Al-Nasawī, Abu | Encyclopedia.com

(*fl*. Baghdad, 1029–1044)

arithmetic, geometry.

Arabic biographers do not mention al-Nasawī, who has been known to the scholarly world since 1863, when F. Woepcke made a brief study of his *al-Muqniʿ fī l-Hisāb al-Hindī* (Leiden, MS 1021). The intro- duction to this text shows that al-Nasawī wrote, in Persian, a book on Indian arithmetic for presentation to Magd al-Dawla, the Buwayhid ruler in Khurasan who was dethroned in 1029 or 1030. The book was presented to Sharaf al-Mulūk, Vizier of Jalāl al-Dawla, ruler in Baghdad. The vizier ordered al-Nasawī to write in Arabic in order to be more precise and concise, and the result was *al-Muqniʿ*. Al-Nasawī seems to have settled in Baghdad; another book by him, *Tajrīd Uqlidis* (Salar-Jang, MS 3142) was dedicated in highly flattering words to al-Murtadā (965–1044), an influential Shiʿite leader in Baghdad. Nothing else can be said about his life except that al-Nasawī refers to Nasā, in Khurasan, where he probably was born.

Al-Nasawī has been considered a forerunner in the use of the decimal concept because he used the rules and where *k* is taken as a power of 10. If K is taken as 10 or 100, the root is found correct to one or two decimal places. There is now reason to believe that al-Nasawī cannot be credited with priority in this respect. The two rules were known to earlier writers on Hindu-Arabic arithmetic. The first appeared in the *Patīganita* ofŚrīdhārācārya (750–850). Like others, al-Nasawī rather mechanically converted the decimal part of the root thus obtained to the sexagesimal scale and suggested taking *K* as a power of sixty, without showing signs of understanding the decimal value of the fraction. Their concern was simply to transform the fractional part of the root to minutes, seconds, and thirds. Only al-Uqlīdisī (tenth century), the discoverer of decimal fractions, retained some roots in the decimal form.

In *al-Muqniʿ*, al-Nasawī presents Indian arithmetic of integers and common fractions and applies its schemes to the sexagesimal scale. In the introduction he criticizes earlier works as too brief or too long. He states that Kūshvār ibn Labbān (*ca*. 971–1029) had written an arithmetic for astronomers, and Abū Hanifa al-Dinawarī (*d*. 895) had written one for businessmen; but Kūshyār's proved to be rather like a business arithmetic and Abū Hanīfa's more like a book for astronomers. Kūshyār's work, *Usūl Hisāb al-Hind*, which is extant, shows that al-Nasawī's remark was unfair. He adopted Kūshyār's schemes on integers and, like him, failed to understand the principle of "borrowing"in subtraction. To subtract 4,859 from 53,536, the Indian scheme goes as follows: Arrange the two numbers as 53536 4859.

Subtract 4 from the digit above it; since 3 is less than 4, borrow 1 from 5, to turn 3 into 13, and subtract. And so on. Both Kūshyār and al-Nasawī would subtract 4 from 53, obtain 49, subtract 8 from 95, and so on. Only finger-reckoners agree with them in this.

In discussing subtraction of fractional quantities, al-Nasawī enunciated the rule $(n_1 + f_1) - (n_2 + f_2) = (n_1 - n_2) + (f_1 - f_2$, where n_1 and n_2 are integers and f_1 and f_2 are fractions. He did not notice the case when $f_2 > f_1$ and the principle of "borrowing"should be used.

Al-Nasawī gave Kūshyār's method of extracting the cube root and, like him, used the approximation where p^3 is the greatest cube in n and $r = n - p^3$. Arabic works of about the same period used the better rule

Later works called $3p^2 + 3p + 1$ the conventional denominator.

Al-Mugniʿ differs from Kūshyār's *Usūl* in that it explains the Indian system of common fractions, expresses the sexagesimal scale in Indian numerals, and applies the Indian schemes of operation to numbers expressed in this scale. But al-Nasawī could claim no priority for these features, since others, such as al-Uqlīdisī, had already done the same thing.

Three other works by al-Nasawī, all geometrical, are extant. One of them is *al-Ishbāʿ*, in which he discusses the theorem of Menelaus. One is a corrected version of Archimedes' *Lemmata* as translated into Arabic by Thahit ibn Qurra, which was later revised by Nasīr al-Dīn al-Tūsī. The last is *Tajrīd Uqlīdis* ("An Abstract From Euclid"). In the introduction, al-Nasawī points out that Euclid's *Elements* is necessary for one who wants to study geometry for its own sake, but his *Tajrīd* is written to serve two purposes: it will be enough for those who want to learn geometry in order to be able to understand Ptolemy's *Almagest*, and it will serve as an introduction to Euclid's *Elements*. A comparison of the *Tajrīd* with the *Elements*, however, shows that al-Nasawī's work is a copy of books I-VI, on plane geometry and geometrical algebra, and book XI, on solid geometry, with some constructions omitted and some proofs altered.

BIBLIOGRAPHY

I. Original Works. Al-Nasawī's writings include "On the Construction of a Circle That Bears a Given Ratio to Another Given Circle, and on the Construction of All Rectilinear Figures and the Way in Which Artisans Use Them,"cited by al-Ṯūsī in Maʾkhūdhāt *Arshimīdis*, no. 10 of his *Rasāil*, II (Hyderabad-Deccan, 1940); *al-Ishb*ʿ, trans. by E. Wiedemann in his *Studien zur Astronomie der Araber* (Erlangen, 1926), 80–85—see also H. Burger and K. Kohl, *Geschichte des Transversalensätze* (Erlangen, 1924), 53–55; *Kitāb al=lāmi*ʿ *fī amthilat al-Zij al-jāmi*ʿ ("Illustrative Examples of the Twenty-Five Chapters of the *Zij al-jāmi*ʿ *of Kūshyār*), in Hājjī Khalīfa, *Kashf* (Istanbul, 1941), col. 970; and *Risāla fī maʾrifat al-taqwim wa60357;l-asturlāb* ("A Treatise on Chronology and the Astrolabe"), Columbia University Library, MS Or. 45, op. 7.

II. Secondary Literature. See H. Suter, "Über des Rechenbuch des Ali ben Ahmed el-Nasawī,"in *Bibliotheca mathematica*, 2nd ser., **7** (1906), 113–119; and F. Woepcke, "Mémoires sur la propagation des chiffres indiens,"in *Journal asiatique*, 6th ser., **1** (1863), 492 ff.

See also Kushyār ibn Labbān, *Usūl Hisāb al-Hind*, in M. Levey and M. Petruck, *Principles of Hindu Reckoning* (Madison, Wis., 1965), 55–83.

A. S. Saidan