

Early Numeration - Tally Sticks, Counting Boards, and Sumerian Proto-Writing

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Work on the published version of my *Sumerian Lexicon* (Logogram Publishing: 2006) has revealed that: 1) the early Sumerians used wooden tally sticks for counting; 2) tally marks led to proto-writing; 3) the Sumerian pictograms for goats and sheep probably derive from tally stick notch conventions; 4) the Uruk period civilization used counting boards; 5) the authors of the proto-cuneiform tablets drew with animal claws or bird talons; 6) the historical Sumerians used clay split tallies as credit instruments; and 7) the Sumerians may sometimes have counted by placing knots or stones on a string.

1. Counting with Wooden Tally Sticks

1.1. The following text caught my attention. It is from The Debate between Sheep and Grain, ETCSL 5.3.2, lines 130-133:

"Every night your count is made and your tally-stick put into the ground, so your herdsman can tell people how many ewes there are and how many young lambs, and how many goats and how many young kids."

The Sumerian reads:

130 ud šu₂-uš-e niĝ₂-kas₇-zu ba-ni-ak-e

131 ^{ĝiš}ŠID-ma-zu ki i₃-tag-tag-ge - the Unicode version has ĝiš-šudum-ma-zu

132 na-gada-zu u₈ me-a sila₄ tur-tur me-a

133 ud₅ me-a maš₂ tur-tur me-a lu₂ mu-un-na-ab-be₂

š is read |sh| and ĝ is read |ng|.

1.2. Taking this passage into account, together with other lexical evidence, my *Sumerian Lexicon* has the following entry:

šita₅, šiti, šit, šid, šed, šudum, šitim₂

n., measure; number (še₃/šu, 'portion', + dim, 'post'; cf., ĝiš-šudum-ma, 'herder's tally sticks', and the different readings of ŠID).

v., to count; to consider; to calculate, figure out; to memorize; to recite; to read aloud.

This lexicon entry for the Sumerian word for 'measure; number' derives its etymology from two simpler words, še₃, 'portion' or šu, 'hand(s); share, portion', and dim, 'post, pillar'. Sumerian polysyllabic words which are not loanwords from Akkadian can usually be analyzed as compounds of simpler monosyllabic words. The introduction to my *Sumerian Lexicon* says, "in view of the Sumerians' observed propensity for forming new words through compounding in the period after they invented cuneiform signs, it should not surprise anyone to find that this same propensity was at work in the logogram words that mostly date from before their invention of written signs." This refers to the fact that 75% of the entries in my published lexicon are transparent compounds of words, each of

which have their own written signs. But I claim that many Sumerian words that have just one written sign also result etymologically from a combination of two simpler words. As a spoken language, Sumerian had a long history before the invention of writing. So I think that many Sumerian words are the result of compounding during that long time period. The etymology of **šudum**, 'to count', which involves simple Sumerian words for 'portion' and 'post or stake', appears to be strong. The vowel and consonant changes are normal because the language tries to achieve phonetic harmony through different types of assimilation including vowel harmony. The etymology, referring to notched tally sticks put into the ground by shepherds, describes the origin in Sumerian of number counting.

1.3. What exactly is a tally stick? One cannot surpass the very learned, illustrated 28-page Tally Sticks chapter in *Number Words and Number Symbols: A Cultural History of Numbers*, by Karl Menninger. [Originally published in German as *Zahlwort und Ziffer* in 1934 and 1958, M.I.T. Press published a revised English edition in 1969. They describe him as a "distinguished German scholar" whose "work embraces the full span of recorded history as it unfolded in cultures throughout the world." His investigation of worldwide counting practices can help clarify the meaning and function of evidence and practices that are found in a particular culture.] The simplest tally stick is a number stick, a stick with as many notches as what the owner wanted to record. Humans have made these notches not just in wood, but also in bone, ivory, shell, and rock. Menninger says, "Number sticks have been used in every period and by all peoples." (p. 226).

The illiterate, unschooled farmer still "had to keep track of his crops and livestock and harvests. The peasant could also be a creditor or a debtor. Where did he get the numerals to reckon with?" "From no one but himself! He developed his own number signs, which were adequate for his own ordinary dealings, and which no one but himself could read and understand." (p. 223) "In the history of language, this is the earliest forerunner of the art of writing." (pp. 223-24) Before writing represented spoken language and before there were standardized systems, illiterate farmers and merchants used idiosyncratic systems of their own devising to record quantities of products. This is not sufficiently recognized in modern works on the origin of writing. Tallies to record commodity quantities were idiosyncratic symbolic marks that did not necessarily have phonetic counterparts. Written signs originated to meet everyday needs, not to represent spoken language. Menninger traces the words for writing in many languages back to words for carving, cutting, or scratching. Furthermore, in bound collections of notched tally sticks or tablets of *beech* wood he sees the ancestor of the modern *buch* or book. He also convincingly traces the basic Roman numerals to tally stick notation conventions.

1.4. It should help students trying to decipher examples of proto-writing from different cultures to learn that, "A study of tally sticks reveals two very important things about early written numerals:

"The crossing of a carved symbol most frequently means a grouping, usually 10.
"Half the symbol stands for half its normal value." (p. 242)

Thus when X means 10, V means 5 - see the Wikipedia article about Roman numerals, Origins at http://en.wikipedia.org/wiki/Roman_numerals.

2. Proto-Writing and Tally Marks

2.1. The tally stick conventions described by Menninger appear also to have inspired the early script of Old Europe, which developed in the middle and lower Danube basin starting around 5,300 BCE, calibrated. Although different theories have been proposed about the signs found on 940 inscribed objects excavated from the Vinča-Tordos region of Transylvania, Eric Lewin Altschuler and Nicholas Christenfeld have shown that nearly one-third of the inscribed pottery objects bear numerical inscriptions. They suggest that the script of Old Europe may have been used for economic purposes, *The Number System of the Old European Script*, 9 Sep 2003, [math.HO] at <http://arxiv.org/html/math/0309157v1>. A literature search fails to find any student of this ancient script who references the tally marks chapter of Menninger's book, probably because nothing about the title, *Number Words and Number Symbols*, indicates that it is about the history of writing. However, if one goes back far enough, economic tally marks are very relevant to the origins of writing. Altschuler and Christenfeld describe how to read the number signs on the Old European Script ('OES') inscriptions - the score marks, the 'comb' motif, and the 'telephone pole' motif. They suggest that the common OES signs V and X or + should be read as 10 and 20. Then, confirming Menninger's description of tally marks as informal writing meant to be read only by its users, Lewin and Christenfeld say, "It might be wondered why the same number is written in more than one way. For a number of reasons we think this is not surprising and is probably even expected. First, as the script was in use for hundreds of years over hundreds of square kilometers we would expect some variation. Second, it must be remembered that standardization is a concept of modernity."

2.2. We should refer to these signs not as writing, but as proto-writing, until such time as the ancient pictograms and the more abstract ideograms can be clearly discerned to have evolved into logograms for representing the words of spoken language. David Crystal's *Dictionary of Language and Languages* defines Writing as, "The process or result of recording spoken language using a system of visual marks on a surface."

2.3. Nissen, Damerow, and Englund describe and illustrate on page 20 of *Archaic Bookkeeping*, Uruk IV-period "tags consisting of small, transversely perforated tablets, usually containing but few ideographic signs and no numerical notations. These signs do not belong to the well-known repertoire of symbols representing goods such as plants, animals, textiles, and metals. The tags therefore may carry personal names and were probably attached with a string to containers or other items, stating the proprietor or receiver of such goods." The idiosyncratic identifying signs on these Mesopotamian clay tags may be compared to other undeciphered short sequences of signs, such as the 'Vinca script' found in Old Europe or the 'Jiahu script' found on tortoise shells in China, both dated to about 6,000 BCE. They may also be compared to the emblems adopted and worn by different U.S. Army divisions towards the end of World War I in Europe (discussed by Claude Levi-Strauss on page 7 of his book *Totemism*). Emblems that distinguish the property of tribes, families, and individuals serve utilitarian purposes. Humans can use pictograms, ideograms, and emblems in systematic ways without having them be a system for encoding the words of spoken language. But, starting in Sumer in the early third millennium BCE, ancient proto-writing did gradually merge with spoken language to create true writing, and the totemistic or idiosyncratic signs began to fall

away, to be replaced by more language-mediated identifiers or names that could be represented with a socially-taught standard symbol set.

3. Sumerian Goat and Sheep Pictograms from Tally Stick Conventions

3.1. The Sumerian **MAŠ** sign with the word-meaning of '(male) goat' was a simple cross. The Sumerian **LU** or **UDU** sign with the word-meanings of 'many' and '(male) sheep' was a cross inside a circle. The symbol of a cross inside a circle having the abstract meaning 'sheep' may already be present among the complex tokens found at Uruk in the fourth millennium, according to their primary investigator, Denise Schmandt-Besserat (*Beyond Writing*, vol. 1, 1992, p. 152). Following Jöran Friberg, she says that, at least in Elam and Uruk, a cylinder token represented one herd animal and a lenticular disk represented 10 herd animals. But, during the fourth millennium Uruk period, tokens with complex markings replaced the plain tokens that had functioned for millennia, driven by the need for greater precision and accuracy in large production centers. Disks were marked differently to count lambs, ewes, and sheep. The mystery why such an abstract symbol as a cross came to represent goats and sheep in the Near Eastern clay token system and Sumerian pictograms is solved when one realizes that, outside the urban centers where complex tokens and writing arose, shepherds traditionally counted goats and sheep by making notches on tally sticks - and shepherds used the cross convention to record groups of goats and sheep.

3.2. The simple cross does not have a numerical meaning in written Sumerian, but the tally mark symbolism of the cross in a circle meaning 'many' is preserved in an alternate reading for the Sumerian sign of the circled cross. When the sign is read **udu**, it means 'sheep', but sometimes it must be read **lu**, meaning 'many, much; to be/make numerous, abundant'. The Wikipedia article on Roman Numerals says that the circled or boxed X or + meant 1000, see Menninger's Fig. 70. Menninger also illustrates a line crossed over with a double crossing, which means $10 \times 10 = 100$. Note that the Sumerian pictogram that means both **an**, 'heaven', and **diĝir**, 'deity', is a line with a triple crossing, which would mean $10 \times 10 \times 10 = 1000$. The pictogram for 'heaven' and 'deity' is traditionally called a 'rosette' or 'star', and it is true that three such signs had the meaning 'star', but the stars of the sky also convey the idea of a large number (the Sumerian word for 'thousand', **lima**, signifies 'overwhelming, awesome, fearsome' - the direction of borrowing between Akkadian *līm* and the Sumerian is not clear - the Sumerian word for four is **limmu** and 1000 is 400 greater than 600, an important large number in the Sumerian sexagesimal counting system). The line with the triple crossing is also found in the Sumerian sign **ama** for 'mother', enclosed in a container-sign that most resembles the signs for **amar**, 'calf; young animal' and **tin**, 'life', but because the line with the triple crossing can be read **an**, 'sky', Sumerologists have traditionally seen the symbol as a meaningless phonetic indicator for **ama**. Seeing the symbol as a line with a triple crossing would emphasize instead the generative fecundity of mothers.

4. The Pictogram for 'Number' and Counting Boards

4.1. The lexical lists give many readings for the cuneiform sign that represents the Sumerian 'measure/number' word mentioned above in section 1.2, the **ŠID** sign, where the same sign is called the **SANGA** sign in proto-cuneiform studies. The major readings were: **šita**₅, **šid**; **lag**; **silaḡ**; **saḡḡa**, **umbisaḡ**; **šudum**; **zandara**; **šub**₆. What did the sign look like?

4.2. In 1929 Prof. Dr. Eckhard Unger of Berlin University described the pictogram that became the **ŠID** sign as 'Tontafel mit Querstrichen (Zeilen) und Griffel' ('clay tablet with lines and stylus'; *Die Keilschrift : Entstehung, System und Ornamentik der Schrift der ältesten Hochkultur*, Leipzig, 1929).

4.3. In 1990, Peter Damerow and Robert Englund described the use of tallying boards for doing calculations - "How such calculations were performed is not understood in detail. Instruments that could have served as calculation aids are as yet not attested in archaeological finds, or have not been identified as such. Lexical lists from later periods, however, suggest that the Sumerians used tallying boards made of wood, which being perishable would not have been unearthed in excavations. There is also some evidence that the sign **SANGA**, designating the chancellor of an economic unit, derives from a pictogram depicting such a tallying board. This, in fact, is supported by the cuneiform sign **ŠID** which, also having developed from this sign, was employed as an ideogram with the meaning "account.""
Archaic Bookkeeping : Early Writing and Techniques of Economic Administration in the Ancient Near East, Chicago and London, 1993, p. 134 (originally published as *Frühe Schrift und Techniken der Wirtschaftsverwaltung im Alten Orient* by H.J. Nissen, P. Damerow, and R. Englund, Berlin, 1990). Elsewhere (in the *Journal of the American Oriental Society* 121.3 (2001), p. 499, in his review of Giuseppe Visicato, *The Power and the Writing: The Early Scribes of Mesopotamia*, Bethesda, Md., 2000), Englund acknowledges a private communication from Jöran Friberg for the suggestion that "the original referent of the sign **SANGA** might have been a counting board to which a box containing early "tokens" was attached on the lower left."

4.4. In 1993, Petr Charvát described the earliest form of the related **DUB** sign as consisting "of a rectangular handled frame filled in by a lattice pattern of intersecting oblique lines. The model for this sign must have been a tablet of some hard but probably organic material (wood or bone) bearing the crossed lines provided for better adherence of the soft writing surface, most probably a wax filling into which individual signs were incised. Such a tablet of wood has been found in the much later shipwreck of Ulu Burun, Turkey (fourteenth century BNC: Payton 1991). That the tablets could also have been cut from bone is indicated by data concerning the most ancient annals of Egypt (Kaplony 1991, 198)."
Mesopotamia Before History, London and New York, 2002, p. 152 (orig. published as *Ancient Mesopotamia*, Prague, 1993, pp. 159 and 203). There are lexicon entries which support the existence of wax-filled writing boards - see the *Sumerian Lexicon* entries for **ḡiṣ-da**, **kaṃ**₃, and **lal**₃-**hur** and the Akkadian word *lē'u(m)*, "writing-board of wood infilled with wax." (*A Concise Dictionary of Akkadian*, 1999).

4.5. Page 99 of Yushu Gong, *Studien zur Bildung und Entwicklung der Keilschriftzeichen*, Hamburg, 1993, has a table showing the variation in the **DA**, **ŠU**, **KID** and **SANGA** signs between Uruk IV, Uruk III, Ur, and Fara, for the purpose of showing how the number of lines could vary in early signs like these that featured parallel lines. Gong does not speculate on what the **SANGA** sign might represent.

4.6. A fuller account of the evolution and meaning of the **SANGA** sign appears in Jean-Jacques Glassner, *Écrire à Sumer : L'invention du cunéiforme*, Seuil, 2000, pp. 141-149 (English translation: *The Invention of Cuneiform Writing in Sumer*). A list that enumerates the titles of the **SANGA** and the **gal** : **SANGA** comes to us in an Eblaite version in which the signs are written syllabically. Instead of the **SANGA** sign, appears *um-bi-sa-ga-im* (the ePSD quotes Ebla Sign List 16 and shows **ub₂#-bi₂-sa-ga-im**), in which we recognize the following early Sumerian word:

umbisaĝ [**SANGA**/ŠID]

scribe; administrator (**umbin**, 'nail impression [on a tablet]', + **saĝ**, 'counted head').

This early reading of the **SANGA** sign gradually became obsolete, with the scribe and administrator functions being taken over by two new titles. Glassner describes how the term **dub-sar**, 'scribe', gradually replaces **umbisaĝ** and **dub-umbisaĝ**, 'scribe', as one moves from the archaic period tablets to the Fara / Šuruppak period tablets (ca. 2650 BCE). The interchangeability of **sar**, 'to inscribe', and **umbisaĝ** suggests that **umbisaĝ** had a verbal meaning, such as 'to count heads by making nail impressions'. The **dub-umbisaĝ** was one who did so on a **dub**, a writing board or tablet. The term **saĝĝa/sanga** apparently evolved from **umbisaĝ** to refer just to the administrator function. The 'leader' semantics of **saĝ**, 'head', may have contributed to this switch, although **saĝĝa** looks like it has a more complex etymology. Based on the Ebla list, the shift from **umbisaĝ** to **saĝĝa** as 'administrator' occurred later than did the shift to **dub-sar** for 'scribe'.

4.7. The Cuneiform Digital Library Initiative (CDLI) site at <http://cdli.ucla.edu/> identifies three forms of the **SANGA** sign in the early Uruk IV period. In this period, **SANGA~a** occurs 96 times, **SANGA~b** occurs 15 times, and **SANGA~c** occurs 2 times. The forms that the **SANGA** sign could have are illustrated in the following.



Figure 1, CDLI #P002207, 1. GIR3~b DUB~c SANGA~c

The above shows all that is on this beautiful tablet. The **ŠIR3** sign can represent the god Šakkan, protector of wild animals, so this inscription could be the name of a scribe.



Figure 2, CDLI #P000958, Col. 3, 2. 1(N01) , BU~a SANGA~b

The above is 1 entry from a tablet of 31 entries, which says on the reverse 5(N14) 4(N01), **GU4# AB2**. The N14 sign is a factor of 10 greater than the N01 sign in the proto-cuneiform sexagesimal system, so the tablet records the receipt of 54 bulls (**GU4**) and cows (**AB2**) from the individuals named in the 31 obverse entries (the numbers in the entries add up to 51 and one entry cannot be read). The **BU~a** sign is usually read in Sumerian as **gid₂**, and can refer to occupations that involve surveying, measuring, or taxing - the above entry records receipt of 1 animal from a scribe in that occupation.

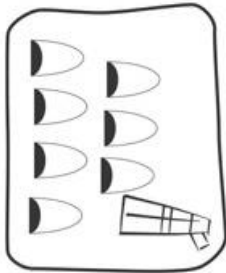


Figure 3, CDLI #P003265, 1. 7(N01) , SANGA~a

The above shows all that is on this tablet. It appears to record the receipt of 7 items from a scribe/administrator.



Figure 4, CDLI #P001447, Col. 2, 1. [...] 2(N01)# , EN@g~b DUB~b SANGA~a UMBIN~a

This is the most legible entry on this interesting tablet, which again appears to record the receipt of items from individuals. The entry could be a verbose way of writing 'lord of

the scribes', **en dub-umbisağ**, but the **UMBIN~a** sign occurs 30 times elsewhere in the Uruk IV tablets and this is the only time that **UMBIN** occurs with the **DUB** and **SANGA** signs. Note the appearance of the **UMBIN** sign at the bottom of this case picture - although this article will continue to investigate whether the **SANGA** sign represents a counting board, I will have more to say about what the **UMBIN** sign depicts in section 5.1.

4.8. Figure 5 shows samples of the **SANGA/ŠID** sign as it evolved in early cuneiform:

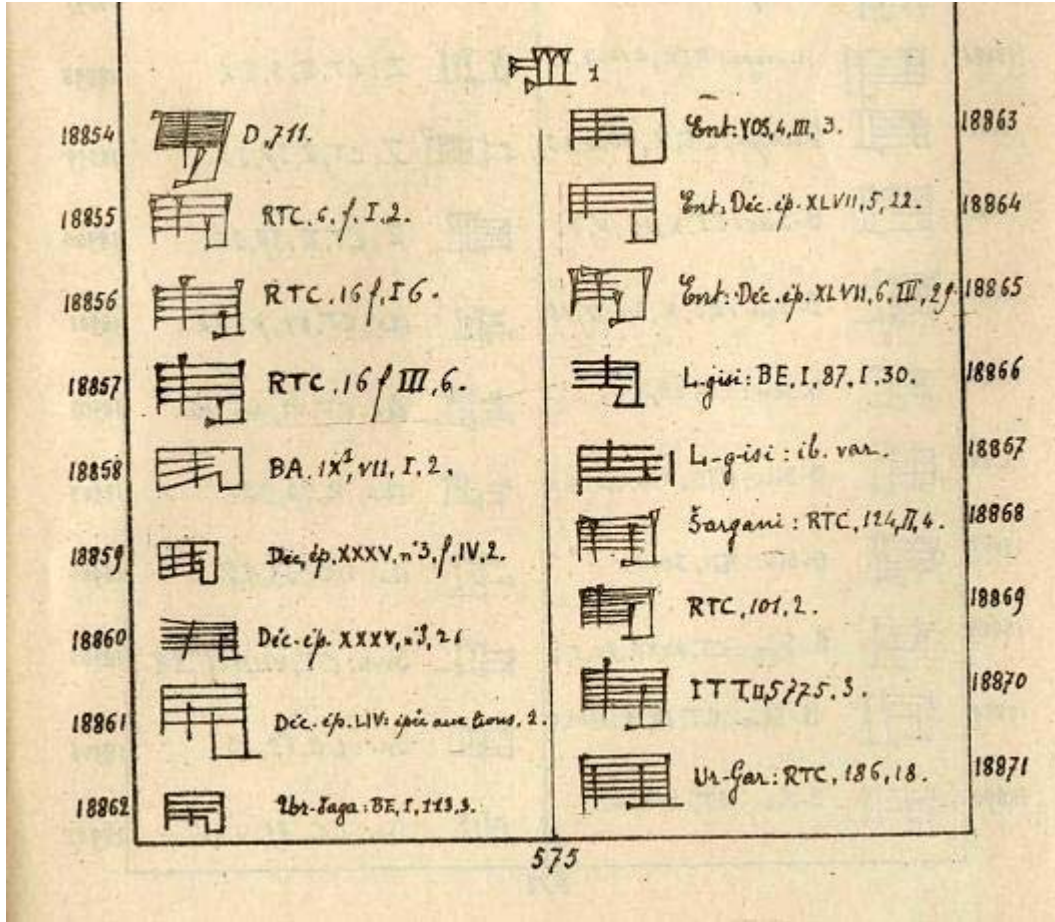


Figure 5, Charles Fossey, *Manuel d'Assyriologie*, Tome II

4.9. Looking back at Figure 4, you see a clear distinction between the object depicted by the **SANGA/ŠID** sign and the **DUB**, a 'writing board' or 'tablet'. The **DUB** is for writing or recording, while the **SANGA/ŠID** is a device for counting that has evolved considerably from the tally sticks described by Menninger. What does the pictogram represent? It is no longer a simple tally stick, as several thousand years have elapsed since the Sumerian shepherds began to count their goats and sheep. The city-dwellers who drew this pictogram had invented a type of counting board or abax which was usually divided into four separate regions representing lower and higher orders of unit in a positional notation, such as ones, tens, sixties, and six hundreds, but which could be used with any base number system. If one had ten marks or tokens in the ones region, they were removed

and a single mark or token placed in the tens region. What is represented by the projection from the sign's side? Candidates include stylus or token-holder, but we can't be sure without archaeological evidence. All instances of the **SANGA** sign have sides that taper from bottom to top. Counting boards could have been cut from tapering branches, but the **umbisaĝ** also needed more room at the bottom to manipulate individual counters. The counting board was the ancient arithmetical calculator. After using it to count a large number of items, in order to record the results or to make a permanent receipt, the scribe had to transfer the calculations either to a wax-filled board or to a tablet of clay.

4.10. The mathematicians Christine Proust and Jens Høyrup have found evidence in the form of calculation errors in Old Babylonian texts for Mesopotamian use of counting devices such as counting boards. See: Proust, Christine, "La multiplication babylonienne: la part non écrite du calcul." (French. English, French summary) ["Babylonian multiplication: the unwritten side of calculation"] *Revue d'Histoire Mathématiques* 6 (2000), no. 2, 293-303; Høyrup, Jens, "A Note on Old Babylonian Computational Techniques, *Historia Mathematica* 29 (2002), 193–198, with footnotes and bibliography of earlier suggestions and literature.

4.11. The following entry from the *Chicago Assyrian Dictionary (CAD)* for *mahisatu* lists the Akkadian and Sumerian terms for 'counting board':

māhiṣātu s. pl. tantum; (an instrument used for calculating(?)); lex.*; cf. *maḥāṣu*.
giš.NÍG.ŠID, **giš.NÍG^{ú-tuk-ku}ŠID** = *ut-tu-ki* (var. *út-tuk-ku*), **giš.NÍG.ŠID** = *ma* (var. *maḥ*)-*i-ša-a-tum* (preceded by *išši minūti*, *išši nikkassi*) Hh. IV|l8ff.;
NÍG.ŠID = *ma-ḥi-ša-[tum]* Malku VI 153; **túg.NÍG^{ú-tu-uk}ŠID** = *ú-tuk-ku*, *ma-ḥi-ša-tum* Hh. XIX 147f.; [**ut-tu-ku**] **GIŠ.NÍG.ŠID** = *ut-tu-ku*, *ma-ḥi-ša-tu* Diri III 22f.; **ut-tu-ku TÚG.NÍG.ŠID** = *ú-tuk-ku*, *ma-ḥi-ša-a-tum* Diri V 137f.
x(IGI or IM?).ra.ki.NAM.esir.ra = *ma-ḥi-ša-tum* Nabnitu XXI 53.

The Akkadian verb *maḥāṣu* corresponds to the Sumerian verb **taga, taka, tuku₅**, which means "to touch, handle; to weave; to strike; to play an instrument." The verb is reminiscent of the etymology of the word 'jetton', French for the casting-counter pieces that were used with medieval European counting-boards. "The word 'jetton' is connected with the French verb *jeter*, used in the sense of 'to push', because the operation of calculating with jettons consisted in shifting them from one position to another on a table." Francis Pierrepont Barnard, *The Casting-Counter and the Counting-Board: A Chapter in the History of Numismatics and Early Arithmetic*, Oxford University Press, 1917, p. 26. The lexical entries quoted by the *CAD* show that the Sumerian word for counting board or abacus was **uttuku** - one might etymologize **uttuku** as **u**, 'ten' (represented on clay as a small circular indentation which represented a pellet-shaped counting token), plus **tuku₅**, 'to touch, handle' (vowel-harmony form of **taga/taka**).

The 1999 book *A Concise Dictionary of Akkadian* has the Akkadian entry, **uttuku II**, *uttuku* (calculating device, phps.) "abacus" jB; < Sum.

It is not a problem that sometimes the determinative for 'wood', **giš**, precedes **uttuku** and sometimes the determinative for 'cloth', **túg**, precedes it. Part II of Barnard's book is titled Counting-Boards and Counter-Cloths. Barnard also calls them 'reckoning-cloths'. But he remarks that, "The extreme rarity of specimens of the counting-board is as remarkable considering its general vogue in Western Europe during the six centuries from 1200 to the French Revolution, as is the survival of any examples of its more perishable substitute the reckoning-cloth, or 'carpet for the counter'" (p. 230). He says that after considerable search and inquiry, he was only able to find unquestioned counting-boards at a museum in Basel and reckoning-cloths in Munich (this from a 1917 book author). Reckoning cloths were used as portable substitutes for counting boards. With surviving examples being so rare in Europe after the passage of just two hundred years, we understand why no counting-boards (^{giš}**uttuku**) or counter-cloths (^{túg}**uttuku**) have survived from Mesopotamia of four or five thousand years ago.

4.12. Figure 6 is the obverse of a German *rechenpfennig*, dated 1691, showing a counting board where the three jettons on the board add up to 1,051. This simple example, which uses both lines and spaces, illustrates the principles of a counting board or abacus.

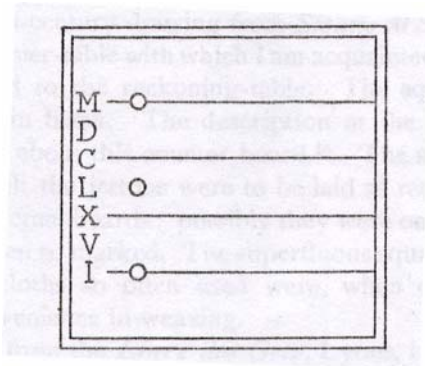


Figure 6, German counting board showing a sum of 1051, F.P. Barnard, *Casting-Counter*, p. 235.

4.13. In Figure 7 below, "Pythagoras is shown calculating with jettons on a counter-table, while Boethius is ciphering at an adjoining table with Hindu-Arabic figures. On the counter-table the **X**, marking the thousand line, is prominent, and ... both lines and spaces are used. The jettons set out display the totals 1241 and 82", F.P. Barnard, *Casting-Counter*, p. 237.

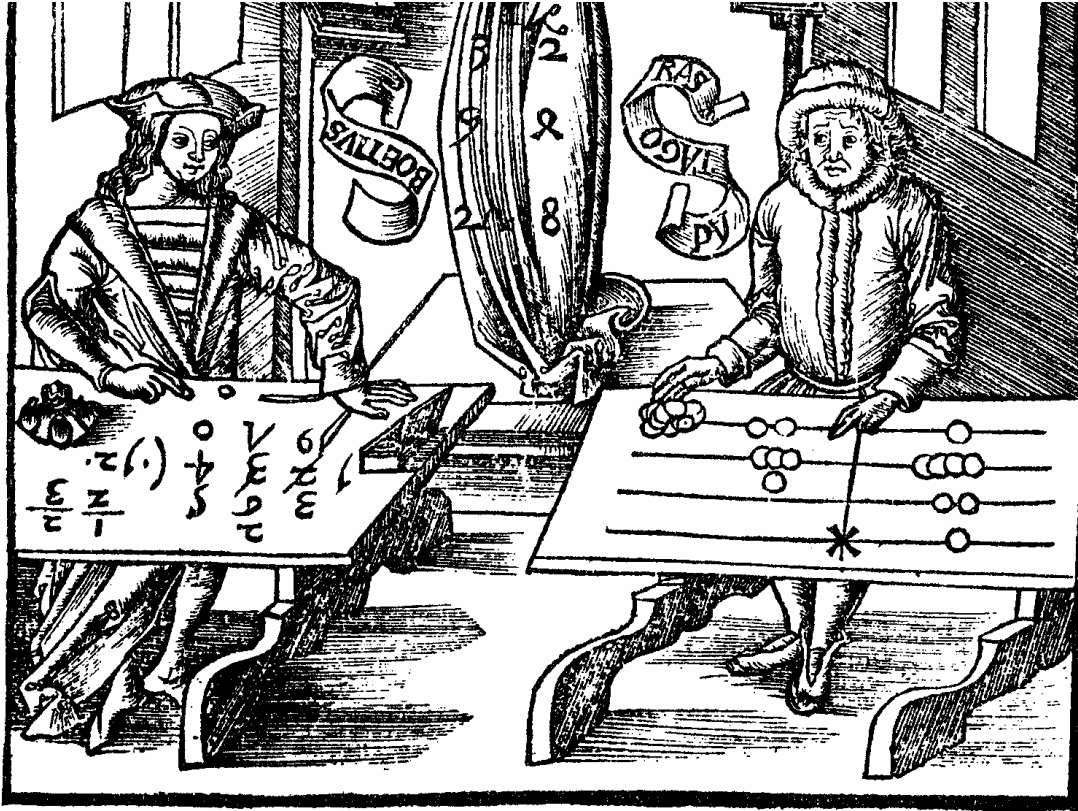


Figure 7, 1503 woodcut showing Hindu-Arabic figures vs. counter-table, *ibid.*, Plate XLVII.

5. The Original Sumerian Writing Instrument

5.1. The shape of the **UMBIN** sign (see the last sign of Figure 4) looks like a curved nail that was removed from a deceased animal, such as the Sumerian mastiff dog. The various meanings collected in my *Sumerian Lexicon* for **umbin** include: "nail; claw; talon; hoof; nail impression (on a clay tablet); hair pin; clamp; finger, toe; a type of chisel; wheel (of a chariot, wagon); leg (of furniture)." Instead of automatically making the assumption that the reed stylus that we know from the historical period extends all the way back to the beginning of proto-cuneiform, into the archaic Uruk IV period (3400-3200 BCE), we should look at the linguistic evidence, including the original designation for a scribe, and consider that animal nails or bird talons provided a durable tool readily at hand in the environment with which the accountant scribes could scratch the outlines of pictographs into wax or clay.

In the early period tablets there is a clear difference between the sharp tool used to draw the curviform lines of the pictographs and whatever was used to make the round holes for numbers that sought to imitate the original look of pressing counting stones into clay. By the Uruk III period we can see that they had developed different sized styluses with round cross sections for making number impressions. There was a gradual transition from the **umbin** as a pointed scratching instrument for writing pictographs to the **gi-dub-ba** reed stylus with a triangular head for making lines and wedges, which happened when writing transitioned from pictographic proto-cuneiform to abstract cuneiform by the time of the archaic Ur and Fara period tablets in the early third millenium. Several centuries

after the invention of proto-cuneiform, the Sumerian scribe adopted what became the standard stylus with one end cut to make wedge marks and the other end rounded for making number signs. The appearance of the pictographs transitioned from being drawn with roundish natural-looking lines to being drawn with straight lines and then to the abstract conventions of the wedge-shaped cuneiform sign repertoire.

6. Split Tallies

6.1. Menninger's book also describes historical instances of the 'split tally' or 'double tally stick', for the use of which in Sumer one finds evidence in the lexical lists. In this system, a creditor and a debtor each kept half of a tally stick that had been split lengthwise after having been notched with the numerical amount that the debtor owed to the creditor. When the two halves of the split tally stick were joined together, the notches matched, and neither the debtor nor the creditor could unilaterally alter the amount that was owed. "Both parties take back their own pieces and keep them until the final settlement. In this marvellously simple fashion the "double bookkeeping" makes any cheating impossible." (*Number Words and Number Symbols*, p. 231). Menninger describes European tenth century use of this same technique with paper contracts where the two parties took away halves that were cut on a wavy or zigzag line, where only the original counterparts would match each other. I will itemize the lexical evidence that the Sumerians used the medium of clay to create probably the earliest forerunners of this 'split tally' system.

6.2. My lexicon has:

im-te₆[ŠID], im-zadru[ŠID]: box to hold matching clay tally halves as proof of credit or debt, the Sumerian version of the split tally system known from other historical cultures (cf., **im-lag**) ('clay' + **te**, 'to approach, reach, meet'/**zandara**, 'one-half (share)'; Akk., *pišannu(m)*, 'box, chest').

The famous **ĤAR-ra** = *hubullu* Sumerian-Akkadian lexicographical series has the following four entries for the ŠID sign:

- 499. **im**^{1a-ag}**lag** (ŠID) *kir-ban-nu*
- 500. **im**^{te-e}**te₆** (ŠID) *pi-sa-nu*
- 501. **im**^{za-ad-ru}**zadru** (ŠID) *ŠU-u*
- 502. **im**^{za-ad-ru}**zadru** (ŠID) *meš-la-nu*

The **ĤAR-ra** = *hubullu* list is organized by related groups - the above clay (**im**) items come after terms for clay bricks and rods for wall construction and before terms for clay balls for slingshots. The Akkadian translations mean "clay lump (*kirbānu(m)*)", "chest, container, basket, box (*pišannu A* in the CAD)", "idem (*ŠU-u*)", and "half (shares) (*mišlānū*)". The ŠID sign is given these readings because, as Damerow and Englund wrote, the ŠID sign was an ideogram meaning 'account', and split clay tally halves recorded the amount and served as proof of financial accounts.

6.3. In the lexical series Antagal F, one finds:

154. ^{pi-sa-an}**pisan**₂ (ŠID) *na-ša-bu ša*₂ *GIŠ*

155. **pisan**₂ (ŠID) **MIN** (^{pi-sa-an}) -**na** *MIN(na-ša-bu) ša*₂ *ŠIKA*

A **pisan**₂ is a box or chest and the Akkadian translations say "for placing (*našābu II*) of wood" and "for placing of sherds". The Akkadian for (pot)sherd, *išhilšu* (from *halāšu/harāšu*, 'to break off') is given in Hh X 376 as an equivalent for Sumerian, **šika-ku**₅-**da**, 'cut sherd'. We are justified in asking, why would the Sumerian ideogram for 'account' be used for a chest into which to place broken sherds, unless those sherds had financial value?

6.4. A line from Ea VII iii appears to relate to cutting or division:

9'. (**tuba**₃:) **tu-ba** ŠID *pi-ir-sa*₃-*nu*

The dictionaries do not know the meaning of *pirsānu*, but the CAD has *pirsu* A, "detachment, section, division, cutting." The Sumerian form appears to relate to **tu**₍₂₎, **tu**₁₀ (-b), **tu**₁₁ (-b), one of whose meanings is "to break up, smash". Note the similar Sumerian **gaz**, meaning "to break; (in math. texts) to divide; to smash, crush, kill".

6.5. The generic word in Sumerian for a split tally appears to have been:

zandara, **zadru** [ŠID]: one-half (share); split tally; IOU (cf., **im-te**₆, **im-zadru**) (**zag**, 'percentage', + **dar**, 'to slice, split', + nominative; cf., Akk., *mišlānū*).

If you look in the ePSD, they call this "a drainage tile", which is really impossible for a reading of the ŠID sign. The PSD editors were probably forced into that secondary meaning of Akkadian *mišlānū*, whose primary meaning is "half (shares)", because they knew that **zandara** refers to a clay object and they did not see how that could relate to the primary meaning of *mišlānū*.

6.6. In the book, *The Origins of Value* (ed. William N. Goetzmann and K. Geert Rouwenhorst, Oxford University Press, 2005), after discussing Chinese use of split bamboo tallies to record loans around 500 B.C., in the chapter "From Tallies and Chirographs to Franklin's Printing Press at Passy: The Evolution of the Technology of Financial Claims," William N. Goetzmann and Laura Williams ask, "Did the use of split tallies develop in China and spread to the West - perhaps along the Silk Road? Or did the bi-partite contractual structure for loans, either as split tallies with notation or as written documents divided between parties, develop independently at both ends of the continent in response to similar problems of authentication and measurement?" The Sumero-Akkadian lexical terminology, which was certainly in use during the second millennium B.C., gives clear precedence to Mesopotamian civilization for inventing this technique for managing and proving credit and debt. Now it is up to the Assyriologists to find surviving evidence, or references in the texts, for the Babylonian use of split tallies.

7. Counting with Stones or Knots on a String

7.1. Finally, Miguel Civil recently reported a little known Sumerian counting method in the following expression:

gu-dili (-a) . . . è: 'stringing [their heads] on one string'; enumerate their number, from a counting device to keep track of people (per M. Civil in *Wisdom, Gods, and Literature* - W.G. Lambert festschrift (2000), p. 115) ('string' + 'single' + locative + 'to bring out').

This counting method may be referred to in the following line from Ea VII iii:

8'. (**tu₁₄:**) **tu-u₂** ŠID *tu-ur-rum*

The primary meaning of *turru(m)* is "binding, knot", but a secondary meaning is "string (of stones)" (*A Concise Dictionary of Akkadian*, page 416).

For the sake of completeness, I should mention an older, but still worthwhile, review article that describes a method for using pebbles to count and record categories of animals in Mesopotamia, particularly in mid-second millenium Nuzi: A. Leo Oppenheim, "On an Operational Device in Mesopotamian Bureaucracy." *Journal of Near Eastern Studies* 18 (1959), 121-128.

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