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(*d* 961/971)

astronomy, mathematics.

Al-Khāzin, usually known as Abũ Jaʿfar al-Khāzin, was a Sabaean of Persian origin. The *Fihrist* calls him al-Khurānāā, meaning from Khurāsān, a province in eastern Iran. He should not be confused with Aʿbd al-Rahmāan al-Khāzinī (*ca*. 1100), the probable author of *Kitāb al-āāt alʿajiba al-raādiyya*, on obsertvation instruments, often attributed to al-Khāzin. (E. Wiedemann attributed this work, inconsistently, to al-Khāzin in the *Enzyklopaedie des Islam*, II [Leiden-Leipzig, 1913], pp. 1005-1006, and to al-Khāziniī in Beiträge, **9** [1906], 190. De Slane confounded these two astronomers in his translation of Ibn Khaldũ's *Prolegomena,* I, 111.

Abũ Ja far al-Khāzin, said to have been attached to the court of the Buwayhid ruler ruler al-Dawla (932-976) of Rayy, was well known among his contemporaries. In particular his *Zij al-āsafāih* ("tables of the Disks [of the astrolabe]"0, which Ibn al-Qiftī calls the best work in this field, if often cited. it may be related to manuscript "Liber de sphaera in plano describenda," in the Laurentian library in Florence (Pal,-Med. 271).

Al-Bīũnīs *Risāla fi fihrist kutub Muhammad b. Zakariyyā al-Rāzi* ("Bibliography") of 1036 lists several texts (written in cooperation with Abũ Naşr Manşũr ibn 'Irāaq), one of which is *Fi tashīh mā waqa'a li Abi Jaʿfar al-Khāzin min al-shaw fi zäj al-safā ih* ("On the Improvement of What Abũ Jaʿfar Neglected in His Tables of the Disks"). In *Tamhid al-mustaqarr li-tahqīq manā al-mamarr,* ("On Transits"), al-Bīũnī criticizes Abũ Ja' al-Khā;zin for not having correctly handled two equations defining the location of a planet but remarks that the *Zī al-safāih* is correct on this matter. Abũ Ma'shar that. unlike manyolthers, he had fully determined the truth about the planets, which he had included in his Zīj. Abũ Jafar al-Khāzin regarded this work as a mere compilation. Al-BiũrŪnī compared Abũ Jaʿfar al-Khāzin very favorably with Abũ Ma'shar, and in his *al-āthār al-bāqiya min al-quũn al-khāliya* ("Chronology of Ancient Nations") he refers to *Zij al safā ih* for a good explanation of the progressive and retrograde motion of the sphere.

An anonymous manuscript in Berlin (*Staats-bibliothek, Ahlwardt Cat*. No. 5857) contains two short chapters on astronomical instruments from a work by Abũ Jafar al-Khāzin, probably the *Zij al-safā ih*. The MS Or. 168 (4) in Leiden by Abũ'l-Jũd quotes Abũ Jaʿfar al-Khāzin's remark in Zij al-safā ih that he would be able to compute the chord of an angle of one degree if angle trisection were possible.

In Kitāb fi isi'ā, dedaling with constructions of astrolabes, al-Biũnī cites Abũ Ja'far al-Khāin's work "Design of the Horizon of the Ascensions for the Signs of the Zodiac." And in his *Chronology* he describes two methods for finding the *Signum Muharrami* (the day of the week on which al-Muharram, the first month of the Muslim year, begins) described by Abũ Jaʿfar al-Khāzin in *al-Madkhal al-kabīr fīilm al-nujūm* ("Great Introduction to Astronomy"). Neither work is extant.

Also treated in al-Bīũnī's *Chronology* is Abũ Jaʿfar al-Kh˜zin's figure, different from the eccentric sphere and epicycle, in which the sun's distance from the earth is always the same, independent of the rotation. This treatment gives two isothermal regions, one northern and one southern. Ibn Khaldũn gives a precise exposition of Abũ Jaʿfar al-Khāzin's division of the earth into eight climatic girdles.

Al-Kharaqī (*d*. 1138/1139), in al-Muntahā, mentions Abũ Jaʿfar al-Khāzin and Ibn al-Haytham as having the right understanding of the movement of the spheres. This theory was perhaps described in Abũ Jaʿfar al-Khāzin's *Sirr al-'ālamin* (not extant).

In *Tahdī nihāyāt al-amākin*. . ., al-Bīũni criticizes the verbosity of Abũ Ja'far al-Khāzin's commentary on the *Almagest* and objects to Ibrāhīm ibn Sānān and Abũ Jafar al-Khāzin's theory of the variation of the obliquity of the ecliptic; al-Bīũnī himself considered it to be constant. The obliquity was measured by al Harawi and Abũ Jafar al-Khāzin at Rayy (near modern Teheran) in 959/960, on the order of Abu'l Faḍl ibn al-'Amid, the vizier of Rukn al-Dawla. The determination of this quantity by "al-Khāzin and his collaborators using a ring about 4 meters" is recorded by al-Nasawi.

Abũ Jaʿfar al-Khāzin was, according to Ibn al Qifţi, an expert in arithmetic, geometry, and *tasyīr* (astrological computastions based on planetary trajectoris). According to al-Khayyāmi, he used conic sections to give the first solution of the cubic equation by which al-Māhānī represented Archimedes' problem of dividing a sphere by a plane into two parts whose volumes are in a given ratio (*Sphere and Cylinder* II, 4) and also gave a defective proof of Euclid's fifth postulate.

Abū Jaʿfar al-Khāzin wrote a commentary on Book X of the *Elements*, a work on numerical problems (not extant), and another (also not extant) on spherical trigonometry, *Maṭālib juziyya mail almuyūl al-juz iyya wa 'l-maṭāli' fi'l0kura al-mustaqima* From the latter, *al-Ţūsī, in Kitāb šakl al-qaṭṭā* ("On the Transversal Figure"), quotes a proof of the sine theorem for right spherical triangles. Al-Tūsī also added another proof of Hero's formula to the *Verba filiorum* of the Banuū Mūsū (in *Majmū al-rasaāil,* II [Hyderabad, 1940]), attributing it to one al-Khāzin. This proof, closer to that of Hero than the proof by the Banū Mūsā, and in which the same figure and letters are used as in Hero's *Dioptra*, is not found in the Latin editions of the *Verbafiliorum*.

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M. Clagett, *Archimedes in the Middle Ages, I, The Arabo-Latin Tradition* (Madison, Wis., 1964), p. 353; and H. Suter, "über die Geometrie der Söhne des Mūsā ben Schākir," in *Bibliotheca mathematica*, 3rd ser., **3,** no. 1 9190-20, p. 271, mention the proof of Hero' formula. For the cubic equation of al-Māhāni, see F. Woepcke, *L', algé du quadrilatére*, A. Carathéodory, ed. (Constantino;le, 1891), pp. 148-151; for the fifth postulate, see G. Jacob and E. Wiedemann, "Zu 'Omer-i-Chajjâm," in Der *Islam*, **3** (1912), p. 56. Other articles by E. Wiedemann containing information on Abū Jaʿfar al-Khāzin are in Beiträge **60** (1920-1921) and **70** (1926-1927), of *Sitzungsberichte der Physikalisch-Medizinischen Sozietät zu Erlangen*. Now available in E. Wiedemann, *Aufsätze zur arabischen Wissenchaftsgeschichte*, II (Hidesheim, 1970), pp. 498, 503, 633.

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