MAX-PLANCK-INSTITUT FÜR WISSENSCHAFTSGESCHICHTE
Max Planck Institute for the History of Science

PREPRINT 183 (2001)

Robert Englund

The State of Decipherment of Proto-Elamite

The Cuneiform Digital Library (CDLI)

The Cuneiform Digital Library Initiative represents the efforts of an international group of Assyriologists, museum curators and historians of science to make available through the internet the form and content of cuneiform tablets dating from the beginning of writing, ca. 3200 B.C., until the end of the third millennium. Despite the 150 years since the decipherment of cuneiform, and the 100 years since Sumerian documents of the 3rd millennium B.C. from southern Babylonia were first published, such basic research tools as a reliable paleography charting the graphic development of cuneiform, and a lexical and grammatical glossary of the approximately 120,000 texts inscribed during this period of early state formation, remain unavailable even to specialists, not to mention scholars from other disciplines to whom these earliest sources on social development represent an extraordinary hidden treasure. The CDLI, directed by Robert. K. Englund of the University of California at Los Angeles and Peter Damerow of the Max Planck Institute for the History of Science, Berlin, is pursuing the systematic digital documentation and electronic publication of these 3rd millennium sources. Cooperative partners include leading experts from the field of Assyriology, curators of European and American museums, and computer specialists in text markup. The CDLI data set will consist of text and image, combining document transliterations, text glossaries and digitized originals and photo archives of early cuneiform.

This electronic documentation should be of particular interest to cuneiform scholars distant from collections, and to museum personnel intent on archiving and preserving fragile and often decaying cuneiform collections. The data will form the basis for the development of representations of the structure of 3rd millennium administrative and lexical documents, making the contents of the texts accessible to scholars from other disciplines. A typology of accounting procedures, graphical representations of formal structures of bookkeeping documents, and extensive glossaries of technical terms later supplemented by linguistic tools for accessing the primary sources by non-Assyriologists are being developed. Data formats, including Extensible Markup Language (XML) text descriptions, with vector-based image specifications of computer-assisted tablet copies, will be chosen to insure high conformance with ongoing digital library projects. Metadata-based lexemic and grammatical analysis of Sumerian in the CDLI markup environment will not only put at the disposal of specialists in the fields of Assyriology and Sumerology available cuneiform documents from the first thousand years of Babylonian writing, but also general linguists, semioticists, and historians of communication and cognition, of administration and early state formation, will for the first time have access to the form and content of these records.

cdli.mpiwg-berlin.mpg.de

cdli.ucla.edu

Version: 21. August 2001

The State of Decipherment of Proto-Elamite

Robert Englund, UCLA

For publication in:
S. Houston, ed., *First Writing*, Cambridge: Cambridge University Press

The State of Decipherment of Proto-Elamite[1]

Robert Englund, UCLA

Introduction

With the continuing publication of the proto-cuneiform texts by the collaborators of the project *Cuneiform Digital Library Initiative* (CDLI)[2], we are achieving a more substantial basis for the continuing discussion of the early development of writing in Mesopotamia. Cuneiform represents a system of writing with a history of over three thousand years of use, and can boast of a text corpus unparalleled in number and breadth before the invention of the printing press. Cuneiform offers, moreover, a unique view of the earliest stages of development of an advanced writing system. In a career spanning over thirty years, Denise Schmandt-Besserat has published and discussed the significance of a means of accountancy employed in the ancient Near East that represents a clear precursor of the first proto-cuneiform tablets. Small clay objects unearthed in prehistoric strata were termed "tokens" by Schmandt-Besserat, who wished to underscore their use as markers in an ancient system of bookkeeping. These clay objects consist on the one hand of simple geometrical forms, for instance cones, spheres, etc., on the other of complex shapes or of simpler, but incised forms. Simple, geometrically formed tokens were found encased within clay balls (usually called "bullae") dating to the period immediately preceding that characterized by the development of earliest proto-cuneiform texts; these tokens most certainly assumed numerical functions in emerging urban centers of the late 4th millennium B.C. Indeed, impressed signs of an array of numerical systems found in proto-cuneiform accounts represented, in both form and function, many of the archaic tokens, so that the forerunner role of the simple tokens in the development of writing in Mesopotamia belongs, as the editor of this volume would understand the term, to the "core knowledge" of modern cuneiformists.

The spate of new proto-cuneiform tablets on the London markets deriving from post-Kuwait War Iraq, including over 400 new texts of both Uruk III and Uruk IV[3] period date, reputedly from the

---

1 Vector images of proto-Elamite texts included in the present study are for the most part based on the hand copies of their original editors. Tablets collated according to inspections of originals (with sincere thanks due to Beatrice André for her permission to collate the published proto-Elamite texts and to inspect the unpublished Susa tablets housed in the Louvre) or photos are so noted. In the illustrations, areas shaded but not enclosed within a line represent surface abrasions, those within a contour line represent broken surfaces that therefore contain no traces of damaged signs.The question of original tablet orientation will, for reasons given in previous publications, not be addressed here; all copies (unless otherwise noted at 75% of original size) depict tablets as prescribed by publication conventions, that is, rotated 90° counter-clockwise from their original position. Transliterations of numerical notations are based on the treatment of their respective number sign systems by Damerow and Englund 1989:18-28.

2 This NSF-funded initiative represents a natural expansion of the goals of the project *Archaische Texte aus Uruk*, directed over the last 25 years by Hans Nissen of the Free University of Berlin. The *CDLI* (http://cdli.ucla.edu/) studies all available Mesopotamian administrative texts of the late 4th and the 3rd millennium. Babylonia and the Susiana were bound by a close interrelationship during this period, seen above all in the evident borrowings of Babylonian writing tradition by Persia. Since the time of the early excavations of both regions, researchers have as a consequence included both proto-Elamite of the late 4th and early 3rd millennium, and linear Elamite of the late Old Akkadian period, in their discussions of cuneiform development. The web data set of the CDLI will soon include a full presentation of the proto-Elamite material, drawing on the files and publications of the collaborators Damerow and Englund (1989) and Friberg (1978-1979), and on the electronic transliterations, based on the sign list of Meriggi 1971-1974 (the list proper was published in vol. 2) now completed by staff member Jacob Dahl. Sign designations, for instance M388, follow the numbering of the Meriggi list.

3 Together representing the last phase of the Late Uruk period in Mesopotamia and dating to ca. 3200-3000 B.C. Lawler (2001b:32-35, 2001c:36-38) has reported on recent excavations in Iraq, and the wholesale plunder of both Umma, modern Djokha, and the neighboring Umm al-Aqirib. According to Margarete van Ess in Lawler (2001a:2419), the chronology of the proto-cuneiform periods in Uruk might have to be adjusted two centuries backward based on radiocarbon dating of Uruk charcoal remains. See below, n. 39, and J. Cooper's contribution in this volume.

ancient city of Umma, have increased the size of the proto-cuneiform corpus to over 6000 tablets and fragments containing more than 38,000 lines of text. Two elements provide us with a relatively firm understanding of the contents of many of the earliest cuneiform documents. First, there is an evident continuous paleographic and semiotic progression of the cuneiform sign repertory into periods, beginning with the Early Dynastic IIIa period ca. 2600-2500 B.C., whose administrative and literary documents are increasingly comprehensible. Second and more importantly, a many centuries long scholastic tradition of compiling and copying lexical lists, ancient 'vocabularies', help bridge the gap between proto-historical and historical context. It should also not be forgotten that the seventy years in which a limited but quite involved circle of Sumerologists has worked on proto-cuneiform have resulted in a number of tools helpful in continuing research, including the first Uruk sign list of Falkenstein (1936) and its revision by Green and Nissen (1987), but also in a growing number of primary and secondary publications by, among others, Friberg (1978-1979; 1982; 1997-1998), Green (1980; 1981; 1987), Charvat (1993; 1998), and the members of the *CDLI*. Despite such research tools enjoyed by those involved in the decipherment of proto-cuneiform, no definitive evidence has been produced that would identify the language of proto-cuneiform scribes. The onus to make the case one way or the other would appear to rest with specialists in the field of Sumerology, since, given its later linguistic presence and the strong cultural continuity in southern Babylonia, Sumerian must be the favorite candidate for an eventual decipherment. Yet neither the evidence for possible multivalent use of signs in the archaic period, nor, for instance, the more sophisticated argument of a unique connection between Sumerian number words and the sexagesimal numerical system, a notational system which appears to be attested already in the token assemblages of the prehistoric clay bullae, have sufficient weight to convince skeptics.[4] On the contrary, it seems that a strong argument from silence can be made that Sumerian is not present in the earliest literate communities, particularly given the large numbers of sign sequences which with high likelihood represent personal names and thus should be amenable to grammatical and lexical analyses comparable to those made of later Sumerian onomastics.[5]

4 See Englund 1988:131-133, n.9, and 145-146, n. 18; 1998:73-81. A troubling tendency to simplify this discussion to a matter of tendentious speculation can be discerned in the more recent publications of some close to, and many at a fair distance from the topic. Krebernik 1994:380-385 gave a measured appraisal of possible rebus values of signs in the proto-cuneiform repertoire in his review of Green and Nissen 1987; the phonetic readings identified by Steinkeller (1995:689-713; 1995-1996:211-214) are, on the other hand, heavily speculative and in some instances reckless. When however these identifications reach the level of treatments twice removed from the original documents, for instance that of Glassner 2000, we are confronted with such statements as "MAŠ+GÁNA—the two signs form a ligature—is *incontestably* [emphasis mine] a loan from the Akkadian *maškanu*, "area of threshing, small agricultural establishment" " (Glassner 2000:210), which although a direct borrowing from Steinkeller (and, incidentally, an indirect borrowing from M. Green, one of the original editors of the signlist Green and Nissen 1987) is nonetheless an indication of a cavalier attitude toward the proto-cuneiform texts. We need to be aware that the self-indulgent transmission of fantastical etymologies from publication to publication can engender an environment of mistrust in the rigor of a field otherwise prone to great caution.

5 Isolatable personal names are most evident, for instance, in the accounts of "dependent workers" SAL and KUR_a in such proto-cuneiform texts as Englund and Grégoire 1991:nos. 212-222, and Englund 1998:177, W 20274,2 and 23999,1. Of course, we cannot determine in any convincing way the nature of name-giving in the archaic period, particularly insofar as this conservative cultural trait is transmitted through large numbers of "dependent workers" who will have been both ethnically and linguistically diverse, yet it seems out of character that *not one* of the sign combinations evidently representing humans in these texts can plausibly be interpreted to conform to standard Sumerian practice, whereas the numbers of personal designations from the Early Dynastic I-II period texts from Ur (Burrows 1935; ca. 100-200 years after the end of Late Uruk) that are susceptible to such morpho-syntactical and even phonetic analysis is not small (di Vito 1993:23-24; Englund 1998:80, n. 168).

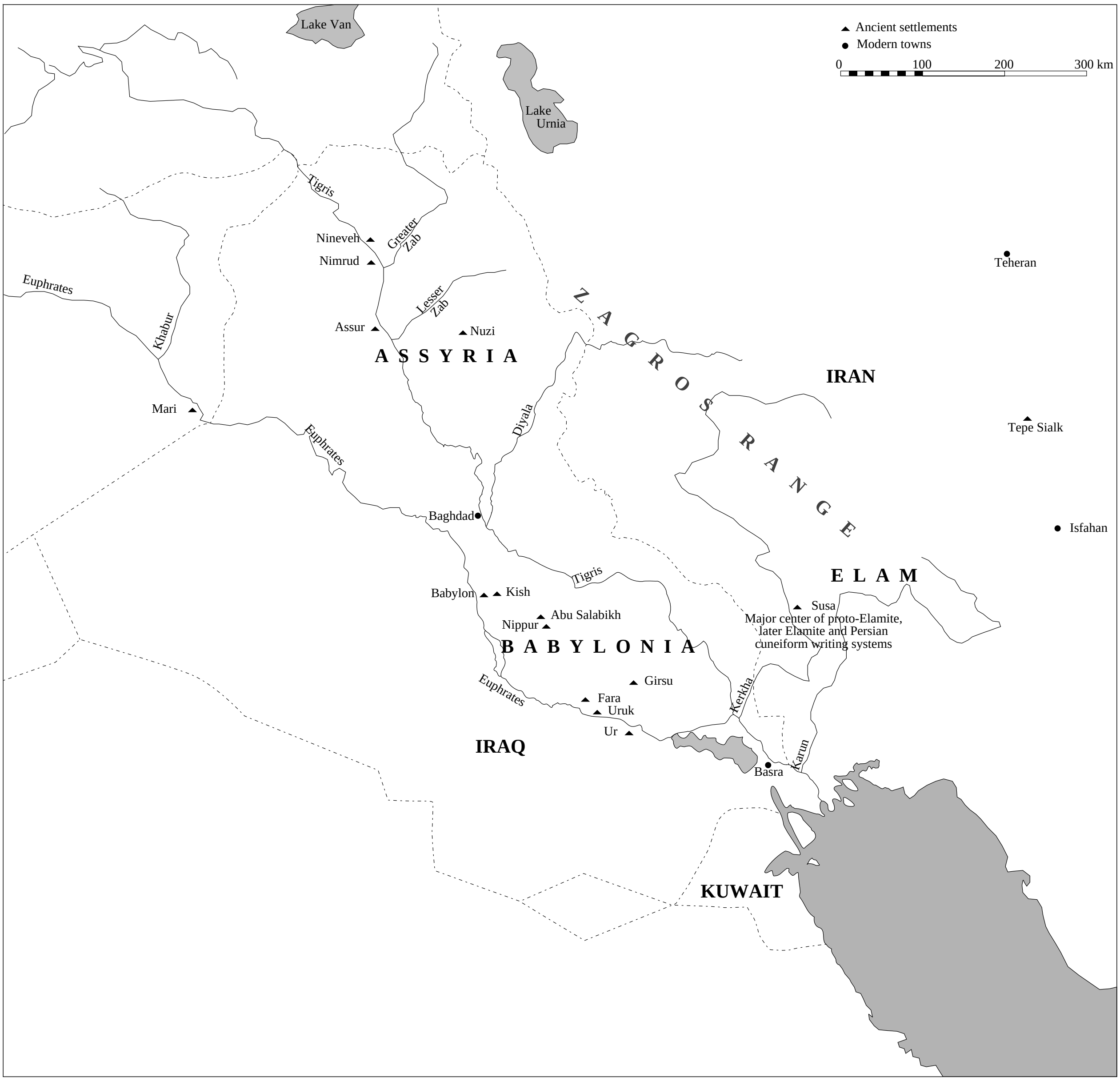


Figure 1: Map of Western Asia

Despite these uncertainties in the proto-cuneiform record, many factors make the interpretation of the earliest phase of writing in Mesopotamia a study of considerable reward. In Mesopotamia we are favored with a substantially unbroken tradition of writing in both form and function through a period of three millennia, including most importantly an exceedingly conservative tradition of so-called *Listenliteratur*, that is, of compilation and transmission of thematically organized word lists beginning with those of the earliest, the Uruk IV-period phase of writing; we count large numbers of inscribed tablets and fragments from archaic Babylonia, now ca. 6000, which for purposes of graphotactical analysis and context-related semantic categorization of signs and sign combinations represents a text mass of high promise; and assuming populations in Babylonia were relatively stable through time, we can utilize language decipherments from texts of later periods in working hypotheses dealing with the linguistic affiliation of archaic scribes.

Against this backdrop, the task of deciphering early texts from Persia seems all the more daunting. Although these texts have played an historically minor role relative to early cuneiform, the French excavations of Susa (Figure 2) made that script the first archaic Near Eastern writing system known to us. A quarter of a century before British-American excavators of Jemdet Nasr, and German excavators of

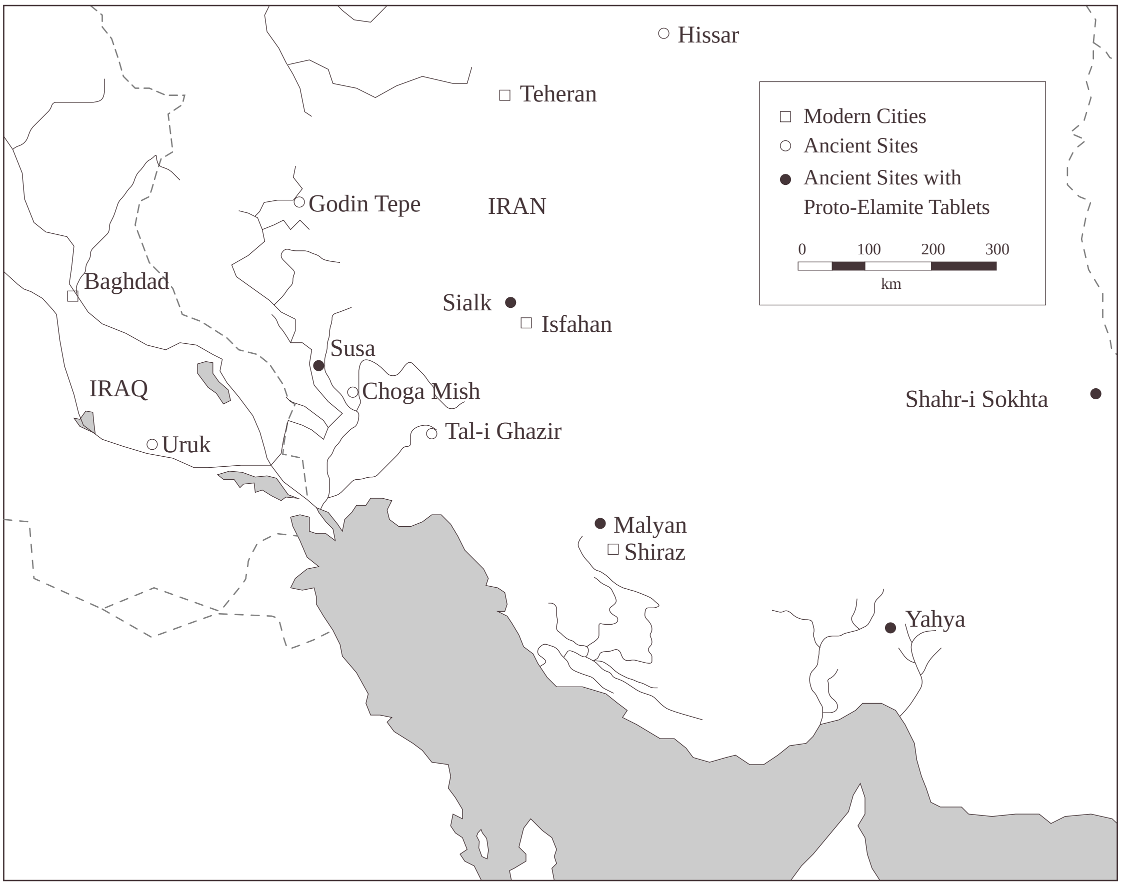


Figure 2: Major sites of Late Uruk proto-Elamite inscriptions in Persia

Uruk unearthed their proto-cuneiform tablet collections, de Morgan's archaeological earth-moving machine sent to the Louvre examples of an evidently very early writing system which, based on a presumed genetic relationship to the later attested Elamite-speaking peoples of the Susiana plain, has been only conventionally named proto-Elamite.[6] The proto-Elamite corpus numbers just over 1600 pieces[7], with ca. 10,000 lines of text, that is, about a quarter as many as from Babylonia (still, it represents a large amount of material compared to the relatively humble inscriptions of Linear A or of early Harappan). The publication of tablets appears to have proceeded with little understanding of the text corpus and the accounting system it represented,[8] and with little attention paid to an accurate

6 Hinz (1987:644) interpreted the indigenous geographical designation ḫa(l)tamti identified in much later texts to mean "god's land" from ḫal 'land' and tamt '(gracious) lord'; "Elam" may be an Akkadianized rendering of these terms influenced by *elûm*, "to be high." "Proto-Elamite" is an artificial term derived from this geographical designation usually used to describe an historical phase in the Susiana plain and the Iranian highlands situated to the east of Mesopotamia generally considered to correspond to the Jemdet Nasr/Uruk III and the ED I periods in Mesopotamia. It is represented in Iran by the levels Susa 16-14B (including, possibly, part of 17A) and corresponding levels from other sites (in particular Yahya IVC, Sialk IV.2, Late Middle Banesh [Banesh Building Level II]). It may be dated to ca. 3100-2900 B.C. The complex stratigraphy of Susa and its relevance to the chronology of the proto-Elamite period will not be considered here (to the French excavations, see N. Chevalier and E. Carter in Harper, Aruz, and Tallon 1992:16-19, 20-24; Carter and Stolper 1984:103-132); levels determined in the acropolis excavations of 1969-1971 are cited as generally accepted standards (cf. Le Brun 1971:163-216, and Dittmann 1986b, 1986c:332-366; "Susa 17" = "Susa Acropolis I 17").

7 208 tablets in Scheil 1905, including two tablets edited in Scheil 1900, 490 in Scheil 1923, 649 in Scheil 1935, and 50 in Mecquenem 1949, approximately 40 in various articles (Mecquenem 1956:202; Vallat 1971:figs. 43 and 58; Vallat 1973:103; Stolper 1978:94-96). Some 100 unpublished fragments from Susa are in the collection of the Louvre, twenty more in the Museum of Archaeology and Ethnology of the University of Sao Paolo. The Teheran Museum, finally, houses seventeen proto-Elamite texts from Tall-i Malyan and possibly more from Susa; the collection of the École Biblique, Jerusalem, contains nine Susa texts presumably deposited there by the Dominican and Susa epigraphist V. Scheil. See Damerow and Englund 1989:2, n. 4.

8 No more than two texts of the entire collection can with some likelihood be assigned to non-administrative, probably

representation in hand copies of the texts themselves.

Accompanying sign lists were published with scant thought given to the high number of signs and the likelihood that the upwards of 5500 signs in the final list attached to a primary publication by Mecquenem (1949) contained large numbers of sign variants. The list published by Meriggi (1974) attempted to solve this problem by including under discrete headings presumed variant graphs and so arrived at a total of less than 400 sign entries. That list was unfortunately itself laced with incorrect identifications and graphic forms of many signs, in part reflecting the wayward decision of the author to opt to follow the original, rather than the established conventional orientation of the proto-Elamite tablets. This, added to the fact that seemingly all of the signs were published as mirror images, and that the important numerical sign systems were defectively organized, makes the Meriggi list a research tool of limited value.[9] However, proto-Elamite inscriptions have been, and will remain highly problematic in a discussion of writing because they represent but a relatively short period of literacy, beginning around 3100 and ending around 2900 B.C., after which, unlike Mesopotamia, no writing tradition existed that might have served to reflect light back to this earliest phase. The few so-called Linear Elamite inscriptions from the late Old Akkadian period, that is, from a period some eight centuries after the proto-Elamite age, exhibit little graphic and no obvious semantic connection to the earlier writing system.[10]

Still, the proto-Elamite writing system exhibits high potential and, but for its uniqueness as a largely undeciphered script of an entirely unknown dead language, has some features which might have made it an even better candidate for decipherment than proto-cuneiform. Among these are a substantially more developed syntax evident in a linear "line of sight" in the writing practice (see below), and in an apparently more static graphotactical sign sequence.

Description

Proto-Elamite clay tablets—to date, no known examples of the script have been found on other materials—exhibit a relatively straightforward and standardized format throughout their history. Entries on the obverse face of a tablet usually began in the upper left corner with a general heading, followed by one or more individual entries. These were inscribed in lines from top to bottom kept in columns defined, if at all, by the shank of the stylus pressed along the length of the tablet. No apparent

---

school exercise context (Scheil 1923:no. 328; 1935:no. 362).

9 In the absence of a better alternative, however, it has served as the provisional basis for the electronic transliterations entered by CDLI staff insofar as the non-numerical signs are concerned; numerical signs have been transliterated according to the Uruk signlist published in Green and Nissen 1987:335-345. See n. 2 above.

10 Meriggi followed three primary assumptions in his analysis of proto-Elamite. First, he presumed it was a genetic relative of later Elamite represented by Linear Elamite of the late Old Akkadian period (in other sources described as "proto-Elamite B"). Second, he believed that isolatable proto-Elamite personal names were written syllabically. Third, he followed an implied rule that the proto-Elamite writing system represented language in rather strict sign sequences. The consequence of this line of thought was to allow the decipherer to test in the proto-Elamite corpus syllabic readings of signs derived from a list of graphically comparable signs of both periods. See Meriggi 1971-74:I, 172-220; 1975:105. Although a graphotactical analysis of the proto-Elamite script would seem to deliver some data of statistical interest (see Figure 20 below), the results of Meriggi's efforts offer little encouragement. There are numerous exceptions to an implied rule of standardized sign sequence, as noted already by W. Brice 1962-1963:28-29 and 32-33. Further, seeming graphic correspondences are notoriously inaccurate and can only be pursued as an avenue of decipherment within the framework of a continuous writing tradition such as that of Babylonia, but even then must be considered highly tentative. Certainly, the use of signs must be shown to derive from comparable text genres and from within parallel contexts in the texts. Given the span of over 700 years unaccounted for between proto- and Old Elamite; given the fact that Linear Elamite was employed only following a period of Old Akkadian domination to record local royal events; and given the high probability of the use in proto-Elamite personal names of logographic signs whose later syllabic values might be seen in the Linear Elamite period, there is, as Gelb (1975:95-104) has also stated, little reason to be optimistic about an eventual language decipherment of proto-Elamite.

organizing importance was attached to the end of these columns; the notation of a particular entry often began in a column at the bottom of a tablet, and continued at the top of the adjoining column. This phenomenon is particularly obvious in the many examples of numerical notations spread across two such "columns."[11]

Their clearly recognizable, standardized structure divides proto-Elamite administrative texts into three major sections (Figure 3). Many texts begin with a *heading*, a sign or a sign combination which qualifies all transactions recorded in the text and which never contains a numerical notation. The clear formal structure of the following individual text entries allows their isolation from the headings and appended summations. These individual entries consisted of, first, a series of ideographic signs representing persons or institutions involved in the account, followed by signs representing objects qualified by further ideograms and by numerical notations. The sign combinations seem to indicate a possibly spoken sequence of substantive followed by qualification, as is also the case with the object designations and the numerical notations themselves.

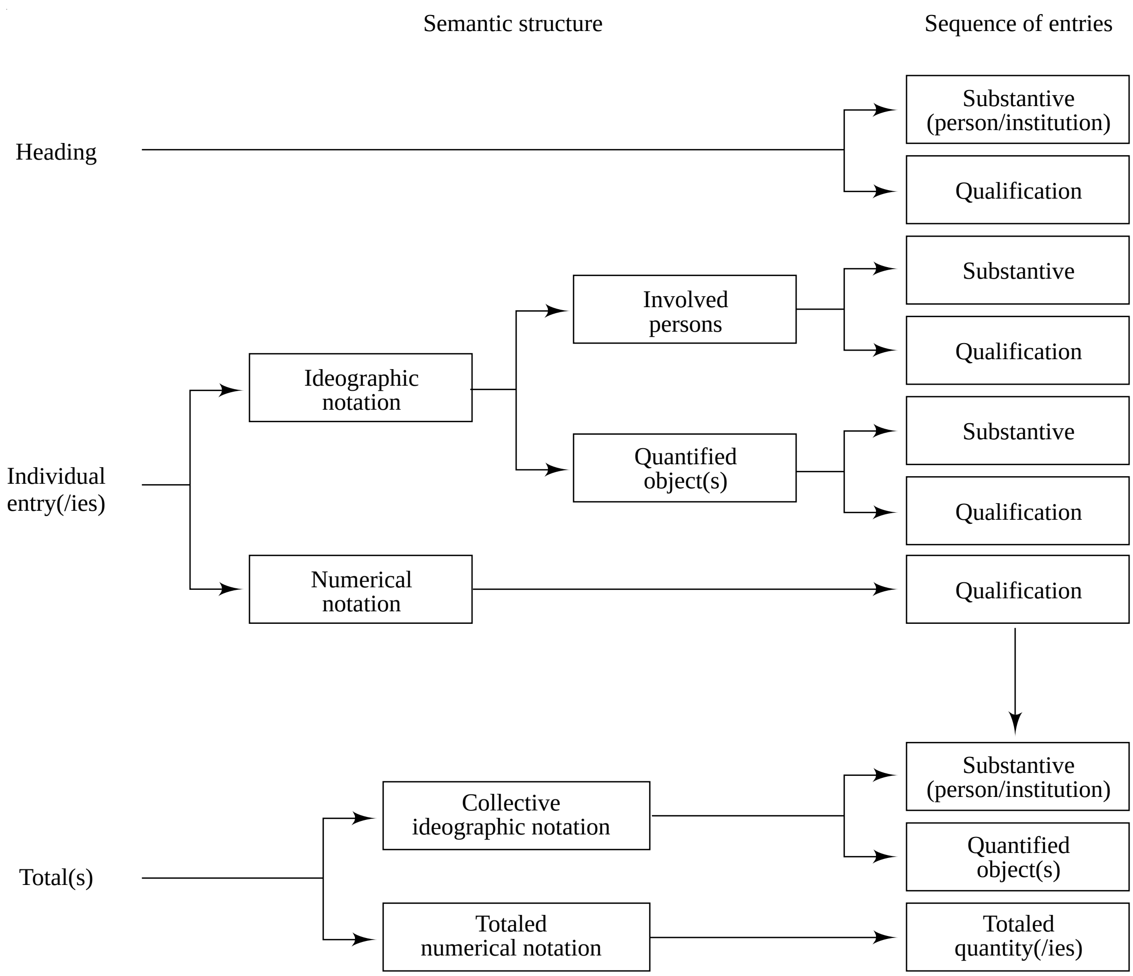


Figure 3: Semantic structure of the proto-Elamite accounts

11 Notations in the metrological cereal capacity system Š# (see the discussion below) form a notable exception to this rule. The entire notation was encased in a rectangle of etched strokes; longer notations in Š# which could not be accommodated in the remaining space at the bottom of a column were moved to the next column, thus leaving a space in the preceding line.

Multiple-entry documents in the proto-Elamite corpus range in complexity from a simple linear sequence of entries of exactly the same type to involved accounts recording the consolidation of numerous primary accounts. A simple example may on the one hand be found in an account from the records of animal husbandry offices consisting of one or more entries representing numbers of animals moving from the care of one person or office to the next. Texts may on the other be highly structured with up to three identifiable levels of hierarchy, reflecting, for instance, the organizational structure of a labor unit.[12]

Particular entries of a higher order which we call totals contain summations of numerical notations from all or some entries together with collective ideographic notations. Since all entries seem to contain numerical notations, the syntax of these texts would seem more to represent the structure of a system of bookkeeping than the division of a spoken language into distinct semantic units, although within strings of ideographic signs we must anticipate such as-yet-undeciphered semantics.[13]

The first attempts to establish a clear relationship between the proto-Elamite and proto-cuneiform scripts were concentrated on the conformity between the number signs and numerical systems used in the respective scripts. This conformity is already suggested by the fact that, contrary to the ideograms, the proto-Elamite and the proto-cuneiform numerical signs exhibit the same sign forms (Figure 4). More importantly, the sequence of the basic signs (i.e., the combinations of vertical and oblique impressions of a round stylus) in the proto-Elamite numerical notations corresponds to that of the proto-cuneiform notations, thus indicating that the scribes of the proto-Elamite texts used numerical systems with at the very least the same quantitative order as known from the proto-cuneiform texts. This implies that the proto-Elamite numerical signs exhibit the same arithmetical ambiguity as the proto-cuneiform numerical signs, in that the numerical value of a particular sign differs according to its specific context of application. The exact quantitative relationships between the various members of an assumed system exhibited by the proto-Elamite text corpus could be inferred in many cases only by this analogy. But when examined according to summations in the texts, these relationships stood in exact conformity with the relationships of the proto-cuneiform numerical systems.

One difference between proto-cuneiform and proto-Elamite numerical systems, however, has already been noted in earlier treatments. In addition to the sexagesimal and the bisexagesimal systems well known from the proto-cuneiform administrative texts as numerical systems used to count discrete objects, a strictly decimal system was used in certain areas of application. Aside from six possible but unlikely exceptions,[14] this numerical system finds no parallel in the proto-cuneiform corpus.

---

12 See, for example, the treatment of Scheil 1905:no. 4997 in Nissen, Damerow, and Englund 1993:78-79.

13 Damerow and Englund (1989:15) have noted that the semantic structure of the proto-Elamite texts proves their close relationship to the proto-cuneiform corpus. Generally, proto-Elamite headings correspond to proto-cuneiform account colophons; entries in proto-Elamite documents correspond to “cases” of proto-cuneiform texts. It must be kept in mind, however, that the semantic hierarchy of proto-cuneiform texts is frequently represented directly by the graphical arrangement of cases and sub-cases, while the hierarchical structure of individual proto-Elamite entries is already on the whole a semantic construction. This latter contrast between the semantic and the syntactical structure of the two writing systems–the more developed separation of semantics and syntax evident in the proto-Elamite texts–is a strong indication of the antecedence of the proto-cuneiform corpus.

14 Englund 1994:pl. 26, W 7204,d edge i 1: ⌜5N_{23}⌝ [ ], W 20649 (unpublished) obv. i 1: [ ] ⌜1N_{23}?⌝ 2N_{34} ⌜3N_{14}⌝ [ ], Damerow and Englund 1987:pl. 60, W 22115,9 rev. i 2: 1N_{23} 1N_{48}, Cavigneaux 1991:143, W 24189 obv. ii 2: 7N_{23} [ ] ⌜BU_a⌝ X [ ] and obv. ii 3: 3N_{23} [ ] 1N_1 X [ ]; an unpublished tablet from the current antiquities market, finally, has rev. iii 1: 2N_{23} 6N_{34} $IŠ_a$ X A [ ]. In the absence of either a meaningful numerical sign sequence including N23 (proto-Elamite: “100”)—N_{23} in the examples listed above should not be followed by N_{34} (“60” in the sexagesimal system) or N_{48} (“600”)—or, for instance, of numerical notations including 6+ N_{14} (“10”) that cannot be explained as having derived from the capacity or the area systems, no proto-cuneiform notations can be considered likely decimal qualifications.

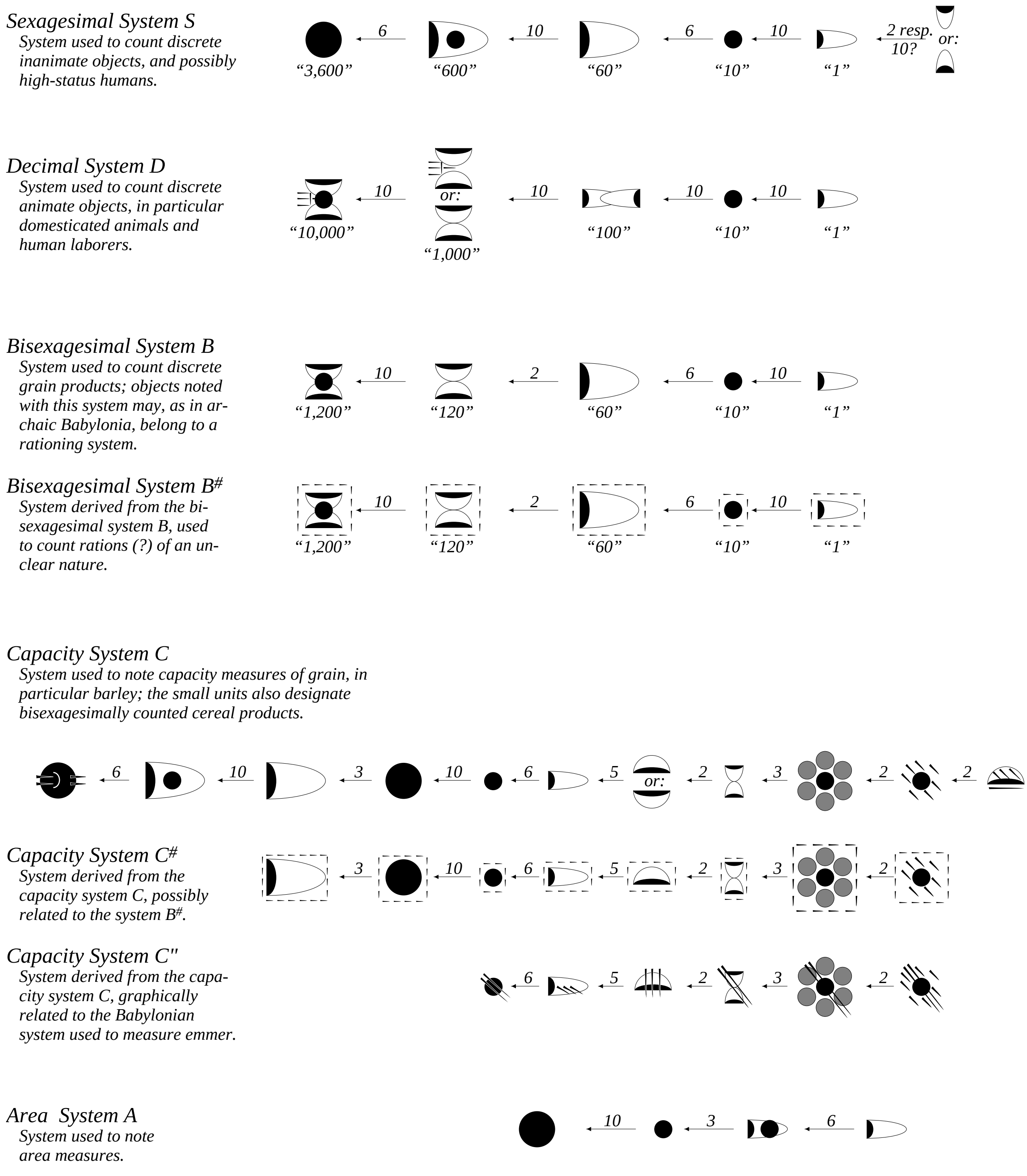


Figure 4: Numerical systems attested in proto-Elamite accounts

An important result of our analysis of the proto-cuneiform numerical systems was the determination of ideograms which indicate in the texts the objects of the bookkeeping activities; this resulted in the confirmation that the numerical systems had distinctive areas of application. A comparably systematic analysis of the areas of application of proto-Elamite numerical systems has not yet been undertaken because of, in large part, the difficulty of identifying the semantic function of the signs.[15] A previous

15 The main reason for this difficulty is the interruption of the paleographic tradition in Elamite sources: later Elamite

publication explored the numerical notations of proto-cuneiform accounts according to probability analysis in an attempt to isolate all systems employed in archaic Babylonian bookkeeping.[16] The same statistical method applied to the corpus of proto-Elamite texts allows us to reject confidently the presumption that the accounts record a hitherto unknown numerical system. The only exception would appear to be the surface area system identified in only one example (see Figure 9). This tablet might represent a physical import from Babylonia.

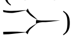
The *sexagesimal system* (see Figure 5) used in Mesopotamia for most discrete objects, including domestic and wild animals and humans, tools, products of wood and stone and containers of in some cases standard measures, is also well attested in the Susa administrative texts, although with an obviously restricted field of application.[17] The few discrete objects counted with the proto-Elamite sexagesimal system that can with some plausibility be identified include vessels and other products of craftsmen, and it seems, humans of high status but excluding animals and dependent laborers. Few tablets contain sufficiently preserved accounts to allow of a clear calculation of individual entries combined in a summation. For instance, Scheil (1935:no. 314) consists of four entries on its obverse surface representing 15, 30, 20 and 10; thus the total on the text's reverse surface is to be considered a sexagesimal notation of N_{34} N_{14} $5N_1$ = 75 (counting presumable beer vessels).[18] Scheil (1905:no. 219) contains the individual entries 6 $^1/_2$ + 2 $^1/_2$ + 1 $^1/_2$ totaling, on its reverse surface, N_{14} N_8 = 10 $^1/_2$. Other texts, though not completely preserved, retain individual entries which are compatible only with a sexagesimal interpretation of the texts' numerical system. For instance, the obverse of Scheil (1905:no. 213) consists of three entries of counted $M149_a$: [13] + 10 + 10 = 33 ($3N_{14}$ $3N_1$, rev. line 2) units, and five of counted M376 12 + 45 $^1/_2$ + 90 + 47 + 67 = or 251 $^1/_2$ ($4N_{34}$ N_{14} N_1 N_8) units (reducing one of the obverse entries by 10); likewise, Scheil (1935:no. 317) may be reconstructed obv. N_{14} $4N_1$ / $6N_1$ / $7N_1$ / N_{14} $1N_1$ / $5N_{14}$ / N_{14} [$4N_1$ N_8] / $2N_{14}$= $2N_{34}$ $2N_1$ N_8 (counting several presumable categories of humans). Both accounts appear to deal with humans of high status.[19] In other

texts, with the exception of the few Old Elamite linear texts, were written with Babylonian cuneiform. The most successful method in the semantic decipherment of proto-cuneiform signs, namely the establishment of paleographic continuity between archaic and later periods, is thus not applicable in proto-Elamite research. Most of the proto-Elamite ideograms, moreover, are of a substantially more abstracted form than proto-cuneiform ideograms, whose pictographic character is often helpful in semantic analysis; the semantic analysis of proto-Elamite is consequently largely dependent on the examination of contextual sign usages. Proto-Elamite texts do, however, exhibit the same close connection between numerical systems and the nature of the objects quantified by respective numerical notations. This connection may well help in future research to establish more correspondences between proto-Elamite and proto-cuneiform ideograms than has been possible heretofore (see below, Figure 14).

16 Damerow and Englund 1987:121-123 and, for instance, 149 n. 20 and 150-51 n. 32.

17 The derived system S', whose function in archaic Mesopotamian documents has not been satisfactorily explained, seems not to have been used in proto-Elamite texts.

18 Although formally the notation could derive from the bisexagesimal systems, for which see directly, there are sufficient indications that all such vessels were counted sexagesimally.

19 Possible representations of high-status humans include the signs M57, M72, M149, M291, M317, M320 and M376 (Figure 14). Affiliation of partricular representations to the category of sexagesimally counted high-status humans must be demonstrated through the identification of clearly sexagesimal notations on the one hand, of semantic subsets and sets qualified by general ideograms on the other. For example, the mentioned texts Scheil 1905:no. 213 and 1935:no. 317 (Figure 5) record in numerous obverse entries groups of objects designated M149 and M376; in the former account, subtotals of the reverse face distinguish between the two objects in numerical notations that both appear to derive from the sexagesimal system, while in the latter the two are subsumed under the collective ideographic designation M376 clearly counted sexagesimally. Such texts as Scheil 1905:no. 315 contain combinations of the sign M376 with both M72 (female laborer) and M388 (male laborer) in sequences comparable to that of the same two signs with M291. M291 () seems evidently in the laborer rationing account Scheil 1905:no. 4997 (Nissen, Damerow and Englund 1993:77-79) to represent a foreman semantically corresponding to Sumerian ugula, a representation of two sticks. This sign M291, together with M72, M57 and M317, is also generally qualified in Scheil 1905:no. 390 (Figure 5) as a member of the class of objects designated by the sign M317 and qualified sexagesimally.

cases, numerical signs in large notations exhibit sequences which in all likelihood are sexagesimal, for example Scheil (1935:no. 461) with $4N_{48}$ $4N_{34}$ $3N_{14}$, and Vallat (1973:103, no. 1) with rev. l. 2 $5N_{45}$ $3N_{48}$ $4N_{34}$ $5^{!?}N_{14}$ $8N_{1}$, are both evidence of large sexagesimal notations, the former text

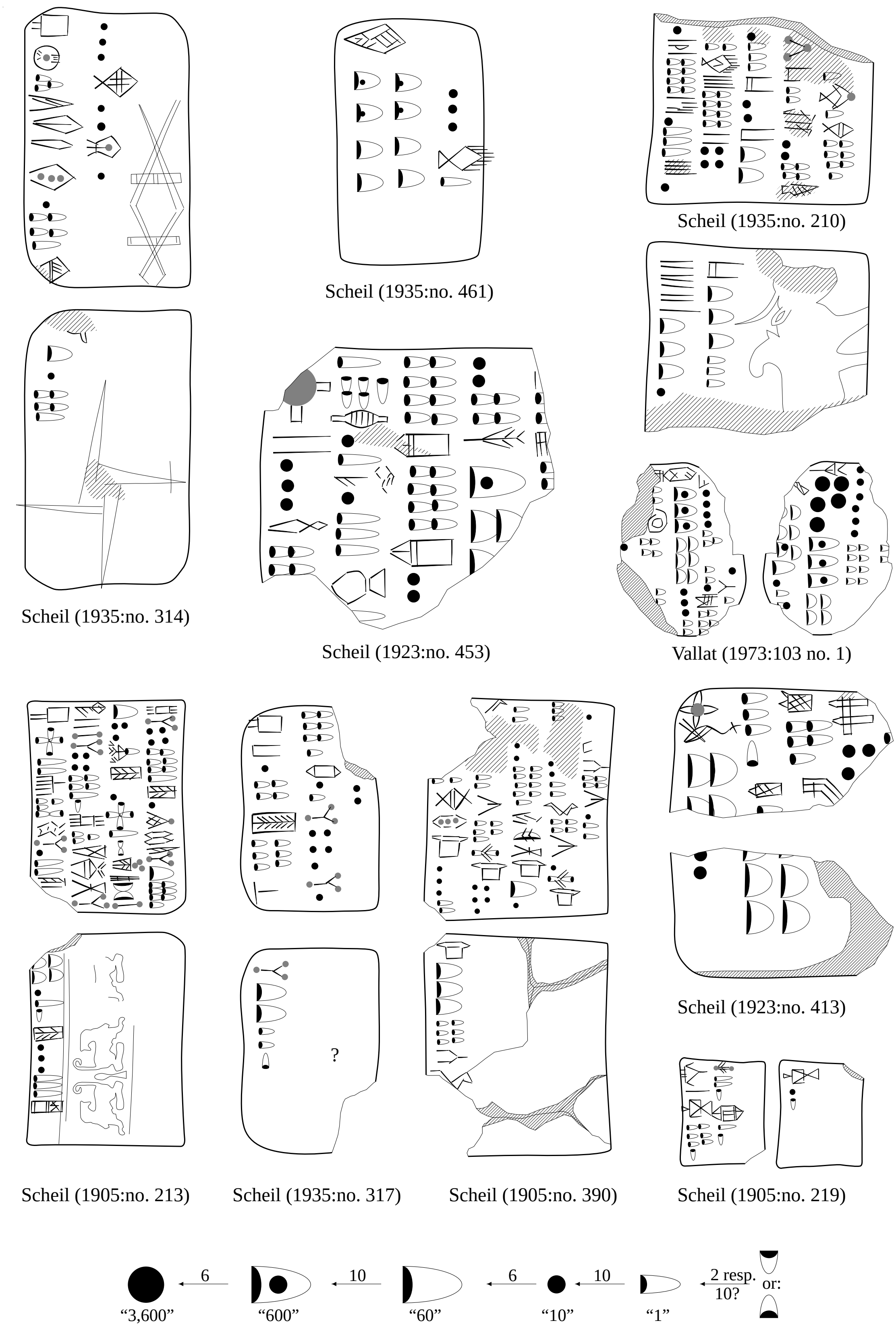


Figure 5: Attestations of the sexagesimal system

counting vessels, the latter among other commodities a sign very close to proto-cuneiform TI and thus possibly designating a large number of “bows and arrows.”[20]

The *decimal system* (Figures 6a-b) was used to count discrete objects in proto-Elamite texts; it has no proto-cuneiform counterpart. A handful of texts offer fully reconstructable calculations of counted objects with summations on reverse tablet surfaces and thus a clear interpretation of the absolute values represented by the individual signs of the system. For example, Scheil (1923:no. 45),[21] contains individual entries on the obverse surface representing 94 + 69 + 147 + 44 + 50 + 112 + 75 subsumed in a notation on the reverse surface equaling 591 ($5N_{23}$ $9N_{14}$ N_1) of counted M388 ( ).[22] Scheil (1905:no. 212)[23] in like manner records in individual groups of small cattle (M346,) notations representing 22 + 9 + 18 + 16 head, subsumed in a notation on the reverse surface equaling 65 ($6N_{14}$ $5N_1$).[24] Accounts such as Scheil (1935:no. 205, Figure 6a) with the sequence

$$N_{51} \leftarrow N_{23} \leftarrow N_{14} \leftarrow N_1, \text{ f}$$

or instance in line 1: N_{51} $7N_{23}$ $7N_{14}$ $4N_1$ (and see the accounts Scheil 1923:no. 19, 86, 105 and 275-277) confirm the structure of the numerical system as reconstructed in Figure 6a, while the use of the sign N_{54} as the bundling unit above 1000 is evident in only two texts, Mecquenem (1949:no. 31), and an unpublished Susa account in the Louvre. Each exhibits the use of this number sign qualified with a graph resembling the proto-cuneiform sign GAL, “large.” Although it would be tempting to imagine a relationship with Semitic /*riba*/ attested in the Ebla corpus, it would seem more likely that the graph is a form of gunification[25] used to differentiate this system clearly from the bisexagesimal system and its higher value signs N_{51} and N_{54} representing 120 and 1200, respectively.

The proto-cuneiform sexagesimal system was used to register *all* discrete objects with the exception of rations. Its field of application is shared in archaic Persia by the proto-Elamite sexagesimal system presumably loaned directly from Mesopotamia, and by a native proto-Elamite decimal system restricted to living beings, including animals *and* humans of low status. This categorization may be taxonomically relevant in our understanding of the world view of ancient Persians. Mesopotamian tradition established a dual gender system of animate and non-animate, whereby non-animate objects included animals and, charged with some ambivalence, occasionally household chattel and state slave laborers.[26] The proto-Elamite sexagesimal system may have been used to count objects of high, the

---

20 20,098 units. Compare the text Scheil 1923:no. 453, in which the same sign is also qualified with a large sexagesimal notation. Two Uruk IV period accounts from the proto-cuneiform corpus contain similarly large sexagesimal notations of TI, the text Englund (1994:pl. 86, W 9656,g) with a notation on its reverse surface representing 1910+ units as a total of individual entries on the tablet obverse recording a possible distribution of TI to the administrative elites at Uruk (see Englund 1994:49), W 21742 (Englund and Nissen n.d.: pl. 79) with a notation representing 740. These numbers would tend to support the interpretation offered here of the numerical notations in Vallat 1973:103, no. 1, which could only be seriously challenged on the basis of the inclusion in the copy of the text’s editors of six instead of the presumptive five N_{14} signs. $6N_{14}$, if after all correct, would point to a possible notation in the capacity system. The immediately following notation of eight N_1 signs would, however, exclude this interpretation (in the capacity system $6N_1 = N_{14}$). The only accounts with very large sexagesimally counted objects from Uruk record the undeciphered object DUR (later Sumerian: “rope’). See Englund 1998:117 Figure 40.

21 Figure 15 below, and Nissen, Damerow and Englund 1993:75-77.

22 This sign must be interpreted to be the proto-Elamite counterpart of proto-cuneiform KUR_a ( ), both representing male dependent laborers. See in particular Damerow and Englund 1989:55-57.

23 Nissen, Damerow and Englund 1993:93-95.

24 For other examples see Damerow and Englund 1989:24, n. 75.

25 This term refers to the addition of a series of strokes to a cuneiform sign to signal a semantic variation from the meaning represented by its basic form.

26 Gender markers in Sumerian were embedded in the grammar with separate pronominal elements representing animate and inanimate subject/object, and were not evident in any known use of numerical systems, including number words.

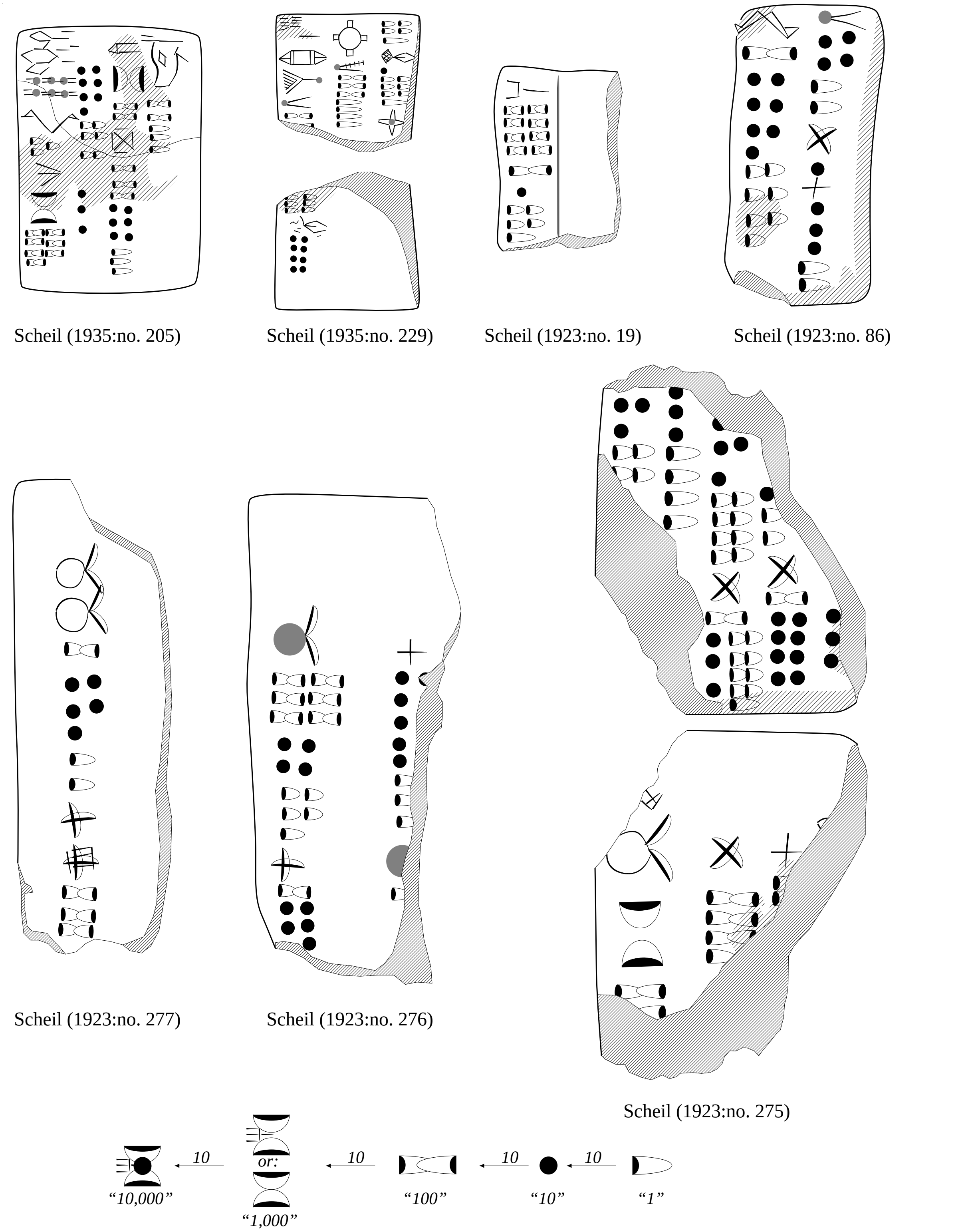
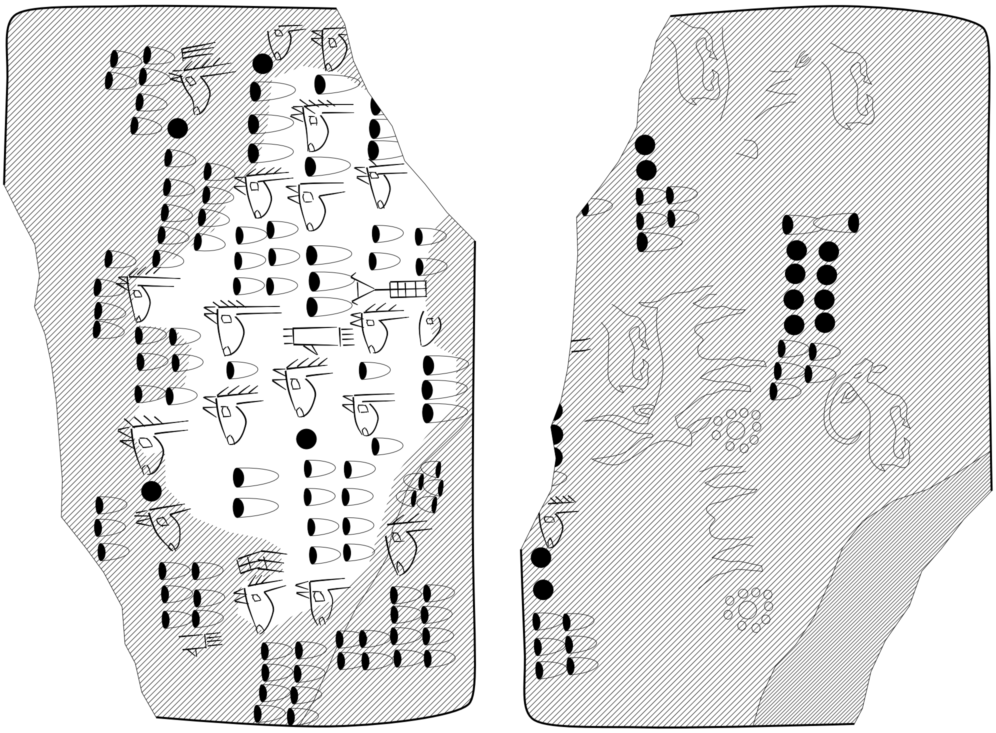


Figure 6a: Attestations of the decimal system

decimal system to count objects of low prestige. As an import from what was seen as a culturally advanced population, the sexagesimal system and the objects it was used to qualify might have enjoyed the status of prestige and power; the native decimal system may have been relegated to a qualifier of low-prestige humans and animals, in substantially the same fashion as Late Uruk Babylonian scribes treated dependent laborers KUR_a and SAL in their accounts. These were recorded with a tablet format wholly parallel to that employed in the bookkeeping of domesticated animals; the only difference between the two types of accounts was the inclusion of personal names in those concerning laborers (Englund 1998:176-180).



Scheil (1923:no. 105)

Figure 6b: Attestations of the decimal system

It should be noted that both the sign representing 1000 (N_{51}) and that representing 100 (N_{23}) in the proto-Elamite corpus, as well as apparently a spate of other numerical signs including N_{28} ($^1/_4$ N_{39} in the grain capacity system)[27] and N_{34} ("60" in the sexagesimal and bisexagesimal systems)[28], were used ideographically, or perhaps more likely phonetically in contexts strongly suggesting they formed parts of personal designations. This frequent usage of numerical signs in non-numerical and non-metrological context should form a particular target of future attempts to reach a language decipherment of the proto-Elamite writing system.

The *bisexagesimal system* (Figure 7) shows only minor differences in its structure and field of application relative to the same system in proto-cuneiform accounts. It was used to record barley rations and other cereal products in the form of discrete objects.[29] These barley products were themselves represented by numerical signs from the lower size registers of the grain capacity system, for instance in the text Scheil (1923:no. 421) with N_{30c} qualified by a bisexagesimal notation including $4N_{51}$ and $2[+n]N_{14}$,[30] or in the text Scheil (1935:no. 50), with N_{30d} followed by a notation representing 120 + 60 units. Other grain products are represented by a combination of low-register capacity signs and an ideogram, for instance the sign contained in the texts Scheil (1905:no. 388 and

27 For instance, impressed as a header of two subsections in the account Scheil (1905:no. 213), in Figure 5.

28 See, for instance, the impression of this sign on the edge of the tablet Scheil (1923:no. 421), below, Figure 7.

29 Our limited understanding of the proto-Elamite object designations makes it impossible to know whether the proto-Elamite bisexagesimal system also qualified numbers of other, possibly ration products, such as cheeses and fresh fish, as was the case in proto-cuneiform texts. See Damerow and Englund 1987:132-135.

30 A calculation of the text would in fact require that the damaged part of this notation be reconstructed as N_{14} $8N_1$, since subtracting the initial grain capacity notation from the total results in $2N_{14}$ $4N_1$ $3N_{39b}$, which divided by the grain product N_{30c} ($=^1/_6 N_{39b}$) results in 498 units. A correction of the total to ... $4N_{39b}{}^!$ would allow a reconstruction of ... $2N_{14}$ [$4N_1$] in the same entry.

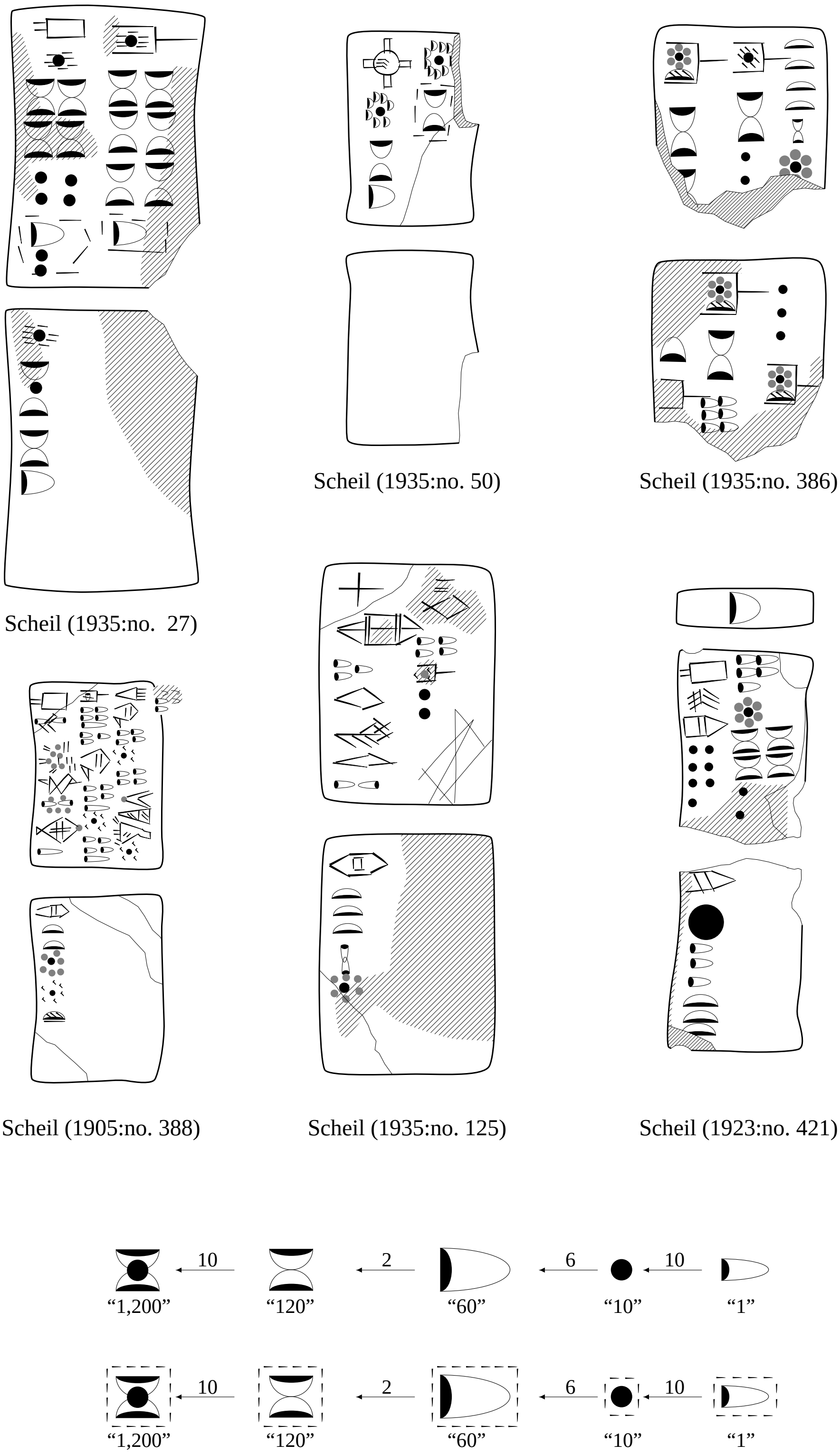


Figure 7: Attestations of the bisexagesimal system

1935:nos. 27, 125, 386) in Figure 7.[31] Further, as in proto-cuneiform texts, proto-Elamite records of grain products can evidently insert grain equivalents of processed items. For example, the text Scheil (1905:no. 388), records various vessels that are followed by notations in the sexagesimal system and

31 This sign M36 forms a functional equivalent to the sign GAR in the proto-cuneiform corpus which is the pictographic representation of the Late Uruk beveled-rim bowl serving as a rationing unit of one man-day in archaic administration. Its pictographic referent might be a measuring can with a handle used in ration distribution, presumably into the same BRBs as in Uruk, since they are found in comparable numbers at Susa and other Late Uruk Persian settlements.

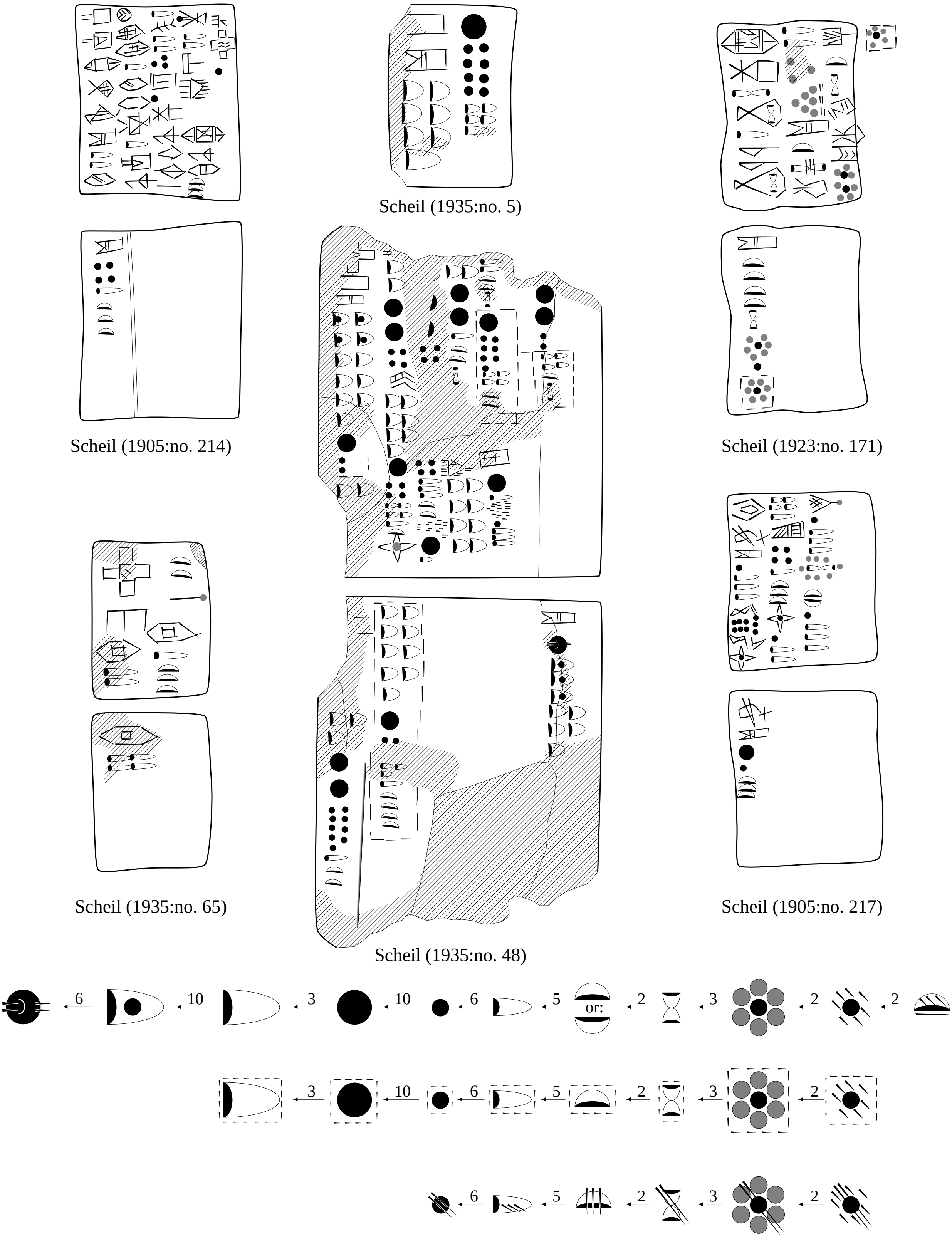


Figure 8a: Attestations of the grain capacity system

accompanied by dry grain products qualified in the bisexagesimal system. All entries were transferred into a grain capacity notation on the reverse surface of the tablet. A sufficient number of these accounts will permit us to determine the capacity typologies of the vessels used in proto-Elamite administration.[32]

32 For some preliminary identifications, see Damerow and Englund 1989:26-27, n. 86.

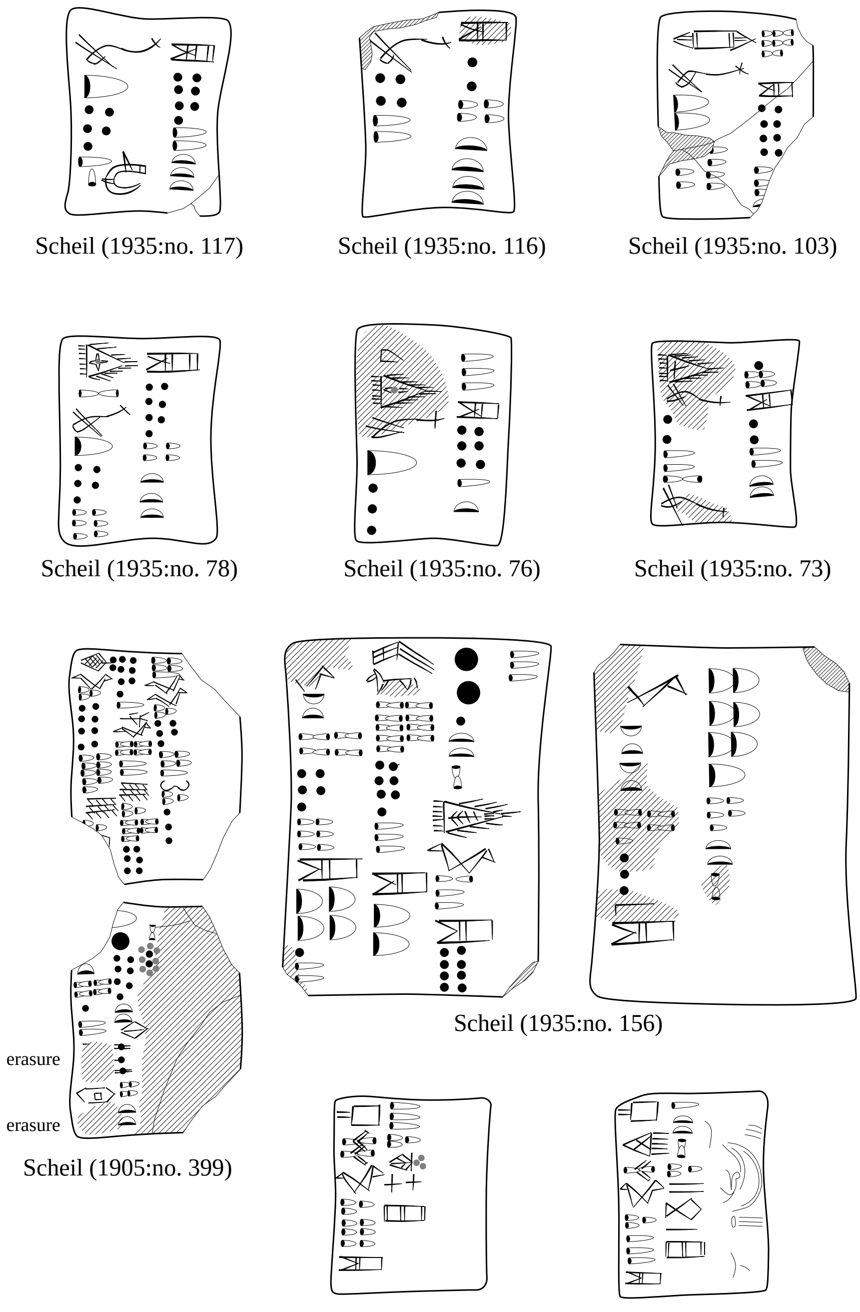


Figure 8b: PLOW = 2N_{39b}, YOKE = 2 $^{1}/_{2}N_{39b}$ ($^{1}/_{2}N_{1}$)

There is no evidence of a proto-Elamite system comparable to the derived proto-cuneiform bisexagesimal system B* characterized by the addition of horizontal and vertical strokes to individual members of the related signs. Instead, proto-Elamite shows a derivation from the basic system in that an entire bisexagesimal notation can be framed with discontinuous strokes (therefore conventionally and mnemonically referred to as $B^{\#}$). The basic and this derived system can be added together, for instance in the account Scheil (1935:no. 27), combining $4N_{51}$ $4N_{14}$ + $N_{34\#}$ $2N_{14}$# + $6N_{51}$ + $N_{34\#}$ (520 + 80 + 720 + 60) in a common total N_{54} N_{51} N_{34} (“1380”), in contrast to the bisexagesimal systems in proto-cuneiform documents. The use of the proto-Elamite $B^{\#}$ system exclusively with grain products, and its graphic similarity to the derived proto-Elamite grain capacity system $Š^{\#}$ (see below) suggests that $B^{\#}$ was used to register grain products containing amounts of grain recorded in the derived $Š^{\#}$

system. This would therefore imply that the basic system B recorded unprocessed grains, the derived system $B^{\#}$ products of those grains, including flour or simply cracked barley, along with breads and possibly malts.

One primary and two derived *grain capacity systems* (Figure 8a) employ signs of the sexagesimalsys-tem, yet with entirely different arithmetical values.[33] This system is as well attested in the proto-Elamite as in the proto-cuneiform sources, and seems to have the same field of application. In particular, the small units of the system are, in the same manner as in Mesopotamia, used as qualifying ideograms for grain products, thus denoting the quantity of grain in one unit of the product (Figure 7). Contrary to the complex proto-cuneiform system of fractions represented by signs of the system below N_{39}, units in the proto-Elamite system are multiples of each other, including linearization down to $^{1}/_{12}$ and $^{1}/_{24}$ of N_{39b}.[34] Accounts such as Scheil (1935:no. 48) with the sequence

$$N_{48} \leftarrow N_{34} \leftarrow N_{45} \leftarrow N_{14} \leftarrow N_{1} \leftarrow N_{39b} \leftarrow N_{24},$$

and Scheil (1923:no. 171) (both Figure 8a) with the sequence

$$N_{39} \leftarrow N_{24} \leftarrow N_{39c}$$

clearly demonstrate the correspondence between the Babylonian and Persian basic systems. Numerical capacity systems derived from the primary system are as common in proto-Elamite texts as are such systems in proto-cuneiform. Best attested is the system $Š^{\#}$, which seems related to the framed bisexagesimal system and probably is the functional equivalent of the proto-cuneiform system Š* used to qualify measures of processed grain. A further derived system with individual signs in a notation qualified with two or more additional impressed bars[35] is graphically similar to the proto-cuneiform system ŠE", which, based above all on its resemblance to the later Sumerian sign zíz, has been interpreted to represent measures of emmer wheat.[36] Evidence concerning the absolute size of measures represented by the signs of the proto-Elamite grain capacity systems is, the same as for those in proto-cuneiform documents, very meager. Although the occurrence of both beveled-rim bowls and of very nearly the same numerical systems for grain measures in archaic Persia as in Mesopotamia might presume that the absolute volumes these numerical signs represented were the same in both administrative centers, we must remember that the proto-Elamite grain capacity system includes a sign in the lower range less than $^{1}/_{2}$ as large as the smallest arithmetically determined member of the proto-cuneiform system. A mean value of 0.6 liters for the beveled-rim bowls in Susa[37] would have the smallest measure corresponding to just 0.15 liter, a measure which seems too small in an administration concerned with, at the least, measures of daily rations. Numerous proto-Elamite texts indicate,

---

33 See Damerow and Englund 1989:18-20 for a short description of the history of research in the decipherment of the proto-Elamite grain capacity system, long believed to reflect a decimal structure in archaic Persia, but also in Babylonia, where there was in fact no decimally structured numerical system whatsoever. Assyriological adherence to this indefensible decimal interpretation of the Late Uruk grain capacity system remained unbridled until the Swedish mathematician Jöran Friberg (1978-1979) demonstrated the relationship N_{14} = 6(not 10!)N_{1} in grain notations of both administrative centers.

34 Note that the sign N_{30c} in the proto-Elamite corpus misled Damerow and Englund 1987 in their treatment of the proto-cuneiform systems to include this sign as a variant of the sign N_{30a} (, N_{30c} absent the central impression). Through the appearance of the text Nissen, Damerow and Englund 1991:14, no. 4.3—and now confirmed in unpublished accounts in the Norwegian Schøyen collection—, N_{30c} has been shown to represent in proto-cuneiform documents a measure of grain equivalent to $^{1}/_{10}$, and not $^{1}/_{6}$ of the measure represented by the sign N_{39}, as is the case in archaic Persia.

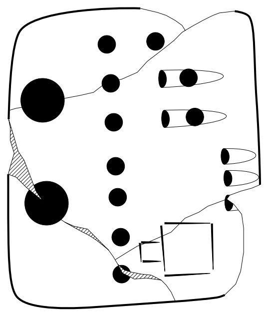
35 The reverse side of the text Scheil 1923:no. 419, with a discrete notation including signs with both two and three additional bars, suggests that the number of bars employed with a notation in the proto-Elamite system Š" was optional.

36 We have followed Vaiman (1974a:21-22) in this interpretation. See Damerow and Englund 1987:139-140, Englund 1998:120, etc.

37 Cf. Beale 1978:289-313, with a range of ca. 0.4 - 0.9 l for archaic Persia.

moreover, that the signs representing worker categories were equated to $^1/_2$ of a basic unit of grain. If these texts followed Babylonian tradition, they most likely recorded the regular monthly rations of dependent workers, so that $^1/_2$ should approximately correspond to a one-month ration for a worker in contemporaneous Mesopotamia. Proto-Elamite grain numerical signs might therefore have represented measures roughly twice as large as those in Mesopotamia.[38]

A substantial number of proto-Elamite accounts attest to a standardized relationship of a given amount of grain recorded in the grain capacity system to a discrete number of objects qualified as YOKE (M54) or PLOW (M56; Figure 8b). For instance, Scheil (1935:no. 117) contains two numerical notations qualifying M56 and the "gur" sign M288 (). The first records 111 $^1/_2$ M56, the second $7N_{14}$ $2N_1$ $3N_{39b}$, that is, $223N_{39b}$ of grain, corresponding to exactly $2N_{39b}$ grain per M56. On the other hand, the large account Scheil (1935:no. 156), contains in its summation the notations M54 $2N_{51}$ $5N_{23}$ $3N_{14}$ N_1, or "2531 M54", followed by M288 $7N_{34}$ $5N_1$ $2N_{39b}$ N_{24}, or 6327 $^1/_2N_{39b}$, resulting in the exact relationship of 2 $^1/_2N_{39b}$ (=$^1/_2N_1$) per M54. P. Damerow and I have interpreted these texts to represent grain distributions for the sowing of fields, whereby M54/YOKE is a sign for seeding workmen or workmen and their plow animals, M56/PLOW a sign for a measure of plowed and sowed field (Englund and Damerow 1989:57-58, n. 159).



Scheil (1935:no. 5224)

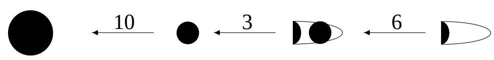


Figure 9: Attestations of the area system

Among the proto-Elamite texts, only Scheil (1935:no. 5224) contains a notation which may have been written in a numerical system used to register *surface measures* (Figure 9). The diagrammed system assumes that the sign representing "10 BÙR" ("BUR'U") in the proto-Elamite corpus replaced the normal sign N_{50} of proto-cuneiform documents,[39] although it must be remembered that its unique occurrence might act as evidence *against* the use of this Babylonian system in Persia, given also the fact that we have reason to believe that the sign M56 discussed above may have served as a measure of arable land, registered in the sexagesimal system.[40] Format and text layout of Scheil (1935:no. 5224), moveover, give the impression of a true proto-cuneiform tablet, so that one might suspect that despite its possibly irregular use of the sign N_{45} this text was imported from Babylonia.

38 The same argument is made to manipulate the absolute volume of the Old Sumerian sìla upward. See Englund 1990:xv-xvi.

39 See Englund and Damerow 1987:142 for a discussion of the same phenomenon in the ED I texts from Ur.

40 If true and if the equivalence of $2N_{39b}$ to 1 unit of M56 represents seed grain, then the land measure would correspond to approximately $^1/_2$ to 1 Babylonian iku, based on a seeding rate of ca 10-20 sìla/liters per iku.

Precursors

Western Persia has been of particular interest to historians of early Mesopotamian history, since as Babylonian hinterland it always enjoyed a very close—oftentimes a desperately close—relationship with the early civilizations of the river plains. Indeed, as a more immediate source of items of trade and plunder, Persia was a natural partner of southern Mesopotamia, more so than ancient Syria to the northwest. For this reason, the Uruk Expansion of the 4th millennium B.C. is best attested in the Persian settlements of Susa, Choga Mish and Godin Tepe. Above all, Susa demonstrates in its archaeological record a development parallel to that of Uruk, so parallel in fact that one might wonder who was influencing whom. In this Late Uruk period of shared culture, the most striking diagnostic features were the common use of seals and the development of writing as an administrative tool.

Figure 10: Examples of simple (left) and complex (right) tokens from Uruk (*digitial images courtesy of CDLI*)

H. Nissen (1983:83-98; 1999:41-50) has emphasized the prehistoric means of administrative communication which in part led to the development of proto-cuneiform, including the use of stamp and then cylinder seals. He makes these claims in part on the basis of material presented in an array of articles and now a monograph by D. Schmandt-Besserat (1992), according to which archaic cuneiform derived from a prehistoric Near Eastern system of administration characterized by the use of small clay markers she terms “tokens” (see Figure 10). The Susiana finds of both simple and complex tokens from the latter half of the 4th millennium represent possible evidence of a borrowing from southern Mesopotamia during the Late Uruk period, a period at the close of which the proto-cuneiform writing system was developed in Uruk. Schmandt-Besserat goes on to cite evidence of the close relationship between Uruk and Susa in the period immediately before the first Uruk IVa tablets characterized above all by the insertion at both of these centers of tokens into clay balls, the outer surface of which was decorated with the impression of a cylinder seal. The next step in this scheme is the impression of those same tokens on the outer surface of the balls, and finally, just before the emergence of pictography, a flat, token-less clay tablet replaced the function of the earlier balls (Figure 11).

Stratigraphically insensitive work at Susa by the mining engineers de Morgan and de Mecquenem—both laboring in a less sophisticated era of archaeological method—heavily disturbed the evidence we might expect from the single largest Persian settlement of the 4th millennium. The scheme devised by Schmandt-Besserat (Figure 12) nevertheless fits well with the stratigraphic sequences outlined by le Breton (1957:79-124) and improved upon by subsequent excavations at Susa and other Late Uruk and proto-Elamite sites in Persia.[41] Thus, the bullae with enclosed tokens derive primarily from level Susa

41 Le Brun 1971:163-216; 1978a:61-79; 1978b:57-154; 1978c:177-192; Steve and Gasche 1971; Dollfus, 1971:17-162; 1975:11-62; Sumner 1974:155-180, 1976:103-114 + pls. I-III; Lamberg-Karlovsky, in Damerow and Englund 1989:v-xiii (the proto-Elamite volume of the Yahya excavations remains unpublished). Glassner 2000:54-66 offers an excellent review of the pertinent excavations.

18, numerical tablets from level 17, and proto-Elamite tablets from 16-14. Architectural seriation by German archaeologists at Uruk has presented us with a confusing chronology from the Babylonian locus of these developments. Neither the context of the bullae W 20987 from Uruk (Damerow and Meinzer 1995:7-33 + plts. 1-4) nor that of the numerical tablets from the area of the so-called Red

Figure 11: Examples of sealed (top), sealed and impressed (middle) bullae, and a numerical tablet (all from Susa; top: Sb 1932, middle: Sb 1940, bottom: Sb 2313; *digitial images courtesy of CDLI*)

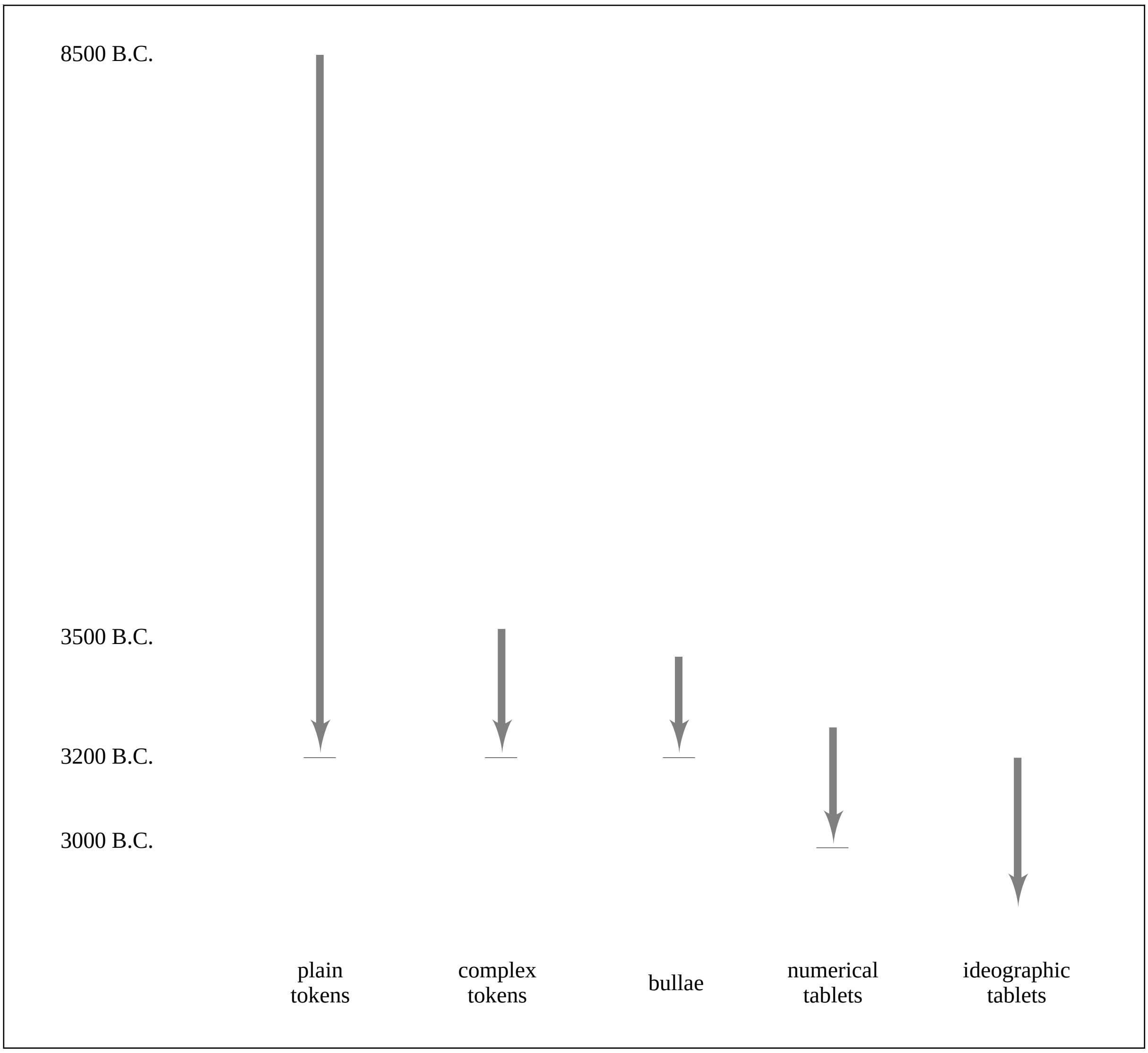


Figure 12: Development of cuneiform, after Schmandt-Besserat (1992)

Temple, was undisturbed in antiquity,[42] so that at the most we can state that the evidence from Uruk does not contradict that from Susa.

Accordingly, Uruk and Late Uruk precursors of writing in Mesopotamia and Persia can be tentatively divided into a *period of early tokens* prior to ca. 3400 B.C., in which simply formed geometric clay counters were used in an ad hoc fashion to record simple deliveries of goods, primarily grain and animal products of local economies. This was followed by a *period of clay envelopes*, ca. 3400-3300 B.C., in which these same geometric clay counters with some further ideographic differentiations were enclosed in clay envelopes, and these envelopes were covered with impressions from cylinder seals. The outer surfaces of some envelopes were impressed with counters in a one-to-one correspondence to the enclosed pieces. The subsequent *period of early numerical tablets*, ca. 3300-3250 B.C., is characterized by flat and rounded clay tablets, sealed and unsealed, that were impressed with counters or with styli cut and shaped to imitate counters, thus representing numerical notations. In the *period of*

42 Englund 1994:12-16. See now D. Sürenhagen 1993:57-70 and 1999, according to whom the earliest phase of the proto-cuneiform system of writing is pushed back to the Uruk V period and thus possibly a century or more earlier than commonly accepted. Recently performed radiocarbon datings in Heidelberg (Lawler 2001a:2419) might result in even greater adjustments in our chronology. These considerations are to be noted to the recent publications of G. Dreyer (J. Baines in this volume and Lawler 2001a:2418-2420) concerning the age of the inscribed Egyptian tags from predynastic Abydos.

late numerical tablets, ca. 3250-3200 B.C., flat and rectangular-shaped, sealed clay tablets were impressed with styli to record numerical notations. Finally, during the last Late Uruk *period of numero-ideographic tablets*, ca. 3200 B.C., flat and rectangular-shaped, sealed clay tablets were impressed with styli to record numerical notations and one or at most two ideograms. All ideograms represented the objects of the transaction, including sheep and goats and products derived from them, above all textiles and dairy oils (Englund 1998:214-215).

The Late Uruk Loan

Interestingly, numerical tablets found in Susa coincide, according to more recent French examination of Susa stratigraphy, with the retreat of the cultural influence exerted by southern Babylonia over Persia and Syria ca. 3200 B.C., that is, at precisely the moment when Uruk succumbed to administrative

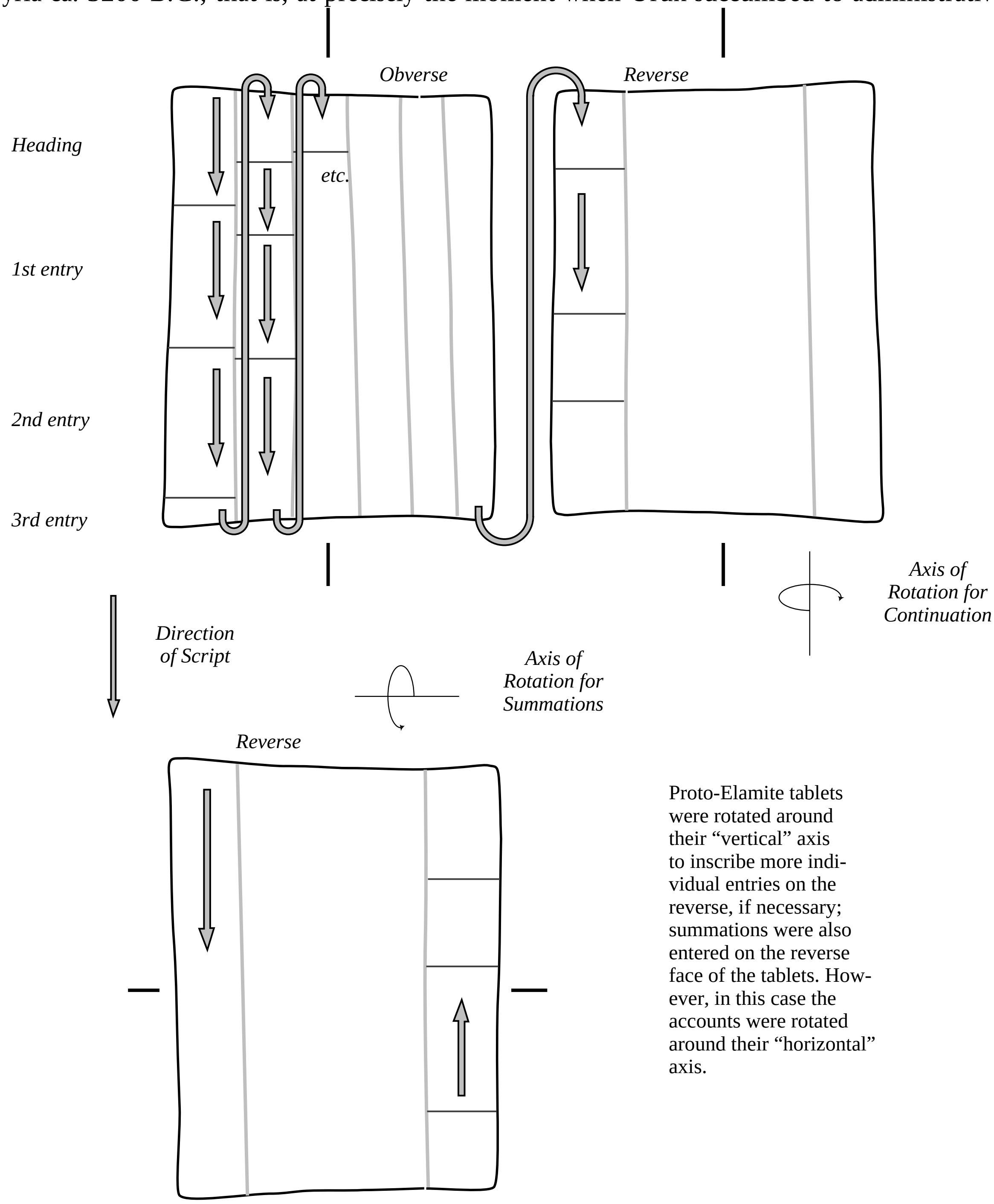


Figure 13: Complex tablet rotation among proto-Elamite tablets (here Scheil 1905:no. 4997)

Ideographic correspondences

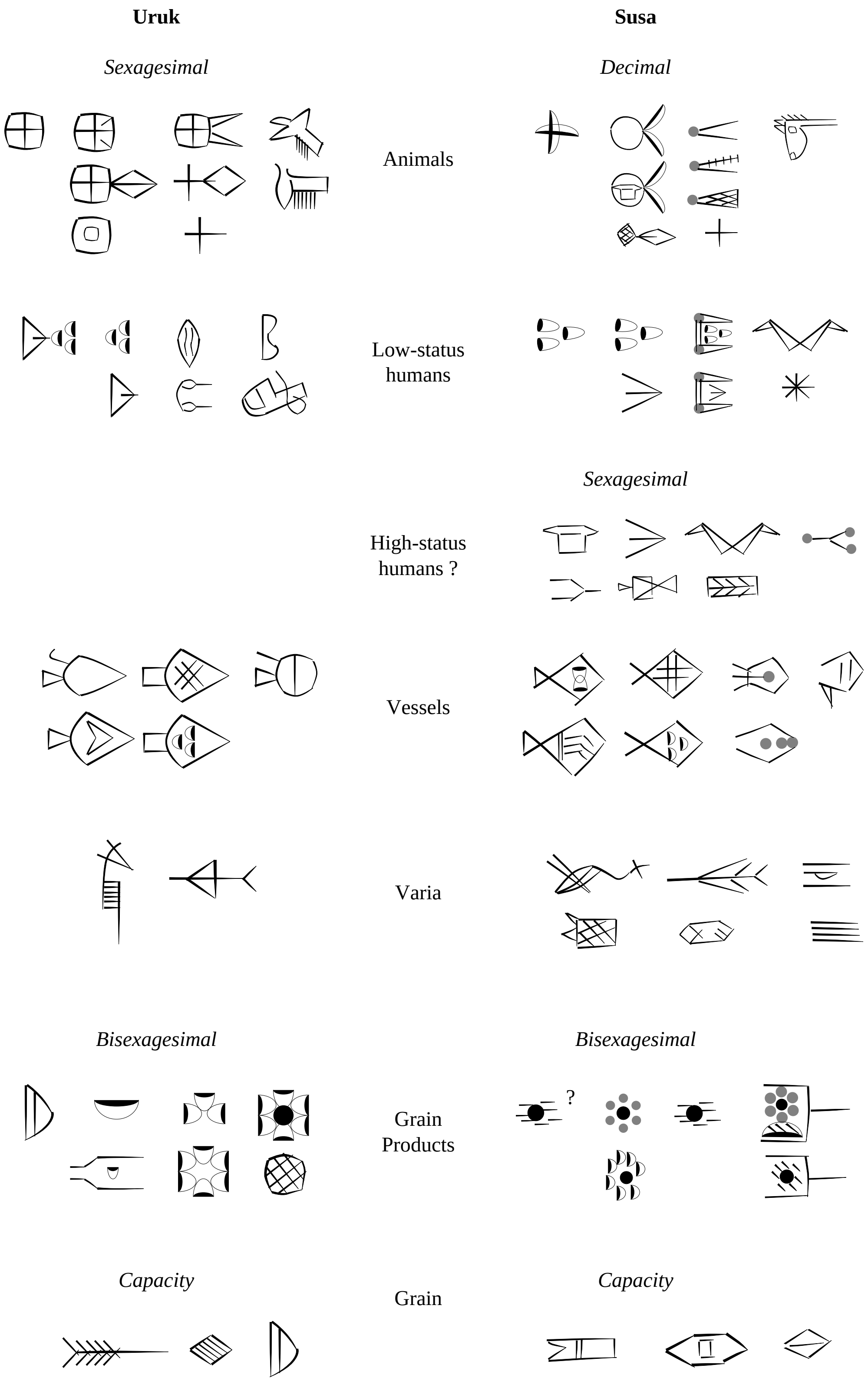


Figure 14: Semantic and graphic correspondences between proto-cuneiform and proto-Elamite ideograms

pressures and began keeping complex written records. Sufficient evidence may be found in the proto-Elamite texts to support this moment in time, corresponding to the architectural level IVa at Uruk, as the period of final direct contact between Uruk and Susa. In the first place, there is general evidence that the proto-Elamite accounting system was strongly influenced by proto-cuneiform, including, in a sequence of increasing importance, the use of

- the same material for writing (clay and evidently a reed or wood stylus[43]);
- the same tablet format (usually ca. 3:2) relative to the direction of writing;
- seals on the surfaces of bullae and the earliest texts (numerical tablets), whereas seals were not used later, when presumably ideograms replaced them in function;
- comparable accounting formats, according to which summations of numerical data on accounts were, as a rule, recorded on the reverse face of the tablets;

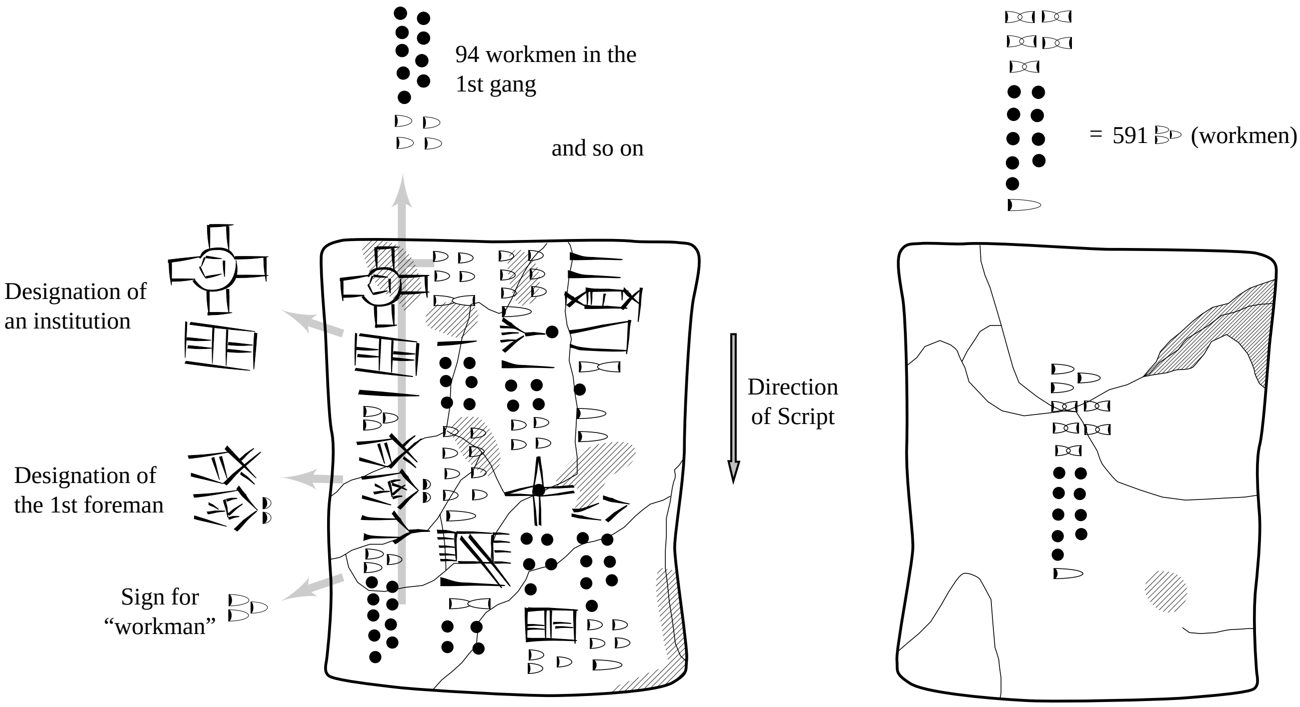


Figure 15: Scheil (1923:no. 45), an account of 7 labor gangs, together 591 workmen

- the same rotation of tablets (simple and complex, Figure 13). When more space for separate entries was required than available on the obverse of a tablet, the scribe continued these entries on the reverse, flipping the tablet over on its vertical axis. Totals were then inscribed by returning to the obverse face of the tablet and flipping it on its horizontal axis, as was normal practice in texts which had only such totals on their reverse faces[44];
- the same numerical signs and sign systems, but including the derivative use of bisexagesimal signs for the 1000 and 10,000 steps of the decimal system found only in Elam (the sign for "100," ⋈, itself follows the productive method of placing two signs in opposition to form the

43 This judgment is based on the form of the signs as found on photos available to me. Through inspection of the originals it should be possible to determine the material of the stylus by examining the butt end, and often simply the lateral surface of the individual impressions. Such wedges on proto-cuneiform tablets often exhibit the grain of the original stylus and thus indicate the use of wood or reed (we can assume that some professionals carried styli made of ivory or precious metal; note the description in Gudea Cylinder A iv 25 // v 22 of the silver stylus used by the goddess of writing, Nisaba: gi dub-ba kù NE-a šu im-mi-du$_8$// gi dub-ba kù NE šu bí-du$_8$-a).

44 This method of record-keeping is a good indication that, like Babylonian texts, the proto-Elamite accounts were stored with this information immediately visible, in baskets or shelves akin to modern filing cabinets.

next bundling step in the system); and of

- the same sign repertoires for humans and animals, including collective designations (Figure 14). For instance, the proto-Elamite tablet Scheil (1923:no. 45), contains an account of various groups of persons qualified with the sign M388 ( ), all together 591, as noted on the reverse of the text (Figure 15). We have found very similar representations of persons designated KUR_a ( ) in the often discussed “slave labor” accounts of Uruk and Jemdet Nasr. Moreover, further qualifications of related signs (Figure 14), for instance the fact that the proto-Elamite sign closely resembling the proto-cuneiform sign TUR is itself qualified with signs which seem clearly to represent male and female slaves, would seem to indicate a borrowing of these signs and sign combinations from Mesopotamia.

Susa stratigraphy and a relative chronology between Babylonia and the Susiana have helped generally date the inception of the proto-Elamite system of writing to the Jemdet Nasr/Uruk III phase of Mesopotamia. It was noted above that the linearity and the apparently developed separation of semantics and syntax of proto-Elamite writing are evidence of a more advanced system than that of proto-cuneiform, in which much of the syntactical burden of the texts was carried by a complex format consisting of cases and sub-cases. This historical argument further supports a relative sequence of Uruk IV texts from Babylonia followed by Uruk III texts in the same region and, contemporaneously, proto-Elamite texts from Persia. However, if we attempt to more precisely define the period of borrowing, then several features of proto-Elamite script are suggestive of contact between Susa and Uruk during the Uruk IVa period. These include:

- use of N_{39b} ( ) in grain capacity notations, as was the rule in proto-cuneiform texts from the earliest writing phase, following which (in the Uruk III/Jemdet Nasr period) Babylonian scribes used exclusively the inverted sign form N_{39a} [45];

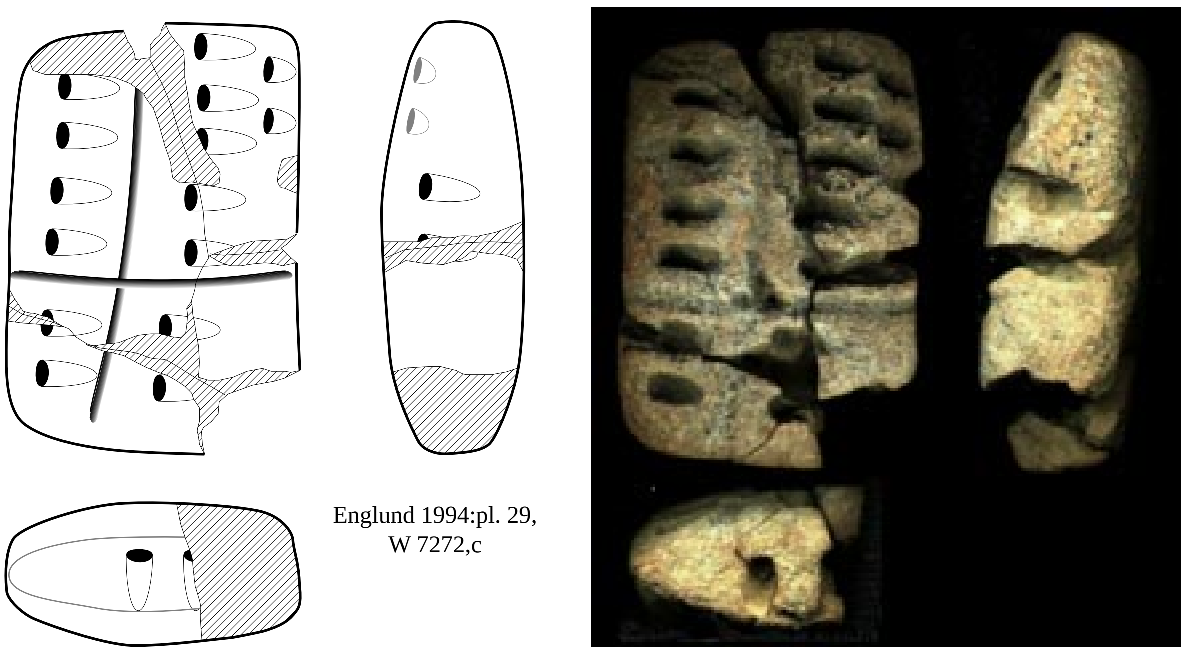
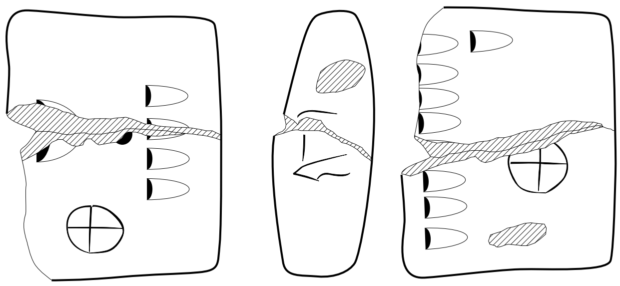


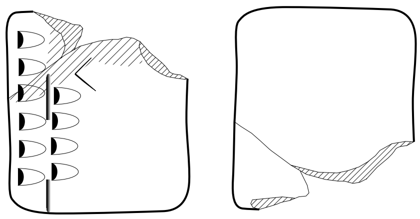
Figure 16: Stylus shank case dividers on a numerical tablet from Uruk
(*digitial image of original courtesy of CDLI*)

45 Note also the signs N_8 and N_8*inversum* ( ) representing $^1/_2$ of a discrete unit in the sexagesimal system; this sign is not found in proto-cuneiform documents.

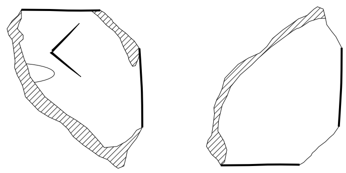
- use of the same dividing lines formed with the shank of a stylus. This is a feature known only, but generally, in the numerical tablets from both Uruk (IVa) and Susa (17, Figure 16);



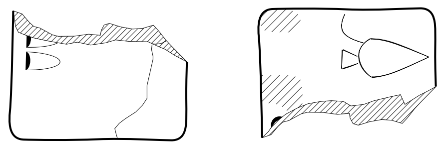
Englund 1994:pl. 17, W 6881,b



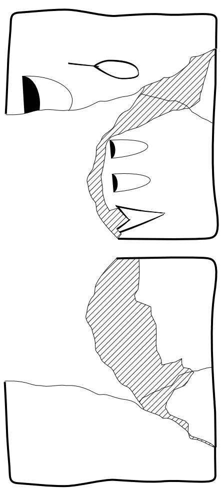
Englund 1994:pl. 20, W 6883,b



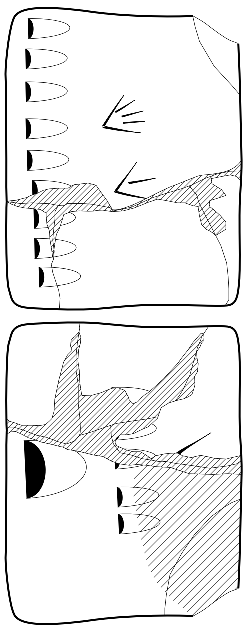
Englund 1994:pl. 21, W 6883,h



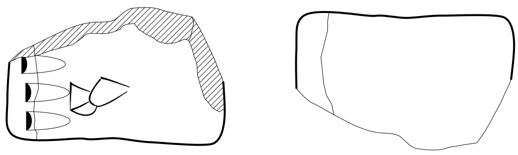
Englund 1998:pl. 24, W 7067,b



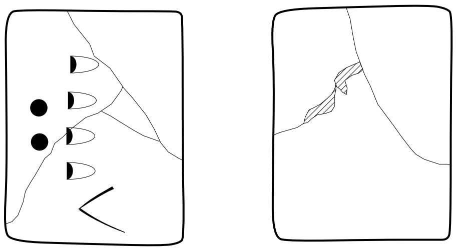
Englund 1994:pl. 27, W 6881,c+f



Englund 1994:pl. 18, W 6881,o2+ab



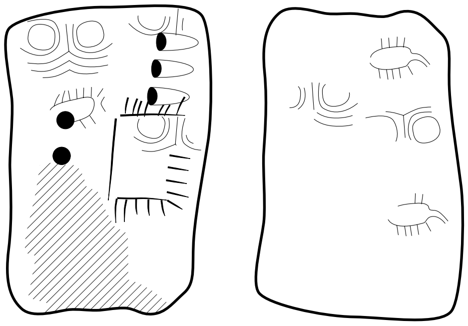
Englund 1994:pl. 17, W 6881,d



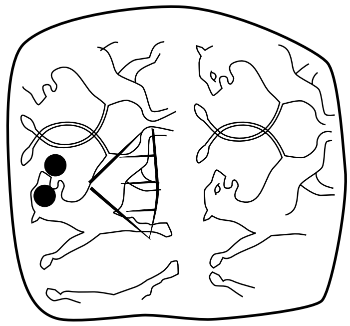
Englund 1996a:pl. 40, no. 78

Figure 17: Uruk "numero-ideographic" texts

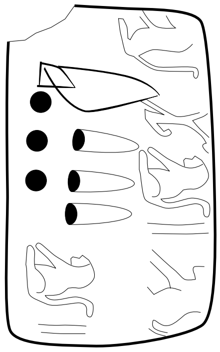
- the same high occurrence of apparent sign variants as an indication of inchoate standardization (this may in fact be a means for the internal dating of the proto-Elamite tablets in a relative sequence, since we should expect to find more and more agreement on particular graphs, as is the case in Uruk)
- the same earliest ideograms. The most telling evidence of continuing contact between Uruk and Susa into the earliest phase of writing is found in a comparison of a number of tablets from both cities which combine the elements of numerical tablets (numerical notations, seal



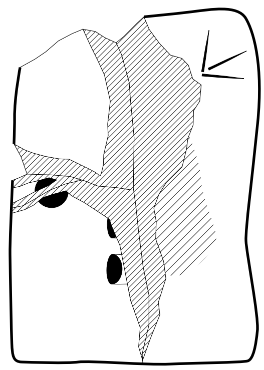
Scheil (1923:no. 106)



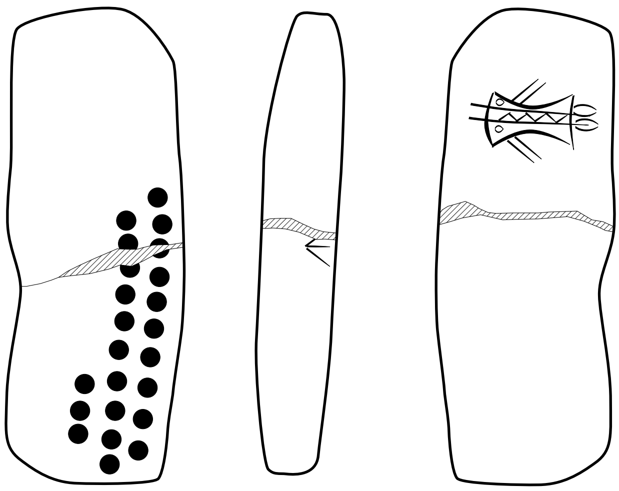
Amiet (1972:no. 474)



Godin V no. 2



Amiet (1972:no. 604)



Ghirshman (1938:no. 1631)(?)

Figure 18: Persian "numero-ideographic" texts

impressions, stylus shank dividers) with one, and at most two, apparent ideograms. I count about a dozen of these texts from unclear Uruk find spots—the stratigraphy of tablets from that settlement is impossible to reconstruct—including both purely numerical and ideographic tablets of phase IVa (Figure 17), and several from Susa, Godin and possibly Sialk in Persia (Figure 18). A simple comparison (Figure 19) of the signs found in this context would seem to show that at least in the case of this first block at the top the same sign is found in both centers.[46] Note that the topmost signs would correspond nicely with a type of “complex” token that is found in nearly all token deposits.

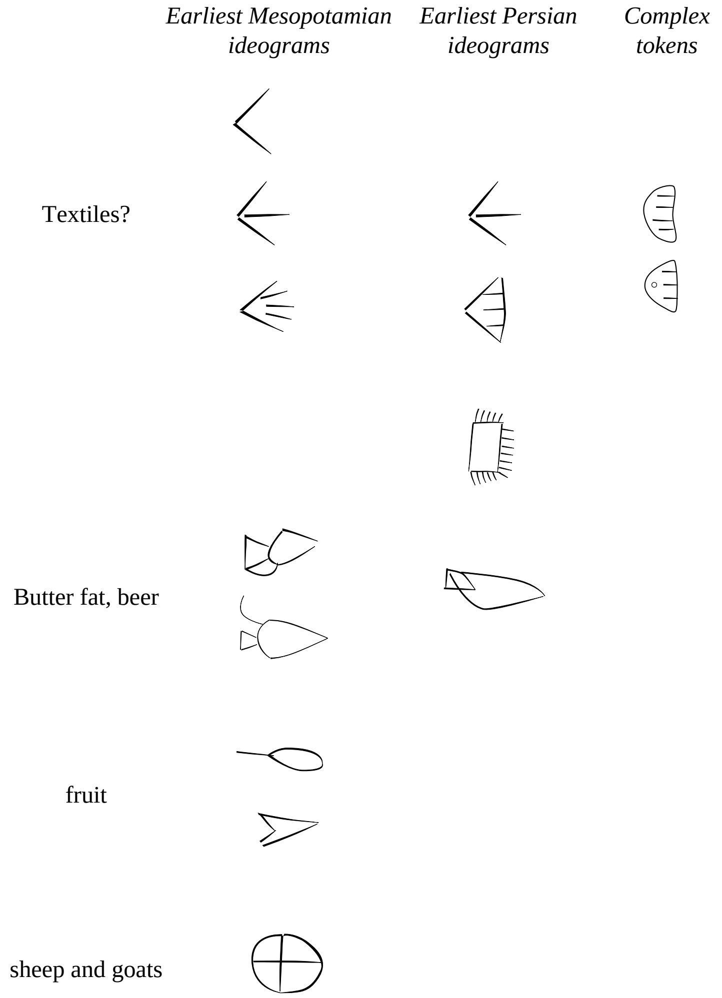


Figure 19: A comparison of “numero-ideograms” in Mesopotamia and Persia

Conclusion

The prospects of discovering script characteristics that could lead to a decipherment of proto-Elamite are not great, but there are some areas of promise. In the first place, the proto-Elamite texts do contain sign sequences which are distinctly longer than the average of those from Mesopotamia. The texts are therefore more likely to consist of syntactical information than the very cursory notations in proto-cuneiform documents. But there is a more important, second point. Statistical analysis of text transliterations should point toward meaningful sign combinations of a fixed sign sequence which could reflect speech (Figure 20). Further, the “proto-Elamites” are not entirely foreign to us. We can assume that they were a people who used a decimal system to count discrete objects, and some of their number words, in particular the words for “hundred” and “thousand,” may have been used syllabically. In proto-Elamite accounts, the numerical notations *follow* counted objects and their qualifications. This deviation stands in contrast to Mesopotamian tradition (we have of late seen only one other example of

46 The sign from Godin Tepe has been discussed by Michel, McGovern, and Badler 1993:408A-413A and Badler 2000:48-56, who proposed an identification with the cuneiform sign representing a jar of beer; archaic pictography, however, would support a jar of butter oil.

such a convention, namely in the 24th century accounts from Syrian Tell Beydar[47]), and more importantly in contrast to the first ideographic tradition in Persia itself, that is, in the numero-ideographic tablets from Susa and Godin Tepe presumably imposed on the local population by Babylonian accountants. We might therefore speculate that our so-called “proto-Elamite” derived from a language whose numerical qualifications were post-positional.

A first step in the reevaluation of the proto-Elamite text corpus is necessarily the electronic transliteration of all texts. CDLI staff have completed this task, and are now beginning a new graphotactical examination of the texts. The following list demonstrates the use to which these data might be put. The proto-Elamite sign M371 (two round impressions connected by a single stroke) appears in the accounts in initial, intermediate, and final position, in altogether over 300 attestations.[48] As seems evident from attestations of the sign in initial and final position, it represents a discrete object counted in the sexagesimal or decimal system. A quick check of the sources confirms that the system is in fact sexagesimal. Scheil (1905:no. 391), for instance, contains clear sexagesimal notations ($1N_{34}$, $2N_{34}$) of objects including M371. Scheil (1923:no. 94) and other accounts imply that M371 is related to the proto-Elamite sign for male laborers (M388), possibly, since M371 is not reckoned in the decimal system, in a supervisory capacity.

1) *M371 in initial and final position:*

Scheil (1935:no. 107)	O0101	INIT&FINAL M371
Scheil (1923:no. 139)	O0102	INIT&FINAL M371 [ ]
Scheil (1923:no. 162)	O0102	INIT&FINAL M371 $1N_1$
Mecquenem (1949:no. 029)	O0103	INIT&FINAL M371 $2N_1$
Scheil (1923:no. 299)	O0104	INIT&FINAL M371 $1N_1$
Scheil (1935:no. 5207)	O0104	INIT&FINAL M371 $1N_{39b}$
Scheil (1935:no. 5196)	O0104	INIT&FINAL M371 $3N_1$
Scheil (1935:no. 020)	O0105	INIT&FINAL M371 $1N_{14}$
Scheil (1935:no. 264)	O0106	INIT&FINAL M371 $1N_{14}$ $2N_1$
Scheil (1923:no. 248)	O0108	INIT&FINAL M371 $2N_1$
Scheil (1935:no. 052)	O0109	INIT&FINAL M371 $1N_1$
Scheil (1923:no. 437)	O0110	INIT&FINAL M371 [ ]
Scheil (1935:no. 329)	O0110	INIT&FINAL M371 $1N_1$
Scheil (1905:no. 215)	O0111	INIT&FINAL M371 $1N_1$
Scheil (1935:no. 002)	O0114	INIT&FINAL M371 $1N_{14}$
Scheil (1935:no. 0335)	O0118	INIT&FINAL M371 $2N_1$ $2N_{39b}$
Scheil (1935:no. 342)	O0123	INIT&FINAL M371 $6N_1$
Scheil (1923:no. 292)	O0217	INIT&FINAL M371 [ ]
Scheil (1905:no. 391)	R0102	INIT&FINAL M371 $1N_{34}$
Scheil (1935:no. 342)	R0104	INIT&FINAL M371 $1N_{14}$ $8N_1$

2) *M371 in initial position, sorted according to following signs:*

Scheil (1935:no. 218)	O0109	INIT M371 $M3_b$ $2N_1$
Scheil (1905:no. 343)	O0112	INIT M371 M9 INTERM371 $M3_c$ $2N_1$
Scheil (1923:no. 121)	R0101	INIT M371 M9 FINALM371 $2N_{39b}$
Scheil (1935:no. 5019)	O0103	INIT M371 M9 FINALM371 $1N_1$
Scheil (1905:no. 344)	O0105	INIT M371 M32 M96 M329? [ ]
Scheil (1935:no. 5206)	O0105	INIT M371 $M36_o$ $1N_{14\#}$
Scheil (1935:no. 256)	O0102	INIT M371 M54 $1N_{14}$ $7N_1$
Scheil (1923:no. 474)	O0103	INIT M371 M139 $M296_c$ [ ]
Scheil (1905:no. 213)	O0109	INIT M371 $M207_a^?$ M376 $4N_{14}$ $7N_1$
Scheil (1935:no. 311)	O0109	INIT M371 M218 $1N_1$

47 See Ismail 1996, Lebeau and Suleiman 1997.

48 The list in Figure 20 has been cleansed of uninformative attestations with breaks and otherwise disturbed lines. The fullness of the remaining entries will hopefully be excused in the interest of a complete representation of the context of one proto-Elamite sign. Dam and Eng = Damerow and Englund; O0101= “obverse face, column 1, line 1” (generally counting just one column on tablet surfaces, see above, *Description*); INIT = initial position, INTERM = intermediate position, FINAL = final position; X = unidentifiable sign.

Scheil (1923:no. 450)	O0105	INIT M371 M218 M220 M132$_b$ M263 2N$_1$
Scheil (1905:no. 380)	O0105	INIT M371 M263 [ ]
Scheil (1935:no. 468)	O0103	INIT M371 M263 2N$_1$
Scheil (1905:no. 293)	O0111	INIT M371 M263 M96 X M243 X [ ]
Scheil (1905:no. 292)	O0109	INIT M371 M295$_k$ M66$^?$ M376 1N$_{8a}$
Scheil (1905:no. 389)	O0103	INIT M371 M298$^?$ 4N$_{14}$ 4N$_{39b}$
Mecquenem (1949:no. 014)	O0102	INIT M371 M325 M376 4N$_{14}$
Scheil (1905:no. 243)	O0106	INIT M371 M332$_d^?$ M218 1N$_1$
Scheil (1905:no. 204)	O0106	INIT M371 M346 2N$_1$
Scheil (1923:no. 292)	O0242	INIT M371 M370$_c$ 1N$_1$
Scheil (1923:no. 292)	O0241	INIT M371 INTERM371 M124$_c^?$ 1N$_1$
Scheil (1923:no. 345)	O0102	INIT M371 M376 5N$_1$
Scheil (1935:no. 284)	O0109	INIT M371 M387 [ ]
Scheil (1935:no. 5037)	O0102	INIT M371 M387 M9 M264$_b$ 3N$_1$
Scheil (1935:no. 5207)	R0102	INIT M371 X M118 M9
Scheil (1935:no. 5055)	O0111	INIT M371 X M131 M263 X 1N$_1$
Scheil (1905:no. 319)	O0110	INIT M371 X M218 1N$_1$
Scheil (1905:no. 5002)	O0109	INIT M371 X M218 1N$_{39b}$
Scheil (1905:no. 300)	R0101	INIT M371 X X M218 X 1N$_1$

3) *M371 in intermediate position, sorted according to preceding signs:*

Scheil (1923:no. 112)	R0116	M387 M372$_a$ M388 M296$_c$ M1 INTERM371 M317 1N$_1$
Scheil (1905:no. 290)	O0110	X M1 INTERM371 M1 1N$_1$ [ ]
Scheil (1923:no. 112)	R0114	M51 M388 M302$_e$ M3$_b$ INTERM371 M317 1N$_1$
Scheil (1923:no. 112)	O0113	M112$_o$ M388 M24$_c$ M3$_b$ INTERM371 M317 1N$_1$
Scheil (1905:no. 316)	R0107	M9 INTERM371 M54 [ ]
Scheil (1935:no. 330)	O0109	M9 INTERM371 M218 3N$_{14}$ 4N$_1$
Scheil (1905:no. 213)	O0104	M149$_a$ M246$_g$ M9 INTERM371 M376 4N$_{14}$ 5N$_1$ 1N$_?$
Scheil (1905:no. 267)	R0105	M318$^?$ M9 INTERM371 M288 4N$_1$ 4N$_{39b}$
Scheil (1935:no. 401)	R0103	M364 M9 INTERM371 M288 1N$_1$
Scheil (1905:no. 240)	O0102	M377 M124$_a$ M48$_d$ M9 INTERM371 M301$^?$ X INTERM371 M348 1N$_{39b}$
Scheil (1923:no. 468)	O0106	X M9 INTERM371 M288 1N$_{14}$
Scheil (1905:no. 311)	O0108	X M24 INTERM371 M376 M370 X [ ]
Scheil (1935:no. 472)	O0109	M32 INTERM371 M317 1N$_1$
Scheil (1905:no. 4999)	O0103	M263$_a$ M33 INTERM371 M288 6N$_{14}$ 1N$_1$
Scheil (1923:no. 023)	O0103	X M33 INTERM371 M288 3N$_1$
Scheil (1905:no. 369)	O0102	M181 M38$_a$ INTERM371 M269$_d$ 1N$_1$
Scheil (1905:no. 369)	O0106	M38$_l$ INTERM371 M264$_a$ 1N$_1$
Scheil (1935:no. 400)	O0102	M54 INTERM371 M243$_g$ 1N$_1$
Dam and Eng (1989:no. 11)	O0116	M388 M72 INTERM371 M346 6N$_1$
Scheil (1923:no. 059)	O0102	M237 M263 M73$_q$ INTERM371 M288 2N$_{14}$ 1N$_1$
Scheil (1935:no. 218)	O0102	M75$_h$ INTERM371 M3$_c$ 1N$_1$
Scheil (1905:no. 258)	O0102 [	] M388 M57$_c$ M96 INTERM371 M288 4N$_1$ [ ]
Scheil (1923:no. 414)	O0106	M240$_i$ M132$_a$ M99 INTERM371 M288$_k$ 1N$_1$
Scheil (1905:no. 240)	O0103	M110 INTERM371 M346 M24 M434 M68$^?$ M266 M241 1N$_{39b}$
Scheil (1923:no. 292)	O0170	M388 M218 M110 INTERM371 M3$_b$ 1N$_1$
Scheil (1923:no. 292)	O0221	M388 M387 M263$_a$ M110 INTERM371 M352 M3$_b$ 1N$_1$
Scheil (1905:no. 267)	O0102	M124$_a$ INTERM371 M9 M288 2N$_1$ 4N$_{39b}$
Scheil (1923:no. 157)	O0107	M124$_a$ INTERM371 M9 INTERM371 M288
Scheil (1935:no. 017)	O0102	M128$_d$ INTERM371 X M290$_c$ 1N$_{14}$
Scheil (1905:no. 4997)	R0106	X M388 M139 INTERM371 M291 M388 M373 1N$_{14}$ 1N$_1$
Scheil (1935:no. 4766)	O0106	M106 M323 M388 M145$_a$ INTERM371 M36 4N$_1$
Scheil (1923:no. 217)	O0102	M145$_a$ INTERM371 M297 1N$_{39b}$
Scheil (1935:no. 033)	O0102	M196 M147$_e$ M145$_a$ INTERM371 M56 M288 3N$_1$
Scheil (1935:no. 0295)	O0104	M388 M145$_a$ INTERM371 M154
Scheil (1905:no. 351)	O0102	M388 M146 INTERM371 M297 2N$_{14}$
Scheil (1905:no. 319)	R0112	M139 M388 M146$_b$ INTERM371 M263 M218 M346 1N$_{14}$ 4N$_1$
Scheil (1905:no. 241)	O0102	M325$_d$ M388 M146$_b$ INTERM371 M29$^?$ [ ]
Dam and Eng (1989:no. 11)	O0111	M388 M206$_b$ INTERM371 M346 7N$_1$
Scheil (1935:no. 400)	O0109	M132 M48 M219 M218 INTERM371 M377$_e$ M390 FINAL M371 1N$_1$
Scheil (1905:no. 292)	O0110	M311$_b$ M388 M218 INTERM371 M218 [ ] [ ]
Scheil (1923:no. 292)	O0204	M388 M219 INTERM371 M3$_b$ 1N$_1$
Scheil (1935:no. 129)	O0102	M305 M388 M222 INTERM371 M387 M20 M263$_a$ 8N$_1$
Scheil (1935:no. 271)	O0102	M305 M388 M226$_c$ INTERM371 M264$_h$ 1N$_1$
Scheil (1923:no. 153)	O0109	M124$_a$ M372 M229$_h$ INTERM371 M132$_a$ X M218 M288$_f$ [ ]
Scheil (1923:no. 112)	O0109	M387$_l$ M372$_a$ M388 X M229$_m$ INTERM371 M317 1N$_1$

Scheil (1923:no. 112)	R0102	M51 M388 M218 M229N INTERM371 M317 1N$_1$
Scheil (1923:no. 185)	O0112	M233 INTERM371 M288 1N$_1$
Scheil (1905:no. 391)	O0102	M157 M374 M9 M388 X M233$_b$ INTERM371 M149$_a$ 8N$_1$
Scheil (1905:no. 212)	O0103	M342$^?$ M388 M4 M235$_a$ INTERM371 M346 2N$_{14}$ 2N$_1$
Scheil (1935:no. 218)	O0113	M4 M240 INTERM371 M54 8N$_1$
Scheil (1923:no. 292)	O0167	X M240$^?$ INTERM371 M3$_b$ M388 [ ]
Scheil (1935:no. 340)	O0106	M377 M254$_c$ INTERM371 M297 1N$_{30c}$
Scheil (1905:no. 309)	O0103	[ ] M351 M255 INTERM371 M288 [ ]
Scheil (1905:no. 205)	O0104	M218$_a$ M259$_c$ INTERM371 M223 X 1N$_1$
Scheil (1905:no. 353)	O0102	M305 M388 M218 M259$_m$ INTERM371 M33 M66$^?$ M346 3N$_1$
Mecquenem (1949:no. 024)	O0103	M291 INTERM371 M320 1N$_1$
Scheil (1935:no. 4758)	O0102	M175 M181 M124$_c$ X M297 INTERM371 M297 M377 X X M124 M226$_f$ M101 X X 1N$_1$
Mecquenem (1949:no. 030)	O0102	X M376 M388 M364 M317$_c$ INTERM371 M288 2N$_1$
Scheil (1905:no. 205)	O0103	M102$_d$ M318$_a$ INTERM371 M297 M150$_d$ 1N$_1$
Scheil (1905:no. 222)	O0102a	M365 M388 M57 M318$_a$ INTERM371 M388 4N$_1$ [ ]
Scheil (1923:no. 345)	O0101	M9 M318$_b$ INTERM371 M321$_a$ [ ]
Scheil (1923:no. 317)	O0102	M388 M9 M318$_b$ INTERM371 M36$_b$ [ ]
Scheil (1923:no. 148)	O0102	M388 M218 M364$^?$ M320$_h$ INTERM371 M288$_i$ 4N$_{14}$ 2N$_1$
Scheil (1905:no. 4994)	O0107	M111 M388 M387N M318$_a$ X M377$_e$ M347 INTERM371 M36$_e$ 5N$_1$
Scheil (1923:no. 043)	O0108	M240 M347 INTERM371 M217$_c$ 1N$_1$
Scheil (1923:no. 490)	R0106	M387$_a$ M377$_e$ M347 INTERM371 M288 1N$_1$
Scheil (1935:no. 353)	O0108	M218 M266 M373 INTERM371 M101 M266 M283$_e$ X M266 3N$_1$
Scheil (1905:no. 258)	O0105	M380 INTERM371 M38$_i$$^?$ M295$_s$$^?$ M218$_a$ 4N$_1$
Scheil (1923:no. 159)	O0103	M195 M388 INTERM371 M387 X [ ]
Scheil (1905:no. 4997)	O0107	M388 INTERM371 M117 M68$_d$$^?$ 1N$_{14}$ 1N$_1$
Mecquenem (1949:no. 031)	O0102	M388 INTERM371 M263 M314$_f$ X X M301 M372 X [ ]
Scheil (1905:no. 4996)	O0103	M263 X X M390 INTERM371 M288 1N$_{14}$
Mecquenem (1949:no. 037)	O0109	M377$_e$ M390 INTERM371 M388 M377$_e$ X X [ ]
Scheil (1935:no. 5218)	O0102	M388 M146$_b$ M377$_e$ M390 INTERM371 M54 1N$_1$
Mecquenem (1949:no. 004)	R0107	X M388 M263 M390 INTERM371 M288 2N$_1$

4) *M371 in intermediate position, sorted according to following signs:*

Scheil (1905:no. 290)	O0110	X M1 INTERM371 M1 1N$_1$ [ ]
Scheil (1923:no. 292)	O0170	M388 M218 M110 INTERM371 M3$_b$ 1N$_1$
Scheil (1923:no. 292)	O0204	M388 M219 INTERM371 M3$_b$ 1N$_1$
Scheil (1935:no. 0298)	O0102	X M377 M263 X INTERM371 M3$_b$ [ ]
Scheil (1923:no. 292)	O0167	X M240$^?$ INTERM371 M3$_b$ M388 [ ]
Scheil (1935:no. 218)	O0102	M75$_h$ INTERM371 M3$_c$ 1N$_1$
Scheil (1923:no. 098)	O0111	M96 X INTERM371 M9 1N$_{30c}$
Scheil (1923:no. 157)	O0107	M124$_a$ INTERM371 M9 INTERM371 M288
Scheil (1905:no. 267)	O0102	M124$_a$ INTERM371 M9 M288 2N$_1$ 4N$_{39b}$
Scheil (1905:no. 353)	O0102	M305 M388 M218 M259$_m$ INTERM371 M33 M66$^?$ M346 3N$_1$
Scheil (1935:no. 4766)	O0106	M106 M323 M388 M145$_a$ INTERM371 M36 4N$_1$
Scheil (1923:no. 317)	O0102	M388 M9 M318$_b$ INTERM371 M36 [ ]
Scheil (1905:no. 4994)	O0107	M111 M388 M387N M318$_a$ X M377$_e$ M347 INTERM371 M36$_e$ 5N$_1$
Scheil (1905:no. 246)	O0119	[ ] X INTERM371 M54 1N$_1$
Scheil (1905:no. 316)	R0107	M9 INTERM371 M54 [ ]
Scheil (1935:no. 218)	O0113	M4 M240 INTERM371 M54 8N$_1$
Scheil (1935:no. 5218)	O0102	M388 M146$_b$ M377$_e$ M390 INTERM371 M54 1N$_1$
Scheil (1935:no. 033)	O0102	M196 M147$_e$ M145$_a$ INTERM371 M56 M288 3N$_1$
Scheil (1935:no. 353)	O0108	M218 M266 M373 INTERM371 M101 M266 M283$_e$ X M266 3N$_1$
Scheil (1923:no. 357)	O0105	X INTERM371 M112$_f$ M36$_o$ 4N$_1$
Scheil (1905:no. 4997)	O0107	M388 INTERM371 M117 M68$_d$$^?$ 1N$_{14}$ 1N$_1$
Scheil (1923:no. 153)	O0109	M124$_a$ M372 M229$_h$ INTERM371 M132$_a$ X M218 M288$_f$ [ ]
Scheil (1905:no. 306)	O0103	[ ] INTERM371 M141M54 X 1N$_{39b}$
Scheil (1905:no. 391)	O0102	M157 M374 M9 M388 X M233$_b$ INTERM371 M149$_a$ 8N$_1$
Scheil (1935:no. 0295)	O0104	M388 M145$_a$ INTERM371 M154
Scheil (1935:no. 5043)	O0103	M388 X INTERM371 M154$_r$ [ ]
Scheil (1923:no. 043)	O0108	M240 M347 INTERM371 M217$_c$ 1N$_1$
Scheil (1905:no. 293)	O0112	X INTERM371 M218 1N$_{14}$
Scheil (1935:no. 330)	O0109	M9 INTERM371 M218 3N$_{14}$ 4N$_1$
Scheil (1905:no. 292)	O0110	M311$_b$ M388 M218 INTERM371 M218 [ ] [ ]
Scheil (1923:no. 292)	O0109	X INTERM371 M218 M376$_a$$^?$ 1N$_1$
Scheil (1905:no. 205)	O0104	M218$_a$ M259$_c$ INTERM371 M223 X 1N$_1$
Scheil (1923:no. 073)	O0120	M218 M259$^?$ INTERM371 M223$_c$ M218 2N$_1$

Scheil (1935:no. 400)	O0102	M54 INTERM371 M243$_g$ 1N$_1$
Scheil (1905:no. 319)	R0112	M139 M388 M146$_b$ INTERM371 M263 M218 M346 1N$_{14}$ 4N$_1$
Mecquenem (1949:no. 031)	O0102	M388 INTERM371 M263 M314$_f$ X X M301 M372 X [ ]
Scheil (1905:no. 369)	O0106	M38$_l$ INTERM371 M264$_a$ 1N$_1$
Scheil (1935:no. 271)	O0102	M305 M388 M226$_c$ INTERM371 M264$_h$ 1N$_1$
Scheil (1905:no. 369)	O0102	M181 M38$_a$ INTERM371 M269$_d$ 1N$_1$
Scheil (1905:no. 258)	O0102	[ ] M388 M57$_c$ M96 INTERM371 M288 4N$_1$ [ ]
Scheil (1905:no. 267)	R0105	M318$^?$ M9 INTERM371 M288 4N$_1$ 4N$_{39b}$
Scheil (1905:no. 309)	O0103	[ ] M351 M255 INTERM371 M288 [ ]
Scheil (1905:no. 4996)	O0103	M263 X X M390 INTERM371 M288 1N$_{14}$
Scheil (1905:no. 4999)	O0103	M263$_a$ M33 INTERM371 M288 6N$_{14}$ 1N$_1$
Scheil (1923:no. 023)	O0103	X M33 INTERM371 M288 3N$_1$
Scheil (1923:no. 059)	O0102	M237 M263 M73$_q$ INTERM371 M288 2N$_{14}$ 1N$_1$
Scheil (1923:no. 185)	O0112	M233 INTERM371 M288 1N$_1$
Scheil (1923:no. 468)	O0106	X M9 INTERM371 M288 1N$_{14}$
Scheil (1923:no. 490)	R0106	M387$_a$ M377$_e$ M347 INTERM371 M288 1N$_1$
Scheil (1935:no. 401)	R0103	M364 M9 INTERM371 M288 1N$_1$
Mecquenem (1949:no. 004)	R0107	X M388 M263 M390 INTERM371 M288 2N$_1$
Mecquenem (1949:no. 030)	O0102	X M376 M388 M364 M317$_c$ INTERM371 M288 2N$_1$
Scheil (1923:no. 148)	O0102	M388 M218 M364$^?$ M320$_h$ INTERM371 M288$_i$ 4N$_{14}$ 2N$_1$
Scheil (1923:no. 414)	O0106	M240$_i$ M132$_a$ M99 INTERM371 M288$_k$ 1N$_1$
Scheil (1905:no. 4997)	R0106	X M388 M139 INTERM371 M291 M388 M373 1N$_{14}$ 1N$_1$
Scheil (1905:no. 351)	O0102	M388 M146 INTERM371 M297 2N$_{14}$
Scheil (1923:no. 217)	O0102	M145$_a$ INTERM371 M297 1N$_{39b}$
Scheil (1935:no. 340)	O0106	M377 M254$_c$ INTERM371 M297 1N$_{30c}$
Scheil (1905:no. 205)	O0103	M102$_d$ M318$_a$ INTERM371 M297 M150$_d$ 1N$_1$
Scheil (1935:no. 4758)	O0102	M175 M181 M124$_c$ X M297 INTERM371 M297 M377 X X M124 M226$_f$ M101 X X 1N$_1$
Scheil (1923:no. 112)	O0109	M387$_l$ M372$_a$ M388 X M229$_m$ INTERM371 M317 1N$_1$
Scheil (1923:no. 112)	O0113	M112$_o$ M388 M24$_c$ M3$_b$ INTERM371 M317 1N$_1$
Scheil (1923:no. 112)	R0102	M51 M388 M218 M229N INTERM371 M317 1N$_1$
Scheil (1923:no. 112)	R0114	M51 M388 M302$_e$ M3$_b$ INTERM371 M317 1N$_1$
Scheil (1923:no. 112)	R0116	M387 M372$_a$ M388 M296$_c$ M1 INTERM371 M317 1N$_1$
Scheil (1935:no. 472)	O0109	M32 INTERM371 M317 1N$_1$
Mecquenem (1949:no. 024)	O0103	M291 INTERM371 M320 1N$_1$
Scheil (1923:no. 345)	O0101	M9 M318$_b$ INTERM371 M321$_a$ [ ]
Scheil (1905:no. 212)	O0103	M342$^?$ M388 M4 M235$_a$ INTERM371 M346 2N$_{14}$ 2N$_1$
Dam and Eng (1989:no. 11)	O0111	M388 M206$_b$ INTERM371 M346 7N$_1$
Dam and Eng (1989:no. 11)	O0116	M388 M72 INTERM371 M346 6N$_1$
Scheil (1905:no. 240)	O0103	M110 INTERM371 M346 M24 M434 M68$^?$ M266 M241 1N$_{39b}$
Scheil (1923:no. 292)	O0221	M388 M387 M263$_a$ M110 INTERM371 M352 M3$_b$ 1N$_1$
Scheil (1905:no. 213)	O0104	M149$_a$ M246$_g$ M9 INTERM371 M376 4N$_{14}$ 5N$_1$ 1N$_?$
Scheil (1905:no. 311)	O0108	X M24 INTERM371 M376 M370 X [ ]
Scheil (1935:no. 129)	O0102	M305 M388 M222 INTERM371 M387 M20 M263$_a$ 8N$_1$
Scheil (1923:no. 159)	O0103	M195 M388 INTERM371 M387 X [ ]
Scheil (1905:no. 222)	O0102a	M365 M388 M57 M318$_a$ INTERM371 M388 4N$_1$ [ ]
Mecquenem (1949:no. 037)	O0109	M377$_e$ M390 INTERM371 M388 M377$_e$ X X [ ]

5) *M371 in final position, sorted according to preceding signs:*

Scheil (1923:no. 120)	O0132	X M3$_b$ FINAL M371 1N$_1$
Scheil (1935:no. 286)	O0103	M4 M9 FINAL M371 1N$_1$
Scheil (1923:no. 292)	O0182	M9 FINAL M371 1N$_1$
Scheil (1923:no. 240)	O0110	M9 FINAL M371 2N$_{39b}$
Scheil (1905:no. 362)	O0103	M29$_a$ M9 FINAL M371 [ ]
Scheil (1923:no. 194)	O0103	M96$^?$ X M251$_b$ M9 FINAL M371 1N$_1$
Scheil (1905:no. 272)	R0114	M120 M9 FINAL M371 3N$_1$
Scheil (1935:no. 0333)	O0110	M124$_a$ M48$_c$ M9 FINAL M371 1N$_1$
Scheil (1923:no. 270)	O0102	M218 X M9 FINAL M371 [ ]
Scheil (1905:no. 271)	O0103	M251$_c$ M9 FINAL M371 4N$_{39b}$
Scheil (1905:no. 267)	O0105	M318$_b$ M9 FINAL M371 2N$_1$ 3N$_{39b}$
Scheil (1905:no. 293)	O0106	M325$^?$ M9 FINAL M371 2N$_{14}$
Scheil (1923:no. 435)	O0107	X M9 FINAL M371 [ ]
Scheil (1905:no. 311)	O0107	M124$_a$ M370 M24$_a$ FINAL M371 [ ]
Scheil (1905:no. 4997)	O0112	M388 M373 M24$_a$ FINAL M371 1N$_{14}$
Scheil (1923:no. 053)	O0102	M9 M24$_d$ FINAL M371 1N$_1$
Scheil (1923:no. 299)	O0103	M24$_d$ FINAL M371 [ ]

Scheil (1923:no. 230)	O0105	M32 FINAL M371 1N$_{1}$
Scheil (1923:no. 436)	O0109	M32 FINAL M371 1N$_{1}$
Scheil (1905:no. 293)	O0116	M251$_{c}$ M32 FINAL M371 1N$_{14}$ 1N$_{1}$
Scheil (1905:no. 206)	O0104	M24 M33 FINAL M371 1N$_{39b}$
Scheil (1923:no. 073)	O0108	M33 FINAL M371 1N$_{14}$
Scheil (1935:no. 5222)	R0101	X M33 FINAL M371 1N$_{1}$
Scheil (1923:no. 120)	O0119	M387$^{?}$ M387$^{?}$ M388 M272 M66 FINAL M371 1N$_{1}$
Scheil (1905:no. 342)	O0103	M263 M94$_{o}$ FINAL M371 [ ]
Scheil (1923:no. 246)	R0101	M99 FINAL M371 1N$_{1}$
Scheil (1923:no. 387)	O0106	M99 FINAL M371 1N$_{1}$
Scheil (1923:no. 279)	O0113	M124$_{a}$ M57 M99 FINAL M371 1N$_{1}$
Scheil (1905:no. 267)	O0109	M131 M99 FINAL M371 1N$_{1}$ [ ]
Scheil (1905:no. 362)	O0106	X M99 FINAL M371 2N$_{1}$ 1N$_{39b}$
Scheil (1935:no. 330)	R0103	M1 M388 M99 X FINAL M371
Scheil (1905:no. 353)	O0103	M104 FINAL M371 1N$_{2}$
Scheil (1923:no. 144)	O0106	M110 FINAL M371 1N$_{1}$
Scheil (1905:no. 286)	O0108	X M110$_{a}$ FINAL M371 9N$_{1}$$^{?}$
Scheil (1923:no. 435)	R0103	X M352N M387$_{a}$ M122 FINAL M371 1N$_{45}$ 6N$_{14}$
Scheil (1923:no. 292)	O0121	M124$_{b}$ FINAL M371 1N$_{1}$
Scheil (1923:no. 031)	O0108	M153 M145$_{a}$ FINAL M371 2N$_{1}$
Scheil (1905:no. 300)	O0108	X M145$_{a}$ FINAL M371 2N$_{1}$
Scheil (1935:no. 5040)	O0103	M146 FINAL M371 [ ]
Scheil (1923:no. 073)	O0112	M146 FINAL M371 1N$_{1}$
Scheil (1923:no. 093)	O0105	M153 FINAL M371 1N$_{1}$
Scheil (1905:no. 276)	O0107	X M218 FINAL M371 3N$_{1}$
Scheil (1935:no. 4835)	O0104	M296 M388 M96 M225 FINAL M371 1N$_{1}$
Scheil (1905:no. 350)	O0103	X M229$_{o}$ FINAL M371 1N$_{14}$
Scheil (1905:no. 258)	O0103	[ ] X M4 M233$_{c}$ FINAL M371 5N$_{1}$
Scheil (1905:no. 212)	O0104	M139 M4 M235$_{a}$ FINAL M371 9N$_{1}$
Scheil (1905:no. 276)	O0108	M251$_{i}$ FINAL M371 1N$_{8a}$
Scheil (1935:no. 054)	O0108	M254$_{c}$ FINAL M371 1N$_{1}$
Scheil (1923:no. 292)	O0171	M370 M288 FINAL M371 [ ]
Scheil (1923:no. 446)	R0102	M291 FINAL M371 [ ]
Scheil (1935:no. 272)	O0105	M9 M318$_{b}$ FINAL M371 1N$_{14}$ 4N$_{1}$
Scheil (1935:no. 272)	O0108	M24$_{d}$ M318$_{b}$ M318$_{b}$ FINAL M371 [ ]
Scheil (1935:no. 400)	O0108	M24$_{d}$ M318$_{b}$ M318$_{b}$ FINAL M371 1N$_{1}$
Scheil (1923:no. 094)	O0109	M387$_{a}$ M388 M9 M318$_{b}$ FINAL M371 1N$_{1}$
Scheil (1935:no. 181)	O0104	M9 M318$_{c}$ FINAL M371 1N$_{14}$
Scheil (1935:no. 052)	O0105	M29$_{a}$ M377$_{e}$ M347 FINAL M371 [ ]
Scheil (1923:no. 446)	O0104	M347 FINAL M371 1N$_{1}$
Scheil (1905:no. 272)	O0109	M377$^{?}$ M347 FINAL M371 1N$_{1}$
Scheil (1935:no. 054)	O0111	M354 FINAL M371 1N$_{1}$
Scheil (1935:no. 252)	O0109	M219 M380 FINAL M371 2N$_{1}$
Scheil (1905:no. 276)	O0105	M386$_{a}$ M380 FINAL M371 2N$_{1}$ 1N$_{8a}$
Scheil (1923:no. 392)	O0102	X M380 FINAL M371 3N$_{1}$
Scheil (1935:no. 330)	O0105	M254$_{a}$ M380$_{b}$ FINAL M371 3N$_{14}$ 2N$_{1}$
Scheil (1923:no. 073)	O0107	M263 M381 FINAL M371 3N$_{1}$
Scheil (1935:no. 284)	O0107	M387$_{c}$ FINAL M371 1N$_{1}$
Scheil (1923:no. 016)	O0106	M357 M388 M262 M390 FINAL M371 1N$_{1}$
Scheil (1905:no. 274)	O0105	M68 M409 FINAL M371 2N$_{1}$
Scheil (1923:no. 292)	O0138	M124$_{a}$ M430 FINAL M371 1N$_{1}$
Scheil (1905:no. 4997)	O0106	M388 M24$_{c}$ M460 FINAL M371 1N$_{14}$ 1N$_{1}$

Figure 20: Example of graphotactical analysis of the proto-Elamite sign Meriggi 371

At first sight, the sign sequences in entries including M371 seem without recognizable structure or repetition, and in fact there is no immediately striking pattern in the data. This may be an indication that we have been too optimistic in anticipating fixed sign sequences representing, for instance, linguistically meaningful personal names, other proper nouns, or even phonetic elements of spoken language. With a range of between one and fourteen, and a mean of ca. five non-numerical signs in this long list, any existing pattern should emerge. Nonetheless, interesting elements in the writing system do appear. For instance, three texts in §2 (Scheil 1905:no. 343; 1923:no. 121; 1935:no. 5019) contain the sign M371 twice, separated by just one sign. In each case, this is the sign M9, consisting of two horizontal strokes and possibly denoting as in Babylonia a sense of "doubling" (cf. Scheil 1923:no. 157 obv. 7 for the same phenomenon in intermediate position). In the case of M371 in intermediate position, the list exhibits a strong relationship between the referent of M371 and those of a number of other signs, including M9 (double stroke, also found regularly in the position immediately preceding M371 when the latter is in final position, §5), M288 (the "gur" sign as a general representation of a measure of grain), and M388 ("KUR" representing a male dependent laborer). We also do not need the explicit proof of Scheil (1923:no. 112) rev. 16 (M387 $M372_a$ M388 $M296_c$ M1 M371 M317 $1N_1$) with both M387 ("100" in the proto-Elamite decimal system, used ideographically) and M371 in the same line[49] to dispose of the idea that the two signs might be graphic variants, based on a possible association between M388 and M376 (three circular impressions connected by incised strokes) and, for instance, between KUR_a and $3N_{57}$ in the proto-cuneiform texts. A simple comparison of the sign sequences, above all the sign clusters in which M371 is found, makes their association, let alone an allographic relationship between the two, highly unlikely. Further short patterns of sign sequence are in these lines; we are hopeful that a comparison of all such patterns in the proto-Elamite corpus will allow us to formulate some general rules of sign application and so to begin an informed speculation about the nature of the ideographic writing system and its possible relationship to the language of proto-Elamite scribes. For it seems unlikely that they, or their archaic Babylonian brethren, should have been entirely successful in hiding their linguistic affiliation behind the evident formulaic bookkeeping symbols of our earliest texts.

Current work on the proto-Elamite corpus thus can draw on both internal data from the Persian documents, and on comparative data from Babylonia. The Babylonian comparisons pose again the question of the ultimate relationship between the two writing systems. Clearly, proto-Elamite must be reckoned to those cases of secondary script origin known from many non-literate regions in contact with literate cultures. Yet it is too facile to declare that Susa imported this idea of writing, along with some few direct loans, at a time when Babylonia had passed into a second writing phase at least several generations after the origin of proto-cuneiform in Uruk IVa. It is evident from our data that those elements which are direct, or nearly direct loans from Babylonian tradition, for instance the numerical sign systems used in grain measures, point to a period within, and not at the conclusion of the initial writing phase Uruk IVa. Moreover, the examples of numero-ideographic accounts demonstrate that both centers employed the same signs at the earliest phase of writing development. At this moment, direct loans from Babylonia were frozen in the proto-Elamite system, whereas they were still subject to paleographic variation in Babylonia. In the case of the number sign N_{39}, Uruk scribes of the Uruk IV period had not agreed upon one or the other of two possible forms, N_{39a} () and N_{39b} (). By the beginning of the following period Uruk III, standardization had dictated in the school the use of only N_{39a}. Persian accountants chose the equally plausible variant N_{39b} from the Uruk IV pool of signs.

This and other comparable agreements in the proto-Elamite syllabary point to a rapid development of a full writing system once its advantages in the administration were understood. One of the more important tasks ahead of us will be an attempt to eliminate from the current proto-Elamite sign list as many of the very numerous variant forms as possible. We count over 1900 discrete signs in 26,320 sign occurrences in our transliteration data set, clustered around approximately 500 basic forms. Of the 1900 forms, however, more than 1000 occur just once, another 300 only twice in the texts. These numbers are a clear indication that the writing system as it has been transmitted to us was in a stage of

49 And cf. Scheil 1923:no. 120 obv. 19, Scheil 1923:no. 159 obv. 3, Scheil 1923:no. 248 obv. 10, etc.

flux, in which a scribal tradition had been unable to care for standardization of characters. Nonetheless, these numbers also tell us that the proto-Elamite system, like that of Babylonia, probably consisted of a mix of ideograms and syllabograms and comprised altogether between 600 and 900 discrete signs.

Chronologically, the proto-Elamite system fits well into the development and expansion of Babylonian proto-cuneiform. We may picture the Uruk expansion into Persia and Syria during the 4th millennium characterized in the history of writing by the appearance of a systematic means of accounting through manipulation of small clay counters whose form indicated both numerical and ideographic qualities. This administrative tool crossed the barrier into transaction representation on one two-dimensional surface, namely on numero-ideographic tablets, when Uruk tradition was still strong in Persia, but the succeeding withdrawal of Babylonian influence, occasioned by developments in the south of Mesopotamia we cannot see, left Persian scribes to their own devices. An apparently continuous administrative apparatus, and a highly adaptable bureaucracy, formed the basis for the development of the proto-Elamite writing system that on its surface seems very foreign, but that on closer inspection reflects much of its Babylonian heritage.

In the meantime, debates continue about the populations which might have been in contact with or even existing within the region of ancient Persia. Given later linguistic evidence, it is likely that an indigenous, Elamite-speaking population was living there at the end of the 4th millennium. And clearly elements from the Babylonian south must have had close, possibly adversarial contact with local peoples. But there may have been much more population movement in the area than we imagine, including early Hurrian elements and, if Whittaker (1998:111-147), Ivanov and others are correct, even Indo-Europeans.[50]

---

50 Rubio (1999:1-16) has reviewed recent publications, and the pioneering initial work by Landsberger on possible substrate lexemes in Sumerian, and concludes that the fairly extensive list of non-Sumerian words attested in Sumerian texts did not represent a single early Mesopotamian language, but rather reflected a long history of *Wanderwörter* from a myriad of languages, possibly including some loans from Indo-European, and many from early Semitic.

Bibliography

Alden, John. 1982. Trade and Politics in Proto-Elamite Iran. Current Anthropology 23:613-640.

Amiet, Pierre. 1966a. II y a 5000 ans: Les Élamites inventaient l'écriture. Archaeologia 12:16-23.
——. 1966b. Elam. Anvers-sur-Oise: Archée.
——. 1972. Glyptique susienne, des origines a l'époque des Perses Achémenides. Mémoires de la Délégation en Perse 43. Paris: Librairie Orientaliste Paul Geuthner.
——. 1985. La periode IV de Tepe Sialk reconsiderée. In: De l'Indus aux Balkans, Festschrift Deshayes, edited by Jean-Louis Huot, Marguerite Yon, and Yves Calvet, pp. 293-312. Paris: Recherche sur les civilisations.
——. 1986. L'age des échanges inter-iraniens. Paris: Ministère de la culture et de la communication, Editions de la Réunion des musées nationaux.

Amiet, Pierre and Maurizio Tosi. 1978. Phase 10 at Shahr-i Sokhta. East and West 28:9-31.

Badler, Virginia. 2000. The Dregs of Civilization: 5000 Year-Old Wine and Beer: Residues from Godin Tepe, Iran,. Bulletin of the Canadian Society for Mesopotamian Studies 35:48-56.

Bauer, Joseph, Robert Englund and Manfred Krebernik. 1998. Mesopotamien: Späturuk-Zeit und Frühdynastische Zeit. Orbis Biblicus et Orientalis 160/1. Freiburg, Switzerland: Universitätsverlag Freiburg Schweiz.

Beale, Thomas. 1978. Bevelled Rim Bowls and their Implications for Change and Economic Organization in the Later Fourth Millennium B.C. Journal of Near Eastern Studies 37:289-313.

Brice, William. 1962-1963. The Writing System of the Proto-elamite Account Tablets of Susa. Bulletin of the John Rylands Library 45:15-39.
——. 1963. A Comparison of the Account Tablets of Susa in the Proto-elamite Script with those of Hagia Triada in Linear A. Kadmos 2:27-38.
——. 1967. The Structure of Linear A, with some Proto-Elamite and Proto-Indic Comparisons. In: Europa. Studien zur Geschichte und Epigraphik der frühen Aegaeis. Festschrift für Ernst Grumach, edited by William Brice, 32-44. Berlin: de Gruyter.

Bulgarelli, Grazia. 1979. The Lithic Industry of Tepe Hissar in the Light of Recent Excavation. In: South Asian Archaeology 1977 : Papers from the Fourth International Conference of the Association of South Asian Archaeologists in Western Europe, edited by Maurizio Taddei, 39-54. Naples: Istituto universitario orientale.

Burrows, Eric. 1935. Ur Excavations. Texts 2. London: Harrison and Sons, Ltd.

Carter, Elisabeth and Matthew Stolper. 1984. Elam: Surveys of Political History and Archaeology. Berkeley: University of California Press.

Petr Charvát. 1993. Ancient Mesopotamia: Humankind's Long Journey into Civilization. Prague: Oriental Institute, Academy of Sciences.

——. 1998. On People, Signs and States. Spotlights on Sumerian Society, c. 3500-2500 B.C. Prague: Oriental Institute, Academy of Sciences.

Damerow, Peter and Robert Englund. 1987. Die Zahlzeichensysteme der Archaischen Texte aus Uruk. In: Zeichenliste der Archaischen Texte aus Uruk. Archaische Texte aus Uruk 2, edited by Margaret Green and Hans Nissen, 117-166 + tables 5460. Berlin: Gebrüder Mann Verlag.

——. 1989. The Proto-Elamite Texts from Tepe Yahya, American School of Prehistoric Research Bulletin 39. Cambridge, MA: Harvard University Press.

Damerow, Peter and Hans-Peter Meinzer. 1995. Computertomographische Untersuchung ungeöffneter archaischer Tonkugeln aus Uruk W 20987,9, W 20987,11 und W 20987,12. Baghdader Mitteilungen 26:7-33 + plts. 1-4.

Daniels, Peter and William Bright, eds. 1996. The World's Writing Systems. New York/London: Oxford University Press.

Dittmann, René. 1986a. Susa in the Proto-Elamite Period and Annotations on the Painted Pottery of Proto-Elamite Khuzestan. In: Ǧamdat Naṣr: Period or Regional Style?, edited by Uwe Finkbeiner and Wolfgang Röllig, 171-198. Wiesbaden: Reichert Verlag.

——. 1986b. Seals, Sealings and Tablets. In: Ǧamdat Naṣr: Period or Regional Style?, edited by Uwe Finkbeiner and Wolfgang Röllig, 332-366. Wiesbaden: Reichert Verlag.

——. 1986c. Betrachtungen zur Frühzeit des Südwest-Iran, Berliner Beiträge zum Vorderen Orient 4. Berlin: Reimer Verlag.

Di Vito, Robert. 1993. Studies in Third Millennium Sumerian and Akkadian Personal Names. Studia Pohl, Series Major 16. Rome: Editrice Pontificio Istituto Biblico.

Dollfus, Geneviève. 1971. Les fouilles à Djaffarabad de 1969 à 1971. Cahiers de la Délégation Archéologique Française 1:17-162.

——. 1975. Les fouilles à Djaffarabad de 1972 à 1974. Cahiers de la Délégation Archéologique Française 5.11-62

Dyson, Robert. 1987. The Relative and Absolute Chronology of Hissar II and the Proto-Elamite Horizon of Northern Iran. Chronologies du Proche Orient, British Archaeological Reports International Series 379, edited by Olivier Aurenche, Jacques Evin, and Francis Hours, 647-678. Oxford: British Archaeological Reports.

Englund, Robert. 1988. Administrative Timekeeping in Ancient Mesopotamia. Journal of the Economic and Social History of the Orient 31:121-185.

——. 1990. Verwaltung und Organisation der Ur III-Fischerei. Berliner Beiträge zum Vorderen Orient 10. Berlin: Reimer Verlag.

——. 1994. Archaic Administrative Documents from Uruk: The Early Campaigns. Archaische Texte aus Uruk 5. Berlin: Gebrüder Mann Verlag.

——. 1996a. Proto-Cuneiform Texts from Diverse Collections. Materialien zu den frühen

Schriftzeugnissen des Vorderen Orients 4. Berlin: Gebrüder Mann Verlag.

——. 1996b. The Proto-Elamite Script. In: The World's Writing Systems, edited by Peter Daniels and William Bright, 160-164. New York/London: Oxford University Press.

——. 1998. Texts from the Late Uruk Period. In: Mesopotamien: Späturuk-Zeit und Frühdynastische Zeit, Orbis Biblicus et Orientalis 160/1, edited by Joseph Bauer, Robert Englund and Manfred Krebernik, 15-233. Freiburg, Switzerland: Universitätsverlag Freiburg Schweiz.

Englund, Robert and Jean-Pierre Grégoire. 1991. The Proto-Cuneiform Texts from Jemdet Nasr, Materialien zu den frühen Schriftzeugnissen des Vorderen Orients 1. Berlin: Gebrüder Mann Verlag.

Englund, Robert and Hans Nissen. 1993. Die lexikalischen Listen der archaischen Texte aus Uruk. Archaische Texte aus Uruk 3. Berlin: Gebrüder Mann Verlag.

——. n.d. Die archaischen Texte der Heidelberger Sammlung. Archaische Texte aus Uruk 7. Berlin: Gebrüder Mann Verlag.

Falkenstein, Adam. 1936. Archaische Texte aus Uruk. Leipzig: Otto Harrassowitz.

Friberg, Jöran. 1978-1979. The Early Roots of Babylonian Mathematics I-II. Göteborg: Department of Mathematics, Chalmers University of Technology and the University of Göteborg.

——. 1982. A Survey of Publications on Sumero-Akkadian Mathematics, Metrology and Related Matters (1854-1982). Göteborg: Department of Mathematics, Chalmers University of Technology and the University of Göteborg.

——. 1997-1998. Round and Almost Round Numbers in Proto-Literate Metro-Mathematical Field Texts. Archiv für Orientforschung 44-45:1-58.

Gelb, Ignace. 1975. Methods of Decipherment. Journal of the Royal Asiatic Society 1975:95-104.

Ghirshman, Roman. 1934. Une tablette proto-élamite du plateau iranien. Revue d'assyriologie et d'archéologie orientale 31:115- 119.

——. 1938. Fouilles de Sialk près de Kashan 1933, 1934, 1937 1. Paris: Librairie Orientaliste Paul Geuthner.

Glassner, Jean-Jacques. 2000. Écrire à Sumer: l'invention du cunéiforme. Paris: Seuil.

——. 1998. Les tablettes dites ‹‹urukéennes›› de Sialk IV_1. Nouvelles assyriologiques brèves et utilitaires 1998:113.

Green, Margaret. 1980. Animal Husbandry at Uruk in the Archaic Period. Journal of Near Eastern Studies 39:1–35.

——. 1981. The Construction and Implementation of the Cuneiform Writing System. Visible Language 15:345-372.

Green, Margaret and Hans Nissen, eds. 1987. Zeichenliste der Archaischen Texte aus Uruk. Archaische Texte aus Uruk 2. Berlin: Gebrüder Mann Verlag.

Harper, Prudence, Joan Aruz, and Francoise Tallon, eds. 1992. The Royal City of Susa: Ancient Near Eastern Treasures in the Louvre. New York: Metropolitan Museum of Art.

Hinz, Walther. 1987. Persia c. 2400-1800 B.C. In: Cambridge Ancient History I/2, 3rd edition, edited by Iorwerth Edwards, Cyrus Gadd, and Nicholas Hammond, 644-680. London: Cambridge University Press.
——. 1975. Problems of Linear Elamite. Journal of the Royal Asiatic Society 1975:106-115.

Ismail, Farouk. 1996. Administrative documents from Tell Beydar (seasons 1993-1995). Subartu 2. Turnhout: Brepols

Johnson, Gregory. 1973. Local Exchange and Early State Development in Southwestern Iran. Anthropological Papers of the Museum of Anthropology, University of Michigan, no. 51. Ann Arbor: University Microfilms International.

Krebernik, Manfred. 1994. Review of Green and Nissen (1987). Orientalistische Literaturzeitung 89:380-385.

Lamberg-Karlovsky, Clifford Charles. 1971a. An Early City in Iran. Scientific American 224/6:102-111.
——. 1971b. Proto-elamite Account Tablets from Tepe Yahya, Iran. Kadmos 10:97-99.
——. 1971c. The Proto-elamite Settlement at Tepe Yahya. Iran 9:87-96.
——. 1974: Urban Interaction on the Iranian Plateau: Excavations at Tepe Yahya 1967-1973. Albert Reckitt Archaeological Lecture 1973. Proceedings of the British Academy 59:282-319. New York/London: Oxford University Press.
——. 1977. Foreign Relations in the Third Millennium at Tepe Yahya. Le plateau iranien et l'Asie centrale des origines à la conquête islamique. Actes du Colloque international du Centre national de la recherche scientifique no. 567, 33- 43. Paris: Centre national de la recherche scientifique.
——. 1978. The Proto-Elamites on the Iranian Plateau. Antiquity 52:114- 120.
——. 1985. The longue durée of the Ancient Near East. In: De l'Indus aux Balkans, Festschrift Deshayes, edited by Jean-Louis Huot, Marguerite Yon, and Yves Calvet, 55-72. Paris: Recherche sur les civilisations.
——. 1986. Third Millennium Structure and Process: From the Euphrates to the Indus and the Oxus to the Indian Ocean. Oriens Antiquus 25:189-219.

Lamberg-Karlovsky, Clifford Charles and Maurizio Tosi. 1973. Shahr-i Sokhta and Tepe Yahya: Tracks on the Earliest History of the Iranian Plateau. East and West 23:21-57.

Langdon, Stephen. 1928. Pictographic Inscriptions from Jemdet Nasr. Oxford Editions of Cuneiform Texts 7. New York/London: Oxford University Press.

Lawler, Andrew. 2001a. Writing Gets a Rewrite. Science 292:2418-2420.
——. 2001b. Destruction in Mesopotamia. Science 293:32-35.

——. 2001c. Iraq Opening Sets Off Scramble for Sites. Science 293:36-38.

Lebeau, Marc and Antoine Suleiman. 1997. Tell Beydar: Three Seasons of Excavations (1992-1994), A Preliminary Report. Subartu 3. Turnhout: Brepols.

Le Breton, Louis. 1957. The Early Periods at Susa. Iraq 19:79-124.

Le Brun, Alain. 1971. Recherches stratigraphiques a l'Acropole de Suse, 1969-1971. Cahiers de la Délégation Archéologique Française 1:163- 216.

——. 1978a. La glyptique du niveau 17B de l'acropole (campagne de 1972). Cahiers de la Délégation Archéologique Française 8:61-79.

——. 1978b. Le niveau 17B de l'acropole de Suse (campagne de 1972). Cahiers de la Délégation Archéologique Française 9:57-154.

——. 1978c. Chantier de l'Acropole I. Paléorient 4:177-192.

Le Brun, Alain and François Vallat. 1978. L'origine de l'écriture à Suse. Cahiers de la Délégation Archéologique Française 8:11-57.

Mecquenem, Roland de. 1949. Épigraphie proto-élamite. Mémoires de la Délégation en Perse 31. Paris: Presses universitaires de France.

——. 1956. Notes proto-élamites. Revue d'assyriologie et d'archéologie orientale 50:200-204.

Meriggi, Piero. 1969. Altsumerische und proto-elamische Bilderschrift. Zeitschrift der Deutschen Morgenländischen Gesellschaft, Supplementa 1:156-163.

——. 1971-1974. La scrittura proto-elamica I-III. Rome: Accademia nazionale dei Lincei.

——. 1972. Comparaisons des systèmes idéographiques mino-mycenien et proto-élamite. Acta Mycenaea 2:9-17.

——. 1975. Der Stand der Erforschung des Proto-elamischen. Journal of the Royal Asiatic Society 1975:105.

Michel, Rudolph, Patrick McGovern, and Virginia Badler,. 1993. The First Wine and Beer: Chemical Detection of Ancient Fermented Beverages. Analytical Chemistry 65.8:408 A-413 A.

Nissen, Hans. 1970. Grabungen in den Quadraten K/L XII in Uruk-Warka. Baghdader Mitteilungen 5:136-142.

——. 1983. Grundzüge einer Geschichte der Frühzeit des Vorderen Orients, Grundzüge 52. Darmstadt: Wissenschaftliche Buchgesellschaft.

——. 1999. Geschichte Altvorderasiens. Munich: R. Oldenbourg Verlag.

Nissen, Hans, Peter Damerow, and Robert Englund. 1991. Frühe Schrift und Techniken der Wirtschaftsverwaltung im alten Vorderen Orient. Berlin: verlag franzbecker and Max Planck Institute for Education and Human Development.

——. 1993. Archaic Bookkeeping. Chicago: University of Chicago Press.

Picchioni, Sergio. 1980. La direzione della scrittura cuneiforme e gli archivi di Tell Mardikh Ebla. Orientalia 49:225251.

Rubio, Gonzalo. 1999. On the Alleged “Pre-Sumerian Substratum”. Journal of Cuneiform Studies 51:1-16.

Scheil, Vincent. 1900. Textes élamites-sémitiques, Mémoires de la Délégation en Perse 2. Paris: Ernest Leroux.
——. 1905. Documents en écriture proto-élamites, Mémoires de la Délégation en Perse 6. Paris: Ernest Leroux.
——. 1923. Textes de comptabilité proto-élamites, Mémoires de la Délégation en Perse 17. Paris: Ernest Leroux.
——. 1935. Textes de comptabilité proto-élamites, Mémoires de la Délégation en Perse 26-26S. Paris: Librairie Orientaliste Paul Geuthner.

Schmandt-Besserat, Denise. 1977. An Archaic Recording System and the Origin of Writing. Syro-Mesopotamian Studies 1/2:31-70.
——. 1980. The Envelopes that Bear the First Writing. Technology and Culture 21:357-385.
——. 1986a. Tokens at Susa. Oriens Antiquus 25:93-125 + pls. IV-X.
——. 1986b. The Origins of Writing: An Archaeologist's Perspective. Written Communication 3/1:31-45.
——. 1992. Before Writing. Austin: University of Texas Press (cf. the reviews by Peter Damerow, Rechtshistorisches Journal 12 [1993] 9-35; Robert Englund, Science 260 [11 June 1993] 1670-1671; Jöran Friberg, Orientalistische Literaturzeitung 89 [1994] 477-502; Piotr Michalowski, American Anthropologist 95 [1993] 996-999; Paul Zimansky, Journal of Field Archaeology 20 [1993] 414-517; see also Jean-Jacques Glassner, Écrire à Sumer [Paris 2000] 91-112).

Steve, Marie-Joseph and Hermann Gasche. 1971. L’Acropole de Suse. Mémoires de la Mission archéologique de Iran 46. Paris: Ernest Leroux.

Stolper, Matthew. 1976. Preliminary Report on Texts from Tal-e Malyan, 1971-1974. In: Proceedings of the IVth Annual Symposium on Archaeological Research in Iran, 3-8 November 1975, edited by Firouz Bagherzadeh, 89-100 + 108-109. Tehran: Iranian Centre for Archaeological Research.
——. 1978. Inscribed Fragments from Khuzistan. Cahiers de la Délégation Archéologique Française 8:89-96.
——. 1985. Proto-elamite Texts from Tall-i Malyan. Kadmos 24:1-12.

Steinkeller, Piotr. 1995. Review of Green and Nissen (1987). Bibliotheca orientalis 52:689-713.
——. 1995-1996. Review of Englund and Nissen (1993). Archiv für Orientforschung 42/43:211-214

Sürenhagen, Dietrich. 1993. Relative Chronology of the Uruk Period. *Bulletin of the Canadian Society for Mesopotamian Studies* 25:57-70
——. 1999. *Untersuchungen zur relativen Chronologie Babyloniens und angrenzender Gebiete von der ausgehenden Ubaidzeit bis zum Beginn der Frühdynastisch II-Zeit 1. Studien zur*

Chronostratigraphie der südbabylonischen Stadtruinen von Uruk und Ur. Heidelberger Studien zum Alten Orient 8. Heidelberg: Heidelberger Orientverlag.

Sumner, William. 1974. Excavations at Tall-i Malyan, 1971-1972. Iran 12:155-180.
——. 1976. Excavations at Tall-i Malyan (Anshan) 1974. Iran 14:103-114 + pls. I-III.

Thureau-Dangin, François. 1927. Tablettes à signes picturaux. Revue d'assyriologie et d'archéologie orientale 24:23-29.
——. 1932. Notes assyriologiques LX: Le système décimal chez les anciens Sumeriens. Revue d'assyriologie et d'archéologie orientale 29:22-23.

Tosi, Maurizio. 1976. Shahr-i Sokhta. Iran 14:167-168.

Vaiman, Aizik. 1972. A Comparative Study of the Proto-elamite and Proto-sumerian Scripts (in Russian). Vestnik Drevnei Istorii 1972/3:124-133 (English summary p. 133; German translation Baghdader Mitteilungen 20 [1989] 114-120).
——. 1974a. Über die protosumerische Schrift. Acta Antiqua 22:15-27.
——. 1974b. The Designation of Male and Female Slaves in the Proto-Sumerian Script" (in Russian). Vestnik Drevnei Istorii 1974/2:138-148 (German translation Baghdader Mitteilungen 20 [1989] 121-133).

Vallat, François 1971. Les documents épigraphiques de l'Acropole (1969- 1970). Cahiers de la Délégation Archéologique Française 1:235-245.
——. 1973. Les tablettes proto-élamites de l'Acropole (campagne 1972). Cahiers de la Délégation Archéologique Française 3:93-107.
——. 1978. Le material épigraphique des couches 18 a 14 de l'Acropole. Paléorient 4:193-195.
——. 1986. The Most Ancient Scripts of Iran: The Current Situation. World Archaeology 17:335-347.

Weiss, Harvey and Theodore Cuyler Young. 1975. The Merchants of Susa. Iran 13:1-18.

Whittaker, Gordon. 1998. Traces of Early Indo-European Language in Southern Mesopotamia. Göttinger Beiträge zur Sprachwissenschaft 1:111-147.