Al-Uqlidisi, Abu'L-?asan A?mad Ibn Ibrahim | Encyclopedia.com

---

(*fl*. Damascus, 952–953),

arithmetic.

No source book mentions al-Uqlīdisī. He is known only from a unique copy of his work entitled *Kitäb al-fusül fl*$_3$ *l-hisäb al-hindī*(MS 802. Yeni Cami, Istanbul), the front page of which bears the author's name and the statement that the text was written at Damascus in 952–953. The manuscript was copied in A.D. 1157. In the introduction the author states that he has traveled extensively, read all books on Indian arithmetic that he has found, and learned from every noted arithmetician he has met. The epithet al-Uqlī;disī generally was attached to the names of persons who made copies of Euclid's *Elements* for sale, so it is possible that he earned his living in that way. Internal evidence shows that he had experience in teaching Indian arithmetic, for he knows what beginners ask and how to answer their questions.

The book is in four parts. In the first, Hindu numerals are introduced: the place-value concept is explained: and the arithmetical operations, ion cluding extraction of square roots, are described, with many examples applied to integers and common fractions in both the decimal and the sexagesimal systems.

In the second part the subject matter is treated at a higher level and includes the method of casting out nines and several variations of the schemes of operations explained in the first part. In the introduction the author states that in this part he has collected the methods used by noted manipulators, expressed in the Indian way. This section contains almost all the schemes of multiplication that appear in later Latin works.

In the thrid part, justifications of the several concepts and steps suggested in the first two parts are given, generally in answer to questions beginning "Why" or "How is it."

A few words may be necessary for an appreciation of the fourth part. The first few lines of the text state that Indian arithmetic, as transmitted to the Arabs, required the use of the dust abacus. Later it is said that the operations depended upon shifting the figures and erasing them. For instance, in the example 329 x 456, the numbers are written as shown below:

Then 3 is multiplied by 4 and the product is inserted in the top line as 12; 3 is multiplied by 5, which requires putting 5 above, erasing 2, and putting 3 in its place; 3 in its place: 3 is multiplied by 6, making it necessary to remove 3 from the top line and write 8 in its place, to erase the 5 before it, and to put 6 in its place. In preparation for the next step, the lower line is shifted one place to the right. The array is now as shown below:

456 is to be multiplied by 2, which is above the units place of 456; the position of the units digit of the multiplicand in the lower line indicates the multiplier. The remaining steps can now be followed with ease.

Obviously paper and ink cannot be easily used with such schemes. In the fourth part of the text, modifications of the Indian schemes are suggested whereby the abacus can be dispensed with, and ink and paper used instead. We can now judge that al-Uqlīdisī's modification presents a first step in a long chain of attempts that resulted in discarding the abacus completely, first in western Islam and, many centuries later, in the eastern part.

After suggesting a modification of each operation, al-Uqlīdisī proposed that:

1. Greek letters might replace the nine Indian numerals.

2. The Indian numerals with superimposed dots might form a new Arabic alphabet.

3. There might be calculating dice, with one or two numerals on each face, to use instead of the abacus.

4. There might be a calculating board to be used by the blind.

The second idea is cited in other texts, and the third is reminiscent of Boëthius' apexes. It is as likely as not that here al-Uqlīdisī is describing methods used elsewhere rather than making original suggestions. The book ends with a lengthy discussion of $\Sigma 2^r$ and the method of extracting the cube root.

Al-Uqlīdisī was proud of the following accomplishments in his work.

1. In part 1 he presented the contents of all earlier texts on Indian arithmetic and applied it in the sexagesimal system. we do not have these texts to enable us to judge how far he was correct in this claim. The Latin *Algorismus corpus*, however, indicates that Indian arithmetic as presented by al-Khwārizmī (ninth century) differed basically from that which spread later in the Muslim world. Application of the Indian schemes to the sexagesimal system is found in all later Arabic arithmetic books.

2. In part 2 he gave mehthods known only to noted arithmeticians, and extended the method of casting out nines to fractions and square roots. On the evidence of later texts, one is inclined to accept this claim of al-Uqlīdisī.

3. In part 4, he showed that Indian arithmetic no longer needed the abacus. This modification was more agreeable to the West than to the East. In support we may note that Ibn al-Bannā' (*d*. 1321) of Morocco included as a curiosity in one of his arithmetical works the statement that the ancients had used dust for calculation, whereas Nasīr al-Dīn al-Tūsī (*d*. 1274) of Persia found the dust abacus still important enough to write a book on it.

4. In discussing $\Sigma 2^r$ he distinguished between the *n*th term and the sum of *n* terms, which he claimed that some manipulators had confused.

5. He claimed to be the first to have written satisfactorily on the cube root.

There are no documents to decide the last two claims, but we have other reasons to consider al-Uqlīdisī's *Kitāb al-fusūl fi'l-hisāb al-hindī*; the most important of some one hundered extant Arabic arithmetic texts.

First, it is the earliest known text that contains a direct treatment of decimal fractions. The author suggests a decimal sign, a stroke over the units' place, and insists that it must always be used. In a process of successive division by 2 he obtains the sequence 13, 6.5, 3.25, 1.625. 0.8125. He knows how to regain 13 by successive multiplication by 2 and by ignoring the Zeros to the right. In a process of repeatedly increasing 136 by one-tenth, he obtains the array

Again, in finding the approximate roots of numbers, he uses the rules

and takes *k* equal to a multiple of ten.

Although many other arithmeticians used the same rules, all of them rather mechanically transformed the decimal fraction obtained into the sexagesimal system, without showing any sign of comprehension of the decimal idea. Only al-Uqlīdisī gives the root in the decimal scale in several cases. In all operations where powers of ten are involved in the numerator or the denominator, he is well at home.

Second, al-Uqlīdisī's is the first text to tell us clearly that Indian arithmetic depended on the dust abacus. In his introduction, the author compared the Indian system with the then current finger-reckoning and made a correct evaluation of the merits and drawbacks of each. It is now known that Abu'l-Wafā' (940 – 997/998) and Ibn al-Bannā" made passing statements about the dust abacus in Indian arithmetic, but these references were too terse to catch the attention of the scholars who first studied their works.

BIBLIOGRAPHY

See A.S. Saidan, "The Earliest Extant Arabic Arithmetic," in *l sis*, **57** (1966), 475–490.

A. S. Saidan