

COMMENTATIONES

Regulating Dairy Productivity in the Ur III Period*

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§ 1. Introduction. Considerations of early dairy technologies¹

Healthy, full-grown cows will calve on average once each year, regardless of the area in which they are herded² The milk production of

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¹ The technological considerations made here owe much to the correspondence and to the collegial discussions — in particular at the 1993 meeting of the Sumerian Agriculture Group in Wassenaar, Holland — I have enjoyed with Michael Teuber, former director of the Institute of Microbiology of the Federal Institute for Milk Research, Kiel, and currently professor at the Institut für Lebensmittelwissenschaft of the Swiss Federal Institute of Technology, Zurich. The understandable predominance of technical publications with data on fertility, gestation and lactation of dairy cows from modern breeds on which such discussions are based may tend to skew our view of the probable difficulties in successfully exploiting cows in semi-arid regions such as Mesopotamia of the third millennium B.C., but must, given the fragmentary information in early texts, be used in an attempt to bridge the many gaps in our knowledge of pre-classical dairying techniques. For instance, data on the exploitation of and feed given milk cows in areas which are unlikely to have supported a substantial vegetative cover over extended periods would be of particular interest, since our cuneiform textual material is almost completely silent about the feeding of cows under such circumstances (green reed growth [gi gibil and gi zi] may have gone in part to dairy operations). However, cattle in such areas — for example, in modern Iraq — have as a rule either been exploited more for meat and draft than for milk and so exhibit expectedly low dairy production, or have been given supplementary and enhanced feeds, and tended according to modern agri-business standards, together hampering meaningful comparison of modern ethnographic reports with data in accounts from third millennium Mesopotamia. This situation stands in contrast to the generally valid inclusion of modern ethnological research in discussions of cuneiform material insofar as it bears on questions of Near Eastern pastoralism. Still, modern technical data do give a rough idea of the practical necessities in dairy farming and with these caveats have been considered here. See generally John Webster, *Understanding the Dairy Cow* (Oxford 1993) 68-90; D. Bath et al., *Dairy Cattle: Principles, Practices, Problems, Profits* (Philadelphia 1978), esp. 267-421; H.-O. Gravert, R. Waßmuth and J. Weniger, *Einführung in die Züchtung, Fütterung und Haltung landwirtschaftlicher Nutztiere* (Hamburg/Berlin 1979) 13-132, esp. 126-132. For a current treatment of third millennium artistic representations of milking and milk processing, see P. Gouin, "Bovins et laitages en Mésopotamie méridionale au 3ème millénaire: Quelques commentaires sur la 'Frise à la laiterie' de el-'Obeid", *Iraq* 55 (1993) 135-145.

² Fertility rates do, of course, vary widely, dependent on health and fodder of the animals (see, for example, the data gathered on African breeds by G. Dahl and A. Hjort, *Having Herds. Pastoral Herd Growth and Household Economy* [Stockholm Studies in Social Anthropology 2; Stockholm 1976] 35-36; pastoral fertility rates of 40-80% are reported). The gestation period of the domesticated cow *Bos taurus* is, dependent on breed, ca. 9½ months; about a month after birth of the calf, the cow enters heat again in cycles of three to four weeks and can be led to the mount. As a rule, they are served in the second cycle, that is, fifty to sixty days after birth and so kept on a yearly schedule.

such cows in semi-arid climates, however, is substantially below that of selectively bred dairy cows from European stocks which can, under normal conditions, reach 4000 liters and more per animal per year³; cows under rudimentary care and not selectively bred for milking have been shown to produce just 700-800 liters per year, dependent above all on the quality of feed of the animals⁴. Of this amount, about half — 350 liters — may be required for the rearing of the calf, leaving between three and four hundred liters of so-called ‘excess milk’ per animal for the owner-herder of suckling cows. Although lactation periods of up to five years after calving have been reported⁵, the norm is between four and eight months and daily production does decline beginning about six weeks after parturition. Herders more interested in milk than in increasing the size of the herd can best augment production of excess milk with the forced weaning or early slaughter of calves, after which continued lactation can be insured if the cows are milked out twice daily.

Milk in countries with hot climates and no means of refrigeration keeps for about half a day and so must be immediately consumed, or processed to prevent it from spoiling and from losing its nutritive value in fat, proteins and minerals. One means of ‘processing’ milk can consist of simply boiling it or allowing it to sour in a controlled environment, after which it will keep for about a week⁶. More involved processing of milk takes many forms, but two procedures have been of primary use in all cultures possessing primitive technologies (see figure 1). In the first, sour or boiled and fermented milk is

³ Statistics show that countries lying in temperate zones, including those in northern Europe, the United States, Argentina/Chile, Australia and New Zealand, are best suited for dairying, production falling with increasing proximity to the equator. Production in the United States and Holland has averaged about 4300 kg since the late 1960s, somewhat less in Germany and Denmark (the German Federal Office of Statistics, *Fachserie B, Reihe 3*, shows the Land Lower Saxony achieved the best production numbers in the Federal Republic for the year 1976 with 4742 kg).

⁴ The average measured milk production among normally healthy stocks in Turkey, Kurdistan and Africa, for example, was between 400 and 650 liters; added to the 350 liters of milk required for rearing the calf, the total milk production per cow was ca. 750-1000 liters (B. Yalcin, “Local Cattle and Sheep Breeds in Turkey and Their Performance”, in: *Mediterranean Cattle and Sheep in Crossbreeding* [FAO Animal Production and Health Paper 6; Rome 1977] 32-35; H. Buitenhuis, “Some Remarks on the Possible Development of *Bos taurus* Breeds in the Near East”, in: J. Clutton-Brock and C. Grigson, eds., *Animals and Archaeology 3: Early Herders and Their Flocks* [BAR International Series 202; Oxford 1984] 213-221; P. Watson, *Archaeological Ethnography in Western Iran* [Viking Fund Publications in Anthropology 57; Tucson 1979] 112; G. Dahl and A. Hjort, *Having Herds* 143-148). This is about the same as production figures from the Middle Ages and not substantially higher than the production of wild races. The occasionally cited very low production of Indian zebu (*Bos indicus*; see K. Krüger, *Natur und Wirtschaft der indischen Union* [Vienna ca. 1960] 87-88: one-tenth of European production) are the result of starvation diets with low-quality fodder and poor care.

⁵ D. Bath et al., *Dairy Cattle* 340; M. French, *Observations on the Goat* (Rome 1970) 104.

⁶ The agent involved in this preservation is the lactic acid resulting from the action of bacteria on milk sugar. A high content of lactic acid in soured milk prevents the growth of the pathogenic bacteria and microbes causing spoiling.

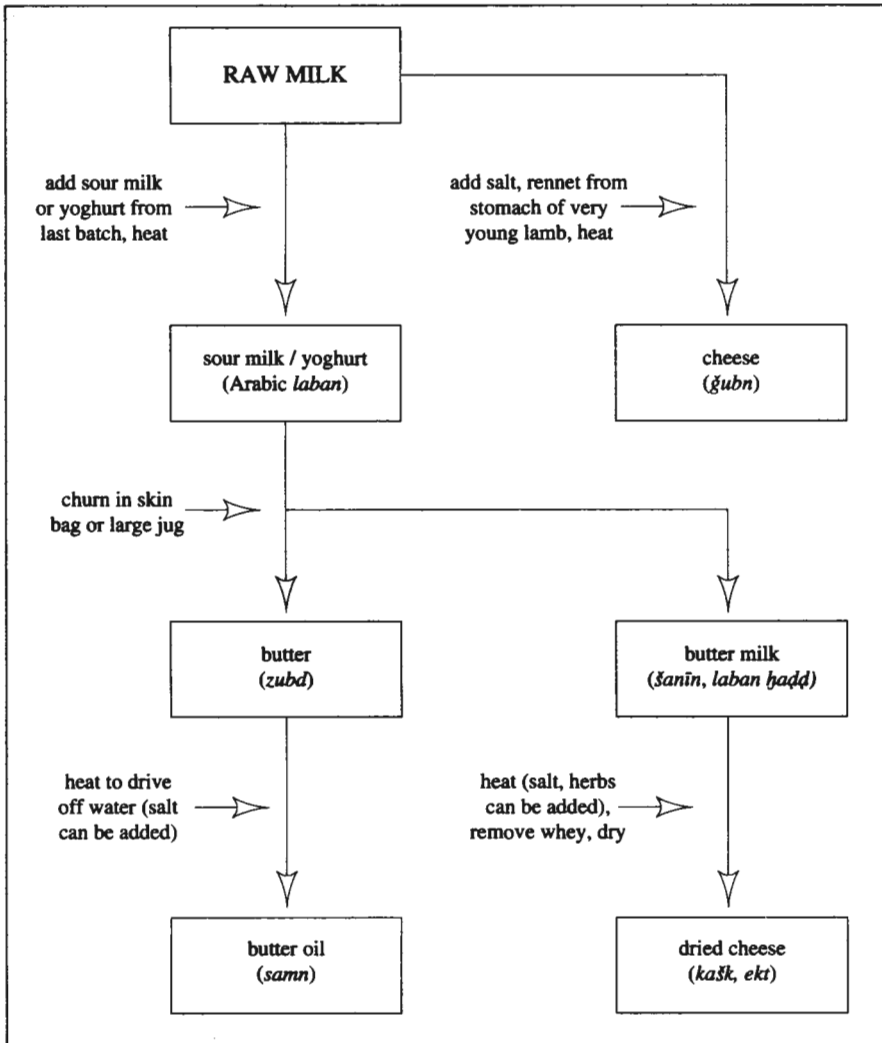


Figure 1: Simplified diagram of the steps employed in nonindustrial production of dried cheese and butter oil in the Near East.

beaten in churns, shaken or rolled in leather bags, etc., all mechanical actions leading to the breakdown of the membranes of fat globules suspended in the milk, causing them to coalesce into lumps of butter. Since it is the existence of water in butter which leads to rancidity, the butter must further be heated to near boiling to force off as much of the water as possible⁷, leaving pure

⁷ Ca. 16% of butter is water; heating to 80°-110° centigrade for four hours can reduce the wa-

butter oil. Once this oil contains less than 1% water, it can be kept for up to a year without becoming rancid. In the second, the butter milk, that is, the milk remaining after all or part of the fat has been removed, can be processed through actions of yeasts or moulds into nutritious drinks or yoghurt-like products, or the solids can be drained from the whey as curds and, as desired, mixed with rennet or a number of plant agents which act to prevent the growth of pathogenic, or to enhance the growth of desirous bacterial flora, and dried. This latter processing results in the myriad of high-protein cheeses found in all countries with milk-bearing domestic animals. In the Near East, completely dried cheeses are known, variously called *kašk* in Syria, *kušuk* or *baql* in Iraq, or *ekt* on the Arabian peninsula, which can be kept for years and even decades without spoiling⁸

Dairy milk from cows consists of approximately 87% water and 13% solids; of these 13%, 3-5% are fat — we know the regulated whole milk count of 3.5%, but healthy Jerseys reach 5.7% in the first weeks after parturition (not the colostrum produced in the first days!) and the remaining 8-9% are other solids. ca. 5% lactose, 3-3.5% casein, and 0.5% each of whey protein and minerals. In other words, from 100 liters of cow milk you might reasonably expect to derive 3-5 liters of butter oil and perhaps 7 liters of *kašk* cheese, assuming in both cases the water has been removed and the specific gravity of dried cheese balls consisting of casein is ca. 0.6 (0.6 is based on my rough measurements of Syrian *kašk*; the balls had a diameter of 1.5 – 2.5 cm). These figures are apposite to the topic of this paper, for they bear a striking resemblance to the delivery quotas of the butter oil known as *i nun*⁹ and the cheese

ter content to 0.25%. Adding herbs, for example, betel or curry leaves as is practiced in southeast Asia, or a high concentration of salt, can further reduce the likelihood of butter oil going bad.

⁸ The word *kašk* is derived from Persian *hušk* ('dry'), probably borrowed via Aramaic (information kindly provided by C. Ott; the word, according to J. Pokorny, *Indogermanisches etymologisches Wörterbuch* I [Bern 1959] 880-881, originally from Indo-European **saus-*, **sus-* [Sanskrit *śūska-*, Avestan *huška-*], was reborrowed in Persian as *kašk*). The processing of this cheese is, as described in ethnological literature, in most cases the same. See the references cited by P. Steinkeller, *Quaderni di Semitistica* 18 (1992) 249^a, M. Abdalla, "Milk and Its Role in Assyrian Culture", *Journal of the Assyrian Academic Society* 6/2 (1992) 12-36, esp. 25-34, and the summary by S. A. Abou-Donia, "Microbial Flora and Chemical Composition of Ekt Cheese", *Egyptian Journal of Dairy Science* 6 (1978) 49-52. As described by A. Kanafani-Zahar, *Müne: La conservation alimentaire traditionnelle au Liban* (Paris 1994) 49-58, a form of (often fermented) *kašk* made in the Near East (*kišk* in Lebanon) contains burgul (cooked and ground barley) and either yoghurt or butter milk. Note the possible connection between Akkadian *eqīdu* and *ekt* (see fn. 10), and that the term *gāmid*, 'solid', is also known in Arabic to refer to *kašk*.

⁹ Akkadian *himētu*, of unclear etymology (see the dictionaries, and D. Edzard, *ZA* 72 [1982] 83-84). Arguments of a primarily technical, rather than philological, nature have heretofore dominated the discussion of the meaning of *i nun* in the Ur III period (and its Old Sumerian correspondences *i áb sè ga/dé a*, Old Akkadian *i áb — i nun* in the Old Akkadian period apparently referred only to the corresponding product from goat's milk, for example, in T. Donald, *MCS* 9/1, no. 251, cited B. Foster, *Umma in the Sargonic Period* (Hamden

known as *ga* 𒀠/UD*gunū*¹⁰ exacted from herders of dairy animals, that is,

1982) 136-137; note also the clear referent 'goat' of the b-variant form of the archaic sign NUN, *ATU* 2 s.v., last sign of the Uruk IV column, *ATU* 5 s.v., and compare *ATU* 5 sub 'LAGAB₆+NUN₆' = UDU₆+NUN₆, further *ATU* 2, p. 129 —, variously translated as 'butter', 'ghee' and 'nun-fat', 'risen' or 'princely fat'. In my opinion, there should be no doubt that a form of 'ghee' (also 'run' or 'clarified butter', 'butter oil/fat'; see K. Butz, "Konzentrationen wirtschaftlicher Macht im Königreich Larsa: Der Nanna-Ningal-Tempelkomplex in Ur", *WZKM* 65-66 [1973-1974] 37⁹²) is meant, and not butter (as still argued by I. J. Gelb, *JCS* 21 [1967] 68; clarified butter is, against Gelb, a semi-liquid at temperatures below 50° centigrade, much like lard kept at room temperature in kitchens today), not only due to the impossibility of dealing with butter in warm climates and to the relative non-perishability of dairy oil, but also as a necessary consequence of an understanding of the terminology for soured milk and the relation of butter oil and cheese which can be derived from it, now found firmly documented in Ur III texts (see below). Literary texts dealing with herding and the uses of dairy products, for example, the dispute between the herder Dumuzi and the farmer Enkimdu (J. van Dijk, *La sagesse suméro-akkadienne* [Leyden 1953] 65-85; Y. Sefati, *Love Songs in Sumerian Literature* [unpubl. dissertation, Bar-Ilan University; Ramat-Gan 1985] 368-389 [reference P. Attinger]), or the Dumuzi laments (see, for one concerning milk products, T. Jacobsen, "Lad in the Desert", *JAOS* 103 [1983] 193-200), are as 'bucolic' compositions not specific in their descriptions of mundane dairy processing and so of limited value in technical discussions of butter oil and cheese.

¹⁰ The sign combination *ga* 𒀠 is commonly read, following A. Falkenstein, *JAOS* 72 (1952) 42-43, in a review of A. L. Oppenheim, *Catalogue of the Cuneiform Tablets of the Wilberforce Eames Babylonian Collection...* (AOS 32; New Haven 1948), in Sumerian *ga* 𒀠, and translated simply 'cheese', presuming that the verbal adjective 𒀠 is used in its sense from grain milling texts of 'ground' (the Akkadian correspondences are *eqīdu*, from which later *ekt* may have derived, and late Babylonian *gubnatu*, from Aramaic *gubnā* [Arabic *ḡubn*]). The final consonant of the reading of 𒀠 is shown to be 'r' in its usage together with *ga* in such texts as *TUT* 127 obv. ii 5' (Ur III Girsu) and in P. Michalowski, *The Lamentation over the Destruction of Sumer and Ur* (Winona Lake 1989) 56, l. 334 (preserved only in UET 6, 131 [Old Babylonian]; see M. Stol, "Milk, Butter, and Cheese", *Bulletin of Sumerian Agriculture* 7 [1993] 105). The texts TCS 1, 169 (= M. Sigrist, *Messenger Texts from the British Museum* [Potomac 1990] no. 312) obv. 11 (letter, Ur III period), and UET 5, 630 obv. 2 (Old Babylonian; cited Stol, *RIA* 8/3-4 [1994] 198-199) seem to attest the form *ga ra* of the word, in the latter text, moreover, immediately after a notation representing a measure of i nun and standing in a 'neo-Sumerian' relation to this butter oil of very nearly 2:3 (284 sila i nun to 420 sila *ga.ra*). These texts may thus be added to the references made by Falkenstein, *JAOS* 72, 43, concerning the Old Babylonian i te.er.da series i te.er.da : *ga* 𒀠 (VS 2, 68 obv. 15-16), *ga* ti.i[r].da · *ga* 𒀠 di₄.di₄, *ga* 𒀠 gal gal (VS 10, 123 obv. iii 12-14) and i.te.er.[da] *ga.ra* di.d[i.la] *ga.ra* gal gal.l[a] (VS 2, 30 rev. 2'-4'); to *ga* i ti.ir.da see Th. Jacobsen, *JAOS* 103, 197 ['buttermilk']; Stol, *RIA* 8, 198: 'butter'?, and compare the close parallels to this sequence in the lexical list 𒀠-ra = *hubullu* 24 and its Old Babylonian forerunners, MSL 11, 81:120-123, 122, § 8:4-9 and 157:347-351) and understood as indications of a phonetic form *ga /ara/*. This interpretation of the sign combination as literally 'milled milk (product)' would seem to make sense, given the fact that *ga* 𒀠 is not counted in discrete units, as may be expected of cakes of cheese and as was the case (for *LAK* 490; see below, fn. 19) up to the Fara period, but rather is recorded in measures of the capacity system. Yet this excludes by no means the referent of small cheese cakes, since the same capacity system was used to qualify apparent breads *ninda*, and a number of fish or fish products, of which the best known from the Ur III period are *ku₆ še₆*, 'smoked/cooked fish', and *ku₆ GAR.KI*, '? fish' (see my *Organisation und Verwaltung der Ur III-Fischerei* [BBVO 10; Berlin 1990, in the following abbreviated *Ur III-Fischerei*] 215-221). Some caution in the reading *ga* 𒀠(a) is advised, however. The two known Ur III forms of the word, *ga* 𒀠 and *ga* UD*gunū*, must be phonetic and not, as suggested by T. Gomi, "On Dairy Productivity at Ur in the Late Ur III Period", *JESHO* 23 (1980) 2⁴, and repeated by Stol, *BSA* 7, 102 (reading *ga murub₆*) and *RIA* 8, 199 (reading *ga.UD-gunū*), dialectical variants, since they can appear in the same text clearly with the same referent (the Umma account MVN 15, 108, dis-

of cows and goats¹¹, as documented in administrative texts from Ur, Drehem and Umma in the Ur III period. With one possible exception, herders of state-owned cattle in these provinces were, according to such texts, required to deliver to central authorities the equivalent of 5 neo-Sumerian sila (\approx 5 liters) of *i nun* and $7\frac{1}{2}$ sila (\approx $7\frac{1}{2}$ liters) of *ga HAR/UDgunû* per adult cow per year (Ur III Lagash norms were, in contrast, apparently one *bán* each of *i nun* and *ga HAR* per cow-year)¹² Not only

cussed below in detail, contains both *ga UDgunû* obv. i 2 as part of the *si.i.tum*, and *passim*, and *ga HAR* rev. iv 112); cf. also the Umma text *SET* 188, obv. i 13, ii 42, iv 65, rev. v 92, 105, vi 123 and vii 141 (according to the new transliteration offered by J. Carnahan and K. Hillard, *ASJ* 15 [1993] 218-223), with *ga HAR gazi*, and, for example, such Umma texts as *MVN* 16, 689, 725 and 1414, with *ga HAR*, next to *MVN* 16, 673, 723, etc., with *ga UDgunû* (all dating from late Šulgi to Šū-Sîn), and see below. *UDgunû* (= *LAK* 157) is known with the reading *murub*, or *mûru*, Akk. *qablu*, 'middle', 'waist' (not to be confused with *nésag* = *LAK* 159), and possibly *iti*, *sag*, and *usar*); a reading *mur* of the sign, and of *HAR mur*, with the meaning 'feed' found in the combination *mur gu*, known from feed and seed texts, can not be reconciled with the term *ga.ra* cited above (but note the entry E. von Weiher, *Spätbabylonische Texte aus Uruk* III [Berlin 1988] 235-242, no. 116 = W 23280, rev. iv 8' [from the late Babylonian commentary series Hg XXIII-XXIV]: *ga HAR* = *x-ru* = *e-[qi-du]*, *x-* read by von Weiher *gub-* or *gab-* to *ka/ubru*, 'thick' [presumably not *gub-na'*], read by M. Civil, *Or* 56 [1987] 234', *gur'*, without interpretation), nor is a reading *ara*, of *UDgunû* suggested by references known to me.

¹¹ Surprisingly, products derived from ewe milk were not registered in Ur III accounts (see below, fn. 45), nor are there to my knowledge records of the use of milk from water buffalo, which with a high protein content of 5% and a very high fat content of 10% should, if available, have been prized by neo-Sumerian administration. R. Boehmer's posited identification in "Das Auftreten des Wasserbüffels in Mesopotamien in historischer Zeit und seine sumerische Bezeichnung", *ZA* 64 (1975) 1-19, of the buffalo — presumably brought into Agade from the Indus Valley — depicted in numerous cylinder seal friezes of the Old Akkadian period, and the animal *áb.za za* still attested in late Ur III texts from Drehem (in particular, *AnOr* 7, 154 [= *MVN* 18, 154], dated to Amar-Suen 9; see N. Schneider, *AFO* 14 [1941-1944] 70-72), with the domesticated water buffalo, was refuted by K. Butz, "Ur in altbabylonischer Zeit als Wirtschaftsfaktor", in: E. Lipiński, ed., *State and Temple Economy in the Ancient Near East* I (OLA 5; Leuven 1979) 354-355²⁵⁸ (including literature concerning the exploitation of buffalo), with the compelling argument that the horn span of the animal in the Old Akkadian seal depictions was compatible only with the very dangerous wild Arni water buffalo, and that the nutritional value of domesticated water buffalo milk together with the ideal conditions for their breeding in southern Mesopotamia (the beasts were until recently widely herded by the marsh Arabs) make improbable their extinction following an assumed introduction in the Old Akkadian period. Butz conjectures with *CAD* sub *apsasû* that the *áb.za za* may have been the zebu, an Indian breed of cattle better known in the United States as the Brahman.

¹² The exception in Ur is found in UET 3, 1214 (dated to Ibbi-Sîn 6), with norms of 5 sila each per year and cow for the two products; see T. Gomi, *JESHO* 23, 14. The texts *MVN* 8, 145, and M. Sigrist, *Toronto* 1, no. 7, are no exceptions to the rule, since they record the *maš.da ri.a* payment by 37 herders (reading in each case obv. l: 37 *unu* (*AB.KU*) *libir*) of 2 sila each of *i nun* and *ga HAR*, nor are the texts *SACT* 2, 256, and T. Fish, *MCS* 8, 88, BM 105375, cited Gomi, *JESHO* 23, 2: of the 37 cattle (*gu*, *áb hi a*) recorded in the former account, ($65 + 5 =$) 13, and of the 46 cattle in the latter, ($90 + 5 =$) 18 cows (confirmed through collation by T. Gomi, *Orient* 17, 41) must have been inspected and certified as milk producers by the bookkeeper involved. Comparable notations are found in the Ur text UET 9, 1097. The yearly norms imposed on herders of state-owned dairy cows in Lagash seem to have been 1 *bán* each of butter oil and dried cheese, according to the pertinent texts CT 5, pls. 25-26, BM 18346 *passim* (cp. the collations in

do these amounts correspond roughly to the optimal quantities of fat and dried cheese which can be derived from 100 liters of milk, but the constant relationship of 2:3 between the two dairy products — the same relationship holds generally for the milk products delivered by goat herders — is also reflected in the specific gravity of dairy fat compared to that of dry cheese: 1 kg of butter oil fills 1.1, and 1 kg of *kašk* fills 1.7 liters.

Neo-Sumerian accounts that have been recently collated or made available for study demonstrate that the dairy norms recorded in Umma accounts in fact corresponded to 100 sila of the product called ga SIG₇/še a in the same province. Assuming this latter product is either soured milk/yoghurt (Arabic *labn*) or creamed milk, the norms assigned Ur III herders (Sumerian ùnu)¹³ from Umma and Ur will have represented

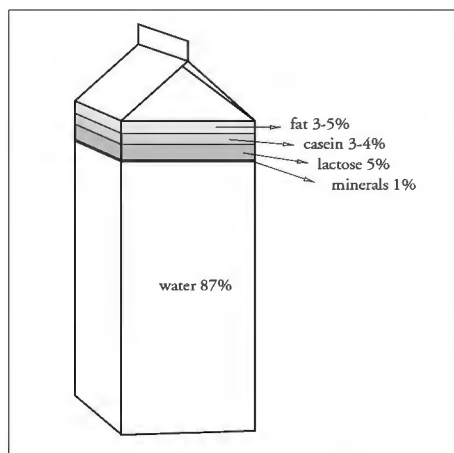


Figure 2: Contents of cow milk.

OrAnt 15, 142), CT 7, pl. 34, BM 18407 rev. 8-10, and B. Lafont and F. Yıldız, *Tablettes cunéiformes de Tello au Musée d'Istanbul* 1 (Leyden 1989) 878 *passim* (to be noted to my remarks in *AfO* 40-41 [1993-1994] 101-102), cited by G. van Driel, "Bones and the Mesopotamian State?: Animal Husbandry in an Urban Context", *BiOr* 50 (1993) 558¹⁷ (the 'norm' was designated i áb gar.ra; compare *Ur III-Fischerei* 100). This represents effectively twice the norms elsewhere attested in the Ur III period and so possibly from two-thirds to the full production of the animals concerned, although the nanny goat milk product norms registered in the same texts of $\frac{1}{2}$ (*TCTI* 1, 878) - $\frac{1}{2}$ (CT 7, pl. 34, BM 18407) sila butter oil and cheese per year are comparable in quantity to those recorded in accounts from other Ur III provinces, but like the cow production figures exhibit a 1:1 ratio between butter oil and cheese, and not 2:3 as was the rule elsewhere (either $\frac{1}{2}$ and $\frac{1}{2}$, or $\frac{1}{2}$ and $\frac{3}{4}$ sila per goat-year, respectively). See below, fnn. 45 and 78.

¹³ For the reading of the sign combination AB.KU = ùnu(d), 'herder (of large cattle)', to be contrasted with utul and PA.UDU = sipa, 'herder (of small cattle, pigs, dogs and fowl)', see H. Waetzoldt, "Das Amt des *utullu*", in: G. van Driel et al., eds., *Zikir šumim (= Festschrift Kraus; Leyden 1982)* 386-397

from a third to a half of the milk production expected to remain after the suckling of the calves and so may be considered comparable to the third rental payment expected from the grain harvest of rented fields best known from the Old Babylonian period on, but now also attested for the Ur III and the Old Akkadian periods¹⁴ The remainder of the dairy products — and these may have been much higher, dependent on the number of calves which the herders decided to keep alive or which the owner required added to the herd as part of the lease agreement with the herder — will have fallen to the lot of the herders in lieu of payment for their services in the form of food and clothing rations.

M. Stol published in 1993, in his usual concise form, a very insightful work on Ur III dairy products, in which some of these topics were discussed¹⁵. Since I have been occupied for some years with accountancy in the early stages of the Babylonian state, among other facets concerning the administration of cattle and dairy products, it seems to me worthwhile to expand on his treatment in this paper, to correct some small failings and to demonstrate that close attention paid to the formal accounting practices employed in dairy record-keeping of the Ur III period can result in dividends which might have otherwise been lost to the Assyriologist.

§ 2. Research history

The first dairy accounts from Mesopotamia to arouse scholarly interest were among the tablets stolen by local robbers from the site Tello, ancient Girsu in southern Babylonia, and sold via the Baghdad antiquities market to individuals and institutions in Europe and America. The administrative texts — from the archives of Enentarzi, and from those of the

¹⁴ See H. Petschow, “Die §§ 45 und 46 des Codex Hammurapi. Ein Beitrag zum altbabylonischen Bodenpachtrecht und zum Problem: Was ist der Codex Hammurapi?”, *ZA* 74 (1984) 181-212, and G. Mauer, *Das Formular der altbabylonischen Bodenpachtverträge* (Diss. Munich 1980) (Old Babylonian); H. Neumann, “Zum Problem der privaten Feldpacht in neusumerischer Zeit”, *Šulmu* 4 (1993) 223-233, especially 226-227 to *CST* 40 (Ur III) (the meaning of *maš a.šà.ga*, once believed to represent the rent paid for fields in this period — cf. F. Kraus, *JCS* 3 [1951] 136-138, and *WO* 8 [1975-1976] 192-193 — is now unclear; see P. Steinkeller, *JESHO* 24 [1981] 113-129, T. Maeda, *ASJ* 4 [1982] 171-172, K. Maekawa, *Zinbun* 21 [1986] 121-127, G. Mauer, *Bodenpachtverträge* 102-103); and K. Volk, “Zum Alter der Dreiteilpacht”, *NABU* 1994/25 (Old Akkadian). There is good indirect evidence for a similar system of share-cropping on public lands in the pre-Sargonic period at Girsu, in which rent was one half of harvest; see Y. Nakahara, “The Share-cropping System and the Newly-opened Land *gán-sir-la* A Study of the *uru, lal* Land” (in Japanese), *Seiyō Shigaku. Bulletin of the Japanese Society of Western History* 50 (1961) 1-12, cited by K. Maekawa, “The Rent of the Tenant Field (*gán-APIN.LAL*) in Lagash”, *Zinbun* 14 (1977) 1-4; see also P. Steinkeller, *JESHO* 24, 129-145.

¹⁵ *BSA* 7, 99-113; see also his article “Milch(produkte)” in *RIA* 8, 189-201.

temple households of the wives of his successors Lugalanda and Urukagina, all city-state rulers from the pre-Sargonic period predating the Ur III Dynasty by some two centuries contained accounts both of the age and sex make-up of cattle herds under the supervision of named herders and of the amounts of dairy products these herders were expected to deliver and really did deliver to the temple households¹⁶

The first of the two accounts found in figure 3, both of which are dated to the fifth regnal year of the énsi Enentarzi, records the apparently complete make-up of herds assigned the named herders Namdam, Mesagnudi and Ur-šugalama, including 'milk cows' (áb ga), 'immature' cows (áb GAR.UD)¹⁷, calves and two breeding bulls (gu₄ áb, 'bull of the cow'). The second account records the delivery quotas expressed in quantities of the dairy products ì áb sè ga, 'butter oil' (literally 'thrown cow oil')¹⁸ and LAK 490¹⁹ (corresponding to later ga HAR)²⁰ of the same herders

¹⁶ See the early treatments of the texts in A. Deimel, "Produkte der Viehzucht und ihre Weiterverarbeitung", *OrSP* 21 (1926) 1-14; id., *AnOr* 2 (1931) 96; J.-M. Kientz and M. Lambert, "L'élevage du gros bétail à Lagash au temps de Lugalanda et d'Urukagina", *RSO* 38 (1963) 93-117 and 198-218 (the dairy terminology was not understood by the authors, pp. 104-105); and K. Maekawa's revision of Deimel's analyses in *Zinbun* 15 (1979) 122-123.

¹⁷ The qualification GAR.UD is to my knowledge not attested in another dairy context which would help to clarify its reading and meaning. A. Deimel speculated *ad sensum* in *OrSP* 20 (1926) 3 that it might signify a type of fodder, reversing himself in *AnOr* 2, 93, with a reading šá tam, in apparent reference to the office of the *šatammu*. Recent commentators have followed the suggestion of R. Scholtz, *MVAG* 39/2 (Leipzig 1934) 35⁵, that the term qualifies a 'Trockenkuh' (see J.-M. Kientz and M. Lambert, *RSO* 38, 102; G. Selz, *FAOS* 15,1 [Stuttgart 1989] 441 to 1:1, but also Deimel, *OrSP* 20, 3!), that is, that GAR.UD is to be read nig laḥ/hád and the cows considered 'dry', 'without milk'. The numbers in the pre-Sargonic dairy texts imply that the GAR.UD cows in fact corresponded to the sexually immature cows in Ur III texts qualified mu.1/2/3, "one-, two- and three-year-olds", so that the term should refer either to their lack of milk or to their immaturity, but in both cases to 'heifers'.

¹⁸ The distribution of the butter oil qualification sè ga and dé.a, literally "thrown flat" and "poured", between texts calculating the delivery duties of herders at the time of herd inspections (gúrum, for example, *DP* 273-275, and compare the texts *Nik.* 1, 259, *TSA* 37, and *VS* 25, 24) and those recording real deliveries (mu.DU and i.dé; for example, *DP* 276, *Nik.* 1, 257, and *RTC* 64), respectively, led J. Bauer, *Altsumerische Wirtschaftstexte aus Lagasch* (StPohl 9; Rome 1972) 327, to propose the terms were accounting *termini technici*. Their restriction to dairy management, in which both would make good technical sense in the processing and delivery of oil, need not speak against this interpretation, although it may be noted that only one account, *Nik.* 1, 257 (following on *VS* 14, 89; note to K. Maekawa, *Zinbun* 15, 137, n. 87), can be offered as evidence of partial delivery of assessed duties.

¹⁹ The archaic form of the sign (𒀭); see M. Green and H. Nissen, *ATU* 2 [Berlin 1987] s.v. GA'AR) does not lend itself to pictographic identification. Note the sequence of entries in the archaic lexical list 'Vessels' (R. Englund and H. Nissen, *ATU* 3 [Berlin 1993] 30-32, 130, ll. 68-82) with GA'AR qualified by a number of ideograms which probably represent various condiments added to the cheese. See further P. Damerow and R. Englund, *ATU* 2, 152⁴³

²⁰ The now clear correspondence was first proposed in 1913 by the prescient Vienna scholar F. Hrozný in his *Das Getreide im alten Babylonien* 177 M. Civil, "Studies on Early Dynastic Lexicography III", *Or* 56, 234⁴⁶, states that while the functional equivalence of LAK 490 and ga HAR is obvious, there remain doubts about reading the sign *ga(h)ar (see above, fn. 10) without corroborating phonological evidence.

<i>DP 93</i> (Enentarzi 5)	<i>DP 274-5</i> (Enentarzi 5)	delivery per milk cow/year: 10 sila ì áb, 18 sila LAK 490
i 13 áb ga ("milk cows") '20' áb GAR.UD 3 gir <amar> sig 6 'gu ₄ amar sig 1 'gu ₄ ' áb ŠU.NÍGIN 43	i 6 dug 10 sila ì áb sè.ga 1;2,3 LAK 490 gur sag+gál	$13 \times 10 = 6 \times 20 + 10 = 130$ sila $13 \times 18 = 1;2,3 = 234$ sila
ii áb gir amar.bi.ta Nam.dam	Nam.dam	
8 áb ga 16 áb GAR.UD 6 gir amar sig 2 gu ₄ amar sig ŠU.NÍGIN '32'	4 dug ì ii 1;0,0 LAK 490	$8 \times 10 = 4 \times 20 = 80$ sila $8 \times 18 = 1;0,0 = 144$ sila
iii Me.sàg.nu.'di'	Me.sàg.nu.di	
4 áb ga 14 áb GAR.UD 1 gir amar sig 3 gu ₄ amar sig 1 'gu ₄ ' áb ŠU.NÍGIN 23 Ur.šú. ^s ùnu áb.'me ...	2 dug ì 0;2,0 LAK 490 Ur.šú.(ga.lam.ma, <i>DP 274</i>) ...	$4 \times 10 = 2 \times 20 = 40$ sila $4 \times 18 = 0;2,0 = 72$ sila

Figure 3: Comparison of the two pre-Sargonic Girsu accounts *DP 93* and *DP 274-275*. Note that the pre-Sargonic measure dug, 'jar' contained 20 sila.

for that year, from which it is possible to calculate — shown in the third column of the figure — the amounts the herders were to deliver per milk cow as 'butter oil (and cheese), property²¹ of Enentarzi' For example, according to *DP 93* the first herd administered by the herder Namdam consisted of 43 animals, of which 13 were milk cows. The second account *DP 274=275* proves that for each of these cows the administrator was required to deliver 10 Old Sumerian sila of butter oil per year, recorded as ($13 \times 10 = 130$ sila \Rightarrow) 6 dug 10 sila, whereby the sign dug represents the metrological equivalent of the ceramic jar with a capacity of 20 sila

²¹ The distinction of the adjectival use of the term *ú.rum* made by G. Selz, *Altsumerische Wirtschaftstexte aus amerikanischen Sammlungen* (FAOS 15,2; Stuttgart 1993) pp. 110-111, has no consequence for its meaning.

used to store fats²²; and 18 sila (dry capacity) of the cheese represented by the sign *LAK* 490, recorded as $(13 \times 18 = 234 \text{ sila} =) 1 \text{ gur } 2$ (barig) 3 (bán). A comparison of these figures with the neo-Sumerian delivery quotas of 5 and $7\frac{1}{2}$ sila of butter oil and cheese, respectively, is dependent on the absolute sizes of the sila measures involved. Since the most persuasive currently available evidence supports a rough correspondence

1 neo-Sumerian sila = 1 liter, and

1 Old Sumerian sila = $1\frac{1}{2}$ liters²³,

the Old Sumerian quotas seem to have been about three times the lower norms and half again as much as Lagash norms of the Ur III period, that is, ca. 5 and $7\frac{1}{2}$ liters of oil and cheese in the provinces Ur and Umma, 10 liters each of the dairy products in Lagash for the Ur III period, as opposed to 15 and 27 liters in pre-Sargonic Girsu. The difference in the numerical relationships between the two dairy products (1:1 and 2:3 in the Ur III period, 5:9 in pre-Sargonic Girsu) is likely due to accounting practices, namely that in the earlier period 10 and 18 sila were, as approximations of realistic dairy production, chosen as specific administrative quantities due to the facility with which these measures could be numerically manipulated (10 liquid sila = $\frac{1}{2}$ dug, 18 dry sila = 3 bán = $\frac{1}{2}$ barig, or, for the bookkeeper, 2 cows = 1 dug ì áb = 1 barig *LAK* 490)²⁴

²² Note the difference in notations between these (semi-)liquid measures and those of the dry capacity gur system, in which 10 sila would have been written 1(bán) 4 sila (it is assumed that the absolute size of the sila was the same in both metrological systems). The relationship of this system with the notational system used in pre-Sargonic and Old Akkadian Lagash for measures of beer and wine, in which the jar dug was divided into two or three NIGIN (read by M. Powell gurgur/gur, gur, in "Masse und Gewichte", *RIA* 7 [1987-1990] 506; cp. W. Sallaberger, *ZA* 84, 147) of, probably, 10 sila each (against Powell, loc. cit.; compare the Old Akkadian texts *ITT* 1, 1189, with 10 sila = $\frac{1}{2}$ dug [= 1 NIGIN?] of high-quality beer, and from Adab, OIP 14, no. 152, with 5 + 5 = 10 sila kaš, further OIP 14, no. 89 obv. 1, and no. 102 [summation 10 + 10 + 4 sila = 1 dug ?]), remains unclear. The most reasonable assumption is that the fractions of the dug will have represented different types of jars used to store liquids and semi-liquids, respectively (the Old Akkadian text *ITT* 1, 1372, suggests the notations 2 NIGIN/NIGIN might refer to two containers which corresponded to one dug and not to a dug of 3 NIGIN, attested, for example, in *ITT* 1, 1397, MVN 3, 114, etc.). In the archaic period, slightly different signs were used, namely, DUG₁ (with a stroke representing a spout) for liquids (beer) and DUG₂ (without a spout) for semi-liquids (butter oil). See my "Grain Accounting Practices in Archaic Mesopotamia", in: J. Høyrup, ed., *Changing Views on Ancient Near Eastern Mathematics* (Berlin forthcoming).

²³ See *Ur III-Fischerei*, p. XVI⁵ In my opinion, the correspondence between delivery norms for butter oil exacted from Old Sumerian herders from Girsu and those apparently required of their neo-Sumerian successors, namely in both cases 10 sila per year, is fortuitous. Most likely, the absolute size of the bán, and not that of the sila, remained more or less constant in Lagash in the second half of the third millennium, representing a capacity of ca. ten liters.

²⁴ The Old Babylonian rates in Ur may have been 12 sila of ì nun and 18 sila of ga HAR, that is, more comparable to pre-Sargonic Girsu norms, according to the a.ru a text UET 5, 821 (obv. 3-4: 0;1,0 ì nun bi-la-si-na / 0;1,3" ga HAR, "(of five cows), 1 (barig)

Moreover, the posited absolute dairy product measures would, according to the technical considerations made above, represent the full milk production of those adult cows suckling calves, since 15 liters of butter oil can be processed from 300–400 liters of milk, dependent on fat content of the milk and water content of the butter oil. Assuming that the cows did in fact calve each year, this suggests that there may have been a crucial difference in the administration of dairy cattle in state herds in the Old Sumerian and the neo-Sumerian periods. herders in pre-Sargonic Lagash served merely as employees of the state, delivering the full or at least a high proportion of the production of their herds to central administrators, whereas neo-Sumerian herders acted as contractors who assumed full responsibility for the cattle assigned them by the state; these herders, comparable to the overseers (*ugula*) of other Ur III economic units, held state capital in lease, compensated the state for use of the cattle with a yearly payment of a fixed fraction of available dairy production, and remained, at risk of personal loss, responsible both for the current numbers of cattle given them by state agencies and for a certain growth in the herd.

That this expected herd growth in the Ur III period also bore an artificially defined relationship to the number of adult cows in assigned herds was apparent in a large account published more than 80 years ago. The tablet AO 5499 was sold in 1910 to the Louvre museum together with a large lot of tablets pilfered from neo-Sumerian levels of a site located in the north of the heartland of the Ur III empire. This text, published in 1911 in H. de Genouillac's *Textes cunéiformes du Louvre*, vol. 2, came from the settlement Drehem, ancient Puzriš-Dagan, an administrative center south of Nippur established by Šulgi in his 39th regnal year to oversee the then instituted system of domestic and colonial tribute and exchange of the Ur III state as well as to guarantee the provisioning of the temples and thus the politically important priesthoods of cults in Nippur.

The tablet itself contained an account of the organization and administration of a herd of cattle dating from its establishment in the year Šulgi 39 the year in which the king “built the house of Puzriš-Dagan” through Šulgi 48, the year of the king's death (see figures 4-5). For each year, the account records the number of cattle in the herd, differentiated according to sex and age, followed by notations representing measures of

butter oil is their ‘yield/tax’, (together with) 1 (barig) 3 (bán)¹² cheese”; see K. Butz, *WZKM* 65–66, 42, and note that the relationship 2:3 was maintained). Compare the unusual situation reflected in the Kassite text BE 14, 99a, of deliveries of 5 sila i nun per cow *with*, and just 2½ sila per cow *without* calf (possibly referring to a cow in its second year of lactation).

the butter oil *i nun* and the cheese *ga HAR*. For instance, the partially reconstructed first section contains entries representing an initial stock of four adult cows together with one heifer calf and one bull calf. The notations of the next two entries represent a butter oil equivalent (*i nun bi*) of 2 (*bán*) = 20 sila and a cheese equivalent (*ga.HAR.bi*) of 3 (*bán*) = 30 sila. Division of the two numbers by the known quotas of 5 and 7½ sila of butter oil and cheese, respectively, shows that the amounts represent the expected delivery of four milk cows. In succeeding years noted in the account, more calves appear and the calves from the previous years are noted, qualified by signs representing their advancing age (see figure 5 and the table below). The full-grown cows in their fourth years were expected to calve and produce milk for the first time²⁵. Mentioned in passing in A. Deimel's treatment in 1926 of the cattle records from pre-Sargonic Girsu²⁶, this text was first analyzed more than half a century after its publication by the Chicago scholar I. J. Gelb, who recognized the highly involved structure of the account and who, based on the terminology in the text, was able to describe the key terms of cattle breeding and dairy production of the Ur III period²⁷.

Gelb's analysis was nonetheless flawed in two ways. In the first case, he misinterpreted the equivalents of numbers of milk-producing cows and yearly delivered butter oil and cheese, basing the per-cow delivery on the number of milk cows documented in the running rather than the previous year. This logical mistake was corrected in a Japanese publication in 1977²⁸. In the second case, Gelb and following him the Japanese Sumerologists T. Maeda and T. Gomi assumed that TCL 2, 5499, was a real account; it was not. The fact that the text records only amounts of butter oil and cheese deliveries which we know to be yearly production norms; that the ten year span of the text saw no deaths of adult animals, indeed, seemed to document the uninterrupted calving and milking of cows into

²⁵ This rule of thumb for the Ur III period may well be based on the expected beginning of the oestrus cycle among sedentary animals in southern Mesopotamia and not a reflection of a conscious herding decision to delay calving into a more stable age. See G. Dahl and A. Hjort, *Having Herds* 33-37; K. Butz, *WZKM* 65-66, 43¹⁰⁷.

²⁶ *OrSP* 21, 11-12; Deimel's calculation of the cheese/silver equivalence was, however, incorrect.

²⁷ "Growth of a Herd of Cattle in Ten Years", *JCS* 21 (1967) 64-69.

²⁸ T. Gomi, *JESHO* 23, 1-42, citing p. 13 an article in Japanese by T. Maeda published in 1977. The point is that beginning in Šulgi 43 (year 5 of the account) each year one heifer comes of age, having calved and entered the category *áb máḥ*. This being the first year in which the cow will have produced milk and assuming cows were serviced to calve late in their fourth year, it was not included in the debit calculation of yearly deliveries of butter oil and cheese. As is evident in figure 5, the first entry of the section recording the year following Šulgi 48, Amar-Suen 1, would have read 12 *áb máḥ*, since in this year for the first time *two* heifers would have calved and entered the adult age category.

i	Obverse ii	iii
[4 áb máh] [1 áb amar ga] [1 gu ₄ amar ga] [ì.nun.bi 0;0,2 [ga.ĤAR.bi 0;0,3 mu é Puzriš- ^d Dagan ba.dù (Šulgi 39)	[4] áb máh [1] áb mu.3 [1] áb mu.2 1 áb mu.1 1 áb amar ga 1 gu ₄ mu.3 1 gu ₄ mu.2 1 gu ₄ mu.1 1 gu ₄ amar ga ì.nun.bi 0;0,2 ga.ĤAR.bi 0;0,3 Šulgi 42	1 áb mu.3 1 áb mu.2 1 áb mu.1 1 áb amar ga 2 gu ₄ gal 1 gu ₄ mu.3 1 gu ₄ mu.2 1 gu ₄ mu.1 2 gu ₄ amar ga ì.nun.bi 0;0,2,5 sila ga.ĤAR.bi 0;0,3,7 1/2 sila
4 áb máh 1 áb mu.1 1 áb amar ga 1 gu ₄ mu.1 1 gu ₄ amar ga ì.nun.bi 0;0,2 ga.ĤAR.bi 0;0,3 Šulgi 40	5 áb máh 1 áb mu.3 1 áb mu.2 1 áb mu.1 1 áb amar ga 1 gu ₄ gal 1 gu ₄ mu.3 1 gu ₄ mu.2 1 gu ₄ mu.1 1 gu ₄ amar ga ì.nun.bi 0;0,2 ga.ĤAR.bi 0;0,3 Šulgi 43	Šulgi 44 7 áb máh 1 áb mu.3 1 áb mu.2 1 áb mu.1 2 áb amar ga 3 gu ₄ gal 1 gu ₄ mu.3 1 gu ₄ mu.2 2 gu ₄ mu.1 1 gu ₄ amar ga ì.nun.bi 0;0,3 ga.ĤAR.bi 0;0,4,5 sila
4 áb máh 1 áb mu.2 1 áb mu.1 1 áb' amar ga 1 gu ₄ mu.2 1 gu ₄ mu.1 1 gu ₄ amar ga ì.nun.bi 0;0,2 ga.ĤAR.bi 0;0,3 Šulgi 41	6 áb máh	Šulgi 45

Figure 4a: Transliteration of the artificial account *TCL 2, 5499*, obverse face (the regnal years follow M. Sigrst and P. Damerow, *Mesopotamian Yearnames* [preprint Berlin 1991]; áb máh / gu₄ gal = 'full-grown cow/bull', áb/gu₄ mu.1/2/3 = 'one-, two-, three-year-old heifer/bull', áb/gu₄ amar ga = 'heifer/bull calf' [literally 'cow/bull-calf-milk']).

their 15th year; that without exception calves were noted in successive years at a rate of one calf per two milk cows²⁹ and always in succession

²⁹ In years based on odd numbers of adult cows, the "half-calves" were disregarded. Note that the scribe made a mistake in Šulgi 46 of the account, recording just 3 instead of the 4 calves for the year required by the first entry 8 áb m áh of the section, and that this mistake was not corrected in the following two recorded years; the calculated amount of cheese was, moreover, for this same year false (47½ sila instead of correct 7 × 7½, or 35 × ½ = 52½). This latter miscalculation was, however, corrected in the totals of the text (reading rev. vi 5: ŠU+NIĞIN I;1,5',2½ sila ga ĤAR gur [collated; from (30 × 5) + 37½ + 45 + 52½ + 60 + 67½]; this 'correction resulted from a simple multiplication of the correct total of butter oil by ½).

vi	Reverse v	iv
ŠU+NÍGIN 18 áb.ĥi.a ŠU+NÍGIN 14 gu ₄ .ĥi.a ŠU+NÍGIN 0;4,3,5 sila ì nun ŠU+NÍGIN 1;1,5;2 1/2 sila ga ĤAR gur kù i.ba 1/3 ma.na 7 1/2 gín kù ga.ba 2 2/3 gín 15 še níg.ka ₉ .ak <i>I-du-a</i> dumu <i>I-sú-a-rí-ik</i> sanga ^d Ištaran	10 áb máĥ 2 áb mu.3 1 áb mu.2 2 áb mu.1 3 áb amar ga 7 gu ₄ gal 1 gu ₄ mu.3 2 gu ₄ mu.2 2 gu ₄ mu.1 2 gu ₄ amar ga ì.nun.bi 0;0,4,5 sila ga.ĤAR.bi 0;1,0,7 1/2 sila Šulgi 48	8 áb máĥ 1 áb mu.3 1 áb mu.2 2 áb mu.1 1 áb amar ga 4 gu ₄ gal 1 gu ₄ mu.3 2 gu ₄ mu.2 1 gu ₄ mu.1 2 gu ₄ amar ga ì.nun.bi 0;0,3,5 sila ga.ĤAR.bi 0;0,5,2 1/2' sila Šulgi 46
	9 áb máĥ 1 áb mu.3 2 áb mu.2 1 áb mu.1 2 áb amar ga 5 gu ₄ gal 2 gu ₄ mu.3 1 gu ₄ mu.2 2 gu ₄ mu.1 2 gu ₄ amar ga ì.nun.bi 0;0,4 ga.ĤAR.bi 0;1,0 Šulgi 47	

Figure 4b: Transliteration of the account *TCL* 2, 5499, reverse face (column vi reads: "Together: 18 diverse cows, together: 14 diverse bulls, together: 4(barig) 3(bán) 5 sila of butter oil, together: 1 gur 1(barig) 5(bán) 2 1/2 sila of cheese; silver (equivalent) of the oil involved: 1/3 ma.na 7 1/2 shekels, silver (equivalent) of the cheese involved: 2 2/3 shekels 15 grains. Account concerning *Idüa*, son of *Issu-arik*, temple administrator of *Ištaran*.")

bull calf – heifer calf – bull calf – etc., that the text totals the ideal butter oil and cheese deliveries of all ten years and converts this total into a silver equivalent, a procedure which might be expected of an artificial account displaying the total return on a initial capital outlay and which has no counterpart in the tens of thousands of real Ur III administrative documents, but which moreover according to our understanding of these

accounts could not exist — all of these facts make clear the entirely theoretical nature of TCL 2, 5499³⁰

Yet it is precisely because this text is a theoretical exercise that it is so important for our understanding of the terminology and the accounting procedures used in Ur III dairy administration. No less than the applied mathematics evident in many problem texts of the Old Babylonian period³¹, TCL 2, 5499, represents an applied theory of accounting in which those elements of dairy administration expressed in the account that have attested counterparts in real ledgers prove a detailed correct knowledge of the accounting of the time. On the level of such details, for example, the silver equivalencies 1 shekel = 10 sila i nun and 150 sila ga HAR, implicit in the final computation of the text³², are found to mirror contemporaneous value norms³³

³⁰ I first stated this conviction in *Ur III-Fischerei* 43-46 (and compare K. Butz, *WZKM* 65-66, 43¹⁰⁸; S. Dunham, *RA* 76 [1982] 41), and the point was further made in H. Nissen, P. Damerow and R. Englund, *Frihe Schrift und Techniken der Wirtschaftsverwaltung im alten Vorderen Orient* (Bad Salzdetfurth/Berlin 1991) 139-144 (available in English translation as: *Archaic Bookkeeping* [Chicago/London 1993] 97-102); see most recently J. Friberg, "Mathematik", in: *RIA* 7 (1987-1990) 542. Soft evidence for the artificial nature of AO 5499 may be found in the fact that the persons recorded in the text's colophon are otherwise unknown in connection with dairies in Drehem or elsewhere in the Ur III period. It may be added, finally, that the inclusion of adult males in the books of a dairy herd would also be unheard of in such accounts, since these animals with the exception of one or two breeding bulls would have been castrated and set to the plow and thus transferred to another administrative unit, that of the en gar and nu banda gu. See generally I. J. Gelb, "Household and Family in Early Mesopotamia", *OLA* 5, 18-22; K. Maekawa, "The Agricultural Texts of Ur III Lagash of the British Museum (IV)", *Zinbun* 21 (1986) 91-103; id., "The Management of Domain Land in Ur III Umma", *Zinbun* 22 (1987) 25-82, esp. 37-40.

³¹ See J. Friberg, "Mathematik", *RIA* 7, 531-585, especially 568-570, and now K. Nemet-Nejat, *Cuneiform Mathematical Texts as a Reflection of Everyday Life in Mesopotamia* (AOS 75; New Haven 1993).

³² The implicit equivalencies are found in the conversions of 0;4,3,5 = 275 sila i nun (rev. vi 4) into 27½ shekels of silver (vi 6) and of 1;1,5,2½ = 412½ sila ga HAR (vi 5) into 2¾ shekels (vi 7).

³³ For dairy oil see D. Sharashenidze, *VDI* 1976/3, 110-111 (Amar-Suen 4, Umma), rev. 37: ŠU+NIGIN 5 sila i nun kü.bi ½ gin (thus 10 sila oil per shekel silver), T. Gomi, *Selected Neo-Sumerian Administrative Texts from the British Museum* (Abiko 1990; in the following = *SNAT*) 382 obv. 5-9: 3 gin kù / 1;0,0 še gur / i.nun.bi 0;0,4 / A.tu šu ba.ti (1 shekel silver = 1 gur grain = 1 bán i nun) and the treatment below of the Umma text MVN 15, 108; note further the rate of 10 sila per shekel silver in the Umma text T. Gomi, *SNAT* 302 (dated to Šulgi 48) obv. i 1-2 (and compare the same rate of 1 shekel silver per bán dairy oil in Old Babylonian Ur in UET 5, 607 obv. 5, 36, rev. 40: 52 and 57), and the rate of 8 sila per shekel for the oil i nun.HA derived from goat's milk attested *passim* in the Ur accounts UET 3, 1198, 1514 (both texts Ibbi-Sin 3) and UET 9, 916 (the qualification HA of the goat's butter oil recorded in Ur texts may indicate either a more highly prized oil or a regional value difference, since the cheese from the same goats' milk was recorded with the silver equivalence of 150 sila per shekel attested for cow milk cheese in TCL 2, 5499, and since according to the account *SET* 130 treated below and possibly the Girsu texts cited by G. van Driel, *BiOr* 50, 558¹⁷, dairy products from nanny goats and cows were apparently value equivalent and possibly even mixed by herding supervisors in Umma and Girsu [this practice is common, for example, in modern Syria; see L. Sweet, *Tell Toqaan. A Syrian Village* (Anthropological Papers, Museum of Anthropology, University of Michigan no. 14; Ann Arbor 1974) 102]; that our data from Umma derive from late Šulgi and Amar-Suen, those from Ur from Ibbi-Sin, during whose reign equivalence values became unhinged [see T. Gomi, "On the Critical Economic Situation at Ur Early in the Reign of Ibbisin", *JCS* 36 (1984) 211-242],

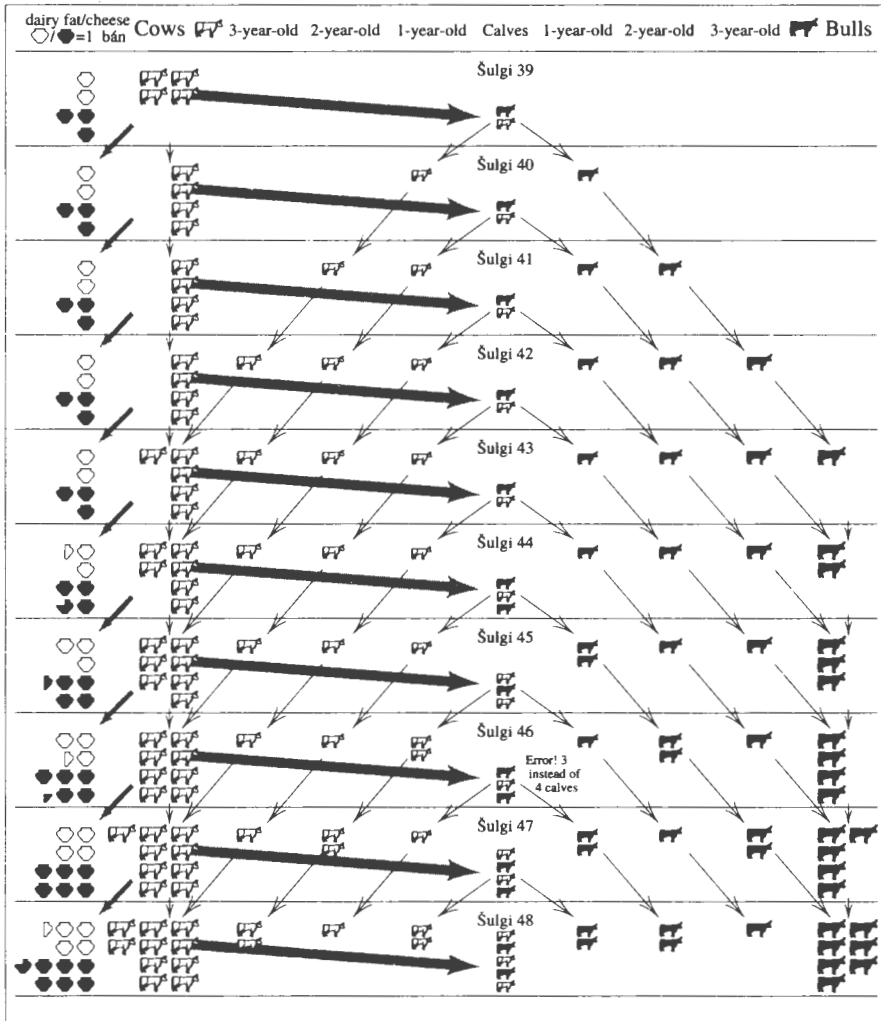


Figure 5: Analysis of the artificial dairy herd account *TCL 2, 5499*, after H. Nissen, P. Damerow and R. Englund, *Archaic Bookkeeping* (Chicago 1993) 101, fig. 78. Note that two errors were made in the section representing *Sulgi 46*: three instead of four calves recorded as born, and $47 \frac{1}{2}$ sila of cheese instead of the correct total of $(7 \times 7 \frac{1}{2}) = 52 \frac{1}{2}$.

should be mentioned as factors possibly skewing the reliability of inferences drawn here). Dairy oil was thus in the expensive range for oils available through the exchange markets of the *dam.gār*. Vegetable oil was handled at a rate of 9-15 sila per shekel, lard at 20 sila and fish oil at 30 sila, for which see D. Snell, *Ledgers and Prices: Early Mesopotamian Merchant Accounts* (YNER 8; New Haven/London 1982) 151-154. For goat's cheese see UET 3, 1198, 1514 and UET 9, 916 (150 sila per shekel silver; see above), and, at a rate of 180 sila per shekel in Umma, Gomi, *SNAT 302 obv. ii 10-11*. The only known reference for a silver correspondence to the cheese qualified *ga uḍgunū* (certainly a variant of *ga ḪAR*) is found in the text *VDI 1976/3, 110-111, rev. 39*: 3 sila *ga uḍgunū kù.bi 3 še*, that is, also 180 sila per shekel, in conformity with the likely interchangeability of these qualifications of cheese from cow and goat's milk in Umma.

On a general level of administrative structures, state-controlled dairy production conformed, according to the text, to a rigid accounting format. The state acted as legal owner of herds of cattle, consisting of breeding bulls, adult cows, and male and female juveniles. Book was kept of the sex and age of the juvenile animals, recording the following categories³⁴:

	<i>females</i>	<i>males</i>
adult	áb máḥ	gu ₄ gal
juvenile in 3rd year	áb mu.3	gu ₄ mu.3
juvenile in 2nd year	áb mu.2	gu ₄ mu.2
juvenile in 1st year	áb mu.1	gu ₄ mu.1
sucking juvenile	áb amar ga	gu ₄ amar ga

These living "capital resources" of the state were placed at the disposal of cattle herders who were to tend animals and thus guarantee for their well-being, care for the yearly calving of the adult cows and, once having calved, for the production of milk and its derived products butter oil and cheese. The state required, beyond the yearly increase of the herd at a rate of one calf per two adult cows³⁵, 5 sila, i.e., ca. 5 liters, of the butter oil qualified *ì nun* and 7½ sila (liters) of the cheese qualified *ga ḤAR*, or their equivalents either in value or in inherent contents in a number of different dairy products, including raw or soured milk.

§ 3. Recent publications concerning Ur III dairy accounts

In an article published in 1980, T. Gomi³⁶ corrected the representations of Gelb of a fluctuating milk productivity attested in the large Drehem account AO 5499, and at the same time buttressed the assumed production norms of 5 sila of butter oil and 7½ sila of cheese in the Ur III period with an assessment of a large number of dairy accounts from Ur, most of which had been published some 43 years earlier. For example, the account UET 3, 1215 (Ibbi-Sîn 8), apparently consolidates a large number of individual accounts of the delivery norms and real deliveries of named herders. Rev. vii 9-21 reads:

³⁴ Compare F. Kraus, *Staatliche Viehhaltung im altbabylonischen Lande Larsa* (Amsterdam 1966) 42-44.

³⁵ The halving of the nominally expected fertility rate of one calf per cow per year may have had a number of causes. The first should be a combination of expected fertility rates of the cows (see above, fn. 2) and the death rates of juvenile animals (10% is common with intensive husbandry; see G. Dahl and A. Hjort, *Having Herds* 37-38), but the accounting 'survival rate' may also have resulted from a conscious decision not to lead cows in heat to bull servicing and so to exploit a two-year lactation cycle, or from necessary or willful culling of juvenile animals from the herd in the course of breeding and feeding techniques, of deliveries to cult sacrifices or of compensation for the herders, as a result of which calves were simply removed from state books.

³⁶ See above, fn. 10.

<p>3 áb i.bi 0;0,1,5 sila</p> <p>ga.ĤAR.bi 0;0,2,2 ½ sila</p> <p>šà.bi.ta 0;0,1,4 sila i 5⁵/₅ sila ga ĤAR 0;0,1,5 sila 10 gín ga še₇(SIG₇).a i.bi 1 sila ga.ĤAR.bi 1½ sila mu.DU LÁ+NI <erasure> i LÁ+NI 0;0,1,5 sila 10 gín ga ĤAR</p> <p>Lú.⁴Utu ùnu</p>	<p>3 (milk) cows, the (butter) oil involved: (3 × 5 =) 1 (bán) 5 sila, the cheese involved: (3 × 7½ =) 2 (bán) 2½ sila</p> <p>Therefrom: 1 (bán) 4 sila oil, 5⁵/₅ sila cheese, 1 (bán) 5 sila 10 shekels ...-milk³⁷: the oil involved: (15½ + 15 ≈) 1 sila, the cheese involved: (1 × 3½ =) 1½ sila, are the deliveries. The deficit: (15 - (14 + 1) =) <nil> oil The deficit: (22½ - (5⁵/₅ + 1½) =) 1 (bán) 5 sila 10 shekels cheese, (Account concerning) Lu-Utu, the cow herder.</p>
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Similar accounts from Ur and Umma cited by Gomi demonstrate the systematization there of these norms in the Ur III period³⁸, which he seems to believe represented actual production figures of the time³⁹. The artificially even numbers evident as calculated delivery norms in debits sections of accounts contrast with the credits sections of the same accounts and with other texts — receipts and transfer confirmations — which record real deliveries of dairy products. In these accounts, the measures of oil and cheese are not evenly divisible by the known delivery norms of 5 and 7½ sila, respectively, nor do they exhibit the relationship of 2:3 between oil and cheese expected in the former texts⁴⁰.

Despite the advances in our understanding of Ur III dairy accounting made by Gomi, the broad structure of state-controlled herding, the entirely artificial nature of delivery norms and the concomitant importance of the equivalence values expressed in dairy accounts, and, as a crux in this discussion, the meaning of the product ga še(SIG₇).a, which Gomi considered a type of cheese⁴¹, remained unclear. In a short examination published

³⁷ For the reading and significance of the qualification see below, § 4.2.2.

³⁸ See UET 3, 1216, UET 9, 894, 985, 1103 (all dated to Ibbi-Sîn 7 or 8); for a general description of the accounting terminology found in Ur III dairy accounts see *Ur III-Fischerei* 13-55. The deficit LÁ+NI, as I have stated there, was an artificial equivalent value to be paid the state by the herders involved; for example, the account UET 3, 1218 (Ibbi-Sîn 8/xii), records amounts of both i nun and ga ĤAR, qualified (ll. 3-6) «LÁ+NI».ám / ùnu.e.ne / in.PI.gál / su.su.dam, “are the deficit, entered against the herders, to be replaced”

³⁹ *JESHO* 23, 1³

⁴⁰ See, for example, the texts UET 3, 1038, 1043, 1067, 1217; UET 9, 911, 1007.

⁴¹ See *JESHO* 23, 3¹⁸ and 5. The author seems to have assumed the position taken by A. L. Oppenheim, AOS 32, pp. 7-8 and 47, that ga in both ga SIG₇.a and ga gazi was an abbreviation of ga ĤAR (the phantom ga.àra.sig₇.a in K. Butz, *WZKM* 65-66, 38, is to be stricken). Oppenheim's understanding, loc. cit., of ga gazi as ga gáz, “crushed cheese”,

in 1990 of the accounting terms found in Ur III dairy accounts, I attempted to point out that the clear distinction in the managers' books between products contained in the debits section of accounts described by the term *sag niḡ gur₁₁.ra(k)*, literally 'head of the goods', and those contained in the credits sections described by the enclosing notation *ša bi.ta .. zi ga*, 'therefrom: .. deducted', must be evident in any treatment of dairy terminology. Thus dairy accounts assume the same general form as accounts known from other administrative units of the Ur III economy:

- 1) DEBITS = *sag niḡ gur₁₁.ra(k)*
 - a) *si i tum LÁ+NI* of the preceding accounting period, expressed in standardized values
 - b) (*úgu*): state property given over to supervisors as 'investment', converted into standardized values
- 2) CREDITS = *ša.bi ta ... zi ga àm*
delivered real products and real work and allowances, converted into standardized values
- 3) BALANCE: debits minus credits
DEBITS greater than CREDITS:
a deficit *LÁ+NI* (probably to be read *lá ià*) will appear as *si.i tum* in the debits section of the following account, or be otherwise dispensed of
CREDITS greater than DEBITS:
a surplus *diri* will appear as *diri* (or *diri niḡ ka₉.ak*) in the credits section of the following account, or be otherwise dispensed of
- 4) COLOPHON: "Account (*niḡ.kā, ak*) concerning ", Date

According to this scheme, the debits represent essentially artificial and state-owned, the credits real quantities and measures of goods and services delivered to the state by contracted managers. We might imagine the following arrangement between a representative of the central administration and a contracted herder in the Ur III period. the herder PN assumes responsibility of 10 milk cows and a breeding bull for one year from an administrator in Ur. At the end of the year, PN must prove he delivered to state agencies to cult personnel, to exchange agents of the state, etc. the equivalent of ($10 \times 5 =$) 50 sila of the butter oil *i nun* and of ($10 \times 7\frac{1}{2} =$) 75 sila of the cheese ga *ḤAR*. Further, he must return or ac-

is, despite the likelihood that pulverized *kašk* would fill approximately a third less space than the corresponding intact cheese balls, erroneous. The sign *gazi* is not attested in this meaning in the third millennium, *gaz* is never found in Ur III texts together with *ga* (*ḤAR*), and the text MVN 2, 130, cited below, fn. 71, states that soured milk (*ga še a*) was employed to make *ga mun.gazi*. The sign combination *mun gazi* was a general designation of spices and herbs including the product *gazi*. See also fn. 70 below.

count for the 11 head of cattle, possibly together with 5 calves born in that year. State accountants have issued receipts for the specific deliveries of the herder made during the accounting year, presumably each time in duplicate, one for the receiving agency and one for the herder or his supervisor. The products noted in these receipts are all the real dairy products which the herder has delivered, including soured milk and products derived from soured milk. These receipts are gathered and recorded in an account of the form discussed above, whereby in summations all dairy products other than *ì nun* and *ga HAR* are by means of known value equivalencies expressed in terms of butter oil and cheese. Let us assume our herder delivered in the year in question altogether 35 *sila ì nun* and 60 *sila ga HAR*, further 150 liters of the product *ga SIG₇.a* which, as we have seen above, corresponds to $(150 \div 15 =) 10$ *sila* of dairy oil and $(10 \times \frac{3}{2} =) 15$ *sila* of cheese. The total of 45 *sila* butter oil is 5 below the required delivery and these 5 *sila* will be entered in the account as a deficit to be repaid the state; that of 75 *sila* cheese fulfills the required norm. How and in what form the herder replaces the 5 missing *sila* of oil is of no particular consequence to the state. He can deliver more oil to fulfill his quota, or he can submit an amount of another product or, for example, of silver to cover the debt. He can also again assume responsibility for the herd, and carry the debit into his second year; in this case, these 5 *sila ì nun* will appear as the first entry in the debits section of the account covering the second year, so that the total debit for that year will be $(5 + (10 \times 5) =) 55$ *sila* butter oil and $(10 \times 7\frac{1}{2} =) 75$ *sila* cheese. We know from accounts of other Ur III economic entities the best documented are those of the trade agents *dam.gàr*⁴² that this procedure can and does go on year for year.

§ 4. New key texts in Ur III dairy accounting

Although Ur III dairy accounts known to me do not record the movement of the actual cattle, they do give ample evidence of the movement of artificial and real amounts of dairy products in full accordance with the example given above. Two texts in particular make very clear the nature of this dairy bookkeeping in the province Umma. The first account, *SET* 130, published a quarter of a century ago by T. Jones and J. Snyder, has only recently been the subject of more interest and is now, as a consequence of collations by J. Carnahan and K. Hillard⁴³, much better understood. Follow-

⁴² See *Ur III-Fischerei* 34-35¹¹⁵

⁴³ Collations of *SET* 130 were first published in 1986 by M. Cooper and J. Snyder (*ASJ* 8, 318); the authors, however, paid no apparent attention to the numbers in the account. Carnahan

ing a short discussion of this text, the second, and for an analysis of Umma dairy management more important account, MVN 15, 108, published in 1991 by D. Owen, will be more fully considered.

§ 4.1 SET 130

The Umma account SET 130, dated to Amar-Suen 4, records the activities of the high official Ur-e'e, supervisor of imposing herds of small cattle (sheep and goats) and responsible for the deliveries of their products. The account contains in standard format the sections 1-4 outlined above. In the first, debits section (obverse i 1 to vi .250), the supervisor assumes responsibility for sheep, goats and measures of butter oil and cheese (i n u n and ga UDgunû = ga HAR) qualified as remaining arrears from the previous accounting year Amar-Suen 3, together, in his running account, with large numbers of sheep and goats and products from these animals⁴⁴, including wool (siki), goat's hair (siki ud₃) and, from the goat herders under his supervision, the same milk products butter oil and cheese⁴⁵. As

and Hillard offered important and very detailed new collations in 1993 in *ASJ* 15, 207-210, with corrections and additions by the latter in *ASJ* 16 (1994) 309. I might take this opportunity to express my thanks to K. Hillard for his precise response to my inquiries after this text and for his considered rebuttal of several of my preliminary suggestions.

⁴⁴ Note also the inclusion in this running debit account, obv. ii 64-68, of five shekels of silver, set in equivalence to 10 sheep with fleece, qualified further as the repaid arrears of the household of the en (5 gin kù.babbar udu.bar./gál.bi 10.àm / LÁ+NI su.ga udu nam./en.na / ki PN.ta; nam.en.na is not bitrú, see *CAD* B s.v., H. Waetzoldt, *Untersuchungen zur neusumerischen Textilindustrie* [Rome 1972] 31-32, and K. Butz, *WZKM* 65-66, 22-23³⁸). The same amount of silver was booked out of the credits section of the account, rev. ix 364-369, and into the running debit account of the Umma silver official and Ur-e'e's son Lukala (úgu Lú.kal.la ba.a.gar; for the genealogical relationships among individuals named in the dairy accounts see below, fn. 52).

⁴⁵ Obv. ii 89 - iii 119, ending with ki sipa ud₃.da [k]e₃.ne.t[a]. This section of the account contains the calculated deliveries of animals (ud₃.máš hi a), milk products and goat's hair from three named goat herders, from two other herders only amounts of goat's hair. Since the amounts of butter oil and cheese recorded in these entries must be based on a yearly norm of ½ and ¼ sila, respectively, per nanny goat (the same assumption must be made for the second section of *AUCT* 2, 391, to be noted to M. Stol, *BSA* 7, 102), it is possible to calculate the number of goats producing milk (see figure 6) and so to see that the first entry in each of the subsections must represent not the number of animals in the care of the individual herders, but rather the number of animals which they were required in the accounting year Amar-Suen 4 to deliver, through the office of Ur-e'e, to state institutions. It may be mentioned in passing that the mean exchange rate for small cattle, regardless of sex and age, was generally ½ shekel silver per animal [in MVN 17, 5, BM 12234, rev. ii 1-2, ½ shekel for billy goats, as in the Old Babylonian period for sheep and goats; see F. Kraus, *Staatliche Viehhaltung* 62; K. Butz, *WZKM* 65-66, 21-22], and that this exchange rate represented approximately 1/10 of that current in the Ur III period for cows (only two references to exchange values for cows from the Ur III period are known to me: *ITT* 3, 6598 [= A. Falkenstein, *NG* 2, no. 187] rev. 1-2 [6½ shekels silver, from Girsu] and *NATN* 741 obv. 1-3 [6 shekels for a two-year-old heifer, from Nippur; see P. Steinkeller, *Sale Documents of the Ur-III-Period* (FAOS 17; Stuttgart 1989) p. 138, table 11 and below, for this text and for Ur III and Old Babylonian references to oxen values], but compare the apparent value equivalence of 1 gu₃ and 10 sheep and goats in deliveries to Drehem, noted in P. Steinkeller, *SAOC* 46, 30-35 [the sources of his standard livestock prices are not obvious], and in my "Ur III Sun-

part of his debits, Ur-e'e also assumed responsibility for the milk production of four named cow herders⁴⁶ with herds including from 6 to 25 milk cows (see figure 6). To each of the subtotals of dairy oil, that is, to that of the nanny goats and to that of the milk cows, is added an amount of oil corresponding to exactly $\frac{1}{15}$ of the subtotals. These entries are qualified *ŠU.GIRgunū* and seem to refer to a type of surcharge assessed to the butter oil⁴⁷.

The credits of *SET* 130 (section 2 of the standard format; obverse vi 251 to reverse xiii 543) contain the real deliveries made by Ur-e'e and his representatives. The registration of these deliveries includes notations representing the same animals and products recorded in the first section of the account, including variously qualified products such as *siki kur.ra*, *siki gi* and *siki gú na* (reverse ix 380-383, 393-394, xii 518), referring to the wool shorn from particular types of sheep (*udu kur ra*, *uli.gi* and *gú.na ku₅ a ur₅.a*)⁴⁸, and *ga gazi* and *ga še a* (reverse ix 399 and 401, x 415 and 419), referring to a particular type of cheese and to raw or soured milk, respectively. The meaning of the latter terms is considered below. In summations, the scribe includes variously qualified products in the general categories of wool, goat's hair, butter oil

dries", *ASJ* 14 [1992] 98, n. 46), i.e., that the exchange values of the animals was reflected in part by their expected milk production. Note that neither in this text nor in any other Ur III accounts are milk products from ewes recorded (the product *i udu* attested, for example, in D. Snell, *Ledgers and Prices* no. 10, pl. XVII-XVIII, rev. iv 1, is a mutton fat or tallow derived from cooking off the fat from slaughtered sheep and possibly, as later, other animals; the exchange value of 20 sila per shekel silver is the same as that for lard; cf. the references to *lipú* in *CAD* s.v., esp. § 1.b [the presumably late Babylonian reading *lib₁* of *LU₁₀* derived from this word, cited by M. Civil, *AuOr* 5 (1987) 30, is otherwise not attested]), which in the early Babylonian periods are only documented in archaic texts from Uruk (M. Green, "Animal Husbandry at Uruk in the Archaic Period", *JNES* 39 [1980] 9). I suggested in "Late Uruk Pigs and Other Herded Animals", in: R. Dittmann, U. Finkbeiner, and H. Hauptmann, eds., *Festschrift Boehmer* (Tübingen, 1995) 128¹⁷, that insofar as nannies produce no more than 50% more milk than ewes and remembering that sheep milk on average contains close to 50% more dairy fat than that of goats, the presumed difference of butter oil quotas set for these animals in Uruk accounts — goat herders were to deliver from 5 to 10 times as much butter oil as sheep herders — was probably due to the personal share accorded the latter, in later periods fully given over to shepherds as partial compensation for their herding duties. The delivery norms of dairy products from goats in the Ur III period remains exceptionally low, considering the fact that these animals probably formed parts of flocks tended by transhumant herders, that they will have enjoyed on average much better feed than their sedentary bovine counterparts and that well-tended modern milch goat breeds can produce 800 kg of milk per lactation, early breeds probably no less than half of this amount (see M. French, *Observations on the Goat* 93-129); compensation of goat herders might then have been essentially comparable to that of sheep herders, whereby in both cases greater value was placed on delivery of wool or hair.

⁴⁶ Obv. iii 120 - iv 137, ending with *ki ù nu dè ne.ta* As may be expected, none of the herders are contained in the corresponding section of the other comparable account from Umma, *MVN* 15, 108, concerning the activities of another supervisor *Atu*, for which see below.

⁴⁷ See the discussion below, § 4.2.1.

⁴⁸ See J. Carnahan and K. Hillard, *ASJ* 15, 207

<i>Debits</i>			
<i>lines:</i>	<i>ì nun</i>	<i>ga UDgunû</i>	<i>milk cows/goats</i>
4-7	0;4,4,5 4 ² / ₃	5;0,5,8 58	= si.l.tum
90-92	0;0,3,6 30 × ³ / ₂ =	0;0,5,4 45	(73)
98-99	0;0,3,3 30 × ³ / ₂ =	0;0,5,0 15	(67)
107-109	0;0,4,2 30 × ³ / ₂ =	0;1,0,3 45	(85)
			(225 ud ₅)
116-117	0;0,0,7 30		(ŠU.GíRgunû ì.nun.bi) ki sipa ud ₅ .da.ke ₄ .ne.ta
120-121	0;1,2,5 × ³ / ₂ =	0;2,0,7 30	(17)
123-124	0;1,1,5 × ³ / ₂ =	0;1,5,2 30	(15)
126-127	0;2,0,5 × ³ / ₂ =	0;3,0,7 30	(25)
130-131	0;0,3,0 × ³ / ₂ =	0;0,4,5	(6)
			(63 áb)
134	0;0,2,1		(ŠU.GíRgunû ì.nun.bi) ki ùnu.dè.ne.ta
225-226	0;0,3,2	0;0,4,5	ki Kaš ₄ .ta
242-247	2;2,5,3 4 ² / ₃	7;2,2,5 13	
<i>Credits</i>			
	<i>ì nun</i>	<i>ga UDgunû</i>	
396-398	0;3,3,7 32 ^{sic}	0;3,2,6 30	
399-400		0;0,3,0	for 0;0,2,0 ga gazi (× ³ / ₂)
401-405	0;0,0,4 18 ^{sic} × ³ / ₂ =	0;0,0,6 27	for 0;1,2,6 ga še.a (× ¹ / ₂₀ = ì nun) úgu Ur- ^a Šulpae gá.gá.dam
414	0;1,4,0		
415-417		0;2,0,7 30	for 0;1,2,5 ga gazi (× ³ / ₂)
418		0;0,5,9 ⁽¹⁾	
419-422	0;0,0,0 21 × ³ / ₂ =	0;0,0,0 31 ¹ / ₂	for 0;0,0,7 ga še.a (× ¹ / ₂₀ = ì nun) [úgu PN gá.gá.dam]
535-540	1;0,2,2 11	1;2,0,9 58 ¹ / ₂	
<i>Balance</i>			
	<i>ì nun</i>	<i>ga UDgunû</i>	
	2;2,5,3 4 ² / ₃	7;2,2,5 13	Debits
	+ 1;0,2,2 11	+ 1;2,0,9 58 ¹ / ₂	Credits
550-553	1;2,3,0 53 ² / ₃	6;0,1,5 14 ¹ / ₂	LÁ+NI

Figure 6: Overview of the entries concerning milk products in the Umma account SET 130 (capacity measures are recorded gur;barig,bán,sila gín, fractions of the sila have been converted into gín); numbers have been corrected according to J. Carnahan and K. Hillard, ASJ 15, 207-210, and ASJ 16, 309. For each nanny goat (ud₅), ¹/₂ sila of butter oil ì nun and ³/₄ sila of cheese ga UDgunû were to be delivered yearly from the goat herders (sipa ud₅.da), and for each cow 5 and 7 ¹/₂ sila, respectively, from the cow herders (ùnu). Note that the presumable surcharges denoted ŠU.GíRgunû in the debits section of this account resulted from calculating ¹/₁₅ of the expected butter oil deliveries from the herders (7 ¹/₂ sila in ll. 116-117 from 112 ¹/₂, 21 sila in l. 134 from 315 sila).

and cheese, thereby demonstrating that these categories of goods represented different products which were of equal value in state accounts⁴⁹

The balance of the account (section 3, reverse xiii 544 to 560) is calculated using the same terminology for animals and products as that found in section 1. As can happen with accounts based on a number of equivalence units instead of just one, for example, flour in milling texts or workdays in accounts of agricultural labor, both deficits (of sheep with fleece, lambs, goats and milk products) and surpluses (of shorn sheep and goat's hair) are found in the balance. These balance entries can be left unresolved as distinct measures⁵⁰, or utilizing the complex system of bookkeeping equivalencies of the Ur III period be resolved into one or the other accounting unit⁵¹. The final section 4 (colophon, reverse xiv 561-565)

⁴⁹ The consistent silver equivalence 10 ma na of wool per shekel derived from different types of sheep (see D. Snell, *Ledgers and Prices* 178-81), as opposed to an equivalence of 30-40 ma.na per shekel for goat's hair (H. Waetzoldt, *Textilindustrie* 75), makes this point sufficiently clear. Although *SET* 130 does not specify whether the milk products of cows and nanny goats were in fact mixed (see above, fn. 33) — the totals of the debits section, including totals of measures of butter oil and cheese from both animals, are to be understood as bookkeeping measures —, certainly the fact that the products from cows and goats form common notations in accounts, from which real deliveries of such products are deducted, proves that the milk of cows and goats were value equivalent. Note the marginally parallel structure of the text *SET* 130 and the two Girsu accounts CT 7, pl. 34, BM 18407, and *TCTI* 1, 878, cited above, fn. 12. The Girsu accounts, however, registered above all dairy products from cows (based on delivery norms of 1 bán each of butter oil and cheese per cow-year) and included substantially lesser quantities of such products expected from goat herders.

⁵⁰ Deliveries of wool totaling 225 gú 9½ ma.na canceled the debits total of the account, which, as J. Carnahan and K. Hillard stated in *ASJ* 15, 208, to ll. 239-241, was in fact ½ ma.na higher than the sum of the individual debit entries and which included no wool notation in its si.ì.tum section. A high percentage of accounts whose debit totals are exactly canceled by credits also lack a si.ì.tum, including, beyond the case of wool in *SET* 130, such texts as BIN 5, 272 (?; Umma, Amar-Suen 3, agricultural work teams, reckoning in grain and labor time), TCL 5, 5675 (Umma, Amar-Suen 4, agricultural work teams, reckoning in grain and labor time), ŠA 76 (Umma, Amar-Suen 4, grain for dam gâr), YOS 18, 123 (= D. Snell, *ASJ* 11 [1989] 204-216; Umma, Amar-Suen 9, dam gâr silver account), MVN 15, 103 (Umma, Šū-Sin 6, grain account) and 257 (Umma, n.d., grain account; balance 'booked in the debit account'). Some of these texts contain summation numbers so complex as to raise a suspicion either of bookkeeping manipulation, or, for instance in the case of wool in *SET* 130, of the specific use of a partial credit surplus (rev. xii 518-524) to strike debit entries from the books.

⁵¹ The account MVN 17, 83, BM 12137 (from Girsu, dated to Šulgi 48/ii-xi), concerning the activities of a foreman charged with delivering bundles of reeds and manu-wood, is an interesting example of this phenomenon. The basis of calculations in the text is an implicit amount of labor time required to harvest and deliver given quantities of the products described: 1 'load' (gú) of manu-wood = 2 'bales' (kilib) of manu-wood, and 1 bale of manu-wood = 10 'bundles of reeds' (sa gi; and, implicitly, 10 sa gi = 1 workday). Whereas the si.ì.tum entry of the debits section of this text (obv. 1-3) consisted of a notation representing only a large number of reed bundles, the complete debits include 17075 reed bundles and 1200 bales of the more valuable manu-wood (obv. 12 rev. 1). Real deliveries of these products are then entered into the ledger and totaled, with the following resolution of the resulting surplus in reed bundles and deficit in manu-wood (rev. 11-17):

ŠU+NIGIN 5.58.00 lá.2 sa.gi
 ŠU+NIGIN 12.32 kilib 2^{ma}.na
 zi.ga

Together: 21480 minus 2 reed bundles,
 together: 752 bales of manu-wood,
 deducted.

contains the name of the year for which, and of Ur-e'e⁵², the supervisor (iš/šùš)⁵³ about whom the account was written, and the notation níg. ka₉.ak udu ì siki "account: small cattle, oil and wool"

The appearance of a rather small number of herds of milk cows in the account *SET* 130 concerned primarily with sheep and goats was until re-

diri 1.13.23 sa.gi kilib'e 10.ta

kilib ⁸⁴ma.nu LÁ+NI.bi 7.20½

diri LÁ+NI gu₇.i

LÁ+NI 7½ kilib ⁸⁴ma.nu

Surplus: (21478 - 17075 =) 4403 reed bundles, at 10 per bale,

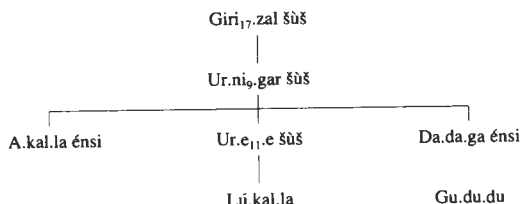
the corresponding deficit of manu-wood is (4403 + 10 ≈) 440½ bales;

let the deficit eat the surplus!

Deficit: ((1200 - 752) - 440½ =) 7½ bales of manu-wood.

Comparable manipulations are found in many Ur III accounts (for a direct parallel see MVN 2, 5 [Girsu, Šulgi 45/xi-xii], rev. 19, also with diri LÁ+NI gu₇ a, further *TUT* 131 obv. ii 10', rev. iii 9 [diri LÁ+NI íb.gu₇], UET 3, 1779 rev. ii 6 [diri LÁ+NI ba.ab.gu₇]).

⁵² The text A. Archi and F. Pomponio, *Vicino Oriente* 8/1 (1989) p. 65, no. 64 (Šulgi 44/x), demonstrates that this official repaid, in silver, debts recorded in texts like *SET* 130 (obv. 1-5: ½ ma.na kù.babbar / LÁ+NI su.ga ì nun ga ḤAR / ki Ure_n.e.ta / Da.da.ga / šu ba.ti, "½ ma.na of silver did Dadaga receive from Ur-e'e as replaced deficit for butter oil and cheese"); the same applies to the cattle supervisor Atu discussed below, who also transferred silver equivalents for dairy fat debts to Dadaga (BIN 5, 333, Šulgi 46/vii; see below, fn. 80). A topic only marginally related to those dealt with here but of some importance for the administrative history of the Ur III empire is the fact that as cattle supervisor Ur-e'e assumed an integral role in the decision-making hierarchy of Umma. In an important article dealing with Umma genealogies evident in the legends of extant seal impressions, D. McGuiness, "The Family of Giri₁₇-zal", *RA* 76 (1982) 17-25 (the major results of which were repeated without apparent knowledge of this work by T. Maeda, "The Father of Akala and Dadaga, Governors of Umma", *ASJ* 12 [1990] 71-78; see also G. Bergamini, "Neo-Sumerian 'Vignettes': A Methodological Approach", *Mesopotamia* 26 [1991] 104-105, and compare the now outdated excursus on Ur-e'e in *SET*, pp. 322-344), demonstrated that this province was ruled at the highest levels by individuals belonging to one family, many of whom are encountered in the dairy accounts (compare the individuals cited in fnn. 54 and 66 below):



This state of affairs must be kept in mind when considering whether high, related officials — Dadaga, chief silver agent in the years Šulgi 39 through Amar-Suen I, was Ur-e'e's brother, and was replaced in this function by Ur-e'e's son Lukala — were held to the same harsh standards of accountability as were the numerous u₉la and ùnu below them. Note also in this regard the fact that the seal legends identify all of these officials as dub.šar, i.e., as literate accountants. Cattle supervisors such as Ur-e'e and Atu (see below) were thus no less integral to the high-level administration very close to the office of the énsi than were šabra, sanga and nu.bànda.

⁵³ Against the conventional readings saḥar or kuš, see most recently R. Beale, "Is KUŠ, the Reading of iš = kizū?", *NABU* 1992/48; further P. Steinkeller, FAOS 17, 180; A. Cavignaux, *NABU* 1992/103.

cently the only known record from the province of Umma which shared some features with the Ur accounts treated by T. Gomi. The following large Umma text, published by David Owen, is thus, as the only known account which deals exclusively with an economic unit in that city organized around the exploitation of milk cows and which, in contrast to the Girsu accounts, contains key information concerning nearly all known *termini technici* of debits and credits in Ur III dairy administration, of overriding importance.

§ 4.2.1. Debits in MVN 15, 108

MVN 15, 108 (see figures 7-15), is a large consolidated account concerning the activities of an official named Atu, supervisor (šùš) of cattle herders in Umma⁵⁴. The text, dated to the third regnal year of the king

⁵⁴ Prosopographical examination proves that MVN 15, 108, is in fact from Umma. In the first place, the cattle supervisor Atu is found in this function in a number of Umma texts, for example, B. Lafont, *RA* 86 (1992) 97-103 and 108-109, no. 1 (Um 92.8.1, dated to Amar-Suen 7), a large account with, in the first lines of the credits section, 2 áb máh / 1 áb mu.1 / 5 gu, giš / 1 gu, mu.3 / 8 gu, mu.1 / 1 gu, ga / kišib Ur. "Suen / úgu A.tu ba.gar, "... (cattle) / sealed tablet of Ur-Suen / entered in the debits of Atu"; M. Sigrist, *Texts from the British Museum* 1 (1993) 187, with 14 gu, / mu Na.ba.sa, dumu Hé.na.ti.šè / A.tu šùš dumu Úr.níg.du₁₀ / su.su.dam / mu en "Nanna máš.e i.pà, "14 oxen, because of Nabasa, son of Henati, Aṭu, the cattle supervisor, son of Urnidu, must replace. Year: the Nanna priestess was designated (Šulgi 43)"; T. Fish, *MCS* 2 (1952) 75-76, BM 112952 (collated by T. Gomi, *Orient* 17 27): 52 gu, áb.ḫi.a / LA+NI[*], recollated by J.-P. Grégoire, 10 September 1987, written over si.i.tum] mu En.mah.gal.an.na ba.ḫun / kišib A.tu / ú.um.de, / kišib Ur. "Šara / zi.re.dam, "52 diverse oxen and cows, deficit of the year 'Enmahgalana was appointed' (= Amar-Suen 4), after the sealed tablet of Atu has been delivered, the sealed tablet of Ur-Šara (probably the šadubba recorded in MVN 15, 108 rev. iii 72) is to be broken" (the accounts demonstrate at the same time that the administration of milk cows was not the only activity of the supervisor Atu; he was clearly responsible for complete herds, that is, herds including the male animals which will have been culled out for meat and for training and use as draft animals); P. Watson, *Catalogue of Cuneiform Tablets in Birmingham City Museum* 2 (1993); in the following *CBM* 2) 79 obv., with 8 gin kù.babbar / LA+NI su.ga i nun / ki A.tu šùš.ta / Gu.du.du / šu ba.ti, "8 shekels of silver, deficit replaced for butter oil, from Atu, the cattle supervisor, did Gududu receive (Šū-Sin 7)" (parallel is A. Archi and F. Pomponio, *VicOr* 8/1, no. 70, dated to Šū-Sin 8/xi, recording a LA+NI su.ga i nun of 5 shekels silver from Atu, following a LA+NI su.ga of 1/3 ma.na silver from the official Kaš; both sums also received by Gududu); cf. also F. Yıldız and T. Gomi, *Die Umma-Texte aus den Archäologischen Museen zu Istanbul*, vol. 3 (Bethesda 1993; in the following *Umma* 3) 1851, MVN 16, 1094, MVN 14, 174, BIN 5, 82 and 333. In the second place, the receiving agents named in the account are without exception Umma officials. The best known is the 'silver agent' Lukala mentioned in rev. iii 70, 85 and 89, but note also the high Umma officials Ur-e in rev. iii 90 and Ur-Šulpa'e in iii 95. To both of these officials see D. Snell, *Ledgers and Prices* 75-90, and note the šu ba ti receipt OrSP 47-49, 385 with notations representing large amounts of dairy products entirely in line with those recorded in MVN 15, 108 rev. iii 91-94, received from Atu by Ur-Šulpa'e (text dated to Amar-Suen 6; transfers of the same products to representatives of the énsi are found documented very often in the texts, for example, in MVN 16, 676, 687, 878, *Umma* 3, 2132, demonstrating that this official was distributing in modest measures dairy products received by him in bulk), and the i.dab, receipt AnOr 1, 45, with 10 gu, ḫi.a / LA+NI su.ga únu.dè.ne / ki A.tu.ta / Kaš, i.dab., "10 diverse oxen, replaced deficit of the cattle herders, from Atu, did Kaš receive (for transfer)" (Kaš is presumably the same receiving official qualified giri in MVN 15, 108, obv. ii 55 and 64, probably also the official of the same name who according to *SET* 130 v 225-228 deposited

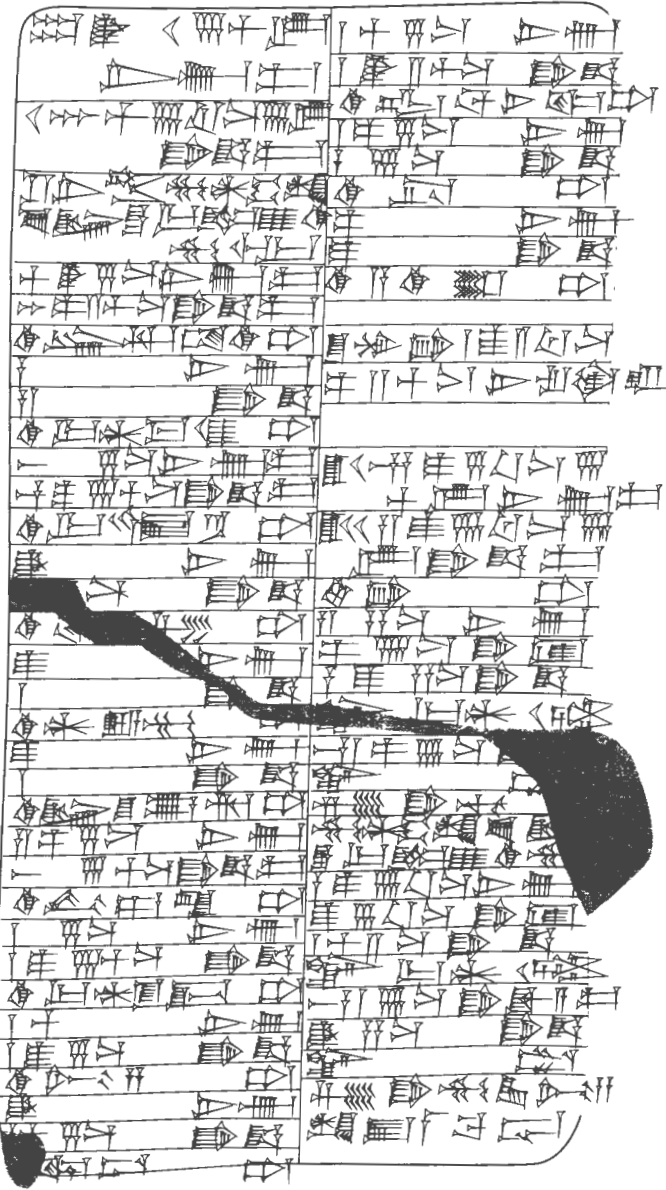


Figure 7a: Copy of the account *MVN* 15, 108, obverse face, reconstructed by the author (1:1, drawn after the original of D. Owen). Shaded areas are not preserved on the tablet; with the exception of reverse ii 10-11 (the signs ŠU+NÍGIN representing 'grand total' are possibly to be corrected to ŠU+NIGIN or KILIB.BA), however, the restorations are secure.



Figure 7b: Reconstructed copy of the account MVN 15, 108, reverse face.

- i 6;1,5 17 1/2 gín ì nun gur
 13;0,1,8 2/3 síla 8 gín ga UDgunû gur
 si.ì.tum mu ^dAmar.^dSuen lugal.e Ur.bí.lum^{ki} mu.ḫul (Amar-Suen 2)
 1;1,5,5 síla ì nun gur
 2;0,2,2 1/2 síla ga UDgunû gur
 ki Lú.Zábalá^{ki}.ta
 0;2,0 ì nun
 0;3,0 ga UDgunû
 ki Ur.^dMa.mi.ta
- 10) 1;0,0,5 síla ì nun gur
 1;2,3,7 1/2 síla ga UDgunû gur
 ki Ur.ni₉.gar.ta
 0;0,5 ì nun
 {0;1,1,5} síla ga UDgunû
 ki D[u₁₁].ge.ta
 0;0,4 ì nun
 0;1,0 g[a] UDgunû
 ki ^dŠára.a.mu.ta
 0;0,4 ì nun
- 20) 0;1,0 ga UDgunû
 ki Lugal.šú.nir.re.ta
 0;3,2,5 síla ì nun
 1;0,0,7 1/2 síla ga UDgunû gur
 ki Šeš.kal.la.ta
 0;1,0,5 síla ì nun
 0;1,3,7 1/2 síla ga UDgunû
 ki Ur.AN.si₄.da.ta
 0;1,1 ì nun
 0;1,4,5 síla ga UDgunû
 ki Gu.za<.na>.ta
- 30) 0;0,5 ì nun
 0;1,1,5 síla ga UDgunû
 [ki] Bu₆.du.ta
- ii 0;1,1,5 síla ì nun
 0;1,5,2 1/2 síla ga UDgunû
 ki Al.ba.ni.du₁₁.ta
 0;1,2,5 síla ì nun
 0;2,0,7 síla ga UDgunû
 ki Uš.ta
- 40) 0;0,2 ì nun
 0;0,3 ga UDgunû
 ki A.ki.šar.ta
 (uninscribed)
 ZI'.GÍRgunû.bi 0;1,4,2 2/3 síla
 0;0,2,2 1/2 síla ì má.gur₈.ra
 (uninscribed)
 ŠU+NÍGIN 11;4,3,5 1/3 síla 7 1/2 gín ì nun gur
 ŠU+NÍGIN 20;3,4,8 2/3 síla 8 gín ga UDgunû gur
 šà.bi.ta
- 50) 0;3,0,4 síla ì nun
 0;0,2,9 síla ga gazi
 0;2,4,4 síla ga UDgunû
 giri Ur.^dŠAKAN
 1;3,2,8 síla g[a.SIG₇.a gur]
 giri Ka[š₄]
 zi.ga bala.[a]
 mu ^dAmar.^dSuen luga[l].e Ur.bí.lum^{ki} m[u.ḫul] (Amar-Suen 2)

Figure 8: Transliteration of the account MVN 15, 108.

- 0;2,3,8 $\frac{1}{3}$ sila ì nun
 0;0,4,6 $\frac{1}{3}$ sila ga gazi
 60) 0;1,1,2 sila ga UD*gunû*
 giri Ur.⁴ŠAKAN
 1;3,0,8 sila ga SIG₇-a gur
 0;0,5,4 sila ga UD*gunû*
 giri Kaš₄
 zi.ga <bala.a> mu kù gu.za ⁴En.líl.lá ba.dím (Amar-Suen 3)
- iii $\frac{1}{3}$ ma.na 1 gín kù.bab[bar]
 a.rá.l.kam
 $\frac{2}{3}$ ma.na 8 $\frac{1}{2}$ gín kù.[babbar²]
 a.rá.2.kam
 70) giri Lú.kal.la
 9 gín kù.[babbar²]
 giri Ur.⁴Šára ša₁₃.du[b.ba]
 9 $\frac{2}{3}$ gín 15 še [kù.babbar²]
 giri Lú.Zàbala⁴[¹]
 sag.na₄.bi 1 $\frac{1}{3}$ gín $\frac{2}{3}$ še kù.[babbar²]
 ì.nun.bi 2;4,5,5 [$\frac{2}{3}$ ' sila] 12 gín gur
 0;0;'1,4' sila ì nun
 [0;0,2,2 sila g]a.'SIG₇'[.a]
 [sá.du₁₁ a.rá].l.kam
 80) [0;0,0,3 sila ì].nun
 'sá.du₁₁' [a.rá].2.kam
 0;1,0 ga SIG₇-a gibil.šè
 káš.dé.a lugal Umma^{ki}.šè gin.na
 kišib.bi 4.àm
 úgu Lú.kal.la gá.gá.dam
 0;1,1,8 $\frac{1}{2}$ sila ì' nun
 0;3,0,5 $\frac{2}{3}$ sila ga UD*gunû*
 0;0,0,7 sila ga SIG₇-a
 kišib Lú.kal.la
 90) úgu Ur.e₁₁.e gá.gá.dam
 3;1,3,3 sila 2 $\frac{1}{2}$ gín ì nun gur
 1;3,5,2 $\frac{5}{6}$ sila ga gazi g[ur]
 4;3,2,3 $\frac{1}{3}$ sila ga UD*gunû* g[ur]
 3;3,5 ga SIG₇-a gu[r]
 kišib Ur.⁴Šul.pa.è
 (uninscribed)
- iv (uninscribed)
 ŠU+NÍGIN 7;3,4,6 $\frac{2}{3}$ sila 4 $\frac{1}{2}$ gín ì nun gur
 ŠU+NÍGIN 2;0,0,8 sila 10 gín ga gazi gur
 100) ga.UD*gunû*.bi 3;0,1,2 sila 15 gín
 ŠU+NÍGIN 6;1,1,9 ga UD*gunû* gur
 ŠU+NÍGIN 7;1,5,5 sila ga SIG₇-a gur
 ì.nun.bi 0;1,5 $\frac{2}{3}$ sila 5 gín
 ga.UD*gunû*.bi 0;2,4,6 sila '7 $\frac{1}{2}$ ' g[ín]
 (uninscribed)
 [ŠU+NÍGIN 6]+2;0,3,7 $\frac{1}{3}$ sila 9 $\frac{1}{2}$ gín ì nun gur
 [ŠU+NÍGIN 7]+2;4,1,7 $\frac{1}{3}$ sila 2 $\frac{1}{2}$ gín ga UD*gunû* gur
 zi.ga.àm
- LÁ+NI 3;3,5,7 $\frac{5}{6}$ sila 8 gín ì nun gur
 110) 10;4,3,1 $\frac{1}{3}$ sila 5 $\frac{1}{2}$ gín ga UD*gunû* gur
 LÁ+NI.àm
 nfg.ka₉.a[k] ì' nun ga HĀR
 A.tu šùš
 (uninscribed)
 mu kù gu.za ⁴En.líl.lá ba.dím (Amar-Suen 3)

Amar-Suen, can be shown to be comparable to the Ur text UET 3, 1215, cited above. The account consists of an initial debits section (obv. i 1 – ii 48)⁵⁵, a credits section (obv. ii 49 – rev. iv 108) and the balance and colophon (rev. iv 109-115).

Although the milk cows concerned are nowhere mentioned in the text in the clear form attested in UET 3, 1215, there is no doubt that MVN 15, 108, is indeed a dairy account. The debits section of the account records first in obv. i 1-3 notations representing large arrears of butter oil and cheese carried over from the preceding year Amar-Suen 2 (the term *si i tum* here corresponds to *LÁ+NI* from the balance of the previous account)⁵⁶ In each of 13 following three-line subsections amounts of *i nun* and *ga UDgunû* are registered together with an entry *ki PN.ta*, ‘from PN’ Since in each case the numerical notations are ‘nice numbers’ divisible by 5 and $7\frac{1}{2}$, respectively, it is obvious that the individuals named are herders and that the numbers represent the size of their dairy herds, recorded at the beginning of the year, multiplied by the amount of butter oil and cheese to be delivered per milk cow. Thus in the first such entry (see figure 9), the herder Lu-Zabala is to deliver $1;1,5,5 = 415$ *silá i nun* and $2;0,2,2\frac{1}{2} = 622\frac{1}{2}$ *silá ga UDgunû*. The first number divided by 5, and the second divided by $7\frac{1}{2}$, equal 83, 83 is consequently the number of milk cows under the direct charge of this herder. The same relationships between amounts of butter oil and cheese and implicit numbers of milk cows hold for the following 12 individuals recorded obv. i 7 – ii 43 (figure 10).

32 *silá i nun* and 45 *silá ga UDgunû* in the debit account of the supervisor Ur-e'e, and who, according to the seal of MVN 16, 965, 1103, etc. bore the full name En-kaš [see W. Hallo, *HUCA* 29, 87²⁷, with reference to N. Schneider, *OrSP* 16, 305]].

⁵⁵ The inclusion of the qualification *sag ní.g.gur₁₁.ra.kam* at the end of debits sections of Ur III accounts is optional; the debits of MVN 15, 108, conclude with the totals of butter oil and cheese recorded in the section. See for the same account format in Girsu the texts cited above, fnn. 12 and 49. The closest parallel to MVN 15, 108, from the Girsu texts is offered by CT 5, pls. 25-26, BM 18346, a debit account of dairy norms imposed on districts within this province. For instance, the first entries obv. i 1-3: $0;4,3$ *i nun áb lugal* / $0;4,3$ *ga HAR lugal* / *Al.la dume Ad.da*, “4 (barig) 3 (bán) butter oil from cow (milk, measured according to the royal (standard), 4 (barig) 3 (bán) dried cheese (measured according to the royal (standard), (from) Alla, son of Adda”, register a delivery requirement of 270 *silá* each of butter oil and cheese imposed on the herder Alla. These and all subsequent notations are evenly divisible by 10 *silá*, so that in our example Alla will have been entrusted by central authorities in Girsu (obv. iii 5) with the care of a herd including 27 adult cows.

⁵⁶ See *Ur III-Fischerei* 25-38. According to the silver equivalencies known for butter oil and cheese in Umma (see below, § 5), the two entries of these arrears corresponded to slightly more than 191 shekels ($1910\frac{3}{4}$ *silá* + 10) and $21\frac{3}{4}$ shekels ($3918\frac{3}{4}$ *silá* + 180), respectively. Although judging from this text approximately half of these arrears may have been covered by deliveries of dairy products or silver in the early part of Amar-Suen 3, since the final deficit corresponds to a silver equivalent of ca. 132 shekels, the size of the debt owed by the supervisor Atu to the central administration was substantial. For an idea of the relative sizes of these debts and the consequences they had for those involved see *Ur III-Fischerei* 47-48⁶³, and fn. 81 below.

Deficit (LÁ+NI = si.i.tum) from the preceding year Amar-Suen 2:			
	6;1,5 17 1/2 ì nun	13;0,1,8 48 ga UDgunû	
Expected performance of the dairy cattle assigned to herders under the supervisor Atu			
(milkcows)	(× 5 =) ì nun delivery	(× 3/2 =) ga UDgunû delivery	from the cowherd:
(83)	1;1,5,5	2;0,2,2 1/2	Lú-Zabala
(61)	1;0,0,5	1;2,3,7 1/2	Ur-nigar
(41)	0;3,2,5	1;0,0,7 1/2	Lu-kaša
(24)	0;2,0	0;3,0	Ur-Mami
(17)	0;1,2,5	0;2,0,7 1/2	Uš
(15)	0;1,1,5	0;1,5,2 1/2	Albanidu
(14)	0;1,1	0;1,4,5	Guza
(13)	0;1,0,5	0;1,3,7 1/2	Ur-Ansida
(10)	0;0,5	0;1,1,5	Duge
(10)	0;0,5	0;1,1,5	Budu
(8)	0;0,4	0;1,0	Šara-amu
(8)	0;0,4	0;1,0	Lugal-šunire
(4)	0;0,2	0;0,3	Akišar
(308)	5;0,4	7;3,3	
Zì ⁹ .GíRgunû.bi: 5;0,4 (total of expected dairy fat ì nun) ÷ 15 = 0;1,4,2 2/3			
0;0,2,2 1/2 sila ì má.gur ₈ .ra (barley rental, converted into ì nun, or used to treat hull ?)			
	ì nun	ga UDgunû	
deficit	6;1,5 17 1/2 gín	13;0,1,8 48 gín	
debit	5;0,4	7;3,3	
Zì ⁹ .GíRgunû	0;1,4,2 40		
má.gur ₈	0;0,2,2 30		
Totals:	11;4,3,5 27 1/2 gín	20;3,4,8 48 gín	

Figure 10: Table of the individual entries of the debits section of *MVN* 15, 108, with summations of the dairy products ì nun and ga UDgunû (entries concerning delivery requirements of the individual herders have been listed according to size of presumed herds).

The first of the final debits entries records an amount of nun oil described as ‘the zì⁹.GíRgunû⁵⁹ involved’ A comparison of the amount of

⁵⁹ The sign combination was read šu-gir in Y. Nakahara, *The Sumerian Tablets in the Imperial University of Kyoto* (Kyoto 1928) no. 19, sig-MUG in *SET* 130, then read zì mun and interpreted by M. Stol, *BSA* 7, 103, as ‘flour (and) salt’, in *RIA* 8, 196, apparently following a discussion of the term at the 1992 Barcelona meeting of the Sumerian Agriculture Group with W. Heimpel, ‘flour-salt’ (presumably meaning ‘rock salt’) added to the butter oil. Recollection by K. Hillard of the text *SET* 130, on which Heimpel seems to have based his reading, has shown that the signs in line 116 and 134 are in fact šu.GíRgunû, as is also found in the texts *Kyoto* 19, and J.-M. Durand, *Documents cunéiformes de la IV^e Section de l’École pratique des Hautes Études I* (Geneva/Paris 1982) 417, cited below. These readings make suspect the copy and transliteration, respectively, of the references to zì in the texts *MVN* 15, 108, and *Umma*

102 $\frac{1}{2}$ sila with the total amount of butter oil expected of the 13 named debit-herders of 5;0,4 = 1540 sila (see figure 10) demonstrates that the oil qualified 'its *zi*[?].*GIRgunú*' was exactly $\frac{1}{15}$ of the total of dairy oil set as the delivery quota for 308 milk cows in the accounting year involved, just as was the case with oil qualified *ŠU.GIRgunú* in the account *SET* 130 seen above. In discussing the meaning of this sign combination, it must be stressed that, in accord with all we know about neo-Sumerian running accounts, the debits represented essentially artificial administrative quantities⁶⁰. It thus makes no sense to speak of a product *zi*(or *ŠU*).*GIRgunú* which 'could be added to the ghee'⁶¹ unless at the least *zi.GIRgunú* is found in contexts identifying it as something other than an administrative measure. Of the references known to me — all from Umma dating to Amar-Suen 3 through 8 —, this sign combination always represents an administrative measure of $\frac{1}{15}$ of an amount of butter oil either from cows or from nanny goats and is never attested referring itself to a real product, but rather, if in an account, appears only in the debits section.

Y. Nakahara, *Kyoto* 19 (Amar-Suen 5)

i 6ff. 4 sila 10 gín i nun
ŠU.GIRgunú.bi 16 $\frac{2}{3}$ gín

...

nidba ⁴En.líl.lá

the calculations:

4 $\frac{1}{2}$ sila ÷ 15 = 16 $\frac{2}{3}$ gín

F. Yıldız and Gomi T., *Umma* 3, 1908 (Amar-Suen 8)

i 1ff. 4 sila 10 gín i nun
zi[?].*GIRgunú.bi* 16 $\frac{2}{3}$ gín

...

nidba ⁴En.líl

4 $\frac{1}{2}$ sila ÷ 15 = 16 $\frac{2}{3}$ gín

J.-M. Durand, *Documents cunéiformes* 417 (Amar-Suen 4)

i 7-8 0;3,0 i nun (sá du₁₁ for one year = $\frac{1}{2}$ sila per day)

ŠU.GIRgunú.bi 0;0,1,2 sil[a]

3 barig ÷ 15 = 12 sila

i 11-12 0;0,1,5 sila i nu[n] (sá du₁₁ for one month = $\frac{1}{2}$ sila per day)

ŠU.GIRgunú.bi 1 sil[a]

15 sila ÷ 15 = 1 sila

3, 1908. The matter is further confused by the fact that after having confirmed the new reading of the *SET* 130 sign combination, Hillard inspected the entries cited to mun, 'salt', in D. Snell, *Ledgers and Prices* 157-158, and found all to be *GIRgunú*; see *ASJ* 16, 309, n. 1. This product, not salt, is according to its position in the trade agent texts a type of resin (note that for instance in *TCL* 5, 6037, this *GIRgunú* is found in obv. iv 18-19 among substances known to be resins and essences in a section following one qualified obv. iii 12 as *nig.ka*, *mun gazi úgu.a gá.gá.dam*, "Account of salt and gazi, to be carried over to the debits (account of the trade agents)"), but need not be connected to our *zi*[?]/*ŠU*[?].*GIRgunú*.

⁶⁰ Even in the case of the trade agent accounts, the domestic products listed in the debits sections are always lost in silver equivalents and are thus no longer real products. This point is made sufficiently clear with the mixing in debit totals of silver equivalents of superficially real products with arrears equivalents which unquestionably represent debt and nothing comparable to 'stock on hand'

⁶¹ M. Stol, *RIA* 8, 196, reading *zi.mun*

SET 130 (Amar-Suen 4; see figure 6 above)

part of debit (sag.nig.gur₁₁.ra.ak)

total: 0;1,5,2½

iii 116 šu.girgunû i.nun.bi 7½ sila

part of debit

total: 1;0,1,5

iii 134 šu.girgunû i.nun.bi 0;0,2,1

milk-producing nanny goats

(225 ud₅ × ½ = 112½ sila)

112½ sila + 15 = 7½

milk-producing cows

(63 áb × 5 = 315 sila)

315 sila + 15 = 21

MVN 15, 108 (Amar-Suen 3, see figure 10)

part of debit

total: (5;0,4 i nun gur)

ii 44 zi[?].girgunû.bi 0;1,4,2½

milk-producing cows

(308 × 5 = 1540 sila)

1540 sila + 15 = 102½

The accounting contexts of this sign combination its qualification of a cultic sacrifice in the first two texts is entirely unclear are suggestive more of an administrative tax or 'adjustment' against the interests of the supervisor concerned, comparable to the *saggilû* discussed in a masterful article by K. Veenhof, than of an object designation⁶²

§ 4.2.2. Credits in MVN 15 108

Real object designations and real transactions, on the other hand, are registered in the credits section of MVN 15, 108 (see figures 11-12). Transactions of this sort consist on the whole in the movement and receipt of goods or services and are recorded in separate texts which have been sealed and dated by a receiving agent. Numerous Ur III accounts demonstrate how this was done: the scribe must gather and sort all receipts (š u ba . ti or i da b₅ texts) issued by an official, concerning whom credits deliveries of goods or services to temple households, to the households of the é n s i or other high state officials are being consolidated. He then enters the essential information of these texts into his ledger, noting whether the goods were delivered to a transferring agent and thus qualified in the account as g i r i (cor-

⁶² See K. Veenhof, "SAG.IL.LA = *saggilû*, 'Difference Assessed' on Measuring and Accounting in Some Old Babylonian Texts", in: J.-M. Durand and J.-R. Kupper, eds., *Miscellanea Babylonica* (= *Festschrift Birot*; Paris 1985) 285-306. One might on the other hand speculate that managers transferred to the herders a set quantity of condiments — for instance, salt or the gazi discussed below — necessary for the production of particular dairy products, and that these were reckoned in value units equivalent to measures of butter fat. In the case of gazi, for every 150 sila of i nun required of the herders, 300 sila of gazi might have been transferred to their stores by state agents, since $150 \times \frac{1}{5} = 10$ sila i nun, and 10 sila i nun and 300 sila gazi were both equivalent to 1 shekel of silver (see below, § 5). The paucity of planned dairy production accounts from the Ur III period, however, makes it difficult to examine the probability of a relationship between the possible products represented by butter fat value units qualified zi[?]/š u[?]. girgunû in the debits, and the amounts of derived dairy products in the credits sections of such accounts; even if it could be demonstrated that no relationship obtained between the two, the inclusion of set amounts of foreign products in the debits of dairy accounts would not preclude their being disposed of in a fashion other than in the processing of specific dairy products.

𒀭 𒊩 𒍪	𒌷	šà.bi.ta
<i>deliveries of dairy products to transferring agents</i>		
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𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷		0;0,2,9 sila ga gazi
𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷		0;2,4,4 sila ga UDgunû
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𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷		1;3,2,8 sila ga SIG ₇ .a gur
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<i>deliveries of silver to transferring agents</i>		
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𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷 𒌷		a.rá.2.kam
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<i>deliveries of dairy products to receiving agents</i>		
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<i>totals and equivalents of dairy products</i>		
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<i>consolidated totals of dairy product deliveries</i>		
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Figure 11: Major components of the credits section of MVN 15, 108. Silver deliveries to transferring agents were converted into butter oil (ì nun) at a rate of 10 sila per shekel (thus a total of very nearly 89 2/3 shekels of silver, × 10 = 895 52/60 sila ì nun).

responding to an *ì.dab₅* text)⁶³ or whether the receiving agent was the ultimate destination of the goods who thus issued a sealed receipt, recorded in the accounts as *kišib* (corresponding to a *šu ba ti* text).

The first two receiving agents (see figure 11) recorded in the credits section of MVN 15, 108, for instance, are qualified *giri* and so identified as officials who assumed responsibility for the products listed and who transferred them on to other economic units, in this case into the system of internal exchange known as *bala*⁶⁴. The dairy products were delivered as probable contributions of the Umma province to this system for the years Amar-Suen 2, that is, the year preceding that of this account, and Amar-Suen 3, all deliveries however made during the latter year and into the hands of the same two officials UR-ŠAKAN and Kaš.

<i>ì nun</i>	<i>ga gazi</i>	<i>ga UDgunû</i>	<i>ga SIG_{7,a}</i>
0;3,0,4	0;0,2,9	0;2,4,4	
			1;3,2,8
0;2,3,8 20	0;0,4,6 20	0;1,1,2	
		0;0,5,4	1;3,0,8
2;4,5,5 52?			
0;0,1,4			[0;0,2,2]
[0;0,0,3]			
			0;1,0
0;1,1,8 30		0;3,0,5 40	0;0,0,7
3;1,3,3 2 1/2	1;3,5,2 50	4;3,2,3 20	3;3,5
7;3,4,6 44 1/2	2;0,0,8 10	6;1,1,9	7;1,5,5
	<i>ga.UDgunû.bi</i> ($\times 3/2$):		<i>ì.nun.bi</i> ($\times 1/20 =$)
	3;0,1,2 15		0;1,5 45
			<i>ga.UDgunû.bi</i>
			($\times 1/20 \times 3/2 =$)
			0;2,4,6 7 1/2
<i>Totals:</i>			
<i>ì nun</i>		<i>ga UDgunû</i>	
7;3,4,6 44 1/2		6;1,1,9	
		3;0,1,2 15	(< <i>ga gazi</i>)
0;1,5 45	(< <i>ga SIG_{7,a}</i>)	0;2,4,6 7 1/2	(< <i>ga SIG_{7,a}</i>)
8;0,3,7 29 1/2		9;4,1,7 22 1/2	

Figure 12: The credits section of MVN 15, 108, listed according to named products. *gazi* cheese was converted into dried cheese (*ga UDgunû*), the postulated soured milk *ga SIG_{7,a}* into butter oil (*ì nun*) and dried cheese (*ga UDgunû*) at the rates noted.

⁶³ See, for example, the *ì.dab₅* text AnOr 1, 45, cited above, fn. 54, certifying receipt of oxen from Atu by Kaš, who in related accounts is qualified with *giri*.

⁶⁴ Most recently discussed in *Ur III-Fischerei* 57, with reference to P. Steinkeller, SAOC 46, 28; W. Sallaberger, *Der kultische Kalender der Ur III-Zeit I* (Berlin/New York 1993) 32-34.

Amounts of silver were given the second group of receiving agents, also qualified as *giri*, by either the supervisor *Atu* or his herders or representatives (rev. iii 66-76). Since as a bookkeeping mechanism the running account was held in butter oil and cheese, these silver transfers were converted, using the equivalence rate of 10 *sila i nun* per shekel silver, into the large sum of nearly 3 *gur* of butter oil⁶⁵. Any of a number of means will have been at the disposal of the cattle supervisor to come into the possession of silver. The most obvious is the dealing for silver of dairy products or of the cattle themselves through the exchange markets in the hands of private dealers or of the state agents known as *dam.gàr*, but less obvious means may have played a substantial role in his liquidity, namely, collection of debts in the form of silver or silver equivalents from his individual herders. Certainly no less than the control mechanisms evident in the Ur text UET 3, 1215, discussed above, running accounts of the production of the supervisor's herders will have been kept and their individual arrears calculated. Although it is not documented how higher management levels represented by such supervisors as *Atu* in *Umma* were able to enforce payment of obligations, this must have been so embedded in the administrative structure that no conflict arose which would have been found in legal documents, so that should the herder *Lu-Zabala*, for instance, have been unable to deliver in full his obligation of (83 milk cows \times 5 =) 415 *sila* of butter oil and $(83 \times 7\frac{1}{2} =)$ 622½ *sila* of cheese for the year *Amar-Suen 3*, he would have owed his supervisor this failing amount, and should the supervisor call in all debts, the herder might have been required to convert by default or sale any valuables in his possession, in the final analysis including members of his household and even himself, into silver to cover the debts involved⁶⁶. If the supervisor *Atu* — and not

⁶⁵ The silver entries may be totaled as 21 *gin* + 48½ *gin* + 9 *gin* + 9¾ *gin* + 1½ *gin* ⅔ *še* = 89½ *gin* 15⅔ *še*. This amount of silver is at 10 *sila* per shekel very nearly equal to $(895\frac{3}{60} =)$ 2;4,5,5 52 *gin* of butter oil *i nun* (the assumed capacity notation for 52 *gin*, [⅔ *sila*] 12 *gin*, would however be unusual, if not unlikely, for the expected ⅓ *sila* 2 *gin*). Note that the final individual entry of silver, rev. iii 75: *sag.na,bi* 1½ *gin* ⅔ *še* *kù*, "the stone 'head' involved: 1½ shekel, ⅔ grain silver", refers to a probable adjustment in the weights used to measure the silver. The quantity recorded bears no obvious 'nice' relationship with the preceding total of silver notations (very nearly 1:66), nor to partial combinations of the entries (ca. 1:52 for the *Lukala* silver, very nearly 1:14 for the *Ur-Šara/Lu-Zabala* silver, etc.). See K. Veenhof, *Fs. Birot* 294¹³.

⁶⁶ The text T. Gomi, *SNAT* 382, dated to *Amar-Suen 7*, is a clear example of how the accounting between *Atu* and one of his herders took place:

0;1,0,7½ <i>sila</i> 1 <i>gin</i> <i>i nun</i>	1 (barig) 7½ <i>sila</i> 1 shekel of dairy oil,
0;2,2,4 <i>sila</i> 4½ <i>gin</i> <i>ga uDgunú</i>	2 (barig) 2 (bán) 4 <i>sila</i> 4½ shekels of cheese,
<i>si.i.tum mu en.unu,gal</i> 'Inanna	arrears of the year 'Enunugal(ana) of Inanna' (= <i>Amar-Suen 5</i>).

his herders were responsible for the arrears, he might himself have been in possession of silver, gained, for example, through personal business, which he could transfer to state ownership to, in effect, partially clear his books⁶⁷

The third group of entries in the credits of MVN 15, 108, involves confirmed deliveries of dairy products by the office of Atu to various state agencies. In each case, the account records the receiving agents, all well-known high officials in the Umma administration close to the level of the *énsi*⁶⁸, and the existence of sealed documents which certify the correctness of the amounts received.

Four dairy products are registered among the credits in this account: beyond the two 'accounting products' *ì nun* and *ga UDgunû* found also in the debits of the account, two further products designated *ga gazi* and *ga SIG₇.a*. We find in the attestations of these latter products in Ur III accounts the same consistency as with *zi²/šu².GIRgunû* in account debits: they are only found in credits sections and so represent real and not at least potentially artificial dairy products. Quantities of the products *ga gazi* and *ga SIG₇.a* are, moreover, converted into *ì nun* and *ga HAR/UDgunû* in MVN 15, 108, as well as in other accounts using the same or comparable equivalence values.

ša.bi.ta
 3 gín kù
 1 še gur
 ì.nun.bi 0;0,4
 A.tu šu ba.ti
 [LA+NI] 0;0,2,7/3 sila 1 gín ì nun
 [0;2,2,]f4¹ sila 4 1/2 gín ga UDgunû
 [nig.ka₆.a]k² ì nun
 'Bu₆.¹du ùnu
 [g]iri Da.da.ga
 mu Hu.hu.nu.ri⁶ ba.hul

Therefrom:
 3 shekels of silver,
 1 gur of grain,
 the corresponding dairy fat: 4 (bán),
 did Atu receive.
 Deficit: 2 (bán 7/3 sila 1 shekel of
 dairy oil,
 2 (barig) 2 (bán) 4 sila 4 1/2 shekels of
 cheese.
 Account of dairy oil
 concerning Budu, the cow herder,
 via Dadaga,
 year: 'Huḥnuri was destroyed' (Amar-
 Suen 7).

According to MVN 15, 108, obv. i 31-33, Budu was in Amar-Suen 3 responsible for deliveries from 10 milk cows; *SNAT* 382 records arrears amounting to the yearly norm of more than 13 cows — of this herder from Amar-Suen 5, that is, just two years later, which were partially covered with the delivery of grain and silver. That Dadaga acted as transferring agent in the transaction suggests that the grain and silver actually went to repay some of Atu's debts, since Dadaga is otherwise known as the official who, prior to Gududu, received silver payments, qualified as *LA+NI su ga*, directly from Atu (see above, § 4.2.1 and fnn. 52 and 54; Lukala, who was chiefly responsible for silver transfers in the years Amar-Suen 2 through Šū-Sin 6, was replaced in this function by his cousin Gududu, whose father Dadaga had himself been chief silver agent before Lukala. Dadaga was named *énsi* of Umma in Šū-Sin 7).

⁶⁷ This use of silver is, by the way, known from accounts concerning other economic activities of state households; see, for example, *Ur III-Fischerei* 127-129, for the transfer of silver in credit sections of fisheries accounts.

⁶⁸ See above, fn. 54.

Four such conversions are known to me of the product *ga gazi* into *ga UDgunû*, all from Umma and all at the rate of three units of *ga UDgunû* per two of *ga gazi*

SET 130 (Amar-Suen 4) in "credits"

rev. ix 399-400 0;0,2 *ga gazi*

ga.UDgunû.bi ($20 \times \frac{3}{2} = 30 =$) 0;0,3

rev. ix 415-16 0;1,2,5 *silâ ga gazi*

ga.UDgunû.bi ($85 \times \frac{3}{2} = 127\frac{1}{2} =$) 0;2,0,7 $\frac{1}{2}$ *silâ*

TCL 5, 6040 (date lost) in "credits"

rev. ix 12-13 [$\text{[}\text{ŠU+NIGIN 0;0,0,7}\text{]}$] *silâ ga gazi* (rev. vi 7 + vi 23 + vii 14 + vii 30)

[ga.UD]gunû.bi ($7 \times \frac{3}{2} = 10\frac{1}{2} =$) 0;0,1, $\frac{1}{2}$ *silâ*

MVN 15, 108 (Amar-Suen 3) in "credits"

obv. ii 51 0;0,2,9 *silâ ga gazi*

obv. ii 59 0;0,4,6 $\frac{1}{2}$ *silâ ga gazi*

rev. iii 78 1;3,5,2 $\frac{5}{6}$ *silâ ga gazi g[ur]*

rev. iv 99 2;0,0,8 $\frac{1}{6}$ *silâ ga gazi gur*

rev. iv 100 *ga.UDgunû.bi* ($608\frac{1}{6} \times \frac{3}{2} = 912\frac{1}{4} =$) 3;0,1,2 $\frac{1}{4}$

The sign combination *ga gazi* is certainly an abbreviation of *ga HAR(/UDgunû)*⁶⁹ *gazi* and represented a cheese processed with the condiment *gazi*⁷⁰; one attestation from Girsu suggests salt could also be

⁶⁹ See the references for *ga HAR gazi* listed by M. Stol, *RIA* 8, 200 (note that *SET* 188 derives from Umma and add W. Hallo, *JCS* 14, 111, no. 15 obv. 7), and *BSA* 7, 108.

⁷⁰ The sign *gazi* is originally a combination of *LAGAB* and, inscribed within *LAGAB*, a sign representing a basic unit in the numerical system *B** (designated *N*₆; see P. Damerow and R. Englund, "Die Zahlzeichensysteme der archaischen Texte aus Uruk", in: M. Green and H. Nissen, *ATU* 2, 134-135), attested in Uruk IV and III levels of Uruk (Damerow and Englund, loc. cit.), in Jemdet Nasr (see Englund and J.-P. Grégoire, *MSVO* 1, *sub* *N*₆, *N*₂₁, *N*₃₈, and *N*₅₂) and possibly in Uqair (see R. Englund, *MSVO* 4, 16 [= *ATU* 1, 646] obv. iii l. '2*N*₂₁' and rev. iii 4: 2*N*₂₁; *MSVO* 4, 14 [= *ATU* 1, 654] obv. i 2). The so-called bisexagesimal system from which *B** was derived seems to have been used to qualify amounts of products used as rations (specific measures of grain and dry grain products, fish, cheese); we may suspect this is also the case with *B**, characterized by the use of gunified variants of the basic bisexagesimal signs. Unfortunately, notations in this system are, with one or two unclear exceptions, not qualified with ideograms and so remain undeciphered. Nonetheless, the fact that such notations must represent foodstuffs probably widely available in southern Babylonia suggests that the early form of *gazi* represented a product similar to if not the same as that of later third millennium tradition. The sign itself following the Late Uruk period mutated to a combination *gá+ziz*, but at least in the extended lexical history of the list 'Tribute' (see R. Englund and H. Nissen, *ATU* 3, 25-29 and 112-120, ll. 4//32) its association with the possible condiments *MUNU*, and *HALUB* remained stable; indeed, the Old Babylonian witness of the list, *SLT* 42 (+ *Ni* 1597), registers the corresponding entries with numerical notations which seem to derive from the Babylonian capacity system used in the Ur III period to qualify the product *gazi*. The product itself remains unidentified despite a long history of research and discussion, possibly made the more difficult by a semantic transfer in sign and referents in the second millennium. The Akkadian *kasi/kasû* was in early glossaries (cf. W. Muss-Arnolt, *Assyrisch-englisch-deutsches Handwörterbuch* I [Berlin 1905] 411) equated with cassia; in 1948, A. L. Oppenheim, *AOS* 32, 7-8 (and, following him, D. Snell, *Ledgers and Prices* 219), after a review of lexical attestations, presumed the Sumerian *gazi* found in Ur III administrative texts had the same referent as its Akkadian counterpart. At the same

added to the cheese⁷¹ The relationship of 2:3 between this flavored cheese and ga ḪAR/UDgunû must be an exchange constant and not an indication of the amount of ga ḪAR/UDgunû which could be processed from a liquid product ga gazi, since it is improbable that the resulting cheese would have grown by 50% during processing. A recently published text with silver equivalencies of dairy products, moreover, tends to support an exchange mechanism evidenced by the conversions in dairy accounts, for which see below, § 5. That herders should have delivered this product is not surprising, since gazi must have been freely accessible through normal exchange mechanisms, for example, directly from harvesters from Umma⁷²

The product ga SIG₇.a seems on the other hand to have been converted into dairy oil and cheese both as a value constant and a constant resulting from actual processing. The first to recognize the importance of the

time, R. Campbell Thompson proposed in *A Dictionary of Assyrian Botany* (London 1949) 192-194 to identify late Babylonian *kasia* with the husks of the carob (*Ceratonia siliqua*), Akk. *ḫarûbu*. B. Landsberger and O. Gurney in *AJO* 18 (1957-58) 337-338, and an unusually irresolute Landsberger in *JCS* 21 (1967) 151-152⁷⁰, ventured instead the translation 'mustard', later doubted, among other reasons because it formed a large component in some beer recipes of the first millennium; see M. Civil, *Studies Presented to A. Leo Oppenheim* (Chicago 1964) 77⁷⁴, and the discussion in *CAD*, vol. K s.v. (for the associated plant za.ḫi.li/*saḫlû*, s. M. Stol, "Cress and its Mustard", *JEOL* 28 [1983-1984] 24-32). Following the discussion at the 1981 meeting of the *RAI* in Vienna by M. Geller of the *kasû* used in beer, and his identification of the condiment with a type of beet ("A Recipe against ŠU.GIDIM", *AJO Beiheft* 19 [1982] 192-197), P. Steinkeller presented an as yet unpublished paper at the 1983 meeting in Baltimore of the American Oriental Society entitled "The Mesopotamian Spice Plant *gazi/kasû*: A New Interpretation" (referred to in his article "The Foresters of Umma: Toward a Definition of Ur III Labor", in: M. Powell, ed., *Labor in the Ancient Near East* [AOS 68; New Haven/London 1987] 92) in which he proposed an identification of the spice with wild licorice (this identification has been hesitantly accepted by the *PSD* group, see volume B, 153, s.v. *bi*₂, *ga*). I have no access to this paper and so cannot judge its merits; note that, since Campbell Thompson, *DAB* 133 (cf. *AHW* 1290), and as W. Lambert noted in *Quaderni di Semitistica* 18 (1992) 59, with reference to Eblaic ⁷¹šūš₁(SE+*NĀM*), ⁷²si-si/*su-si*, licorice is believed to be Akkadian *šūšu*, later Sumerian *šūš*₁(GIS.MUŠ_{2A}.SEŠ_{2A}), and see the suggestions of M. Civil, in: F. Rochberg-Halton, ed., *Festschrift Reiner* (AOS 67; New Haven 1987) 45, that *kl.⁷³NANNA/munzer* may be the older form of this 'licorice', and of M. Stol, *RIA* 8, 200, that *gazi* is a dodder (already refuted by Landsberger and Gurney, *AJO* 18, 337). Note that according to literature cited by M. Abdalla, *JAAS* 6/2, 26⁷³, the sumac *Rhus hirta* is used in the Near East as a seasoning in dried cheese. For a discussion of the common Sumerian designation of spices, *mun gazi*, s. K. Maekawa, "Cultivation of Legumes und *mun-gazi* Plants in Ur III Girsu", *BSA* 2 (1985) 97-118.

⁷¹ MVN 2, 130 obv. 1-3: 4;0,0 ga še.a gur lugal / ki Ur⁷⁴gigir šūš.ta / ga mun gazi.šē, "4 gur of soured milk (measured with the) royal (measure), from the cattle supervisor Ur-gigir, for salt-gazi cheese" The qualification *mun.gazi* might, however, represent a general designation 'spiced', 'seasoned'; see the preceding fn.

⁷² See P. Steinkeller, AOS 68, 94, with reference to *Nik.* 2, 401. Steinkeller's discussion AOS 68, 96, of the 'sale' of *gazi* to 'private entrepreneurs' *dam.gār is*, however, based on an illogical representation of *kù gazi* (cf. *Ur III-Fischerei* 162-164) and of the accounting formats used in his forestry texts, in particular his no. 19, MVN 1, 106, pp. 104-105 ('assets' = debits, 'expenditures' = credits, '(positive/negative) balance' = deficit/surplus; note that the 150 sila of *gazi* recorded in the debits section of the account, obv. i 14, and in BIN 5, 8, *passim*, represent the partial expected yearly performance of each of the named workers).

latter fact was M. Stol, who also noted the likelihood that *ga* *šIG₇.a* was a variant writing of *ga šē.a* attested mainly in Umma⁷³ An examination of extant references to both products makes the interchangeability of the two certain and so supports the proposed reading of *ga* *šIG₇.a* = *ga šē_x.a*⁷⁴. Although the exact meaning of the phrase remains elusive⁷⁵, technical considerations make Stol's *ad sensum* translation 'sour milk' preferable. In the first place, *ga šē_(x).a* is in accounts from Umma and Ur found only in the credits sections and so represents a real dairy product. Secondly, it is converted into *ì nun* and into *ga* *ḪAR/UDgunù* at rates entirely consonant with those expected to result from the processing of soured milk into butter oil and cheese⁷⁶ These conversions would further be very difficult to

⁷³ *BSA* 7, 100-101; *RIA* 8, 193 (appeared in 1994, manuscript submitted in March 1991 [see *BSA* 7, 99]; the point was missed by T. Gomi, who following A. L. Oppenheim [see fn. 41 above] refers in *JESHO* 23, 1-42, to an impossible *ga* *šIG₇.a* cheese). A reading *ga/šē/(šIG₇).a* was suggested to Stol by Th. Krispijn, based on the identification of the variant reading *šIG₇* = *se₁₁*^{76c} by P. Steinkeller in *ASJ* 7 (1985) 195 (*se₁₁* is possibly a typographical error in Steinkeller's article, meaning *se₁₂* [*se₁₁* is *šIG*], but certainly not *šē₁₂* as proposed by Stol, *RIA* 8, 193, which is a reading of the sign *MUŠXA*; the sign readings in both articles should be corrected to *šē_(x)(šIG₇)*). Stol may be thinking of a nominalized intransitive "which has sat (out)" with his translation of sour milk; however, this interpretation would not be in accord with Steinkeller's understanding of the verb as a plural stem of *ti*, "to live" (but note the OBG I entries 647-655 with the apparent singular stem *šē_(x)* cited by M. Yoshikawa, *ASJ* 3 [1981] 117). For a possible meaning "to cause to cream" of the verb see fn. 76 below.

⁷⁴ Compare, for example, the pertinent references in the Umma texts *SET* 130, *TCL* 5, 6040 and *MVN* 15, 108, cited below.

⁷⁵ The likelihood that *šē_(x).a* represents a verbal adjective of a transitive verb /*še*/ is supported by a literary reference offered by S. Kramer, *PAPS* 107 (1963) 505, to *ga šē_(x)(šIG₇).a* made of *ga* *u_d*, goat's milk, and to the imperative form *šē_x(šIG₇).a* *ma.ab*, "let (the milk) cream" for me" (*ISCT* 2, 15-16, Ni. 9602 iii 18; see the following fn.).

⁷⁶ See the discussion above, fnn. 7-10. Conversions in accounts from the two cities Umma and Ur are based on a fat content of *ga šē_(x).a* of between 5 and 6½%, respectively. These figures would be too high for fresh milk (since the milk itself only appears in credits sections of accounts, a manipulation by state bookkeepers of expected fat content to a *higher* figure is out of the question), and even though soured milk will have lost some percentage of its water content, dependent on whether and how long it had been heated in initial processing, this seems unlikely to account for a fat content twice that expected of modern cows. For this reason, M. Teuber has suggested to me that the designation *ga šē_(x).a* might represent the top half of fresh milk kept in containers over-night, into which the cream had separated and which had thus 'yellowed' This interpretation would return the discussion of *šIG₇/še* to a possible translation "to cause to cream", literally "to cause to be yellow" (Akkadian *wurruqum*), with, however, two complications. In the first place, the amount of casein in the creamed milk would have been proportionally reduced according to the amount of milk considered *ga šē_(x).a*, making our hypothetical calculation of the amount of dried cheese which can be processed from 100 liters of sour milk less stable. Textual evidence, in the second, suggests that (*w*)*arqum* corresponded only to Sumerian *se₁₂(g)* in the Ur III, as it did in the Old Babylonian period (both *ḫamtu* and *marù*; cf. G. Gragg, *TCS* 3, 177-178; H. Steible, *FAOS* 1, 47; S. Cohen, *ELA* 473; P. Michalowski, *Fs. R. Kutscher* 124-125¹⁷; Gudea Cyls. A xxx 10 and B xvi 20). Note that receipts recording the delivery of amounts of *ga šē_(x).a* in Umma are on the whole dated, if at all, to the final and first months of the year (for example, *MVN* 16, 725 [Amar-Suen 6/xiii], *Umma* 3, 1651 [Šū-Sîn 4/i] and N. Forde, *Nebraska* 20 [Šulgi 41/iii]); however, the scattered dates of comparable texts from Drehem (for example, S. Langdon, *TAD* 7 [Ibbi-Sîn 2/x], *BIN* 3, 586 [Šū-Sîn 9/vi/21], and *TCL* 2, 5482 [Ibbi-Sîn 1/vii/13; rev. ii 5: 3 sila *ga šē.a* *sā.du₁₁* *ur.gi₇.ra!*]) would seem to exclude the assumption that

explain as value equivalents, since such bookkeeping acrobatics would unnecessarily complicate accounts and since we know for example with silver and with *ga gazi* that as a rule one or the other of the ‘accounting products’ was chosen in value conversions. Finally, the two known *ga še_(x).a* butter oil conversion rates of 20:1 and 15:1 were consistently used in Umma and in Ur, respectively; in both cities, to the amount of butter oil expected to derive from a delivered amount of *ga še_(x).a* a fixed measure of cheese is added, at exactly the same ratio of 2:3 as that recorded in the debits sections of dairy accounts in the yearly delivery norms of milk cows (5 and 7½ sila)⁷⁷ and nanny goats (⅓ and ½ or ½ and ¾ sila)⁷⁸ in the cities Umma, Drehem and Ur.

ga še_(x).a i nun = 20 1 in Umma

SET 130 (Amar-Suen 4) in “credits” (from cows and/or nanny goats?; see figure 6 above)

rev. ix 401-5 0;1,2,6 sila *ga še.a*
 i.nun.bi (86 + 20 ⇒) 4¹⁸/₆₀ sila
 ga.UDgunû.bi (4¹⁸/₆₀ × ¾ ⇒) 6²⁷/₆₀ sila
 rev. ix 419-23 0;0,0,7 sila *ga še.a*
 i.nun.bi (7 + 20 ⇒) 2¹/₆₀ sila
 ga.UDgunû.bi (2¹/₆₀ × ¾ ⇒) 6³/₁₂₀ sila

TCL 5, 6040 (date lost) in “credits” (from cows)

rev. ix 9-11 ŠU+NÍGIN 0;0,0,2 sila *ga še_x(SIG₇).a*
 i.nun.bi (2 + 20 ⇒) 9⁶/₆₀ sila
 †*ga.UDgunû¹.bi* (9⁶/₆₀ × ¾ ⇒) 9⁶/₆₀ sila

such deliveries might be used to determine the real period of lactation in Ur III Babylonia. See A. Poyck, *Farm Studies in Iraq* (Wageningen 1962) 53, for modern data.

⁷⁷ The conversion rates on which the Ur texts were based were noted (as 1:15 for ghee and 1:10 for cheese) but incorrectly analyzed by T. Gomi, *JESHO* 23, 1-42. M. Stol noted these rates in *BSA* 7, 101, and added the rates of 1:20 and 1:13, respectively, for the Umma text *SET 130*, but did not calculate correctly (*RIA* 8, 193) the rates in the texts *MVN 15, 108*, and *TCL 5, 6040*; all three are 1:20 for butter oil soured milk and (1:20) × ½ for cheese. It needs to be emphasized that book-keepers used ‘nice numbers’ in administrative texts and never exhibited the playful weakness of Old Babylonian scribes for calculations in mathematical exercises with such sexagesimally irreducible numbers as 7, 11, and 13, discussed by J. Høyrup, “‘Remarkable Numbers’ in Old Babylonian Mathematical Texts: A Note on the Psychology of Numbers”, *JNES* 52 (1993) 281-286 (Høyrup speculated p. 286 that Ur III accountants may have been using these numbers, given the fact that at least the number 7 had already been singled out for mathematical exercises in the Fara period; however, none of the ca. 35,000 published Ur III texts is known to substantiate this belief). Certainly the amount of butter oil derived from the soured milk was calculated first, and this result increased by ½ to find the amount of processed cheese. Thus also 1:10 for cheese in Ur is really (1:15) × ¾.

⁷⁸ See above, fn. 45, the texts cited by M. Stol, *RIA* 8, 194, § 6.2, and, for a rate of ½ and ⅓ in Girsu, *TCTI* 1, 878 (cited above, fn. 12; *FAOS* 16, 947, is, as Gomi suspected, almost certainly a Girsu text).

MVN 15, 108 (Amar-Suen 3) in "credits" (from cows; see figure 12)

rev. iv 102-104 $\text{\textcircled{S}}\text{U}+\text{NIGIN } 7;1,5,5$ sila ga $\text{\textcircled{S}}\text{e}_x(\text{SIG}_7).\text{a}$
 i.nun.bi ($2215 + 20 = 110\frac{3}{4} =$) $0;1,5,\frac{3}{4}$ sila
 ga.UDgunu.bi ($110\frac{3}{4} \times \frac{1}{2} = 166\frac{1}{8} =$) $0;2,4,6\frac{1}{8}$ sila

ga $\text{\textcircled{S}}\text{e}_x(\text{SIG}_7).\text{a}$ i nun = 15 l in Ur

UET 3, 1214 (Ibbi-Sîn 6) in "credits" (from cows)

i 13' - ii 1 $0;0,4,5$ sila ga $\text{\textcircled{S}}\text{e}_x(\text{SIG}_7).\text{a}$
 i.bi ($45 + 15 =$) 3 sila
 $[\text{ga.}\text{\textcircled{H}}\text{AR}]\text{.bi}$ ($3 \times \frac{3}{2} =$) $4\frac{1}{2}$ sila]

ii 6'-8' $0;0,2$ ga $\text{\textcircled{S}}\text{e}_x(\text{SIG}_7).\text{a}$
 i.bi ($20 + 15 =$) $1\frac{1}{2}$ ' sila
 ga.bi ($1\frac{1}{3} \times \frac{3}{2} =$) 2 sila

rev. iii 3-5 $0;0,3,5$ sila ga $\text{\textcircled{S}}\text{e}_x(\text{SIG}_7).\text{a}$
 i.bi ($35 + 15 =$) $2\frac{1}{3}$ sila
 ga.bi ($2\frac{1}{3} \times \frac{3}{2} =$) $3\frac{1}{2}$ sila

UET 3, 1215 (Ibbi-Sîn 8/i) in "credits" (from cows)

rev. vi 2-4 $0;0,2$ ga $\text{\textcircled{S}}\text{e}_x(\text{SIG}_7).\text{a}$
 i.bi ($20 + 15 =$) $1\frac{1}{3}$ sila
 ga.bi ($1\frac{1}{3} \times \frac{3}{2} =$) 2 sila

rev. vii 16'-18' $0;0,1,5$ sila 10 gín ga $\text{\textcircled{S}}\text{e}_x(\text{SIG}_7).\text{a}$
 i.bi ($15\frac{1}{2} + 15 =$) 1 sila
 $\text{ga.}\text{\textcircled{H}}\text{AR}.\text{bi}$ ($1 \times \frac{3}{2} =$) $1\frac{1}{2}$ sila

UET 3, 1216 (Ibbi-Sîn 8/i-vi) in "credits" (from cows)

rev. iii 13-15 $0;0,3$ ga $\text{\textcircled{S}}\text{e}_x(\text{SIG}_7).\text{a}$
 i.bi ($30 + 15 =$) 2 sila
 ga.bi ($2 \times \frac{3}{2} =$) 3 sila

rev. iv 4-6 $\text{\textcircled{S}}\text{U}+\text{NIGIN } 0;2,3,5$ sila ga $\text{\textcircled{S}}\text{e}_x(\text{SIG}_7).\text{a}$
 i.bi ($155 \div 15 =$) $0;0,1,\frac{1}{3}$ sila
 $\text{ga.}\text{\textcircled{H}}\text{AR}.\text{bi}$ ($10\frac{1}{3} \times \frac{3}{2} =$) $0;0,1,5\frac{1}{2}$ sila

UET 9, 894 (Ibbi-Sîn 8/i-vi, consolidated in 1216) in "credits" (from cows)

i 21-23 $[0;0],1,5$ sila g[a $\text{\textcircled{S}}\text{e}_x(\text{SIG}_7).\text{a}$]
 $[\text{i.b}]\text{i}$ ($15 + 15 =$) 1 [sila]
 $[\text{ga.b}]\text{i}$ ($1 \times \frac{3}{2} =$) $1\frac{1}{2}$ [sila]

rev. iv 7-9 $[\text{\textcircled{S}}\text{U}+\text{NIGIN } 0;2,3],5$ sila ga $\text{\textcircled{S}}\text{e}_x(\text{SIG}_7).\text{a}$
 $[\text{\textcircled{S}}\text{U}+\text{NIGIN } \text{i}].\text{nun.bi}$ ($155 + 15 =$) $0;0,1,\frac{1}{3}$ sila
 $\text{\textcircled{S}}\text{U}+\text{NIGIN } \text{ga.}\text{\textcircled{H}}\text{AR}.\text{bi}$ ($10\frac{1}{3} \times \frac{3}{2} =$) $0;0,1,5\frac{1}{2}$ sila

The purpose of these conversions is the same as that of converting into silver goods dealt for and delivered to the state by dam.gàr agents. the mechanism of exchange equivalencies reduced various goods and service to internally common and comparable artificial accounting units and so facilitated record keeping of an increasingly complex administration. It is obvious that the summations of the delivered goods in MVN 15, 108 (rev. iv 106-107, see figure 13), as quantities of *i nun* and *ga UDgunu* represent artificial accounting units, since the actually delivered *gazi* cheese

ŠU+NÍGIN 7;3,4,6 $\frac{2}{3}$ sila 4 $\frac{1}{2}$ gín ì nun gur	Total: 2326 $\frac{89}{120}$ sila butter oil.
ŠU+NÍGIN 2;0,0,8 sila 10 gín ga gazi gur	Total: 608 $\frac{1}{6}$ sila gazi-cheese,
ga.UDgunú.bi 3;0,1,2 sila 15 gín	($\times \frac{3}{2}$ =) 912 $\frac{1}{4}$ sila its cheese.
ŠU+NÍGIN 6;1,1,9 sila ga UDgunú gur	Total: 1879 sila cheese.
ŠU+NÍGIN 7;1,5,5 sila ga SIG _{7,a} gur	Total: 2215 sila soured milk,
ì.nun.bi 0;1,5 $\frac{2}{3}$ sila 5 gín	(+ 20 =) 110 $\frac{3}{4}$ sila its butter oil,
ga.UDgunú.bi 0;2,4,6 sila 7 $\frac{1}{2}$ gín	(110 $\frac{3}{4}$ sila $\times \frac{3}{2}$ =) 166 $\frac{1}{8}$ sila its cheese.
ŠU+NÍGIN 8;0,3,7 $\frac{1}{3}$ sila 9 $\frac{1}{2}$ gín ì nun gur	
ŠU+NÍGIN 9;4,1,7 $\frac{1}{3}$ sila 2 $\frac{1}{2}$ gín ga UDgunú gur	
zi.ga.àm	

Figure 13: Real dairy products delivered according to the credits section of the account MVN 15, 108, lines 98-108: ì nun, ga UDgunú, ga gazi, ga SIG_{7,a}. Shaded areas indicate the products converted into butter oil and cheese.

and the soured milk ga še_x a were lost in the preceding conversion. These equivalence conversions, found in any number of Ur III accounts, are at the heart of the bookkeeping system of that period⁷⁹.

§ 4.2.3. Balance of MVN 15, 108 (figure 14)

Once the products registered in the credits section of MVN 15, 108, have been converted and consolidated as quantities of butter oil and cheese, these totals are subtracted from the original debits, resulting in the balance of the account. It is not difficult to imagine that the herders under the supervisor Atu might have had a particularly productive year; that Atu in his private affairs might have been very successful and so have transferred to the account of the Umma administrator Lukala more silver than would have been necessary to fulfill his dairy product quotas; that indeed the scribe of this account might have made a calculation error in favor of the dairy supervisor, so that the total of deliveries might have exceeded that of his debits. In this case, seldom found in Ur III accounts, the difference between the debits and the credits totals would have been qualified as diri and either included in the following account as such in the cred-

⁷⁹ The level of bookkeeping represented by MVN 15, 108, SET 130, UET 3, 1215, and other accounts is presented in figure 15. The cattle recorded in these texts is essentially to be considered property of the state represented in Umma, for instance, by the énsi, tended by individual herders, the supervisor Atu was responsible for managing the books of the 13 herds registered in the debits section of our account, for collecting and transferring the dairy products to the household of the énsi. Should Atu have remitted silver or dairy products to the high officials Lukala or Ur-Sulpa'e, such transactions are nonetheless to be understood as having gone through the office of the énsi, since they are then dealt with in the books of these latter officials as property of his household, of course not of Atu.

its section — thus in exact correspondence to performed services or delivered goods of the supervisor or foreman involved — or possibly simply ‘cashed in’ by the supervisor in the form of silver, labor or realia. The great majority of Ur III accounts, including MVN 15, 108, however, show credit totals smaller than debits. In these cases the difference is qualified LÁ+NI and will either have been transferred to the following account as the first entry in the debits section (qualified *si.i.tum*), as we have seen, or will have been called in by central authorities; such clearings of debits are contained in receipts characterized by the term LÁ+NI *su.ga*, “replaced/repaid deficit”⁸⁰

		<i>Debits:</i>	
			(ŠU+NÍGIN 11;4,3,5 1/3 sila 7 1/2 gín ì.nun gur)
			(ŠU+NÍGIN 20;3,4,8 2/3 sila 8 gín ga.UDgunû gur)
		<i>Credits:</i>	
			(ŠU+NÍGIN 8;0,3,7 1/3 sila 9 1/2 gín ì.nun gur)
			(ŠU+NÍGIN 9;4,1,7 1/3 sila 2 1/2 gín ga.UDgunû gur)
		<i>Balance:</i>	
			LÁ+NI 3;3,5,7 5/6 sila 8 gín ì nun gur
		110)	10;4,3,1 1/3 sila 5 1/2 gín ga UDgunû gur
			LÁ+NI.àm
		<i>Colophon:</i>	
			níg.ka ₉ .ak ì nun ga H ₂ AR
			A.tu šuš
			mu kù gu.za ^e En.líl.lá ba.dím (Amar-Suen 3)
<i>Balance:</i>		<i>Original deficit:</i>	
ì nun	ga UDgunû		6;1,5 17 1/2 gín ì nun, 13;0,1,8 48 gín ga UDgunû
- 11;4,3,5 27 1/2	- 20;3,4,8 48	<i>Final deficit</i>	
+ 8;0,3,7 29 1/2	+ 9;4,1,7 22 1/2	in ì nun, silver:	3;3,5,7 58 ≈ 113.8 shekels
- 3;3,5,7 58	10;4,3,1 25 1/2	in ga UDgunû, silver:	10;4,3,1 25 1/2 ≈ 18.2
			132 shekels

Figure 14: The balance of MVN 15, 108; silver equivalences are meant to convey the general size of debt faced by the supervisor Atu (employing the equivalencies 1 shekel = 10 sila ì nun = 180 sila ga UDgunû).

⁸⁰ BIN 5, 333, dated to Šulgi 46/vii, states explicitly that Atu made such payments in an amount of silver corresponding to 162½ sila of the butter oil ì nun:

16 gín igi.4.gál kù.bábar
LÁ+NI su.ga ì nun

16¼ shekels of silver,
repaid deficit for the butter oil,

Although according to MVN 15, 108, the supervisor Atu was able to substantially reduce his initial arrears (from about 6 to less than 4 gur butter oil and from 13 to less than 10 gur cheese), the fact that he still shows very heavy debts in the balance of the account and the fact that such arrears are the rule in Ur III accounting suggest that the delivery norms and the standardized equivalencies, both established by the state, may have been unrealistic and thus that accounting might have been ex-

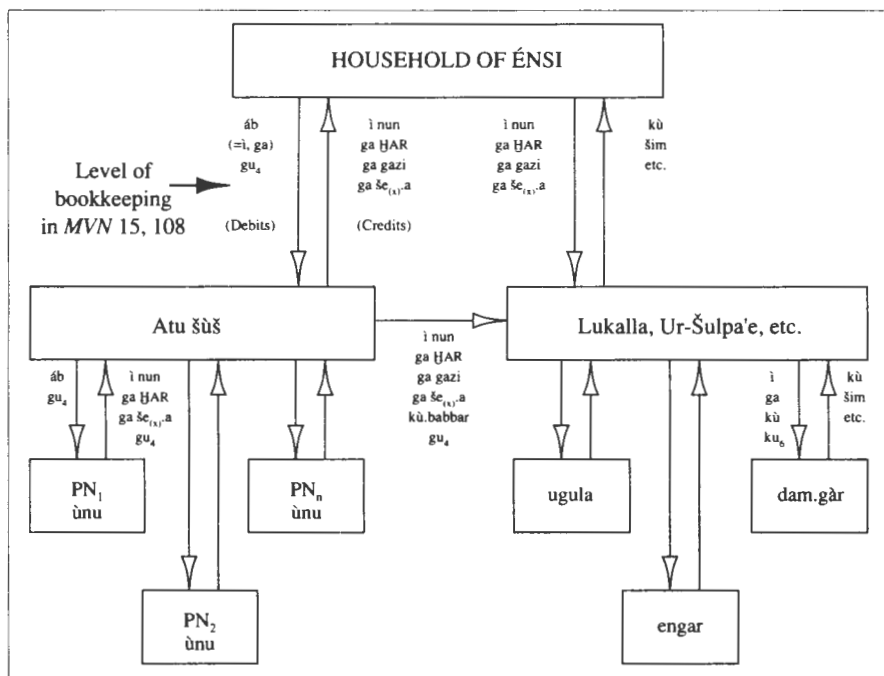


Figure 15: The level of bookkeeping attested in such accounts as MVN 15, 108.

ki A.tu.ta
Da.da.ga
šu ba.ti
iti min.èš
mu Ki.maš^{ki} ba.ĥul

from Atu
did Dadaga
receive.
Month: 'mineš'
Year: Kimaš was destroyed.

See further the text P. Watson, *CBM* 2, 84, with, presumably, obv. 4: $\frac{1}{2}$ ma.na kù 'A'.[t]u (following similar entries representing amounts of silver paid by the Umma officials Ur-e'e and Kaš) and rev. 2-4: SU+NIGIN $6\frac{1}{2}$ ma.na $2\frac{1}{2}$ gin 'kù'.babbar / LA+NI ku₃.a gál.la / giri Ur.Šára ša₁₃.dub.ba, "Together: $6\frac{1}{2}$ ma.na $2\frac{1}{2}$ shekels of silver, arrears payment on account, via the chief accountant Ur-Šára" (to ku₃.a gál.la compare *NATN* 107 rev. iv 19 [copy apparently incorrect] and T. Fish, *Iraq* 5 [1938] 169, no. 2 [correct transliteration, incorrectly interpreted as 'in fragments']).

ploited by state officials to insure the highest possible return on what they considered state property⁸¹

§ 5. Possible relationships of silver values to equivalencies from dairy texts

The comparison of equivalent measures of the dairy products treated here in dairy accounts can be based either on the concrete derivation of one product from another, for example, of butter oil from soured milk or of flour from barley, or on the artificial equivalence of quantities of two products or services based on standardized accounting units of value, of which silver is the best known, but including gold and other precious metals, barley, fish, oil, and even, well documented beginning in the Ur III period but probably derived from earlier practice⁸², labor. A small number of accounts offer some information about the system of silver equivalencies employed in Ur III bookkeeping to price dairy products. Not in all cases consistent for the entire Ur III state, the silver equivalencies seem just the same standardized within, and at least comparable among provinces, and so reflect bookkeeping mechanisms which were probably generally known to state accountants. Currently available texts present us with the following data (the products from goat's and cow's milk were of approximately equal value):

<i>Product</i>	<i>Amount per shekel</i>	<i>Reference texts</i>
i nun.ḪA	8 sila	Goats: UET 3, 1198 obv. 3 and <i>passim</i> ; 1514 obv. 9; UET 9, 916 obv. 7' (all references Ur)
i nun.ḪA	10 sila	Goats: <i>SNAT</i> 302 obv. i 1-2 (Umma)
i nun	10 sila	Cows: TCL 2, 5499 rev. vi 4 and 6 (Drehem); MVN 15, 108 rev. iii 66-76; <i>VDI</i> 1976/3, 110-111:37 (both Umma)

⁸¹ The household of the cow herder Ur-kaNara, who according to MVN 10, 155, was responsible for butter oil and cheese arrears corresponding to ca. 15 shekels of silver at the time of his death, bore the burden of these debts: children and slaves of the herder were transferred to state property (see *Ur III-Fischerei* 42-48). Equally disagreeable fates suffered by the families of herders or foremen of similar status in the Ur III administration, who were unable or unwilling to cover debts owed the state, are documented in the texts TIM 6, 55 ii 9-12 (= rev. iii 17-20 [cited by H. Waetzoldt, *AOS* 68, 139¹⁵³]: 1 áb mu.3 / 1 gu₄ giš / su.su Lugal.⁸²gigir.re nu.su / mu.bi.še Nin.ab.ba.na dam.ni Ama.gi.na dumu.ni uš.bar.še ba.ab.dab, "1 three-year-old heifer, 1 plow ox, to be replaced, Lugal-gigir did not replace them, as a result of which Nin-abbana, his wife, and Ama-gina, his daughter, have been transferred to the [state-owned] weavers"), CT 7, pl. 32, BM 18395, and CT 10, pl. 25, BM 14313 rev. iv 22-24. See fn. 56 above and compare the payment of two-year-old cattle to partially cancel the deficit of the cow herder Šeš-ani, received by Kaš, in the text BIN 5, 335.

⁸² See *Ur III-Fischerei* 96-100.

<i>Product</i>	<i>Amount per shekel</i>	<i>Reference texts</i>
ga 𐤇𐤀𐤓	150 sila	Cows: TCL 2, 5499 rev. vi 5 and 7 (Drehem); Goats: UET 3, 1198 obv. 5 and <i>passim</i> ; 1514 rev. 1, UET 9, 916 obv. 9' (Ur)
ga 𐤇𐤀𐤓	180 sila	Cows: <i>SNAT</i> 302 obv. ii 10-11 (Umma)
ga UDgunû	180 sila	Cows: <i>VDI</i> 1976/3, 110-111:39 (?) (Umma)
ga gazi	120 sila	Cows: <i>SNAT</i> 302 obv. i 2-3 (Umma)
gazi	300/360 sila	TCL 5, 6051 obv. i 5-6; <i>HUCA</i> 30, 113 rev. 5-6 (both Umma)
ga še.a	180 sila	Cows: <i>SNAT</i> 302 obv. ii 4-5 (Umma)

This table suggests the following distribution of values in the Ur III administrative centers Umma, Drehem and Ur (reckoned in amount of products per shekel silver)⁸³:

	i nun(.𐤇𐤀)	ga 𐤇𐤀𐤓/UDgunû (and ga še. _(x) .a?)
Umma	10	180
Drehem	10	150
Ur	8	150

We may use these data as soft and as hard evidence for speculation about the relationship between arbitrary value equivalencies and conversion rates used in Ur III bookkeeping to control ingredients in processed dairy goods. In the first case, ga gazi with a silver equivalence of 120 sila per shekel may be compared with the silver equivalence of ga UDgunû of 180 sila in Umma. Since $120 \times \frac{1}{2} = 180$ sila ga UDgunû and since the silver equivalence of gazi is 300 or 360 sila per shekel, the conversion of ga gazi may have resulted from a processing of 180 sila ga UDgunû together with 180 sila gazi without volume increase in the original cheese. Employing the gazi/silver equivalence of 360 sila per shekel, the silver value equivalent of the two products together would be $1\frac{1}{2}$ shekels $((180 \div 180) + (180 \div 360))$, and $180 \div 1\frac{1}{2}$ shekels would correspond to an equivalence of 120 sila per shekel ga gazi⁸⁴ In the second

⁸³ Available accounts from Ur document only silver equivalents of dairy products derived from goat's milk, which, as stated above, may also in Ur have been valued the same as those from cow milk. The rate of 180 sila ga še._(x).a per shekel silver from Umma is attested in just one text, *SNAT* 302, and its applicability to this province is thus debatable. Since the text remains an indication of the value equivalence between equal measures of soured milk and cheese (each 180 sila per shekel silver) in Umma, however, the same may be speculated of Drehem and Ur, namely, that outside of Umma soured milk could be exchanged at a rate of 150 sila per shekel.

⁸⁴ This is, as I stated, the 'soft' case and must be considered *cum grano salis*. Correspondingly, cheese in Drehem and Ur, with a rate of 150 sila ga 𐤇𐤀𐤓 per shekel silver, could be processed with an amount of gazi manipulated to result in comparable figures.

case, we can, beginning with the attested silver equivalence of 180 sila ga še_(x).a per shekel in Umma and assuming this refers to cow's milk⁸⁵, calculate the products derived from this volume of soured milk in the same city as $180 \div 20 = 9$ sila i nun and $9 \times \frac{3}{2} = 13\frac{1}{2}$ sila ga 𒀠/UDgunû. Using the conversion rates attested in Umma, the amounts of these two products have together the following value:

$$\frac{9}{10} + \frac{27}{360} (180 \text{ sila ga } 𒀠/UDgunû \text{ per shekel}) = \frac{351}{360} = 0.975 \text{ shekel silver.}$$

The same procedure applied to products and equivalencies attested in Drehem (and possibly Ur) results in.

$$\frac{9}{10} + \frac{27}{300} (150 \text{ sila ga } 𒀠 \text{ per shekel}) = \frac{297}{300} = 0.99 \text{ shekel silver,}$$

and thus in both cases⁸⁶ in equivalent values which support the contention that the sign combination ga še_(x).a found in the credits section of accounts designated a real delivered dairy product and that this product was equivalent to the quantities of processed products to which it corresponded both as the source of these products and as an exchange value.

One consequence of the likelihood that the delivery norms per milk cow in the Ur III period were 5 sila i nun and $7\frac{1}{2}$ sila ga 𒀠/UDgunû in Ur and Umma and that at least in Umma precisely these quantities were processed from 100 sila of the soured milk ga še_(x).a is that we can re-examine what the delivery norms really mean, namely, approximately one to two hundred liters of soured milk per adult cow per year. Since we know that reasonably well-fed and well-cared for cows in comparable climates will produce for the herder from seven to eight hundred or, after the nursing of their calves, between three and four hundred liters of milk, it seems most reasonable to assume that these hundred liters of ga še_(x).a represented a partial return on production for the owners of the cattle, that is, the state, and that the remaining milk was kept by the

⁸⁵ Even if it does not, milk from cows and that from goats, which according to *SET* 130 were of equal value, were probably interchangeable in silver transactions (cf. also the equivalency of 10 sila of the goat's butter oil i nun 𒀠 and 1 shekel of silver in the same text *SNAT* 302).

⁸⁶ Comparable calculations for Ur based on a value equivalence of i nun from cows and i nun. 𒀠 from goats are more speculative, considering the fact that goat's cheese from Ur was valued the same as cheese made from cow milk in Drehem. Note that in both cases of hypothetical conversions of soured milk into its constituent dairy fat and cheese, it is difficult to decide whether labor costs were included in the calculations ($\frac{9}{360}$ shekel or $4\frac{1}{2}$ grains of silver in Umma might represent from less than 1 to as many as $4\frac{1}{2}$ labor days of the simple workers gurusš/érin and géme, see *Ur III-Fischerei* 193-197 [2 še silver per day], and, for example, *SNAT* 259 ii 6-8 [3 še per day; collated], *TCL* 5, 6166 *passim* [4 še per day] and the Girsu text *TUT* 137, obv. i 9'-11' [$4\frac{1}{2}$ še per day]). The same difficulty is met in analyses of other Ur III labor texts, in particular of accounts from Umma flour mills.

herders as compensation for feed and care of the animals⁸⁷ If we take, based on the debits section of the account MVN 15, 108, an average size of individual milk cow herds of $(308 \div 13 \approx) 25$ and multiply this by an average $ga\ \check{s}e_{(x)}$, a surplus of 200 sila — that is, basing our calculation on suckling cows —, the resulting 5000 sila would correspond to approximately 28 shekels of silver or, more generally, 28 gur of barley, from which all costs of the dairy operation involved, including feed, rations of helpers, personal compensation, and so on, had to be covered. Since there remain many unknown variables, for instance, the number and value of calves which the herder may have kept, and the number of juvenile cattle and bulls he will have been expected to care for together with the milk cows, these figures must be understood as merely indications of the order of valuables dairy herders at a lower level probably dealt with.

The manager Atu as a high official of the Umma administration was responsible for the production of 308 cows in the year Amar-Suen 3 and thus operated at an order of 10 times the value levels of the dairy herders whom he supervised. Texts which offer an idea of the *total* size of cattle holdings based on recorded milk cows imply that Atu will have administered altogether some three times as many⁸⁸, or probably close to 1000, animals. Remembering that Atu was one of perhaps several such supervisors — although he may well have managed the largest herds —, the size of dairy operations alone in the province Umma becomes more apparent and so also, for example, the capacity of this and other Ur III provinces, above all Lagash, to plow and tend the very large fields used in the cultivation of grain⁸⁹ The

⁸⁷ See the discussion above, § 1.

⁸⁸ See, for example, the treatment above of the pre-Sargonic Girsu text *DP* 93 and the Ur III Drehem text *TCL* 2, 5499; receipts such as those cited above, fn. 54, furthermore, state explicitly that Atu was also responsible for oxen.

⁸⁹ Several Girsu accounts give us an idea of the total area of fields in that province farmed for grain in the Ur III period. The best known is *RTC* 407, which recorded field totals ranging in size from 4134½ to 4261 bùr for the years Šulgi 28, 30 and 32 (see H. Nissen et al., *Archaic Bookkeeping* 140-142). These figures are supported by the accounts *TUT* 5, *CT* 10, pls. 18-19, *BM* 12922, C. Walker, *AJO* 24, 122-123 + pls. XVII-XVIII, Truro no. 1, G. Pettinato, *Rendiconti* 32/1-2, 65-71, and K. Maekawa, *ASJ* 8, 118, no. 33 (*BM* 25055), cited variously by K. Maekawa, "The Development of the é-mi in Lagash During Early Dynastic III", *Mesopotamia* 8-9 (1973-1974) 140-143 (see also Maekawa, *Zinbun* 13 [1974] 11-14), and I. J. Gelb, "Ebla and Lagash: Environmental Contrast", in: H. Weiss, ed., *The Origins of Cities in Dry-Farming Syria and Mesopotamia in the Third Millennium B.C.* (Guilford 1986) 159. Support is found further in such harvest accounts as D. Charpin and J.-M. Durand, *DCS* 63 (date broken), with reverse ii 2 + 4: 34.50.42;1,0 grain harvested in Lagash; this total divided by 30 (gur per bùr) equals ca. 4181½ bùr (compare *CT* 7, pl. 8, *BM* 12926 [cited K. Maekawa, *ASJ* 15, 117] with a total for the year Amar-Suen 2 of 27.39.55;0,5,2 [obv. i 12; see rev.

oxen pulling the plows on these fields were reared by the milk cows recorded in our dairy accounts⁹⁰

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iv 2-3: níg.ka₃.ak še kilib.ba / šà Gír.su¹⁴). The plowing and seeding of these tracts required, according to figures presented by J. Renger, “Überlegungen zur räumlichen Ausdehnung des Staates von Ebla an Hand der agrarischen und viehwirtschaftlichen Gegebenheiten”, in: L. Cagni, ed., *Ebla 1975-1985 Dieci anni di studi linguistici e filologici* (Naples 1987) 293-311 (see in particular his table 1, pp. 303-307, with notes 5-6 on p. 305), and “Report on the Implications of Employing Draught Animals”, *BSA* 5 (1990) 267-279 (see further K. Maekawa, “Cultivation Methods in the Ur III Period”, *BSA* 5, 115-145), a minimum of ca. 8000 plow animals, of which relative to equids oxen always formed the large majority. This number could have been still higher, assuming that at least half of such quantities as 12,354 and 11,652 bùr in the Girsu texts BM 28673 and 23837 (K. Maekawa, *ASJ* 9 [1987] 122-124, nos. 52-53, first text dated to Ibbi-Sîn 5), respectively, reflect land that was really under plow, the other half being fallow (see E. Ebeling, *RLA* 3, 36; A. L. Oppenheim, *AOS* 32, 75; I. J. Gelb, “Ebla and Lagash”, 159; K. Maekawa, *ASJ* 4, 90-91, and *Zinbun* 22, 52-55, to a šà/buru₁₄ bal). The estimates of the numbers of plow oxen — in Sumerian usually qualified gu₄ apin (more specifically qualified according to the type of plowing done) — requisite for working these fields are on the whole based on recent literature concerning agriculture in sub-Saharan Africa published above all by the Food and Agriculture Organization of the United Nations (reckoning with a mean of 3,75 ha per animal and season), and on information culled from Ur III administrative documents which record the amount per bùr a given team of oxen was to plow, namely, ca. 1 bùr per plowing season consisting of three types of plowing: deep plowing (with the so-called Near Eastern *ard*, Sumerian (apin.) túg gur_{10x}), harrowing (giš ùr) and seed plowing (numun). Depending on the work life of plow oxen, keeping these numbers available for farm operations in the area surrounding Girsu would require between two and four thousand adult cows and one hundred or more bulls, reckoning roughly with a service ratio of 20:1. Old Babylonian accounts from Ur which certify the existence of up to 20,400 cattle belonging to the Nanna temple⁷ (UET 5, 849; the total of 16,803 given by K. Butz, *WZKM* 65-66, 30, and repeated by M. van de Mieroop, *BBVO* 12 [Berlin 1992] 87, seems incorrect given the notation rev. 3·[ŠU+NIGIN] '51.40.03 [the basis of van de Mieroop's objection to reconstructing 'Nanna in the colophon of the account is unclear to me]) are in accordance with the relative sizes postulated for the Ur III period.

⁹⁰ This breeding model will remain our primary working hypothesis as long as the ultimate destination of the cattle sent to Dreheim from the eastern provinces of the Ur III empire, most importantly from Elam (see above, fn. 45), is unclear.