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Newtonianism: An Introduction

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Related Topics

Mechanical philosophy · Mechanics · Mixed mathematics · Experimental philosophy

Introduction

Isaac Newton is one of the few figures in the history of science and philosophy whose fame reaches popular culture. And justly so, Newton's contributions to mathematics, mechanics, and the study of light changed the ways the sciences of his time were practiced. More importantly, those contributions embodied a philosophy of science and vision of scientific methodology that was at once clearly successful and controversial. Eighteenth-century attempts to extend Newton's approach to natural knowledge resulted in overlapping schools of thought that can broadly be described as "Newtonianisms." Attempts to critique Newton's approach were just as influential, resulting in a variety of "Anti-Newtonianisms." Whether they argued for or against him, scientists, philosophers, and physicians (particularly Scottish physicians) of the late seventeenth and early eighteenth centuries saw Newton and his thought as objects with which they must engage, both in substance (vis-à-vis the development of celestial mechanics or experimental chemistry) and in method (vis-à-vis the development or rejection of his empiricist methodology). This section details Newton's thought on the science and methodology of his time, its interaction with his main interlocutors and his other pursuits, as well as its relation to several preceding and succeeding movements.

Newtonianism and the Sciences

Isaac Newton is remembered mostly for his work in mathematics and (what we now call) physics and chemistry. In mathematics, he is best known for co-discovering the calculus. In physics, he is known for arguing for universal gravitation, codifying the laws of motion, and making significant advances in theoretical and experimental optics. He also influenced the development of chemistry, although the extent of his impact is only now beginning to be appreciated. His scientific legacy, however, has obscured the fact that he spent the bulk of his time on other researches. In fact, his writings on theology, biblical exegesis, and biblical chronology dwarf his "scientific" writings. Even the relative importance of his "scientific" pursuits has been traditionally misjudged. His work in physics and mathematics, while central to the image he projected during of his life,

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actually occupied less time than his experimental work in alchemy. Newton was also engaged in numerous public projects related to his post as warden of the mint. Sadly, contemporary works on Newton tend to focus on one of these pursuits to the exclusion of others. An "integrated" picture of Newton has yet to emerge, but the fragmentary glances we have of him assure us that pursuing it is a worthy effort.

Newton's most famous work, the *Mathematical Principles of Natural Philosophy* (1687), explained the trajectories of the planets and comets, projectile motion on the surface of the earth, and the ebb and flow of the tides. Its wide explanatory scope set off a series of debates concerning the necessity and coherence of its fundamental concepts. These include the nature of gravity and how it differs, metaphysically speaking, from properties of matter like inertia; the characteristics of absolute space and its centrality to the practice of physics; and the law of action and reaction, for which there was no precedent in the mechanics of Newton's time. The entries in this section by Slowik and Miller detail these.

In particular, the metaphysics of gravity and absolute space profoundly influenced the thinkers of Newton's time and their successors: from John Locke to Immanuel Kant in "traditional" philosophy, from Pierre Louis Moreau de Maupertuis to Leonard Euler in mathematics and physics, from Archibald Pitcairne to Karl Ludwig von Haller in medicine, and from Stephen Hales to John Dalton in chemistry, to name just a few. Before "Newtonian" physics became popular, the dominant model of physical explanation was mechanical. On this model, all physical phenomena were to be explained by reference to the configuration and push-pull actions of the fundamental particles of matter, which were themselves possessed of only a limited set of attributes like size, shape, impenetrability, and mobility. "Mechanical" philosophers provided an underlying metaphysics and conception of physical inquiry that validated this mode of explanation. Although few of them were directly concerned with the technical details of Newton's work, its explanatory success required revision to their metaphysics and vision of human knowledge or, at least, an active engagement with Newton's suppositions. Domski's entry (on Descartes) outlines the parameters of this project. Although Descartes died during Newton's childhood, Newton's philosophical thought is a direct response to Descartes and, despite irreconcilable differences, highly influenced by it. Reid's entry (on the Cambridge Platonists) discusses another, neo-platonic, source of Newton's philosophical thought. Entries by Jorati, Gorham, Pierce, Shein, and Slavov discuss the responses of Leibniz, Locke, Spinoza, Berkeley, and Hume (respectively) to both these mechanical and neo-platonic currents. One subject that repeatedly occupied these philosophers was the wild nature of Newton's claim that *every* particle in the universe attracted every other. How can such a general claim be established on the basis of empirical evidence? Most philosophers did not grasp the details of Newton's methodology. It is explained more fully in the entry by Belkind and still serves as a useful model and foil for discussions of scientific methodology. Not surprisingly, responses to Newton were also colored by various political and national affiliations. Henry's entry discusses how Newtonianism was generally received in Britain, where Newton was held as a hero. Henry's chapter importantly addresses the rise of medical Newtonianism, an often-ignored area of Newton's influence. Mandelbrote's entry discusses how Newton was received on the continent. It is also important to keep in mind that Newton's natural philosophy and reaction to it were deeply intertwined with various theological and religious commitment. Snobelen's entry survey's the field of Newton's religious and theological interests and their relation to his natural philosophy.

Newton's influence on the sciences themselves is the subject of our remaining entries. A triplet of essays explores Newton's influence on the creation of rational mechanics, the development of the life sciences, and foundational issues in chemistry (Hepburn, McLaughlin and Demarest, and Newman). One shared item of note is that Newton's popular reputation as an Enlightenment ideal does not fit with the actual development of science and philosophy after him. These entries show that

Newtonian ideas were as contested as they were influential. His successors were not simply extending Newtonian philosophy into new domains, but revising and responding to that philosophy in order to settle questions which it had left unanswered. The three entries articulate these questions in the domains of physics, biology, and chemistry.

Cross-References

- ▶ Antimathematicism in Early Modern Philosophy and Science
- ▶ Chemistry, Alchemy
- ▶ Clarke, Samuel
- ▶ Color in the Early Modern Period
- ▶ Descartes's Mechanical Philosophy
- ▶ Du Châtelet and Newton
- ▶ Empiricism, Early Modern
- ▶ Euler, Leonard
- ▶ Laws of Nature
- ▶ Light, Mechanization of
- ▶ Mechanical Philosophy: Mechanics, Mechanism and Chemistry in Early Modern Natural Philosophy
- ▶ Mechanics, Mixed-Mathematics
- ▶ Mechanism, Mathematical Laws

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