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Ṣadr al-Sharīʿa al-Thānī: ʿUbaydallāh ibn Masʿūd al-Maḥbūbī al-Bukhārī al-Ḥanafī

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Ṣadr al-Sharīʿa (al-thānī, *i. e.*, "the Second") was a theoretical astronomer and religious scholar who created original and sophisticated astronomical theories of time and place, and under circumstances that have long been considered devoid of original scientific research. Ṣadr was famous for his commentaries on Islamic jurisprudence (*sharīʿa*, hence his nickname Ṣadr al-Sharīʿa, "preeminent [scholar] of the *sharīʿa*"). He was called "the Second," after his great-great-grandfather, Ṣadr al-Sharīʿa al-Awwal ("the First"). Ṣadr also wrote on Arabic grammar, *kalām* (theology), rhetoric, legal contracts, and *ḥadīth* (prophetic traditions).

Ṣadr's astronomical writings are found in the third volume of his three-volume encyclopedia of the sciences, the *Taʿdīl al-ʿulūm* (The adjustment of the sciences). The first two volumes dealt with logic and *kalām*. The third volume was called *Kitāb Taʿdīl hayʾat al-aflāk* (The adjustment of the configuration of the celestial spheres).

Ṣadr al-Sharīʿa represents one of several theorists who worked within the astronomical tradition of theoretical astronomy (*hayʾa*). This tradition had its roots within the early Islamic period, especially with **Ibn al-Haytham**, but it began to flourish among the group of astronomers who were assembled at the Marāgha Observatory in northwestern Iran by the polymath **Naṣīr al-Dīn al-Ṭūsī**. One of the major issues that was of concern to these theorists was the irregular motion produced in several of **Ptolemy**'s models, such as that brought about by the equant, and they sought to substitute models that would adhere to the physical principle of uniformity of motion in the heavens. Ṣadr frequently cites two works from this tradition – Ṭūsī's *al-Tadhkira fī ʿilm al-hayʾa* (Memoir on astronomy), and *al-Tuḥfa al-shāhiyya* (The imperial gift) of **Quṭb al-Dīn al-Shīrāzī**. He does this in order to correct their work, and to present solutions to problems they missed.

In the *Kitāb Taʿdīl hayʾat al-aflāk*, Ṣadr critically reviews the planetary models of his predecessors, especially Ptolemy, and points out their weaknesses. He then describes his own models that are meant to rectify them. The most significant problems Ṣadr addresses are: the lunar prosneusis point, the equant; planetary latitude theory, and the motion of Mercury.

In the case of the Moon, Ptolemy proposed that one orb rotate uniformly around the center of the Universe while maintaining a constant distance around another point, the deferent center; Ṣadr objects to this since it produces irregular motion in the celestial realm. Furthermore, rather than measure the motion in anomaly from the visible apogee of the lunar epicycle, Ptolemy measured it

from the mean epicyclic apogee aligned with a point, the prosneusis, introduced into the model solely for this purpose. In offering a physically consistent model, Ṣadr employed both a rectilinear and a curvilinear "Ṭūsī couple." Both of these devices combined circular motions in such a way as to produce a compound motion that oscillates along a line. In the rectilinear case, a smaller circle, internally tangent with a larger circle, rotates in such a manner as to produce linear motion; and in the curvilinear case, concentric spheres are made to rotate in such a way as to produce an approximate curvilinear motion along the surface of the epicycle sphere.

In the case of the upper planets (Mars, Jupiter, and Saturn), for which Ptolemy was compelled to introduce the equant point, Ṣadr followed **Muʾayyad al-Dīn al-ʿUrḍī** and Shīrāzī, without acknowledgment, and employed an epicyclet (an epicycle on an epicycle).

The Ptolemaic theory of planetary latitude and the revisions to it made by Islamic successors attempted to provide models for the planets' deviations from the ecliptic and involved complex, nonuniform spherical motions. Ṣadr summarized the work of his three predecessors and offered his own observations. As of this date, however, this problem has been insufficiently studied, so the significance of Ṣadr's work on the theory of planetary latitude remains obscure.

The case of Mercury involved several equant-like problems and thus was particularly complicated. Ṣadr employed two geometrical tools invented by his predecessors – the "ʿUrḍī lemma" and the spherical "Ṭūsī couple" to arrive at his solution. Late medieval Islamic astronomy has as yet been insufficiently studied to assess fully the possible influence of Ṣadr on subsequent astronomers, such as **Khafrī** and others.

Ṣadr's work is also significant in that it provides a counterexample to two long-standing paradigms of Islamic intellectual history. First, Ṣadr, who was a prominent religious scholar, contradicts the conclusions of traditional Orientalist scholarship, according to which the Islamic religious establishment was virtually completely opposed to science, and this opposition was supposedly a major factor in the decline of science in Islam. Second, Ṣadr stands as a major counterexample to the prevalent view of Islamic historiography whereby Islamic culture enjoyed a brilliant flourishing from the 9th century until the 11th century, but then suffered unmitigated decline in large part due to the critiques of rational science and philosophy by such religious scholars as Ghāzālī (died: 1111). Ṣadr clearly represents a very high level of mathematical and scientific sophistication within a tradition that falls well within the period of supposed decline.

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