Episodes in the Mathematics of Medieval Islam. By J. L. Berggren. New York (Springer-Verlag). 1986. xiv + 197 pp. $23.00 (cloth).

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Recent research in the history of science has already demonstrated that one cannot study the history of medieval science in any serious manner without taking into account the contributions of scientists who wrote in Arabic. In the case of the exact sciences, especially mathematics, astronomy, and optics, one can even assert that the writings of medieval authors on these subjects are almost incomprehensible if they are not read against the backdrop of Arabic science. Therefore, the need to assemble whatever material one can find on medieval Arabic science is definitely critical. To make that material available to the widest circle of historians of science, especially to those who have no direct access to Arabic, is indeed a great service. But how does one do that? Can one write a book on the history of medieval Arabic science, or the "History of Mathematics in Medieval Islam" as Professor Berggren would put it, when so much material still remains to be looked at, catalogued, and properly studied?

The answer is definitely negative, and Professor Berggren readily admits that his book, here under review, is not a history of mathematics in medieval Islam, for "such a book could not be written yet" (p. viii). Could one then collect an anthology of representative texts from those that have been identified so far in the style of the *Source Book* series of Harvard University Press? Such an idea was contemplated more than 10 years ago and rightly abandoned, for the work required is so formidable that no one person could hope to accomplish it in a reasonable amount of time. A third possibility would be to ask experts working in the various disciplines of Arabic science to write their own tentative surveys of the research results they have reached thus far, and then assemble these surveys in one book, hoping that some general idea about the quality and scope of Arabic science might then emerge. Such a possibility is indeed feasible, and, in fact, one such book is under way, to appear in Arabic, English, and French, under the editorship of Prof. R. Rashed of the CNRS, Paris.

Professor Berggren's book differs from all of the above approaches. In his own words, he only wished "to exhibit some ways in which writers of the Islamic world contributed to the development of the mathematics one learns in high school" (p. viii). This he says after lamenting the fact that there is "no textbook on the history of mathematics in English [dealing] with the Islamic contribution in more than a general way" (p. vii). Therefore, this book is only a synopsis (or in the author's words some "episodes") of the contributions of Islamic mathematics. But it is also a very limited synopsis, for Professor Berggren has intentionally avoided some aspects of the mathematical treatises he has selected because they "go well beyond high school mathematics." We should then understand that the

topics selected for this book were intentionally curtailed in order that they might be understood by high-school students, and not, as one would have hoped, to reflect the nature and the scope of Islamic mathematics in general.

The very structure of the book corroborates this point: the first chapter deals very briefly (and I should say sometimes inaccurately) with general historical topics, the second is on Islamic arithmetic, the third on geometrical constructions, the fourth on algebra, the fifth on trigonometry, and the sixth on spherics. Each of these chapters is supplemented by a set of exercises and a collective bibliography, presumably intended for the student who wishes to go further in his study. As such, the book is indeed written for a high-school student, whose mathematical prowess cannot be overtaxed and whose eagerness for research has not yet been nurtured.

One cannot place the same demands on the author of a textbook as one would place on the author of a research study. Had Professor Berggren intended to write a text on the history of Islamic mathematics, then we would have needed to know how many of the results he reports in his book are his own findings and how many are due to others. As it stands, only experts in Arabic mathematics, and not the students for whom the book is intended, could possibly know, for example, that such terminology as the "arithmetization of algebra" (p. 111) was actually first coined by Professor R. Rashed. Incidentally, Rashed's paper "L'arithmétisation de l'algèbre au XIIe siècle" (*Actes du XIIIe Congrès d'Histoire des Sciences* [Moscow, 1974], Sect. III and IV, pp. 3–30) is not listed in the bibliography, nor is Rashed and S. Ahmad's work on al-Samaw'al, *Al-Bāhir en Algèbre d'al-Samaw'al* (Damascus: Univ. of Damascus Press, 1972), whose introductory section has a part devoted to the very same concept and has exactly the same title. Like most bibliographies in textbooks, this one merely suggests further readings rather than documenting ideas. It does, however, refer the reader to one paper by Rashed, namely, his "Recommencement de l'algèbre au XIe et XIIe siècles," which also contains such terminology.

Since this volume is intended as a high-school textbook, it should be evaluated from that perspective. We might then ask: does it make pedagogical sense to introduce high-school students to such a topic by using this book and by adopting this style? Once this question is raised, one would like to know the pedagogical philosophy behind the book. Should the student learn from a 10th-century book how arithmetical operations were carried out on actual problems, as is well illustrated, for example, on pages 39–48, and then jump to the 15th century to learn how approximate square roots were determined? More generally, should the student be learning arithmetical operations or the history of these operations? If the latter, which I presume to be the case (otherwise there is no sense in teaching these techniques to modern students, who can perform these operations much more efficiently now) then the student should be given some justification for these chronological gaps in order for the context of these operations to come to life. Maybe that is asking too much of a textbook which makes no pretense of being a history of mathematics. The book is about some episodes in the history of Islamic mathematics, and is not a continuous essay on the subject.

Taken strictly as a textbook, this work is highly commendable. The idea of such a textbook, at a high-school level, is in itself intriguing, and for this reviewer slightly romantic. Would we not all hope that modern-day high-school students, who by all national statistics are on the average mathematically illiterate, would be driven to ponder such intriguing and thought-provoking problems as the ones this book so brilliantly illustrates? After years of experience with college students, this reviewer cannot in all honesty share the expectations of the author. But if students can be found—at any level, high-school or college—who will diligently go through this book, learn all the medieval techniques, solve all the problems, and pursue the suggested readings at the end of each chapter, then this reviewer would be the first to applaud the effort put into it, and would love to have these students in his graduate seminars on Arabic science.

Without implying any negative criticism of the contents of the book *per se*, these same students should watch out for some humorous mistakes that have crept into the final version of the text. I will only signal two of them here, and leave the rest for the diligent student to discover, for that could be educational, too, and in line with the intent of the book. In the section on al-Samaw'al's division of polynomials, pages 115–116, the coefficients in the chart on page 116 are not those of the intended problem given on page 115. The coefficients in the chart on page 116 do indeed correspond with those in the edition cited above of al-Samaw'al's *al-Bāhir* edited by Rashed (p. 45 of the Arabic text), but the statement of the problem on page 115 is different from the one given in al-Samaw'al's work on page 44 of the same edition.

The second case is much more involved, and more interesting. The excerpts from Bīrūnī's sine table (pp. 146–147) are not only rearranged by the translation from Arabic into English in such a way that the English version gives the differences between the successive entries before it gives the corrections, but contain nonsensical numbers in the Arabic text. The Arabic alphabetic numeral 15 should always be rendered as *yh*, and never as *yt*, despite the fact that printers in the Arab world, who probably first set the type for the Arabic table from which this excerpt was taken, are in the habit of adding two dots on top of a final *hā'* irrespective of whether that made sense or not. In this case it does not. Incidentally, in this reviewer's copy of Bīrūnī's work, published in Hyderabad, India, such a mistake does not occur in the Arabic text.

Whether students read it or not, Professor Berggren's book is a first of its kind and one which this reviewer finds very interesting. It is definitely the product of a skillful mathematician who over the years has collected a reasonably large number of interesting problems from medieval Arabic mathematics. None of them is pursued to exhaustion, but all are arranged in such a way that, together with accompanying exercises, they should engage an active mind and help to introduce a subject to which at this stage it is very difficult to find introductions.