after many able mathematicians and observers had generally investigated the numberless problems contained in the 'Principia,' Laplace published his 'Exposition du Système du Monde,' followed in the course of the first quarter of this century by the 'Mécanique céleste';[1] and at the close of the present century the most learned astronomer of the age could say that the 'Principia' still formed the sole foundation of all investigations in that domain.[2]

12. The gravitation formula.

It is interesting to see how in a simple formula the mathematician is able to condense an almost immeasurable volume of thought, bringing the theory and the observations of past ages to a focus from which new lines of thought diverge in many directions. Every mathe-

[1] The 'Exposition du Système du Monde' appeared, 1796, in 2 vols. 8vo: the first and second volume of the 'Mécanique céleste,' 1799, 4to; the third, 1802; the fourth, 1805; the last, 1825. Before publishing this work, which has been termed a second edition of the 'Principia,' Laplace had himself during thirty years assisted in dispelling the last doubts as to the sufficiency of the doctrine of universal gravitation to explain all cosmical phenomena; and he had especially brought the investigations of Clairaut, Euler, d'Alembert, Lambert, and Lagrange to a final result by publishing in successive memoirs between 1773 and 1786 the doctrine of "the stability of the system of the universe," based upon the invariability of the major axes and the periods of revolution of the planetary orbits. He and his predecessors also extended the solution of the problem "to find the orbit of two bodies, acting under the law of mutual gravitation," which was given by Newton in such a way that the action of one or more third (disturbing) bodies could be taken into account, dealing thus with the case of nature, which had in the first instance presented itself in treating of the complex motion of the moon. Laplace himself, who in numberless passages of his works recurs to the discoveries of Newton, announced the object of the 'Mécanique céleste' to be the treatment of astronomy "as a great problem of mechanics, from which it was important to banish as much as possible all empiricism," and to perfect it so as "to borrow from observation only the most indispensable data" ('Méc. cél.,' vol. i. introd.)

[2] The late Professor Rudolf Wolf of Zürich, whose 'Handbuch der Astronomie, ihrer Geschichte und Litteratur,' 2 vols., 1890-93, as well as his earlier 'Geschichte der Astronomie,' München, 1877, I warmly recommend.