

2. As is well-known, heliocentric in this context means “centered on the mean Sun,” not the “true Sun.”
3. Swerdlow, “The Derivation and First Draft of Copernicus’s Planetary Theory” (see Note 1), pp. 471–8. See also N.M. Swerdlow and O. Neugebauer, *Mathematical Astronomy in Copernicus’s De Revolutionibus*, 2 parts (New York: Springer-Verlag, 1984), part 1, pp. 54–64, esp. 55–8. Dennis Duke provides animations showing this transformation from Ptolemaic epicyclic models to eccentric models to Copernican models at <<https://people.sc.fsu.edu/~dduke/models>> (25 September 2016). For the treatise by ‘Alī Qushjī that may well have provided the basis for Regiomontanus’ propositions, see F. Jamil Ragep, “‘Alī Qushjī and Regiomontanus: Eccentric Transformations and Copernican Revolutions,” *Journal for the History of Astronomy*, 36(4), 2005, pp. 359–71.
4. Swerdlow, “The Derivation and First Draft of Copernicus’s Planetary Theory” (see Note 1), p. 478.

5.

This [introduction in the *Commentariolus* of the heliocentric theory] really has nothing to do with the principle of uniform circular motion that started Copernicus’s investigations in the first place, but it seems likely that in the course of the intensive study of planetary theory undertaken to solve the problem of the first anomaly, he carried out an analysis of the second anomaly leading to his remarkable discovery.

(Swerdlow, “The Derivation and First Draft of Copernicus’s Planetary Theory” (see Note 1), p. 425). See also Swerdlow, “The Derivation and First Draft of Copernicus’s Planetary Theory,” p. 430: “... the Marāgha theory is, in any case, relevant only to the first anomaly, not to the heliocentric theory.”

6. For the purposes of this paper, the most important is E.S. Kennedy and V. Roberts, “The Planetary Theory of Ibn al-Shāṭir,” *Isis*, 50(3), 1959, pp. 227–35, reprinted E.S. Kennedy, “Colleagues and Former Students,” in D.A. King and M.H. Kennedy (eds), *Studies in the Islamic Exact Sciences* (Beirut: American University of Beirut, 1983), pp. 55–63.
7. V. Roberts, “The Solar and Lunar Theory of Ibn Ash-Shāṭir: A Pre-Copernican Copernican Model,” *Isis*, 48(4), 1957, pp. 428–32, n. 2 on p. 428.
8. Although neither Swerdlow nor Neugebauer thought there was a connection between Copernicus’ heliocentrism and his Islamic predecessors, it should be noted that both consistently maintained the importance of Islamic astronomy, and in particular Ibn al-Shāṭir’s models, for Copernicus:

The planetary models for longitude in the *Commentariolus* are all based upon the models of Ibn ash-Shāṭir – although the arrangement for the inferior planets is incorrect – while those for the superior planets in *De revolutionibus* use the same arrangement as ‘Urđi’s and Shīrāzī’s model, and for the inferior planets the smaller epicycle is converted into an equivalent rotating eccentricity that constitutes a correct adaptation of Ibn ash-Shāṭir’s model. In both the *Commentariolus* and *De revolutionibus* the lunar model is identical to Ibn ash-Shāṭir’s and finally in both works Copernicus makes it clear that he was addressing the same physical problems of Ptolemy’s models as his predecessors. It is obvious that with regard to these problems, his solutions were the same.

The question therefore is not whether, but when, where, and in what form he learned of Marāgha theory. (Swerdlow and Neugebauer, *Mathematical Astronomy in Copernicus’s De Revolutionibus* (see Note 3), part 1, p. 47)

9. George Saliba has perceptively discussed the reasons for Ibn al-Shāṭir’s dismissal of eccentrics and justification of epicycles in several of his writings; see G. Saliba, “Critiques of