ANIMAL HUSBANDRY IN SUSA DURING THE PROTO-ELAMITE PERIOD*

by Jacob L. Dahl

Summary: Previous studies have explained proto-Elamite signs according to their graphic properties, or as direct loans from neighboring proto-cuneiform, based on graphic as well as semantic similarities. This article builds on the recent advance in the study of proto-Elamite by members of the Cuneiform Digital Library Initiative (CDLI) <http://cdli.ucla.edu>, and proposes a partial decipherment of Susa animal terminology. Doing so, bookkeeping techniques relating to the herding of sheep and goats are described and discussed.

0. Introduction

Susa, located in close proximity to the Zagros foothills, was presumably an ideal place for livestock breeding. The earliest textual record, moving beyond the numerical tablets from the period of intense contact between Mesopotamia and Susiana, exhibits a vivid record of animal herding and a correspondingly developed terminology.

The first indigenous writing-system from Iran is called proto-Elamite and it was long thought of as a precursor to a (hypothetical) indigenous Elamite writing-system. Proto-Elamite, as well as linear-Elamite, remains un-deciphered. At present it is idle speculation to postulate a relationship between the two writing systems. Proto-Elamite was used during a brief period around 3000 BC, whereas linear-Elamite is attested for an equally brief period sometime during the later half of the 3rd millennium BC.

The proto-Elamite writing-system was used over a very large geographical area, stretching from Susa in the west, to Tepe Yahya in the east (see figure 1). Finds of proto-Elamite tablets from various places in Iran cannot always be certified: some amount to nothing more than a few clay lumps with some signs that may or may not be proto-Elamite (i.e. Tepe Hissar, see Tosi and Bulgarelli 1989, 39-40). The signs and number-signs found on such tablets could as well belong to an earlier period of close inter-regional contact represented by the numero-ideographic tablets of the latter part of the so-called Uruk-expansion (Uruk IV). See in particular

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the singular tablet from Shahr-i-Sohkta (sealed) with one or two non-numerical signs and a numerical notation (for a photograph see Salvatori, Tosi, and Vidale 2001, 36), as well as the tablets from Choga Mish (Delougaz and Kantor 1996, 120 and plate 33), Godin Tepe (Weiss and Young 1975, 9 figure 4), Tal-i Ghazir (Whitcomb 1971, 37 + pl XI, A.; see also Alden 1982), among others, and compare to Englund 1998, 51-53 and figure 16 on page 54. Tablets of this kind found on the Susa Acropolis Mound apparently came from levels 18 and 17B, immediately below the reported leveling of the entire acropolis in ancient times (= level 17A; see Morgan 1905, 16, and compare with Potts, 1999, 71-79), and the introduction of the proto-Elamite culture proper (level 16 to level 14B).

It is however possible that we can use the tablet format to determine the origin of a given numero-ideographic tablet (Uruk IV). Since any tablet holding both a non-numerical notation and a qualifying numerical notation is bound to reflect on the order of objects and qualifiers believed to be specific to either of the two writing systems discussed here. In proto-cuneiform we generally find the qualifying numerical notation preceding the object, whereas the reverse order is found in proto-Elamite inscriptions. It can therefore tentatively be suggested that numero-ideographic inscriptions of the kind commonly classified as Uruk IV can be divided into two groups; a Mesopotamian group—where the numerical notation precedes the non-numerical notation, and an Iranian group—where the numerical notation follows the non-numerical notation.

Some of the more substantial finds of proto-Elamite tablets outside of Susa, such as the Yahya texts (see Damerow and Englund 1989), are clearly identifiable as proto-Elamite although they have a high number of sign variants or even singletons (non-repeated signs) in the sign-repertoire. Even the single tablet from Tepe Ozbaki (Majidzadeh, no date) can be safely ascertained as proto-Elamite since it deals with some of the same signs and bookkeeping techniques as discussed in the present article (although one of the signs for animals is apparently only attested there, and in one text from Tepe Sialk: see forthcoming short study by the author on the regional terminology relating to animal herding during the proto-Elamite period). Among the proto-Elamite tablets found outside of Susa, the texts from Malyan most closely resemble the Susa material (Stolper 1985, 5). It is perhaps due to the excavation methods that Susa has yielded a disproportional large number of proto-Elamite tablets. More than 1,500 tablets and fragments from Susa have been published. To date, 27 tablets and fragments have been found at Tepe Yahya, betweeen 30 and 40 at Malyan, and 22 at Sialk, whereas only one tablet has been found at Ozbaki Tepe. The tablets from Godin Tepe, Choga Mish, Tepe Hissar, as well as most of the tablets from Tepe Sialk, must be grouped with the numero-ideographic tablets of the period immediately prior to that of the proto-Elamite tablets (Uruk V and early Uruk IV), their relationship to the proto-Elamite culture cannot be established at present.

The use of some of the same signs, or sign-groups for "owners" (see below) throughout the region suggests a more intricate geo-political system than a superficial take-over of a Susa invention by local elites. No further suggestions to the nature of the geographical spread of proto-Elamite will be offered here.

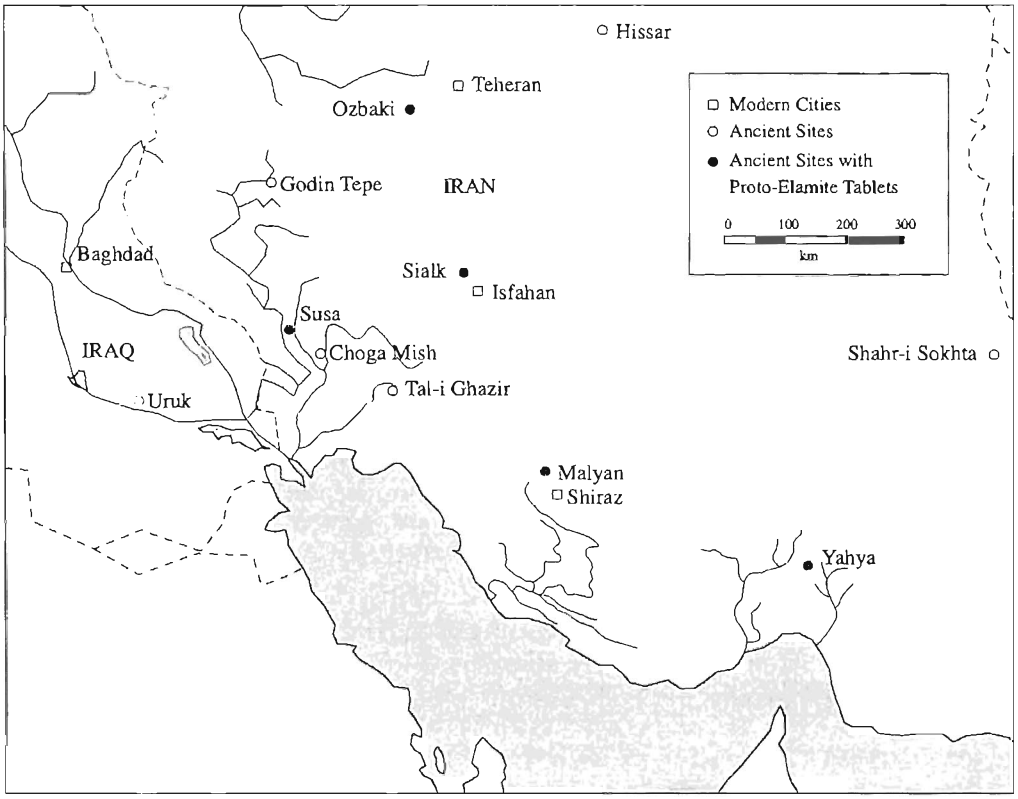


Fig. 1 – Map of Ancient Iran.

In an earlier article I explored the surprisingly free formation of complex graphemes, particularly visible in the Susa animal herder texts (Dahl 2005). The present study is devoted to an analysis of the organization of animal husbandry in ancient Susa, according to the same proto-Elamite texts. Meanwhile I will attempt to deduce the proto-Elamite terminology for herded animals. Since the majority of the texts discussed here seem to come from the same archive this introduction will briefly discuss the problems presented to us by the archaeological record.

Following initial surveys by English and French explorers in the latter half of the 19th century, Jacques de Morgan was able to initiate the first major excavations of Susa in 1897. Morgan, who was trained as a mining engineer, leveled the acropolis mound digging in increments of 5 meters. He had established these artificial levels after drilling "galleries" into the mound (see Dyson 1968, for an introduction to the early work at Susa). Morgan had already reached what he called "Niveau II", an artificial level ca. 10 meters below the surface of the top of the acropolis mound by the second season (1898-9). That level would later become iconic since the entire mound was leveled to that height by the end of 1911. Only one portion of the acropolis, now known as the "Témoin de Morgan", was left standing. Although "Niveau III" was dug into in the beginning of the 20th century it was never fully realized; the task of leveling the entire mound had become impossible, although Morgan had put in a small rail-road, and could count on as many as 1,200 workers

at one point. Instead, Morgan, and his successor Roland de Mecquenem focused their efforts on a few deep surveys.

Proto-Elamite tablets were not found in the first two layers (Niveau I and II), but plans for digging deeper had already been made in the spring of 1899 (Morgan 1900, 138). The first proto-Elamite tablets were found immediately below Niveau II in trench 7, supposedly corresponding to level 14B of Le Brun 1971 figure 31. Trench 7 was apparently the central trench in what later came to be Morgan's "Grande Tranchée". Those first tablets (reported in Morgan 1900, 138) are probably identical with the two tablets published by Scheil in 1900 (MDP 2, 130 and 131; republished as MDP 6, 399 and 4996); they correspond to what I have called the late writing-phase, and at least two tablets were found in the same level during the later controlled excavations (see Vallat 1971, DAFI 1, 58 1 and 2). During the subsequent seasons the initial trenches were widened and deepened, and in particular Trench 7 seems to have yielded substantial numbers of proto-Elamite tablets. It seems reasonable to attribute the proto-Elamite tablets to three of the deep survey areas of Susa, Morgan's "Grande Tranchée", and Mecquenem's "Sondage I" and "Sondage II" (see figure 2, below). The central survey area apparently yielded no tablets. Targeted studies aimed at reconstructing the ancient archives, such as the present, combined with a careful reading of the original excavation reports and the reports of the later surveys may allow us to, in the future, hypothesize findspots for the larger groups of proto-Elamite tablets from Susa.

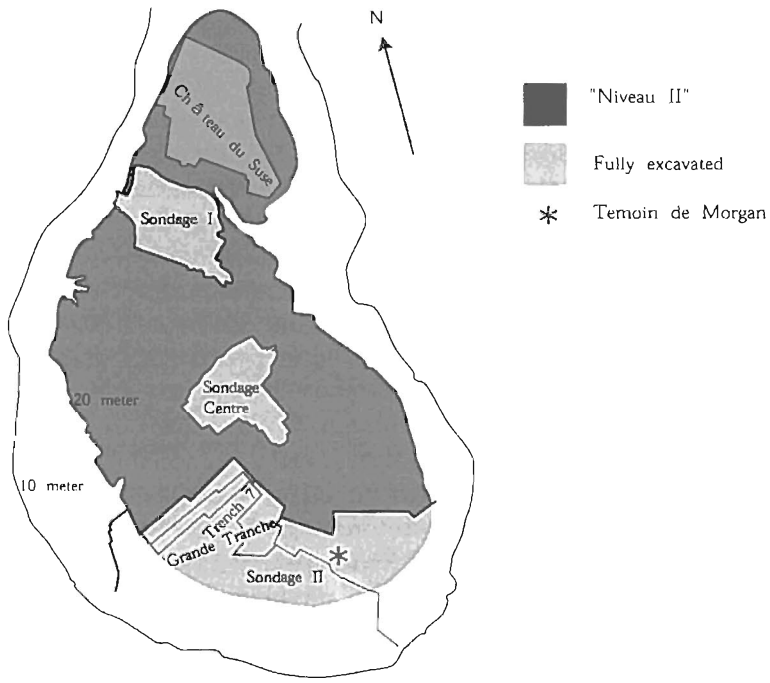


Fig. 2 – Susa after the excavations of Morgan and Mecquenem (figure adopted from Steve and Gasche, 1971, Plan 1). The outline of the mound is reconstructed using maps dating prior to the complete physical change of the mound by the debris from Morgan's and Mecquenem's excavations.

Three large texts (text A, B, and C), briefly discussed in Dahl 2005, are key-texts for the understanding of Susa animal terminology and animal herding. They are discussed below together with a number of related receipts (text D, E, and F). The entire corpus of proto-Elamite texts has been used to strengthen and broaden the arguments. One of the key-texts of this article (text C) was discussed by M. W. Stolper in 1992 (with reference to the parallel text B, but not text A). Stolper's interpretation was based, in turn, on Englund and Damerow 1989, and Meriggi 1971 (in particular 84 (§238 - §240), and 1974b, 115 – 116). The majority of the Susa texts concerning animal herding were published in 1923 (as MDP 17) by the epigrapher to the French mission to Persia, Vincent Scheil. They were apparently found after the 1907-8 season, during the excavations of Mecquenem (see Scheil 1923, i). For several reasons, given below, it can be postulated that this group of texts came from the same physical archive. We may tentatively suggest that this archive was one of the "large lots" found in either trench 7 or 24 (see Scheil 1900, i). Trench 7 was the original center-trench of what became Morgan's "Grande Tranchée". I have been unable to localize trench 24. The archive discussed here could also have been found in one of Mecquenem's surveys "Sondage I or II" (see figure 2). A few structurally similar texts were published by Scheil in 1935 (as MDP 26). They were apparently found after the rupture of the agreement concerning the French excavations in Iran, in 1927, after which date all finds had to be divided equally between Paris and Teheran (see Scheil 1935, i, and compare to Mecquenem 1949, 44). According to Mecquenem the tablets of MDP 26 were drawn by M.-G. de Mecquenem using a "chambre claire". A chambre claire is a mechanical device used to project an image of the object onto another surface used for copying the inscription. The tablets published in MDP 26 do not seem to have come from the same archive as those published in MDP 17: none of the owner signs found in the archive published in MDP 17 are found in the animal texts published in MDP 26. It is possible that the texts in MDP 26 concerning herded animals are slightly younger than those published in MDP 17. Approximately 150 tablets published by Scheil as a supplement to MDP 26 (drawings by M. P. Toscanne, according to Mecquenem 1949, 44) came from the same lots as those published by Scheil in 1905 (MDP 6). The texts published in MDP 26 have been included in this study for comparative use only, since they were not available for collations at the time. The remaining texts discussed below have all been collated. The regrettable state of publication of the Susa proto-Elamite material allows for no argument to be made based solely on the primary publications. A re-edition of the Louvre proto-Elamite texts, including complete photographical documentation, is being prepared by the author, in cooperation with Béatrice André-Salvini, curator at the Louvre Museum.

1. Signs for animals

The fact that a few proto-Elamite signs, together with a majority of the numerical systems and signs, seem to have been direct loans from the better-known and older Mesopotamian writing-system, here referred to as proto-cuneiform, or perhaps more correctly to have common ancestry, has allowed scholars to isolate cer-

tain classes of signs. In the absence of a successor writing-system that approach has proven to be very productive.

Basically, proto-Elamite signs can be divided into five groups according to their place and function in the sentence. Sentence is used here to denote each self-contained unit in a proto-Elamite text; the header, an entry, the subscript, or the total (see also Englund 2004, 105 figure 5.3a). The five groups are 1) signs denoting an "owner" or a "household", understood in the broadest of terms, as an individual, a temple or family household, a clan, or any other comparable socio-economic unit; 2) signs used to designate a person according to his or her social status, gender, age or similar categories; 3) signs standing for counted objects, including humans and animals; 4) numerical signs; and 5) signs used in the later phases of the writing system to write one of the two first types by combining two or more signs in a complex way. Note that there exists some overlapping between the signs of groups 1, 2, and 3. The high number of singletons (non-repeated signs) in proto-Elamite is in good accordance with the characteristics of proto-writing as described by Damerow 1999. As was also shown for the so-called Indus Script the number of singletons will increase with each new text publication (Farmer, Sproat and Witzel 2004, 36). It remains to be studied whether the number of singletons in proto-Elamite decreased over time, and if proto-Elamite like proto-cuneiform, underwent some form of standardization during the late phase of its use (a reevaluation of the results reached in Dahl 2002 may be needed). We shall briefly discuss the proposed evolution of the sign-repertoire while examining text F, below.

Images of all signs discussed in this essay are given in the figures accompanying this study, as well as in the appendicies. Appendix A includes factor diagrams of all proto-Elamite numerical systems. Appendix B provides a sign-list of the signs discussed in this paper. Appendix C has transliterations of the three key-texts (A, B, and C) discussed in this paper. For a description of the system of transliterations implemented by the author see Dahl 2005 §3.9. The numbering of the signs follows loosely Meriggi 1974a (see Dahl 2005, § 1.3 for an assessment of the application of Meriggi 1974a). In the present study all signs and tablet copies have been turned 90 degrees counterclockwise to conform to the traditional direction of cuneiform signs from the early periods in scholarly publications.

Among the most well known of the "loans" from proto-cuneiform is the sign for sheep, proto-cuneiform UDU. Whereas that sign in proto-cuneiform is written with a sign which has been described as a quartered disk (see figure 3, below), the corresponding sign in proto-Elamite (M346) is written by crossing two half-circles (see figure 6, below), obtaining almost the same visual result (Englund 1998, 150; and Meriggi 1971, 53 (§142)). Each of the two half-circles making up M346 were made by pressing the round end of a thick stylus (with a diameter of on an average 7-10 mm) into the surface of the clay, holding the stylus at a 45° angle. The same stylus was used to write the numerical signs N_{39B}, N_{34}, N_{45}, etc., and was also used to write a number of non-numerical signs for example M362, discussed below. UDU, on the other hand, was drawn with a pointed stylus. The Susa scribe had at least two styli, corresponding in size to the numerical signs N_{45} and N_{14} respectively (the larger one used for writing N_{45}, and other signs, had a flat end, whereas the smaller stylus used for N_{14}, N_1, and other signs, had a slightly rounded end). The opposite pointed end of one of these styli was presumably used for drawing the non-numerical signs.

However, it is also possible that the scribe had a third stylus, used exclusively to write non-numerical signs (for a discussion of the styli of the scribes who wrote the proto-cuneiform texts see Englund 1988, 133-4). In the tablet copies of proto-Elamite texts the circles pressed deeply into the clay are color-coded black, whereas circles pressed lightly into the surface of the tablet are color-coded gray. Some proto-Elamite texts (perhaps belonging to a late phase of the writing-system) had signs written with near-wedge-shaped lines, indicating that the stylus had a tri- or quadrangular head. Note, that although aspects of proto-Elamite animal terminology may be inspired by the slightly older proto-cuneiform, or have common roots, the Susa scribes used their own, indigenous, decimal system to count animals (see Englund 2004, 110 and 112).

Using M346 as a point of departure a whole range of semantically related signs have been isolated (cf. Englund 1998, 128), and this study builds on that important understanding of the specific sign-repertoire relating to animal terminology. See for example Meriggi's list of products in Meriggi 1969, 16; Meriggi attempted a classification based on some of the same principles that members of the CDLI have engaged in, although his efforts suffered from a restricted understanding of important concepts of early numeracy at the time (see below for a discussion of the possibly incorrect identifications of animal signs in Damerow and Englund 1989, 53 fn. 144, based on a correct methodology restricted by the flawed primary publications). The breakthrough in deciphering early numerical notations came with Friberg 1978-79.

Proto-cuneiform sheep and goat terminology was reconstructed in Englund 1998, 149, (following Green 1980, 5 figure 3; avoid Glassner 2000, 475); it is presented on figure 3, below. Signs for fat-tailed sheep, and certain signs of uncertain classification have not been included on this figure.

<table>
<tr><td rowspan="4">Sheep and Goats
UDU$_a$</td><td rowspan="2">Goats</td><td>age \ sex</td><td>females</td><td>males</td></tr>
<tr><td>adults</td><td>UD$_{5a}$ UD$_{5b}$ UD$_{5c}$</td><td>MAŠ$_2$</td></tr>
<tr><td>juveniles</td><td>EŠGAR</td><td>MAŠ</td></tr>
<tr><td rowspan="2">(wool) Sheep</td><td>adults</td><td>U$_{8a}$</td><td>UDUNITA$_a$ b c</td></tr>
<tr><td>juveniles</td><td>SAL.SILA$_{4c}$=KIR$_{11}$</td><td>SILANITA</td></tr>
</table>

Fig. 3 – Late Uruk sheep and goat terminology, adapted from Englund 1998, figure 51 p. 149.

We mentioned above that proto-cuneiform UDU and proto-Elamite M346 seems to have identical roots, and likely identical application. Note, however, that proto-Elamite M346 is not used as a summarizing sign for sheep and goat as is the case with Late Uruk UDU, except perhaps in MDP 6, 317 where a herd of ewes and rams seem to have been summarized by M346 (Damerow and Englund 1989, 55 fn. 146). Other interpretations are possible for the next two texts mentioned by Damerow and Englund (MDP 26, 176 and 437): both texts seem to be exclusively records of sheep (M346), the last "owner" listed in MDP 26, 437, however, being described with a sign presumably closely related to a sign for an animal. Both texts should be collated before any further conclusions are made. Note therefore, additionally, that at least one of the animal signs in the list given by Damerow and Englund 1989 (M251, see page 55 fn. 146) is not the sign for an animal (the very poorly executed hand-copies of MDP 26, 133 and 437 allows for the suggestion to be made that a sign comparable to M251 designated a herded animal, collation is needed). It is also important to stress that proto-Elamite M346 is believed to represent a female adult sheep, an ewe, perhaps corresponding to a primordial meaning of UDU.

Apart from UDU and M346 two other sign are suspiciously similar in both systems: MAŠ in proto-cuneiform and M6 in proto-Elamite, as well as UD_5 and M362. Damerow and Englund (1989, 51) identified M367 and its variants with UD_5. I do not agree with this identification, and argue that a more apparent graphic similarity exists between M362 and UD_5, see also Stolper 1992, 78, who came to the same result. Meriggi identified M362 with a cow, or a cow-pen, based partially on a structural analysis of the same texts described here and partly on a comparison with the cuneiform sign for a cow-pen TUR_3 (see Meriggi 1971, 58 (§156) – 59 (§159), and 84 (§239)). However, it is very possible that graphically related signs did not share the same semantic qualities in the two systems: a very simple sign such as M6/MAŠ may be found in many un-related writing-systems, or even systems composed purely of "symbols", as recently suggested for the Indus writing system (Farmer, Sproat and Witzel, 2004), having a wide range of semantic meanings. In fact, there exist two signs in proto-Elamite that are strikingly similar, $M5_a$ and M6 (see figure 4, below). Both form the visible image of a cross, but the vertical and the horizontal stroke of M6 are identical, and without a notable wedge-shaped "head", or starting point (M6 is in fact drawn identically to proto-cuneiform MAŠ). The vertical stroke of $M5_a$, on the other hand, is in fact two wedge-shaped lines joining at the middle where it crosses the horizontal line, whereby each "arm" has its own "head" or wedge-shaped beginning; likewise, the horizontal line has a starting point, or wedge-shaped head at its left end. Only M6 is a sign for an animal, $M5_a$ is presumably a sign for a title, and perhaps related to M5, M390, or M391. $M5_a$ never appears as a counted object; M6 only appears as a counted object. $M5_a$ often appears in the position of a header of a text, a spot normally reserved for "household" signs, and $M5_a$ can be inscribed in object-signs, another quality reserved for "household" or "owner" signs. M6 cannot be inscribed into other signs, nor can it function as a header; but "owner" signs, such as $M5_a$, can qualify M6. The two signs, M6 and $M5_a$, cannot always be distinguished in the hand-copies, see MDP 6, 221 and 317 for a good example of both (both texts have been published with photo as well as hand-copy, see MDP 6, plate 13, and 16; for MDP 6, 221 see also Friberg 1978-79, 16-19 and figures 4 and 5). The use of different styli to draw different signs has not

been studied so far (Meriggi briefly mentioned similar observations in 1974a, 25), and we note that M390 seems to be written with the same stylus as used to write the numerical sign N_1, and with a thick "regular" stylus producing a wedge-shaped head.

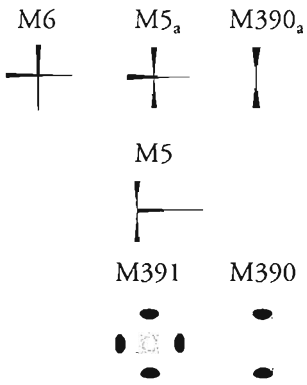


Fig. 4 – Possible graphical variants differentiated by use of stylus.

It may be worth noting that the majority of proto-cuneiform signs for sheep and goats are formed by altering the basic signs UDU, and that most signs for male animals are constructed by adding a rhombic figure to the left of the sign. Likewise, several proto-Elamite signs for animals are composed of reoccurring graphical elements.

In several proto-Elamite texts (discussed in section 2 of this paper) we find eight signs for animals. Note, that only one text (A) is complete enough to reconstruct the entire sequence, but other texts give parts of it. Half of these signs can be argued to represent derived forms of the first four, due to their particular graphic form. In other texts we find the same eight signs for animals grouped in pairs; either one main-form sign together with another, or a main-form sign with its derived sign. Since one of these signs is M346 it seems reasonable to argue that all of these are signs for sheep and goats. The very high numbers of these animals found in several texts support the general classification proposed here, and argues against the otherwise tempting suggestion of Meriggi identifying M362 with a dairy-cow (see Meriggi 1971, 58 (§156) – 59 (§159). The derived signs can be shown to designate juvenile animals and will therefore not concern us at first (see below for more on these identifications). The four signs for (adult) animals have been numbered M362, M367, M346, and M6. They are always listed in that order when listed together.

A comparable system of ordering, mentioning the adult animals prior to the juveniles, can be found in texts from the Uruk III period. In the Uruk texts it seems as if ewes (U_8) are considered more important than goats, as they are always mentioned first (cf. Green 1980, 2-3). Uruk sheep and goat herding was first adequately described in Green 1980, for a more recent discussion see Englund 1998, 143-150. It is important for our investigation to note that adults of both genders are men-

tioned before the juveniles in proto-cuneiform texts (see also Englund 1988, 147), and it is necessary to accept *prima face* that the same ordering principle also existed in the proto-Elamite animal herding texts. Substantial structural differences between the two systems exists, the most important being that whereas proto-cuneiform texts—early texts from Mesopotamia—are arranged in visual hierarchies, proto-Elamite texts are written in an in-line format perhaps coding certain elements of speech (contrary to proto-cuneiform, cf. Englund 2004, 104). Below is an outline of a proto-cuneiform text relating to the administration of herded animals (figure 5, on the left) and that of a proto-Elamite text (figure 5, on the right). The actual document may be substantially larger and seemingly more complex, dealing with mixed herds of both sheep and goats, however that complexity results from a repetition of the general pattern shown in the outline below. The proto-cuneiform tablet is rotated on its horizontal axis. In comparison, we note that whereas proto-Elamite tablets as a rule are also rotated on their horizontal axis for writing the total (see for example text B and C), some texts, such as text A, are rotated on their vertical axis in order to continue the text of the obverse on the reverse, and then rotated on their horizontal axis for writing the total (if present), resulting in a reverse face with text running in two opposing directions. All directions here are given according to the traditional presentation of early cuneiform texts; rotated 90 degrees counterclockwise to their original orientation.

Although Damerow and Englund identified M367 with the nanny goat (1989, 51), it is the proposal of this study that M367 was a sign for a billy goat. Damerow and Englund's claim seems based solely on a slight graphical similarity between M367 and UD_5. The main argument used in this study to identify M367 with a billy goat rather than a nanny goat is in fact a purely logical one.

M367 is often mentioned as a pair with either M6 or M362, but rarely with M346 (only in MDP 17, 25; and perhaps MDP 26, 437), whereas M6 is mentioned as a pair with M346 and M367 but never with M362. This kind of pairing is best explained if it relates to a split in both gender and genus at the same time. For example, males of both sheep and goats will be listed together in certain documents if these deal with, for example, slaughtered animals (see below). Females of both genus will be mentioned together in other texts if these are concerned with dairy production, or the growth of a herd, etc. Males and females of either sheep or goats will be mentioned together if animals of that specific genus are concerned, and so forth (both sheep and goats belong to the same sub-family (*caprinae*), sheep to the genus *ovis* and goats to the genus *capra*). Females of one genus and males of another will only rarely be mentioned as a pair.

It can therefore be argued that if we can identify one of the animals in the proto-Elamite texts then we can also identify the one it never forms a pair with since it must be opposite in both gender and genus (see figure 6, below).

Subsequently it may be proposed that M367 is most likely a male adult goat, a billy goat (it never forms a pair with the female ovine, the ewe, M346). And it becomes likely, and will be substantiated below that M362 is an adult female goat, a nanny goat, and M6 an adult male sheep, a ram (the two never form a pair). The

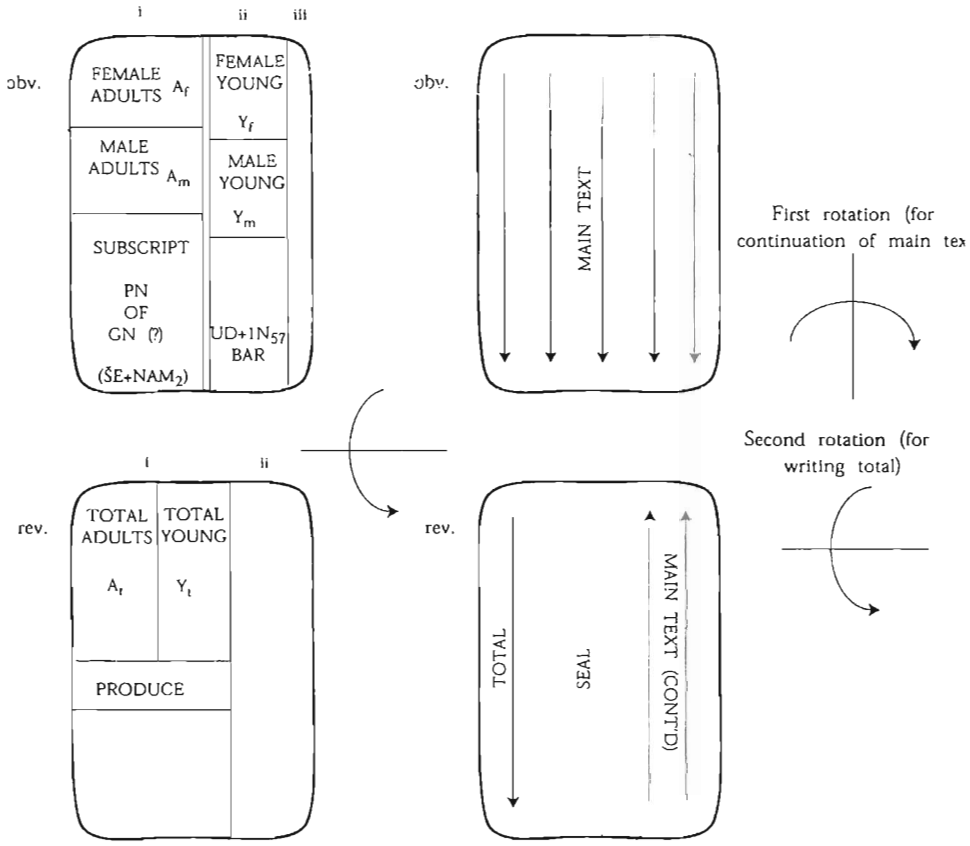


Fig. 5 – To the left a representation of the structure of a Late Uruk text concerning sheep and goats (adapted from Green 1980, 2, figure 1): to the right the structure of a proto-Elamite text, note that the entries of a proto-Elamite text may run from one line to another.

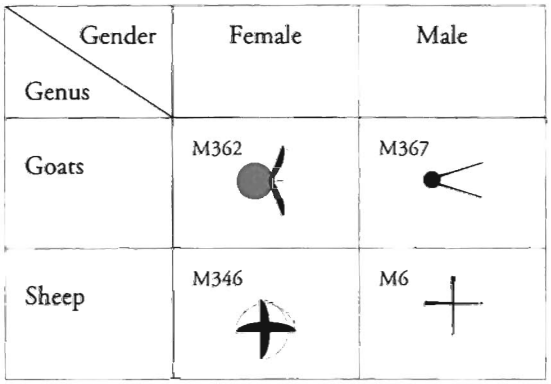


Fig. 6 – Adult sheep and goats in Susa.

primary argument for this is, that M362 is mentioned first in texts presumed to be concerned with among other things, dairy products, and that goats yield twice as much milk as for example sheep. See figure 6 for a first attempt at reconstructing Susa animal terminology. The derived sign-forms, supposedly used to write juveniles, follow the same pattern (see figure 7 below). Other forms of evidence exist, that, as we shall see supports this logical identification.

As mentioned above a list of eight different animals can be extracted from certain Susa animal herder texts, the four first being M362, M367, M346, and M6. These have tentatively been identified as nannies, billies, ewes, and rams. The list then continues with four signs that can clearly be described as graphically derived forms of the first four. They are all formed either by hatching or crossing the "legs", or the "head", of the original signs. These four signs have been numbered $M362_a$, $M367_a$, $M346_a$, and $M6_a$; and like the first four signs they are always listed in that order when listed together (compare with Meriggi 1971, 59 (§161), 64 (§174), and passim). They apparently correspond to female kids, male kids, female lambs, and male lambs (see figure 7). We shall discuss in detail these identifications below.

Gender / Genus	Female	Male
Goats	$M362_a$ 	$M367_a$ 
Sheep	$M346_a$ 	$M6_a$ 

Fig. 7 – Juvenile sheep and goats in Susa.

Mesopotamian scribes of early cuneiform operated with a system for creating derived sign-forms, known by its pseudo-Sumerian name as gunification, whereby is meant the addition of a series of strokes to the main form of the sign, altering its semantic qualities. It has been briefly suggested in Englund 2004 (111), and will be substantially elaborated on in this paper, that the scribes who wrote the proto-Elamite tablets used an almost identical system. As in cuneiform, proto-Elamite gunification is apparently used exclusively to change the semantic quality of the main sign-form. Some of the derived sign-forms are attested in very few texts each, as is the case with the signs believed to represent juvenile animals discussed here, and it is likely that this kind of semantic alteration could be applied in a very *ad hoc* manner by the scribes, allowing for rather substantial graphic variations.

The suggestion presented above, that the four derived signs represent juvenile animals of the same kinds and gender as the those represented by the main-form signs, is therefore based on a structural analysis of the order in which the signs

appear compared to the Mesopotamian accounting practice of the same objects. The observation that Susa scribes, as their neighbors, operated with a system of main sign-forms and derived sign-forms, here referred to as gunification, used to alter the semantic properties of the main-form sign; and finally, the identification proposed above is substantiated in the discussions of the signs below.

Several of the proto-Elamite signs for sheep and goats resemble the proto-cuneiform signs for the same category of animals, however, not always with the same semantic identification. It should perhaps be the working hypothesis that Mesopotamian and Iranian animal terminologies developed independently of each other, but built on a set of common signs. It is in this regard interesting to note that all the signs in both systems are entirely abstract; perhaps indicative of a long prehistory as symbols or counters (e.g., Schmandt-Besserat 1992, 142-143). In the following we shall discuss each pair of signs, main form and derived form, in order to substantiate the identifications proposed above.

Nanny goats and female kids (M362 and M362$_a$)

Whenever M362 appears together with other signs for herded animals in the supposedly hierarchically organized administrative documents it is always listed first, and we may therefore speculate that it was the most important among the sheep and goats.

Based on the aforementioned graphical similarity with proto-cuneiform UD$_5$, and the fact that M362 ranks as the most important animal in texts supposedly concerned with dairy products (see below), among other things, suggests that we can safely identify M362 with a sign for an adult female goat, the nanny goat. Nannies produce much more milk that ewes, and they are therefore traditionally preferred in dairy farming, even though ewe's milk is richer. The numbers of different animals found in especially text A (=MDP 17, 96+325+380) argues in favor of identifying M362 with a female animal. In most flocks, ancient as well as contemporary, the female animals out-number the males by at least five-to-one. In text A we find a ratio of M362 to M367 in the range from three-to-one, to as high as seven-to-one. This seems to be consistent in all texts mentioning the pair M362 and M367. However, the flocks mentioned in text A have an unusually high ratio of goats (M362 and M367) to sheep (M346 and M6), and an equally unusual ratio of ewes (M346) to rams (M6). In other texts, such as MDP 17, 277, a fragmentary text with only a part of the total preserved (that text can, presumably, be compared to text A discussed below), we find a much larger number of M346 and the derived form M346$_a$ than of M362 and the derived form M362$_b$. Note that M362$_b$ can be shown to be nothing but a graphical variant of M362$_a$, based on a text such as MDP 17, 301, a fragment of a summary account of the same type as text A. In MDP 17, 301 we find M362$_b$ in the spot where we would expect to find M362$_a$ according to the better preserved of the two text (text A). Returning to MDP 17, 277, we see that the totals of adults and juveniles are bundled together, which is a good indication that both belonged to the same kind (adults and juveniles, of the same sex and genus), and note that sheep and goats are not bundled. However, M362 and M362$_b$ are still mentioned first, suggesting that this animal is the largest or the most important. The different ratio between sheep (M346 and M6), and goats (M362 and M367) found in various texts, argues against using these numbers to credit or discredit the identifications suggested here. We shall re-

turn to a discussion of the composition of the herds later in this study.

Finally we note, that the seal found on text C (see below) has the image of a herd of goats, clearly distinguishable by the bearded males. Images of goats seem to prevail in the glyptic record of the proto-Elamite period, with no certain representations of sheep. That observation supports the identifications suggested here.

The derived sign-forms used to describe the juvenile female goat, the female kid is formed in at least two different ways; by hatching the inside of the large circle ($M362_a$), or by hatching each of the two half-circles attached to the large circle ($M362_b$). It is possible that $M346_c$ is a graphical variant of M362. The sign occurs in only two texts (MDP 17, 86 and 172), and only in a context equivalent to that of M362.

Billy goats and male kids (M367 and $M367_{a+}$)

In the herding texts discussed below we find modest numbers of billy goats (M367), these texts were presumably concerned with mixed herds of sheep and goat kept primarily for dairy production. In other texts we find much larger numbers of billy goats (M367), which presumably represent slaughtered male caprids (see also above).

Basing ourselves on the aforementioned pattern of formation of derived forms designating juveniles, we can suggest that $M367_a$ and other variants (formed by hatching the area between the two "legs" of the sign) are male kids of the domesticated goat. However, a wide array of graphical variants of M367 exists, and it is by no means certain that all of these signs represent juvenile animals. It is very likely that some denote different animals, for example, wild hunted goats.

Classification	Image	Name
Adults		M367
Juveniles (graphic variants)		$M367_i$
		$M367_a$
		$M367_b$
		$M367_c$
		$M367_d$
Indeterminable (semantic variants)		$M367_e$
		$M367_f$
		$M367_g$

Fig. 8 – Male caprids.

$M367_c$ is presumably a variant of $M367_a$. It appears in a few texts where we would expect $M367_a$: that is, following M367 and as a pair with $M6_a$ (see MDP 17, 161, and presumably MDP 26, 90). It appears alone in a few other texts in very large numbers (more than twenty thousand animals are listed in MDP 31, 31). $M367_b$ is presumably another sign for a juvenile male goat, it appears in two texts from MDP 26 (numbers 229 and 350). In both cases it probably functions as $M367_a$. In MDP 26, 350 we find the sign $M367_f$ just before $M367_b$; this is the sole attestation of that sign known to me. $M367_d$ is only attested in MDP 17, 217 and seems to be the sign for a juvenile male caprid. $M367_i$ appears in two texts, MDP 17, 101; and MDP 31, 4. In both texts it is presumably the sign for an adult caprid. In figure 8, above, it has been grouped with the signs for juveniles due to its graphical similarities with those signs. In MDP 31, 4 it is listed next to M376 receiving half the rations of that creature ($4N_1$ for each M376 and $2N_1$ for each $M367_i$), M376 was identified by Damerow and Englund as a high-status human since it is counted in the sexagesimal system (Damerow and Englund 1989, 22-23 and fn. 67; see also Englund 2004, 125 figure 5.14). For the graphically similar signs $M368_a$, $M368_b$, and $M368_c$, see Damerow and Englund 1989, 32, and add the texts MDP 17, 64, and 124. These signs may not be signs for animals (see appendix B).

Ewes and female lambs (M346 and $M346_a$)

Conforming to a hypothetical early semantic classification of UDU as essentially a sign for an adult female sheep, M346 was identified as the proto-Elamite sign for an ewe. We have already seen the pair M346 and $M346_a$ while we discussed nanny goats and female kids above, and it seems beyond doubt that $M346_a$, and its variants, constitute the sign for the juvenile equivalent of M346. The derived sign is formed in the same way as the two previously discussed signs, by hatching the "legs" of the sign for the adult animal. All attestations of juvenile female lambs are found exclusively in texts recording herds composed of several different animals. M346 is found in many other texts.

Whereas nanny goats are primarily attested in the herding accounts (see section two of this paper) sheep and rams occur in a multitude of different text-groups. One such text-group is of great interest for the study of the proto-Elamite sign-repertoire, since it gives clues to the possible existence of a proto-Elamite syllabary. These texts—of which MDP 6, 253; 337; 353; MDP 17, 93; 350; and 463 are good examples—all consist of a header followed by short lists of entries each consisting of a string of non-numerical signs followed by a counted object (M346) and a numerical notation. The considerable length of the non-numerical portion of the strings, and the fact that these can be divided into two different segments that can be found in different constellations throughout the corpus is suggestive of an interpretation of these as "spelling" the title and the name of the "owner" of the counted object. The number of signs used for writing these "names" is less than one hundred and does therefore conform to what is commonly believed to be the prerequisites for a true syllabary (see already Meriggi 1971, 172 – 184 (§453 - §480)). I will return to this subject in a later study.

Rams and male lambs (M6 and $M6_a$)

The sign we have proposed for the Susa ram, M6, is identical with that used by the Mesopotamian scribes to designate a male juvenile goat. However, in the Susa texts it almost always appears as a pair with M346, the sign we have previously decided is the ewe. In some texts M6 forms a pair with M367, and its derived form $M6_a$, with the derived form of M367, $M367_a$, suggesting that these must be lists of male sheep and goats.

The sign we have suggested as the sign for the juvenile counterpart of the ram, the male lamb, $M6_a$, is clearly formed in the same way as the sign suggested for the juvenile counterpart to the ewe, $M346_a$ (see also the copy of text A, below).

We are now able to represent a reconstruction of Susa sheep and goats terminology (see figure 9):

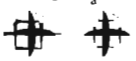
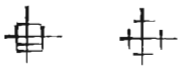
	sex / age	females	males
Goats	adults	M362 	M367 
	juveniles	$M362_a$ $M362_b$ 	$M367_a$ 
Sheep	adults	M346	M6 
	juveniles	$M346_a$ 	$M6_a$ 

Fig. 9 – Proto-Elamite sheep and goat Terminology.

Other herded animals in the Susa texts

A few other signs for herded animals can be distinguished, although they cannot easily be identified. One of these is M348 which mostly appears together with M346 (M348 is formed by placing two half circles of the same size as those used to draw M346 with the flat side facing each other, the graphically similar sign M347 is formed by placing two half circles with the round side facing each other, that sign is not a sign for an animal, however). The two signs (M346 and M348) are sometimes bundled (e.g., MDP 6, 317), other times not (e.g., MDP 17, 93). M348 often appears as if it is counted as a capacity container, or in a context with a capacity sign, and may represent a standard "ration" unit (see, e.g., MDP 6, 238, and MDP 17, 423 where we find the complex sign M348+M288!). See in this regard especially MDP 26S, 5011 (cf. Damerow and Englund 1989, 55 fn. 147), suggestive of M348 being exclusively tallied as a grain notation. It is also possible that M348 is a par-

ticular grain-fed sheep, and therefore totaled according to a standard grain-conversion. M206$_d$, another possible sign for a herded animal, is quite similar in functions to M348 (see, e.g., MDP 26, 1), but no further conclusions are drawn here.

Fig. 10 – Susa herded animals of unknown identification.

Only three signs for animals can be shown, beyond doubt, to be the actual picture of an animal; these have been numbered M334, M335, and M336$_d$. Two of these signs are used only in a handful of texts each (M334 only in MDP 17, 105 and 124; and M336$_d$ only in MDP 17, 440+453+460 (physical join confirmed in the Louvre), and MDP 26, 156). M334 is the image of the head of a large animal, perhaps an equid. M335, which is very similar to M334, may also be a sign for a person or an official (see for example MDP 26, 119 and 120). M336$_d$, the image of an animal, can be compared to the other signs grouped together in the sign-list under the same number (M336$_{(a-d)}$), due to their slight graphical similarities. M336$_d$ is used to describe counted objects. On the other hand, none of the signs M336$_{a-c}$, M332, and M340, all images of animals or heads of animals, can be found in a position as a counted object. Note that M332 has a derived form, created by hatching the outline of the main form (the main form is here tentatively listed under the numbers M332$_c$ and M332$_d$, and the derived form under M332$_a$), for more on the formation of derived forms in proto-Elamite see elsewhere in this study.

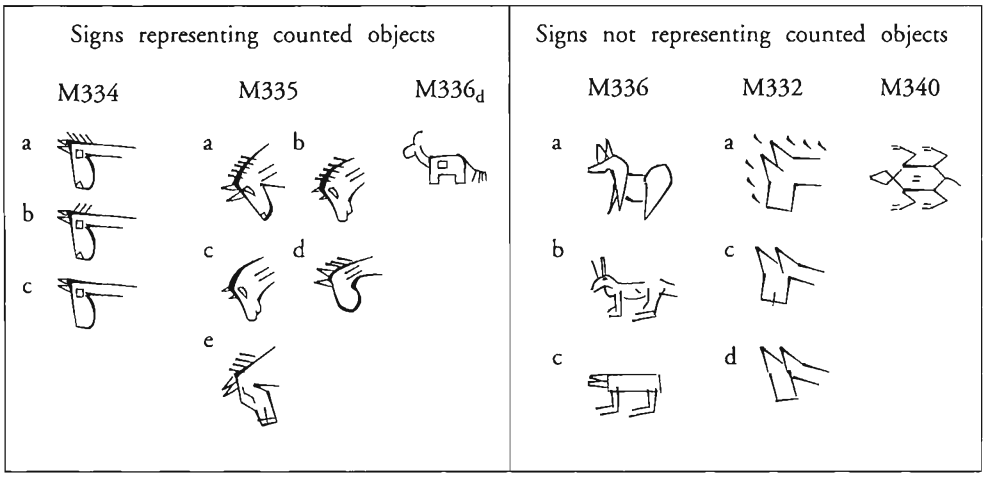


Fig. 11 – Proto-Elamite signs with the visible appearance of an animal or part of an animal.

The apparent absence of bovines from the textual records remains enigmatic. The possibility that the Susa administrators cared little for cow herding remains pure speculation, and it is not supported either by the archaeological nor the iconographical record. It is more likely that bovine terminology is still escaping us, or that we have not found the archives concerning Susa cattle herding.

2. Animal herding

The Susa animal herder texts can be roughly divided into two groups, primary and secondary documents. This distinction is well known from later Mesopotamian bookkeeping practices, but identified in the Susa documents for the first time here. Moreover, it seems appropriate to use this terminology, inherited from Ur III studies, since it can be shown that the secondary documents were summaries of primary documents. It may even be possible to speak about receipts and accounts since most secondary documents have a total, and the primary documents were sealed (some accounts were sealed as well, see below). The secondary documents, the accounts, can be further divided into accounts concerning the size of the herds, and accounts concerning the production obtained from the herd. The following analysis is based partly on three accounts (text A = MDP 17, 96+325+380; text B = MDP 17, 85; and text C = MDP 17, 97), presumably listing the same fourteen flocks of animals, and partly on a number of primary documents relating directly or indirectly to these accounts (text D = MDP 17, 182; text E = MDP 17, 191; and text F = MDP 17, 151).

Text A (MDP 17, 96+325+380) is the only more-or-less well-preserved account listing the number of animals from different herds. MDP 26, 217 may be another account listing several flocks, but since it was unavailable for collations at the time of writing this study it has not been included here. The much better preserved accounts B and C (= MDP 17, 85 and 97) are examples of accounts recording the production from the same herds listed in text A. MDP 26, 100, and presumably MDP 26, 251, are likewise accounts recording the production from animal-herding, but their archival relationship to the rest of the corpus remains unclear: they have not been included in this study.

Several fragments of tablets from both groups of accounts can be found in MDP 17. The following texts may be classified as fragments of herd accounts; MDP 17, 241; 253; 275; 284; 285; and 301; and with only the total preserved, MDP 17, 276; 277; and 282. Only two fragments qualify as examples of production accounts, they are MDP 17, 305, and 476.

I have found 14 documents that can be classified as receipts relating to the herding of animals. These are MDP 17, 35; 151 (= text F); 161; 154?; 172; 182 (= text E); 183; 186; 191 (= text D); 220; 222; 223; 265; and 267.

These 28 texts are believed to have formed part of a real archive, stored together, and consisting of both primary and secondary documents. It is also the hypothesis of this paper that that archive was in use for more than one "accounting period", and that each accounting period may have corresponded to a solar year.

Text A (figure 12)

This damaged text can with some certainty be reconstructed to consist of fourteen entries: eleven entries are clearly distinguishable, and three more can be estimated from the size of the break. The text has no header, presumably making it a top-level document, summarizing all other documents of its class; the same is true for the two other accounts discussed below. Each entry lists the animals belonging to a particular owner, described by inserting a household sign into the first sign for an animal (M362) or bundling the two (see Dahl 2005, §4.6 to §4.9 and § 5.2). In Dahl 2005 I briefly suggested that this scribal practice resembles the branding of animals with owner's marks, a practice known all over the world. See in this regard the Mongolian system described in Waddington 1974. The close parallels between these and many other systems should not lead us to seek a common origin of animal herding, or a common origin of the symbols used as brands (compare to Lynch and Robbins 1977, 539), rather they can be used to formulate models for understanding the use of symbols and owner's marks by (semi)-literate animal-herders, and the impact on writing from such systems.

Returning to text A, we note that for some obscure reason the first flocks are not the largest, and we must recognize that the ordering principle was not the same hierarchical principle as in most Mesopotamian texts, unless we argue that the first flock was "owned" by the most important person or house. That the list of owners was not "fixed" speaks against that assessment, see also below. Each flock is made up of from five to eight different kinds of animals. All the animals are seemingly counted in the indigenous proto-Elamite decimal system, as can be inferred from the fragments MDP 17, 276; 277; and 282. These three fragments hold nothing but the totals of apparently similar accounts (see Englund 2004, 110-111 and figure 5.6a). The total of MDP 17, 276 (645 nannies; 160+ ewes; and 96? rams) is much larger than our estimate for text A (i.e. ca. 400 nannies; 75 billies; etc.): text A does not seem to have been totaled. Text A has been reconstructed from the three fragments; MDP 17, 96; 325; and 380. MDP 17, 96 and 325 do not touch, but the join can be asserted from the fact that MDP 17, 380 fills the space between the two, and joins, physically, with number 96, whereby it provides the second of the two clear points of reference with number 325, i.e., the left half of a M362 sign (see copy below). There are at least two erasures in text A. The copies of the six proto-Elamite tablets presented below were all made using high-resolution digital-images, while also consulting the originals.

Finally, it is worth mentioning that MDP 17, 105 is a close parallel to our text A. Its size, seal-impression, as well as content suggests that the two tablets were stored together and belonged to the same archive. MDP 17, 105 deals, presumably, with equids belonging to approximately ten households, each flock of animals consists of three different kinds of the same animal (differentiated by the style of the mane only). The owners of the animals are described by some of the same household signs we find in texts A, B, and C described here, but due to the fact that the animal signs in MDP 17, 105 leave little room for inscribing these, they are all placed next to the sign for the animal. The fact that it is sealed with the same seal as found on our text C, and MDP 17, 444, also confirms its relation to the texts described here. That latter text has yet another seal which is again found on one of the primary documents shown to relate closely to text A (see below).

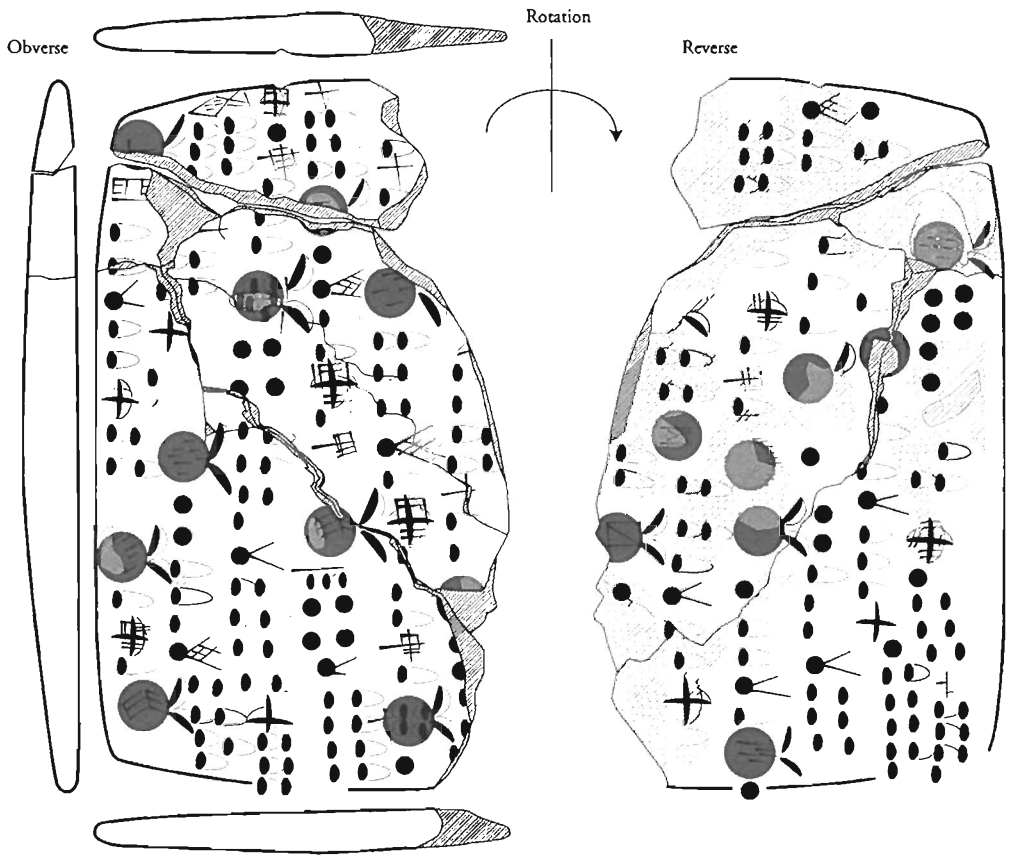


Fig. 12 – Text A (= MDP 17, 96+325+380; Sb 22286+22480+22534; 141x80x26 mm).

The basic flock in text A is composed of roughly 20 to 50 nanny goats and six to eight billy goats, although some flocks are much smaller. A similar ratio between the sexes exists for the juvenile goats. Each flock also consists of a much smaller number of sheep, rams, and male and female lambs (see figure 13, below, for a schematic representation of one of the best preserved entries of text A). Although the ratio of adult sheep and rams to their juveniles is approximately the same as that between adult goats and kids, the ratio between the sexes is one-to-one.

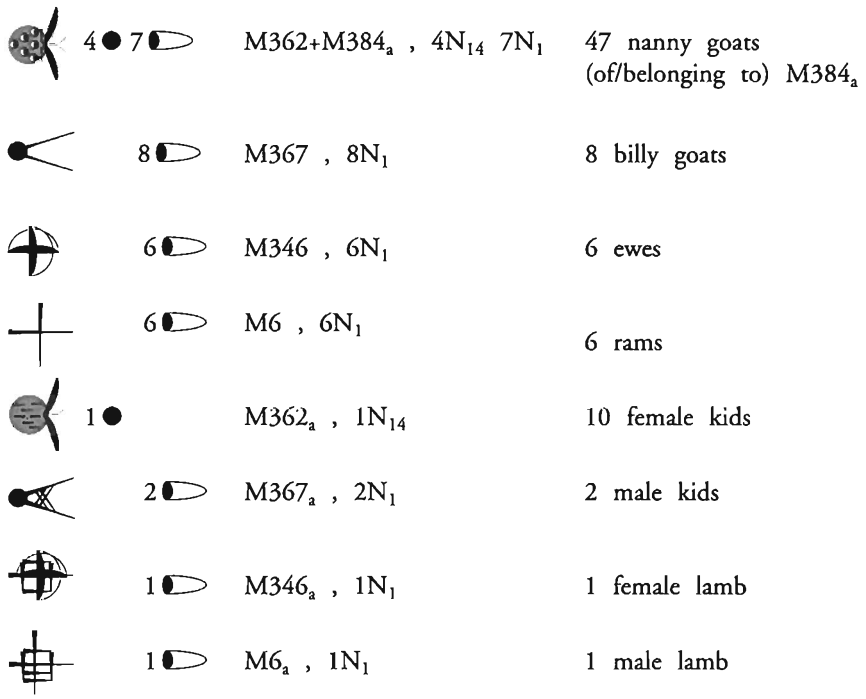


Fig. 13 – Sample entry from text A (entry number 3) with tentative translation; compare to figure 17.

The make-up of the mixed flocks reported in this text does not correspond well with what we are used to seeing in ancient herding texts (Van De Mieroop 1993, 165 and table 1 and 2); nor with what is known as the standard ratio between sheep and goat in contemporary herding (Ryder 1993, 17-18). Only the proportion of nannies to billies, as well as male to female kids is in good agreement with what is otherwise known from ancient as well as contemporary records of sheep and goats. The male kids would be slaughtered at an early date for both meat and hides. The nannies would be kept, presumably, for breeding and for their milk. In traditional herding the ratio between sheep and goats is normally five-to-one or even higher (some Susa texts do show higher numbers of sheep than goats, see also above). Note however the 2:1 ratio of goat to sheep in the Banesh-period (i.e. proto-Elamite) bone-remain samples from Malyan (see Zeder 1991, 137, and table 26, note the progression in the ratio described on pages 139 to 140). In her discussion Zeder (1991, 161-164), suggests that the high ratio of goat bone-remains in the samples may result from higher offspring yield, and resulting increased culling of goats, rather than from an actual 2:1 rate of goats to sheep in the herds (see also Hesse and Zeder 2000, for an assessment that ancient goats-herders in the Zagraos mountains kept few adult animals alive).

Although these suspicious ratios of sheep to goat in our texts, could be used to discredit the terminology as it has been reconstructed above there are several other options available. It is possible that the records here served a different purpose than the herd accounts otherwise known from the ancient Near East, and that goats therefore appear more prominently in the record. It is possible that goats

were favored by the Susa administrators for their milk, but these texts may also be partial records of the original herds. Note also that if the sign M362 were a sign for an ewe, thus conforming to the high number of adults in comparison to contemporary herding, we would be at a loss to explain the low numbers of juvenile female animals from the same genus.

Text B and C (figures 14 and 15)

The two accounts B and C are of almost equal size, and the break-pattern of both suggest that they were stored together (see in this regard my comments concerning the two texts MDP 6, 366 and 386 in Dahl 2005, § 3.7). It is my suspicion that the two texts represented the accounts of the production from the same herds as listed in text A over a period of two accounting periods, most likely two years. Text C was treated by Stolper in 1992, with reference to text B; the interpretation given here is not far from that of Stolper 1992. As of today no time-keeping systems have been identified in the proto-Elamite texts, but we may speculate that time-notations were inferred from the grain-ration systems, and in the production norms found in production records, such as the ones presented here (see also Damerow and Englund 1989, 27).

Texts B and C both list 14 units, designated in the same way as the ones found in text A. It is immediately apparent that many of these units are identical in all three texts, although the order is not (see figure 20, below). Texts B and C list, presumably, the production from the same sheep and goat herds listed in text A. Due to the entirely fixed structure of the entries in these two texts it is possible to reconstruct the missing sections to a certain degree (a quantitative reconstruction can only to some extent be pursued, whereas the order of the objects can be verified in all cases).

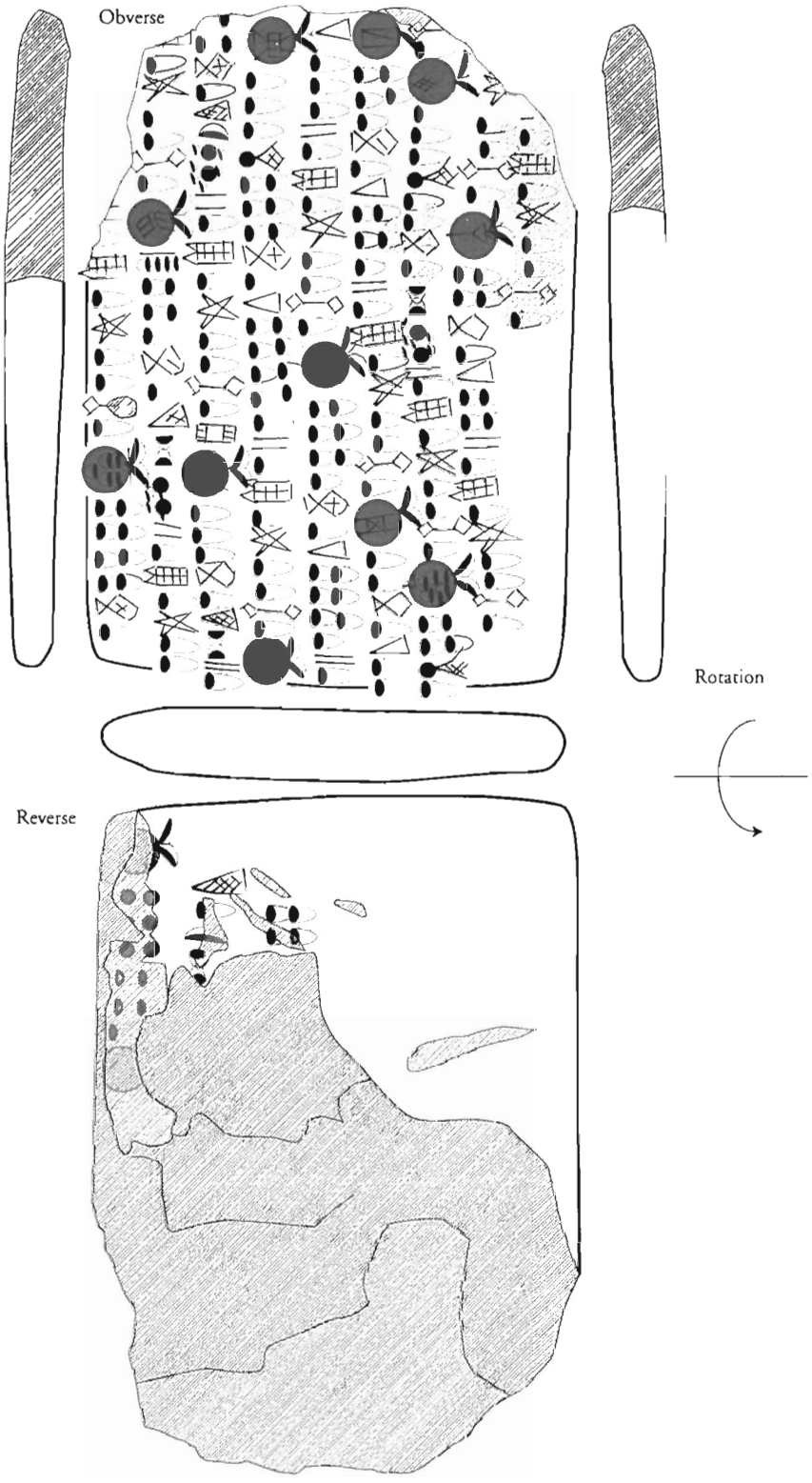


Fig. 14 – Text B (= MDP 17, 85; Sb 22276; 154x110x31 mm).

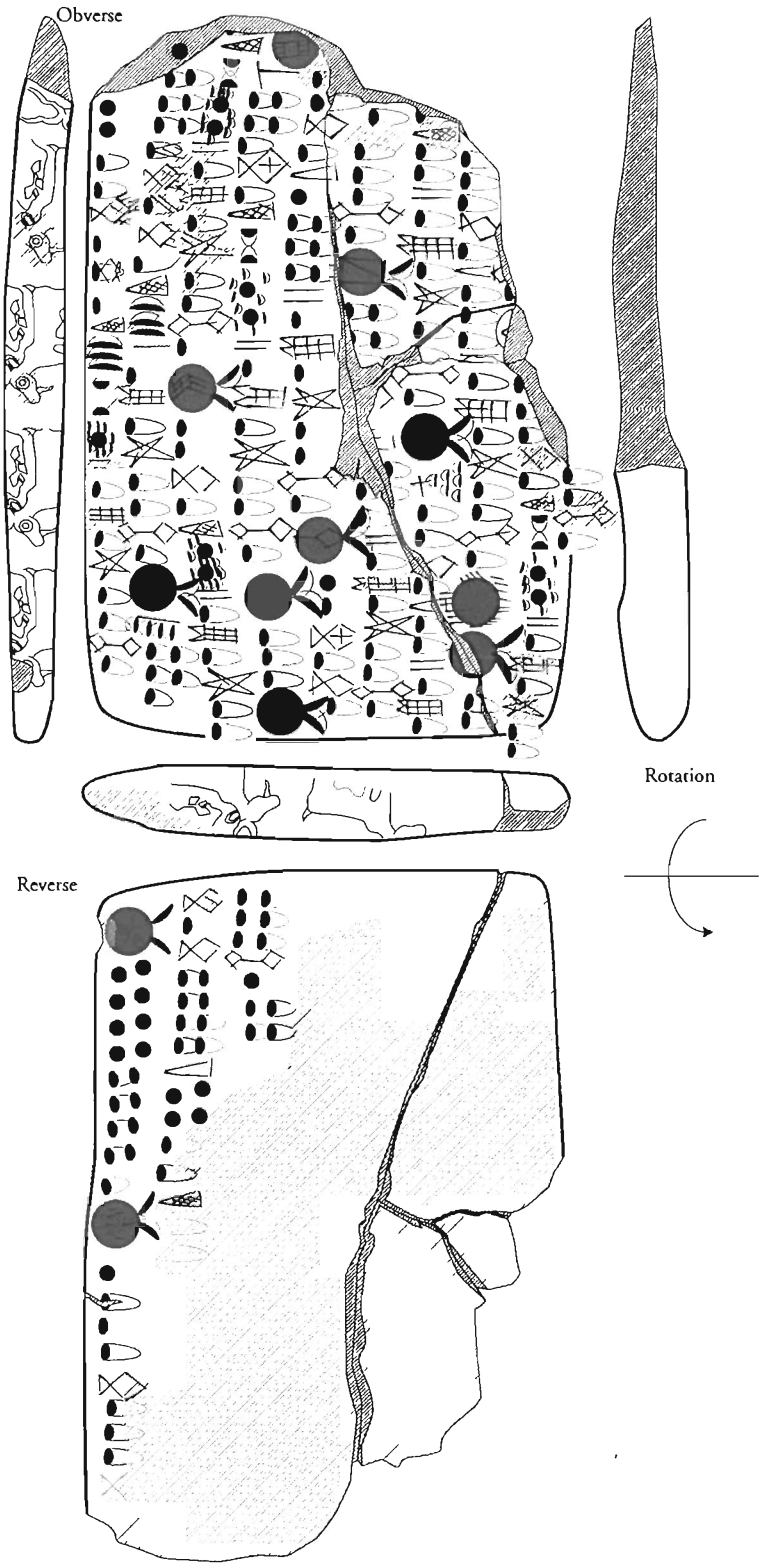


Fig. 15 – Text C (= MDP 17, 97; Sb 6353; 165x110x32 mm).

The first entry of both text B and C is missing, or partly damaged, but we may suggest, in line with text A, that neither text had an actual header, but began listing the first entry directly.

In both texts the products are recorded in a fixed order, with only minor differences when listing products of the two first categories. There are several erasures in text C, but due to our limited understanding of proto-Elamite it is difficult to understand the processes behind these. Two entries of text B list both nanny goats and male kids (M362 and $M367_a$), whereas at least one of the corresponding entries in text C lists nanny goats and female kids (M362 and $M362_a$). In either text the overwhelming majority of the animals are of the first, and apparently most important kind, the nanny goat (M362). It is not completely clear why nannies are listed here in the production accounts, since we would expect for example male kids to represent parts of the yearly "production" delivered together with dairy-products, goat's hair, and hides, etc. In the receipt, text E, quoted below we find a much higher number of nannies, and in the account of the herds, text A, we also find numbers of nannies of up to ten times higher than in text B or C. Finally, in the receipt, text F, cited below (perhaps belonging to a later phase of the writing-system) we find billies at exactly the place where we find nannies in text B, C, and E. Is it possible that each nanny goat listed in text B, C, and E, actually represented a kid, or a certain increase in the herd?

After the animals, each text lists a number of products in a completely fixed hierarchy (see figure 16). The first product is either M260 or $M269_{(a)}$ (avoid the index in Dahl 2005, figure 4) or both. The next entry counts M106 or $M106_a$. $M106_a$ is counted in the capacity system C, whereas M106 is apparently counted in the bisexagesimal system. The third entry is M9, the fourth $M206_g$, the fifth $M102_e$, and the last is $M309_a$; all presumably counted in the bisexagesimal or the sexagesimal system. We shall discuss the possible identification of some of these products below.

Text C is sealed, text B is apparently not. It can be difficult to detect a seal on a proto-Elamite tablet since the seals were rolled over the inscription, sometimes blending in with this. When the seal is rolled on a blank surface, such as the edge, it is easily detectable. The seal impression found on text C is also found on MDP 17, 444, and MDP 17, 105. It was published as number 147 in Legrain 1921, and as number 924 in Amiet 1972.

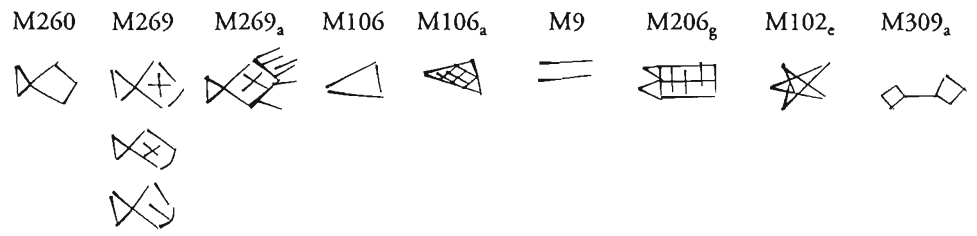


Fig. 16 – Products found in text B and C.

Other types of documents dealing with animals and animal products exist. However, the structure of the documents discussed here is, by far, more complex than that of any other text from Susa concerning herded animals known to me. See for example MDP 17, 241 a similar account; it uses a somewhat different terminology, and may belong to a different archive or a different period. It does include some products, but does not display the same complexity as text A. MDP 17, 253 is a fragment of a document similar to MDP 17, 241, perhaps even the same tablet?

Primary documents

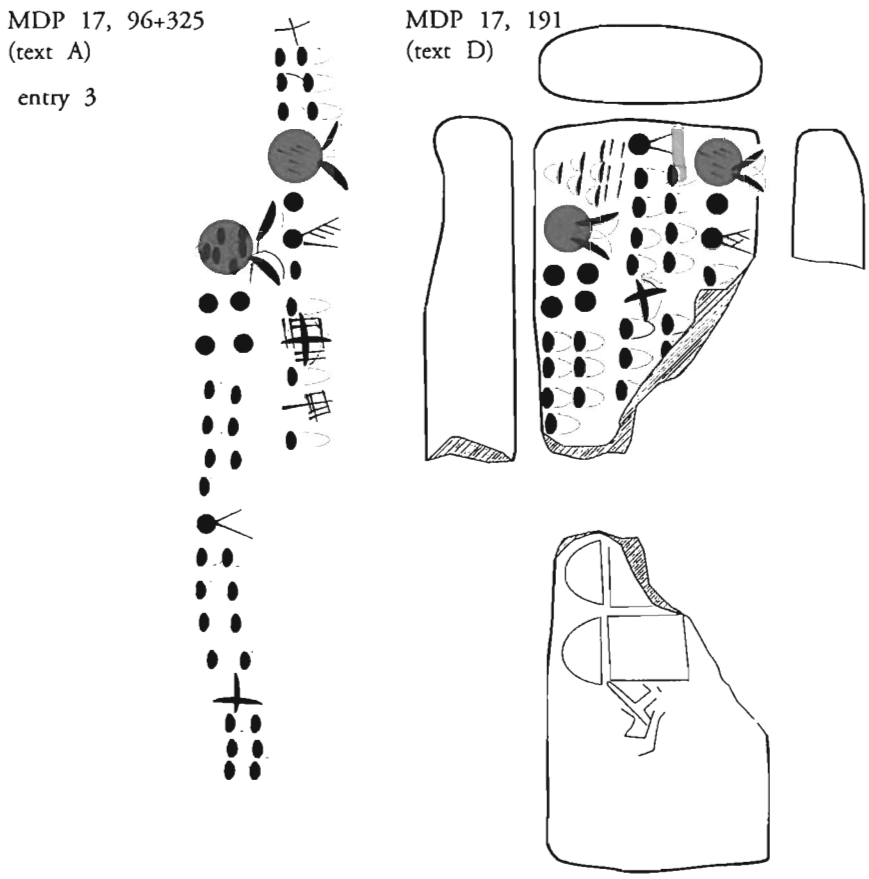
In his groundbreaking research the Soviet scholar V. V. Struve discussed and demonstrated the concrete relationship between the accounts and receipts in the Ur III administration (Struve 1969, 156-157). Nothing comparable to the sophisticated bookkeeping system known from the Ur III period (ca. 2100 – 2000 BC) has so-far been attested in earlier Mesopotamian societies. Here I have tentatively suggested that documents with only a single entry can be described as primary documents or receipts. When dealing with animal herding, a single entry is defined as one flock, or the production from one flock. In the following we shall see how the Susa administrators employed a system of accounting comparable in scope albeit not in scale to that of the Ur III state.

Given the disastrous excavation history of Susa it is surprising to observe that targeted studies still enable the reconstruction of specific ancient archives. Two problems impose themselves however. First, the few proto-Elamite tablets found during controlled excavations, some of which can be shown to be intimately related to texts found during Morgan's and Mecquenem's excavations (compare CahDAFI 1, 58: 1, to MDP 17, 153, both tablets have the same scribal design on the reverse), were not found in a context that is suggestive of large archives and a centralized administration (see the tablets published by Vallat 1971, figure 58, and compare the find spot information with Le Brun 1971, 178-179; 189-199; and 196, and figures 31 through 34). Second, even a brief survey of the hand-writing found on the more than 1,000 proto-Elamite tablets stored at the Louvre Museum suggests that the number of scribes who wrote these documents can be counted in the tens (surveys such as measuring specific signs to compare the writing-tools can in this regard be very valuable), conforming to the information from the introduction to Scheil 1923, that the early finds consisted of a few major lots.

However, we may speak about Susa archives since at least one primary document can be shown to relate directly to one of the accounts (see already Dahl 2005, § 4.7; see also Stolper 1985, 10-11 for a likely identification of receipts and accounts in the Malyan texts). Text D (=MDP 17, 191) is the primary document used to record the third entry of text A. It is sealed, whereas text A is not. Text D has been partially reconstructed using text A. The reverse of text D is, as expected, not inscribed. The seal found on text D is listed as number 930 in Amiet 1972 (= 223 and 222 in Legrain 1921). The same seal is found on MDP 17, 242, a document which is similar to text D, and on MDP 17, 444. MDP 17, 444 is a fragment of a large account, presumably concerned with, among other things, by-products from dairy farming. It will not be discussed here. The seal seems to represent humans(?) car-

rying sacks up a ladder leading to a structure with a domed roof, perhaps a silo? See Mecquenem 1934, 183 for a brief discussion of this seal in relation to an actual grain silo found *in situ* at Susa. According to the standard view humans were not represented on proto-Elamite glyptic; however, the tablets mentioned here may belong to the earliest period of the use of the proto-Elamite script, when seals with Uruk IV motifs were still in use in Susa. It is also possible to interpret the figures on the seal as animals doing human chores, a well-known motif from Susa seals. It is important to note that MDP 17, 444 is sealed with two distinct seals, numbers 924 and 930 (from Amiet 1972). We saw above that seal 930 was found on three tablets (it was also found on a sealing, that object has since been lost, see Amiet 1972, 134). Seal 924 is also found on three tablets, namely the accounts MDP 17, 97, our text C; and MDP 17, 105 (Amiet 1972, 133). MDP 17, 105 and our text A are strikingly similar. Many of the signs for owners found inscribed in, or bundled with the first animal-signs in text A can also be found in MDP 17, 105. A study of the seal-impressions and scribal marks found on the proto-Elamite tablets is in preparation by the author.

For a comparison of text D to text A see figure 17. The seemingly free formation of complex graphemes in proto-Elamite was discussed in Dahl 2005; the two texts presented in figure 17 form part of the core argument behind the claims in that article.



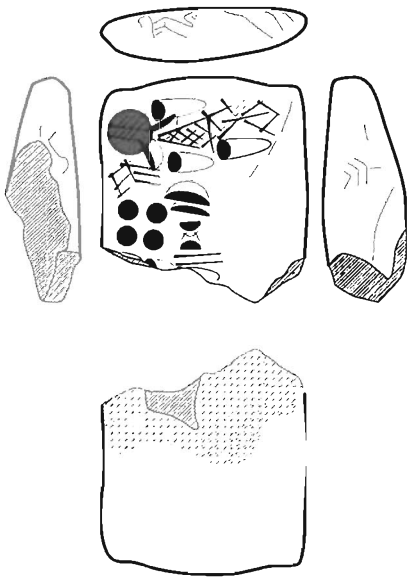
Text A (entry 3)
Obverse
Column 1
03. M362+M384$_a$, 4N$_{14}$ 7N$_1$
03a. M367 , 8N$_1$
03b. M346 , 6N$_1$
03c. M6 , 6N$_1$
03d. ⌜M362$_a$⌝ , 1N$_{14}$
03e. M367$_a$, 2N$_1$
03f. M346$_a$, 1N$_1$
03g. M8$_b$, 1N$_1$

Text D
Obverse
Column 1
01. M384$_{ab}$ M362 , 4N$_{14}$ 7N$_1$
02. M367 , 8N$_1$
03. M346 , ⌜6N$_1$⌝
04. [M6] , [6N$_1$]
05. M362$_a$, 1N$_{14}$
06. ⌜M367$_a$⌝ , ⌜2N$_1$⌝
07. [M346$_a$] , [1N$_1$]
08. [M8$_b$] , [1N$_1$]

Fig. 17 – Text D (= MDP 17, 191; Sb 6355; 64x41x17 mm), and entry 3 of text A.

Text E (=MDP 17, 182) is another primary document which can perhaps be related to one of our accounts, although it is not a direct match. Text E is broken, but we are able to reconstruct it using the information from texts B and C. The document is presumably a receipt (note that a seal-impression is visible on all the edges but not on the reverse) calculating the number of nannies (M362) in a flock, and the (anticipated?) production. See figure 18 for a copy of text E. The list of products is similar to that found in any of the entries in the two production records (text B and C). However, there are ten times the number of nannies recorded in text

E as in the average entry of text B or C. This more likely corresponds to the number of nannies recorded in text A. Most of the deliveries of products are apparently not dependent on the number of animals, except $M106_a$, which is always recorded at a rate of $1N_{30c}$ to one M362 (see below).



Text E
Obverse
Column 1
01. $M362_{gc}$ $M59_d$, $4N_{14}$ ⌜$5N_1$⌝
02. [M269] , $1N_1$
03. ⌜$M106_a$⌝ , $1N_1$ $2N_{39b}$ $1N_{24}$
04. ⌜M9⌝ , ⌜$1N_1$⌝ [...]
05. [$M206_g$] , [...]
06. [$M102_d$] , [...]
07. ⌜$M309_a$⌝ , $1N_1$

Fig. 18 – Text E (= MDP 17, 182; Sb 22353; 39x37x13 mm).

Administration of herded animals in Susa

The three herding accounts discussed in this section are unique for two reasons. First, they contain evidence of a system of "consecutive accounts". Second, we can isolate a set of production rates, comparable to those found in both contemporary and later Mesopotamian sheep and goat herding texts.

Evidence for a system of consecutive accounts

Although it is perhaps impossible to prove, the two production accounts discussed here show certain features indicative of a system of "running accounts" abundantly attested in later Mesopotamian administrative systems. That is, it seems reasonable to assume that the two texts B and C were accounts concerning two consecutive accounting periods. This is not only based on the fact that the two accounts are surprisingly similar in structure, with only minor differences in the content—even the break-pattern suggests that the two texts were stored together—it is also based on a certain logical suggestion of the accounting span inferred from the production numbers (see below).

Production-rates

Damerow and Englund (1989), following Friberg (1978-79), showed the existence of certain fixed relationships in proto-Elamite texts between a particular sign, or sign-group, and a particular amount of what can be inferred to be a grain prod-

uct (see figure 19, below, for some known relationships in proto-Elamite texts). Grain-products in the proto-Elamite corpus have been identified partly by analyzing the numerical systems by which they are counted; it is presumed that these systems have identical application in both proto-cuneiform and proto-Elamite.

In eleven very similar texts we find a relationship between one unit of the sign-group M54 M388 and $2N_{39b}$ $1N_{24}$ (= 1/2 N_1) of the product M288, counted in the capacity system C (Friberg 1978-79, 26-28; and Damerow and Englund 1989, 27). The eleven texts with this relationship are of approximately the same size (with an approximate mean size of 67x45x16 mm), and they are sealed with either seal number 329 or 334 in Legrain 1921. These texts have a number of structural features in common as well; 1) they have only one entry; 2) the header is the same in all texts (M157; except for MDP 26, 99 which has as the header $M387_1$); 3) the entry is followed by a rather lengthy subscript; 4) and as far as can be established they all have a top-edge inscription ($1N_{34}$). The texts are MDP 6, 223; 236; MDP 17, 67; MDP 26, 99; MDP 26S, 295; 4752; 4773; 4783; 4802; 4803; and 5043. This and other like groups of texts should form the basis for further grapho-tactical investigations, aimed at deciphering proto-Elamite. Damerow and Englund suggested that these texts concerned the monthly rations for people plowing the fields; partially based on the fact that $2N_{39b}$ $1N_{24}$ equals 30 times $1N_{30d}$, the unit believed to correspond to the Mesopotamian unit for a daily ration.

In a number of texts we find a relationship of one pictogram of a plow (M56) to $2N_{39b}$ of the product M288 (see first Friberg 1978-79, 19-20; and see Damerow and Englund, 34 and fn. 159 for a discussion of both this, and the previous set of equivalences). The hypothesis of Damerow and Englund, upheld here, is that this is in fact a sowing rate or an implicitly stated area of measure (one plow (M56) = 2 iku = c. 1 3/4 acre or 0.72 hectares).

Finally, we are tempted to designate certain texts as fodder-texts due to the fact that certain signs for animals appear in a fixed relationship to certain quantities of what is assumed to be grain-products. These relationships appear to resemble fodder-rations known from later Mesopotamian sources, albeit not as abundantly attested (see above under the discussion of M348, and cf. Damerow and Englund 1989, 55 fn. 147).

In the Susa animal herding texts we find a relationship between one nanny goat (M362) and $1N_{30c}$ of the product $M106_a$ (see Appendix A for factor-diagrams of all numerical notations in this paper). Based on an identification of this product as dry cheese (see below), and an estimate of production rates and obligations, this amount may be assumed to correspond to a yearly delivery.

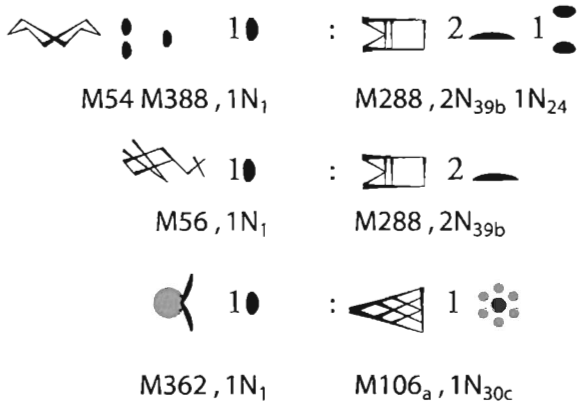


Fig. 19 – production-rates.

Administrative units

There exists no visible relationship between the numbers of nannies in the production accounts (text B and C) and nannies in the flock registry (Text A). However, we can extrapolate a surprisingly coherent list of "owners" from the three texts. Due to the fragmentary state of preservation we are unable to reconstruct the list in full, but we can show that the list was not identical in the three documents. This is indicative of two things, first, that the texts are actual administrative documents relating to real economic situations, and second, that no master-document, or "lexical" list, existed, which recorded important houses, or titles, in a fixed form as is known from early Mesopotamia.

The signs that are inscribed in, or bundled with M362, are believed to represent the "owners" of the animals (see Dahl 2005, § 4.9). The majority of these signs are attested in the same capacity in other documents. Few of them are unique to the animal herder texts. However, there seems to be a subtle change between some owner signs from text to text, for example the owner sign in text E is not identical with any of the owner signs in the three accounts (A, B, and C), although it is a composite made up of signs found in these. Note in this regard the system of *tamaga's*, or horse brands, from Mongolia, described in Waddington 1974. Waddington even suggested that such a system could be interpreted as a fore-runner of writing (Waddington 1974, 484). The subtle change recorded here could also refer to intricate familial or "political" constructions in Susa escaping our limited understanding of that society.

Five of the fourteen households can be found in all three texts (text A, entry 4 = text B, entry 3 = text C, entry 3; text A, entry 5 = text B, entry 12 = text C, entry 10; etc.); several of the remaining signs or sign-clusters can be found in two texts. Note that entry 11 of text C is partly visible on the hand-copy in MDP 17, but completely abraded today. The total number of entries is reconstructed partly based on the fact that each entry counts one N_1 of the product $M309_a$, sumarized in text C as 14 units (counted in the bisexagesimal system B). Following this, it is possible to reconstruct the basic structure of the missing parts of both text B and C, whereby a total of 14 units is obtained.

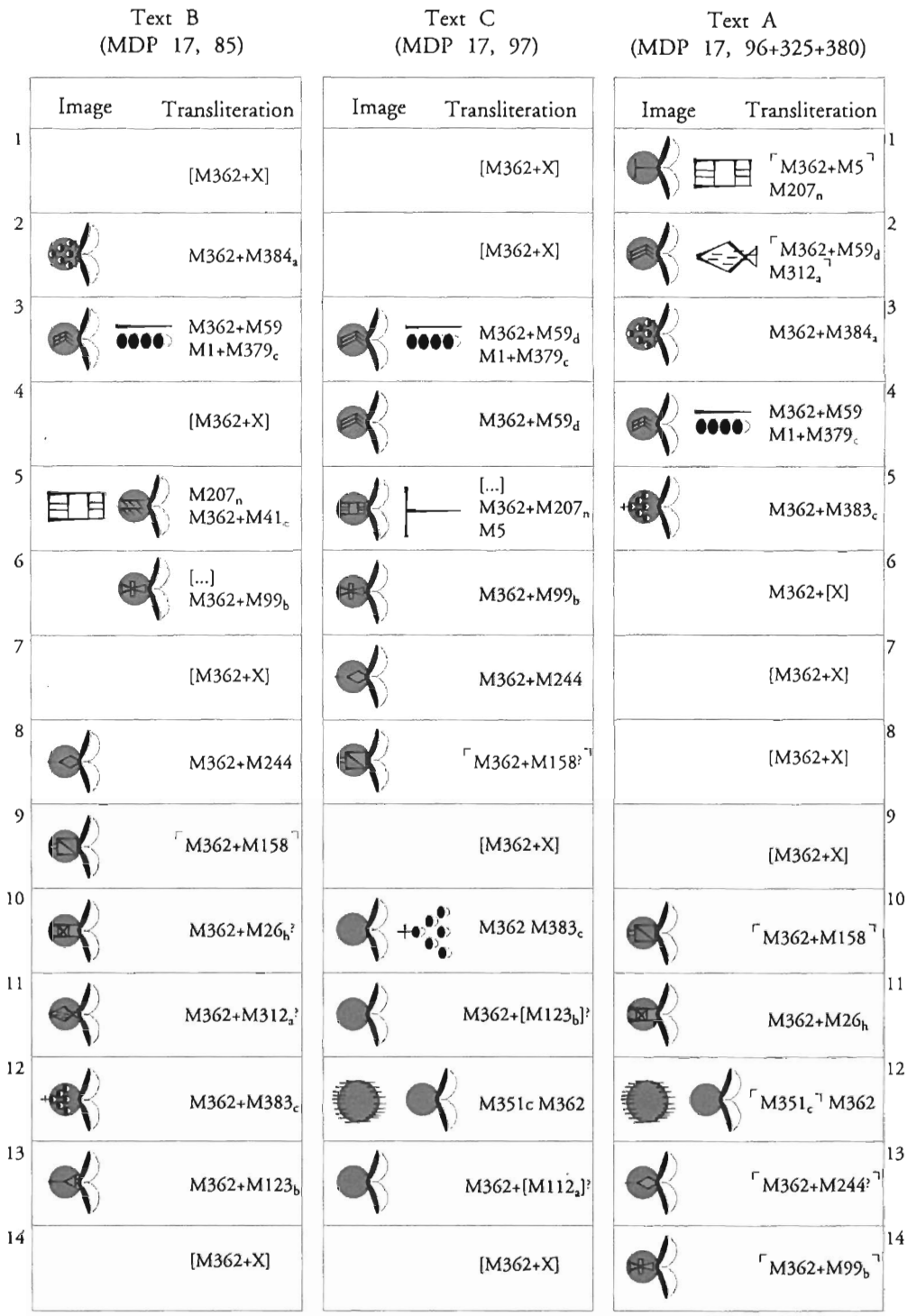


Fig. 20 – List of administrative units.

Identification of products

The first two products in the production accounts (texts B and C), as well as in the corresponding receipt (text E), are M260 or $M269_{(a)}$, and $M106_{(a)}$. It may be assumed that the most important products obtained from a herd of sheep and goats are dairy products, followed by wool for sheep, goat-hair, hides and meat, as well as other products such as hoofs, tendons, horns, bones, etc. Dairy products, as it is well known, must be refined for preservation in the absence of refrigeration. As is also well researched, most cultures that practice dairy farming know of the process of producing butter-oil (also known as clarified butter, essentially water-free dairy fat) and dry cheese (basically fat- and water-free milk proteins) from raw milk. Butter-oil and dry cheese can be preserved almost indefinitely. It is therefore my hypothesis that the two first signs in our production account are to be interpreted as butter-oil and dry cheese (cf. Stolper 1992, 78, who identified the first with milk and the second with a grain product, based on the fact that it is counted in the capacity system C, generally used to note capacity measures of grain). The first sign, either M260 or a variant of $M269_{(a)}$, has a slight graphic resemblance to the Mesopotamian sign for butter-oil ($KISIM_{a/b}$, see already Damerow and Englund 1989, 52, who suggested an identification of $M269_a$ with a dairy-bottle, see also Englund 2004, 130, figure 5.19); whereas the second, $M106_{(a)}$, only through circumstantial evidence can be demonstrated to be dry cheese.

It has already been shown how 3rd millennium Mesopotamian dairy cattle herders had certain obligations to meet in exchange for herding the animals of the "state" (Englund 1995b). The same has been suggested for late 4th millennium dairy herders (Englund 1995a). As a general rule neo-Sumerian dairy cattle herders were obliged to deliver 5 liters of butter-oil and 7 1/2 liters of dry cheese annually per each adult cow, to the owners of the cattle. This can be shown to correspond to about one third of the milk left after feeding the calf, or ca. 100 liters of raw milk. Although these numbers are of course all very rough estimates they are based on the assumption that a dairy cow in a hot semi-arid environment produces ca. 600 liters of milk in one lactation period, and that half of this is given to the calf. The production from goats and the rate at which the goat-herder was obliged to return dairy products to the owners of the animals is not understood with equal detail. Late 3rd millennium goat herders (from Ur III Umma) had rates of fulfillment of 1/2 liter of butter-oil and 2/3 liter of dry cheese a year, corresponding to ca. 20 liters of raw milk, or much less than even a very pessimistic estimate of the yield from one nanny goat during one lactation period (Englund 1995b, 399 fn. 45). We can estimate very tentatively that a nanny goat from ancient Mesopotamia or ancient Susa produced half the amount of milk of a cow. Although the chemical make up of cow's milk and goat's milk is very different, they are rather comparable when it comes to the amount of fat, protein, and other solids (Teuber 1995, 25 table 1). Subsequently, 100 liters of goat's milk will yield about the same amount of butter-oil and dry cheese as 100 liters of cow's milk. The reason for the low delivery amounts from late 3rd millennium goat-herders must lay within the costs of herding and the expected profit. Dairy products from sheep's milk are almost absent from the Mesopotamian record of 3rd millennium BC, but attested in the 4th.

M260 and $M269_{(a)}$ are presumably counted in the sexagesimal system, a system reserved for discrete objects; see for example text F (MDP 17, 151) discussed below.

The derived sign $M269_{(a)}$ is formed by crossing the inside of M260; additional hatching of the sides can make it look as if there were strokes protruding from its sides. Unfortunately we are unable to estimate the absolute size of this jar.

In Uruk, shepherds returned one unit of $KISIM_a$ for every 20 ewes, and 1 unit of $KISIM_b$ (gunified $KISIM_a$) for every three to three and two-thirds nanny goats annually (Englund 1998, 147 – 148). We note for comparison that the Uruk container for dairy fat, $KISIM_{a/b}$ was also counted in the sexagesimal system. Green (who identified $KISIM_{a/b}$ with a fermented dairy product like buttermilk, or yogurt) suggested that $KISIM_a$ and $KISIM_b$ shared the same semantic qualities (Green 1980, 9). To Green the difference in sign forms could be purely abstract, referring to for example different production quantities. Englund, on the other hand, suggested that the gunified sign symbolized some form of visible difference in the jars used for butter-oil made from sheep and goat's milk. Products made from goat's milk are notorious for their "spicy" taste resulting from the particular make-up of the milk solids (note especially the high content of the three fatty acids capric, caprylic, and caproic, combined with the high values of casein B; see for example information made available from the American Dairy Goat Association at www.adga.com, for more on goat's milk).

The identification of $M106_{(a)}$ as dry cheese is based on both the fact that it is listed immediately after M260 / $M269_{(a)}$, and the production rate extrapolated from texts B, C, E, as well as other texts. Above we established a relationship of one unit N_{30c} (measured in the capacity system C) of the product $M106_a$ for each nanny goat. It is likely that this represented the annual delivery from the herder to the owner of the animals, as is the case in similar Mesopotamian texts, and not necessarily the entire production. One N_{30c} is presumably equivalent to between one and two liters (see Englund and Damerow 1989, 26-27 for a possible estimate of the absolute size of Susa capacity notations). If $M106_a$ is identified as dry cheese it would mean that the Susa herder delivered almost twice the amount of dry cheese as his Mesopotamian counterpart did 900 years later. Although this would amount to a poorer compensation of the Susa goat herder than of his neo-Sumerian counterpart, we are still dealing with rather low yearly deliveries of refined products, compared to the assumed total production of milk from each nanny.

If we accept the hypothesis that $M106_{(a)}$ represents some form of dry cheese produced from the goat's milk or sheep's milk, and by comparison that M260 / $M269_{(a)}$ represents the butter-oil from the same animals, then we must also assume that these accounts covered a period of what would be equivalent to one solar year (the lactation period of goats is 305 days). A monthly delivery of 1-2 liters of dry cheese per nanny goat is not possible. There are no recognizable indicators in either of the two production accounts suggesting that this was an account of one year, divided into 12 months for example. Certain proto-cuneiform texts dealing with dairy products and the growth of the herds are arranged in a similar way. These do, normally, include a time-notation corresponding to one year. However, it is likely and perhaps even possible to prove that Susa accountants operated with inferred systems of timekeeping rather than with explicit time-notations (cf. Englund 1988). Unfortunately we can not use the numbers of juvenile animals listed in our text A or D to assert whether these are actual annual documents (cf. Green 1980, 14 and passim).

The two products (butter-oil and dry cheese) are written with (at least) four different signs. For each pair we can isolate a main form and a graphically derived variant (formed by modifying the original, comparable to the procedure known as gunification in Mesopotamia). This pairing is analogous to the situation in Mesopotamia where butter-oil from ewe's milk is written with the sign $KISIM_a$; and butter-oil from nanny's milk is written with the sign $KISIM_b$—a gunified variant of $KISIM_a$ (see Englund 1995a, 45, figure 10, and note that Uruk sheep and goat herders did not, apparently, deliver dry cheese). Is it possible that the same distinction existed in Susa? Due to the fragmentary nature of the first couple of entries of text C it is hard to judge if signs $M269_a$ and M269 are mere graphical variants, or if the difference is semantic as well. The poorly preserved total of text C (see figure 15) appears to contain multiple entries of semantically distinct dairy bottles, suggesting a more complex system than the one described here.

As we have seen, some of the fourteen units of the two production accounts (text B and C) produced M260, while others produced $M269_{(a)}$. Likewise, some units produced M106, and others $M106_a$ (for images of the signs see figure 21, below). Does this differentiation relate to the make-up of the flocks? Even given the poor state of preservation of text A it is possible to give a tentative, but affirmative answer to this question. The flocks with a majority of nannies and female kids produced, as a rule the derived forms of the two products, that is $M106_a$, and $M269_{(a)}$ (compare entries number 3, 4, and perhaps 5 of text A, with entry 3 from text B, and entry 3 of text C). Whereas the flocks with a majority of ewes and female lambs produced M106 and M260 (compare entries 5 and 6 on the reverse of text A, with entry 9 from text B, and entries 7 and 8 from text C). We can visualize our findings in the following way (figure 21):

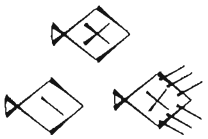
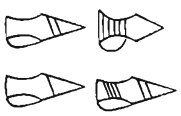
Product / Base	Butter-oil		Dry cheese	
	Susa	Uruk	Susa	Uruk
Sheep's milk	M260 	$KISIM_a$ 	M106 	$GA'AR_a$ 
Goat's milk	$M269_{(a)}$ 	$KISIM_b$ 	$M106_a$ 	(only attested for dairy cattle)

Fig. 21 – Susa and Uruk dairy products.

Following butter-oil and dry cheese we find four other products which are more difficult to decipher. The first of these products is written with the sign M9. It is clear that more semantically distinct signs were written with the same sign M9 (or two M1, a simple horizontal stroke). When M9 appears in the animal production accounts it is without doubt an animal by-product. However, M9 can also appear as part of the strings believed to be used exclusively to write personal names. I will not discuss the remaining products here.

Text F (figure 22)

Text F (MDP 17, 151) is a primary document with two entries, and a total. The overall structure of text F is identical to text E, discussed above. There are, however, substantial minor differences between text F and the other documents discussed in this study. The most important of these is that the owners in text F are described with a string of signs instead of only one sign as in the other texts discussed here. The "hand" of text F is also different from the other documents described in this study, and the strokes are "near-wedge" shaped.

Based on three arguments I will claim that text F belongs to a late phase of proto-Elamite writing, and that the other texts discussed here belong to an early phase. First, the scribal hand of text F resembles that of the texts found in levels 15 through 14B during the secure excavations of Susa in the 60's and 70's. The other texts described in this study have a stronger resemblance to the texts found in level 17B and 16. Information from the old French excavations of Susa supporting this line of argumentation is not readily available but we may suggest that for example the tablets published in MDP 6 and apparently found in the 1899 – 1900 season in trench 7 came from the same level as text F. One of the two texts reported in Morgan 1900, seemingly identical with the second of two texts published in Scheil 1900 (= MDP 6, 4996), and apparently found immediately below "Niveau II" (corresponding, presumably to level 14 in Le Brun 1971 figure 32), is more closely related to text F than to any of the other texts discussed here. The other text published in Scheil 1900 (= MDP 6, 399), and presumably found in the same layer as the one discussed above in fact resembles text A, B, C, D, and E more than F, at least with regard to structure. However, the handwriting of MDP 6, 399 is closer to text F than to the other texts.

The list of products in text F is the same as that found in the production accounts (text B and C), and the primary document text E. However, the form of certain signs is considerably different, this is summarized in figure 23. I suggest, therefore, that the change in sign-forms does not represent a regional or dialectical difference, but rather a temporal evolution in the repertoire. In fact, this can be shown to be likely by looking at the entire body of proto-Elamite texts. It is possible, in all cases, to describe the evolution of the sign-form in terms of a gradual alteration from one to the other, although intermediate forms are missing from the record. The sign-forms used in some of the animal-herder texts published in MDP 26 seem, in some cases, to be closer to those in text A, B, C, D, and E, and in others to be closer to text F. Collation may verify whether or not these texts belonged to a middle phase of the proto-Elamite writing-system.

If we look at the semantic properties we see an evolution as well. A sign like $M206_g$, for example, which is only found in the "early" texts mentioned in this

study, has only the same semantic use described here (i.e. an animal by-product). The sign replacing it in MDP 17, 151, $M292_f$, on the other hand, which is found exclusively in texts assumed to belong to the later phase of the writing system appears to have multiple semantic meanings. The same can be applied to the early sign $M102_e$ and its late form $M102_d$.

The third argument used here to describe text F as a late text is the micro-structure. Whereas the first five texts discussed in this paper described owners with one sign, often clustered or inscribed in the object sign it was qualifying, text F describes the two owners with more than two signs each (owner one: line 2; owner two: line 9). The text also contains a real header. This is in good agreement with what can be observed from the few texts found in secure excavations where the only texts with long strings of signs were found in level 15 and 14B, whereas texts found in levels 17 and 16 can be compared to the texts described on the first pages of this paper.

Finally, such an increased complexity as the one described above is best described as referring to a temporal evolution in the sign-repertoire, considering also that the texts come from the same limited geographical area.

As noted above (section 2, discussion of text B and C), text F lists billy goats, and not nannies as the first entry, further suggesting that these documents are true yearly production records of herded animals. Unfortunately it is not possible to estimate the increase in the herd, since we do not have the corresponding herd account nor the corresponding production account.

The two products shown in the first line of figure 23, below, M309, $M206_g$, along with the sign for a nanny goat, M362, are given here in accordance to the forms we find in texts B and C. The same products are found in text F, however, with substantial graphic alteration, here presented in the second line of figure 23. Note, that $M309_a$ in text E is drawn somewhat closer to the later version of that sign ($M246_m$). M359 is also found in MDP 6, 362; MDP 26, 152 and 350. It is only possible to argue for an identification of the sign as a variant form of M362 in the two last text examples.

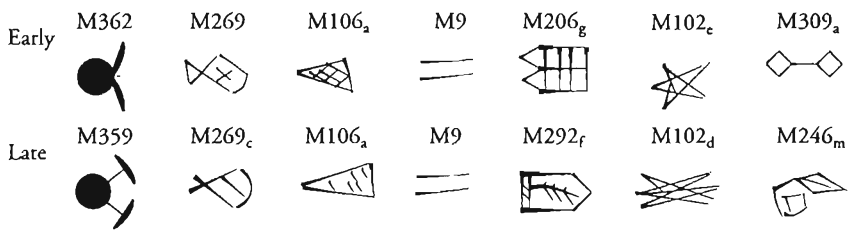
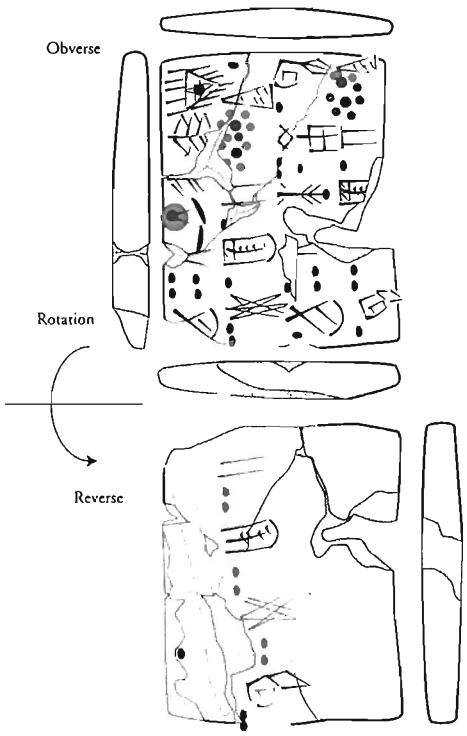


Fig. 23 – Evolution of sign-forms: the sign-forms in the first line are given according to texts A, B, C, D, and E, and in the second line according to text F.



Obverse
Column 1
1. M136+M365 ,
2. M125 ⌜X⌝ M359 M367 , $4N_1$
3. $M269_c$, $1N_{8a}$
4. $⌜M106_a⌝$, $2N_{30c}$
5. M9 , $1N_1$
6. $⌜M292_f⌝$, $1N_1$
7. $M102_d$, $2N_1$
8. $M246_m$, $1N_1$
9. $M209_c$ M388 $M80_a$ ⌜X⌝ ⌜M367⌝ , $4N_1$
10. $M269_c$, $⌜1N_{8a}⌝$
11. $⌜M106_a⌝$, $2N_{30c}$
12. M9 , $1N_1$
13. $⌜M292_f⌝$, $[1N_1]$
14. $[M102_d]$, $2N_1$
15. $M246_m$, $1N_1$

Reverse
Column 1
1. [...] , [...]
2. [...] , $⌜1N_1⌝$
3. M9 , $2N_1$
4. $M292_f$, $2N_1$
5. $M102_d$, $4N_1$
6. $M246_m$, $2N_1$

Fig. 22 – Text F (= MDP 17, 151; Sb 22329; 65x52x18 mm).

3. Conclusions

In this article we have discussed both Susa animal terminology and Susa animal husbandry according to the written sources from that city during the period known as the proto-Elamite period, dating to sometime around 3000 BC. Susa animal terminology shares many signs and features with the slightly older and much better understood proto-cuneiform writing-system. However, sharing a common set of signs and organizing principles did not apparently, have the effect of a complete take-over of the sign-inventory used by the Mesopotamian scribes describing domesticated animals. Rather, I suggest, based on the results of this study, that the Susa scribes used and expanded on a common sign-repertoire pertaining to herded animals—used in both Mesopotamia, and South-Western Iran, and perhaps beyond—in a surprisingly indigenous way.

Whereas the proto-cuneiform signs for sheep and goat were abstract, the corresponding cattle terminology was not. Susa cattle terminology still escapes us, but signs for bovines may closely resemble signs for certain groups of humans; they are thus not missing but merely hiding in the vocabulary.

In order to advance the identification of Susa animal signs we accepted the hypothesis that proto-Elamite M346, and proto-cuneiform UDU have common roots and identical semantic application. M346 appears to be the sign for an adult female sheep, an ewe. This identification was based not only on its graphic and semantic similarities with proto-cuneiform UDU, but also on its relations to other

signs for herded animals and its general use in proto-Elamite. Unfortunately, we could find little or no proof that M346 possesses all of the same qualities as Late Uruk UDU: M346 does not seem to function as a summarizing sign for sheep and goats. By accepting that first identification (M346 = UDU), certain other signs for animals were identified, and we were able to suggest a reconstruction of the Susa animal terminology (figure 9), based not only on logical arguments but also on a thorough analysis of the entire corpus of proto-Elamite texts.

Of course, it is not surprising to find that the people of Iran herded sheep and goats even in the proto-Elamite period. What is surprising, and shown here for the first time, is the degree of control exercised by the central organization in keeping detailed records of this activity. The textual sources from Susa, therefore, do not support the statement in Zeder 1991, 25, that "herding sheep and goat is not an activity, however, that lends itself to central control" (note that Zeder does not place much economic importance on milk products, page 34). The Susa bookkeeping procedures are surprisingly sophisticated, suggesting an extensive administrative apparatus. The static nature of the deliveries in the two production records is suggestive of a highly developed administrative system of requirements. Systems with fixed delivery or production rates often operate based on delivery norms, resembling a planned economy of sorts.

We also rudimentarily explored the use of seals, concluding that specific seals were related to specific offices, further that the iconography on proto-Elamite seals may relate to the activities of these offices. Future studies of the proto-Elamite archives will aim at establishing such links.

Apparently two sets of documents followed each flock of animals. One set consisting of primary and secondary documents tallied the size of the flocks, another set, likely made up of both receipts and accounts as well, computed the production of the same flock. We can estimate, but not prove, that the two by-product accounts (text B and C) were year's-end accounts, based on supposed production rates. It has long been the hypothesis that time-notations in proto-Elamite were inferred from the grain-notations. It is still impossible, due to the vexing state of publication, to show whether the top-edge notations found on many proto-Elamite tablets had any relations to a time-notation system.

The presentation here will hopefully aid the further advancement in the decipherment of proto-Elamite. The identification of classes of semantically distinct groups of signs is believed to be essential to this process. The finding that certain signs developed over time not only in graphic shape but also semantically may have great importance for our understanding of proto-Elamite. While deciphering the signs for various domestic animals, and the production obtained from this activity we observed, that the Susa scribes operated with a system of main forms and derived forms. Signs for young animals were formed by hatching the "legs" of signs for adults; signs for products obtained from goat's milk were formed by hatching the signs for products obtained from sheep's milk. This sort of proto-Elamite "gunification" (a term we adopted from cuneiform-studies) can also be observed in the hypothesized syllabary used to write what has been postulated to represent names. Common signs used exclusively to write certain strings believed to represent names have both a main and a derived form (see figure 24). One of these ($M102_d$) is identical with the late form of one of the product signs from the list of products distilled from text F discussed in this paper.

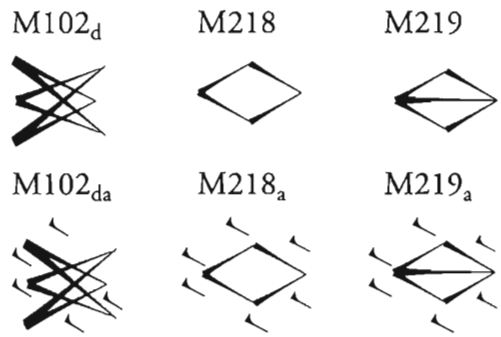


Fig. 24 – Proto-Elamite gunification.

We have also shown that it is possible to distinguish two phases of writing in Susa during the proto-Elamite period, and a clear development in the sign-forms between these two. We also briefly investigated the possible evolution of the semantic qualities of the signs moving from the early texts to the late.

At present, nothing is known of the links between the proto-Elamite writing-system and speech, and in the case of the early texts (A, B, C, D, and E), at least, it is unlikely that the system encoded much if any linguistic information (compare Damerow 1999, and Farmer, Sproat and Witzel 2004). On the other hand, it is possible that later texts, such as text F, may hold some speech coding, as suggested by the inclusion of much longer strings of non-numerical signs, and by indications of polyvalency in the use of those signs. While it cannot be proven at present, the possibility remains open that some of these longer sequences may have encoded some type of phonetic data, possibly involving the *ad hoc* use of rebuses or puns to write personal names, as is known to occur in a number of primitive "picture writing" or mnemonic systems, lacking a systematic syllabary. Whether or not *ad hoc* phoneticism of this type existed in proto-Elamite, or whether it may even have undergone some level of standardization, can only be known when the entire corpus has been re-edited and made available for study.

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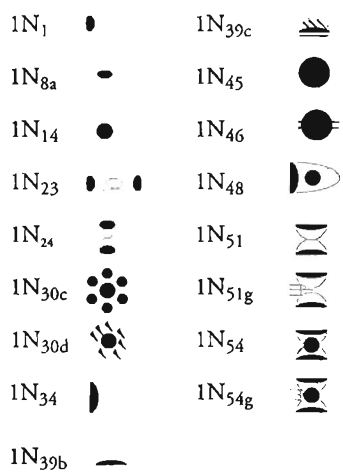
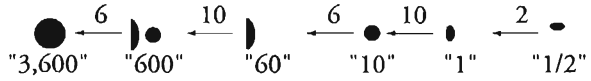
Appendix A: numerical signs in the proto-Elamite texts from Susa; and a reconstruction of the numerical systems used in the texts from the same city, explained as factor diagrams (adapted from Englund 2004)

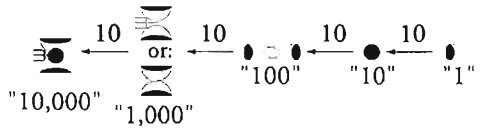
Numerical signs found in the proto-Elamite texts from Susa.



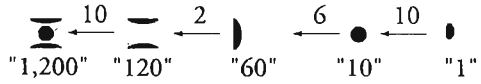
Sexagesimal System S
System used to count discrete inaimate objects.



Decimal System D
System used to count discrete aimate objects, in particular domesticated animals and human laborers.

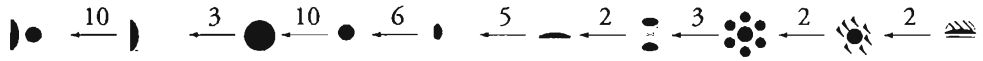


Bisexagesimal System B
System used to count discrete grain products; objects noted with this system may, as in archaic Babylonia, belong to a rationing system.

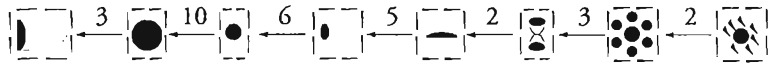


Bisexagesimal System B#
System derived from the bisexagesimal system B, used to count rations (?) of an unclear nature.

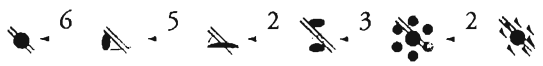
Capacity System C
System used primarily to note capacity measures of grain, in particular barley; some of the small units also designate bisexagesimally counted cereal products.



Capacity System C#
System derived from the capacity system C, posibly related to system B#



Capacity System C''
System derived from the capacity system C, graphically related to the Babylonian system used to measure emmer.



Appendix B: proto-Elamite signs

M1		Unknown multiple semantic meanings?
M5		"Household"
$M5_a$		"Household"
M6		Animal adult male sheep
$M6_a$		Animal juvenile male sheep
M9		Multiple semantic meanings by-product from animal herding
M54		Uncertain team of workers or animals
M56		Plough
$M102_d$		Multiple semantic meanings by-product from animal herding non-object
$M102_{da}$		Non-object
$M102_e$		Object by-product from animal herding
M106		Dry-cheese from sheep's milk?
$M106_a$		Dry-cheese from goat's milk?
M157		"Household"
$M206_d$		Animal?
$M206_g$		Object by-product from animal herding
M218		Non-object
$M218_a$		Non-object
M219		Non-object
$M219_a$		Non-object
$M246_m$		Object by-product from animal herding
M251		Unknown
M260		Butter-oil from sheep's milk?
M269		Butter-oil from goat's milk?
$M269_a$		Butter-oil from goat's milk?
M288		Grain container
$M335_a$		Animal
$M335_b$		Animal
$M335_c$		Animal
$M335_d$		Animal
$M335_e$		Animal
$M334_a$		Animal
$M334_b$		Animal
$M334_c$		Animal
$M336_d$		Animal
$M336_a$		Non-object
$M336_b$		Non-object
$M336_c$		Non-object

Appendix B: proto-Elamite signs

M292$_f$		Object by-product from animal herding	M367$_a$		Animal juvenile male goat
M309$_a$		Object by-product from animal herding	M367$_b$		Animal juvenile male goat
M332$_a$		Non-object	M367$_c$		Animal juvenile male goat
M332$_c$		Non-object	M367$_d$		Animal juvenile male goat
M332$_d$		Non-object	M367$_e$		Animal male goat ?
M340		Non-object	M367$_f$		Animal male goat ?
M346		Animal adult female sheep	M367$_g$		Animal male goat ?
M346$_a$		Animal juvenile female sheep	M367$_i$		Animal adult male goat
M346$_c$		Animal adult female goat?	M368$_a$		"Household" ?
M347		Non-object	M368$_b$		"Household" ?
M348		Animal?	M368$_c$		"Household" ?
M359		Animal adult female goat	M376		Human?
M362		Animal adult female goat	M387$_l$		"Household"
M362$_a$		Animal juvenile female goat	M388		Human worker
M362$_b$		Animal juvenile female goat	M390		"Household"
M367		Animal adult male goat	M391		"Household"

Appendix C: Transliterations of texts A, B, and C

Text A = MDP 17, 096+325+380

Obverse

Column 1

1. M362+M5 $M207_b$, $2N_1$
1.a. M367 , $2N_1$
1.b. M346 , $4N_1$
1.d. $M362_a$, $1N_1$
1.f. $M346_a$, 1 N_1
2. M362+$M59_d$ $M312_a$, 6 N_1
2.a. ⌜M367⌝ , ⌜$4N_1$⌝
2.b. M346 , $1N_1$
2.d. $M362_a$, $2N_{14}$ $3N_1$
2.e. $M367_a$, $7N_1$
2.f. $M346_a$, $1N_{14}$
2.g. $M6_a$, ⌜3 N_1⌝
3. M362+$M384_a$, $4N_{14}$ $7N_1$
3.a. M367 , $8N_1$
3.b. M346 , $6N_1$
3.c. M6 , $6N_1$
3.d. ⌜$M362_a$⌝, $1N_{14}$
3.e. $M367_a$, $2N_1$
3.f. $M346_a$, $1N_1$
3.g. $M6_a$, $1N_1$
4. M362+M59 M1+$M379_c$, $4N_{14}$
4.a. M367 , ⌜$9N_1$⌝
4.b. [M346] , ⌜$2N_1$⌝
4.c. M6 , ⌜$3N_1$⌝
4.d. $M362_a$, $6N_1$
4.e. $M367_a$, $1N_1$
4.f. $M346_a$, $3N_1$
4.g. $M6_a$, $1N_1$
5. M362+$M383_c$, $1N_{14}$
5.a. [M367] , [...]
5.b. ⌜M346⌝ , ⌜$6N_1$⌝
5.c. M6 , $2N_1$
5.d. ⌜$M362_a$⌝, ⌜$2N_{14}$ $1N_1$⌝
5.e. [$M367_a$] , [...]
5.f. [$M346_a$] , [...]
5.g. [$M6_a$] , [...]

(two entries missing)

Reverse

Column 1

(two entries missing)

1.f. [...] , ⌜1N$_{1}$⌝
1.g. ⌜M6$_{a}$?⌝ , 1N$_{1}$
2. ⌜M362+M158⌝ , 1N$_{14}$ [...]
2.a. ⌜M367⌝ , [...]

(two or more lines missing)

2.d. ⌜M362$_{a}$?⌝ , 4N$_{1}$
3. M362+M26$_{h}$, 5N$_{1}$
3.a. M367 , 2N$_{1}$
3.b. M346 , 1N$_{1}$
3.d. ⌜M362$_{a}$?⌝ , ⌜6N$_{1}$⌝
3.e. [M367$_{a}$] , 1N$_{1}$
3.f. ⌜M346$_{a}$⌝ , 1N$_{1}$
3.g. ⌜M6$_{a}$⌝ , 1N$_{1}$
4. ⌜M351$_{c}$⌝ M362 , 3N$_{1}$
4.a. M367 , 1N
4.d. M362$_{a}$, 1N$_{14}$ 1N$_{1}$
4.e. ⌜M367$_{a}$⌝ , [2N$_{1}$]
4.f. [M346$_{a}$] , ⌜2N$_{1}$⌝
4.g. M6$_{a}$, 1N$_{1}$
5. ⌜M362+M244?⌝ , 3N$_{14}$ 3N$_{1}$
5.a. M367 , 6N$_{1}$
5.b. ⌜M346?⌝ , ⌜1N$_{14}$ 4N$_{1}$⌝
5.c. [M6?] , 2N$_{1}$?⌝
6. ⌜M362+M99$_{b}$⌝ , 2N$_{14}$ 1N$_{1}$
6.a. ⌜M367⌝ , 3N$_{1}$
6.b. M346 , 1N$_{14}$ 9N$_{1}$
6.c. [M6?] , [...]
6.d. ⌜M362$_{a}$⌝ , ⌜6N$_{14}$⌝
6.e?. [M367$_{a}$?] , ⌜4N$_{1}$⌝
6.f. M346$_{a}$, N$_{14}$ 6N$_{1}$
6.g. M6$_{a}$, 7N$_{1}$

Text B = MDP 17, 085

Obverse

Column 1

1. [...] ,
2.a. [M362+X] , [x+1N_1]
2.b. [M260] , [...]
2.c. [M106$_a$] , [...]
2.d. ⌜M9⌝ , 1N_1
2.e. M206$_g$, 1N_1
2.f. M102$_e$, 2N_1
2.g. M309$_a$, 1N_1
3.a. M362+M384$_a$, 6N_1
3.b. M269 , 1N_1
3.c. [M106$_a$] , [...]
3.d. [M9] , [...]
3.e. ⌜M206$_g$⌝ , 1N_1
3.f. M102$_e$, 2N_1
3.g. M309$_a$, 1N_1
4.a. M362+M59 M1+M379$_c$, 5N_1
4.b. M269$_1$, 1N_1
4.c. M106$_a$, 1N_{24} 2N_{30c}
4.d. M9 , 1N_1
4.e. M206$_g$, 1N_1
4.f. M102$_e$, 2N_1
4.g. [M309$_a$] , [...]
5.a. [M362+X] , ⌜8N_1⌝
5.b. M269 , 1N_1
5.b. M106$_a$, 1N_{39b} 2N_{30c}
5.d. M9 , 1N_1
5.e. M206$_g$, 1N_1
5.f. M102$_e$, 2N_1
5.g. M309$_a$, 1N_1
6.a. M207$_n$ M362+M41$_e$, 3N_1
6.b. M260 , 1N_1
6.c. M106$_a$, 1N_{24}
6.d. ⌜M9⌝ , 1N_1
6.e. [M206$_g$] , [...]
6.f. [M102$_e$] , [...]
6.g. [M309$_a$] , [...]
7.a1. [...] M362+M99$_b$, 3N_1
7.a2. M367$_a$, 6N_1
7.b. M269 , 1N_1
7.c. M106 , 9N_1
7.d. M9 , 1N_1

7.e. $M206_{g}$, $1N_{1}$
7.f. $M102_{e}$, $2N_{1}$
7.g. $M309_{a}$, $1N_{1}$
8.a. ⌜M362+X⌝ , [...]
8.b. [M269?] , ⌜$1N_{1}$⌝
8.c. M106 , $3N_{1}$
8.d. M9 , $1N_{1}$
8.e. $M206_{g}$, $1N_{1}$
8.f. $M102_{e}$, $2N_{1}$
8.g. $M309_{a}$, $1N_{1}$
9.a. M362+M244 , $7N_{1}$
9.a. M269 , $1N_{1}$
9.b. M106 , $7N_{1}$
9.c. M9 , $1N_{1}$
9.d. [$M206_{g}$] , [...]
9.e. [$M102_{e}$] , [...]
9.f. [$M309_{a}$] , [...]
10.a. ⌜M362+M158⌝ , $5N_{1}$
10.b. $M269_{1}$, $1N_{1}$
10.c. M106 , $5N_{1}$
10.d. M9 , $1N_{1}$
10.e. $M206_{g}$, $1N_{1}$
10.f. $M102_{e}$, $2N_{1}$
10.g. $M309_{a}$, $1N_{1}$
11.a. $M362+M26_{h}$? , $2N_{1}$
11.b. M260 , $1N_{1}$
11.c. M106 , $2N_{1}$
11.d. [M9] , [...]
11.e. [$M206_{g}$] , [...]
11.f. [$M102_{e}$] , ⌜$1N_{1}$⌝
11.g. ⌜$M309_{a}$⌝ , $1N_{1}$
12.a1. ⌜$M362+M312_{a}$?⌝ , $3N_{1}$
12.a2. $M367_{a}$, $2N_{1}$
12.b. ⌜M269⌝ , $1N_{1}$ $1N_{24}$ $2N_{30c}$
12.c. M9 , $1N_{1}$
12.e. $M206_{g}$, $1N_{1}$
12.f. $M102_{e}$, $2N_{1}$
12.g. $M309_{a}$, $1N_{1}$
13.a1. $M362+M383_{c}$, $4N_{1}$
13.a2. $M367_{a}$, $1N_{1}$
13.b. [M269?] , [...]
13.c. [M106] , [...]
13.d. [M9] , [...]
13.e. [$M206_{g}$] , [...]
13.f. ⌜$M102_{e}$⌝ , $2N_{1}$
13.g. ⌜$M309_{a}$⌝ , $1N_{1}$
14.a. $M362+M123_{b}$, $4N_{1}$

14.b. ⌜M260⌝ , $1N_1$
14.c. M106 , $4N_1$
14.d. M9 , $1N_1$
14.e. $M206_g$, $1N_1$
14.f. $M102_e$, $2N_1$
14.g. $M309_a$, $1N_1$
15.a. [M362+X] , [x+$1N_1$]
15.b. [M269?] , [...]
15.c. [M106] , [...]
15.d. ⌜M9⌝ , ⌜$1N_1$⌝
15.e. $M206_g$, $1N_1$
15.f. ⌜$M102_e$⌝ , $2N_1$
15.g. ⌜$M309_a$⌝ , $1N_1$

Reverse

Column 1

1. ⌜M362⌝ , $6N_{14}$ $5N_1$
2. ⌜$M362_a$?⌝ , [...]
3.b. [...] , [...]
3.c. $M106_a$, $1N_1$ $1N_{39b}$ $1N_{24}$
(several entries missing)
3.g. [$M309_a$] , [$1N_{14}$] $4N_1$

Text C = MDP 17, 097

Obverse

Column 1

1.a. [M362+X?] , $2N_{14}$ $2N_1$
1.b. $M269_{a2}$, $3N_1$
($1N_1$ written over erased M269)
1.c. $M106_a$, ⌜$3N_{39b}$⌝ $1N_{24}$ $1N_{30c}$
($3N_{39b}$ partly erased (nail-marks))
1.d. M9 , $1N_1$
1.e. ⌜$M206_g$⌝ , $1N_1$
1.f. $M102_e$, $2N_1$
1.f. $M309_a$, $1N_1$
2.a. [M362+X?] , ⌜$1N_{14}$⌝ $7N_1$
2.b1. $M269_a$, $1N_1$
($1N_1$ written over erased $M269_b$)
2.b2. $M269_b$, $1N_1$
2.c. $M106_a$, $3N_{39b}$
2.d. ⌜M9⌝ , $1N_1$
(M9 partly erased (nail-marks))

2.e. $M206_g$, $1N_1$
2.f. $M102_e$, $2N_1$
2.g. $M309_a$, $1N_1$
3.a. $M362+M59_d$ $M1+M379_c$, $5N_1$
3.b1. [$M269_a^?$] , [...]
3.b2. [$M269_b^?$] , $1N_1$
3.c. $M106_a$, $1N_{24}$ $2N_{30c}$
3.d. M9 , $1N_1$
3.e. $M206_g$, $1N_1$
3.f. $M102_e$, $2N_1$
($M102_e$ partly erased (nail-marks))
3.g. $M309_a$, $1N_1$
4.a. $M362+M59_d$, $2N_1$
4.b. M260 , $1N_1$
4.c. $M106_a$, $2N_{30c}$
4.d. M9 , $1N_1$
4.e. $M206_g$, $1N_1$
4.f. $M102_e$, $2N_1$
4.g. [$M309_a$] , [$1N_1$]
5.a. ⌜$M362+M207_n$⌝ M5 , $5N_1$
5.b. $M269_3$, $1N_1$
5.c. $M106_a$, $1N_{24}$ $2N_{30c}$
5.d. M9 , $1N_1$
5.e. $M206_g$, $1N_1$
5.f. $M102_e$, $2N_1$
5.g. $M309_a$, $1N_1$
6.a1. $M362+M99_b$, $3N_1$
6.a2. $M362_a$, [...]
6.b1. [...] , ⌜$1N_1$⌝
6.b2. M260 , $1N_1$
6.c. M106 , $1N_{14}$ $6N_1$
6.d. M9 , $1N_1$
6.e. $M206_g$, $1N_1$
6.f. $M102_e$, $2N_1$
6.g. $M309_a$, $1N_1$
7.a. M362+M244 , $1N_{14}$ $1N_1$
7.b1. $M269_3$, $1N_1$
7.b2. M260 , $1N_1$
7.c. [...] , [...]
7.d. [M9] , [...]
7.e. [$M206_g$] , [...]
7.f. [$M102_e$] , ⌜$2N_1$⌝
7.g. $M309_a$, $1N_1$
8.a. ⌜M362+M158⌝ , $5N_1$
8.b. ⌜M260⌝ , ⌜$1N_1$⌝
8.c. ⌜M106⌝ , $5N_1$
8.d. M9 , $1N_1$

8.e. $M206_{g}$, $1N_{1}$
8.f. $M102_{e}$, $2N_{1}$
8.g. $M309_{a}$, $1N_{1}$
9.a. [M362+X?] , [...]
9.b. [...] , ⌜$1N_{1}$⌝
9.c. ⌜M106⌝ , $2N_{1}$
9.e. M9 , $1N_{1}$
9.f. $M206_{g}$, $1N_{1}$
9.f. $M102_{e}$, $2N_{1}$
9.g. $M309_{a}$, $1N_{1}$
10.a. M362 $M383_{c}$, $2N_{1}$
10.b. ⌜M260⌝ , $1N_{1}$
10.c. M106 , $2N_{1}$
10.d. M9 , $1N_{1}$
10.e. $M206_{g}$, $1N_{1}$
10.f. [$M102_{e}$] , [$2N_{1}$]
10.g. [$M309_{a}$] , [$1N_{1}$]
11.a. ⌜M362+$M123_{b}$?⌝ , $3N_{1}$
11.b. ⌜M260⌝ , $1N_{1}$
11.c. M106 , $3N_{1}$
11.d. M9 , $1N_{1}$
11.e. $M206_{g}$, $1N_{1}$
11.f. $M102_{e}$, $2N_{1}$
11.g. $M309_{a}$, $1N_{1}$
12.a. $M351_{c}$ ⌜M362⌝ , $3N_{1}$
12.b. [...] , [...]
12.c. [...] , [...]
12.d. [M9] , [$1N_{1}$]
12.e. [$M206_{g}$] , [...]
12.f. [$M102_{e}$] , [$2N_{1}$]
12.g. [$M309_{a}$] , [$1N_{1}$]
13.a. ⌜M362+M312?⌝ , ⌜$3N_{1}$⌝
13.b. ⌜M269?⌝ , $1N_{1}$
13.c. ⌜$M106_{a}$⌝ , $1N_{24}$ $2N_{30c}$
13.d. M9 , $1N_{1}$
13.e. $M206_{g}$, $1N_{1}$
13.f. $M102_{e}$, $2N_{1}$
13.g. [$M309_{a}$] , [$1N_{1}$]
14.a. [M362+X] , [...]
14.b. [...] , [...]
14.c. [...] , [...]
14.d. [M9] , [$1N_{1}$]
14.e. [$M206_{g}$] , $2N_{1}$
14.f. ⌜$M102_{e}$⌝ , $1N_{1}$
14.g. ⌜$M309_{a}$⌝ , [$1N_{1}$]

Reverse

Column 1

1.a1. M362 , $8N_{14}$ $9N_{1}$
1.a2. $M362_{a}$, $1N_{14}$ $3N_{1}$
1.b1. ⌜M260[?]⌝ , $3N_{1}$
1.b2. ⌜M260[?]⌝ , ⌜$1N_{1}$⌝
1.b3. [...] , [...]
1.b4. ⌜M260[?]⌝ , $1N_{1}$
1.b5. M260 , $8N_{1}$
1.b1. M106 , $4N_{14}$ $2N_{1}$
1.b2. ⌜$M106_{a}$⌝ , [...]
1.d. [M9[?]] , [$1N_{1}$ $4N_{1}$]
1.e. [$M206_{g}$] , [...]
1.f. [$M102_{e}$] , [$2N_{14}$] $8N_{1}$ˈ($6N_{1}$)
1.g. $M309_{a}$, $1N_{14}$ $4N_{1}$