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## Banū Mūsā

Josep Casulleras

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### ***Ja'far Muḥammad***

*Born* **Baghdad, (Iraq), beginning of the 9th century**

*Died* **January or February 873**

### ***Abū al-Qāsim Aḥmad***

*Born* **Baghdad, (Iraq), beginning of the 9th century**

*Died* **Baghdad, (Iraq), 9th century**

### ***Ḥasan***

*Born* **Baghdad, (Iraq), beginning of the 9th century**

*Died* **Baghdad, (Iraq), 9th century**

The three brothers, the three sons of Musā ibn Shākir, generally known under the single name of the Banū Mūsā, were among the most important scientists of Baghdad in the 9th century; they played a prominent role as private patrons of scientific translations and research, and excelled in the fields of astronomy, mechanics, and mathematics.

It is quite impossible to write separate biographies of them. Their father, Mūsā ibn Shākir, is described as a reformed bandit who became a renowned astronomer or astrologer and a close friend of **Ma'mūn** (reigned: 813-833) before he was a caliph, while residing in Marw in Khurāsān. After Mūsā's death, the brothers became the wards of Ma'mūn, who cared for their education and sent them to the House of Wisdom (*Bayt al-ḥikma*), which was the major scientific institution in his time. After finishing their education, the Banū Mūsā collaborated with Ma'mūn and his successors in a variety of activities, which ranged from scientific matters (such as geodetic surveys) to managerial affairs (such as contracting for the building of public works and structures), thus becoming wealthy and powerful. This allowed them to devote a great deal of their acquired fortune to sponsoring scientific research. They actively sought classical works by ancient writers and sent agents or went themselves to Byzantium to purchase manuscripts that they translated on returning to Baghdad. On one such trip, Muḥammad met the famous mathematician and translator **Thābit ibn Qurra** of Ḥarrān and brought him back to Baghdad, where Thābit joined the circle of scientists and

translators who were working under the patronage of the Banū Mūsā. The Nestorian Christian Ḥunayn ibn Ishāq (died: *circa* 877), considered one of the most prolific and significant translators of 9th-century Baghdad, was also part of the Banū Mūsā team. In sum, these brothers promoted to a great extent the movement of translations that made it possible to assimilate the main classical scientific works into Arabic. Their significance to science and astronomy is not limited to this sponsorship of translations alone; like the scholars gathered around them, the Banū Mūsā also authored very important original scientific works of which there is a known list of some 20 books on astronomy, mechanics, and mathematics.

Almost a dozen of the works attributed to the Banū Mūsā are related to astronomical research. Muḥammad, the eldest son, wrote a treatise *On the Visibility of the Crescent*, a *Book on the Beginning of the World*, and a book variously known under the titles of *Book on the Motion of Celestial Spheres* (*Kitāb Ḥarakāt al-aflāk*), *Book of Astronomy* (*Kitāb al-Hay'a*), or *Book on the First Motion of the Celestial Sphere* (*Kitāb Ḥarakāt al-falak al-ūlā*), which contains a critique of the Ptolemaic system of the Universe. In it Muḥammad explains the daily motion of the heavens by the rotation of all the spheres of the Sun, the Moon, the five planets, and the fixed stars, denying the existence of the 9th sphere, which is the origin of movement in **Ptolemy**. Aḥmad is reportedly the author of a *Book on the Mathematical Proof by Geometry That There Is Not a Ninth Sphere Outside the Sphere of the Fixed Stars*, two texts on two questions that he discussed with his contemporary **Sanad ibn 'Ali**, and a *zīj* (astronomical handbook), which is mentioned by the Egyptian astronomer **Ibn Yūnus**, who also says that there is another *zīj* by the three brothers. Finally, listed under the name of the Banū Mūsā are: *A Book of Degrees on the Nature of Zodiacal Signs*, regarding which it is stated in the manuscript that it is a translation of a Chinese work; a *Book on The Construction of the Astrolabe*, quoted by **Bīrūnī**; and, a *Book on the Solar Year*. The latter has traditionally been attributed to Thābit ibn Qurra, but recent research has shown that this is most likely a misattribution and that the treatise is actually by the Banū Mūsā. The majority of these books are now lost; however, the list of titles and the studies on the extant works show that the Banū Mūsā dealt extensively with the major concerns of astronomy in their time. Moreover, the interest of the Banū Mūsā in astronomy is also attested by reports that the brothers were involved in various activities, such as leading the astronomical observations that were made in Baghdad during the course of the 9th century or collaborating in the expeditions mounted by Ma'mūn for the purpose of making a geodetic measurement of the length of a degree along a terrestrial meridian.

The Banū Mūsā produced major work in the field of mechanics. Their efforts show important advances over those of their Greek predecessors: writers such as Philo of Byzantium (end of third century BCE) and Hero of Alexandria (middle of first century), whose works were extensively known by Muslim engineers. The Banū Mūsā also wrote many works in the field of mathematics, many devoted to geometrical problems. One of their most important works, *Book on the Measurement of Plane and Spherical Figures*, was the object of a recension by **Naṣīr al-Dīn al-Ṭūsī** in the 13th century and of a Latin translation by **Gerard of Cremona** in the 12th century under the titles *Liber trium fratrum de geometria* and *Verba filiorum Moysi filii Sekir*. This treatise was one of the fundamental texts on geometry in the Middle Ages, and its contents (in both the Arabic and European contexts) are found in authors such as Thābit ibn Qurra, **Ibn al-Haytham**, Leonardo Fibonacci of Pisa (died: 1250), Jordanus de Nemore (died: 1260), and **Roger Bacon** (died: *circa* 1292). The other works on geometry attributed to the Banū Mūsā are three books related to the *Conic Sections* of **Apollonius of Perga** (third century BCE), a *Book on a Geometric Proposition Proved by Galen*, a *Reasoning on the Trisection of an Angle* (by Aḥmad), and a *Book on an Oblong Round Figure*. The latter concerns the ellipse and contains a description of what is known as the gardener's construction, a procedure for drawing an ellipse by means of a string fastened to two pegs and based on the fact that the sum of the two focal radius vectors of any point belonging to a given ellipse is constant.

Finally, the family tradition of the Banū Mūsā seems to have been continued to a certain extent by a

son of the eldest brother, Nu'aym ibn Muḥammad ibn Mūsā, who wrote *Book on Geometric Propositions*.

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