A Survey of Publications on Sumero-Akkadian Mathematics, Metrology and Related Matters (1854–1982)

By Jöran Friberg

New edition prepared by
Jens Høyrup

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Editor's **preface**

In 1970, "Mesopotamian mathematics" was close to being dead as a research area.[1]

Mathematicians would know about it from the standard secondary literature, presenting the results that had been achieved by Otto Neugebauer and François Thureau-Dangin before 1950 (most mathematicians, loyal to their tribe, would evidently think of Neugebauer only).

Historians of mathematics had largely left the field as already exhausted, as indeed it was as long as the perspective remained that of the 1940s. "Babylonian mathematics" was dutifully dealt with in the beginnings of general histories of mathematics, it is true, but no active work (and too often, little understanding) was involved. The few mathematical texts that had been published more recently (the Susa mathematical texts published in [Bruins & Rutten 1961], the Ešnunna texts published by Taha Baqir [1950a, 1950b, 1951, 1962]) were not taken much note of.

Assyriologists, finally, "would leave texts containing too many numbers in sexagesimal place value notation as a matter for Neugebauer", as formulated by Hans Nissen (around 1982, quoted from memory). Those working on economic texts would evidently have to deal with numbers and with metrological questions, but mostly as ancillary matters serving social and agricultural history.

Change was first announced by a member of the latter group, namely Marvin Powell, who made his doctoral work on "Sumerian Numeration and Metrology", presented in [1971]. A number of further publications from his hand followed in [1972a; 1972b; 1976], and more since then, not least of course in [1990] his monumental survey of "Maße und Gewichte" in *Reallexikon der Assyriologie*. "If any 'grand old man' exists in relation to the revival of interest in Mesopotamian mathematics", Powell was certainly the one – as I wrote to him in March 1996 (which did not avert his turn from Assyriology to active farming, much to the regret of his friends in the field of Mesopotamian mathematics).

In the second half of the decade, three of us – all amateurs inasfar as Assyriology is concerned – approached Mesopotamian mathematics from our particular perspectives. Jöran Friberg of Chalmers Tekniska Högskola, Gothenburg, who in earlier times had published about "Asymptotic behavior of integrals connected with spectral functions for hypoelliptic operators" and "Some Function Classes Connected with Partially Hypoelliptic Differential Operators" (probably as far beyond the reader's horizon as beyond mine) undertook an analysis of numbers and measures contained in proto-cuneiform and proto-Elamite accounting texts, and showed how the assumption that proto-literate accountants could calculate correctly

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[1] For this statement to be true, one needs to distinguish Mesopotamian *mathematics* from Mesopotamian *astronomy*.

changed most of what had been written on the topic. Peter Damerow, a philosopher and psychologist working at the time at the Max-Planck-Institut für Bildungsforschung in West Berlin, was interested in the emergence of arithmetical thinking, for which purpose he took up the study of ancient Egyptian and Mesopotamian mathematics. I myself, a run-away physicist sheltered in social sciences at Roskilde University, Denmark, was engaged in exploration of the links between state formation, institutionalized teaching and changing mathematical mode of thought in Mesopotamia.

Mutual acquaintances brought us into contact, and other mutual contacts made Hans Nissen and Johannes Renger discover us. They suggested to organize a "Workshop on Mathematical Concepts in Babylonian Mathematics" at Altorientalisches Seminar, Freie Universität Berlin, which actually took place in August 1983. It was followed by five more in the years until 1994.[2]

Before that, however, Jöran Friberg [1982] had published his first *magnum opus*, a bibliographic survey of Mesopotamian mathematics beginning with Edward Hinck's and Henry Rawlinson's discovery of the sexagesimal place value system in 1854. I was invited by *Zentralblatt für Mathematik* to make a critical abstract, which ran as follows:

> This annotated bibliography discusses some 500 publications on cuneiform mathematics and its precursors, i.e., mathematics as known from proto-Sumerian, proto-Elamite, Sumerian and Akkadian sources, ordered chronologically from 1854 to 1982. The time-span covered ranges from the fourth milleniura to the late first millenium B.C., and the delimitation of the concept of "mathematics" is liberal, including numeration, mathematical vocabulary, and the mathematical structure of metrological systems. No complete coverage of comparative metrology or of publications on the absolute magnitude of metrological units is attempted. Publications dealing with mathematical astronomy are almost completely left out, as are all but the most important popular or semi-popular secondary expositions of "Babylonian" mathematics. On the other hand, many publications dealing mainly with other matters are included when they contain information of importance for the history of mathematics (still, publications of cuneiform sources where mathematics is applied, like field plans or accounts, are not included systematically). The annotation for each item describes the mathematically important aspects of its contents – when necessary at great length. Besides, connections to other publications discussed in the bibliography are drawn up, e.g. when later work has revised an interpretation, or when an older publication can be placed in a new perspective. In many cases, finally, the author indicates briefly his own objections, alternative interpretations or further thoughts. The 154 pages' bibliography are preceded by a 15 pages' essay sketching the development of the study of cuneiform mathematics, from the early investigations of metrology through the discovery of "higher" Babylonian mathematics in the 1930s, to the recent breakthroughs concerning third-millenium and earlier mathematics. The bibliography is by far the most complete existing on the subject. Neither

[2] Listed in [Høyrup & Damerow 2001: XV–XVI]. The last of them, held at the new Max-Planck-Institut für Wissenschaftsgeschichte, was the first step toward the Cuneiform Digital Library.

> the Isis bibliographies nor Borger's *Handbuch der Keilschriftliteratur* I–III (Berlin 1987–75) attain anything similar (disregarding the different aim and organization of the latter). I noticed a certain but restricted number of omissions concerning the genuine history of mathematics, but none of great importance; at the fringe of the field covered, a larger number of items which might have been but are not included can (of course) be found. According to a rather large number of spot checks, the bibliographical data given are fairly reliable. Few of those errors which I found will prevent a library from getting hold of the publication described. Partly thanks to the assistance of the author, the following supplements and corrections to the "List of journals..." shall be given: MVN *Materiali per il vocabulario neosumerico* (Rome), SBAW [should be] *Sitzungsberichte der Bayer. Akad. der Wiss., Math.-nat. Abt.*, MEE [may also in library catalogues be listed as] *Istituto universitario orientale di Napoli, Seminario di studi asiatici*. Series maior, 3. *Materiali epigrafici di Ebla*, VIFMN *Voprosy istorii fizičeskih-natematičeskih nauk* (Moscow), VL *Visible Language*.

This wonderful tool was published as a mimeograph. Friberg sent it to friends, colleagues and various institutes, and probably to a number of libraries. It was never for sale (as far as I know). The friends and colleagues are slowly dying off, and what happens to our paper books when that happens is too well known. Old institutes are closed or absorbed into larger units, and what happens to their libraries is a guess. Some library copies can still be traced on www.worldcat.org, but they may be difficult to get hold of for whom may need them.

Accordingly, when Ugarit Verlag expressed interest in something from my hand, I immediately suggested Friberg's *Survey* to them. The publisher agreed, and so did Friberg. Health problems and age, however, would not allow him to transfer the typewritten text to an electronic format, which I then promised him as well as the publisher to do. This gave me the opportunity to go through the work a second time after 40 years, a great pleasure! The outcome is what follows – with correction of inconsistencies and mistakes and the omissions mentioned in my critical abstract but otherwise unchanged. Handwritten cuneiform characters are copied from Friberg's paper edition.

Jöran Friberg has gone through the new edition twice. Unfortunately he no longer possesses the photocopies on which he based the original, and a few questions mentioned in my footnotes therefore have to be left unanswered.

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Contents

1. Introduction

1.1. Early studies of Assyrian, Babylonian and Sumerian metrology

The study of cuneiform mathematical texts began at an early stage of the history of Assyriology. As early as in 1855, H.C. Rawlinson published a table of squares from a tablet excavated the year before by W. K. Loftus at Senkereh (Larsa). Later, a second tablet from Senkereh was published and discussed over several years by G. Smith, R. Lepsius, Th. G. Pinches and others. This second tablet contained on one side tables of cubes, squares, and square roots and on the other side "metrological tables" for length measures. Such metrological tables were, eventually, understood to be aids for the conversion of quantities expressed in the various units of a measure system into sexagesimal multiples of some basic unit, and vice versa, all for the sake of easier computations. The study of the multitude of complicated systems of notations used in cuneiform texts for numbers as well as for measures of length, area, weight, and capacity, was to continue past the end of the nineteenth century. It is, in a sense, still going on today (Powell, *ZA* **72** (1982)). For this study were used not only the few preserved metrological tables that had been found in excavations, but also a wealth of other Assyrian, Babylonian and, ultimately, Sumerian documents. These could be in the form of economical or legal cuneiform texts, and of inscriptions on field plans or boundary stones and other monuments. Notable contributions in this respect were made by J. Oppert, C. F. Lehmann, G. Reisner, and, after them, by F. H. Weissbach, F.-M. Allotte de la Fuÿe, A. Deimel, and last but not least F. Thureau-Dangin. The latter collected his views on the subject in the comprehensive paper "Numération et métrologie sumeriennes", *RA* **18** (1921).

1.2. Metrological information in monolingual and bilingual lexical texts

An independent source of information about the many cuneiform systems of numbers or measures was provided by sections of bilingual or monolingual lexical texts devoted to such matters. In many cases a lexical text would give both the sign form, i.e. the standard cuneiform notation, and the Sumerian and/or Akkadian pronunciation, for each member of some linguistically coherent group of numerals (including fractions) or measures. The first examples of such lexical lists were published by E. Norris, F. Delitzsch, F. Lenormant, B. Meissner, and V. Scheil, and they were used by G. Bertin, C.F. Lehmann, and others, in their phonetical studies of Sumerian and Akkadian number words. In more recent times, similar material has been included in Akkadian dictionaries (*CAD*, *AHw*), in comprehensive editions of Sumerian and Akkadian lexical texts (*MSL*), etc. Of particular interest in this connection is M. A. Powell's dissertation *Sumerian Numeration and Metrology*, 1971, which to a large extent builds on material from the lexical texts. Powell is also the first one, after Thureau-Dangin, who has devoted himself seriously to thinking about the nature of the Sumero-Akkadian measure systems and notations for numbers and measures (see, for instance, "Sumerian area measures and the alleged decimal substratum", *ZA* **62** (1972)).

1.3. The Esagila tablet with the measures of the ziqqurat in Babylon

A "metrological" text of great interest but unusually difficult to interpret is the "Esagila Tablet", which gives the dimensions of the ziqqurrat in Babylon. This tablet was first described by G. Smith in 1876, after which it disappeared. It was rediscovered and published by V. Scheil in 1914, and then again by Thureau-Dangin in 1922. Other names connected with the study of this important text are Weissbach (1914), S. H. Langdon (1918), W. von Soden (1971), and, most recently, Powell (1982). It was called by Powell "a key document for Babylonian metrology".

1.4. Babylonian multiplication tables and tables of "reciprocals"

A great step forward in the writing of the history of Babylonian mathematics was taken with the publication by H. V. Hilprecht in *BE* **20**/1 (1906), of two big groups of cuneiform table texts, one from the Isin (early OB) period, the other from the later Kassite period. The collection contained 20 multiplication tables, 3 tables of reciprocals ("division tables"), two tables of squares and square roots, 15 metrological tables, and one algorithm text (further discussed below). However, due to an incomplete understanding of the principles behind the Babylonian system of notation used for sexagesimal numbers, Hilprecht was in many cases unable to give a correct interpretation of the details of organization of the table texts he published. Thus, Hilprecht's imaginative interpretation of his "division tables" was not rejected until V. Scheil in *RA* **12** (1915) was able to describe the real character of a Babylonian table of reciprocals. Also the idea behind the organization of the big combined sexagesimal multiplication tables remained hidden until O. Neugebauer in *QS* B 1 (1930/1931) could show that a close connection exists between such combined multiplication tables and the standard table of reciprocals.

1.5. Babylonian mathematical algorithm texts

The algorithm text published by Hilprecht, the very early OB tablet *CBM 10201*, was observed by Scheil in *RA* **13** (1916) to be an example of a clever iterative method to compute the reciprocal of a given (regular) sexagesimal number, and to derive a series of reciprocal pairs from an initially given pair of reciprocal numbers. Scheil's observation was subsequently confirmed by several other (younger) texts published later, in particular by the very explicit algorithm text *CBS 1215* presented by A. J. Sachs in *JCS* **1** (1947). Another important algorithm text, *Ist S 428*, published by Scheil in *SFS* (1902), was correctly interpreted first when P. Huber in *EM* 3 (1957) was able to show that it is an example of the employment of a certain factorization method for the extraction of square roots. A comment on the choice of data in this particular application of the method can be found in J. Friberg *HM* 8 (1981).

1.6. Babylonian mathematical cuneiform texts, published 1900–1935

The first mathematical cuneiform texts to be published, other than table texts and algorithm texts, were the collections of Old Babylonian mathematical problems *BM 85194* and *BM 85210* (L. W. King, *CT* **9** (1900)). For several reasons (lack of understanding of the Babylonian sexagesimal notation, unfamiliarity with the specific mathematical meaning of otherwise known Akkadian or Sumerian words or logograms, the use of abbreviations in the often very lapidary texts, etc.), these problem texts turned out to be very difficult to understand, and they remained untransliterated and uninterpreted for a long time.

A first breakthrough came in 1916, when E. Weidner (*OLZ* **19** (1916)) managed to give an essentially correct interpretation of two geometrical problems from the text *VAT 6598*, probably helped by the presence on the tablet of line drawings illustrating the problems. In two other papers in the same issue of *OLZ*, H. Zimmern and A. Ungnad followed up with a number of linguistic improvements to Weidner's article and even made some comparisons with problems from the big mathematical texts in *CT* **9**.

A further impetus came from the publication of the unique text *BM 15285* (C. J. Gadd, *RA* **19** (1922)) with its many geometric diagrams and brief accompanying texts (later joined by an additional large fragment in Saggs *RA* **54** (1960). Gadd's text gave visual clues to the meaning of many geometric terms and hinted at an unexpected sophistication of Babylonian mathematics.

E. Peet's modern edition of the Egyptian "*Rhind Mathematical Papyrus*" appeared in the following year, 1923. It demonstrated how relatively advanced Egyptian mathematics was at a time roughly corresponding to the Old Babylonlan (OB) period in Mesopotamia. And then C. Frank published, in *StrKT* (1928), the six "Strassburger" texts, small OB tablets with only one or a few mathematical problems on each tablet. The presence of line drawings once more facilitated the interpretation. This was given by O. Neugebauer in *QS* B 1 (1929). The same year, Neugebauer analyzed, together with V. V. Struve, some of the problems on the big tablet *BM 85194* which clearly showed that the "theorem of Thales" and the "Pythagorean theorem" were known and applied in OB geometry.

Sensationally, H.-S. Schuster was then able to show (in *QS* B *1* (1931) that quadratic equations were posed and correctly solved in OB mathematical texts. Schuster based his arguments on problems from the OB *StrKT* and *CT* **9** texts, but he was able to identify problems leading to quadratic equations also in the nearly 1500 years younger Seleucid mathematical text *AO 6484*, published by F. Thureau-Dangin in *TCL* **6** (1922). Deriving from Thureau-Dangin are also several other publications of important mathematical cuneiform texts: the early OB prism *AO 8862* (*RA* **29** (1932)), the small tablet *AO 17264* with its sophisticated "six brothers" problem (*RA* **31** (1934)), the big text with mixed problems *BM 85196*, and the systematically arranged algebraic text *BM 13901* (*RA* **32** (1935), **33** (1936)). In addition, Thureau-Dangin published in *TCL* **6** (1922) the "six-place" table of reciprocals *AO 6456* from Seleucid Uruk (cf. Neugebauer *QS* B 1 (1931), Friberg *HM* 8 (1981) p. 465).

1.7. Cuneiform mathematical texts published in *MKT* and *MCT*, 1935–1945

All the important mathematical cuneiform texts mentioned above were analyzed in Neugebauer's massive volumes *MKT* **1–2** (1935), **3** (1937), which included also the first publication of two new big tablets with mixed mathematical problems (the joined text *BM 85200 + VAT 6599*, and the Seleucid text *BM 34568*), many new table texts, several smaller VAT-texts from Berlin, and a number of "series texts" from the Yale Babylonian Collection (*YBC*), New Haven, Conn. A fascinating account is given by Neugebauer in *QS* B **3** (1934) of his work with the difficult interpretation of the exhaustingly systematic and extremely abbreviated lists of problems, mostly algebraic, in the series texts. Complementary to the publication *MKT* **1–3** was the appearance of Thureau-Dangin *TMB* (1938), with many improvements, mathematical as well as linguistic, of Neugebauer's translations and interpretations.

The next big step forward was taken with the publication by Neugebauer and A. J. Sachs of *MCT* (1945), with many new texts from American museums in Chicago, Philadelphia, New Haven, etc. (museum numbers beginning with *A*, *CBS*, or *MLC*, *NBC*, *YBC* ...). Particularly interesting in this new volume are the mathe-matical-practical "lists of constants" *YBC 5022*, *YBC 7243*, and the famous tablet *Plimpton 322*, which proved beyond doubt that the mathematical discipline called number theory has Babylonian origins. (Cf. the paper by S. Gandz on "Indeterminate analysis in Babylonian mathematics", *Osiris* **8** (1948).) In *MCT* is included also a chapter by A. Goetze on "The Akkadian dialects of the Old-Babylonian mathematical texts", which allows a tentative grouping of many of the *MKT* and *MCT* texts with respect to age and geographic origin. An often exaggeratedly critical but occasionally clever and constructive review of *MCT* is contained in a paper by H. Lewy in *OrNS* **18** (1949). Other interesting complements to the discussion in *MCT* are contained in a short note by Sachs in *BASOR* **96** (1944).

1.8. Texts from museums in the West, published after 1945

After the publication of *MKT* **1–3** and *MCT* only a handful of new Babylonian mathematical texts from American and European museums have been published: by Sachs in *JNES* **5** (1946) (a small table of diminutive rectangular areas), in *JCS* **1** (1947) (texts concerned with the algorithm for computation of pairs of reciprocal numbers), and in *JCS* **6** (1952) (a table of approximate reciprocals to irregular numbers, and a text with an algorithm for extraction of cube roots by factorization); by W. F. Leemans and E. M. Bruins in *CRRA* **2** (1951) (a small text about concentric circles, possibly having to do with indeterminate quadratic equations); by A. A. Vaĭman in *EV* **10** (1955) (a tablet with a series of drawings of triangles divided into parallel strips – a similar text was published by Bruins in *CPD* (1951)); a tablet with a drawing of a single subdivided triangle was presented by Vaĭman in *EV* **12** (1958); again by Vaĭman in his very attractive book *ŠVM* (1961) (in particular the new compilatory text *Erm 15073* with eight problems, among which is a problem recognized by Vaĭman as a "two-way trapezoid partition problem"); by Figulla and Martin in *UET* **5** (1953) (several texts, identified by Vaĭman in ŠVM as mathema-tical problem texts written "in Sumerian", cf. section 10 below); by A. D. Kilmer in *OrNS* **29** (1960) (two new "lists of constants"); by T. G. Pinches, posthumously, in *LBAT* 1955 (a number of fragments of Seleucid "six-place tables of reciprocals", etc., edited by Sachs (three further fragments were published by A. Aaboe in *JCS* **19** (1965), and in *CT* **44** (1963) (a "catalogue text" of quadratic equations for squares and circles, cf. Friberg *JCS* **33** (1981)). Of great interest, finally, is the dis-cussion in Vaĭman *DV* **2** (1976) of an obscure point in problem 1 of the unique "sketchy" text *VAT 8522* (concerning the links between the OB measures of volume and capacity, and the meaning of an enigmatic phrase in one of the lists of con-stants). Worth mentioning here is also K. Vogel's book *Vorgriechische Mathematik* **2** (1959).

1.9. Texts of known provenance, published after 1950

On p. 60 of his book *The Exact Sciences in Antiquity* (2^{nd} ed., 1957/1969), Neugebauer remarks that "until 1951 not for a single astronomical or mathematical (cuneiform) text was its provenance established by excavation". The situation changed when T. Baqir, in *Sumer* **6** (1950), **7** (1951), **18** (1962), published a number of small OB mathematical tablets from the new sites Tell Harmal and Tell Dhiba'i, similar in content to previously published tablets, yet clearly distinguishable from those in style and format. Other tablets of the same general appearance were observed by Bruins in the Iraq Museum, Baghdad, and published in *Sumer* **9** (1953), **10** (1954). Together with M. Rutten, Bruins published also *MDP* **34** (*TMS*), a collection of 26 unusually sophisticated mathematical texts, dating from the OB period but excavated in Susa (in south-west Iran) in 1936 by R. de Mecquenem. The uniqueness of the *TMS* texts is made clear by the fact that the only other cuneiform mathematical texts known to have a non-Mesopotamian origin are the "school exercises" from Susa in P. E. van der Meer, *MDP* **27** (1935), the strange metrological tables, also from Susa, in Scheil *RA* **35** (1938), and the metrological tables from Ugarit (Syria) published by J. Nougayrol in *Ugaritica* **5** (1968). In addition, of course, there are the recently published mathematical tablets from Ebla, about which more will be said below. (The tablets from Ugarit resemble a metrological tablet from Assur, which was published by O. Schroeder in *KAV* (1920), in that they presuppose the use of a decimal system of numeration. Cf. also, in this respect, the unusual Late-Babylonian metrological tables in Hunger *STU* **1** (1973). Still another recently published metrological text is the nearly intact big table for area measures in S. Greengus Ishchali (1979). Further could be mentioned, in this context, the table of reciprocals from Mari in M. Birot *ARMT* **9** (1960), the table of square roots from Kisurra in B. Kienast *ABUK* **19** (1978), and the short list of constants in D. O. Edzard *Tell ed-Dēr* (1970).) An interesting and useful review of *TMS* is given in *BiOr* **21** (1964) by W. von Soden, who similarly reviewed *MKT* **1–3** and *TMB* in *ZDMG* **91** (1937), **93** (1939). After TMS and the tablet from Tell Dhiba'i, no further mathematical cuneiform text from recent excavations have been published, apart from the pre-Babylonian texts discussed on the following pages. However, a new tablet from Tell Haddad, with a number of mixed problems, and some smaller texts, are presently being prepared for publication by M. D. Roaf and F. ar-Rawi, with the cooperation of J. Friberg.

1.10. Sumerian and Akkadian (pre-Babylonian) mathematical texts

I quote again from the book *ESA* (2nd ed. ((1957)1969)), p. 49, where Neugebauer says: "There exists a single fragment of a mathematical text written in Sumerian (*MKT* **1** p. 234*f.*). Because Sumerian was still practiced in the schools of the Old-Babylonian period nothing can be concluded from such a text for the Sumerian origin of Mesopotamian mathematics. The same holds for the exceedingly frequent use of Sumerian words and phrases throughout all periods." The fragment mentioned by Neugebauer is the early OB (?) text *CBM 12648* from Hilprecht *BE* **20/1** (1906), which was left untranslated and uninterpreted in *MKT* 1. Actually, as I remark in my review below of *MKT* **1**, this unique text contains a problem that can be reconstructed, and in which the sides of a rectangular solid figure are computed (by way of the solution of a cubic equation), given the ratios between the sides in addition to the volume. As the solid turns out to have the dimensions ($\frac{1}{2} \cdot \frac{1}{3} \cdot \frac{1}{6}$ cubic cubits) of a common type of bricks, this "Sumerian" mathematical text provides a link between the many OB mathematical "brick texts" in *MKT* and *MCT* and Ur III economic texts dealing with bricks, such as for instance the two tablets discussed by Scheil in *RA* **12** (1915). In addition to the *CBM* tablet, many of the series texts of the *YBC* and *VAT* collections (in *MKT* **1–3**) are written entirely or almost entirely with Sumerian words and phrases, but as they lack, as a rule, all Sumerian grammatical elements, they cannot with certainty be classed as true Sumerian texts. An often repeated argument (see, in particular, Vogel *MN* **18** (1958)) is that the use in mathematical cuneiform texts of words like "upper" for what is really "left", etc., is a proof of the allegation that the origin of Babylonian mathematics must be ascribed to some time early in the Sumerian period, when the cuneiform script was still written in a vertical direction. This argument is now no longer valid without qualification, after the publication of Picchioni's paper in *OrNS* **49** (1980), where it is contended that vertical writing was still in use at the beginning of the OB period. (Cf. for example the inscription on the OB jar which was used by J. N. Postgate in *Iraq* **40** (1978) for a computation of the absolute value of the OB capacity unit.) Nevertheless, the pre-Babylonian origin of several central themes in "Babylonian mathematics" can hardly any longer be put in doubt. It is only the theory of quadratic equations, with its many algebraic and geometric applications, that cannot yet with certainty be traced back to a date before the early OB period. Thus, it is probably not an empty boast, when the Ur III king Sulgi in a royal hymn (see Castellino *Two Sulgi hymns* (1972)) claims that he is skilled in many things, in particular accomplished in "subtracting, adding, counting and accounting", etc. Cf. in this connection the extremely interesting paper by A. Sjöberg in *ASum* **20** (1975), "The

Old Babylonian eduba". It contains explicit quotations from an "examination text" and some so called "dialogue texts", where the curriculum of the OB school (the é – d u b – b a or 'tablet house') is described in considerable detail, in Sumerian, with an interesting enumeration of, in particular, mathematical terms such as a – r á i g i i g i – b a i g i – g u b – b a, etc. Four important early OB mathematical texts, written entirely in Sumerian, were discussed for the first time in Vaĭman's book *ŠVM* (1961), among them the quite sophisticated *UET* 5 no. 121 (Figulla and Martin (1953)). From the Sargonic period are four other mathematical texts, which were published in H. Limet *Étude* (1973) and further discussed by M. Powell in *HM* **3** (1976), small tablets with apparently simple, but really quite sophisticated, geometric-metrological exercises. A fifth Sargonic tablet of similar type is *MAD* **5** no. 112 (Gelb (1970)), a geometric exercise involving very big numbers. This text has so far, unfortunately, proved impossible to understand (unless it contains a serious nume-rical error). A sixth example is *HS 815* in Pohl *TMH* **5** (1935) (see again M. Powell (1976)). Slightly older than this small group of Sargonic exercise texts is probably the mathematical-metrological table of squares (or rather square areas) *OIP* **14** no. 70 (Luckenbill (1930); cf. the interpretation by Edzard in *Festschrift v. Soden* (1969)), which is a veritable treasure trove of early Sumerian metrological nota-tions. An even older table of square areas is the well known Fara text *VAT 12593* (Deimel *Inschr. Fara* 2 = *SF* (1923) no. 82). Interestingly enough, another Fara tablet contains an area computation probably based on data from just such a table of square areas, namely *TSŠ* no. 188 (see my commentary to Jestin, *TSŠ* (1937)). Jestin's book *TSŠ* contains in addition two other well known mathematical Fara texts, the pair *TSŠ* no. 50 and *TSŠ* no. 671, with two different solutions to the same mathematical-metrological division problem. Attempts to reconstruct the division algorithms used in these two parallel texts have been published by G. Guitel (*RA* **57** (1963)), M. Powell (*HM* **3** (1976)), and J. Høyrup (*HM* **9** (1982)). A non-mathe-matical text from the Fara period, finally, which nevertheless is of mathematical interest, is the sheep text *IM 81438*, published by R. D. Biggs and J. N. Postgate in *Iraq* **40** (1978). This text gives the oldest known example of the use of the "Semitic" decimal hybrid system of number notation, and also an early example of the simultaneous use of cuneiform and curviform or "round" number signs (as in the texts from Ebla).

1.11. Mathematical texts from Ebla (the middle of the third millennium)

Out of the many thousands of tablets that were excavated at now famous Ebla (Syria) just some years ago, only three have so far been identified as mathematical texts. On the other hand, each one of these three texts is of the greatest importance from the point of view that has been adopted in this survey. One of these, *TM.75. G.2198*, is a small monolingual lexical text with the first ten Sumerian cardinal numbers in syllabic spelling, but as such valuable because of its great antiquity. Indeed, the lexical list on this tablet was composed when Sumerian was still a living language. Commentaries to the text can be found in Edzard *SEb* **3** (1980), Pettinato

MEE **3** (1981). The interpretation of the second mathematical text from Ebla, on the other hand, turned out to be more problematic. It has been explained in various ways in articles by A. Archi (*SEb* **3** (1980)), by Pettinato and by I. Vino and T. Viola (*MEE* **3** (1981)), and by F. M. Fales (*SEb* (1982)). However, a simple comparison with the notations used in a number of Sumerian texts from the Fara period suggests that this text, too, is a kind of lexical list, namely of Sumerian number notations for big numbers. (In particular, the comparison with the Sumerian usage shows that the text in one case lists two notations for the same big number.) The text is of special interest because it may be an abortive attempt to figure out a notation for the (unrealistically big) number 60^4 (about 13 millions). This interpretation is confirmed by the observation that *TM.75.G.1700*, an economic Ebla text published by Archi in *CRRA* ((1981)1982), seems to indicate that there existed a number word in the Eblaite decimal number system for a hundred thousand, but not for a million. The third of the mathematical Ebla texts is *TM.75.G.1392,* which has been claimed by F. Pomponio in *MEE* **3** (1981) to be a metrological table for Eblaite capacity measures. A closer analysis reveals instead that the text contains an example of the use of a clever algorithm for the division (with round-off) of a big decimal number by a small "non-regular" decimal number (namely in this case 33). If the interpretation is correct, then it follows that Eblaite mathematicians at the middle of the third millennium B.C. were experimenting with what we would call, in modern mathematical terminology, "representations of non-regular rational numbers by periodic non-terminating decimal fractions". However, all praise should not go to the Eblaites. In fact, the parallelity of the third mathematical tablet from Ebla and the pair of division texts *TSŠ* no. 50 and *TSŠ* no. 671 from Suruppak is so obvious that it may be reasonable to assume that mathematicians of the Fara period in Sumer were equally familiar with the approximation of non-regular rational numbers by sexagesimal fractions. Let me finally mention also the interesting paper in *OrAnt* **19** (1980), in which Pomponio shows that, in the Eblaite system of notations for capacity measures, the fractions of a shekel written as 2-NI, 3-NI, 4-NI, 5-NI, 6-NI, must stand for, respectively, $2/3$ (!), $1/3$, $1/4$, $1/5$, and $1/6$ of a shekel.

1.12. Proto-Sumerian and proto-Elamite metrology (c. 3000 B.C.)

Over the years, many more or less well-founded attempts to explain the origin of the Sumero-Akkadian sexagesimal system of numeration have been published by a number of authors. See, for instance, Neugebauer *AGWG* **13** (1927), Thureau-Dangin *Esquisse* (1932), H. Lewy *JAOS* **69** (1949), and, most recently, Powell *VL* **6** (1972). Actually, as pointed out by Powell, the problem has several different aspects: it is necessary to discuss separately the late Sumerian (?) origin of the Sumero-Babylonian positional sexagesimal system (cf. Powell *HM* **3** (1976)), the early Sumerian (?) origin of the written sexagesimal system of number notations, and finally, the not necessarily directly related, and sparely documented, history of Sumerian (Akkadian, etc.) spoken systems of numeration. It is also important to keep in mind Neugebauer's observation (op. cit.) that the history of the sexagesimal system is intimately associated with the history of the various Sumero-Akkadian metrological systems. With our present state of knowledge, this means that we have to take into consideration the structure of the metrological systems for length, area, and capacity that are documented in texts from the end of the fourth millennium B.C., that is, in texts from the Uruk IV and Jemdet Nasr periods, in Sumer and neighboring Elam (Iran). No texts clearly documenting the use of a system of notation for weight measures during the "proto-literate" period have so far been published. It is difficult to say what the significance is of this circumstance. Note, for instance, the observation by M. Dahood, in *Archives* (1981), that the term 'mina' for a well known Sumero-Akkadian weight unit, may very well be "Canaanite" in origin. As for the other metrological systems of the proto-literate period, to begin with only the systems for length and area were well understood, as they are identical with the corresponding classical Sumerian systems. The structure of the system for capacity measures, on the other hand, was for a long time completely misinterpreted, due to an erroneous "proof" in van der Meer *RA* **33** (1936) of the alleged decimal character of this system. This incorrect view was still prevailing when Vaĭman wrote his otherwise very informative papers on proto-literate metrology in *VDI* **3** (1972) and *13thMKIN* (1974). Not until in Friberg, *DMG* (1978–9) was it shown that the basically identical proto-Sumerian and proto-Elamite capacity systems of the Jemdet Nasr period (and the preceding Uruk period ?) had a kind of inverted sexagesimal structure, with the successive higher units of the system equal to 6 (!), 60, 180, 10×180,... "proto-ban" units. The fractional parts of a smaller unit, equal to 1/5 such proto-ban unit, were written, physically, as 2, 3, 4, 5, or 6 "eyes" (this is true for the proto-Sumerian system only), foreshadowing the classical Sumerian ' i g i – *n* – g á l ' notation, in which *n* runs from 3 to 6 (and the Eblaite '*n*-NI' notation as well). With the correct interpretation of the proto-literate capacity system, it became possible for the first time to understand in every detail the nature of the computations on a large number of proto-Sumerian and proto-Elamite account tablets. Perhaps the best example of this is the big "bread and beer" text *IM 23426* published by A. Falkenstein in *OLZ* **40** (1937). (The lack of signatures on this tablet makes it quite likely that it is an advanced mathematical-metrological exercise text.) New in Friberg *DMG* (1978–9) was also the observation that a decimal system of numeration was used in proto-Elamite (but not (!) in contemporary proto-Sumerian) texts, exclusively in connection with counting of (probably) animals. (Cf. Vaĭman *VDI* **3** (1972), where the simultaneous existence of decimal and sexagesimal counting in proto-Elamite texts is noted, but not correctly explained.) It is important to point out that the metrological and numerational systems in use in the proto-literate texts may actually predate the invention of writing. Thus, clear examples can be found on so called "numerical" or "impressed" clay tablets (the immediate predecessors of the inscribed tablets of the Uruk IV period) of the use of the "proto-literate" capacity system described above, both fractional units (*Godin Tepe 73–291*; cf. Weiss and Young *Iran* **13** (1975)) and higher units (*Sb 2313* from Susa; cf. *MDP* **43** no. 922, Amiet (1972)). The use of the proto-Elamite decimal system on impressed tablets is also documented (*Sb 6299*, *MDP* **43** no.

666). All the mentioned examples are reproduced in photographs in D. Schmandt-Besserat *VL* **15** (1981).

1.13. Pre-literate numeration and metrology: clay tokens and bullae

In *JNES* **17** (1958), A. L. Oppenheim made public his view that the hollow clay ball *HSS* **16** no. 449 with its original content of 48 little "stones" that matched an inscription naming 48 small cattle, must have been a device for recording and documentation in the Nuzi administration (middle of the second millennium B.C.). He also made references to certain entries in a bilingual lexical text, which may be interpreted as giving the Sumerian and Akkadian names of various counting boards on which "stones" of a similar kind were used as counters. Later, in *Archeologia* **12** (1966) and *Elam* (1966), Amiet made the crucial observation that the "spherical bulla" *Sb 1927* was a preliterate document (resembling the much later Nuzi bulla in that it contained a number of stones and had a matching impression on its outer surface). The lack of a proper inscription in the case of the archaic document from Susa was compensated by the fact that the stones it contained were of a number of different shapes: one big and three small cones, and three disks. Hence, Amiet drew the conclusion that such stones, or rather formed pieces of clay, of several shapes and sizes, were symbols for various kinds and quantities of traded commodities. This idea was taken up by Schmandt-Besserat in a series of articles (see, for instance, *AJA* **83** (1979)), and it soon became clear that the clay bulla with its content of clay symbols was a very "late" innovation, on the threshold to the invention of writing in the second half of the fourth millennium. In fact, "loose" tokens of clay in the form of cones, disks, spheres, or rods, could be shown to have been in use over the whole Middle East, continuously since the seventh millennium B.C., and almost certainly as a means of accounting and documentation. Therefore, it now seems natural to assume that the Sumero-Akkadian metrological and numerational systems of notation, with which we have been concerned above in this survey, were the direct descendants of an ancient system of record keeping with its roots stretching much farther back than anybody would have dared to guess just one or a few decades ago. It is only fair to add, however, that not all the interpretations offered by Schmandt-Besserat of the existing pre-literate material are unopposed and the final word on the subject. Polemizing against too hasty conclusions and contributing new important observations are, in particular, two interesting papers by M. A. Brandes in *Akkadica* **18** (1980), and by S. J. Lieberman in *AJA* **84** (1980). For the further development, see for instance the article by A. Le Brun and F. Vallat in *DAFI* **8** (1978). There it is shown, with reference to excavations at the Susa Acropole, that, at least in this part of Elam, the transitions, first from envelopes (bullae) with seal impressions and containing clay tokens to similar envelopes with impressed number notations, and then from such envelopes to tablets with seal impressions and impressed number signs, took place within a very short time period, corresponding to the level Acr. 18. Impressed tablets with isolated non-numerical signs began to appear shortly after that, in the level Acr. 17, succeeded in levels Acr. 16–14 by the first inscribed tablets with writing in the proto-Elamite script. There is no reason to doubt that the development in Mesopotamia itself followed a similar pattern.

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1.14. Summary

On the preceding pages, I have tried to write a brief historical survey of what has been published during the last 125 years, or so, in various books and journals, on the subject of "Sumero-Akkadian mathematics, metrology and related matters". As should be clear from my division of the survey into subsections, my intention has been to consider the following main topics:

1–3. The initial struggle, lasting half a century or more, to understand the nature of the many diverse systems of expressing numbers and measures, used in the cuneiform texts of the Sumerians and their successors during two and a half millennium.
4–5. The efforts to understand the method of construction and the purpose of certain unusually complicated or enigmatic table texts (combined multiplication tables, reciprocal tables, ...) or algorithm texts (computations of sequences of pairs of reciprocals, or of Pythagorean triples, etc., square root extraction through factorization, ...).
6–8. The difficult work with the interpretation of OB and Seleucid mathematical problem texts, culminating in the volumes of mathematical cuneiform texts *MKT* **1–3**, *TMB*, *MCT* (and *TMS*).
9–13. The escape from the limitations of the previous studies, as new mathematical texts started coming in from controlled excavations, not only in Mesopotamia but also in the neighboring countries, Iran (Susa, ...), Syria (Ebla, Ugarit), etc., and as more and more texts of mathematical interest were identified belonging to various pre-Babylonian periods (Ur III, Sargonic, Fara, proto-literate). Thus, as a result of the most recent developments, it now seems that a fairly complete picture is emerging of the evolution of mathematical and metrological ideas and practices in the Middle East, from the pre-literate record keeping by use of clay tokens and all the way to the very sophisticated Seleucid mathematical tables and problem texts.

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1.15. Bibliography and reviews

The bibliography that follows is designed so that it matches the preceding survey with regard to choice of topics. It is also chronologically arranged in order to stress the historical aspect, to make it possible to follow the progress of our understanding of and access to the source material, and, above all, to view every mentioned book or article against the background of what was known about the subject when it was written. I have not included more than a few references to publications dealing with Babylonian astronomy, of which I am too ignorant. Neither have I tried to write a bibliography of works on Sumero-Akkadian metrology as such (efforts to determine the absolute values of various weights and measures, comparisons between Mesopotamian weights and measures and those used in other later or contemporary cultures, etc.), or on the influence of Babylonian mathematics on the early stages of development of Greek, Islamic, Hindu, or Mediaeval European mathematics. Within its given boundaries, I have made the bibliography reasonably complete. Thus, for instance, some otherwise unimportant contributions have been mentioned just because of their historical interest (they show when a certain aspect of the subject was first considered), or because they are often mentioned in references in other publications (in which case a cross reference in the bibliography may eliminate the need to read the publication at all). The abbreviations used have, as far as possible, been chosen to conform with the abbreviations in R. Borger's *HKL* (*Handbuch der Keilschriftliteratur* **1–3**, (1967–1975)). It ought to be quite clear, otherwise too, that Borger's *HKL* has been of invaluable help in my preparation of the bibliography. As for the way of transliterating quotations of words or sentences in Sumerian, Akkadian, etc., I have been facing various difficulties, in particular when quoting from older publications. As a compromise, I have chosen to use a uniform mode of transliteration in the majority of the quotations: words in non-Sumerian languages are underlined, words in Sumerian are not.[3] The convention that capital letters denote an uncertain phonetic reading has been used only sparingly. In some cases I have tried to modernize a transliteration, to the best of my limited ability in this respect. On the other hand, I have consequently chosen to keep the sexagesimal number notation of the original texts also in my transliterations and translations. In the same way, I have tried to stay as close as possible to the original in my transliteration of measure notations of various kinds. My reason for doing this is that I am strongly convinced that simple numerical relations in the original can be entirely hidden in the transliteration if this rule is not followed. (Let me mention just one example, the not uncommon practice to convert all capacity numbers into so and so many 'silà'. There are cases when the original computations were based on the choice of, for instance, the 'bán' as the most convenient unit, and a transliteration with conversion into 'silà' will then make the text unnecessarily difficult to understand. Cf., for instance, my commentary to the analysis in Powell, *RA* **70** (1976) of the bread and beer texts from Umma *CT* **50** *55–59*.) For the transliteration of sexagesimal numbers in the Babylonian positional notation, I have found it convenient to use a simplified version of Neugebauer's convention, writing, for example, 1 00.40 for $1\times60+0\times1+40\times{}^1/_{60}$; cf. my review of Neugebauer *AfO* **8** (1932–1933). Numbers in the pre-Babylonian, non-positional sexagesimal number system and other similar systems have occasionally been transcribed using the model $1(60^2) + 2(60)$ for $1\times60^2 + 2\times60$, etc.

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[3] JH: Actually, all transliterations were written in a distinctive script font in Friberg's typewritten original. In the present edition I have taken advantage of the possibilities offered by electronic typesetting and followed the established habit of using spaced writing for Sumerian (not universally applied, it is true, but an informative device), Italics for Akkadian (etc.), and capital letters for sign names.

The work on this survey and bibliography has been highly rewarding, in that it has given me a unique opportunity to look through almost everything (I hope) that has been written on the chosen subject. As a result, I have come across quite a few open problems, or problems that in my opinion have not found their definitive solution. Thus the bibliography and the introductory survey is in some sense also a research report: I have in many instances included my own thoughts and improved interpretations in the reviews of the individual publications. In each such instance, my own contribution has been clearly indicated by being written within square brackets.

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2. Bibliography

1854–1870

Hincks, Edward. Cuneiform inscriptions in the British Museum. *LG* **38** (August 1854), p. 707; On the Assyrian mythology *TRIA* **22** (1854), pp. 405–422.

H. observes here that in *K 90*, a tablet allegedly concerned with “the magnitude of the illuminated portion of the lunar disk on each of the thirty days of the month”, the sequence of numbers 5, 10, 20, 40, 1 20, 1 36, 1 52, ..., 4 makes sense only if 1 20, 1 36, 1 52, ... are equal to 80, 96, 112, ..., i.e., only if the numbers are expressed in a *sexagesimal* number system with identical symbols for 1 and 60. (Cf. Sayce, *ZA* **2** (1887); Weidner, *Babyl.* **6** (1912).) Consequently, in *K 170*, a list of eleven deities, the “numbers” of the most important gods are 60 (not 1), 50, 40, 30, ... (Anu, Bêl, Ea, Sin, ...). (Note the appropriateness of the number 30 for the moon god Sîn.)

Rawlinson, Henry Creswicke. Notes on the early history of Babylonia. *JRAS* **15** (1855).

Remarks, on p. 217, note 4: “that the Babylonians did really make use both of the centesimal and sexagesimal notation, as stated by Berosus, is abundantly proved by the monuments; and from the same sources we can illustrate the respective uses of the *Sarus*, the *Nerus*, and *Sossus* in the calculation of higher numbers”. Appends, as a specimen, “the concluding portion of a table of squares, which extends in due order from 1 to 60”. (This is one of the “tablets from Senkereh”, so called in Lenormant, *Essai* (1868), excavated by Loftus at ancient Larsa in 1854. Cf. Neugebauer, *MKT* **2** (1935), p. 3: *BM 92 680*, photo in Pullan, *History of the abacus* (1968).)

Rawlinson, Henry Creswicke, and Norris, Edwin. *2 R = The cuneiform inscriptions of Western Asia* **2** *(A selection from the miscellaneous inscriptions of Assyria)*. London 1866.

Pl. 14–15: *K 50, 56, 60*, obv. II, 27–41, a section of a bilingual lexical text, with Sumerian and Akkadian phrases involving the fractions $^{1}/_{3}$, $^{1}/_{4}$, $^{1}/_{5}$ and $^{1}/_{10}$. (Cf. Neugebauer, *MKT* **1** (1935), p. 28; Landsberger, *MSL* **1** (1937): *ana ittišu* tabl. 4 pp. 51, 58.)

Lenormant, François. *Essai sur une document mathématique chaldéen, et à cette occasion sur le système de poids et mesures de Babylone.* Lithographed, Paris 1868.

Publishes, and renews the study of Rawlinson’s “table of squares” (Rawlinson (1855)) and makes a not very successful survey of Babylonian notations for numbers and measures.

1870–1880

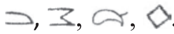
Smith, George. On Assyrian weights and measures. *ZÄS* 10 (1872), pp. 109–112.
Discusses a second tablet from Senkereh, with "on one side a table of cube roots, and on the other a comparative table of measures of length". This metrological text allows S. to give an almost correct description of the "Assyrian" system of length measures, and also to identify the cuneiform signs for the fractions ⅓, ½, ⅔, and ⅚. (See Neugebauer, *MKT* **2** (1935), p. 3: BM 92 698 (obv.III–IV, rev. I); Pinches, 4 R2 (1891).)

Oppert, Jules. L'étalon des mesures assyriennes, fixé par les textes cunéiformes. *JA* (6)**20** (1872), pp. 157–177; (7)**4** (1874), pp. 417–486. (Reviewed by M. Cantor *ZMP* **20** (1875), pp. 149–165.)
Concerned with a somewhat premature attempt to describe the cuneiform systems of notations for length, area, and weight, relying rather more on a comparative analysis than on available cuneiform texts.

Smith, George. *4* R^1 *= The cuneiform inscriptions of Western Asia* **4** *(A selection from the miscellaneous inscriptions of Assyria)* ("prepared by H.C. Rawlinson"). London 1875.
P. 40, note 1: here is published the fragment *BM 92 698* (Smith (1872)). Cf. Pinches, 4 R2 (1891).

Lenormant, François. *Choix de textes cunéiformes inédits ou incomplètement publiés*. Paris (1873–)1875.
Pp. 80–81, 219–225: L. publishes here a hand copy of *K 90* (Hincks, *LG* **38** (1854)) which he says is a "table des phases de la lune", and republishes *BM 92 680* and the fragment of *BM 92 698* as "première" and "deuxième table mathématique de Senkereh".

Sayce, Archibald Henry. The astronomy of the Babylonians. *Nature* **12** (1875).
P. 489: A better translation, and a new interpretation of K 90.

Sayce, Archibald Henry. Babylonian augury by means of geometrical figures. *TSBA* **4** (1876), pp. 302–314.
S. discusses here the two omen texts *K 99* and *K 2087*. In both of these the omens are coupled to the observation of certain "geometric" figures. In *K 99*, for instance, the following figures appear in the left margin: .

Smith, George. The temple of Belus. *Athenaeum* (Feb. 12 1876), 232–233.
Preliminary discussion of a Babylonian text with "a remarkable account of the Temple of Belus at Babylon ... giving the arrangement and dimensions of the buildings". Cf. Thureau-Dangin, *JA* (10)**13** (1909); *TCL* **6** (1922) and *RA* **19** (1922).

Lepsius, R. Die babylonisch-assyrische Längenmass-Tafel von Senkereh. *ZÄS* **15** (1877), pp. 49–58; Die babylonisch-assyrischen Längenmasse nach der Tafel von Senkereh, *AAWB* (1877), pp. 105–144 + tables and photograph; *Die Längenmasse der Alten*. Berlin 1884, pp. 48–71.

L. gives a renewed and improved discussion of the metrological list on the second tablet from Senkereh and makes some important remarks concerning the ab-sence of the sexagesimal point and of any special signs for final or medial zeros in the Babylonian notation for sexagesimal numbers. L. identifies also correctly the cuneiform signs for š a r (60×60) and n e r (10×60), and corrects a mistake in *Lenormant, Essai (1868)* concerning the form of some signs in the Babylonian (non-mathematical) “centesimal” system of number notations.

Delitzsch, Friedrich. Soss, ner, sar. *ZÄS* **16** (1878), pp. 56–68.

Contains, in particular, an interesting discussion of the meaning of the passage 4 (š a r) 3 (n e r) 1 UŠ 3 *qa-ni* 2 k ù š *ni-bit šum-ia mi-ši-iḫ-ti duri-šu aš-kun*, ‘4 s a r 3 n e r 1 s o s s 20 cubits, the number of my name, do I make the measure of my wall’, in an inscription by the Assyrian king Sargon (Pinches, *5 R* (1884), no. 36, no. 55).

1880–1890

Haupt, Paul. *ASKT* = *Akkadische und sumerische Keilschrifttexte* (AB 1). Leipzig (1881–)1882.

P. 63, note 177, a hand copy of a section of a lexical text, with only the Sumerian part preserved of a list of the names of the fractions $1/2$, ..., $1/5$, $1/10$, $2/3$ (*K 8687*, cf. Neugebauer, *MKT* **1** (1935), p. 29; Landsberger, *MSL* **5** (1957), pp. 1*ff*). P. 73: *K 50, 56, 60* (cf. Rawlinson & Norris, 2 R (1866)).

Vaščenko-Zaharčenko, M.E. *Istoričeski ĭ očerk' matematičesko ĭ literatury hal-deev'*. Kiev 1881.

Bertin, George. The Assyrian numerals. *TSBA* **7** (1882), pp. 370–389.

Discusses the phonetic forms of Assyrian numerals for integers and fractions, men-tioning, in particular, the vocabulary fragments *K 4604* (Pinches, *5 R* (1884), 12) and Rm 2,200.

Pinches, Theophilus Goldridge. *5 R* = *The cuneiform inscriptions of Western Asia* **5** *(A selection from the miscellaneous inscriptions from Assyria and Babylonia)*. London (1884(1909)).

Pl. 36–37: BM 92 693, a lexical text (cf. Thompson, CT 12 (1901)).

de Sarzec, Ernest. *DC* = *Découvertes en Chaldée* **2** (“avec la concours de Arthur Amiaud et F[çois] Thureau-Dangin”). Paris 1884–1912.

P. 8, pl. 16: Gudea Statue B col.III, 10: in the phrase š à - l ú - š a r × b u r ’ u - t a ‘from the midst of a multitude of men’, the number sign ‘from the midst of a multitude of men', the number sign š a r × b u r ' u is otherwise known only from the fish text *AO 4303* (Cros, *Nouvelles fouilles* (1910)) with the value $10{\times}60^2$, and from the area text Schneider, *AnOr* 1 (1931) no. 303 with the value 10×60 b ù r (cf. Edzard, *Sumer* 15 (1959), Archi, *SEb* 3 (1980)). P. 47: a copy of the inscription on the silver vase of Entemena (cf. Thureau-Dangin, *ZA* 17 (1903)), and of the Entemena cone A. Pp. 51–52: copies of the Uru-KA-gina cones B, C (cf. the photo on pl. 32^{bis} of the three cones together, and Sollberger, *Corpus* (1956): Ent.28, Ukg.4–5). P. 57, pl. 5^{bis}: a Sargonic stele with big area numbers (Thureau-Dangin, *RSém* 5 (1897)). Pp. 34–35, pl. 1^{bis}: an archaic clay tablet ("the figure aux plumes"), and a fragment of an archaic stele, both likewise with big area numbers. Pl. 15: a photo of the drawing board in the lap of Gudea Statue F, with a half-cubit (?) ruler divided into 15 (possibly 16) fingers, where five of the fingers are further subdivided into halves, thirds, fourths, and fifths; this ruler gave valuable information about the absolute size of the finger (š u - s i) in post-Sargonic Lagaš (Thureau-Dangin, *JA* (10)13 (1909)). Pl. 26^{bis}: photos of one big and two small Ur III weights, and of an older weight with the inscription 5 m a - n a g i - n a $^{\text{d}}$Šu-$^{\text{d}}$*Šîn* | l u g a l kal - g a | l u g a l u r i$_2$ $^{\text{ki}}$m a | l u g a l - a n - u b - d a - 4 - b a '5 minas true, Šu-Šîn, mighty king, king of Ur, king of the four corners of the world' (cf. Oppert, *RA* 5 (1898), Powell, *SNM* (1971), p. 252). See Borger, *HKL* 1 (1967), p. 436 for further references.

Delitzsch, Friedrich. *AL^3 = Assyrische Lesestücke*, 3rd edition. Leipzig 1885.
Pp. 86–90: the lexical text *K 4378* (Landsberger, *MSL* **5** (1957), pp. 143*ff*), a bilingual lexical text with, in particular, names for water clocks (col.I, 10–11), counting instruments (col. 1, 16–22, cf. Salonen, *Hausgeräte* (1965), Lieberman *AJA* **84** (1980)), and ships loading various numbers of g u r (col.VI, 15–22; cf. Powell, SNM (1971), p. 85 note 4).

Lehmann(-Haupt), Carl Friedrich. Ueber protobabylonische Zahlwörter. *ZA* **1** (1886), pp. 222–228.
Discusses the phonetic forms of proto-Babylonian (=Sumerian) number words, with departure from the lexical text *5 R 36–37* (Pinches, *5 R* (1884); cf. Lehmann *BA* 2 (1894); Thompson, CT 12 (1901)).

Bezold, Carl. *Literatur = Kurzgefasster Überblick über die babylonisch-assyrische Literatur*. Leipzig 1886.
§115: Mathematics.

Sayce, Archibald Henry. Miscellaneous notes. *ZA* **2** (1887).
Gives the full text of *K 90* (Sayce, *Nature* (1875)), here called *K 490*.

Oppert, Jules. Les mesures assyriennes de capacité et de superficie, *RA* **1** (1886), pp. 124–147; La notation des mesures de capacité dans les documents juridiques cunéiformes, *ZA* **1** (1886), pp. 87–100; Confirmation définitive du système des mesures agraires babyloniennes, *ZA* **4** (1889), pp. 97–100; Les signes numé-riques des mesures babyloniennes de capacité, *ZA* **4** (1889), pp. 371–373.

This series of articles presents a well documented analysis of the Neo-Babylonian-Assyrian systems of capacity and area measures, with a discussion of the values of the special number signs employed for capacity measures. It is shown that the simple "agrimensor formula A = ½(a+c)×½(b+d)" was in regular use. (The formula gives, as a rule, slightly high values.) Basic area unit: 1 g i (× g i), with 1 n i n d a n = 7 g i .

Bezold, Carl. *Cat.* = *Catalogue of the cuneiform tablets in the Kouyunjik collection of the British Museum* **1**. London 1889.

P. 400: part of the curious mathematical table *K 2069* (cf. Hilprecht, *BE* **20**/1 (1906)).

Amiaud, Arthur. Les nombres ordinaux en assyrien. *JA* (8)**13** (1889), pp. 297–312.

1890–1900

Pinches, Theophilus Goldridge. *4 R*^{2} = *The Cuneiform Inscriptions of Western Asia* **4** (2nd edition) *(A selection from the various inscriptions of Assyria)* ("prepared by H.C. Rawlinson"). London 1891.

Pl. 37, p. 9: the initially published fragment of *BM 92 6 98* (G. Smith, *4 R*^{1} (1875)) is here joined to a second fragment (obv. I–II, rev. II–III), containing on the reverse tables of squares and square roots, and on the obverse a new metrological table of length measures (cf. Neugebauer, *MKT* **1** (1935), p. 71 note 1). [The first published fragment contains a table of length measures, from ... ⅔ k ù š // 50 to 2 k a s k a l . g í d //12, while the similar table on the new piece goes from ... ⅚ k ù š 1 š u - s i //4 40 to 1⅚ k a s k a l . g í d //55 .... Therefore the first metrological table shows how to convert length measures into sexagesimal multiples of the basic unit k ù š (Akk. *ammatu*) or 'cubit', and the second table gives the same information relative to the basic unit n i n d a n (= 12 cubits). Thus, the addition of the new fragment could have been used to show the falseness of the conjecture in Lepsius, *AAWB* (1877) that the metrological table of length measures was used for the conversion of Assyrian, less sophisticated, length measures into Babylonian, sexagesimal, length measures.]

Meissner, Bruno. Studien zur Serie ana ittisu. *ZA* **7** (1892).

Pp. 31–32: copies of the lexical text fragments *BM 64390* (82-9-18, 4370) and *Rm 2200*, both essentially duplicates of *K 8687* (Haupt, *ASKT* ((1881–)1882); cf. Neugebauer, *MKT* **1** (1935), pp. 29–30). All three fragments are published, in the form of one single text, in Pinches, 5 R (1884), p. 40 note 4.

Lehmann-Haupt, Carl-Friedrich, Das altbabylonische Mass- und Gewichts-System als Grundlage der antiken Gewichts, Münz- und Maass-Systeme. *8th Congress* **2** (1893), pp. 165*ff.*

Oppert, Jules. Les mesures de Khorsabad. *RA* **3** (1893), pp. 89–104.

Meissner, Bruno. *BAP = Beiträge zum altbabylonischen Privatrecht* (AB 11). Leipzig 1893.

Pp. 98–101: an analysis, due to Lehmann-Haupt, of the OB system of capacity measures, found to be different from the Assyrian system (cf. Oppert, *ZA* **4** (1889)). In particular, it is noted that phrases of the type *n* še gur are typical for OB texts. Pp. 56–57: a metrological list of weights (*VAT 1155*), from ... 15 še kù-babbar to 50 gur .... P. 58: a copy of a metrological list of capacity measures on the cylinder VAT 2596, from 1/3 sila še to šár × 50 še gur, šár + 1 šu-*ši(?)* še gur.

Delitzsch, Friedrich. Der Berliner Merodachbaladan-Stein. *BA* **2** (1894), pp. 258–273.

Presents in transliteration and translation the text on a Marduk-apil-iddina *kudurru* (cf. the hand copy in Messerschmidt and Ungnad, *VS* **1** (1907)). The text contains three area computations, with the results expressed in a form reproduced by D. as "*n*(capacity units) seed grain: *ina* KAR.AŠ 1 Ú *rabīti*" (the correct version is given in Weissbach, *OLZ* **17** (1914)). The three area computations as well as the total sum (pap pap) seem to be grossly in error (?). Cf. the reference to this text in Powell, *ZA* **72** (1982).

Scheil, Vincent. Fragments de syllabaires assyriens *ZA* **9** (1894), pp. 218–223.

P. 129: a copy of the lexical text fragment *F^st S 485* (Sch.1) from Sippar, with part of a standard table of reciprocals, augmented by a column of phonetic spellings for the Sumerian number words. Cf. Neugebauer, *MKT* **1** (1935), pp. 26–27 for an accurate hand copy, and for a join with a second fragment. See also Powell, *SNM* (1971), 54–58; Steinkeller, *ZA* **69** (1979).

Lehmann(-Haupt), Carl-Friedrich. Ein Siegelcylinder König Bur-Sin's von Isin. *BA* **2** (1894), pp. 601–608.

Continues the discussion of the lexical text Pinches, *5 R* no. 36–37 (Lehmann (Haupt), *ZA* **1** (1886)).

Thureau-Dangin, François. La comptabilité agricole en Chaldée. *RA* **3** (1895), pp. 118–146.

Having been given access to photographic copies of some of the newly excavated Sumerian texts from Telloh, T. is here able to show, e.g. that (1) the sign LAL was used as a cuneiform minus sign; (2) the values of the cuneiform capacity units deduced from the table on the cylinder *VAT 2596* (Meissner, *BAP* (1893)) are confirmed by texts where expenses or taxes are computed by use of fixed proportions, as for instance 8 s i l à per ass and day, or 1 (b a r i g a) 3 (b á n) per g u r , etc.; 3) the area measures š a r and i k u are equal to the areas of squares of side 1 nindan and 10 nindan, respectively.

Oppert, Jules. Un grand U. *ZA* **10** (1895), pp. 254–257.

Gives an incorrect interpretation of the seed grain-area formula on the Marduk-apil-iddina *kudurru* (Delitzsch, *BA* **2** (1894)), based on the mistaken idea that the *ammatum rabītum* would be an area measure. Cf. Weissbach, *OLZ* **17** (1914), Powell, *ZA* **72** (1982).

Reisner, George. Altbabylonische Maasse und Gewichte. *SPAW* **19** (1896), pp. 417–426.

In an exemplary analysis of the metrological relations in about 500 Sumerian texts from Telloh, now in Berlin (Reisner, *TUT* (1901)), R. gives here an accurate description of the "old-babylonian" (actually Sumerian) metrological systems for weight, area, and capacity measures. The results partly overlap those in Thureau-Dangin, *RA* **3** (1895).

Thureau-Dangin, François. Quelques mots de métrologie. *ZA* **11** (1896), pp. 428–432.

An analysis of the method used for the computation of areas in some texts from Telloh (King, *CT* **1** (1896)). Concludes in particular, erroneously, that the Pythagorean theorem was employed for the computation of the height against the base of "symmetric" trapezoids. Actually, the height is, in the texts quoted by T., given among the data as the "north" dimension of the trapezoidal fields. (Cf. Allotte de la Fuÿe, *RA* **12** (1915).)

Thureau-Dangin, François. Un fragment de stèle de victoire d'un roi d'Agadé. *RSém* **5** (1897), pp. 166–173.

Hand copy, transliteration, and translation of a fragment of a text in which some Sargonic king claims sovereignty over a territory covering an area of 5 51 34 b ù r. The reading of the area number is doubtful (cf. the photo in *RA* **3** pl. 6 or de Sarzec, *DC* (1887) pl. 5bis; T. reads 11 01 34 b ù r, with some hesitation). This causes T. to make a survey of notations for big numbers and area measures.

Thureau-Dangin, François. Un cadastre chaldéen. *RA* **4** (1897), pp. 13–27.

Discusses the methods (among them an ingenious way of checking the accuracy of the lengthy calculations) involved in the computation of the area of the Ur III district Šulgi-sib-kalama in the field plan text *MIO 1107* (*RTC* no. 416, Thureau-Dangin, *ZA* **17** (1903)). This text gave T. a welcome opportunity to analyse the

structure of the Ur III system of area measure notations. A conflicting and incorrect interpretation was offered in Oppert, Un cadastre chaldéen du quatrième millenium, *CRAIB* (1896), pp. 331–348. It was immediately refuted in Reisner, Notes on the Babylonian system of measures of area, *ZA* **11** (1896), pp. 417–424.

Thureau-Dangin, François. Les chiffres fractionnaires dans l'écriture babylonienne archaïque. *BA* **3** (1898), pp. 588–589.

A brief survey, based on texts from Telloh, of the Sumerian notations for numerical fractions and fractional area or capacity measures, with inclusion of both curviform and cuneiform variants.

Thureau-Dangin, François. *REC = Recherches sur l'origine de l'écriture cunéiforme*. **1** *Les formes archaïques et leurs équivalents modernes*. Paris 1898.

Notes 481–517: number notations.

Oppert, Jules. Les poids chaldéens. *RA* **5** (1898), pp. 57–64.

O. tries here to determine the absolute value of the Sumerian weight unit m a - na, with departure from an "archaic" marble cone (inscription m a - na kù | |, meaning $\frac{1}{3}$ mina), a big diorite ellipsoid and two smaller similar ellipsoids (cf. de Sarzec, *DC* **2** (1884); the inscriptions read: 5 m a - n a ^{d}Šu-^{d}Šín ..., 10 g í n g i - n a , 5 g í n , hence Ur III), and a duck weight from Telloh of white limestone (Powell, *SNM* (1971), p. 257) with the vertically written(!) inscription $\frac{1}{2}$ m a - na. Comput-ing with a Sumerian cubit of 0.54 meters (the value given by Gudea's graded ruler, see again de Sarzec, *DC* **2** (1884–1912)), and with a density of diorite of 3.1, O. finds that the value of the mina may have been determined originally as the weight of a cube of diorite with sides of length $\frac{1}{10}$ cubit, i.e. 3 fingers (š u - si). O. repeats also an argument from his paper in *JA* (6)**20** (1872), based on a small weight with the inscription 22$\frac{1}{2}$ še, and resulting in the conclusion that a weight of 1 grain (še) is equal to $\frac{1}{180}$ of a g í n (O. calls it drachme). Cf. Powell, *SNM* (1971), p. 273.

1900–1910

King, Leonard William. *CT* **9**. London 1900 (reprinted London 1962).

Pl. 8–13: hand copies of the two big mathematical problem texts BM 85194 and BM 85210. These texts remained uninterpreted for a long time, partly because of the use of a special, unfamiliar, mathematical vocabulary, partly because of considerable intrinsic difficulties of several kinds. Cf. Zimmern and Ungnad, *OLZ* **19** (1916); Neugebauer, *MKT* **1** (1935), 142–193, 219–233; Neugebauer, *MKT* **2** (1935), pl. 5–6, 9. The mathematical character of BM 85194 was indicated, for instance, by the presence in the text of line drawings of several circles and a circle segment.

<u>Scheil</u>, Vincent. *MDP* **2** = *Textes élamites-sémitiques, première série*). Paris 1900.

Pl. 6, p. 24: on the obelisk of the Sargonic king Maništusu one can read, for instance, the following passage, giving the price of a field in barley and in silver: col. 7, 19–col. 8, 4: 3 (šar) 3 (bur'u) 3 (bùr) ^{ašag} | níg-šám-*su* | 3 guru₇ 3 (geš'u) 3 (geš) gur-sag-gál | níg-šám | 1 gín kù-babbar | 1 (gur) še gur-sag-gál | kù-babbar-su | 3 gún 33 ma-na kù-babbar | níg-šám ašag; the passage shows that in the Sargonic period the price of 1 bùr of land was 60 gur-sag-gál of barley, or 1 ma-na of silver (cf. Neugebauer and Sachs, *MCT* (1945), p. 74 note 179, where it is remarked that the equating in OB mathematical texts of wages of 1 bán of barley with wages of 6 še of silver corresponds exactly to the rate of exchange in the Ur III period: 1 gur of barley = 1 gín of silver; the same passage also shows that the guru₇ sign in the Sargonic period was used to denote a capacity of 60^2 gur-šag-gál, just as it in the Ur III period would be used to denote 60^2 gur(-lugal) (cf. Maekawa, *ASum* **3** (1981)). Pl. 30: S. publishes here hand copies of

a) the “Walters’ tablet” (Deimel, *Inschr.Fara* **1** (1922), p. 73 note 3), a stone tablet of Jemdet Nasr type with the area number 1(ŠAR’U)^{ašag};

b) two proto-elamite tablets, the first such tablets excavated at the Susa Acropole. [One of these tablets (= Scheil, *MDP* **6** (1905) no. 399) gives a unique example of a complicated computation involving both a proto-Elamite decimal system used for counting animals (?) and a proto-literate system of capacity measures, different from the system of capacity numbers used in the classical Sumerian texts. Cf. Friberg, *DMG* (1978–9).]

<u>Thompson</u>, Reginald Campbell. *CT* **12**. London 1901.

Pl. 1–3: *BM 92693* (= Pinches, *5 R* (1884) no. 36–37), a lexical text with a section for < gi-gu-ru and its multiples (cf. Borger, *HKL* **1** (1967), p. 540 for references; see also Powell, *SNM* (1971), pp. 18*ff*); thus, the text contains the names of the area units, from bur-1 // u gi-gu-ru // 1 (bùr) $^{bu\text{-}ur}$*eqlim* to bur-50 // 5 (bu'u) // 50 búru, but also entries of many other types, as for example bur-mi-in // uni-iš // uu // u gi-gu-ru min-na-bi // 2 (bùr) $^{ši\text{-}in\ 2}$*eqlim*; ni-iš // uu // *eš-ra-a*; ...; mi-in // uu // ^{d}*Šamaš* (here it is shown that the same cuneiform sign can be read as ‘2 bùr’, ‘2’, ‘two’, ‘⅓’, ‘the sun-god *Šamaš*’, etc. Pl. 24: *BM 38129* (cf. Borger *HKL* **1** (1967), p. 541 for references; see also Powell, *SNM* (1971), pp. 73–78), a lexical test with a section for šár'u and its multiples, from šár-10 // [šár × 1 // 10 *šāru*] to šar-gal-2 // šár × gal-2 // gal-2 [*šāru*]. Cf. my commentary to Fales, SEb (1982) [JH: apparently retracted].

<u>Reisner</u>, George. *TUT* = *Tempelurkunden aus Telloh* (MOS 16). Berlin 1901.

Of the texts published here, the following were used in Reisner *SPAW* (1896), for the study of the Sumerian weight measure system: *VAT 2243*, *VAT 2244*;

respectively for the study of the area measure system: *VAT 2201*, *VAT 2202*, *VAT 2210, VAT 2213.*

Scheil, Vincent, *SFS* = *Une saison de fouilles à Sippar*. Cairo 1902.
Presents, unfortunately in a corrupt form, hand copies of a unique and important mathematical text (*Ist S. 428*; cf. Oppert, *CRAIB* 1902), of a table of square roots, and of several fragments of metrological lists for measures of weight ("money") and capacity.

Scheil, Vincent. *MDP* **4** = *Textes élamites-sémitiques, deuxième serie*). Paris 1902.
Pl. 11–162: Codex ḫammurapi (cf. Borger, *HKL* **1** (1967), p. 89: *BabL* = Driver+ Miles, *The Babylonian laws* **2** (1955)); this law codex contains several numerical data of potential interest for the understanding of OB mathematical texts; for instance: the fee for storing barley in another man's house (§121: 5 *qa* for 1 še gur during 1 year), the wages paid to various kinds of workers (§274: 5 shekels of silver for a tailor for 1 day, ...), the cost of renting a 60-gur boat (§276: $^1/_6$ shekel for 1 day), etc.

Oppert, Jules. Six cent cinquante-trois : les carrés mystiques chaldéens. *CRAIB* (1902), pp. 457–468; Sechshundert drei und fünfzig. Eine babylonische Quadrat-tafel, *ZA* **17** (1903), pp. 60–74.
O. offers here an entirely unfounded "mystic-cabbalistic" interpretation of the admittedly far from trivial text *Ist S 428* (Scheil, *SFS* (1902); cf. Huber, *EM* **3** (1957), Friberg, *HM* **8** (1981), pp. 293–294).

Thureau-Dangin, François. La mesure du . *ZA* **17** (1903), pp. 94–95.
Interpreting the somewhat vague inscription on Entemena's silver vase (Sollberger, *Corpus* (1956), Vase D) as saying that the vase has a capacity of 1 nigin, and using the known relations 1 dug = 30 (sometimes 20) silà = 3 nigin, T. arrives here at the conclusion that the size of a Sumerian silà was about 0.41 litres. (Cf. Thureau-Dangin, *RA* **9** (1912), and Postgate, *Iraq* **40** (1978), with an estimate of about 0.82 litres for the Neo-Babylonian and the Old Babylonian *qa* (silà), respectively. T.'s estimate in the present note seems to be wrong by a factor 2.)

Thureau-Dangin, François. *RTC* = *Recueil de tablettes chaldéennes*. Paris 1903.
No. 137, 413: a Sargonic and an Ur III text, both concerned with bricks (sig$_4$); cf. my commentary to Powell, *ZA* **72** (1982). No. 412: an Ur III text concerned with volume computations; cf. Allotte de la Fuÿe, *RA* **6** (1907) No. 416: the field plan for Šulgi-sib-kalama; cf. Thureau-Dangin, *RA* **4** (1897). Interesting are also, for instance, no. 106 and no. 129 with unusual notations for big numbers, and

no. 408 with scribbled positional sexagesimal numbers in an Ur III seed grain text (unfinished; cf. Powell, *HM* **3** (1976)).

Bezold, Carl. *Assyriologische Randbemerkun*gen. *ZA* **17** (1903), pp. 95–96.
Mentions texts such as *K 8111*, *Sm.162*, etc., listed in Bezold's *Cat.* **5** (1899), p. 2031b, all with drawings of squares and other geometric figures.

Scheil, Vincent. *MDP* **6** = *Textes élamites-sémitiques*, troisième serie). Paris 1905.
S. here publishes a substantial collection of proto-Elamite tablets, in hand copies and/or photos, with a sign list and an attempted decipherment of the proto-Elamite system of numeration. Thus, in no. 219 (dealing with people (?)), S. identifies the sign for $\frac{1}{2}$ correctly (see p. 116); otherwise most of the identifications are incorrect, except for a conjectural identification of the signs for $\frac{1}{30}$ and $\frac{1}{60}$ (capacity units). Typical is that S. postulates the use of a decimal number system and then announces that some computations on the tablets are correct, such as the one in no. 220, while others contain "a small error (which is customary)" (this is said, in particular, about the barley text no. 221; cf. p. 116). [no. 5242 is a quite spectacular, big and almost intact tablet with an addition of a long series of capacity numbers (barley). In the photo published here, a big capacity number on one edge is omitted (verified by inspection); taking this fact into account, it is possible to check that the sum on the reverse probably is correct. Since this sum is an "almost-rounded number" (cf. Friberg, *DMG* (1978–9)), and since it is followed by a second almost-rounded number, which is about $\frac{3}{10}$ as big, this text offers an interesting parallel to the big proto-Sumerian bread-and-beer text *IM 33426* in Falkenstein, *OLZ* **40** (1937).]

Hilprecht, Herman Vollrat. *Die Ausgrabungen der Universität von Pennsylvania im* Bêl-Tempel *zu Nippur*. Leipzig 1903; *BE* **20**/1 *Mathematical, metrological and chronological tablets from the Temple Library at Nippur*. Philadelphia 1906.

After publishing in *Bêl-Tempel* (p. 60) the first two known examples of Babylonian multiplication tables, H. proceeds in *BE* **20**/1 to publish and analyze in detail two groups of mathematical and metrological table texts, one from the Isin period (early OB), the other from the time of the Kassites (post-OB (?)). Many of the texts are still of great importance.

No. 1–16 are "single" sexagesimal multiplication tables for the "head numbers" 2, 6, 9, 18, 30, 36, 1 30, 1 40, 2 30, 7 12, 7 30, 12 30; no. 17–24 are "combined" multiplication tables (or fragments of such), often with a table of reciprocals at the end (cf. Neugebauer, *QS* B **1** (1930–1931)); no. 20 is an interesting exercise text, with the teacher's original and the pupil's copy side by side.

Older than the other tablets in the collection is no. 25 (*CBM 10201*), an important algorithm text, which is in part correctly interpreted by H., but which also tempts him to speculations (see pp. 28–34) about the role in Babylonian mathematics of the "number of Plato" (simply because he does not yet understand the nature of the Babylonian sexagesimal notation which lacks special signs for final zeros and for any indication of where the fractional part of a number begins). Cf. Scheil, *RA* **13** (1916), Sachs, *JCS* **1** (1947).

Quite old (Ur III (?) or early OB) is also no. 25^{a} (*CBM 12648*) a fragment of a text with several mathematical problems, written in Sumerian, with Sumerian grammatical verb forms, and because of this unique (cf. Neugebauer, *MKT* **1** (1935), pp. 234–235: ub-te-kú, ba-e-íl, ba-zu-zu, ḫé-gar, e-du$_{8}$, ...). [The text seems to have contained a series of parallel problems. A complete problem with solution can therefore be reconstructed from two problem fragments, and it turns out that this reconstructed problem asks for the sides of a rectangular solid figure, given the volume and the ratios bet-ween the sides. The sides are computed in terms of the solutions of a cubic equation, and the answer given is such that it is probable that the whole text was originally restricted to problems dealing with bricks of certain standard formats.]

No. 26 is a table of squares, no. 27–28 two tables of square roots. On pp. 11–34, H. discusses the mathematical texts of his collection, and also, on pp. 25–28, the unique fragment *K 2069* from Ninive, with its strange table of reciprocals (of the type $^{7}/_{6n}$ or $^{70}/_{n}$).

After the mathematical tablets follow the metrological tablets, of which two are of extraordinary interest: no. 29 (*CBM 10990+19185+19757*) is a fragment of a big combined metrological list for capacity measures (from ..., 1 (bán) to šár × 50^{gur}, šár-gal^{gur}, šár-gal šu-nu-taga$_{x}$^{gur}), for weight measures (from 1 40 ku-babbar, 2½ še to šár ×$50^{gún}$, šár-gal gún, šár-gal nu-taga$_{x}$ gún, for area measures (from 1 šar ašà (?) to ŠÁR × 50 ašag, ŠÁR × GEŠ.GAL^{ašag}, ŠÁR×GEŠ.GAL šu-nu-taga$_{x}$) and for length measures (from 1 šu-si to 1 10 nindan, ...) – this metrological table belongs to the Isin group.

No. 30 (*CBM 8539*) is a big piece of a "Kassite" (Neo-Babylonian) combined metrological table for

(a) length measures, with basic unit 1 nindan (from ..., 3 20 // ⅔ kùš to 1 30 // kaskal-gíd);

(b) length measures, with basic unit 1 kùš of 30 šu-si (caption: *an-ni-ti* šu-si šá 30 šu-si^{meš} | 1 kùš *am-mat* še-numun *ù* gi^{meš} | *šá* 1 a-da-pà | *am-mat* ì-dub *ù* dagal-tùn | *ù* 1 kùš ^{giš}sil; cf. pp. 35–38, where H. conjectures that the adapa was a cylindrical vessel, in the present case with upper and lower width (*našpaku* and *agarinnu*) and height (*ṣillu*) all equal to 1 cubit; the table goes from 2 // 1 šu-si to 1 // 30 1 kùš si, ...);

(c) length measures, with basic unit 1 kùš of 24 šu-si (from ..., 30 // 12 ⅓ kùš si);

(d) length measures, with basic unit 100 kùš of 24 šu-si (cf. Vaĭman, *ŠVM* (1961), pp. 28–32; the table goes from 1 30 // 1 šu-si to 36 // 24 si // 1 kùš, and it has the caption *an-ni-ti* šu-si šá 24 šu-si meš | 1 kùš *ammat* še-numun *ù* gi meš ...; cf. Thureau-Dangin, *JA* (10)**13** (1909), Neugebauer and Sachs, *MCT* (1945), p. 143: the Neo-Babylonian cubit of 24 fingers was used at a time when areas were measured in "seed-grain" according to the formula '300 sq. cubits = 1 sìlà seed grain' (cf. Powell, *ZA* **72** (1982));

(e) length measures (only about half the caption is preserved, and nothing of the table);

(f) weight measures, basic unit 1 ma-na (from ..., 50 // 1 *me* 50 še // ⅚ gín to 30 // ½ ma-na); and

(g) capacity measures, with basic unit 1 pi (from 10 // 1 ninda to 1 // 12 gur, ...).

No. 31–34 are small tablets or fragments with tables of weight (?) measures. No. 35–36 are OB tables of capacity measures, with basic unit 1 sìlà (or 1 bariga). No. 37–38 are OB lists of capacity measures (on one side syllabaries). No. 39–40 are OB tables of area units, with basic unit 1 šar. No. 41–43 are OB tables of length units, with basic unit 1 kùš (no. 41) or 1 nindan. The collection includes also a king-list for the dynasties of Ur and Isin (no. 46), lists of names of the months, etc. In no. 46, with names of the thirteen months, the ideogram for 'month' is very clearly written as ud × 30, i.e. as '30 days'.

Messerschmidt, Leopold, and Ungnad, Arthur. *VS = Vorderasiatische Schriftdenkmäler* **1**. Leipzig 1907.

No. 37: the Merodachbaladan *kudurru*; cf. Delitzsch, *BA* **2** (1894); Borger, *HKL* 1 (1967), p. 351.

Weissbach, Franz Heinrich. Über die babylonischen, assyrischen und altpersischen Gewichte. *ZDMG* **61** (1907), pp. 379–402, 948–950; Zur keilschriftlichen Gewichtskunde. *ZDMG* **65** (1911), pp. 625–696.

A sharp critique of the methods followed by Lehmann-Haupt, the last major representative of the school of comparative metrology, and from 1888 to 1907 "the oracle of metrological wisdom" (see the extensive discussion in Powell, AOAT 203 (1979) of this and related subjects).

Allotte de la Fuÿe, François-Maurice. La mesure des volumes dans les textes archaïques de la Chaldée. *RA* **6** (1907), pp. 75–78.

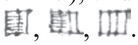
Discusses *RTC* no. 412 (= *AOT 305*; Thureau-Dangin, *RTC* (1903)), an Ur III text involving computations of the volume of certain irrigation constructions, and concludes that the unit of volume, a "volume-šar", used in this text is the

volume of a flat rectangular solid of base 1 area - šar and height 1 cubit. In fact, the word used in this text for 'volume' is the word normally used for area (a-šà).

Scheil, Vincent. *MDP* **10** = *Textes élamites-sémitiques*, quatrième série). Paris 1908.
P. 97: the first published hand copy of a "numerical" or "impressed" tablet, with only seal impressions and numbers (a "ten" and two units). Cf. Amiet, *MDP* **43** (1972), no. 629; Schmandt-Besserat, *VL* **15** (1981).

Cantor, Moritz. Babylonische Quadratwurzeln und Kubikwurzeln. *ZA* **21** (1908), pp. 110–115.
A discussion of the terminology used in OB tables of square roots and cube roots.

Ungnad, Arthur. Aus den neubabylonischen Privaturkunden §5: Zum babylonischen Geldwesen. *OLZ* (1908), Beiheft 2, 26–28.
Using insufficient data in a very clever way, U. here manages to deduce a correct list of the values and names of the Neo-Babylonian fractions of a shekel ($\frac{2}{3}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{8}$, $\frac{1}{10}$, $\frac{1}{12}$, $\frac{1}{24}$ shekel). Cf. Sachs, *JCS* **1** (1947); Powell, *SNM* (1971), 234.

Pinches, Theophilus G. *The Amherst tablets* 1; Texts of the period extending to and including the reign of Bûr-Sin. London 1908.
No. 52 ("accounts of asses, cattle, etc."): P. points out here (p, 105) how the simple sign su-nigín is used to indicate subtotals in the main text, while the iterated sign su-nigin (= su-nigín+nigín) is used for grand totals (col. XIV), and the sign nigín+nigín+nigín for totals of profit and loss: .

Nikol'skiĭ, Michail Vasil'evič. *DV* **3**/2 = *Dokumenty hozyaĭstvennoĭ otčetnosti drevneĭseĭ ėpohi Haldei*, 'Economical documents from the oldest period of the Chaldeans'). St. Petersburg 1908.
No. 8: A Sumerian excavation text, in which a number of work teams, comprising in all 80 $\frac{1}{2}$ men, excavate a canal (?), with a work norm of 2 cubits per man and day (1ú 1-šù | kin ú-2-ta). The total length of the excavation is given as kin-bi 1 eše 7 gi <lal> ú 1 kin-dù-a. [This use of eše (rope), gi (reed), and ú (cubit) as length units, with the exclusion of the nindan which was reserved for longer distances, is characteristic of the pre-Sargonic Sumerian texts (cf. Allotte de la Fuÿe, *RA* **12** (1915)). The same system of notations for length measures is employed in no. 34, a text with two area computations using an interesting round-off technique (round-off before the forming of the product). See also Nikol'skiĭ, *DV* **5** (1915) no. 64–65].

Pinches, Theophilus G. Some mathematical tablets of the British Museum. *Hilprecht Anniversary Volume* 1909, pp. 73–78.

Considers, in particular, the combined multiplication table *BM 80150* (cf. Pinches, *CT* **44** (1963); Neugebauer, *MKT* **2** (1935), p. 6), which ends with a partial copy of the algorithmic table on Hilprecht's tablet *CBM 10210* (Hilprecht, *BE* **20**/1 (1906)).

Allotte de la Fuÿe, François-Maurice. Un document de comptabilité de l'époque d'Oroukagina. *JA* (10)**6** (1905), pp. 551–558 ; Mesures de capacité dans les textes archaïques de Telloh. *JA* (10)**13** (1909), pp. 235–247 ; Le gour saggal et ses subdivisions d'après les documents présargoniques de Lagaš. *RA* **7** (1910), pp. 31–47.

After a false start in *JA* (10)**5** (1905), A. gives here a correct description of the g u r - s a g - g á l system of capacity measures used in the pre-sargonic texts from Lagaš (from Entemena and onwards). A. also discusses the g u r - 2 - UL of the earlier texts, as well as the use of cuneiform number signs as variants to the normal curviform number signs in the pre-Ur III texts.

Kugler, Franz Xaver. Die Symbolik der Neunzahl bei den Babyloniern. *Hilprecht Anniversary Volume* 1909, pp. 304–309.

K. suggests here that not only 7 but also 9 may have been a sacred number in cunei-form texts, used in particular as a symbol of the eradication of evil things. As an example is mentioned the year formula for the year Šulgi 54: m u S i - m u - u r - r u - u m^{ki} ... a - r á 10 l a l 1 - k a m - a š b a - ḫ u l 'the year Simuru was destroyed for the "ninth" time'.

Evans, Arthur J. *Scripta Minoa* **1** = *The hieroglyphic and primitive linear classes*. Oxford 1909.

Pp. 147–148, 170, 256–259: E. gives a description of the system of numerals used on "hieroglyphic", or rather semi-pictographic, clay bars, etc., from the earliest literate period of the Minoan civilization on Crete (contemporaneous with the late OB period in Mesopotamia (?)). The units of this decimal system of numeration were written as "lozenges" for thousands, long straight lines for hundreds, dots for tens, and short straight or curved lines for ones. [Although not noticed by E., the similarity with the Sumerian-Early OB system of notations for sexagesimal numbers is striking. (Cf. also Evans, Scripta Minoa 2 (1952))].

Barton, George Aaron. *HLC* = *The Haverford Library Collection of cuneiform texts from the temple archives of Telloh* **2**. Philadelphia/London 1909.

Pp. 13–19: A study of the reed text Barton, *HLC* **1** (1905) no. 24 enables B. to demonstrate that the Sumerian number notation š á r - g a l has the value 60^3 = 216,000. H. then goes on to discuss the meaning of the big numbers occurring in the big metrological list *BE 20/1 29* (Hilprecht, *BE* **20**/1 (1906)), and in the lexical text *BM 92693* (Thompson, *CT* **12** (1901)). The interesting suggestion that the highest, number occurring in the metrological text should be read as šár gal šu nu šum 'the great š á r, its double', is probably not correct.

Thureau-Dangin, François. Le rapport de valeur entre l'or et l'argent en Babylonie. *OLZ* **12** (1909), pp. 304–309.

Claims that the Babylonian values of gold, silver, and copper originally were to each other as 600: 1: $^{1}/_{6}$, and suggests that these ratios were fixed by the Sumerian inventors of the sexagesimal system. T. discusses also lexical information about notations for '$^{1}/_{6}$' and its derivatives, with departure from the lexical entry š u - u š // U // š u - u š - š u (*CT 12 1*, col. II, 8). Cf. the extremely interesting discussion in Powell, SNM (1971) Chapter 5.

Deimel, Anton. Studien zu CT I, III, V, VII, IX und X. *ZA* **23** (1909), pp. 107–144.

Considers in detail the computations on a group of "round tablets" (Ur III), concerned with fields and their produce. Cf. Thureau-Dangin, *ZA* **11** (1896), Reisner, SPAW 19 (1896), Pettinato, TVLU = AnOr 45 (1969).

Thureau-Dangin, François. L'U, le Qa et la Mine, leur mesure et leur rapport. *JA* (10)**13** (1909), pp. 79–111.

A comparative study of Sumerian, Old Babylonian, Neo-Babylonian, and Assyrian metrological systems for length, capacity, and weight measures. T. claims that all three systems were based, originally, on a length unit, the cubit. However, an essential part of the discussion builds on a (probably) false assumption about the size of the Sumerian silà (see Thureau-Dangin, *ZA* **17** (1903)), and on an unwarranted estimate of the number of š e(grains) in a s i l à. In an appendix, T. reprints G. Smith's *Athenaeum* article of (1876), with its preliminary discussion of the implications of the important "Esagila tablet".

1910–1920

Myhrman, David W. *BE* **3**/1 = *Sumerian administrative documents dated in the reigns of the second dynasty of Ur* ...). Philadelphia 1910.

No. 92: cf. Pettinato and Waetzoldt, *StOr* **46** (1975), Maekawa, ASum 3 (1981).

Cros, Gaston (+Th.-Dangin). *NFT* = *Nouvelles fouilles de Tello*. Paris 1910.

Pp. 183*ff*: note in the late Sargonic(?) text *AO 4303* the big number š u - n i g i n 2 (š á r) - g a l š a r×b u r ' u 3 (š á r) l a l 4(60) 10 ḫ a - a b - b a (cf. Archi, *SEb* **3** (1980)). *AO 4210*: a bronze text (cf. Limet, *Métal* (1960)). P. 263: an archaic contract, with the field productivity formula š e - g u r - 2 - u l - t a a š a g - 1 - a .

Delaporte, Louis. Document mathématique de l'époque des rois d'Our. *RA* **8** (1911), pp. 131–133.

Discusses the earliest known example (Ur III (?)) of what was to become the standard Babylonian type of tables of reciprocals. This particular table, however (*Ist T 7375*; Delaporte, *ITT* **4** (1912), pl. 14), is unique in that it begins 2 [i g i 30] and ends 59 i g i n u , 1 i g i 1. In other words, it does not list the "reciprocals" of ⅔, 1 20, and 1 21, but mentions instead that certain numbers lack reciprocals. (Cf. Neugebauer, *MKT* **1** (1935), p. 10.)

Langdon, Stephen. *TAD = Tablets from the archives of Drehem*. Paris 1911.

No. 12: an excavation text; note DÚL = 'depth'. No. 42: see Neugebauer, *MKT* **1** (1935), p. 82.

Thureau-Dangin, François. La mesure du *qa*, *RA* **9** (1912), pp. 24–25.

Using a plausible reconstruction of a stone jar, of which is preserved a relatively big fragment with the inscription 3 ⅓ n i n d a (i.e., one third of a Neo-Babylonian *qa*), T. draws the conclusion that the *qa* of the NB period must have had a value of about 0.81 litres. The fragment (Scheil, *MDP* **14** no. 60) was found at Susa. (Cf. Postgate, Iraq **40** (1978).)

Lehmann-Haupt, Carl-Friedrich. Vergleichende Metrologie und keilinschriftliche Gewichtskunde. *ZDMG* **66** (1912), pp. 607–696.

For comments to this and other publications (not mentioned in this bibliography) from the decade of exchanges between L. and his opponent Weissbach, see the paper by Powell quoted under Weissbach, *ZDMG* **61** (1907).

Hussey, Mary Inda. *HSS = Sumerian tablets in the Harvard Semitic Museum*. 1. *Chiefly from the reigns of Lugalanda and Urukagina of Lagash*. Cambridge, Mass. 1912.

Pp. 2–8 (numerical notation): a thorough investigation of the principles after which cuneiform respectively curviform number signs were used in the texts of the collection, in particular in the "detailed totals", the "summary", and the "sum total". Pp. 8–11 (clerical errors): H. notes here that "the accurate and analytic method with which accounts were kept is astonishing".

Weidner, Ernst F. Zur babylonischen Astronomie 2: Mondlauf, Kalender und Zahlenwissenschaft. *Babyl.* **6** (1912), pp. 8–28.

Pp. 11–15, pl. 3: a new interpretation, and a photo, of the astronomical text *K 90* (Hincks, *LG* **38** (1854)).

Weidner, Ernst F. Babylonische Messungen von Fixsterndistanzen. *Babyl.* **6** (1912), pp. 221–233.

(1) The text *K 9794*: although the distances listed in this short and fragmentary text are written, successively, as 9 *lim*, 18 *lim*, 18 *lim*, 30 *lim,* 6 *lim* (k a š k a l . g i d),

W. refuses to admit that 30 *lim* 6 *lim* may be a way of writing 36000. Cf., however, Safar, *Sumer* **7** (1951).

2) The "Nippur text" with star distances (?). Cf. Neugebauer, *QS* B **3** (1936) and the very interesting discussion in Neugebauer, *ESA*^{2} ((1951)1957), pp. 99, 139.

Thureau-Dangin, François. *TCL* **3** = *Une relation de la huitième campagne de Sargon (714 av. J.-C.)*. Paris 1912.

Contains some interesting examples of Neo-Assyrian number notations: line 369 (pp. 56–57, pl.18): 1 *me* 6(10) 2 g ú n 20 m a - n a 6-SU l a l k u - b a b b a r '162 talents 20 minas minus one-sixth of silver'; note the way in which 60 is written as six tens, here as elsewhere in the same text, while for instance in line 378 the number 96 is written in a more familial way as 1 36; see note 12 on p. 57 for a documentation of the identity 6-SU = 10 g í n , from which it does not necessarily follow, however, that 1 SU = $^1/_{36}$ (*ma-na*), hence 3-SU = $^1/_{12}$ mina, as claimed by T, [it is, a priori, equally possible that *n*-SU = $^1/_n$ (mina), so that 3-SU = $^1/_3$ (mina), etc.]. Line 394 (pp. 62–63, pl. 20): here the number 305,412 is written in the form 3 *me* 5 *lim* 4 *me* 12, probably in direct imitation of the spoken language.

Legrain, Léon. Collection Louis Cugnin. *RA* **10** (1913), pp. 41–68.

Cf. Scheil *RA* **12** (1915), pp. 161–172.

Scheil, Vincent, and Legrain, Léon. *MDP* **14**. Paris 1913.

P. 60: cf. Thureau-Dangin, *TCL* **3** (1912). P. 90, note 35: a bronze text (see Limet, *Métal* (1960)).

Thureau-Dangin, François. Distances entre étoiles fixes d'après une tablette de l'époque des Séleucides. *RA* **10** (1913), pp. 215–225. (Cf. the commentary on the astronomical significance of the text in Kugler, *RA* **11** (1914), pp. 1*ff.*)

A discussion of the astronomical text *AO 478* (Thureau-Dangin, *TCL* **6** (1922), no. 21), with its table of distances between zodiacal stars, listed in three separate columns where the distances are expressed (1) in weight units (indicating the use of a water clock), (2) in terrestrial length units, and 3) in celestial length units. Thus, the table starts (in T.'s transliteration): 1 ½ m a - n a *šuqultu* // 9 u š *i-na qaq-qa-ri* /16 *lim* 2 *me bêru* [*i-na ša-me-e*] '1 ½ mina weight, 9 degrees (?) on the ground, 16200 *bēru* in the sky'. (This shows that a "weight" of 10 shekels corresponded to 1 u š "on the ground", and to 1800 *bēru* "in the sky".) The total, after 26 such lines, is given as p a p 1 *biltu* // 12 *bêru* 4 u š // š u - n i g i n 6 *me* 55 *lim* 2 *me bêru*, displaying two different ways of writing the word 'total', and suggesting that the maximum capacity of the water clock corresponded to a

"weight" of precisely 1 talent. (See Borger, *HKL* **1** (1967), p. 563 for references and parallels.)

Scheil, Vincent. Esagil ou le temple de Bêl-Marduk à Babylone. *MAIB* **39** (1914), pp. 293–308, 2 planches.

Dieulafoy, Marcel. Temple de Bêl-Marduk, étude arithmétique et architectonique du texte. *MAIB* **39** (1914), pp. 309–372.

A detailed presentation of the important "Esagila tablet" (cf. G. Smith, *ZÄS* **10** (1872), Thureau-Dangin *JA* (10)**13** (1909)), with photo, hand copy, and a thorough discussion of the content. See also Weissbach, *OLZ* **16** (1914), Langdon, *RA* **15** (1918), Thureau-Dangin, *RA* **15** (1918), **19** (1922), and *TCL* **6** (1922), no. 32.

Poebel, Arno. *PBS* **5** = *Historical and grammatical texts*. Philadelphia 1914.

Pl. 39–40 (hand copy) and pl. 99–100 (photo): the "inscription of three kings", an OB copy of original inscriptions of three Sargonic kings (cf. Legrain, *PBS* **15** (1926); Hirsch, *AfO* **20** (1963)). The text contains several examples of unusual and enigmatic notations for decimal (?) or sexagesimal big units; in one case (a bilingual text fragment) the same number appears in different forms in the Sumerian and the Akkadian columns (obv. V–VI: Sumerian 13 (?) e r i n = Akkadian 9(100) (?) or 9(600) g u r u š g u r u š. It is possible that the number in the Sumerian column is a badly copied 1 30 (= 90(60), i.e. 5400).

Weissbach, Franz Heinrich. Zu den Massen des Tempels Esagila und des babylonischen Turmes. *OLZ* **17** (1914), pp. 193–201.

A discussion of the metrological difficulties involved in an attempted interpretation of the Esagila text. Among other things, W. gives a brief survey of various standards for measuring the size of fields in terms of their "seed grain", for instance the formula that is known from *kudurru* inscriptions. Cf. Delitzsch, *BA* **2** (1894). A good example taken from the *kudurru* of the Kassite king Nazimaruttaš (Scheil, *MDP* **2** (1900), p. 87, pl. 16) can be found in lines 35–36: p a p 1 *me* ⟨g u r⟩ š e - n u m u n 1 (i k u)$^{\text{ašag}}$ 3(b á n) | 1 k ù š g a l^{tum} 'total: 100 gur seed-grain: 1 i k u = 3 s â t , the big cubit'. (Cf. Powell, *ZA* **72** (1982), Thureau-Dangin, *RA* **19** (1922).)

Kewitsch, Georg. Zur Entstehung des 60-Systems. *ZA* **29** (1915), pp. 265–283.

(Cf. the extensive review in Archibald, *RMP* **2** (1929).) The particular interest of this paper is due to the author's coining of several thought-provoking slogans: "Counting precedes measuring", "Counting precedes writing", "Counting precedes computing", "Counting is an ethnological, not a mathematical question", etc.

Weissbach, Franz Heinrich. Die Senkereh-Tafel. *ZDMG* **69** (1915), pp. 305–320.

A detailed analysis of the “Senkereh tablet” *BM 92698*. Not understanding the pur-pose for which a metrological table was composed [conversion from metrological to sexagesimal numbers, expressing given measures as multiples/ fractions of a basic measure unit], W. believes that the two metrological tables for length measures on this tablet express length measures as multiples of the hypothetized length units ‘ ½-finger’ and ‘ 1'/10-finger’, rather than of the correct basic units ‘cubit’ (note that 1 cubit = $\frac{1}{2} \times 60$ fingers) and nindan (1 nindan = $\frac{1}{10} \times 60^2$ fingers). Cf. Thureau-Dangin, *RA* **27** (1930).

Clay, Albert Tobias. *YOS* **1** = *Miscellaneous inscriptions in the Yale Babylonian Collection*. New Haven 1915.

No. 22–24: three quite complex Ur III field plans (cf. Hanson, *MCS* **2** (1952)); in no. 22, the areas are expressed as high multiples of 1 šar rather than being converted into standard area measures; no. 21 (a quadrilateral) and no. 25 are field plan sketches (dating difficult).

Schwenzner, Walter. *MVAG* **19**/3 = *Zum altbabylonischen Wirtschaftsleben, Studien über Wirtschaftsbetrieb, Preise, Darlehen und Agrarverhältnisse*. Leipzig 1915.

A useful survey, with a well documented discussion (see, for instance, the paragraph on “seed-grain” and area measures, pp. 54–62), and with 15 tables of concor-dances of prices for various commodities, etc., in texts from a number of publications. Cf. Snell, *Ledgers and Prices* (1982).

Scheil, Vincent. Le calcul des volumes dans un cas particulier à l’époque d’Ur. *RA* **12** (1915), pp. 161–172.

S. uses here the Drehem text Legrain, *RA* **10** (1913), no. 15 to show that bricks in the Ur III period were counted in multiples of a brick-šar of 12×60 bricks. [From this fact can be inferred the one time existence of a standard brick of dimensions $1 \times 1 \times \frac{1}{5}$ cubic cubits and weight 1 talent. Cf. H. Lewy, *OrNS* **18** (1949).] S. uses also the Ur III tablet *AO 7667* to “prove” the existence of a nindan of 24 cubits. This second text is still badly understood (cf. Neugebauer and Sachs, *MCT* (1945), pp. 95–96). [It is probably concerned with an account of the use of bricks of two different types for the building of a brick construction similar to the construction in the text *NBC 7934* (Neugebauer and Sachs, *MCT* (1945), pp. 55–56).] See also de Genouillac, *ITT* **5** (1921), no. 6908).

Allotte de la Fuÿe, François Maurice. Un cadastre de Djokha. *RA* **12** (1915), pp. 47–54.

A field plan (Ur III), of no particular interest.

Allotte de la Fuÿe, François-Maurice. Mesures agraires et formules d'arpentage. *RA* **12** (1915), pp. 117–146.

Puts right a mistaken interpretation of the text *Bu 94-10-16, 4* (Thureau-Dangin, *ZA* **11** (1896)), by showing that areas of trapezoids in the Sumerian texts from Telloh were computed by use of the correct formula involving the height of the trapezoid. A. then continues with a description of the systems of measures of length and area used in the pre-Sargonic texts from Lagaš, as in particular in the nine texts *DP 604–612* (Allotte de la Fuÿe, *DP* FS (1920)). (The basic length units in these texts are 60⟨n i n d a n⟩, 10⟨n i n d a n⟩, ½⟨e š é⟩, g i, š u . b a d, š u . d ù . a, š u - s i.) About half the paper is devoted to a study of the various methods used in the texts to compute areas of quadrilaterals, and of the different degrees of round-off used in calculations of areas of, respectively, fields, gardens, and houses. (Note that areas of houses are designed by the phrase é - b i instead of the normal a š a g - b i, which is reserved for more extensive areas.)

Scheil, Vincent. Les tables 𒁹 i g i × g a l - b i, etc. *RA* **12** (1915), pp. 195–198.

S. uses here the example of a previously unpublished table of reciprocals "not later than the time of Hammurabi" to refute Hilprecht's hypothesis about the "number of Plato", and to describe the real character of a table of reciprocals. S. observes also that in this particular text, the form of the sign for 40 is different in integers and in sexagesimal fractions, respectively, and draws the conclusion that the table is a table of fractions of the number 60. This observation is confirmed by the unique conclusion of the table, which according to S. should be read as: "i g i - g a l 𒁹 d a - k a m Fractions de 60" (cf. Steinkeller, *ZA* **69** (1979)). Cf. also Neugebauer, *MKT* **1** (1935), p. 10 note 4.

Nikol'skiĭ, Michail Vasil'evič. *DV* 5 (*Dokumenty ...* **2**: *Epoha dinastii Agade i epoha dinastii Ura 'Documents ...* **2**: *The epoch of the dynasty of Agade and the epoch of the dynasty of Ur'*) . Moscow 1915.

No. 26–36, 83: bread and beer texts; and no. 8, 64–65: excavation texts. See my commentary to Powell, *RA* **70** (1976).

Scheil, Vincent. Le texte mathématique 10201 du Musée de Philadelpie. *RA* **13** (1916), pp. 138–142.

Makes the observation that the mysterious text *CBM 10201* (Hilprecht, *BE* **20**/1 (1906), no. 25) exemplifies an algorithm for systematic computation of pairs of reciprocals. S. further explains the table on *K 2069* (the only known Assyrian mathematical text of any importance) as a table of fractional parts of 1 10 = 70. (Cf. Hilprecht's characterization of the same text as a "division table, containing a number of divisors of 195,955,200,000,000" (i.e., of 70×607!).

Förtsch, Wilhelm. *VS* **14** = *Altbabylonische Wirtschaftstexte aus der Zeit Lugal-anda's und Urukagina's*. Leipzig 1916.

No. 40: an area text in which 1 10 (n i n d a n) ½(e š é) 3 g i × 7 g i = 2 ½ (i k u) 𒃷^{ašag}, hence 𒃷 = ⅙ i k u. No. 89: in this text 1 d u g = 20 s i l à. No. 129:

here = 10×60 (n i n d a n). No. 184: š e - g u 4 - k ú. (See Maekawa, *ASum* **3** (1981)).

Weidner, Ernst F. Die Berechnung rechtwinkliger Dreiecke bei den Akkadern um 2000 v. Chr. *OLZ* **19** (1916), pp. 257–263.

Succeeds in giving a correct mathematical interpretation of part of an OB mathematical problem text (*VAT 6598*; Neugebauer, *MKT* **1** (1935), p. 277), thus opening the way for a better understanding of the special terminology used in mathematical cuneiform texts. This particular text gives examples of two different methods for the approximative solution of the problem to find the length of the diagonal of a rectangle, of which the sides are known. Cf. Neuge-bauer, *AfO* **7** (1931–1932).

Zimmern, Heinrich. Zu den altakkadisehen geometrischen Berechnungsaufgaben. *OLZ* **19** (1916), pp. 321–325.

Ungnad, Arthur. Zur babylonischen Mathematik. *OLZ* **19** (1916), pp. 363–368.

The two papers above contain critical reviews of Weidner, *OLZ* **19** (1916), mostly from a linguistic point of view, with repeated references to the big compilatory mathematical problem texts in King, *CT* **9** (1900).

Weidner, Ernst F. Zahlenspielereien in akkadischen Leberschautexten. *OLZ* **20** (1917), pp. 257–266.

Pognon, Henri. Notes lexicographiques et textes assyriens inédits. Au sujet de la mesure de capacité appelée *akalou* ( ). *JA* (11)**9** (1917), pp. 373–382.

Discusses the question whether the names of the five Babylonian units of capacity measure (including the akalu = 1/10 qa) were of Semitic origin or not.

Ungnad, Arthur. Lexikalisches: 1. *itguru* „verwickelt“. *ZA* **31** (1917), pp. 41–43. 2. *ginindanakku* “Messrohr”. *ibid.* p. 257. 3. *kīšu* “Korb”. *ibid.* pp. 264–265. (In „Sprechsaal“) Die Platonische Zahl. *ibid.* pp. 156–158.

1. Suggests the reading “I can solve complicated divisions and multiplications, hard to see through” for the boast *u-pa-ṭar* I.G I A.RA.E *it-gu-ru-ti ša la i-šú-u pi-it pa-ni* in a well known Assurbanipal text (L^4: *K 2694* + *K 3050*).
2. Suggests the reading n i n d a for the length unit GAR.
3. Discusses the mathematical text *BM 85194* problem 14 (obv. III, 23–30; Neugebauer, *MKT* **1** (1935), p. 142). 4. Cf. Hilprecht, *BE* **20**/1 (1906).

Langdon, Stephen. Syllabar in the Metropolitan Museum. *JSOR* **1** (1917), pp. 19–23.

Contains a strange list of otherwise unattested number words. See Thureau-Dangin, *RA* **25** (1928), pp. 119*ff*; Landsberger, *MSL* **4** (1956) (NBGT 4).

Scheil, Vincent. La mesure (g i š) BA-AN. *RA* **15** (1918), pp. 85–86.

Discusses the possibility that the word (g i š) b a - a n did not originally denote a measure of necessarily the capacity 10 *qa*. (Cf. the lengthy discussion in Torczyner (Tur-Sinai), *ATR* (1913), pp. 1–4.)

Thureau-Dangin, François. Note métrologique. *RA* **15** (1918), pp. 59–60.

About "big" and "small" cubits in the Esagila text (Scheil, *MAIB* **39** (1914)).

Langdon, Stephen Herbert. Mathematical observations on the Scheil-Esagila tablet. *RA* **15** (1918), pp. 110–112.

Explains, in particular, that the conversion factor 18 in the Esagila text can be derived from the well known formula 1 i k u area = 30 *qa* "seed-grain". In fact, this formula can easily be transformed into the identity 1 š a r area = 0.18 *qa* seed-grain (since $^{30}/_{100} = {}^{18}/_{60}$).

Scheil, Vincent. Sur le marché aux poissons de Larsa. *RA* **15** (1918), pp. 183–194.

Contains, in particular, a beautiful hand copy of the tablet *HE 113*, from the fish market in Larsa (early OB). The tablet gives a great deal of information about how prices were expressed in various situations. Thus, a price table on the tablet has the following headings for its four columns: ḫ a - z u n - a - a b - b a (fishes), a z a g - b i (price), k i - l a m *a-na* 1 g í n (sell-rate per shekel), m u – b i - i m (their name). Examples: line 10: 2 (g u r) 4 (b a r i g a) // $2\frac{2}{3}$ g í n 24 <š e> // 1 g u r // z i - g u r - ḫ a. Line 18: 50 // i g i - 6 - g á l $7\frac{1}{2}$ ⟨š e⟩ // 4 *šu-ši* // ḫ a – š e - ḫ a, (thus, the k i - l a could be given either in capacity measure or directly in numbers).

Keiser, Clarence Elwood. *YOS* **4** = *Selected temple documents of the Ur dynasty*. New Haven 1919.

No. 293: Recognized in Powell, *HM* **3** (1976) as the earliest known example of the use of the Sumero-Akkadian sexagesimal system in its mature, truely positional form. This particular text is an Ur III account (Ibi Sin) of silver, using the positional notation only for auxiliary computations.

1920–1930

Keiser, Clarence Elwood (J.B. Nies+[4]). *BIN* **2**. *Historical, religious and economic texts and antiquities*. New Haven 1920.

Pp. 1–12, pl. 1–3, 57–58 (*NBC 2501*): the "net cylinder" of Entemena (Sollberger, *Corpus* (1956): Ent. 29). Pp. 12–14, pl. 4, 59 (*NBC 2515*): an archaic, pre-Sargonic contract on limestone, with early examples of small weight

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[4] JH: The title page actually gives the authors as "James B. Nies, Ph.D., and Clarence E. Keiser, Ph.D.", in this order.

measures ( k ù - b a b b a r ŠA.NA, 5 k ù - b a b b a r g í n, ...). P. 51, pl. 66 (*NBC 2513*): an OB table of weight measures on a hexagonal clay cylinder (from 1 š e // 20 to 50 g ú // 50, 1(60) g ú // 1 k ú - b a b b a r). Pl. 8, 73: various weights and their inscriptions.

Meissner, Bruno, and Schwenzner, Walter. Eine Flächenmassskala auf der Esagiltafel. *OLZ* **23** (1920), pp. 112–114.

Discusses a brief paragraph towards the end of the Esagila text with an interesting series of equations (a short bilingual lexical text) for the successive units of the contemporary (Kassite-Neo-Babylonian) systems of area measures. Cf. Thureau-Dangin, *RA* **18** (1921).

Meissner, Bruno. Lexikographisches: i k ú. *AOTU* **2**/1. *Assyriologische Forschungen* **2**, pp. 52–55. Breslau 1920.

Lutz, Henry Frederick. A mathematical cuneiform tablet. *AJSL* **36** (1920), pp. 249–257.

Presents and makes an analysis of a combined multiplication table with an initial table of reciprocals (*CBS 8536*; Neugebauer, *MKT* **1** (1935), pp. 11, 52). Note that in his transcription of the numbers in the text, L. is still making use of decimal notation and common fractions, instead of a much simpler and more informative straight-forward rendering of the sexagesimal notation of the original.

Delaporte, Louis. *CCL* = *Musée du Louvre, catalogue des cylindres orientaux* **1**. *Fouilles et missions*. Paris 1920.

Pl. 39–45: in addition to several proto-Elamite tablets with inscriptions and seals, D. here publishes also the numerical tablets (tablets with seal impressions and numbers) *S. 170* (Scheil, *MDP* **10** (1908), no. 97) and *S. 318*, as well as the similar bulla *S. 455*, all from Susa. [The bulla is imprinted with the number , which clearly belongs to the proto-literate system of capacity numbers described in Friberg, DMG (1978–9)].

Schroeder, Otto. *KAV* = *Keilschrifttexte aus Assur verschiedenen Inhalts* (*WVDOG* **35**). Leipzig 1920.

No. 184 (*VAT 9840*) : a unique metrological list with capacity measures (from ... 1 (b á n) to 17 *imēru*, with 1 *imēru* = 1 (b a r i g a) 4 (b á n) = 100 *qa*), sexagesimal-decimal counting numbers (from ... 1 20 to 1 *šu-ši lim*, and then on to 7 *me lim*, i.e., to 700,000), and weight measures (from ..., 3 g í n n a_4 to 4 g í n n a_4 ..., and then again from 1 g í n to 1 m a - n a ... g i n). No. 185 (*VAT 10288*): an inventory of stone weights. (Cf. the photograph in Meyer, *Vier Jahrtausende (1956).)*

Allotte de la Fuÿe, François-Maurice. *DP* FS = *Documents présargoniques, fascicule supplémentaire* (DP 468 à 669). Paris 1920.

DP 604–612: cf. Allotte de la Fuÿe, *RA* **12** (1915). [Of particular interest is *DP 609*, which on the reverse contains what seems to be hasty notes concerning an area computation that is presented in standard format in obv. I. The fact that the computed area is given as a š a g - b i ½ (i k u) 4 š a r $^{\text{ašag}}$ on the obverse, but as 34 š a r on the reverse, suggests that the scribbled notation 34 š a r may stand for '.34 <i k u>, in the range of the š a r', where the sexagesimal fraction .34 i k u is a first rough approximation to the correct result. In fact, this approximate result may have been obtained as follows: given the sides ½ ⟨e š é⟩ 6 <g i> k ù š 3 and ½ e š é 3 ⟨g i⟩ of a rectangle, the area of the rectangle is found to be *A* = .49 30 e š é × .39 e š é ≈ .50 e š é × .40 e š é = 33 20 i k u ≈ .34 i k u. If this interpretation is correct, *DP 609* offers us maybe the oldest example of the use of "sexagesimal fractions" as an aid in computations. Cf., however, Pomponio, *MEE* **3** (1981).]

Thureau-Dangin, François. *RAcc* = *Rituels accadiens*. Paris 1921.

Thureau-Dangin, François. Numération et métrologie sumériennes. *RA* **18** (1921), pp. 123–138.

A continuation of the survey in Thureau-Dangin, *JA* (10)**13** (1909) of the Sumero-Akkadian metrological systems during various periods of the history of Mesopotamia. New here is in particular the reference to a "*sūtu* of 10 minas" (*AO 6451*, a Seleucid text; Thureau-Dangin, *RAcc* (1921)) which is used by T. in an effort to prove that the Sumerian g u r - s a g - g á l of 4×6×6 s i l a represented "the volume of water of which the weight is equal to a quadruple-talent, or nothing but a cubic cubit". (In fact, if, as T. assumes, the cubit measures .495 meters, the s i l a .842 liters, and the mina .505 kilograms, then a cubic cubit measures about 0.122 cubic meters or 122 liters, corresponding to a volume of water weighing 122 kilograms, which is precisely 4 talents or 240 minas, corresponding in its turn to 24 b á n (*sūtu*) or 1 g u r – š a g - g á l.) In a table listing Sumerian number words, T. claims that the š á r - g a l is equal to 60 š á r - g e š or 60^4, which is probably an incorrect conclusion (based on an interpretation of the ambiguous list of number words in the lexical text *BM 38 129*; Thompson, *CT* **12** (1901), pl. 24). On p. 127, T. gives (in note 2) an interesting but unconvincing suggestion concerning the interpretation of the difficult first part of the series of metrological equations (a brief lexical text) towards the end of the Esagila text (Thureau-Dangin, *TCL* **6** (1922), no. 32, rev. 9–11). [An alternative interpreta-tion is that the initial phrase of the metrological section describes the unit $^{1}/_{100}$ b ù r as follows: 18 *mu-šar* // 1 GAR // 3 *qa ù šuššānu*$^{\text{ú}}$ GAR.GAR (?). In fact, as the same text states that 1 b ù r corresponds to 1 g u r 4 PI, i.e., to 9 PI = 9×6×6 *qa* = 324 *qa*, it follows that $^{1}/_{100}$ b ù r should correspond to 3 $^{24}/_{100}$

qa ≈ $3\frac{1}{3}$ *qa*. Note the simultaneous use in this series of metrological equations of the NB (Neo-Babylonian) gur of 5×6×6 *qa* and of the Kassite formula for the seed-grain/area correspondance.) In the main text are used both the NB and the Kassite formulas. Cf. my commentary to Powell, *ZA* **72** (1982).

de Genouillac, Henri. *ITT* **5** = *Époque présargonique, époque d'Agadé, époque d'Ur*. Paris 1921.

P. 6: here are mentioned some interesting Ur III brick texts, among them *ITT* **5** no. 6677 in which 9 brick-šar correspond to 10 days' work (?), and *ITT* **5** no. 6908 in which the equation 48 šar sig$_4$ | giš-e(?) ud 1-a 1 20-ta 10-ta im-du | á-bi 7 [12] kal ud-1-še tells us that 7 12 man-days at a work norm of 1 20 bricks per man and day corresponds to the fabrication (?) of 48 šar = 48×12 00 bricks (cf. Scheil, *RA* **12** (1915); Legrain, *RA* **10** (1913) no. 15). Interesting are also the excavation texts de Genouillac, *ITT* **5** (1921), no. 6864, no. 6865.

Thureau-Dangin, François. *TCL* **6** = *Tablettes d'Uruk à l'usage des prêtres du temple d'Anu au temps des Séleucides*). Paris 1922.

Here are published the impressive "six-place" table of reciprocals *AO 6456* (*TCL* **6** no. 31; cf. Neugebauer, *QS* B **2** (1933)); the Esagila text *AO 6555*, now acquired by the Louvre (*TCL* **6** no. 32; cf. Thureau-Dangin, *RA* **19** (1922)); the important Seleucid compilatory mathematical problem text *AO 6484* (*TCL* **6** no. 33; Neugebauer, *MKT* **1** (1935), 96), and also the astronomical text *AO 6478* (*TCL* **6** no. 21; cf. Thureau-Dangin, *RA* **10** (1913)).

Thureau-Dangin, François. Les calculs de la "tablette de l'Esagil". *RA* **19** (1922), pp. 89–90.

Contains a renewed analysis of the Esagila text. Cf. Weissbach, *OLZ* **17** (1914), Langdon, *RA* **15** (1918), Thureau-Dangin, *RA* **18** (1921), and Powell, *ZA* **72** (1982).

Gadd, Cyril. Forms and colours. *RA* **19** (1922), pp. 149–158.

Presents and discusses the unique and important text *BM 15285*, a large fragment of an OB tablet bearing a number of geometric diagrams with accompanying texts (later to be joined by a second large fragment – see Saggs, *RA* **54** (1960)). Although the principle behind the arrangement of the diagrams is still not well understood, each diagram is a separate exercise concerned with the computation of areas of various smaller geometric figures into which a square of unit size has been divided by a set of straight lines or circle segments. Cf. the discussion in Vaĭman, *VDI* (1963), which is partly based on an analysis of some of the diagrams in this text.

Zimolong, P. Bertrand (Franz). *Ass.523* (= *Das sumerisch-assyrische Vokabular Ass. 523*). Leipzig (1922) (dissertation, Breslau).

According to the colophone “tablet 2 ⟨of the series⟩ ‘e - a // A / n a - a - k u m’”. Presented by Z. in clear photographs, transliteration, and an interesting commentary (see for instance the discussion on p. 41 of the error committed by the scribe in obv. II, 70, where he writes the incorrect equation b u r n i - i š //  //2 (b ù r)$^{\text{ašag}}$). The text, which is extensively quoted in Powell *SNM* (1971), contains a great deal of information about Sumerian and Akkadian notations for numbers and measures. Thus, there are sections with the initial equations a š //  // *ištin* (obv. I, 50–60; obv. II, 39–58; rev. III, 30–42), ú //  // *ú-ba-an* (obv. II, 59–rev. III, 18), and s a - a n t á k //  // *iš-tin* (rev. III, 62–rev. IV, 17).

Deimel, Anton. *Inschr.Fara = Die Inschriften von Fara*. **1** LAK (= *Liste der archaischen Keilschriftzeichen*; *WVDOG* **40**). **2** *SF* (= *Schultexte aus Fara*; *WVDOG* **43**). Leipzig 1922–1923.

LAK 815–870: a section of the sign list, with an up to date review of Sumerian and Akkadian number notations, and many references both to the Fara texts and to younger texts; *SF* no. 82 (*VAT 12593*): famous as the oldest known mathematical table, a table of square areas, from [(1 n i n d a n)^2 = 1 š a r] to (1(g e š ’ u) n i n d a n)^2 = [3 (š á r) 2 (b u r ’ u)] (cf. Neugebauer, *MKT* **1** (1935), p. 91; a photo of one side of the tablet can be found in van der Waerden, *Science awakening* **1** ((1956) 1961)). Cf. my discussion of the area text *TSŠ* no. 188 in the review of Powell, *HM* **3** (1976).

Clay, Albert Tobias. *BRM* **4**. *Epics, hymns, omens, and other texts*. New Haven 1923.

No. 31: a fragment with a syllabary and a brief metrological list. No. 36: on the obverse a multiplication table for 44 26 40, ending in a strangely corrupt way with the lines 33 55 18 31 06 40 | 45 04 26 40 TES - á m i b - s i$_8$ where 45 04 26 40 may be the result of a confusion between 45 and 44 26 40; on the reverse a multiplication table for 24 and a date formula (cf. Neugebauer, *MKT* **1** (1935), p. 54). No. 37: an early OB table of reciprocals (cf. Neugebauer, *MKT* **1** (1935), p. 10). No. 38: a dated multiplication table for 10 (cf. Neugebauer, *MKT* **1** (1935), p. 39). No. 39: a multiplication table for 16. No. 40: a dated metrological table (from ⅔ s i l à // 20 to 5 (b á n)$^{\text{gur}}$ // 50). No. 41: a metrological list of weight measures (from [1/2 š e] k ù - b a b b a r to 15 g ú, .… cf. Neugebauer, *MKT* **1** (1935), p. 92). No. 42: a table of squares (from 20 a - rá 20 // 6 40 to ⟨31 a - rá⟩ 31 // 16 01; cf. Neugebauer, MKT 1 (1935), p. 70).

Peet, T. Eric. *RMP = The Rhind Mathematical Papyrus*. London 1923.

Pp. 27–31: a comparison of Egyptian and Babylonian mathematics. It is still possible for P. to say here, with justification, that “our knowledge of Babylonian geometry is slight”.

Vetter, Guido. La moltiplicazione e la divisione babilonese. *ASS* **4** (1923), pp. 233–240 (= ČPMF (4)**51** (1922), pp. 271–278).

A systematic discussion of the collection of multiplication and “division” tables in Hilprecht, *BE* **20**/1 (1906), with in particular the crucial observation that the multiplicands in the multiplication tables have as only prime factors the numbers 2, 3, and 5.

Scheil, Vincent. *MDP* **17** = *Textes de comptabilité proto-élamite, nouvelle série*. Paris 1923.

S. publishes here a second substantial collection of proto-Elamite texts. In a com-ment to the text no. 107 (an account of various kinds of jars), he correctly identifies the sign for 60 (▽). Interesting is also his discussion of the famous “horse tablet” *MDP 17 105*, an account enumerating several small herds of equids, identified by owner’s name (?), and with young and old animals of both sexes separately indicated (?). [On the horse tablet, the decimal proto-Elamite system of numeration is used, a fact suggesting that the decimal system was used exclusively for the counting of animals (cf. Friberg, *DMG* (1978–9)). Note also the texts no. 328 (possibly a metrological exercise, but only a small piece of the tablet is preserved), and no. 434 (a “numerical tablet” with impressions of two cylinder seals and with the number 63 or, which is equally possible, $6 \times 6+3 = 39$)].

Langdon, Stephen Herbert. *OECT* **1** = *Sumerian and Semitic religious and historical texts*. Oxford 1923.

Pl. 32–35: the famous “farmer’s almanac” (for references, see Borger, *HKL* **1** (1967), p. 285; a more complete version of the text can be found in Gadd and Kramer, *UET* **6**/2 (1966); cf. also Powell, *ZA* **62** (1972), Maekawa, *ASum* **3** (1981)).

Langdon, Stephen H. *OECT* **2** = *Historical inscriptions, containing principally the chronological prism, W.-B. 444*. Oxford 1923.

Pl. 1 (*W.-B.*, (1923), no. 444): the Sumerian king list (for references, see Borger *HKL* **1** (1967), p. 201, under Jacobsen, Thorkild, *AS* **11** (1939)); interesting is here, in particular, the passage in lines 36–39: 5 u r u$^{\text{ki meš}}$ | 8 l u g a l | m u š á r - 1 - g a l 7 (š á r) | a - m a - r u b a - ú r - r a - t a ‘5 towns, 8 kings, 1(60^3) 7(60^2) years; the flood came up’, in which an unusual form of the notation for š á r - g a l is used (cf. the comment on p. 9, note 3).

Poebel, Arno. *Grundzüge der Sumerischen Grammatik*. Rostock 1923.

§287–338 and p. 324: a chapter on number words in Sumerian, with many explicit and interesting examples from the literature.

Deimel, Anton. ŠG^1 = Šumerische Grammatik der archaistischen Texte mit Übungsstücken (zum Selbstunterricht). Or **9–13** (1923).

Pp. 179–228: A detailed account of Sumero-Akkadian metrology, with many explicit references.

Deimel, Anton. Die Vermessung der Felder bei den Šumerern um 3000 v. Chr. *Or* **4** (ed.2) (1924).

Pp. 1–43: Discussion of a number of new Sumerian texts from the *VAT* collection in Berlin, in particular of some belonging to the class of so called "m u - g i d texts". D.'s claim here to have discovered the use of the area measure 1 GAR = 60 š a r in the difficult text Myhrman, *BE* **3**/1 (1910), no. 92 depends on a misinterpretation (cf. the correct interpretation in Powell, *ZA* **62** (1972)).

de Genouillac, Henri. *PRAK* = *Premières recherches archéologiques à Kich. Mission 1911–1912* (Fouilles françaises d'El-'Akhymer). **1**. Paris 1924; **2**. Paris 1925.

With a number of (fragmentary) metrological lists, multiplication tables, tables of square roots or reciprocals, a piece of a table of powers (B 199 = *Ist 0 4583*; cf. Neugebauer, *MKT* **1** (1935), pp. 77–78; Bruins, *CRRA* **17** ((1969) 1970)), and two fragments of mathematical problem texts, *AO 10642* (C 22; Neugebauer, *MKT* **1** (1935), p. 123) and *AO 10822* (D 63, concerned with brick problems; cf. Neugebauer, *MKT* **1**, (1935), p. 124; Thureau-Dangin, *TMB* (1938), p. 204; von Soden, *ZDMG* **93** (1939), p. 149). See also Neugebauer, *MKT* **1** (1935), p. 388 and Neugebauer, *MKT* **2** (1935), p. 5.

Meissner, Bruno. *BuA* = *Babylonien und Assyrien* **2**. Heidelberg 1925.

Pp. 380–395: a chapter on the exact sciences in Mesopotamia.

Thureau-Dangin, François. La grande coudée assyrienne. *RA* **22** (1925), p. 30.

In this brief note, T. suggests that the Assyrian "big cubit" was equal to the normal Babylonian cubit (0.495 meters), and that the normal Assyrian cubit was $\frac{4}{5}$ of the Assyrian big cubit, while the Babylonian big cubit on the other hand is known to be equal to $1\frac{1}{2}$ normal Babylonian cubits.

Speleers, Louis. *RIAA* = *Recueil des inscriptions de l'Asie Antérieure*. Bruxelles 1925.

No. 125: a field plan. No. 268–274 (*O 160–166*): a number of multiplication tables (see Neugebauer, *MKT* **2** (1935), p. 6).

Thureau-Dangin, François. Le š e, mesure linéaire. *RA* **23** (1926), pp. 33–34.

Presents a small Assyrian lexical text (cf. Landsberger, *WZKM* **56** (1960), pp. 109*ff*) with a series of equations for the successive units of the Sumero-Akkadian system of length measures, starting with 6 š e // š u - s i (this relation was not known before this text was published). Interesting are also 10 š u - s i // *ši-zu-u*, 15 š u - s i // $\frac{1}{2}$ $^{ú\text{-}...}$ k ù š, and 3 k ù š // n i g - g a s. Cf. the similar text Hunger, *STU* **1** (1973), no. 102.

Scheil, Vincent. *Qatâ* dans les fractions. *RA* **23** (1926), pp. 45–47.

Discusses the idiomatic expressions 2-*ta* š $u^{meš}$ '2 hands' for $\frac{2}{3}$, 3 š u^{me} '3 hands' for 3/4, in the NB text *H.S.146*. Cf. Rundgren, *JCS* **9** (1955).

Legrain, Léon. *PBS* **15** = *Royal inscriptions and fragments from Nippur and Babylon*. Philadelphia 1926.

No. 41: a new large fragment of "the inscriptions of the kings of Agade, as compiled by a scribe of Nippur on a large 28 column clay tablet *CBS 13972*. About B.C. 2500". The first recovered fragment was published by Poebel, *PBS* **5** (1914)). As in Poebel's fragment, the text of the new fragment contains several big numbers written by use of a series of unfamiliar notations for number units, possibly decimal (?):  (1),  (10),  (60),  (100 or 600),  (1000 or ...), and  (3600?). Example (in col.17): š u - n i g í n š á r 3() 16 g u r u š - g u r u š.

Thureau-Dangin, François. Tablettes à signes picturaux. *RA* **24** (1927), pp. 23–29.

T. presents here an archaic onyx tablet (*AO 8844*) with unmistakable area number notation, and 12 clay tablets from Jemdet Nasr (*AO 6850–3861*) with what T. erroneously holds to be evidence for the use of a decimal, hence non-Sumerian, number system. (Cf. Friberg, DMG (1978–9)).

Dossin, Georges. *MDP* **18** = *Autres textes sumériens et accadiens*. Paris 1927.

No. 9, 11, 15, 16: "school texts": a metrological exercise, two fragments of metrological lists, and a fragment of a combined multiplication table.

Woolley, C. Leonard. The excavations at Ur, 1926–7. *AJ* **7** (1927).

Pl. 47 (*U 7803*): a "geometrical tablet illustrating method of calculating area"; cf., however, the similarity of the drawing on this tablet with the schematic drawings of ziqqurrats discussed in Wiseman, *AnSt* **22** (1972).

Neugebauer, Otto. Zur Entstehung des Sexagesimalsystems (*AGWG* Math.-Phys. Kl. N. F. **13**/1). Berlin 1927.

The most interesting of several publications over some decades (cf. in particular Kewitsch, *ZA* **29** (1915)), all containing more or less wild conjectures about the origin of the Babylonian sexagesimal system. However, since N. does not question the general opinion at this time that decimal (or centesimal) number systems were used in the recently excavated archaic tablets from Kish and in the proto-Elamite tablets from Susa (cf. Thureau-Dangin, *RA* **24** (1927)), the discussion in the book is based exclusively on the several centuries younger Fara texts, or even later: Sumerian and Babylonian or Assyrian texts. Consequently, N. is led to develop a highly hypothetical theory (which must now be abandoned) about the evolution of the sexagesimal system. Anyway, his main thesis is still valid, namely that the history of the sexagesimal system is intimately associated with the history of the Sumero-Akkadian metrological systems.

Hoppe, Edmund. Die Entstehung des Sexagesimalsystems und die Kreisteilung. *Archeion* **8** (1927), pp. 449–458.

H. criticizes the theory developed in Neugebauer *AGWG* (1927) and suggests an origin for the sexagesimal system in angular and time measures based on the number 1/6. (Cf. Neugebauer's answer in *Archeion* **9** (1928), pp. 209–216).

Thureau-Dangin, François. L'origine du système sexagésimal. *RA* **25** (1928), pp. 115–121; L'origine du système sexagésimal. Un postscriptum. *RA* **26** (1929), p. 43.

T. criticizes Neugebauer's suggestion that the sexagesimal system was developed from an original "natural core" ½, ⅓, ⅔, 1, 10, and proposes instead the simpler core ⅙, 1, 10 or 1, 10, 60.

Thureau-Dangin, François. Le système ternaire dans le numération sumérienne. *RA* **25** (1928), pp. 119–121.

T. calls attention here to a section of a Sumerian-Akkadian lexical text (Langdon, *JSOR* **1** (1917)), which seems to indicate the existence of a primitive Sumerian (?) ternary number system with the number words m e r g a, t a k a, p e š, p e š - b a l a, p e š - b a l a - g i $_4$, ... Cf. Landsberger, *MSL* **4** (1956), pp. 163*ff* and 191; Powell, *SNM* (1971), pp. 28–32.

Thureau-Dangin, François. La division du cercle. *RA* **25** (1928), pp. 187–188.

Allotte de la Fuÿe, François-Maurice. La sens du mot k a r dans les comptes rendus de Larsa. *RA* **25** (1928), pp. 23–30.

A discussion of the meaning of phrases such as "*n* (units of merchandise) k a r - b i *m* g í n - t a (or m a - n a - t a, *qa* - t a) k ù - b i *w*) (silver units)", where $w = m{\times}n$ or $w = m/n$, depending on the text. Clearly the k a r in the texts considered (C.-F. Jean, *RA* **24** (1927), pp. 51*ff*) stands for the rate of exchange silver-merchandise per unit of silver (or merchandise). In one quoted example the corresponding computation is quite laborious: 2 g u r of sesame at a k a r of 110 qa = 5 ⅓ m a - n a 1 ¼ gín 5 š e.

David, Antal. La mesure de capacité « *matu* » sur les tablettes de Kirkuk; La mesure de superficie « *epinnu* ». *RA* **25** (1928), pp. 99–100.

Blome, Friedrich, d u / GAB in Angaben über die Grösse der Brote. *Or* **34–35** (1928), pp. 129–135.

A review of the use of expressions of the type *m* n i n d a b a - a n - NE *n* - d u $_8$ to measure the size of loaves of bread in Sargonic and pre-Sargonic texts. (Cf. the Jemdet Nasr bread and beer text *IM 23431*, discussed in Friberg, *DMG* (1979), and Nikol'skiĭ, *DV* **5**/2 (1915) no. 31, referred to in my review of Powell, *RA* **70** (1976)).

Mercer, Samuel Alfred Browne. Two Babylonian multiplication tables. *AA* **26** (1928), pp. 145–146.

Presents multiplication tables for 12 30 (*ROMA 711*) and 7 (*ROMA 767*) and a photo of an unrelated mathematical (?) text. Cf. Neugebauer, *MKT* **1** (1935), p. 237.

Neugebauer, Otto. Zur Geschichte des Pythagoräischen Lehrsatzes. *NGWG* 1928, pp. 45–48.

Shows, in a commentary to the text VAT 6598 rev. I–II (cf. Weidner, OLZ 19 (1916)) that the OB mathematicians might have been familiar with the "Pythagorean" theorem.

Frank, Carl. *StrKT* = *Strassburger Keilschrifttexte*. Berlin/Leipzig 1928.

Pp. 19–23, pl. 4–9: hand copies and a preliminary transliteration and translation of six very important OB mathematical problem texts, no. 6–11 = *Str 362–364*, *Str 366–368*. Cf. Neugebauer, *MKT* **1** (1935), pp. 238–263.

Langdon, Stephen Herbert. *OECT* **7** = *Pictographic inscriptions from Jemdet Nasr*. Oxford 1928.

A collection of almost 200 hand copies (often of inferior quality) of texts or fragments from Jemdet Nasr, important because of the light they throw on the origin of the cuneiform script and its various numerational and metrological number systems (see the sign list, no. 438–463). Cf. Borger *HKL* **1** (1967), p. 287 for references.

Belaiew, N.T. Au sujet de la valeur probable de la mine sumérienne. *RA* **26** (1929), pp. 115–127.

Neugebauer, Otto. Zur Geschichte der babylonischen Mathematik. *QS* B **1** (1929), pp. 67–80.

N. gives here improved translations of the texts *Str 367* and *Str 364* (in particular with respect to the rendering of the Babylonian sexagesimal number notation) (cf. Frank, *StrKT* (1928)). The problems in these texts, concerned with the partitioning of, respectively, a trapezoid and a triangle into parallel strips, are shown to lead to systems of linear and, in some cases, quadratic equations (with no indication of the solution method). The mathematical meaning of the terms a š à (area), í d (strip), and RI (transversal line) are derived from the context.

Neugebauer, Otto, and Struve, Vasilij Vasil'evič. Über die Geometrie des Kreises in Babylonien. *QS* B **1** (1929), pp. 81–92.

Discusses the technical terms RI, *tu-ur-dam*, and GAM = *kippatum* (arc, circle, circumference). Goes on to show that in *BM 85194* obv. I, 37 to obv. II, 18 (dealing with a ring-formed construction) the approximations 3 and 5 (= 1/12) are used for the constants π and $^1/_{4\pi}$. In addition, *BM 85194* obv. II, 23–37 is shown to give an incorrect formula for the volume of a truncated cone, while rev. I, 33–43 proves that the "theorem of Thales" and the Pythagorean theorem were employed in OB mathematics in problems about circle segments and chords.

Gandz, Solomon. The origin of angle-geometry. *Isis* **12** (1929), pp. 452–481.

Refutes all claims that the Greek angle-geometry and concept of parallel lines had Egyptian or Babylonian origins.

Archibald, Raymond Clare. Bibliography of Egyptian and Babylonian mathematics. In A.B. Chase, L. Bull, and H.P. Manning *RMP = The Rhind Mathematical Papyrus* **2**. Oberlin, Ohio 1929.

Contains an extensively annotated review of publications on (Egyptian and) Babylonian mathematics between the years 1854 and 1930.

Scheil, Vincent. Tablettes pictographiques. *RA* **26** (1929), pp. 15–17.

No. 2: a copy of a Jemdet Nasr text with an area number on one side and a capacity number on the other, hence probably a seed-grain text. [Gives a clue to the absolute size of the proto-Sumerian capacity units. For details, see my review of Maekawa, *ASum* **3** (1981).]

1930–1940

Thureau-Dangin, François. La table de Senkereh. *RA* **27** (1930), pp. 115–119.

T. gives here an essentially correct interpretation of the "Senkereh tablet" *BM 92698*, which he says has been "since the beginnings of Assyriology, a *crux interpretum*". While refuting the mistaken explanation in Weissbach, *ZDMG* **69** (1915) of the purpose of the metrological tables on this tablet, T. does not himself venture to propose an alternative explanation. [Cf. my commentary to Pinches, *4 R2* (1891).)

Luckenbill, Daniel David. *Inscriptions from Adab* (*OIP* **14**). Chicago 1930.

No. 70 (*A 681*): a pre-Sargonic baked tablet with a table of (small) square areas, expressed in the cumbersome notation of the time for fractions of the š a r (see Edzard, *Tell ed-Dēr* (1969)). No. 116: a Sargonic (?) tablet with an early and interesting example of area computation [indeed, the surprisingly nice end result of the computation suggests that the sides of the trapezoidal field considered in this text may have been obtained after some preliminary calculation; note that the area of the field is 1 b u r ' u = 5 00 00 š a r, the long side (the height) is 5 15 (i.e., 7×45) n i n d a n, and the longer of the parallel sides is 1 10 (i.e. 7×10) *nindan*; thus, the shorter of the parallel sides can be computed as the solution of the equation $\frac{1}{2} \times (x + 1\ 10) \times 5\ 15 = 5\ 00\ 00$, or $9x + 10\ 30 = 2\ 00\ 00/7 \approx 2 \times 8\ 35 = 17\ 10$, from which follows that $x \approx 6\ 40/9 = 44.26\ 40 \approx 44\frac{1}{2}$, which is precisely the length of this side given in the text); cf. the close parallel in the text Hackman, *BIN* **8** (1958) no. 24). Other texts with interesting computations are the wool text no. 155 ($1\frac{1}{4}$ mina wool per sheep; cf. Waetzoldt, *Textilindustrie*

(1972)); the area text no. 163 (6 g u r of barley per b ù r of area); the fragment no. 168 (12 š e silver per b á n of barley); etc.

Allotte de la Fuÿe, François-Maurice. Mesures et calcul des superficies dans les textes pictographiques de Djemdet-Nasr. *RA* **27** (1930), pp. 65–71.
Correctly interpreting the two proto-Sumerian texts Langdon, *OECT* **7** (1928), no. 99–100, A. shows that, except for the use of curviform number signs of an archaic type, the proto-Sumerian system of area measure notations is essentially identical with the corresponding Sumerian system, and that in the system for length measures multiples of the unnamed length unit are counted in tens and sixties, i.e., as numbers in the sexagesimal system. It is noteworthy that in these texts the total area is divided into thirds (with a remainder of fractional area units), of which two thirds are kept for the EN, while the remaining third is further divided among several functionaries. This indicates that the texts may be contracts about leases of land by thirds.

Jordan, Julius. *UVB* **2** (*APAW* 1930/4). Berlin 1931.
Fig. 36–39; photographs of proto-Sumerian account tablets from Uruk (Uruk IV), clearly demonstrating that a sexagesimal numerational system was used in this period (as confirmed by a communication from O. Neugebauer).

Wieleitner, Heinrich. Zur Geschichte der Entdeckung des babylonischen Sexagesimalsystems. *Festgabe G. Sticker* (Historische Studien und Skizzen zu Natur- und Heilwissenschaft). Berlin 1930, pp. 11–17.

Neugebauer, Otto. Sexagesimalsystem und babylonische Bruchrechnung. I: *QS* B **1** (1930), pp. 183–193; II: *QS* B **1** (1931), pp. 452–457; III: *QS* B **1** (1931), pp. 458–463; IV: *QS* B **2** (1933), pp. 199–210.
I,II: Here it is made clear, with departure from the example of the combined multiplication table in Lutz (1920), how Babylonian tables of reciprocals and (combined) multiplication tables were constructed. Thus, it is shown that, with very few exceptions, the "head numbers" of multiplication tables are identical with the reciprocals of suitably restricted "regular" sexagesimal numbers, and that the numbers appearing in the first column of the reciprocal tables by necessity are just such regular numbers. III: Considers more unusual types of tables of reciprocals. IV: Contains a detailed (although not quite convincing) explanation of how the enormous table of reciprocals *AO 6456* (Thureau-Dangin, *TCL* **6** (1922)) may have been constructed. (Cf. Friberg, *HM* **8** (1981), p. 465.)

Thureau-Dangin, François. La graphie du système sexagésimal. *RA* **27** (1930), pp. 73–78.
Contains a copy of columns I, II of the cylinder *AO 8865* (Samsuiluna, year 1) with a metrological table of length measures (from 1 š u - s i // 10 to 20 k a š k a l - g í d // 20; basic unit 1 n i n d a n). See Neugebauer, *MKT* **1** (1935), p. 88.

<u>Neugebauer</u>, Otto. Über die Approximation irrationaler Quadratwurzeln in der babylonischen Mathematik. *AfO* **7** (1931–1932), pp. 90–99.

Gives a renewed discussion of the approximate formulas for $(h^2+w^2)^{1/2}$ in *VAT 6598* rev.I,II (Weidner, *OLZ* **19** (1916), Neugebauer, *NGWG* 1928); cf. also the remark in Neugebauer, *MKT* **1** (1935), p. 287). Makes further the important observation that in mathematical texts sexagesimal numbers for length measures may stand for multiples or fractions of the n i n d a n, even if other length units are mentioned in the data. In particular, a phrase like 40 k ù š s u k u d may have to be read as "0.40 n i n d a n, the height [in the range of the cubits]".

<u>Unger</u>, Eckhard. Altorientalische Zahlensymbolik. *FF* **7** (1931), p. 263.

<u>Schuster</u>, Hans-Siegfried. Quadratische Gleichungen der Seleukidenzeit aus Uruk. *QS* B **1** (1931), pp. 194–200.

S. uses here the example of the four problems in *AO 6484*, rev.10–27 (Thureau-Dangin, *TCL* **6** (1922), Neugebauer, *MKT* **1** (1935), pp. 96*ff*), all of them equations of the purely algebraic type *igû u igi-bu-ú m* ($x+1/x = m$), to show that Babylonian mathematicians of the Seleucid period were familiar with general quadratic equations and possessed algorithms for their correct solution. For examples of correctly solved quadratic equations in Old Babylonian texts, he refers to Frank, *StrKT* (1928) and King, *CT* **9** (1900). S. further notices the continuity of the Babylonian mathematical tradition, at the same time as he points out differences in terminology between Old Babylonian and Seleucid mathematical texts.

<u>Schneider</u>, Nikolaus. Die Drehern und Djoha-Urkunden. *AnOr* **1** (1931).

No. 303: in this text appears in several places the unique notation š á r × b u r ' u for the area unit 10×60 b u r. The same notation is used for the number 10×60 in the fish text *AO 4303* (Cros and Thureau-Dangin *NFT* (1910)), and in the inscription on Gudea statue B col.III, 10 (de Sarzec, *DC* (1884)).

<u>Thureau-Dangin</u>, François. 1. Notes sur la terminologie des textes mathématiques. *RA* **28** (1931), pp. 195–198; 2. Le prisme mathématique *AO 8862*. *RA* **29** (1932), pp. 1–10 + pl. 1–4; 3. Un post-scriptum. *RA* **29** (1932), pp. 89–90.

1. Explains the technical terms *en-nam* (what), *kamâru* (add), and *šutakalla* (multiply) by reference to examples in the combined problem text *AO 8862* (a four-sided prism from Senkereh).
2. Gives photos and a full translation of *AO 8862*. The text (early Old Babylonian) contains a) problems stated in terms of quadratic equations, b) problems concerned with payments to groups of workers for carrying bricks. T. observes that the quadratic equations are formulated so that they regularly lead to a unique solution.

3. An improved interpretation of the brick-carrying problems, due to a remark by Neugebauer.

Thureau-Dangin, François. Le système decimal chez les anciens Sumériens. *RA* **29** (1932), pp. 22–23.

Puts forward the (correct) idea that the allegedly decimal system of numeration used in some of the texts from Uruk IV, Jemdet Nasr, and archaic Ur, may be a special system of notations for capacity measures.

Allotte de la Fuÿe, François-Maurice. La table mathématique *AO 6456*. *RA* **29** (1932), pp. 11–19.

Cf. Neugebauer, *QS* B **2** (1933).

Thureau-Dangin, François. 1. *Iku* "levée de terre"; 2. *Utlellû* "s'élever"; 3. Le calcul de la surface d'un segment de cercle. *RA* **29** (1932), pp. 24–28; 4. Mathématique babylonienne. *RA* **29** (1932), pp. 60–66; 5. Encore un mot sur la mesure du segment de cercle; 6. BAL = "raison (arithmétique ou géométrique)"; 7. *Warâdu* "abaisser une perpendiculaire"; *elû* "élever une perpendiculaire"; 8. La mesure du volume d'un tronc de pyramide. *RA* **29** (1932), pp. 77–88; 9. Le théorème de Pythagore. *RA* **29** (1932), pp. 131–132.

In this series of brief notes, T. gives translations, interpretations, and discussions of technical terms in a number of mathematical problems in the compilatory problem texts *BM 85194*, *BM 85210* (*CT* **9** (1900)), as well as in some of the *StrKT* texts (Frank (1928)).

Thureau-Dangin, François. Esquisse d'une histoire du système sexagésimal. Paris 1932.

See the English translation, Thureau-Dangin, *Osiris* **7** (1939).

Waschow, Heinz. Angewandte Mathematik im alten Babylonien (um 2000 v. Chr.). Studien zu den Texten CT IX, 8–15. *AfO* **8** (1932–1933), pp. 127–131, 215–220.

A discussion, similar to the one in Thureau-Dangin, *RA* **29** (1932), of various questions related to the texts *BM 85194*, *BM 85210* in King, *CT* **9** (1900). In particular, W. observes that vertical dimensions in these thexts are measured in cubits, hence volumes in volume-š a r, with 1 š a r equal to 1 n i n d a n^2 × 1 cubit (cf. Allotte de la Fuÿe, *RA* **6** (1907)). This observation leads him also to a correct evaluation of phrases like *i-na* 1 k ù š 1 k ù š š à - g a l (inclination 1 cubit per cubit, i.e. 1:1). In addition, W. points out that the special notation for area numbers is employed in the previously badly understood problem 7 of *Str 364* (see Neugebauer, *MKT* **1** (1935), 249).

Vogel, Kurt. Eine Pyramidenstumpf-Aufgabe bei den Babyloniern. *AfO* **8** (1932–1933), pp. 220–221.

Suggests, in a commentary to *BM 85194* rev.II,41–49, that OB mathematicians may have known the formula $V = h\times[(\frac{1}{2}(a+b))^2+(\frac{1}{2}(a-b))^2]$ for the volume of a truncated cone. Cf. Neugebauer, *MKT* **1** (1935), p. 187.

Neugebauer, Otto. Zur Transkription mathematischer und astronomischer Keilschrifttexte. *AfO* **8** (1932–1933), pp. 221–223.

N. presents here two well motivated suggestions for a standardized rendering of numbers and ideograms in Babylonian mathematical and astronomical texts: a) sexagesimal numbers in mathematical texts should be reproduced as, for instance, 1,.,40 in transliterations, but as, say, 1,.;40 in translations (for the number with the value $1\times60 + 0\times1 + 40\times60^{-1}$), while numbers in astronomical texts should be reproduced as, for instance, $29^d + 3;11,0,50^H$ or $0;17^\circ$ [cf. Friberg, *HM* **8** (1981), where I have suggested the use of a simplified version of Neugebauer's convention, namely to write 1 00 40 rather than 1,.,40 and 1 00.40 rather than 1,.;40]; b) ideograms and whole phrases in Sumerian should not be replaced by their Akkadian equivalents, in particular because ideograms may be supposed to have played the same role in Babylonian mathematical texts as symbols in modern mathematical texts!

Thureau-Dangin, François. Carré et demi-cercle. *RA* **29** (1932), pp. 136–139.

Treats the difficult and today still badly understood problem *BM 85210* rev. I, 0–22 (see Neugebauer, MKT 1 (1935), p. 229).

Thureau-Dangin, François. La clepsydre chez les Babyloniens. *RA* **29** (1932), pp. 133–135; Clepsydre babylonienne et clepsydre égyptienne. *RA* **30** (1933), pp. 51–52.

An interesting discussion of four texts concerned with what is probably waterclocks ($^{\text{giš}}$d i b - d i b) of various dimensions (*BM 85194* obv. II, 27–33, 34–40, 41–48, and *BM 85210* rev. II, 10–16). (T. gives an improved interpretation in *TMB* (1938), pp. 25–27, 52–53. Cf. Salonen, *Hausgeräte* (1965), p. 292.)

Thureau-Dangin, François. La mesure du "qa". *RA* **29** (1932), pp. 189–192.

A first, unsuccessful attempt to derive the size of the *qa* measure from the data in the capacity problems *BM 85194* rev. I, 44–46, rev. II, 1–6. Cf. the improved interpretation in Thureau-Dangin, *TMB* (1938), pp. 32–34, and Vaĭman, *DV* **2** (1976).

Jordan, Julius. *UVB* **3** = *Ausgrabungen in Uruk 1930/31*. (1932). Pl. 19: photos of a "numerical tablet" in gypsum (no. 10133).

Nöldeke, A. *UVB* **4** (1932), (1932/33); *UVB* **5** (1934) = *Ausgrabungen in Uruk 1931/32*.

UVB 4 pl. 14, 5 pl. 14: photos of three more numerical tablets.

Fish, Thomas. *CST* = *Catalogue of Sumerian tablets in the John Rylands Library*. Manchester 1932.

No. 4–6, 14: see my commentary to Powell, RA 70 (1976).

Waschow, Heinz. Verbesserungen zu den babylonischen Dreiecksaufgaben *QS* B **2** (1932), pp. 211–214.

This paper suggests an improved reading of Str 364 problem 3, a geometric problem leading to a system of ten linear equations in ten unknowns. (See Neugebauer, MKT 1 (1935), pp. 248ff.)

Neugebauer, Otto. Studien zur Geschichte der antiken Algebra 1. *QS* B **2** (1932), pp. 1–27, 253–254.

A methodological study, illustrating a "synoptic" method, on the example of the quadratic equation problems in AO 8862 (Thureau-Dangin, *RA* **29** (1932), pp. 1–10), and a "comparative" method, in a comparison of *AO 8862* with texts of, respectively, the "StrKT-type" and the "CT 9-type". N. quotes in his introduction an observation by S. Gandz that the origin of the title of al-Ḫwārizmī's famous book *Ḥisāb alǧabr walmuḳabalah* is to seek in a noun related to the (Assyrian) verb *gabrū* = *maḫâru* 'correspond, be equal to' and its Arabic counterpart muḳābalah 'equation'. Cf. Gandz, *Isis* **26** (1936). [Note the frequent use of the (Sumerian) word g a b a - r i to denote copies of clay tablets, etc. Cf. for instance, the colophone of the Esagila tablet, or the inscription *a-na* g a b a - r i k i - l á dŠ u l - g i 'in imitation of a weight of Sulgi' on *BM 91005* (Powell, *SNM* (1971), p. 254).]

Neugebauer, Otto, and Waschow, Heinz. Bemerkungen über Quadratwurzeln und Quadratwurzel-Approximationen in der babylonischen Mathematik. *QS* B **2** (1933), pp. 291–297.

N. and W. consider here three geometric problems in the text *AO 6484* obv.12–20 (Thureau-Dangin, *TCL* **6** (1922)), concerned with (a) an isosceles triangle with rational sides (5, 5, 6) and height (4); (b) a rectangle with rational sides (8, 15) and diagonal (17); and (c) approximations to 2 (1.25) and 1/2 (.42 30). The assertion that the indeterminate equation $a^2 = b^2 + 22\ 30$ in *BM 85194* obv. II, 8–12 can be reduced to the equation $a_2 = \sqrt{2\ 30}1$ is probably not correct.[5]

Waschow, Heinz (+ Neugebauer, Otto). Reihen in der babylonischen Mathematik. *QS* B **2** (1933), pp. 298–304.

Deals with: (1) arithmetic and geometric progressions in Babylonian mathematics (the siege ramp problem *Str 362* rev. 15–21, and the broken cane problem *Str 362* rev. 11–14; cf., however, the remark in Neugebauer, *MKT* **3** (1937), p. 56). (2) the meaning of the phrase *ki ma-ṣi*. (3) a geometric progression in the Seleucid text *AO 6484* obv. 3–5; (4) a sum of squares (*ibid*. obv. 3–5; (5) a table for $n^2 + n^3$ (*VAT 8492* rev. II; see Neugebauer, *MKT* **1** (1935), pp. 76*f*, and Neugebauer, NGWG (1933)).

Thureau-Dangin, François. La ville ennemie de Marduk. *RA* **29** (1932), pp. 109–119, 139–142.

Neugebauer, Otto. Babylonische "Belagerungsrechnung". *QS* B **2** (1933), pp. 305–310.

Thureau-Dangin, François. Poliorcétique babylonienne. *RA* **30** (1933), p. 126; Le nom du "cercle" en babylonien. *RA* **30** (1933), pp. 187–188.
Waschow, Heinz. Wehrwissenschaft und Mathematik im alten Babylonien (um 2000 v. Chr.). *UntM* **39** (1933), pp. 368–373.

In the five papers enumerated above are treated problem texts dealing with constructions for military purposes: siege ramps (*arammu*) in *BM 85194* obv. I, 1–12 and *Str 362* rev. 15–21; similar constructions in texts beginning with phrases like *uru-ki na-ki-ir* ᵈ*Marduk* 'a town, enemy of Marduk' (*BM 85194* rev. II, 7–21, 22–33, and *BM 85210* obv. I, 1–7, 8–12,13–16, 17–21; obv. II, 1–14, 15–27); the circular fortification in the difficult text *BM 85194* obv. I, 37–obv. II, 18. Cf. Powell, *JCS* **34** (1982), Thureau-Dangin, *RA* **30** (1933), p. 187f.

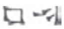
Vogel, Kurt. Zur Berechnung der quadratischen Gleichungen bei den Babyloniern. *UntM* **39** (1933), pp. 75–81.

V. makes the important observation that the four quadratic equation problems in *AO 8862*, for instance, can all be reduced to systems of equations of the normal form $x+y = a$, $xy = b$, and that such systems can be solved, without any detour over general quadratic equations, by use of, say, the identity $(\frac{1}{2}(x+y))^2 - xy = (\frac{1}{2}(x-y))^2$. Parallels are then drawn with Euclid's *Elements* II.5, and with a passage in Diophant's *Arithmetica* II (*Opera* I.27, ed. Tannery pp. 61*ff*).

Neugebauer, Otto. Zur Terminologie der mathematischen Keilschrifttexte. *AfO* **9** (1933–1934), pp. 199–204.

(1) [*kabiru* "Quadrat"]. (2) RI = *pirkum* "Trennungslinie". (3) *mutaridum* "Höhe". (4) *Igum* und *Igibum* "Zähler" und "Nenner". (5) si = *šanānu*.

Schott, Albert. Zur Terminologie der mathematischen Keilschrifttexte. 1: *ki ma-ṣi*. QS B **2** (1933), pp. 364–368.

Thureau-Dangin, François. 1. La lecture de  dans les textes mathématiques; 2. Le zéro dans la système babylonien. *RA* **30** (1933), p. 144; 3. *Igû* et *igibû*. *RA* **30** (1933), p. 183.

Allotte de la Fuÿe, François-Maurice. La table mathématique AO 6456. *RA* **29** (1932), pp. 11–19. Cf. Neugebauer, *QS* B **2** (1933), pp. 199–210.

Neugebauer, Otto. Das Pyramidenstumpf-Volumen in der vorgriechischen Mathematik. *QS* B **2** (1933), pp. 347–351.
A discussion of various interpretations of *BM 85194* rev. II, 41–49.

Neugebauer, Otto, Über die Lösung kubischer Gleichungen in Babylonien. *NGWG* **I**:43 (1933), pp. 316–321.

Discussing a series of cubic equations in BM 85200, N. claims that Babylonian mathematicians solved such equations by reducing them to certain “normal forms”, which could then be solved by use of tables such as the n^3+n^2-table *VAT 8492* (Neugebauer, *MKT* **1** (1935), p. 76). [A less pretentious explanation regarding the n^3+n^2-table is that it was used as an auxiliary table for the computation of the sum of the geometric series $1^2+...+n^2$ in the form $(n^3+n^2+{}^1/_2\,n(n+1)/3$. Cf. the similar formula for $1^2+...+n^2$ in AO 6484 obv. 3–5 (Neugebauer, *MKT* 1 (1935), p. 103).) Cf. also Vogel, SBAW (1934).

Matouš, Lubor. *LTBA* **1** (*Lexikalische Tafelserien: Serie ḪAR-ra = ḫubullu*). Berlin 1933.
No. 63, lines 30–31: 1 a-rá 1 1 5 a-rá 5 25 8 a-rá 8 14 (twice). Cf. Landsberger, *MSL* 5 (1957), pp. 83ff, 143ff.

Thureau-Dangin, François. Note sur la “tablette de l’Esagil”. *RA* **30** (1933), p. 116.

Thureau-Dangin, François. La tablette de Strasbourg nº 11. *RA* **30** (1933), pp. 184–187; *RA* **31** (1934), pp, 30, 70.
A discussion of the “broken cane” problem on Str 368 (which leads to a quadratic

Vogel, Kurt. Kubische Gleichungen bei den Babyloniern? *SBAW* (1934), pp. 87–94.
V. uses a geometric approach in an effort to elucidate the method of solution of a “general” cubic equation, used in the two problems *BM 85200* obv. I, 9–14, 15–20 (Neugebauer, *MKT* 1 (1935), pp. 210–211).

Dossin, Georges. *TCL* **18** = *Lettres de la première dynastie babylonienne*). Paris 1934.
No. 154: a hand copy of the small compilatory mathematical text *AO 6770*. Cf. Thureau-Dangin, *RA* **33** (1936), Neugebauer, *MKT* **2** (1935), pp. 37*ff*, **3** (1937), p. 62.

Gordon, Cyrus Herzl. Numerals in the Nuzi tablets. *RA* **31** (1934), pp. 53–60.
A review of phonetic writing of numerals (1–5, 9, 60, 100, 1000) in the Nuzi texts.

Scheil, Vincent. Meru = 100. *RA* **31** (1934), pp. 49–52.

Thureau-Dangin, François. 1. Nombres ordinaux et fractions en accadien ; 2. Carré et racine carrée. RA 31 (1934), pp. 49–52.

Thureau-Dangin, François. Une nouvelle tablette mathématique de Warka. *RA* **31** (1934), pp. 61–69.
Contains a hand copy and a discussion of the small mathematical problem text *AO 17264*, with a partly novel terminology, and with a problem of “six brothers”.

This text gives, although in a badly corrupted form, the first known example of an "iterated trapezoid partition problem", of greatest importance for the history of number theory. [In fact, the trapezoid partition problem can be used to generate a complete set of rational solutions to the indeterminate equation $x^2 - y^2 = y^2 - z^2$ (closely related to the familiar Pythagorean equation $a^2+b^2 = c^2$; cf. Friberg, *DMG* (1980–3))]. The problem solution in the text is plainly seen to be using similarity of triangles in an essential way. Cf. Neugebauer, *MKT* **1** (1935), pp. 126–134, Gandz, *Osiris* ((1938)1948), and Caveing, *HM* **12** (1985).

Neugebauer, Otto. Über die Rolle der Tabellentexte in der Babylonischen Mathematik. KDVSM 12/13 (1934), pp. 3–14.

Neugebauer, Otto. *Vorgriechische Mathematik* (Vorlesungen über Geschichte der antiken mathematischen Wissenschaften I). Berlin 1934.

A rapid survey, without references, of (Egyptian and) Babylonian mathematics: (1) Babylonian techniques of computation. (2) General history, language, and writing. (3) Number systems. (4)–(5), Egyptian and Babylonian mathematics. (The new texts soon to be published by N. in Neugebauer, *MKT* **1–2** (1935), are not taken into consideration in this book.)

Neugebauer, Otto. Serientexte in der babylonischen Mathematik. *QS* B **3** (1934–1936), pp. 106–114.

N. announces here the existense of extensive Babylonian "series texts", i.e., groups of numbered clay tablets, each with a large number of systematically arranged, stereotyped problems (or equations). The text category is exemplified by the text *YBC 4708* (Neugebauer, *MKT* **1** (1935), pp. 389*ff*; Neugebauer and Sachs, *MCT* (1945), p. 94), with its 60 linear or quadratic equations for brick constructions (rectangular prisms or truncated pyramids).

Vogel, Kurt. Babylonische Mathematik. *BBIG* **71** (1935), pp. 16–29.

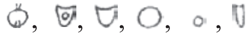
A bibliography covering the period 1916–1934, with a brief survey. (Vogel's publication served as a model for the present bibliography.)

Schneider, Nikolaus. *Die Keilschriftzeichen der Wirtschaftsurkunden von Ur III*. Rome 1935.

Pp. 123–136: a comprehensive survey of number notations occurring in Ur III texts, with references. Noteworthy is a quotation from Chiera, *STA* (1922): 26 41 57 1/3 5 g í n g í m '26 41 57 1/3 5/60 women (1 day)'.

Scheil, Vincent. *MDP* **26** = *Textes de comptabilité proto-élamites* (troisième serie) + *supplément* (suite de la première série)). Paris 1935.

S. continues here to improve his analysis of the proto-Elamite number systems. In particular, he points out the importance of the texts no. 362, possibly an exercise in addition (of a long series of big and small capacity numbers), and no. 109–113 (rations or wages, in multiples of two 1/5-units). S. still believes that the

capacity unit is 1 g u r [instead of the correct value: about 1 b á n]. [Big capacity numbers occur not only in the text no. 362 considered by S., but also in no. 48. The evidence of these two texts together makes it possible to correct a small error in no. 362 and so arrive at the conclusion that the succesive integral units in the proto-Elamite capacity system were  = 60×180, 10×180, 180, 60, 6, and 1 capacity units, not counting the secondary unit  = 1/5 capacity unit.

Burrows, Eric. *UET* **2** = *Archaic texts*. London 1935.

Pl. 35–37: a sign list for number signs in the archaic Ur texts. On p. 5 (§12), B. states: "The numeral system agrees on the whole with that of Jemdet Nasr. The centesimal system is used when the reference is to a measure of capacity. The barred numerals occur frequently." In fact, the archaic Ur tablets seem to use the same archaic sexagesimal number signs (see no. 88), the same capacity number system (cf. no. 83), and the same barrred number signs for spelt (z í z, see no. 73) as the JN texts. On the other hand, in these texts appear for the first time in Sumerian texts the signs for s i l à (as a measure of capacity), g u r and m a - n a u r u d u, as well as the term for summation g ú + a n + š ù (mostly in area texts; cf. no. 127, and p. 5, §8; note, however, that the text *OECT* **7** no. 12 (Langdon, *TAD* **7** (1928)) was found in the palace of Kish and cannot be precisely dated (see Falkenstein, *ATU* (1936), p. 13 note 2); cf. also the discussion in Pomponio, *OrAnt* 19 (1980), which takes into account new evidence from the Ebla texts).

Pohl, Alfred. *TMH* **5** = *Vorsargonische und sargonische Wirtschaftstexte*. Leipzig 1935.

No. 65 (*HS 815*): a geometric exercise from the Sargonic period, with one of the earliest known examples of the deliberate use of regular sexagesimal numbers. Cf. the review of Powell, *HM* 3 (1976), where other similar texts are mentioned.

Thureau-Dangin, François. La mesure des volumes d'après une tablette inédite du British Museum. *RA* **32** (1935), pp. 1–28.

Presents in full detail the important compilatory mathematical problem text *BM 85196*. Of its problems, 12 are concerned with volume computations, 2 with rope-making, one with interest paid out in barley (?), and one with a Pythagorean triangle (the "cane-against-a-wall problem", cf. Friberg, *HM* **8** (1981)). For a discussion of the difficult sixth and tenth problems, see my review of Sachs, BASOR **96** (1944). [In these problems occurs an otherwise rarely documented volume unit, the volume-š e, equal to 0.00 00 20 volume-š a r (cf. *CBM 12648* in my review of Neugebauer, *MKT* **1** (1935)).]

Meek, Theophile James. *HSS* **10** = *Excavations at Nuzi* III; *Old Akkadian, Sumerian, and Cappadocian texts from Nuzi*). Cambridge 1935.

No. 160, 214: two examples of the use of the phrase a - r á *n*-k a m 'for the *n*-th time' in Sumerian economical (non-mathematical) texts.

Thureau-Dangin, François. Terminologie mathématique babylonienne. *RA* **32** (1935), p. 188.

Legrain, Léon. Quelques textes anciens. *RA* **32** (1935), pp. 128–129.

Presents, in photographs and translation, an interesting brick text from Sumerian Umma, with volume computations and conversions into brick-š a r units. Two different kinds of brick are mentioned (s i g4 *ù-ku-ru-um* and s i g4 *za-ri-in*), but the data in the text are not sufficiently detailed to allow a computation without ambiguity of the parameters (in particular the linear dimensions) of these types of bricks.

van der Meer, Petrus E., *MDP* **27** = *Textes scolaires de Suse*). Paris 1935.

No. 57: a fragment with a syllabary and a list of capacity measures. No. 59: an almost complete list of capacity measures (from ½ š e (?) to 2 g ú; notations in a middle column are difficult to understand). No. 60: an arithmetical exercise of unknown significance. No. 61: a syllabary and a multiplication table (Ur III (?); cf. the interesting discussion in Neugebauer, *MKT* **3** (1937), p. 50). No. 63: a few lines of a syllabary and of a list of weight measures. No. 291: an arithmetical exercise (?). No. 292–297: fragments of multiplication tables, a combined multiplication table, and a table of reciprocals.

Neugebauer, Otto. Der Verhältnisbegriff in der babylonischen Mathematik. *AnOr* **12** (1935), pp. 235–253.

In this fascinating paper, N. discusses in detail the detective work that led him to the correct interpretation of the series text *YBC 4712* and the new technical terms appearing in it (such as i g i-TE-EN š à u š s a g - š è for y/x, if u š = x, s a g = y, and i g i-TE-EN š á u š s a g - š è s a g - š e í l for $(y/x)y = y^2/x$. The text contains 10 basic systems of linear, quadratic, or simple cubic equations, each with a number of systematic variations, indicated by brief, stereotyped phrases. A bigger series text, *YBC 4668*, itself marked as "3rd tablet", contains the text of *YBC 4712* in its columns rev. II–III (Neugebauer, *MKT* **1** (1935), pp. 420–466).

Neugebauer, Otto. *MKT* = *Mathematische Keilschrifttexte* **1**. *Texte*; **2**: *Register, Glossar, Nachträge, Tafeln*. Berlin 1935. (Reprinted as one volume Berlin/Heidelberg/New York 1973.)

1. With the ambition to collect in two big volumes everything that can be said about Babylonian mathematics, N. presents in this classic work transliterations, translations, and commentaries to all Babylonian mathematical texts known to him in 1935.

Chapter 1, Table texts, contains many useful diagrams with systematic surveys of, in particular, 33 single and 38 combined multiplication tables, 26 tables of squares or square roots, cubes or cube roots, and 28 tables of reciprocals. Interesting are the three new fragments *VAT 2117*, *VAT 3462*, *VAT 3463* [all three possibly belonging to one common table with entries for $10/n$, $(10/n)^2$]. In a section on metrology are published two metrological tables included as parts of big combined table texts, *VAT 6220* and *Ist A 20 + VAT 9734*, the latter (Neugebauer, *MKT* **1** (1935), pp. 47, 92) with a multiplication table for 1 40 replaced by a table of areas, from 1 a-rá ⟨1 40 nindan^2⟩ // 1 40 ⟨šar⟩ // 1 ⟨iku⟩$^{\text{ašag}}$ to 50 ⟨a-rá 1 40 nindan^2> // 1 23 20 ⟨šar⟩ // 2(bùr) 2(e š é) 2(i k u)$^{\text{ašag}}$, and with the concluding lines 1 40 a-rá 1 40 | 2 46 40 // 5 b[u-ur 1]0 iki ... (100 iku = 5 bùr eše 4 iku).

Chapters 2 and 3 contain only previously published texts from Paris and London: *AO 6484*, *AO 8862*, *AO 10642*, *AO 10822*, *AO 17264*, *BM 15285*, *BM 85194*, *BM 85200* (+*VAT 6599*), *BM 85210*.

Previously published in Chapters 5: *CBM 12648*, to which N. adds some signs readable near the edge of the reverse, still without being able to offer an interpretation of the text [actually, anyway, this unique "Sumerian" mathematical text contains an example where a volume of 1 1/12 še has the sides uš, sag, bùr = ½, ⅓, and ⅙ kùš, respectively]; and *Str 362–364*, *Str 366–367* (of which *Str 366* still resists interpretation; cf. von Soden, *ZDGM* **91** (1937)). New is here the fragment *Ist O 4360* with its series of drawings of triangles.

In Chapter 6, *VAT 6598* and *Str 368* are already published, while 19 other *VAT* texts are new. Particularly interesting among these are: *VAT 6505* with its explicit description of an algorithm for computation of reciprocals of regular sexagesimal numbers through factorization (a related text is *CBM 10201*, Hilprecht, *BE* **20**/1 (1906)); the fragment *VAT 7530*, dealing with prices (*maḫīrum*); *VAT 7531* with some curious trapezoid partition problems; *VAT 7532*, *VAT 7535*, two "broken cane" problems which are more complicated variants of the artificial area measuring problem in *Str 368*; *VAT 8389*, *VAT 8391*, two texts concerned with relations between the areas of two fields with different productivity figures (4 and 3 gur / bùr, respectively); *VAT 8390*, a system of two quadratic equations; *VAT 8512*, a geometrically interesting triangle bisection problem; *VAT 8521*, a curious text with interest calculations, in which the interest is assumed to be a square number (a-rá *ša* ib-si$_8$), a cube number a-rá *ša* ba-si), or a number of the form $n^2(n+1)$ (a-rá *ša* ba-si 1-lal) (cf. Thureau-Dangin, *RA* **33** (1936), pp. 71*ff*); *VAT 8528*, dealing with interest (máš or ur$_5$-ra), in one example with interest added to capital after each five year period, in another with interest paid on a steadily decreasing debt (Thureau-Dangin, *RA* **33** (1936), pp. 65*ff*); *VAT 8522*, unique because its four problems are accompanied by sketches of solutions, scribbled on the lower half of the tablet; one of the problems is about a wooden log (truncated cone); see the discussing of this important text in the interesting paper Vaĭman, *DV* **2** (1976); *VAT 8523*, concerned with earth work for a canal (simple computations but difficult terminology).

In Chapter 7, entirely devoted to series texts, *YBC 4708* and *YBC 4668* (and the parallel texts *YBC 4712*, *YBC 4713*) have already been published.

New are: *YBC 4709*, *YBC 4710*, *YBC 4715*, *VAT 7537* (and, less well preserved, *YBC 4695*, *YBC 4697*, *YBC 4711*), all dealing, formally, with rectangular areas, but in fact with series of variants of certain basic systems of quadratic and linear equations; *YBC 4696*, formally dealing with bisected triangles; the very interesting *YBC 4714*, dealing with sums and differences of squares; *YBC 7528*, about canal work; and finally *YBC 4669*, with volume computations for a series of vessels of standard capacity, from 1 b a r i g a to 1 g í n, as well as problems dealing with work norms (é š - k à r), and interest (computed year by year).

2. Starts with concordances with respect to (a) museum numbers, and (b) publications, with a short bibliography, and with Akkadian and Sumerian glossaries. A preliminary discussion of the five problems on *AO 6770* is based on the hand copy in Dossin, *TCL* **18** (1934) (cf. Thureau-Dangin, *RA* **33** (1936), pp. 75*ff*); new discussions are given of *BM 85196* and *YBC 4696*; then follow 34 plates with photographs, 26 with hand copies, and 9 with schematic drawings of a number of combined multiplication tables (as a rule, photos and hand copies published elsewhere are not reproduced here). (For references see Borger, HKL 1 (1967), pp. 360–361.)

Waschow, Heinz. Review of Neugebauer, *MKT* **1**, **2** (1935). *AfO* **11** (1936–1937), 245–247.

Thureau-Dangin, François. L'équation du deuxième degré dans la mathématique babylonienne d'après une tablette inédite du British Museum. *RA* **33** (1936), pp. 27–48.

T. presents here, in hand copies and with extensive commentaries, the early OB tablet *BM 13901*, with its collection of 24 systematically arranged quadratic equations or systems of quadratic and linear equations, all with detailed solutions.

Thureau-Dangin, François. Review of Neugebauer, *MKT* **1**, **2** (1935). *RA* **33** (1936), pp. 55–61.

This review, as well as Waschow's review cited above, contains many improvements in detail of the readings and commentaries in Neugebauer, *MKT* **1**, **2**, but also some more essential observations. Thus, T. observes that the "tables of reciprocals" are really conversion tables (fractions into sexagesimal numbers); that in the first four problems of *BM 85210*, the $^{\text{giš}}$I-DIB is a siege ramp with steps of given width (*nakbasum*) and height (g ī r - g u b - b a), and that the "broken cane" problems in *Str 362* and *AO 6770*, as well as the interest problem in *VAT 8528*, are nice examples of computation with arithmetic series. In several cases, T. and Waschow have coinciding views on these matters. (Cf. Waschow's discussion of the ramp-with-steps problem in *UntM* **39** (1933).)

Thureau-Dangin, François. Textes mathématiques babyloniens. *RA* **33** (1936), pp. 65–84.

T. starts the discussion by giving new, improved interpretations of the interest texts *VAT 8521*, *VAT 8528* (cf. T.'s review of Neugebauer, *MKT* **1**, **2** above in *RA*

33 (1936)). He then proceeds to present in full detail, with photos, new transliterations, translations, and interpretations, the five problems in the important but difficult text *AO 6770* (Dossin, *TCL* **18** (1934)). The first of these problems is a unique “abstract” text, describing an arithmetical problem and its solution without the use of any numerical example; the second is an interest problem with what is probably a linear interpolation in an interest table; the third is a “weight stone problem” leading to a linear equation with “irregular” co-efficients; the fourth is a problem about spreading of bitumen, using the coefficient (*igi-gub-bu-um*) 15, denoting a rate of spreading corresponding to .15 *qa* per square cubit (?); while the last problem is the “broken cane problem” mentioned above (Thureau-Dangin, *RA* **33** (1936), pp. 55–62).

Thureau-Dangin, François. Notes sur la mathématique babylonienne. [1] LUL = *sarru*. [2] *VAT 7530*. [3] AO 6484 l.21 ss. [4] YBC 4708. [5] VAT 6505. *RA* **33** (1936), pp. 161–168. [6] Nouvelles observations sur YBC 4708. [7] BM 85200, nº XXI. [8] La notation numérique des mesures dans les textes mathématiques. *Ibid.* no. 180–184.

(1) An improved interpretation of the “broken cane” problems in *VAT 7532*, *VAT 7535*, and *Str 368*, based on the reading LUL = *sarru*, ‘false, provisional’ in several places.

(2) Some crucial observations regarding the meaning of the phrase kaspum *li-li ù li-ri-id* ‘may the silver go up and down’ in the text *VAT 7530* [the still remaining difficulties in this text depend largely on the misreading of the word which is simply i g i-4$^{a\text{-}at}$ (= *ribāt* ‘1/4 of a š e’) as š i - z a - a - a t].

(3) A discussion of the mysterious volume-coefficient 6 NI.DUB (NI.DUB = *našpaku*) in the five otherwise simple problems in *AO 6484* obv. 21–rev. 9 (cf. my commentary to Postgate, *Iraq* **40** (1978), pp. 67–69).

(4) A demonstration of the fact that the series text *YBC 4708* is a brick text, in which the opening phrase is s i g$_4$ s i g$_4$-*anšu* (= *amarum* ‘pile of bricks’).

(5) T. points out here the important connection between *VAT 6505* and the algorithm text *CBM 10201* (Hilprecht, *BE* **20**/1 (1906)): both texts are concerned with an algorithm for the computation of reciprocals of long regular sexagesimal numbers.

(8) Exceedingly important is T.’s clarification here, through a number of examples, of the confusing Babylonian custom of writing, for instance, 5 š u - s i, when what is really meant is something like ‘5, the sexagesimal equivalent (in n i n d a n) of a not very big number of fingers (š u - s i)’ or, in modern notation, .05 n i n d a n!

Vogel, Kurt. Bemerkungen zu den quadratischen Gleichungen der babylonischen Mathematik. *Osiris* **1** (1936), pp. 703–717.

Contains the interesting conjecture that the origin of the Babylonian theory of quadratic equations is to be sought in the systematic reversal of linear problems. (Cf. Slavutin, *IMEN* **16** (1974).)

Frankfort, Henri. *OIC* **20** = *Fifth preliminary report of the Iraq expedition*. (1936). Fig. 19: a photo of a numerical tablet from Khafaje, inscribed only with 1(“ten”) 6.

Neugebauer, Otto. Zur geometrischen Algebra. *QS* B **3** (1936), pp. 245–259.
N. stresses here the possibility of a smooth transition from pre-Greek (i.e., Babylonian) to classical Greek mathematics.

Neugebauer, Otto. Review of J. Schaumberger, *Drittes Ergänzungsheft* zu F. X. Kugler, *Sternkunde und Sterndienst in Babel*. *QS* B **3** (1936), pp. 271–277.
In a discussion of Hilprecht’s “Nippur text” with star distances (?), from the Kassite period (?) and closely resembling a mathematical problem text, N. points out the unique way in which in this text the number 14 04 26 50 is written as 14 KUD 4 26 5O, where KUD = *parāsu* ‘separate’. Cf. Sachs, *JCS* **1** (1947).

Archibald, Raymond Clare. Babylonian mathematics. *Isis* **26** (1936), pp. 63–81.

Gandz, Solomon. Mene Mene Tekel Upharsin, a chapter in Babylonian mathematics. *Isis* **26** (1936), pp. 82–94.
G. suggests that the famous words in Daniel 5:25–28 with the ominous interpretation ‘numbered, weighed, and divided’ were an allusion to a mathematical phrase *meni, tekul, perus* with the original meaning ‘add and subtract, multiply, and divide’. Cf. Sjöberg, *AS* **20** (1975).

Bortolotti, Ettore. 1. Interpretazione storica dei testi matematici babilonesi. 2. I problemi del secondo grado nella matematica babilonese. *PM* **16** (1936), pp. 65–81, 128–143, 225–241.
(1) An attack on some overly enthusiastic claims in Neugebauer’s *MKT* **1–2**. B. shows that the cubic equations in BM 85200 have possibly been solved simply by factorization and testing; that no traces of “biquadratic equations” can be found in the texts themselves; that the interest computations in *VAT 8521*, *VAT 8528* show no signs of the use of “logarithmic tables”, etc.
(2) B. makes here the sweeping claim that all quadratic problems in Babylonian mathematical texts were ultimately reduced to one of the two normal forms $xy = A, x \pm y = B$.

von Soden, Wolfram. Leistung und Grenze sumerischer und babylonischer Wissenschaft (Schluss). *DWG* **2** (1936), pp. 509–533 (reprinted, Darmstadt 1965).
It is attempted here (1) to separate from each other the Sumerian and the Akkadian contributions to what we call “Babylonian mathematics”, and (2) to look at Babylonian mathematics against the background of what we otherwise know about Babylonian and Sumerian science and wisdom literature. Some of the new insights won in this way are: The Sumerian influence is apparent in the mathematical and metrological tables, and in the “series texts” of mathematical problems, all so similar to Sumerian lexical lists and enumerations, while the

Akkadian influence is stronger in the mathematical problem texts with full solutions (keyword: z a - e or *at-ta* ‘you’), comparable with Babylonian chemical, medical, or even ritual texts. In this connection it is remarked that, strangely enough, the renaissance of Babylonian mathematics that was brought about by the birth of Babylonian computing astronomy came much later than the middle-Babylonian renaissance of the other just mentioned branches of Babylonian science.

Falkenstein, Adam. *ATU = Archaische Texte aus Uruk* (*ADFU* **2**). Berlin 1936.
No. 202–214: a sign list for number signs used in this big collection of Uruk IVa and Jemdet Nasr texts, with extensive references to ocurrences in the individual texts. In the older texts (Uruk IVa), the proto-sexagesimal number system of the Jemdet Nasr texts is already in use. Hints of the use of the Jemdet Nasr capacity system (here called the “hundred system”) can be found in a few texts. The use of the classical Sumerian notation for area measures also in some Uruk IVa texts (*W 10602*, *W 14731g*) is announced on p. 49, note 1. Today, half a century after they were excavated, these and many other important proto-literate texts from Uruk are, unfortunately, still unpublished (although they are now, at last, being prepared for publication in the near future, by H. J. Nissen and M. Green in Berlin). The meaning of a special series of number notations in the texts no. 214–235, 293, 311, 321 (Uruk IVa) is not clear (cf. Vogel, *Vorgriechische Mathematik* **1** (1958), p. 19.)

van der Meer, Petrus E. Dix-sept tablettes semi-pictographiques. *RA* **33** (1936), pp. 185–187 + 3 pl.
A collection of well preserved tablets from the Jemdet Nasr period, often with interesting computations. Cf. Friberg, *DMG* (1979–15). [The tablets are now part of the *KU* collection at Nijmegen. In his paper, vdM gives an incorrect “proof” of the value 300 s i l à for the basic unit in the JN capacity system. This mistake, which was finally corrected in Friberg, *DMG* (1978–9), made it for several de-cades impossible to understand the computations in all proto-Sumerian and proto-Elamite texts involving the use of the proto-literate capacity system, i.e., in almost all early texts of any importance.]

Gandz, Solomon. The Babylonian tables of reciprocals. *Isis* **25** (1936), pp. 426–432.
G. suggests that the name “tables of reciprocals” is a misnomer, and that it ought to be replaced by the more correct “tables for the conversion of common fractions into sexagesimal fractions” (why not simply “tables of sexagesimal fractions”?). In appraisal of Neugebauer’s *MKT*, G. says also that “When, in 1926, I first established the fact of the Babylonian origin of the term ‘algebra’ (*AMM* (1926), pp. 437*ff*) and uttered the conjecture that the Babylonians must have cultivated the science of algebra, I hardly dreamt of it that the next ten years would bring such a splendid confirmation of my vague hypothesis”.

Neugebauer, Otto. Overleveringen af babylonske matematiske Metoder gennem græske Skrifter. *MT* B (1937), pp. 17–21.

N. points out here the importance of the work *Anaphorikos* by Hypsikles (c. 150 B.C.) for our evaluation of the influence of Babylonian models on classical Greek mathematics and astronomy. In particular, this work introduces sexagesimal fractions for the first time in Greek literature, it deals with "linear zigzag functions" and linear interpolation to describe the generation of periodic fluctuations, and it contains in its first part three theorems about arithmetic progressions, with non-geometric proofs. N. claims that these proofs are exactly the kind of proofs that may have been in existence in the Babylonian oral mathematical tradition.

Falkenstein, Adam. *ATI* = Archaische Texte des Iraq-Museums in Bagdad. *OLZ* **40** (1937), pp. 402–408.

Of the six Jemdet Nasr texts published here, one (*IM 23426*) is a bread and beer text with a whole series of computations, involving at the same time large sexagesimal numbers, large and small capacity numbers (including fractions), and possibly special numbers for jars of beer. Consequently, this text is important for our understanding of the proto-Sumerian number systems of the Jemdet Nasr period. [Falkenstein, unfortunately, relying on the erroneous notion of a JN "centesimal system" (van der Meer (1936)), claims that most of the computations on his tablets are "almost, but not quite, correct".] Cf. Friberg, *DMG* (1979–15).

Thureau-Dangin, François. Observations sur l'algèbre babylonienne. *Archeion* **19** (1937), pp. 1–11.

T. begins by showing how quadratic systems in one of the Babylonian normal forms $xy = a$, $x \pm y = b$ or $x^2+y^2 = a$, $x \pm y = b$ may have been solved by methods identical with the ones in Diophant's *Arithmetica* I. 27–30; but he also shows that, contrary to the claim in Bortolotti, *PM* **16** (1936), there are examples of Babylonian quadratic equations or systems that are solved after being reduced to normal forms of the type $ax^2+bx = c$, as for instance the system in *Str 363* obv. 1–12.

Thureau-Dangin, François. Notes sur la mathématique babylonienne. *RA* **34** (1937), pp. 11–28.

Treats, in particular, the harvest problem *BM 85194* rev. II, 34–40 (see also Thureau-Dangin, *TMB* (1938), p. 36), with the introductory phrase *i-na* 4 a b - s í n 30 *im-qu-u i-na* ½ n i n d a n 1 s i - l à š e 'on 4 furrows falls .30 (n i n d a n), on the half-n i n d a n 1 *qa* of barley'. T. shows also that the cubic equation in *BM 85200* rev. I, 9–14 may have been solved by a clever trial and error method, hence that there is no reason to assume that Babylonian mathematicians possessed any sophisticated methods for the solution of "general" cubic equations.

Jestin, Raymond. *TSŠ = Tablettes sumériennes de Šuruppak* (MIFA Stamboul 3). Paris 1937.

Contains the oldest known mathematical exercises: the two parallel texts *TSŠ* no. 50, *TSŠ* no. 671 (sexagesimal division problems), and a probable geometrical exercise, *TSŠ* no. 77 (cf. Powell, *HM* **3** (1976)). [In addition, *TSŠ* no. 188 is an exercise in area computation, involving very big numbers just like the division texts above. It is worth noting here that while *TSŠ* no. 50, for example, uses the classical purely sexagesimal system, other texts in the collection use the "duo-sexagesimal" number system that is otherwise known from archaic Ur and Jemdet Nasr texts. Thus, in *TSŠ* no. 969, the total is written š u - n i g í n 1(10×2×60) 4(2×60) 1(60) 1(10).]

Neugebauer, Otto. *MKT = Mathematische Keilschrifttexte* **3**: *Ergänzungsheft*. Berlin 1937 (reprinted Berlin/Heidelberg/New York 1973).

Chapter 1 presents, in addition to the previously published text *BM 13901*, also two new texts. The first of these, *BM 34568*, is a Seleucid text, in style and content clearly related with the only other known Seleucid mathematical problem text, *AO 6484*. (Translation and commentary are due to Pinches and Waschow.) *BM 34568* contains 18 systematically arranged problems about "Pythagorean" right triangles (and one odd problem about a metal object). Of particular interest is obv. II, 17–24, a "cane-against-a-wall" problem which may have been the prototype for the other Pythagorean triangle problems in this text. (Cf. BM 85196 obv. II, 7–16; Friberg, *HM* **8** (1981).) The other new text, *YBC 6504*, contains a series of four closely related systems of quadratic and linear equations.

Chapter 2 contains new or improved material about some of the series texts presented already in Neugebauer, *MKT* **1** (1935), Chapter 7: *YBC 4669* with a series of disparate and still incompletely understood problems about bricks, work norms, linear equations, metal work, wool, etc.; *YBC 4673*, similar to *YBC 4669*, and equally difficult to penetrate; *YBC 4695*, a series text with 97 linear equations; *YBC 4098*, another difficult series text with disparate groups of problems, concerned with various kinds of price relations (cf. Thureau-Dangin, *RA* **34** (1937)); *YBC 4697*, *YBC 4711*, both with sequences of quadratic equations.

Chapter 3, about table texts, discusses the atypical multiplication tables van der Meer, *MDP* **27** (1935), no. 61 (primitive type; Ur III?), and *W 169* (head numbers 3 30, 2 13 20; Seleucid?).

Chapter 4 takes up, in particular, a number of important remarks and corrections due to Thureau-Dangin, Waschow, Becker, and Schott. Important is the observation that nine problems in *YBC 4669* and two in *BM 85194*, all dealing with the capacity of standard containers, lead to the conclusion that 1 *qa* (in Old Babylonian texts) is the capacity of a cube of side length 6 š u - s i (i.e., .01 n i n d a n !). (Cf., however, Vaĭman, *DV* **2** (1976), and Postgate, *Iraq* **40** (1978).) Important is also the interpretation of the computation in the interest

problem *AO 6770* obv. 9–17 as a correctly executed linear interpolation (only with the result by error given in months rather than days).

The volume ends with a complementary glossary, an index, and hand copies (unfortunately no photographs) of the new or recently cleaned texts.

Waschow, Heinz. Review of Neugebauer, *MKT* **3** (1937). *AfO* **12** (1937), p. 277.

W. makes here the important observation that the computation in *YBC 4669* rev. II, 1–11 of the area of a piece of silver (*ruqqum*) shows that 1 g í n = 180 š e; he gives also an improved reading of the *maḫīrum* text *YBC 4698* rev. I, 11–13, a parallel text to *VAT 7530*. [If *X* and *Y* have *maḫīrum* 7 and 11, and if you spend 1 g í n silver, then you can buy (š à m) equal amounts (i b - s à) of each, namely $7 \times 11/(7+11) = 4.16\ 40$ m a - n a .]

Thureau-Dangin, François. 1. La mesure du "qa". *RA* **34** (1937), pp. 80–86. 2. Review of Neugebauer, *MKT* **3** (1937). *RA* **34** (1937), pp. 87–92.

1. Shows that the boat text *BM 85194* rev. III, 1–6 refers to bricks of the dimensions ½ cubit × ⅓ cubit × 5 fingers [cf. *CBM 12648*, in my review of Neugebauer, *MKT* **1** (1935)], and gives a new proof of the basic relation 1 *qa* = (6 š u - s i)^3 (i.e. ≈ 0.97 liters). T. gives also a plausible explanation of the puzzling phrase GAM *ù* GAM in the container text *BM 85194* rev. 1, 44–46.
2. Through improved readings of words and phrases, T. facilitates here the understanding of some problems left open by Neugebauer, for instance the è š - k á r problem *YBC 4669* rev. I, 1–7. Convincingly explained is also the strange problem *AO 8862*, in which è š - k á r, days, and men are added together to give a quadratic equation. The many improved readings of difficult terms in the unique series text *YBC 4698* give clues to the understanding of most of the problems in this important text. [For instance, in obv. II, 12–18, which may be read as 1 g u r ì - g i š | *i-na* š à m 1 g í n | 2 *qa* TAG | 7 ½ g í n k ù - d i r i g | e n - n a m à m - m a | e n - n a m b a l - r a 1 b á n) š à m - m a | 8 *qa* b a l - r a, we are told that 1 g u r of oil is sold with an overhead (TAG) of 2 *qa* per g í n, and a total profit (k ú - d i r i g) of 7 ½ g í n, hence that the selling rate (b a l - r a) is 8 *qa* and that the buying rate (š à m) is 1 b á n (per g í n). A related example appears in *KLC 1842*; cf. Lewy, *Or* **18** (1949). Both examples lead to quadratic equations.]

Thureau-Dangin, François. La clepsydre babylonienne. *RA* **34** (1937), p. 144.

T. returns here to the water clock problems in *BM 85194* and shows, in particular, that the phrase in rev. II, 41: 15 *ta-mar* 10 š u - s i ½ 10 š u - s i must be translated '.15 (n i n d a n) you see, i.e., .10 (n i n d a n) or its equivalent, a finger, and 1/2 of .10 (n i n d a n), equivalent to a finger'. This translation leads to a physically reasonable interpretation of the text.

von Soden, Wolfram. Review of Neugebauer, *MKT* **1–2** (1935), **3** (1937). *ZDMG* **91** (1937), pp. 183–203.

Contains a great number of new or corrected readings of words or entire sentences, often resulting in a decisive improvement of the comprehensibility of the problem texts. In addition, vS. emphasizes in this review how very unfortunate the method is, which is used in Neugebauer, *MKT* **1–3** to explain Babylonian mathematical algorithms and solution methods, namely by way of a reformulation in terms of equations and formulas using modern mathematical symbols and terminology. In fact, this method is not only historically incorrect, it also tends to obscure the meaning of the texts, and it makes the understanding of them more difficult than necessary.

Gandz, Solomon. The origin and development of the quadratic equations in Babylonian, Greek, and early Arabic algebra. *Osiris* **3** (1937), pp. 405–557.

Gives a very useful classification of all the "normal types" of quadratic equations or systems (consisting of a quadratic and a linear equation) to which quadratic equations or systems appearing in Babylonian mathematics are always ultimately reduced. Of six normal types for quadratic systems, four can be seen to reappear in the works of Euclid and Diophant, while three normal types for quadratic equations in one unknown are identical with the three "Arabic" types introduced by al-Khwārizmī. G.'s method of presenting the Babylonian solution algorithms is true to the original texts and easy to understand (cf. von Soden's objections above to the style of the mathematical commentaries in Neugebauer, *MKT* **1–3**). The paper abounds with examples, and many improvements are given of earlier interpretations. An Appendix is devoted to a discussion of the precise meaning of the difficult terms í b - s á (í b - s i $_8$) and *mi-it-ḫar-tum*.

Landsberger, Benno. *MSL* **1** (Die Serie *ana ittišu*). Rome 1937.

An OB lexical series in 7 tablets (found in the library of Assurbanipal), mostly with phrases borrowed from the language of legal contracts. Interesting relations with mathematical texts have, in particular, the following passages: tabl. 2 I, 41–43: m á š 1 g í n i g i - 5 - g á l š e - t a - à m 'an interest per shekel of $^1/_5$ shekel', etc.; tabl. 4 II, 43–72: i g i - 3 - g á l - l a // š a l - š a - a - t u '(a fee of) one-third', etc.; tabl. 6 III, 11–12, 21–22: á - u d - d a - b i u d - 1 - k a m | 1 (b á n) š e - t a - à m a n - á g - e 'as his pay for 1 day he will measure up 1 b á n of barley', ..., á - m u - a - n i 10 g í n k ù - b a b b a r | l u g a l - a - n a i n - n a l á - e 'as his pay for 1 year he will weigh up 10 shekel of silver to his lord'.

Legrain, Léon. *UET* **3** (*Business documents of the third dynasty of Ur*). Plates, London 1937; Indexes, etc., London 1947.

No. 447: cf. Vaĭman, *25^{th} Congress* (1960). No. 377: note the phrase 1 s i - l à ì š e - b i 1(b á n)-t a (cf. *YBC 4698*, Neugebauer, *MKT* **3** (1937), p. 42). No. 1386: see Vaĭman, *ŠVM* (1961).

Riftin, A.P. *SVYAD* = *Staro-vavilonskie yuridičeskie i administrativnye dokumenty v sobraniyah SSSR* 'Old-Babylonian legal and administrative documents in collections of the USSR'). Moscow/Leningrad 1937.

No. 112: a dated wool text (from Larsa, Rim-Sin year 19), with a curious simultaneous use of sexagesimal and decimal numbers, and with correctly executed non-trivial divisions; the text contains accounts of three herds of sheep and goats, male and female, the total amounts of wool produced by each herd separately and by all the three herds together, the average amount of wool per animal in each herd, and the differences between the actual amounts of wool produced and the calculated amounts (corresponding to an assumed average of 2 minas of wool per animal); example (the first herd): 3 30 ganam | 57 ^{sal}s i l á - ù z | 3 27 u d u - n i t á | 53 s i l á - ù z | 5 m e 27 g a n a m - u d u | s í g - b i 18 g ú n 3 m a - n a | *ib-ši-te* u d u - 1 e 2 m a - n a 3 g í n i g i - 4 - g á l 9 š e | d i r i g 29 m a - n a. No. 114, 116: two similar accounts in tabular form of the monthly expenditure of barley to three groups of workers and their foremen; headings of the columns: e r í n - p a š a 6 ⅔ | e r í n^{há} *ša* 2 s i l à | š u - n i g í n e r í n^{há} | š e - b i n i g - u d - 1 - k a m | š u - n i g í n š e - b i n i g - i t u - 1 - k a m | m u - b i - i m (superficially these tabular texts resemble very much the famous mathematical table text *Plimpton 322* (Neugebauer and Sachs, *MCT* (1945)), which, as a matter of fact, was first catalogued as a commercial account); these two texts are from Larsa, Rim-Sin year 31, and they use decimal numbers throughout (note, in particular, the writing 1 8 m e 1 34 for 1894 in no. 116 II,5).

van der Meer, Petrus E. *OECT* **4** (*Syllabaries A, B^1, and B with miscellaneous lexical texts*). Oxford/London 1938.

No. 132: an exercise tablet with a syllabary and a metrological list. No. 156: a six-sided prism (*W 1923–366*; the Isin dynasty) with (1) a table of length measures (1 š u - s i to [60] k a s k a l - g í d, basic unit 1 n i n d a n); (2) another table of length measures (1 š u - s i to 10 n i n d a n, basic unit 1 cubit) [the explanation for the use of two basic units is that separate tables were needed for the conversion of length measures into n i n d a n and cubits, respectively, because volumes were measured in the unit volume-š a r = n i n d a n^2 × cubit]; (3) a table of square roots.

Oppenheim, Leo. Seqel, Mine und Talent in Nuzi. *OLZ* **41** (1938), pp. 485–486.

Lewy, Hildegard. La mesure de l'*imēru* dans les textes de Nuzi. *RA* **35** (1938), pp. 33–35.

Demonstrates that the Nuzi area measure *imēru* had a value of 80 hundred GIR^2, by quoting formulas such as *imēr eqli ki-a-am* 1 *ma-at* GÌR.TA *egli* 8O GÌR *pi-ir-ki ša egli* (*N V 550*, 5). Suggests, in addition, the identity of the GIR with the "step" *purīdu* (= ½ g i); cf. the list of metrological equations in the Late Babylonian text *W 22309a+b* (Hunger, *STU* **1** (1973)), which includes a section where the basic unit is the *purīdu*. [Hence, 1 *imēru* = 2,000 g i^2 = 500 š a r = 5 i k u (?).]

Thureau-Dangin, François. *TMB* = *Textes mathématiques babyloniens*. Leiden 1938.

A reedition of almost all the mathematical problem texts in Neugebauer, *MKT* **1–3** (1935–1937), valuable because it incorporates, in the introduction and in a great number of footnotes, many amendments due to T. himself in the first place

but also to von Soden, to Waschow, etc. Unfortunately, any direct comparison with Neugebauer, *MKT* is made difficult by a different organization and a new numbering of the texts, and by a different mode of transliteration where consistently ideograms and Sumerian words and phrases have been replaced by their Akkadian equivalents. No texts are reproduced in hand copies or photographs, but the volume is provided with an ample set of references to relevant older publications, and the glossary is very useful (the Sumerian section is organized as a cuneiform mathematical dictionary).

Thureau-Dangin, François. La méthode de fausse position et l'origine de l'algèbre. *RA* **35** (1938), pp. 71–77.

The solution of a certain class of algebraic problems, for instance those that can be reduced to a pure quadratic equation, can be obtained through a "method of false value". Typical examples are BM 13901 problems 10–11, 15, 17. In this article, T. tries to show that also the broken cane problems in *Str 368*, *VAT 7532*, *VAT 7535*, and the barley field problems in *VAT 8389*, *VAT 8391* were solved by the same method. [This mathematically suspect interpretation was caused by the appearance in these texts of technical terms such as "false area", etc., or "false (quantity of) barley 2 (a - š à LUL = *eqlum sarrum*; *še-um sarrum*), although these terms are possibly denoting just the coefficients in quadratic or linear equations.]

Scheil, Vincent. Tablettes susiennes: exercises scolaires, calcul des surfaces. *RA* **35** (1938), pp. 92–103.

An interesting metrological table on two OB tablets (cf. Neugebauer and Sachs, *MCT* (1945), pp. 6–10). Tablet I lists in a semi-systematic way a sequence of 33 almost-square rectangles and their areas, from ½ k ù š u š ⅓ k ù š s a g | a - š à - b i 12½ š e to 13 n i n d a n 4 k ù š u š | 12½ n i n d a n s a g | a - š à - b i 1 (i k u)$^{\text{ašag}}$ 1(60) 6⅔ š a r. Tablet II lists 30 more rectangles, ending with 25(60) n i n d a n u š | 20(60) n i n d a n s a g | a - š à - b i 1(ŠAR'U) 6(ŠAR) 4 (b u r ' u). Then come 30 squares, from 1 š u [- s i í b - s á i g i - 12 - g á l e] to 4 n i n d a n í b - s á | a - š à - b i 16 š a r, and, finally, 14 circles, from ½ n i n d a n k a - š ì r | a - š à - b i 1 g í n i g i - 4 - g á l to 1(60^2) k a - š ì r (?) | a - š a - b i 1 (ŠAR'U) (?).

Thureau-Dangin, François. [1] Histoire d'un problème babylonien; [2] "Multiplier par" dans les textes cunéiformes du temps des Séleucides. *RA* **35** (1938), pp. 104–106.

1. Shows that the cane-against-a-wall problem in BM 85196 problem 9 and BM 34568 problem 12 reappears in the *Liber abaci* of Leonardo Fibonacci. 2. Demonstrates that DU = *alâku*, as technical term for multiplication in Seleucid mathematical problem texts such as BM 34568.

Thureau-Dangin, François. Le "grain", mesure de surface. *RA* **35** (1938), pp. 156–157.

Claims that the equation 1 š a r = 3 00 00 š e, which is confirmed by the tables in Scheil, *RA* **35** (1938), seems to be disproved by the text Tell Sifr 44 (Jean, (1931)[5]). [Actually, in this text a house measuring 1 š a r is divided between six brothers so that the oldest gets two shares and the five others one share each, with one share equal to 1/7 × 3 00 00 š e ≈ 8 30 × 3 š e ≈ 25 (sixties !) š e.]

Thureau-Dangin, François. Sketch of a history of the sexagesimal system. *Osiris* **7** (1939), pp. 95–141.

Begins with a survey of earlier authors' thoughts on the subject, from Theon, Simon Stevin, Wallis, and Formaleoni to Neugebauer. Then follow sections on (1) The Sumerians; (2) The genesis of Sumerian numeration; (3) The unit fraction; (4) Metrology and the sexagesimal system; (5) The division of the day and the division of the circle; (6) The abstract system; (7) The abstract system and the origin of algebra; (8) The abstract system and astronomy; (9) Conclusion.

Deimel, Anton. *ŠG² = Šumerische Grammatik*, 2nd edition. Rome 1939.

Pp. 117–121: a paragraph on Sumerian number words.

Sarton, George. Remarks on the study of Babylonian mathematics. *Isis* **31** (1939/40), pp. 398–404.

A bibliography of memoirs on Babylonian mathematics and astronomy published or reviewed in *Isis* and *Osiris*, together with short biographies over *Thureau-Dangin* and *Neugebauer*, and an appeal for "a primer of Babylonian mathematics wherein a few examples would be completely explained from the very beginning".

von Soden, Wolfram. Review of *TMB* (1938). *ZDMG* **93** (1939), pp. 143–152.

Contains new readings of technical terms, such as ZU-ZUM = *sà-súm* (base), A-RÁ-ḪUM (coefficient), *zaqru* (tall), and also valuable new or improved transliterations and translations of entire sections of difficult texts, in particular the three brick problems AO 10822 obv. II, 7–12, and the inheritance problem *VAT 6597* obv. II, 9–15.

1940–1950

Thureau-Dangin, François. *Notes sur la mathématique babylonienne.* 1, *Les problèmes babyloniens du troisième degré. 2, « tawirtum » dans la mathématique babylonienne. 3, Les Babyloniens avaient-ils la notion du nombre négatif ? 4, à propos d'Euclide*. *RA* **37** (1940), pp. 1–10.

2. Suggests that the technical term *tawirtum* (original meaning: irrigated field, as in *VAT 8389*, *VAT 8391*), may be behind the ideogram read as *nárum* (canal) and the corresponding phonetic *...-ra-tum* in *Str 364*, *Str 367*, and *VAT 8512*.

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[5] JH: That is, Charles-François Jean, *Tell Sifr: textes cunéiformes conservées au British Museum*. Paris 1931.

3. Translating the term b a - l a l in YBC 4668 problems 42, 45 with b a - l a l = *imṭi* (is smaller than), T. is able to avoid the need to assume that Babylonian mathematics made use of negative numbers. Thus, the phrase a . n a u š u - g ù s a g d i r i g 1 40 a - š à b a - l a l can be translated as “by 1 40 the area (A) is smaller than that by which the side (u) is greater than the front (s)”, or, in modern terms, $(u\text{-}s)$-1 40 = A (rather than A-$(u\text{-}s)$ = – 1 40, the interpretation given in Neugebauer, *MKT* **1** (1935), p. 455).

Thureau-Dangin, François. L’origine de l’algèbre. *CRAIB* 1940, pp. 292–318.
Quoting as counter-examples *AO 8862* problem 3 and *YBC 4668* problem A37–47, T. shows the invalidity of the claim in Gandz, *Osiris* **3** (1937), that general quadratic equations of “Arabic type II”, i.e., equations reducible to the normal form $ax^2+c = bx$, were avoided by all means in Babylonian mathematics.

Gandz, Solomon. Studies in Babylonian mathematics 2: Conflicting interpretations of Babylonian mathematics. *Isis* **31** (1940), pp. 405–425.
1. Mathematics and philology.
2. The discovery of Babylonian mathematics.
3. Transcription of the text. Sumerian or Babylonian language.
4. Divergences in translation.
5. Babylonian numerals. The sexagesimal system.
6. Angle geometry.
7. The geometry of the circle.
8. Thureau-Dangin, the interpreter of Babylonian mathematics.

Neugebauer, Otto. On a special use of the sign “zero” in cuneiform astronomical texts. *JAOS* **61** (1941), pp. 213–215.
On the use in texts from two schools of scribes in Seleucid Uruk of a medial “zero” in combinations like  [meaning 20 07], where it is used in its original function as a sign of separation.

Sachs, Abraham Joseph. Some metrological problems in Old-Babylonian mathematical texts. *BASOR* **96** (1944), pp. 29–39.
S. elucidates the difficult tenth problem of *BM 85196* (Neugebauer, *MKT* **2** (1935), pp. 43*ff*) by noting that the volume of the *sussulum* (trough) is expressed in volume-š e and that the puzzling phrase i g i - 6 - g á l ... is the medium area, [in fact, the medium area is .14 35 g í n ≈ ⅙ ⟨g í n⟩ 13 š e, and the volume is .09 43 20 g í n or ⅔×43 š e^{vol}. In a parallel computation in problem 6, a circular cylinder of circumference .30⟨n i n d a n⟩, height .40⟨k ù š⟩, has the bottom area 1.15⟨g í n⟩ and the volume .50⟨g í n⟩. Expressing the bottom area in š e, possibly by use of a table for circular areas (cf. Neugebauer and Sachs, *MCT* (1945), p. 9), the scribe works with a circumference of .20⟨n i n d a n⟩ and obtains the incorrect area A’ ≈ .34 gín = ½⟨gín⟩ 12 še, hence the incorrect volume V = ⅔ ×102 š e = 68 š e written as 1-*šu ša-am-nu-um* š e (!)] S. gives also interesting

new interpretations of the *gi-sa* (reed bundle) problems *BM 85194* problems 14–15, *BM 85196* problem 2, and of the boat problem *BM 85196* problem 5, all concerned with reed bundles (?) in the. fom of truncated cones with the dimensions 24 fingers (circumference at the base), 12 fingers (circumference at the top), and 6 cubits (= 1 g i, the height). The paper ends with the observation that *YBC 4669* problem 13 is a brick text, based on the equivalence 1 b ù r s i g = 30 00 š a r s i g 4 = 4 10 volume-š a r .

Lewy, Hildegard. Assyro-Babylonian and Israelite measures of capacity and rates of seeding. *JAOS* **64** (1944), pp. 65–73.

A discussion in the ill-credited tradition of "comparative metrology", leading up to the claim that the Middle Assyrian and Nuzi *qa* measure (= $^1/_{100}$ *imēru*, the Neo-Babylonian measure of the same name (= $^1/_{180}$ *kurru*), and the "Hebrew desert measure" 1 *qab* (= $^1/_{180}$ *kor* = 24 "eggs" of 6 cubic fingers) all would have a capacity of 1.34 liters.

Segrè, Angelo. Babylonian, Assyrian and Persian Measures. *JAOS* **64** (1944), pp. 73–81.

Another paper of "comparative metrology", of doubtful value.

Neugebauer, Otto, and Sachs, Abraham J. *MCT* = *Mathematical cuneiform texts* (AOS 29). New Haven 1945.

Chapter I (Introduction): contains a discussion of translation and transcription principles, republishes Scheil's metrological tables (*RA* **35** (1938)), and presents two new metrological exercises (computations of square areas: *NCBT 1913*, *NBC 8082*).

Chapter II (Table texts) contains: a list of 13 new tables of reciprocals; the early OB fragment *CBS 29.13.21* with extensive examples of the use of the algorithm for computation of pairs of reciprocals (cf. *CBM 10201*, Scheil, *RA* **13** (1916)) and with an unexplained occurrence of the term *arakarūm*; two other related exercises, *YBC 4704*, *VAT 5457*; fragments of six-place tables of reciprocals, *Liverpool 29.11.77.34*, *MM 86.11.406*, *MM 409*, *MM 410* [cf. Friberg, *HM* **8** (1981), p. 465 (408 and 409 are a probable join)]; *YBC 10529*, a table of reciprocals of non-regular sexagesimal numbers (cf. *M 10*, Sachs, *JCS* **6** (1952)), from [50] to 1 20; *YBC 7234*, *YBC 7235*, *YBC 7353*, *YBC 7354*, *YBC 7355*, *YBC 7358*, *YBC 11125*, *YBC 11127* (and *PTS 247* ?) [exercises to the problem of equal purchases, previously known from *VAT 7530* and *YBC 4698*]; a list of 77 new single multiplication tables (with these, the 40 known "head numbers" are all represented by single multiplication tables, except for 48, 2 15, and 1 20); a list of 30 new combined multiplication tables, among them the unique cylinder *A 7897*; several new tables of squares, in particular *CBS 1535*, a table of squares of half-integers; finally, the table of "exponentials" of base 16 and "logarithms" of base 2, *MLC 2078* (cf. Bruins, *Janus* **67** (1980)).

Chapter III (Problem texts) begins with *Plimpton 322*, a famous OB "number-theoretical" text with a list of Pythagorean triples (cf. Friberg, *HM* **8** (1981)). The chapter continues with: *YBC 6295*, exemplifying a method (*ma-ak-ṣa-ru-um ša* ba-si) of computing cube roots by factorization (cf. *IM 54472*, Bruins, *Sumer* **10** (1954)); *YBC 7289*, a lenticular school tablet with a geometric drawing displaying the very good approximations $\sqrt{2}$ 1.24 51 10 [and $1/\sqrt{2}$ 42 25 35]; the simple exercises *YBC 7290*, *YBC 11126*, *YBC 7302*, *YBC 11120* with drawings of trapezoids and circles: the interesting trapezoid partition problem in *YBC 4675*, *YBC 9852* (cf. Bruins and Rutten, *TMS*, and Vaĭman, *ŠVM*, both (1961)), with the new technical term dal múrub 'middle trans-versal' (also, once more, the unexplained *arakarūm*); the more elementary triangle and trapezoid partition problems in *MLC 1950*, *YBC 4608*; *YBC 8633* with a line drawing and a very curious geometric factorization method (with once more the term *ma-ak-ṣa-ru-um* 'bundling') for the computation of a triangular area by a substitute for the Pythagorean theorem (?); elementary volume computations in *NBC 7934*, and a computation of the area of a circle segment (GÁN-UD-SAR) in *MLC 1354*; *YBC 8600* with a computation of the "thickness" of a log, measured in *qa* (2 sìla *ku-bu-ur* giš), making use of the igi-gub-ba 4 48 (= $2/25 \approx 1/4\pi$; cf. Bruins and Rutten, *TMS* (1961)); the excavation text *YBC 5037* (catch word ki-lá), with 44 serially arranged problems involving volume computations, work norms, and expenses for wages (10 gín eš-kàr 6 še á-bi); the similar group of texts *YBC 4657*, *YBC 4662*, *YBC 4663* (in some of these texts the phrase 6 še á-bi lú-ḫun-gá is replaced by 1(bán) še-ta-àm á-bi lú-ḫun-gá, demonstrating the equivalence of 6 še silver with 1 bán (or 6 volume-še) barley; *YBC 8588* with a single ki-lá problem and the difficult phrase *i-na iš-te-en ka-la-ak-ki-im* 9 *ka-la-ak-ku* [in one excavation there are 9 segments (?)]; the serially arranged text YBC 4666 concerned with maintenance work on a little canal (pa$_5$-sig) of rectangular or trapezoidal cross-section (with a slope of 1:2 expressed as *i-na* 1 kùš bùr-bi ½ kùš kú ì-kú); the related text *YBC 7164*, with different work norms at different depths of the canal: 1 kuš-*šu* ⅓ ma-na *si-lu-tum* | 2 kùš-*šu* saḫar 10 gín dusu; *BM 85196* problem 16, which now gets its explanation through a comparison with *YBC 7164*; *YBC 7894*, with a single canal work problem, accompanied by a drawing [and with the result of the compu-tation given as 2 40 (nindan !) *iš-ka-ar a-wi-lim iš-te-en*]; the "irrigation" text *YBC 4186*; the important problem text *YBC 4607*, giving the dimensions l, b, h, and the size of the brick-šar, for bricks of five standard types (all with h = 5 šu-si, and with $l{:}b$ = 3:2 for sig$_4$-bricks, = 2:1 for sig$_4$-áb -bricks and = 1:1 for sig$_4$-al-ùr-ra -bricks; the conversion formula, in some of the problems, of the type 3 še saḫar-bi 5 silà ì-šám saḫar-bi suggesting the reading ì-šám = *maḫīrum*, conversion rate); *YBC 7284*, a small lenticular tablet with an excerpt from a coefficient list, showing that s i g_4-bricks of volume .00 41 40 volume-g í n had a weight of 8 ⅓ m a - n a, corresponding to an i g i - g u b - b a 12, standing for 12 talents of weight per volume-g í n [i.e., ⅕ cubic cubit per talent of weight, giving a brick of the dimensions $1 \times 1 \times 1/5$ cubic cubits a weight of 1 talent]; the brick-carrying text *YBC 10722* and the puzzling brick oven text *YBC 7997*; *YBC 9856* with two problems about proportions and about an arithmetic progression, both leading to linear equations; *YBC 4652* with a series of problems about stone weights (n a $_4$ k i - l á - n u - n a - t a g), also leading to linear equations (it is remarked here that *YBC 4669* problem B4, in a corrected trans-literation, has turned out to be a problem of similar type); *YBC 4612*, *YBC 4692*, two serially arranged area texts leading to simple quadratic equations; *MLC 1842*, a *maḫīrum* problem (cf. Lewy, *JAOS* **69** (1949)); the two "series texts" *A 24194*, *A 24195* with 4 00 and [3 00] equation variants (systems of quadratic and linear equations); *YBC 6967*, an i g i *ù* i g i - b i text leading to a quadratic equation; and *YBC 7326* (a parallel text to *YBC 4669* problem B8), a sheep and lambs text giving rise to a system of linear equations. Of extraordinary interest are the two lists of coefficients (mathematical or physical constants) *YBC 5022* (with the heading i g i - g u b - b a *ša né-pi-iš-tum*) and *YBC 7243*, both with coefficients relating to bricks, objects of metal, geometric figures, etc. A last paragraph devoted to late texts discusses, in particular, a Seleucid text *VAT 7848* with several geometric problems, interesting not least because of the metrological difficulties involved in their interpretation. (A comparison is made with the metrological formula in a Neo-Babylonian metrological table published in Hilprecht, *BE* **20**/1 (1906) (*CBS 8539* rev. III, 15–18).)

The volume is completed with indices, vocabulary, and a complete set of hand copies and photographs. For references, see Borger, *HKL* **1** (1967), p. 360.

<u>Goetze</u>, Albrecht. The Akkadian dialects of the Old-Babylonian mathematical texts. In Neugebauer and Sachs, *MCT* (1945), pp. 146–151.

Shows that, on linguistic grounds, several of the OB problem texts in Neugebauer, *MKT* and *MCT* can be shown to belong to one or another of six distinct groups. Of these, group 1, comprising such important texts as *Plimpton 322*, the prism *AO 8862*, the i g i - g u b lists *YBC 5022*, *YBC 7243,* and the trapezoid partition text *YBC 4675*, and group 2, with excavation texts such as *YBC 4662* and the quadratic equations text *BM 13 901*, represent a relatively old and original family of southern OB mathematical texts, at home in Larsa. Group 3, to which belongs the interesting *Str* texts, the *maḫīrum* text *VAT 7530*, and the broken reed text *VAT 7535*, and group 4, with the barley field problems in *VAT 8389*, *VAT 8391*, the triangle partition problem *VAT 8512*, the two algebraic and geometric *makṣarum* problems *YBC 6295*, *YBC 8633*, and the interest text *VAT 8528*, represent another southern variety probably to be localized at Uruk. Finally, groups 5 and 6 with, in particular, the big compilation texts *BM 85194*, *BM*

85196, *BM 85200*(+*VAT 6599)*, and *BM 85210*, show northern characteristics and are slightly younger than the other groups; they may therefore comprise northern modernizations of southern (Larsa) originals.

Neugebauer, Otto. The history of ancient astronomy: problems and methods. *JNES* **4** (1945), pp. 1–38.
With a section on Babylonian mathematics, etc.

Goetze, Albrecht. Number idioms in Old Babylonian. *JNES* **5** (1946), pp. 185–202.
A fully documented discussion of phonetic spellings of numerals (cardinal numbers, ordinal numbers, and fractions) in Old Babylonian texts, in particular mathematical problem texts.

Sachs, Abraham J. Notes on fractional expressions in Old Babylonian mathematical texts. *JNES* **5** (1946), pp. 203–214.
Presents the small OB tablet MLC 1731, containing a list of computations of small rectangular areas (?), with the results expressed in multiples and fractions of an *uṭṭetum* [from 10 × 5 (i.e., from .10 n i n d a n × .05 n i n d a n = 1 š u - s i × ½ š u - s i (?)) = *ši-ša-at ra-ba-at ú-ṭe*4*-tim* (one-sixth of one-fourth of an *uṭṭetum*) and upwards; cf. Scheil's Susa texts, Neugebauer and Sachs, *MCT* (1945), p. 6*ff*]; goes on to give a highly interesting discussion of how the Babylo-nians may have solved the problem of converting sexagesimal fractions to (a sum of) non-sexagesimal submultiples, with examples chosen both from one OB mathematical text (*YBC 7164, MCT* 1(945,) p. 16), and from Seleucid economic texts.

Neugebauer, Otto. The water clock in Babylonian astronomy. *Isis* **37** (1947), pp. 37–43.

Oppenheim, A. Leo. Review of *MCT* (1945). *JNES* **6** (1947), pp. 126–128.
With a number of philological remarks.

Lewy, Hildegard. Marginal notes on a recent volume of Babylonian mathematical texts. *JAOS* **67** (1947), pp. 305–320.
It is suggested here (1) in connection with the exponential table on *MLC 2078* (powers of 16) and the enigmatic problem *Str 366* problem 1, that the basic unit in Babylonian "investment" problems was 2 minas of gold or 16 minas of silver; (2) mistakenly, that all "*qú*-vessels" were of the same height but of different bottom areas; (3) that the GÁN-UD-SAR problem *MLC 1354* and some of the items in the coefficient lists were concerned with regular polygons inscribed in circles.

Gandz, Solomon. Studies in Babylonian mathematics 3: Isoperimetric problems and the origin of the quadratic equations. *Isis* **32** (1947), pp. 101–115.
An unconvincing attempt to explain the origin of quadratic equations in Babylonian mathematics.

Sachs, Abraham J. Two Neo-Babylonian metrological tables from Nippur. *JCS* **1** (1947), pp. 67–71.

Presents two texts which, together with *CBS 8539* (Hilprecht, *BE* **20**/1 (1906), pl. 20), "constitute the complete corpus of extant Neo-Babylonian metrological tables". The first, *CBS 11032*, is a table of fractions of the g í n, from 2 30 | *gír-ú* ($^1/_{24}$ g í n) to 1 | 1 g í n; the second, *CBS 11019*, is a similar, but more elaborate table, from 10 | *mi-šil* | ½ s e to 1 | 1 *me* 1 20 š e | 1 g í n. Cf. Hunger, *STU* **1** (1973); Powell, *SNM* (1971), pp. 226–236.

Sachs, Abraham J. Babylonian mathematical texts 1: Reciprocals of regular sexagesimal numbers. *JCS* **1** (1947), pp. 219–240.

Contains a complete and highly interesting discussion of the algorithm for computation of sequences of pairs of reciprocal numbers which was originally known from *CBM 10201* (Hilprecht, *BE* **20**/6 (1906), no. 25; from the Ur III or Isin periods). Previously published examples are also *BM 80150* (Pinches, *Hilprecht Anniversary Volume* (1909); following a combined multiplication table), the problem text *VAT 6505* (Neugebauer, *MKT* **1** (1935)), and *CBS 29.13.21* (Neugebauer and Sachs, *MCT* (1945)). New examples are (1) *N. 3958*, sharing with *CBS 29.13.21* a method of dividing many-place sexagesimal numbers into several parts, probably for easier handling of them, by means of a separation sign [resembling the KUD used in a similar way in Hilprecht's star distance text; Neugebauer, *QS* B **3** (1936)]; (2) *CBS 1215*, a table listing every step of the algorithm in 21 successive cases; (3) the three small tablets *YBC 1839*, *MLC 651*, *YBC 10802*, and the fragment *N 3891*, with excerpts from more complete tablets displaying examples of the algorithm. (Also mentioned are *VAT 5457* and *Str* 366, problem 2, both previously published.)

Gandz, Solomon. Studies in Babylonian mathematics. 1. Indeterminate analysis in Babylonian mathematics. *Osiris* **8** ((1938)1948), pp. 12–40.

In this remarkable paper, G. is able to demonstrate the Babylonian origin of the ancient and venerable branch of mathematics called indeterminate analysis, at the same time as he gives new and convincing explanations to a number of badly understood Babylonian problem texts: (1) BM 85194 problem 4, a ring-wall problem leading to the indeterminate equation $x^2–y^2$ = 22 30 (cf. Diophantos II.10); (2) AO 17264, a "composite trapezoid partition problem" based on the existence of "chains" of "Babylonian triples" (i.e., solutions of the indeterminate equation $n^2–q^2 = q^2–m^2$, such as, in this text, (17,25,31), (31,41,49), (41,61,71)), which can be constructed, according to Diophant III.7 and II.19, by use of the generating formula $(m,q,n) = (x, x+1, 2k–x)$, $x = (2k^2–1)/2(k+1)$; (3) VAT 8512, a triangle partition problem, easily solved by transformation into a trapezoid partition problem; and (4) *AO 6770* problem 1, a purely algebraic problem, offering the solution of the equation $x+y = xy$ in the general case (i.e., not for particular values of x or y) as, in modern terms, $y = {}^{x}/_{x–1}$.

Goetze, Albrecht. Review of *MCT* (1945). *JCS* **2** (1948), pp. 33–37.

With a number of philological remarks concerning technical terms such as *ḫadālum*, *kalakkum, šilūtum*, *ter.dī.tum*, *taraḫḫum*, all concerned with excavation and irrigation work, s i g 4 *agurrum* and *zarinnum*, two different kinds of bricks, and, in the lists of constants, g e š t u . z a . m í = *ḫasīs sammīm*, GÁN-z a r à, and GÁN-UD-SAR, all possibly related to different shapes of doors.

Lewy, Hildegard. Origin and development of the sexagesimal system of numeration. *JAOS* **69** (1949), pp. 1–11.

An occasionally interesting discussion but built on false assumptions and therefore quite unreliable.

Lewy, Hildegard. Studies in Assyro-Babylonian mathematics and metrology. *OrNS* **18** (1949), pp. 40–67, 137–170.

In an exaggeratedly critical review of Neugebauer and Sachs, *MCT* (1945), L. here considers (1) the canal work texts *YBC 9874* and *YBC 7164* problem 2 ; (2) the *maḫīrum* text *MLC 184* (discussed with some success); (3) the geometric *makṣarum* text *YBC 8633*; (4) items related to bricks in the coefficient list *YBC 5022*: it is shown that the *nalbanum* value of a given type of bricks is the number of bricks of that type together weighing 1 talent, that the corresponding *nazbalum* value is the number of bricks of that type carried over a distance of 1 00 n i n d a n in a day's work, that 1 brick-š a r of bricks of type 1 has a price of .03 40 gin, or 11 š e, of silver (*YBC 7284*), hence that 10 volume-š a r of bricks of this type costs 4 24 g í n silver (?); interesting interpretations are given also of the brick or mud carrying texts *YBC 4673* problem 5 and *YBC 4669* problem 10; finally it is suggested that the two lists of constants *YBC 5022* and *YBC 7243* were compiled for the needs of an architect or a contractor involved in the construction of some important building; (5) the meaning of the terms *ruqqum* (metal sheet) and *râṭum* (metal spiral?), as well as GÁN-MAN (area of a sun-emblem??).

Neugebauer, Otto. Comments on publications by Mrs. Hildegard Lewy on mathematical cuneiform texts. *OrNS* **18** (1949), pp. 423–426.

A sharp rejoinder to some of the more exaggerated claims in the publications referred to in the title (Lewy, *OrNS* **18** (1949), ...).

Bruins, Evert M. On Plimpton 322. Pythagorean numbers in Babylonian mathematics. *IndM* **11** (1949), pp. 191–194.

Proposes a "one parameter" generating formula for the list of Pythagorean triples in Plimpton 322, and remarks that the almost linear decrease of the ratios diagonal/length in that list may be accidental.

de Mecquenem, Roland. *MDP = Mémoires de la Mission Archéologique en Iran* **31** (Épigraphie proto-élamite). Paris 1949.

No. 31: a proto-Elamite tablet with what looks like very high numbers in the decimal system [possibly, for instance, the total on the reverse, written as , is the number 23,600 (?)].

1950–1960

Baqir, Taha. 1. An important mathematical problem text from Tell Harmal. *Sumer* **6** (1950), pp. 39–54 + 2 pl. 2. Another important mathematical text from Tell Harmal. *ibidem*, pp. 130–148 + 5 pl.

1. Presentation of *IM 55357* (Harmal III = early First Dynasty of Babylon), with a geometric drawing and a problem text proving that OB mathematicians were acquainted with "similarity theorems" for right triangles.
2. B. presents here *IM 52301*, with two geometric problems concerned with the computation of the *meḫrum* of two triangles or trapezoids, a third problem with the initial phrase *šum-ma a-šà uš la mi-it-ḫa-ru-ti*, and a brief list of constants with seven i - g i - g u - u b values.

Bruins, Evert M. Quelques textes mathématiques de la mission de Suse. *IndM* **12** (1950), pp. 369–377.

A preliminary report about the small library of important mathematical problem texts which was found by de Mecquenem in Susa (Ville Royale I) in 1936 (together with the more elementary texts already published by van der Meer in *MDP* **27** (1935)). See Bruins and Rutten, *TMS* (1961).

Bruins, Evert M. Nouvelles découvertes sur les mathématiques babyloniennes. *CPD* (1951), pp. 5–29.

An interesting survey of recent results, with several references to the texts from Susa, as well as to other texts, for instance the important text *MAH 16055* (also discussed in Bruins, *Physis* **4** (1962)).

Steele, Francis Rue. Writing and history: the new tablets from Nippur. *UMB* **16**/2 (1951).

Pl. 7 (bottom) "Mathematical problem text: to find area of a field" (a photo without any comment in the paper; the text seems to be concerned with the computation of a square area).

Safar, Fuad. A further text of Shalmaneser III. From Assur. *Sumer* **7** (1951), pp. 3–21 + 3 pl.

This beautiful and extremely well preserved document, recording the annals of the first twenty campaigns of Shalmaneser, contains many interesting examples of Neo-Assyrian number notations, just as the Sargon text Thureau-Dangin, *TCL* **3** (1912): See, for instance, col. IV, 34–40: 1 *me lim* 10 *lim* | 6 *me* 10 *šal-lu-tu* 1 20 *lim* 2 *lim* 6 *me di-iq-tu* | 9 *lim* 9 *me* 20 a n š u - k u r - r a$^{\text{meš}}$ a n š u *ku-di-ni* | 30 *lim* 5 *lim* 5 *me* 65 g u d$^{\text{meš}}$ 19 *lim* 6 *me* | 1 30 a n š u$^{\text{meš}}$ 1 *me lim* 1 20 *lim* 4 *lim* 7 *me* 55 | u d u$^{\text{meš}}$ *ḫu-ub-tu ša ištu reš šarru*$_4$*-ti-ia a-di* | 20 *palē*$^{\text{meš}}$*-ia* '110,610 captives, 82,600 killed, 9,920 horses (and) mules, 35,565 oxen, 19,690 donkeys, 184,755 sheep ..., the spoils from the beginning of my reign to my twentieth *palē*'.

Leemans, Wilhelmus François, and Bruins, Evert M. Un texte vieux-babylonien concernant des cercles concentriques. *CRRA* **2** (1951), pp. 31–35.

A discussion of the lenticular text *de Liagre Böhl 1821*, with a problem involving an area between two concentric circles (a - š à d a l - b a - a n - n a), leading to a quadratic equation: $S = 3(R+r)(R-r)$ [actually an indeterminate equation similar to the Pythagorean equation $c^2 = (a+b)(a-b)$].

Baqir, Taha. Some more mathematical texts. *Sumer* **7** (1951), pp. 28–45 + 13 pl.

The first publication of 10 small OB mathematical problem texts found in Tell Harmal (1949), datable to the reign of Ibalpiel II, and characterized by their common longish format, by the near absence of ideograms, and by the common initial phrase *šum-ma ki-a-am i-ša-al-ka um-ma šu-ú-ma* 'if somebody asks you thus'. Important contributions to the interpretation have been given in von Soden, *Sumer* **8** (1952), and Bruins, *Sumer* **9** (1953).

Problem 1: *IM 54478*, a simple excavation problem.

Problem 2: *IM 53953*, a problem about a bisected triangle (*ša-ta-ku-um*; cf. Bruins, *Sumer* **9** (1953)), solved by the method of false position.

Problem 3: *IM 54538*, a brick-carrying problem (bricks type 4; cf. von Soden, *Sumer* **8** (1952)), with the new problem formulation *ki ma-ṣí ṣá-ba-am ú-ma-ka-li-a-am* 'how many men for 1 day'.

Problem 4: *IM 53961*, a simple work division problem, concerned with the volume of a mud wall (*igi-gub-ba*: 3 45 *pí-ti-iq-tum*, IM 52301, Baqir, *Sumer* **6** (1950)).

Problem 5: *IM 53957*, a grain vessel text, similar to YBC 4669 problem 4 (see Neugebauer and Sachs, *MCT* (1945), p. 103), with the technical terms *ši-ta-tum* (remainder; von Soden (1952)) and *ri-ši-e-um* (original grain quantity) [a contraction of *reš šeim* ?].

Problem 6: *IM 54010*, a harvest text (?), badly damaged.

Problem 7: *IM 53965*, a simple broken reed problem (*šurum* = g i - k u d - a; Bruins, *Sumer* **9** (1953)), displaying also the term *meḫrum*, here as in *IM 52301* (Baqir, *Sumer* **6** (1950)) standing for the half-sum $\frac{1}{2}(x+y)$.

Problem 8: *IM 54559*, a simple geometric problem [leading to a system of linear equations: $s = \frac{2}{3} u$, $u_1 = u+10$, $us = 20$].

Problem 9: *IM 54464*: a *maḫīrum* problem.

Problem 10: *IM 54011*, another work division problem, concerned with the volume of a mud wall [this time with a trapezoidal cross section of height 1 *ni-ka-áš* (3 cubits), base 2 cubits (!), and inclination ½ cubit (*ammat ḫe-pé* (!)) per cubit].

Drenckhahn, Friedrich. Ein geometrischer Beitrag zu dem mathematischen Problem-Text von Teil Harmal IM 55357 des Iraq Museums in Baghdad. *ZA* **50** (1952), pp. 151–162 = *Sumer* **7** (1951), pp. 11–17.

Lewy, Hildegard. Studies in Assyro-Babylonian mathematics and metrology. *OrNS* **20** (1951), pp. 1–12.

A discussion, not entirely convincing, of the relations between the "*kurrum* of Gasur", that "of Akkad", and the one "of Gudanišum", all used in Old Akkadian

texts from Nuzi (Meek, *HSS* **10** (1935)). Interesting is the observation that the approximation $(a+u)\times(b-u) \approx ab$ seems to have been used in several of the texts in order to simplify complicated area computations.

Goetze, Albrecht. A mathematical compendium from Tell Harmal. *Sumer* **7** (1951), pp. 126–155.

A careful presentation of three closely related OB mathematical tablets, *IM 52916* (1), *IM 5268* (2), *IM 52304*, sadly mutilated but of extraordinary importance. The main topics are: (1A) and (1B), quadratic equations, but formulated in a hitherto unknown, abstract way (example: *a-na* a - š à KIL *eš-re-et* u š-*ia wa-ṣa-ba-am* 'to add to a square area ten times my side'); (1C), constants for geometric figures; (1D), inscribing geometric figures into each other (example: *na-al-ba-tam i-na li-bu na-al-ba-tim e-pé-ša-am*, to make a 'brick mold' within a 'brick mold'); (1E), coefficients for brick carrying problems (example: *a-na* 20 n i n d a n *a-za-bi-il* 5 *al-lu-um*, 'were I to carry over 20 n i n d a n, the allum would be 5'); (1H), probably problems for bisected triangles (*ḫa-am-ša-at* s a g - k i a n - t a *i-na uš wa-ra-da-am* '1/5 of the upper front to descend from the side'); (1F), (1I), more constants; (1J), diverse problems (example: *qa-na-am el-qé-e mi-id-di*-[...], the initial phrase of a "broken reed problem"). Note in particular, on the second tablet, a group of "commercial problems" (example in 2F: *ma-ḫi-ra-tim na-sa-ḫa-am ša-ma-am ù ka-ma-ra-am* 'to subtract or add rates and to make purchases'(?)).

Hanson, A. W. Field plans. *MCS* **2** (1952), pp. 1–3, 21–26.

A discussion of the field plans *Or* **47–49** no. 507 and Clay, *YOS* **1** (1915), no. 22–23 (cf. Stephens, *JCS* **7** (1953)).

Sachs, Abraham. Babylonian mathematical texts, II: Approximations of reciprocals of irregular numbers in an Old-Babylonian text; III: The problem of finding the cube root of a number. *JCS* **6** (1952), pp. 151–156.

II: Presents the OB text *M 10* in the John F. Lewis Collection of Cuneiform Tablets in the Free Library of Philadelphia, a curious table (?) of approximate reciprocals to the often appearing irregular numbers 7, 11, 13, 14, 17; difficult to understand is here that the last two reciprocals seem to have been multiplied by a factor 10, and also the use of the word SI-NI-ÍB 'remainder, deficit', in opposition to the common dir.ig, to indicate the non-exactness of the reciprocals; (cf. Neugebauer and Sachs, *MCT* (1945), p. 16: *YBC 10529*).

III: The OB text *VAT 8547* seems to contain a parallel to the *makṣarum* method in *YBC 6295* for the extraction of cube roots, although it does not really make much sense.

Evans, Arthur J. *Scripta Minoa* **2** = *The archives of Knossos, clay tablets inscribed in Linear Script B*, edited from Notes and Supplemented by J. L. Myres). Oxford 1952.

(Cf. Evans, *Scripta Minoa* **1** (1909).) P. 51: a survey of decimal number notations in Minoan Linear Scripts A and B; units: |, – or ·, ○, ,  (10,000).

von Soden, Wolfram. Zu den mathematischen Aufgabentexten von Tel Harmal. *Sumer* **8** (1952), pp. 49–56.

Cf. the discussion above of Baqir, *Sumer* **7** (1951).

Berriman, A. E. *Historical metrology. A new analysis of the archaeological and the historical evidence relating to weights and measures*. London/New York 1953.

Although in many respects unreliable and a typical example of "comparative metrology", this book contains many interesting illustrations and can be used as a handy reference. See, for instance, the photo of the "Indus Valley weights" (p. 34; the system of weights used at Mohenjo-Daro and Harappa can be shown to include standard weights in the form of rectangular blocks, corresponding to $^1/_{16}$, $^1/_8$, $^1/_4$, $^1/_2$, 1, 2, and 5 "units", with the "unit" approximately equal to $^1/_{18}$ Babylonian mina). The length of the "Indus inch" is derived from the markings on a piece of shell (p. 39; the "inch", which seems to have been further divided into fifths or tenths, is said to have been equal to 2, or possibly 4, Sumerian š u - s i. The many but more well known illustrations related to Egyptian metrology will not be mentioned here. Among illustrations of importance for the study of Babylonian metrology ought to be mentioned, for instance, Gudea's rule (pp. 53–54), Entemena's vase (p. 65), the duck weights of Dudu, high priest at Lagash in the reign of Entemena (p. 56; 1 wool-mina; originally published by Langdon in *JRAS* (1921)), and of Merodach-Baladan (p. 8; 30 minas), etc., and the double-mina of Nebuchadnezzar II, with its reference to king Šulgi of Ur (p. 57).

Raik, A.E. Iz ranneĭ istorii algebry: kvadratnye uravneniya u vavilonyan 'From the early history of algebra: quadratic equations in Babylonia'. *UZPU* **8** (1953), pp. 31–63.

Stephens, Ferris J. A surveyor's map of a field. *JCS* **7** (1953), pp. 1–4.

A renewed discussion, with departure from an improved hand copy, of the field plan Clay, *YOS* **1** (1915) no. 22 (cf. Hanson, *MCS* **2** (1952)). The computation of the area of a quadrilateral in *YOS* **1** no. 21 is mentioned briefly.

Lambert, Maurice. La période présargonique: La vie économique à Shuruppak. *Sumer* **9** (1953), pp. 198–213; **10** (1954), pp. 150–190.

Figulla, Hugo Heinrich, and Martin, William J. *UET* **5** (*Letters and documents of the Old-Babylonian period*). London 1953.

Contains, as shown by Vaĭman, several important early OB mathematical texts written entirely in Sumerian.

No. 121 (cf. Vaĭman, *ŠVM* (1961), p. 248): begins with an inheritance problem, for the solution of which one has to sum a geometric progression and then perform a non-regular division; continues with three "shepherd problems" exploiting the surprisingly neat divisibility properties of the exceptionally conspicuous numbers 1 01 O1 01 and 1 01 01, as, e.g., in the second problem: 1 (š a r - u - g a l) 1 (š a r) 1 1 u d u$^{\text{ḫá}}$ 13 s i b a | s i b a 1 - e e n - n a m *íb-ši-ti* | 4 41 37 *íb-ši-ti* '1 01 01 01 sheep 13 shepherds; what is the lot of 1 shepherd; 4 41 37 is his lot' [note the common term *íb-ši-ti* in this text and in the wool text Riftin, *SVYAD* (1937), no. 112].

No. 855–856 (Vaĭman, *TGErm* (1961)): two interesting excavation texts.

No. 858: a trapezoid partition problem.

No. 859: two geometric problems leading to pure quadratic and cubic equations and a non-regular division; one is required to divide the volume 1 04 01 36 by the area 10 40 16 (= 16×7^4) to get the depth (= 6); the abstract number for the volume is converted into 1 š a r $_4$ g í n $_4$ ½ š e i g i - 18 - g á l š e - k a m (?), where the fraction seems to be an error for $^{18}/_{60}$ š e (Vaĭman suggests the corrected version 18 š e - ḫ a r).

No. 864 (*BM 131432*; cf. Vaĭman, *ŠVM* (1961), pp. 250–258 for a discussion of this and the two preceding texts): a still badly understood geometric problem, in which appear the difficult technical terms *ad-ku-uš* and *di-ki-iš-ti-im* (cf. Kilmer, *OrNS* **29** (1960)).

Bruins, Evert M. A contribution to the interpretation of Babylonian mathematics; triangles with regular sides. *IndM* **15** (1953), pp. 412–422.

Shows that there are, basically, only two Pythagorean triples *a,b,c* with the diagonal *c* and one of the sides regular: 3,4,5 and 7,24,25, Proceeds to make an analysis of the data in the algebraic text *AO 6484* and in the geometric text *BM 34568*, both related to the theory of Pythagorean triples.

Bruins, Evert M. La classification des nombres dans les mathématiques babyloniennes. *RA* **47** (1953), pp. 185–188.

The discussion here is based on B.'s interpretation (probably not correct) in *Sumer* **9** (1953), pp. 241–253 of the edge inscription on *IM 52301*.

Falkenstein, Adam. Die babylonische Schule. *Saeculum* **4**(2) (1953), pp. 125–137.

Cf. Sjöberg, *AS* **20** (1975). In particular, F. gives improved readings of some interesting passages discussed in Ungnad, *ZA* **31** (1917) and Kramer, *JAOS* **69** (1949).

Bruins, Evert M. Revision of the mathematical texts from Tell Harmal. *Sumer* **9** (1953), pp. 241–253.

A critical review of the text interpretations in Baqir (1950), (1951). Of particular interest is the claim that the inscription on the edge of *IM 52301* (Baqir, *Sumer* **6** (1950)) is a verbal description of a method (usually ascribed to Heron) for the approximate extraction of square roots.[It is equally possible, however, that the

method described is the well documented "agrimensor" method for the approximate computation of areas of quadrilaterals!]. In two appendices are published (in transliteration only) *IM 53963*, *IM 31247* [from Tell Harmal?], with a series of geometric problems leading to quadratic systems.

Bruins, Evert M. Three geometrical problems. *Sumer* **9** (1953), pp. 255–259.
B. publishes here:

IM 43996, with the master's original and the student's copy of a drawing of a trisected triangle [possibly an approximative solution to the problem of dividing a triangle into three parallel strips of areas A, 2A, A, using the approximation $\sqrt{3} \approx 1.45$; the widths of the strips are then 2(00), 1 30, 30]; cf. the photo in Bruins, *CCPV* **1**/3 (1964).

IM 31248 [from Tell Harmal ?], with on one side a triangle divided into strips of widths 3, 1, 3, 1, 3, and on the other side a problem in which a trapezoid (?) is divided into strips of widths 40, 20, 10, 10; in this text appears the Accadian variant *pa-ni n*, etc., instead of the more common i g i *n* or, in other Tell Harmal texts, i - g i *n*.

Bruins, Evert M. Some mathematical texts. *Sumer* **10** (1954), pp. 55–61.

Mentions the following new table texts: *IM 52001*, a table of square roots on a three-sided prism; *IM 5436*, *IM 54216*, *IM 52548*, *IM 55111*, four single multiplication tables, and *IM 55292*, *IM 52879*, parts of combined multiplication tables, some of these with interesting mistakes in the text; *IM 54486*, a metrological table for silver (?).

In addition are published here (in transliteration only): *IM 54472*, illustrating the use of the *makṣarum* method of *YBC 6295* (*MCT* (1945)) for extraction of square roots; *IM 31210*, written in six columns, with eight preserved problems concerned with division of money. In particular, problem 2 uses the method of false position to solve a problem in terms of an arithmetic progression (with the terms *meḫrum* for "false value" and *i-ba-ni-kum* for "correction factor"; problem 3 is a damaged problem about "three purses"; problem 4, which again uses false position, is a strangely phrased exercise in counting with fractions; problem 5 is a nicely arranged problem for an arithmetic progression, in which appears the phrase UR.TA.MA.BU, of unknown meaning.

Unknown is also the meaning of the terms BAR and BAR.BI appearing in several of the problems. The paper ends with a discussion of *IM 52672*, with its brief list of types of quadratic systems, resembling the sections 1A, 1B in Goetze's "compendium" (Goetze, *Sumer* **7** (1951)).

Bruins, Evert M., and Rutten, Marguerite. La notation des fractions, un nouveau texte de série. *CREA* **3** ((1952)1954).

See Bruins and Rutten (1961), TMS 5 (Aa).

Gadd, Cyril John. Inscribed prisms of Sargon II from Nimrud. *Iraq* **16** (1954), pp. 173*ff.*

Col.6 lines 27–24 (pp. 186–187, pl. 43, 47): see Powell, *JCS* (1982).

Rundgren, Frithiof. Parallelen zu akk. *šinēpum* "⅔". *JCS* **9** (1955), pp. 29–30.

Bruins, Evert M. On the system of Babylonian geometry. *Sumer* **11** (1955), pp. 44–49.

Contains a discussion, to be continued in several other of B.'s papers, of how OB mathematicians were able to obtain significant geometrical results, for instance a derivation of the Pythagorean theorem without recourse to the concepts of angle and of parallel lines.

Bruins, Evert M. Pythagorean triads in Babylonian mathematics. The errors on Plimpton 322. *Sumer* **11** (1955), pp. 117–121.

Points out the use of an empty space for medial zeros in *Plimpton 322*, discusses the generating formula for Pythagorean triples used in the same text, and gives references to related texts. In addition, B. gives here a convincing and illuminating explanation of the error in the second line of the text.

Huber, Peter. Zu einem mathematischen Keilschrifttext (VAT 8512). *Isis* **46** (1955), pp. 104–106.

Cf. Gandz, *Osiris* **8** ((1938)1948).

Vaĭman, A. A. Ermitaznaya klinopisnaya matematičeskaya tablička Nº 015189. *EV* **10** (1955), pp. 71–83.

Presents in full detail the OB (?) tablet *Erm 015189* (from the Ermitage, Leningrad) with a sequence of drawings illustrating the use of similarity to set up a series of exercises from a single set of data. The exercises in this case are related to the "composite trapezoid partition problem" and are based on the pair of "Babylonian triples" 1,5,7 and 7,13,17.

Sachs, Abraham Joseph. *LBAT = Late Babylonian astronomical and related texts*, copied by T. G. Pinches and J. N. Strassmaier, prepared for publication by A. J. Sachs with the co-operation of J. Schaumberger.) Providence 1955.

Contains mainly texts of astronomical interest. (Thus, for instance, no. 1–159 deal with mathematical astronomy; cf. Neugebauer, *ACT* (1955)[6]). However, no. 1631–1646 are tablets or fragments with tables of reciprocals or squares of regular sexagesimal numbers, in some cases with computations with such numbers. Cf. Vaĭman, *ŠVM* (1961), Aaboe, *JCS* **19** (1965), Friberg, *DMG* 1980-3). Small fragments of problem texts are no. 1647–1648.

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[6] JH: That is, Otto Neugebauer, *Astronomical Cuneiform Texts: Babylonian Ephemerides of the Seleucid Period for the Motion of the Sun, the Moon, and the Planets*. London 1955.

Veselovskiĭ, I. N. Vavilonskaya matematika 1. *TIIET* **5** (1955), 241–303.

A very critical review of, in particular, the theories of Neugebauer and H. Lewy concerning the origin of the Sumero-Babylonian sexagesimal system.

Goff, Beatrice L., and Buchanan, Briggs. A tablet of the Uruk period in the Goucher College collection. *JNES* **15** (1956), p. 231–325.

Presents Goucher College tablet no. 869, a tablet of a transitional type between the "numerical tablets" and the inscribed tablets from the Uruk IVa period. The tablet is inscribed with the single sign ∧ (probably denoting some kind of animal). It features the number 24 (?), and it is covered by interesting seal impressions.

Meyer, Gerhard Rudolf. *Durch vier Jahrtausende altvorderasiatischer Kultur* (1st edition). Berlin 1956.

P. 155: photo of the metrological table *VAT 9840+9889* (see Schroeder, *KAV* (1920)).

Hallock, Richard T., and Landsberger, Benno. Neobabylonian grammatical texts, in *MSL* **4**. Rome 1956.

Pp. 163–165 (text IV): a bilingual lexical text, published in Langdon, *JSOR* **1** (1917), and containing a strange list of number words (cf. Thureau-Dangin, *RA* **25** (1928), pp. 119–121.

Oppenheim, A. Leo. *CAD = The Assyrian Dictionary of the University of Chicago* (Ḫ). Chicago 1956.

P. 74: *ḫamuštu*. See Brinkman, *OrNS* **32** (1963), *JNES* **24** (1965).

Sollberger, Edmond. *Corpus des inscriptions « royales » présargoniques de Lagaš*. Genève 1956.

Ent. 28–29 = cones A–B: note in B. II, 15–18 the passage gán ^{d}N i n - g i r - s u - k a | 3 30 ½ e š é GAR.DU | á GIŠ.ḪU^{ki} | m u - k i which ought to be translated as follows 'the land of Ningirsu, 3 35 n i n d a n [!] to the side of Umma he cut off' (cf. the discussion in Allotte de la Fuÿe, *RA* **12** (1915) of notations for length measure in pre-Sargonic Lagas). The famous enigmatic passage in B. III, 3–11, B. IV, 39, involving big capacity numbers may have found its proper interpretation, finally, through a new translation of the phrase k u d - r á b a - ú š (see my review of Steinkeller, *JESHO* **24** (1981)).

Ent. 32 I and Ukg. 5 VIII, 5-6: examples of the phrase š à - l ú - š a r ' u - t a, etc.; cf. Edzard, *Sumer* **15** (1959). Ent. 34 Vase D: cf. Thureau-Dangin, *ZA* **17** (1903). Further references in Borger, *HKL* **1** (1967), p. 497.

Smith, Sidney, and Wiseman, Donald J. *CCT = Cuneiform texts from Cappadocian tablets in the British Museum* **5**. London 1956.

BM 120508, BM 120508A (pl. 20): cf. Brinkman, *OrNS* **32** (1963), (1965).

Landsberger, Benno. *MSL* **5** = *The series HAR-ra * kubullu, tablets I–IV*). Rome 1957.

Tablet II contains long lists of terms appearing also in mathematical texts concerned with measuring, storing, buying and selling (II.129, KI.LAM // *ma-ḫi-ru*), and surveying (col. II, 228–251, a n - t a // *e-liš* 'above', ..., u š - s a g // *šid-du-pu-u-tum* 'rectangle(!)'. Tablet IV gives the names of instruments for measuring or computation, such as in col. IV, 10, g i š - d i b - d i b // *maš-tak-tum* 'water clock(?)', and in col. IV, 16*ff*: g i š - ŠID-*ma* // *iṣ-ṣi-mi-nu-ti* 'counting sticks(?)', etc. (cf. Delitzsch, *AL*^{3} (1885), Lieberman, *AJA* **84** (1980)).

Borger, Rykle. niṣirti bārûti, Geheimlehre der Haruspizin (Zu Neugebauer-Sachs, MCT, V und W, und einigen verwandten Texten). *BiOr* **14** (1957), pp. 190–195.

Shows the non-mathematical character of the texts MCT (1945) V and W.

Huber, Peter. Bemerkungen über mathematische Keilschrifttexte. *EM* **3** (1957), pp. 19–27.

(1) Suggests the use of a factorization method in some of the stages of the construction of the tables on Plimpton 322. (2) Shows that the mysterious text *Ist S 428* (Cf. Oppert, *CRAIB* (1902)) is an example of the use of the *makṣarum* method for extraction of square roots through factorization. (Cf. Friberg *HM* **8** (1981), pp. 177–318.)

Caratini, Roger. Quadrature du cercle et quadrature des lunules en Mésopotamie. *RA* **51** (1957), pp. 11–20.

On the drawings on BM 15285 (Neugebauer, *MKT* **1** (1935), p. 137), and the indications they give of a Babylonian "circle geometry" with possiblible affinities to the much later Greek geometry (cf. the "lunes of Hippocrates").

Vaĭman, A. A. Vavilonskie čisla 'Babylonian numbers'. *IMI* **10** (1957), pp. 587–589.

Cf. the corresponding sections in Vaĭman, *ŠVM* (1961) (pp. 195–206).

Goetze, Albrecht. Old Babylonian documents from Sippar in the collection of the Catholic University of America. *JCS* **11** (1957), pp. 15–40.

No. 33 (*CUA 34*) contains a series of area computations, arranged in tabular form with the headings u š, s a g, a š à.

Neugebauer, Otto. *ESA*^{2} = *The exact sciences in antiquity*, 2nd edition. Providence 1957. (1st edition Princeton 1952;[7] Dover edition New York 1969).

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[7] JH: Actually, the first edition was originally published Copenhagen 1951 as *Acta historica scientiarum naturalium et medicinalium* vol. **9**.

Chapter I: Numbers. II: Babylonian mathematics. III: The sources; their decipherment and evaluation. IV: Egyptian mathematics and astronomy. V: Babylonian astronomy. VI: Origin and transmission of Hellenistic science. App.I: The Ptolemaic system. II: On Greek mathematics. What new material is contained in this book is mostly confined to the extensive and very informative "notes and references" after each chapter. Of particular interest among the illustrations are the two photos on pl. 9 of the tablet YBC 4712 before and after cleaning (a hand copy of the same tablet can be found on pl. 8).

Vaĭman, A. A. Ermitažnaya klinopisnaya matematičeskaya tablička N° 15188. *EV* **12** (1958), pp. 89–93.
Gives a reconstruction of the slightly damaged text on the lenticular tablet *Erm 15188*, with its drawing of a triangle divided into parallel strips. A similar drawing on *IM 43996* (Bruins, *Sumer* **9** (1953)) is used as a reference.

Vogel, Kurt. Ist die babylonische Mathematik sumerisch oder akkadisch; *MN* **18** (1958), pp. 377–382.
It is argued here that Babylonian mathematics was inherited from the Sumerians. This opinion is based on (1) the fact that the overwhelming majority of technical terms (words, ideograms, entire phrases) in Babylonian mathematics are of Babylonian[8] origin, and (2) the assumption that the use in Babylonian mathematical texts of words like "upper", etc., for what is really "left", etc., shows that the origin of Babylonian mathematics can be back-dated to before the time when the orientation of the cuneiform script was changed, i.e., presumably to some time early in the period of Sumerian domination. (For a contrasting opinion, see the interesting paper by Picchioni, *OrNS* **49** (1980).)

Lacheman, Ernest-R. *HSS* **14–16** = *Excavations at Nuzi*). Cambridge 1950–1958. See Oppenheim, *JNES* **17** (1958), Zaccagnini, *OrAnt* **14** (1975).

Oppenheim, A. Leo. On an operational device in Mesopotamian bureaucracy. *JNES* **17** (1958), pp. 121–128.
In a review of Lacheman, *HSS* **16** (1958), O. observes the importance of *HSS* **16** no. 449, a hollow egg of clay which when found contained 48 little stones, and which bears an inscription enumerating 48 animals of various kinds. This and several other texts from Nuzi (of the middle of the second millennium) shows clearly that small "stones" were used together with written records as a simple recording device to control the transfer of animals, etc. Examples: *HSS* **16** no. 282: *annûtu ša nadnu ina* NA_4.MEŠ-*ti la nadû* 'these have been handed over but not deposited among the stones'; *HSS* **14** no. 508: NA_4.MEŠ-*šu-nu la*

[8] JH: *sic* – evidently meant as "Sumerian".

šu-bal-ki-tum ‘their stones have not been transferred’. O. remarks also that in Ḫḫ tablet IV, 16*f* the entries g i š.ŠID.m a = *iṣ-ṣi mi-nu-ti* and g i š . n i g.ŠID = MIN *nik-kás-si* may refer to counting boards on which “stones” were used as counters. (See Landsberger, *MSL* **5** (1957).)

Hackman, George Gottlob. *BIN* **8** = *Sumerian and Akkadian administrative texts from predynastic times to the end of the Akkad dynasty*). New Haven 1958.

No. 3, 5: texts from the Jemdet Nasr period, used in Friberg, *DMG* (1978–9) to demonstrate that in the JN system of capacity measures the sign  has the value 6 (indeed, in no. 3 it is plainly seen that ).

No. 4: another JN text, probably a seed-grain account (see Friberg, *DMG* (1979–15)); note that the two capacity numbers on the obverse are $472 = 8\times59$ and $519\,{}^{1}\!/_{5} = 8\times{}^{11}\!/_{10}\times59$ capacity units, respectively, which implies the presence of a “constant factor” ${}^{10}\!/_{11}$ in this text, to be compared with for instance the factor ${}^{5}\!/_{6} = {}^{10}\!/_{12}$ in the seed grain text *CS 86* (Umma, see my commentary to Pettinato and Waetzoldt, *StOr* **46** (1975)).

No. 24 (according to H. from the Fara period or slightly younger, perhaps contemporary with the texts *OIP* **14**, no. 49–77, Luckenbill, *Adab* (1930)): [after correction of errors in H.’s copy, it seems to be clear that this text is a close parallel to the mathematical exercise (?) *OIP* **14**, no. 116 – in fact, a field in the form of a trapezoid, of area 4 b ù r = 2 00 00 š a r, with the long side (i.e., the height) equal to 5 30 (!) = 30×11 n i n d a n, and one short side to 22 = 2×11 n i n d a n, would have the remaining short side equal to the solution of the equation $\tfrac{1}{2}\times(x+22)\times 5\ 30 = 2\ 00\ 00$, or $x+22 = 8\ 00\ 00/11 \approx 8\times 5\ 27 = 43\ 36$, so that $x \approx 43\tfrac{1}{2}-22 = 22\tfrac{1}{2}$, which is the length of this side given in the text]; in the second half of the same text, the yield (?) of the field is computed according to the formula 1 (i k u)$^{\text{ašag}}$ - b i 1(g u r) 1 (b a r i g a)$^{\text{še gur}}$ - t a ‘1 ¼ g u r per i k u’.

No. 67–68: two “messenger tablets” from about the time of Entemena, with detailed accounts of deliveries of bread and beer “to a number of cities and people”; in these two texts, the ⅓ d u g (of beer) is denoted simply by an “overturned” unit .

No. 81: an account of assignments of lengths (to be excavated?) to a number of officials and workers; in this text we find an early example of the use of the following series of length measures: GAR.DU (n i n d a n), k ù š, GIŠ.BAD (= k ù s), ŠU.BAD (z i p a ḫ), and, possibly, GAR.RA(?).

No. 116: a pre-Sargonic account of grain deliveries (measured in še-gur-l u g a l) to the superintendent of the storehouse (g u r u $_7$), with the unusually compact date formula  (7-1-7 ‘year 7, month 1, day 7’).

No. 49, 54, 62, 111: a sign copied in these texts which looks like some new metrological unit is, in reality, nothing but 2 (b a r i g a); similar problems arise with H.’s copies of the area measures (quoted from Powell, *HUCA* **49** ((1978)1979), p. 6 note 7).

Edzard, Dietz Otto. Königsinschriften des Iraq Museums. *Sumer* **15** (1959), pp. 19–28 + pl. 1–4.

E. claims here that the inscription on the statue of alabaster *IM 8969* from Umma should be read as ^{d}e n - l i l - g i$_4$ p a-GIŠ.BIL.g a l u g a l - š á r × d i š ‘for Enlil, Pabilga, king of the 60 š á r (?)’, where the phrase l u g a l - š á r × d i š (or l u g a l - š á r × g e š the sign is written ) seems to have been an honorary title for the kings of Umma. E. quotes also the variations of the phrase ... š à - l ú - š à r (š a r ’ u) - t a š u - n i b a - t a - a n - d a b$_5$ - b a - a ‘as the hand (of Ningirsu) had chosen him out of 3600 (×10) men’ in inscriptions of Entemena, Uru-KA-gina, and Gudea (cf. Sollberger, *Corpus* (1956), de Sarzec, *DC* **2** (1884)).

Geršman, I.G. Nerazrešennye voprosy vavilonskoĭ metrologii ‘Unresolved problems in Babylonian metrology’. *VDI* **68** (1959), pp. 100–112.

(1) On partitioning of time and work norms in ancient Babylonia. (2) On norms for plowing and seeding in the OB period. (3) The evolution of the capacity measure system in the most ancient period of the history of Babylonia. (4) The role of hoes for working the soil in the OB epoch.

Vaĭman, A. A. O geometričeskoĭ figure absamikku klinopisnyh matematičeskih tekstov ‘On the geometric figure absamikku in cuneiform mathematical texts’. *VDI* **68** (1959), pp. 91–94.

Several parameters associated with the geometric figure *absammikku* (GÁN-ZÀ-MÍ, etc.) appear in the Babylonian lists of constants, and in some problem texts (see Bruins and Rutten, *TMS* (1961)). V. suggests here that the figure may be a “skew trapezoid” and gives two possible reconstructions of it.

Vygodskiĭ, M. Ya. Proishoždenie znaka nulya v vavilonskoĭ numeracii ‘The origin of the zero in Babylonian numeration’. *IMI* **12** (1959), pp. 393–420.

A detailed analysis of the handling of “medial zeros” in Babylonian mathematical texts from the Seleucid period (the six-place table *AO 6456*), the Neo-Babylonian period(?) (*W 1931–38*, Neugebauer, *MKT* **1** (1935), p. 72; *CBS 1535*, *MCT* (1945), p. 34), the Kassite period (*HS 214a* = Hilprecht, *BE* 2**0**/1 (1906), no. 8), and the OB period (*Plimpton 322*, Neugebauer and Sachs, *MCT* (1945), p. 38). V. emphasises that the special sign for “zero” in the later texts, as well as the empty space, could be used for various purposes: to replace missing units, as in 1. 24 for 10 24, or missing tens, as in 12 .4 for 12 04, or missing sexagesimal places as in 10 . 24 for 10 00 24.

Vogel, Kurt. *Vorgriechische Mathematik*. **1** *Vorgeschichte und Ägypten*; **2** *Die Mathematik der Babylonier*. Hannover & Paderborn, 1958–1959.

Contains a brief but good introduction to Babylonian mathematics.

1960–1970

Kilmer, Anne Draffkorn. Two new lists of key numbers for mathematical operations. *OrNS* **29** (1960), pp. 273–308 + 3 pl.

Publishes (in photographs but no hand copies) two new lists of constants: *A 3553*, a brief, intact list (50 entries) of the usual OB type, and *CBS 10996*, a less well preserved Kassite list with sections for: the strings of some musical instrument, boat loads of bricks and reeds, measuring vessels (very obscure), sesame, astronomy, pomegranates, irrigation, wagon loads, and geometry(?). The paper includes also a concordance of all known lists of constants, with an index of Akkadian words in the lists and a Sumerian cross-reference to the Akkadian index.

Resina, Giuseppe. *Sumer e Akkad: Metrologia*. Catania 1960.

Contains, in particular, several references to the Code of Hammurabi (cf. Scheil, *SFS* (1902)). (Cf. the references in Borger, *HKL* **1** (1967), p. 89.)

von Soden, Wolfram. Zweisprachigkeit in der geistigen Kultur Babyloniens. *SÖAW* **235** (1960), pp. 3–33.

Says, in a section on Babylonian mathematics (pp. 26–32): “In the history of intellectual manifestations, Babylonian mathematics is irrevocably a one time phenomenon, both in terms of its achievements, and with respect to its narrow limitations, and it has by no means been a necessary station on the road from primitive methods of computation to scientific mathematics in the modern sense”.

Vaĭman, A. A. Vavilonskie geometričeskie risunki prostranstvennyh figur ‘Babylonian geometric drawings of solid figures’. *IMI* **13** (1960), pp. 379–382.

In this survey, V. points out that of six drawings of three-dimensional figures in cuneiform mathematical texts, three are drawn in a simple perspective from above (the ring wall in *BM 85194* problem 4, the triangular fundament in *BM 85196* problem 1, the water reservoir in *Erm 15073* problem 5, Vaĭman, *ŠVM* (1961), p. 234). The remaining three are what V. calls “symbolic” drawings with no clear perspective (the dams with trapezoidal cross sections in *Erm 15073* problem 6 and problem 7(?), and the siege ramp in *BM 85196* problem 17).

Landsberger, Benno. Einige unerkannt gebliebene oder verkannte Nomina des Akkadischen 1. *ūṭu* = “halbe Elle”, “Spanne”. *WZKM* **56** (1960), pp. 109–112.

L. takes as the starting-point for his discussion the line in the small lexical text from Assur (Thureau-Dangin (1926)) which says: 15 š u - s i // ½ $^{\text{ú-[tu]}}$k ù š, and then proceeds to discuss the appearance in various lexical texts of equations for the parts of the cubit: ŠU.BAD = zipaḫ = *ūṭu* (Nuzi, NB), *rūṭu* (NA) = ½ cubit; š u - d ù - a = *šizū* = ⅓ cubit. Noteworthy is that the measure unit š u - d ù - a

was out of use already at the time of Sargon of Akkad, and the unit ŠU.BAD not much later; in spite of this both terms appear in the considerably younger lexical texts available to us.

Vaĭman, A. A. Über die sumerisch-babylonische angewandte Mathematik. *25th Congress* 1960.

V. sketches here a program for future studies in Sumero-Akkadian mathematics, stressing that it is desirable to consider, much more than has been done before, the relation between cuneiform documents concerned with, respectively, "applied" and theoretical mathematics. In particular, V. suggests that economic and other texts of more or less pronounced mathematical interest, field maps, metrological texts, etc. ought to be collected in one place, in a volume of the MKT type, for ready reference, to be used both by Assyriologists and by people doing research in history of mathematics. As examples of applied texts of mathematical interest are mentioned Legrain, *UET* **3** (1937+1947)), no. 447, no. 1386; Figulla and Martin, *UET* **5** (1953), no. 855–857); and *Erm 15066* (Riftin, *SVYAD* (1937)).

Birot, Maurice. *ARMT* **9** = *Textes administratifs de la salle 5 du palais*. Paris 1960.

No. 299: a table of reciprocals from Mari, with the non-standard first line 1 - t á - a m 2⁄3 bi b i // 40 - à m.

Saggs, Henry William Frederick. A Babylonian geometrical text. *RA* **54** (1960), pp. 131–145.

S. publishes here another large fragment (recently identified by C. J. Gadd) of the OB tablet bearing a number of geometrical diagrams with accompanying texts which originally appeared in Gadd, *RA* **19** (1922) (*BM 15285*; Neugebauer, *MKT* **1** (1935), pp. 137–142). The new fragment adds 14 additional diagrams (+text) to the 15 considered by Gadd in 1922. The paper includes photographs of the joined fragments, hand copies of the texts of the new fragment, plus transliterations and translations of texts from both fragments. In his commentary, S. discusses new technical terms documented in *BM 15285*, such as PAD. TA.(ÀM) *dakašu* 'to construct a border' (cf. Kilmer, *StOpp* (1964)), ÚR.BÀD 'rectangle;' (cf. von Soden, *BiOr* **21** (1964), p. 47 note 5, where the undoubtedly more correct readings *ṣi-li-ip-tum* and *ṣi-il-pa-tum* are suggested, which means that the word *ṣiliptum* 'diagonal' is used here as a substitute for a special word for 'rectangle'), GÁN.GIŠ.KU(?) 'regular concave-sided tetragon'; GÁN.GIŠ. ZA.MI 'figure in the form of a certain musical instrument'; GÁN.UD.GAG. SAR 'kite, peg and semi-circle'; GÁN.GIŠ.BAN 'field of the bow'; GÁN.GIŠ. SAR 'rhomb?'; KA.DA (?), 'circle quadrant?'; and GÁN.GIŠ.MÁ.GUR$_8$ 'boat-shaped figure'. (Cf. Vaĭman, *VDI* (1963).)

Vogel, Kurt. Der “falsche Ansatz” in der babylonischen Mathematik. *MpSB* **7** (1960), pp. 89–95.

V. points out that the barley field problems *VAT 8389*, *VAT 8391*, and the broken cane problem *Str 368*, which were claimed by Thureau-Dangin to be Babylonian examples of the use of the method of “false position” (*RA* **35** (1938), pp. 71–77), are not proper examples of that method. (Cf., however, *BM 13901*, problem 10*ff*, quoted in the same paper.) Instead, V. mentions the examples of the two geometric problems *TMS* 19 (C) (Bruins and Rutten (1961)), and *YBC 4608* problem 1 (Neugebauer and Sachs, *MCT* (1945), p. 49).

Limet, Henri. *Métal = Le travail du métal au pays de Sumer au temps de la III dynastie d’Ur*. Paris 1960.

Pp. 66–74: L. convincingly demonstrates here that the phrase UD.KA.BAR (z a b a r)-*n*-l a l refers to a bronze that is an alloy of (*n*-1) parts copper and one part tin, with *n* between 6 and 10. Examples: in Thureau-Dangin, *RTC* (1903), no. 23 b1 $1\frac{1}{3}$ mina of copper corresponds to $13\frac{1}{3}$ shekel of tin (cf. Hallo, *BiOr* **20** (1963)), hence $n = 7$; in Legrain, *MDP* **14** (1913), no. 35, 5 m a - n a 5 g í n 1 m a - n a - t u r AN.NA (n a g g a ‘tin’) is mixed with $40\frac{2}{3}$ m a - n a 2 g í n m a - n a - t u r of copper, hence $n = 9$ (cf. Hallo, *BiOr* **20** (1963)); this text is a Susa text from the Agade period; in Reisner, *TUT* (1901), no. 124, where a certain loss in the metallurgical process is accounted for, we have k i - l á - b i 1 m a - n a 10 g í n 7 l a l | n e - k ú - b i $4\frac{2}{3}$ g í n | ... | n a g g a - b i 10 g í n $\frac{2}{3}$ | u r u d u - l u ḫ - ḫ a - bi 1 m a - na b i 1 m a - n a 4 g í n ‘weight 1 mina 10 shekels of bronze 7, loss $4\frac{2}{3}$ shekel, tin $10\frac{2}{3}$ shekel, copper 1 mina 4 shekel’ [it is possible to follow the course of the computation here: with a “loss” of $\frac{1}{15}$ of the finished bronze, we see that bronze + loss = (1 10+4.40) g í n = 1 14.40 g í n; one-seventh of this, precisely(!) $10\frac{2}{3}$ shekel, is the required amount of tin, and the copper is 6 times as much, or the 1 mina 4 shekels given in the text];

Pp. 99–109: a section where L. discusses the relative prices of metals, etc. Example: in Pinches, *Amherst* (1908), no. 50, 1 talent $54\frac{1}{3}$ minas $3\frac{1}{3}$ shekel of wool, at 10 minas (of wool per shekel of silver) is said to have a price in copper (!) of $28\frac{1}{2}$ mina 6 shekels of copper, at $2\frac{1}{2}$ minas (of copper per shekel of silver). Cf. also *BM 34568* problem 16 in Neugebauer, *MKT* **3** (1937).

Vaĭman, A. A. Dva klinopisnyh dokumenta o provedenii orositel’nogo kanala ‘Two cuneiform documents about the construction of an irrigation canal’. *TGErm* **5** (*KINV* **6**) (1961), pp. 24–30.

V. shows that the two OB texts *UET* **5** no. 855 and 856 both describe the division of work in connection with the construction of a certain irrigation canal, and that one of the texts is based on preliminary measurements, while the other makes use of more accurate data.

Vaĭman, A. A. *ŠVM* (= *Sumero-vavilonskaya matematika, III-I tysyačeletiya do n.e.* 'Sumero-Babylonian mathematics, third to first millennium BCE'). Moscow 1961.

An excellent introduction to Babylonian mathematics, regrettably available in Russian only. Original contributions by the author are contained in an Appendix with:

(1) A discussion of some of the mathematical texts in *LBAT* (1955): the three-place table of squares *BM 34592* (no. 1637), and several fragments of six-place tables of reciprocals (no. 1632–1635), or squares (no. 1636, 1638–1639, 1641), or regular numbers.

(2) An interpretation of *VAT 2117* (Neugebauer, *MKT* **1** (1935), p. 23) as a table of pairs of regular reciprocals of the form $(20/n)^2$ // $(3n)^2$.

(3) A presentation of the new compilatory problem text *Erm 15073* (late OB), with eight partly preserved problems: problem 1, [a trapezoid partition problem related to the Babylonian triple 1,5,7]; problem 2, a "two-way trapezoid partition problem" for a "false trapezoid" related to the triples 7,13,17 and 7,17,23; problems 4–5, excavation problems for water reservoirs (?); problems 6 and 7(?), volume problems for dam constructions; problem 8, a work division problem [for the building a an earth wall?].

(4) A discussion of the volume text Legrain, *UET* **3** (1937), no. 1386, in which the formula for the work norm is k a l 1-š e u d 1-a 3⅔ 5 g í n - t a '60 man-days = 3.45 š a r' [cf. the i g i - g u b - b a 3 45 for work on an earth wall; the section of the text with the conversion of volume into man-days is introduced by the phrase s a ḫ a r d u$_8$ á giš-gi 'convert the volume (and find) the work equivalent' (?)].

(5) The observation that the exercise Thureau-Dangin, *RTC* (1903), no. 413: c304 is a brick text (bricks of type 1) [the scribbled numbers on the reverse: 6 21 40(!), 3 10 50 indicate the course of the computations and shows that the incorrect result is due to mistaking sexagesimal multiples of one š a r × š u - s i for multiples of one volume-š a r].

(6) A discussion of the four important problem texts (in Sumerian!) *UET* **5** no. 121, no. 858, no. 859, and no. 864 (See Figulla and Martin, *UET* **5** (1953)).

(7) An ingenious new interpretation of the combined trapezoid partition problems *VAT 7531* problems 1–4: V. shows that in all four cases the trapezoids are built up of a rectangle and one or two Pythagorean triangles in a way which is reminiscent of a method for construction of "Heronic triangles", and of the way in which quadrilaterals are built up of Pythagorean triangles in early Hindu mathematical texts (cf. Pottage, *AHES* **11–12** (1973)). The Pythagorean triples used by the author of VAT 7531 are 3,4,5; 7,24,25; and 19,180,181. [It is worth noticing that the pairs 24,25 and 180,181 can be written as $\frac{1}{2}(n^2 \pm 1)$ with $n = 7$ and 19, respectively. Hence two of the three triples have non-regular generating parameters.)

(8) A metrological list on a lenticular tablet (*Emt 15063*, with capacity measures from ⅓ s i l à to 2 b a r i g a 5(b á n).

(9) A table of cube roots, from 1 // 1 to 7 30 // 30.

<u>Bruins</u>, Evert M., and <u>Rutten</u>, Marguerite. *MDP* **34** (*TMS* = *Textes mathématiques de Suse*). Paris 1961.

The final publication of the 26 mathematical texts from Susa (end of the OB period), excavated in 1933 and first announced in Bruins, *IndM* **12** (1950), *CPD* (1951). Only 12 of the texts are offered with photos, otherwise the edition is complete. The texts discussed are:

No. 1, a tablet with a drawing of an isosceles triangle with base b = 1(00) and height h = 40 together with its circumscribed circle of radius R = 31 15; since it can be shown that $R = \frac{1}{2}\,(h + b^2/h)$, and that R, $h–R$,b/2 is a Pythagorean triple if b and h are integers, the text may have been related to a method of constructing Pythagorean triples (cf. Price, *Centaurus* **10** (1964)).

No. 2 obv., a drawing of a regular hexagon made up of six equilateral triangles, with indication of the side $s = R = 30$ and the area A = 6 33 45 of one such triangle, implying the use of the approximation $\sqrt{3} \approx 1.45$ (= $7/4$).

No. 2 rev., a similar drawing of a heptagon made up of seven isosceles triangles with the sides 35 and 30(?); the legend ...*-ma* 7 *a-na* 7 55(?) í l-*ma* | ...*-in si-ra-ti* | *ta-na-as-sa-aḫ-ma* | a - š à ‘multiply 7 into 7 55, you subtract the excess (?), and (you have) the area’ suggests that the height and the area of the isosceles triangles were computed as $10\times\sqrt{10} \approx 31.40$ and 15×31.40 = 7 55, with the use of the approximation $\sqrt{10} \approx 3.10$ (= $19/6$)].

No. 3 (I) is a list of constants with 70 entries and the heading (von Soden, *BiOr* **21** (1964)) i g i - g u b *šà mi-im-ma ka-li-šu* ‘constants for what all you have’; of particular interest are, for instance, constants for the pentagon, the hexagon, and the heptagon (3 41 i g i - g u b *šà* s a g-7), and the capacity/volume ratios 6 *šà na-aš-pa-ak šà-al-šu-di-im* (von Soden, *BiOr* **21** (1964), cf. Postgate, *Iraq* **40** (1978)), 6 40 *šà na-aš-pa-ki-im* (see Vaĭman, *DV* **2** (1976)), 7 12 *šà na-aš-pa-ak guru*₇ (cf. no. 14 (U)), and the cryptic 10 *šà* 1 2 *ù* 1 [indicating, possibly, that an excavated volume equal to 1 kùš × 2 k ù š × 1 n i n d a n would correspond to the usual work norm of 10 g í n].

No. 4 (K), a multiplication table for 25.

No. 5 (Aa), a complex catalogue of linear and quadratic equations or systems (cf. Goetze, *Sumer* **7** (1951), 1A–1B; Friberg, *HM* **8** (1981)); as coefficients in the equations appear a sophisticated set of integers and fractions with a novel type of abbreviated notations (examples: 2 11 7 for $2\times1/11\times1/7$, and 2 3'' 2' 3' 11 7 for $2\times2/3\times1/2\times1/3\times1/11\times1/7$ (where 3'', 2', 3' stand for the usual special notations for ⅔, ½, ⅓). Interesting types of equations are: a-šà

2 u š *ù* a - š à GAR-*ma* 1 15 for $(2x)^2+x^2 = 1\ 15$; 2 l a g a b *muḫ* a - š à 45 d i r i g for $2x–x^2 = 45$, immediately followed by ½ l a g a b *ki-ma* a - š à for $\frac{1}{2}x = x^2$; and, finally, a short series of equations in which a difference $x^2–y^2$ is interpreted geometrically as the area between two squares, called a - š à *dal-ba-ni*. No. 6 (Bb) is of similar type.

No. 7 (A, B) offers two problems dealing with systems of linear equations in two unknowns, with two different methods of solution presented in both cases.

No. 8 (V) contains two simple quadratic equation problems.

No.9 (H) shows how quadratic systems can be reduced to normal form by a change of variables; in one case two different methods are used, the less attractive method being commented by the phrase *ki-a-am Ak-ka-du-ú* 'thus the Akkadian (method)'.

No. 10 (G) and no. 11 (P) contain further quadratic systems, in text G formulated as a silver sharing problem ("two brothers").

No. 12 (M) is a quite sophisticated problem, cleverly interpreted by B., in which the solution of a quadratic system provides the data for first a second, and then a third, quadratic system.

No. 13 (L) is essentially a parallel to the "buy and sell" problem *YBC 4698* problem 9, but with Akkadian instead of Sumerian words, and with a more explicit solution.

No. 14 (U) is concerned with the dimensions of a grain magazine (g u r u $_7$).

No. 15 (E) is a problem in which figures a gate and its dimensions [actually a "double gate" (m i n . k á) (?); in the calculations is used a method for the construction of Pythagorean triples, possibly a parallel to problem 10 of Book 9 in the early Chinese mathematical work *Chiu Chang Suan Shu* (the end of the first millennium B.C.; translated by K. Vogel (1968))].

No. 16 (F) [here two indeterminate linear equations (!) are solved through a method of trial and verification, whereby GI is used as technical term for substitution of the tentative value into the equation].

No. 17 (0) is a simple quadratic system.

No. 18 (S) is a cleverly formulated problem for a bisected triangle [leading to the quadratic system $r\times(s+r) = 14\ 24$, $r^2+s_2 = 20\ 24$, which may have been solved by choosing $(r+s)$ and $2r^2$ as new unknowns].

No. 19 (C) is a geometric problem, solved by application of the Pythagorean theorem and the method of false position. No. 19 (D) is a strange geometric algebraic problem leading to the system of equations $ab = 20$, $b^3c = 14\ 48\ 53\ 20$, a,b,c a Pythagorean triple [the system seems to have been reduced to a quadratic system of standard type: $uv = 3\ 39\ 28\ 43\ 27\ 24\ 26\ 40$, $u–v = 6\ 40$, by choosing as new unknowns $u = b^2c^2$, $v = b^2b^2$].

No. 20 (Z) contains the equation "area+length+diagonal of an *abusamiku*" = 1 16 40, or $Au^2+u+du = 1\ 16\ 40$, where A and d are the area and diagonal of

the *abisamiku* with "lengt" $u = 1$. No. 21 (R) is another text dealing with the dimensions of the *abusamiku*.

No. 22 (Q) is a text where a debt of 1 31 58 48 (g u r ?) at an interest rate of $^3/_7$ of the current capital C (written as $^1/_2(C–C/2)$) is amortized by 4 annual payments of 1(g u r ?) each.

No. 23 (T) is a unique text displaying two different methods of solving a very sophisticated "iterated trapezoid partition problem"; a probable implication of the text is that OB mathematicians knew that if a,b,c is a Pythagorean triple and x,y,z a Babylonian triple, then $bx–ay$, $ax+by$, cz is a second Babylonian triple, and that there is a geometric interpretation of this relation between two Babylonian triples!

No. 24 (W) deals with an excavation, *ka-la-ak-ku*; it is remarkable that this text contains the earliest documented cases of the use of a separation sign (here GAM) for medial zeros, as in 1 10 GAM 18 45 for 1 10 18 45, 14 GAM 3 45 for 14 03 45, and 20 GAM 3 13 21 33 45 for 20 03 13 21 33 45.

No. 25 (U) is an irrigation problem (?), involving the constant of a small canal: 48 i g i - g u b p a $_5$ and a problem about a wooden log (?).

No. 26 (Y) contains various (damaged) trapezoid partition problems (cf. the many improved readings in the critical review of Bruins and Rutten, *TMS* (1961) in von Soden, *BiOr* **21** (1964)).

Becker, Oskar. Die Bedeutung des Wertes 3 $^1/_8$ für π in der babylonischen Mathematik. *PrM* **3** (1961), pp. 58–62.

Suggests, following an idea due to K. Vogel, that the OB approximations 3 and 3 $^1/_8$ to the circle constant π may have been deduced from the dimensions of the regular hexagon and the regular dekagon, respectively. [A much simpler suggestion is that the approximation 4 48 (= $^2/_{25}$) for $^1/_{4\pi}$ was chosen because it is the two-place regular sexagesimal number which is closest to the best value that could be obtained through careful measurement of the ratio area : circumference^2.]

von Soden, Wolfram. Die Zahlen 20–90 im Semitischen und der Status absolutus. *WZKM* **57** (1961), pp. 24–28.

van der Waerden, Bartel Leendert. *Science awakening* 1, Leiden (1954^1), 1961^2 (*Erwachende Wissenschaft*, Basel/Stuttgart 1956); 2, Leyden/New York 1974 (*Anfänge der Astronomie Groningen* 1966).

In part 1, Chapter 2 (Number systems, digits and the art of computing) one finds, in particular, photos of the table of squares *VAT 15293* (Deimel, *Inschr.Fara* 2 (1923)), and of the exercise tablet *YBC 7289* with its famous approximation of √2 (Neugebauer and Sachs, *MCT* (1945)). Chapter 3, on Babylonian mathematics, contains, in particular, a renewed discussion of the first, "abstract"

problem on *AO 6770*, here called a "lesson-text" (cf. Thureau-Dangin, *RA* **33** (1936), pp. 75*ff*; Bruins, *RA* **62** (1968)).

Part 2 contains, in particular, Chapter 2, Old-Babylonian astronomy. Chapter 3, The Assyrian period. Chapter 4, The neo-Babylonian and Persian period. Chapter 6, Theory of the moon. Chapter 7, Babylonian planetary theory. Chapter 8, The spread of Babylonian astronomy. Note, for instance, the star map (Fig. 7) depicting the constellation mul*ikû*, "the dwelling-place of Ea" (= the "rectangle of Pegasus").

Bruins, Evert M. Interpretation of cuneiform mathematics. *Physis* **4** (1962), pp. 277–341.

A survey of recent results. P. 304: a photo of *MAH 16055* (Bruins, *CPD* (1951)).

Baqir, Taha. Tell Dhiba'i: New mathematical texts. *Sumer* **18** (1962), pp. 11–14 + 3 pl.

Presents the OB text *Db$_2$-146*, with a simple quadratic system for the sides of a Pythagorean triangle, illustrated by a drawing of a rectangle divided by its diagonal into two subtriangles.

Seidenberg, A. The sixty-system of Sumer. *AHES* **2** (1962–1966), pp. 436–440.

Vaĭman, A. A. Vavilonskaya geometriya racional'nyh otrezkov 'The Babylonian geometry of rational segments'. *VIFMN* (1963), pp. 83–89.

Points out that it is characteristic of Babylonian geometry to deal only with problems such that data and solutions alike are represented by rational numbers. Examples: In MAH 16005 (Bruins, *CPD* (1951)), a right triangle is divided into three strips such that the first and the third have equal areas; the problem to divide a right triangle into two strips of equal area does not have any (rational) solution. In *TMS* no. 23 (T) are given two methods of dividing a trapezoid into four strips in such a way that the first and the fourth have equal areas, and also the second and the third; the problem to divide a trapezoid into three or more strips of equal area does not have any (rational) solution. V. concludes by making the remark that *TMS* no. 23 (T) actually may be concerned with a "false trapezoid", that is, with a solution of a "two way trapezoid partition problem".

Vaĭman, A. A. Istolkovanie geometričeskih postoyannyh iz suzskogo klinopisnogo spiska I (Suzy) (Interpretation of the geometric constants in the cuneiform tablet I from Susa). *VDI* (1963 no. 1), pp. 75–86.

According to V., the list of constants on Bruins and Rutten, *TMS* (1961), no. 3 (I) includes constants for area (i g i - g u b), diameter (DAL), and transversal (*pi-ir-ku*) of, in lines 2–4, circles (*šà* g u r); lines 7–9, "crescents" (*šà uš-qa-ri*) (cf. the interpretation suggested by Bruins in Bruins and Rutten, *TMS* (1961) – half-circles); lines 10–12, "bows" (*šà* GAN *pa-na-ak-ki*) (Bruins – one-third-circles); lines 13–15, "boats" (*šà* GÁN GIŠ.MÁ) (Bruins – GIŠ.RU "bows"); lines 16–

18, "grains" (*šà* a - š à š e) (Bruins – quarter-circles?); lines 19–20, "ox eyes" (š à i g i - g u d); lines 22–24, [tambourines (?)] (*šà a-bu-sà-am-mi-ki*), explained by V. to be "concave squares" [cf. C. Engel, *Music of the most ancient nations*. London 1929, Figs. 64, 66]; line 25, "triangular tambourines (?)" (*ša a-bu-sà-am-mi-ki šà* 3); line 30, squares obliquely inscribed in bigger squares (*ša* š á r) (Bruins – "perfect circles"). Unexplained remain lines 5–6, "circles with 2 (or 3) grains inscribed" (*šà* g ú r *šà* 2(3) š e *i-na* s a g $_4$. g ú r GAR).

Gundlach, Karl-Bernhard, and von Soden, Wolfram. Einige altbabylonische Texte zur Lösung "quadratischer Gleichungen". *AMSH* **26** (1963), pp. 248–263.

Contains improved transliterations and translations, and a renewed analysis, of the Tell Harmal text *IM 52301* (Baqir (1950)) and the Susa text no. 13 (L) (Bruins and Rutten, *TMS* (1961)).

Guitel, Geneviève. Signification mathématique d'une tablette sumérienne. *RA* **57** (1963), pp. 145–150.

G. is here the first one to point out the mathematical significance of the School text *TSŠ* (1937) no. 50 (see Powell, *HM* **3** (1976)).

Pinches, Teophilus Goldridge. *CT* **44** (*Miscellaneous texts*). London 1963.

No. 38, a multiplication table for 44 26 40. No. 39, *BM 80209*, a catalogue of quadratic equations (see Friberg, *JCS* ***33*** (1981)). No. 40, a metrological table for length measures (1 š u - s i // 10 to 10 n i n d a n // 10; basic unit 1 n i n d a n). No. 41, no. 42: combined multiplication tables (= Neugebauer, *MKT* **1** (1935), p. 49 note 105, p. 59 note 137; see also Neugebauer, *MKT* **1** (1935), p. 23 concerning the algorithm text at the end of the table).

Neugebauer, Otto. The survival of Babylonian methods in the exact sciences of Antiquity and Middle Ages. *PAPS* **107** (1963), pp. 528–535.

Says, in particular, about Babylonian mathematics: "Since we have mathematical cuneiform texts from the Seleucid period and since Greek and Demotic papyri from the Greco-Roman period in Egypt show knowledge of essentially the same basic material, one can no longer doubt that the discoveries of the Old Babylonian period had long since become common mathematical knowledge all over the ancient Near East."

Hulin, Peter. A table of reciprocals with Sumerian spellings. *JCS* **17** (1963), pp. 72–76.

Here is presented the Sultantepe tablet *ST 399* (*S.U.* **52**/5), a table of reciprocals differing from the "standard tables" by spelling out many of the numbers and fractions in Sumerian (cf. in this respect the less elaborate phonetic spellings in *Ist S 485*, Neugebauer, *MKT* **1** (1935), p. 26; both texts are discussed extensively in Powell, *SNM* (1971), pp. 58–69). The text seems to be corrupt in several places; H. conjectures that it is a copy of a damaged tablet, and that the scribe was working from dictation. In particular, there is a frequent coalescing of the first sibilants of fraction names with the last of the preceding number words. A typical example is igi *ḫi-pí* gál-bi for 'the reciprocal of [36] is one-and-two-thirds'. This example, by the way, should be compared with, for instance, igi me-nu šu-u|igi e-šá gál-bi šu-šá-an 'the reciprocal of two is one-half, the reciprocal of three is one-third'. [The three examples together show that a table of reciprocals is not a division table for either 1 or 60, but rather a table of complementary numbers whose product is equal to "1".] Interesting, finally, is also H.'s remark that the omission of gál-bi in the entries for the reciprocals of 2 and 9 is closely paralleled by similar omissions in the same two entries in *Ist S 485*.

Hallo, William W. Review of *Le travail du métal au pays de Sumer*, Limet 1960. *BiOr* **20** (1963), pp. 136*ff.*

P. 38: H. suggests here that the silver ḫar in Ur III texts may have denoted armbands or bracelets designed so that pieces of desired weight could be broken off, and therefore precursors of coined money (cf. Powell, *Festschr. Matouš* (1978)).

P. 139: here are offered improvements of the interpretations in Limet, *Métal* (1960) of the metal texts Thureau-Dangin, *RTC* (1903), no. 23 and Legrain, *MDP* **14** (1913), no. 35; in particular, H. points out that the latter text gives a confirmation of the value 60 še ($\frac{1}{3}$ gín) for the *ma-na-tur*, which was suggested, on somewhat loose grounds, in Thureau-Dangin, *OLZ* **12** (1909). On the other hand, the documentation existing for the value 3 še for the gín-tur seems to be inadequate, and it is asked if it not possible that the gín-tur was instead the predecessor of the še ($\frac{1}{180}$ shekel).

Brinkman, John A. New evidence on Old Assyrian *ḫamuštum*. *OrNS* **32** (1963), pp. 387–394. Note on Old Assyrian *ḫamuštum*. *JNES* **24** (1965), pp. 118–120.

The first of these two papers is a survey of older and younger theories about the contested meaning of the word *ḫamuštum* in Old Assyrian texts from Cappadocia. It gives also B.'s own view on the subject, essentially based on a comparison of the inscriptions on the loan tablet *BM 120508* and its envelope Smith and Wiseman, *CCT* **5** (1956), no. 20b, where $\frac{1}{2}$ mina *a-na* 20 *ḫa-am-ša-tim* carries an interest described on the tablet itself as 1 $\frac{1}{2}$ gín-ta *ṣí-ip-tám* | *a-na* 1 ma-na *im* | *i-na* iti-kam, i.e., '1 $\frac{1}{2}$ shekel interest per mina and month', but on the envelope as 5 gín kù.babbar *ṣí-ip-tam*. Since at the given rate of interest (2.5% per month!) an interest of 5 shekel would accumulate after 6 $\frac{2}{3}$ = $\frac{20}{3}$ months, B. concludes that the *ḫamuštu* = 10 days.

[Hovever, in the second paper, the reading 5 gín is corrected, after collation., to ⌈2?⌉ $\frac{1}{2}$ gín, which invalidates the argument above. Cf. the example in Oppenheim, *CAD* (ḫ) (1956), p. 74, sub *ḫamuštu*, c), *ša* 5 ma-na *kaspim ša* 8 *ḫa-am-ša-tim ù ša-pá-tim* $\frac{2}{3}$ gín 15 še *ṣibtam alqi* (Kültepe 651), where the interest rate of ⅔ shekel 15 š e corresponds exactly to the interest for a five-day period which, compounded over a whole year, gives the accumulated rate of 12 shekel per mina and year, i.e., the rate of interest known from, for instance, the mathematical problem texts *VAT 8521*, *VAT 8528* (Neugebauer, *MKT* **1** (1935)).

Hirsch, Hans. Die Inschriften der Könige von Agade. *AfO* **20** (1963), pp. 1–82.
H. gives here new transliterations and translations of the "inscriptions of the kings of Agade" (see Legrain, *PBS* **15** (1926)), in the sections named 'Sargon b 1' and 'Rīmuš b 1'.

Bruins, Evert M. *CCPV = Codex Constantinopolitanus Palatii Veteris*. Part Three. Leiden 1964.
Pl. 2: a photo of the exercise tablet *IM 43996* (see Bruins, *Sumer* **9** (1953)), with the master's original drawing and the student's poor copy.

Price, Derek J. de Solla. The Babylonian "Pythagorean triangle" tablet. *Centaurus* **10** (1964), pp. 219–231.
Notes that the tables on the tablet *Plimpton 322* (Neugebauer and Sachs, *MCT* (1945)) may have been constructed very simply by use of a generating formula for Pythagorean triples a,b,c involving a parameter pair p,q of regular sexagesimal numbers, subjected only to the very natural restrictions that $1 < q < 1\ 00$, $p/q < 1+\sqrt{2}$ (ensuring that $a < b$, $1 < p/q$). This assumes that the tablet was meant to be inscribed not only with the 15 lines on the obverse, but also with an additional 23 lines on the edge and reverse. P. adds the interesting remark, due to A. Aaboe, regarding the Susa text TMS no. 1, with its drawing of an isosceles triangle inscribed in a circle, etc. (cf. Bruins and Rutten, TMS (1961)), that this text is possibly an illustration to a method for the construction of Pythagorean triples or triangles.

Kilmer, Anne Draffkorn. The use of Akkadian *dkš* in Old Babylonian geometry texts. *StOpp* 1964, pp. 140–146.
Suggests the meaning "indent" for the mathematical technical term *dakāšu*, and supports this view by an extensive discussion of occurences of the verb and its derivatives in texts of various genres, in particular in the mathematical texts Martin, *UET* **5** (1953), no. 864 (cf. Vaĭman, *ŠVM* (1961), Friberg, *JCS* **33** (1981)), *de Liagre Böhl 1821* (Leemans and Bruins, *CRRA* **2** (1951)), and *BM 85194* [Neugebauer, *MKT* **1** (1935), p. 144). Cf. also von Soden, *BiOr* **21** (1964).

Lewy, Hildegard. The assload, the sack, and other measures of capacity. *RSO* **39** (1964), pp. 181–197.

von Soden, Wolfram. Review of *TMS* (1961). *BiOr* **21** (1964), pp. 44–50.
Contains many corrections and improved readings of single words and phrases in TMS (Bruins and Rutten, *TMS* (1961)). Particularly interesting is the new

reading *di-ik-šu* in *TMS* no. 15 (E) and the following general discussion (including some remarks about certain of the diagrams in the text considered in Saggs, *RA* **54** (1960)).

Aaboe, Asger. *Episodes from the early history of mathematics.* Washington 1964.
Pp. 5–33: A brief but readable presentation of some basic features in Babylonian mathematics. (Note Fig. 1.4: Ancient Mesopotamian schoolrooms.[9])

Lenzen, Heinrich J. *UVB* **20** (Winter 1961/62) 1964; **21** (Winter 1962/63) 1965.
UVB **20**, pl. 26–27: hand copy and photograph of *W 20570*, a numerical tablet of the transition type (from Uruk), with seal impressions, the number 2×60 (plus some smaller units) of the proto-sexagesimal system, and the single logogram ŠU(?); *UVB* **21** pl. 19: clay tokens from the spherical envelopes (*W 2098,27*).

Lambert, Maurice. La vie économique à Umma à l'époque d'Agadé. *RA* **59** (1965), pp. 61–126.
A review of the texts in Hackman, *BIN* **8** (1958).

Falkenstein, Adam. Fluch über Akkade. *ZA* **23** (1965), pp. 43–124.
The poem contains a few lines with the following description of economic misery in the country (lines 178–182): u$_4$-ba ì 1 gín-šè ½ silà-àm | še 1 gín-šè ½ silà-àm | *síg* 1 gín-šè ½ ma-na-àm | kù 1 gín-šè ^{giš}ba-an-e íb-si | ma l ba ... ... KA.ḪI-gim ḫé-eb-sa$_{10}$ 'in those days the rate of oil for 1 gín (silver) was ½ silà, of barley ½ silà, of wool ½ mina, of fish 1 ^{giš}ba-an, they were sold at the rate of ...'. For a comparison of these absurdly low rates (i.e., high prices) with the normal rates, see the commentary on pp. 108–109.

Cocquerillat, Denise. Les calculs pratiques sur les fractions à l'époque séleucide. *BiOr* **22** (1965), pp. 239–242.
A well documented review of the use of various notations for small fractions (notably of a day) in a group of contracts (i.e., non-mathematical texts) from the Seleucid period. Examples (in *VS* **15** = Otto Schroeder, *Kontrakte der Seleukidenzeit aus Warka* (1916), lines 10–11): 30$^{u'\text{-}ú}$ *ù šal-šú ina* 60$^{šu\text{-}u'\text{-}ú}$ *šà* 4$_4$*-mu* '$^1/_{30}$ and one third of $^1/_{60}$ of a day', *ḫa-an-za ina* 2ta ŠU^2 'one fifth of two thirds'.

Aaboe, Asger. Some Seleucid mathematical tables (extended reciprocals and squares of regular numbers). *JCS* **19** (1965), pp. 79–86.
A presentation and discussion of three new fragments of Seleucid six-place tables of reciprocals (*BM 41101*) and reciprocals (*BM 33567*, *BM 32178*) of re-

9 JH: Since then identified as a storage room.

gular sexagesimal numbers. The new table fragments are compared with five similar fragments of tables of squares published in Sachs, *LBAT* (1955) (cf. Vaĭman, *ŠVM* (1961); Friberg, *HM* (1981)). Untypically, the fragment *BM 41101* lists regular numbers not in the range between 1 and 3.

Gingerich, Owen. Eleven-digit regular sexagesimals and their reciprocals. *TAPS* **55** (1965), pp. 3–38.

A table of 3,338 eleven-place regular sexagesimal numbers and their reciprocals, computed on an IBM 7094 computer in order to serve as an aid in the study of and reconstruction of fragments of many-place tables of reciprocals or squares, etc. [Although very useful, this table is much too big. As a matter of fact, in the [10] by Vaĭman and Aaboe, the tables of pairs of reciprocals *n // n'* are always such that either *n* or n' is a six-place regular number, and it would have been better, therefore, to use the computer to construct a complete table of reciprocals for six-place regular numbers plus the corresponding table of squares (often more than twelve-place)!]

Salonen, Armas. *Die Hausgeräte der alten Mesopotamier nach sumerisch-akkadischen Quellen* 1. Helsinki 1965.

Pp. 273–295 (Part 11, Measuring devices and measures) starts with a discussion of terms for mathematical devices mentioned in Landsberger, *MSL* **5** (1957) (u r $_5$ - r a = *ḫubullu*): g i š - š i t i m - m a = *iṣi minūti* 'counting stick', etc. (cf. Lieberman, *AJA* **84** (1980)); continues with an extensive listing of Sumerian and Akkadian terms for measuring devices (*ginindanakku*, ...), length measures, scales (*gišrinnu*, . ..) and weights, capacity measures, water clocks, and weather vanes.

Bruins, Evert M. Fermat problems in Babylonian mathematics. *Janus* **53** (1966), pp. 194–211.

Mainly devoted to a sharply worded criticism of the views proposed in Gundlach and von Soden 1963. Since B.'s arguments are not very convincing, none of them will be quoted here.

Amiet, Pierre. *Elam.* Paris 1966. Il y a 5000 ans les Elamites inventaient l'écriture. *Archeologia* **12** (1966).

Elam pp. 70–71: clear photographs of the bulla (spherical envelope) *Sb 1927* from "proto-urban" Susa (= *MDP* **43** (1972) no. 539) and of its contents, seven clay tokens (three disks and three small and one big cone) exactly corresponding to seven impressions on the surface of the envelope. A. suggests that the clay tokens and the envelope, which is covered by seal imprints, constituted an ancient accounting system, and notes that the tokens of various forms and sizes may have denoted "at the same time the nature and the quantity of the commodities

[10] JH: lacuna in the original.

in question". Similar objects are, according to A., known from Uruk and Ninive. Cf. Schmandt-Besserat, *SMS* **1** (1977), *TaC* **21** (1980).

Gadd, Cyril John. Omens expressed in numbers. *JCS* **21** (1967), pp. 52–63.
Discusses a group of originally five related tablets with omen texts in which the presages are expressed in terms of systematically varied number combinations. Example (*DT 72 = BM 92684*): each line begins with one of the number combinations 12 5 1 (or 2, 3, ...) 1 11 30 (or 7, 4, 3, cyclically repeated) 4 31.

Vygodskiĭ, M. Ya. *Arifmetika i algebra v drevnem mire* 'Arithmetics and algebra in the ancient world', second edition. Moscow 1967.
Chapter 2 (pp. 76–233) contains a survey of Babylonian mathematics.

Raik, A.E. *Očerki po istorii matematiki v drevnosti* 'Essays on the history of mathematics in antiquity'. Saransk 1967.
Chapter 2 (pp. 42–143) is about Babylonian mathematics.

Bruins, Evert M. Reciprocals and Pythagorean triangles. *Physis* **9** (1967), pp. 373–392.
Proposes two different new answers to the question of how the OB mathematicians constructed their extensive six-place tables of reciprocals, exemplified by *AO 6456*. The algorithms considered, however, are both quite sophisticated, and it is difficult to believe that any of them were used by the OB mathematicians. Nevertheless, B.'s discussion of Neugebauer's "index triangle" for the indices of six-place regular sexagesimal numbers is interesting and useful.

Pullan, J.M. *The history of the abacus*. London 1968.
P. 3: a photo of the tablet from Senkereh *BM 92680* (Rawlinson, *JRAS* **15** (1855)). Pp. 7–8, P. observes that "evidence suggesting the use of counters in early civilizations, possibly before the introduction of written notations, comes from the finding of small flat discs, usually of stone, at various levels during excavations in Palestine and Mesopotamia". He then mentions specifically groups of pebbles found at Gezer, Jericho and Kish, quoting books by R. A. S. Macalister, K. Kenyon, and E. Mackay.

Bruins, Evert M. Le premier problème de *AO 6770*. *RA* **62** (1968), pp. 80–82.
Criticizing the translation in van der Waerden 1961, pp. 73–74 of what van der Waerden fittingly calls the "lesson-text" *AO 6770* (Neugebauer, *MKT* **2** (1935), p. 39; Thureau-Dangin, *TMB* (1938), p. 145), B. gives here his own version, hardly more convincing than the one he criticizes. Cf., however, the remark made by P. J. Huber in his review of B.'s paper (in *Mathematical Reviews* **38** (1969), no. 4258): "The inconsistency (in van der Waerden's translation and interpretation of the text in question) can also be removed if one translates *arû* by 'factor' instead of 'product'."

Nougayrol, Jean. Textes suméro-accadiens des archives et bibliothèques privées d'Ugarit. *Ugaritica* **5** (1968).

No. 143–152 (pp. 251–257, 426–431): N. is able to reconstruct here, from several fragments, most of the text of two metrological lists from Ras Shamra (Ugarit): *RS 20.14*, an intact list of capacity measures, in four columns (from ½ š e k ù - b a b b a r to 1 š u - š i g ú - u n k ù - b a b b a r), and *RS 21.10* with (1) capacity measures, from [7(b à n) s i l à š e] over 1 g u r š e, to 2(ŠÚ) (= 20 g u r), 1(SIG_7) (= 60 g u r), and 1 š u ⟨- š i SIG_7⟩ (= 60×60 g u r)]; (2) weight measures, [from ½ š e k ù - b a b b a r to [10 g ú - u n k ù - b a b b a r]; (3) area measures, from 3' š a r a - š a, over 2(ŠÚ)! a - š à (= 3 è š e), to 1(SIG_7) (= 10 ŠÚ), and 6 (SIG_7)], in six columns. [The use in the second text of the sign SIG_7 for 6 ŠÚ = 60 g u r in the case of capacity measures, and for 10 ŠÚ = 15 (or 30?) è š e in the case of area measures, ought to be compared with the use in El-Amarna and Boghaz-Köi (cf. Labat, *Manuel* ((1948)1976) no. 351) of the same sign (possibly: l i m $^{\text{gunú}}$) for 10,000.]

Aaboe, Asger. Two atypical multiplication tables from Uruk. *JCS* **22** (1968–69), pp. 88–91.

A. studies here two remarkable multiplication tables: (1) *U 91* (Istanbul), with the head numbers . .., 32, 28 48, 18 45, 11 15, 9 22 30, 6 45, 4 20, 3 30, 2 15, 2 13 20, of which two are irregular (3 30=7/2 and 4 20 = 13/3), and only one (2 15) present in the standard list of head numbers; and (2) *IM 64893*, with the similarly non-standard head numbers 2 13 20 (= 1/27) and 2 24 (= 1/25). The new table of squares *IM 64783* and the new multiplication table *IM 2899* are also mentioned.

Goetsch, H. Die Algebra der Babylonier. *AHES* **5** (1968–1969), pp. 79–160.

A survey based on the mathematical texts in Neugebauer, *MKT* **1–3** (1935–1937), *MCT* (1945), and *TMS* 1961. Chapter 1, number notations. Chapter 2, arithmetical operations. Chapter 3, progressions, ratios, proportions. Chapter 4, linear equations. Chapter 5, quadratic equations. Chapter 6, equations of higher degree than second; exponential equations.

Civil, Miguel. *MSL* **12** (The series l ú = š a and related texts), Rome 1969.

P. 171: the OB l ú-series, rec. A 464–468, l ú š u m u n - g i $_4$ = *ša šu-ma-ki-i*, etc., quoted in Lieberman, *AJA* **84** (1980) as possible names of officials trusted with the use of various counting instruments.

Edzard, Dietz Otto. Eine altsumerische Rechentafel (OIP 14,70). *Festschr. vSoden* (*lišān mitḫurti*). Kevelaer/Neukirchen-Vluyn (1968)1969.

Interprets the text *A 681* (*OIP* **14** no. 70; Luckenbill, *Adab* 1930) as a pre-Sargonic table (slightly older than from the period of Eanatum of Lagaš) of small square areas (cf. the not much older table of big square areas *SF* no. 82; Deimel, *Inschr.Fara* **2** (1923)). The table, which uses a very complicated system of notations for fractional area measures (some of which appear in no texts older than this), goes from 1 k ù š s i 8 // 1-SA10 - m a - n a 15 g í n (i.e., 1 square cubit = $^1/_{144}$ square n i n d a n = 1.15 × $^1/_3$ × $^1/_{60}$ š a r) to 11 k ù š s i 8 // 1 s a r LÁ 10 gín 1-SA10 15 (i.e., (11 cubits)^2 = $^{121}/_{144}$ š a r = (1– $^1/_6$ + $^1/_{144}$) = 1 š a r = 10 g í n + 1.15 SA10). Note that the trivial line 2 g i - s i 8 // 1 šar is ommitted in the text.

van den Brom, Lourens. Woher stammt das 60-System; *Janus* **56** (1969), pp. 210–214.

Contains the attractive hypothesis (cf. Kewitsch, *ZA* **29** (1915)) that the Sumerian sexagesimal system may have had its origin in a certain method of finger arithmetic, with numbers up to five recorded on the fingers of one hand, and multiples of 6 on the fingers of the other hand, with a change of hands after 30 (= 5 times 6). [The idea is attractive in view of the fact that the proto-Sumerian capacity number system is now known to have been based on a counting in sixes and tens of sixes.]

1970–1980

Bruins, Evert M. La construction de la grande table de valeurs réciproques AO 6456. *CRRA* **17** (1969)1970, pp. 99–115.

Contains, in particular, the interesting idea that the tables of powers *Ist O 3816*, *Ist O 3862*, *Ist O 4583* (powers of 3 45 = 15^2) and *Ist O 3286* (powers of 9 = 3^2, and of 1 40 = 10^2) (cf. Neugebauer, *MKT* **1** (1935), pp. 77–78) were possibly used for the construction of large six-place tables such as *AO 6456*. (Cf. Bruins, *Janus* **58** (1971).)

Ellis, Maria de J. A note on the “chariot’s crescent”. *JAOS* **90** (1970), pp. 266–269.

As noted by E. (cf. Powell, *HM* **3** (1976)), the Ur III text *YBC 4179* discussed here, a balanced account of grain for preparation of beer, contains two early examples of scribbled numbers used as aids for the memory and written in the positional sexagesimal system: 5(g u r) 1 30 for 5(g u r) 1 ½ s ì l a, and 7(g u r) 1 46 30 for 7(gur) 1(PI) 4 (bán) 6½ sìla.

Reiner, Erica, *ana nalban*. *AfO* **23** (1970), pp. 89–90.

A discussion with several references to certain mathematical technical terms with contested interpretations: *nalbanum*, g i š . ù . š u b = *nalbantu* ‘brick mold, truncated pyramid, ...’, cf. Neugebauer and Sachs, *MCT* (1945), p. 133, and Kilmer, OrNS 29 (1960).

Edzard, Dietz Otto. Altbabylonische Rechts- und Wirtschaftsurkunden aus Tell ed-Dēr im Iraq Museum, Baghdad. München 1970.

No. 236 (*IM 49.949*): a brief list of constants (16 entries, mostly concerned with bricks). The list is of a new type in that it gives specifications of the constants both in Sumerian and in Akkadian. Examples: Line 3, 2 13 20 // i g i - g u b //

$^{\text{giš}}$d u s u // *šu-up-ši-ki-im* (cf. von Soden, 20.D.Or.Tag (1977)); line 9, 6 // i g i g u b // é ÙR.RA // *na-aš-pa-ku-um* (cf. Postgate, *Iraq* **40** (1978).

Gelb, Ignace Jay. *MAD* **5** = *Sargonic texts in the Ashmolean Museum, Oxford*. Chicago 1970.

No. 112: a small Sargonic tablet, which seems to contain a standard computation of a rectangular area, although of immense dimensions. The reverse of the tablet contains this text: 7(ŠAR.LIL) 4(ŠAR'U.GAL) | 7 (SAR) 1(b u r ' u) 7 b u r) 2(e š é) | 3 ½ i k u) 10 š a r | 16 g í n ⅔-ŠA | b a - p à d. Presumably, 1(ŠÁR.LIL) = 60^2 ŠÁR = 60^3 b u r, but it has so far been impossible to give any satisfactory interpretation of this curious text.

Lambert, Maurice. Deux textes de l'époque d'Agadé. *RA* **65** (1971), pp. 167–168.

Text A, a small text from the Agade period, in which several small payments of silver are added: 9 times ⅙ ⟨g í n⟩, 5 times ¼ ⟨g í n⟩, once ⅓ ⟨g í n⟩, and once ½ ⟨g í n⟩. [Since the sum is given as 3 g í n i g i-6-g á l, it is likely that ½ g í n stands here for ½×⅙ g í n, and that the sum was obtained as (9×1+5×1½ +1×2+1×½)×⅙ g í n = 19×⅙ gín = 3⅙ g í n].

Bruins, Evert M. Computation in the Old Babylonian period. *Janus* **58** (1971), pp. 222–267.

Here are published for the first time photographs of the badly conserved tablets *Ist O 3816* (Ki 9) and *Ist O 3286* (Ki 10). Cf. Bruins, *CRRA* **17** (1969).

Meriggi, Piero. *La scrittura proto-elamica* **1**. Rome 1971.

Pp. 159–172 (§420–452): A chapter entirely devoted to a systematic account of the occurrence of number signs, in various combinations and in various contexts, in proto-Elamite inscriptions on clay tablets from the time of the Jemdet Nasr period. Unfortunately, it is difficult to make proper use of this survey because of the non-suggestive system of transliteration of number signs employed here, and because M. still adheres to an incorrect evaluation of the units of the capacity system of the Jemdet Nasr period in Elam and Sumer. (Cf. Friberg, *DMG* (1978–9).)

von Soden, Wolfram. Etemenanki vor Asarhaddon nach der Erzählung vom Turmbau zu Babel und dem Erra-Mythos. *UF* **3** (1971), pp. 253–263.

Contains some suggestions about the impossibility of number-theoretical speculations behind the measures of the Etemenanki, in which the number 3 45 and its powers (cf. Bruins, *CRRA* **17** ((1969)1970)) are proposed to have played a prominent role. In the paper is also documented the author's search in the literature for texts mentioning the ziqqurrat in Babylon before the time when the Esagila tablet was composed.

Biggs, Robert D. An archaic Sumerian version of the Kesh Temple Hymn from Tell Abū Ṣalābīkh. *ZA* **61** (1971), pp. 73–88.

Fig. 2 and p. 204 note 19: the presence in this archaic version of the Kesh temple hymn of the phrase ^{d}Š Á R × DIŠ-g i $_{4}$ where several OB copies of the same hymn have only ^{d}a š -ŠIR allows B. to confirm the identity of the two expressions. (Cf. Edzard, *Sumer* **15** (1959).)

Powell, Marvin A., Jr. *SNM* (= *Sumerian numeration and metrology*). Dissertation, University of Minnesota. Minneapolis 1971 (University Microfilms 72-14 445, Ann Arbor 1973).

Part I. Numeration: Whole numbers. A systematic and exhaustive account of Sumerian numerals, based on lexical sources such as, in particular, the second tablet of the series e - a = A = *nāqu* (cf. Zimolong, *Ass.523* (1922)). Of special interest is the establishment of /d i š/ and /g e (D)/ as the only documented Sumerian readings of 'one' (cf., however, Steinkeller, *ZA* **69** (1979): /g e š t/ = '60'), and the improved transliteration and analysis of the two quasi-phonetically written reciprocal tables *Ist S 485* (Neugebauer, *MKT* **1** (1935), p. 27) and *ST 399* (Hulin, *JCS* **17** (1963)).

Part II. Numeration: Fractional numbers. Starts with an extremely interesting penetration of the problem complex centered around the etymology of the Akkadian word *šuššu* 'one-sixth', with its alleged connection with the Akkadian word for 'sixty'. Thus it is shown that *šuš-šu*, with the root **šdš*, cannot possibly be related with *šu-ši* 'sixty', and that Sumerian š u š a n a 'one-third (m a n a)' is probably derived from an Akkadian *šuššān* as the dual of *šuššu*, while Sumerian š a n a b i 'two-thirds (m a n a)' may be derived from an original Akkadian form *$š^{a}$nay pī* 'two holes' (cf. Rundgren, *JCS* **9** (1955)). Next, P. looks for the origin of Sumerian *šu-ri-a* 'one-half', ŠU.BAD 'one-third of a cubit', and š u - d u - a 'one-third of a cubit' in various hand gestures. It is convincingly demonstrated that the special sign *bartendeššeku* () for 'one-third' is derived from an original š ú +  + š a - š a - n a (m a - n a), while the special signs for 'two-thirds' and 'five-sixths' are later developments, the original notation for two-thirds of a m a n a being  + š a - n a - b i / p i. For k i n - g u - s i l - l a is suggested the etymology g í n 'shekel' + *g u - s i l + a, meaning not known.

Part III: Weight measures. Begins with two chapters on the methodology of weight metrology and on the existence of different weight standards. Then follows a chapter discussing the origin and development of the Mesopotamian weight system, in which P. distinguishes between a first, Sumero-Akkadian phase, and a second, first-millennium phase, where the second phase is characterized mainly by the appearance of new divisions of the mina and shekel, reflecting the decimal structure of Semitic numeration (cf. the NB metrological tables published by Sachs, *JCS* **1** (1947)).

The exposition is concluded with Appendix. I: Equipment and terminology employed in weighing. II: Tables of notation. III: Weights with Mesopota-

mian connections (a list of weight specimens). An extensive bibliography. And a useful index of Sumerian and Akkadian terms discussed in the dissertation.

Powell, Marvin A., Jr. The origin of the sexagesimal system: The interaction of language and writing. *VL* **6** (1972), pp. 5–18.

Distancing himself from the theories concerning the evolution of the sexagesimal system proposed by, among others, Thureau-Dangin (*Osiris* **7** (1939)) and Neugebauer (*AGWG* **13** (1927)), P. stresses that (1) the origin of counting with sixty as a base is a linguistic and anthropological problem which must be studied through the ancient lexica, and (2) sexagesimal place notation arose from an interaction between the numerational framework of the Sumerian language and the symbols used to write those numbers, but the sudden appearance of place notation about 2050 B.C. indicates that the final step toward the creation of place notation was an act of conscious invention.

Powell, Marvin A., Jr. Sumerian area measures and the alleged decimal substratum. *ZA* **62** (1972), pp. 165–221.

P. emphasizes here that Sumerian metrological notation was based on the same graphic procedure as was used to make numerical notation, and that it was governed by two principles: the structure of the system of numeration on one hand and the need for visual linguistic contrast on the other. He warns that one must be extraordinarily cautious in drawing conclusions about numeration from notation alone, and he refutes the current theories about the evolution of the Sumerian system of area measures, in particular the hypothesis that this system contained a decimal substratum. Unfortunately, however, the new theory proposed by P. himself, in which the alleged existence in some Sumerian texts of an area unit NÍG (=60 š a r) is a corner-stone, is not sufficiently well supported to be accepted as the last word on this matter.

Interesting, however, is the chapter devoted to lexical and other philological evidence pertaining to Sumerian surface measures. Worth noticing is the new reading /n i n d a n/ for the length unit NÍG, based on (1) the various writings of the word *ginindanakku*, (2) phrases such as a b - s í n - b i 1 NÍG-n a 12-t a (King, *CT* **1** (1896), pl.12*f*), (3) the interpretation of the DU in the pre-Ur III graph NIG.DU as a semantic indicator appropriate for a length measure. New is also the reading SAR = /š a r/ for the area measure n i n d a n^2, and the interpretation of the i k ú-measure as the area of a square with side 1 EŠÉ.

Fundamental for the understanding of Sumerian seed grain texts is the interpretation given of a passage in the “Farmer’s Almanac”: 1 NÍG-t a - à m a b s i n$_3^{\text{ab-sín}}$ 8 - à m g u b - b a - a b ... | 2 š u - s i - t a - à m ^{d}a š n a n h é - e n - š u b | 1 NÍG - t a - à m š e 1 g í n ḫ a - r a - a n - g a r) as saying that if barley is dropped in the furrows with regular intervals of two fingers, and if there are eight parallel furrows for every n i n d a n (measured across the furrows), then 1 g í n of barley will be dropped in a furrow of length 1 n i n d a n, and consequently 8 s i l à, for instance, in a field of area 1 00 š a r. (Cf. Gadd and Kramer, *UET* **6**/2 (1966), no. 172. col.2, 8, 12–13; Maekawa, *ASum* **3** (1981).)

The paper ends with a suggested system for the transcription of numbers written in the Sumero-Akkadian area notation (Girsu-, BIN 8-, or Ur III-type), and with tables of various kinds, all very useful.

Wiseman, D. J. A Babylonian architect; *AnSt* **22** (1972), pp. 141–147.

Discusses, in particular, a late Babylonian tablet with a drawing that "shows in elevation a six, originally seven, stepped ziggurat with the principal dimensions given". (Cf. Gurney, *UET* **7** (1973), no. 116–117.) Note the interesting discussion (p. 47) of terms for surveyors and their tools (*abašlu* 'father of the line', *ginindanakku* '1-n i n d a n-reed', $^{\text{giš}}$*pa-lu-um* 'measuring rod?') and the suggestion that a surveyor's rod and rope may be the "ring and staff" carried by some gods.

Salonen, Armas. *Die Ziegeleien im alten Mesopotamien* (*AASFB* **171**). Helsinki 1972.

Pp. 88–99: discussing textual documentation of words for 'open brick mould' (Akk. *nalbanu*, *nalbattu*), S. includes in this section extensive quotations from Neugebauer and Sachs, *MCT* (1945); very informative are the many illustrations at the end of the book such as, for instance the photo of the pre-dynastic copper statuette of a naked man carrying a *tupšikkum* ((u) š u b + (i) s i g_4), evidently containing square bricks (pl. 9; text p. 202). Cf. von Soden, *20.D.Or.Tag* (1977).

Amiet, Pierre. *MDP* **43** = *Glyptique susienne des origines à Suse de 1913 à 1967.* 1. *Textes*. 2. Planches. Paris 1972.

In this volume are published or republished several numerical tablets and spherical envelopes, for instance, no. 460$^{\text{bis}}$ and 539, two spherical envelopes with clay tokens and impressions (cf. Amiet, *Elam* (1966)); no. 488, a spherical envelope with clay tokens; no. 666, a spherical envelope with impressions (▯▯▯▯▯; numbers?); no. 520, 666: numerical tablets with (probably) decimal numbers; no. 545, 641: numerical tablets with sexagesimal numbers (?) [2(60)+1(10) and 4(60)+1(10), respectively; the number signs in the latter case are upside down relative to the seal impressions and "tagged"]. No. 642, 922, numerical tablets with capacity numbers (?) (2(60)+3(6)+1 and 3(180)+1(60)+4(10), respectively). No. 924 is a reproduction of the famous "horse tablet" (Scheil, *MDP* **17** (1923)). Some of the spherical envelopes and numerical tablets have recently been published once more in articles published by Schmandt-Besserat in 1980–1981.

Waetzoldt, Hartmut. *Untersuchungen zur neusumerischen Textilindustrie*. Rome 1972.

In chapter 2 (pp. 17–23) the subject is the "fleece weight" in Neo-Sumerian texts, and in texts from other periods and other locations. In particular, W. points out

(p. 22) that "in some wool-cutting texts from Lagaš and Umma, the average fleece weight is always exactly 2 minas". Cf. in this respect the text *Erm 15066* from Larsa (Riftin, SVYAD (1937)).

Castellino, Giorgio R. *Two Šulgi hymns (BC) (SS 42)*. Rome 1972.

In these two Sumerian hymns of self-glorification there are, in particular, two passages where the king Šulgi emphasizes his extraordinary mathematical abilities. C.'s commentary with regard to these passages is detailed and very interesting. See 3:16–19 (pp. 32–33, commentary pp. 85–92), and C:45–47 (pp. 252–253; commentary pp. 277–280). In an updated transliteration and translation by J. Klein (personal communication) the lines in question sound as fellows: nam-dub-sar-ra ki-nam-kù-zu-ba lú im-mi-re$_6$|zi-zi ĝá-ĝá šid nì-ŠID-dè zà im-mi-til-til 'at the place where one goes to study the scribal art, I have completed (my education in) subtracting, adding, counting and accounting', etc.; and šid nì-ŠID giš-ḫur-kalam-ma-ka|igi-gál sum-mu-bi á-bi-še in-ga-zu 'of counting and accounting, which regulate the land, their given wisdom I perfectly learned as well'. Even this updated version, though, is only tentative. This is true also for the translation of the proverb Gordon, *JAOS* **77** (1957), p. 75, quoted by C. (p. 88) šà-nì-ŠID-nu-zu ša-igi-gál-tuku 'there are hearts that have no understanding for reckoning, there are hearts that possess wisdom. Cf. Sjöberg, *AS* **20** (1975).

Sollberger, Edmond. *CT* **50** = *Pre-Sargonic and Sargonic economic texts*). London 1972.

See the review in Powell, *ZA* **63** (1973).

Sjöberg, Åke. In praise of the scribal art. *JCS* **24** (1972), pp. 126–131.

Note in this composition line 15: na$_4$-rú-a ab-sar-e-dè|a-šà-ga gíd-e-dè nì-ka$_9$ sá-du$_{11}$-ge-dè ... 'to write a stele, to draw a field, to settle accounts, ...'. Cf. Sjöberg, *ZA* **64** (1975).

Bruins, Evert M. Tables of reciprocals with irregular entries. *Centaurus* **17** (1972–1973), pp. 177–188.

Knuth, Donald E. Ancient Babylonian algorithms. *CACM* **15** (1972), pp. 671–677; **19** (1976), p. 108.

A discussion of Babylonian mathematics, emphasizing those aspects which seem to be of greatest interest from the standpoint of computer science. One of the many interesting conclusions is that the Babylonian-type algorithmic problem solutions made use of, in effect, a "machine language" représentation of formulas instead of a symbolic language. K. further commends the Babylonians for developing a clever way of defining algorithms by use of numerical examples. Particular attention is devoted to the extensive table of reciprocals *AO 6456* (cf.

Friberg, *HM* **8** (1981), p. 465), referred to here as "the earliest known example of a large file of data that has been sorted into order".

Vaĭman, A. A. O svyazi protoelamskoĭ pis'mennosti c protosumerskoĭ 'On links between the proto-Elamite and proto-Sumerian scripts'. *VDI* **3** (1972), pp. 124–133.
V. points out the essential identity of the proto-Elamite and proto-Sumerian systems of capacity measures and gives a correct interpretation of the notations for fractional capacity units. He mentions also the existence of both a decimal and a sexagesimal system of numeration in the proto-Elamite texts and suggests that the proto-Elamite sexagesimal system was used for weight measures only, as an early precursor of the Sumero-Babylonian talent-mina-shekel system. (Cf. Friberg, *DMG* (1978–9).)

Gurney, Oliver R. *UET* **7** = *Middle Babylonian legal documents and other texts*. London 1973.
No. 114: an OB table for length measures (from 1 š u - s i // 10 to 2 k a s k a l - g í d // 1, basic unit n i n d a n). No. 115: two similar tables (from [1 š u - s i // 10] to [20 k a s k a l - g í d // 10], and from 1 š u - s i // 2 to 20 š u - s i // 2, basic units n i n d a n and k ù š). No. 116–117: OB cadastral plans (cf. Donald (1962), Wiseman (1971),[11] Woolley, *AJ* **7** (1927)). No. 155 rev., "excerpts from a vocabulary, spelling exercises, a fable (?), a multiplication table [actually a table of squares, from 1 a - r á 1 // 1 to 12 a - r á 12 // 2 24 ...], and a literary text". Quoted by number only are no. 182–189 (multiplication tables for 4, 6, 9, 36, 7 30, 12 30, 16 40), no. 190–192 (tables of squares), no. 193–194 (tables of square roots), no. 195 (a table of cube roots), and no. 196–198 ("other numerical lists").

Lambert, Maurice. Textes et documents. *RA* **67** (1973), p. 96.
A hand copy of an Old Akkadian contract, *AO 7754*. Cf. Pomponio, *OrAnt* **19**, 1980.

Sürenhagen, Dietrich, and Töpperwein, Eva. Kleinfunde. *MDOG* **105** (1973), pp. 20–33.
Contains, in particular, photos of a numerical tablet and a spherical envelope with clay tokens (from Habuba Kabira 1971–1972).

Anagnostakis, Christopher, and Goldstein, Bernard R. On an error in the Babylonian table of Pythagorean triangles. *Centaurus* **18** (1973), pp. 64–66.
Suggests that the error in Plimpton 322 col.I,10 (Neugebauer and Sachs, *MCT* (1945)) was caused by the use of a table of squares such as *BM 34592* (Pinches, *LBAT* (1955)) and by a failure to observe the presence of a medial zero in the value borrowed from the table.

[11] JH: The references "Donald 1962, Wiseman (1971)" are not clear to me.

Powell, Marvin A., Jr. On the reading and meaning of GANA$_2$. *JCS* **25** (1973), pp. 178–184.

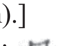
P. shows here clearly that the sign GANA$_2$ in Old Sumerian could be read in three different ways: as /a š a g/, meaning ‘field’, ‘area of land’, as /g a n a/ meaning more generally ‘land’, ‘ground’, ‘soil’, or silently, as a semantic indicator in area notations.

Powell, Marvin A., Jr. A note on the “*imērum*” measure at Mari. *RA* **67** (1973), pp. 77–78.

Powell, Marvin A., Jr. Review of *CT* **50**. *ZA* **63** (1973), pp. 99–106.

Treats, in particular, questions of metrology in *CT* **50**, “one of the most important contributions to the knowledge of the Pre-Ur III period since the appearance of BIN 8”.

Area texts, no. 53, 60, 67, with the standard Umma system of area notations (the same as in Hackman, *BIN* **8** (1958)). [Note also no. 40, from pre-Sargonic Lagaš, with the same system of length measures as in *DP 604–612* (Allotte de la Fuÿe, *RA* **12** (1915)) (units: g i, b a$_7$ = ½ e š é or 5 n i n d a n, U = 1 e š é or 10 n i n d a n, AŠ = 6 e š é or 60 n i n d a n).]

Weights: in no. 72, special notations are used for ⅓ g í n:  [P. reads ½ g í n], and ½ mina:  [The same text displays also a d u g of 30 s i l à, and a sell-rate for fine oil of 10 s i l à per g í n of silver. Cf. *YBC 4698* problem 8, Neugebauer, *MKT* **3** (1937).] The small weight unit m a - n a - t u r makes one of its rare appearances in no. 79 [and, although damaged, this text confirms that 1 m a - n a - t u r = ⅓ g í n].

Capacity measure: no. 137–138 use the following set of notations for fractions of a s i l à (!): ⅓.ŠA, ½.ŠA (?), ⅚.ŠA (!), where the ŠA has taken on a purely semantic character. In no. 10 and 11 appears a capacity unit l i d - g a (<*lit-qu*; M. Civil) of 240 s i l à, which seems to be identical with the g u r - š a g - g a l of 240 s i l à (!), used, for instance, together with the g u r a - k à - d è^{ki} of 300 s i l à, in the bread and beer texts no. 55–59. In no. 149 appears a g u r - m a ḫ in the role of the g u r a - k à - d è^{ki}, i.e., in connection with flour for baking of bread [and also, atypicaliy, in connection with beer, at the exchange rate of 1 d u g beer for 30 s i l à of flour].

Liquid measure: A n i g i n of 10 s i l à is attested in no. 146–148, and the d u g of 30 s i l à in these and other texts. Special notations for fractions of this d u g appear in no. 55–59:  = ⅔,  = ½, and  = ⅓ d u g. The corresponding exchange rates of barley to beer in these three texts are, for three qualities of beer, 7:3, 5:3, and 3:3 (b á n per n i g i n), cf. Powell, *RA* **70** (1976). Note that in no. 167, a bread and beer text from Lagaš (Girsu), 39 10 n i n d a - d u$_8$ (cf. Blome, *Or* **34–35** (1928)) are equated with 39 10×1/20 b á n or 4(g u r) 3(b a r i g a) 3 (b á n) 5 s i l à^{gur}. This implies, as P. points out, the use here of a g u r of 4×6×10 s i l à, identical with the g u r - s i - s à in the

Lagaš text *RTC* 126 (Thureau-Dangin, *RTC* (1903)). [In the same text (no. 157), 43 d u g of beer are equated with 5(g u r) 4 (b á n) of barley. This corresponds to an exchange rate of barley to beer of 4 b á n per d u g, i.e., of 4:3 (b á n per n i g i n) (?).] Worth noticing is also P.'s observation (p. 103 note 12) that "the practice of transcribing 1/2/3/4 n i g i d a is erroneous and rests upon a misunderstanding".

Pottage, John. The mensuration of quadrilaterals and the generation of Pythagorean triads: a mathematical, heuristical and historical study with special reference to Brahmagupta's rules. *AHES* **11–12** (1973), pp. 299–354.

Gives an exhaustive account of what may be a late development on Indian ground of originally Babylonian mathematical traditions (the famous *Brāhma-sphuṭa-siddhānta* of Brahmagupta appeared c. A.D. 628). P. states in his introduction that "the work on quadrilaterals was intimately connected with the generation of 'PYTHAGOREAN' triangles out of *bīja* (= 'seed') numbers by the same method as had probably been used by the mathematicians of Old Babylonia". (Cf. Friberg, *HM* **8** (1981) and the references given there, in particular to works treating early Chinese and late Egyptian mathematical texts.)

Hunger, Hermann. *STU* **1** = *Spätbabylonische Texte aus Uruk*. Berlin (1973).

No. 101 = *W 2260a*: a fragment of a remarkable Late Babylonian mathematical-metrological table text with (1) a metrological table for weight measures [conversion of sexagesimal fractions of a g í n into decimal multiples of a š e, from 10 // *mi-šil* š e to 50 // 1 *me* [50 š e // $\frac{5}{6}$ g í n]] (cf. CBS 11019, Sachs, *JCS* **1** (1947)); (2) a "reciprocal table" [with conversion of sexagesimal fractions into reciprocals of decimal integers] from 10 // š i - i š to 6 // 6 *me-ú* [i.e., from .10 = $\frac{1}{6}$ to .00 06 = $\frac{1}{6000}$]; (3) a "multiplication table for 100" [or rather a table of sexagesimal multiples and sub-multiples of 100], from ... 42 // 1 10-*ú* to 2 // 12 *lim-ú* [i.e., from ... .42×100 = $\frac{7}{10}$×100 = 70 to 2 00×100 = 120×100 = 12000].

No. 102 = *W 22309a+b*, another fragment, of an equally remarkable Late Babylonian metrological text, with (1) a metrological table for capacity measures, from ... 1(bán) 7 s i l à // 17 to 1(10×60) 3(60) g u r // 1 05 [i.e., from ... 1 b á n 7 s i l à ... = 17 s i l à to 13 00 g u r = 13 00×5 00 s i l à = 1 05 00 00 s i l à]; anachronistically, this table uses the g u r of 300 s i l à, and the non-positional sexagesimal system (in the left hand column, i.e., before the g u r-sign); (2) a non-tabular description of the structure of the system of length measures, divided into three (or more) sections, (a) from [1 *gu-ú* // $\frac{1}{2}$ š e] (with *gu-ú* = "thread"(?)) to 6 š e // *ú-ba-an*,...30 *ú-ba-an* // *am-mat*,... 21 *lim* 6 *me* TA *am-mat* / 1 kaskal-gíd, 10 TA[,..]... 2(šár) // [20 kaskal-g í d(?)]; (b) from 2 *pu-ri-du* // *qa-nu-u*, 4 *pu-ri-du*/n i n d a n, 20 *pu-ri-du* // *ṣu-up-pan*, 40 *pu-ri-du* // *ašlu*, 2 *me* 40 *pu-ri-du* // 1-UŠ GI.DIŠ. NINDAN

[which possibly stands for 60 *ginindanakku*, i.e., for 60 n i n d a n-reeds (?)], ..., to 7 *lim* 2 *me pu-ri-du* // 1 k a s k a l - g í d; (c) from 2 *qa-ne-e* // 1 n i n d a n, 10 *qa-ne-e* // *ṣu-up-pan*, and upwards.

Limet, Henri. *Etude de documents de la période d'Agadé appartenant à l'Université de Liège*. Paris 1973.

No. 36–39: Publication and preliminary discussion (impedimented by the appearance in these texts of some new length units) of a group of four Sargonic mathematical exercises, *PUL 27–29, 31*. See Powell, *HM* **3** (1976) for a resolution of the metrological difficulties and a correct interpretation of the mathematical content of the texts. As noted by L., there seems to be a close affinity between this group of tablets and the curious text Gelb, *MAD* **5** (1970), no. 112.

Pettinato, Giovanni, and Waetzoldt, Hartmut. *MVN* **1** (*CS = Collezione Schollmeyer*). Rome 1974.

See Pettinato and Waetzoldt, *StOr* **46** (1975).

Petschow, Herbert P.H. *ASAW* **64** = *Mittelbabylonische Rechts- und Wirtschaftsurkunden der Hilprecht-Sammlung Jena*. Berlin 1974.

No. 65 (*HS 184*): a fragment of a table text (a multiplication table for 44 26 40, and a table of reciprocals).

Maekawa, Kazuya. Agricultural production in ancient Sumer, chiefly from Lagash materials. *Zinbun* **13** (1974), pp. 1–60.

(I) Productivity at the end of Early Dynastic III. (II) The Akkad period and the Lagash II period. (III) The Ur III period: (1) Thureau-Dangin, *RTC* (1903) no. 407, the "general fiscal texts" and Reisner, *TUT* (1901), no. 1; (2) The "round tablets"; (3) The "round tablets" of *AS* **7** and **8**;[12] (4) The "yield texts" of NS times; IV. Conclusions and supplement.

Vaǐman, A. A. Protošumerskie sistemy mer i sčeta 'The proto-Sumerian systems of measures and numbers'. *13th MKIN* 1974, pp. 6–11.

In this survey of eight different proto-Sumerian systems of number symbols, V. points out, in particular, that: (1) The "decimal-sexal" system of numeration (i.e., the proto-sexagesimal system) appears in a regular variant (with a special sign for 10×60) and a modified variant (with special signs for 2×60 and 10×2×60); (2) The proto-Sumerian capacity system appears in three variants (the regular variant, which is used for barley, and two variants used for wheat and emmer, distinguished by various kinds of tags on the individual number signs); (3) There seems to be a special system of signs for use in dates, indicating respectively the number of the day, of the month, and of the year.

[12] JH: (1). Richard T. Hallock, *AS* 7, *The Chicago Syllabary and the Louvre Syllabary AO 7661*, Chicago, 1940. (2) Samuel N. Kramer, *AS* 8. *The Sumerian prefix forms BD- and BI- in the time of the earlier princes of Lagaš*, Chicago 1936.

Slavutin, E. I. O matematičeskih metodah drevnih (princip obraščeniya) ‘On the mathematical methods in antiquity; the principle of transformation’. *IMEN* **16** (1974), pp. 191–199.

Demonstrates, with examples from ancient Babylonia, Greece, and China, the fundamental importance of the “principle of transformation” for the first stages in the development of a corpus of mathematical problems and results. The essence of the principle is that new problems can be fabricated out of old ones simply by exchanging the roles of data and unknowns in the equations. (Cf. Vogel, *Osiris* **1** (1936).)

Zaccagnini, Carlo. The yield of the fields at Nuzi. *OrAnt* **14** (1975), pp. 181–225.

The metrologically interesting parts of this paper deal with the ratio of seed grain to area in texts from Nuzi. The correctness of the identification of the area measure *imērū* (a n š e) with the capacity measure *imērū* ‘ass (-load)’ is clear from the fact that typical seed rates are 1:1, 13:10, and 8:10. Example (Meek, *HSS* **10** (1935), no. 233), 26 a n š e š e$^{\text{meš}}$ | *a-na* n u m u n *ša* 20 a n š e a - š à$^{\text{meš}}$.... Interesting are also the references (p. 218) to Old Akkadian texts from Nuzi (Meek, *HSS* **10** (1935), no. 15–17, ...) with the strangely large seed rate (š e n u m u n - *su*) 6 b á n per i k u. Cf. Maekawa, *ASum* **3** (1981).

Sjöberg, Åke W. The Old Babylonian eduba. *AS* **20** (*Sumerological studies in honor of Thorkild Jacobsen*) ((1974)1975), pp. 159–179; Examenstext A. *ZA* **64** (1975), pp. 137–146.

In *AS* **20**, in the section “The curriculum of instruction: Mathematics and surveying”, S. quotes the following line from “Examination text A”: a - r á i g i i g i - b a i g i - [g u b - b a] n i - k a$_9$ k u [r u]$_7$ š i d - d ù g a - l á á - d ù - a d ù - a - b i d ù - a ḫ a - l a ḫ a - l a - b i a - š à s i - g e - d è ì - z u - ù ‘do you know multiplication, reciprocals, coefficients, balancing of accounts, administrative accounting, how to make all kinds of pay allotments, divide property, and delimit shares of fields?’. Other enumerations of mathematical topics in the curriculum of OB schools can be found in so called “eduba dialogues”, such as Dialogue 1 (Kramer, *SLTN* **116** (1934)): a - r á ḫ é - b i - š i d z a - b i - š è n u - e - z u i g i - d i r i ḫ é - d u$_8$ k i - ú š n u - m u - r a - a b - d a b$_5$ ‘you may recite the multiplication table, but you do not know it perfectly, you may solve inverted numbers, but you cannot ...’ and a - r á i g i - d i r i n ì - k a$_9$ s a ḫ a r - g a r - r a z à - b i - š è ì - z u ‘you have learned perfectly multiplication, inverted numbers, accounting and calculation of volume’. Equally interesting is the quotation made by S. from Enki-mansum and Girini-isag (Gadd and Kramer, *UET* **6**/2 (1966), no. 150), g á n a b a - e - d è g e n - n a g á n a n u - m u - d a - b a - e - e n | a - š à s i - g e - d è g e n - n a é š - g á n a g i - D I Š - n i n d a n u - m u - d a - ḫ a - z a | ... ‘go to divide a field but you won’t be able to divide it, go to delimit a field but you won’t be able to hold the tape and the measuring rod, ...’. S. finally quotes also the passages of mathematical interest that appear in some royal

hymns (cf. Castellino, *Two Šulgi hymns* (1972)). See also Kramer, Schooldays, *JAOS* **69** (1949), pp. 199–215 (in particular lines 61–62 of the quoted text) and Falkenstein, *Saeculum* **4**(2), (1953) (p. 129). Of related content is the discussion of Daniel 5:25–28 in Gandz, *Isis* **25** (1936).

Nemet-Nejat, Karen R. A Late Babylonian field plan. *ANES* **7** (1975), pp. 95–101.
A field plan inscribed with Seleucid script (*BM 46703*, a representative of a whole group of similar field plans in the British Museum). The lengths of the sides of a quadrilateral are here given in k ù š and SI, the area in g i, k ù š, and SI (fingers). [The area computation is easy to verify. It builds on the area notation regularly used in the NB period (cf. Powell, *ZA* **62** (1972), p. 187 note 46; Oppert, *ZA* **4** (1889)).] In this notation a given area is always equated with the area of a rectangle of standard base equal to a reed (g i) of 7 cubits or 7×24 fingers, and the area is therefore expressed by simply stating the length of the side of the rectangle as so and so many reeds, cubits, and fingers.

Powell, Marvin A., Jr. Review of Limet, *Étude* (1973). *JCS* **27** (1975), pp. 180–188.
Commenting on the mathematical exercise texts *PUL 27–29* and *PUL 31*, P. states that the computations in these texts involve some knowledge of reciprocals and elementary algebraic reasoning, and he therefore wonders how much of OB mathematics is really a product of the third millennium. The review is complemented by a table giving a useful (partly tentative) reconstruction of the Sargonic systems of area and length notations, including the identification of the g i š . b a d with the normal cubit of 30 fingers, and of the k ù š . n u m u n with a double cubit.

Weiss, Harvey, and Young, T. Cuyler. The merchants of Susa: Godin V and plateau-lowland relations in the late fourth millennium B.C. *Iran* **13** (1975), pp. 1–17.
Contains a number of hand copies of a group of "numerical tablets" from Godin V, with close parallels in similar tablets from Susa Ca/b and Susa Acropolis level 17 (cf. Le Brun (1971),[13] Amiet, *MDP* **43** (1972)). [Particularly interesting is the tablet in Fig. 4:5, which is inscribed with what may be the earliest known documentation of the use of the "proto-literate" system of capacity notations. Thus, the number on the edge of the tablet is 1() 4 () 1(), or 1 4/5 1/10 capacity units. Fig. 5:1, with the number 9() may be another example of the same kind.]

Pettinato, Giovanni, and Waetzoldt, Hartmut. Saatgut und Furchenabstand beim Getreideanbau. *StOr* **46** (1975), pp. 259–290.
A survey of texts of various categories in which the furrow: n i n d a n ratio is mentioned. The two most interesting examples discussed are Myhrman, *BE* **3**/1

[13] JH: this reference is not clear to me – unless "1971" is a misprint for "1978", in which case the reference is to Le Brun & Vallat, *DAFI* **8** (1978).

(1910), no. 92 (transliteration in Powell, *ZA* **62** (1972)) and Pettinato and Waetzoldt, *CS* (1974), no. 86. [Note that in these two texts the ratio of m u r - g u $_4$ ‘fodder for the oxen’ to seed grain seems to have been a number fixed beforehand: in the Nippur text Myhrman, *BE* **3**/1 (1910), no. 92 it is exactly 1:2, in the Umma text *CS* no. 86 exactly 5:6 (cf. my review of Maekawa, *ASum* **3** (1981)).]

Hallo, William W. Review of Pettinato and Waetzoldt *CS* (1974). *BiOr* **33** (1976), pp. 38–40.

Observes, in particular, that the ratio of fodder to seed grain in *CS* no. 86 is “better than 9:11”. [Actually, $\frac{9}{11} \approx \frac{5}{6}$, the exact value.]

Vaĭman, A. A. Über die protosumerische Schrift, in J. Harmatta and G. Komoröczy, *Wirtschaft und Gesellschaft im alten Vorderasien* (*AASH* **22**) ((1974)1976), pp. 15–27.

Essentially a repetition of the results in Vaĭman (1974).

Vaĭman, A. A. Issledovanie po sumero-vavilonskoĭ metrologii (On Sumero-Babylonian metrology). *DV* **2** (1976), pp. 37–66.

As shown by Thureau-Dangin in *RA* **34** (1937), pp. 80–86, the relation 1 s i l a $= (6$ š u - s i$)^3 \approx 0.97$ liters can be deduced unambiguously from the “boat text” *BM 85194* problem 30 (cf. Neugebauer and Sachs, *MCT* (1945), p. 96). On the other hand, from *YBC 4669* problems 1–9 can be deduced either once more the same relation (assuming that the text is concerned with vessels of certain standard capacities, with square bottom pieces), or the new relation 1 s i l a$^{cyl} = \frac{\pi}{4} \times (6$ š u - s i$)^3 \approx 0.762$ liters (assuming cylindrical vessels with circular bottom pieces; cf. Neugebauer, *MKT* **3** (1937), 28). V. now shows that the difficult text *VAT 8522* problem 2 (cf. Neugebauer, *MKT* **3** (1937), p. 61) can be understood by assuming that the answer is given in s i l a^{cyl}: the volume of the whole log [*ka-lu-šu!*] is then 45 00 s i l a^{cyl}, and the volume of the piece to be cut off is ten times less, i.e., 4 30 s i l a^{cyl}. It is important to note that the use of the s i l a^{cyl} seems to be coupled to the use of the constant 6 40 i g i - g u b *na-aš-pa-ki-im* (sic! cf. Bruins and Rutten, *TMS* (1961), p. 27). [in fact, a cylinder of circumference c n i n d a n, height h n i n d a n, has the volume $V = .05\, c^2h$ n i n d a n$^3 = c^2h$ volume-š a r (assuming that $\pi \approx 3$). Hence, if the diameter of the cylinder is d n i n d a n, $c = \pi d$, it follows that $V = \pi^2 d^2 h$ š a r^{vol}, or $V \approx 9d^2h$ š a r^{vol} (with π still ≈ 3). But if, as above, 1 s i l a$^{cyl} = \frac{3}{4} \times (6$ s u - s i$)^3 = .45 \times (.01$ n i n d a n$)^3$, then it follows that 1 s i l a$^{cyl} = 9$ š a r^{vol}, 1 š a r$^{vol} = 6\ 40$ s i l a^{cyl} (in the Babylonian notation without zeros). Hence the nice formula $V = d^2h$ s i l a^{cyl} ($\times 60^3$).] Note also the use of the verb *kabāru* ‘to be thick’ to express the size, in s i l a^{cyl}, (1) of “cubic” pieces at either end [2 b a - s i(!) | 2 d a l, 4 b a - s i | 4 d a l] and (2)

of the whole log. This should be compared with the situation in *YBC 8600*, another log text, in which the "thickness" of the log seems to be expressed as the size, in "ordinary" s i l a, of a slab of the log of unit length (so in Neugebauer and Sachs, *MCT* (1945), pp. 57–59). According to V., however, this text proves the existence of an "area-s i l a" = (6 š u - s i)^2.

Other sections of the paper deal with, in a not quite convincing way: the two *pi-sa-nu-um* problems *BM 85194* problems 34–35, in which the constant 6 40 appears again, and the water clock problems *BM 85194* problems 6–8 and *BM 85210* rev. II problem 4. Assuming (quite arbitrarily) that the water clocks are cylindrical, and that the s i l a ^{cyl} is used, V. gives a reconstruction of the dimensions of the water clocks and comes to the conclusion that the "standard" OB water clock could hold precisely 40 s i l a ^{cyl} of water, with a weight of precisely 1 talent (g ú n). In other words, the conclusion is that the OB units of weight and capacity were deliberately chosen so that 1 g ú n = the weight of 40 s i l a ^{cyl} of water ≈ 30.30 kg. [This hypothesis ought to be compared with the hypothesis that 1 g ú n = the weight of a "standard brick" of the dimensions 1 cubit^2 × 6 fingers. Cf. Lewy, *JAOS* **69** (1949), Scheil, *RA* **12** (1915).] See also the discussion of water clocks in Thureau-Dangin, *RA* **29** (1932), **30** (1933).

Powell, Marvin A., Jr. The antecedents of Old Babylonian place notation and the early history of Babylonian mathematics. *HM* **3** (1976), pp. 417–439.

A remarkable pioneering paper in which P. manages to show, by a multitude of examples, that the Babylonian sexagesimal system with its place value notation must have been invented well before the end of the Ur III period, and that the origins of Babylonian mathematics can now be traced back to the middle of the third millennium B.C.

P. first mentions the dated Ur III text *YBC 1793* (Keiser, *YOS* **4** (1919)) which clearly demonstrates how computation with "money" (i.e., silver) was made easy by going back and forth between the metrological notation for weight measures and the positional sexagesimal system. Example: The sum, which can be computed to be 1 33 27 40, is immediately converted back into the weight system and given as 1½ m a - n a 3½ g í n l á 7 š e k u g - a. [Incidentally, this example shows that not only positionally written sexagesimal integers, but actually even sexagesimal fractions were used in everyday situations in the last century of the third millennium.]

Of extraordinary interest are a number of mathematical exercises from the Sargonic period, discussed in detail in this paper. *PUL 29* (Limet, *Étude* (1973), no. 38) is a geometric exercise in which the division problem u š = 2 40 (n i n d a n), u š × s a g = 1(i k u) has a solution given as sag = 3 k ù š - n u m u n 1 GIŠ.BAD 1 ŠU.BAD. Since 1 (i k u)/2 40 n i n d a n =

.37 30 n i n d a n, P. draws from this the conclusion that 1 n i n d a n = 6 k ù š - n u m u n = 12 GIŠ.BAD = 24 ŠU.BAD (z i p a ḫ), hence that the GIS.BAD is a cubit and the k ù š - n u m u n a double cubit. Note the unrealistic ratio between the lengths of the sides of the rectangle! Limet, *PUL 31* (Limet, *Étude* (1973), no. 39) is a similar problem, only this time with u š = 4 03 (n i n d a n). The solution is not given, instead the text says s a g - b i p à - d è - d a m 'the front is to be found'. The importance of this example is that it shows that the idea of reciprocals and regular numbers was known already in the Sargonic period!! [In fact, 4 03= 243 =3^5 is a regular sexagesimal number, which ensures that the given division problem has an exact solution that may have been found by the Ur III mathematics student in the following way (or by some similar method): Start by observing that 1 i k u = 1 40 n i n d a n ^{2} = 10 00 k ù s - n u m u n × 1 n i n d a n = 10 š a r š u - s i × 1 n i n d a n = 1 š á r - g a l š e × 1 n i n d a n. Next, find the reciprocal of 4 03 = 3^5 by use of the following algorithm: 1 š á r - g a l = 60^3 = 3×20 00 00 = 9×6 40 00 = 27×2 13 20 = 1 21×44 26.40 = 4 03×14 48.53 20. Combining the results, you get that 1 i k u ≈ 4 03 n i n d a n × 14 49 š e. Therefore, the solution of the given problem is that *sag* = 14 49 š e (–$\frac{1}{9}$ š e) = 2 k ù s - n u m u n 1 ŠU.BAD 13 š u - s u 1 š e (–$\frac{1}{9}$ š e). *PUL 27* (Limet no. 36) is a seemingly "simple" computation of the area of a square of side 11 NÍG.DU 1 k ù š - n u m u n 1 GIŠ.BAD 1 š u.BAD. The problem has most likely been solved by conversion to sexagesimal notation: Writing a = 11.17 30 n i n d a n, one finds that a^2 = 2 07.30 06 15 š a r. The given answer is a^2 = 1(i k u) $\frac{1}{4}$(i k u)$^{\text{ašag}}$ 2 $\frac{1}{2}$ š a r 6 g í n 15 g í n - t u r, which is not quite correct, since its sexagesimal equivalent is 2 07.36 15 š a r (a typical error in a notation without zeros!). [The "playfulness" of the author of this text is apparent from the choice of a special type of number for the length of the side of the square: a = 1(10) 1 n i n d a n 1 k ù š - n u m u n 1 GIŠ.BAD 1 ŠU.BAD.

Numbers of the same special type can be found in the following three, in this and other ways unusually interesting texts: Figulla and Martin, *UET* **5** (1953) no. 121, *Ist S 428* (cf. Friberg, *HM 8* (1981)), and *Ist Ni 2739* (Neugebauer, *MKT* **1** (1935), p. 79), a square root table with the entries 1-e 1 | 1 02 01-e 1 01 | 1 02 03 02 01-e 1 01 01 | ... (cf. Neugebauer, *MKT* **3** (1937), p. 52).

HS 815 (Pohl, *TMH* **5** (1935)) is a parallel to *PUL 31* above, but this time with the given side = 1 07 $\frac{1}{2}$ n i n d a n, where 1 07$\frac{1}{2}$ is another regular number (= 2^{-1}×3^3×5). The exact answer is given as 1 NÍG.DU 5 k ù š 2 š u - d ù - a 3 š u - s i $\frac{1}{3}$ š u - s i (1 š u - d ù - a = $\frac{1}{3}$ k ù š). Gelb, *MAD* **5** (1970), no. 112, another seemingly simple area computation, unfortunately contains some serious error (?) that makes it impossible to find a proper interpretation of this tantalizing text.

The last paragraph of the paper discusses what evidence there is for mathematical activities in the Fara period. P. first quotes the well known metrological-mathematical table of square areas *VAT 12593* (Deimel, *Inschr.Fara* **2** (1923), no. 82), and the school tablet Jestin, *TSŠ* (1937), no. 77 which contains a geometrical drawing that looks like an early precursor of the drawings on BM 15285 (Saggs (1960)): four circles inscribed in a square.[14] Then follows a comparison of the two closely related mathematical texts *TSS* no. 50 (cf. Guitel, *RA* **57** (1963)) and *TSŠ* no. 671. In both texts, the problem is to divide the barley in a g u r u $_7$ (a store house) into x portions of 7 s i l à each. The correct answer is given by *TSŠ* no. 50: x = 45 42 51 (written in the non-positional notation of the period), with a remainder of 3 s i l à, while *TSŠ* no. 671 gives the incorrect answer x = 45 36 00. According to P., the gur of the Fara period contained 40 00 g u r of 8×6×10 s i l à [no references are given], and the computations were based on the use of approximate reciprocals of the irregular number 7 (in *TSŠ* no. 50: .08 34 17 08, in *TSŠ* 671: .08 33). [The postulated equation 1 g u r u $_7$ = 40 00×8 00 s i l à = 5 20 00 00 s i l à (during the Fara period) should be compared with the standard relation 1 g u r u $_7$ = 1 00 00 g u r = 1 00 00×5×6×10 s i l à = 5 00 00 00 s i l à (in the Ur III period; cf. my review of Scheil, *MDP* **2** (1900)). A g u r of 8 b a r i g a is not used in all Fara texts (cf. the text *TSŠ* no. 81, in which figures a g u r of 4 b a r i g a). Note also that the interpretation suggested by P., with its reference to a four-place reciprocal of 7, can be replaced by a simplified variant: Suppose that only a two-place reciprocal of 7 was known, for instance in terms of a relation such as 1 š a r = 1 00 00 = 8 34 × 7 + 2. Then it would follow that 1 g u r u $_7$ = 5 20 š a r i l à = 5 20 × (8 34 × 7 + 2) s i l à = 45 41 20 × 7 s i l à + 10 40 s i l à, while the remainder could be taken care of in a second stage of the computation: 10 40 s i l à = 1 31 × 7 s i l à + 3 s i l à. With this interpretation, the "wrong" result in *TSŠ* no. 671 would be a result of (1) the use of the reciprocal 8 33 instead of 8 34, and (2) the fact that all space on the tablet was used up so that the second stage of the computation would have to be carried out on another tablet or be ommitted. A remarkable confirmation of the interpretation of *TSŠ* no. 50 and no. 671 suggested here comes from the area computation in *TSŠ* no. 188. There the square of 5 (10×60) (n i n d a n) is claimed to be equal to 1(ŠÁR-GAL) 2(ŠAR'U) 7(ŠAR) 3(b u r ' u). The computation seems to have taken place in several steps: First the relation (10×60 n i n d a n) = 3(ŠÁR) 2(b u r ' u) is quoted from a table of squares such as *VAT 12593* (see above), but incorrectly, with the value of the square given as 3(ŠÁR) 3(b u r ' u). Then this value is multi-

[14] JH: No precursor. As was shown by Manfred Krebernik (*N.A.B.U.* 2006 no. 1, pp. 13*f*), this tablet is an intruder in the collection and actually of Old Babylonian date.

plied with a factor 10, giving 10×3(ŠÁR) 3(b u r ʼ u) = 3(ŠARʼU) 5(ŠAR). Finally, a multiplication by 2 ½ (written in the lower right corner of the tablet) gives the wanted value: $(5\times10\times60)^2$ š a r = $25\times(10\times60)^2$ š a r = 2½ ×(3(ŠARʼU) 5 (ŠAR)) = ..., i.e., the result in the text. (Cf. Pomponio, *MEE* **3** (1981), Høyrup, *HM* **9** (1982)!)].

Powell, Marvin A., Jr. Two notes on metrological mathematics in the Sargonic period. *RA* **70** (1976), pp. 97–102.

(1) Sargonic bread and beer texts: considering the Umma texts Sollberger, *CT* **50** (1972), no. 55–59, P. concludes that these texts use a g u r - s a g - g á l of 4×6×10 s i l à for dry capacity, and a d u g of 30 s i l à for liquid capacity, with special notations for ⅔, ½, and ⅓ d u g (cf. Powell, *JCS* **27** (1975)). A d u g divided into thirds was used also in the pre-Sargonic "messenger tablets" Hackman, *BIN* **8** (1958), no. 67–68, but there the notations ,  were used for ⅓ and ⅔ d u g. P.'s claim that a d u g of 20 s i l à was used in pre-Sargonic Girsu lacks explicit references, and the suggestion that the switch to the d u g of 20 s i l à is "evidence for manipulation of the metrological system to accomodate sexagesimal calculations" does not seem to be well founded. [Actually, the "minor miscalculations by the ancient scribe", which are so puzzling to P., can be explained if one assumes that the b á n rather than the s i l à is the basic unit in the calculations, and that the following approximations were used: ⅙, ⅓, ⅔, and ⅚ b á n ≈ 1½, 3, 6, and 8 s i l à, respectively. (Example: in Sollberger, *CT* **50** (1972), no. 55, 1 d u g of 7(b á n)/d u g, 7 d u g - 1 s i l à of 5 (b á n)/d u g, and 2⅔ d u g of 3 (b á n)/d u g are equated with 7+(35-⅙)+8 = 50–⅙ b á n or 2(g u r) 2(b á n) - 1½ s i l à (!).) Other bread and beer texts of the same type as Sollberger, *CT* **50** (1972), no. 55–59 (recognizable through their metrology and through the dating by the m u - i t i - u$_4$ 'year-month-day' formula) are Fish, *CST* (1932), no. 4–6, and Nikol'skiĭ, *DV* **5**/2 (1915), no. 26–36, no. 44–45 (where the only d u g-fraction is the half-d u g, and the only beer strengths are 1 (b a r i g a)/d u g and 3 (b á n)/d u g. Note in no. 31 the unusually explicit formula for bread size n i n d a - z í d-1(b á n)-10 d u$_8$ 'breads of which 10 can be made out of 1 b á n of flour'; a similar explicit formula for beer strength in no. 26–32 is k a š - š e - 1(b a r i g a)-g u r$_8$- g u r$_8$. In Fish, *CST* (1932), no. 14 and in Nikol'skiĭ, *DV* **5**/2 no. 83 appear again the beer strengths 7, 5, 3(b á n)/d u g, but in the *DV* text the only fractions of the dug are ¾ and ¼ d u g, and use is made of the approximation ¾ b á n ≈ 8 s i l à. Note in *CST* no. 14 the phrases s á - d u g$_4$ 1 u$_4$, 1 i t i.].

(2) Work assignment ratios for excavations: P. tries here to trace the work norm '10 g í n per man and day' which is known from OB (mathematical) excavation texts, to its presumed third millennium origins. His point of departure is the Sargonic m u -*iti*-u$_4$ text Nikol'skiĭ, *DV* **5**/2 (1915), no. 64. [After

renewed inspection of the text by P. himself (personal communication) it is now possible to improve the interpretation of this important text: it appears that three teams of diggers have excavated sections of a canal of lengths 1 i g i - 4 - g á l, ½ (e š é) 4(k ù š), and 1(e š é) 5 k ù š, respectively; note the use here of the sequence of length measures ½ (e š é), g i, k ù š, the same as in the pre-Sargonic area texts from Lagaš *DP* no. 604–612 (Allotte de la Fuÿe *RA* **12** (1915), *DP* FS (1920)) and Sollberger, *CT* **50** (1972), no. 40 (cf. Powell, *JCS* **27** (1975)), as well as in the k i n - d ù - a texts from the same period Nikol'skiĭ, *DV* **5**/2 (1915) no. 8, and *VAT 4851* (Fö 187; Förtsch, *VS* **14** (1916)). The total volume of the three excavated sections, which can be computed to be 14½ (= 29/2) š a r^{vol} is indicated in the text as 5–1/6 (=29/6) SU.KUR.RU, and then evaluated as ki n-AKA i t i - 3 LÁ 3 u_4, i.e., as '3 months – 3 days (= 3×29) days of excavation work'. Consequently, the work norm here is exactly 1/6 š a r^{vol} = 10 g í n, and the SU.KUR.RU (or SU+3+RU(?)) = 3 š a r^{vol} = the work norm for 18 diggers. The only other text of a similar kind is Nikol'skiĭ, *DV* **5**/2 (1915) no. 65, unfortunately damaged and difficult to interpret. Interesting is that in this text appears in the place of the SU+3+RU a simple SU.RU and its fractions ½ SU.RU and 10 g í n.]

Labat, René. *Manuel d'épigraphie Akkadienne (signes, syllabaire, idéogrammes)*. Paris (1st edition 1948) 5th edition 1976.

A very useful inventory of nearly 600 cuneiform signs, their most common graphical variants, and their phonetic or semantic values. The presence of indexes of various kinds makes it possible for the non-specialist to use the book as a rudimentary Sumero-Akkadian dictionary. Of special interest are the many references to the use of cuneiform numbers as cryptograms; see, for instance, no. 470*ff* and no. 578: 15 = *immitu* 'right', 2 30 = *šumelu* 'left'; both 20 and 2 30 = 'king'; *pa-liḫ* 21 50 u 40 'he who honours Ana, Enlil, and Ea'; 30 u 20 'moon and sun', etc. (Cf. the discussion in Delitzsch, *ZÄS* **16** (1878), p. 64). Another example of the cryptographic use of numbers in a cuneiform text is offered by, for instance, the Seleucid religious text *AO 6458* "The exaltation of Istar" (Thureau-Dangin, *RA* **11** (1914), pp. 141–158). The last line of this text reads as follows; 'tablet of ^{I}21 35 35 26 44, son of ^{I}21 11 20 42'.

Matthiae, Paolo. *Ebla, un impero ritrovato*. Turin 1977; *Ebla, an empire rediscovered*. London 1977.

Pl. 25: A photograph of the economic Ebla text *TM.75.G.1527*, which clearly shows that the "semitic" hybrid system of numeration with Sumerian sexagesimal notation up to 99, but with phonetically written number words for 100, ... (cf. Biggs and Postgate, *Iraq* **40** (1978)) was used at Ebla at the middle of the third millennium B.C.

von Soden, Wolfram. Mathematische Konstantenlisten als Zeugnisse für Arbeitsnormen in Babylonien. *20.D.Or.Tag* 1977, pp. 107–109.

A great deal of information about life in ancient Mesopotamia may be hidden in the OB and MB lists of constants. To illustrate this point of view, vS. considers the constant 2 13 20 = $60^n/27$ known from two such lists, the line 2 13 20 *ù* 1 15 *ša* $^{\text{giš}}$d u b - í l in *YBC 5022* rev.44 (Neugebauer and Sachs, *MCT* (1945), p. 135), and the line quoted in my review of Edzard, *Tell ed-Dēr* (1970) (*IM 49.949*, line 9). Referring to the existence of a late early-dynastic statuette of a naked man carrying on his head a *tupšikkum* containing, probably, a square brick (cf. Salonen, *Ziegeleien* (1972)), vS. conjectures that the constant 2 13 20 indicated the work norm of carrying 72 bricks of the standard format $2/3 \times 2/3 \times 1/6$ cubic cubits in a day. [Note, however, that the volumes of single square bricks of the two formats $2/3 \times 2/3 \times 1/5$(!) and $1/2 \times 1/2 \times 1/5$ cubic cubits are, respectively, $60^{-1}/27$ = .00 02 13 20 and $60^{-1}/48$ = .00 01 15 volume-š a r. Cf. Scheil, *RA* **12** (1915), Lewy, *JAOS* **69** (1949), and the systematic discussion of brick formats in Powell, *JCS* **34** (1982).]

Michalowski, Piotr. Ur III topographical names. *OrAnt* **16** (1977), pp. 287–296.

ASM 12080: the first line of this text gives the following description of a boat, presumably for hire: 1 m á 20 g u r a - n a 1 g u r 1 s i l à - t a 'a boat of 20 g u r, at 1 s i l à per d a n a and g u r'. Cf. the boat in the mathematical problem text *BM 85194* problem 10, with a computed capacity of 8(g u r) 1 40; cf. also the boats called $^{\text{giš}}$m a-*n*-g u r, with *n* between 60 and 5, in the lexical text Ḫḫ tablet 4 (Landsberger, MSL 5, (1957); Deimel (1885)[15]).

Pettinato, Giovanni. TSŠ 242, Fondazione della citta UNKEN$^{\text{ki}}$. *OrAnt* **16** (1977), pp. 173–176.

It is suggested here that the numbers listed in *TSŠ* no. 242 (Jestin, *TSŠ* (1937)) are three area numbers, expressed as sexagesimal multiples of simple or double area units (e.g., i k u-units (?)), but that if this is true, then there must be a computational error in the text. [In fact, if the suggestion is correct, then the sum of the area numbers in the first column of the tablet is: (40 00–40)+$1/2$(52 00–10) double area units. Now, assume that round-off was used, so that numbers less than 10 units were disregarded. Then the sum would become equal to: (40 00–40)+(26 00–5) $\approx$ 1 06 00–40 = 1 05 20 double units. The sum indicated in the text is 1 06 20 double units. Thus P. was right; the text contains a small computational error, 6 instead of 5 sixties.]

Schmandt-Besserat, Denise. An archaic recording system and the origin of writing. *SMS* **1** (1977), pp. 31–70. The earliest precursor of writing. *ScAm* **283**:6 (1978), pp. 50–59. An archaic recording system in the Uruk-Jemdet Nasr period. *AJA* **83** (1979), pp. 19–48 + 1 pl.

In this extremely interesting series of papers, the author carries a good bit further the identification made in Amiet, *Elam* (1966) of clay envelopes from Susa, containing various types of clay tokens, as an archaic accounting method. It is

convincingly demonstrated that the invention of writing may have come as the last step in the evolution of a sophisticated system of recording that was indigenous to the whole region of the Middle East since the ninth millennium B.C. This system was based on clay tokens of various geometric and odd shapes, most commonly tokens in the form of spheres, disks, rods, cones, or tetrahedrons. According to this hypothesis, the invention of clay envelopes for the tokens (around the middle of the fourth millennium B.C.), and of the method to use imprints on the surface of the envelopes as an indication of the contents, very soon led to the invention of writing (cf. again Amiet, *Elam* (1966)). Against this background it becomes easy to explain the instant standardization of writing in a widespread area, as well as the abstract shapes of all the numerical signs and of the signs (in the Sumerian script) for a score of commodities of daily use (most notably the sheep sign ATU 761 and the many signs related to it).

Kienast, Burkhart. *ABUK* **19** = *Altbabylonische Urkunde und Briefe aus Kisurra.* Wiesbaden 1978.
n179: a square root table, from 1 // 1 í b - s i $_8$ to 38 24 // 48 í b - s i $_8$ [...].

Zaccagnini, C. A note on the talent at Alalah (AT 401). Iraq 40 (1978), pp. 67–69.
The Alalah IV text AT 401 is used here to show that the Syrian (decimally adapted) talent (*ka-ku-rú*) was divided into 3000 shekels.

Postgate, J. N. An inscribed jar from Tell Al Rirnah. *Iraq* **40** (1978), pp. 71–75.
This is “the first published attempt to deduce metric equivalences for the OB capacity measures by comparison with an actual container”. The container in question is TR 5055 = *IM 78658*, a jar measuring about 121 liters, with on the shoulder the inscription 1 a n š e 5(b á n) ⅓ s í l a *i-na* GIŠ.BÀN ^{d}U t u, written vertically [cf. Picchioni, *OrNS* **49** (1980)!]. Hence the OB *qa*, in the ‘*šūtu* of Šamaš’, must have measured between 0.79 and 0.82 liters, allowing a 2 % margin of error. P. gives also a review of other publications concerned with attempts to determine the absolute values of Old Babylonian, Neo-Babylonian, and Neo-Assyrian capacity measures. It is interesting to note that the value of the OB *qa* deduced in the present article is precisely ⅚ of the value (6 š u - s i)^3 = 0.97 liters that was derived from OB mathematical problems by Neugebauer in *MKT* **3** (1937) and by Thureau-Dangin in *RA* **34** (1937). Therefore, the OB *qa* in the *sūtu* of Šamaš seems to be the *qa* that is connected with the constant 6 *šà na-aš-pa-ak šà-al-šu-di-im* in the list of constants *TMS* no. 3 (Bruins and Rutten, *TMS* (1961); cf. Vaĭman, *DV* **2** (1976)). See also Thureau-Dangin, *RA* **9** (1912), where T. uses a reconstructed inscribed stone jar to estimate the value of the Neo-Babylonian qa: ≈ 0.81 liters.

Sollberger, Edmond. *MVN* **5** = *The Pinches manuscript*. Rome 1978.
No. 61: a tablet with two field plans, not very detailed.

Biggs, Robert D., and Postgate, J. N. Inscriptions from Abu Salabikh, 1975. *Iraq* **40** (1978), pp. 101–117 + pl. 17–19.

IM 81438 (IAS 519): one half of a tablet dealing with large numbers of sheep and goats, the earliest documentation of the use in Sumer of the Semitic "pseudo-decimal" system of written number notations, known from later periods, and now also from Mari and Ebla (cf. *ARMT* **19** no. 462; Pettinato, *Archives* (1981)). The preserved numbers are: 7 () 4() 40 s i l a 4 n i t a *mi-at*, and š u - n i g í n n i g í n 13 () *li-im* 9 () *mi-at* 1 12 u d u - n i t a ... . Since the text is not intact, and since the number signs are not written in linear order after each other, it is impossible to guarantee the correctness of the transcription. Note however the use of alternatingly horizontal and vertical number signs, which may have been intended to distinguish the thousands front the hundreds.

Powell, Marvin A., Jr. A contribution to the history of money in Mesopotamia prior to the invention of coinage. In *Festschr. Lubor Matouš* (ed. B. Hruška and G. Komoróczy). Budapest 1978, pp. 211–243.

In this paper, P. demonstrates that the term ḪAR k ù - b a b b a r (*šewīr kaspim*) may have been used not only for silver rings but also for silver coils of the well known type that could serve as "money". In particular, he conjectures that the MB word for '$^1/_8$ shekel', namely *bitqu* (literally "cutting"), originally denoted a piece of standard size cut off from such a silver coil. As evidence he uses the mathe-matical text *BM 85196* problem 16 (Thureau-Dangin *RA*, **32** (1935), pp. 1–28). As a matter of fact, in this text figure two silver coils, of weight, respectively, 35 and 33 times $^1/_8$ g í n, from which are cut off one-seventh (i.e., $5\times{}^1/_8$ g í n) and one-eleventh (i.e., $3\times{}^1/_8$ g í n) in order to make each coil weigh as much as the other one ($30\times{}^1/_8$ g í n). [The strange way in which this problem is solved in the text becomes easier to understand if one observes the connection between this silver coil problem and the series of *maḫīrum* problems in *VAT 7530*. That such a connection exists is hinted at by the occurence in the silver coil problem of the phrase *lu-ú* 1 g í n *ša ta-aḫ-ru-ṣú li-li ù li-ri-id-ma* ḪAR k ù - b a b b a r *li-im-ta-aḫ-ru* 'may the one shekel you have cut off go up or down so that the silver coils become equal'. A similar phrase is characteristic of the *maḫīrum* problems, and the first part of the solution of the silver coil problem (forgotten or omitted in this particular text) is likely to have been related to the method of solution of the problems in *VAT 7530*. Indeed, the given problem can be reformulated in algebraic form as a system of equations: $^x/_7+{}^y/_{11} = 1$, and $x-{}^x/_7 = y-{}^y/_{11}$. In order to solve the indeterminate linear equation $^x/_7+{}^y/_{11} = 1$, one may start by looking for the solution in the simplest case, i.e., when x and y both are equal to a common value q. Then $^q/_7+{}^q/_{11} = 1$, so that $q = 11\times7/(11+7)$. In the general case, the solution of the indeterminate equation is $x = q+7z$, $y = q-11z$ ('the silver goes up and down'!). The value of z is determined by insertion of these values for x and y in the second equation: since $x–{}^{x}/_{7}$ = q+7z–${}^{q}/_{7}$–z and y–${}^{y}/_{11}$ = q–11z–${}^{q}/_{11}$+z, the second equation then is reduced to an equation for z: q–${}^{q}/_{7}$+6z = q–${}^{q}/_{11}$–10z, or (10+6)z = ${}^{q}/_{7}$–${}^{q}/_{11}$ = ${}^{11–7}/_{11+7}$ = ${}^{4}/_{18}$ = .13 20. Conse-quently, z = .13 20/16, or z = 50 (in Babylonian sexagesimal notation). It then follows, precisely as in the text of the silver coil problem, that the weights of the coils are given by the equations y = 11×(${}^{7}/_{11+7}$–50) = 11×(23 20 – 50) =11 × 22 30 = 4 07 30, x = 7×(${}^{11}/_{11+7}$+50) = 7 × 37 30 = 4 22 30. To tell the truth, however, the text makes some puzzling shortcuts even in this last, straight-forward part of the solution algorithm].

Vogel, Kurt. Das Fortleben babylonischer Mathematik bei den Völkern des Altertums und Mittelalters, in *Beiträge zur Geschichte der Arithmetik*. München 1978, pp. 19–34. (= *Tr.25°KVV* **1**. Moscow (1960)1962, pp. 249–256.)

A brief, but thoroughly researched and most informative survey of the transmission of methods and traditions of Babylonian mathematics to many contemporary and succeeding civilizations.

Note on p. 30, note 16, the observation that a scholion to Euclid's *Elements* 10, Def. 4 (ed. Heiberg (1888)[15] vol.5, p. 436) refers to a square with the ratio between diagonal and side approximately equal to (7.04 15)/5 (= 1.24 51 10). This is the same approximation to 2 as in *YBC 7289* (Neugebauer and Sachs, *MCT* (1945), p. 42). (The Greek way of writing 7.04 15 50 is ζ δ' ιε" ν'''.)

Vallat, François. Le matériel épigraphique des couches 18 à 14 de l'Acropole. *Paléorient* **4** (1978), pp. 193–195; Le Brun, A., and Vallat, François. L'origine de l'écriture à Suse. *DAFI* **8** (1978), pp. 11–59.

In these two papers of extraordinary importance, conclusions concerning the origin of writing are drawn from material excavated since 1969 at the Susa Acropole. It is shown that the transitions (1) from spherical envelopes with seal impressions and a content of clay tokens to similar spherical envelopes with, in addition, impressed number notations on the surface, and (2) from such envelopes to tablets with seal impressions and impressed number notations, took place within a very brief span of time, in the period corresponding to the Susa level Acr. 18. Further, a few examples are known from level Acr. 17 of tablets with number signs and an isolated non-numerical sign (denoting some commodity;). The first tablets with writing appear in levels Acr. 16–14 (proto-Elamite script). An interesting observation is that the only clay tokens that have been found in these excavations are tokens in the shape of: sticks, spheres, disks, small cones, and bigger, pierced cones. (Cf. Schmandt-Besserat 1977–1979.) The authors conjecture that these five kinds of tokens correspond to the units of a proto-Elamite number system.

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[15] JH: That is, J. L. Heiberg, (ed., trans.), Euclidis *Elementa*. 5 vols. Leipzig 1883–1888.

Friberg, Jöran. The third millennium roots of Babylonian mathematics. 1: A method for the decipherment, through mathematical and metrological analysis, of proto-Sumerian and proto-Elamite semi-pictographic inscriptions. *DMG* (1978–9), pp. 1–56.

The starting point for this paper is the crucial observation that the ration text Hackman, *BIN* **8** (1958), no. 5 shows that, in the proto-Sumerian (Jemdet Nasr) system of number notations for capacity measures (here called the "ŠE-system") a small circle stands for 6, rather than 10, capacity units. Hence the sequence of relative values of the successive units ("cup", "disk", "big disk", "big cup", ...) must be 1, 6, 60, 180, ..., rather than 1, 10, 100, 300 (cf. van der Meer, *MDP* **27** (193)). Next, it is shown that three different systems of number notations are made use of in proto-Elamite texts (roughly contemporeaneous with the proto-Sumerian texts of the Jemdet Nasr period): (1) a proto-sexagesimal system, used to count people, loaves of bread, jars,..., with the sequence of units 1, 10, 60, 120, 1200,... ; (2) a purely decimal (non-positional) system, used to count animals(?); (3) a capacity system almost identical with the proto-Sumerian capacity system. Example: Scheil, *MDP* **6** (1905), no. 399 is a ration text in which 1412 "animals" (counted decimally) each gets a ration of $\frac{1}{5}$ capacity unit, hence together $282\frac{2}{5}$ capacity units of one commodity, and each $\frac{1}{60}$ unit, hence together $23\frac{17}{30}$ (written as $3\times6+5+2\times\frac{1}{5}+\frac{1}{10}+2\times\frac{1}{30}$) capacity units of a second commodity. Particular attention is given to proto-Elamite and proto-Sumerian "bread and beer texts", and a comparison is made with Egyptian "pefsu problems" such as Rhind Papyrus no. 75. A comparison is made also between systems of fractional notations in proto-Elamite, proto-Sumerian or Sumerian, and Egyptian texts.

Friberg, Jöran. The early roots of Babylonian mathematics 2: Metrological relations in a group of semi-pictographic tablets of the Jemdet Nasr type, probably from Uruk-Warka. *DMG* (1979-15), pp. 1–80.

Contains a detailed analysis of the metrological relations in a group of proto-Sumerian tablets from the Jemdet Nasr period, consisting of three separate lots, originally published in Hackman, *BIN* **8** (1958), no. 3–5, 9), Falkenstein, *OLZ* **40** (1937), no. 1–6, and van der Meer, *RA* **35** (1935) no. 1–17. The homogeneity of this group is apparent from the common use in tablets of all three lots of the same set of "signatures" (some of which appear also in the "census text" *ATU 585* and the "professions list" Langdon, *OECT* **7** (1928), no. 104) and from the similarity between the three lots with regard to the text classes to which the individual tablets can be referred.

Of particular interest are: (1) the correct interpretation of the big bread and beer text (possibly a metrological exercise) *IM 23426* (cf. the discussion in Falkenstein, *OLZ* **40** (1937)) from which follows that the absolute size of the proto-Sumerian capacity unit was of the same order of size as 1 b á n; (2) the observation that proto-Sumerian (and proto-Elamite) bread and beer texts as

a rule display a grand total which is an “almost-rounded number” (example: in *IM 23426* the grand total is (2–1/100)×180 capacity units; (3) the conjecture that the proto-Sumerian and proto-Elamite capacity units were related to the normal barley ration for a five day week. Examples: *BM 116730* (Langdon, *OECT* **7** (1928)), and Scheil, *MDP* **6** (1905), no. 221; cf. Friberg, *DMG* (1979–15) p. 17).

Greengus, Samuel. *Old Babylonian tablets from* Ishchali *and vicinity* (PIHANS 44). Istanbul 1979.

No. 292 (*A 21948*): a metrological table for area measures (basic unit 1 š a r), from ⅓ š a r // 20 to 1(ŠAR×2).GAL^{ašag} // 1 (i.e., 2×60^2 b ù r = 60^4 š a r).

Amiet, Pierre. Alternance et dualité. *Akkadica* **15** (1979), pp. 2–22 + 2 pl.

A continuation of the discussion in Le Brun and Vallat 1978.

Alberti, Amedeo. Sul valore della misura “mun-du”. *OrAnt* **18** (1979), pp. 217–224.

After a survey of the literature, A. is able to find only two pre-Sargonic texts from Lagaš in which the flour measure or container m u n - d u (a “sack”?) figures in such a way that its size can be determined: *MAH 15998* (*Genava 26*, Sollberger 1948[16]); Nikol’skiĭ, *DV* **3**/2 (1908), no. 25. The latter of these texts allows A. to confirm Sollberger’s hypothesis (op. cit.) that the m u n - d u contained 2 b á n or 12 s i l à.

Steinkeller, Piotr. Alleged GUR.DA = u g u l a - g e š - d a and the reading of the Sumerian numeral 60. *ZA* **69** (1979), pp. 176–187.

S. starts with an illuminating discussion of the history of transliteration of the word u g u l a - g é š - d a ‘officer of sixty (men)’. (The complex PA.1-d a can easily be misread as GUR-d a). As evidence for the suggested reading is used a new transliteration and translation of the text *MVN* **2**[17] no. 359, an Umma-text (?) describing a lend-lease agreement, according to which the interest on a loan of barley (or its silver equivalent) is equated with the fee for a rented field that is divided among sixty soldiers under the supervision of an u g u l a - g é š - d a. [In the translation given, it is contended that the barley is measured “with a 72 sila(-container)”. What the text actually says, is the following: 30 (g u r) š e $^{gur+silà}$-1(b a r i g a) 2(b á n)-t a | š e m a š s i - g i - d è | k u r$_6$ é r i n g é š - d a 4(i k u)^{ašag} t a u r u$_4$ - d a m a š - b i l a l - d è | k i U r - n ì g i n - g a r - t a | I n - d a u g u l a - g é š - d a - k e$_4$ | š u - b a - t i ‘30 g u r of barley, at 1 b a r i g a 2 b á n (per g u r), in interest

[16] JH: That is, Edmond Sollberger, *Documents cunéiformes au Musée d’art et d’histoire* (Genava XXVI). Geneva 1948.

[17] JH: Herbert Sauren, *Wirtschaftsurkunden des Musee d’Art et d’Histoire in Genf*, *MVN* **2**, Rome 1974.

for the barley; prebend land for sixty soldiers, 4 i k u each, will be cultivated in exchange for the rent; from Ur-nigingar; Inda, officer of sixty, received it'. This means that the rate of interest was 8:24 (assuming a g u r of 4×6 b á n), i.e., the usual rate of 20:60. Hence the interest carried by the 30 g u r was 10 g u r, corresponding to 10 g í n silver, in exchange for the lease of 240 i k u of land. In other words, the land was leased at the rate of 1 g í n for 1 ⅓ b ù r of land. – The introduction *ad hoc* of a 72 sila-container is repeated on p.180 note 12, where S. postulates the existence of a 62 sila-container in an effort to explain the following passage from an Ur III text (Legrain, *TRU* (1912), no. 374): š u - n í g i n 240(g u r) š e g u r s a g b a - r í - g a 2 s ì l a - t a š e - b i 8(g u r) š u - n í g i n - n í g i n 248(g u r) š e g u r. There are simpler ways to explain the addition of 2 s i l à per b a r i g a, i.e., of a surplus of one-thirtieth, for instance just measuring with "good measure".]

The second part of the paper contains an interesting discussion culminating in the suggestion that the proposed reading /ge(d)/ for 'one' in Sumerian (Powell 1971) is incorrect and ought to be replaced by the reading /ŋešt/ for 'sixty'. The most important implication is that the first line in the reciprocal table *Ist S 485* (Neugebauer, *MKT* **1** (1935), p. 27; cf. Powell, *SNM* (1971), p. 55) can now be reconstructed as g i - [e š - d a] [š á] - [n a - b] i - [b] i 40 [à m] (i.e., /g e š t - a k š a n a b i - b i 40) 'of sixty, its two-thirds is forty', with parallels in other early reciprocal tables. [Actually, it was claimed already in Scheil, *RA* **12** (1915) that the unique last line i g i - g á l || - da - kam of an early table of reciprocals (Neugebauer, *MKT* **1** (1935), p.10 no. 4) must be translated as 'fractions of 60'!]

Powell, Marvin A., Jr. Notes on Akkadian weight metrology: methods, problems and perspectives. *AOAT* **203** (1979), pp. 71–109.

An updating of the corresponding section in Powell, *SNM* (1971).

Powell, Marvin A., Jr. Notes on Akkadian numbers and number syntax. *JSS* **24** (1979), pp. 13–18.

Zaccagnini, Carlo. The tallu measure of capacity at Nuzi. *Assur* **2** (1979), pp. 29–34.

Demonstrates, using Lacheman, *HSS* **15** (1955), no. 257 and other texts, that at Nuzi oil was measured in the *tallu* of 8 *qa*. Cf. Lacheman, *HSS* **14** (1950) no. 123, which demonstrates that at Nuzi, sometimes, the *sūtu* = 8 *qa* (Zaccagnini, *OrAnt* **14** (1975)).

Pettinato, Giovanni. *Ebla, un impero inciso nell'argilla*. Milano 1979; *The archives of Ebla*. New York 1981.

Chapter 7:3, Units of measure, contains a survey of the metrological relations in texts from Ebla: (1) the units of the capacity system are *gubar*, *parīsu*, s i l à, *anzam* with the relative values 120,60,6,1; (2) the units of weight are m a - n a, g í n, -NI, with relative values 360,6,1 (in addition there are special names for

⅔, ½, and ⅓ m a - n a : ŠA.PI = *šanapi*?, KU_5, GUR_8); (3) the basic area unit is the (i k u), and there are no higher units (cf. *TSŠ* no. 242 in Pettinato, *OrAnt* **16** (1977); (4) for counting is used the Semitic hybrid system of numeration, with the units 1, 10, 60, 100 (1 *mi-at*), 1000 (1 *li-im*), 10,000 (1 *ri-ba*$_x$), 100,000 (1 *ma-i-at* or *ma-i-ḫu*). For the discussion in Chapter 8 part 3 of the mathematical text *TM.75.G.1693*, cf. Archi, *SEb* **3** (1980). See also the comparison in Pomponio, *OrAnt* **19** (1980) of the pre-Sargonic text *AO 7754* with the Ebla texts with respect to metrology, etc.

1980–1982

van der Waerden, B. L. On pre-Babylonian mathematics 1–2. *AHES* **23** (1980), pp. 1–46.

One in a long series of papers by vdW and other authors (cf., for instance, A. Seidenberg, The origin of mathematics, *AHES* **18** (1978)), in which a possible common origin of Babylonian, Egyptian, Indian, Chinese, and Greek mathematics is discussed. It is suggested here, without very much factual evidence, that this common origin is to be sought in Neolithic Europe.

Brandes, Mark A. Modelage et imprimerie aux debuts de l'écriture en Mésopotamie. *Akkadica* **18** (1980), pp. 1–30.

A valuable complement to the articles by Schmandt-Besserat 1977–1979, beginning with an extensive review of publications on bullae (envelopes) and clay tokens. (It appears that the author already in 1969, at a conference at l'Institut des Hautes Etudes de Belgique, proposed an identification of clay tokens in the form of cones, spheres, etc., with number signs on proto-Sumerian clay tablets.) The paper contains also an attempt to verify Schmandt-Besserat's identification of 15 categories of 'miniatures' (clay tokens) with proto-Sumerian logograms, through the establishment of a concordance between such miniatures and numbers in the sign list of Falkenstein, *ATU* (1936), etc.

Lieberman, Stephen J. Of clay pebbles, hollow clay balls, and writing: A Sumerian view. *AJA* **84** (1980), pp. 339–358.

A critical review of Schmandt-Besserat 1977–1979. In an effort to lessen the time gap between the clay tokens and envelopes of the late fourth millennium and the superficially similar Nuzi bulla described in Oppenheim (1958), L. conjectures that the well known way in which curviform (round) and cuneiform numerals sometimes were used together on the same tablet, as late as during the Ur III-period (cf. Pinches, *Amherst* **1** (1908); Lambert (1966)[18]), indicates that the curviform numerals may have represented manipulated clay calculi, while the cuneiform numerals stood for computed numbers (?). L. discusses also at length the meaning of the successive glosses l ú š u m u n - g i $_4$, l ú ^{geš}d a b $_4$ - d í m, l ú ^{na4}n a, l ú i m -^{na} n a in the "OB Lu-series", which he compares with a similar series of glosses g e š - ŠID - m a = *iṣ-ṣi mi-nu-ti* 'wooden counting sticks',

[18] JH: this reference is not clear to me.

..., $^{\text{geš}}$d a b$_4$ - d í m ‘counting board(?)’, $^{\text{geš}}$š u - m e - g e = *šu-me-ek-ku-ú* ‘abacus (?)’. [The tentative translation of $^{\text{geš}}$NÍG-ŠID = *ma-aḫ-ḫi-ṣa-a-tú* as ‘heddle(?)/loom(?)’ should perhaps be replaced by ‘web, network, cross-ruled board (?)’, as more fitting in the context.] In particular, it then follows that i m - n a ‘clay stone’ may be the Sumerian word for ‘calculus, counting stone, clay token’.

Schmandt-Besserat, Denise. The envelopes that bear the first writing. *TaC* **21** (1980), pp. 357–385.

Contains, beside several interesting photographs, a chart listing the contents of 11 envelopes with clay tokens from Susa (plus 1 from Tepe Yahya). The somewhat disappointing conclusion is that most of the envelopes contained only cylinders (rods) and small spheres (that is, tokens corresponding to small numbers), with only a few instances of envelopes containing also disks, cones, or tetrahedrons. Therefore it is not yet possible to say anything definite about the nature of the transactions documented by such envelopes.

Archi, Alfonso. Un testo matematico d’età protosiriana. *SEb* **3** (1980), pp. 63–64, fig. 15a–b.

Presents photos and a preliminary discussion of the mathematical text *TM.75. G.1693* from the great archive L.2769 in Ebla, palace G. The text contains a list of “big units” in the Sumerian sexagesimal system and makes a reference to a “scribe of Kiš”. [A comparison with big number units appearing in roughly contemporaneous texts from Šuruppak (Jestin, *TSŠ* (1937)) makes it probable that the correct transliteration of the list runs as follows: g e š ’ u - g a l ($10{\times}60{\times}60$), š á r - g a l ($60^2{\times}60 = 60^3$), š a r ’ u - g a l ($10{\times}60{\times}60$), š a r - u$_x$ - g a l (a variant form of the preceding number!), 6 (š a r ’ u$_x$ - g a l) n u - d a - š i d ($6{\times}10{\times}60{\times}60 = 60^4$), ‘I could not count it’). Cf. Cros, *NFT* (1910) (*AO* 4303).]

Picchioni, Sergio Angelo. La direzione della scrittura cuneiforme e gli archivi di Tell Mardikh Ebla. *OrNS* **49** (1980), pp. 225–251 + pl. 7–11.

A thoroughly documented discussion of the perplexing question concerning at what stage of the evolution of the cuneiform script the texts started to be written horizontally rather than vertically. The unorthodox answer given here is that the vertical mode of writing was in use as late as at the beginning of the Old Babylonian period. Of particular interest is the remark (due to D.O. Edzard) that if this is true, then it would be less difficult to explain the strange use of a n . t a and k i . t a (‘upper’ and ‘lower’) in grammatical texts to denote prefixes and suffixes, respectively, and in OB mathematical texts to denote what has been interpreted as “left” and “right” in geometrical figures. (Cf. Edzard, Grammatik, in *RLA* **3** 1957–1971, and Vogel, *MN* **18** (1958).

Edzard, Dietz Otto. Sumerisch 1 bis 10 in Ebla. *SEb* **3** (1980), pp. 121–127 + pl. 26.

See Pettinato, MEE 3 (1981), pp. 212–213, where the same text is discussed.

Pomponio, Francesco. AO 7754 ed il sistema ponderale di Ebla. *OrAnt* **19** (1980), pp. 171–186.

Starts with a discussion of *AO 7754*, a pre-Sargonic text(?), in Semitic language, and with several points of contact with documents from Ebla, notably the nomenclature for weight measures. Of great general interest are the author's discussions of (1) the relative frequency of the use of the phrases a n . š è . g ú (etc.) and š u . n í g i n to denote 'totals' and 'sub-totals' in texts from Fara, Abu Ṣalabīkh, Ur I, and Ebla; (2) the values of the Eblaite weight measures 2-NI, 3-NI, 4-NI, 5-NI, 6-NI (which are shown to be $\frac{2}{3}$(!), $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$ of a shekel, as is clear from texts like *MEE 1 814* where 13 3-NI of gold is equated with precisely five times as much silver, that is with 66 2-NI of silver); (3) a concordance of Eblaite with pre-Sargonic and Sargonic notations for weight measures, with extensive documentation; P. points out the conspicuous simplicity and linearity of the Eblaite notations.

Del Monte, Giuseppe F. Metrologia hittita, 1: Le misure di capacità per aridi. *OrAnt* **19** (1980), 219–226.

Shows that the Hittite dry capacity measures had the relative values: 1 *parisu* (PA) = 6 *sūtu* [b á n] = 24 *hazil* = 144 (sometimes 72 or 120) *upnu*.

Bruins, Evert M. On the history of logarithms: appendix. *Janus* **67** (1980), pp. 259–260.

Contains, in particular, a photo of the table of "exponentials and logarithms" *MLC 2078* (cf. Neugebauer and Sachs, *MCT* (1945), pp. 35–36).

Buck, R. Creighton. Sherlock Holmes in Babylon. *AMM* **87** (1980), pp. 335–345.

Demonstrates how cuneiform mathematical tables (combined multiplication tables...) can be looked upon as interesting mathematical "puzzles", to be solved by a variety of clever methods. A drawing of a mounted clay cylinder with a combined multiplication table shows the cylinder with its axis horizontal. Regarding the meaning of the table on the famous tablet *Plimpton 322* (Neugebauer and Sachs, *MCT* (1945), text A), B. quotes a suggestion due to D. L. Voils that the table may have been constructed to be a pedagogical tool enabling teachers of mathematics in the schools of the OB period to make up a large number of *igû-igibû* exercises in quadratic equations, with known solutions and with easily checked intermediate solution steps.

Schmidt, Olaf. On Plimpton 322: Pythagorean numbers in Babylonian mathematics. *Centaurus* **24** (1980), pp. 4–13.

Suggests a simple routine for the construction of the tables on *Plimpton 322*, under the assumption that the text, when intact, had columns for x, $\{x\text{-}\}$, $\frac{1}{2}(x - \{x\text{-}\})$, $\frac{1}{2}(x + \{x\text{-}\})$, and $(\frac{1}{2}(x + \{x\text{-}\}))^2$, where x and $\{x\text{-}\}$ were taken from a three-place table of reciprocals (cf. Bruins, *IndM* **11** (1949)).

Friberg, Jöran. A historically motivated study of families of Pythagorean or Babylonian triples and their generating semigroups of P- or B-orthonormal matrices. *DMG* (1980-3), pp. 1–112.

A mathematically oriented paper, inspired by the fact that certain types of OB geometry problems can be described in terms of indeterminate quadratic equations. See, in particular, Chapter 5, The triangle parameter problem and the simple and iterated trapezoid partition problems in Old Babylonian geometry.

Schmandt-Besserat, Denise. From tokens to tablets: A re-evaluation of the so-called "numerical tablets". *VL* **15** (1981), pp. 321–344.

Contains a useful survey of publications of "numerical tablets", i.e., clay tablets from the late Uruk period with impressed number signs, with or without seal impressions, but with no other kind of inscription. The new name "impressed tablets" is suggested for such tablets. Several nice photographs illustrate the article, in particular of *Sb 6299* with an impressed number with more than 5 units, hence probably belonging to a decimal system of numeration (animals?), of *Sb 213* and *Godin Tepe 73–291* with numbers clearly belonging to the "proto-Elamite" system of capacity notations (3(180)+1(60)+4(6) and 5(1)+2($^1/_5$)+ 1($^1/_{10}$), respectively). [The tablet *Sb 1975 bis* has what looks like an early example of a "tagged" number (upside down with respect to the seal impression), possibly to be read as 4(60)+2(10). Similar tagged numbers are known from proto-Sumerian tablets of the Jemdet Nasr period.]

Ellison, Rosemary. Diet in Mesopotamia: The evidence of the barley ration texts (c. 3000–1400 B.C.). *Iraq* **43** (1981), pp. 35–45.

The calculations in this paper are based on the observation that the most common barley rations in the Early Dynastic period at Lagas were 72, 48, 36 and 24 s i l à a month, while those at Kiš, etc., in the Agade period, and at Lagaš itself in the Ur III period, were 90, 60, 40, 30 and 20 s i l à. Assuming that the ration system itself did not change, the author draws the conclusion that at the transition from the ED III period to the Agade period the size of the s i l à increased by a factor of $^6/_5$, i.e., from 0.83 liters (the lower of the values derived in Thureau-Dangin 1921 from measurements of the inscribed vase of Entemena) to almost 1 liter. [If this conclusion is correct, it implies that the size of the b á n was doubled at the transition to the Agade period, which seems doubtful. Note, in fact, that the barley rations mentioned above can just as well be described as 12, 8, 6, 4, and 9, 6, 4, 3, 2 b á n, respectively, in the two time periods considered, since the b á n in pre-Sargonic Lagas contained only 6 s i l à. Besides, it is difficult to see how this result fits in with the fixing of the value of the OB s i l à in Postgate, *Iraq* **40** (1978).]

Steinkeller, Piotr. The renting of fields in early Mesopotamia and the development of the concept of "interest" in Sumerian. *JESHO* **24** (1981), pp. 113–145.

An interesting account of the development of and terms for the concepts of "field rent" and "interest" in texts from the (OB,) Ur III, Sargonic, and pre-Sargonic peri-

ods. It is claimed, in particular, that the Ur III term m a š / m á š a - s a g $_4$ - g a 'fee for the irrigation of a field' was derived from a pre-Sargonic term meaning 'goats of the field'. Cf. a phrase such as 4(b ù r) g á n a / m á š - b i 6 k u g g í n / d u - b i 4 u d u - n i t a '4 b ù r of land, its m a š-fee 6 shekels of silver, its sheep 4 rams' in a Sargonic text *(OIP* **14** no. 114 = *A 790*, Luckenbill, *Adab* (1930)). In a similar way, it is noted that the use of the word m á š in the meaning of 'interest' cannot be documented before Ur III. Instead, it is suggested that the phrase k u d - r á ... ú š ('to add a portion'?) in pre-Ur III texts should be interpreted as 'to yield interest'. This construction is also attested in a difficult passage of a famous inscription (Sollberger, *Corpus* (1956), Ent.28), which can now be read as š e ^{d}n a n š e | š e ^{d}n i n - g í n - s u - k a | 1 k u r u $_7$ - a m $_6$ | l ú u m m a ^{i} - k e $_4$ | u r $_5$ - š è ì - k ú | k u d - r á b a - ú s | 4 (š a r ' u) k u r u $_7$ - g a l | b a - k u $_4$ | b a r š e - b i n u - d a - s ù - s ù - d a - k a | ... | š e l a g a š ^{i} š á r k u r u $_7$ - a m $_6$ ì - s u ['the barley of Nanše, the barley of Ningirsu, one store-house full, the man of Umma consumed, as a loan; it accumulated interest, grew into $40{\times}60^2$ (g u r), a big store-house; because this barley was not being returned ... ... he returned the barley of Lagaš (but only) 60^2 (g u r), 'a storehouse full'. In other words, the meaning of the text may be that the "loan" was returned, but without full payment of the accumulated rent.] See the discussion on pp. 143–145, in particular, p. 144 note 85.

<u>Maekawa</u>, Kazuya. The agricultural texts of Ur III Lagash of the British Museum (1). *ASum* **3** (1981), pp. 37–61.

No. 1 (*BM 18060*): this unique text is "a final account of barley (and emmer?) harvests from the g á n - g u $_4$ fields under the ultimate control of the governor during the ten years of Šul-gi–Amar-^{d}Suen"; as such it contains some very big numbers: the text begins with 9(ŠÁR).GAL 4(ŠAR'U) 9(ŠAR) 2(b u r ' u) 5(b ù r) 2(e š è) 4(i k u)^{ašag} | š e - n u m u n - m u r - g u $_4$ - b i 14 g u r u $_7$ 38(60) 44 [1(b a r i g a) 5(b á n)?] 1⅔ s i l à $_{gur}$ | š e - g ú - n a - b i 4(60) 54 g u r u $_7$ 42(60) 56(g u r) 3(b a r i g a) 2(b á n)^{gur}. As the text shows, the average amount of š e - n u m u n m u r - g u r $_4$ (seed-grain and fodder to draught animals) in Ur III Lagaš over a ten year period was close to 1(g u r) 2(b a r i g a) 3(b á n) or 1½ g u r per area unit (b ù r), which is the most common figure referred to in the so called g á n - u r $_x$ - a texts. The estimate of the average amount of yields (š e - g ú - n a - b i) is precisely 30 g u r per b ù r. In a most interesting review of ratios between amounts of fodder and seed in texts from various places and periods, M. presents the following examples: in the Lagaš text Reisner, *TUT* (1901), no. 5, seed grain+fodder is equal to 1½ or 1⅘ g u r per b ù r for barley and to 2 g u r per b ù r for emmer, while for wheat seed grain (in wheat) is counted at 1⅕ g u r per b ù r and fodder (in barley) at precisely half this rate; in Thureau-Dangin, *RTC* (1903), no. 409, seed grain + fodder is equal to 2 and 2½ g u r per b ù r, respectively, for barley and emmer, while the seed grain for wheat is put to 1 g u r per b ù r and the corresponding fodder to just as much; in no. 4 (*BM 12398*), seed grain and fodder for wheat are counted at either 1 and ½ or 1⅕ and ⅗, g u r per b ù r; in both cases the fodder

is computed at half the rate of the seed grain; in no. 5 (*BM 19739*), seed grain + fodder is equal to 3 g u r per b ù r or 2 g u r 3 b á n per b ù r (in the case of a g á n g i š - g a b - t a b); in the same text, lentils are used as seed at the rate of 2 g u r 3 b á n per b ù r, or, in a more concise notation, 2.0.3 g u r/b ù r while the fodder (in barley!) is computed at 3⁄7 of this rate, 0.4.3 g u r/b ù r [note how carefully the rates have been chosen so as to alleviate the necessary computations; it is probable that the figures given in the texts as so and so many g u r/b ù r were converted into b á n/i k u when fractional area units were present, after the formula *n* g u r/b ù r = $n\times 30$ b á n/18 i k u = $n\times 5/3$ b á n/i k u; thus, 1, 1.1.0, 1.2.3, 1.4.0, 2.0.3, ... g u r/b ù r = 1 2⁄3, 2, 2 1⁄2, 3, 3 1⁄2, ... b á n/i k u]; in the pre-Sargonic Lagaš text Allotte de la Fuÿe, *DP* FS (1920), no. 546, the fodder + seed grain for an area of 2 b u r 3 e š è is given as š e - n u m u n š e - g u $_4$ - d u - k ú - b i 8(g u r)-s a g - g á l (i.e., 3 g - s - g / b ù r)[19]; for another pre-Sargonic Lagas text, *Fö 184* (Förtsch, *VS* **14** (1916)), š e - g u $_4$ - k ú - n u m u n - b i and š e - n u m u n - b i are computed, separa-tely, at the common rate of 1 1⁄2 g - s - g / b ù r, and combined, at the rate of 3 g - s - g / b ù r; in the Sargonic texts Hackman, *BIN* **8** (1958), no. 122, 123, the rates of š e - n u m u n š e $_4$ - g u - e - k ú are, respectively, 2.2.0 and 2 g u r / b ù r (i.e., 4 and 3 1⁄3 b á n / i k u); in the two texts from Umma and Nippur *CS* no. 86 (Pettinato and Waetzoldt *MVN* **1** (1974)) and Myhrman, *BE* **3**/1 (1910),no. 92, the fodder is precisely 5⁄6 and 1⁄2, respectively, of the amount of seed grain [this was observed already in Friberg, *DMG* (1979-15), p. 54, in connection with the discussion there of the Jemdet Nasr text Hackman, *BIN* **8** (1958), no. 4, which is, possibly, a seed grain text, and if so, with the ratio fodder:seed grain equal to 10⁄11 ; another Jemdet Nasr text, which may be a seed grain text, too, is Scheil, *RA* **26** (1929), no. 2: in this text the "barley" for an area of 1 b u r ' u is equal to 2(60) 5(6) capacity units, which means a rate of 15 JN capacity units of barley per b ù r, where the JN capacity unit is known from ration texts and bread and beer texts to be comparable in size to a Sumerian b á n]; in another Umma text, Schneider, *AnOr* **7** (1932), no. 339, the concluding phrase is š a - n u m u n - b i 24.4.3,4 1⁄2 s i l à 7 g í n^{gur} | z í z - n u m u n - b i 3(g u r)^{gur} | [m u r - g u $_4$ - u d ?] - i l 21.3.4.S [2⁄3 s i l à] 9 g í n^{gur} | š à - g a l AMAR.AMAR n u - t u k [the most likely interpretation is that here again the ratio of fodder to seed grain is 5⁄6 for the barley, while the ratio is only 1⁄3 for the emmer; note in the phrase 'no fodder required for the calves?' the use of the word š à - g a l for 'fodder', the word used in OB problem texts to indicate the slope of the side of a canal; cf. Neugebauer and Sachs, *MCT* (1945), pp. 80–81]; the amount of seed grain per area unit is in the texts mentioned above (*CS 86*; Myhrman, *BE* **3**/1 (1910), no. 92, Schneider, *AnOr* **7** no. 339) given not directly, but in terms of the number of furrows per n i n d a n (cf. Pettinato and Waetzoldt, *StOr* **46** (1975), Powell, *ZA* **62** (1972)) [if, as advised in the "farmer's almanac" (Gadd, *UET* **6**/2 (1966), no. 172 col.2, 12–13), 1 g í n of barley is dropped in a furrow of length 1 n i n d a n, and if *N* is the number of furrows, cross-wise, per n i n d a n, then the rate of seed grain

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[19] JH: I suppose Friberg's unexplained g - s - g stands for g u r s a g - g á l.

expended per area unit is *N* gín / šar = *N*/6 bán / iku = *N*/10 gur / bùr; thus, for instance, the case *N* = 10 corresponds to the rate 1 gur / bùr; documented values of *N* are 8, 8½, 9, 9½, 10, 11, 12]; M. suggests that in the "farmer's almanac", *UET* **6**/2 no. 172 col.1, 29*f* the phrase 1(bur)$^{\text{ašag}}$-ba 3(gur?) še-gur-am ba-an-gá-gá refers to a rate of seed grain + fodder equal to 3 gur / bùr (?) ; finally, he mentions also a text from Ur (Legrain, *UET* **3** (1937), no. 1364), in which this rate is 2 gur / bùr. (See also the discussion in Zaccagnini, *OrAnt* **16** (1975), pp. 217–219, in particular the reference there to several Old Akkadian texts in Meek, *HSS* **10** (1935) with the high rate 6 bán / iku = 33/5 gur / bùr !)

Pettinato, Giovanni. Lista di numeri sumerici: testo N. 54. *MEE* **3** (1981), pp. 212–213.

This paper, and Edzard, *SEb* **3** (1980), are two independent examinations of the Ebla text TM.75.G.2198 = *MEE* **1** no. 1636, a monolingual lexical text with the first ten Sumerian cardinal numbers in syllabic notation (valuable because of its antiquity compared with previously known lexical texts containing related information). In transliteration (following Pettinato) the list runs as follows: *dili*, *me-nu*, *iš*$_{x}$*-ša-am*, *li-mu*, *ia*$_{9}$, *a-šu*, *ù-me-nu*, *ù-ša-am*, *ì-li-mu*, *u*$_{9}$*-wu-mu* (Edzard: *ha-wu-mu*). Note the copula(?)-*am* after *iš*$_{x}$*-ša* and *ù-ša* [perhaps to enhance the rythm of the sequence?].

Pettinato, Giovanni. Il problema dello scriba di Kiš: n.73. *MEE* **3** (1981), pp. 269–270.

A renewed discussion of the Ebla text *TM.75.G.1693* (cf. Archi, *SEb* **3** (1980)). P. repeats here what he said already in *Ebla* (1979): "it is probably a table for conversions between the sexagesimal system and the decimal system".

Pomponio, Francesco. Tabella di concordanze di misure per aridi. *MEE* **3** (1981), pp. 270–271.

The Ebla text *TM.75.G.1392* (*MEE* **3** no. 74) is interpreted here as a concordance of two series of capacity measures. [Actually, the text is a mathematical algo-rithm text, offering a close parallel to the famous text Jestin, *TSŠ* (1937), no. 50; cf. Høyrup, *HM* **9** (1982). Although not stated explicitly, the problem given seems to be to find out how much barley is needed for the rations of 260,000 persons if 1 *gú-bar* of barley is enough for 33 persons. The ingenious solution algorithm proceeds in a series of simple steps; in modernized notation, the steps of the algorithm are the following: (1) $100/33 \approx 3\,^{1}/_{30}$; (2) $1000/33 \approx 30.3$; (3) $10{,}000/33 \approx 303\,^{1}/_{30}$; (4) $100{,}000/33 \approx 3030.3$; (5) $200{,}000/33 \approx 6060.6\ ^{1}/_{60}$ (corrected); (6) $60{,}000/33 \approx 1818.2$; (7) $260{,}000/33 \approx 7879$. In other words, the solution method appears to be to compute first, in a number of steps of increasing accuracy, approximate values for $10^{N}/33$ (N = 2, 3, 4, 5), and after that, for $2\times10^{5}/33$ and $6\times10^{4}/33$. The final result is obtained through

addition of the last values, and round-off. (No similar algorithm is known from any OB text of any kind. Cf., however, the Fara text *TSŠ* no. 50, Høyrup, *HM* **9** (1982).)]

Vino, I., and Viola, T. Testo n.73: un problema algebrica. *MEE* **3** (1981), pp. 278–285.

Mistaking the sign GAL in the list of big sexagesimal numbers in the Ebla text *TM.75.G.1693* (cf. my commentary to Archi, *SEb* **3** (1980)) for a mathematical symbol indicating an algebraic operation, the authors of this note claim that the text is a list of mathematical equations. Example: the line reading š a r - g a l (meaning simply 60×60) is translated here as "š á r, i.e., 60, is the GAL of what?", or something to that effect.

Dahood, Mitchell. Ebla, Ugarit, and the Bible, in Pettinato *Archives* (1981), pp. 271–321.

Pp. 228–289: D. claims to have identified in the Hebrew Bible the number words *ribbô* '10,000'and *m*^{e} *ʿōtāyw* '100,000', related to the Eblaite *ri-ba*$_{x}$ and *ma-i-at*. As evidence he quotes the following new translation of two difficult passages in the Bible: Isa. 48:19 *way*^{e}*hī kaḫol zar ʿ.ekā w*^{e}*ṣe ʾ*^{e}*ā ʾē mē ʿēkā* [*kim*^{e} *ʿ ōtāyw*] 'your offspring would have been like the sand, and the issue of your body like its hundred thousand grains'; and Ps. 4:8(7) *mā ʿōt d*^{e}*gānām* | *w*^{e}*tirōšām rabbū*

Friberg, Jöran. Methods and traditions of Babylonian mathematics: Plimpton 322, Pythagorean triples, and the Babylonian triangle parameter equations. *HM* **8** (1981), pp. 277–318.

Starts with a discussion of the nature of the break at the left margin, and the size of the missing part, of the tablet Plimpton 322 (Neugebauer and Sachs, *MCT* (1945)), based on new hand copies of the text. A log-log-diagram of the distribution of the parameter pairs for the solutions of the Pythagorean equation implied by the text makes more precise the observation in Price 1964, that the set of solutions is complete within its given boundaries. It is shown that if the intact tablet contained columns for the variables $\bar{b}, \bar{c}, \bar{c}^2$ (=1+ $\bar{b}^2$), b, c, n, then the computation of the square of the up to five-place number c may have been achieved by use of a "factorization method" in which the computation of the relatively prime numbers b and c was an intermediate step. As an independent illustration to the use of a related factorization method is mentioned the text *Ist.S 428* (cf. Huber, *EM* **3** (1957)), in which the square root of 2 02 02 02 05 05 04 (the square of 1 25 34 08, the approximate square root of 2 02 02 02 02 02 02) is computed by means of an algorithm based on factorization.

Next follows a discussion of the errors of the text and of its purpose (a "teacher's aid" for setting up "solvable" problems concerning right triangles or quadratic equations).. (The existence of an OB table of "fractional squares which would give new squares with ±1" was postulated in Gandz, *Osiris* **3** (1937)

in connection with Gandz' study of the meaning of the quadratic equation in *BM 13901* problem 23.)

A final section is devoted to some reflections on the origin of the "Pythagorean theorem", with departure from the "cane-against-a-wall problems" *BM 34568* problem 12 and *BM 85196* problem 9 and their many parallels in late Egyptian and early Hindu and Chinese mathematical texts. It is pointed out in this connection that the "triangle parameter equations" (or generating equations for "Pythagorean triples") may have been known before the general form of the Pythagorean theorem.

(The paper is concluded by simple algorithms for multiplication of sexagesimal numbers, by hand or by use of a programmable pocket calculator.)

Friberg, Jöran. On the Babylonian standard tables of reciprocals and squares of "six-place" regular sexagesimal numbers. *HM* **8** (1981), p. 465.

A preliminary report, concerned with an attempt to explain the composition of the huge table of reciprocals *AO 6456* (Thureau-Dangin, *TCL* **6** (1922), no. 31; Neugebauer, *MKT* **1** (1935), pp. 14–22,) by means of an "index-star" represent-ing the indices of pairs of reciprocals (*n*,*n'*) in that table (with either *n* or *n'* being a six-place regular sexagesimal number). The same idea can be used to analyze the many fragments of six-place tables of reciprocals or squares that are pub-lished in, for instance *LBAT 1631–1646* (Sachs, *LBAT* (1955); cf. Vaĭman, *ŠVM* (1961), Aaboe, *JCS* **19** (1965)). It is possible to show that all these fragments, probably originating from Babylon, have the appearance of being copies of a single six-place table of the same general type as, but clearly distinct from, the single (intact) table *AO 6456*. (This latter tablet is shown by its colophone to come from Seleucid Uruk. Cf. Hunger, *Kolophone* (1968), p. 45.).

Høyrup, Jens. Videnskabens antropologi – et essay om "ydre" og "indre" årsager og deres sammenhæng. *IUMVR* (1981).

This essay on the "anthropology of science" contains a very interesting section about "an inter-cultural investigation of the role that the existence of an institutionalized teaching of mathematics may have played for the evolution and inner organization of mathematical thinking". H. follows, in fact, the gradual development of mathematical ideas and principles, and the changing role of the profession of scribes and teachers of mathematics, from the proto-literate period in Mesopotamia (when there are clear signs of efforts to establish coherence and uniformity in the numerational and metrological notations), via the school of scribes in the Ur III period (when there was no room in the curriculum for "l'art pour l'art"), to the proud and self-conscious OB mathematicians (in a time of far-reaching individualization of the economic and social life), and finally to the time of the militaristic Kassites and their successors when mathematical traditions were kept alive only through the efforts of a few "families of scribes").

Damerow, Peter. Die Entstehung des arithmetischen Denkens, in *Rechenstein, Experiment, Sprache* (ed. P. Damerow and W. Lefèvre). Stuttgart (1981).

§4, The sources for a reconstruction of the prehistory of the OB arithmetics. §5, Structural pecularities in the OB arithmetics. §6.1, Computational means before the invention of writing. §6.2, Context dependent number signs. §6.3, The origin of the sexagesimal number system. §6.4, OB arithmetical methods. §7, Resume: Computational means and arithmetical thinking. (Note, in particular, the observation (p. 97 note 89) that tables of length measures are the only type of metrological tables that may be included on a Babylonian tablet with "combined multiplication tables" (together with standard tables of squares and of reciprocals).

Huot, Jean-Louis. Fouilles françaises au pays de Sumer. *HA* (March 1981), pp. 62–71.

Pp. 66, 70–71: photographs of the jar and its contents (in particular a great number of ellipsoidal weights) of the goldsmith's treasure, dated to Samsu-iluna year 11, which was excavated at Larsa in 1976.

Arnaud, Daniel. Les textes de Larsa. *HA* (March 1981), pp. 72–75.

P. 72: a photograph of a stele from the reign of Nazi-maruttash (1323–1298). Note the unusual variant of the standard Kassite area formula used in this text: *n* še-numun 𒁹 íku(!) 3 (bán) 1 kùš gal^{tu4}.

Høyrup, Jens. Investigations of an early Sumerian division problem, c. 2500 B.C. *HM* **9** (1982), pp. 19–36.

A renewed discussion of the early Sumerian mathematical texts *TSŠ* no. 50 and no. 671 (Jestin, *TSŠ* (1937); cf. Powell, *HM* **3** (1976)), with photographs and corrected hand copies. Of particular interest is the observation that the incomplete problem solution in *TSŠ* no. 671 may have come about in the following way: Assuming, with Powell, that the $guru_7$-silo contained 40 00 gur of 8 00 silà, in a first step the 40 00 gur are divided by 7, which gives 1 $guru_7$ = 5 42 × 7 gur, with a remainder of 6 gur, which is discarded. In a second step, the result is then converted to 1 $guru_7$ = 8 00 × 5 42 × 7 silà = 45 36 00 × 7 silà (not counting a remainder of 48 00 silà[20]). [On the other hand, the interpretation above of *TM.75.G.1392* (Pomponio, *MEE* **3** (1981)) suggests the following alternative possibility: Start, for instance, with the equation 1 šár = 8 34 × 7 (+2) (which means that 8 34 is an approximate sexagesimal reciprocal of the irregular number 7; the incomplete solution in *TSŠ* no. 671 would be the result of using the less correct approximative reciprocal 8 33). Go on and find more accurate approximate reciprocals by establishing the equations 1 šar'u

[20] JH: I allow myself to point out that *if* the remainder is taken into account, then the correct result of no. 50 results, which is the main point of the article.

= 1 25 42 × 7 (+6); 1 š á r - g a l = 8 34 17 × 7 (+1). Finally, then, 5 š á r - g a l + 2 š a r ' u = 45 42 51 × 7 (+3), which gives the result in *TSŠ* no. 50. Note the use of the ŠAR.GAL in *TSŠ* no. 183, which contradicts the claim of H. that big numbers are not present in the TSŠ texts.]

Archi, Alfonso. Wovon lebte man in Ebla? *CRRA* ((1981)1982).

Contains, in particular, the Ebla text *TM.75.G.1700*, in transliteration. The phrase 10 *ma-i-at* 5 *rí-bab* 5 *li* 5 *mi* 30 š e *g ú - b a r* in rev. I,1 of this text makes it probable that no sign for 1,000,000 (here written as 10 *ma-i-at*) existed in the Eblaite script. (Cf. Archi, *SEb* **3** (1980)).

Fales, Frederick Mario. TM.75.G.16593: how to get to ŠAR.DIŠ.ŠAR (60^5). *SEb* (1982).[21]

This renewed attempt to interpret the by now well known Ebla text *TM.75.G. 16593* is based on the incorrect assumption (based on a misunderstanding of the š á r section in the lexical text Thompson, *CT* **12** (1901), pl. 24) that appending the sign GAL to a sexagesimal number has the same effect as multiplying that number by either 60 *or* 60^2. (Cf. Archi, *SEb* **3** (1980).

Friberg, Jöran. Methods and traditions of Babylonian mathematics 2: An Old Babylonian catalogue text with equations for squares and circles. *JCS* **33** (1981), pp. 57–84.

The OB tablet *BM 80209*, published as Pinches, *CT* **44** (1963), no. 39, is here shown to be a "catalogue" of linear and quadratic equations for squares and circles, similar in type to the bigger catalogue text *TMS* no. 5 (Aa) (Bruins and Rutten, *TMS* (1961)), and to sections 1A, 1B of the "compendium" *IM 52916* (Goetze, *Sumer* **7** (1951)). Interesting is the equation obv. 4: *šum-ma* 10 TA *im-ta-ḫar di-ik-šum mi-nu-um*, in which the badly understood term *dikšum* appears, unfortunately in a connection that does not make its meaning become less obscure. (Cf. Kilmer, *StOpp* (1964)). Considerable attention is given in this paper to how the author of the catalogue text chose the data (coefficients and solutions) of his series of equations, and an attempt is made to analyze the meaning of the scribbled numbers that follow the main portion of the text. Finally, a parallel is drawn between a group of equations in the text: a - š à g ú r d a l g ú r *ú sí-ḫi-ir-ti* g ú r UL-g a r-*ma A*, "circle area, circle transversal, and circle perimeter added make *A*" (i.e., in modern terms $5u^2+20u+u = A$), with a couple of similar equations in the Alexandrine mathematician Heron's *Geometrica*, written about 2000 years after BM 80209.[22]

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[21] JH: Friberg does not indicate the volume number, probably because he had received a manuscript version. Actually, it appears that the paper was never published – perhaps because of Friberg's objections.

Caveing, Maurice. La tablette babylonienne *AO 17264* du Musée du Louvre et le problème des six frères. *HM* **12** (1985) pp. 6–24.[22]

The "problem of six brothers" on the small tablet *AO 17264* (Thureau-Dangin, *RA* **31** (1934); Neugebauer, *MKT* **1** (1935)) is at the same time one of the most sophisticated (although corrupt) and the most enigmatic of all preserved Babylonian mathematical problem texts. Formally stated as an "iterated trapezoid partition problem", in which a given trapezoid is to be divided into three bisected sub-trapezoids, all with rational sides, the problem is really number-theoretical in nature [and can be reduced to what in modern terminology would be called a "discrete boundary value problem"]. G. suggests here that the ancient scribe who wrote the tablet, and who knew the numerical solution (remember that in Babylonian mathematics often whole groups of problems have the same data), simply "invented" a solution formula giving the correct length of one of the transversal lines in the trapezoids. (Finding this length was the most difficult part of the problem.) C. emphasizes that the incorrect solution formula, far from showing the primitivity of OB mathematics, shows instead the inventiveness and audacity of OB mathematicians, who may have arrived at some of their most celebrated mathematical discoveries precisely by constructing solution formulas with departure from the known numerical data, without any deeper theoretical insights.

Høyrup, Jens. Babylonian algebra from the view-point of geometrical heuristics. *IUMVR* (1982).

In this long paper, H. tries, as others have done before him (cf., for instance, Vogel, *Osiris* **1** (1936)), to show that OB algebra was largely based on geometric considerations, here called "cut-and-paste-procedures". H. divides the evidence into three main categories: terminological (the structure of the vocabulary in OB mathematical texts, and the semantics of the terms), procedural, and psychological. He also mentions as additional evidence that geometric derivations of solution algorithms for algebraic problems are known from ancient Greek, Arabic, Hindu, and Chinese mathematical texts. In spite of all this collected evidence, including a great number of carefully analyzed examples of OB mathematical problem texts, the proposed existence of an OB method of "geometrical heuristics" is still very far from being established, at least in the opinion of the present reviewer. Nevertheless, the paper considers several interesting ideas and observations. In particular, H. points out that, in the problem texts he has considered, two different terms for addition (*kamārum*, *waṣābum*), five different terms for multiplication (a - r á, *eṣēpum*, *našum*, *šutakalum*, n i g i n), etc., do not seem to have been used indiscriminately. Further studies along these lines could probably turn up a lot of useful information about the OB way of mathe-

[22] JH: Friberg gives the bibliographic data as *HM* [1982]. He must have received the manuscript from Caveing.

matical thinking. Note that the paper contains a couple of useful tables of Sumero-Akkadian mathematical terms and proposed new, distinctive translations of alternative terms for superficially identical algebraic operations. [I am not going to explain in detail why I do not believe that OB mathematicians ever made use of any "geometrical heuristics" in their treatment of predominantly algebraic problems. Observe, however, that the point of departure for the discussion in this paper is the interpretation in Bruins, *Sumer* **9** (1953) of the edge inscription on IM 52301 as a description of a geometric method for the extraction of square roots. As pointed out in my review of Bruins' paper, this interpretation of the difficult text is probably not correct. Also in his treatment of the text *TMS* no. 13 (L) (Bruins and Rutten, *TMS* (1961)), H. builds on an incorrect interpretation due to Bruins. Thus, following some remarks in the critical review of *TMS* in von Soden, *BiOr* **21** (1964), I suggest this improved reading of lines 9–12 in *TMS* no. 13: 4 *a-na* 1 17 d a ḫ 1 21 *ta-mar mi-na* i b - s i(!) 9 í b - s i | 9 g a b a 〈- r i〉 (= DUḪ, not d a ḫ)) g a r ½ 4 *šà ta-ak-ši-tu ḫe-pe* 2 *ta-mar* | 2 *a-na* 9 1-k a m d a ḫ 1 *ta-mar i-na* 9 2-k a m z i 7 *ta-mar* '4 to 1 17 add, 1 21 you see, what is the square root? 9 is the square root, 9 a (second) copy set down, ½ of 4 that you cut off (as overhead) break off, 2 you see, 2 to the first 9 add, 11, from the second 9 subtract, 7 you see'. As a matter of fact, H. himself quotes a similar passage in *YBC 6967* (Neugebauer and Sachs, *MCT* (1945), p. 129), obv. 10–rev. 4: ib-si $_8$ 1 12 15 *mi-nu-um* 8 30 | 8 30 *ù* 8 30 *me-ḫe-er-šu i-di-ma* | 3 30 *ta-ki-il-tam* | *i-na iš-te-en ú-su-uḫ* | *a-na iš-te-en ṣi-ib* | *iš-te-en* 12 *ša-nu-um* 5. This proves the equivalence g a b a 〈 - r i〉 = *meḫru*).

Powell, Marvin A., Jr. Merodach-Baladan at Dur-Jakin: A note on the defence of Babylonian cities. *JCS* **34** (1982), pp. 59–61.

In the accounts of the Assyrian king Sargon's campaign against Merodach-Baladan in 709, there is an interesting metrological passage relating to the defensive measures taken by the Chaldean king at his city Dur-Jakin (cf. Gadd, *Iraq* **16** (1954)). P. points out here the striking similarity between this passage and the difficult ring-wall problem in the mathematical text *BM 85194* problem 4 (Neugebauer, *MKT* **1** (1935), p. 144; Gandz, *Osiris* ((1938)1948)). The rele-vant lines of the annals are, in P.'s transliteration and translation, *udannina kirḫēšu* | 10.NINDA(var.: *áš-la*).TA.ÀM *lapan dūrišu rabī unessīma* | 2 ME *ina* 1 *ammati rupuš ḫarīṣi iškunma* | 1½ NINDA *ušappilma* | *ikšuda mê nagbi* 'He strengthened its ring walls. All along in front of its main wall he moved back a distance of 10 *nindan* (var.: an *ašlu*) and made a moat 200 cubits broad and he went down 1½ *nindan* until he reached groundwater'. It seems that the numbers given in this text must be greatly exaggerated (the length of the nindan is 6 meters, that of the cubit ½ meter); P. estimates the earthworks involved to have required more than 24,300 man-days of labor.

Powell, Marvin A., Jr. Metrological notes on the Esagila tablet and related matters. *ZA* **72** (1982), pp. 106–123.

This is a renewed analysis of the many bits and pieces of information about Babylonian metrology contained in the text of the famous Esagila tablet (cf. Thureau-Dangin, *RA* **19** (1922)). P. starts by mentioning that the excavators of the ziqqurrat at Babylon found an inner core of unbaked brick with a square ground plan of side length 61.15 m., indicating a probable planned side length of 120 cubits, hence a planned area of precisely one (Sumerian–OB) i k u. The inner core was cloaked with an outer wall of baked brick, 91.55 m. or 180 cubits on each side (corresponding to the combined length of 270 square bricks of standard format, i.e., with a side of ⅔ cubit). Thus, the outer dimensions were chosen so that the resulting extended ground plan had an area of one i k u *ina ammatum rabītum* 'an iku in the big cubit'. In the Esagila text itself, the length of the side of the base of the Etemenanki are given in three different ways: (a) 3(1+*šu*) *ina* 1 k ù š *as*₄*-lum* '3(60) in the *aslu* cubit'; (b) 10 n i n d a n *ina* 1 k ù š *a-rá-e* '10 n i n d a n in the *arû* cubit'; (c) 15 n i n d a n. (A fourth way of indicating the same length can be found in *Asarh.* 24 Ep.34 (Borger 1956[23]); *ašlu ṣuppan* 'a rope and a half'.) On the other hand, the bricks in the outer wall of Etemenanki have been ascribed to Nebuchadnezzar or his father Nabopolassar, and in an inscription of Nebu-chadnezzar recording a temple restoration (*VAB* **4**, no. 76; Langdon (1912)[24]) are mentioned 3 s i g ₄ - a l . ù r . r a *ša* 16 š u - s i - t a - à m *ù mi-ši-il* s i g ₄ - a l - ù r . r a '3 square bricks of 16 fingers square, and a half square brick'.

From all this P. draws the conclusion that the NB standard cubit of 24 fingers (cf. Hilprecht, *BE* **20**/1 (1906), no. 30) = the *aslu* cubit ≈ 50 cm. (= the OB cubit), that the big cubit = the a r â cubit = 1½ standard cubit, that the i k u in the big cubit = $(3/2)^2$ OB i k u, etc. The last documented occurrence of the i k u in the big cubit is on the *kudurru* of Merodach-Baladan II (cf. Delitzsch, *BA* **2** (1894)). In three out of four area calculations on the Esagila tablet, the square *arû* n i n d a n are transformed into seed grain-area units by multiplying by 18. This is explained by the Kassite-Early NB formula (cf. Langdon, *RA* **15** (1918)), according to which "seed grain" was computed at the rate of 3 b á n / i k u = 18 g í n / š a r (in the big cubit). [Contrary to what is claimed by P., this may be regarded as a realistic rate of seed grain per area unit. In fact, the rate is equivalent with 4/3 b á n / i k u in the standard cubit, which with *N*/6 b á n / i k u (cf. my commentary to Maekawa, *ASum* **3** (1981)) corresponds to the common number (in Neo-Sumerian texts) of *N* = 8 furrows per n i n d a n.] In the standard NB seed grain-area system (used after the middle of the seventh century B.C) one meets another area formula (cf. the review of Hilprecht, *BE* **2**/1 (1906), no. 30).

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[23] JH: this reference is not clear to me.

[24] JH: this reference is not clear to me.

The NB area formula is used in the remaining area computation on the Esagila tablet. (The area of the base of the Etemenanki is computed twice, in obv.20–24 using the Kassite-Early NB formula, and in obv.16–19 using the standard NB formula.) Thus, we read, in obv.17–19, 3(1+*šu*) s a g *ina* 1 k ù š *as*4*-lum* n ì -ŠID-*su a-na* ḪI.ḪI 3 [a - r á 3] | 9; 9 a - r á 2; 18 *ki-i* 18 n u - z u - ú 3(PI)^PI^ š e - n u m u n *i-na* 1 k ù š t u r-[...]|*ki-gal-li* é - t e - m e - e n - a n - a n - k i s u k u d *ki-i* k a u š [*ù* s a g] ‘3(60) the side, 3(60) the front, in the *aslu* cubit; to make your computation: 3 times 3 is 9, 9 times 2 is 18, if you do not understand 18, it is 3 PI seed grain in the small cubit; base of the Etemenanki; the height is the same as the side and the front’. Thus, in this passage, 9×60^2 square cubits are converted into 18 *sūtu* = 3 PI seed grain-area units through multiplication by the constant 2. In other words, this means that 60^2 square cubits = 2 *sūtu*(b á n), or 100 square cubits = ⅓ *qa*. Hence $(100 \text{ cubits})^2$ = 33 ⅓ *qa* = 5 *sūtu* 3 *qa* 3 ⅓ *akalu* as in *BE* **2**/1 no. 30 d (since in the NB capacity system 1 *sūtu* = 6 *qa* = 6×10 *akalu* (n i n d a). As shown by the computation in the quoted passage this implies the strangely high seed grain to area ratio 3 PI / i k u in the big cubit, or 8 b á n / i k u in the standard cubit. P. mentions also the NB system of measuring areas “by reeds” (cf. Nemet-Nejat, *ANES* **7** (1975)), but without going into any details.

P. mentions also (in Appendix II, “Bricks as evidence for metrology”) Mesopotamian bricks of various types as “the only surviving artifact for which textual evidence attests that they incorporate norms of length, area, volume, capacity and weight”, and goes on to verify this claim in some detail. Of particular interest is P.’s attempt to date the origin of the Sumero-Akkadian brick counting system: At Girsu, for instance, the transition from the plano-convex bricks of the Late Early Dynastic III period to flat bricks is associated with the time of Entemena. On the other hand, the tablet Thureau-Dangin, *RTC* (1903), no. 137 is dated by Neugebauer and Sachs, *MCT* (1945), p. 94 note 241) as “pre-Old-Akkadian”. This leads to the conclusion that the intricate brick counting system, as well as other metrological innovations (Powell, *HM* **3** (1976)) can be dated to the beginning of the Akkad period. [In the text *RTC* no. 137, the only complete computation is in rev.I,1–4: š u - n i g í n 1(e š è) 3(i k u) ^ašag^s i g4 | 1(60) 33 ½ GAR.DU g í d - b i | d a g a l - b i 2 k ù š | s u k u d - b i 4 k ù š, which means that 1 33 30 × .10 × 4 or 1 02.20 š a r^vol^ bricks is equated with 1 e š è 3 i k u or 900 š a r s i g 4. This corresponds to a *nalbanam* of 14.24 brick-š a r/volume-š a r, or a brick volume of 1 12/14.24 = ½ cubit^2 × ⅙ cubit. In other words, it seems likely that the bricks in this text had the dimensions ⅓ cubit × ¼ cubit × ⅙ cubit.]

In Appendix I, “The so-called metrological table at the end of the Esagila tablet”, P. points out that the NB capacity system, which seems to be used in the second formula of the metrological table, is different from the Kassite capacity system used in at least three of the calculations of the main text. For this and other reasons, he concludes that “the metrological practices were no

longer intelligible to a scribe in 229 BC" (the tablet, is dated year 83 of the Seleucid era, but is a copy of an older tablet, as indicated by the phrase d u b g a r - r i B a r - s i p$^{\text{ki}}$; cf. Neugebauer, *QS* B **2** (1932)).

[It is possible, however, that P.'s low estimate of the scribe's competence is unfounded. The NB s ū t u of 6 *qa* may have been used also in the first formula of the table (cf. my commentary to Thureau-Dangin, *RA* **18** (1921)), and the superficially strange fact that the NB capacity system but the Kassite seed grain-area formula are used in the table may be explained by assuming that the original tablet was written during the period of transition from the Kassite to the NB era. To this comes that the standard transcription of the metrological table quoted by P. does not take into consideration the unconventional way in which the formulas of the table are written: the formulas have the character of mathematical equations. (Vaguely similar are the metrological tables discussed in Thureau-Dangin, *RA* **23** (1926) and in Hunger, *STU* **1** (1973), no. 102) Therefore, it may be a good idea to try to give an alternative transliteration of the table, in an effort to make clear how it is constructed:

18 *mu-šar*	//1 GAR (?)	//*qa ù šuššanu*(20$^{\text{ú}}$) GAR.GAR
50 *mu-šar*	//*ú-bu*	//*sūtu* 3 *qa*
1[m e(?)] ⟨*mu-šar*⟩	//*i-ki*, 1(i k u)$^{\text{ašag}}$	//3(b á n)
6 ⟨i k u⟩	//1(e š è) (*eb-lu*)$^{\text{ašag}}$	//3(PI)$^{\text{PI}}$
3⟨e š è⟩	//*bu-ru*, b u r ' u	//1(g u r $^{\text{gur}}$ 4(PI)$^{\text{PI}}$
6(10) *bur'u*	//*ša-a-ri*, š á r	//1 *me* 8(g u r)$^{\text{gur}}$

Note here, in particular, the confusing (not to say incorrect) way in which the area measure *būru*(b u r) is written "phonetically" in the text by use of the sign b u r ' u (= 10 b u r)! The mysterious GAR.GAR (?) in the first equation, very difficult to explain (P. is here, rightly, critical of the "explanation" given in Thureau-Dangin, *RA* **18** (1921)), may just possibly be the ideogram for "add" which is common in OB mathematical texts. The 1 GAR (?), also in the first equation, is, perhaps, the name of the new area unit 18 *mu-šar* = $^{1}/_{100}$ *būru* ?]

Index to bibliography

Page numbers in italics point to Friberg's review of the publication in question, those in Roman type to references within other reviews or in notes.

List of journals and other series of publications

AA	Art and Archaeology
AAWB	Acta antiqua Academiae Scientiarum Hungaricae
AAWB	Abh. der Kön. Akad. der Wiss. zu Berlin, phil.hist. Kl. (Berlin)
AfO	Archiv für Orientforschung (Berlin/Graz/Horn)
AGWG	Abh. der Kön. Ges. der Wiss. zu Göttingen, hist.phil. Kl.
AHES	Archive for History of Exact Sciences
AHw	von Soden, Akkadisches Handwörterbuch
AJ	The Antiquaries Journal (London)
AJA	American Journal of Archaeology (Baltimore)
AJSL	American Journal of Semitic Languages and Lit. (Chicago)
Akkadica	publ. by Fondation Assyriol.G. Dossin (Brussels)
AMM	American Mathematical Monthly
AMSH	Abh. aus dem Math. Sem. der Univ. Hamburg (Hamburg)
ANES	Journal of the Ancient Near Eastern Soc. of Columbia Univ. (New York)
An Or	Analecta orientalia (Rome)
AnSt	Anatolian Studies (London)
AOAT	Alter Orient und altes Testament (Kevelaer/Neukirchen-V.)
AOTU	Altorientalische Texte und Untersuchungen
Archeion	
Archeologia	
ARMT	Archives royales de Mari, Transkriptionen
AS	Assyriological Studies (Chicago)
ASAW	Abh. der Sächs. Akad. der Wiss., phil.hist. Kl.
ASS	Archivio di storia della scienza
Assur	
ASum	Acta sumerologica
Athenaeum	The Athenaeum Journal of the Literature ... (London)
BA	Beiträge zur Assyriologie und semit. Sprachwiss. (Leipzig)
Babyl.	Babyloniaca, Études de philol. assyro-babylonienne (Paris)
BASOR	Bulletin of the American Schools of Oriental Research (NH)
BBlG	Bayerische Blätter für das Gymnasialschulwesen
BE	The Babylonian Expedition of the Univ. of Pennsylvania
BIN	Babylonian Inscriptions in the Coll. of J. B. Nies (NH)
BiOr	Bibliotheca orientalis (Leiden)
BRM	Babylonian Records in the Libr. of J. Pierpont Morgan (NH)
CACM	Communications of the Assoc, for Computing Machinery

CAD	The Assyrian Dictionary of the Univ. of Chicago (Chicago)
CCT	Cuneiform Texts from the Cappadocian Tablets in the BM
Centaurus	Intern. Magazine of the History of Science ... (Copenhagen)
SthCongr.	Actes du huitième congr. intern, des orientalistes
25thCongr.	Trudy dvadcat'-pyatogo meždun. kongr. vostokovedov
CPD	Les conferences du Palais de la Découverte (Paris)
tfPMF	Časopis pro peštování matematiky a fysiky (Prague)
CRAIB	Comptes rendus... Acad, des Inscriptions at Belles-Lettres
CRRA	Compte rendu de la... rencontre assyr. intern.
CT	Cuneiform Texts from Babylonian Tablets in the BM (London)
DAFI	Cahiers de la Délégation Archéol. Française en Iran (Paris)
DC	de Sarzec, Découvertes en Chaldée
DMG	Department of mathematics CTH-GU (Göteborg)
20.D.Or.Tag	XX. Deutscher Orientalistentag (Erlangen)
DV	Drevnosti vostočnyya
EM	L'enseignement mathématique
EV	Epigrafika vostoka
FF	Forschungen und Fortschritte
HA	Histoire et archéologie
HKL	Borger, Handbuch der Keilschriftliteratur
HM	Historia Mathematica (Toronto)
HSS	Harvard Semitic Series (Cambridge, Mass.)
HUCA	Hebrew Union College Annual (Cincinnati)
IMEN	Istoriya i metodologiya estestvennyh nauk
IMI	Istoriko-matematičeskie issledovaniya
IndM	Indagationes mathematicae (Kon. Nederl. Akad. van Wet.)
Iran	Journal of the British Inst. of Persian Studies (London)
Iraq	(London)
Isis	
ITT	Inventaire des tablettes de Tello (Paris)
IUMVR	Inst. for uddannelsesforskning og videnskabsteori ... (Roskilde)
JA	Journal asiatique (Paris)
Janus	Revue intern. de l'histoire des sciences (Leiden)
JAOS	Journal of the American Oriental Society (New York/New H.)
JCS	Journal of Cuneiform Studies (New Haven)
JESHO	Journal of the Economic and Social Hist. of the Orient (Leiden)
JNES	Journal of Near Eastern Studies (Chicago)
JRAS	Journal of the Royal Asiatic Soc. of Gr. Br. and Ireland
JSOR	Journal of the Soc. of Oriental Research (Chicago/Toronto)
JSS	Journal of Semitic Studies (Manchester)
KDVSM	Det Kgl. Danske Vidensk. Selskab, mat.fys. medd. (Copenh.)

LG	The Literary Gazette, Journal of Science and Art
LTBA	Die lexikalischen Tafelserien der Babylonier und Assyrer
MAD	Materials for the Assyrian dictionary (Chicago)
MAIB	Mémoires, Acad. des Inscriptions et Belles-Lettres (Paris)
MCS	Manchester Cuneiform Studies (Manchester)
MDOG	Mitteilungen der deutschen Orient-Gesellschaft (Berlin)
MDP	Mémoires de la délégation/mission archéol. en/de Perse/...
MEE	Materiali epigrafici di Ebla (Naples)
13thMKIN	Trudy XIII meždunarodn. kongr. po istorii nauki
MN	Mathematische Nachrichten
MpSB	Mathem.-Physik. Semester-Berichte
MSL	Materialien zum sumerischen Lexikon (Rome)
MVAG	Mitteilungen der Vorderasiat. Gesellschaft (Berlin)
MT	Matematisk Tidsskrift (Copenhagen)
Nature	
MVN	Materiali per il vocabolario neosumerico (Rome)
NGWG	Nachrichten der Gesellschaft der Wiss. zu Göttingen
OECT	Oxford Editions of Cuneiform Texts (Oxford)
OIC	Oriental Institute Publications (Chicago)
Or	Orientalia (Rome)
OrAnt	Oriens antiquus (Rome)
OrNS	Orientalia, Nova series (Rome)
Osiris	
Paléorient	
PAPS	Proceedings of the American Philos. Soc. (Philadelphia)
PBS	Publications of the Babylonian Section, the Univ. Museum
Physis	Rivista intern. di storia della scienza (Florence)
PM	Periodico di matematica
PrM	Praxis der Mathematik
RA	Revue d'assyriologie et d'archéologie orientale (Paris)
RSém	Revue sémitique d'épigraphie et d'histoire anciennes
Saeculum	
SBAW	Sitzungsberichie der Bayer. Akad. der Wiss., math.nat.Abt.
ScAm	Scientific American
SEb	Studi eblaiti (Rome)
SMS	Syro-Mesopotamian studies
SPAW	Sitzungsberichte der Preuss. Akad. der Wiss., phil.h. Kl. (Berlin)
StOr	Studia Orientalia (Helsinki)
STU	Spätbabylonische Texte aus Uruk (Wien)
Sumer	(Baghdad)
SttAW	Sitzungsberichte der Österr. Akad. der Wiss., phil.h. Kl. (Wien)

TaC	Technology and Culture (Chicago)
TAPS	Transactions of the American Philos. Soc. (Philadelphia)
TCL	Textes cunéiformes, Musée du Louvre (Paris)
TGErm	Trudy Gosudarstv. Ermitaža (Leningrad)
TIIET	Trudy instituta istorii, estestvozn. i tehniki (Moscow)
TMH	Texte und Materialien der Frau Hilprecht Coll. (Jena)
TRIA	Transactions of the Royal Irish Acad. (Dublin)
TSBA	Transactions of the Soc. of Biblical Archaeology (London)
UET	Ur Excavations, Texts (London)
UF	Ugarit-Forschungen (Kevelaer/Neukirchen-Vluyn)
UMB	The University Museum, Bulletin (Philadelphia)
UntM	Unterrichtsblätter für Mathematik ...
UVB	Vorläufiger Bericht über die ... in Uruk/Warka ... (Berlin)
UZPU	Učenye zapiski Mordovskogo gosudarstv. univ. (Permsk. univ.)
VDI	Vestnik drevneĭ istorii (Moscow)
VIFMN	Voprosy istorii fisičeskih-matematičeskih nauk (Moscow)
VL	Visible Language
VS	Vorderasiat. Schriftdenkmäler der Königl. Museen (Berlin)
YNER	Yale Near Eastern Researches (New Haven)
YOS	Yale Oriental Series (New Haven)
WaG	Die Welt als Geschichte
WZKM	Wiener Zeitschrift für die Kunde des Morgenlandes (Wien)
ZA	Zeitschrift für Assyriologie (Berlin/Leipzig)
ZÄS	Zeitschrift für Ägyptische Sprache und Altertumskunde (Berlin/Leipzig)
ZDMG	Zeitschrift der Deutschen Morgenl. Ges. (Leipzig/Stuttg.)
Zinbun	Memoirs of the Research Inst. for Human. Studies (Kyoto)
ZMP	Zeitschrift für Mathematik und Physik

Postscript

In my studies of Sumero-Akkadian mathematics and metrology, etc., which finally led me to the writing of the preceding survey and bibliography, I was, at least to begin with, severely handicapped by the fact that I lacked not only formal schooling in Assyriology but also ready recourse to an Assyriological research library. If I have now, to some extent, been able to overcome this double handicap, it is thanks to the generous and unselfish help from many persons and institutions I have come in contact with. It is, therefore, a pleasure for me to acknowledge in this way, first of all, my gratefulness to the following friends and colleagues: A. Aaboe, C. Anagnostakis, B. André-Leicknam, A. Archi, R. Borger, E. M. Bruins, R. C. Buck, P. Damerow, J. W. Dauben, V. Donbaz, D. O. Edzard, M. Elat, B. Foster, O. Gurney, G. Haayer, W. W. Hallo, H. Hirsch, J. Høyrup, P. Huber, P. Hulin, H. Hunger, B. Ismail, L. Jakob-Rost, J. Klein, C. C. Lamberg-Karlovsky, S. J. Lieberman, W. Littman, K. A. Lohf, P. Matthiae, P. Michalowski, H. J. Nissen, J. Oelsner, O. Neugebauer, E. R. Phillips, S. A. Picchioni, M. A. Powell, F. ar-Rawi, M. D. Roaf, W. H. Ph. Römer, D. Schmandt-Besserat, O. Schmidt, A. Shaffer, Å. W. Sjöberg, W. von Soden, P. Steinkeller, A. A. Vaĭman, K. Vogel, B. L. van der Waerden, H. Waetzoldt, C. B. F. Walker, H. Weiss, A. Westenholz, and D. J. Wiseman. I am, further, grateful for having been given access to libraries and to collections of cuneiform texts in Berlin, Chicago, Copenhagen, Heidelberg, London, Paris, New Haven, and elsewhere, as well as for the manifold services rendered by the central libraries of the Chalmers Institute of Technology and the University of Göteborg. Last but not least, I want to thank for the financial support from the Department of mathematics at CTH-GU, Göteborg, and from the following research funds: Anna Ahrenbergs fond för vetenskapliga m.fl. ändamäl, Association franco-suédoise pour la Recherche, Kungl. och Hvitfeldtska Stipendieinrättningen, Kungl. Vetenskaps- och Vitterhetssällskapet i Göteborg, and Längmanska Kulturfonden.

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