Preface

Ancient Mesopotamian mathematics is known from hundreds of texts recorded on clay tablets in the *cuneiform* script. Some of the mathematical cuneiform texts are quite large and contain many exercises or long tables of numbers or measures. The great majority of these texts are *Old Babylonian*, from the first half of the second millennium BCE.[1] A few are *Kassite*, from the latter half of the second millennium BCE, some are *Late Babylonian/Seleucid*, from the latter half of the first millennium BCE, and others are *pre-Babylonian*, from various periods within the third millennium, or the last part of the fourth millennium. New clay tablets with mathematical cuneiform texts keep appearing from time to time, excavated in the field, extracted from the archives of large museums in Europe, America, and the Near East, or offered for sale in the antiquities market. Therefore, the writing of the history of Mesopotamian mathematics is a dynamic, never-ending process.[2]

Egyptian mathematics, on the other hand, is known from a comparatively much smaller number of original documents, belonging to three distinct groups. The first group consists of texts from the earlier part of the second millennium BCE, written in the *hieratic* script. It contains two mathematical papyrus rolls, *P.Rhind = P.BM 10057/8* (Peet, *RMP* (1923), Chace, Bull, and Manning, *RMP* (1927-29), Robins & Shute, *RMP*

1. Among the oldest known OB mathematical texts are those from the southern cities Ur, Uruk, and Larsa, before their destruction by Samsuiluna in 1739 BCE, and texts from Nippur before its destruction in 1721 BCE. Other early texts are those from Eshnunna, before 1763, and those from Mari, destroyed by Hammurabi in 1757. The mathematical cuneiform texts from northern sites, like Sippar, are later, and so are the mathematical texts from Susa. The OB period ended in 1595 BCE. (All these dates are given in the Middle Chronology.)

(1987)), and *P.Moscow E 4676* (Struve, *QSA 1* (1930)), the *Mathematical Leather Roll P.BM 10250* (Glanville, *MLR* (1927)), the papyrus fragments *P.Berlin 6619* (Schack-Schackenburg, *ZÄS* 38 (1900)), and the *Lahun mathematical fragments*, formerly known as the *Kahun fragments* (Griffith, *HPKG* (1898), Imhausen and Ritter, *UCLLP* (2004)). There are also two wooden tablets *WT.Cairo 23567/8* and two ostraca.[3] Texts belonging to this first group, in the following referred to as "hieratic mathematical papyri", will be discussed in Chapter 2.

The second group of known Egyptian mathematical texts consists of documents from the Hellenistic and Roman periods, mostly from the last part of the first millennium BCE, written in the *demotic* script. The group consists of one large papyrus, *P.Cairo*, and six smaller texts or fragments, all published by Parker in *JNES* 18 (1959), *Cent.* 14 (1969), *DMP* (1972), and *JEA* 61 (1975), plus several ostraca. A number of exercises from Parker's "demotic mathematical papyri", will be discussed in Chapter 3.

The third group of known Egyptian mathematical texts consists of documents from the Hellenistic and Roman periods, that is from the last part of the first millennium BCE and the first half of the first millennium CE, written in *Greek*. A small subgroup including 6 ostraca, a papyrus roll, and three papyrus fragments, all related in one way or another to Euclid's *Elements,* will not be considered here. However, the third group also includes

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2. See the fascinating story of the development of the history of Mesopotamian mathematics, as described by Høyrup in *HSci* 34 (1996). See also the annotated bibliography Friberg, *HMAP* (1985), with an updated edition on CD-ROM (2000). Recently published works on Mesopotamian mathematics not mentioned in those bibliographies are Chambon, *FlM 6* (2002), Damerow, *ChV* (2001), Englund, *ChV* (2001), Foster and Robson, *ZA* 94 (2004), Fowler and Robson, *HM* 25 (1998), Friberg, *BaM* 30 (1999), *AfO* 46/47 (1999/2000), *BaM* 31 (2000), *ChV* (2001), *MCTSC* (2005), *CDLJ* (2005/2), Høyrup, *HM* 29 (2002), *UOS* (2002), Jursa and Radner, *AfO* 42/43 (1995/96), Melville, *UOS* (2002), Muroi, *SCIAMVS* 1 (2000), *HSci* 10 (2001), *SCIAMVS* 2 (2001), *HSci* 12 (2002), *SCIAMVS* 4 (2003), *HSci* 13 (2003), Nemet-Nejat, *UOS* (2002), Oelsner, *ChV* (2001), Proust, *RHM* 6 (2000), *FlM* 6 (2002), *TMN* (2004), Quillien, *RHM* 9 (2003), Robson, *SCIAMVS* 1 (2000), *UOS* (2002), *HMT* (2003), *SCIAMVS* 5 (2004).

3. Cf. the timeline in Imhausen, *ÄA* (2003), Table 1: The majority of the Egyptian hieratic mathematical texts are from the time of the Middle Kingdom, Dyn. 11-12 (2119-1794/93 BCE). Only *P.Rhind* is from the Second Intermediary Period, Dyn. 13-17 (1794/93-1550 BCE), although the preface of *P.Rhind* states that the papyrus is a copy of a text from the time of a king of the twelfth dynasty.

texts that show almost no signs of having been influenced by high level Greek mathematics. The most interesting examples of such "non-Euclidean" Greek mathematical texts include a codex of six papyrus leaves, *P.Akhmîm* (Baillet, *BMA* (1892)), a large papyrus roll, *P.Vindob. G. 19996* (Gerstinger and Vogel, *GLP 1* (1932)), six smaller papyri or papyrus fragments, an ostracon, and a wooden tablet. These "Greek-Egyptian mathematical documents" will be discussed in Chapter 4.

All the mentioned *hieratic* mathematical texts had already been published by 1930, the *demotic* mathematical texts by 1975, and the *Greek-Egyptian* mathematical texts by 1981. Since then not much has happened in the study of Egyptian mathematics. The few books and papers that have been written about "Egyptian mathematics" have been concerned exclusively with the hieratic mathematical texts[4] and have mostly reiterated the interpretations and presentations of those texts that were offered already in the original publications.[5] Very little[6] seems to have been written about the demotic mathematical texts since they were published by Parker, and not much[7] about the Greek-Egyptian mathematical texts.

My original impetus to search for links between Egyptian and Babylonian mathematics came from an observation that two small but particularly interesting mathematical texts from the Old Babylonian city Mari have clear Egyptian parallels, one in an exercise in the well known hieratic *Papyrus Rhind*, the other in a relatively unknown Greek-Egyptian papyrus fragment. The details will be presented below in Chapter 1.

My observation that there seems to exist clear links between Egyptian and Babylonian mathematics is in conflict with the prevailing opinion in formerly published works on Egyptian mathematics, namely that practically no such links exist. However, in view of the mentioned dynamic

4. Recently published works on the subject of hieratic mathematical texts are Cavéing, *Essai* (1994), Clagett, *AES 3* (1999), Couchoud, *ME* (1993), Imhausen *UOS* (2002), *HM* 30 (2003), *ÄA* (2003), Ritter, *EHS* (1989), *AHST* (1995), *HNWM* (2000), *UOS* (2002), Robins and Shute, *RMP* (1987).

5. Cf. Høyrup's poignant statement in his review of Couchoud, *ME* (1993) in *MR* (1997), that the book "presents the state of the art as it has looked without fundamental change since the early 1930s".

6. Known to me are only Zauzich, *BiOr* 32 (1972), Kaplony-Heckel, *OLZ* 76 (1981), Knorr, *HM* 9 (1982), Fowler, *MPA* (1987 (1999)), Sec. 7.3(e), and Melville, *HM* 31 (2004).

7. See, in particular, Fowler, *MPA* (1987 (1999)), Secs. 7.1(d), 7.2, 7.3(c)-(e).

character of the history of Mesopotamian mathematics, not least in the last couple of decades, it appeared to me to be *high time to take a renewed look at Egyptian mathematics against an up-to-date background in the history of Mesopotamian mathematics!* That is the primary objective of this book.

My search for links between Egyptian and Babylonian mathematics has been unexpectedly successful, in more ways than one. Not only has the search turned up numerous possible candidates for such links, but the comparison of Egyptian and Babylonian mathematics has in many cases led to a much better understanding of the nature of important Egyptian mathematical texts and of particularly interesting exercises that they contain. In addition, my careful examination of a great number of individual Egyptian hieratic, demotic, and Greek mathematical exercises has made this book into a useful survey of a substantial part of the whole corpus of Egyptian mathematics.

Several of the techniques and concepts that I have developed in the course of my intensive study of mathematical cuneiform texts during the last 25 years have proven themselves to be eminently suitable also for a study of Egyptian mathematical texts. An obvious example of a helpful technique is the use of "conform" transliterations for detailed outlines of mathematical texts.[8] A particularly useful concept is that of a "mathematical recombination text", which is an appropriate name for a large mathematical text with a somewhat chaotic collection of individual exercises.

The detailed comparison in this book of a large number of known Egyptian and Mesopotamian mathematical texts from all periods has led me to the conclusion that the level and extent of mathematical knowledge must have been comparable in Egypt and in Mesopotamia in the earlier part of the second millennium BCE, and that there are also unexpectedly close connections between demotic and "non-Euclidean" Greek-Egyptian mathematical texts from the Ptolemaic and Roman periods on one hand and Old or Late Babylonian mathematical texts on the other.

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8. Compare the conform transliterations of Babylonian mathematical cuneiform texts in Figs. 1.1.2-3, 1.1.5-6, 1.2.1-2, 2.1.9-11, 2.1.17, 2.2.1, 2.2.3, 2.3.2, 3.1.8, 3.3.1, and 3.3.6 below with the similar conform transliterations (in mirror images because the Egyptian direction of writing was from right to left) of hieratic mathematical texts in Figs. 1.1.7, 2.1.4, 2.1.7, 2.2.2, 2.2.5-.6, 2.3.3-5, and 3.1.3, and of demotic mathematical texts in Figs. 3.1.5, 3.1.9, 3.1.12, 3.2.1, 3.3.2-4, 3.5.1, 3.7.1, and 3.7.6.