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Ibn Mu‘ādh: Abū ‘Abd Allāh Muḥammad ibn Mu‘ādh al-Jayyānī

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Died probably (Spain), after 1079

Ibn Mu‘ādh al-Jayyānī was the author of several astronomical works, and yet very little is known about him. Recent scholarship suggests that he was born in the early 11th century. The only secure date we have for him is 1079, the year of a solar eclipse he describes from first-hand observation. “Jayyānī” means from Jaen, the capital of the Andalusian province of the same name where he served as a *qāḍī* (judge) for much of his life. In fact, he belonged to a family of judges and jurists from that province.

Among Ibn Mu‘ādh's astronomical works was the *Tabulae Jahen*, a set of astronomical tables probably translated into Latin by [Gerard of Cremona](#) with the title *Liber tabularum Iahen cum regulis suis*. A printed edition of the canons, lacking the tables, appeared in 1549 at Nüremberg as *Scriptum antiquum saraceni cuiusdam de diversarum gentium Eris, annis ac mensibus et de reliquis Astronomiae principiis*. These tables were based on the tables of [Khwārizmī](#), and were adapted to the geographical coordinates of Jaen for the epoch of midnight, 16 July 622 (the date of the *hijra*). But there are some modifications introduced by Ibn Mu‘ādh, such as the value of the geographical longitude of the city, which are in accordance with the corrected values found in Andalusian astronomers from the 10th century. In some points he seems to be independent of his sources, as is the case in Chapter 19, devoted to the visibility of the new Moon, and also in the trigonometric section. This work included a table of stars that improved the one in Khwārizmī and was also independent of the Toledan tradition. In Chapter 18 we find the first exact method used in Andalusia to determine the azimuth of the *qibla*, the so-called *method of the zījes*, probably taken from a work by [Birūnī](#). In short, there is considerable new material as well as a personal vision; in addition there is a possible influence from eastern astronomers such as Birūnī, who until recently was thought not to have been known in Andalusia.

Although we do not have evidence of any astronomical observation made by Ibn Mu‘ādh, there is a treatise on the solar eclipse already mentioned, which occurred on 1 July 1079. The text of this treatise, “On the Total Solar Eclipse,” was translated into Hebrew by Samuel ben Jehuda (flourished: *circa* 1335). Another treatise by him, entitled “On the Dawn,” was also translated into Hebrew. The Arabic texts of these two works are not known to be extant. A Latin translation of the latter work was made by Gerard of Cremona as the *Liber de crepusculis*. It deals with the phenomena of morning and evening twilight, and in it Ibn Mu‘ādh gives an estimation of the angle of depression of the Sun at the beginning of the morning twilight and at the end of the evening twilight, obtaining the value of 18°. On the basis of this and three other basic parameters (the

mean distance between Earth and Sun [1,110 in terrestrial radii], the relative size of Sun and Earth [5.5:1 in terrestrial radii], and the circumference of the Earth [24,000 miles]), and through the use of simple trigonometric functions, Ibn Mu'ādh calculates the height of the atmosphere to be around 52 miles. The work found a wide interest in the Latin Middle Ages and in the Renaissance, and this figure, 52 miles, remained canonical in the Latin West until the end of the 16th century, when the issue of atmospheric refraction was raised to prominence by [Tycho Brahe](#). Consequently, this figure of 52 miles was drastically reduced by [Johannes Kepler](#) and succeeding astronomers.

An astrological work by Ibn Mu'ādh is *Maṭrah shu'ā'āt al-kawākib* (Projection of the rays of the stars) is preserved in an Arabic copy in the Biblioteca Medicea Laurenziana Orientale 152. Although as yet not properly studied, it seems to be the source of later works on the subject such as the *Libro del Ataçyr* composed under the patronage of [Alfonso X](#) the Wise in Toledo in the 13th century and included among the *Libros del Saber de Astronomía*.

Several mathematical works by Ibn Mu'ādh are also extant in Arabic. His treatise *Kitāb Majhūlāt qisī al-kura* (Determination of the magnitudes of the arcs on the surface of a sphere), which is also cited in his *Tabulae Jahen*, is a work on spherical trigonometry, probably the most ancient treatise on this topic in the medieval west. It is also a text in which this discipline is entirely independent from astronomy, and in which the author shows that he was aware of the main novelties introduced by Eastern Islamic mathematicians at the end of the previous century. Ibn Mu'ādh probably had access to Eastern literature on spherical trigonometry, but he was also capable of dealing with this subject in an independent way.

The *Maqāla fī sharḥ al-nisba* (On ratio) is a defense of Euclid. It falls into a tradition of geometric research documented in the works of earlier Andalusian mathematicians such as Mu'taman ibn Hūd and Ibn Sayyid. Ibn Mu'ādh says in his preface that this treatise is intended "to explain what may not be clear in the fifth book of Euclid's writing." There was a general dissatisfaction among Arabic mathematicians with Euclid V, definition 5. As a consequence of the abstract form in which the Euclidean doctrine of proportions was presented, the Arabs, from the ninth century on, tried either to obtain equivalent results more in accord with their own views, or to find a relation between their views and the unsatisfying theory. The most successful among them was Ibn Mu'ādh, who showed an understanding comparable with that of Isaac Barrow, who is customarily regarded as the first to have really understood Euclid's Book V.

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