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Ibn Sahl: Abū Saʿd al-ʿAlāʾ ibn Sahl

Len Berggren

Flourished **late 10th century**

Ibn Sahl was a geometer who worked in the late 10th century. Although he is not mentioned in the known biobibliographical sources from the medieval period, Ibn Sahl is mentioned by **Ibn al-Haytham**, whose working life spanned the late 10th and early 11th centuries. On the other hand, he commented on one of **Abū Sahl al-Kūhī**'s treatises, and Kūhī probably died before the end of the 10th century.

His two works most relevant to the history of astronomy are his *Proof that the Vault of the Heavens Is Not Completely Transparent* and his commentary on Abū Sahl al-Kūhī's treatise on the astrolabe. In the former he gives, inspired by his study of the fifth book of **Ptolemy**'s *Optics*, a proof that whatever substance one is given, such as that composing the heavenly spheres of Aristotelian cosmology, it is always possible to find a substance that refracts light less. Ibn Sahl agrees with **Aristotle**, however, that the heavenly spheres are indeed more transparent than any sublunar substance such as crystal. It is this work that Ibn al-Haytham cites in his short treatise *Discourse on Light*.

Very much connected with this treatise is another of Ibn Sahl's works, this one on burning mirrors. In it he addresses the question of how to design not just mirrors but lenses that will focus incoming light rays at a given distance. He distinguishes between the cases in which the incoming rays originate from a source such as the Sun, which may be considered to be at an infinite distance, or from a source at a finite distance. Ibn Sahl considers both the theoretical and the practical aspects of this problem, which in the case of lenses demands consideration of refraction. And he states a geometrical relation between incident and refracted rays that, rewritten in modern trigonometric notation, is equivalent to the Law of Refraction, although it does not involve the notion of the refractive index of a medium.

In his commentary on Kūhī's astrolabe treatise, Ibn Sahl discusses the different possibilities for an astrolabe formed by projecting the sphere on to two surfaces. He argues that since one surface must rotate smoothly over the other, and remain completely in contact with it during the rotation, such surfaces must arise as surfaces of revolution of some curve around the axis of the sphere. In addition, the curve, which may of course be a straight line, must lie in a plane containing the axis. Among the more unusual examples he mentions for surfaces of astrolabes are those of conics of revolution, such as paraboloids.

Selected References

Rashed, Roshdi (1993). *Géométrie et dioptrique au Xe siècle: Ibn Sahl, al-Qūhī et Ibn al-Haytham*. Paris: Les Belles Lettres.

Sabra, A. I. (1989). *The Optics of Ibn al-Haytham: Books I–III On Direct Vision*. 2 Vols. London: Warburg Institute, esp. vol. 2, lii–liii and lx.

Sezgin, Fuat *Geschichte des arabischen Schrifttums*. Vol. 5, *Mathematik* (1974): 341–342. Vol. 6, *Astronomie* (1978): 232–233. Leiden: E. J. Brill.