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Mathematics in Ancient Egypt: A Contextual History (Book Review)

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Abstract
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Mathematics in Ancient Egypt: A Contextual History

Mathematics in Ancient Egypt: A Contextual History is one of the latest outstanding monographs in history of mathematics published by Princeton University Press. Over the last decade and a half Princeton has produced around three dozen new books in this area, several of them definitive contributions to our understanding of ancient and non-Western mathematics. Annette Imhausen's book does for ancient Egyptian mathematics what Eleanor Robson's did for Mesopotamian mathematics and Kim Plofker's did for Indian mathematics: it delivers a deeply informed up-to-date contextual history and overview of a culture's practice and development of mathematics. As such, it expands upon and further contextualizes her earlier contribution on *Egyptian Mathematics* in the *Sourcebook edited by Victor Katz* — all of these are wonderful Princeton University Press books.

Imhausen sketches the history of mathematics in ancient Egypt from Pre-Dynastic times (3200 BC) through the Greco-Roman periods (400 AD), expanding the story in both directions far beyond the mathematics of the Middle Kingdom (c. 1800 BC), which has the most readily accessible source material and is therefore best known. As this is all done in about 200 pages, the book obviously can't go into minute detail on many aspects of the mathematics, but it is far more than the introduction to Egyptian mathematics Imhausen modestly hopes it will be. Based on years of doctoral work and a decade of post-doctoral research, *Mathematics in Ancient Egypt* exhibits intimate familiarity with a wide range of primary and secondary sources. The book includes 40 tables and figures, some 400-plus footnotes, and a 15-page bibliography with almost 400 entries. But while the book is grounded in extensive scholarship, it does not read like an arcane treatise for experts only: it does, as intimated, provide a masterful highly accessible self-contained introduction to ancient Egyptian mathematics.

Like that of other ancient cultures, the history of Egyptian mathematics has undergone a major transformation in the last few decades. Earlier work going back to the 1920s focused on helping readers familiar with modern mathematics understand the content and methods of the older mathematics itself. What invariably resulted was a narrative with very little real-life context and a first-order technical analysis that translated ancient mathematics into modern symbolic forms. As historians became committed to interpreting mathematical developments within their social and cultural contexts and became more aware of the distortions introduced by anachronistically using algebraic notation as an interpretive medium, new approaches were forged that furnished a more faithful picture of the mathematics of older non-Western cultures as it was actually practiced.

Imhausen's authoritative treatment of Egyptian mathematics sits comfortably and self-consciously within this historiographical trend. Her analysis of Egyptian problem-solving techniques does make use of some modern symbolism for drawing formal comparisons between different solution methods, but it is not presented as a series of transformed equations resulting in

summary formulas; it is used to exhibit algorithmically the step-by-step computational procedures that were performed on numerical data. More importantly, the breadth of her exposition makes it clear that Egyptian mathematics was by-and-large developed and used for real-life purposes by scribes trained in its standard techniques — for apportioning rations, setting work quotas, measuring agricultural fields, determining grain storage capacity, making bread and beer from flour, etc. In addition to using the standard sources for elucidating their mathematics (Rhind Mathematical Papyrus, Moscow Mathematical Papyrus, Mathematical Leather Roll), Imhausen makes use of a variety of artifacts and other texts to round out our picture of the administrative, religious, and cultural milieus in which Egyptian mathematics actually functioned.

Mathematical readers will benefit greatly from the contextualization supplied by Imhausen as that is probably farthest from their ability to provide. But they will undoubtedly still be most curious to learn just what the mathematics of ancient Egypt was like and how it worked within such settings, so I'll make a few remarks on this as well.

Even though the book is not specifically focused on systematically explicating the mathematics, Imhausen does select a fair number of examples to show how Egyptian scribes did their calculations and solved their problems, both the practical everyday problems and the more abstract aha-problems. This latter class of about 15 problems, found mainly in the RMP and the MMP, has been acclaimed as the Egyptians' contribution to the rise of algebra (solving simple first-degree problems). Solutions to these problems have traditionally been perceived as demonstrating one of the earliest uses of the method of false position, though some have seen them instead as involving algebraic transformations of equations. As her concern is not to assess how far Egyptian mathematics advanced beyond basic calculation and concrete problem solving, Imhausen makes no attempt to adjudicate between these opposing viewpoints, but one can infer that she would hesitate even to call these problems or their solutions algebraic. Much ink has been spilled since Unguru's controversial paper on geometric algebra in 1975, both in supporting and denying the existence of algebra in ancient cultures. A more nuanced notion of algebra as proposed in 2002 (and earlier) by Høyrup in *Lengths, Widths, Surfaces* could revive this issue for profitable discussion, but here Imhausen takes no particular stand on this beyond refusing to use symbolic equations to display Egyptian solution procedures.

In a book of this size, even given its wealth of information, one is inevitably left with wanting more. The status of Egyptian "algebra" is one such topic; the changing character of their fraction arithmetic is another. Imhausen briefly introduces Middle Kingdom fraction arithmetic by way of a complex example, but mathematical readers might wish to see this discussed further in terms of available techniques. Toward the end of the book, she returns to consider how fractions were handled in Greco-Roman times, posing some fascinating theses, based upon Fowler's earlier work, about how their ideas moved closer to what we would call common fraction arithmetic, but this topic begs for further analysis and exposition. As Imhausen's treatment of these later periods is quite brief (about 20 pages), much remains to be said. Perhaps she will develop this further in a later article or book.

Egyptian geometry is also covered in this book; here, too, one would occasionally like to know a bit more. Egyptian mathematics is often noted for how it calculates the area of a circular field.

Imhausen discusses RMP problems 48 and 50 where this occurs, but she says nothing about how such a procedure might have arisen. Is this because to say anything would be sheer speculation, as she hints in the *Introduction*? The same may apply to the Egyptians' method of calculating a truncated/partially built pyramid: Imhausen briefly discusses several theories for how it may have arisen but gives no reasons for accepting or rejecting them.

The *Pythagorean Rule*, as she terms it following Høyrup's suggestion, first makes its Egyptian appearance in Greco-Roman times in connection with pole-against-the-wall problems. Here she notes without going into detail that one cannot assign a definite source for such a result. Unfortunately, the subject index only cites an earlier passage where it is said that the *Pythagorean Rule* was not used (nor needed); no pages are given for where she discusses its positive appearance. Imhausen also mentions the Egyptians' formulation of a constant-slope concept, used in constructing ramps and pyramids. The subject index gives two places where this concept is mentioned; it fails to cite where it is first introduced (page 56), though there *slope* is defined as the inverse of what it is later taken to be.

Taking *Mathematics in Ancient Egypt* on its own terns, however, as a contextual sketch by a professional historian of "the mathematical practices that were developed and used in ancient Egypt," one can only applaud its achievement. This book is a very welcome addition to the literature on the topic and belongs in every college and university library. It will be read with profit by anyone interested in learning more about Egyptian mathematics.