

ADMINISTRATIVE TIMEKEEPING IN ANCIENT MESOPOTAMIA*

BY

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One of the ostensibly unassuming but, for want of better examples, often cited contributions of the Sumerian to modern culture has been the sexagesimal division of the hour into 60 minutes (medieval Latin: (pars) *minuta prima*, “smallest part of the first order”), of the minute into 60 seconds ((pars) *minuta secunda*, “smallest part of the second order”). Unfortunately, even this contribution is laced with borrowings and bears no direct relation with Sumerian tradition. Texts of the 3rd millennium B.C. attest to no Sumerian hour, no minute in the modern sense; indeed, were we the heirs of the entirely artificial administrative division of the workday into 60 parts known from the Ur III period, we would with some likelihood have watches recording 120 “hours”, consisting in modern time reckoning of 12 minutes each. The sexagesimal system of counting, moreover, might itself be nothing more than a popularization of the Sumerians, since its use

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is attested in periods much earlier than any secure attestation of the Sumerian language, namely in the periods Uruk IV-III, and possibly in some token assemblages from clay envelopes unearthed in levels of proto-Elamite Susa corresponding to Uruk V (cf. below, fn. 9). This counting system was used much later by Babylonian astronomers in very involved time/distance measuring calculations; the fascination felt by classical antiquity for Babylonian astronomy, finally, carried sexagesimal counting into the modern system of time divisions first quantified and standardized by medieval clock builders. Sumerians counted "things" with the sexagesimal system, albeit including years, months and days.

A mixture of this sexagesimal system with a heritage of natural cycles resulted in the 3rd millennium time divisions attested by administrative documents. The fact that the new moon returned *nearly* every 30 days, that harvest time returned *nearly* every 12 moons, led an increasingly involved organizational control, faced with necessary conversions of time units into counted things—in particular rations—to correct this "unevenness" in its administrative dealings. The resulting system of artificial time measurement, which without question complemented throughout the 3rd millennium natural, lunistellar divisions, is attested in its basic form of a twelve-month, 360-day year in the archaic documents from the end of the 4th millennium. A discussion of the textual material which necessarily leads to this conclusion is best prefaced with a cursory presentation of the most standardized form Sumerian administrative timekeeping achieved, namely in the system found accompanying the statist Ur III bureaucracy at the end of the 3rd millennium.

1. Ur III time notations: cultic and administrative calendars.

A good deal of confusion can arise in the treatment of Ur III time notations when the documents exhibit simultaneously these two parallel systems of time divisions. Cult festivals based in part on the agricultural year dominated in the designation of nearly all 3rd

millennium month names¹). Specifically, the moon cult dictated the *de facto* division of the year (mu) into 12 synodical months (iti), each consisting of very nearly 29.53 days²). The resulting year of approximately 354 1/3 days consequently fell short of the 365 1/4 days of the tropical year (equinox to corresponding equinox), so that an intercalation of the so-called diri month was necessary, on average, every three years³).

1) See in general B. Landsberger, *Der kultische Kalender der Babylonier und Assyrer* (= LSS 6/1-2; Leipzig 1915), N. Schneider, *Die Zeitbestimmungen der Wirtschaftsurkunden von Ur III* (= AnOr. 13; Rome 1936), A. Ungnad, "Datenlisten", in RIA 2 (Berlin 1938) 131-147 and H. Hunger, "Kalender", in RIA 5 (Berlin 1976-1980) 297-303 (Ur III); F. Kugler, *Sternkunde und Sterndienst in Babel* 2,2,1 (1912) 211-223, A. Deimel, "Die Monatsnamen in Lagaš zur Zeit Urukaginas", *Or.* 1 (1920) 58-63 and Y. Rosengarten, *Le concept sumérien de consommation dans la vie économique et religieuse* (Paris 1960) 406-425 (presargonic Lagash).

2) M. Sigrist has drawn to my attention the necessary inferences to be made from a chronological analysis of the moon cult: Ur III deliveries of cultic offerings are destined for sacrifices in the e₂.u₄.7, e₂.u₄.15 and e₂.u₄.sakar, i.e. the 7th, 15th and *new moon* days. PDT 612 for example lists so-and-so many sacrificial animals, eš₃.eš₃ e₂.u₄.15 iti u₄.12 ba.zal "the eš₃-offerings for the 15th (delivered) at the end of the 12th day (of the month of Šu-Su'en 1 v)". Similarly, new moon offerings are recorded only on the 27th-30th days of particular months; a wandering new moon celebration—a prerequisite for a calendar divested of synodical dependence—would have been dated throughout the month. It is highly improbable that the "new moon" should have taken on the meaning of the first of an administrative 30-day month, the more unlikely considering extant evidence for a three-year intercalation cycle: the synodical month reckoning would require the diri-insertion every three years, a 360-day year the insertion every six. All evidence (for a cursory treatment see here fn. 3) speaks against a six-year intercalation. The cultic/agricultural calendar might itself be attested in the administrative (bakery) text TUT 102, which records 59 (60 la₂ 1) days in months 3-4 of the Lagash calendar. Compare also such texts as C. Bedale, *Sumerian Tablets from Umma* ... (Manchester 1915) 8-10, 13 and T. Pinches, *PSBA* 37 (1915) 126ff., IV-VII, discussed by N. Schneider, *AIO* 14 (1941-1944) 336-340.

3) N. Schneider, *AnOr.* 13, offers the most recent more detailed examination of time recording in the Ur III period, see particularly to intercalation pp. 77-78 (Drehem), 85-87 (Umma) and 91-94 (Girsu), where a three year cycle seems indisputable. Schneider's best evidence are texts covering longer time spans, for instance the Drehem text L. Legrain, *Les temps des rois d'Ur* (Paris 1912) Nr. 2:

Obv. pisan.dub.ba	Tablet basket:
nig ₂ .ka ₉ .ak	accounts
Na.lu ₅	of Nalu
iti ^{ti} maš.da ₃ .[g]u ₇	from the "Gazelle-eating (festival)"
	(month 1, Drehem calendar)

Scribal computations carried at the same time an *administrative* system of time division, which acted at once to simplify calculations and, collaterally, to increase the state's demands on labor. The

<p>mu a.r[a₂ 2.]kam.aš Si.mu.ru.um^{ki} ba.hul.ta iti.diri še.kiN.ku₅</p>	<p>of the year "Simurum was destroyed for the second time" (= Šulgi 26) through the extra month "Harvest (-festival)" (month 13)</p>
<p>Rev. mu.us₂.sa e₂ PUZUR₄-iš- dDa-gan ba.du₃ mu.us₂.sa.bi.še₃ mu.16.kam ša₃.ba iti.diri.6.am₃ i₃.gal₂</p>	<p>of the year following the year following "The house/temple of Drehem was built" (= Šulgi 41), It is (a period of) 16 years, including 6 extra months.</p>

Six intercalations have thus taken place in 16 years (ša₃.ba is in the final line unquestionable despite B. Lafont, *Acta Sumerologica* (in the following = ASJ) 7 [1985] 185), or nearly one in three years. Another strong support for a three year intercalation cycle is the Kish text O 555 published by E. Unger, *AnOr.* 12 (1935) 312-318 (recently collated by T. Gomi, ASJ 7 [1985] 190), listing the year names Šulgi 33 through 47 (following current chronology) together with the months of each year. The Umma calendar used gives us for that province intercalations in the years Šulgi 33, 36, 40, 41, 44 (and [47]?), i.e. very nearly every three years. Schneider's (op.cit., 91-94) established cycle of intercalations in Girsu, moreover, corresponds very well with this expected norm. See for further evidence in the same direction D. Calvot, *RA* 63 (1969) 102, AO 19548 (60 months, 2 intercalations); CT 5, BM 18358 (62 months, 2 intercalations); P. Dhorme, *RA* 9 (1912) 158 (17 years, 5 intercalations); M. Ellis, *JAOS* 90 (1970) 268-269, YBC 4179 (12 years, 5 intercalations); ITT 2/1, 3699 (93 months, 2 intercalations); ITT 5, 6800 (70 months, 2 intercalations); ITT 5, 8215 (59 months, and 26 days, 1 intercalation); T. Pinches, *Amherst* 31 (37 months, 1 intercalation); moreover T. Gomi, "Ein gewöhnliches Jahr mit einem Schaltmonat", *BiOr.* 34 (1977) 275-281 (concerning the Drehem and Ur calendars). Gomi's attempt in ASJ 6 (1984) 1-18 to reorganize Umma intercalation in the middle years of Šulgi's reign is compromised by his disregard—see in particular pp. 6-7—of the rule basic to Umma administration that iti = 30 days and no less in primary calculations. An unlucky discussion is for instance that of TCL 5, 5665 obv. 6-7 on p. 7, which is simply (3.57;0,4,1 =) 71,141 sila ÷ 10 sila per day (as a standard production quota) = 7114.1 workdays; 7114.1 × 7/6 (igi.6.gal₂.bi i₃.ib₂.gar; presumably the compensatory dug.a workdays, which on the opposite side of sag.nig₂.GA.ra(k), "debit", would have been not added to, but deducted from the working total) = 8299.783, or very nearly the given 8300. 8300 thus has nothing to do with the months registered in lines 4-5.

The hard evidence pointing to a normal 3-year intercalation must be weighed against the puzzling fact that for instance in Drehem up to 4 intercalary years (Amar-Zu'en 9 through Šu-Sin 3) seem to be attested in succession. The three attested presargonic Lagash intercalations date, similarly, to the successive years Urukagina (lugal) 4-5 (see fn. 17). On the other hand, Schneider notes p. 94 that

largest unit in this system was, parallel to the synodical system, the year of 12 months; each month consisted however not of either 29 or 30, as might be expected of an average month of 29 1/2 days, but rather consistently of 30 days (u_4); that is, the rounded lunistellar year of 360 days, which at the turn of this century was a topic of some interest to historians of the natural sciences⁴), formed from ca. 2100-2000 B.C. the basic parameter for administrative accounting. The workday further, for purposes of administrative calculations—to be discussed later—consisted of 60 “shekels” (gin_2). In their dependency on the parallel synodical year, Ur III administrators inserted the intercalary diri month, again in principle every three years. To facilitate computations, the diri month too consisted always of 30 days.

This equation of the administrative year

$$\mu = 12 \text{ (intercalary: 13) } \text{iti} = 360 \text{ (intercalary: 390) } u_4$$

is made imperative by an examination of Ur III feed schedules and workday ledgers. The more important latter texts document the state-

Šulgi 33 (= 32) is in documents from Girsu listed explicitly as a year with *and* without intercalation. Such irregularities cannot at present be explained, but will probably have been caused by the confusion of local calendars amongst themselves and with the so-called “Reichskalender” promulgated late in the reign of Shulgi and best attested in the texts from Drehem. The publication of a chronological index of all published Ur III documents, planned by M. Sigrist, will doubtless help to redefine the contours of this problem.

4) F. Zimmern, “Das Prinzip unserer Zeit- und Raumteilung”, *Berichte über die Verhandlungen der königlichen sächsischen Gesellschaft der Wissenschaften zu Leipzig, philologisch-historische Classe* 53 (1901) 47-61, discussed the possible derivation of the sexagesimal system from the rounded year consisting of 360 days, resuming a position taken first by Formaleoni in 1789 and further developed by M. Cantor, *Vorlesungen über Geschichte der Mathematik I*² (1894) 89-93. In *Dei fonti degli errori nella cosmografia e geographia degli Antichi* (Venice 1789), quoted in F. Thureau-Dangin, “Sketch of a History of the Sexagesimal System”, *Osiris* 7 (1939) 97, Formaleoni concludes that “La lunghezza dell’anno era dunque incontestabilmente de 360 giorni al tempo dei primi contemplatori” (he was convinced that at the time of the deluge—and the inception of the sexagesimal system—the year was exactly 360 days long).

supplied labor "capital"⁵⁾ (sag.nig₂.GA.ra(k)) of the various administrative units of the economy, followed by a listing of real (goods and services) and administratively artificial production (I am thinking here of, for instance, the workdays labeled u₄.dug.a and u₄.ku.a, for which see below to MVN 11, 106 and TCL 5, 6036, and footnotes 8 and 45). The formula "(number of workers) × (period recorded) = expendable labor" used in the section recording a unit's "capital" allows of a straightforward confirmation of the administrative time divisions noted in the equation above⁶⁾.

Quite aside from trivial calculations in undamaged texts which underlie this assertion, for instance TCL 5, 5669 i 1-4:

36 geme₂
 iiⁱⁱŠE.KIN.ku₅.ta
 iii ^dDumu.zi.še₃
 a₂.bi u₄.3.36.00

36 female workers
 from "Harvest(-festival)" (month 1, Umma
 calendar)
 through "Tammuz (-festival)" (month 12),
 performance involved: 12,960 days
 (= 36 × 12 × 30),

or TCL 5, 5670 i14-ii2:

36 geme₂ 0;0,3

36 female workers (receiving) 3 (ban) (of grain
 per month)

5) "Capital" understandably arouses the disfavor of ancient historians, since it is overloaded with modern economic associations. It is on the other hand a term which, taken neutrally, approaches the sense of sag.nig₂.GA.ra(k), literally "the head of the goods". These laborers, translated into workdays, are "assets" of the state; from the standpoint of the gang foremen, in whose name the ledgers are written, a more applicable translation would be "debit" (German: Soll), since they are commanding workers put at their disposal by a state which otherwise continues to assume responsibility for the workers' monthly and yearly rations, and which demands that production norms be met to its advantage. F. Kraus, *Staatliche Viehhaltung im altbabylonischen Lande Larsa* (Amsterdam 1966) 10-18, has reached comparable conclusions in his treatment of sag.nig₂.GA.ra(k) in livestock management of the Old Babylonian period.

6) This is a method already used in exemplary fashion by F. Thureau-Dangin, RA 8 (1911) 153-154 in determining the sequence of the Umma calendar; by V. Struve in I. Diakonoff, ed., *Ancient Mesopotamia* (Moscow 1969) 127-172 (English translation of an article written in 1948). In the translation of Ur III day terminology I have chosen a standardized "n workdays, male/female workers" for the Sumerian n guruš/geme₂ u₄.1.še₃. The literal translation of this phrase "n male/female workers for 1 day" does, in my opinion, little justice to its idiomatic use in administrative texts, in which the inclusion of guruš/geme₂ is often optional. This would lead, in the final analysis, to a general translation guruš/geme₂ u₄.1.še = "workday".

ⁱⁱⁱ še.kar.ra.gal ₂ .la	from the end of the 23rd of "Barley brought to the kar" (month 3, Umma calendar)
mu Ha.ar.š ^{ki} Ki.maš ^{ki} ba.hul	of the year "Harši and Kimaš were destroyed" (Šulgi 48)
u ₄ .23.zal.la.ta	
ⁱⁱⁱ Si ^{gi} ₄ . ^{ki} ₃ .šub.ba.ga ₂ .ra	through the 7th of "Bricks set in the moulds" (month 2)
mu.us ₂ .sa Ha.ar.ši Ki.maš ^{ki} ba.hul	of the year following "Harši and Kimaš were destroyed"
u ₄ .7.zal.la.še ₃	(Amar-Zu'en 1),
a ₂ .bi u ₄ .3.08.24 g ^{me} ₂ .u ₄ .1.še ₃	performance involved: 11,304 workdays, female workers (= 36 × (7 + (10 × 30) + 7), where zal records a <i>completed</i> workday ⁷),

it is helpful to remember these administrative time divisions in pressing information from less well preserved texts as well as in avoiding the sort of mistakes made by A. L. Oppenheim, AOS 32, p. 86 to

7) The text means that after 23 completed workdays there remain the 24th through the 30th, i.e. 7 days. Comparable is the text CT 7, BM 13138 obv. 6-8 with the notations ⁱⁱⁱezen.^dLi⁹.si₄ u₄.24 ba.zal.ta / ⁱⁱⁱezen.^dDumu.zi u₄.3 ba.zal.še₃ / iti.2 u₄.10 la₂.1.kam, i.e. 25th-30th = 6; 6 + 3 = 9 days. There was a lively early discussion in Assyriology of when the Babylonian day began, for which compare E. Hoppe, "Die Zeitmessung im Altertum", Mitteilungen der Mathematischen Gesellschaft in Hamburg V/7 (February 1919) 262-263 and 268-269. N. Schneider, AnOr, 13, 117-118 came to the correct conclusion that zal = "end of the day" by using the defective premise of a 29-day month in his analysis of the text TUT 17 rev. x16-18. u₄.15 ba.zal of the 8th through u₄.15 ba.zal of the 9th month (Lagash calendar) equals 30 days requires, in fact, the *exclusion* of the 15th day of the first month, that is: 16-30 = 15; 1-15 = 15; 15 + 15 = 30. T. Gomi has shown in ZA 75 (1985) 4-6 the consequences a clear understanding of zal can have in the decipherment of text transliterations which have been published without copy or photo. TMH NF 1/2, 121 rev. 24-26 might represent a contradiction to the expectation u₄.zal = "completed day": ⁱⁱⁱNE.NE.gar.ra (month 5, Nippur calendar) u₄.17 zal.la.ta / u₄.30 zal.la.še₃ 1 sila₃ zi₃.gu 2 sila₃ dabin.ta / še.bi 0;0,4,2 sila₃. Since 42 ÷ 3 = 14, the period 17.zal through 30.zal should be 14 days, a period *including* the 17th. The Nippur text contains further irregular calculations (obv. 8-11, rev. 27-30I, cf. H. Waetzoldt's collation, OrAnt. 15 [1976] 320; the latter section as well as F. Yildiz and K. Mackawa, Zinbun 18 [1982] 98, Nr. 3, i 1-4, indicate that zi₃.gu like dabin was converted into še at the rate of 1:1) which I am equally unable to explain. It is likely that the often noted periods of 7 and 15 days represent not necessarily moon phases, but successive divisions of the 30-day month by 2 required by household administration. This division of the month, moreover, would not be surprising in any synodical calendar in preclassical and classical antiquity, so that there is neither need to recognize magic Babylonian numbers (entirely implausible the suggestion of H. and J. Lewy, HUCA 17 [1942-1943] 19, that the week originated in a Babylonian system of seven wind directions) nor to assume, for instance, a need for dispersed market days, in order to reasonably explain our seven day week.

H26 (incorrect figures and premises led to the identification of a 27-day month) in analyzing well preserved ones.

For example the following reconstruction of the text MVN 11, 106, i1-10:

[20 guruš.š] ^{iš} gid ₂ .da	20 ^{iš} gid ₂ .da-workers,
[(x)].me	...,
[2 +]2 ug ₃ .ga ₆	and 4 porters
[ⁱⁱ š]E.KIN.ku ₅	from "Harvest(-festival)" (month 11, Girsu calendar)
[m]u gu.za ^d En.lil ₂ ba.dim ₂ .ta	of the year "The throne of Enlil was constructed" (Amar-Zu'en 3)
[ⁱⁱⁱ]Amar.a.a.si	through "Amar.a.a.si" (month 10)
[mu] en.mah.gal.an.na	of the year "Enmahgalana was installed
[e]n ^d Nanna ba.a.hun.šc ₃	as priestess of Nanna" (Amar-Zu'en 4),
a ₂ .bi 2.36.00 guruš u ₄ .1.šc ₃	performance involved: 9360 workdays, male workers,
iti.13.kam	it is (a period of) 13 months,
iti.diri.1.am ₃ ša ₃ .ba i ₃ .gal ₂	including one extra month.

is required by two calculations made within the preserved parts of the text. First, the division $9360 \div 390$ (days in 13 months) results in 24 workers altogether, second the entry rev. i20'-21':

2.36 guruš u ₄ .1.šc ₃	156 workdays, male workers,
a ₄ .ku.a igi.10.gal ₂ ug ₃ .ga ₆	are the porters' KU.a (compensatory) days at 1/10

verifies the reconstructed 4 porters in obv. i3, since

$$156 \times 10 = 1560, \text{ and } 1560 \div 390 = 4.$$

Further TCL 5, 6036 ii23-27:

iti.13.šc ₃	... for 13 months,
[ⁱⁱ š]E.KIN.ku ₅ .ta	from "Harvest(-festival)" (month 1, Umma calendar)
iti.diri.šc ₃	through the extra month (month 13),
a ₂ .ug ₃ .ga ₆ .bi u ₄ .2.52.15	porter performance involved: 10,335 (work)-days,
a ₂ .dumu.gi ₇ .bi u ₄ .16.15	performance of the dumu.gi ₇ 's: 975 (work)-days

must assume $10,335 \div 390 = 26 \frac{1}{2}$ porters and $975 \div 390 = 2 \frac{1}{2}$; $2 \frac{1}{2} \times 2 = 5$ dumu.gi₇ workers (standard performance: 1/2), in the same text, iv8':

15.55 1/2 guruš u ₄ .1.šc ₃	955 1/2 workdays, male workers,
a ₂ .u ₄ .du ₈ .a ug ₃ .ga ₆	du ₈ .a performance of the porters,

indicates a dispensation for 24 1/2 porters, since $955 \frac{1}{2} \times 10 = 9555$, and $9555 \div 390 = 24 \frac{1}{2}$ ($u_4.du_8.a = 1/10$ is shown by the series ii14-18, for instance 14-15: 40 $la_2.1$ guruš $u_4.1.še_3$ / $a_2.u_4.du_8.a$ Lu₂.Eb.gal, i.e. $390/10 = 39$; see obv. x34-36 and above to MVN 11, 106),

J.-P. Grégoire, AAS Nr. 135 i15:

[$a_2.bi$] u_4 11.03.00.kam¹

since $39,780 \div 360 = 110 \frac{1}{2}$, a “nice number”, instead of the ca. 70 workers proposed by Grégoire (p. 175; by “nice numbers” I mean those which can be explained as resulting from artificial administrative calculations, such as grain equivalencies in texts from mills and bakeries, production quotas and, here, the composition of a productive labor unit).

The text BIN 5, 226 1-4:

𒍪 guruš
 — ug₃.ga₆
 iti.12.še₃
 $a_2.bi$ u_4 .20.00

3 (full) workers,
 1 (1/3 performance) porter
 for 12 months,
 performance involved: 1200 days,

should be translated as given, since $1200 \div 360 = 3 \frac{1}{3}$.

These administrative work ledgers, when viewed against the parallel synodical calendar, favored the bookkeepers of the state, for in a system of set work quotas the foremen responsible for productivity (nu.bandā, ugula) carried the burden of a month lengthened artificially by a factor of 1 in 60, i.e. 300 workdays were demanded of a crew of 10 men in a month not of 30 but of 29 1/2 days: the laborers “paid” 5 workdays each month, of course converted into units of production, for the fact that the synodical month approximated 30 from the underside. In contrast, the important Ur III feed schedules document a use of administrative timekeeping which seems to be disadvantageous to the state in that, by the same factor of 1 in 60, more grain will have been allotted the livestock fatteners than required. For instance TCL 5, 6057 i8-16:

2.00 udu.niga 1 1/2 sila₃.ta

120 fattened sheep, 1 1/2 sila (of grain) each (per day)

u ₄ .15.še ₃	over 15 days,
še.bi 9;0,0 gur	grain involved: 9 kor (= 120 × 1 1/2 × 15),
ⁱⁱⁱ E ₂ .iti.6	(in): "E ₂ of the 6th month" (month 8, Umma calendar).
2.00 udu.niga 1 1/2 sila ₃ .ta	120 fattened sheep, 1 1/2 sila (of grain) each (per day),
še.bi 18;0,0 gur	grain involved: 18 kor (= 120 × 1 1/2 × 30),
1.30 udu.niga 1 sila ₃ .ta	90 fattened sheep, 1 sila (of grain) each (per day).
še.bi 9;0,0 gur	grain involved: 9 kor (= 90 × 1 × 30),
ⁱⁱⁱ dLi ₉ .si ₄	(in): "Lisi (-festival)" (month 9).

and so forth, not only attests the sequence of month names in Umma's cultic calendar, but also demonstrates the use of the administrative, 30-day month in those rationing texts, namely feed schedules, which play an important role in uncovering the managers' timekeeping system in earlier periods. Further examples of this phenomenon are E. Szlechter, TJA I, pl. 54, IOS 22; H. Lutz, UCP 9/2, 50; S. Kang, SACT 2, 261.

I know of no exception in administrative records to the basic applicability of this system, although with the addition to or subtraction from the 30-workday month of a variety of compensatory time periods, the production records can exhibit on their surface a considerably more involved structure⁸).

One should expect to find in the older text corpora antecedents of such a simplifying, at the same time elaborate system of time notation, since clearly the bulk of the tablets so far unearthed are bound to centralized bookkeeping, and the scribes themselves, being midlevel officials and thus willing to assume only very limited responsibilities, will have taken pains to record the exact time span their

8) See for only some examples p. 170 and fns. 3 (where u₄.du₈.a added to production estimations is discussed), 44-46; A. Deimel, Or. 2 (1920) 63 to Wengler 41 (incorrect connection with "real workdays"); H. de Genouillac, Bab. 8 (1924) 43 (du₈ = "feries"?); V. Struve, Ancient Mesopotamia 139-143 (u₄.gab = "days of detachment"); M. Civil, Aula Orientalis 1 (1983) 52-53; H. Waetzoldt, "Die Situation der Frauen und Kinder anhand ihrer Einkommensverhältnisse", AoF (forthcoming) section 4; J.-P. Grégoire, AAS p. 175; see also the treatment of these compensatory allowances in Grégoire, Die neusumerischen Getreideverarbeitungsanlagen (Berlin, forthcoming). It is interesting in this regard that the so-called "sick-days" tu.ra as well as, probably, those days following a worker's death, are logged as achieved production in the active sections of accounts; see fn. 46.

documents covered. Moreover the very nature of the forces requiring administrative documentation, namely the efficient recording of production and redistribution of centrally amassed wealth, carries with it the implicit necessity of accurate time notations. It will be evident from a cursory analysis of feed texts from presargonic Girsu that very much the same system of Ur III time reckoning was in use in the 24th century B.C. Our work in Berlin on the archaic texts from Uruk, dating between 3200 and 3000 B.C., has led to an evaluation of the time notations found in those documents as well as in the closely related Uruk III period texts from Jemdet Nasr and elsewhere. As a result I have been able to conclude that in the protoliterate period the same system of administrative time reckoning was employed as was the notational basis 1000 years later⁹). It can be understood as a sign

9) It should be noted here that the results presented derive, so far as paleographical controls allow of any judgment, almost entirely from the period Uruk III; hard evidence comes in fact from sites other than Uruk, namely Jemdet Nasr and, probably, Uqair. I am able to say no more about the Uruk III material from Uruk itself than that it stands in no contradiction to the system evident in texts from the other sites; alone the likely Uruk IV texts W 14777,c, W 19568,c (with the compositum \rightarrow), ATU 1 Nr. 581 (with \Rightarrow), Nr. 585 and W 20573,3 (with \rightarrow) give evidence of comparable time divisions in the earliest protoliterate period, which H. Nissen dates to ca. 3200 B.C. See for a survey of the Uruk period time notations P. Damerow and R. Englund, "Die Zahlzeichensysteme der Archaischen Texte aus Uruk" in M. Green and H. Nissen, *Zeichenliste der Archaischen Texte aus Uruk* (= ATU 2; Berlin 1987) 145-146. There also pp. 125-126 a detailed explanation of the notational system we have chosen to transliterate text entries and see below for notations such as $5N_{14}$ used here. Transliterations of archaic texts are entirely conventional, following the readings given in ATU 2, and do not represent a judgment of the language(s) spoken in the archaic period. Since the isolation of the assumed personal name EN.LIL₂.TI "May (the god) Enlil give life" in the Jemdet Nasr corpus by S. Langdon, OECT 7, p. VII, and its discussion by A. Falkenstein, ATU 1, pp. 37-38 (see now H. Nissen, ATU 2, p. 17), it has been generally accepted that at least in the period Uruk III and with high probability in Uruk IV that spoken language was Sumerian. The basis of this contention has been that a multivalent stage of writing had been achieved, i.e. that the pictograph "ARROW" (Sumerian: ti) in fact was read /ti/ in the archaic texts and could represent the homophonous Sumerian ti(l), "to live".

There are however compelling reasons to remain neutral in the matter. A. Vaiman, *Acta Antiqua* 22, 15, has questioned this rebus writing example ti = ti(l) in pointing out that the sign LIL₂ must (better: could equally) be read E₂ 'house'. Vaiman's critique is supported by my recent collation of the text W 21126 (= City

of a still limited understanding of the archaic texts that no judgment about the probable synodical, cultic calendar used in the protoliterate

List A; M. Green, JNES 36, 293), which resulted in the following copy of line 3:



that is, the only highly probable archaic lexical attestation of "Enlil" (= NIBRU) is not EN:E₂ but EN:KID(-a) (𒂗); cf. R. Biggs, JCS 20, 84⁸⁵; OIP 99, p. 80 to Nrs. 21-22 and p. 111³: late Early Dynastic godlists exhibit the writings ^dEN.E₂ = ^dENLIL, ^dNIN.KID = ^dNINLIL). The meaning of this form of KID is not known (see our discussion of notations for large numbers, ATU 2, 149¹⁵, among which KID-a seems, like GAL, to qualify artificially high quantities), but is never confused with the other form KID(-b) listed in ATU 2 (𒂗), which is well attested as a commodity in ration lists from Jemdet Nasr. Other references should in fact be preliminarily read EN.E₂ as Vaiman supposed, cf. however the following attestations of EN:KID(-a) from Jemdet Nasr: OECT 7, 29 Rev.i1 (EN EN:KID), 32 + 187 = 128 Rev.1b1 (5N₁₄ ŠE EN:KID PA.KALAM), 33 Obv.i4 (SANGA EN:KID BA X), 66 Rev.ii1 ([JEN:KID) and 74 Rev.iii1 ([] 3N₅₇ SU.GIBIL ENGIZ ŠAGAN EN:KID) (all KID(-a)). Vaiman has often (Soobščeniya Gosudarstvennogo Ermitaža 27 [1966] 62; Peredneaziatskiy sbornik 1966/2, p. 9; Acta Antiqua 22, 16) cited the sign GI (= "reed" and "return" in Sumerian) as the rebus writing which demonstrates that the archaic texts represented the Sumerian language. While it does seem clear that the graph is very often used in administrative context, precluding in those usages the meaning "reed" or anything in the semantic field of "reed", Vaiman's view is complicated by the fact that various commodities, including parcels of land, qualified by the signs BA (probably = "eye", "inspect"; usually translated "to disburse") and GI, represent subtotals and are *added together*. Vaiman has himself made note of this fact in ActAnt. 22, 16 with copy of ATU 1, Nr. 626 on p. 18, however without sensing any consequence in the summation for his translation of GI = "zurückerstatten". One text which Vaiman might have cited in his favor is ATU 1, Nr. 297 with the entries obv. i1: 7N₁ BA; i2: N₁ GI; rev.: 6N₁ BAR², i.e. possibly 7-1 = 6. See also fn. 18.

A sophisticated argument supporting a Sumerian substrate in the archaic texts was raised by M. Powell, ZA 62 (1972) 172, namely that the sexagesimal notations of the period must have originated in a spoken Sumerian, since only that culture is known to have had a sexagesimally structured numberword sequence. It might be added to our reservations in ATU 2, 150²² concerning this argumentation that should Powell's reconstruction of the Sumerian numberwords ten (u) through fifty (ninu from *niš-min-u, "two twenties, ten") prove to be valid for the third millennium, then one will be faced with the difficulty of explaining why a vigesimal (I expect that even ušu = 30 is derived from *(n)iš-u, "twenty, ten") should have been graphically represented with an additive decimal structure. Powell considers this graphic representation convenient (see ZA 62, 169) for reasons unclear to me; there is in any case an important qualitative difference between IX for Latin novem and ● for Sumerian niš. niš seems to be a primary numberword requiring, in a system depicting Sumerian numeration, a differentiated representation comparable

period can be made here¹⁰); this sort of assessment presupposes a higher linguistic level of decipherment than that afforded by the now solid clarification of the arithmetical operations behind administrative timekeeping in archaic sources.

2. The archaic numbersign systems.

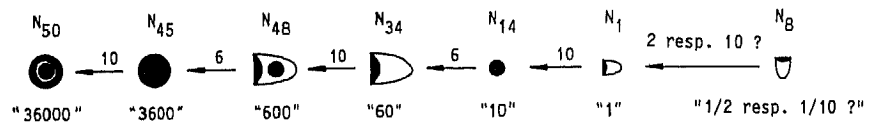
Administrative time notations are intimately tied to the use in the archaic texts of varying numerical systems, so that it will be important first to explain the transliterational system we have chosen to represent numbersign notations as well as to survey the numbersign systems, the study of which has been a matter of some emphasis in the Berlin Uruk Project. The Uruk Signlist identifies altogether 60 separate numbersigns, which have been clustered according to graphic similarity and consecutively numbered ZATU N-1 through ZATU N-60 (in the present paper simplified to N₁, N₁₄, etc.; for an overview of the numbersigns and their respective systems see pp. 184-185). All numbersigns were written with two, perhaps three styli: in general, smaller quantities, smaller units of a particular system

to the sign \square , which in the vigesimal system of the Aztecs meant "man" and "twenty" (i.e. fingers plus toes). In sum: the demonstrated sexagesimal structure for the Sumerian numberword sequence above 60 is not attested for the 3rd millennium, the partially attested Sumerian numberword sequence below 60 is not sexagesimal.

10) There may be an association between notations of the possibly mixed type $3N_{57}+U_4$ su 6[+?]N₁ GIBIL ... (3rd year, 6th[+?] month ...?) and N₁₄.2N₁ su GIBIL GI (12th month ...?) in the texts OECT 7, 134 and 32 + 187 = 128 (= Ashm. 1926, 581-582) and the archaic cultic calendar on the one hand, a system of recording rationing periods akin to that of the presargonic period (see fn. 17) on the other (J. Friberg mentioned the first possibility to me in 1983). su and GIBIL are otherwise not seldom attested in Jemdet Nasr together with XN₅₇ (with N₅₇ in OECT 7, 30, 70 and 80; with 2N₅₇ in 78 and 154; with 3N₅₇ in 24 (obv. ii! according to new copy courtesy of J.-P. Grégoire), 25, 74, 134 (3N₅₇+U₄!) and 138; with 4N₅₇ in Nr. 24 (rev. i); compare the notations su GIBIL SUHUR resp. KU₆ in the Uruk texts W 24011,8 and W 24188, A Cavigneaux, UVB 33-34, forthcoming), just the same I have been able neither to posit a plausible time reckoning system in the notations nor to give any semantic justification for the combination of su and GIBIL.

were impressed with a smaller rounded stick or reed, while a larger rounded stylus was used to impress larger quantities or units. Scribes drew with a third, sharp-edged stylus (the same as used for pictograms and possibly, as in later tradition, simply the reverse, sharpened end of one of the rounded styli) the horizontal and vertical strokes N₅₇ resp. N₅₈, but also etched additional strokes or dots on numbersigns of the impressed type to indicate units of a derived system. For instance, while the sign N₁ represents in the grain system a given unit of, perhaps, barley (cf. A. Vaiman, *ActaAnt.* 22, 21-22), the same sign with the addition of dotted impressions identified specifically the use of the same quantity of grain in the production of beer and other grain products.

Of the 60 identified numbersigns at least 52 were thus used in five basic and a further five derived numbersign systems. The sexagesimal and "bisexagesimal" (60 and 120-base) systems were employed to represent discrete objects: animals, fish, beads, rationing units, etc. The šE system, akin to the gur systems of later tradition, was used in the representation of amounts of grain. Field (surface) measures were noted in a further, the GAN₂ system, and finally we have evidence of a basic numbersign, the so-called EN system (based on the particular usage of the pictogram EN with one of its numbersigns), for which we could cite no clear parallel system in later texts. The method first advanced by J. Friberg in *Early Roots of Babylonian Mathematics II* (Göteborg 1979) 13 to represent archaic numbersign systems, namely the factor diagram, was chosen for the presentation of the Uruk numbersign systems in the Uruk Signlist. Thus the most widely used sexagesimal system is diagrammed in the following manner:



Archaic sexagesimal numbersign system.

The factor diagram offers a clean representation of the arithmetical relationships between the various members of a particular system, without the necessity of often misleading modern interpretations. Further, the one-to-one correspondence of impressed numbersigns to sign names precludes the ambiguity so characteristic of past and current transliterations of numbersigns in 3rd millennium texts. It is important to conventionalize this representation particularly of archaic numbersigns, since although the archaic scribes had a large number of signs at their disposal, yet often the same sign had different meanings when used in different systems. Thus the relationship between N_{14} and N_1 is 10:1 in sexagesimal and bisexagesimal, however 6:1 in grain notations. A numerical ascription of "10" to N_{14} in transliterations would at best be misleading, at worst simply incorrect. Such interpretations will be reserved in the present discussion for tentative translations.

The relationship $N_{14} = 6N_1$, as will become clear, played a vital role in the analysis of the archaic time notations and in the comparison of these notations with those of later cuneiform traditions, for in the archaic as well as in later texts the conversion of time into grain gave important clues for the unraveling of the time span involved.











3. Earlier work on the archaic time notations.

No serious attempt was made by the first editors of the archaic corpora from Jemdet Nasr and Uruk to analyse the archaic time notations, although both S. Langdon and A. Falkenstein were in agreement that time divisions were expressed by use of the sign u_4 , "day(light)". Falkenstein translates in ATU 1, p. 48 the subscript to the text Nr. 585: N_{57+u_4} KAŠ NINDA as "für einen Tag Bier (und) Brot", and does not comment on further notations. Langdon, from a faulty understanding of the grain notations, believed that the notations of the form $u_4 + XN_8$ were daily grain rations or the like (confusion of N_8 𒌦 and N_{39} 𒌧 as a division of N_1 in grain notations), the notations $u_4 \times XN_1$ were then according to Langdon a further con-

fusion of the grain rationing or possibly day notations (see his commentary in OECT 7 to the signs 172-177); finally to sign 66 (\rightarrow , \Rightarrow , \Rightarrow etc.) he remarked "A comparison of [these signs] with the sargonic form \rightarrow REC 236 makes the identification [with iti = month] certain". This identification was subsequently assumed by R. Labat in his signlist *Manuel d'épigraphie akkadienne*, and has until recently been the object of no further study.

4. Vaiman's archaic time divisions.

The first Assyriologist to devote serious attention to the formal make-up of archaic time notations was the Soviet scholar A. Vaiman, who reconstructed the following system of time notations for the Uruk period:

	one year		two years etc. up to		eight years
	one month		two months etc. up to		eighteen months
	one day		two days etc. up to		fifteen days
			one month and fourteen days ¹¹⁾		

The formal characteristics of this system were that it was based on the sign u_4 (\rightarrow), that is pictorially correct \rightarrow and considering the sign's later semantic range from day(light) to white to sun(god) generally assumed to have been the representation of the sun rising

11) See A. Vaiman, "Über die protosumerische Schrift", *Acta Antiqua* 22, (1974) 19-20; id., "Protošumeriskie sistemy mer i sceta" [Protosumerian Metrology and Numeration], in: *Trudy XIII Mezhd. Kongr. PO Ist. nauki* (1974) 10-11. Vaiman refers with the notation $(u_4 \times N_1) + N_{14} \cdot 4N_8$ to the text OECT 7, Nr. 84, which according to collation and contextual calculation must be read $(u_4 \times N_1) + 5^1 N_8$ (see p. 152 for a new copy of the text). In an earlier publication (*Peredneziatskij sbornik* 1966, 8⁺¹⁰) he followed the proposals of Langdon that $N_{57} + u_4 =$ month, so that the misreading of OECT 7, Nr. 84 evidences the formal nature of the corrected system published in 1974.



among the eastern mountains of Mesopotamia), with horizontal strokes (XN_{57}) to the left of u_4 to count years, very likely sexagesimal numbersigns impressed with the rounded end of the stylus within the sign to count months, and finally likely sexagesimal numbersigns turned 90° to the right impressed to the right of the sign to count days.

Do we have reason to accept this important construct? I have been unable to ascertain the basis for Vaiman's assumptions, nor is it clear how many days he saw in a month, how many months in a year; he may have arrived at his diagram of archaic time notations through reasonable extrapolations from notations found particularly in the presargonic corpus from Girsu, but doubtless his construction is derived primarily from an intuitively astute assessment of the framework of the Uruk period notations themselves¹²).

An informed judgment about the formal make up of any counting system rests on a sufficiently large pool of internally differentiating examples of the system members, and on an understanding of the milieu in which the counting system is used. Sufficient text examples of an archaic time counting system have been available since the publication in 1928 of the archaic tablets unearthed at Jemdet Nasr. These texts, in fact, still constitute the most important source for the examination of archaic time reckoning, even though a large number of unpublished texts from Uruk could be added to the sources available to Vaiman (including, beyond OECT 7, ATU 1, BagM and UVB reports up to 1974 as well as a number of archaic texts published in scattered articles) with notations for "days", "months" and "years" (see ATU 2, 145-146). We have now notations for up to $10N_{57}+u_4$ (10[th] years?; it will be demonstrated below that cardinal and ordinal usages of these time notations were not graphically differentiated) in W 14731, u+, up to $u_4 \times N_{14} \cdot 2N_1$ (12 months?; the text OECT 7, Nr. 4 contains the largest attested "month" notation with

12) Vaiman delivered a paper at the 31st Rencontre assyriologique internationale, Leningrad, on 3rd millennium time reckoning, of which I have been unable to obtain either a copy or synopsis.

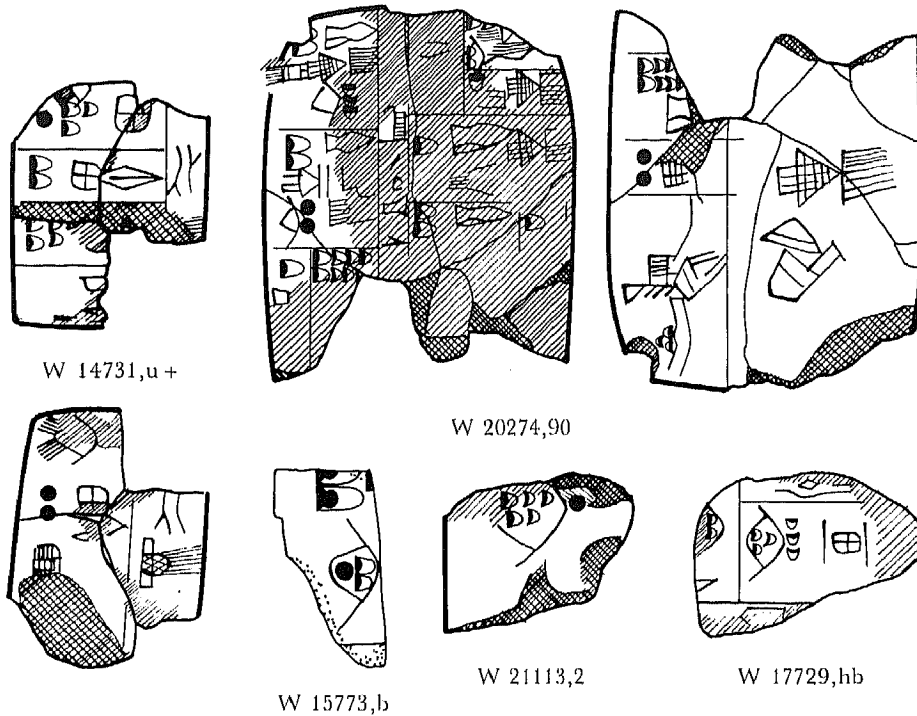
$u_4 \times 3N_{14}.2N_1 = 32$ months?) in W 15773,b and up to $u_4 + 2N_{14}$ (20 days?) in W 20274,90.

Vaiman could cite only one mixed notation of the type $(u_4 \times XN_1) + (YN_{14}.)ZN_8$ for X “months” and $(10Y+)Z$ “days” (OECT 7 84; see fn. 11); from the unpublished Uruk texts come but three more attestations, namely the notations $(u_4 \times 3N_1) + 3N_8$ (3 months and 3 days?) in W 17729,hb, $(u_4 \times [+]5N_1) + N_{14}$ (5+ months and 10 days?) in W 21113,2 and probably $(u_4 \times 2N_1) + 2N_{14}$ (2 months and 20 days?) in W 14111,o. Another likely candidate is the sign OECT 7, 177 () which according to collation has been correctly rendered by Langdon. I think, however, that with some certainty the scribe intended the mixed notation , and simply realized too late that he had drawn the sign u_4 too large for the space required to write $(u_4 \times 2N_1) + 2N_{14}.N_8$ or 2 “months” and 21 “days”.

No notations of the type $XN_{57} + (u_4 \times YN_1)$ for X “years” and Y “months” are attested, rather, notations up to $u_4 \times 3N_{14}.2N_1$ (32 months?) in the text OECT 7, Nr. 4 (see below. sec. 7) and $u_4 \times 2N_{14}.4N_1$ (24 months?) in ATU 1, Nr. 653 (see sec. 9); that is, $u_4 \times N_{14}.2N_1 =$ “12 months” was not as a rule, as one might have expected, replaced by $N_{57} + u_4 =$ “one year”¹³).

Vaiman’s system enjoys more conviction when considered in the context of the conceptual framework behind archaic records. This argument rests in the nature of archaic numbersign notations (cf. ATU 2, 117-121): signs representing larger quantities are impressed to the left of (more precisely: *above*) numbersigns of the same notation representing smaller quantities. Thus it would not be surprising to find archaic scribes patterning time notations after the rule: larger

13) The only candidate for a mixed “year/month” notation known to me is the difficult $3N_{57} + u_4 su 6[+]N_1 \dots$ in OECT 7, 134 referred to above fn. 10. Ur III scribes, certainly for the purpose of clear calculation readability, referred in work-day ledgers of twelve month spans not to $mu.1$ but rather to $iti.12.kam$, see for instance MVN 10. 196 cited below, fn. 42. For Ur III notations of up to 93 months see fn. 3.



Examples of Time Notations from the Uruk Corpus (Copies 2:1)

(W 14731,u+ rev.i: $10N_{57}+U_4 = 10\text{th year?}$; W 15773,b (copy A. Falkenstein): $U_4 \times N_{14} \cdot 2N_1 = 12 \text{ months?}$; W 20274,90i1-2: $U_4+3N_8 = 3 \text{ days?}$, $U_4+2N_{14} = 20 \text{ days?}$; W 17729,hb: $(U_4 \times 3N_1)+3N_8 = 3 \text{ months and 3 days?}$; W 21113,2: $(U_4 \times 5N_1[+?])+N_{14} = 5 + \text{ months and 10 days?}$)

quantities to the left, with the supplemental refinement of varying signforms for years, months and days; indeed, alone month notations, impressed inside the sign U_4 , would have in most cases been identical with the primary numbersign notation of a given case (usually the sexagesimal or ŠE systems), both N_{57} and N_8 outside of the sign would scarcely have been confused with signs of the primary notation.

This system is therefore formally reasonable: moreover it can beyond formal grounds be shown not only to be correct, but also to have had the same number make-up (1 year = 12 months = 360 days)

as the presargonic and Ur III administrative time notations, and thus to have predated the older of the two by more than 500 years. Before presenting the evidence from archaic sources, however, it will be important to establish the use of the 360-day year in the presargonic period (ca. 2500-2350 B.C.), which temporal link makes the administratively rounded year an historically more plausible construct for the archaic period¹⁴).

5. Presargonic time notations.

The ration and feed texts from presargonic Girsu exhibit notations for one month and one day which manifestly correspond to those pro-

14) Fara-period texts offer little hope for an understanding of the time reckoning system used. A. Deimel rejected in LAK p. 3-4 the interpretation of F. Thureau-Dangin (RTC p. II) that the well attested term *bala* written before personal names at the end of "sale contracts" from Fara stood for regnal year or the like, preferring to see in the term an expression of the destruction (invalidation) of a contract. S. Langdon, "The Sumerian Word for 'Year' and Origin of the Custom of Dating by Events", RA 32 (1935) 131-149, interested in establishing that *mu* was *not* the Sumerian word for year, supported Thureau-Dangin's arguments (see below, fn. 18). See further D. Edzard, SRU Index p. 219, following Thureau-Dangin with *bala* = "Wechselamt" (term of office); J. Krecher, ZA 63 (1973) 181-183, reasoning against a translation "term of office", wants instead to connect the term *bala* either with a legal transaction of contract duplication, or with the symbolic contractual closing, the so-called "bukanum-Formel", for which see D. Edzard, ZA 60 (1970) 8-53. In the absence of analytical research of the Fara period administrative texts, the matter can scarcely be solved. Of the other time divisions expected in administrative documents, alone the Fara texts TSS 150 rev. vii with the notation for 7(th) day(s) (?) written: $u_4 + \text{𒌷}$, TTŠ 882 rev. ii1 with $\text{𒌷} \text{|||} \text{𒌷}$ (= ?) and CT 50, 12 rev. ii3 with 𒌷 (= ?) can be cited as examples.

G. Pettinato has drawn to my attention the fact that, comparable to presargonic Lagash usage, Ebla notations of numbers of years, like persons, used cuneiform stylus impressions:

$$\begin{array}{ccccccc} & & ? & \leftarrow & ? & \blacklozenge & \leftarrow & \frac{10}{1} & \vee \\ & & & & & 10 & & & 1 \end{array}$$

in contrast to the use of the rounded end of the stylus to impress numbers of other discrete objects, of the grain quantity *gu*₂.bar, etc. Texts like TM.75.G.530 cited by A. Archi, StEb. 5 (1982) 212, further, attest to an Eblaite *administrative month* comprising 30 days, we have obv. vi6 - rev. i7: 10 še bar ninda guruš.guruš 40 e₂.duru₅^{ki} in 1 u₄ ... 3 mi-at še bar ninda guruš.guruš 1 iti (10 × 30 = 3 hundred). These Eblaite time notations should be added to archeological and paleographic analysis—for a recent discussion see E. Sollberger, StEb. 5, 221-228—which suggest a date for the Ebla texts later than the Fara period.

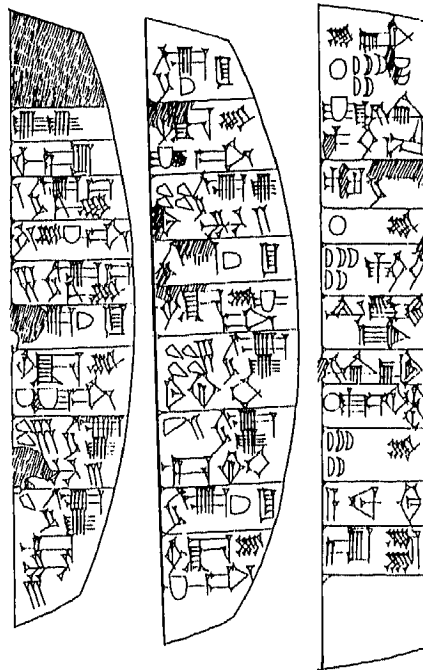
posed for the Uruk IV-III periods, namely to $u_4 \times N_1$ and to $u_4 + N_8$:

𐎠 ití(d) = one month

𐎠 u₄+1 = one day

In the sections devoted to swine feed, for instance in HSS 3 31 obv. vii4 - rev. ii2 we have the following entries:

1 šah ₂ .gišgi /	𐎠 še 0:0;1.ta
5 šah ₂ .gišgi / [š]ah ₂ .1.še ₃ /	𐎠 .da še 0:1;4.ta
26 šah ₂ .u ₂ [SAL m]u.3 /	
10 šah ₂ .u ₂ nita mu.3 / šah ₂ .1.še ₃ / r	𐎠 .da ¹ še 0:0;3.ta
40 šah ₂ .u ₂ SAL mu.2 / šah ₂ .1.še ₃ /	𐎠 .da še 0:0;2.ta
45 šah ₂ .u ₂ SAL ša ₃ .HI /	
1.02 šah ₂ .u ₂ nita ša ₃ .HI / šah ₂ .1.še ₃ /	𐎠 .da še 0:0;1.ta
še.bi 15;2,3 Lugal.pa.e ₃ / sipa. ^r šah ₂ ¹	



Obv.vii

Rev.i

Rev.ii

HSS 3, 31

Using the following diagram of the presargonic Lagash gur system



it is a matter of simple calculation to see what the text is recording.

According to the formula: number of animals \times feeding period \times quantity of barley ($\text{\textcircled{š}}\text{ah}_2.1.\text{\textcircled{š}}\text{e}_3$ = "each" when more than one is recorded) we have:

pigs	time	grain in timespan		total grain	daily ration
1	one day	0;0,1	($\times 30$) =	1;1,0	6 sila ₃
5	one month	0;1,4	=	2;0,2	2 sila ₃ ¹⁵⁾
36	one month	0;0,3	=	4;2,0	3/5 sila ₃
40	one month	0;0,2	=	3;1,2	2/5 sila ₃
107	one month	0;0,1	=	4;1,5	1/5 sila ₃
---				-----	
189				15;2,3	

Feeding schedules are here varied according to the size of the animals. The $\text{\textcircled{š}}\text{ah}_2.\text{\textcircled{š}}\text{i}\text{\textcircled{š}}\text{gi}$ (the largest wild boar kept for breeding?) was being fed one ban = 6 sila daily during the month recorded; the other animals received substantially less, between 2 sila daily for the second recorded $\text{\textcircled{š}}\text{ah}_2.\text{\textcircled{š}}\text{i}\text{\textcircled{š}}\text{gi}$'s down to one ban per month = 1/5 sila per day for the piglettes $\text{\textcircled{š}}\text{a}_3.\text{HI}$ (see below). The necessary multiplication of the largest animal's daily ration by a factor of 30 to result in correct summations in this and many other like texts establishes the use of the same administrative 30-day month we have seen in the Ur III period.

Beyond the notations $u_4 \times \uparrow$ (one month) and $u_4 + \uparrow$ (one day) with the consequences the time spans in conjunction with grain notations have for the size of the presargonic sila and hence for the iden-

15) Cp. HSS 3, 32 rev.ii (//MVN 3, 4 obv. iii): 3 $\text{\textcircled{š}}\text{ah}_2.\text{\textcircled{š}}\text{i}\text{\textcircled{š}}\text{gi}$ / $\text{\textcircled{š}}\text{ah}_2^1.N_1.\text{\textcircled{š}}\text{e}_3$ / $u_4 + \uparrow \text{\textcircled{š}}\text{e} 2.\text{sil}_3.\text{ta}$ (= 0;1,4 per month).

tification of the domesticated animals being fed¹⁶), these texts demonstrate with the use of further time notations for the two units month and year a rich blend of time measurement in the 24th century: both the artificial administrative and traditional agricultural time divisions seem to have existed side by side. Some examples:







month Its colophon (rev. iii-iv) identifies HSS 3, 31 as a document recording regular monthly feed grain disbursements (še ninda ziz₂ nig₂.sa₂.du₁₁ iti (ϕ).da) in the month ⁱⁱⁱEzen.munu₄.gu₇ ('Malt-eating festival'). This month is administratively the ninth 30-day rationing period (GAR.am₆; a parallel and in some cases overlapping term is X.ba.am₆). In expected fashion the succession 1-12.GAR/ba.am₆, i.e. the first through twelfth rationing month, is attested in the presargonic corpus, as well as in three known cases 13.GAR/ba.am₆, corresponding exactly

16) Pigs were fattened in the Ur III period with up to 3 2/3 sila (ca. 3 2/3 liters). Cf. the texts Ashm. 1971, 390 (unpubl., courtesy J.-P. Grégoire), BM 20904a (unpubl., courtesy M. Sigrist), ITT 5, 9630, S. Kang, SACT 2, 263 and D. Owen, JCS 24 (1972) 162, Nr. 64. The pigs qualified as ze₂.da in the text Owen Nr. 64 obv. ii11 received nothing (še nu.dab₅). These will have been the *unweaned piglets* corresponding to an age group younger than the presargonic šah₂ ša₃.H1, a suspicion confirmed by the texts Metropolitan Museum Nrs. 11.217.9a and .9b (unpubl., courtesy M. Sigrist), which record the feeding of goats' milk to šah₂.ze₂.da. The presargonic equids anše.bir₃ received each day 0;0,3 = 18 sila₃, i.e. 4 1/2 sila₃ each assuming with A. Deimel, Or. 32 (1928) 45 and ŠL 393, 10a (cp. J. Bauer, AWL p. 181 to i1 and 191 to i9) a standard team (bir₃) of four draft animals, similar to the team of draft animals known to be counted in the Fara texts as one unit (cf. ATU 2, 149¹³; considering the relative value to the elites of donkeys and soldiers, the most reasonable transliteration of Ent. 28,3:19-21 = 29,4:10-12 [against H. Steible, FAOS 5 II, 119] still seems to be anše.bir₃.ni 1.00.am₆, 'his (contingent) of 60 donkey teams'). The tradition of bir₃ = 4 draft animals continues into the Ur III period, as L. Delaporte proved in a footnote to ITT 4, 7065 (now = MVN 6, 65). Sheep (udu) were fed just 0;0,5 each month = 1 sila₃ per day according to the presargonic feed texts. See below to the use of N₂₄ (according to our proposals, ATU 2, 153-154⁶⁰, approximately equal to 2.4 liters) as a possible standard measure for sheep feed rations in the archaic period.

to the Ur III "diri" intercalation¹⁷). Thus the same equation that obtained in Ur III administration:

17) F. Kugler, *Sternkunde* 2,2,1, p. 216, A. Deimel, *Or.* 1, 62 and *Or.* 32 (1928) 35-37 and E. Rosengarten, *Le concept* 420 cite TSA 35 with colophon dating the text to the 13th rationing period (13.GAR.am₆) of the 5th year of the "king" (lugal) Urukagina (thus the 6th regnal year, including his first year as ensi). G. Selz has very kindly referred me to two further attestations of intercalations in rationing texts published subsequent to the treatment of this genre by Deimel, namely CT 50, 35 and BIN 8, 344. Both texts are dated Urukagina 4 (lugal) xiii (i.e., we have two intercalations in as many years, which fact Kugler, *loc. cit.*, anticipated based on his reconstruction of the presargonic calendar!; see fn. 3 to the unexplained irregularities in intercalation), the latter text is moreover qualified with the month name ^{iti}Ezen.še.gu₇, "Barley-eating festival". Since these probable intercalations occurred very late in the presargonic period, the supposition would still hold that only then the attempt was made to introduce some regularity into the cultic-agricultural calendar.

The presargonic system of time reckoning in its entirety was first discussed by F.-M. Allotte de la Fuÿe, *RA* 6 (1907) 107-108, and has been expanded upon by F. Kugler, *Sternkunde* 2,2,1 pp. 211-223, A. Deimel, *Or.* 1, 58-63, *Or.* 32, 1-83 and *Or.* 43-44 (1929?) 1-131 (regarding the rationing periods GAR and ba), and M. Lambert, *Revue historique* 224 (1960) 1-26. The various attempts to synchronize Lagash' cultic calendar, comprising some 40 month names, have been on the whole unconvincing, whereas the less complex system of administrative timekeeping used for rationing and year dates is well understood. M. Powell, *HUCA* 49 (1978) 9¹⁶, on the basis of R. Biggs, *BiMes*, 3 (1976) Nr. 10 (text from Lagash, mod. al-Hiba), has been able to date this administrative system at least to the time of Enanatum I.

The subsequent mu-iti system, which saw limited use at the end of the presargonic and the beginning of the Old Akkadian periods, seems, on its surface, to be a rational development from the system it replaced; the *basis* of a 30-day month carries on (cf. for instance the texts B. Foster, *Umma in the Sargonic Period* [Hamden 1982] pl. 18, Nr. 37, discussed by J. Friberg, *Scientific American* 250/2 [Feb. 1984] 114 and Foster, *ASJ* 4 [1982] 43 obv. iii9-11) and, for a period at least, a graphically comparable method of representing year dates, with now vertical strokes impressed on either side of the long horizontal, was used (the date of the text BIN 8, 117,   , which both Powell, *HUCA* 49, 9 and B. Foster, *Or.NS* 48 (1979) 156 and USP p. 7 read 7 (mu) 1 (iti) 7 (ud), should be registered with some scepticism). Only here is the refinement of day added, so that documents are dated, for example, 7 mu 5 iti 11 u₄ (USP 36), comparable to 27.6.1979. Foster's suggestion that this was a *necessary* development, in that writing numerals higher than 10 with the presargonic "ligatures" (his term; I presume he means year notations) had become increasingly awkward is without merit, since no such notations are attested. The twelfth month was simply , and the two texts cited by M. Lambert, *RSO* 47 (1972) 21⁴ (BIN 8, 352 and RTC 16) write year notations as in later practice, namely  = the 17th and  = the 19th (year of ENTEMENA). Intercalation has not been satisfactorily demonstrated for the mu-iti



mu = 12 (intercalary 13) iti resp. GAR/ba = 360 (intercalary: 390) u₄

is evident in presargonic Lagash.

year HSS 3. 31 is further identified as a document from the first year (—) of the ensi Urukagina. The horizontal stroke on which regnal years were reckoned might well be no more than a simplification of the sign mu = "year" \rightarrow (18); one could on the other hand posit a connection

system. Foster's reading (Or.NS 48, 156²¹) of the date given on the probable Lugalzagesi text NBC 10235, 29 mu 13 ud(?) \rightarrow is corrected by Powell's copy, HUCA 49, 41 Nr. 6, to 29 mu 11¹ iti (i.e. \rightarrow , 12 rewritten by scribe to 11). Thus alone the text BIN 8, 246, cited by Foster USP p. 161⁷⁹ with 'iti'¹.13, might indicate an intercalary month, 'iti' could however be 'u₄', and the 13th month, as Foster stated, should be written 13.iti. Note just the same such notations as 4 mu iti.6 in USP Nr. 14.

18) The signform \rightarrow of the Uruk period was identified by A. Falkenstein, ATU 1, 118, against the earlier objections of S. Langdon, OECT 7, 26, with the later sign mu. Although not seldom in the Uruk corpus, the sign does not lend itself to semantic analysis, beyond the possibility that it is used to qualify foodstuffs, primarily a type of grain or grain product. For instance the text ATU 1, Nr. 599 (cf. also 600-604 and OECT 7, Nr. 84 [here p. 152]) col. ii contains the addition: N₁ HI.gunu + N₁.N_{2B} ZATU714 = 2N₁.N_{2B} ZATU715 (= ZATU714 × HI.gunu) MU, whereby both the grain numbersign notations and the cereal HI.gunu make clear the nature of this notation. No usage of the sign suggests a connection with the later meaning "year" nor is the "slot" for year available (as will be shown, = \rightarrow), so that one might posit a provisional, primary reading of *muhaldim with the meaning perhaps of "roasted" or the like (B. Landsberger, "Die Anfänge der Zivilisation in Mesopotamien", Ankara Üniversitesi ... 2 [1944] 431-437, reprinted in English translation by M. Ellis, MANE 1/2 [Los Angeles 1974] 8-12, has included MU with reading nuhaldim in his list of "Proto-euphratic" occupational names, translating "cook"; there is however no support in the proto-literate documents for this later, albeit related meaning of the sign). This approach is not unlikely, since we know that new, particularly phonetic units could be derived from the writing system through simple abbreviation of primary readings, thus mu(haldim; I. Gelb's assertion in A Study of Writing [London 1952] p. 111 that there is no evidence for this "acrophonic principle" in Sumerian writings is based largely on his distinction between "true acrophany"—his example being the picture of a house standing for an alphabetic sign h—and a "phonetic process" by which numerous logograms such as tud, kid, etc., acquired the syllabic values tu, ke₄ and so on). The suggestion of S. Langdon, RA 32, 131-149 (followed by A. Ungnad, RIA 2, 132), that mu only secondarily meant year in Sumerian, originally simply = (year)name, is difficult to assess, since in contradiction to Langdon the meaning of mu = year as an administrative unit is well attested in the presargonic corpus from Lagash (see below fn. 37), poorly attested on the other hand are year

with the horizontal stroke (N₅₇) drawn before u₄ and presumably denoting a year in the archaic notations. At least two points imply that XN₅₇ could serve in archaic texts as a free variant of XN₅₇+u₄. The first can be made by a comparison of the Uqair (?) texts ATU 1, Nr. 621 and Nr. 627, namely the equivalence of  and , both equal to 8(th) "years" (see below, section 8 and fn. 33). Secondly, the notation 3N₅₇+u₄ su 6[+]N₁ GIBIL 'NI+RU¹ in OECT 7, 134 (see fn. 10) suggests that the numerous parallel notations XN₅₇ su GIBIL ... in the JN corpus are all to be understood as notations for "years". This "free variant" N₅₇ was then, as we shall see directly, in frequent use to indicate the apparent age of domestic animals, with, in the case of swine, a correspondence between the archaic time notations 3N₅₇+, 2N₅₇+ and N₅₇+šUBUR/šAH₂ and the presargonic sequence šah₂.u₂.SAL/nita / mu.3, mu.2 and ša₃.HI (male and female u₂-pigs in their third, second and first year).

Ascending rations with increasing age, as they are attested in these presargonic feed schedules, should be expected, and this sort of notation is well documented for other domestic animals and in like fashion for workers¹⁹); although no similarly differentiated rationing system is evident in the archaic texts, age differences are recorded, and they

names from that period, all of which come from Nippur. See C. Wilcke, "Zum Geschichtsbewußtsein im Alten Mesopotamien", in: *Archäologie und Geschichtsbewußtsein* (= Kolloquien zur Allgemeinen und Vergleichenden Archäologie 3; Munich 1982) 47⁴.

Unknown remains the language of the Uruk texts, however it seems that an analysis of such Sumerian "reductions" as mu(halDIM) might support the assumption of a non-Sumerian culture at the time of the script origin. To this question see fn. 9 and ATU 2, 150²².

19) Cf. J. Krecher, "Eine unorthographische sumerische Wortliste aus Ebla", *OrAnt.* 22 (1983) 179-189; I. Gelb, "The Ancient Mesopotamian Ration System", *JNES* 24 (1965) 230-243; K. Butz, "Zur Terminologie der Viehwirtschaft in den Texten aus Ebla" in L. Cagni, ed., *La lingua di Ebla* (Naples 1981) 321-353; S. F. Monaco, "Parametri e qualificatori nei testi economici della terza dinastia di Ur: I. Parametri qualificatori numerici", *OrAnt.* 24 (1985) 17-44.

might serve as a starting point for a logical ordering of candidates for the earliest year notations.

6. Uruk herding texts.

As M. Green has shown in her article on the Uruk herding texts²⁰), archaic records divided consequently the herd into adult and juvenile animals. Thus in herds of sheep or goats the ewes ($u_8 \oplus$) and male sheep ($UDUNITA \oplus$), female and male goats ($UD_5 = \oplus$, $MAŠ_2 = \oplus$) were listed separate from the offspring KIR_{11} and $SILANITA$ (\oplus and \oplus) resp. $EŠGAR$ and $MAŠ$ (\oplus and \oplus). These juveniles, presumably born in the given administrative year, were subsumed under the heading N_{57+U_4} (\oplus), "(animals in their) first year" (Green, pp. 6-7). Uruk texts document the further use of the notation N_{57+U_4} , for instance W 20274,57 iii with the entry $3N_{14} N_{57+U_4} GURUŠ MUNUS$ (30 female slaves and $GURUŠ$ for one year?), W 20514,1 ii with $5N_1 N_{57+U_4} ZATU 718 E_2 AMAR$ (5 calves in the year for the ... household?) and W 20514,2 ii' with $N_1 N_{57+U_4} KU_6$ (one fish of/for? one year?, in the first year?; compare the lexical Fish List with entries $U_4 KU_6 / 2N_{57+U_4} KU_6$ (collated)²¹)).

The same system was obviously in use for Uruk swine²²). The unique Uruk swine list W 12139²³), for example, includes the signs

20) "Animal Husbandry at Uruk in the Archaic Period", JNES 39 (1980) 1-35.

21) R. Englund, Die Fischerei im archaischen Uruk (unp. Master's paper, Munich 1984) 33.

22) ATU 2, 146 + 79; both domestic and wild pigs (*Sus domesticus* resp. *scrofa*) have been identified for the archaic period from Uruk, cf. J. Boessneck et al., "Tierknochenfunde in Uruk-Warka", BagM 11 (1984) 176-178. The statement p. 176: "Die Schweine wurden wie überall bereits in jugendlichem Alter geschlachtet. Im Fundgut aus Uruk-Warka befindet sich kein einziger (sicherer) Hinweis auf ein voll ausgewachsenes Schwein" says little about the 3rd millennium since, ignoring for the moment the need of adult animals for purposes of breeding, from that period perhaps just two individuals were identified; written records make a lively pigherding through the Ur III period secure, with adult animals doubtless living into their fourth years.

23) The text—see the photo of the obv. in UVB 6, pl. 32e—was first connected with $UR =$ "dog" by A. Falkenstein, ATU 1, 45-46. I am able to recognize no merit in this identification, which has been repeated by H. Nissen in L. Cagni, La lingua 102 and M. Green, ATU 2 under $ŠUBUR$.

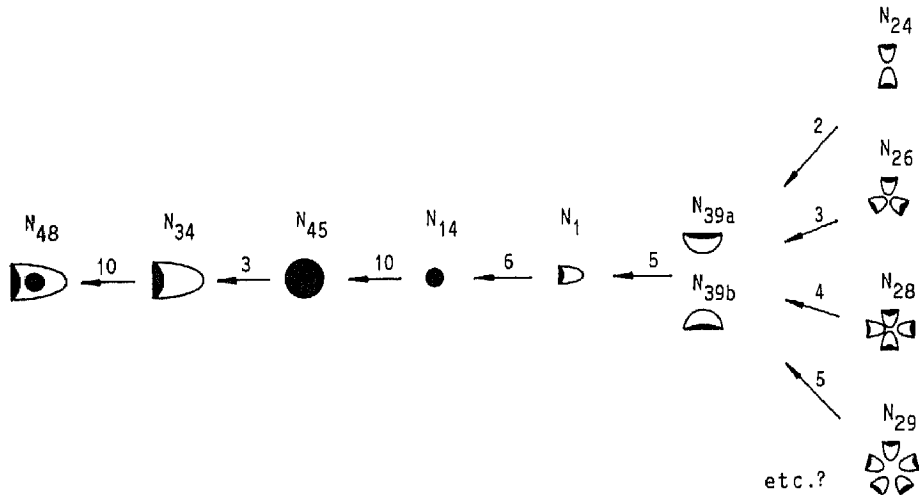
$N_{57} +$, $2N_{57} +$ and $3N_{57} + \text{šUBUR}$ (= šAH!; swine in their first, second and third year?), in exact correspondence to the piglets (ša₃.HI²⁴), one (mu.2) and two year old (mu.3) swine of the presargonic Girsu archive. The text W 23948 (A. Cavigneaux, UVB 33-34, forthcoming) offers moreover proof that šAH₂ (= šUBUR. gunu) were themselves kept in herds and administratively divided according to age exactly as in the sheep and goat herds. Here 66 adult animals form a herd together with 29 juveniles, called $N_{57} + \text{šAH}_2$ (the sign is in fact šubur of the Fara and later periods).

7. Cardinal time notations: Archaic fodder and ration texts.

What may be feed rations for domestic animals firmly establish the correctness of Vaiman's proposed system of archaic time notations. These probable feed notations seem to have recorded the grain expended on sheep, goats (together in summations qualified as UDU) and possibly calves (AMAR) over a given span of time, in some cases reducing more complicated figures into easily manipulated "feed-days", much the way Ur III scribes estimated their production as a total of workdays according to the formula (a guruš × b days) + (c guruš × d days) + (...) = (ab + cd + ..) (see pp. 128-129 and below, p. 153 to OECT 7, 84). To understand the grain notations in these

24) We have questioned in ATU 2, 156⁸⁰ the usual reading of ša₃.dug₃ with a translation "sweetheart", "gutherzig" (see A. Deimel, ŠL 384, 177; J. Bauer, AWL p. 193; I. Gelb in: M. Dandamayev et al., Festschrift Diakonoff, 85; M. Lambert, RA 46, 113: "nubile" certainly incorrect), since this age designation qualifies, beyond slave children, domestic animals: piglets, lambs and kids. The text DP 94 seems to be more specific in the use of age qualification, for instance obv. i1-3: la₂.a 1 ud₅ / 1 maš im.ma / 25 maš ša₃.HI "Arrears: 1 nanny, 1 male kid from last year, 25 male kids 'from this year'", in close correspondence to the qualifications in DP 243 of maš im.ma and maš mu.a.kam (male kids of the previous and of this year; cp. fn. 37 for im.ma). The Ur III use of the qualification ša₃.HI in the Drehem text AnOr. 7, Nr. 156 (2.02 ud₅ / 26 maš₂.nita / ... / 43 maš₂.ša₃.HI u₃.tu.da, "(of 122 nannies) born: 43 kids"; reference K. Butz) indicates that the meaning "in the first year" was retained for animals beyond the presargonic period.

ration texts, it is important first to be acquainted with the structure of the šE system discussed above (see ATU 2, 136-139).



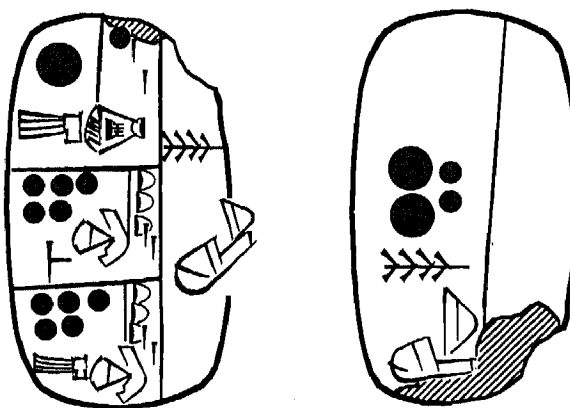
Archaic šE numbersign system

It is probable that the given diagram represents a systematization of the everyday use of a number of natural measures varying in size, that is below N_{39a} perhaps a mixture of vessels and baskets; N_{34} at the higher end of the diagram might be a quantity of grain kept in a small silo which, according to our calculations, ATU 2, 153-154⁶⁰, would hold approximately 4320 liters (see below, section 7 and fn. 32). N_{34} probably represented the largest archaic natural grain measure, since from N_{34} upwards the foreign sexagesimal system seems to have been used, including, in the related šE' system, the sign corresponding to the sexagesimal $N_{45} = 6N_{48}$. The strict sexagesimal progression above gur in grain systems of later cuneiform tradition, incidentally, led to this sign N_{45} (= Sumerian šar₂), which corresponded to the logogram for "silo", namely guru₇. That is, in later systems, the sexagesimal numbersigns led to, and not from, the largest natural grain measure.

The sexagesimal relationship $N_{14} = 10N_1$, in early work on the archaic texts ascribed incorrectly to the middle members of the

archaic ŠE system, gave rise to unnecessary speculation about a decimal substrate in archaic numeration (cf. ATU 2, 137 g). In 1978, the Swedish mathematician J. Friberg published the results of his analysis of a large number of archaic grain texts, demonstrating that in the šE system $N_{14} = 6$ (and not 10) $\times N_1$ ²⁵.

One consequence of Friberg's proof has been the decipherment of the sign TAR-a (𒊸) as in some cases an indicator of an administrative process involving adding 1/10 to a given quantity of grain²⁶). OECT 7, Nr. 103, for example, can only be understood as a list of grain notations, to each of which the addition of 1/10 is indicated with the sign TAR-a.



OECT 7, Nr. 103 (= Ashm. 1926. 630; copy 1:75, by P. Damerow)

25) The Early Roots of Babylonian Mathematics (originally: The Third Millennium Roots of Babylonian Mathematics) I: A Method for the Decipherment, through Mathematical and Metrological Analysis, of Proto-Sumerian and Proto-Elamite Semi-pictographic Inscriptions (CTU-GU Göteborg 1978). Since even very recent publications dealing with archaic—both Mesopotamian and Elamite—texts refer, in ignorance of this important work, to a decimal grain notation, it might stand being stressed again here (cp. ATU 2, 137⁺⁵⁵) that this relationship is not subject to doubt.

26) J. Friberg and I reached independently this conclusion. TAR-a, in ATU 2 together with two unrelated signs under TAR (all therein cited lexical attestations are TAR-a), could in fact be the cuneiform character corresponding to the sign N₂₄, both = 1/10 of N₁ in grain notations.

		Grain in units in N ₁	10 percent
Obv.i1	N ₄₅ / N ₁₄ TAR-a SANGA ŠITA.GUNU × N ₆	60	6
2	5N ₁₄ / 3N ₁ TAR-a ME NI + RU	30	3
3	5N ₁₄ / 3N ₁ TAR-a SANGA NI + RU	30	3
Obv.ii	ŠE GU ₇		
Rev.	2N ₄₅ .2N ₁₄ ŠE GU ₇	120	12

The subscripts to lines 1-3 list presumable officials of the Jemdet Nasr administration, who by rights of office have *received as rations* (no archaic attestation known to me speaks against an interpretation of the sign GU₇ as a human receiving the rationing/beveled-rim bowl NINDA) the recorded amounts of barley, the first official for instance something in the order of 1500 liters (see below, section 9) plus 10 percent. The purpose of the addition of 1/10 is obscure²⁷).

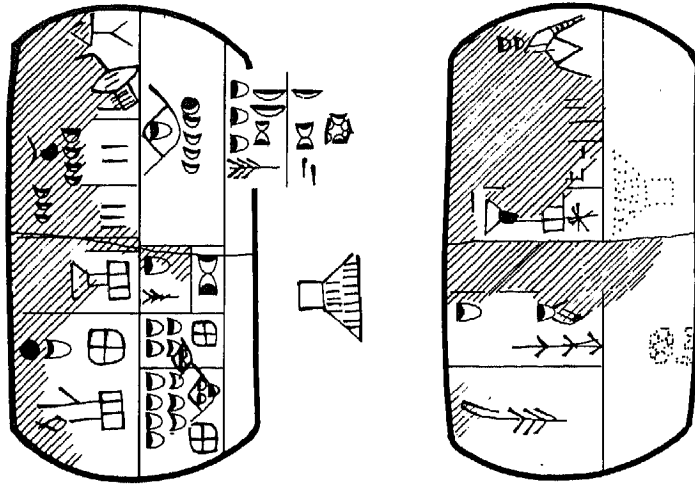
27) There may be a connection to the "sag bariga" of some Ur III accounts, for instance:

TRU 374:12-15 šU+NIGIN₂ 4.00 še gur together 240 kor barley
 sag ba.ri₂.ga 2.sila₃.ta the "head" of the barig: 2 sila each,
 še.bi 8 še gur barley involved: 8 kor,
 šU+NIGIN 4.08 še gur total: 248 kor barley

P. Steinkeller, ZA 69 (1979) 180¹² interprets this notation as indicating a kor measured with a (barig-) vessel of 62 sila, and seems to be following M. Powell, ZA 63 (1973) 103¹², who translates sag "the difference between a heavier and the standard norm". This interpretation however is likely not differentiated enough, as K. Veenhof in J.-M. Durand and J.-R. Kupper, eds., Festschrift Birot (Paris 1985) 294-297 implies, since a number of other texts record not only grain (e.g. NATN 578: 48;0,0 še gur / gur 1.02 (sic!, due to such notations as ... gur 1.15 sila₃.ta in MVN 4, 27-29, etc.) sila₃.GA.ta; BM 19959 [unpubl., courtesy M. Sigrist]: 10; 0,0 še gur.lugal / sag.bi 0;1,4 lugal) but also wool (e.g. R. Sweet, RIM 1, 23: 5 gu₂ siki.gir₂.gul / sag.bi 10 ma.na), to quantities of which a constant sag = 1/30 is added (2 sila₃ of barley, 2 ma.na of wool = 1/30 barig resp. gu₂). In grain notations other measures are possible, as Veenhof has shown, but the references known to me always employ a "sag" standing in a relationship to the measured quantity of 1:30, 1:20, 1:15 (e.g. BM 21091 [unpubl., courtesy M. Sigrist]: 41.26;2,0,4 sila₃ še gur.lugal / gur 1.04 sila₃.ta) and 1:5 (MVN 2, 359 cited Steinkeller, op.cit. 179). The text RTC 118 (28.40;0,0 še gur.A.ga.de₃^{ki} / sag.gur.bi 56;3,2 še gur) with a close approximation of sag = 1/30 (lines 4-5 should be read [2.00;0,0] še gur / [sag.g]ur.bi 4;0,0 še gur) might attest the same system in the Old Akkadian period; compare also the notations 3;1,3 gu₂.nida / ba-ba-at gur 0;0,1.ta / 3[3;0,0 glu₂.nida gur and 10;0,0 še gur / ri-wa-at gur 0;0,1.ta a-di₂

A similar entry is found in the text Ashm. 1927-62 (unpubl., courtesy of J.-P. Grégoire²⁸) with the notation N_{34} URU.IB.MA [] / $3N_{14}$ TAR-a, that is $180N_1 (= N_{34}) \times 1/10 = 18N_1 (= 3N_{14})$.

OECT 7, Nr. 84 brings the sign TAR-a into connection with time notations.



OECT 7, 84 (= Ashm. 1926, 586; presently IM 55582. Copy 2:1)

5.00;0,0 gur in B. Foster, ASJ 4, 43 obv. i9-ii1 and iii6-7, both of which clearly indicate some sort of administrative "adjustment" to quantities of grain at the rate of 1:30 (1 ban per gur; reference J. Friberg).

The Ur III $za_3.10$ (and $igi.10.gal_2$) = $1/10$ (for example in AUCT 1, 497; MVN 1, 241 ($igi.10.gal_2.bi$); T. Fish, Cat. Ryl. Lib. 741; N. Schneider, AnOr. 7, 164; MVN 6, 84 (= ITT 4, 7085; $za_3.10/5.bi$ ba.dab₅, said of sheep and goats) cited P. Steinkeller, JESHO 24, 140-141⁷⁵, etc., often with the standardized formula: so-and-so much delivered, $za_3.10/igi.10.gal_2.bi$ $ib_2.ta.zi/ba.dab_5$) was probably as a tax deducted from deliveries. For further references see E. Salonen, Über den Zehnten im alten Mesopotamien (= StOr. 43/4; Helsinki 1972) (Ur III pp. 17-18; M. Ellis, "Taxation in Mesopotamia", JCS 26 [1974] 211-250, is an extended treatment of the *Babylonian tax miksu*).

28) Grégoire has made available to the Uruk Project his new copies of the JN texts still housed in the Ashmolean Museum, Oxford, without which we would have in many cases been unable to decipher Langdon's copies. I have in the meantime been able to collate all Ashmolean texts cited herein; with the exception of OECT 7, Nr. 103, all Baghdad texts in March 1986, all Oxford texts in November 1987.

A reasonable reconstruction of the obverse is:

1a1	$[u_4 + N_{14} \cdot 8N_1]$ N_{57} 'TI GIR ₃ .gunu'	[18 days'] (rations) for the first (sheep? in the care of?) PN,
a2	$[u_4 + N_{14} \cdot 4N_8^1]$ $2N_{57}$	'14 days' ¹ (rations) for the second,
a3	$[u_4 +]3N_8$ $3N_{57}$	3 [days'] (rations) for the third:
b	$(u_4 \times N_1) + 5N_8^{29}$	(altogether) one month and 5 days,
c	$3N_1 \cdot 2N_{39a} \cdot N_{24}$ šE	(makes) 35 N_{24} .
d	$N_{39a} \cdot N_{24} \cdot N_{30}$ TAR-a	1/10 : 3 1/3 (!?) N_{24} ,
e	UNUG	(destined for?) Uruk.
2a	[] NAMEŠDA	[...] for the NAMEŠDA
b	N_1 šE	N_1 in grain,
c	N_{24}	(1/10 is?) N_{24} .
3a	$N_{14} \cdot N_1$ UDU PAP.BU.NAM ₂	11 sheep (for?) PN,
b1	$4N_1$ UDU $u_4 \times 2N_1$	(comprised of) 4 sheep (for?) two months
b2	$7N_1$ UDU $u_4 \times 3N_1$	and 7 (for?) 3 months.

What does this mean? My belief is that the necessity of converting rationing days into consumed grain, in this case recording three differing rationing periods (for sheep?) has obliged us with confirmation of the otherwise only formally surmised archaic time notations for the day and the month. It would be best to start with the final number-sign notation in line 1 to make this clear, which qualified by TAR-a must represent 1/10 of the foregoing notation. In fact $3N_1 \cdot 2N_{39a} \cdot N_{24} \times 1/10$ should result in $N_{39a} \cdot N_{24} \cdot N_{28}$ (i.e., $35N_{24} \times 1/10 = 3 \frac{1}{2} N_{24} = N_{39a} \cdot N_{24} \cdot N_{28}$), of which the given $N_{39a} \cdot N_{24} \cdot N_{30a}$ is at the least a good approximation ($N_{28} = 1/2$, $N_{30a} = 1/3 N_{24}$; this discrepancy might have resulted from the difficult calculation of 1/10 of $2N_{39a} \cdot N_{24}$: round off to $2N_{39a}$, $2N_{39a} \times 1/10 = 1/5 N_{39a} = N_{29} \cdot N_{29}$, unattested in JN, had finally to be expressed as either N_{28} or N_{30}). Assuming for the moment the preceding $(u_4 \times N_1) + 5N_8$ represents 1 30-day month plus 5 days and stands in a numerical relationship to the following grain quantity, one can propose the division

$$3N_1 \cdot 2N_{39a} \cdot N_{24} \div 35 \text{ days} = N_{24} \text{ per day,}$$

29) The first sign of $5N_8$ is: ●, that is, an N_{14} more deeply pressed into the clay at the bottom than at the top. Thus the sign is, leaving the computation aside, with high likelihood a clumsily impressed N_8 , as Langdon also copied it in OECT 7. Vaiman has apparently read his $(u_4 \times N_1) + N_{14} \cdot 4N_8$ from a photo, and has not observed the connection with the following grain notations.

which produces ‘‘nice numbers’’, if admittedly still hypothetical. It may or may not be coincidental that the sign N_{24} , representing the amount of grain necessarily disbursed daily for 35 days to result in the grain notation $3N_1.2N_{39a}.N_{24}$, is listed corresponding in an obscure fashion to N_1 in line 2; it can in any case be demonstrated in the following text OECT 7, Nr. 136 that N_{24} is indeed the daily ration meant. Albeit $1/10$ of N_1 in grain notations, N_{24} should, as OECT 7, Nr. 84 makes obvious, not be confused with the sign TAR-a. The point here is that each day recorded will have *corresponded* to one N_{24} of grain.

The first, damaged notations, very tentatively reconstructed in cases 1a1-a3, can well represent *subtotals* to 35 days. More problems of interpretation, however, arise: the addibility of time notations can be questioned, and the meaning of the strokes N_{57} needs to be discussed. The commentary below on the text OECT 7, Nr. 4 elucidates the first point; as to the second, the likely ordinal use of the signs N_{57} , $2N_{57}$ and $3N_{57}$ has already been advanced in ATU 2, 145. It is evident from ATU 1, Nr. 621, moreover, that these strokes can also have ordinal meaning when used in the compositum XN_{57+U_4} (for the xth year?; see below, section 7). Thus the first, second and third rationing periods, representing together a period of 35 days, required 35 N_{24} ($= 3N_1.2N_{39a}.N_{24}$) of grain, to which was appended $1/10$ for unclear reasons. The connection of this computation with the following notations for 11 sheep is equally obscure, however two further archaic texts show that sheep were recorded together in similar contexts with time notations and thereby suggest that section 1 of text 84 might have documented a feeding schedule.

The first text OECT 7, Nr. 31 (//Ashm. 1924, 1246 = S. Langdon, JRAS 1931, 832 Nr. 2) Obv.³ ii3 contains the notation: N_1 UDU $U_4+N_{14}.5N_8$ GAL.[šAB] (collated; one sheep for the GAL.šAB for 15 days?).

The important second text OECT 7, Nr. 4 demonstrates (according to collation) both the close connection between sheep, grain and time notations as well as the addibility of time notations. There we have in obv. ii the following

1a) $u_4 \times N_{14} \cdot 8N_1$ $u_4 \times 6N_1$ $3N_{14}$ $[u_4 \times N_{14} \cdot 2N_1]$ $[6N_{14} \dots]$	18 months (comprised of) 6 months: 18 grain units N_1 [and 12 months: [36 grain units $N_1 \dots]$ 54 grain units N_1 []]
b) $9N_{14}$ [] 2a) $u_4 \times 3N_{14} \cdot 2N_1$ $u_4 \times 2N_{14}$ $4N_{14} \text{ uDU}$ $u_4 \times N_{14} \cdot 2N_1$ $2N_{14} \cdot 4N_1$	32 months (comprised of) 20 months: 40 sheep and 12 months: 24 (sheep) 64 sheep ...
b) $N_{34} \cdot 4N_1$ [GI uDU]	

The second case shows that the notations for 20 and 12 months have been added together; one could posit that a herd of 40 animals has been reduced to 24 after 20 months, in which case the possible total of sheep in i3: $2N_{34} \cdot N_{14} \cdot 5[+ ?]N_1 \text{ uDU}$, i.e. $135[+]$ sheep, in no apparent relationship to the sum of 64 sheep (note the relationship of 2 sheep per month), would be difficult to explain. A likelier explanation would have to do with a mixed notation of "feed-days"³⁰. No parallel to these notations can be cited from the unpublished Uruk corpus.

The constant correspondence of the grain measure N_{24} to $u_4 + N_8 =$ one day is not a seldom occurrence in the archaic sources. OECT 7, 92-93 (one tablet), for instance, with the notation:

$u_4 \times N_{14} \cdot 8N_1 / [2 +]7N_{14}$ 18 months (at N_{24} per day =) $9 N_{14}$ units of grain,

(itself followed by $N_{34} \cdot 2N_1 [+]$ [UDU], $62[+]$ sheep) and possibly ATU 1, Nr. 633 rev. with the notation:

$u_4 \times 2N_1 / N_{14} \text{ U}_4$ 2 months (at N_{24} per day =) $1 N_{14}$ of grain (?),

30) The question of "feed-day" consolidation is, incidentally, an important one, since this was an established practice in Ur III times. The texts discussed by K. Maekawa, "The Management of Fattened Sheep (udu-niga) in Ur III Girsu/Lagash", ASJ 5 (1983) 81-111 and 6 (1984) 55-63, for instance, demonstrate that in some cases daily counts of varying numbers of animals have been subsumed in monthly tallies, in others a constant number averaging below 100 has been multiplied by the "month-factor" 30 for a monthly total of feed days (see in particular ASJ 5, p. 83). The texts thus convert 60 sheep, each fattened daily with 2 sila (≈ 2 liters) of barley, into the notation $30.00 (= 1800) \text{ udu } 2 \text{ sila}_3$.

seem both to imply the use of N_{24} as a constant rationing quantity. Certainly for these and other notations based on the daily quantity N_{24} , scribes will have utilized simple timespan/grain measurement conversions of the type $u_4 + N_8 = N_{24}$ (one day is N_{24}), $u_4 \times N_1 = 3N_1$ (one month is $3N_1$), $u_4 \times 2N_1 = N_{14}$ (two months are N_{14}) and, as we shall see, $N_{57} + u_4 = 6N_{14}$ (one year is $6N_{14}$; see below, sec. 9).

The nature of the writing system in administrative context, namely as a simple memory aid in an increasingly complex bureaucracy, made optional the use of many signs when the meaning of a particular transaction was otherwise clear. The probable omission of the sign TAR-a in a text involving grain disbursements can be demonstrated in OECT 7, Nr. 2 (= 129; collated):

i	$4N_{14} \cdot 2N_1 \cdot 2N_{39a} u_4 \times 8N_1 \text{ \textcircled{S}E}$	264 N_{24} grain units, 8 months:
ii	$3N_1 \text{ ME}$	30 N_{24} grain units for PN_1 ,
	$5N_1 \text{ EN. PAP. DU}$	50 N_{24} grain units for PN_2 ,
	$3N_{14} \cdot 2N_{39a} \text{ \textcircled{S}E} \text{ 'MUD' } [\quad]$	184 N_{24} grain units for PN_3 .

with the conversion:

$$8 \times 30 \times N_{24} = 240 N_{24}$$

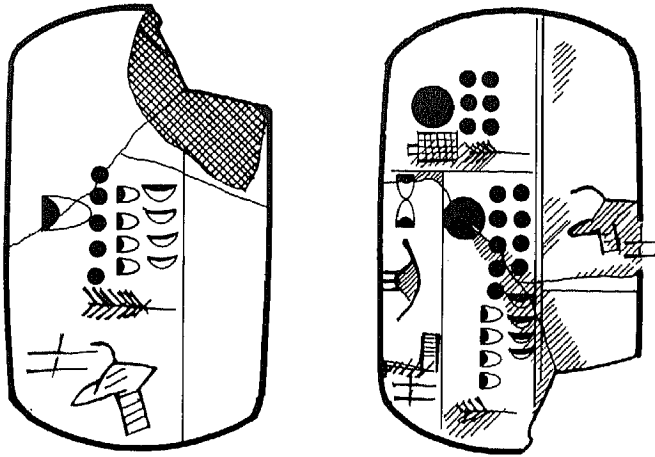
plus $1/10$ (TAR-a):

$$240 N_{24} \times 11/10 = 264 N_{24}.$$

The sum of 264 daily rations seems then to have been distributed among the three individuals named in col. ii.

This understood operation with TAR-a is involved in further texts from the archaic sources which exhibit the conversion of the compositum $XN_{57} + u_4$ into a grain measurement and demonstrate therewith the equation $N_{57} + u_4 = \text{"year"} = 360$ days. The collated copy of the first example OECT 7, Nr. 136³¹ deviates substantially from that of S. Langdon:

31) For their permission to collate and recopy OECT 7, Nrs. 84 and 136 my thanks to Drs. M. Damerji and B. Ismail of the Iraq Museum, Baghdad. Text Nr. 136 required substantial cleaning, which was facilitated by the fact that the JN texts were all baked by an ancient conflagration. It became apparent while working with the tablets that Langdon attempted no more than a summary surface cleaning, which resulted in many unnecessarily incomplete copies.



OECT 7, Nr. 136 (= Ashm. 1926, 589; presently IM 55596. Copy 2:1)

ii	$N_{45} \cdot 6N_{14}$ DUB ŠE	960 N_{24} grain units from the account (?),
2a	$N_{24} \cdot 3N_{57+U}$ EN.PA	3 years at N_{24} (per day) (for the official?) EN.PA
b	$N_{45} \cdot 9N_{14} \cdot 4N_1 \cdot 4N_{39a}$ ŠE	(totaling) 1188 N_{24} grain units
ii	PA.GIR ₃ -gunu ¹	(from?) PA.GIR ₃ -gunu
Rev.	$N_{34} \cdot 5N_{14} \cdot 4N_1 \cdot 4N_{39a}$	(altogether:) 2148 N_{24} units of grain
	ŠE PA.GIR ₃ -gunu	grain (from?) PA.GIR ₃ -gunu

Assuming a constant administrative year of 360 days, we can first reconstruct for line 2 the conversion:

$$3 \times 360 \times N_{24} = 1080 N_{24}.$$

The additional 108 in the subtotal must, the same as in OECT 7, Nr. 2, be an understood operation with the sign TAR-a, thus

$$1080 N_{24} \times 11/10 = 1188 N_{24}, \text{ or } N_{45} \cdot 9N_{14} \cdot 4N_1 \cdot 4N_{39a},$$

and finally both grain quantities of the obverse are added for the total on the reverse.

A second text from Jemdet Nasr with, similar to OECT 7, Nr. 2, the omission of both signs N_{24} and TAR-a, seems intimately connected with, possibly even the detailed account to Nr. 136 presented above. The document OECT 7, Nr. 24 (collated) contains on the reverse the following notations:

$N_{45}.9N_{14}.4N_1.4N_{39a} 3N_{57+U_4}$ ŠE GI AB NI+RU
PA.GIR₃.gunu / EN.PA BAD+DIŠ.

Not only are the same officials involved, but the same equation obtains:

$$3 \times 360 (\times N_{24}) = 1080 N_{24}; 1080 N_{24} \times 11/10 = 1188 N_{24}.$$

Two similar texts drawn to my attention by J. Friberg (personal communication) demonstrate the use of the grain quantity N_{39} ($= 2N_{24}$) as a probable rationing unit corresponding to one day. The first, OECT 7, Nr. 134 (collated) contains on the reverse (?). col. i the notation

$N_{34}.9N_{14}.3N_1.3N_{39a}$ NIGIN₂ $3N_{57+U_4}$ 1188 N_{39} grain units, total of 3 years,
GI+GI PA.GIR₃.gunu AMAR+N₂ ... (from?) PA.GIR₃.gunu (for the?) AMAR+N₂
(... calves?),

that is

$$3 \times 360 (\times N_{39}) = 1080 N_{39}; 1080 N_{39} \times 11/10 = 1188N_{39}.$$

This "total" (NIGIN₂) amount of grain is then, in parallel fashion to OECT 7, Nr. 2, divided into three lots recorded in column ii, expecting $[9N_{14}.2N_1] + N_{45} + 2N_{45}.N_1.3N_{39a}$. Of unclear purpose is the time notation $U_4 \times 4 [+4 ?]N_1$ qualifying the first lot; no meaningful arithmetical relationship between the probable notation for 8 months and the necessary reconstruction of $9N_{14}.2N_1 = 280 N_{39}$ is apparent, there may however have been more information than a simple grain notation in the corner broken away, since the case itself is divided into two sub-cases.

The same person PA.GIR₃.gunu, whom we have also seen in the text OECT 7, Nr. 136, seems responsible for a transfer of grain rations in the second text OECT 7, 32 + 187 (= 128; collated). The very involved grain/time notations of its reverse (?)

$N_{37}.2N_{47}.2N_{20}$ (?) ŠE 4N_{57+U₄} AMAR 1560 N_{39} grain units, 4 years, (for the?) AMAR

and

$2N_{34}.N_{45}.8N_{14}$ ŠE 6N_{57+U₄} [] 2340 N_{39} grain units, 6 years, [...]

exhibit, it seems, an increase of the daily grain unit N_{39} over a period of 4 and 6 years not by the usual factor of $1/10$, but rather by $1/12$:

$$4 \times 360 (\times N_{39}) = 1440 N_{39}; 1440 N_{39} \times 13/12 = 1560 N_{39} \text{ (expressed in } \check{S}^*, \text{ cf. ATU 2, pp. 140-141); } 6 \times 360 (\times N_{39}) = 2160 N_{39}; 2160 N_{39} \times 13/12 = 2340 N_{39}.$$

I am at a loss to explain this deviation from the normative addition of $1/10$, which in grain notations corresponded to N_{24} of N_1 , since $1/12$ would not have this tabular correspondence in calculations of grain quantities. Concern for an unattested intercalation, i.e. 12 plus 1 month = $13/12$ year, must remain idle until we better understand the purpose of these long "rationing" periods altogether, and in particular until some reasonable explanation can be given connecting the notations on the "obverse" with those on the "reverse" of the two texts OECT 7, Nrs. 134 and 32+. The obverse in both cases lists in standardized fashion quantities of realia (grain in \check{S}^* and \check{S}' , sheep and so on) followed by possible time notations given in a system different from that discussed here (perhaps notations of rationing periods, cf. fn. 10). Neither these assumed time notations nor the given grain quantities evidence an arithmetical relationship with the time/grain notations on the "reverse", nor is, in the case of Nr. 32+, the division of the preserved first section of the reverse amenable to plausible explanation. There, the scribe has perhaps divided the total $N_{37}.2N_{47}.2N_{20}$ into 5 lots of grain recorded in both the \check{S} and \check{S}^* systems ($5N_{14} + 5N_1 + 3N_{20}.3N_5.2N_{42a}.N_{25} + 3N_{14} + N_{34}.9N_{14}.3N_1.2N_{39a}.N_{24}$), excluding from the count the quantity recorded in \check{S}' ($7N_{19}.N_4$).

Are we able to say anything about the absolute size of the measures N_{24} and N_{39} ? P. Damerow and I have proposed in ATU 2, using an unpublished study by H. Nissen on the size of the Uruk period beveled-rim bowls, the correspondence of N_1 in grain notations to the later barig, in the Uruk period with a capacity of ca. 24 liters. Thus N_{24} of this quantity would be ca. 2.4 liters, which can be compared with sheep fattening rations in the presargonic Lagaš texts of 1 sila₃ (see fn. 16), in the Ur III period ranging from 1-2 sila₃ per

day; N_{39} would be twice as large, ca. 4.8 liters³²). Should the time/grain notations discussed here in fact represent archaic feed or rationing schedules, and in the case of livestock feed the herder/fattener's rations could have been included, then we might have another indication for the general range of absolute values offered in ATU 2.

8. Ordinal time notations: Rations.

A number of texts give clear witness to the ordinal use of time notations for days and years, surprisingly not for months. All are closely tied to rations, primarily in grain and grain products.

The ordinal nature of the time notations in the texts OECT 7, Nrs. 40 and 94 seems quite clear, judging from the uniform quantities of textile products (?) and dried fruits in the first text, of grain rations or products in the second. The first two columns of Nr. 94, for instance, record the disbursement of amounts of grain to two officials (?) during days one and two of a five day period:

32) See ATU 2, 153-154⁶⁰. The hypothetical equation of N_1 with the later sila, made by M. Powell in AfO 31 (1984) 60-62⁺⁸⁵⁻⁸⁸, is to be rejected. Particularly since A. Falkenstein's analysis of the text IM 23426 in OLZ 40 (1937) 402-406, it has been clear that the unit Powell calls E (= N_{39}) was divided into at least 6 parts; Friberg in ERBM, cited fn. 85, referred to the proto-elamite division of E into 12 parts. Further, the $geme_2$ cited in fn. 87 (correct to PI 10) are likely plural "female and male slaves" (reading SAL+KUR); the time span of their assumed "rations" would, in any case, tell us little about the size of those rations. The slaves will have received, as in later periods the workers, only enough to keep this work force alive and producing. Draft and fattening livestock required and were allotted substantially more. Cf. K. Mackawa, ASJ 5, 81-111; 6, 55-63 and the exhaustive footnote dealing with livestock feeding rations in the 3rd millennium by Powell, op. cit., 51-52⁶⁵. ITT 3. 6415 exemplifies the sort of texts which seem to record—as a didactical handbook?—the daily feed schedules of a number of various animals probably being fattened for offerings, beginning with sheep at 1 1/2 resp. 1 sila, down through $u_5^{mušen}$ (?) with 2/3 sila, uz.tur (ducks) with 1/2 resp. 1/3 sila and ending with 17 rodents ($PEŠ_2$), each receiving 1/15 sila (= 4 gin₂). The text TEL 95 exemplifies the real usage of these schedules: it records the fattening, together with a variety of other animals listed in ITT 3, 6415, of 129 $PEŠ_2.gi^3 gi$ = Akk. ušummu (this rodent, probably the bandicoot rat, *Nesokia indica*, is well known as a delicacy in later periods), as well as the total grain expended by this temple stockyard in one month.

Obv. i 1	5N ₁ ¹	ZATU659	5 units of the "grain product" ZATU659
	2 N ₁ .N ₈	N _{39a}	1 1/2 units of N _{39a}
	3 N ₁	N ₂₄	1 unit of N ₂₄
	4	ZATU651+NINDA	(responsible?:)...
		3N ₅₇ A IB	
		U ₄ +N ₈	First day.
ii 1	5N ₁	ZATU659	5 units of ZATU659
	N ₁	N ₂₄	1 unit of N ₂₄
	5N ₁	5N ₅₇ + NINDA	5 units of NINDA
		GABURRA EN	...
		UR BA NUN	
		U ₄ +2N ₈	Second day

and so forth with the notations U_4+3N_8 , U_4+4N_8 and U_4+5N_8 following comparable quantities of (bisexagesimally counted) grain units (cf. ATU 2, 132-134; 138). The *natura* are totaled on the reverse (excluding the first column of the reverse!), so

$$\begin{aligned}
 5N_1 + 5N_1 + 5N_1 + N_{14}.5N_1 + N_{14} &= 4N_{14} \text{ ZATU659 (40 units of ZATU659),} \\
 N_1.N_8 + 3N_1 + 2N_1 &= 6N_1.N_8 \text{ N}_{39a} \text{ (6 1/2 units of N}_{39a}\text{),} \\
 5N_1 + 4N_{14} + 2N_{14} &= N_{34}.5N_1 \text{ NINDA (65 units of NINDA),}
 \end{aligned}$$

further:

$$6N_1.N_8 \text{ (N}_{39a}\text{)} + 8N_1 \text{ (ZATU726)} + N_{34}.5N_1 \text{ (NINDA)} = N_{34}.N_{14}.9N_1.N_8 \text{ NINDA (79 1/2 units of NINDA).}$$

This final addition remains an enigma, since it would be difficult to imagine a purpose in subsuming different grain quantities (NINDA as a *standard mass*, i.e. when it does not qualify, as in summations, all "rationing" quantities, seems to have been 1/6th the size of N_{39a}; the size of ZATU726 has not been ascertained). The same problem obtains for other texts which total units of various grain quantities in a bisexagesimal notation, for example ATU 1, Nrs. 307 and 334. It might be that in the administrative system the number of *rations* were to be recorded, possibly as a bookkeeping check against the more important final grain quantity disbursed.

J. Friberg has suggested in *Scientific American* 250/2 (February, 1984) 111 that the period recorded in OECT 7, Nr. 94 represented a week of 5 days; considering however that the only other parallel text Nr. 40 records in like fashion a period of 4 days, and that a reasonable reconstruction of the absolute measures of the ŠE system would, if at

all, favor a week of 6 days (corresponding to the sign $N_{39} = 6N_{30}$; see below), this proposal cannot be sustained.

Two texts from Uqair (?)³³) contain in parallel fashion ordinal notations for years, indeed, both texts record a period of eight years, and both arrive at the same "sum" of 660 of the units N_1 .


ATU 1, Nr. 621	Nr. 627
Obv. i $2N_{45}.6N_{14} \text{ \textcircled{E}} \dots N_{57+U_4}$	i $2N_{45}.8N_{14} \dots N_{57+U_4}$
$2N_{19}$	
$N_{14} \dots$	
$N_{45}.9N_{14} \dots 2N_{57+U_4}$	$N_{45}.7N_{14}^1 [\dots 2N_{57+U_4}]$
$N_{45}.5N_{14} \dots 3N_{57+U_4}$	$[\dots] + N_{14} [\dots 3N_{57+U_4}]$
$8N_{14} \dots$	
$4N_{14} [+ \dots]$	
[$\dots 4N_{57+U_4}$]	$8N_{14} [\dots 4N_{57+U_4}]$
ii $6N_{14} \dots 5N_{57+U_4}$	$5N_{14} [\dots 5N_{57+U_4}]$
$8N_{14} \dots 6N_{57+U_4}$	$7N_{14}^1 \dots [6N_{57+U_4}]$
$7N_{19} \dots 7N_{57+U_4}$	ii $N_{45}.6N_{19} \dots 7N_{57+U_4}$
$2N_{45}.N_{14} \dots 8N_{57+U_4}$	$9N_{14} \dots 8N_{57}$
Rev. $3N_{34}.2N_{45} \dots 8N_{57+U_4} \text{ \textcircled{E}} GU_7$	$3N_{34}.2N_{45} \text{ \textcircled{E}} \dots$

Although difficulties remain with the calculations, it's quite clear from the size of the grain quantities that the entries of the obverse were totaled on the reverse of the tablets, therefore that the separate entries qualified with $1-8N_{57+U_4}$ recorded amounts from separate years. On the basis of two parallel texts, any judgment about the meaning of an eight-year period would carry little conviction.

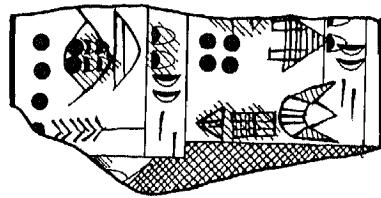
9. Daily NINDA.

A final important point speaks in favor of the correctness of Vaiman's proposed time notation system: the grain numbersign system itself seems to imply a division of the month into 30 days. As we have suggested in ATU 2, 153-154⁶⁰, following a belief held by H. Nissen for some years, the Uruk period beveled-rim bowl with an average

³³) J. Friberg, ERBM II, 10-11, tentatively ascribed the texts ATU 1, Nrs. 621-656 (purchased by the Berlin Museum in 1903) to Uqair on the basis of script and format. The view has been repeated by M. Green, ASJ 8 (1986) 78, who cites the subscript $KU_6.RAD.UR_2$ as common to both the ATU texts and the tablets from Uqair excavations published by F. Safar, JNES 2 (1943) 155-158 + pls. XXX-XXXI.

capacity of 0.8 liter apparently served as the model for the pictogram GAR = NINDA and represented in general one day's grain ration. This sign NINDA, aside from its general usage in summations, usually indicated a specific quantity of grain. The key text for the understanding of the archaic ŠE system, IM 23426 (J. Friberg, ERBM II, 33-43), allows the determination of this quantity, it being 1/6 of the quantity represented by N₃₉, itself known by summations to be 1/5 N₁. That is, NINDA represented a grain quantity equal to the sign N₃₀ = , or 1/30 N₁.

ATU 1, Nr. 653 (provenience: Uqair?; the join "ohne Anschluß" with Nr. 651, posited in ATU 1, p. 4³, could not be confirmed) can represent the link between the sign NINDA and the proposed archaic feed texts discussed above:



ATU 1, Nr. 653 (= VAT 5307. Copy 2:1)

1a	$4N_{14} \text{ ŠE } U_4 \times 2N_{14} \cdot 4N_1 \text{ NINDA}$	720 N ₃₀ grain units in 24 months: NINDA(-rations)
b	$2N_1 \cdot 2N_{39a} \text{ TAR-a}$	72 N ₃₀ units are 1/10
2a	$4N_{14} \text{ GA } \times [\quad]$	720 N ₃₀ grain units, GA ...
b	$2N_1 \cdot 2N_{39a} \text{ TAR-a}$	72 N ₃₀ units are 1/10
c	[SU E ₂] ŠAGAN	(for?) PN.

We thus have an apparent rationing quantity NINDA = 1/30th of the basic unit N₁:
















$$24 \text{ months} \times 30 \text{ days} \times N_{30} = 720 N_{30} (= 4N_{14}),$$

to which in like manner to the feed/rationing texts 1/10 (TAR-a) is added:

$$720 N_{30} \times 1/10 = 72 N_{30} (= 2N_1 \cdot 2N_{39a}).$$

In contrast however to the "feed texts", ATU 1, Nr. 653 might remain an exceptional document, since NINDA in most cases seems itself to represent one "ration day", thus making any further time notation superfluous; in labor rationing context, the sign N_1 stood for $U_4 \times N_1 =$ one month, the unit basic to rationing systems in all subsequent periods. A further pursuit of this line of thought of course ends with the problem of $N_{14} = 6$ months, for which I have no reasonable explanation, but must just the same note that a six-month period makes better sense than, say, a period of ten months.

It will be helpful in further work on these archaic rationing schedules to refer to the following table of time/grain correspondences for the three grain units discussed, NINDA, $N_{24} (= 3 \times \text{NINDA})$ and $N_{39} (= 2 \times N_{24})$:

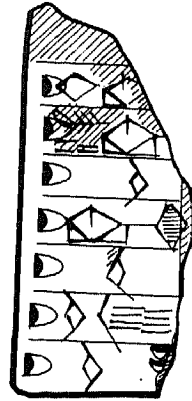
U_4 ŠE			
			
			
			

10. Divisions of the day.


We have seen that the archaic sources offer correspondences to later periods in notations of the units day, month and year. What does the schema look like going in the other direction, namely in divisions of the day? Although no known administrative texts attest to this further division, the so-called "Uruk Plant List"³⁴) seems to include in its

³⁴) Cp. the list SF 7, vi19-23 ($7 \times U_4?$), 24 ($U_4 \cdot U_4$) and 25-27 ($U_4 \times N_1 \dots$) (unclear). With completion and publication in 1987 of the revised Uruk Signlist (ATU 2), one should expect publication of all Uruk lexical lists in 1988. I follow


section on likely time notations the division of the day into smaller units (Archaic: A = W 20363; Early Dynastic: A = NTSSŠ 123; B = SF 58; C = OIP 99, Nr. 301):





W 20363





Archaic	Early Dynastic	
11) Ai1' HI.I[M]	Aiii11' HI.IM+A	?
12) Ai2' ¹ GI.5N ₅₇ ²¹ .IM	Bi11 HI.IM+A	
13) Ai3' u ₄	Bi12 HI.15.IM+A ³⁵)	?
14) Ai4' IM.KI	Bi13 u ₄ .u ₄ .IM+A	morning
15) Ai5' SIG	Bi14 IM+A.  ³⁶)	midday(?)
	Bi15 u ₄ .sig.IM+A	evening

in partitur and translation of lines 11-16 M. Green's preliminary edition of the list, certain ED witnesses of which were first discussed by M. Civil and R. Biggs, RA 60 (1966) 8-11.





35) The number "15" (here written with cuneiform characters: , in the same text day divisions written with the rounded end of the stylus) is as a standardized time notation otherwise only attested in the Ur III usage e₂.u₄.15 "(house?) of the 15th (of the month)", referring presumably to the full moon. I do not understand the badly damaged and uncertain archaic correspondence 5N₅₇².

36) The sign is a KI without the horizontal strokes, which form seems to signify a commodity in the archaic text LAK p. 73 Nr. 2 obv. ii4 (N₃₄ KI.nutillu; colated). I do not have access to an Ur III recension of lines 11-16 of the list (6 N-T 933) to be published by M. Civil; M. Green transliterates from photo line 14: KI.u₄.im, which would suggest a reading ki_x. One might also consider two other possibilities: a reading sur_x (sur = "to separate, divide"; cf. Civil, OrAnt. 21 [1982] 8-11) on the basis of OIP 99, 83 viii11'; ^dAš₂.šur_x (; defective  of the "Aššur treaty" col. ii and passim); or a reading sa_x, for which cp. H. Steible, FAOS 5 II, 155⁸⁹ to Urk. 4,11:5 = 5, 10:5 (u₄.sa₂ = u₄.sa_g/sa.am₃, mišil ūim "midday"?).

16)	Ai6'	u ₄ .G1 ₆	Bi16	gi ₆ .IM+A.N1 (= zal?)	day and night
17)	Ai7'	u ₄ 2N ₈ ^{sic}	Bi17	u ₄ .IM+A 3N ₈	day: 2 (3 parts)
18)		[G1 ₆ 2N ₈]	Bi18	gi ₆ .IM+A 3N ₈	night: [2] (3 parts)
			Cii1	gi ₆ 3N ₈	
19)		[u ₄ .G1 ₆ 4N ₈]	Bi19	u ₄ .IM+A.gi ₆ .6N ₁ ^{sic}	[day and night: 4] (6 parts)
			Cii2	u ₄ .gi ₆ 6N ₈ ^{sic}	
20)		[IM-a?]	Bi20	IM+A	parts.
			Cii3	IM+A	

One can see alone from this truncated section that the "Plant list" will prove to be of some lexicological interest. The meaning of the signs IM ( with its variant ) and IM+A ( = ni₂?) for instance, both possible representations of a sail (or a "weather vane"?) with and without the addition of the water(-way) sign A, should come under particular scrutiny. While due caution is well rewarded in ad hoc sign identification, still experience in coastal regions draws attention to the timely regularity of wind directions there; less likely seems a possible connection of the sign with a time-measuring device³⁷). Also, the usage of u₄ () and its inversum sig

37) The "south" and "north" winds (lines 25-26 of the same list) are written IM.U₅ resp. IM.MTR in ED witnesses A and B, IM+A.U₅ resp. IM+A.MTR in the source OIP 99, 23 + 24 ii'5'-6'. A Deimel, ŠL 399, identified the sign IM as a depiction of a sail. For an appraisal of wind directions in antiquity, derived primarily from architecture and later, historical sources, see J. Neumann, "The Winds in the World of Ancient Mesopotamian Civilizations", *Bulletin of the American Meteorological Society* 58 (1977) 1050-1055. To be dismissed is the claim of H. and J. Lewy, *HUCA* 17, 5-6, that the oriental day was not based on observation of the sun at all, but according to the diurnal winds prevalent in coastal Iraq.

A connection of IM with the later usage of im(.ma) (presargonic Lagash and later; Akkadian šaddaqqdi/a(m) with lexical equivalent MU.IM.MA [MSL 5, 65:195]), meaning "previous (year)" is not apparent. For the latter usage cf. particularly DP 280 (= 281), a presargonic temple document which "loads onto the backs" (gu₂.ne.ne.a e.ne.gar) of the fisheries foremen Ne.sag and Lugal.ša₃.la₂.tuku the quota arrears of im.im.ma.kam , im.ma.kam  and mu.a.kam , that is of the year before last = year one (of the king Urukagina [second regnal year]), of last year = year 2 and of this year = year 3. Also DP 243: goats of various colors / maš im.ma.kam / ditto / maš mu.a.kam and DP 94: maš im.ma as delivery arrears noted after grown nannies (ud₅) and before maš ša₃.n1 (//mu.a.kam, "of the current year"), further maš im.ma = maš.gal.gal in the summation rev. i2 (see footnote 17 to the notations of the type ). A parallel usage is found in the Old Akkadian text ITT 2/1, 3078 obv. 1-4: 3 1/2 ma.na siki / [i]m.ma.kam / 1 gu₂ la₂.4 ma.na siki / mu.a.kam. It would seem difficult to reconcile this clear usage im = "previous year" with the often translated im = "account tablet" (im = clay)

(ϕ), both in administrative time notations³⁸) as well as together with AN.MUŠ₃ (presumably ^dInanna)³⁹) in similar contexts, lends support to an antonymy “morning/evening” already in the earliest texts.

However of apposite interest to the present discussion are in particular the lines 17-19. I am convinced that the Fara witnesses document the division of day and night into three parts each, altogether six. A correspondence to the Old Babylonian division of the night into 3 watches (maššartu)⁴⁰) should be considered probable, although

of Ur III accounts. la₂+ni su.ga im.ma.ta (for example TUT 28 rev. iv4, see G. Pettinato, *Studi per il Vocabolario Sumerico* 1/3 [Rome 1985] 203) might better be translated “from the restored arrears of the previous year”, in conformity with A. Deimel, *ŠL* 399, 165.

38) For instance the text W 20274, 1 (s. H. Nissen, *World Archaeology* 17 [1986] 322; ATU 2, p. 81, pl. 18) contains the summation col.i: N₄₈.4N₃₄ U₄ GIŠ.tenu.KAR + 9N₃₄ SIG GIŠ.tenu.KAR = 2N₄₈.3N₃₄ UDU SANGA SUKKAL SAR-a PAP ŠURUPPAG HI.E₂.NUN, that is: “840 (sheep inspected(?)) in the morning ..., 540 (sheep inspected (?)) in the evening ...; altogether 1380 sheep (inspected by) the exchequer (?; SANGA) ...”.

39) A. Falkenstein has in ATU 1, p. 48³ already drawn attention to this parallel usage, referring to the texts ATU 1, Nr. 602 iii (^dINANNA + BABBAR “(zum) Aufgang der Venus”) and Nr. 606 Rev. 2 (^dINANNA + ŠU₂+ŠU₂ (= SIG) “(zum) Untergang der Venus”). I would propose a translation of simply “(offerings) for the morning and evening Venus (star)”. This usage of U₄//SIG is well attested in the unpublished Uruk texts with ca. 20 references from 15 texts, for example W 20274,77 with i1: EZEN ^dINANNA.SIG and i4: EZEN INANNA^{sic}.U₄ (“... for the festival(?) of the evening/morning Venus”) and W 21671 with i3: EZEN ^dINANNA.U₄, ii1: EZEN ^dINANNA.SIG and ii9: EZEN ^dINANNA.U₄, to mention but those texts including at once both notations. Cf. also Gudea Cyl. A xix1-2: uru.ni ki.Lagaš^{ki}.e sig.zal.a / U₄ mu.ti.ni.ib₂.zal.e, “His city, the region of Lagash, the evening spent, spends the day with him”.

40) “Watch” is the literal translation of maššartu, maprast- form from the verb našāru “to guard (over)”, doubtless originally nomen loci, i.e. guard tower or the like. The term is from the Old Babylonian period on attested for the span of four hours, so in W. Lambert and A. Millard, *Atra-hasis: The Babylonian Story of the Flood* (Oxford 1969) 46 I 70, 72 (mišil maššarti, “the middle of the (night) watch”); VAS 16, 186:7 (mūšum šalušti maššarti, “the night’s third watch”). The term danna (KASKAL.GID₂) equal to 1/2 “watch” or one double hour in the 1st millennium, is well attested in sources from Old Akkadian and Ur III archives, however always as a measure of distance. The texts ASM 12080 (P. Micholowski, *OrAnt.* 16 [1977] 292-293) and M. Sigris, *Andrews University Cuneiform Texts* 2 (forthcoming) 307 establish the use of a barge rental rate in the Ur III period of 1 sila₃ barley per loaded gur per danna, i.e. a barge transporting 20 gur of barley over a distance of 20 danna would result in a rental fee of 20 × 20 = 400

I know of no clear attestation to this division of the day from the 600 year span between the Fara and Old Babylonian periods.

The collated final line of W 20363 imposes the reconstruction offered of an *archaic* division of the 24-hour day into four six-hour periods.

11. Ur III sexagesimal workday division.

A further administrative division of the day is not evidenced from notations in the archaic texts⁴¹), nor should such a time division be reasonably expected to have arisen out of a milieu not attendant on strict schedules. There were however other means which could have led to an artificial sub-unit of the day, of which labor management during the Ur III period offers very instructive examples. There, a workday (= gurus/geme₂ u₄.1.še₃) consisting perhaps of, on

sil₃ = 1:1,4 še gur. A similar text Sigris, AUCT 1 (Berrien Springs, Michigan, 1984), 386, 4-6: Nibru^{ki}.ta / Uri^{ki}.še₃ / kaskal.bi 15 da.na, "From Nippur to Ur, distance involved: 15 danna" is an appealing confirmation of Šulgi Hymn A 76: (the route between Ur and Nippur) kaskal.15.danna.am₃ šu hu.mu.nigin (partitur version, J. Klein, Three Šulgi Hymns [Ramat-Gan, Israel, 1981] p. 198; see id., "The Royal Hymns...", Trans. Am. Phil. Soc. 71/7 [1981] 17⁺⁶⁸); both texts inform us that, assuming the route was more or less direct (Nippur is situated ca. 160 km north of Ur), the danna (= 1800 ninda(n)) was a distance of ca. 10 2/3 km in the Ur III period, as later (160/15 = 10 2/3). For a survey of literary and further references to danna see K. Veenhof, "Babylonian Expressions for "over/at a Distance of ..." ..", JEOL 27 (1981-1982) 70-71. The later time unit danna is usually explained as the time spent marching between (see AHw under bī/ēru) two points a danna apart.

41) In an adventuresome article "Ein frühsumerisches Kalenderhaus in Uruk-Warka", BagM 9 (1978) 134-156 + pls. 75-79, R. Behm-Blancke and W. Hübner suggested that the Uruk IV period "Pfeilerhalle" was in fact a very sophisticated time recording device and that "Die Ungenauigkeit der damaligen [Uruk IVa] Zeitmessung dürfte etwa in dieser Größenordnung [ca. 15 minutes in modern time reckoning] gelegen haben" (p. 150). It would have been very gratifying to find helpful data from Uruk period architecture concerning the time question, however the authors have developed and used highly speculative computer models, the data for which itself had to be manipulated (exchange of problematic corner columns) to produce satisfying results.

average, 12 hours (sunrise to sunset)⁴²), was, first, divided into the usual fractions 5/6, 2/3, 1/2 and 1/3. Of these, 1/2 is the only fraction known to me to have served not only as an artificial, but also as a real division of the day in Ur III times: the text MVN 2, 15 refers explicitly to a workforce of 10 hired laborers working for a period of 6 1/2 days. The workday was further divided into the entirely artificial 60 gin₂. This division, unexceptional considering the standard usage of the shekel as a sexagesimal sub-unit in a number of Ur III metrological systems and already noted for “kal” (guruš) and “gim₃” (geme₂) by N. Schneider⁴³), is quite obvious from a large number of attestations, for instance:

42) The objection that the hot climate in Mesopotamia would preclude a 12 hour workday need not apply to Ur III standards, nor should one forget the large numbers of workers who are either explicitly or implicitly involved in reduced workloads. As is implied in TRU 379, to cite an extreme example, the guruš a₂.10.gin₂ (= 1/6) was expected to perform 1/6 of a workperiod, be it in fact a shortened day or, more likely, a five-day month. The text MVN 10, 196 (see fn. 45) implies that a group of ten guruš during a period of 12 months in this case were obliged to work not the given 3600 days (i1-3, ii10-12, iv1-2: 10 guruš iti.u₄.12.še₃ / a₂.(guruš).bi 1.00.00.kam / u₄.1.še₃) but rather just 1800 = 1/2. Such hidden performance reductions are often the cause of some confusion in workledger computations by modern scholars, but of course presented the archaic managers with no problems. Another source of some confusion has been the often only implicitly used quotas established to control and direct the productive capacity, and certainly often willingness, of the labor force. J.-P. Grégoire, *Getreideverarbeitungsanlagen* (Berlin, forthcoming), will discuss the production quotas set for Ur III labor units devoted to milling, cf. for example 1 ban of dabin flour per day attested in TCL 5, 5665 and 5669. I hope to discuss elsewhere the possibilities evidence for work quotas in other productive units present for a broader analysis of productivity and labor schedules amongst Ur III workers, including on the one hand such mundane quotas as 3 3/4 gin₂^{vol} = 1/16 volume šar of pise wall (im.du₈.a) to be erected per workday per guruš, attested in BM 20054 cited p. 178, BIN 5, 258, NATN 61 and probably UET 3, 1386 (cp. the OB mathematical exercise O. Neugebauer, MKT III, p. 30 obv. iii9 - rev. i7 with im.du₃.a = im.du₈.a and 3,45 (sahar) giš.gar₃ = guruš 1.e 3 2/3 gin₂ 15 še.ta), or the often mentioned quota of 10 gin₂^{vol} in excavation projects, on the other hand quotas which must have been set in a more esoteric fashion, such as the 15 workdays expended per gur capacity in barge construction (a barge of 30 gur capacity should be built with 450 workdays) attested in TCL 5, 5673 (MVN 2, 3 seems to record a quota of ca. 10 days per gur capacity).

43) KWU p. 132 c. F. Thureau-Dangin in *Osiris* 7 (1939) 111 has already stated that “the gin finally assumed the abstract sense of the “sixtieth part” of any unit

- 1) H. de Genouillac, Babyl. 8 (1924)
37-40:
to Pupil 21 Obv.1:
la₂ + NI 2.22.50 1/2 5 gin₂ guruš
u₄.1.še₃ arrears: 8570 1/2 workdays 5 shekels,
male workers.
- 2) RTC 305 obv. i2:
2.09.06 5/6 geme₂ u₄.1.še₃ 7746 5/6 workdays, female workers.
- 3) H. Waetzoldt, WO 6 (1970-71) 28 Nr.
1 iv1:
49.20 1/2 3 gin₂ guruš u₄.1.še₃ 2960 1/2 workdays 3 shekels, male
workers.
- 4) T. Gomi, Orient 16, Nr. 109 obv.1:
7.02 2/3 5 gin₂ guruš.1.še₃ 422 2/3 workdays 5 shekels, male workers.
- 5) TCL 5, 5676:
obv.ii šU+NIGIN₂ 2.31.08 10 gin₂ total: 9068 workdays 10 shekels, male
guruš.1.še₃ workers;
rev.xiii: šU+NIGIN₂ 2.33.22 1/3 guruš total: 9202 1/3 workdays, male workers;
u₄.1.še₃
diri 2.24 10 gin₂ guruš.1.še₃ surplus: 144 [correct: 134!] workdays 10
shekels, male workers.
- 6) L. Legrain, TRU 379:
1 guruš sag.dub 1 fulltime worker (?),
1 guruš a₂.1/2 1 halftime worker,
2 guruš a₂.10.gin₂ 2 10 shekel workers⁴⁴),

whatsoever", and refers loc.cit. fn. 42 to the use in RTC 306 iv4 of the gin₂ division in a further metrological system, namely of the bundles of harvested reed called sa.gi. There we apparently have 10 gin₂ = 1/6 sa.gi. The sa.gi itself was a standard quantity necessary to produce a KID-mat measuring ca. 1m × 1m, or 1/36 šar, to judge from the texts presented by A. Goetze, "Umma Texts Concerning Reed Mats", JCS 2 (1948) 165-202. See in particular such texts as TCL 5, 6036 rev. iii30-35, also cited by M. Civil, StOpp. 80, with the equation ki.la₂.bi (of 3 mash-cooling mats) 1/2 šar / gi.bi 18 sa, "weight" (= extent of material) involved: 1/2 šar (ca. 18m²), reed involved: 18 bundles". 6 sa.gi. = 1/6 šar were to be matted in one day, so that we can also expect in matting texts the conversion 1 sa.gi = 10 gin₂ or 1/6 workday.

44) TRU 379 is the only text known to me which explicitly records the category of a₂. "1/6" (written sexagesimally; see already T. Fish, MCS 3 [1953] 49). Notations of the sort known from UET 3, 1443 obv. 10 (11 10 gin₂ guruš gir₃.se₃.ga mar.sa.me) and 14 (27 10 gin₂ guruš lu₂.azlag₂ u₃ lu₂.gu.me) need not necessarily represent an addition of work categories including "a₂.1/6", since the common categories a₂.1/2 and a₂.2/3 added together would result in 1 + 10 gin₂ (cp. for example S. Kang, SACT 2, 71, with the addition 1.02 2/3 + 27 1/2 + 3 1/2 + 1.58 1/2 + 5 + 5 + 10 + 39 = 4.31 10 gin₂); texts like SET 274, 41-46, with the calculation (170 2/3 + (12 2/3 × 1/2) + 7 1/3) × 360 = 66,360 and HLC 2, pl. 54, Nr. 7, ii3-4 and 19-20 with the calculation (1 2/3) × (1/2) × (10 months) × (0;3,3 fish per month) = 5;4,1 fish, suggest that, in the final analysis, this a₂.10 gin₂ could have been the result of an artificial combination of the categories a₂.1/3 and a₂.1/2, i.e. that a₂.1/3 and a₂.1/2 might be members of two qualitatively differentiated labor

	1 5/6 guruš	(altogether:) 1 5/6 workers.
7) TCL 5, 5670 ii3-4:	31 10 gin ₂ geme ₂	31 workdays 10 shekels, female workers;
	u ₄ .1.še ₃	
	a ₂ .u ₄ .du ₈ .a geme ₂	du ₈ .a (compensatory) workday perfor-
	ba.BAD.a	mance of the female BAD worker.
8) MVN 10, 196 rev. ¹	i22-26; rev. ¹ ii27-30 ⁴⁵ ;	
Rev. ¹ i	31.04;30 ¹ (guruš u ₄ .1.še ₃)	1864 (workdays) 30 (shekels), (male
		workers)
	zi.ga.am ₃	deducted;
	30.00 guruš u ₄ .1.še ₃	1800 workdays, male workers,
	a ₂ .u ₄ .KU.a	KU.a (compensatory) workday per-
		formance,
	a ₂ .diri 1.04 1/2 guruš	performance surplus: 64 1/2 "workers";
Rev.ii	šU+NiGIN ₂ 30.00 ¶	total 1800 + (?; correct: 37.51 1/2 = 2271
		1/2)
	(guruš u ₄ .1.še ₃)	(workdays, male workers)
	zi.ga	deducted;
	30.00 guruš u ₄ .1.še ₃	1800 workdays, male workers,
	a ₂ guruš u ₄ .KU.a	KU.a (compensatory) workday
		performance, male workers,
	a ₂ .diri 7.51;30	performance surplus: 471 (workdays) 30
		(shekels).

Numbers 1-4 alone show that the gin₂ must be a unit smaller than 1/5 of 1/6 guruš u₄.1.še₃ (workday), combining the notations 5/6 u₄ and 5 gin₂; Nr. 5 allows of the equation 1/3 guruš u₄.1.še₃ - 10

systems (full and halftime (a₂. 1/2) workers on the one hand, full and 2/3, 1/2, 1/3 and 1/4 workload expectations on the other). Extant references to workers qualified sag.dub have been presented by M. Yoshikawa, ASJ 7 (1985) 191-192, who considers J.-P. Grégoire's translation (AAS, Glossary) "homme touchant le pleine salaire" a reflex from a primary meaning "(worker at the) head of the tablet".

45) Grégoire's obverse and reverse are to be exchanged. The additions are obv.¹ ii17 - rev.¹ i26: 30 (u₄) + 1.00 + 2.30 + 2.20 + 10 + 4.30 (a.ra₂ 1 in.nu gur; 1 gur = 1 u₄, i.e. the average worker should harvest one gur of in.nu (= straw?) per day) + 17.46 (a.ra₂ 2 etc.) + 1.07 1/2 (u₄, derived from 2.15 gu NiGIN gi.zi at the rate of 2 gu per worker per day) + 47 + 24 = 31.04;30^{sic} deducted (zi.ga); 30.00 are "a₂.u₄.KU.a"; (thus 1.00.00 - (31.04;30 + 30.00)) = 1.04 1/2^{sic} workdays beyond (diri) the quota. u₄.KU.a, here equal to 1/2 the expected workdays, is provisionally translated "offtime" (Freizeit) by H. Waetzoldt, "Die Situation der Frauen und Kinder anhand ihrer Einkommensverhältnisse", AoF (forthcoming). In rev. ii, the vertical wedge after 30.00 of the summation could indicate the surplus 7.51 1/2 workdays made obvious by the further calculation. Not only is in this text clear the equation 1/2 (guruš) u₄.1.še₃ = 30 (gin₂), but also the nature of calculations leading to the day division, namely the conversion of a commodity into the workdays necessary for its production (135 bundles of zi-reeds divided by 2 bundles per day = 67 1/2 workdays).

gin₂ = 10 gin₂, i.e. 1/3 workday = 20 gin₂, Nrs. 6 and 7⁴⁶) the equa-

46) TCL 5, 5670 ii3-4 represents 1/6 of the period recorded on rev. i23-ii4:

BAD Nin.he ₂ .gal ₂	The BAD(-worker) Nin.hegal
ⁱⁱⁱ E ₂ .iti.6 mu Ha.ar.ši	from "E ₂ of the 6th month" (month 8, Umma calendar)
mu Ha.ar.ši Ki.maš ^{ki} ba.hul.ta	of the year "Harši and Kimaš were destroyed" (= Šulgi 48)
ⁱⁱ Si ₄ .giš ₁₃ .šub.ba.ga ₂ .ra	through "Bricks set in the moulds" (month 2)
mu.us ₂ .sa Ha.ar.ši Ki.maš ^{ki} ba.hul	of the year following "Harši and Kimaš were destroyed"
u ₄ .7.zal.la.še ₃	(= Amar-Zu'en 1), having completed the 7th day,
a ₂ .bi u ₄ .3.07.kam	performance involved: 187 days.

That is, (6 months × 30) + 7 days = 187 days; 187 × 1/6 (the standard fraction of female workdays called u₄.du₈.a, usually translated "free time") = 31 1/6 and hence 1/6 workday = 10 gin₂. The two entries are, incidentally, very attractive additions to our knowledge of Ur III accounting altogether. Since Nin.hegal will have been one of the female workers recorded in obv. i15 and thus included in the initial calculation of total available workdays, the period when she was "out of service" (BAD) had to be *deducted* from the debit (sag.nig₂.GA.ra(k)); in parallel fashion the du₈.a days already accorded her for the full work period in obv. ii7 (also 1/6 of the total in obv. ii2) had to be *included* in the debit. This complex but entirely reasonable state of affairs must be the subject of another study. So much to the question of BAD: T. Gomi, ASJ 6, 17²² reads conventionally BAD = ug₇, "dead", but seems confused about the consequences of the days *after* Nin.hegal's death being recorded as her labor performance. In fact, as I have just stated, a death in the workforce is a plausible explanation of the matter, however I am compelled to draw attention to two points: first, to the fact that Nin.hegal's "separation" was recorded from the *first* of the month, which may be of administrative significance (compare in this regard the Umma text MVN 10, 102 rev. ii25-26: BAD 1/3 Ku₃.dŠara₂ dumu Gu₃.zi.de₂.a / u₄.30.še₃ a₂.bi u₄.10 u₄.du₈.a nu.ub.gar, "BAD: the 1/3(-performance worker) Ku.Šara, son of Guzide'a, for 30 workdays, performance involved: 10 days. The du₈.a-days have not been added.", and K. Maekawa's treatment in Zinbun 16 [1980] 2-5 of the Girsu text CT 10, pl. 28-29, BM 14316. The account records, always reckoned in full months, the periods in which persons qualified zah₂, "fugitive", uš₂, "dead" and amar.ku₅, "?", did not receive rations). Second, to the qualification in such texts as CT 9, BM 21348 rev. i10, MVN 10, 149 obv. ii4-5 and TLB 3, 146 rev. i13 of those workers as ba.BAD who seem to enjoy a compensatory dispensation of exactly 1/2 of the noted work period covered by the texts. Supportive of a translation "dead" of BAD in TCL 5, 5670 is the text T. Fish, MCS 4, 9, BM 105397, which seems to be an addendum to an account of Ur.mes. This foreman had apparently forgotten the fact that one of his men had been sick for 4 months during the period covered by his yearly account. Since the sickness had been verified by the ensi (kišib ensi₂.ka),

tion $10 \text{ gin}_2 = 1/6 \text{ guruš } u_4.1.\text{še}_3$ and Nr. 8 the equation $1/2 \text{ guruš } u_4.1.\text{še}_3 = 30 \text{ (gin}_2)$. It is thus clear that $\text{guruš/geme}_2 u_4.1.\text{še}_3 = 60 \text{ gin}_2$.

I have noted three likely occurrences of a half shekel = $1/120$ workday. First, the clear entries in CT 10, 22 (BM 14308) iv25-26: 6.57 $1/2 \text{ } 1/2 \text{ gin}_2 \text{ geme}_2 u_4.1.\text{še}_3$ (diri nig₂.ka₉.ak; "417 $1/2$ workdays $1/2$ shekel, female workers, accounting surplus"), and rev. xii 5-12: 2.05.51 $5/6 \text{ } 1/2 \text{ gin}_2 \text{ geme}_2 u_4.1.\text{še}$... diri 5.53 $5/6 \text{ } 1/2 \text{ gin}_2 \text{ geme}_2 u_4.1.\text{še}_3$ ("7551 $5/6$ workdays $1/2$ shekel, female workers, ... surplus: 353 $5/6$ workdays $1/2$ shekel, female workers"; the calculation is [iv 20-21] $1.59.58 - 2.05.51 \text{ } 5/6 \text{ } 1/2 \text{ gin}_2 = -5.53 \text{ } 5/6 \text{ } 1/2 \text{ gin}_2$, "negative" from the perspective of the state. Note also the close correspondence between iv 25-26 and xii 11-12). Second J.-P. Grégoire, AAS Nr. 135 vii15: 3.16.11 $12 \text{ } 1/2 \text{ gin}_2 \text{ geme}_2 u_4.1.\text{še}_3$, "11771 workdays $12 \text{ } 1/2$ shekels, female workers". The third text AnOr. 1, 250 i1-6 with the notations 21 17¹ $1/2 \text{ gin}_2 \text{ geme}_2 u_4.1.\text{še}_3 / \text{iti}.12 / \dots / a_2.\text{bi} 2.07.45$, "21 female workers, 17¹ $1/2$ shekels, (during a period of) 12 months, ..., performance involved: 7665 (workdays; $21 \text{ } 35/120 \times 360 = 7665$)" complicates the simplistic view on which the generation of even very small fractions of the workday in Ur III administration is based, namely that they result from the conversion of production units into labor time. In this text it seems that not production time, but in fact laborers have been subsumed in a total of $21 \text{ } 17/60 \text{ } 1/120$. Two explanations for this phenomenon can be proposed. First, $35/120$ is to be considered the result of an addition of otherwise unattested work categories, for instance $a_2.1/6 + a_2.1/8$, i.e. $10 + 7 \text{ } 1/2$ shekels. One, might, secondly, imagine a *division* of a given total labor time, in the case of AnOr. 1. 250 of 7665 by 360 (days in the recorded year). According to texts known to me, the

the 120 (lost) workdays (!) had to be deducted from his arrears (where *si-ig-tum* = $la_2 + ni$). The scribe in so doing did not forget to regain for the state those $12 u_4.\text{dug}.a$ "workdays" ($1/10$ being the standard compensation for *guruš*) which, of course, could not be allotted an invalid, in exact parallel to the situation in TCL 5, 5670.

second procedure seems to be more plausibly reconstructable. Consider the text ITT 5, 6859 obv. 1-9:

3.00 la ₂ .1/2 geme ₂	179 1/2 female workers
ⁱⁱ Mu.šu.du ₇ .ta	from "Mu.šu.du" (month 9, Girsu calendar)
ⁱⁱⁱ Še.il ₂ .la.še ₃	through "Barley transported" (month 12)
mu ^d I-bi ₂ - ^d Zu'en lugal	of the year "Ibbi-Sin is king" (= Ibbi-Sin 1),
2.51 geme ₂	171 female workers
ⁱⁱ Gan ₂ .maš.ta	from "Gan.maš" (month 1)
ⁱⁱⁱ Ezen. ^d Ba.ba. ₆ .še ₃	through "Festival of Baba" (month 8)
mu en ^d Inanna Unug ^{ki} maš ₂ .c i ₃ .pa ₃	of the year "The Inanna priest of Uruk..."
	(= Ibbi-Sin 2),
a ₂ .bi 17.23.00 [u ₄ .1.še ₃]	performance involved: 62,580 workdays.

The straightforward calculations

$$(179 \frac{1}{2} \times 4 \times 30) + (171 \times 8 \times 30) = 62,580,$$

could have been presented more compactly by dividing 62,580 by 360, which would have resulted in an average of 173 5/6 female workers per day. If we imagine the same number of workers as given in the text, but in the first case for 5 instead of 4 months, in the second for 7 instead of 8, the artificial number of daily workers would have been

$$((179 \frac{1}{2} \times 5 \times 30) + (171 \times 7 \times 30)) \div 360 = 174 \frac{1}{2}, 2 \frac{1}{2} \text{ shekels,}$$

i.e. a number which more closely reflects the initial workforce on the text AnOr. 1, 250.

This hypothetical procedure is at least in part confirmed by the parallel Umma texts S. Langdon, PSBA 35 (1913) 47-52, pl. IV (date missing), and J.-P. Grégoire, AAS Nr. 35 (CFC 9, dated to Ibbi-Sîn 1). The accounts record the number of geme₂ available *as a debit* (sag.nig₂.GA.ra(k)) to a gang foreman in each of 12 months in the year covered, summing up in the first text with the notations rev. 9-14 (according to new copy of the text, Ashm. 1912, 1141, courtesy of J.-P. Grégoire):

ŠU+NIGIN₂ 30.16 (sic) geme₂ ^r0;0,3¹
 ŠU+NIGIN₂ 1.48 geme₂ a₂. ½ 0;0,3
 geme₂ 0;0,3 igi.12.gal₂.bi 2.31 1/3 (sic)
 geme₂ a₂. ½ igi.12.gal₂.bi 9
 iti.12.š^rše₃¹
 a₂.bi u₄.15.š^r35.00¹ (sic)

“Together: 1816 female workers (each receiving) 3 (ban per month),
together: 108 female halftime workers (each receiving) 3 (ban per month).
1/12 of the female workers (each receiving) 3 (ban per month): 151 1/3,
1/12 of the halftime female workers: 9,
for 12 months,
performance involved: 56,100 (work)days.”

The number of workers each month is here the entirely artificial average of the text's entries

$$((153 \times 6) + (150 \times 4) + (149 \times 2)) \div 12 = 151 \frac{1}{3}$$

and, trivially,

$$(9 \times 12) \div 12 = 9;$$

from these figures, the foreman's available labor time for the entire year is computed:

$$(151 \frac{1}{3} + (9 \times \frac{1}{2})) \times 360 = 56,100.$$

The second text AAS Nr. 35, rev. 14'-20', may correspondingly be restored to:

šU+NIGIN₂ 13.20 'la₂.3' geme₂ 0;0,3
šU+NIGIN₂ 1.24 [g]eme₂ a₂.½ [0;0,3]
[iti.1]2.kam.x (?)
[geme₂ 0;0,3 igi].12.ga[l₂.b]i '1'.[06] 1/3' 5 gin₂
[iti.12].še₃
[a₂.bi] '7.00.00' la₂.30.kam,

since

$$((67 \times 6) + (66 \times 5) + (65 \times 1)) \div 12 = 66 \frac{25}{60},$$

$$(7 \times 12) \div 12 = 7 \text{ and finally}$$

$$(66 \frac{25}{60} + (7 \times \frac{1}{2})) \times 360 = 25,170.$$

These accounts document in their generally decreasing gang size the likely female workforce attrition rate of, just the same, less than 3% in the course of a year (through death and, presumably, child-bearing). They use, furthermore, real numbers; both computations represent account debits, as can be demonstrated by an abbreviated version of this text type, TLB 3, 70, with the notations rev. 2-5:

šU+NIGIN₂ 28.13 geme₂
iti.10.kam
sag.nig₂.GA.ra a₂.geme₂
giri₃ Lu₂.dingir.ra dub.šar

“Together: 1693 female workers
 (during a period of) 10 months.
 Debit: (expected) performance of the female workers.
 Responsible: Lu.dingira, the scribe.”

There were no apparent bounds to this exacting scribal nature, which as we have seen operated with fractions representing 1/120th of a workday. G. Boson, *Aegyptus* 21, 159 i 1-2, evidences the use in similar fashion of 1/3 shekel = 1/180th workday, with the notations [+]6 1/3 gin₂ [geme₂] 0;0,3 and 5 16 1/3 gin₂ geme₂ uš.bar⁴⁷, and UET 9, 62 rev. iii 8'-9' of an apparent 1/6 shekel = 1/360th workday with the notation 6.13 8 gin₂ igi.6.gal₂ guruš u₄.1.še₃.

This sixty-base division, leaving aside speculations about a possible connection to a workday consisting of six double-hours (danna; see fn. 40), makes sense from the standpoint of other elements in labor administration of the period, namely:

47) M. Powell, *Historia Mathematica* 3 (1976) 421-422, claims incorrectly that 1/2 and 1/3 gin₂ in AnOr. 1, 250 and *Aegyptus* 21, 159 refer to 30 and 20 shekels, i.e. 1/2 and 1/3 mana (= day) respectively. The two attestations of 1/3 shekel in the latter text, incidentally, make tempting the correction of STA 2 i3: 1.43 2/3 4 gin₂ geme₂ 0;0,3 into 1.43 4 2/3¹ gin₂ geme₂ 0;0,3, since

$$((103 + (4 \cdot 2/3)/60) + (5 \times 1/2)) \times 390 = 41,175 \cdot 1/3,$$
 or 11.26.15 1/3 as in the text. V. Struve, *Ancient Mesopotamia* 133, prudently offered no calculation for this text.

The trying text UET 3, 1554 should be mentioned here for the deviation it offers to the standard practice of labor time notations known from Lagash and Umma. In this account of linen production from a gang of female workers in Ur, the basic unit of reference in sexagesimal notations of labor time is not the day but rather the month, i.e. 1 gin₂ = 1/60 workmonth or 1/2 workday. We thus have obv. iii 2:

3.57 2 gin₂ la₂ igi.6.gal₂ geme₂ iti.1.še₃

“237 months 2 less 1/6 shekels, female workers,”

i.e. 7110 11/12 (would be: 55 gin₂) workdays. Judging from rev. i 20 - ii 2 (10 ma.na gu gada du a₂.2.gin₂.ta ... geme₂.bi '20' / a₂ iti.1.kam, where 10 ma.na at 2 “month-shekels” labor time per shekel flax = 20 labor months), rev. i 15 (8 ma.na 3 gin₂ gada ša₃.ga.du₃ gu.za.e₃ a₂.10.še.ta) might document a piecework notation of 10 “month-grains” (= 1/36 workday) per unit. I have been unable to follow Th. Jacobsen’s treatment of this text in W. Moran, ed., *Toward the Image of Tammuz ...* (= HSS 21; Cambridge, Mass., 1970; article first published in 1953) 222-224. Compare the texts UET 3, 1446, 1607 (with, it seems, a₂.bi u₄.n = a₂.bi iti.n), 1750 and 1778; UET 9, 13 and 325; T. Gomi, *Orient* 16, 107 Nr. 174:4.

1) Workers were assigned to categories of workload expectations, i.e. beyond full-time assignments we have $a_2.2/3$, $a_2.1/2$, $a_2.1/3$, $a_2.1/4$ and $a_2.10$ $gin_2 = 2/3, 1/2, 1/3, 1/4$ and $1/6$ -day workloads⁴⁸).

48) See for pertinent literature and a summary of the Ur III notations of these worker categories S. F. Monaco, *OrAnt.* 24 (1985) 17-44, who demonstrates that the rations disbursed amongst the various categories of workers bore no direct relationship to those categories. Thus the following table of rations is based on Monaco's results:

category	75	60	50	40	30	25	20	10
sil ₃ /month								
guruš (and geme ₂)	x	x	x	x	x			
geme ₂				x	x			
dumu							x	x
D, a ₂ .2/3			x					
a ₂ .1/2, guruš				x				
a ₂ .1/2, geme ₂					x	x		
—, a ₂ .1/3					x			
—, a ₂ .1/4					x			

Clearly, the term a_2 refers not to "salary" or "ration", but rather, as can be deduced from an examination of Ur III workload texts, to expected performance, work quota of the laborers, which fact I. Gelb, *Rocznik Or.* 41/2 (1980) 33, has already pointed out. This is confirmed, on the one hand, by such texts as ITT 3, 5196 obv. 3-5, which records full guruš with a work quota of hoeing 5 šar each day next to guruš.(a₂)1/2, who are to hoe just 2 1/2 šar. On the other hand TUT 162 rev. x 19, listing actual rations given various laborer categories ranging from 4 down to 1 ban per month and including 14 weavers called geme₂ a₂.1/2 0;0,3 3 ma.na.ta, proves that the a₂.1/2 weavers received the same 3 ban ration as the fulltime geme₂ 0;0,3, i.e. that a₂.1/2 0;0,3 did not result in a reduction to 15 sila per month (or, as A. Uchitel, *ASJ* 6 [1984] 77, 85, suggested, from 60 to 30 sila for guruš-workmen). Parallel are the notations in CT 3, BM 18344 passim, T. Gomi, *ASJ* 3 (1981) 152, Nr. 108, ITT 4, 8010 (for a₂.1/2) and ITT 4, 7746 and F. Yildiz and K. Maekawa, *Zinbun* 18, 103, Nr. 9 (for a₂.1/3). Such texts as SET 274, 42 with the notation 12 2/3 geme₂ a₂. 1/2 do not appear to be in conformity with, and may thus underscore the need for further differentiation in this system of labor classification; see fn. 44 above.

A variant of the Ur III workload system may have been in use already in presargonic Lagash. A series of difficult texts dealing with workloads for what seems to be canalwork list in kuš₃ = cubits (possibly a volume measure) the amount of work assumed by various classes of temple personnel. The text H. de Genouillac, *TSA* 23, for example, begins with the lu₂ (= later guruš?) assigned each 4 kuš₃ šu.du₃.a.2 šu.si.4 (= 4 4/5 cubits) as kin.du₃.a i7 al.du₃, "accomplished work, canal-digging". There follow col. iii5-9:

Thus a sexagesimal division of the day, rather than, say, the progressive division by two into 1/2, 1/4, 1/8 day and so on, should be expected to facilitate labor management and allocation.

2) The flexible system of workload/workday conversions (= production quotas) allowed managers to reckon, for instance, the fisherman's delivery of just 2 instead of the set quota of $6 \frac{2}{3}$ sila₃ of smoked (NE = še₆) fish as 18 gin₂ of the workday in those cases when the ledgers required labor time as a common denominator (cf. MVN 11, 106, discussed by the author in *Ur III-Fischerei*, forthcoming). The point in these equivalencies can best be made clear by presenting the first section of the exemplary text BM 20054 (unpubl., courtesy M. Sigrist):

12 1/2 (N ₈ !)	lu ₂ lu ₂ .1.še ₃ kin kuš ₃ .3.ta i ₃ .ši.ti kin.bi 6 gi kuš ₃ .1 šU.BAD.1 Ur. ^d še ₃ .nir.da	12 1/2 men (= workdays?), per man (workday?) the work: 3 cubits each assigned (s. J. Bauer, AWL p. 68-69 to i3-4), work involved: 37 1/2 cubits, under PN.
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Assuming a workload of 3 kuš₃ meant a volume measure, one reasonable explanation of this matter might be:

$$3 \text{ kuš}_3 \times 3 \text{ kuš}_3 \times 1 \text{ kuš}_3 = 3 \frac{3}{4} \text{ (volume) gin}_2 \text{ (i.e. } 1/4 \times 1/4 \text{ ninda} \times 1 \text{ kuš}_3 = 1/16 \text{ šar}^{\text{vol}}).$$

which is a standard wall construction workload for the Ur III period (cf. fn. 42), or one could imagine a connection with the texts discussed in fn. 49, with something like $1/2 \text{ šar}^{\text{vol}}$ excavated per running ninda, thus here:

$$(3 \text{ kuš}_3 =) 1/4 \text{ ninda} \times 1/2 \text{ šar}^{\text{vol}} \text{ per ninda} = 7 \frac{1}{2} \text{ gin}_2^{\text{vol}} (1/8 \text{ šar}^{\text{vol}}) \text{ per man-day.}$$

Similar are the puzzling sargonic texts Nik. II 64-65, which seem to posit a workload of $3 \frac{1}{3} \text{ gin}_2^{\text{vol}}$ (?) of the volume measure SU.KUR.RU PAD².DU (cp. H. Saggs, RA 54 [1960] 141-142: PAD.TA.AM₃ adkuš, "I drew a border"?) per day. I have been able to make no good sense of the three treatments of, in particular, Nr. 64 offered to date (M. Powell, RA 70 [1976] 100-102; B. Foster, USP pp. 26-27; J. Friberg, A Survey of the Publications on Sumerian-Akkadian Mathematics, Metrology and Related Matters (1854-1982) [Göteborg 1982] 117-118). The presargonic text OIP 14, 70 edited by D. Edzard, AOAT 1 (1969) 101-104, might in the same manner as TSA 23 contain a table not only of surface but also of volume measurements (lines 5-6: [3 kuš₃] sa₂ / [4 gi]n₂ la₂ igi.4 [= 3 3/4 gin₂]).

- Obv. 1) 3.19 ninda gid₂ 1 1/2 kuš₃ dagal i₃.HI 4 kuš₃ sukud
 1 ninda.na 1/2 šar.ta
 kin.bi 1.39 1/2 šar
 guruš.1.e 3 2/3 gin₂ 15 še.ta
 5) a₂.bi 26.32 guruš u₄.1.šē₃
 guruš.1.e a₂.ni 6 sila₃.ta
 še.bi 31;4,1,2 sila₃ gur
 lu₂ hun.ga₂.me

Translation:

- 1) (Pise wall:) 199 ninda(n) the length, 1 1/2 cubits
 the average width, 4 cubits the depth.
 Per (running) ninda(n) (thus) 1/2 (volume) šar.
 Work involved: 99 1/2 (volume) šar.
 Per worker (per day) 3 3/4 (volume) gin₂.
 5) Output involved: 1592 workdays.

Per worker, his disbursement: 6 sila (barley).
 Barley involved: 31 kor, 4 (barig), 1 (ban), 2
 sila.

Hired laborers⁴⁹).

The calculations:

199 n(indan):
 $1 n \times (1.5 \text{ kuš}_3 + 12 =) 3/24 n$
 $\times 4 \text{ kuš}_3 = 1/2 \text{ š(ar)}^{(ol)}$
 $199 n \times 1/2 \text{ š}^v/n = 99 1/2 \text{ š}^v$

$99 1/2 \text{ š}^v + 3 3/4 \text{ gin}_2^{vol}/\text{day} =$
 1592 days

$1592 \text{ days} \times 6 \text{ sila}_3/\text{day} = 31;4,1,2$
 sila₃

Thus we see that with the Ur III system of conversions, managers were capable of quickly and efficiently calculating the “cost” of any of a number of different defined jobs by converting the figures into the medium desired, in this case from a required masonry project to necessary workdays to the ultimate goal, namely the total amount of

49) For the values ninda(n) and šar see M. Powell, ZA 62, 189-193; 197-201. ninda gid₂ is not, as Powell asserts p. 200⁹⁰, a graphic variant of ninda, but describes lengths in excavation and construction works. Powell cites loc.cit. the text CT 3 35ff. (BM 21335) with the parallel notation 20 ninda gid₂ 2 šar.ta, meaning “(length:) 20 ninda, (per running) ninda 2 šar^{vol}”, i.e. assuming 1 NINDA (length) \times xNINDA (width) \times ykuš₃ (depth) = 2 šar^{vol}. The term qualifying the width in BM 20054, i₃.HI, is presumably connected with the same term used in sargonic and Ur III field measurements to qualify opposing sides of a surface, see B. Foster, ASJ 4 (1982) 13 and 45-46, Nr. 14 passim; ITT 1, 1374; ITT 2/1, 2923 and 4473; H. Limet, Études de documents de la période d’Agade ... (Paris 1973) Nr. 38 (= 29), obv. 1; D. Luckenbill, OIP 14, Nr. 116 (sargonic); HLC I, pl. 44 Nr. 90; NRVN I, 265; G. Pettinato, AnOr. 45 (Rome 1969) 12-13 (HI passim in the “round tablets”; Ur III) translates tentatively “gemischt”, “diverse” (i.e. = balālu, “to mix”). Doubtless scribes resorted to the qualification HI when explicit calculations of divers triangles along an irregular border would have unduly complicated text format.

barley allotted to the workers specifically hired or assigned to construct the wall.

12. Ancient time perception?

This rationalization and quantification of labor time executed by ancient management presupposes an outlook which many will recognize in present day organization, however it is often asserted that the Mesopotamian culture represented by other, much more publicized text genres, viewed time and space in a fashion essentially different from that of the modern world. The time consciousness of the ancients, as expressed primarily in cult literature, but also evident in epics and historical inscriptions, is generally considered cyclical and mythopoeic⁵⁰), i.e. in its essence anti-historical. To avoid the impression of a consequently "cold" society, as C. Levi-Strauss would term it⁵¹), it would be prudent to remember about whom we are speaking when the (a)historical consciousness of the ancients is at issue. A certain dichotomy likely obtained then as now between administrative exactitude and literary/religious reality; there are thus good reasons to reject the identification of a unified "oriental conception of time very different from our own" (C. Wilcke, AVA Kolloquien 3, p. 33) until it can be shown on the one hand that there is a conception of time peculiar to us moderns, that a narrow ancient literature was broadly representative of Mesopotamian society on the other. It is unfortunate that a thorough documentation of time division terminology in Mesopotamian literature, i.e. of such expressions as *gi6.ba*, *u4.sa2* and *gi6.an.na* ("morning, midday and evening") in Urk. 4-5 x 4-6, *gi6.an.na* and *an.ba.ra* ("evening and midday") in

50) See for instance H. and H. A. Frankfort, "Myth and Reality", in H. Frankfort et al., *The Intellectual Adventure of Ancient Man* (Chicago 1948) 3-27, esp. 23-25; M. Eliade, *The Myth of the Eternal Return* (Princeton 1971) 51-92.

51) For a useful description of current theoretical discussions in ethnography on time perception see J. Friedman, "Our Time, Their Time, World Time: The Transformation of Temporal Modes", *Ethnos* 50/3-4 (1985) 168-183.

Gudea Cyl. A xvii 8-9, and gi₆.u₃.na and an.NE.GAN in SRT 6 iii 25-26 // vii 36-37 ("evening and midday"), has not been undertaken. Such an inquiry, in determining the relative value of the statements these and numerous like passages make⁵², will do well to balance literary/religious testimony against contemporary administrative records documenting mechanisms which people of the time felt every day.

It seems this populace lived at least from the inception of writing with a reality-distorting system of timekeeping, which is a by no means surprising development. The Aztecs, for instance, translated their vigesimal counting system into a year consisting of 18 months, each with 20 days. Instead of intercalation, however, the five remaining days, an "unclean" time, were appended to this 360 day year before commencement of the new year. The closest approximation to the Mesopotamian system of the 3rd millennium might have been that of predynastic Egypt, where there seems to have been at once an administrative year of 12 30-day months with the addition of 5 days at the end of the year, parallel to which a synodical calendar remained in use⁵³).

Technology has doubtless had the greatest impact on modern time consciousness. J. Weizenbaum has recently⁵⁴) underscored the fun-

52) The cited terminology was not foreign to the administration of cultic practice in the Ur III period. Cp. the usage in S. Kang, SACT I, Nrs. 160, 180 and H. de Genouillac, La trouvaille de Dréhem Nr. 77 of a₂.gi₆.ba.a and a₂.u₄.te.na, in T. Gomi, Orient 16 (1980) p. 42, Nr. 11 of a₂.u₄.te.na and a₂.gu₂.zi.ga, in SET 188, ll. 104, 126 and 134 of (sa₂.du₁₁) gi₆.ba.a, an.ba.ra and u₄.te.na, and particularly in UET 3 and 9 (see p. 61 of the index to UET 3; in UET 9 cp. Nrs. 814, 846-847, 976, 1005, 1054, 1135 and 1138) of a₂.gi₆.ba.a (in the standard notation a₂.gi₆.ba.a u₄.x.kam, with x = 1-29; cp. also A. Salonen, StOr. 19/2 [1953] 1-2, P523). An unpublished Sargonic text (IM 5592/3 + 6) discussed by P. Steinkeller at the July 1987 meeting of the Sumerian Agriculture Group in Leiden contrasts in apparent water measurements the terms a.gi₆ and a.an.nē/bar₇ (Steinkeller: "midnight" and "noon"); the presargonic Lagash text DP 43 ix2-4 (1 maš^dNanše / gi₆.ba.a.ka / i.nu) seems, finally, to refer to a "nightly" delivery.

53) An easily accessible summary of the Egyptian calendar together with pertinent literature is to be found in O. Neugebauer, The Exact Sciences in Antiquity² (New York 1969) 80-86, 94.

54) Computer Power and Human Reason (New York 1976) 23-26.

damental impact on modern man made by the invention of the mechanical clock, that therewith we began to understand our days not according to the natural, but according to a constructed world. It might be argued that we have in the 4th and 3rd millennium time notations a related shift in consciousness imposed by administration, akin to the medieval adaptation to the clock-tower. The managers of both societies will have played the critical, if not witting, role in this subtle revolution.

Time Notation Paleography *

Time Unit / Period	Year	Month	Day	Further Divisions
Uruk IV-III				= 1/4 (full day)
Archaic Ur	?		?	?
Fara				= 1/6 (full day)
Presargonic Lagaš				
Old Akkadian				
Ur III				= 1/2 (workday) = 1/3 etc. = 1/60
Old Babylonian				maššartu (en.nun) = 1/6 (full day)

*) references are to representative signforms

a) SF 7, vi25; b) cf. R. Biggs, *Or. NS* 42 (1973) 44 fig. 3; c) TSŠ 150; d) passim; e) BiMes. 1, passim (sic?; the use of the "Winkelhaken" at this early date seems unlikely and might be the confusion suggested by M. Powell, *HUCA* 49, 915); f) Royal inscriptions; g) BiMes. 1; h) early sargonic, "mu-iti"; B. Foster's Group "C" (*USP* p. 5); i) CT 50, 52; CT 50, 154; j) KWU 408 depicts 46 different signforms (a paleographical sequence of the sign iti in the Ur III period has not been determined); k) passim, Gudea occasionally, e.g. *Cyl. A* xix2; l) Gudea passim; m) T. Pinches, *Behrens Coll.* 95.

Survey of the Archaic Numbersigns
(from Damerow and Englund, ATU 2, p. 166)

N ₁		N ₂₁		N ₄₁	
N ₂		N ₂₂		N ₄₂	a b
N ₃		N ₂₃		N ₄₃	
N ₄		N ₂₄		N ₄₄	
N ₅		N ₂₅		N ₄₅	
N ₆		N ₂₆		N ₄₆	
N ₇		N ₂₇		N ₄₇	
N ₈		N ₂₈		N ₄₈	
N ₉		N ₂₉	a b	N ₄₉	
N ₁₀		N ₃₀	a b c	N ₅₀	
N ₁₁		N ₃₁		N ₅₁	
N ₁₂		N ₃₂		N ₅₂	
N ₁₃		N ₃₃		N ₅₃	
N ₁₄		N ₃₄		N ₅₄	
N ₁₅		N ₃₅		N ₅₅	
N ₁₆		N ₃₆		N ₅₆	
N ₁₇		N ₃₇		N ₅₇	
N ₁₈		N ₃₈		N ₅₈	
N ₁₉		N ₃₉	a b	N ₅₉	
N ₂₀		N ₄₀		N ₆₀	

Survey of the Archaic Numbersign Systems
 (from Damerow and Englund, ATU 2, p. 165)

