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Helmholtz's
investiga-
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vortex theory of matter. As this is one of the most remarkable instances of the fruitful reaction of abstract mathematical reasoning on the progress of physical research, it will be useful to consider for a moment by what gradual steps this novel idea was evolved or suggested. The immediate occasion which led to it was the publication, in 1858, by Helmholtz of a purely mathematical investigation of some peculiar forms of fluid motion.¹ About a hundred years before Helmholtz published his memoir, Euler had laid the foundation of theoretical hydrodynamics—*i.e.*, of the theory of the motion of fluids. In doing so, it was necessary to define

¹ Helmholtz's memoir, "Ueber Integrale der hydrodynamischen Gleichungen welche den Wirbelbewegungen entsprechen," appeared in the 55th volume of Crelle's 'Journal für die reine und angewandte Mathematik.' It was translated into English by Prof. Tait in the 'Philosophical Magazine' for 1867. Helmholtz's occupation with the subject had originated in the acoustical researches which he was carrying on at the time. These necessitated an analysis of the more complicated conditions which the motion of incompressible and elastic fluids presents in actual experience. The hydrodynamical equations had been solved under certain simplifying assumptions. Discontinuity of motion and internal friction had been left out of consideration. Helmholtz's researches led him to the study of these more complicated phenomena; and he successfully applied the mathematical methods which had proved useful in other branches of physical science for the solution of these problems. Notably in the paper on whirling motion, he came

upon very remarkable and unexpected results, which ten years later led in this country to the novel speculations of Lord Kelvin. It is interesting to note how at that time researches in England or Germany could for many years remain unnoticed in the other country. The result was that the same problems were frequently taken up in ignorance of the fact that they had been treated before. See Hicks's "Report on Hydrodynamics," 'Brit. Assoc. Reports,' 1881-82. Especially the labours of Stokes seem to have been little known to German writers, who usually started from the better-known French researches. Stokes had anticipated some of Helmholtz's results referring to whirling and discontinuous motion of fluids. About the middle of the century the periodical "Fortschritte der Physik" was started by the "Physikalische Gesellschaft" of Berlin. Helmholtz himself contributed several valuable reports on acoustical subjects. See the 'Wissenschaftliche Abhandlungen,' vol. i. *passim*.