tion and repulsion at a distance rather received additional weight and importance when, following Newton's cosmical measurements, Cavendish and Coulomb, towards the end

the mere framing of hypotheses and conjectures, for which he professes to have little fancy, though "the heads of some great virtuosos run much upon hypotheses"; and he describes his earlier speculations as "guesses which I did not rely on." In fact, the elaboration of the theorems contained in the 'Principia' marks the transition from the metaphysical to the exact or scientific treatment of natural phenomena. Before Newton showed the far-reaching consequences, the unexpected grasp of a simple mathematical formula in combining facts apparently disconnected, no one could have suspected that such would be possible, and it is not to be wondered at that when once philosophers realised the power of such formulæ, an opposite movement set in through which mathematical processes were extolled at the expense of experiment and observation on the one side, and of philosophical reasoning on the other. Newton himself never fell into this error. He knew well the importance of observation, and he retained to the end of his life a great interest in the philosophical or metaphysical problems which lay beyond or behind the mathematical statement; he carefully distinguished between the *vis gravitatis* and the *causa gravitatis*. Two other great thinkers, second only to Newton himself, took up a similar position to the law of gravitation. Whilst firmly believing in it, they considered it to be not an ultimate law of nature, a *causa occulta*, but believed that it must be possible to derive it from some mechanical properties of matter. The one was older than Newton. It was Huygens (1629-95) who through his analysis of centrifugal forces (1673) had done so much to pave the way for Newton's own work. In 1690, after having paid a visit to England in order to become more intimately acquainted with Newton's work, he published at Leyden his 'Discours sur la Cause de la Pesanteur,' a treatise which was little noticed at the time, and in which he is supposed to have revived the vortices of Descartes. Those who have carefully examined it (Fritsch, 'Theorie der Newton'schen Gravitation,' &c., Königsberg, 1874; and Isenkrahe, 'Das Räthsel von der Schwerkraft,' p. 87, &c.), find that Huygens reverted to his conception of a material fluid, an ether, such as he had suggested for the explanation of optical phenomena, "which surrounds the earth up to very great distances, which consists of the minutest particles, which fly about in the most different ways in all directions with tearing velocity"—an anticipation surely of Lesage's "ultramundane corpuscles." The other great thinker who, whilst firmly believing in Newton's law, sought for a mechanical explanation of it, was Leonhard Euler (1707-83). In his ether theory, to which he reverts frequently, he made an attempt to explain the various physical agencies, among them gravitation (1743, in his 'Dissertatio de Magnete,' which received in 1744 the prize offered by the Paris Academy), by the pressure of the ether. He admits the difficulty of the problem, but insists upon the necessity of finding a mechanical cause for gravitation. See Isenkrahe in 'Zeitschrift für Mathematik und Physik,' vol. xxvi.; but