or mechanical view of natural phenomena, and of the scientific tendency or habit—derived from his profession as an engineer—of constructing for every phenomenon to be explained a mechanical model. In a succession of memoirs beginning in 1850, Rankine put forward his theory of "molecular vortices," "which assumes that each atom of matter consists of a nucleus or central point enveloped by an elastic atmosphere" ('Scientific Papers of Macquorn Rankine,' ed. Miller, London, 1881, p. 17). Clerk Maxwell in 1878 wrote of Rankine's theory: "Whatever he imagined about molecular vortices was so clearly imaged in his mind's eye that he, as a practical engineer, could see how it would work. However intricate, therefore, the machinery might be which he imagined to exist in the minute parts of bodies, there was no danger of his going on to explain natural phenomena by any mode of action of this machinery which was not consistent with the general laws of mechanism. Hence, though the construction and distribution of his vortices may seem to us as complicated and arbitrary as the Cartesian system, his final deductions are simple, necessary, and consistent with facts. Certain phenomena were to be explained. Rankine set himself to imagine the mechanism by which they might be produced. Being an accomplished engineer, he succeeded in specifying a particular arrangement of mechanism competent to do the work." Maxwell goes on to say: "As long as the training of the naturalist enables him to trace the action only of particular material systems, without giving him the power of dealing with the general properties of all such systems, he must proceed by the method so often described in histories of science—he must imagine model after model of hypothetical apparatus, till he finds one which will do the required work. . . . The theory of molecular vortices was distinguished from other theories which attribute motion to bodies apparently at rest, by the further assumption that this motion is like that of very small vortices, each whirling about its own axis" (Clerk Maxwell in 'Nature,' 1878; 'Scientific Papers,' vol. ii. p. 662, &c.; and Prof. Tait's memoir of Rankine in the 'Collected Papers,' p. xxix). In the most recent attempt to reconcile the two fundamental ideas without which we do not seem to be able to proceed in a description of natural phenomena—viz., that space is a *plenum*, filled by a continuous something, and that matter