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ABSTRACT

This dissertation explores two different research traditions in eighteenth-century science, namely the tradition of mechanics and gravitational physics. These traditions are aligned with the first and third book of the *Principia* respectively. With respect to the first tradition, I argue that the exploration of new principles and the development of new mathematical methods is one of the defining features of eighteenth-century mechanics. The endpoint of my study is Lagrange, who in his *Méchanique analitique* lays down the principle of virtual velocities, and from this one principle, by the aid of the calculus of variations, was able to deduce the whole of mechanics. With regards to the gravitational physics tradition, I show that enormous creative forces were required to put gravity theory on a solid theoretical and evidential foundation. I frame Laplace's *Traité de mécanique céleste* as the culmination point and synthesis of eighteenth-century progress in gravitational physics and argue that his work can be interpreted as an "updated version" of Book III since the problems which Newton dealt with qualitatively were reworked in a theoretically more satisfying and exact manner. In contrast to one-legged narratives, my pluralistic reception history also provides a more nuanced picture of the eighteenth-century reception of the *Principia*. The first generation of mathematicians focused on Newton's propositions in Book I, while the physics of Book III received very little attention. I show that the situation gradually reverses. Newton's mechanics was "overcome" by Eulerian-Lagrangian mechanics, but at the end of the eighteenth century, a mainstream Newtonian-Laplacian physics was available which served as a basis for further research during the nineteenth century.

This dissertation also examines the methodological underpinnings of the rational mechanics and gravitational physics tradition. The mechanics tradition not only engaged in fruitful interactions with pure mathematics, but was also inclined to follow the Euclidean method. Newton, Euler, d'Alembert, Maupertuis and Lagrange all searched for general principles and attempted to organize rational mechanics axiomatically-deductively. The methodological challenges in gravitational physics were of a different nature. Even though, ultimately, theory and observation have to come together, this process is not obvious. During the eighteenth century, Newton's theory was often tested and criticized in a hypothetical-deductive manner. This dissertation shows that during the time of Laplace, however, it was widely believed that every remaining discrepancy could be accounted for by gravitational causes and that theory and empirical data eventually converge to an ideal limit.