Karine Chemla · Agathe Keller · Christine Proust
Editors

Cultures of Computation and Quantification in the Ancient World

Numbers, Measurements, and Operations in Documents from Mesopotamia, China and South Asia

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Pour Daphné, qui compte sans mesure
Pour Elina, qui n'a pas de prix

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Chapter 3
Measuring Grain in Early Bronze Age Mesopotamia: Form, Use, and Control of the *Bariga* Container in the Twenty-First Century BCE

Walther Sallaberger

Abstract In Early Bronze Age Mesopotamia, barley was the basic cereal, produced in large quantities. Collective labor, collection in communal granaries, and distribution to consumers all required careful measuring of large quantities of grain. The enormous textual record from the time of the Third Dynasty of Ur (twenty-first century BCE) attests to the all-encompassing use of capacity measures. Up to now, however, it has remained unknown how grain was measured. In this chapter, the main measuring containers are identified and their form and material are reconstructed using textual data. Furthermore, various operating standards are established which depended on the actual stage of processing and storing barley after threshing. The documents also point to the control of vessels for measuring grain by the administration.

3.1 The System of Capacity Measures and the *Bariga* Standard[1]

Capacity measures in the Mesopotamian textual record most often appear as measures of grain, predominantly barley (Sumerian *še*). Both bread and beer, the two funda-

[1] Conventions: Capacity measures always refer to the Standard Akkad to Old Babylonian system (Table 3.1) and are given in transliterations in the format used for this volume, namely 1(gur) 2(bariga) 3(ban$_2$) 4 sila$_3$ gur instead of 1.2.3 4 sila$_3$ gur (i.e. $300 + 2 \times 60 + 3 \times 10 + 4 = 454$ *sila*). Only exceptions from the standard notations are indicated according to the CDLI system—1(diš), 1(aš) etc., but this does not apply for this chapter (1 written AŠ appears as usual with the capacity measure gur). Dates refer to year and month (e.g. Š 48/08) with the following abbreviations: Š = Šulgi (48 years, 2092–2045 BCE), AS = Amar-Suena (9 years, 2044–2036 BCE), ŠS = Šu-Suen (9 years, 2035–2027 BCE), IS = Ibbi-Suen (24 years, 2026–2003 BCE). Year dates BCE refer to the 'Middle Chronology' (with Hammurapi 1792–1750). For the textual references see the list at the end of the chapter.

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Table 3.1 Standard measures of the capacity system in Early Bronze Age Mesopotamia (following Powell 1990; Sallaberger 1996b)

Standard Fara to Akkad (Babylonia, 26th–23rd cent. BCE).								
sila	×10	***ban***	×6	***bariga***	×4	*lidga gur* (= 240 *sila*)	×2	*gurmaḫ* (= 480 *sila*)
Standard Akkad to Old Babylonian (Babylonia, 23rd–17th cent. BCE), including Ur III (21st cent. BCE)								
sila	×10	***ban***	×6	***bariga***	×5	*gur* (= 300 *sila*)		
Presargonic Tell Beydar (Northern Mesopotamia, 24th cent. BCE)								
sila	×10	***ban***	×6	***bariga***	×10	*gur* (= 600 *sila*)	×10	*miat* (= 6 000 *sila*)
Presargonic Girsu (Babylonia 24th cent. BCE)								
sila	×6	***ban***	×6	***UL***	×4	*gur* (= 144 *sila*)		

Note: The fixed relation of *bariga* : *ban* as 1 : 6 (in bold)

mental components of the daily diet, were made of barley.[2] Barley was grown on large fields in the irrigation culture in the alluvium of the Euphrates and Tigris rivers, encompassing the land of Sumer in the Early Bronze Age, the third millennium BCE. Although good approximated values exist for the absolute value of capacity measures, and although their use for barley, other crops and goods, as well as for liquids is attested in tens of thousands of administrative texts from the second half of the third millennium, the practice of measuring has largely remained unknown. Powell (1990), for example, in his classic treatment of measures and weights, was unable to provide evidence for the actual form and material of the vessels used for measuring grain.[3] This chapter deals with measuring vessels and their use as attested at the end of the Early Bronze Age. The period of the kings of the Third Dynasty of Ur, abbreviated as Ur III (2110–2003 BCE), provides the best textual documentation for Southern Babylonia. More than 80 000 documents are currently published, stemming mostly from a short period of three to four decades towards the end of the dynasty's rule.[4] The system of capacity measures in use at that time is very well known, a system which became generally used in Mesopotamia and which integrated various features of earlier systems (Table 3.1).

The unit *sila* can be estimated to have been about one metric litre, and the more precise absolute values probably varied historically and regionally (Powell 1990: 503–504). In all Early Bronze Age systems the *ban: bariga* (or *ban: UL* in Presargonic Girsu) relationship remains stable at 1:6. This is a first hint that the *bariga* assumes a

[2] Brunke provides a richly documented study on food in Sumer; note especially Chap. 4 in Brunke (2011a: 213–230) on the predominance of bread and beer (sometimes combined with 'soup' made of flour, pulses, sometimes meat or fish, salt, and spices) in the daily diet. On the brewing of beer see Sallaberger (2012).

[3] Powell (1990: 492–498, 502–505).

[4] Molina (2008). The number is constantly growing due to the catalogization and publication of documents from recent, illicit excavations, mainly in the late 1990s and early 2000s.

central position within the capacity measure system.[5] Another indicator is the fact that at Presargonic Tell Beydar the large capacity measures called 'one hundred' (*miat*) or 'one thousand' (*līm*) of 10 and 100 *gur* refer back to the *bariga* as a central unit, not to the *gur*.[6] The central position in the capacity system assumed by the *bariga* becomes evident in Ur III administrative texts which refer to different *bariga* standards of not only 60, but also of 62, 72, 75, or 80 L.[7] The standard expression is translated literally '*n* (royal) *gur* of barley, *gur* of 60 *sila*' (*n* še gur (lugal) gur $sila_3$ ŋeš$_2$ (1:00)-da-ta), similarly with the other values. Gomi (1993: 36) argued that '60 etc. *sila*' is 'the size of a (bariga)-container with which the barley was measured'. And an explicit reference to a *bariga* (ba-ri$_2$-ga, TRU 374:12, Text 6 below) with a supplement (saŋ) of 2 *sila* proves that the measuring container was indeed called *bariga* (here of 62 *sila*).[8] Thus the Sumerian noun *gur* denoted both the capacity measure of 300 *sila* and the basic standard of the system, represented by the measuring container *bariga* of 60 *sila.* The use of the term *gur* for the measuring standard, based on the unit of 60 *sila*, may well be related to the designation of a reed container, called *gur* in Sumerian, which contained 60 *sila* in the Ur III period (twenty-first century BCE).[9] The *bariga* of 60 *sila* continued to be used in the subsequent Old Babylonian period.[10] In addition, the reed container of 60 *sila*, Sumerian ^{ge}gur, was called *pānum* in Old Babylonian Akkadian. The word *pānum* also designated the size of 60 *sila*/*qû*,[11] another sign of continuity with the later third millennium practice of measuring in Southern Mesopotamia.

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[5] It is impossible to prove the size of the Presargonic *sila* used at Girsu. The surprisingly low monthly grain allotments for workers could perhaps indicate that the *sila* was larger at Presargonic Girsu than elsewhere, so that even in absolute measures the *bariga*/UL may have constituted a widely used Mesopotamian standard with its local and temporal variations (note in Table 3.1: 1 *bariga* = 60 *sila* in the Standard Akkad to Old Babylonian system; 1 UL = 36 *sila* in Presargonic Girsu). On the Presargonic rations at Girsu see Prentice (2010: 64) for an example on the distribution of monthly allotments for women: there the standard is 18 and 24 *sila* instead of the usual 30 *sila* in the Ur III record and elsewhere; men at Presargonic Girsu most often received 36 *sila* instead of the standard 50 or 60 *sila* (Ur III and elsewhere). This tendency would agree with the measure used for liquids called 'pot' (*dug*) which contained 20 *sila* in Presargonic Girsu (twenty-fourth century BCE), but 30 *sila* in the later Akkad period (23rd-twenty-second centuries BCE); on the attestations, see Powell (1990: 504–505). Does this evidence point to a ca. 2:3 relationship of the standard *sila* (ca. 1 L) to the Presargonic *sila* (thus ca. 1.5 L)?

[6] Sallaberger (1996b: 82–84).

[7] Gomi (1993). The references were also collected by Maekawa (1992: 218–220 notes 27–30). Further examples of measuring grain are discussed by Gomi (1996). Note that both Gomi (1993, 1996) and Maekawa (1992) still read $sila_3$ ŋeš$_2$(1:00)-da-ta 'of 60 *sila*' as '60 $sila_3$ da-ta' or similarly. On the word for '60' as ŋeš$_2$-d(a), see Steinkeller (1980).

[8] Gomi (1993: 37) with additional literature, including Veenhof (1985)and Englund (1988: 151–152, footnote 27), who interprets saŋ as 'some sort of administrative "adjustment" to quantities of grain at the rate of 1:30 (1 ban per gur)'.

[9] ^{ge}gur, e.g. *TCL* 5, 6036 xiii 36–41. In the preceding Sargonic period (twenty-third century), the *gur* container of reed contained both 2 and 1 *barigas* (^{ge}gur 2(bariga) and ^{ge}gur 1(bariga)), see *OSP* 2, 45:8–9 and 48:67.

[10] See Veenhof (1985) with many examples.

[11] *CAD* P: 100, there separated into *pānu* A and *pānu* B.

3.2 Clay Vessels as Standard Containers

Specific clay vessels of standard size served as quasi-measures for liquids. In this case the quantity of liquids s not indicated in the standard capacity system (Fig. 3.1) in the documents, but according to a fixed set of vessels. Thus, for example, the 'pot' (Sumerian *dug*, written dug) of mostly 20 or 30 L, is predominantly attested for oil; in Presargonic Girsu (twenty-fourth century BCE) the beer-drinking cup of circa half a litre (or more) was called 'friend' (*guli*, gu_5-li); and beside various other standard clay vessels appears the large transport container for beer with a volume of 50 'friends' (*mud,* mud_3(LAK449)).[12]

Clay vessels themselves were sometimes described by their size without serving as measuring vessels in the strict sense. According to three potter documents from Ur III Umma (twenty-first century BCE), clay vessels like the spindle-formed bottles for perfumed oil ($^{dug}saman_4$) were produced in sizes of 120, 110, 2, 1 *sila*, large bowls or pots ($^{dug}utul_2$) in sizes of 60, 10, 3, 2, 1 *sila.*[13] Whereas these two vessels were characterized by a specific form related to their function, in this case as oil flasks or cooking pots, other clay vessels were only identified by their capacity, called 'the one of 30/15/10/5/ … *sila*' ($^{dug}niŋ_2$-3(ban_2)/1(ban_2) 5 $sila_3$/5 $sila_3$/ …).[14]

To this last group belonged the clay '*sila* vessels' ($^{dug}sila_3$), of which various kinds existed. The '*sila* vessel for (regular) consignments' was produced in the greatest numbers by the potters of Umma. No other ceramic type reached this quantity. A large variety of vessel types was produced by the potters of Umma, and whereas only a few specimens of more specific types left the workshop per year, a few hundred of the more widespread types are attested, sometimes even one or two thousand exemplars.[15] Against this background the attestations for 60,217 or 65,396(?) '*sila* vessel for consignments' ($^{dug}sila_3$ sa_2-du_{11})[16] stand out for their large quantity. Unfortunately, the recipient of the largest number of *sila* vessels is not preserved in the three balanced accounts about the potters of Umma, but it may be assumed that it was the city ruler ($ensi_2$) himself. The large number of vessels is listed as the first expenditure of the potters, and the city ruler appears in similar annual accounts in the first position. Furthermore, '(regular) consignments' (sa_2-du_{11}) of foodstuffs, mostly flour, for the city ruler ($kišeb_3$ $ensi_2$(-ka)) belong to the most common text types in Umma. So, the large amount might have been used at the local court at Umma or for the

[12] Powell (1990: 505–508), Powell (1994), Sallaberger (1996a: 55–56). On pictorial representations of Presargonic beer vessels see, for example, Sallaberger (2013).

[13] *MVN* 1, 231; 232; *MVN* 21, 203. On the first two texts see Sallaberger (1996a: 62–66) (with previous literature).

[14] See Sallaberger (1996a: 78) on designation according to capacity.

[15] Some examples for figures from *MVN* 21, 203: 2422 + x 'large vessels' (dug-gal; rev. ii 20), 2290 '15 *sila*-vessels' (dug 1(ban_2) 5 $sila_3$; rev. ii 22, 1046 '5 *sila*-vessels' ($^{dug}niŋ_2$-5-$sila_3$; rev. iii 15), and various kinds of *sila*-vessels with numbers around one to two thousand of each kind (rev. iv).

[16] *MVN* 1, 232 rev. iv 13; the total in *MVN* 21, 203 rev. iv 24 is broken, but the numbers in iii 10′, iv 29 and rev. i 20 add up to the total given above.

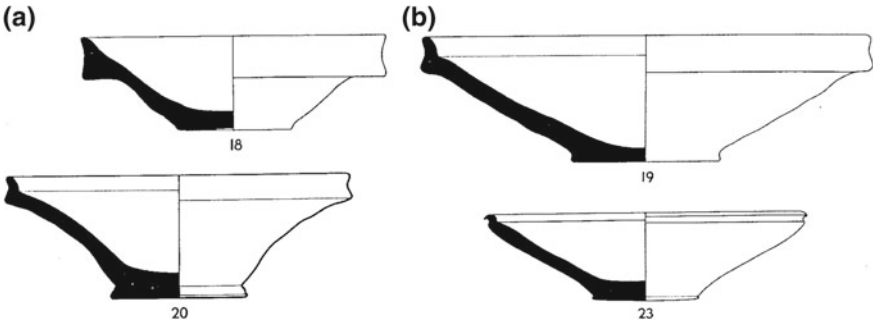

Fig. 3.1 Bowls Types 8A (18, 20) and 8B (19, 23) from Ur III Nippur (twenty-first century BCE), to be identified with the '*sila*-vessel of consignments' (^{dug}sila$_3$ sa$_2$-du$_{11}$) of the textual record (Figure from McCown, Haines, OIP 78, pl. 82)

provincial organizations which distributed food. A much smaller amount, 240 *sila* vessels, was used at monthly offerings in the sanctuary of Girgiš.[17]

Because of its eponymous size and its textually attested frequency, the '*sila* vessel' of the Ur III textual record can confidentially be identified archaeologically with a specific bowl, a type found in very large numbers in the Ur III levels of living quarters in Nippur (see Figs. 3.1 and 3.2). These bowls with a diameter of around 15 and a height of 4 cm contain about one litre, and thus were fittingly called '*sila*' (sila$_3$), meaning 'litre'.

According to their form, the *sila* bowls found in large numbers in the Nippur houses represent successors to a similar vessel type of the Sargonic period (twenty-third century BCE), called '*sila* bowl' by archaeologists because of its size. These '*sila* bowls' apparently served as bowls for food as well, but there is no indication that these mass-produced, irregularly shaped clay bowls could ever be used as measuring pots.[18] They would never have been needed in large numbers, the clay would break easily, and such a small measure is of little use for dealing, for example, with the large amounts of grain harvested from the fields.

In conclusion, the identification of the Sargonic and Ur III bowls with the '*sila* vessels (for consignments)' seems certain, and evidently they did not serve as measuring vessels but can only be understood as bowls for eating bread and soup

[17] At the military station of Garshana, likewise located in the province of Umma, *sila* vessels called '*bur-zi sila* vessels' (^{dug}sila$_3$ bur-zi) were used for food (Brunke 2011b: 42).

[18] Senior and Weiss (1992) have coined the term '*sila* bowls'. Contrary to the opinion of the authors, however, these are not 'capacity measures' (thus explicitly Senior and Weiss 1992: 19), but bowls of a standardized size used for eating (and drinking). At that time (in 1992), the idea of 'state potters' may have been acceptable, but we now understand better that potters were integrated into various communal organisations in the same way as other professions. Thus, one would hardly interpret the presence of potters in grain allotment lists as a sign of political control of the craftsmen and their products.

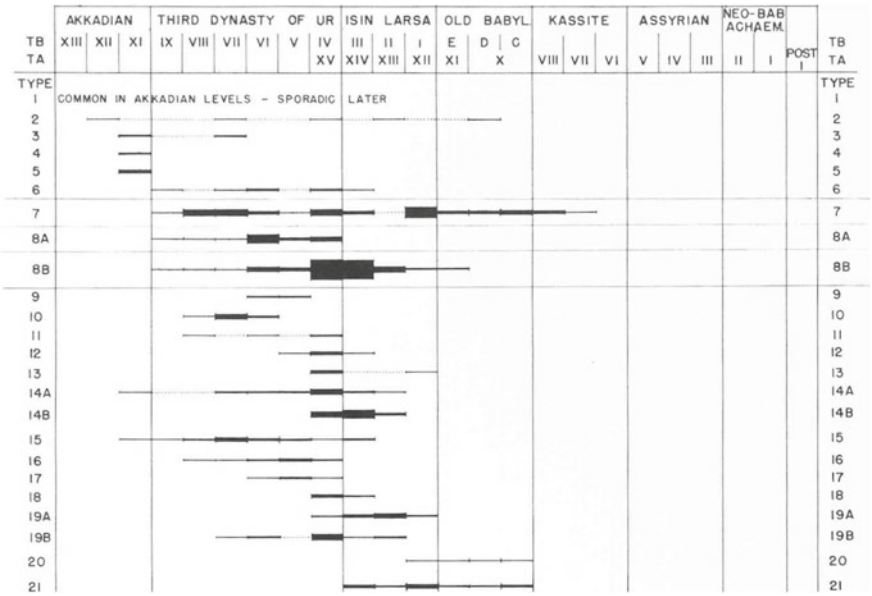

Fig. 3.2 Distribution of Types 8A and 8B and other Ur III pottery types at Nippur (from OIP 78, plate opposite p. 77)

(tu_7) and perhaps even for drinking beer,[19] the most prominent dishes of the period (Brunke 2011b). For the sake of completeness, it may be added that the Sumerian designation as '*sila* vessel' was not strictly restricted to bowls containing exactly one litre, but was exceptionally used also for larger or smaller bowls of presumably the same form and function.[20]

3.3 Operating Standards of Capacity Measures in Ur III

In the Ur III period, the capacity measures were called 'royal' (*lugal*) and thus referred to the system established by Ur-Namma of Ur, the founder of the dynasty. The system dates back to the Sargonic period, the *gur* of the capital at Akkad. The dynasty's first king, Ur-Namma, not only fixed the internal relationship between the capacity measures *sila*, *ban*, *bariga*, and *gur*, but also produced a standard measure in metal which served as a model (see Sect. 3.8).

In administrative practice, however, some Ur III documents indicate that various standards were used. As the names of these standards indicate, they refer to the

[19] Every month, the sanctuary at Girgiš received one set of vessels for the production of beer, 10 '*ban* vessels' (i.e. 10 *sila*), and 20 '*sila* vessels' (i.e. 1 L); see Sallaberger (1996a: 64, paragraph j).

[20] Brunke (2011b: 42), note 126 with further references.

Table 3.2 Examples for Old Babylonian operating standards of capacity measures (following Chambon 2011: 161–171)

sūt Šamaš	'*sutu* (= 10 L) of (the god) Šamaš' as an interregional measure
sūt kināte/kinattê	'*sutu* of the domestics' as a local measure
sūt Marduk ša namḫarti	'*sutu* of (the god) Marduk for receipts'
sūt Marduk ša ṣīti	'*sutu* of (the god) Marduk for expenditures'

Table 3.3 The Ur III operating standards of capacity measures (sequence after *Nisaba* 24, 9)

	Sumerian name	Translation	Attested at
	gur zabar (ŋar-ra)	'bronze *gur*' (called also: '*gur*, plated with bronze')[21]	Girsu, Nippur, Puzriš-Dagan, Umma[22]
(a)	gur še ŋeš e_3-a	'*gur* of barley after threshing(?)'	Girsu, Nippur, Umma[23]
(b)	gur (še) ma_2-a[24] si-ga	'*gur* (of barley) (at) having the boat loaded'	Umma
(c)	gur še nuŋun	'*gur* of barley for seed'	Umma
(d)	gur sa_2-du_{11}	'*gur* (for) consignments'	Girsu, Umma

specific density of grain at certain stages of processing and to the use of grain. They may be called 'operating standards'.

The presence of various operating standards within the same capacity system is known elsewhere, and for the subsequent Old Babylonian period (ca. 2000–1600 BCE) the terminology was recently studied by Chambon (2011). The basic capacity measure in the Old Babylonian period was the *sūtu*, corresponding to the Sumerian *ban* of 10 *sila*, and some selected designations for capacity measures in Old Babylonian Syria and Upper Mesopotamia (nineteenth–eighteenth century BCE) are listed in Table 3.2.

Under the Ur III dynasty various operating standards for measuring barley were used, but hardly ever noted in the administrative record. The known standards (Table 3.3) appear together in one large document concerning the measurement of grain and stemming from the city ruler's archive at the provincial capital of Umma (*Nisaba* 24, 9, date not preserved). The designations all refer to the *gur* (of 300 *sila*) as standard. But in accordance with the procedure of measuring with *bariga* vessels

[21] For gur zabar ŋar-ra see for example: *ITT* 4, 7261 (Girsu, Š 40): 4:11(gur) 3(bariga) še gur lugal/gur zabar ŋar-ra-ta '251 royal *gur* 3 *bariga* of barley, (measured) by the (operating standard) *gur* plated with bronze'; similarly *MVN* 11, 9 (Girsu, Š 46); on *MVN* 12, 506 (Girsu, IS 1/03)//*TCTI* 2, 4304 (IS 1/04) see below *sub*.3.7.

[22] At Umma also called gur zabar-ra '*gur* of bronze', e.g. *Or*SP 47–49 155 (Š 31); referring to a 'new' (gibil) operating standard: *MVN* 12, 209 (Š 47, Girsu); attested at Nippur: *NATN* 147 (see below); at Puzriš-Dagan: *YOS* 4, 34 (Š 38).

[23] For *ṣimdum* at Nippur see below *sub* 3.6. *NATN* 548.

[24] In *Nisaba* 24, 9 the authors (F.N.H. al-Rawi, F. D'Agostino, J. Taylor) transliterated 'diri' ('SI'.A) for ma_2-a.

(see Sect. 3.1), the measuring container must also have contained 60 *sila* in these cases.

The operating standards are explicitly used to measure an amount of grain, barley (še), emmer (ziz_2), or wheat (kib_3) (thus in *Nisaba* 24, 9), given in the 'royal' (lugal) standard (see note 16). Therefore, they do not refer to a different system of capacity measures and are not connected with specific grains. The four operating standards of a) '*gur* of barley after threshing(?)' (gur še ŋeš e_3-a), b) '*gur* of barley (at) having the boat loaded' (gur (še) ma_2-a si-ga), c) '*gur* of barley for seed' (gur še nuŋun) and d) '*gur* (for) consignments' (gur sa_2-du_{11}) clearly refer to various stages in the administration of grain after the harvest.

(a) The term for the first stage, tentatively identified as 'after threshing' (?), literally 'having left the wooden (threshing instrument, e.g. flail, threshing sledge)', is known as an idiomatic expression referring to grain at the end of its treatment on the threshing floor.[25]

(b) After threshing and winnowing, the grain was shipped to its destination. In the calendar of Umma, the third month, corresponding roughly to the time of June, was called 'Grain placed at the harbour' (še kar-ra ŋal$_2$-la), referring to the same stage.[26]

(c) šu-nuŋun 'handling of the seed' was the name of the fourth month (about July) at Nippur and Girsu, the sixth month (about September) at Umma. Sowing took place in late autumn (October/November).

(d) As for 'consignments' (sa_2-du_{11}) destined for workers, menials, meals of the palace, or offerings, the grain was distributed from the granaries throughout the year.

This background explains the use of various operating standards according to various stages in the processing of grain: grain quantities were transferred and more often calculated with utmost precision even for very large amounts of grain. Thus, the above-mentioned grain account from Umma (*Nisaba* 24, 9) noted single *sila* ('litres') within transfers of sometimes up to 100 *gur* (30,000 L). Numerous other documents concerning grain attest to even larger numbers and greater precision.[27] Even small variations (of few percent only) in the consistency of the grain may lead to differences in the amounts measured. I would thus argue that the operating

[25] Civil (1994: 98) on še ŋeš e_3-a: 'It is obviously the condition of grain after the threshing floor operations and just before it is divided up among farmers and other sharecroppers. … Thus giš-è either designates the clean grain, ready for sharing, with no concrete reference to a particular operation (grain "issued", but then why the giš?), or, preferably, it means "roughly measured (lig. coming out from) with the stick" and thus the emphasis on specific types of measures would be understandable since a second, regular measurement was needed". The context of the operating standard gur še ŋeš e_3-a, not known to Civil, in fact shows that the term itself does not refer to measuring, but to the stage in the management of grain (see the first cited phrase).

[26] Cohen (1993: 166–167), Sallaberger (1993: 235).

[27] To cite just one example, taken from a summary of Girsu's expenditure of grain during one year (AS 2): *CT* 7, 8 r. i 11 šu-niŋen$_2$ 28 $kuru_{13}$ 51:01(gur) 2(bariga) 2(ban$_2$) 3 $\frac{2}{3}$ $sila_3$ gur = 30,240,000 + 918,300 + 120 + 20 + 3 + $\frac{2}{3}$ *sila* = 31,158,443 $\frac{2}{3}$ *sila* ('litres, corresponding to ca. 31,158 m^3); the figure must have been based on the documents available at the accountancy of Girsu.

standards ensured that for the administration, producers and consumers alike, one *gur* of harvested barley remained exactly one *gur* even when it was distributed to the consumers some months later, despite the actual shrinkage in the process of drying. As an educated guess one may imagine that a measuring vessel according to the first operating standard (a) gur še ŋeš e_3-a) was larger than the last operating standard (d) sa_2-du_{11}) so that an actual loss of the barley's volume was compensated; this allowed a fair treatment first of all of the producers and the keepers of the grain-storages. The documents, however, do not indicate any numbers for conversion linked to the various operating standards.

The 'bronze *gur*', also called '*gur* plated with bronze', is the best-attested operating standard, but cannot easily be inserted into the sequence. In *Nisaba* 24, 9, it appears after the first stage (gur še ŋeš e_3-a, iv 40–42. v 8–10) and before the last stage (gur sa_2-du_{11}, v 20–22), perhaps even before the '*gur* of barley for seed' (gur še nuŋun, vi 44–vii 4). This document never lists the 'bronze *gur*', however, in the sub-totals that indicate the sequence of stages discussed above. Given the distribution of terms it was probably (more or less?) identical with the stage of grain for loading a boat (gur še ma_2-a si-ga). This is the most plausible explanation, since the latter standard exactly describes the situation when grain was measured and distributed to the various destinations and granaries. So, the 'bronze *gur*' was probably the operating standard used at the measurement of the grain heaps before their distribution. Furthermore, the context in which the term 'bronze *gur*' (gur zabar) is used implies that it does not refer to the material of the measuring vessel itself, but to an operating standard.[28] As indicated by the volume of 60 *sila* as a measuring standard (see end of Sect. 3.1), the measuring vessel was the size of a *bariga*. This is further indicated by Texts 1–5, where the terms for the operating standards are combined with the word *bariga*, 'measuring container of 60 L'. According to texts such as Text 3 below, the *bariga* container was also handled together with other vessels, in this case the 'large *gur*-basket' made of reeds, a container of 60 *sila*,[29] the same size as the *bariga* container (see also footnote 11).

Text 1: *NATN* 147 (ŠS 1/[?], Nippur):

1 ba-ri_2-ga / zabar ŋar-ra

1 *bariga* (container) (of the operating standard) plated with bronze (from PN_1, PN_2 has received it).

Text 2: *TENS* 158 (AS 6/13, Umma).

1 3 ba-ri_2-ga gur še ŋeš e_3-a / e_2-gal-e-si i_3-dab_5

2 2 ba-ri_2-ga gur še ŋeš e_3

1 ba-ri_2-ga gur sa_2- <du_{11}> (?) / ki ^{d}$šara_2$-ba-zi-ge

[28] The month names attested for gur zabar in Texts 3 (month 3) and 4 (month 5) could agree with this assumption. Text 2 is dated to the intercalary month 13 (around March), and thus can be understood as a document representing an annual summary.

[29] *TCL* 5, 6036 xiii 41.

3 1 ba-ri$_2$-ga gur še e$_3$-a / ki ur-^{d}lamma lu$_2$ lu$_2$-diŋir-ra
4 1 ba-ri$_2$-ga še ma$_2$-a si-ga / lugal-iti-da
5 1 ba-ri$_2$-ga gur še ŋeš e$_3$-a / e$_2$ ensi$_2$-ka
6 2 ba-ri$_2$-ga gur še ŋeš e$_3$-a / ki lu$_2$-diŋir-ra
7 1 ba-ri$_2$-ga gur {BI} [sa$_2$]-du$_{11}$ ki u$_3$-ma-ni
8 1 ⌜x⌝ ur-^{d}zuen
9 ki ka-kuru$_{13}$-ta
10 lugal-niŋ$_2$-lagar-e ki-bi / ge$_4$-ge$_4$-dam

1 3 *bariga* (containers) (of the operating standard) *gur* of barley after threshing(?): Egalesi has taken it over;
2 2 *bariga* (containers) (of the operating standard) *gur* of barley after threshing(?),
1 *bariga* (container) (of the operating standard) *gur* (for) consignments: with Šarabazige;
3 1 *bariga* (container) (of the operating standard) *gur* of barley after threshing(?): with Ur-Lamma, man of Ludiŋira;
4 1 *bariga* (container) (of the operating standard) *gur* of barley (at) having the boat loaded: Lugalitida;
5 1 *bariga* (container) (of the operating standard) *gur* of barley after threshing(?): in the house of the city ruler;
6 2 *bariga* (containers) (of the operating standard) *gur* of barley after threshing(?): with Ludiŋira;
7 1 *bariga* (container) (of the operating standard) *gur* (for) consignments: with Umani;
8 1 (with?) Ur-Suena:
9 From the director of the granary;
10 Lugalniŋlagare has to return them to their place.

Text 3: *BPOA* 7, 1556 (AS 7/03, Umma).

1 ba-ri$_2$-ga / še ma$_2$-a si-ga
12 ^{ge}gur EN
ki ka-kuru$_{13}$-ta / kišib e$_2$-gal-e-si

1 *bariga* (container) (of the operating standard) *gur* of barley (at) having the boat loaded,
12 large *gur*-containers of reed:
From the director of the granary; seal (of the recipient) Egalesi.

Text 4: *BPOA* 1, 1450: 1–2 (IS 2/05, Umma):

1 ba-ri$_2$-ga / gur zabar

1 *bariga* (container) (of the operating standard) bronze *gur* (given from PN$_1$ to PN$_2$).

Text 5: *BPOA* 2, 2154 rev. 3–4 (AS 5, Umma):

1 ba-ri$_2$-ga saŋ-bi nu ŋa$_2$-ra / ša$_3$ gur še giš-e$_3$

1 *bariga* (container), its surplus amount not applied, within the (operating standard) *gur* of barley after threshing(?)

3.4 Measurement by the *Bariga*

The measuring vessel *bariga* usually contained 1 *bariga* of 60 *sila*, and was made for measuring this size. In practice, vessels of various sizes between 60 and 80 L (see Sect. 3.1) also circulated. Their exact measurement was quantified and indicated in documents that were written in the context of the measuring of grain, thus indicating the process by which the final amount of measured grain was obtained. Usually, however, when an amount of grain was handled, it was not necessary to indicate the operating standard used and the specific size of the *bariga* container used, since the measuring containers were all related to and integrated into the system of capacity measures generally employed, as defined by the royal standard (see Sects. 3.1 and 3.8).

Examples for the calculations employed to obtain the amount of grain in the royal system of capacity measures after the actual process of measuring (occasionally using larger containers) were discussed by Gomi (1996). Text 6 refers explicitly to a *bariga* measuring vessel of 62 *sila* instead of 60. More uneven amounts also appear in the records of the Ur III period (Text 7).

Text 6: *TRU* 374 rev. 12–15 (see Comi 1996: 143).

šu-niŋen$_2$ 4:00 še gur
saŋ ba-ri$_2$-ga 2 sila$_3$-ta
še-bi 8 gur
šu-niŋen 4:08 še gur

Total: 240 *gur* (of 300 *sila*) of barley,
the surplus amount of a *bariga* (of 60 *sila*) is 2 *sila* each,
the corresponding grain: 8 *gur*.[30]
(New) total: 248 *gur* of barley.

Text 7: *TCTI* 2, 3381 (no date, Girsu; see also Lafont and Yıldız 1997: 286–287 with further literature):

11(gur) 2(bariga) 1(ban$_2$) 6 sila$_3$ še gur / saŋ 7:04 gur-kam
ba-ri$_2$-ga ba-ri$_2$-ga / 1-e saŋ 1 ½ sila$_3$ 7 giŋ$_4$-/ta im-gub
še a-ša$_3$ u$_2$-KI.KAL

11 *gur* 2 *bariga* 1 *ban* 6 *sila* (= 3436 *sila*) of barley is the surplus of 424 *gur*;

[30] 2 *sila* (surplus amount) × 5 (*bariga* per *gur*) × 240 (total of *gur*) = 2,400 *sila* = 8 *gur*.

the *bariga* (used) has added (lit. 'placed') a surplus of 1 ½ and $\frac{7}{60}$ *sila* to each *bariga.*

Barley from the UKI.KAL field.[31]

The actual basis for measuring grain was provided by counting the measuring containers (see Gomi 1993, 1996; Texts 8 and 9). In Text 8, the exact amount of barley is given, measured according to the 'bronze *gur*' standard, the main operating standard of the period (see Sect. 3.3). As argued above, the operating standards were apparently used to balance the differences in capacity caused by the specific consistency of barley; such operating standards apparently did not exist for the rarely used wheat and emmer, and so for these grains Text 8 indicates only the number of *bariga* measuring containers, which would allow for an exact calculation.

Text 8: *Umma* 17 (no date, Umma): Barley, wheat and emmer with ploughmen; only two sections cited here:

Obv. 1–4

3:13(gur) 4(bariga) še gur zabar-ta
10 la_2 1 kib_3 ba-ri_2-ga
1:11 ziz_2 ba-ri_2-ga
ur-niŋar^{ŋar} engar

193 *gur* 4 *bariga* barley (according to the operating standard) bronze *gur*,
9 *bariga* containers (of 60 *sila*) of wheat,
71 *bariga* containers (of 60 *sila*) of emmer:
Ploughman Urniŋar

Rev. 8–11:

1:08(gur) 1(bariga) še gur zabar-ta
16 kib_3 ba-ri_2-ga
1:08 ziz_2 ba-ri_2-ga 1:12 $sila_3$-ta
lugal-$saga_{10}$

68 *gur* 1 *bariga* barley (according to the operating standard) bronze *gur,*
16 bariga containers (of 60 *sila*) of wheat,
68 *bariga* containers of 72 *sila* of emmer:
(Ploughman) Lugalsaga

Text 9: *BPOA* 2, 1892: 1–6 (AS 7/vii, Girsu): Grain in the sealed storehouse

1:00 ba-ri_2-ga 1(bariga)-ta / ziz_2-bi [12] gur / a-ra_2 1-kam

[31] The underlying operation may have been a division, as kindly suggested by Christine Proust; according to her, the approximation process of the division may explain the small difference between the calculated result and the total as given in the text (published only in transliteration). For purely illustrative purposes, the following multiplication might explain the numbers: 1.616666 (= 1 + ½ + $\frac{7}{60}$ surplus amount) × 5 (*bariga* per *gur*) × 424 (total of *gur*) = 3427.3 *sila* = 11 *gur* 2 *bariga* 7 ⅓ *sila.*

4:20 la_2 1 ba-ri_2-ga 1(bariga)-ta / ziz_2-bi 51(gur) 4(bariga) gur / a-ra_2 2-kam...

60 *bariga* containers of 1 *bariga* (= 60 *sila*), its wheat [12] *gur*; first time
259 *barigas* of 1 *bariga* (= 60 *sila*), its wheat 51 *gur* 4 *bariga*; second time etc.

Texts such as these not only document the use of various *bariga* containers for measuring, but also hint at their close control by the administration. The term used in administrative documents for adjusting to the standard is kab_2 du_{11}-g/e/di ('to check, to gauge, to calibrate').[32] In an account about barley dealing with amounts of several *gur* (of 300 *sila*) one finds the exceptionally low amount of '1 *bariga* 2 *ban* (= 80 *sila*) of barley for checking the *bariga*' (ba-ri_2-ga kab_2 di, *Nisaba* 6, 26 viii 40′, Umma, AS 4/09). Text 10 is a small note, apparently written after checking two *ṣimdum* measuring vessels of 30 *sila* (see Sect. 3.6); one was correct, the other contained 0.57 L, thus ca. 1.9% too much. Differences in measures could be assigned to the account of the producer, and since most consignments were of regular nature, an adjustment could usually be balanced in the course of time (Text 11, a subtraction of 3.3%).

Text 10: *YOS* 4, 227 (no date, Umma?).

zi-im-tum lu_2-^{d}en-lil_2-la_2-ka / ½ $sila_3$ 4 $giŋ_4$ i_3-ib_2-^{r}diri$^{?\urcorner}$
zi-im-tum ab-ba-ge-na / i_3-gi-in
(space) 8 $giŋ_4$

The *ṣimdum* (measuring container) of Lu-Enlila, it was in excess (?) by ½ and $\frac{4}{60}$ *sila*.
The *ṣimdum* (measuring container) of Abbagena was correct.
$\frac{8}{60}$.[33]

Text 11: *SAT* 2, 482 (Š 6?/ii, Umma):

20 $inda_3$ DU gur / ki-la_2 $inda_3$ bala-a / du_8-a zi_3-bi kab_2 / ba-ab-du_{11} ba-ri_2-ga-ba igi-30-$ŋal_2$-bi / ba-an-tur / muhaldim-ra ba-an-na-zi[34]

20 *gur* of normal bread, (deduced from the) weight of the bread baked for the term of office; its flour was checked, and at its *bariga*, it was reduced by $\frac{1}{30}$; it is subtracted for the baker (sealed by the city ruler Ur-Lisi)

The *bariga* measuring containers could be transported easily by hand, since workers carried them to the barley fields for use on the threshing places (as in Text 12 and similar examples).[35]

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[32] Gomi (1996: 145, footnote 3) gives various examples (still reading, however, 'nag du_{11}', and translating 'to become moist'). On kab_2 du_{11}-g/e/di see Attinger (1993: 572–576), Civil (1994: 153–163).

[33] The meaning of this note is unclear to me.

[34] The text is published only in transliteration, which can be improved.

[35] Further examples are: *UTI* 4, 2447: 7–10 (ŠS 4, Umma): '3 men for [1?] day carrying (il_2-la) *bariga* containers from the Manu-field to the Nin-[…]-field'; *BPOA* 7, 1697 (00/05, Umma): '1 *bariga* container, 16 *gur* containers for transport (lit. for the way) of 1 *bariga* (capacity), from Urdu,

Text 12: BPOA 7 1705 (Š 47/05, Umma):

4 ŋuruš u_4 1-$še_3$
a-$ša_3$ ka-ma-ri_2-ta / ki-su_7 gu-la a-$ša_3$ la_2-maḫ-$še_3$
ba-ri_2-ga il_2-la / u_3 ki-su_7-ra-ka gub-ba

4 men for 1 day carrying *barigas* from the Kamari field to the large (or: old) threshing place of the Lamaḫ field and stationed at the threshing place. (Overseer: Urgigir; seal(ed receipt by) Kugani)

3.5 The Measuring Container *Bariga* as an Object: A Bitumen and Leather-Coated Reed Vessel with Bronze Reinforcements

The textual evidence presented so far points to the *bariga* as the standard measuring vessel used in the Ur III period. A *sila* corresponded to ca. 1 L, 60 *sila*/1 *bariga* of barley thus weighed around 40 kg. If the measuring vessel itself was of a manageable format and not too heavy, this weight could easily be handled by well-trained men accustomed to measuring grain for days. In the Ur III period barley was harvested through collective labor and stored in the large granaries of the communal organizations. It was most effective to use a standard measuring vessel of ample volume. In addition to the *bariga* container, smaller measures are also known (see Sects. 3.6 and 3.7), but I am not aware of any reference to a larger one.

Bariga measuring containers were usually made of reed, which allowed for their relatively low weight. Evidence for the basic material comes from the occasional use of the determinative ge ('reed').[36] The smaller measuring containers, however, were usually made of wood (see Sect. 3.6). The use of reed implies a strict cylindrical form for the *bariga*, and so its actual size can be estimated as in Table 3.4. The depiction of a container for measuring grain on a Late-Akkadian seal, identified by A. Otto (see Chambon and Otto in press), points to the slimmer and longer variety of the two vessels (of 59 cm height and an outer diameter of ca. 44 cm).

The *bariga* container of reed was coated with bitumen, using 2 or 3–5 L per piece (Texts 13 and 14).[37] For a reed mat used for the wet beer draff, one litre of bitumen

for the Enkara field'; *BPOA* 7, 2217 (Š 45/07, Umma): '7 men for 2 days, 1 man for 1 day, carried (i_3-il_2) *bariga* containers, to the Kamari (field); overseer: Dada'.

[36] E.g. ^{ge}ba-ri_2-ga *UET* 3 847:5 in an inventory; *CUSAS* 3, 1372 (= Text 24 below) ^{ge}gur ba-ri_2-ga 'reed *gur* containers (of one) *bariga*'. *PSD* B: 20 s.v. ba-ri_2-ga cites references for a *bariga* allegedly made of wood; in these texts Old Babylonian date (Rimsin year 33, i.e. MC 1790 BCE), the term *bariga* has adopted a more general meaning such as 'measuring container', since it qualifies the actual container called ^{ŋeš}ba-an '*ban* measure': ^{ŋeš}ba-ri_2-ga ^{ŋeš}ba-an 2(ban_2) 'wooden measuring container (lit. *bariga*) of 2 *ban*' (UM 29-15-918:2, cited *PSD* B: 20; for a photograph see http://www.cdli.ucla.edu/dl/photo/P256568.jpg).

[37] Further references include: *RA* 65, 21 no. 9 (Š 36/11, Girsu), '19 ⅓royal litres of liquid bitumen, from Urdu, to cover and to coat *bariga* containers' (ba-ri_2-ga šu di-di-de_3 su-bu-de_3).

Table 3.4 Two possible reconstructions of a cylindrical *bariga* of 60 L with walls of 4 cm thickness (numbers rounded)

	Inner diameter (cm)	Outer diameter (cm)	Height (cm)	Inner surface (m^2)	Outer surface (m^2)	Total surface m^2
a	36	44	59	0.769	0.968	1.737
b	40	48	48	0.729	0.895	1.624

was enough to coat 0.75 m^2,[38] implying a bitumen layer 1.3 mm thick. Using 5 L of bitumen for a *bariga*, it may have been coated with bitumen both inside and outside, resulting in a layer of almost 3.0 mm (assuming with Table 3.4 an average surface of 1.7 m^2). 5 L of bitumen add about 5 kg of weight to the *bariga*.

Text 13: *MVN* 9, 18: 1–2 (Š 48, Girsu):

1(bariga) 3(ban_2) $esir_2$ e_2-a lugal, ^{ŋeš}ba-ri_2-ga-bi 30-am_3 ba-ab-su_3

1 royal *bariga* 3 *ban* (ca. 90 *sila*) of liquid bitumen, 30 wooden *barigas* were plastered with it (i. e. 3 *sila* per *bariga*)

and in lines 10-11: 60 *sila* of bitumen for 30 *barigas* (i.e. 2 *sila* per *bariga*)

Text 14: *BPOA* 2, 2529 (Š 47, Umma):

2 ^{ge}ba-ri_2-ga $esir_2$ su-ba / siki ud_5-bi 4 ma-na / $esir_2$-bi 1(ban_2)

4 zi-im-tum / kuš gud-bi 3 / $esir_2$ e_2-a-bi 8 $sila_3$

2 reed *barigas* plastered with bitumen: 4 *mana* (ca. 2 kg) goat wool (for ropes) for them; 1 *ban* (= 10 *sila,* ca. 10 litres) bitumen for them;

4 *ṣimdum* measuring vessels: 3 ox hides for them; 8 *sila* (ca. 8 litres) liquid bitumen for them

The reed walls of the *bariga* container could also be reinforced by a lining of gypsum.[39] Since two documents (Texts 15a and 15b) note consignments to the same person and date to the same month, the same *barigas* probably received both a gypsum lining and a bitumen coating.

Text 15a: *UTI* 4, 2760 (ŠS 3/03, Umma):

10 ma-na IM.BABBAR$_2$, ba-ri_2-ga su-bu-de_3

10 minas of gypsum to coat *barigas*, (received by Lu_2-^{d}TUG$_2$.AN-ka)

Text 15b: *BPOA* 1, 1437: 1–2 (ŠS 3/03, Umma):

[38] See *TCL* 5, 6036 xiii 30–35: '3 reed mats for wet draff (of beer), coated with bitumen, their surface ½ *sar* (= 18 m^2), … their bitumen 2 *ban* 4 *sila* (= 24 *sila* = 24 L)'.

[39] The use of gypsum linings to reinforce reed containers is rarely attested. For a comparable example see *TCL* 5, 6036 xv 6–11: '2 thin *gur*-containers, coated with bitumen; … their bitumen ⅓ *sila*; … their gypsum 12 *gin* (= ca. 100 g)'.

1(ban$_2$) esir$_2$ e$_2$-a / ba-ri$_2$-ga ba-ab-su-ga

1 ban (= 10 *sila*) liquid bitumen, *barig*as were coated with it, (received by Lu$_2$-^{d}TUG$_2$.AN-ka)

Goat wool, mentioned in Text 14, provided the basic material for ropes, so the measuring vessels could be equipped with ropes either for reinforcement and/or for more comfortable use.[40] Furthermore, Text 14 lists leather, apparently for an inner covering coat to permit a better flow of the grain. Text 16 similarly speaks of lining the interior of the cylindrical vessel, Text 17 uses the verb 'strengthening', while in other texts the verb used remains unclear.[41]

Text 16: *TCL* 5, 5672 rev. ii 17 (Š 40/12, Umma):

5 kuš amar ba-ri$_2$-ga gibil šar$_2$(HI) la$_2$-a

5 hides of calves: the new *barigas* lined inside (*via* Urdu, director of the granary, ka-kuru$_{13}$)[42]

Text 17: *MVN* 16, 768: 4–5 (ŠS 2, Umma):

1 kuš gud mu 1 / ba-ri$_2$-ga u$_3$ zi-im-tum ba-ra-kala

1 hide of a one year old ox, the *bariga* and *ṣimdum* were strengthened with it (ba-ra-kala)

A measuring vessel received rough handling for a considerable time, but its exact form had to be carefully preserved. For this purpose, the *bariga* was also equipped with bronze (zabar) or copper (uruda) bands affixed to the opening (ka-g) of the vessel (see also Text 24) or perhaps to the interior as bracing bands—the relevant Sumerian term is still poorly understood. Furthermore, the name of the most widely spread operating standard, '*bariga* (plated) with bronze,' points to a metal bracing. An 'opening' of wood (^{ŋeš}ka) for a *bariga* is attested once, probably another kind of reinforcement of the rim.[43] Text 20 is the only document on the amount of work used to produce measuring vessels, in this case a *ṣimdum* (of 30 *sila*) and a *ban* (of

[40] *MVN* 5, 273 (no date, Girsu), an account of workmen, includes (rev. i 17′–19′): 2 carpenters (naŋar), 2 basket makers (^{ad}adgub), 2 tanners (ašgab): '120 ropes, old … *bariga* containers equipped with them' (2:00 eš$_2$ ba-ri$_2$-ga šumun GAG šu du$_{11}$-du$_{11}$-ga), via Lugena, director of the granary.'.

[41] *BPOA* 1, 963 obv. 5—rev. 2 (AS 8/12, Umma): '1 hide of a 1 year old ox, *bariga* and *ṣimdum* containers were …ed with it' (1 gud mu 1 / ba-ri$_2$-ga u$_3$ / zi-im-tum / ba-ra-NAGAR); *DCEPHE* 234 (Š 45, Umma): '9 hides of 2 year old calves, treated by feces (a-ŋar gu$_7$-a), *bariga* containers were …ed with it (ba-ra-NAGAR)'; *BPOA* 6, 1430 (ŠS 1/04, Umma): '7 hides of one year old calves, to erect the reed *bariga* containers on a stand(?)' (literal translation, sense unclear; 7 kuš amar mu 1, ^{ge}ba-ri$_2$-ga ŋiri$_3$ du$_3$-a, a$_2$-bi u$_4$ 7-kam); *SAT* 2, 251: 5–6 (Š 40, Umma): '5 oxen … (of/for) *bariga* containers, at the director of the granary' (5 gud dug-du$_3$ ba-ri$_2$-ga / ki ka-kuru$_{13}$-ka).

[42] The verb šar$_2$(HI) la$_2$, last treated by Veldhuis (2004) ('to close an opening by means of {a} tying a hide'), more precisely means 'to line, cover an interior (of a frame, an opening)'.

[43] *MVN* 1, 106 r. ii 9′ = r.iii 2′ (AS 3, Umma): Production of 'foresters', preserved in totals: 8 ^{ŋeš}ka ba-ri$_2$-ga.

10 *sila*). It presents strangely deviating numbers for the days of work which cannot readily be explained.[44]

Text 18: *Or*NS 40, 390 no. 4 (= *NATN*, pl. VII) (no date, prov. unknown, letter order).

1 ba-ri$_2$-ga / [k]a-ba uruda ŋar-ra

1 *bariga*, on its opening plated with copper

Text 19: *ITT* 5, 6988 (ŠS 5/03, Girsu).

3 ^{uruda}nig$_2$-su-a-ka ba-ri$_2$-ga, ki-la$_2$-bi ⅓^{ša} la$_2$ ½ giŋ$_4$, [ba]-la$_2$

3 copper bracing bands(?) for the *bariga*, their weight: ⅓mina minus ½ shekel (i.e. 19.5 *giŋ*) was weighed (i.e. 6.5 *giŋ*, ca. 54.6 grams, per piece)[45]

Text 20: *UTI* 6, 3514 (ŠS 8, Umma), in an account concerning the work of basket-weavers, including:

(13) 2 ^{ge}zi-im-tum a$_2$-bi u$_4$ 10+[...]
(15) 3 ^{ge}ba-an x(‘hašhur$^{!}$’) a$_2$-bi u$_4$ 2

(13) 2 *ṣimdum*-measures, their work: 10+x days
(15) ‘3 *ban*-measures of ..., their work: 2 days’

The use of a *bariga* measuring container sets some requirements for the material used. The size had to be fixed exactly at the upper rim in order to allow fast and exact measuring, which precludes clay vessels formed on the potter’s wheel. Only clay vessels formed with a mould and trimmed in height could be calibrated, similar to the small clay vessels used in ancient China. The moulding technique, however, was not used in Mesopotamia. Furthermore, clay vessels are much too heavy for larger capacity measures and can break easily. Reed is thus the ideal candidate. The container’s size could be determined by simply trimming its height, and perhaps adjusted with layers of gypsum and bitumen. Reed containers were light, which was indispensable given the relatively large size of 60 L, corresponding to ca. 40 kg of grain, a size necessary to measure the large heaps of barley harvested on the fields of Sumer and stored in communal granaries. The problem of stability was solved by coating the reed containers with bitumen and sometimes gypsum, by covering them with leather, and by adding bronze braces. This equipment surely implied further weight, which however should not have exceeded another ten kilograms.

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[44] The text is published in transliteration only.

[45] niŋ$_2$-su-a-ka, known only in this context, must refer to bronze bands affixed to the measuring vessel. The verb probably also appears as su-a, approximately ‘braided’, in the description of shoes and ropes (Paoletti 2012: 172). Other references: *UTI* 6, 3720 (ŠS 9, Girsu?): 4 ^{uruda}niŋ$_2$-su$^{!}$(‘zu’)-a-ka / ba-ri$_2$-ga / u$_3$ ar-ma-tum ‘4 copper bracing bands(?) for a *bariga* container and sheeting’, its weight 37 ⅔*giŋ* (ca. 31.4 g); *armatum* taken here as derived from *arāmu* ‘to cover’ (differently *AHw.*, see *CAD* A II: 291 s.v. *armatu* A, ‘it refers possibly to metal sheeting or plating’); *TUT* 124 rev. ii 2 (n.d., Girsu) šu-niŋen$_2$ 1:00 ^{uruda}niŋ$_2$-su-a-ka ba-ri$_2$-ga.

The *bariga* of 60 *sila* predominantly used in the third and the early second millennia is a relatively large measuring container. In Old Babylonian times the *sūtu* of 10 *sila* was more widely used. This better corresponds to the situation in ancient Egypt, where during the Old Kingdom measuring containers of 2, 3, or 4 Hekat (each of ca. 4.8 L) were used, replaced later, from the New Kingdom onwards, by the Oipe (of 4 Hekat, 19.2 L).[46] In Egypt, the cylindrical measuring vessels were made of wood or of unknown material and covered (according to textual references) with leather.[47]

3.6 Other Measuring Containers Made of Wood and Bronze

The *bariga* was the standard measuring container for barley used in the fields and in other contexts where large quantities were handled. But there as well smaller quantities had to be measured exactly, for which there existed sets of various containers (see Text 24).

At Nippur, more rarely also at Umma, the *ṣimdum* was used, serving according to Akkadian sources as the capacity measure for 30 *sila*, thus half a *bariga*.[48] The next smaller vessel was the *ban* of 10 *sila*, again attested as a half-sized container of 5 *sila*. The *ban* vessels were usually made of wood, only rarely of copper (see footnote 53), and again its opening could be strengthened with copper.[49] The smallest measuring container is the *sila* ('litre'), again regularly made of wood[50] or of copper.[51]

[46] Pommerening (2005: Chap. 5 ('Die Kornmaße')).

[47] For the depiction of a set of capacity measures of various sizes in the grave of Ḥsjj-Rʿ at Saqqara, dating to the reign of Djoser in the Third Dynasty, see Pommerening (2005: 282–287), a depiction which also includes a strickle.

[48] At Nippur e.g. in the witnessed grain loan *NATN* 315 (IS 2): '68 *gur* according to the royal *ṣimdum* measure, (in GN); after the harvest it should be repaid'. At Nippur also combined with the operating standards (Sect. 3.3), e.g. *NATN* 548: 2f. *ṣimdum* … še ŋeš e_3-a. For Umma see above Texts 14, 17, and 20.

[49] *TJSASE* 291 (AS 3/12, Puzrish-Dagan), an inventory of various objects in a house, including l. 17–19: 2 ^{ge}ba-ri_2-ga, 1 ^{ŋeš}ba-an ka-ba uruda ŋar-ra, 1 ^{ŋeš}ba-an 5 $sila_3$, '2 *bariga* containers of reed (of 60 *sila*/litres), 1 wooden *ban* container (of 10 *sila*/litres), plated with copper at its opening, 1 wooden *ban* container of 5 *sila*/litres'.

[50] *BE* 3/1, 71: 26 (Nippur): 2 ^{ŋeš}1 $sila_3$, '2 wooden one-*sila*(-measuring vessels)'.

[51] *UET* 3, 739 from Ur, a list of copper objects, includes (lines 6′-8′): 1 ^{uruda}ba-an 5 $sila_3$, 1 ^{uruda}niŋ$_2$-3-$sila_3$, 1 ^{uruda}niŋ$_2$-2-$sila_3$, '1 copper *ban* container of 5 *sila*/litres; 1 copper 3-*sila*/litre (vessel), 1 copper 2-*sila*/litre (vessel)'.

3.7 The Control of Measuring Containers

Measuring containers were carried to fields and threshing places for use (see Sect. 3.4, Text 12 and footnote 36) and transferred from one official to another. A receipt tablet was issued for this transfer (see Text 21).[52] This attests to the control of the measuring tools by the responsible officials, among whom the most prominent is the 'director of the granary' (ka-kuru$_{13}$).

Text 21 explicitly states the purpose, namely to measure the grain on hand in the stocks. In addition to the *bariga* measuring container, the transaction even notes the strickle (ŋeš-ur$_3$, literally 'wood for levelling'), which was used to measure the grain exactly to the rim of the container.[53]

Text 21: *BPOA* 2, 2034: 1–9 (AS 3/11, Umma):

1 ba-ri$_2$-ga / 1 ŋeš-ur$_3$
ki urdu$_2$-ta
na-kab-tum-ma/ še aŋ$_2$-e-de$_3$
lu$_2$-ib-gal / šu ba-ti
ba-ri$_2$-ga-bi gu$_2$-ru-dam

1 *bariga*, 1 strickle
from Mr. Urdu(d),
in order to measure grain on hand in the stocks:
Mr. Lu'ibgal has received it.
This *bariga* is to be returned.
(The tablet is sealed by Urgigir as noted in the text)

Text 22 includes the valuable information that the measuring containers could be inscribed with the name of the political authority, in this case the grand vizier.[54] In the year Ibbisuen 1 this was the powerful Urdu-Nanna (Irnanna), who also acted as city ruler of Girsu, and it was obviously in this function that he provided the standards for the measures used in his province. Interestingly, the measuring vessels of the operating standard of the bronze *gur* (see Sect. 3.3) had to be returned after the grain owed to the state in the term of office was delivered. This implies that, when measuring out the barley for a royal tax, one used the measuring containers

[52] Examples for transfers of measuring containers include: *MVN* 2, 186 (no date, Girsu): 16 *bariga*s received by 7 persons; *SAT* 3, 1971 (Š 43, Umma): 3 *bariga*s received by 2 persons; *BPOA* 2, 2154 (AS 5, Umma): a list of *bariga*s kept in different places, namely 3 in Apisal, 2 with a named individual, 1 in the household of the city ruler, 1 in Nippur; and Text 2, the distribution of measuring vessels by the director of the granary, one functionary is responsible for returning the vessels.

[53] See also *BE* 3/1, 160 (no date, Nippur), a list of sealed receipts (kišeb) of six individuals; five had received one *bariga* each, one a strickle (ŋeš-ur$_3$).

[54] Another reference for an inscribed *bariga* is *YOS* 4, 34 (Š 38, Puzrišdagan), an account of grains, pulses, and spices: [bešeŋ?]-dub-ba-bi gur zab[ar] la-ba-sar, igi šabra-še$_3$, igi PN ka-kuru$_{13}$-še$_3$, 'its [accoun]tant(?) did not inscribe the (measuring vessels of the) bronze *gur* (operating standard); in front of the administrator, in front of PN, director of the granary (as witnesses).'

(*bariga*) controlled by the highest political authority of the province Girsu. At a more general level this provincial control of the measures ties in well with the provincial jurisdiction under the city ruler. In this way, the royal standard (see Sect. 3.8) was distributed throughout the state of Ur.

Text 22: *MVN* 12, 506 envelope: 1–3 (Girsu, IS 1/03) // *TCTI* 2, 4304: 1–2, 7–8 (Girsu, IS 1/04).

387 še gur // 183 še gur

še bala-a $Urim_2^{ki}$-$še_3$

gur zabar mu-sar sukkal-mah(-bi) su-su-dam

387 (// 183) *gur* of barley,

grain of the term of office, for Ur;

the (measuring vessels of the) bronze *gur* (operating standard), (marked) with a name-inscription of the grand vizier, have to be replaced. (From the Uaduga field; officials of transaction; date; seal of receiving official)

The control of the measuring containers becomes most evident in cases of adjustments or of transfers between various organisations and their officials. Text 23, although not entirely clear, provides a unique example for these administrative processes.

Text 23: *BPOA* 1, 7 (date not preserved, Girsu):

<beginning fragmentary>

[ ] ^{ge}ba-ri_2-ga / [ ] ^{ge}$niŋ_2$-2(ban_2) / $ensi_2$-gal-ta en-nu-$še_3$ / lu_2-^{d}ba-u_2 dumu a-tu šu ba-ti

(7') ba-ri_2-ga-bi lu_2-diŋir-ra dumu ma-an-$šum_2$-ke_4 / ur-^{d}ig-alim dumu lu_2-ge-na-ra / in-na-an-$šum_2$

(10') 2 ^{ge}ba-ri_2-ga / $ensi_2$-gal-ta / ur-bad_3-dab_5-ra dumu ur-tur-ke_4 / bešeŋ-dub-ba-še / bešeŋ-dub-ba-ka in-na-an-$šum_2$ / iti izim-^{d}lisin(NE.SI_4)

(16') 2 ^{ge}ba-ri_2-<ga> e_2-kišeb$_3$-ba / lu_2-^{d}ba-u_2 dumu ^{d}utu-bar-ra-ke_4 / in-ge-ne_2

(19') ur-šu-ga-lam-ma dumu ur-^{d}nin-ŋeš-zi-da si_7-ke_4 / zabar $ŋa_2$-$ŋa_2$-de_3 ba-an-de_6

(21') lu_2-diŋir-ra dumu ab-ba-$ŋu_{10}$ $ensi_2$ gal / bešeŋ-dub-ba-ke_4 / $ša_3$-tam-$še_3$ / bi_2-in-tuku

(24') ba-ri_2-ga-bi 2-am_3 / na-na lu_2 ^{ŋeš}tukul-ke_4 šu ba-ti

(2 lines broken)

[x] reed *bariga*, [x] reed-measures of 2 *ban*: from the *ensigal* for the watchhouse, Lu-Bawu, son of Atu, has received them.

Ludiŋira, son of Manšum, has given these measuring containers (*barigas*) to Ur-Igalim, son of Lugena.

2 *bariga*s from the *ensigal*: Ur-Badtibira, son of Urtur, has given them to the accountant for the account baskets; in the month 'Festival of Lisi'.

2 *bariga*s of the seal[ed store] house: Lu-Bawu, the son of Utubara, will calibrate them there. Ur-Šugalama, son of Ur-Ninŋešzida, the blacksmith, has taken them with him to plate them with bronze. Ludiŋira, son of *ensigal* Abbaŋu, the accountant, has taken hold of them for the inspection. There are 2 *bariga*s. Nana, the armed man, has received them. <remainder lost>

Weights and measuring containers were kept by the individuals responsible for measuring. Perhaps coincidentally, inventories of weights within a household are better attested in the textual record.[55] The most comprehensive list is the balanced account concerning Adadtillati, the majordomo (šabra) who managed the military settlement at GARšana near Umma (Text 24). The long list of millstones, weights, and measuring containers handed over (šu šum$_2$-ma) by the scribe Ibni-Adad[56] included two *bariga* measuring containers made of reed, with different reinforcements of the rim, as well as a set of smaller vessels from 30 to 1 *sila* (ca. 30–1 L), all made of wood. The text can be seen as a witness to the distribution of calibrated weights and measuring containers to a specific organisation in the service of the state.[57]

Text 24: *CUSAS* 3, 1372 (IS 3/08; GARšana), balanced account concerning the majordomo Adad-tillatī, beginning with 5 millstones of various qualities; a set of weight stones (of 1 *gun*/talent, 30, 10, 5, 4, 3, 2, 1, ⅔, ½, ⅓ *mana*/minas, 10, 5, 4, 3, 2, ½, ⅓, ¼*giŋ*/shekels, of diorite; obsidian; weights of wood; scales); lines 91–101 (// 34–45):

1 ^{ge}gur ba-ri$_2$-ga ka-ba uruda ŋar-ra

1 ^{ge}gur ba-ri$_2$-ga ka-ba si ŋar-ra

(1 ^{ŋeš}bešeŋ tur gid$_2$-da na$_4$)

1 ^{ŋeš}niŋ$_2$-3(ban$_2$) / 1 ^{ŋeš}niŋ$_2$-2(ban$_2$) / 1 ^{ŋeš}niŋ$_2$-1(ban$_2$) 5 sila$_3$ / 1 ^{ŋeš}niŋ$_2$-1(ban$_2$) / 1 ^{ŋeš}niŋ$_2$-5 sila$_3$ / 1 ^{ŋeš}niŋ$_2$-3 sila$_3$ / 1 ^{ŋeš}niŋ$_2$-2 sila$_3$ / ^{ŋeš}niŋ$_2$-1 sila$_3$

1 *gur*-basket of (/1) *bariga,* at its opening covered with copper;

1 *gur*-basket of (1) *bariga,* at its opening covered with horn;

1 long, small wooden box for weight stones;

1 wooden (measuring) container (literally 'thing') of 30 *sila*, / of 20 / 15 / 10 / 5 / 3 / 2 / 1 *sila.*

A document from Umma lists small measuring vessels made of wood, listed as the 'bequest' (e$_2$-du$_6$-la) of an individual. The set consists of one container each of 1 'royal' *sila* (ca. 1 L), ½, ⅓, ⅙, ~~document,~~ and $\frac{1}{12}$ *sila* (1 ^{ŋeš}5-giŋ$_4$ mes, i.e. ca. 0.083 L). The largest vessel is made of Russian olive, the others of hackberry (*celtis*) wood.[58]

[55] For the Old Sumerian evidence from Girsu see Selz (2010:19–21 and 23–24); for Ur III e.g. *ITT* 2, 909 iii; *AAICAB* I/3, Bod.S 138.

[56] Ibni-Adad apparently served as an intermediary between some higher authority and the majordomo Adad-tillatī, since he appears in large inventories or as the investigator in the case of a shipwreck; see Kleinerman and Owen (2009: 476).

[57] Garšana was headed by Šu-Kabta, a royal general, and thus can be considered an organisation of the state, not of the province of Umma.

[58] *Santag* 7, 63 (AS 1, 08; Umma); identification of ŋeš-ab-ba- and mes-wood by Heimpel (2011: 126–127 and 130–132).

3.8 The Royal Edict of Ur-Namma Concerning Capacity Measures

Within the state of the Third Dynasty of Ur, the measures were established by the king. In this way, one common standard of weights and measures could be and indeed was used. This common standard was especially necessary in the context of state deliveries, for example the large grain shipments to state institutions like the cult in the main sanctuaries of Sumer, the army, royal craftshops, and other organizations, or to the royal palaces. But the state standard was generally also used in other contexts.[59]

The standard of capacity measures and weights was established by the founder of the state and the dynasty, Ur-Namma of Ur, as one of the means of uniting legal obligations within his newly established state. Ur-Namma in fact used the royal system of Akkad and fixed the relative values of 1 *bariga* as 60 *sila*, of 1 *ban* as 10 *sila.* This implies a value of 1 *bariga* of 6 *ban*, as explicitly stated. Furthermore, he prepared a bronze *sila* vessel which then must have served as a model for the absolute measure of 1 *sila*. How exactly this capacity standard is related to the weight standard still remains unclear.

Text 25: Code of Ur-Namma S_1:11–17. 20–21//N_1 iii 43–iv 7 following Wilcke 2013:181 (see also Wilcke 2002: 308–309):

^{uruda}ba-ri$_2$-ga ḫu-mu-gub / 1:00 sila$_3$-am$_3$ ḫe$_2$-ge-en

^{uruda}ba-an ḫu-mu-dim$_2$ / 10 sila$_3$-am$_3$ ḫe$_2$-ni-ge-en

^{uruda}ba-an si-sa$_2$ lugal-la / ḫu-mu-dim$_2$ / 6-am$_3$ (*var*. ‘5’) ḫe$_2$-ni-ge-en

zabar 1 sila$_3$ (*var*. 1 sila$_3$ zabar) hu-mu-dim$_2$

1 ma-na-a (or min)/-am$_3$ he$_2$-ni-ge-en

I determined a copper *bariga*; I fixed it as 60 *sila.*

I fashioned a copper *ban*; I fixed it there (i.e. within the *bariga*) as 10 *sila* .

I fashioned the royal standard copper-*ban*; I fixed there (i.e. within the *bariga*) 6 (of these).

I fashioned a bronze 1 *sila* (measuring vessel).

I fixed the *mana* (= weight of 0.5 kgs)(?) within.

The relative and absolute standards of capacity measures established by king Ur-Namma were followed within the state of his dynasty. The numerous transfers of barley and other grains at sowing, harvesting, shipping, storage, and distribution

[59] Sarah Clegg of the University of Cambridge was preparing her dissertation on measuring in the late third millennium, including a discussion of various standards in use before and during the Ur III period and of the political importance of the use of royal measures. I am very grateful to her for informing me about her important study and for illuminating discussions. To avoid overlap, this section as well as Sect. 3.1 on measuring are kept extremely concise and are restricted to the points presented at the SAW meeting in Paris in March 2013. [Note 09/2020: Sarah Clegg’s Cambridge dissertation of 2015 has remained unpublished and thus could not be consulted.].

required the frequent use of vessels for measuring grain. References from the administrative documents shed light on this practical aspect of measuring, and on the form, use, and control of containers for measuring.[60]

Sumerian Terms

ba-ri$_2$-ga.
ban$_2$.
gur (basket).
gur (capacity measure).
gur sa$_2$-du$_{11}$.
gur še ŋeš e$_3$-a.
gur (še) ma$_2$-a si-ga.
gur še nuŋun.
gur zabar (ŋar-ra).
sa$_2$-du$_{11}$.
sila$_3$.
^{dug}sila$_3$(-sa$_2$-du$_{11}$).
UL.
zi-im-tum.

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AHw. Soden, Wolfram von. 1956–1981. *Akkadisches Handwörterbuch.* Wiesbaden: Harrassowitz.

BE *The Babylonian Expedition of the University of Pennsylvania, Series A: Cuneiform Texts.* 1893–1914. Philadelphia: University Museum.

BPOA *Biblioteca del Próximo Oriente Antiguo.* Madrid: CSIC. 2006–.

CAD Oppenheim, A. Leo, Erica Reiner *et al.* (eds.). 1956–2010. *The Assyrian Dictionary of the University of Chicago.* Chicago and Glückstadt: The Oriental Institute/J.J. Augustin.

CT *Cuneiform Texts from Babylonian Tablets in the British Museum.* 1896-. London: British Museum.

CUSAS *Cornell University Studies in Assyriology and Sumerology.* Bethesda, Md.: CDL press (2007–).

[60] This chapter was finished in January 2014. The topic of measuring grain was taken up later in the following contribution: Sallaberger, Walther 2016: Getreide messen. In: *Libiamo ne' lieti calici. Ancient Near Eastern Studies Presented to Lucio Milano on the Occasion of his 65th Birthday by Pupils, Colleagues and Friends*, ed. Paola Corò, Elena Devecchi, Nicla De Zorzi, Massimo Maiocchi, 237–248. Münster: Ugarit-Verlag.

DCEPHE Durand, Jean-Marie. 1982. *Documents cunéiformes de la 4e section de l'EPHE.* Paris: Geuthner.

ITT Thureau-Dangin, François, Henri de Genouillac and Louis Delaporte. 1910–1921. *Inventaire des tablettes de Tello conservées au Musée Impérial Ottoman, 1–5.* Paris: Leroux.

LAK Deimel, Anton 1922. *Liste der archaischen Keilschriftzeichen von Fara.* Leipzig: Hinrichs.

MVN *Materiali per il vocabolario neosumerico.* 1974–. Rome: Multigrafica editrice e.a.

NATN Owen, David I. 1982. *Neo-Sumerian Archival Texts Primarily from Nippur in the University Museum, the Oriental Institute and the Iraq Museum.* Winona Lake: Eisenbrauns.

Nisaba *Nisaba. Studi assiriologici Messinesi*. 2002–. Messina: Di.Sc.A.M.

*Or*NS *Orientalia.* Nova Series. 1932–. Rome: Istituto Biblico.

*Or*SP *Orientalia.* Series prior 1–55. 1920–1930. Rome: Istituto Biblico.

OSP 2 Westenholz, Aage. 1987. *Old Sumerian and Old Akkadian Texts in Philadelphia, Chiefly from Nippur* 2. Copenhagen: Carsten Niebuhr Institute.

PSD Sjöberg, Åke W. *et al*. (eds.). 1984–1998. *The Pennsylvania Sumerian Dictionary. The Sumerian Dictionary of the University Museum of the University of Pennsylvania.* Vol. A/I–III. B. Philadelphia: University Museum.

RA *Revue d'assyriologie et d'archéologie orientale*. Paris: Geuthner e.a.

Santag 7 Ozaki, Tohru. 2002. *Keilschrifttexte aus japanischen Sammlungen.* Wiesbaden: Harrassowitz.

SAT Sigrist, Marcel. 1993–2000. *Sumerian Archival Texts.* Bethesda, Md.: CDL.

TCL *Textes cunéiformes. Musée du Louvre, Département des Antiquités Orientales.* 1910–1967. Paris: Musée du Louvre.

TCTI Lafont, Bertrand and Fatma Yıldız. 1989–1996. *Tablettes cunéiformes de Tello au Musée d'Istanbul: datant de l'époque de la IIIe Dynastie d'Ur*. Istanbul, Leiden: NINO.

TENS Sigrist, R. M. 1983. *Textes économiques néo-sumériens de l'Université de Syracuse*. Paris: ÉRC.

TJSASE Sigrist, Marcel. 2010. *Tablets in Jerusalem: Sainte-Anne and Saint-Étienne*. Changchun: Northeast Normal University.

TRU Legrain, Leon. 1912. *Le temps des rois d'Ur: recherches sur la société antique d'après des textes nouveaux*. Paris: Champion.

TUT Reisner, George. 1901. *Tempelurkunden aus Telloh.* Berlin: Spemann.

UET *Ur Excavations. Texts* 1–9. 1928–1976. London and, Philadelphia: British Museum/University Museum.

UM University Museum (Philadelphia), tablet signature.

Umma Contenau, Georges. 1916. *Umma sous la dynastie d'Ur*. Paris: Geuthner.

UTI 3–6 Yıldız, Fatma and Tohru Gomi. 1993–2001. *Die Umma-Texte aus den Archäologischen Museen zu Istanbul = İstanbul Arkeoloji Müzelerinde bulunan Umma metinleri.* Bethesda, Md.: CDL.

YOS *Yale Oriental Series. Babylonian Texts.* 1915–. New Haven: Yale University Press.

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