Al-Māh | Encyclopedia.com

(*b*. Mahān, Kerman, Persai; *fl*. Baghdad, *ca*. 860; *d*. *ca*. 880)

mathematics, astronomy.

Our main source of information on al-Māhānī's life consists of quotations from an unspecified work by al-Māhānī in Ibn Yūnus' *Ḥākimite Tables*. Here Ibn Yūnus cites observations of conjunctions and lunar and solar eclipses made by al-Māhānī between 853 and 866. Al-Māhānī remarked, in connection with the lunar eclipses, that he calculated their beginnings with an astrolabe and that the beginnings of three consecutive eclipses were about half an hour later than calculated.

Al-Māhānī main accomplishments lie in mathematics; in the *Fihrist* he is mentioned only as geometer and arithmetician. Al-Khayyāmī states that al-Māhānī was the first to attempt an algebraic solution of the Archimedean problem of dividing a sphere by a plane into segments the volumes of which are in a given ratio (*On the sphere and the Cylinder* II, 4). Al-Māhānī expressed this problem in a cubic equation of the form $x^3 + a = cx^2$, but he could not proceed further. According to al-Khayyāmī, the problem was thought unsolvable until al-Khāzin succeeded by using conic sections. In Leiden there exists a manuscript copy of a commentary to al-Māhānī's treatise, probably by al-Qūhī

Al-Māhānī wrote commentaries to books I, V, X and XIII of Euclid's *Elements*. Of these, the treatise on the twenty-six propositions of book I that can be proved without a *reductio ad absurdum* has been lost. Part of a commentary on book X, on irrational ratios; an explanation of obscure passages in book XIII; and three (different?) treatises on ratio (book V) are extant. Since book V, on the theory of proposition, was presented in a synthetic form which did not reveal how the doctrine of proportions had come into being, Arabic mathematicians were dissatisfied with definition 5, the fundamental one. They did not deny its correctness, however, and accepted it as a principle. Gradually they replaced the Euclidean "equimultiple" definition by the pre-Eudoxian "anthyphairetic" definition, which compared magnitudes by comparing their expansion in continued fractions. The "anthyphairetic" conception appears in explicit form in al-Māhānī's treatise, in which he referred to Thābit ibn Qurra. Al-Māhānī regarded ratio as "the mutual behavior of two magnitudes when compared with one another by means of the Euclidean process of finding the greatest common measure." Two pairs of magnitudes were for him proportional when "the two series of quotients appearing in that process are identical." Essentially the same theory was worked out later by as-Nayrīzī. Neither established a connection with Euclid'definition, which was first done by al-Haytham.

At the request of some geometers al-Māhānī wrote an improved edition of the *Sphaerica* of Menelaus—of book I and part of book II—which has been lost. His improvements consisted of inserting explanatory remarks, modernizing the language (with special consideration given to technical terms), and remodeling or replacing obscure proofs. This edition was revised and finished by Aḥmad ibn Abī Saīd al-Harawī in the tenth century. Al-Ţūsī, who wrote the most widely known Arabic edition, considered al-Māhānī's and al-Harawī's improvements valueless and used the edition by Abū Naṛ Maṇūr ibn Irāq.

BIBLIOGRAPHY

I. Original Works. C. Brockelmann, *Geschichte der arabischen Literatur*, supp. I (Leiden, 1937), 383, lists the available MSS of al-Māhānī. Information on al-Māhānī is also given in H. Suter's translation of the *Fihrist in Das Mathematiker-Verzeichniss im Fihrist des Ibn abī Jakuūb al-Nadīm, in Abhandlungen zur Geshichte der Mathematik*, VI (Leipzig, 1892), 25, 58. Partial translations and discussions of al-Māhānī's work are in M. Krause, *Die Sphärik von Menelaos aus Alexandrien* (Berlin, 1936), 1, 13, 23–26; G. P. Matvievskaya, *Uchenie o chisle na srednevekovom Blizhnem i Srednem Vostoke* ("Studies on Number in the Medieval Near and Middle East"; Tashkent, 1967), ch. 6, which deals with commentaries on Euclid X; and E. B. Plooij, *Euclid's Conception of Ratio* (Rotterdam, 1950), 4, 50, 61.

II. Secondary Literature. On al-Māhāhānī's observations, see "Ibn Yūnus, *Le livre de la grande Table Hak´mite*, trans. by J. J. A. Caussin de Perceval in *Notices et extraits de la Bibliothèque nationale*, **7** (1804), 58, 80, 102–112, 164. Information on al-Māhānī as a mathematician, especially his treatment of the Archimedean problem, is in F. Woepcke, *L'algèbre d'Omar Alkhayyāmī* (Paris, 1851), 2, 40–44, 96. On the anthyphairetic theory, see O. Becker, *"Eudoxos Studien I," in Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik*, Abt, B. **2** (1933), 311–333.

Yvonne Dold-Samplonius