BOOK REVIEWS

Islamic Astronomy and Copernicus by F. Jamil Ragep (Ankara: Turkish Academy of Sciences Publications, 2022). pp 398. ISBN: 978-625-8352-02-3.

Several discoveries in the history of Islamic science since the last quarter of the XX century have led to a re-evaluation of the origins of the Scientific Revolution. The main criticism of the Scientific Revolution concept, which is handled on the Copernicus-Galilei-Newton axis, is that the historical context of this revolution is ignored. Since the sources of both Islamic and European scientific traditions are similar, it is unthinkable for the new ideas to be independent of each other, and this attitude has provided evidence that scientific change predates modern science. F. Jamil Ragep, who discusses the influence of Islamic astronomy on Copernicus' work in "*Islamic Astronomy and Copernicus*", provides substantial evidence considering the orthographic background of history. Ragep showed that there are remarkable similarities between Islamic astronomers and Copernicus and that this is not a coincidence. Since Islamic science is based on observation and mathematics, it played an essential role in developing Copernicus' heliocentric universe model.

Author Prof. Dr. F. Jamil Ragep was born in West Virginia (USA). Ragep, who completed his Ph.D. in the History of Science at Harvard University (1982), worked as a professor in Oklahoma from 1990-2006 after postdoctoral studies and short teaching positions and finally retired from McGill as Professor Emeritus in 2020. Ragep has held many professional positions at the Institute of Islamic Studies, such as Canadian Research Chair and Honorary Member of the Turkish Academy of Sciences (TÜBA). Ragep, who has many publications, continues his studies on Astronomy and the History of Science in Islam.

In the most important of these works, *Islamic Astronomy and Copernicus*, he not only proved that the origin of Copernicus' heliocentric universe model is based on Islamic astronomers but also discussed how he was influenced by their thoughts and methods. The author first began by discussing the role of philosophy in the Islamic world. Bīrūni said that he could produce astronomical information through mathematics and observation without the need for philosophical physics (p. 32). Similarly, Qushji argued that astronomical attempts could be achieved with geometry and appropriate hypotheses. The attempt to save astronomy from philosophy and make it an independent scientific discipline is an essential development in the history of Islamic science. In this context, Islamic astronomers were skeptical of Ptolemy's work and developed several mathematical models to explain the movements of the planets. With the development of astronomical and mathematical models, the heliocentric universe model has become a necessity.

At the beginning of these models is the Nasir al-Din Ṭūsī couple, who can explain the movements of the planets without the need for epicycles. The Ṭūsī couple consists of two nested circles of different sizes, rotating at different speeds. The smaller circle is tangent to the larger one from the inside at one point. The movement of the small circle causes the tangent point to move in a straight line. The Ṭūsī couple has been used as a method in astronomy to explain the complex motion of the planets. Two important features of this method stand out: First, it explains the motion of the planets through their outer cycles and ensures their motion in a straight line. Secondly, it is used to explain the motion of the planets in latitude. If we consider the small circle as the equator orbiting the planet, the large circle corresponds to the elliptical motion. The movement of the small circle, on the other hand, causes a linear motion of its tangent point, which is the planet's path in latitude.

The Ṭūsī couple played an important role in the development of European astronomy and was used by Nicolaus Copernicus in his heliocentric model of the universe. Noel Swerdlow and Otto Neugebauer summarized the use of the Ṭūsī couple of Copernicus in this way: "*In De revolutionibus, he uses the form of Ṭūsī's device with inclined axes for the inequality of the precession and the variation of the obliquity of the ecliptic, and in both the Commentariolus and De revolutionibus he uses it for the oscillation of the orbital planes in the latitude theory*" (p. 85). This shows that Copernicus abandoned the claim of physical models and relied on a mathematical model, the Ṭūsī couple. Dr. Ragep stated that the Ṭūsī couple entered Europe through Gregory Chioniades, who traveled to Tabriz in 1295. Those who state that intercultural transfer was closed after the 12th century are those who follow scientific developments with a Eurocentric perspective. For this reason, Ragep said that without historical contact or transmission, mathematical discoveries become impossible.

The most interesting aspect of Ṭūsī models is that certain spheres can move others. So why didn't Ṭūsī allow the motion of the Earth like Copernicus did? This shows Ṭūsī's characteristic nature, for he is a reformer rather than a revolutionary (p. 133). Therefore, Ṭūsī remained true to Potelmy's parameters. But Ṭūsī's demonstration that the Ptolemaic system could be reformed both mathematically and physically would eventually lead to the disappearance of classical cosmology (p. 134).

Copernicus' models in *De Revolutionibus* bear a striking resemblance to those of Ibn al-

Shāṭir. For this reason, Ragep said that these models form the basis of Copernicus' heliocentric universe model. Unlike Ptolemy's, Shaṭir's models do not need epicycles to explain the motions of the planets. Moreover, Ptolemy's models could not fully explain the orbits of the planets, but Shaṭir's models more accurately predicted both the orbits and positions of the planets. Thanks to the recently published work of Tzvi Langermann and Robert Morrison, it is known that during Copernicus's training in Italy, a Jewish scholar named Moses Galeano brought Shaṭir's models around Padua. He may have convinced Copernicus of the heliocentric model of the universe, as Shāṭir's models of Venus and Mercury resembled "heliocentric bias" (p. 187) because it is not a coincidence that Copernicus first presented the model without the couple and then justified and added the couple.

Copernicus was somewhat aware of the Islamic tradition in the paragraph on the motion of the Earth in his book *De Revolutionibus*. To prove that Ptolemy's observational evidence in the Almagest was not true, Copernicus appealed to comets, as in Ṭūsī (p.279). Since Copernicus considers this an astronomical problem rather than a natural philosophy, his attitude shows that he is dependent on late medieval Islamic astronomy rather than Latin Scholasticism. Because the use of comets to describe the rotation of the Earth in the Islamic World has become the focus of ongoing debate, and the absence of such evidence in Europe before Copernicus strengthens our claim (p. 283). Moreover, al-Qushji who was in Istanbul just before Copernicus was born evaluated the possibility of the Earth's rotation. He expressed this thought as follows: "Thus nothing false (fâsid) follows [from the assumption of a rotating Earth]" (p. 291). Considering the context of this discussion, while science was tried to be produced based on Aristotle's natural philosophy in Europe, a physics understanding based on astronomy developed in Islam.

Islamic astronomers opposed Aristotelian philosophy and made the determination of the Earth's motion dependent on observational evidence. These attitudes show that they are interested in the physical reality of mathematical models. The fact that the arguments used by Copernicus in his heliocentric model of the universe were discussed extensively by his Islamic predecessors should not be overlooked. Consequently, Islamic astronomy played an important role in creating an intellectual and cultural milieu in medieval and early modern Europe.

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