CHAPTER V

THE ARABIC TEXT AND THE TRANSLATIONS OF AL-KHOWARIZMI'S ALGEBRA

The Arabic text of Al-Khowarizmi's algebra, together with an English translation, was published by Frederick Rosen in 1831. This excellent work is unfortunately out of print, and so is not available to most students of mathematics. The translation is made with care and intelligence, but not literally. Thus the Arabic invocation to the Deity is frequently omitted, just as it often is by modern translators.

The translation of the Algebra into Latin was made not only by Robert of Chester, but also, as we have indicated, by some other student of Arabic science who lived about the same time as Robert. This Latin version, as found in two Paris manuscripts, was published by Libri. Björnbo believed that he had established this to be the work of Gerard of Cremona, which indeed is probable. A list of the numerous translations due to Gerard was made soon after Gerard's death by some friend and admirer, and the list was published by Boncompagni. Included among the titles is the algebra, Liber alchoarismi de iebra et almucabula tractatus I. However, the question is somewhat complicated by the fact that a mediæval adaptation of the algebra which was published by Boncompagni bears the name of Gerard of Cremona. The text of this version does not follow the Arabic at all closely, and there is little reason for considering it as a direct translation. Probably the meaning of the title is that the text of this version is based upon Gerard's translation.

1 Portions of the Arabic text and translation have been examined by Professor W. H. Worrell, to whose courtesy I am indebted for the information about the character of the translation.
The Libri text varies essentially in phraseology and construction from that by Robert. The Arabic is closely followed up to the long list of problems, "Various Questions." Even here all the problems with the exception of two\(^1\) are given in the Latin by Gerard, but not absolutely in the order in which they occur in the Arabic. The slight changes in the sequence of problems may well have been the fault of the particular Arabic manuscript which Gerard used, if it is not due to some transcriber of Gerard's work. One problem which is omitted is not very clear in the Arabic, but the second omission is a problem of the same type as others which are given. Some other slight omissions are made in the Latin text, and the longest of these corresponds to the passage in our text p. 84, line 25 to p. 86, line 2. Another omission in the Libri text corresponds to our text, page 74, line 25, \textit{quod . . . reperies.} The Libri text also frequently omits the common invocation to the Deity which is so often interjected by Arabic writers.

The Latin translation by Robert of Chester is not as faithful nor as correct as the text ascribed to Gerard of Cremona, published by Libri. Omissions, transpositions, and additions to the text are so numerous that it does not seem desirable to list them all. No evidence exists, however, that Robert's text is based upon another Arabic original than that of the Libri text. The text proper, as opposed to the illustrative problems, follows the general lines of the Arabic original. The longest omission is the section dealing largely with the operations upon the square root of 200, which is illustrated, in the Arabic and in the Libri text, by geometrical figures with corresponding demonstrations.\(^2\)

A sentence is left out on page 98 of our text, line 6, after the word \textit{acquiparatur}. This sentence Rosen translates, "Compute in this manner every multiplication of the roots, whether the multiplication be more or less than two." Lines 9–11, \textit{Natura . . .}

\(^1\) Rosen's translation, p. 48, line 15 to p. 50, line 4, and p. 53, lines 12–20. Neither of these problems is given by Robert of Chester, nor does either appear in the Boncompagni version. The first problem reads: "If some one say: 'I have purchased two measures of wheat or barley, each of them at a certain price; I afterwards added the expenses, and the sum was equal to the difference of the two prices, added to the difference of the measures.'" The second reads: "Three-fourths of the fifth of a square are equal to four-fifths of its root."

\(^2\) Rosen, \textit{loc. cit.}, p. 27, lines 5–18, and p. 31, line 11, to the bottom of p. 34; Libri, \textit{loc. cit.}, p. 269, lines 2–12, and p. 271, line 16–p. 274, line 14. The Libri version omits the statement of one problem, as stated by Rosen, p. 27, lines 14–16, but the geometrical explanation is complete.
fractionibus, on the same page of our text, seems to be an addition by Robert. The introduction of the passage, 'On Mercantile Transactions,' pp. 120–124, is not at all carefully translated by Robert, who retains poor transliterations of four technical expressions used in the Arabic. The four expressions in question refer to the four terms of a proportion in which when three are given the fourth is determined. If a given quantity of goods is sold at a fixed or set price, then the price of any other quantity of the same goods, or the amount of goods to be obtained for a given sum of money, is determined by a proportion in which the three given quantities enter. The unit of measure, or quantity sold at a fixed price, is termed by Robert Almusarar; instead of al-musa'-ir, and the fixed price Alszarar, instead of al-si'r; the quantity of goods desired is Almuthemen, instead of al-muthamman and the amount to be expended for goods is termed Althemem, instead of al-thaman. Magul, which is used by Robert for the unknown term in a proportion, would be in modern transliteration al-magul.

Robert of Chester does not present the complete list of problems which occur in the Arabic text of Al-Khowarizmi's algebra, but only a selection of about one-half of the total number. Upon what basis this selection was made does not appear, except that typical problems are chosen, and the repetitions which are found in the Arabic and the Libri text are eliminated. In the footnotes to our English version we have indicated the problems which have been omitted by our author.

The translation of the text and solutions of the problems which are given present peculiarities entirely similar to those which have been noted in the preceding discussion of the Latin text by Robert. A noteworthy omission is made both by Robert of Chester and by the translator of the version published by Libri. This concerns the fifth problem of the set of six which illustrate in order each of the six types of quadratic equations. After the solution of the problem to the point to which our text carries the problem, the Arabic, as translated by Rosen, adds: 'Or, if you please, you may add the root of four to the moiety of the roots; the sum is seven, which is likewise one of the parts. This is one of the problems which may be solved by addition and subtraction.'