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Ibn al-Raqqām: Abū ‘Abd Allāh Muḥammad ibn Ibrāhīm ibn ‘Alī ibn Aḥmad ibn Yūsuf al-Mursī al-Andalusī al-Tūnisī al-Awsī ibn al-Raqqām

Josep Casulleras

Born probably Murcia (Spain), circa 1250

Died Granada (Spain), 27 May 1315

Ibn al-Raqqām was a prolific author who wrote on numerous branches of learning. According to the Andalusian historian Ibn al-Khaṭīb (1313–1374), he was a versatile master (*shaykh*), unique in his time for his skills in arithmetic, geometry, medicine, astronomy, and other disciplines. Though probably a native of the region of Murcia, it is clear that he lived for a time in North Africa. One of his preserved works (*al-Zīj al-qawīm*) indicates that Ibn al-Raqqām lived in Tunis, since a number of tables are calculated for the coordinates of this city. That he also lived in Bijāya (Bejaïa, in Algeria) is confirmed by the existence of many astronomical tables computed for the latitude of this city in another of his extant works (*al-Zīj al-shāmil*). At the invitation of the second king of the Naṣrid dynasty, Muḥammad II (1273–1302), Ibn al-Raqqām left Bijāya for Granada, where he lived until his death. Ibn al-Raqqām taught medicine and jurisprudence in addition to other subjects. He had two known students: Abū Zakariyyā’ ibn Hudhayl (died: 1352), who studied mathematics, geometry, algebra, and astronomy, and Naṣr, another ruler of the Naṣrid dynasty (reigned: 1309–1314), who studied the composition of almanacs and the construction of astronomical instruments.

Ibn al-Raqqām wrote a number of astronomical works, of which three are extant. Two of these, are *zīj*es (astronomical handbooks with tables), *al-Zīj al-shāmil fī tahdhīb al-kāmil*, and *al-Zīj al-qawīm fī funūn al-ta’dīl wa-’l-taqwīm*. *Al-Zīj al-shāmil* was composed in 1280/1281 in Tunis. According to the introduction, his aim was to make appropriate improvements to **Ibn al-Hā’im**'s *al-Zīj al-kāmil*. These included condensing the explanations of this book, adding tables missing in the original, and revising parameters in order to reach a better agreement between computation and observation. One of the modifications made by Ibn al-Raqqām in the explanations, or *canons*, consisted of copying the words of Ibn al-Hā’im without his careful geometrical demonstrations. The additional tables added by Ibn al-Raqqām are, in general, those of **Ibn Ishāq al-Tūnisī**. Ibn al-Raqqām's *zīj* thus represents one of three known editions of Ibn Ishāq's work produced at approximately the same time, the other two being the *zīj* of **Ibn al-Bannā’** and an anonymous recension (written *circa* 1266–1281) preserved in Hyderabad. *Al-Zīj al-qawīm* seems to be a simplified version of *al-Zīj al-shāmil*, with a simplified set of canons and the adaptation of some tables to the geographical coordinates of Granada. On the whole, both *zīj*es are similar in format and share several numerical tables; however, there are differences since some similar tables in each *zīj* have been formulated

for a specific location. For example, the tables in *al-Zij al-shāmil* for computing daylight lengths and unequal hours are calculated for a stated latitude of 36°, which applies to Bijāya, while in *al-Zij al-qawīm* they are for 36° 37', the latitude of Tunis. Moreover, the latter *zīj* has a table for lunar visibility calculated for the latitude of Granada, given as 37° 10', a different figure from the usual one for Granada in medieval times. This indicates that Ibn al-Raqqām reworked *al-Zij al-qawīm* after his arrival in Granada and that he must have made a very precise determination of the latitude of this city, for the value he uses is exactly the modern one.

The other preserved astronomical work of Ibn al-Raqqām, his *Risāla fī 'ilm al-ẓilāl*, represents the only complete Arabic treatise on gnomonics of Andalusian origin. The work, organized into 44 chapters, is devoted to the construction of several kinds of sundials and discusses the mathematical and astronomical principles relevant to gnomonics, such as the determination of hour lines or the curves of the lines for the midday (*ẓuhr*) and afternoon (*'aṣr*) prayers. Ibn al-Raqqām's presentation is well organized, graphic, and descriptive; the work also demonstrates his ability to use the analemma, a graphical technique not previously known in Andalusian gnomonics.

Ibn al-Khaṭīb refers to another astronomical work by Ibn al-Raqqām, which may have been a revision of *al-Manāj fī ru'yāt al-ahilla* (on lunar crescent visibility) of Ibn al-Bannā'. Nonastronomical works by Ibn al-Raqqām mentioned by Ibn al-Khaṭīb include a work written in the style of **Ibn Sīnā**'s encyclopedic *Kitāb al-Shifā'*, the *Abkār al-afkār fī al-uṣūl* (on jurisprudence), a summary of the *Kitāb al-Ḥayawān wa-'l-khawāṣṣ* (probably a treatise on medical cures using parts of the body of animals).

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