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★**Ruggiero Boscovich's theory of natural philosophy: points, distances, determinations.**

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The Jesuit scholar Roger (Ruggiero) Boscovich occupied the position of *professor matheseos* at the Roman College in Rome from 1740 to 1764, after which he occupied positions in Pavia, Milan, Paris and Bassano del Grappa. Throughout his career he published writings on various topics in astronomy, physics and mathematics. His major work *Theory of natural philosophy* appeared in 1758 with an expanded edition in 1763. Here he formulated his ideas about forces acting between points, with the magnitude of the force between two points being depicted graphically as a function of distance. Historians of physics have viewed Boscovich as an important influence on the dynamical theories of such later physicists as Michael Faraday, William Rowan Hamilton and James Maxwell. (In 1832 Hamilton wrote that his own theory was nearly that of Boscovich and consisted "in representing all phenomena of motion as produced by the action of localized energies of attraction and repulsion, each energy having a centre in space".)

Guzzardi's book is an erudite and absorbing account of Boscovich's scientific career and thought. The book documents in impressive detail Boscovich's "powerful mix of (meta)physical speculation and mathematics" as it emerged in the religious and intellectual setting of his time. In keeping with current history of science the author's purpose is "not to consider natural philosophy as a system of *concepts*, but as a scientific practice—more generally as a web of *practices*" (p. xviii, emphasis in the original). The book is also informative about the work over the past several decades of other historians of science who have contributed to Boscovich studies.

The Society of Jesus to which Boscovich belonged was committed to geocentric and geostatic cosmology, a position that went back to the time of Galileo Galilei (Copernicus's book was put on the Index in 1616) and remained official Jesuit doctrine until 1757. Jesuit astronomers adopted some version of the Tychonic system, which may be viewed as the heliocentric system observed from the Earth. Boscovich opposed Copernicanism, but as his interest in Isaac Newton grew, he came to see that a stationary Earth involved certain physical difficulties. Nevertheless, he continued to espouse a form of "compatibilism", the view that observational and physical astronomy were consistent with the hypothesis of a central motionless Earth. This belief was connected to a wider conviction that while physical reality can be interpreted in different ways there is an underlying transcendent mathematical structure to the world.

In Chapter 2 Guzzardi examines the basic tenets of Boscovich's natural philosophy and the relationship of his doctrines to those of contemporary Newtonian corpuscularians and later figures such as Faraday. The author is critical of the portrayal of Boscovich in established history of physics. Not only has Boscovich's thought been misrepresented in this history, the author maintains, but even major scientific figures such as Faraday, Hamilton and Maxwell misunderstood his philosophy. In particular, Guzzardi believes it is wrong to locate the concept of a force field in Boscovich's natural philosophy. Boscovich always considered a force acting between points, where the magnitude of the force depends only on the distance along the line joining the points. Nowhere did he have the idea that the force associated with a point could act hypothetically at any location in space. The argument here is developed in detail in Chapter 3. The author also identifies important differences between Leibniz's dynamics and Boscovich's theory.

In Chapters 4 and 5 Guzzardi examines the place of Aristotelian and Leibnizian doctrines in Boscovich's thought, particularly with respect to conceptions of continuity and continuous magnitude. Boscovich is shown to have synthesized important elements of both philosophers in his development of natural philosophy.

Boscovich's natural philosophy with its emphasis on mathematics never achieved the deep integration of mathematical analysis and mechanical conception found in his contemporary Jean d'Alembert's *Traité de dynamique* of 1743. His theory of forces in its initial development was general and qualitative. However, by the 1750s he had become more engaged with mathematics, a subject that is covered in Chapter 6 of Guzzardi's book, "Touching infinity". Here one learns of Boscovich's various ruminations on the properties of intersecting lines and curves, and transformations of figures involving properties of lines at infinity. In 1754 he produced the substantial tract "On the transformation of geometric loci, where it is dealt with the law of continuity and certain mysteries of the infinite". Boscovich proceeded to investigate the graphical curve of forces between two points. He arrived at an analytical expression of the graph as the ratio of two polynomials and related this description to geometric properties of the curve. The analysis was further interpreted in terms of the meaning of the curve in natural philosophy. Although the scope of his investigation was restricted because he did not adopt calculus techniques, his theorizing about the force curve was original and noteworthy.

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