Grain Accounting Practices in Archaic Mesopotamia[1]

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The appearance in 1991 of the first volume of a new scientific series entitled *Materialien zu den frühen Schriftzeugnissen des Vorderen Orients* marked the beginning of a format of publications chosen by the members of the Berlin research project *Archaische Texte aus Uruk*[2] to present to a wider public certain aspects of our work on the edition and decipherment of the earliest written documents from Mesopotamia. This volume, *The Proto-Cuneiform Texts from Jemdet Nasr, I: Copies, Transliterations and Glossary,* authored by Jean-Pierre Grégoire and myself, represents the desire on our part and on that of the series editors to publish in a form complementary to the primary project publications—in the series *ATU,* comprising text copies and catalogues of the archaic texts from Uruk/Warka[3]—not only glossaries and commentaries to the Warka material, but also our work on text groups from sites and periods other than the levels Uruk IV–III in Warka.

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1   For abbreviations see the dictionaries: W. von Soden, *Akkadisches Handwörterbuch.* Lieferung 16 (Wiesbaden: 1981) ix–xvi; I. J. Gelb et al., eds., *Chicago Assyrian Dictionary,* vol. A (Chicago: 1964), xxiv–xxxiv; Å. Sjöberg, ed., *Philadelphia Sumerian Dictionary,* vol. B (Philadelphia: 1984) vii–xxv. My thanks are due to Peter Damerow and Jöran Friberg for their comments on earlier versions of this paper, as well as to J.-P. Grégoire and R. Matthews, co-author and collaborator, respectively, in the recent publication of the proto-cuneiform tablets from Jemdet Nasr, of which a number are dealt with in the following. Matthews was directing renewed British excavations of the northern Babylonian site when the Kuwait war broke out. His work on the administrative sealing practices employed at Jemdet Nasr and ED I Ur appeared in 1993 as vol. 2 of *MSVO* under the title *Cities, Seals and Writing: Archaic Seal Impressions from Jemdet Nasr and Ur.*

2   The project, under the direction of Hans Nissen, has been funded primarily by the German Research Association (Deutsche Forschungsgemeinschaft [DFG]) and administered by the Free University of Berlin. Since 1982, Peter Damerow of the Max Planck Institute of Human Development and Education, currently of the Max Planck Institute for the History of Science in Berlin has as associate of the Uruk Project been instrumental in the ordering of our electronic data and in our thinking about conceptual developments in the archaic period, which may be dated roughly to 3200–3100 (Uruk IV) and 3100–3000 B.C. (Uruk III/Jemdet Nasr). It has not been possible in all cases to reconstruct the authorship of specific ideas in our work; above all, P. Damerow and J. Friberg have made frequent contributions now ascribed generally to the work of "project associates."

3   Publication of the primary material from Uruk will continue to be reserved for the series *Archaische Texte aus Uruk* (abbreviated *ATU*), edited by H. Nissen. A. Falkenstein's *Archaische Texte aus Uruk (= Ausgrabungen der Deutschen Forschungsgemeinschaft in Uruk=Warka,* vol. 2 [Berlin: 1936]) has been retroactively numbered volume 1 of the series, a revised signlist *Zeichenliste der Archaischen Texte aus Uruk* by M. Green and H. Nissen (Berlin: 1987) is *ATU* 2. *Die lexikalischen Listen der archaischen Texte aus Uruk* (= *ATU* 3), by Nissen and myself, appeared in 1993, and Nissen's complete *Katalog der archaischen Texte aus Uruk* (= *ATU* 4) should appear in the coming year. Five further volumes will complete the series, with copies of the administrative documents from Uruk, comprising some 85 percent of the text corpus from that site. These volumes commenced with my *Archaic Administrative Texts from Uruk: The Early Campaigns* (= *ATU* 5 [Berlin: 1994]),

While it is true that the great bulk of proto-cuneiform tablets resulted from the German excavations in these Warka levels—we count at present 5,000 archaic tablets and fragments from Warka excavations alone, and many more pieces may lie unaccessioned in the Iraq Museum—still the circa 400 proto-cuneiform tablets from other excavations or from the antiquities market are of more than passing interest.[4] A private collection of such texts auctioned off in London in December of 1988 is a case in point. These tablets

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including copies of the primarily Uruk IV period texts from Falkenstein's *ATU* 1, as well as the many fragments excavated before 1932 but not included in *ATU* 1 by Falkenstein, thereafter copies of the tablets excavated subsequent to those published in *ATU* 1. With *ATU* 5, a copy of our complete data base was included on diskette; subsequent volumes will include an expanded data base on CD-ROM, in the hope of alleviating the frustration common to our field of attempting to follow textual arguments based on unpublished reference texts, without recourse to the same material the author is using. Access to these data should aid in cutting short the sort of unfounded speculation about archaic sign identifications which has burdened recent discussions. An example of this problem is the identification of the name Nergal recently proposed in *ZA* by W. Lambert and P. Steinkeller, and in particular the latter's use of the sign list *ATU* 2 in *ZA* 80 (1990), 53–54. Of the signs ZATU32, 219, 297, and 428, Steinkeller claimed the first three were incorrectly, only the last correctly identified by M. Green. Assuming the author means with 'identification' the reasonable proof that the archaic signs in question were graphic precursors of ED signs whose readings can be inferred from contextual evidence, and not the 'readings' themselves, it is still difficult to understand the reasoning in his argument that ZATU428 = 'pirig,' since no lexical correspondences exist between this sign and ED 'pirig'. Tribute 67 would, if anything, point to UG (i.e., with final /g/; the combinations 'PIRIG'+NUNUZ [Green: AZ], + MA [Green: ALIM] and 'GIR₃ PIRIG' [Green: TIDNUM] are irrelevant in this discussion). The author's "almost certain" identification of ZATU297 with ANŠE also has no lexical foundation, since the Ebla witness TM.75.G.1912 cited by him contains ii 3 the clear entry '*LAK* 244' (*MEE* 4, 872; PÉŠ).⸢DA⸣, for which see the photograph *MEE* 3/A, pl. XX, and M. Krebernik, *Die Beschwörungen aus Fara und Ebla* (Hildesheim: 1984), 287–290 (whereas such administrative texts as *Frühe Schrift:* 38, no. 4.69 obv. i 2 [counted KIŠ after GU₄], imply that this or at least a closely related sign may have represented a large animal). The identification of ZATU32 is consequently without merit (Green's identification of ZATU219 with 'GIR₃' was based on Cities 35 [GIR₃ // *LAK* 248], of course, not on the reading of Nergal's name in Cities 23; if the witness W 24222 ii belongs to this list, then to Cities 16–21). No effective use of administrative attestations has been made in the Nergal debate or in similar treatments of archaic topics, for which the Uruk Project, but also, for instance, unstable conditions in Iraq, bear some blame. This point is made—and for comparison a table of these identifications offered below—merely to underscore the need for a more cautious approach to archaic lexicography, based on a consideration of all available sources.

	Green:	Steinkeller:	Lexical correspondence:
ZATU32	ANŠE	KIŠ	*LAK* 239 (based on Vessels 49)
ZATU219	GIR₃	?	*LAK* 248
ZATU297	KIŠ	ANŠE	'*LAK* 244' (probably /peš/)
ZATU428	PIRIG	PIRIG	*LAK* 256 (probably /ug/)

4   Beyond the 244 *MSVO* 1 texts known to be from Jemdet Nasr and Kish, some 90 texts resulted from excavations at various sites including Tell Uqair near Jemdet Nasr, Tell Asmar in the Diyala basin, and possibly Larsa, and in small lots from the antiquities market. These texts have been gathered and re-edited by the author in *Proto-Cuneiform Texts from Diverse Collections* (= *MSVO* 4; Berlin: 1996). The most notable collection of proto-cuneiform documents in private hands was certainly the Erlenmeyer collection, for which see directly.

exhibited a state of preservation unknown in the texts from Uruk. Whereas the Uruk tablets, having been deposited in antiquity almost without exception in trash dumps or used as fill in new floors and walls, were only rarely fully preserved, the majority of the Erlenmeyer collection were in nearly perfect condition.[5]

The importance of this state of preservation for a reconstruction of the bookkeeping practices employed in the archaic period cannot be overstated. In particular, the reconstructability of the numerical calculations involved in specific texts as well as in accounting genres is painfully impaired by the damaged surfaces so characteristic of the Uruk texts which formed part of the rubbish cleared from accounting offices of the Eanna district. Faced with these damaged but nearly complete tablets or, still worse, with the innumerable fragments of texts from this site, we were often forced in our formal analyses of the Uruk numerical sign systems to resort to the statistics of sign repetition and sequence to build up probabilities of numerical and metrological system structures; only in rare cases were we in a position to utilize fully preserved summations to prove or disprove the existence of numerical structures heretofore ascribed to the archaic material.[6] Figure 1 presents factor diagrams of those numerical systems that were of major importance in the archaic accounting of the primary administrative activity in archaic Mesopotamia, namely, of grain storage and distribution; although the control of grain resulted in by far the greatest number of accounts in Uruk, the fragmentary state of these texts severely limited our understanding of the bookkeeping system they represented.[7]

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5   See the auction catalogue published by Christie's, London, *Ancient Near Eastern Texts from the Erlenmeyer Collection, 13 December 1988,* and H. Nissen, P. Damerow, and R. Englund, *Frühe Schrift und Techniken der Wirtschaftsverwaltung im alten Vorderen Orient* (Berlin: 1990, ²1991), of which a revised English translation appeared in 1993 as *Archaic Bookkeeping: Early Writing and Techniques of Economic Administration in the Ancient Near East* (University of Chicago Press). An edition of the texts will appear forthcoming by P. Damerow and the author as vol. 3 of *MSVO.*

6   See P. Damerow and R. Englund, "Die Zahlzeichensysteme der Archaischen Texte aus Uruk," *ATU* 2: 117–166, particularly 121–126; P. Damerow, R. Englund and H. Nissen, "Die Entstehung der Schrift," and "Die ersten Zahldarstellungen und die Entwicklung des Zahlbegriffs," *Spektrum der Wissenschaft,* February 1988: 74–85 and March 1988: 46–55, respectively (the two articles were reprinted in B. Riese, ed., *Schrift und Sprache* [Heidelberg: 1994], 90–111); *Archaic Bookkeeping:* 25–29.

7   The figure includes only the so-called basic numerical systems, excluding the representation of derivative systems achieved through the addition of, for example, dotted impressions to the capacity system, signaling an amount of cracked or rough-ground barley groats used in the production of beer and other grain products. The names of the various numerical signs were assigned more or less arbitrarily, but generally according to sign form, numbering all numerical signs from 1 to, now, 60, thus N_1, N_2, ..., N_{60}. Numerals below the members of the two systems used to quantify discrete objects, the sexagesimal and the bisexagesimal systems, correspond to the number of units represented by the sign. Quotation marks signal the fact that the quantities are translations and that the signs do not represent abstract numbers. See P. Damerow and R. Englund, *ATU* 2: 117–166, for a complete discussion of these numerical notations.

System used to count most discrete objects, for example, humans and animals, dairy and textile products, fish, wooden and stone implements, and containers

System used to count discrete grain products, cheese, and fresh fish; all objects noted with this system appear to belong to a rationing system

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

System used to note time and calendar units (twelve 30-day months to a year)

Figure 1. Numerical sign systems employed in archaic grain accounting.

It was thus often necessary in our work on the Uruk corpus to resort to analyses of a group of texts from the northern Babylonian site Jemdet Nasr which, although much smaller in number, were in many cases of greater interest than the collection from Uruk. For an ancient conflagration appears to have at once capped an Uruk III level of occupation at the site and simultaneously resulted in the collateral baking of the clay tablets in that level. The resulting state of preservation of the tablets concerned was such that, taken together, they often clearly retained a higher level of information about bookkeeping practices and economic structures than that given us by the Uruk material, and in

many respects these texts remain, despite the Erlenmeyer collection, our primary source for analyses of administrative organization in the proto-literate period. Without this information, we in many instances could not have bridged the large gaps in the evidence for numerical structures garnered from the large corpus from Uruk.[8]

Since Peter Damerow and I have in the course of the first three Berlin colloquia on Babylonian mathematics[9] offered only preliminary analyses of a number of the texts from Jemdet Nasr, it would seem appropriate to undertake here a closer look at a group of those texts so as to make clear the advances, and at the same time the limits of our current understanding of the involved accounting procedures employed at Jemdet Nasr, a site which was certainly little more than an economic outpost in comparison with the size of the contemporary settlement in the southern Babylonian city of Uruk.

One of the texts in this group, *MSVO* 1, 93 (see figures 2–4),[10] is sufficiently preserved to allow of a nearly complete reconstruction of a consolidated accounting transaction which exhibits in concise form much of the complexity for which the administrative texts of 3rd millennium Mesopotamia are so well-known.

The obverse face of the tablet contains three clearly defined sections. The first presents in distinct notations a number of grain products together with the amount of grain necessary for their production. These products include both dry and liquid goods. In the case of the liquid goods, it seems very clear that the products accounted for in the first two cases of the second column employing pictographic representations of ceramic jugs are in fact types of barley beer.[11] As to the dry goods, no consensus has been reached whether the products involved are in fact baked breads or unbaked cereal units. It seems likely that both forms of dry cereal products are represented, as will be argued in the discussion below.

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8 It may be added that the Erlenmeyer and the Jemdet Nasr texts complemented each other in that the Erlenmeyer collection seems to have been the administrative archive of a production unit concerned with the distribution of beer and the ingredients used in beer brewing, which sector of the economy is only summarily represented in the Jemdet Nasr texts. These latter texts, on the other hand, cover very broad aspects of the archaic provincial economy, including land utilization, worker rationing, and other distributive mechanisms, etc. Compare R. Englund and J.-P. Grégoire, *MSVO* 1: 8–9.

9 See the preface to this volume.

10 The tablet with the museum no. Ashm. 1926-564 was first published, missing one fragment, as *OECT* VII, 78; its reverse face was also published in E. Mackay, *Report on Excavations at Jemdet Nasr, Iraq* (= *Field Museum of Natural History, Anthropology Memoirs* I/3; Chicago: 1931), pl. 76, 1. It was copied for *MSVO* 1 by J.-P. Grégoire, recopied here using standard computer graphics discussed most recently by H. Nissen, P. Damerow and R. Englund, *Archaic Bookkeeping:* 152–156, and in greater detail in *id.,* "Zur rechnergestützten Bearbeitung der archaischen Texte aus Mesopotamien (ca. 3200–3000 v.Chr.)," *MDOG* 121 (1989): 139–152. *MSVO* 1, 93, now measures $113 \times 83 \times 21$mm. All copies in this article are at 75% of original size.

11 See our preliminary treatment in *Archaic Bookkeeping:* 36–46, in particular 43–46.
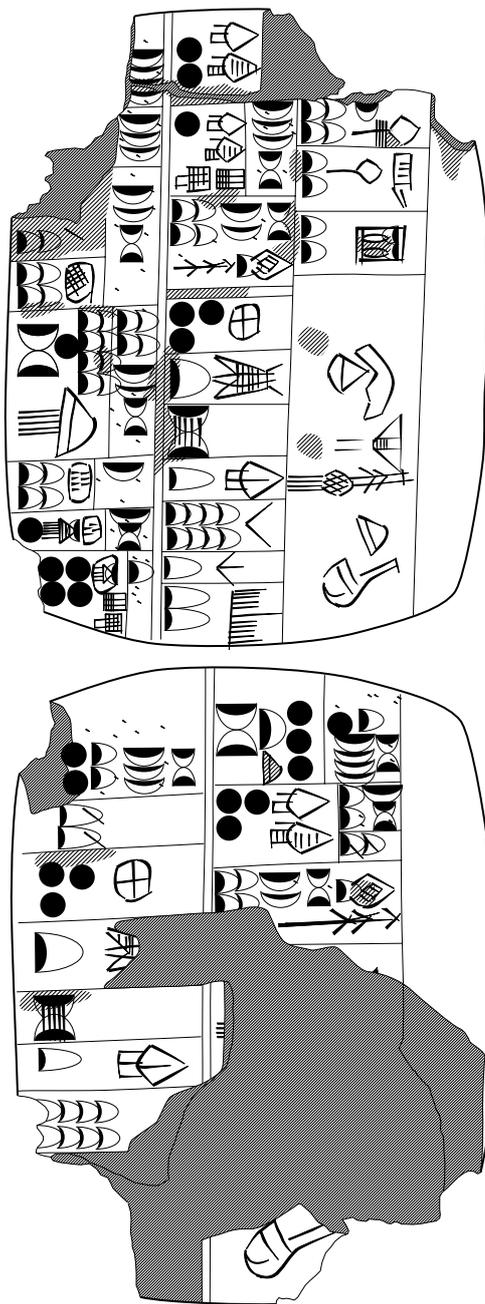
Figure 2. *MSVO* 1, 93.

Obv. i
- 1a $[4N_1]$; $[1N_{39a}]$
- 1b   ⌜$4N_{42a}$⌝ ;
- 2a $[6N_1]$; $[1N_{24}]$
- 2b $3N_{42a}$;
- 3a1 $[2N_1]$? ; [   ]
- 3a2 ⌜$2N_1$?⌝ ; ⌜ZATU726$_d$⌝
- 3a3 $4N_1$; SIG$_{2a2}$
- 3b $2N_{42a}$ $1N_{25}$;
- 4a $1N_{51}$ $1N_{14}$ $8N_1$; GAR+$5N_{57}$
- 4b $4N_5$ $2N_{42a}$ $1N_{25}$;
- 5a $4N_1$; GUG$_{2a}$
- 5b $1N_{42a}$;
- 6a $1N_{14}$; ŠA*gunû* GUG$_{2a}$
- 6b $1N_{42a}$ $1N_{25}$;
- 7a $4N_{14}$; LAGAB$_a$+ŠA E$_{2a}$ DUB$_a$
- 7b $1N_5$;

ii
- 1a $2N_{14}$; DUG$_a$ KAŠ$_a$
- 1b $[1N_5$ $3N_{42a}]$;
- 2a $1N_{14}$; DUG$_a$ KAŠ$_a$ DUB$_a$ E$_{2a}$
- 2b $3N_{42a}$ $1N_{25}$;
- 3 $4N_5$ $2N_{42a}$ $1N_{25}$; MU ZATU 714+HI.*gunû*$_a$
- 4 $3N_{14}$; UDU$_a$
- 5 $1N_{34}$; SUHUR$_a$
- 6 $1N_{52}$;
- 7 $1N_1$; DUG+AŠ$_c$
- 8 $8N_1$; ŠU$_2$
- 9 $1N_1$; ZATU644$_a$
- 10 $2N_1$; ZATU753

iii
- 1 $[4N_1]$; [MA] (?)
- 2 $4N_1$ $1N_8$; HAŠHUR
- 3 $2N_1$; MA ZATU735$_b$
- 4 $2N_1$; ⌜GA$_{2a1}$+GEŠTU$_{c5}$⌝
- 5   NI$_a$+RU $2N_{57}$ SU$_a$ GIBIL GU$_7$

Rev. i
- 1 $2N_{20}$ $2N_5$ $3N_{42a}$ $1N_{25}$;
- 2 $2N_3$;
- 3 $3N_{14}$; UDU$_a$
- 4 $1N_{34}$; ⌜SUHUR$_a$⌝
- 5 $1N_{52}$;
- 6 $1N_1$; DUG+AŠ$_c$
- 7   ⌜$8N_1$⌝ ; [ŠU$_2$]
- 8 $[1N_1]$; [ZATU644$_a$]
- 9 $[2N_1]$; [ZATU753]
- 10 $[1N_{14}$ $2N_1$ $1N_8]$; [MA] (?)

ii
- 1a $1N_{51}$ $1N_{34}$ $3N_{14}$; ⌜GAR⌝
- 1b $1N_{20}$ $1N_5$ $4N_{42a}$ $1N_{25}$;
- 2a $3N_{14}$; DUG$_a$ KAŠ$_a$
- 2b1 $2N_5$ $1N_{42a}$ $1N_{25}$;
- 2b2 $2N_3$;
- 3 $4N_5$ $2N_{42a}$ $1N_{25}$; ZATU714+ HI*gunû*$_a$ MU
- 4   [NI$_a$+RU $2N_{57}$] ⌜SU$_a$ GIBIL GU$_7$⌝

Figure 3. Transliteration of the text *MSVO* 1, 93.

These objects are quantified in two ways. First, the discrete units were counted using a number sign system probably derived from the sexagesimal system, based on the count of two sixties, or 120, instead of 60 and thus called by us the bisexagesimal system. An examination of all contexts in which this system was used suggests that its purpose was in recording units of rations, since the products involved are without exception food-stuffs and are invariably qualified by the sign GU$_7$, for which see the discussion below. Second, in a following parallel sub-case a notation corresponding to the amount of grain requisite for the production of the units recorded was inscribed, using numerical signs from a system derived from the grain numerical sign system. This derived system is characterized by the addition of an arbitrary number of impressed dots, which seem to

graphically represent the coarsely ground barley groats or simply cracked barley used in the grain products.[12]

The scribe responsible for *MSVO* 1, 93, drew a double dividing line below the last grain notation in obv. ii 3. Following the grain section of this text we find a second section including notations representing all non-cereal objects accounted for. These include animals and animal products (sheep, dried fish; containers of animal fats, textile goods) and dried fruits. The numerical notations used in this section all served to count discrete objects, as may be expected with the products involved. With the exception of the still poorly understood notation N_{52} (a sign derived from the sign N_{51} of the bisexagesimal system representing "120" units; cf. figure 1 above) in the case ii 6, all notations derive from the sexagesimal system.

The final section is comprised of an abbreviated ideographic notation describing the function of the text. This notation includes what appears to be a toponym NI_a+RU, a time notation $2N_{57} SU_a GIBIL$ and a qualification of all the recorded products, GU_7, which may be translated "rations."

The procedures involved in the more complicated first section of this account are known to us from other Jemdet Nasr tablets as well as from a large number of tablets from Uruk. Certain discretely counted grain products required for their production well-defined and generally known quantities of grain. The most obvious case for the use of this quantifying qualification is that in which a numerical sign from the grain system represented a product containing the given amount of grain. The largest product so qualified seems to be N_1 (variant $NINDA_2+N_1$), which according to our calculations represented some 25 liters of grain.[13] Accounts recording such grain products generally begin with the largest unit considered and continue through units of decreasing size. All of these counted cereal products are totaled on the reverse of the tablet and qualified with the ideographic sign GAR, which with Sumerian reading ninda

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12   Some justified criticism has been leveled at the sign names chosen for these numerical signs by M. Green in *ATU* 2 and employed by us in Uruk Project publications. It will, just the same, be impossible to avoid the complicated transliterations resulting from the use of these sign names, and any attempt to introduce rival transliterations will, in my opinion, only serve to make matters worse. Nevertheless, in order to avoid overburdening the reader with difficult transliterations of, in particular, derived numerical signs, such signs will in the following discussion generally be referred to by their equivalent forms from the main systems, for example, in the calculations of grain products into equivalent amounts of rough-ground barley the sign N_{42a} from the system Š* (for the differentiation of these notations see *ATU* 2: 140–141) will generally be referred to by its capacity equivalent N_{39}.

13   The evidence for this identification has been summarized by P. Damerow and myself in *ATU* 2: 153–154, n. 60. See also R. Englund, "Administrative Timekeeping in Ancient Mesopotamia," *JESHO* 31 (1988; in the following abbreviated *Timekeeping*): 160, n. 32, and P. Damerow and R. Englund, *The Proto-Elamite Texts from Tepe Yahya* (= *American School of Prehistoric Research Bulletin* 39; Cambridge, MA: 1989), 24–27.

and Akkadian correspondence *akalu* in later tradition stood for grain rations and at some point in the 3rd millennium doubtless for (baked) bread. The meaning of this sign in the archaic period is, as we believe to have convincingly demonstrated in recent publications, "cereal ration," and the concrete precursor of this pictogram was certainly the beveled-rim bowl, which was a ubiquitous find, a so-called diagnostic ware dating from the Middle Uruk, but at its most common during the Late Uruk period.[14] Together with the summation of all counted GAR, the ancient accountant included on the reverse the total of the amounts of grain used in the production of the grain products.[15]

These summations allow for a solid, albeit not entirely incontestable reconstruction of the first three damaged cases on the obverse of the tablet *MSVO* 1, 93. Since the addition of the well-preserved entries obv. i 3a3–i 7 results in a total of 196 cereal products and the grand total of such products on the reverse is 210, 14 units of grain must comprise the first two cases and the damaged section of the third case on the obverse. It seems likely based on other such texts that the first entry will have recorded a number of the unit N_{39a} and thus, since the grain required for their production totaled $4N_{39}$ (corresponding to the amount $4N_{42a}$ recorded in the derived system Š*) necessarily 4 such units. The second entry will almost certainly have dealt with the next smaller grain unit, N_{24} (= $^1/_2\,N_{39}$), so that six of these units will have resulted in the grain quantity $3N_{39}$. These two conjectured counts of grain products would represent the *minimum* number of units requiring the amount of grain recorded in the preserved sections of the corresponding entries.

The total of ten units would allow for just four more grain units in the damaged section for a total of eight units in the third case of the tablet obverse, column i. It seems probable that all such products will have required the same amount of grain,[16] and since we know from other Jemdet Nasr grain accounts that the bookkeepers resorted to rounding when faced with grain quantities which could not be expressed simply, the division of $2N_{39}\,1N_{24}$ = $2^1/_2\,N_{39}$ by 8 suggests that these products will have contained circa $^1/_3\,N_{39}$ or $1N_{26}$ grain

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14 The discussion of the function of these bowls continues unabated. Beyond *Timekeeping,* in particular: 162–164 with the treatment of the text *MSVO* 4, 27 (= *ATU* 1, 651+653), according to which the role of GAR as a rationing unit representing one day of grain in the archaic system of administrative timekeeping could be *firmly established,* see the most recent discussions in A. Millard, "The Bevelled-Rim Bowls: Their Purpose and Significance," *Iraq* 50 (1988): 49–57, and G. Buccellati, "Salt at the Dawn of History: The Case of the Bevelled-Rim Bowls," in P. Matthiae et al., eds., *Resurrecting the Past* (Leyden: 1990), 17–40.

15 For a discussion of the actual cereal grains found at Jemdet Nasr see H. Field, "Ancient Wheat and Barley from Kish, Mesopotamia," *American Anthropologist* 34 (1932): 303–309. Much of the grain was found inside pots.

16 Calculation roundings often found in Jemdet Nasr accounts and the uncertainty of standardized ingredients used in specific grain products (see the attestations listed below in the appendix to this contribution), however, leave room for much skepticism. A consolidation of the ingredients needed for two different products recorded
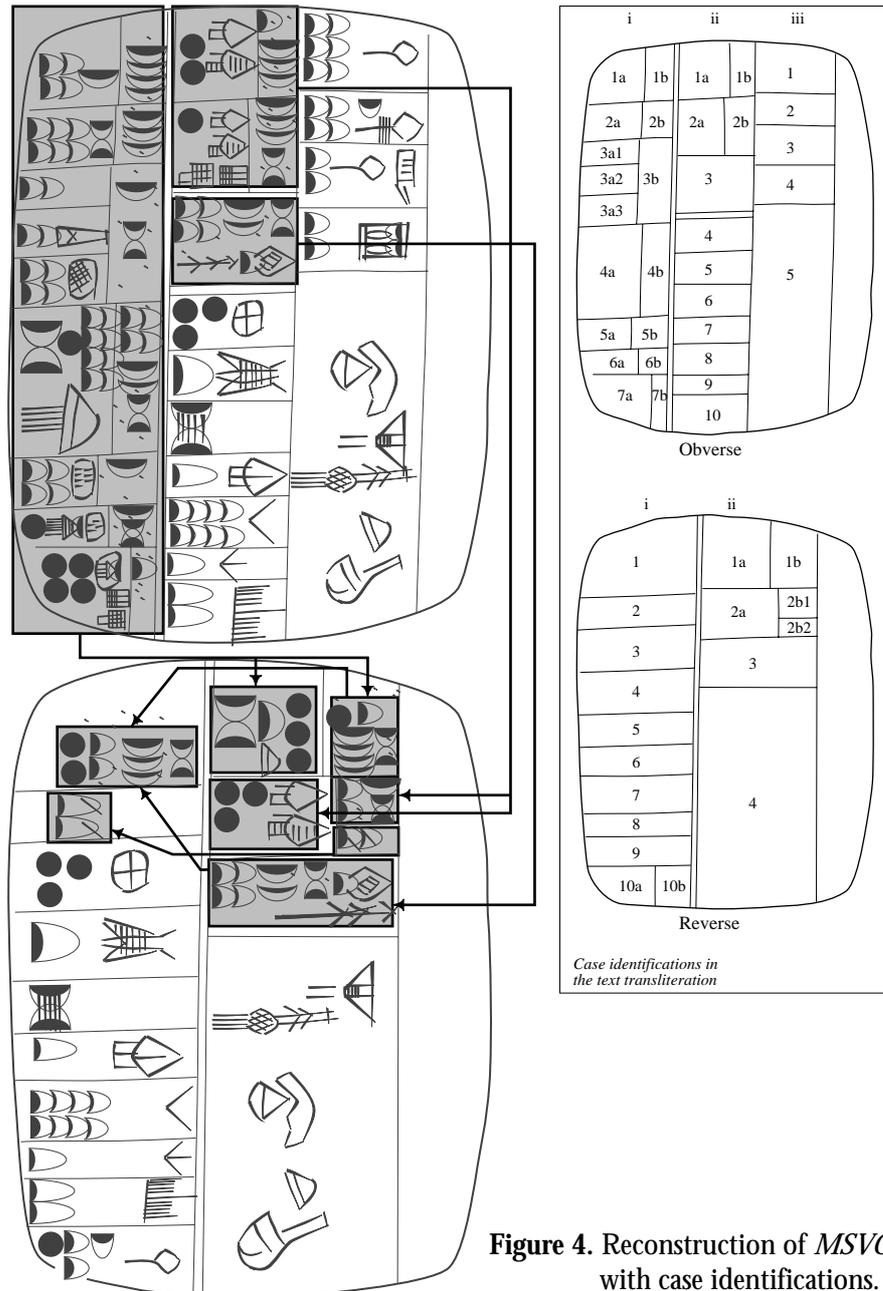
Figure 4. Reconstruction of *MSVO* 1, 93,
with case identifications.

each. Such units, as we know from other texts, could be qualified with the sign from the grain numerical sign system N_{26}; to judge from the preserved section of the third case, however, these units will all have been qualified by ideograms, of which the sign SIG_{2a2} is known to us as a grain product from other sources. The impressed cross-hatching of this last sign seems suggestive of a characteristic pattern on the crust of a bread, similar to that known from the representations of such breads in early dynastic Egypt.

The following, fourth case, records 138 of the products $GAR+5N_{57}$. These strokes N_{57} could be added in apparently arbitrarily varying numbers to the sign GAR to indicate a grain ration of a specific size, as a rule corresponding to $1/6$ of the unit N_{39}, represented by the sign N_{30a}. This should be, as has been demonstrated in another publication,[17] the standard daily ration of a dependent laborer in the service of the central administration at Jemdet Nasr. In the present text, the scribe has apparently made a small mistake in his calculation, since 138 of the units N_{30a} should result in ($138 \div 6 =$) 23 of the units N_{39} or, reduced, $4N_1$ $3N_{39}$.

The next three cases also record cereal products qualified with ideograms, listed according to size. In the first case, the product GUG_{2a} must represent the quantity $1/4$ N_{39} (= N_{28}), since $4 \times N_{28} = N_{39}$. The grain necessary in the production of the object ŠA*gunû* GUG_{2a} seems likely to have been $1/6$ N_{39}; the resulting $10/6 = 1\,2/3$ N_{39} will have been rounded to $1\,1/2$ N_{39}, just as was the case in the third line of this text. Finally, the product $LAGAB_a+$ŠA E_{2a} DUB_a contained $1/8$ of the quantity represented by N_{39}, since $40/8 = 5N_{39} = 1N_1$. It may be added in this connection that the numerical sign for $1/8$ N_{39} is unattested.[18]

The second part of the first section in *MSVO* 1, 93, deals with quantities of beer counted in jugs using, as is clear from other texts, not the bisexagesimal but the sexagesimal numerical sign system. Here again the total of the amount of barley groats used in its brew-

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twice in the account *Archaic Bookkeeping:* 42, figure 38, moreover, allows a calculation of *different* amounts of rough-ground barley required in the production of the respective units ŠA*gunû* (x) and $DU_{8c}gunû$ (y). In the first case (obv. ii 2), 30 x and 30 y reqired the equivalent of $8N_{39}$ grain, or on average $2/15$ N_{39} per unit; in the second (obv. iii 2), 120 of the former and 60 of the latter products required the equivalent of $26N_{39}$. Since the replacement of x and y with the factor $2/15$ would in the second case result in ($180 \times 2/15 =$) 24 instead of the recorded 26 N_{39}, the solution which fits both equations $30x+30y = 8N_{39}$ and $120x+60y = 26N_{39}$ will require x ≠ y. This solution, which also harmonizes with what we know from other attestations of the products concerned, requires that x = $1/6$ and y = $1/10$ N_{39} (solving for y: $120x = 32N_{39} - 120y$ and $120x = 26N_{39} - 60y$, or $60y = 6N_{39}$, or y = $1/10$ N_{39}, with, directly, x = $1/6$ N_{39}), that is, that ŠA*gunû* ≈ N_{30a}, and $DU_{8c}gunû$ ≈ N_{30c} (see fig. 1 above).

17   *Timekeeping:* 162–164.

18   The previous candidate N_{31}, attested only in the Uruk IV period text *ATU* 1, 345, (now *ATU* 5, pl. 79, W 9655, d+) seems, based on the now known meaning of the sign $N_{30c} = 1/10$ N_{39} (see P. Damerow, R. Englund and H. Nissen, *MDOG* 121, 145[17]) in the Erlenmeyer text *Frühe Schrift:* 14, no. 4.3 obv. i 1a and 3a, best disregarded.

ing, recorded on the reverse of the tablet, allows us to confidently reconstruct the first of the two beer notations as 20 beer jugs (DUG_a $KAŠ_a$), requiring ($2N_1$ N_{39} N_{24} [rev. ii 2b1] – $3N_{39}$ N_{24} [obv. ii 2b] =) N_1 $3N_{39}$, or eight of the units N_{39}. This means that each jug of $KAŠ_a$ required $^2/_5$ N_{39} or perhaps just $1^1/_2$ – 2 liters of barley groats.[19] More grain than this will have been used in the production of a jug of beer, however, since an amount of malted barley standing in a fixed relation to the barley groats was added in the summation on the reverse of the tablet. In the case of the first noted sort of beer, the malt will have been added at a rate of 1:1. The second beer $KAŠ_a$ E_{2a} DUB_a required apparently $^1/_3$ N_{39} of grain for each of ten jugs. Instead of the expected $^{10}/_3 = 3^1/_3$ N_{39}, the scribe has in a rounding process noted $3^1/_2$ N_{39}. This $^1/_3$ N_{39} is also attested as the grain quantity necessary for the production of a jug of beer $KAŠ_a$ in the text *MSVO* 4, 66.[20]

The final grain notation in the first section of this text records an amount of barley groats, the meaning of which is unclear. This sort of notation invariably is made directly after summations of dry and liquid grain products in comparable texts, and the quantity of barley groats recorded as a rule comprises between $^1/_2$ and $^1/_3$ of the groats recorded in the total of the other grain products. Both signs MU and ZATU714+HI*gunû*$_a$ are found generally in context with grain and numerical grain notations. The signs HI and HI*gunû*$_a$ are, moreover, often found together with notations for malt barley, and may represent a special type of grain used in brewing.

These grain notations are totaled on the reverse of the tablet (see figure 4). There we have in the first case of the second column the notation N_{51} N_{34} $3N_{14}$ = 210 GAR, for which a corresponding quantity of groats is recorded in the adjoining case. This quantity of grain is the total of the seven grain notations in the first column of the obverse. There follows in reverse ii 2 a notation of 30 jugs of beer (20 + 10), for which (2×5 =) $10 + 1^1/_2$ N_{39} of groats was used. Only in the summation of this beer account do we find a given amount of malt added to the total of groats used in the brewing. This amount varies, but seems as a general rule to correspond to approximately $^3/_5$ of the amount of groats. Since the large majority of the references to malt used in beer brewing are in contexts of totals of mixed types of beer, such variation is not unexpec-

19 This may have been substantially more complex. As the text *MSVO* 4, 66 (= A. Falkenstein, *OLZ* 40 [1937]: 409–410, no. 6; see below) tells us, the sign combination DUG_a $KAŠ_a$ represented itself a variety of types of beer: in this text DUG_a+U_{2a}, DUG+$AŠ_a$, and $KAŠ_a$.

20 We have there obv. ii 3: $5N_{34}$ $KAŠ_a$ / $3N_{20}$ $2N_5$, with 300 ÷ ((3×6+2) $\times$ 5 =) $100N_{39}$ = 3 jugs per N_{39}. The second sort of beer recorded in *MSVO* 1, 93, seems to have received not an amount of malt equal to the groats employed, but $^3/_5$ as much, the same as in *MSVO* 4, 66. Compare the treatment of this text in J. Friberg, *The Early Roots of Babylonian Mathematics* II (Göteborg: 1979), 33–43, in copy in *id.,* "Mathematik," *RlA* 7/7–8 (1990): 539, and see below, especially footnote 23.

ed.[21] In the present case, this relationship is 20:23, for reasons which may have had to do with the uneven combinations of the beers qualified on the obverse of the tablet with the sign combinations DUG_a $KAŠ_a$ and DUG_a $KAŠ_a$ E_{2a} DUB_a.[22] Kept separate from these two summations is the amount of groats qualified as ZATU714+HI*gunû*$_a$ MU.

All three of these totals are then added together for a grand total of groats recorded in the account, which is noted in the first case of the first column of the reverse. Immediately below this grand total, the scribe records separately the amount of malt used in the beer brewing.

The nature of the grain calculations inherent in the first section of the account *MSVO* 1, 93, is most obvious in the text *MSVO* 4, 66 (= IM 23426).[23] This text (see figure 5[24]), which was accurately copied and to a point interpreted by Falkenstein, was to be the key document in Friberg's successful decipherment in the late '70s of the archaic numerical capacity system.[25] The text represents one of but a handful of archaic documents which may be classified as bookkeeping "school exercises," since it at once deals with large and "round" numbers, and since it contains no ideograms representing the agents requisite to a real administrative account.

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21   No fixed rule concerning the inclusion of malt measures with entries of individual types of beer, however, is evident in available texts. See the treatments of *MSVO* 4, 66, and *MSVO* 1, 108, below.

22   Those cases which document an even relationship between the barley groats and the malt used in the production of the Jemdet Nasr beer varieties suggest either that breweries were free in their choice of ingredients, or that, as will be suggested below, we simply cannot know which and how many specific sorts of beer are represented by the sign combination $KAŠ_a$ DUG_a. In the case of *MSVO* 1, 108 (see below), $KAŠ_a$ DUG_a is recorded employing a mixture of 7 parts barley groats to 4 parts malt, whereas $KAŠ_a$ DUG_a DUB_a E_{2a} employed just half the amount of malt, namely 7 parts to 2. These seem superficially to be "nice numbers," however at least in the case of $KAŠ_a$ DUG_a this may be coincidental. *MSVO* 1, 109 (and possibly 111), exhibits a relationship of very nearly 7:2 (exactly 25:7) for this sort of beer, *MSVO* 1, 116, records a mix of 3:1 for beer qualified simply $KAŠ_a$, regardless of the strength of the beer.

23   See R. Englund, *Proto-Cuneiform Texts from Diverse Collections* (= *MSVO* 4; Berlin: 1996): 14–19. The tablet belonged to a group of six texts acquired from the local antiquities market by the Iraq Museum in 1933 under the directorship of the Uruk excavator J. Jordan. According to the dealer, they resulted from clandestine excavations in Larsa, which may be correct, since this was the year in which A. Parrot departed for the new French excavations at Mari, leaving at the same time in apparent disgust the task in Larsa of not only fighting unbearable sand storms, but also of driving off insatiable local antiquities thieves, having even to resort to the use of threatening attacks with airplanes against the marauders (cf. *RA* 30 [1933]: 175). The 17 Uruk III period texts bought and published in 1936 by P. van der Meer (*RA* 33: 185–190) have the subscript AN PA_a MAR_a in common with these Iraq Museum texts and may thus stem from the same site.

24   The presented copy of the tablet in the Iraq Museum, Baghdad, was collated in May of 1989 and again in April of 1990, with but insignificant corrections of Falkenstein's copy.

25   See footnote 20 above.
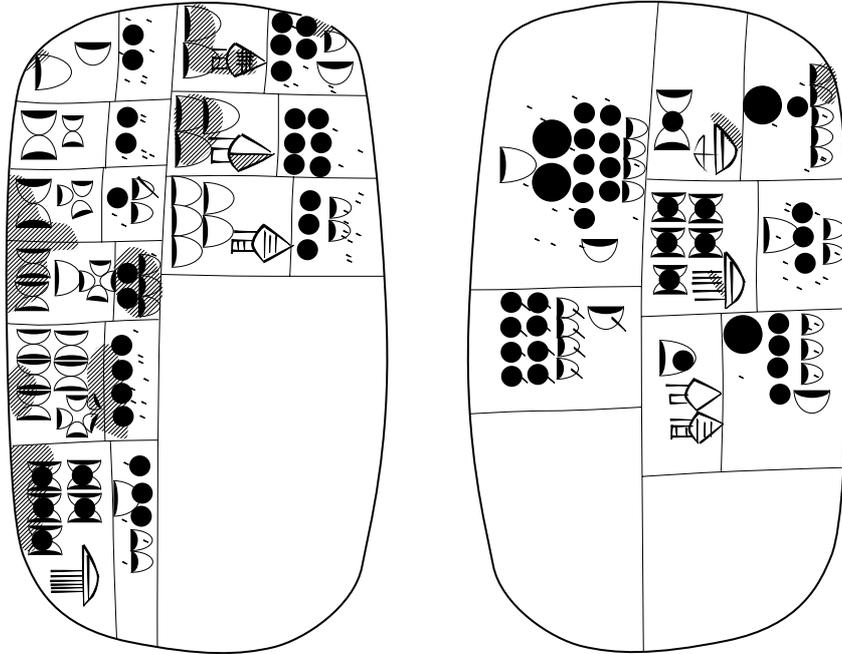
Figure 5. Friberg's "key text" *MSVO* 4, 66.

MSVO 4, 66 demonstrates in concise form the interplay in archaic accounts between numerical systems employed to qualify discrete objects and the capacity system used to qualify measures of grain. The first column records numbers of dry grain products—thus counted with the bisexagesimal system—followed in each case with the amount of grain used in their production. In the first case, the production of 60 units of the product ◡ (= $^1/_5$ ▷) required $60 \times {}^1/_5$ ▷ = 12 ▷ (and since 6 ▷ = 1 ●) = 2 ●.[26] Precisely the same kind of calculations are made in the following cases with ever larger numbers of ever smaller grain products,[27] ending not with a member of the capacity numerical system, but with its ideographic equivalent, the sign GAR+6N$_{57}$, which, as we have seen, was the pictographic representation of the beveled-rim rationing bowl supplemented with a varying number of strokes and which had its correspondence in the capacity system with the sign ⊠ representing $^1/_{30}$ of the basic unit ▷.

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26   See above, footnote 12, to this simplified representation.

27   Each of the products are in fact well represented as such in the archaic text corpus. This is most obviously the case when they are attested together with numerical notations incompatible with the grain system, for example, 8N$_1$ N$_{39a}$ in W 21022,3 obv. i 2 (unpublished; 8N$_1$ incompatible with the bundling rule of

Obv. i	1	$1N_{34}$; $1N_{39a}$	$2N_{20}$
	2	$1N_{51}$; $1N_{24}$	$2N_{20}$
	3	$\ulcorner 1N_{51} \urcorner$; $1N_{26}$	$1N_{20}$ $2N_5$
	4	$\ulcorner 2N_{51} \urcorner$ $1N_{34}$; $1N_{28}$	$\ulcorner 2N_{20}$ $3N_5 \urcorner$
	5	$5N_{51}$; $1N_{29a}$	$4N_{20}$
	6	$\ulcorner 5N_{54} \urcorner$; GAR+$6N_{57}$	$1N_{37}$ $3N_{20}$ $2N_5$
ii	1	$\ulcorner 2N_{34} \urcorner$; $\ulcorner DUG_a + U_{2a} \urcorner$	$\ulcorner 5N_{20} \urcorner$ $1N_5$ $1N_{42a}$
	2	$\ulcorner 3N_{34} \urcorner$; DUG+$AŠ_a$	$6N_{20}$
	3	$5N_{34}$; $KAŠ_a$	$3N_{20}$ $2N_5$
Rev. i	1	$1N_{54}$; BA GAR	$1N_{47}$ $1N_{20}$ $\ulcorner 5N_5 \urcorner$
	2	$5N_{54}$; GAR+$5N_{57}$	$1N_{37}$ $3N_{20}$ $2N_5$
	3	$1N_{48}$; DUG_a $KAŠ_a$	$1N_{47}$ $4N_{20}$ $3N_5$ $1N_{42a}$
ii	1	$1N_{37}$ $2N_{47}$ $9N_{20}$ $4N_5$ $1N_{42a}$	
	2	$8N_{18}$ $4N_3$ $1N_{40}$	

The calculations:

Obv. i	1	$60 \times {}^1/_5 \rhd$	($\ominus$)	$= 12 \times \rhd =$		$2 \times \bullet$		
	2	$120 \times {}^1/_{10} \rhd$	($\boxtimes$)	$= 12 \times \rhd =$		$2 \times \bullet$		
	3	$120 \times {}^1/_{15} \rhd$	($\boxtimes$)	$= 8 \times \rhd =$		$1 \times \bullet$	$2 \times \rhd$	
	4	$300 \times {}^1/_{20} \rhd$	($\boxtimes$)	$= 15 \times \rhd =$		$2 \times \bullet$	$3 \times \rhd$	
	5	$600 \times {}^1/_{25} \rhd$	($\boxtimes$)	$= 24 \times \rhd =$		$4 \times \bullet$		
Rev. i	1	1200			$1 \times \bullet$	$1 \times \bullet$	$5 \times \rhd$	
Obv. i	6	$6000 \times {}^1/_{30} \rhd$	(GAR+$6N_{57}$)	$= 200 \times \rhd = 1 \times \rhd$		$3 \times \bullet$	$2 \times \rhd$	
ii	1	$120 \times \approx {}^1/_4 \rhd$	($DUG_a + U_{2a}$)	$\approx 30 \times \rhd =$		$5 \times \bullet$	$1 \times \rhd$	$1 \times \ominus$
	2	$180 \times {}^1/_5 \rhd$	(DUG+$AŠ_a$)	$= 36 \times \rhd =$		$6 \times \bullet$		
	3	$300 \times {}^1/_{15} \rhd$	($KAŠ_a$)	$= 20 \times \rhd =$		$3 \times \bullet$	$2 \times \rhd$	
Rev. i	3	600			$1 \times \bullet$	$4 \times \bullet$	$3 \times \rhd$	$1 \times \ominus$
					$1 \times \bullet$	$1 \times \bullet$	$5 \times \rhd$	
					$1 \times \rhd$	$3 \times \bullet$	$2 \times \rhd$	
					$1 \times \bullet$	$4 \times \bullet$	$3 \times \rhd$	$1 \times \ominus$

Grand total of groats used: $1 \times \rhd$ $2 \times \bullet$ $9 \times \bullet$ $4 \times \rhd$ $1 \times \ominus$

Grand total of malt used: $1N_{47}$ $4N_{20}$ $3N_5$ $1N_{42a}$ (rev. i 3) $\times {}^3/_5 \approx$ $8 \times \bullet$ $4 \times \rhd$ $1 \times \ominus$

Figure 6. Transliteration and calculations of *MSVO* 4, 66.

$6N_1 = N_{14}$ in grain system); N_1 N_8 N_{39a} and $6N_1$ N_8 N_{39a} in *MSVO* 1, 84 obv. i 2 and rev. ii 2b1, respectively (N_8 not a member of the grain system); N_{14} $6N_1$ N_{24} in W 19568,d obv. i 2b (unpublished; $6N_1$ incompatible with the grain system); $6N_1$ N_{24} in W 19784 obv. i 5 (unpublished); N_{14} $8N_1$ N_{24} in W 20044,38 obv. i 3 (unpublished); $6N_1$ N_{24} in *MSVO* 1, 111 obv. i 2a; N_{51} N_{26} in *ATU* 5, pl. 108, W 9656,fm obv. i 1 (N_{51} is a member only of the bisexagesimal system); $5N_{51}$ N_{26} in *ATU* 5, pl. 32, W 8273 obv. i 1; $6N_1$ N_{28} in *ATU* 5, pl. 46, W 9206,b rev. i 1; N_{51} GAR N_{28} in *MSVO* 1, 111 obv. i 3a (in this case the sign N_{28} explicitly qualifies the ration symbol GAR and the notation is followed by a numerical notation N_{20} representing the corresponding amount of groats needed for the production of "120" of the units N_{28}); $6N_1$ N_{28} in *MSVO* 1, 145 obv. i 4a (followed by a notation representing a corresponding amount of groats). In fact, in all cases cited, the counting system employed with these grain products is bisexagesimal.

The summation on the reverse of the account keeps distinct this final grain ration from the total of the other, larger grain products. The meaning of the qualification BA GAR of these larger products, however, remains obscure, although the sign BA is very common in administrative context and seems, as we might expect, to represent a distributive process. Whether the gunification of the GAR sign refers to rations for simple laborers, the qualification BA GAR to allotments given higher officials, is a matter of speculation.

The second column of the obverse face of the document records three entries of large numbers of beer containers followed by the respective measures of grain used in their production. As with the dry grain products, the type of beer recorded in the first entry required more grain for its production, the following two types progressively less.[28] In the first case, the production of each jar of beer would have required about 6 liters of barley groats, in the second about 5, and in the third about $1^2/_3$ liters. It is of particular interest that all three types of beer are qualified in the total on the reverse with the sign combination DUG_a $KA\check{S}_a$ we have seen in the account *MSVO* 1, 93. This suggests that DUG_a is indeed the denoter of a beer vessel of any size,[29] and $KA\check{S}_a$ the denoter of the liquid itself, further that the sign combination generally referred to a combination of different sorts of beer.

The right-hand column of the reverse of *MSVO* 4, 66, thus contains in a fashion parallel to the obverse notations the totals of the dry grain products and of the beer vessels, in each case with a notation of the total amount of grain used in the production of the goods. These three grain capacity notations are consolidated in the first case of the second, left-hand column in a grand total of barley groats accounted for in the document. A final notation in a derived capacity system we have called Š' seems at first sight, however, to stand in no obvious relation to any of the grain notations on the reverse; moreover, there were no notations whatsoever in this derived numerical system on the obverse face of the tablet. As we know from this text and from *MSVO* 1, 93, from related texts from Jemdet Nasr, and now from numerous accounts in the so-called Erlenmeyer ar-

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28 This presumably does not, however, mean that the first beer containers were larger, but rather that in line with later brewing tradition in Mesopotamia, the higher beer qualities simply required more barley in the brewing process than did the beer of the "common man." Just the same, the assumption that the common beer $KA\check{S}_a$ was produced at a rate of $1:1$ in barley to finished beer presents us with a problem, since our metrological interpretation of the capacity system would allow for a jug of no more than 3 liters for the common beer. No archaeological finds from archaic levels in Babylonia are suggestive of a ceramic typology which would allow for this size of mass produced jugs.

29 The differentiation between DUG_a and DUG_b was in the archaic sources very strict. The latter sign, lacking the representation of a spout, referred without exception to vessels containing different kinds of fats, for the most part animal fats such as ghee, lard, and the like. It may be assumed that this pictographic representation was based on the real viscosity of the materials involved: fats and oils will have had to have been ladled and not poured out of the vessels. Vessels with spouts will have been used for fluids which could be easily poured into receiving vessels, be they simple jars, cups, skins, etc.

chive, notations of quantities of grain qualified with an oblique stroke represent measures of barley malt added in the production of beer.[30] The quantity of malt added varies according to the sort of beer[31]; in the case of *MSVO* 4, 66, the malt was added to all three sorts at an average rate of 3 measures of malt to 5 of barley groats, since $1N_{47}\ 4N_{20}\ 3N_5\ 1N_{42a} \times {}^{3\check{S}}/_{5\check{S}^*}$ = very nearly $52^1/_3\ N_3$, or so close to the recorded $8N_{18}\ 4N_3\ 1N_{40}$, that the missing $^1/_2\ N_{40}$ may be disregarded. Ingredients recorded in other texts suggest nonetheless that no less than with groats, the malt formed a higher proportion of the total contents of more prized beers.[32]

The second section of the obverse of the tablet *MSVO* 1, 93, to which we now return, comprises a list of counted object designations, with the exception of the third entry all quantified with use of the sexagesimal system. The first entry (obverse ii 4) records 30 small cattle,[33] the second 60 dried fish.[34] The third entry employs a derivative form of the bisexagesimal system to qualify objects which seem generally to be implicitly understood, since there is in the available evidence but one case of a possible identifying ideogram together with a numerical notation in this system. This sign ZATU711 and the usual context of the notations in this system lead me to believe that, first, the object recorded may be an aquatic foodstuff, second, that it may, like products qualified with the

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30　We assume that the stroke is the pictographic representation of the sprout from the individual kernels, just as the dotted impressions of the system $\check{S}^*$ are suggestive of cracked or rough-ground barley groats.

31　For instance the beers qualified $\check{S}EN_b$ in the text *Archaic Bookkeeping:* 44, figure 39a (see pp. 43–46) were brewed with the addition of malt at the rate of $1:1$ for both types GAL_a and TUR. In the same text, a beer qualified simply DUG_a was supplemented with malt at the rate of $2:3$, and in the case of p. 42, figure 38 (see p. 43), malt was added to DUG_a beer at the rate of just $1:2$. These brewing processes will be discussed in detail in volume 3 of the series *MSVO,* now in preparation by P. Damerow and myself, with copies, glossary, and commentary to the complete Erlenmeyer archive.

32　See, for example, the treatment below of the account *MSVO* 1, 108.

33　The sign UDU_a served as a general qualification for both sheep and goats; compare M. Green, "Animal Husbandry at Uruk in the Archaic Period," *JNES* 39 (1980): 1–35, and *Archaic Bookkeeping:* 89–94.

34　The sign SUḪUR was the pictographic representation of a split and dried fish whose head had been removed. The process of drying will have required the use of fish of a relatively low fat content; fatty carp and the herring-like *Hilsa ilisha,* for example, will not have been suitable for such preservation and so were doubtless either eaten fresh or used to produce fish oil or some sort of garum sauce. See J. Waterman, *The Production of Dried Fish* (= *FAO Fisheries Technical Paper* no. 160; Rome: 1976), 8–14, 18–32; C. Cutting, *Fish Saving: A History of Fish Processing from Ancient to Modern Times* (London: 1955); J. Smith, *Historical Observations on the Conditions of the Fisheries Among Ancient Greeks and Romans, and on Their Mode of Salting and Pickling Fish* (= *U.S. Commission on Fish and Fisheries, Report of the Commissioner for 1873–4 and 1874–5;* Washington DC: 1876, with references from classical authors). The SUḪUR fish are recorded with some regularity and in large numbers in texts from Uruk; in texts from Jemdet Nasr, on the other hand, they are booked rather infrequently, recording at most 120 fish. The dried $SUḪUR_a$ were qualified without exception with the sexagesimal, it seems the fresh fish KU_{6a} with the bisexagesimal numerical system (see *ATU* 2, 134, and the texts cited there and in footnote 44).

sign GAR and counted bisexagesimally, have been rationed out to dependents of the Jemdet Nasr administration.

The following entries in obverse ii 7–iii 4 include object designations which form a particular set of goods best documented in a large group of Jemdet Nasr tablets sealed with the so-called City Seal.[35] The objects concerned seem primarily to be dried fruits and products from the textile manufactories. The sign $DUG+A\check{S}_c$ should be here the exception, since a comparison of this sign and its contextual usage suggests that it like DUG_c[36] was used to designate a type of processed animal fat. The size of the jar $DUG+A\check{S}_c$ is unfortunately still a matter of speculation; the comparable jar designated DUG_c may have held circa 8 liters.

After the notation of 1 jar $DUG+A\check{S}_c$, the account records three counts of objects which defy pictographic analysis and so must be isolated in their contextual usage. This seems to indicate that all three were designations of textile products, since they are most often found in connection with deliveries of textile/wool represented by the signs TUG_{2a} and SIG_{2b}. The first two signs $\check{S}U_{2a}$ and ZATU644 (= $\check{S}U_{2a}+N_{57}$), moreover, are often found together with the sign $GADA_a$—possibly referring to linen as in later periods—and could thus represent similar products. The third object designated ZATU753 remains unclear.

The last group of objects recorded in *MSVO* 1, 93, seems to consist entirely of dried fruits. This assumption is based primarily on the pictography of the sign MA and on the later use of this sign together with length measurements.[37] The form of the sign is very suggestive of a cord strung through fruit and tied in the middle to avoid the obvious problem of the fruit sliding off. The use of the sign N_8 with numerical meaning "$1/2$" N_1 in the sexagesimal system, further, parallels length measures of the Ur III period. Whether the sorts MA (later Sumerian pèš, designating figs) and ḪAŠḪUR (an apple?) designated the same fruits throughout the 3rd millennium is unclear. The qualification $ZATU735_b$ of MA is, although unclear, specific to this usage. The meaning of the final object designation is not known.

Whether the dried fruit was included in the summation of the tablet cannot be ascertained. If so, then available space in the break of the first column of the reverse makes highly prob-

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35   This important seal is the object of particular interest in R. Matthews, *Cities, Seals and Writing: Archaic Seal Impressions from Jemdet Nasr and Ur* (= *MSVO* 2; Berlin, 1993). See also Matthews' catalogue and copies of the seal impressions on Jemdet Nasr texts in *MSVO* 1.

36   See R. Englund, "Dairy Metrology in Ancient Mesopotamia," *Iraq* 53 (1991): 101–104.

37   See in particular I. J. Gelb, "Sumerian and Akkadian Words for 'String of Fruit'," *Fs. Kraus* (Leyden: 1982), 67–82; *ATU* 2, 150[28]; and my remarks in *Organisation und Verwaltung der Ur III-Fischerei* (= *BBVO* 10; Berlin: 1990), 38–39 with footnotes.

able that the likely four notations would have had to have been consolidated into one or possibly two. This sort of semantic consolidation, which occurred in the following notation of GAR (rev. ii 1) and which is of imposing interest in establishing semantic categories of object designation in the archaic texts, is, however, not known from other text witnesses for fruits; thus, the reconstruction of this section offered in figure 4 is highly speculative.

It may be of some interest that in all cases the entries of *MSVO* 1, 93, and those of comparable administrative documents from Jemdet Nasr (see below for further examples) record on the whole modest numbers and measures of goods. In the present account, we have totals rev. i 1–2 of, according to our understanding of the absolute measures of the capacity numerical signs, little more than 350 liters of groats and of 50 liters of malt. These 350 liters of groats may have represented some 400 day-rations or, if we may extrapolate from value equivalencies known in the later 3rd millennium, perhaps the inherent worth of one or two sheep. It is thus likely that the real value of the goods accounted for in these texts lay first in the sheep themselves, and then in the textile products, which represented substantially more invested labor than did rough ground flour. dabin-flour was produced in the Ur III period at a rate of 10 liters per female worker per day, which in turn cost the state a ration of, as a rule, just 1 liter (sìla). These numbers will remain of limited value, however, until the purpose of the rations can be more clearly delineated.

The final section of the obverse of the account consists of a complex combination of ideograms which offer summarizing information about the text. This ideographic notation seems to define the function of the account, state the time period covered therein, and to establish the locality for which the account was drawn up. The first sign combination NI_a+RU is in my opinion the archaic toponym for Jemdet Nasr. The evidence for this identification is not overwhelming, but at least interesting enough to warrant a broader discussion elsewhere. Preliminarily, I draw attention to the fact that the sign combination is attested only in the Jemdet Nasr text corpus, yet in very large numbers.[38] Further, a characteristic entry sequence in the large city seal text group: (personal designation) / NI_a+RU / $3N_{57}$ $MUŠ_{3a}$ / $UNUG_a$, may be interpreted as: (so-and-so much fruit, wine, etc.) "(from PN) of Jemdet Nasr, for the male(?)[39] Ištar in Uruk," corresponding to a sequence KU_{6a} UR_2 RAD_a / AN $3N_{57}$ / $UNUG_a$ in the text *MSVO* 4, 15,[40] presumably from Uqair (= KU_{6a} UR_2 RAD_a). This sequence of entries seems to exhibit the pattern PN / GN_1 / DN / GN_2. We have moreover the combination NI_a+ RU most often attested

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38   In fully 59 of 244 texts.

39   That the three horizontal strokes clearly served as a cursive variant of the sign KUR_a in archaic sources is demonstrated by their use in the sign ŠURUPPAK (cf. the corresponding entry in *ATU* 2). Whether, however, with these variant forms the original meanings of KUR_a, that is, either "male (slave)" or still possibly "mountain" is implied, or whether through means of homophony an entirely different meaning has been attached to the sign, cannot be determined.

40   Compare *MSVO* 4: 12[+22].

with AB_a, which may be the "strange building" of Jemdet Nasr,[41] as well as with SAN-GA_a, which should approximate "bookkeeper." The signs themselves, which most commentators following Langdon[42] have allotted phonetic readings and interpreted as some sort of Sumerian verbal form, seem likely to describe the clay devices NI_a and RU, the former representing a vessel containing dairy oil, the latter possibly the sickle, an article generally diagnostic of Ubaid-ED I sites in southern Mesopotamia and as elsewhere ubiquitous on the Jemdet Nasr mound. Since it has not been possible to isolate the sign combination NI_a+RU in a context exclusive to toponyms such as in a lexical compilation, however, it cannot be excluded that NI_a+RU itself refers to a $SANGA_a$ official at Jemdet Nasr, much the same as the sign combination KU_b+$\check{S}IM_a$ seems to have represented a $SANGA_a$ of beer production whose activities were recorded in the Erlenmeyer archive.[43]

The sign combination SAG+GAR = GU_7 is extremely common in archaic texts from Jemdet Nasr and Uruk. While SAG seems, *pars pro toto,* to represent a human in general and not, as in later usage, a chattel slave, its use together with a number of qualifying signs or simply (so-called *gunû-*) strokes apparently served to create abstract concepts. This must be the case with GU_7, since it is in no way obvious that this sign designated "rationed persons," but rather rationing in the abstract. A differentiation between this sign and the common BA is not obvious in texts known to me; they were, however, not interchangeable, since, for instance, only objects qualified with BA and not those qualified with GU_7 could be subsumed in a total with objects qualified with GI.

The sign combination $2N_{57}$ SU_a GIBIL must represent a time notation, since it is in a position otherwise occupied by signs denoting years, U_4+nN_{57}. Furthermore, the double stroke $2N_{57}$ seems to lend numerical meaning to the entire combination, although it has been impossible to discover the numerical structure of the apparent system in the same fashion as was possible to delineate the archaic administrative time notations for year, month, and day.[44] We have in this system the numerical notations $1N_{57}$, $2N_{57}$, $3N_{57}$, $4N_{57}$, in one text (*MSVO* 1, 94) $6N_1$ and $1N_{14}$ $2N_1$ and in *MSVO* 1, 90, the complex notation U_4+$3N_{57}$ SU_a $6N_1$ GIBIL:[45]

94	obv. ii	1	[ ] ⌜$6N_1$⌝ SU_a [ ]	⌜AMAR⌝ GI	AB_a NI_a+RU
	iii	8	$1N_{14}$ $2N_1$ SU_a GIBIL	GI	
108	obv. ii	6	$1N_{57}$ SU_a		AB_a NI_a+RU
	rev. iii	3	$1N_{57}$ SU_a GIBIL		⌜AB_a⌝ NI_a+RU

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41   Compare *MSVO* 1: 7–8, 13 and the literature cited there.

42   Compare *OECT* 7: 28 *s.v.*

43   Compare *Archaic Bookkeeping:* 36.

44   See *Timekeeping:* 136–164.

45   To facilitate the clearness of the list, the order of the signs has been standardized to: presumable time notation–descriptive elements–acting officials–institution–toponym. All texts are from *MSVO* 1.

99	rev. iv	1	[ ] SU$_a$ ⸢GIBIL	EN$_a$⸢?⸣ [ ]	
	iv	2	1N$_{57}$ SU$_a$ GIBIL	ŠAGAN ENGIZ	
160	obv. ii	6a	⸢1N$_{57}$⸣ SU$_a$ GIBIL		⸢NI$_a$+RU⸣
93	obv. iii	5	2N$_{57}$ SU$_a$ GIBIL	GU$_7$	NI$_a$+RU
	rev. ii	4	[2N$_{57}$] ⸢SU$_a$ GIBIL	GU$_7$⸣	[NI$_a$+RU]
135	rev. i	2	2N$_{57}$ ⸢SU$_a$⸣ GIBIL		⸢NI$_a$+RU⸣
103	rev. iii	4	⸢3N$_{57}$? SU$_a$⸣ [ ]		
95	rev. ii	1	3N$_{57}$ SU$_a$ GIBIL [ ]	EN$_a$ KID$_a$ ŠAGAN ENGIZ	
	rev. ii	2	[ ] GIBIL	EN$_a$ [ ]	
109	obv. ii	5	⸢3N$_{57}$⸣ SU$_a$ GIBIL [ ]	⸢GU$_7$⸣	NI$_a$+RU
117	obv. ii	1	3N$_{57}$ SU$_a$ GIBIL		
179	rev. i	1	3N$_{57}$ SU$_a$ ⸢GIBIL⸣	GA$_a$ GU$_7$	[ ]
90	obv. iii	4	3N$_{57}$+U$_4$ SU$_a$ ⸢6N$_1$ GIBIL⸣	[ ]	⸢NI$_a$+RU⸣
89	obv. ii	1	⸢4N$_{57}$ SU$_a$ GIBIL⸣	X [ ]	
	rev. i	1	4N$_{57}$ SU$_a$ ⸢GIBIL⸣		
133	obv. ii	6	4N$_{57}$ SU$_a$ GIBIL	EN$_a$ BAR PA$_a$	
97	rev. ii	1	[ ] SU$_a$ ⸢GIBIL⸣	BA ⸢ŠAGAN ENGIZ⸣ APIN$_a$ AB$_a$	NI$_a$+RU
111	rev. ii	4	[ ] ⸢SU$_a$⸣ GIBIL [	GU$_7$	NI$_a$+RU]
130	obv. ii	2	[ ] ⸢GIBIL⸣ [ ]		⸢NI$_a$+RU⸣
144	obv. iii	1	[ ] ⸢SU$_a$⸣ GIBIL [ ]		

The notation U$_4$+3N$_{57}$ SU$_a$ 6N$_1$ GIBIL suggests that the strokes in connection with SU$_a$ GIBIL imply the existence of U$_4$ and thus designate numbers of years,[46] whereas SU$_a$ (GIBIL) itself may refer to a month and thus in *MSVO* 1, 90, "in the third year, sixth month …(?)" or, possibly, something associated with a (new year's) festival.[47] The two notations 6N$_1$ and 1N$_{14}$ 2N$_1$ in *MSVO* 1, 94, may refer to $^1/_2$ and 1 full year, since we know that the sexagesimal curvilinear system was used to count months, which in administrative notations would normally have been written within the sign U$_4$. The succession in these texts of from 1 to 4 × N$_{57}$, that is, either one to four years, or, as seems more probable, first to fourth year—no apparent association between the goods, in particular the grain products, recorded in the underlying accounts and an assumed time span has been found—, could represent an early form of time reckoning according to regnal years. As in many elements of archaic accounting, this form of possible timekeeping seems unattested in the much larger corpus of texts from southern Uruk.[48]

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46 The optional nature of the sign U$_4$ in (ordinal) year notations could be demonstrated in the case of tablets which may have come from Tell Uqair; compare *Timekeeping:* 162–164 and *MSVO* 4: 11–12.

47 An Uruk text I recently inspected in Heidelberg, W 21671, seems to record the receipt by the official EN$_a$ of deliveries of various textiles, listed according to festival or possibly month names EZEN$_b$ U$_4$ AN MUŠ$_{3a}$ (obv. i 3), GIBIL NUN$_a$ (i 8), EZEN$_b$ SIG AN MUŠ$_{3a}$ (ii 1), SU$_a$ NUN$_a$, and so on. The combination EZEN$_b$ U$_4$/SIG AN MUŠ$_{3a}$ has been reasonably interpreted as a designation of a (seasonal) festival in *Timekeeping:* 167[39], and *Archaic Bookkeeping:* 17 with 44, text a, obv. iii 7–8.

48 Only in peripheral notations are found sign combinations in five Uruk accounts which bear some similarity with the Jemdet Nasr texts cited above. In W 20274,75 obv. ii 5a and W 21733,7 obv. ii 3a (both texts unpublished), a numerical notation recording an unnamed object is found together with a sign com-

The reverse face of *MSVO* 1, 93, contains, as we have seen, a summation of the information on the obverse. It may be that the final case on the reverse included not just a repetition of the third section of the obverse, but also another sign combination representing the official responsible for the text.

This account is one of a number of examples of rationing texts from Jemdet Nasr which exhibit parallel formats and contents. The text *MSVO* 1, 108, represents the best currently available parallel text to *MSVO* 1, 93, both in the general format and in specific features found in the account (see figure 7). A first section recording numbers of dry grain products together with the barley groats necessary for their production is followed by a second recording quantities of beer together with both measures of groats and malt. Next, we find a measure of barley groats qualified MU ZATU714+HI*gunû*$_a$. After the insertion of a subscript $1N_{57}$ SU$_a$ AB$_a$ NI$_a$+RU, the third column of the obverse contains a section of non-grain products: small cattle, dried fish, excepting some missing items in exactly the same sequence as that recorded in *MSVO* 1, 93.

The reverse face of text no. 108 also presents a nearly exact parallel to that of no. 93. The first case of the second column contains the numerical notation representing the total of all dry grain rations listed on the obverse, N_{51} $2N_1$ = 122 GAR+nN_{57}, for which a given quantity of groats is recorded corresponding to the total of the nine grain notations in the first column and the first two cases of the second column of the obverse.

There follows a notation of 15 jugs of beer (10 + 5), for which $5\,^1/_4$ N_{39} of groats was used. Immediately below this total of groats, the scribe recorded separately the amount of malt used in the beer brewing, which in contrast to *MSVO* 1, 93, had been included with the individual beer entries on the obverse of the account. The three totals of barley groats recorded in the second column of the tablet reverse—for dry grain products, beer, and a product qualified MU ZATU714+HI*gunû*$_a$—are then added together for a grand total of groats recorded in the account, which is noted in the first case of the first column of the reverse. Immediately below this grand total, the scribe recorded separately the total amount of malt used in the beer brewing, followed here not by a list of the remaining non-grain products, but by the tablet subscript N_{57} SU$_a$ GIBIL NI$_a$+RU ⌜AB$_a$⌝, which may

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bination representing an official and the combination $2N_{57}$ SU$_a$ GIBIL. The account A. Cavigneaux, *BagM* 22 (1991): 95, W 24011,8 obv. i 2, contains a notation of 1560[sic] dried fish or measures of dried fish (SUḪUR) with [ ] SU$_a$ GIBIL, followed by an entry with a notation in the numerical system B*, that is, two entries in the same sequence as is the norm in the presumably dated accounts from Jemdet Nasr. Finally, the text *ATU* 2, pl. 27, W 20274,26 obv. iii 4, contains the notation N_{14}; U$_4$ SIG EZEN$_b$ MUŠ$_{3a}$ SU$_a$ GIBIL, and for similar sign combinations see the preceding note to W 21671. Since the signs U$_4$ SIG EZEN$_b$ MUŠ$_{3a}$ seem in other contexts to refer to a 'festival of the morning and night star Venus,' the combination SU$_a$ GIBIL may in this case specify the named festival as a calendrical event.

very tentatively be translated "(for the) new-growth festival of the first year (?) in the 'household' of NIRU." Perhaps due to the lack of space, the scribe in this text re-cord-ed dutifully the same quantities of non-grain products as were listed on the obverse in a separate, third column of the reverse.

The account *MSVO* 1, 108, also contains evidence to verify the quantities of grain used in the production of certain items qualified with ideograms. For example, two units of the product GUG_{2a} are recorded on obv. i 6 with a grain equivalent of N_{28} (= $^1/_4 N_{39}$), that is, with a grain equivalent of $^1/_8 N_{39}$ per unit. This is the same equivalent as that recorded for the product in *MSVO* 1, 93, obv. i 6. The same applies for the product qual-ified ŠA*gunû* GUG_{2a} (ca. $^1/_6 N_{39}$). Although the same correspondence does not seem to hold for the product GAR+nN_{57}—text no. 93 exhibited the expected relation of six units per N_{39}, whereas no. 108 shows $55 ÷ 12^1/_2 = 4.4$—it seems possible that some number of GAR products requiring a larger amount of grain may have been included in the 55 units recorded in text no. 108, since the ration products between $N_{24} = ^1/_2 N_{39}$ and those equivalent to $^1/_6 N_{39}$ are missing in this account. In an appendix at the end of this presentation, I have compiled a preliminary overview of the types of grain products attested in similar contexts in accounts from the archaic text corpus, noting in particular those referents which allow of an explicit or implicit calculation of the amounts of grain required in their specific production.

In the case of the recorded measures of beer, both sorts $DUG_a KAŠ_a$ and $DUG_a KAŠ_a$ $E_{2a} DUB_a$ are recorded, strangely, with a grain equivalence of approximately 3 jars per N_{39} of barley groats. This is also the relationship for the latter type in *MSVO* 1, 93; how-ever, there the former type was produced at the rate of just $2^1/_2$ jars per N_{39}. The two sorts seem in *MSVO* 1, 108, differentiated not by the quantity of barley groats employed in their production, but rather by the quantity of malt. Here twice as much malt is used in the brewing of the beer qualified $DUG_a KAŠ_a$ as that used for the sort $DUG_a KAŠ_a$ $E_{2a} DUB_a$ ($^1/_5 N_{39}$ per jar in the former, $^1/_{10}$ per jar in the latter case).

The text *MSVO* 1, 107 (see figure 7, bottom), seems to demonstrate the next level of accounting after *MSVO* 1, nos. 93 and 108. In this summation of an account concern-ing a particular official or household, the scribe dispensed with an item-specific account-ing of different sorts of dry and liquid barley products, opting merely to record the totals of a ledger which may or may not have been inscribed.[49] All the elements of the previ-ously discussed accounts are to be found in this text: In the first column the grand total

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49   We have been able to locate in the archaic sources few examples of individual receipts or journals which were copied into larger accounts (see *Archaic Bookkeeping:* 44, figure 39b, and 72–73, figures 62b–c), al-though as is argued here, the accounts themselves can scarcely be otherwise explained. Still the nature of bookkeeping will certainly have been rudimentary, with the probable use of a number of devices such as tally sticks and tokens as supplements to the procedure of drawing up books for extended time periods.
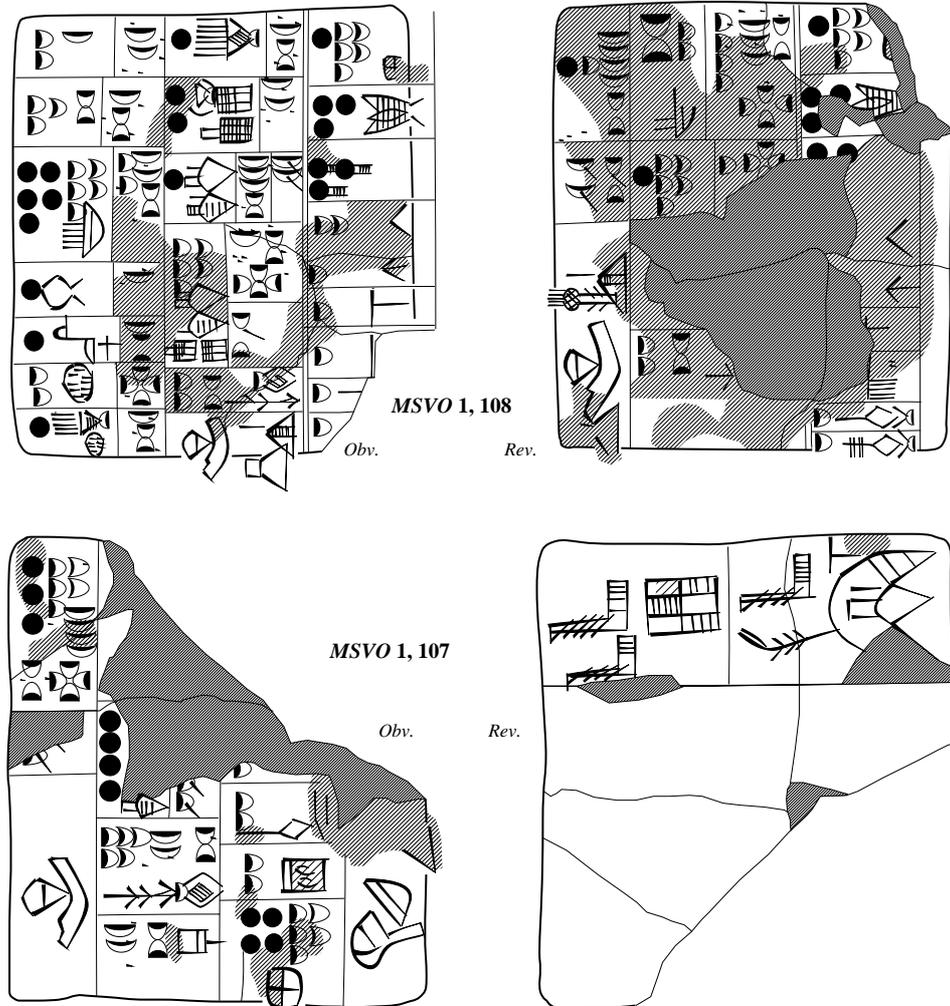
Figure 7. *MSVO* 1, 107 and 108.

of barley groats used in the production of dry and liquid grain rations, followed by the amount of malt employed only in beer production, and finally a subscript of the grain account NI_a+RU. The second column contains, partially destroyed, a total both of numbers of dry grain rations (GAR) and of jars of beer together with their respective grain equivalents and, in the case of the beer, with the malt added in the brewing process. After the requisite notation of the grain product called MU ZATU714+HI*gunû*$_a$, the scribe has listed non-grain products, including both small cattle and dried fruits.

A final subscript in the fourth column of the obverse of the account seems to have been the same as that of *MSVO* 1, 93, however the reverse contains two ideographic notations which are new. The first case contains the personal designation EN_a NIBRU, the second ENGIZ ŠAGAN. It may seem precipitate to assume that the first name refers to the local ruler (EN_a) of the city Nippur and that these goods were destined for that settlement. Yet that need not be so far-fetched. Since we may infer from the texts *MSVO* 1: 2–6, that an official called EN_a in Jemdet Nasr commanded far and away the largest agricultural holdings, it may be posited that this must be the designation of the highest official in this settlement. Further, the sign combination EN_a KID_a is in the archaic lexical texts attested only in the meaning of Nippur in the City List, line 3.[50] Finally, it would not be unusual to find transfers of goods from this apparent economic outpost to urban centers, in particular Nippur, which as a religious center enjoyed a special status in this regard throughout the 3rd millennium. It is, moreover, known from the use of the so-called 'City Seal' that Jemdet Nasr was probably in some fashion part of a league of settlements in contact with one another. This seal included as its third toponym Nippur, there written EN_a NUN_a.[51]

The designation ENGIZ (or probably better EN_a ME_a GI) is known to refer to a profession in later tradition related to the muḫaldim, the "cook"[52] of 3rd millennium Babylonia. While the meaning of ŠAGAN remains unclear, certainly the pictographic representation of the beer jar DUG_a under some sort of covering can be considered in line with the responsibilities of the official in charge of foodstuffs for the central administration. ENGIZ is in the Jemdet Nasr corpus attested only together with the sign ŠAGAN.[53] The connection between the ruler of Nippur and a highly placed official in charge of meal preparation is, unfortunately, not obvious.

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50   See *Timekeeping:* 131–133[9] and R. Englund and H. Nissen, *Die lexikalischen Listen der archaischen Texte aus Uruk* (= *ATU* 3; Berlin: 1993) *s. v.* P. Steinkeller, in *BiOr.* 52 (1995): 700 to no. 142, misunderstood the published record concerning this sign combination. I have been very clear in stating that KID_a and KID_b were *never* variants in the archaic period, and that KID_a and E_2 were without exception used in distinct contexts. Thus EN KID_a was the consistent writing of Nippur and, presumably "Enlil", and was unconnected to all attestations of EN E_2 (including those with TI, for instance, *MSVO* 1, 196 i 2; 212–213 *passim; MSVO* 4, 13 ii 1; 36 iii 6, still misconstrued as ENLIL.TI, "Enlil [gives] life").

51   Compare R. Matthews, *MSVO* 2: 30–36.

52   Compare line 63 of the list Lú A, *ATU* 3: 80. The correspondence of ENGIZ with the later Akkadian *engiṣu* and *nuḫatimmu,* both officials in charge of royal and temple kitchens, is clear, however none of the rather numerous attestations of the designation in Jemdet Nasr texts make a connection to the kitchen obvious.

53   This is true in only one of four administrative attestations from Uruk (W 24024,1, now published in *BagM* 22 [1991]: 115), however in a context different from that of the Jemdet Nasr ration texts. Although listed as a distinct entry in the lexical list Lú A (see the preceding footnote), the entry for ENGIZ follows immediately on that for ŠAGAN, so that we may assume that they were considered related designations.

The final step in the bookkeeping procedures beginning with the rationing text *MSVO* 1, 93, seems represented by a number of accounts from Jemdet Nasr, two of which are depicted in figure 8. Both of the texts *MSVO* 1, 95 and 96, contain the consolidation into a more comprehensive ledger of four accounts of the type of nos. 93 and 108. The accounts consolidated here were concerned with precisely the same dry and liquid grain products, and in general with the same types of non-grain goods, including sheep and goats, fishery products (? – derived bisexagesimal system), and with products from the textile manufactories.[54]

The apparent delivering agents (?) of the goods listed are with one exception persons well-known from the Jemdet Nasr field accounts *MSVO* 1: 2–6, according to which they enjoyed rights to parcels of agricultural land the size of which stood in a fixed relation to that held by the ruler EN_a.[55] These must be high officials of the central administration, ranking immediately below the city ruler in status. Both texts include the names of the persons ME_a, $GIR_3 gunû_b$ DI, and probably $GIR_3 gunû_b$ PA_a. Whereas *MSVO* 1, 95, has as subscript of the fourth column of the obverse the designation GAL_a $ŠAB_a$, no. 96 records NAM_2 DI as subscript of its second column.[56]

Based on the analysis of the texts *MSVO* 1, 93 and 108, it is clear that the references in these accounts to amounts of barley groats and malt can only imply that the booked grain quantities had been used in the production of dry grain products and of beer. These quantities of such goods are, moreover, comparable with those recorded in the individually itemized accounts. Finally, the tablet subscripts on the reverse faces of the accounts contain many of the same elements as those known from itemized accounts: that is, in the case of text no. 95, a probable calendrical designation $3N_{57}$ SU_a GIBIL, followed by a personal designation ENGIZ ŠAGAN and a toponym NIBRU (the final ideographic notation of this text, GIBIL EN_a, is otherwise not attested in this form), in the case of no. 96 a more complex subscript, but also including ENGIZ ŠAGAN and, probably, NIBRU.

Unfortunately, we are unable to determine the final purpose of these texts, due in part to the still limited number of attestations to like transactions in the archaic text corpus—the approximately 5,000 texts and fragments from Uruk, for example, offer practically no evidence of a similar nature—, but due in great measure to the difficulties of

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54   There are here, however, a number of ideograms for which I can propose no meaning, among them in *MSVO* 1, 96 obv. i 4: MAR, i 5: KID_b, i 6: MU and ii 9: $KU_3 gunû$. A full treatment of the attestations for these objects is in preparation.

55   The ruler controlled a parcel exactly twice as large as the total amount of land allotted five high officials, including the wife of the ruler (? – SAL EN_a).

56   Of these five officials, two—NAM_2 DI and GAL_a $ŠAB_a$ —are attested in lines 3 and 25 respectively of the list Lú A. The former is conventionally translated 'judge,' the latter seems to be the Sumerian designation of trader, later replaced by the Akkadian loan dam.gàr (cf. M. Powell, *Oikumene* 2 [1978]: 140[+37]).
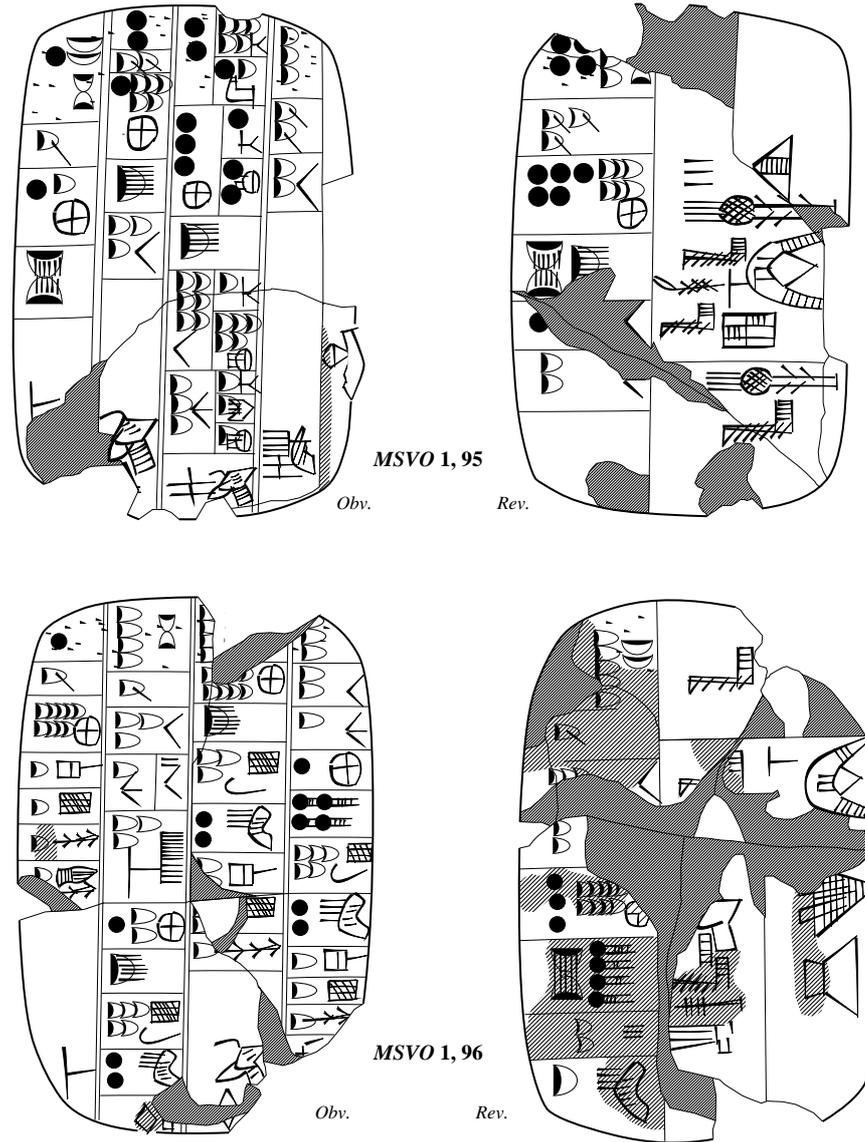
Figure 8. *MSVO* 1, 95 and 96.

understanding texts almost entirely lacking syntactical information about the direction of goods, about the responsibilities of acting officials, about the time span covered. Reading a very insightful article by I. Winter recently on the rituals surrounding the maintenance and care of royal statues as images of divinized rulers,[57] I was reminded of an idea which Friberg wrote to me some years ago concerning the lists of goods in the Jemdet Nasr grain texts, namely, that they might represent precursors of offering texts of the sort known from the later 3rd millennium in which a full palette of provisions for deities or revered elites was registered. Such offerings, which could be presented over time, were known as sá.du$_{11}$ rations, and it is striking that the goods and even occasionally the sequence in which they were registered, that is, bread and beer, sheep, fish, dairy products and fruits, paralleled those booked centuries earlier. However, who the recipients of these favors are is not apparent in the proto-cuneiform documents—either the central administration ostensibly acting as intermediary between a donor and the object of his reverence, or the individuals recorded, for example, in the subscripts to the obverse columns of the texts depicted in figure 8—, and the possible connection of the texts considered here to the still more involved, seemingly long-term accounts represented by such texts as *MSVO* 1, 85 (possibly a consolidation of *MSVO* 1, 86[+]87), 89–90, and 94, has not made the latter documents more transparent. Yet despite such occasionally bewildering archaic noise, the information in proto-cuneiform accounts can be very precise and formally clear. This still evolving clarity is above all the result of a serious attention to numerical detail by archaic bookkeepers, on the one hand, on the other of the perspicacious decipherment of their ledgers by modern logicians, in particular Friberg and Damerow, who best understood and, in our Berlin colloquia on concept development in ancient Mesopotamia, most forcefully stressed the fact that advanced accounting techniques played a major role in the emergence of pre-classical science.[58] For, when dealt with playfully, such techniques, in use already at the beginning of written tradition, led later scribes to leave the mundane field of administration for interesting flights in mathematics.

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57   "'Idols of the King': Royal Images as Recipients of Ritual Action in Ancient Mesopotamia," *Journal of Ritual Studies* 6/1 (1992): 13–42, especially 29–30.

58   See in particular Damerow, P. *Abstraction and Representation: Essays on the Cultural Evolution of Thinking.* Boston Studies in the Philosophy of Science, Bd. 175. (Dordrecht: Kluwer Academic Publishers, 1995), Chapter 9.

Appendix: Designations of Cereal Products and Rations in the Archaic Texts

DRY CEREAL PRODUCTS AND RATIONS: GENERAL DESIGNATIONS

GAR	GAR$gunû_a$	GAR+3-6N$_{57}$
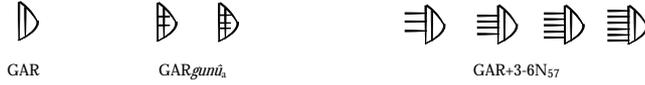
DRY CEREAL PRODUCTS AND RATIONS: NUMERICAL SIGNS IN IDEOGRAPHIC USE

N$_{39a/b}$	N$_{24}$	N$_{26}$	N$_{28}$	N$_{29a}$	N$_{29b}$	N$_{30a}$	N$_{30c}$	N$_{30d}$	N$_{31}$	N$_{32}$	N$_{33}$
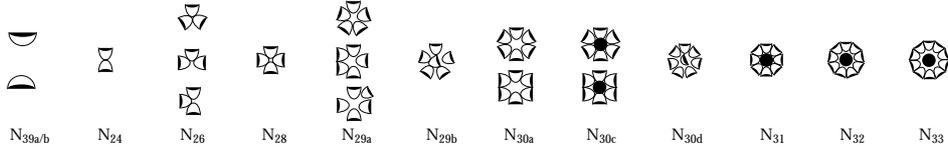
DRY CEREAL PRODUCTS AND RATIONS: COMBINATIONS OF NUMERICAL SIGNS AND IDEOGRAMS
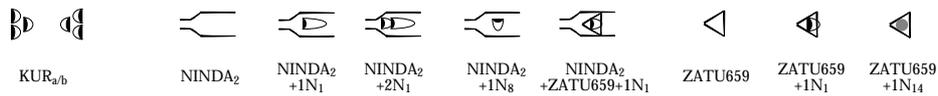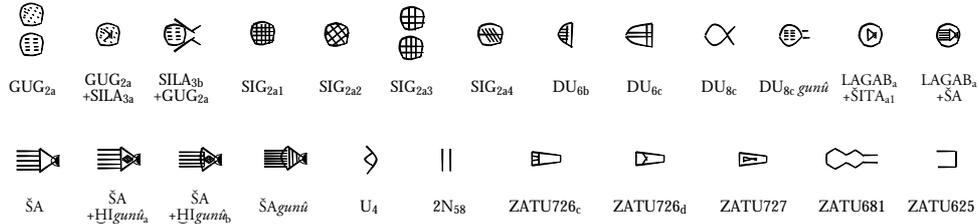
KUR$_{a/b}$	NINDA$_2$	NINDA$_2$ +1N$_1$	NINDA$_2$ +2N$_1$	NINDA$_2$ +1N$_8$	NINDA$_2$ +ZATU659+1N$_1$	ZATU659	ZATU659 +1N$_1$	ZATU659 +1N$_{14}$

DRY CEREAL PRODUCTS AND RATIONS: IDEOGRAMS

GUG$_{2a}$	GUG$_{2a}$ +SILA$_{3a}$	SILA$_{3b}$ +GUG$_{2a}$	SIG$_{2a1}$	SIG$_{2a2}$	SIG$_{2a3}$	SIG$_{2a4}$	DU$_{6b}$	DU$_{6c}$	DU$_{8c}$	DU$_{8c}$ $gunû$	LAGAB$_a$ +ŠITA$_{a1}$	LAGAB$_a$ +ŠA

ŠA	ŠA +ḪI$gunû_a$	ŠA +ḪI$gunû_b$	ŠA$gunû$	U$_4$	2N$_{58}$	ZATU726$_c$	ZATU726$_d$	ZATU727	ZATU681	ZATU625

LIQUID PRODUCTS CONTAINING CEREALS: BEERS

DUG$_a$	KAŠ$_a$	DUG$_a$ KAŠ$_a$	DUG$_a$ +U$_{2a}$	DUG +AŠ$_a$	ŠEN$_b$ GAL$_a$	ŠEN$_b$ TUR	ŠEN$_c$ $tenû$	ZATU710

Uruk IV: / Uruk III: (DUG$_a$)
Uruk IV: / Uruk III: (KAŠ$_a$)

SEMI-LIQUID PRODUCTS CONTAINING CEREALS: DAIRY FATS (?)

KAŠ$_b$	KAŠ$_c$

Uruk IV: / Uruk III: (KAŠ$_b$)
Uruk IV: / Uruk III: (KAŠ$_c$)
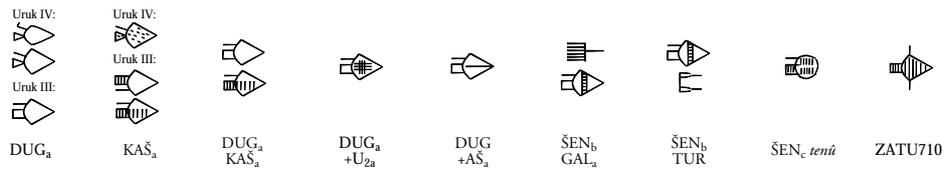
DRY CEREAL PRODUCTS AND RATIONS: GENERAL DESIGNATIONS

GAR

passim as a general designation of dry grain products and rations, including simple capacity measures (in contrast to GUG_{2a} denoting baked breads ?; see below with reference to *MSVO* 1, 109 obv. iii 1a and *MSVO* 1, 111 rev. ii 1a, and compare the summation rev. i 1 of grain products booked in *ATU* 5, pl. 38, W 9123,ae [DU_{8c}, SIG_{2a3}, $ZATU726_d$ and GAR] with the similar qualification of a total in the text W 9169,c cited below s. $1N_{39a/b}$ [N_{24}, N_{26} and N_{28}]), but also as designation of a specific grain product of a standard size, usually corresponding to an amount represented by the numerical sign N_{30a} (see P. Damerow and R. Englund, *ATU* 2, 153-154, fn. 60 [add *MSVO* 1, 140 = *OECT* 7, 8, obv. i 1a with an explicit N_{30a} qualifying a GAR reconstructed according to the parallel text *MSVO* 1, 138, and *Archaic Bookkeeping*, p. 42, fig. 38, obv. ii 5a (calculated contents correspond to $1N_{29a}$ per unit)], and R. Englund, *JESHO* 31, 162-164); pictogram of the beveled-rim bowl. Qualification of the products GAR with the metrological signs N_{24} (*ATU* 5, pl. 42, W 9169,b obv. i 4 [Uruk IV] and *MSVO* 1, 90 obv. ii 6a [?; Uruk III]), N_{28} (*ATU* 2, pl. 56, W 15920,a2 obv. i 2-3 [Uruk IV] and *MSVO* 1, 111 obv. i 3a [Uruk III]), N_{29a} (*ATU* 2, pl. 56, W 15920,a2 obv. i 1 [Uruk IV]), and N_{29b} (*ATU* 2, pl. 56, W 15920,a2 obv. i 4 [Uruk IV]) indicates a departure from the normal amount of grain required for their production. Cp. the entries containing U_4

GAR, GAR and GAR GAL in the archaic lexical list 'Grain', ll. 19, 21 and 29, respectively (*ATU* 3, pp. 142-143).

GAR*gunû*a

all Uruk IV (Uruk III // GAR+nN_{57} ?) Qualified with the metrological signs N_{39b} (*ATU* 5, pl. 42, W 9169,b obv. i 2), N_{24} (obv. i 3), and N_{28} (pl. 42, W 9169,c obv. ii 1). There is no clear attestation of GAR*gunû*a without metrological qualification. Cp. the use of GAR*gunû*b and GAR*gunû*c in the archaic lexical list 'Grain', ll. 20 and 26, respectively (*ATU* 3, pp. 142-143).

GAR+nN_{57}

all Uruk III (Uruk IV // GAR*gunû*a ?) $3N_{57}$: *MSVO* 1, 84 rev. i 5; Blau Plaque (see I. J. Gelb, P. Steinkeller and R. Whiting, *OIP* 104 [Chicago 1989] pl. 12) i 3a4 (ED I-II; cp. *ATU* 3, p. 132, ll. 99-100, and *ATU* 5, p. 12, fn. 7);
$4N_{57}$: *BagM* 22, 107, W 24018,2 obv. i 2; *MSVO* 1, 84 iv 4, v 4;
$5N_{57}$: *BagM* 22, 136, W 24061 obv. i 2; *MSVO* 1, 84 obv. ii 3; 93 obv. i 4a (calculated contents closely correspond to $1N_{30a}$ per unit); 103 obv. iv 2a (calculated contents likely correspond closely to $1N_{30a}$ per unit); 108 obv. i 3a (calculated contents approximate $1N_{28}$ per unit); *MSVO* 4, 66 rev. i 2a ($5N_{57}$ is here graphic variant of $6N_{57}$);
$6N_{57}$: W 21755 rev. i 1; *MSVO* 1, 113 obv. iii 3; *MSVO* 4, 66 obv. i 6a (the calculated contents correspond to $1N_{30a}$ per unit).

DRY CEREAL PRODUCTS AND RATIONS: NUMERICAL SIGNS USED IDEOGRAPHICALLY

$1N_{39a/b}$

Uruk IV: *ATU* 5, pl. 22, W 6940,b obv. i 2; pl. 42, W 9169,b obv. i 2; pl. 42, W 9169,c obv. i 3, rev. i 1 (together with N_{24}, N_{26} and N_{28}; cp. the text W 9123,ae cited above under GAR with a similar qualification of a total [DU_{8c}, SIG_{2a3}, $ZATU726_d$, GAR]); pl. 52, W 9312,n1 obv. i 1; pl. 105, W 9656,ew obv. i 2, rev. i 2; *Archaic Bookkeeping*, p. 31, fig. 29d, W 20044,38 obv. i 2; fig. 29c, W 20044,58 obv. i 2; W 20044,32 obv. i 2.
Uruk III: *ATU* 2, pl. 57, W 16719 obv. i 2; pl. 60, W 22112 obv. ii 5, iii 3, rev. ii 2 (qualifying ZATU625); *ATU* 5, pl. 1, W 5233,a obv. i 1; pl. 2, W 5233,b obv. i 1; pl. 2, W 5233,c obv. i 1; W 15797,a+

obv. i 5 (qualifying GUG_{2a}?); W 16465 obv. i 2; W 16477 obv. i 2; W 17440 obv. i 2; W 20522,4 obv. i 1; W 21022,3 obv. i 2; *MSVO* 1, 84 obv. i 2, iv 2, v 2, rev. i 2, ii 2b1; 93 obv. i 1a (restored); 108 obv. i 1a; 111 obv. i 1a; 141 obv. i 1a; 145 obv. i 2a; *MSVO* 4, 66 obv. i 1a.

$1N_{24}$

Uruk IV: *ATU* 5, pl. 22, W 6940,b obv. i 3; pl. 42, W 9169,b obv. i 3-4 (qualifying GAR and GAR*gunû*a); pl. 42, W 9169,c obv. i 4, rev. i 1 (together with N_{39b}, N_{26} and N_{28}); pl. 105, W 9656,ew obv. i 3, rev. i 3; pl. 113, W 9656,hy obv. i 2; *Archaic Bookkeeping*, p. 31, fig. 29d, W 20044,38 obv. i 3; W 20044,32 obv. i 3; W 20244,54 obv. i 2.

Uruk III: *ATU* 2, pl. 57, W 16719 obv. i 3; *ATU* 5, pl. 1, W 5233,a obv. i 2; pl. 2, W 5233,b obv. i 2; pl. 2, W 5233,c obv. i 2; A. Cavigneaux, *BagM* 22 (1991) 143, W 24187 obv. i 2; 143, W 24188 obv. ii 2; W 15968 obv. i 1; W 16465 obv. i 3; W 16477 obv. i 3; W 17440 obv. i 3; W 19784 obv. i 5-6; W 21119,2 obv. i 1; W 21119,3 obv. i 1; W 21695 obv. i 2a; *MSVO* 1, 84 obv. i 3, ii 2, iv 3, v 3, rev. i 3, ii 3a (qualifying U_4 ?); 90 obv. ii 6a (?; qualifying GAR); 93 obv. i 2a (restored); 108 obv. i 2a; 111 obv. i 2a; 122 obv. i 2a (possibly a rationing unit; cf. R. Englund, *JESHO* 31, 157); 141 obv. i 2a; 145 obv. i 3a; *Archaic Bookkeeping*, 42, fig. 38, obv. i 1a; *MSVO* 4, 66 obv. i 2a.

$1N_{26}$

Uruk IV: *ATU* 5, pl. 32, W 8273 obv. i 1; pl. 34, W 9071,f obv. ii 1 (qualifying U_4); pl. 42, W 9169,c obv. i 5, ii 4 (?; qualifying DU_{8c}), rev. i 1 (together with N_{39b}, N_{24} and N_{28}); pl. 108, W 9656,fm obv. i 1.
Uruk III: *ATU* 2, pl. 57, W 16719 obv. i 4; *ATU* 5, pl. 1, W 5233,a obv. i 3; pl. 2, W 5233,b obv. i 3; pl. 2, W 5233,c obv. i 3; *BagM* 22, 143, W 24187 obv. i 3; W 16465 obv. i 4; W 17440 obv. i 4; *Archaic Bookkeeping*, 42, fig. 38, obv. i 2a; *ATU* 1, 632 iv 4 (?); *MSVO* 4, 66 obv. i 3a.

$1N_{28}$

Uruk IV: *ATU* 2, pl. 56, W 15920,a2 obv. i 2-3 (qualifying GAR), ii 1; *ATU* 5, pl. 14, W 6738,c obv. i 1b; pl. 42, W 9169,c obv. i 6 (qualifying [ ] $GI_6^?$), ii 1 (qualifying GAR*gunû*$_a$), ii 3 (qualifying SIG_{2a2}), rev. i 1 (together with N_{39b}, N_{24} and N_{26}); pl. 46, W 9206,b obv. i 4 (qualifying $ZATU726_d$), rev. i 1; pl. 97, W 9656,cq obv. i 1; pl. 106, W 9656,ey obv. i 4.
Uruk III: *ATU* 3, pl. 88, W 16918,g obv. i 2 (possibly lexical); *MSVO* 1, 111 obv. i 3a (qualifying GAR); 145 obv. i 4a; *Archaic Bookkeeping*, 42, fig. 38, obv. i 3a; *Frühe Schrift*, 14, no. 4.3, obv. i 2a, ii 1a (qualifying GUG_{2a} ?); *MSVO* 4, 66 obv. i 4a.

$1N_{29a}$

Uruk IV: *ATU* 2, pl. 56, W 15920,a2 obv. i 1 (qualifying GAR); *ATU* 5, pl. 42, W 9169,c obv. ii 2 (?).
Uruk III: *ATU* 3, pl. 88, W 16918,g obv. i 1 (possibly lexical); *Archaic Bookkeeping*, 42, fig. 38, obv. i 4a; *MSVO* 4, 66 obv. i 5a.

$1N_{29b}$

Uruk IV: *ATU* 2, pl. 56, W 15920,a2 obv. i 4 (qualifying GAR).
Uruk III: *ATU* 2, pl. 55, W 21021 obv. i 1; pl. 58, W 21537 rev. i 1 (?), ii 1 (?).

$1N_{30a}$

Uruk IV: *ATU* 2, pl. 58, W 20044,25 obv. i 1-3.
Uruk III: *MSVO* 1, 78 obv. i 1-3, ii 1-2; 140 obv. i 1a (qualifying [GAR]); *Archaic Bookkeeping*, 42, fig. 38, obv. i 6a.

$1N_{30c}$

Uruk IV: *ATU* 5, pl. 79, W 9655,d+ obv. i 4.
Uruk III: *Frühe Schrift*, 14, no. 4.3, obv. i 1a, i 3a (qualifying DU_{8c}).

$1N_{30d}$

Uruk IV: *ATU* 5, pl. 79, W 9655,d+ obv. iii 2 (cp. *ATU* 5, p. 22, and pl. 117, W 9656,km obv. i 1)

$1N_{31}$

Uruk IV: *ATU* 5, pl. 79, W 9655,d+ obv. i 5.
Uruk III: *ATU* 3, pl. 88, W 16918,g obv. i 3 (lexical ?).

$1N_{32}$

Uruk IV: *ATU* 5, pl. 79, W 9655,d+ obv. i 2-3.
Uruk III: W 20631,2 rev. i 2 (?).

$1N_{33}$

Uruk IV: *ATU* 5, pl. 79, W 9655,d+ obv. i 1.

DRY CEREAL PRODUCTS AND RATIONS: COMBINED NUMERICAL AND IDEOGRAPHIC SIGNS

$KUR_{a/b}$

ATU 5, pl. 42, W 9169,c obv. i 1 (KUR_b; Uruk IV). Cp. the use of KUR_a in the witness W 21208,8+ of the archaic lexical list 'Grain', ll. [ ]-14 (*ATU* 3, p. 142; Uruk III).

$NINDA_2$

Uruk IV: *ATU* 5, pl. 42, W 9169,c obv. i 2; pl. 105, W 9656,ew obv. i 1; W 15893,g obv. i 1, together with GUG_{2a}.

Uruk III: an unnumbered fragment from Uruk in the Iraq Museum contains the notation [ ] ⌜$1N_{54}$ $3N_{51}$⌝ $2N_{14}$ [ ] ⌜$2N_1$⌝ [ ] $NINDA_2$, i.e., corresponding to a minimum of 1582 $NINDA_2$ (Uruk III).

$NINDA_2+1N_1$

Uruk III: *ATU* 2, pl. 57, W 16719 obv. i 1; W 16477 obv. i 1; W 17440 obv. i 1; W 19422,a obv. i 1; *MSVO* 1, 145 obv. i

$NINDA_2+2N_1$

Only attested in line 2 of the archaic lexical list 'Grain' (*ATU* 3, p. 142; Uruk III).

$NINDA_2+1N_8$

Uruk IV: *ATU* 5, pl. 105, W 9656,ew rev. i 1; see P. Damerow and R. Englund, *ATU* 2, 154, fn. 63 ($\approx N_8 = {}^1/_2 N_{14}$?).

$NINDA_2+$
$ZATU659+1N_1$

Uruk III: *MSVO* 1, 26 obv. i 5, rev. i 1.

ZATU659

passim as designation of a probable grain product. ZATU659 is best known from accounts of apparent victuals in which the sign is listed first, followed by notations including other dry grain products and beer (e.g., *Archaic Bookkeeping*, p. 31, fig. 29c-d, W 20044,58 and 38, W 20044,54 followed by or preceding N_{39a}, N_{24} and GUG_{2a}, W 11791+11792 (?) followed by GAR [Uruk IV]; *ATU* 2, pl. 45, W 10736, *BagM* 22, 109, W 24021,1 followed by

1a; cp. the entry $NINDA_2+1N_1$ in line 1 of the archaic lexical list 'Grain' (*ATU* 3, p. 142; Uruk III).

GAR, W 19412,10 followed by DUG_a, *MSVO* 1, 84 followed by N_{39a} or N_{24}, and W 20496,1 followed by GAR and SUḪUR [Uruk III]), and from texts which seem to book objects represented by this sign in contexts of standard rations (confer, e.g., W 15775,k [Uruk III] with numbers of ZATU659 following counted SAL, 'female laborers'; cf. in particular the series of texts *MSVO* 1, 146-150, in which the objects $ZATU659+1N_1$ seem to have been included in the totals of GAR). Although no extant summation makes this explicit, ZATU659 seems to have been counted bisexagesimally and thus probably represents a grain ration.

$ZATU659+1N_1$

Uruk III: *ATU* 5, pl. 40, W 9168,h+n+? obv. v 1, W 15785,a2 obv. i 2a, 3a, 5, *MSVO* 1, 146-150 *passim*, *MSVO* 4, 55 obv. ii 3, rev. i 1-2, with an apparent correspondence between the designations $ZATU659+1N_1$ and GAR in wholly parallel accounts.

$ZATU659+1N_{14}$

Uruk IV: *ATU* 5, pl. 22, W 6940,b obv. i 1 followed by N_{39b} and N_{24}.

DRY CEREAL PRODUCTS AND RATIONS: IDEOGRAPHIC SIGNS

GUG_{2a}

passim as designation of a grain product, possibly a round bread as opposed to dry grain products of all types, including simple capacity measures, qualified by GAR (cp. *MSVO* 1, 109 obv. iii 1a and *MSVO* 1, 111 rev. ii 1a, GUG_{2a} together with GAR as general qualifications); often with indications of the amount of grain used in its production, usually $1N_{28}$ per unit; for example, *Archaic Bookkeeping*, p. 31, fig. 29d, W 20044,38 obv. i 4; W 20044,32 obv. i 3 (Uruk IV); W 15893,g obv. i 1, together with $NINDA_2$; W 15893,l obv. i 1; W 21022,3 rev. i 2; *MSVO* 1, 93 obv. i 5a (calculated contents correspond to $1N_{28}$ per unit); *MSVO* 1, 108 obv. i 6a (calculated contents correspond to ${}^1/_8 N_{39}$ [sign not attested] per unit); *MSVO* 1, 111 obv. i 5a (calculated contents correspond to $1N_{28}$ per unit); *MSVO* 1, 135 obv. i 2a (calculated contents correspond to $1N_{28}$ per unit); *Frühe Schrift*, 14, no. 4.3 obv. ii 1a (qualified by $1N_{28}$) (Uruk III); cp. ll. 30-32 of the lexical list 'Grain' (*ATU* 3, 143) with GAL GUG_{2a}, GUG_{2a} and GUG_{2a} GUG_{2a} (Uruk III). N.B.: some forms of the sign read SIG_{2d} in *ATU* 2 *s.v.* are in fact

GUG_{2a}; see also $GUG_{2a}+SILA_{3a}$, DU_{8c}*gunû*, $LAGAB_a+ŠA$, ŠA and ŠA*gunû*.

$GUG_{2a}+SILA_{3a}$

Uruk IV: W 11791+11792 obv. i 3 (with GUG_{2a}; dating uncertain).

$SILA_{3b}+GUG_{2a}$

Uruk III: *Archaic Bookkeeping*, p. 42, fig. 38, obv. ii 6a (calculated contents correspond to $1N_{29}$ per unit).

SIG_{2a1}

Uruk III: *BagM* 22, 91, W 24008,21 obv. i 3; 143, W 24188 obv. ii 3[sic].

SIG_{2a2}

Uruk IV: *ATU* 5, pl. 42, W 9169,c obv. ii 3 (qualified by $1N_{28}$).
Uruk III: *ATU* 5, pl. 2, W 5233,b obv. i 6; pl. 2, W 5233,c obv. i 6; *MSVO* 1, 93 obv. i 3a3 (calculated contents probably correspond closely to $1N_{26}$ per unit); *MSVO* 1, 103 obv. iv 1a3 (calculation not possible, together with $ZATU726_d$ and GUG_{2a} ŠA ?); *Archaic Bookkeeping*, p. 42, fig. 38, obv. i 5a1 (with $ZATU726_d$, calculated contents might correspond to $1N_{29}$ per unit).

SIG_{2a3}

Uruk IV: *ATU* 5, pl. 38, W 9123,ae rev. i 1 (summation with objects DU_{8c}, SIG_{2a3}, $ZATU726_d$, and GAR); pl. 42, W 9169,b

obv. ii 3; pl. 46, W 9206,b obv. i 2; pl. 64, W 9579,t obv. ii 1; pl. 108, W 9656,fm obv. i 2; *Archaic Bookkeeping*, p. 31, fig. 29c, W 20044,58 obv. i 5.
Uruk III: W 17973,a obv. i 4.

SIG$_{2a4}$

Uruk III: *ATU* 2, pl. 57, W 16719 obv. i 6; W 16465 obv. i 6.

DU$_{6b}$

Uruk III: *ATU* 2, pl. 57, W 16719 obv. i 5; *BagM* 22, 91, W 24008,21 obv. i 1-2; unclear relationship of this and the following sign to the sign DU$_{6b}$ registered in the lexical list Lú A, ll. 86-90 (see *ATU* 3, 82; Uruk III), attested with GAL$_a$, KUR$_a$, KISAL$_{b1}$, KU$_{b1}$ BA and TAR$_a$.

DU$_{6c}$

Uruk III: *ATU* 5, pl. 1, W 5233,a obv. i 5; pl. 2, W 5233,b obv. ii 3; pl. 2, W 5233,c obv. i 4.

DU$_{8c}$

Uruk IV: *ATU* 5, pl. 38, W 9123,ae rev. i 1 (total of DU$_{8c}$, SIG$_{2a3}$, ZATU726$_d$, and GAR); pl. 42, W 9169,c obv. ii 4 (qualified by 1N$_{26}$?); pl. 46, W 9206,b obv. i 3; pl. 64, W 9579,t obv. i 1; pl. 105, W 9656,ew rev. i 4; *Archaic Bookkeeping*, p. 31, fig. 29c, W 20044,58 obv. i 4.
Uruk III: *ATU* 5, pl. 1, W 5233,a obv. ii 2; *BagM* 22, 136, W 24061 obv. i 1; 143, W 24188 obv. ii 4; *MSVO* 1, 108 obv. i 4a (calculated contents correspond to 1N$_{30c}$ per unit); *Frühe Schrift*, 14, no. 4.3, obv. i 1a, i 3a (qualified by 1N$_{30c}$).

DU$_{8c}$*gunû*

Uruk III: W 14111,a+b+d+e obv. i 2-3; W 15878,l obv. iii 2; W 21022,3 rev. i 1; *Archaic Bookkeeping*, p. 42, fig. 38, obv. ii 2a2 (together with ŠA*gunû*, calculated contents correspond to 1N$_{30c}$ per unit), iii 2a2 (ditto) (possibly = GUG$_{2a}$).

LAGAB$_a$+ŠITA$_{a1}$

Uruk III: *ATU* 5, pl. 1, W 5233,a obv. i 7; pl. 2, W 5233,b obv. ii 4; see below to the lexical list 'Grain', l. 34.

LAGAB$_a$+ŠA

Uruk III: *MSVO* 1, 93 obv. i 7a (calculated contents correspond to $^1/_8$ N$_{39a}$ [sign not attested] per unit); *MSVO* 1, 103 obv. i 5a (with GUG$_{2a}$; calculated contents closely correspond to 1N$_{30a}$ per unit); *MSVO* 1, 108 obv. ii 2a (calculated contents correspond to 1N$_{30c}$ per unit); *MSVO* 1, 111 obv. i 7a (or LAGAB$_a$+ ŠITA$_{a1}$?; calculated contents may correspond to 1N$_{30c}$ per unit); *MSVO* 1, 137 obv. i 2a (or LAGAB$_a$ +ŠITA$_{a1}$?; calculated contents seem to correspond to 1N$_{30c}$ per unit); all references qualified by E$_{2a}$ DUB$_a$, for which see also DUG$_a$ KAŠ$_a$; cf. ll. 33-34 of the lexical list

'Grain', in the first case LAGAB$_a$+ŠA together with ŠITA$_{b3}$, in the second with LAGAB$_a$+ŠITA$_{a1}$ (*ATU* 3, 143; Uruk III).

ŠA

Uruk III: *MSVO* 1, 103 obv. i 4a (calculated contents closely correspond to 1N$_{30a}$ per unit), iv 1a2 (calculation not possible, with ZATU726$_d$ and SIG$_{2a2}$); *MSVO* 1, 111 obv. i 6a (calculated contents may correspond to $^1/_{20}$ N$_{39}$ [sign not attested] per unit) (in all cases with GUG$_{2a}$); *BagM* 22, 136, W 24061 obv. ii 4.

ŠA+ḪI*gunû*$_a$

Uruk III: *ATU* 5, pl. 3, W 6066,a obv. i 7; W 20522,8 obv. ii 1; W 22101,2 obv. i 3; *MSVO* 1, 108 obv. ii 1a (calculated contents very closely correspond to 1N$_{30a}$ per unit).

ŠA+ḪI*gunû*$_b$

Uruk III: *ATU* 5, pl. 2, W 5233,c obv. ii 3; pl. 3, W 6066,a obv. i 6; pl. 9, W 6573,a obv. i 6; pl. 30, W 7343,1 obv. i 6.

ŠA*gunû*

Uruk III: *ATU* 2, pl. 45, W 10736 rev. ii 3; W 15878,a rev. i 2; W 15878,l obv. iii 1, preceding DU$_{8c}$*gunû*, W 21864 obv. iii 2, rev. ii 3; *MSVO* 1, 93 obv. i 6a (calculated contents closely correspond to 1N$_{30a}$ per unit); *MSVO* 1, 108 obv. i 7a (calculated contents closely correspond to 1N$_{30a}$ per unit); *MSVO* 1, 137 obv. i 1a (poor state of preservation makes calculation impossible) (all cases in *MSVO* 1 together with GUG$_{2a}$); *Archaic Bookkeeping*, p. 42, fig. 38, obv. ii 2a1 (together with DU$_{8c}$ *gunû*, calculated contents correspond to 1N$_{30a}$ per unit), iii 2a1 (ditto).

U$_4$

Uruk IV: *ATU* 5, pl. 34, W 9071,f ii 1 (qualified by N$_{26}$); pl. 64, W 9579,t obv. i 2; pl. 105, W 9656,ew obv. i 4, rev. i 6; *Archaic Bookkeeping*, p. 31, fig. 29c, W 20044,58 obv. ii 1.
Uruk III: *ATU* 5, pl. 1, W 5233,a obv. i 6; pl. 2, W 5233,b obv. i 5; *MSVO* 1, 84 rev. ii 3a (?; qualified by 1N$_{24}$?).

2N$_{58}$

Uruk III: *ATU* 2, pl. 57, W 16719 obv. ii 1; *ATU* 5, pl. 1, W 5233,a obv. i 4; pl. 2, W 5233,b obv. i 4; pl. 2, W 5233,c obv. i 5.

ZATU726$_c$

Uruk IV: *ATU* 5, pl. 42, W 9169,b obv. ii 2.
Uruk III: *ATU* 5, pl. 1, W 5233,a obv. ii 1; pl. 2, W 5233,b obv. ii 1; *BagM* 22, 72, W 23998,1a obv. i 5 (correspondence ZATU726$_c$ = 726$_d$ = 727 likely).

ZATU726$_d$

Uruk IV: *ATU* 5, pl. 38, W 9123,ae rev. i 1 (summation with objects DU$_{8c}$, SIG$_{2a3}$, ZATU726$_d$, and GAR); pl. 42, W 9169,c obv. ii 5; pl. 46, W 9206,b obv. i 4 (qualified by N$_{28}$); pl. 105, W 9656,ew obv. ii 1, rev. i 5.
Uruk III: *ATU* 2, pl. 57, W 16719 obv. ii 2 (?); *BagM* 22, 91, W 24008,21 obv. i 4; W 16465 obv. ii 1; W 21119,3 obv. i 3; *MSVO* 1, 84 obv. iii 2, rev. i 4, ii 2b2; *Archaic Bookkeeping*, p. 42, fig. 38, obv. i 5a2 (together with SIG$_{2a2}$, calculated contents correspond to 1N$_{29}$ per unit ?) (see comments to ZATU726$_c$ above).

ZATU727

Uruk III: *ATU* 5, pl. 2, W 5233,c obv. i 7 (see ZATU726$_c$).

ZATU681

Uruk III: *ATU* 2, pl. 57, W 16719 obv. ii 2 (?); *ATU* 5, pl. 1, W 5233,a obv. ii 3; pl. 2, W 5233,b obv. ii 2; pl. 2, W 5233,c obv. ii 2; *BagM* 22, 86, W 24007,3 obv. i 1 (?); W 16465 obv. ii 2.

ZATU625

Uruk III: *ATU* 2, pl. 60, W 22112 obv. i 3, rev. i 3 (with DUB$_b$), obv. i 4, ii 5, iii 3, rev. ii 2 (qualified by N$_{39a}$).

LIQUID PRODUCTS CONTAINING CEREALS: BEERS

DUG$_a$

Uruk IV:

Uruk III:

passim as a general designation of a container of beer (KAŠ$_a$; as a rule, DUG$_a$ alone represented beer in Uruk IV and III texts from Uruk, in Jemdet Nasr the filled containers were invariably written DUG$_a$ KAŠ$_a$) made of rough-ground barley and malt, as opposed to DUG$_b$ (⊂▷) representing a container of dairy fats (cf. R. Englund, *Iraq* 53 [1991] 101-104); the only known texts with reference to the capacity of DUG$_a$ written alone are *Archaic Bookkeeping*, p. 42, fig. 38, obv. iii 1a (calculated ingredients correspond to 3N$_{29a}$ = $^3/_5$ N$_{39}$ barley plus 3N$_{30c}$ = $^3/_{10}$ N$_{39}$ malt per jar), and p. 44, fig. 39a, obv. iii 8, rev. i 1b4a (calculated ingredients correspond to 6N$_{29a}$ = 1 $^1/_5$ N$_{39}$ barley plus 4N$_{29a}$ = $^4/_5$ N$_{39}$ malt per jar).

KAŠ$_a$

Uruk IV:

Uruk III:

passim as a general designation of beer (the pictogram seems to represent the container DUG$_a$ with spout, filled with dotted impressions apparently the same as those used to qualify amounts of rough-ground or cracked barley used in the production of baked goods and beer, the so-called derived numerical system Š*; these impressions were straightened to inscribed lines within the sign DUG$_a$ in the Uruk III period); the only known texts with reference to the capacity of KAŠ$_a$ written alone are all from the Uruk III period and probably all from Jemdet Nasr: *MSVO* 1, 116 obv. i 4a (calculated ingredients correspond to $^5/_8$ N$_{39}$ barley plus 1N$_{28}$ = $^1/_4$ N$_{39}$ malt per jar), ii 4a (calculated ingredients correspond approximately to 3N$_{30c}$ = $^3/_{10}$ N$_{39}$ barley plus 1N$_{30c}$ = $^1/_{10}$ N$_{39}$ malt per jar); 138 obv. i 3a (calculated ingredients correspond to $^1/_8$ N$_{39}$ [sign not attested] barley per jar [the entry for malt, probably on the reverse, is not preserved]); 140 obv. i 2a

(calculated ingredients correspond to $^1/_8$ N$_{39}$ barley per jar [entry for malt, probably on the reverse, is not preserved]); *MSVO* 4, 66 obv. ii 3a (the calculated ingredients correspond to 1N$_{26}$ = $^1/_3$ N$_{39}$ barley per jar [the amount of malt required was recorded in the total of the products DUG$_a$+U$_{2a}$, DUG+AŠ$_a$ and KAŠ$_a$ on the reverse qualified with the combination DUG$_a$ KAŠ$_a$]).

DUG$_a$ KAŠ$_a$

passim as a general designation of containers of beer, particularly in the proto-cuneiform texts form Jemdet Nasr; since the sign combination can qualify jars of differing sizes or, more likely, beers of differing brewing strengths, texts with calculated grain capacities of the barley and malt employed in brewing beer delivered in averaged containers can only be offered as rough indications of the amount or strength of beer in specific jars; cf., for example, *MSVO* 1, 93 obv. ii 1a (calculated ingredients correspond to 2N$_{29a}$ = $^2/_5$ N$_{39}$ barley per jar [the amount of malt required was recorded in the total on the reverse]), ii 2a (qualified by E$_{2a}$ DUB$_a$; calculated ingredients closely correspond to 1N$_{26}$ = $^1/_3$ N$_{39}$ barley per jar [the amount of malt required was recorded in the total on the reverse]), rev. ii 1a (calculated average ingredients approximately correspond to $^3/_8$ N$_{39}$ barley plus 1N$_{26}$ = $^1/_3$ N$_{39}$ malt per jar); *MSVO* 1, 103 rev. i 2a (calculated ingredients closely correspond to 1N$_{26}$ = $^1/_3$ N$_{39}$ barley plus 1N$_{30c}$ = $^1/_{10}$ N$_{39}$ malt per jar), iii 2a (calculated ingredients correspond to 2N$_{29a}$ = $^2/_5$ N$_{39}$ barley plus 1N$_{29a}$ = $^1/_5$ N$_{39}$ malt per jar); *MSVO* 1, 108 obv. ii 3a (calculated ingredients closely correspond to 1N$_{26}$ = $^1/_3$ N$_{39}$ barley plus 1N$_{29a}$ = $^1/_5$ N$_{39}$ malt per jar), ii 4a (qualified by E$_{2a}$ DUB$_a$; calculated

ingredients closely correspond to $1N_{26}$ = $^1/_3 N_{39}$ barley plus $1N_{30c}$ = $^1/_{10} N_{39}$ malt per jar); *MSVO* 1, 111 obv. i 8a = rev. ii 2a (calculated ingredients correspond approximately to $1N_{26}$ = $^1/_3 N_{39}$ barley plus $1N_{28}$ = $^1/_4 N_{39}$ malt per jar); *MSVO* 1, 145 obv. i 6a (calculated ingredients correspond to $1N_{28}$ = $^1/_4 N_{39}$ barley per jar [no malt was booked]); *MSVO* 4, 66 rev. ii 3a (calculated average ingredients correspond approximately to $^3/_4 N_{39}$ barley plus $^4/_9 N_{39}$ malt per jar) (all texts to be dated Uruk III, probably all from Jemdet Nasr).

DUG$_a$+U$_{2a}$

Uruk III: *MSVO* 4, 66 obv. ii 1 (calculated ingredients correspond to $^{13}/_{10} N_{39}$ barley per jar [the amount of malt required was recorded in the total of DUG$_a$+U$_{2a}$, DUG+AŠ$_a$ and KAŠ$_a$ on the reverse qualified DUG$_a$ KAŠ$_a$]).

DUG+AŠ$_a$

Uruk III: *BagM* 22, 102, W 24013,16 obv. iii 1a; W 21700 obv. iv 3; *OLZ* 40, 409-410, no. 6, obv. ii 2 (calculated ingredients correspond to $1N_{39}$ barley per jar [the amount of malt required was recorded in the total on the reverse qualified DUG$_a$ KAŠ$_a$]).

ŠEN$_b$ GAL

Uruk III: *Archaic Bookkeeping*, p. 42, fig. 38, obv. i 7a (calculated ingredients correspond to $3N_{24}$ = $^3/_2 N_{39}$ barley plus $3N_{24}$ = $^3/_2 N_{39}$ malt per jar); p. 44, fig. 39a, obv. *passim*, rev. i 1b1a (calculated ingredients correspond to $3N_{24}$ = $^3/_2 N_{39}$ barley plus $3N_{24}$ = $^3/_2 N_{39}$ malt per jar); fig. 39b, obv. i 1, 4, ii 1; *Frühe Schrift*, p. 15, no. 4.7, obv. ii 2.

ŠEN$_b$ TUR

Uruk III: *Archaic Bookkeeping*, p. 42, fig. 38, obv. i 8a (calculated ingredients correspond to $3N_{29a}$ = $^3/_5 N_{39}$ barley plus $3N_{29a}$ = $^3/_5 N_{39}$ malt per jar); p. 44, fig. 39a, obv. *passim*, rev. i 1b2a (calculated ingredients correspond to $3N_{29a}$ = $^3/_5 N_{39}$ barley plus $3N_{29a}$ = $^3/_5 N_{39}$ malt per jar); fig. 39b, obv. i 5; *Frühe Schrift*, p. 15, no. 4.7, obv. ii 3; no. 4.9, obv. i 1a2 (together with the object ZATU710, ingredients must be less than $^3/_5 N_{39}$ grain [ḪI and ḪI*gunû$_a$*] plus $^3/_5 N_{39}$ malt per jar).

ŠEN$_c$*tenû*

Uruk III: *BagM* 22, 107, W 24018,2 obv. ii 1; *Archaic Bookkeeping*, p. 42, fig. 38, obv. ii 1a (calculated ingredients correspond to $3N_{30c}$ = $^3/_{10} N_{39}$ barley plus $3N_{30c}$ = $^3/_{10} N_{39}$ malt per jar); p. 44, fig. 39a, obv. *passim*, rev. i 1b3a (calculated ingredients closely correspond to $1N_{28}$ = $^1/_4 N_{39}$ barley plus $^3/_8 N_{39}$ malt per jar); fig. 39b, obv. i 2, 6, ii 2, 4; *Frühe Schrift*, p. 14, no. 4.4, obv. i 1; p. 14, no. 4.5, obv. i 1, 3; p. 25, no. 4.30, obv. ii 1.

ZATU710

Uruk III: W 20517,1 obv. i 4; *MSVO* 1, 140 obv. i 3a (calculated ingredients correspond to $1N_{24}$ = $^1/_2 N_{39}$ barley per jar [the entry for malt, probably on the reverse, is not preserved]); *Frühe Schrift*, p. 15, no. 4.9, obv. i 1a1 (together with ŠEN$_b$ TUR, calculated ingredients of the total of 7 containers averages ca. $1N_{26}$ = $^1/_3 N_{39}$ grain plus $1N_{26}$ = $^1/_3 N_{39}$ malt per jar); P. van der Meer, *MSVO* 4, 54 obv. i 5; cp. the use of the sign ZATU711 (=GAN$_c$?) in W 20920,1 obv. ii 1.

SEMI-LIQUID PRODUCTS CONTAINING CEREALS: DAIRY FATS (?)

KAŠ$_b$

Uruk IV:

Uruk III:

passim as a general designation of containers of a liquid, possibly a dairy fat (= DUG$_b$) mixed with crushed barley, rather than the usual interpretation "beer", which seems better reserved for the signs KAŠ$_a$, ŠEN$_b$, and ZATU710 (i.e., signs representing products containing both crushed barley and malt); see, for example, the texts *ATU* 5, pl. 42, W 9169,c obv. iii 2; pl. 62, W 9579,d, pl. 88, W 9656,s and pl. 103, W 9656,el (KAŠ$_b$ together with UDU$_a$ and MAŠ) (Uruk IV); W 15774,b obv. i 1 (together with DUG$_c$ representing a container of dairy fat, cf. R. Englund, *Iraq* 53, 101-104); W 20511,2 obv. v 3a, vi 1b3, 2b3 (registering counted KAŠ$_b$ SILA$_{3a}$ BA in a large account of dairy fats) (Uruk III); the use of the sign combination KAŠ$_b$ U$_4$+1N$_{57}$ in the Uruk text *ATU* 5, pl. 40, W 9168,h+n+? obv. vi 1, and the Jemdet Nasr accounts *MSVO* 1, 86(+87 ?) obv. i 1, and 106 obv. i 1a (all Uruk III) is not clear; see further the discussion above of KAŠ$_a$, and cp. ll. 21 and 24 in the lexical list 'Vessels', the first section of which seems concerned with archaic herding and related products (*ATU* 3, 123-134).

KAŠ$_c$

Uruk IV:

Uruk III:

passim as a general designation of containers of a liquid, possibly a dairy fat (= DUG$_c$, *Iraq* 53, 101-104) mixed with crushed barley; see, for example, the texts W 19408,5 (KAŠ$_c$ together with DUG$_b$), 12, 17, 20044,40 and M. Green, *VL* 15 (1981) 355, fig. 4a, W 21049 (together with DUG$_c$) (all Uruk IV); *MSVO* 1, 179 obv. i 3 (KAŠ$_c$ following DUG$_b$) (Uruk III, in no instance together with DUG$_a$).