

## Accounting for Change: The Development of Tabular Book-keeping in Early Mesopotamia\*

Eleanor Robson  
All Souls College, Oxford

### *Introduction*

Tables are ubiquitous in the modern world: almost any dataset, it appears, is subject to tabulation, from huge and complex databases published for academic analysis to bus timetables on lampposts. We are so familiar with the idea of handling information in this way that we hardly notice or question the presence of tables in the ancient historical record: in concentrating on their content we miss their very table-ness. But this is not simply a blindspot within our own field: the history of table-making in general is only just beginning to attract attention from historians in other areas, perhaps because of its very cross-disciplinary nature. A recent collaborative work on the history of tables within mathematics and related disciplines puts it thus:

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\* Many kind colleagues aided my hunt for tabular accounts: Jo Renger, Piotr Steinkeller, Marc Van De Mieroop, and Niek Veldhuis (who pointed me to the Ur III example). Christopher Walker indefatigably tracked down relevant unpublished tablets in the British Museum for me, and Jane Siegel gave access to those in the Columbia Rare Book and Manuscript Library. Seth Richardson generously provided transliterations of over twenty late OB tabular accounts from his doctoral thesis. I thank all of them for their help (and blame none of them for the results). But I owe a particular debt of gratitude to two people: Stephanie Dalley, the driving force behind *OECT* 15, who has worked patiently with me on the Ashmolean tabular accounts for over a decade now; and the late and much-missed John Fauvel, who first gave me the idea that the topic was worth exploring.

Their importance as a central component and generator of scientific advance ... can be underestimated by sheer familiarity. Like other apparently simple technological or conceptual advances (such as writing, numerals, or money) their influence on history is very deep. The history of tables now deserves, and is ready, to be brought forward from the narrow floodlights of particular special studies into the open sunlight.

The issues turn out to be very interesting. From the earliest times there has been a range of different kinds of table, from the representation of mathematical functions to documents summarizing empirical values. What they have in common is an expression of complex information in a two-dimensional form. From the start, issues of design and legibility jostle with issues of abstract information processing. The structure of tables, the transition from one-dimensional to two-dimensional layout in the location of information, has a far greater significance than might naively be expected. (Fauvel in Campbell-Kelly *et al.* 2003: 1-2)

Given the great strides made in studying the history of ancient Near Eastern data storage, from preliterate accounting tokens to the document formatting reforms of the Ur III period, the rise of the table deserves to be discussed and problematised too. I have attempted a general survey of tables within Mesopotamian culture in the volume just cited (Robson 2003); here I explore in more depth the development and spread of tabular formatting within accounting practices of the Old Babylonian period.<sup>1</sup>

The matter has been on my mind for some years now. In the early 1990s, as part of my doctoral work, I was trying to track down the origins of the laboured constants that appear frequently in Old Babylonian school mathematics. This involved delving into a lot of Ur III agricultural accounts (though my search was by no means exhaustive). At the same time I was working with Stephanie Dalley on copying Old Babylonian tablets, mostly from Larsa, in the Ashmolean Museum for *OECT* 15. I noticed, as has everybody before me, that the Ur III documents were all formatted as rather cumbersome lists.

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<sup>1</sup> The only explicit reference I can find in the specialist literature to the origins of tabularisation is Hallo's observation that "In accounts and other ledger-like texts, the transition from one-dimensional lists to two-dimensional graphs [*i.e.*, tables] began in the Old Babylonian period" (Hallo 1964:61, n. 29).

For instance, CBS 8162 (Example 1 on p. 110f.; *NATN* 61; Robson 1999:158-59), found at Nippur, is concerned with the work, labour and wages for repairs to walls and ditches in an orchard. Each linear entry gives the lengths, widths, and heights of one section of wall, and where this information is too long to fit the column width the next line is indented. Entries are separated by horizontal lines. Total volumes are given immediately below each group of entries, followed by wage calculations and the name of the workman responsible. Totals of wages in grain and in wool end the account, and there is a summary of its purpose on the left edge of the tablet. The tablet is not dated, but can be assigned to early Ur III Lagash through its association to the well-known figure of Ur-meme (Hallo 1972; Zettler 1984).

On the other hand, many of the Old Babylonian tablets I was copying were clearly tabular, with quantitative and qualitative information organised and stored separately and categorised into columns as well as rows. Like CBS 8162, Ashmolean 1922.290 (Example 2 on p. 112-15; *OECT* 15 18) also records the lengths, widths, and depths of earth works. The volumes of canals dug and not yet dug are calculated and assigned to named workmen or overseers, with subtotals and totals of lengths and volumes given at various points in the document. But unlike CBS 8162, Ash 1922.290 groups each category of information into headed columns, only breaking out of columnar format to give linear descriptive comments to totals and subtotals. The tablet is not dated, but the palaeography and prosopography lead to a likely attribution to the Larsa area around the time of Hammurabi or Samsuiluna.

*Example 1: CBS 8162*

- obv. I 1½ ninda 5 kùš gíd ½ kùš daġal 3 kùš sukud  
 1½ ninda 3 kùš gíd ½ kùš daġal 2 kùš sukud  
 5 ninda gíd ½ kùš daġal 3 kùš sukud  
 21 ninda 3 kùš gíd ⅔ kùš daġal 3 <kùš> sukud  
 5 im-du<sub>8</sub>-a-bi 4⅔ sar ½ gín 22½ še  
 guruš-bi 1 14⅔ ud-1-šè  
 še-bi 1 gur 4 barig 5 bán 8⅔ silà gur  
 á ša-gal 8 [silà]  
 lugal-ì-<sup>r</sup>sa<sub>6</sub><sup>1</sup> [um-mi-a]  
 [.....]
- obv. II 11½ ninda 1 kùš [gíd.....] 3 [.....]  
 im-du<sub>8</sub>-a-bi [..... sar] igi-4-ġál 7 [še]  
 guruš-bi 2 08 ud-[1-šè]  
 še-bi 3 gur 2 barig 4 silà gur  
 ur-<sup>d</sup>bil<sub>4</sub>-ga<sup>1</sup>-mes um-mi-a  
 5 ġiš-kiri<sub>6</sub> gu-la  
 14 ninda 4 kuš gíd ⅔ kuš [daġal] 3 kùš sukud  
<sup>r</sup>34 ninda<sup>1</sup> [.....]  
 [.....]
- rev. III Missing  
 rev. IV [.....]  
 im-<sup>r</sup>du<sub>8</sub><sup>1</sup>-[a-bi .....]  
 guruš-bi [.....]  
 še-bi 1 barig 2 bán [.....]  
 5 6 nindan gíd 1 [kùš daġal 3 kùš sukud]  
 saġar-bi 1½ sar  
 guruš-1-e 6 gín-ta  
 guruš-bi 15 ud-1-šè  
 síg-bi 4 ma-na  
 10 ġiš-kiri<sub>6</sub> bàd še-ga  
 dug<sub>4</sub>-ga um-mi-a  
 šu-niġín á 8 41 guruš ud-1-šè  
 še-bi 13 gur 4 barig 2 bán <sup>r</sup>8⅓ silà  
 šu-niġín 15 guruš ud-[1-šè]  
 15 síg-bi 4 ma-na
- l.e. im-du-a ak ù paš ba-al-la  
 ġiš-kiri<sub>6</sub> lugal-kù-zu  
 ġir ur-<sup>d</sup>iškur  
 ur-me-me ugula

*Translation*

- obv. I 1½ rods 5 cubits length, ½ cubit width, 3 cubits height  
 1½ rods 3 cubits length, ½ cubit width, 2 cubits height  
 5 rods length, ½ cubit width, 3 cubits height  
 21 rods 3 cubits length, ⅔ cubit width, 3 <cubits> height
- 5 Its mud wall: 4⅔ sar ½ shekel 22½ grains  
 Its workers: 74⅙ for 1 day  
 Its grain: 598⅔ litres  
 Food wages: 8 [litres]  
 Lugal-isa [the craftsman]  
*Rest of column missing*
- obv. II 11½ rods 1 cubit [length .....]  
 Its mud wall: [.....] a quarter, 7 grains  
 Its workers: 128 [for 1] day  
 Its grain: 1024 litres  
 Ur-Bilgames the craftsman
- 5 The large orchard  
 14 rods 4 cubits length, ⅔ cubits [width], 3 cubits height  
 34 rods [.....]  
 [.....] *Rest of column missing*
- rev. III *Missing*
- rev. IV *Top of column missing*  
 [Its] mud wall: [.....]  
 Its workers: [.....]  
 Its grain: 80(+) litres
- 5 6 rods length, 1 [cubit width, 3 cubits height]  
 Its volume: 1½ sar  
 Each worker at 6 shekels (volume daily rate)  
 Its workers: 15 for 1 day  
 Its wool: 4 minas
- 10 Repairing the orchard wall  
 Duga the craftsman  
 Total: wages for 521 workers for 1 day  
 Its grain: 4168⅓ litres  
 Total: 15 workers [for 1] day
- 15 Its wool: 4 minas
- l.e. Making a mud wall and digging a ditch  
 Lugal-kuzu's orchard  
 Under the authority of Ur-Iškur  
 Ur-meme, overseer

*Example 2: Ashmolean 1922.290*

Obverse	1	'UŠ'	SAG	GAM
		4½ NINDA	1 NINDA	5 KÙŠ
5	5	13 NINDA	½ NINDA 5½ KÙŠ	4 KÙŠ
		47 NINDA		3½ <KÙŠ>
		27½ NINDA 4 KÙŠ		3 KÙŠ
		1 UŠ 27½ NINDA 4 KÙŠ		
10	10	25 NINDA	½ NINDA 5½ KÙŠ	4 KÙŠ
		10 NINDA		3½ KÙŠ
		1 UŠ 39 NINDA		3 KÙŠ
		2 UŠ 14 NINDA		
15	15	9 UŠ 59½ <NINDA> 2 KÙŠ	½ NINDA 5'½' <KÙŠ>	3 KÙŠ
		3 UŠ 33½ <NINDA>		2½ KÙŠ
		13 UŠ 33 NINDA 2 KÙŠ		
		½ DANA 2 UŠ 15 <NINDA>		
		ša AD.DA- <sup>d</sup> MAR.TU.MEŠ		
		7 UŠ 20 NINDA	½ NINDA 5½ KÙŠ	3 KÙŠ
	[40] 'NINDA'	2½ KÙŠ		
	[.....]	2½ KÙŠ		
	[.....]			

*Rest of obverse missing**Translation*

Obverse	1	Length (rods)	Width (rods)	Depth (cubits)
		4;30	1	5
5	5	12	0;57 30	4
		47	<ditto>	3;30
		27;50	<ditto>	3
		1 27;50		
10	10	25	0;57 30	4
		10	<ditto>	3;30
		1 39	<ditto>	3
		2 14		
15	15	9 59;40	0;57 30	3
		3 33;30	<ditto>	2;30
		13 33;10		
		17 15		
		That the Amorites		
		7 20	0;57 30	3
	[40]	<ditto>	2;30	
	[...]	<ditto>	2;30	
	[...]	[...]	[...]	

*Rest of obverse missing*

SAĤAR <i>na-as-bu</i>	SAĤAR <i>la na-as-bu-<sup>1</sup>u<sup>1</sup></i>	ŠU.NIGÍN SAĤAR	[.]	[MU.BI.IM]
	22½ SAR	22½ SAR		KA.ÍD.DA
49⅝ SAR		49⅝ SAR		KI.1
0.0.1½ <sup>gána</sup> 7⅔ SAR		0.0.1½ <sup>gána</sup> 7⅔ SAR		KI.2
0.0.½ <sup>gána</sup> 30 SAR		0.0.½ <sup>gána</sup> 30 SAR		KI.3
0.0.2½ <sup>gána</sup> 37½ <SAR>		0.0.2½ <sup>gána</sup> 37½ <SAR>	<i>ša</i>	<i>e-ri-ib-d</i> SUEN <i>i-pu-šu</i>
	0.0.½ <sup>gána</sup> 45⅝ <SAR> 33½ <SAR>	0.0.½ <sup>gána</sup> 45⅝ <SAR> 33½ <SAR>		KI.1 KI.2 KI.3
0.0.2½ <sup>gána</sup> 34⅔ <SAR>		0.0.2½ <sup>gána</sup> 34⅔ <SAR>		KI.3
0.0.2½ <sup>gána</sup> 34⅔ <SAR>	0.0.1 <sup>gána</sup> 29⅓ <SAR>	0.0.4 <sup>gána</sup> 14 SAR	<i>ša</i>	<i>i-din-d</i> en.lil <sup>li</sup> <i>i-pu-šu</i>
0.2.5 <sup>gána</sup> 23½ <SAR>		0.2.5 <sup>gána</sup> 23½ <SAR>	24	KI.1
0.0.4½ <sup>gána</sup> 42⅓ <SAR>		0.0.4½ <sup>gána</sup> 42⅓ <SAR>	2	KI.2
1.0.4 <sup>gána</sup> 15<⅔> SAR		1.0.4 <sup>gána</sup> 15<⅔> SAR	26	<i>ša i-li-i-din-nam i-pu-šu</i>
1.1.3½ <sup>gána</sup> 37<SAR> 10 GÍN 1 <sup>gána</sup> 29⅓ SAR		1.1.5 <sup>gána</sup> 16½ <SAR>	26	<i>i-pu-šu</i>
0.1.4 <sup>gána</sup> 35	0.0.2 <sup>gána</sup> [30] SAR	0.2.0 ½ <sup>gána</sup> 15 SAR		KI.1
0.0.½ <sup>gána</sup> 45⅝ <SAR>	[...]	0.0.½ <sup>gána</sup> 45⅝ <SAR>		KI.2
[.....]	[...]	[...] <sup>gána</sup> 37		KI.3
[.....]	[0.0.2 <sup>gána</sup> 30 SAR]	[.....]	<i>ša</i>	<i>gi-X X [i-pu-šu]</i>

Volume excavated (sar)	Volume not excavated (sar)	Total volume (sar)	[...]	[Its name]
	22;30	22;30		River mouth
49;50		49;50		First one
2 37;40		2 37;40		Second one
1 20		1 20		Third one
4 47;30		4 47;30	that	Erib-Sîn did
	1 35;50 33;30	1 35;50 33;30		First one Second one Third one
4 44;40		4 44;40		Third one
4 44;40	2 09;20	6 54	that	Iddin-Enlil did
28 43;20		28 43;20	24	First one
8 12;20		8 12;20	2	Second one
36 55;40		36 55;40	26	that Ili-iddinam did
46 27;10	2 09;20	48 36;30	26	did
17 15	3 50	21 05		First one
1 35;50		1 35;50		Second one
[...]	[...]	[.] 37		Third one
[...]	[...]	[...]	that	Gi-..... [did]

*Beginning of reverse missing*

Reverse	1'	[.....]	[.....]	[.....]
		[.....]	[.....]	[.....]
5'	[.....]	[.....]	[.....]	
	[2 07 <sup>?</sup> NINDA]	[4 <sup>?</sup> KÙŠ]	3 KÙŠ	
	[4 UŠ]	4 KÙŠ	3 KÙŠ	
	5 38 <NINDA>	4 KÙŠ	3 KÙŠ	
10'	8 20 <NINDA>	½ <NINDA> 2 KÙŠ	3 KÙŠ	
	5 52½ <NINDA>	1 NINDA	2 KÙŠ	
	1 DANA 2 UŠ 5½ NINDA			
	2 DANA 9 UŠ 5½ NINDA			
15'	[ša]	<i>pi-il-kum na-du-ú-ma</i>		
	'5 40 <sup>1</sup> <NINDA>	1 NINDA	1½ KÙŠ	
	'ša <sup>1</sup>			
	9 40	ZAG PA <sub>5</sub> <i>a-bi-i-li-i</i> EN.NA <sup>id</sup> <i>ú-ma-nu-ur</i>		
20'	13 15	ZAG ÍD <i>ú-ma-nu-ur ša</i> É.UD.NAGA		
	½ DANA 2 55 NINDA			
	ša	<i>ik-ka-as-sà-mu-ú-ma</i>		
	3 DANA 2 UŠ ½ NINDA			
	ÍD <sup>2</sup>			

*Beginning of reverse missing*

Reverse	1'	[.....]	[.....]	[...]
		[.....]	[.....]	[...]
5'	[.....]	[.....]	[...]	
	[2 07 <sup>?</sup> ]	[0;20 <sup>?</sup> ]	3	
	4 00	0;20	3	
	5 38	0;20	3	
10'	8 20	0;40	3	
	5 52;30	1	2	
	32 05;30			
	1 09 05;30			
15'	[of]	the work zone that was abandoned		
	5 40	1	1;30	
	That was dug			
	9 40 <rods>			
20'	13 15 <rods>			
	22 55 rods	were	cut	
	whose (trees)	down	but	
	1 32 00;30 rods			
	Ka-..... canal			



[.....]	[.....]	[.....] 22 SAR	ZAG [...] EN.[NA ...]
[0.0.1 <sup>gána</sup> ] 28 SAR		0.0.1 <sup>gána</sup> 28 SAR	ZAG [...] EN.NA [...]
[22] SAR		22 SAR	ZAG <i>tí</i> -[...] EN.NA [...]
[0.0.1] <sup>gána</sup> 27 SAR		0.0.1 <sup>gána</sup> 27 SAR	ZAG PA <sub>5</sub> [...]EN.NA[...]g <sup>is</sup> KIRI <sub>6</sub> d <sup>SUEN</sup> - <i>ú-sé-li</i>
	0.0.2 <sup>gána</sup> 40 SAR	0.0.2 <sup>gána</sup> 40 SAR	ZAG g <sup>is</sup> KIRI <sub>6</sub> d <sup>SUEN</sup> - <i>ú-sé-li</i> EN.NA <i>mi-ih-ši-im</i>
	0.0.3 <sup>gána</sup> 38 <SAR>	0.0.3 <sup>gána</sup> 38 <SAR>	ZAG <i>mi-ih-šú-um</i> EN.NA GÚ <i>ha-šu-úr</i> <sup>ki</sup>
0.1.5 <sup>gána</sup> 45 SAR		0.1.5 <sup>gána</sup> 45 SAR	ZAG GÚ <i>ha-šu-úr</i> <sup>ki</sup> EN.NA KASKAL LARSA <sup>ki</sup>
<i>ša i-na up-pu-ši-im SAĤAR ŠĀ ÍD.DA wa-aš-bu</i>			
0.0.1 <sup>1/2gána</sup>	0.1.0 1 <sup>1/2gána</sup> 5 SAR	0.1.1 <sup>gána</sup> 5 SAR	ZAG KASKAL LARSA <sup>ki</sup> EN.NA <sup>id</sup> <i>ú-ma-nu-ur</i> ù [...]
0.2.5 <sup>gána</sup> 22 SAR	0.2.1 <sup>gána</sup> 5 SAR	1.2.0 <sup>gána</sup> 27 SAR	KL.2 <i>ša e-tel</i> -KA- <sup>d</sup> AMAR.UTU <i>i-pu-šu</i>
3.2.5 <sup>gána</sup> 1 SAR 5 GÍN	1.0.3 <sup>1/2gána</sup> 28 <sup>1/2</sup> <SAR>	5.0.2 <sup>1/2gána</sup> 29 SAR	<i>i-ih-ḫi-ru-ú</i>
<i>ih-ḫi-ru-ú</i>	0.1.0 <sup>gána</sup> 15 SAR	0.1.0 <sup>gána</sup> 15 SAR	ZAG <sup>id</sup> <i>ú-ma-nu-ur</i> ù [...] EN.NA PA <sub>5</sub> <i>a-bi-i-li-i</i>
<i>ša É.UD.NAGA d<sup>NIN</sup>.GIŠ.ZI.DA</i>			
<sup>d</sup> NIN.GIŠ.ZI.DA EN.NA URU <sup>ki</sup> <i>za-wa-ar</i>			
<i>la ih-ḫi-ir-ru-ú</i>			
KA [.....]			

[.....]	[...]	[...] 22	Right: [...] Left: [...]
[2] 08		2 08	Right: [...] Left: [...]
[22]		22	Right: [...] Left: [...]
[2] 07		2 07	Right: [...]. Left: [(..)] Sîn-uselli's orchard
	4 00	4 00	Right: Sîn-uselli's orchard. Left: swamp <sup>??</sup>
	5 38	5 38	Right: swamp. <sup>??</sup> Left: the edge of Hjašur town
15 45		15 45	Right: the edge of Hjašur town. Left: the Larsa road to which the volume of the river has been added in the calculated amount <sup>?</sup>
50	10 55	11 45	Right: the Larsa road. Left: Umanur river and ...
28 42	21 45	50 27	Second one that Etel-pî-Marduk did
1 58 21;05	36 18;30	2 34 49	
	but	dug	
	10 15	10 15	Right: Umanur river and ... Left: the Abi-ili canal
Right: the Abi-ili canal; Left: the Umanur river of Ningišzida's ..... temple			
Right: the Umanur river of Ningišzida's ..... temple; Left: Zawar town			
that was not dug			
1 32 00;30 rods			
Ka-..... canal			

To talk about tables clearly and effectively we need a consistent terminology to describe them. I shall define a *formal* table as having both vertical and horizontal rulings to separate categories of information; *informal* tables, on the other hand, separate quantitative and qualitative data by spatial arrangement only, without explicit delimiters. All the tables discussed here are formal; informal tables are found, for instance, in Old Babylonian mathematics (Robson 2003). *Headed* tables have columnar headings, while *unheaded* tables do not. Some tables are preceded by *titles* or introductory *preambles*; others are followed by *summaries* and/or *colophons*. In Old Babylonian tables, any other qualitative or descriptive information is almost invariably contained in the final right-hand column, or interrupts the table as an *explanatory interpolation*, as in Ash 1922.290. Documents like CBS 8162 with no tabular formatting at all we might call *prose-like* or *prosaic*.

Ash 1922.290, both formal and headed, is at the upper limits of Old Babylonian tabular complexity. We could describe it as having two *axes of organisation*: the horizontal axis, along which different types of numerical information are categorised, and the vertical axis, down which the data is attributed to different individuals or areas. All tables are organised along two axes. Calculations, however, are a different matter. Some tables exhibit just one, usually vertical, axis of calculation, or none at all—in which case I refer to them as *tabular lists*. Ash 1922.290, though, has two *axes of calculation* too: horizontally, the volumes dug and not yet dug are totalled, while vertically the lengths of canal and the three categories of volume (dug, not dug, total) are subtalled and totalled. The logic of tabular calculations always moves from left to right, from top to bottom (Robson 2001). Ash 1922.290 has three *levels of calculation*, shown here with degrees of shading. The first level subtotals are marked with the phrase ‘that PN did’ in the final column; the second by a descriptive phrase running the whole width of the tablet; the third is the grand total at the end (which does not include the final second-level total of length of canal not yet dug).<sup>2</sup>

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<sup>2</sup> For the purposes of this paper my definition of (cuneiform) tables is restricted to those which contain *more than one* column of quantitative information. Documents with one column of numbers and one of description could be considered simply as formal numerical lists, or as rather trivial and uninteresting tables. They very rarely have headings, and by their very structure can have at most one axis of calculation.

When, how, and to what extent did tabular document formatting develop? Why did it happen and what were its effects? These are the questions that I shall deal with here.

### *The third millennium*

The earliest table in the cuneiform record appears fully fledged in the Early Dynastic period, with headings and a horizontal axis of calculation: the well-known table of square areas from Shuruppag (*SF* 82; Nissen *et al.* 1993: fig. 119), in which the first two columns each contain lengths from 9 (UŠ) down to perhaps 1 (ninda) and the third their products in area measure. A roughly contemporary tablet from Adab (*IA*:70) contains similar data, in prosaic layout, showing that tabulation was not the only choice scribes made in formatting metrological conversions. The Shuruppag table is all the more remarkable, not only for pre-dating any other cuneiform table by some five centuries, but for being the first of just two truly tabular documents in the whole of the cuneiform mathematical tradition—the other being the famous table Plimpton 322, also headed and with a horizontal axis of calculation (Robson 2001; 2003:29-35).

There is, to my knowledge, just one published tabular account securely datable to the Ur III period. AUAM 73.0400, probably from Puzrish-Dagan (Example 3; *AUCT* 1 56; Robson 2003:23-24), is an account of sheep and goats. It is dated to Ibbi-Suen year 1 (2028 BC by the Middle Chronology), the penultimate year of known operations at Puzrish-Dagan.

#### *Example 3: AUAM 73.0400*

obv. 1	3	3	ʿ3ʹ	ʿ2ʹ	1	udu-sila <sub>4</sub>
	1 33	1 33	1 33	1 [02]	31	udu-a-lum
	6	6	6	4	2	máš-gal
	1 42	1 42	1 42	1 08	[3]4	
5	puzur <sub>4</sub>	<sup>d</sup> šul	a-ba	si-ʿsá <sup>1</sup>	[...]	
			(traces)	(traces)	[... ...]	
			ki ʿsipa <sup>1</sup> -[.....]			
rev. 1	iti [.....]					
	mu <sup>d</sup> r <sub>i</sub> -b <sub>i</sub> - <sup>d</sup> suen lugal <sup>1</sup>					

Like later administrative tables, the row labels (types of ovids) are at the end of each row, but the column 'headings' are at the bottom of the obverse below each column total. They appear to be abbreviations, perhaps for personal names. Strikingly, the entries are always in the same proportions 1 lamb : 31 sheep : 3 goats down the rows and 3 : 3 : 3 : 2 : 1 across the columns. On the damaged edge and reverse the column formatting seems to be abandoned in order to give the usual sort of summary information: the names of the official(s) responsible for the record and the date on which it was drawn up.

Ashmolean 1910.759 (Example 4; *TAD* 42; *MKT* 1:82; *AAICAB* 1: pl. 17) is less securely attributable to the Ur III period, but it shares many of the same features.

*Example 4: Ashmolean 1910.759*

obv. 1	8	4	sig <sub>5</sub>
	12	6	uš
	20	10	eš
	20	10	za
	5	1 00	30
	2 00	1 00	
	ša	an	

rev. *blank*

Once again, the row labels are on the right, the column labels at the bottom. Both sets of labels appear to be single-sign abbreviations. The entries are in proportion 2 : 1 across the columns and 2 : 3 : 5 : 5 : 15 down the rows. All are conspicuously round and regular, especially the columnar totals. The numeral 3, written on the left edge, may be the grand total, as Neugebauer (*MKT* 1:82) suggests.

Why such a tiny number of tabular documents in a published corpus not far short of 50 000?<sup>3</sup> The conspicuous roundness of the entries in the tables hints at school exercises (*MKT* 1:82), but the date on AUAM 73.0400 suggests otherwise. The use of abbreviations implies

<sup>3</sup> The CDLI database <<http://cdli.ucla.edu>> contained some 46 600 Ur III administrative documents as of July 2003.

that this was a tablet format designed for rough jottings, estimates, and calculations, which was not intended to be viewed by superiors or archived for posterity—just as Powell (1976) suggested many years ago for Ur III sexagesimal calculations. This raises the interesting (but untested) possibility that the ‘accountant’s nightmare’ of drawing up annual accounts from daily records (Van De Mierop 1999-2000) might not have been as labour-intensive as it appears if the scribes were able to collect, summarise, and calculate the quantitative data involved in tabular format before transferring it to the final, non-tabular version.

### *Old Babylonian tabular accounting*

Over the course of the nineteenth century BC, tables gradually became established as an acceptable format for presenting accounts but it was never a popular presentation method in the Old Babylonian period. In all, I have found over 320 examples (Table 1), the earliest and most abundantly attested of which belonged to a single archive from Nippur, c. 1850-36 (Table 2). They are attested elsewhere—or at least published—in increasing numbers for about half a century, until the middle of Rim-Sin’s reign, 1837-1784 (Tables 3-5) and then reappear thirty years later in the last years of Hammurabi and the first decade of his successor Samsu-iluna, 1758-25 (Table 6). I have found no tables from the later years of Samsu-iluna or his successors for half a century. The final group dates to the reigns of Ammi-ditana and Ammi-šaduqa, 1679-26 (Table 7). The undatable tablets are listed in an Appendix (Table 8).

Is this a true reflection of the waxing and waning of tables in administrative fashion, or an outcome of larger patterns of preservation, with bureaucratic finds clustering towards the ends of regimes (Civil 1992: 38-39)? More modern factors are at work too. I have used a very simple, even simplistic, evidential methodology, seeking examples of tables in the major publications of Old Babylonian cuneiform copies from southern Babylonia. What I have found is limited by what earlier scholars have chosen to copy: recalling Bob Englund’s recent observation that ‘few Assyriologists like numbers’ (Englund 1998: 111), there is a strong likelihood that tabular accounts are underrepresented in publications. Of the 122 OB tabular accounts outside the Nippur archive fully half of them were not in the public domain when I began this study in late 2000 (*OECT* 15; Richardson 2002; Robson forthcoming).

Many of those new tablets fill large gaps in the pattern of attestation (1790s, 1670-20s). That said, I doubt I have collected all published examples. A further weakness in my method is that not every copyist clearly marks vertical rulings; on the reverse of VAT 7874 (*VAS* 18 83), for instance, they gradually disappear under the script. If no vertical rulings show at all on copies of tables, then I have not been able to detect them. This can be no more than a provisional study then, and I look forward to the developmental scheme presented here, which is necessarily an *argumentum ex silentio*, being revised or abandoned as new material comes to light.

*Table 1: Tabular accounts from the Old Babylonian period*

Publication	Tabular acc.	Dated	Undatable	Provenance	Dates
<i>BBVO</i> 1	2	1	1	Larsa	1637
<i>BiMes</i> 7	1	–	1	Kish	–
<i>BiMes</i> 11	201	201	–	Nippur	1850?-36
<i>CT</i> 45	10	3	7	Sippar	1748-1626
<i>OECT</i> 13	4	1	3	Kish	1796
<i>OECT</i> 15	19	4	15	Larsa	1822, 1758
<i>PBS</i> 8	8	7	1	Nippur	1837-1797, 1752
Richardson 2002	21	16	5	Sippar	1679-30
Robson forthcoming	21	20	1	Larsa area	1792-91, 1758-25
Sanati-Müller 1991-93	4	3	1	Uruk	1821-10
Scheil 1918	1	1	–	Larsa	1744
Sigrist 1985	1	1	–	Larsa area	1837
<i>TCL</i> 10-11	8	4	4	Larsa	1758-53
<i>TLB</i> 1	4	1	3	Larsa area	1784
<i>UET</i> 5	8	3	5	Ur	1837-00
<i>VAS</i> 18	3	1	2	–	1748
<i>YOS</i> 5	3	2	1	Ur or Larsa	1822-13
<i>YOS</i> 12	2	2	–	–	1748-47
<i>YOS</i> 13	1	1	–	–	1629
Total number of tables	322	272	50		

*The Nippur sattukkum tablets*

Some two hundred tabular accounts from Nippur record regular *sattukkum*-offerings of bread, flour, and beer made in Ninurta's temple E-šumeša, over about eighty years of the nineteenth century BC. The whole archive, as recovered, comprises around 420 tablets, excavated in the fifth season of post-War excavations at Nippur and published by Marcel Sigrist (Sigrist 1984 = *BiMes* 11). The tablets were all found in the Parthian period fill near the Inana Temple, but it is unclear whether they had been transported there directly from their original site of use and storage, or from some secondary locus such as a rubbish tip. Most are in very bad condition.

Sigrist classified the tablets in the archive according to the number of columns they contain (Sigrist 1984: 17-33); the two- and six-column tablets, along with most of the smaller categories and the unclassifiable and fragmentary tablets, exhibit simple linear or list-like structures, with vertical rulings used only as column markings and not as classification separators. The 201 five-column tablets, however, are partially tabular.

The obverse sides of the five-column tablets, as exemplified by 5NT 95 (Example 5, p. 122f.; Sigrist 1984:73), list the offerings made to each of the divine statues and other cult objects in the E-šumeša. The first column is always divided into five narrow sub-columns to the left, listing quantities of bread (*ninda*), shortbread (*ninda-ì*), *eša*-flour, *utú*-flour, and beer (*kaš*) in that order. The wider sub-column to the right lists the objects of the offerings, always in the same order within a single administrative year. The second column is split vertically into three, with the first two narrow sub-columns holding quantities of unknown commodities (the headings, if there were any, do not survive), and the final column again naming the divine recipients. There is no sign of totalling at the bottom of the columns, as far as I can judge; we could thus describe these tables (partially) headed but with no axes of calculation. They are, in other words, tabular lists.

The reverse sides of the tablets, which record the redistribution of these offerings to human functionaries and dependents of the E-šumeša, are always in list format, with clear spatial separation of the numbers and the names. As on the obverses, the order of entries remains fixed throughout each administrative year. The best preserved is 5NT 90 (Example 6, p. 124f.; Sigrist 1984:84).

## Example 5: 5NT 95

obv. I

1	'ninda <sup>1</sup> ninda-ì eša utú kaš		[...] kaš <sup>giš</sup> gu-za
	[...]	[...]	2 31 <sup>d</sup> nin-urta
			5 <sup>d</sup> é-igi-šu-galam-ma
	1(bán) 6	1(bán) 1	8 <sup>d</sup> nuska
5	4	1(bán)	<sup>d</sup> suen
	'2(bán) <sup>1</sup> 6	1(bán) 2	8 <sup>d</sup> en-ki
	[2(bán)] 6	1(bán) 4	1 4 <sup>d</sup> innin
	'2(bán) <sup>1</sup> 4	1(bán) 2	4 <sup>d</sup> iškur
	'5 <sup>1</sup>	1(bán)	1 2 <sup>d</sup> utu
10			1 <sup>dr</sup> nin-gur-gi <sub>4</sub> -lu <sup>ki</sup>
	3	1(bán)	2 2 <sup>d</sup> nè-irigal
	3	1(bán)	1 <sup>d</sup> nin-tin-ug <sub>5</sub> -ga
			<sup>d</sup> da-mu
			<sup>d</sup> nin-šubur
15	[.....]	[.....]	1 3 <sup>d</sup> ba-ú
	[.....]	[.....]	<sup>d</sup> nin-sumun
	[.....]	[.....]	4 <sup>d</sup> nin-in-si-na
	[.....]	[.....]	<sup>d</sup> nin-kir <sub>4</sub> -maš-a
	[.....]	[.....]	<sup>d</sup> šul-pa-èd
20	[.....]	[.....]	<sup>d</sup> šu-zi-an-na
	[.....]	[.....]	4 <sup>d</sup> nin-nibru <sup>ki</sup>
	[.....]	[.....]	[..] urud <sup>mi</sup> -tum
	[.....]	[.....]	[..] urud <sup>alam</sup> -gu-la
	[.....]	[.....]	[..] urud <sup>alam</sup> -š-a-bi

obv. II

1	[...]	[...]	[ <sup>d</sup> nin-ḡiš-zi-da]
1		3	[ <sup>d</sup> nin-si <sub>4</sub> -an-na]
			<sup>d</sup> [na-na-a]
			<sup>dr</sup> kal <sup>1</sup> -[kal]
5			<sup>d</sup> mar-[tu]
			<sup>d</sup> pa-bil-[saḡ]
			<sup>d</sup> en-á-[nun]
	5	1(bán)	ká-gal-[maḥ]
	1(bán) 1	1(bán)	<sup>d</sup> en-nu-[gi <sub>4</sub> ]
10	sá-		<sup>d</sup> ug <sub>4</sub>
	1 (bán)		<sup>d</sup> nuska
	2	[...]	[erasures]
15			
	1		[erasures]
	1		[erasures]
	2		[erasures]

rev. I *missing*rev. II *missing until:*iti-še-kin-kud 'ud<sup>1</sup>-[4-kam]mu-<sup>d</sup>en-líl-[ba-ni] lugal é-me-zi-[da] é-ki-áḡ-ḡá-ni <sup>d</sup>en-ki-ramu-<sup>r</sup>na-an-dù<sup>1</sup>



*Translation*

obv. I					obv. II				
	bread (in silà)	short- bread	<i>eša-</i> flour	<i>utu-</i> flour	beer	[...] beer for for the throne			
1	[...]	[...]	2	31		Ninurta	1	[...]	[Ningišzida]
				5		E-igi-šu-galama		1	3
	16	11		8		Nuska			[Ninsiana]
5	4	10				Suen	5		[Nanaya]
	'26'	12		8		Enki			Kalkal
	[2]6	14	1	4		Innin			Martu
	[2]4	12		4		Iškur			Pabilsaĝ
	'5'	10	1		2	Uru			En-anun
10				1		Nin-gur-gilu	10		Great gate
	3	10	2	2		Nergal		5	10
	3	10	1			Nintinuga		11	10
						Damu			Ennugi
						Ninšubur	10		<i>sattukkum</i> -offerings
15	[.....]	[.....]				Bau		10	Nuska
	[...]	[.....]		4		Nin-sumun		2	[...]
	[...]	[.....]				Nininsina			[.....]
	[...]	[.....]				Nin-kirmaša			[.....]
	[...]	[.....]				Šul-pa-ed			[.....]
20	[...]	[.....]				Šuzi-ana			
	[...]	[.....]		4		Nin-Nibru			
	[...]	[.....]	[..]			<i>mitum</i> -weapon			
	[...]	[.....]	[..]			big statue			
	[...]	[.....]	[..]			third statue			

rev. I *missing*rev. II *missing until:*

Month xii, day 4.

The year that Enlil-bani the king built E-mezida, his beloved temple, for Enki. (Enlil-bani year i)

## Example 6: 5NT 90

rev. I

1	ša-bi-ta	From it:
	2(bán) 3 silà é-sikil	23 litres for the E-sikil
	5 silà àr-àr šu-nu-nu	5 litres for the miller of Šununu
	kaš-a-gub-ba	<nothing> for the beer attendant
5	18 silà ugula-é	18 litres for the temple overseer
	àr-àr <sup>d</sup> nuska	<nothing> for the miller of Nuska
	muš-laḫ <sub>4</sub>	<nothing> for the snake-charmer
	10 a-ù-a <sup>d</sup> nuska	10 for the ferryman of Nuska
	5 silà <sup>d</sup> en-líl-za-me-en	5 litres for Enlil-zamen
10	4 kù- <sup>d</sup> nanna	4 for Ku-Nanna
	10 lú- <sup>d</sup> nanna	10 for Lu-Nanna
	2 silà kap-sar	2 litres for the stone-carver
	1 silà ì-du <sub>8</sub> kisal-luḫ	1 litre for the door-keeper and courtyard sweeper
	6 silà àr-àr <sup>d</sup> innin	6 litres for the miller of Inana
15	4 silà àr-àr <sup>d</sup> suen	4 litres for the miller of Sin
	àr-àr <sup>d</sup> en-ki	<nothing> for the miller of Enki
	2 silà gîr-sì-ga	2 litres for the <i>gerseqqum</i> -official
	8 silà nin-dingir <sup>d</sup> nin-urta	8 litres for the Nindingir-priestess of Ninurta
	7 silà išib <sup>d</sup> nin-urta	7 litres for the <i>išippum</i> -priest of Ninurta
20	1(bán) nar-gal	10 litres for the chief singer

rev. IV

1	1(gur) 4(barig) [2 silà é-gal-tuš]	54[2 litres for the palace residentsu]
	2 silà [a-bal]	2 litres [for the water-drawer]
	2 silà sagi-lugal	2 litres for the royal butler
	5 silà é-sikil ninda dirig	5 litres for the E-sikil: extra bread
5	7 silà na-kam-tum ka- <sup>d</sup> innin	7 litres for the storehouse: Pî-Inana
	10 zabar-dab <sup>d</sup> nin-urta	10 for the <i>zabardabbum</i> -official of Ninurta
	30 be-lî-i-di-ni kisal-luḫ	30 for Beli-iddini the courtyard-sweeper

rev. V

1	še-ba-àm	Its grain is:
	1 30 dumu-saḡ- <sup>d</sup> nin-urta	1 30 for the heir of Ninurta
	2(barig) 15 dumu <sup>d</sup> nanna-da-X	135 litres for the son of Nanna-da...
	iti apin-a ud-1-kam	Month vii, day 1
5	mu <sup>d</sup> en-líl-ba-ni lugal ḡiš-gu-za	Enlil-bani year I ('The year that Enlil-bani
	bará kù-sig <sub>17</sub> <sup>d</sup> nanna-ra	the king had a throne and a golden
	mu-na-dím	dais built for Nanna')

Table 2: Chronological distribution of the E-šumeša sattukkum tablets

Dynasty	Ruler	Year of reign	Date	2-col. (prosaic)	6-col. (prosaic)	5-col. (tabular)	Other & fragments	Total
Larsa	Sumu-el	24	1871	27				27
Larsa	Sumu-el	25	1870	9				9
Isin	Lipit-Enlil	5	1869				1	1
Larsa	Sumu-el	27	1868				1	1
Larsa	Sumu-el	28	1867		1			1
Isin	Erra-imitti	da	1866-61		22			22
Isin	Enlil-bani	1	1860		1		1	2
Isin	Enlil-bani	h	1859-44				3	3
Isin	Enlil-bani	?	1859-44		5			5
Isin	Enlil-bani	?	1859-44		6			6
Isin	Enlil-bani	?	1859-44		2			2
Isin	Enlil-bani	i	1859-44			42		42
Isin	Enlil-bani <sup>4</sup>	d	1859-44			8	1	9
Isin	Enlil-bani	l	1859-44			40		40
Isin	Enlil-bani	c	1859-44			4		4
Isin	Enlil-bani	aa	1859-44			11		11
Isin	Enlil-bani	?	1859-44			5		5
Isin	Enlil-bani	?	1859-44			6		6
Larsa	Sin-iddinam	7	1843			4		4
Larsa	Sin-eribam	1	1842			3		3
Larsa	Sin-eribam	2	1841			2		2
Larsa	Sin-iqišam	1	1840			3		3
Larsa	Sin-iqišam	2	1839			6		6
Larsa	Sin-iqišam	3	1838			47	10	57
Larsa	Sin-iqišam	4	1837				1	1
Larsa	Sin-iqišam	5	1836			20		20
Larsa	Warad-Sin	1	1835				3	3
Larsa	Warad-Sin	4	1832				1	1
Isin	Damiq-ilišu	?			1			1
Isin	Damiq-ilišu	13	1804				1	1
Larsa	Rim-Sin	28	1795				7	7
Larsa	Rin-Sin	?					3	3
	Undated		–	15			87	102
Total				51	38	201	120	420

<sup>4</sup> This group was dated to Lipit-Enlil 1 (1874) by Sigrist on the basis of the partially preserved year name 'x' d<sup>en</sup>-líl-lá on 5N-T 109 (Sigrist 1984:45). But in that case one would expect the last signs to be lugal-e not lá. A better fit for these remains would be [mu] 'lagar' d<sup>en</sup>-líl-lá <ba-hun> of Enlil-bani d.

Looking at the chronological distribution of the tablets across the archive, a clear pattern emerges (Table 2). The earliest datable records in the archive, dating from the 24th year of Sumu-el of Larsa (1871), are twenty-seven simple linear tablets, a style which seems to have been replaced in 1867, the last year of Sumu-el's reign, by an expanded, six-column version of this same format. The six-column tablet continued in use even after the re-conquest of Nippur by Isin under Erra-imitti the following year, but was replaced in favour of the five-column tabular structure at some point during the regime of his successor Enlil-bani.

Because the order of Enlil-bani's year names are not yet established, we cannot pin down the exact date of the change-over, but we can at least make an estimate. Eleven of the sixteen relevant regnal years 1859-44 are attested in the archive. If we assume that all the six-column and fragmentary tablets predate the tabular ones, then the change cannot have happened before 1855 or after 1850.

Nippur was retaken in 1843, Enlil-bani's seventeenth regnal year, by Sin-iddinam of Larsa, then in his seventh year of office. The use of the tabular account documents continued uninterrupted in the E-šumeša for a further six years until the accession of Warad-Sin in 1835. Thereafter a variety of tabular and non-tabular book-keeping methods were used, but the archive peters out with only a dozen or so documents attesting to the last forty years of its existence.

In short, the tabular records fall into a single phase of 15-20 years from 1855 or 1850 to 1838. Changes in political rule, either of individual kings or between the rival states of Isin and Larsa, seem to have had little or no effect on bureaucratic style. Rather, my feeling is that the chronological distribution of these tablets is more a function of the length of scribal careers: the six-column prosaic format and the five-column tabular list which succeeded it both have a life-span consonant with the working life of a senior administrator. Tables are so rare in the cuneiform record we should consider their adoption a matter of individual choice—even if those individuals are anonymous to us—rather than the outcome of large-scale, impersonal forces.

*Outside the E-šumeša: Before Rim-Sin*

It may simply be the accidents of discovery and publication that explain why just as the E-šumeša archive tails off, accounts in tabular format begin to appear elsewhere in cities under Larsa control (Table 3). All but one of the earliest tablets are unheaded and just one has one, vertical, axis of calculation. In other words, they are essentially tabular lists, just like the five-column accounts of the E-šumeša.

*Table 3: Dated tabular accounts before the reign of Rim-Sin<sup>5</sup>*

<i>Publication</i>	<i>Museum no.</i>	<i>Proven</i>	<i>Cols</i>	<i>Hdgs</i>	<i>Or</i>	<i>Axes</i>	<i>Notes</i>	<i>Year</i>	<i>Date</i>
PBS 8/1 24	CBS 15216	Nippur	3		P			Siq 4	1837
UET 5 806		Ur	3		P	V <sup>1</sup>		Siq 4	1837
Sigrist 1985	PSR	Ur	8+	O	–	–	–	Siq 4	1837
PBS 8/1 26	CBS 15169	Nippur	5		L			WS 11	1824

*PBS 8/1: 24* ration account? Tabular format abandoned after a few lines; thereafter continues prosaically.

*UET 5 806* account of cows and bulls, first column totalled after tabular formatting ends.

*Sigrist 1985* summary of shepherd's annual accounts. Year names in all surviving columns; tablet too fragmentary to determine orientation; no entry entirely numerical as all qualified by *lá-ì* or *dirig*.

*PBS 8/1 26* non-sexagesimal number notation in columns 1-3, column 4 grain measure. Many erasures (calcuations?) on reverse.

<sup>5</sup> Tables 3-8 use the following abbreviations and conventions:

Columns: lists the number of tabular columns, including the final row label; '+' indicates that more columns may be missing. Occasionally abbreviated to 'Cols.'

Headings: I = introductory preamble; M = with final heading MU.BI.IM, O = with some other final heading; Y = yes, final heading missing or illegible; – = existence of headings undetermined. Occasionally abbreviated to 'Hdgs'.

Orientation: L = landscape, with width longer than height; P = portrait, with height longer than width; R = round; S = square; – = orientation undetermined. Occasionally abbreviated to 'Or'.

Axes (of calculation): V1 = vertical, 1 level; H2 = horizontal, 2 levels, etc.; – = undetermined.

Notes (explanatory interpolations within the body of the table): L = linear, breaking the tabulation; C = within a single cell of the table; – = undetermined.

Year: Siq = Sin-iqišam; WS = Warad-Sin; RS = Rim-Sin; Di = Damiq-ilišu; Ha = Hammurabi; Si = Samsu-iluna; Ad = Ammi-ditana; Aš = Ammi-šaduqa.

Date: according to the Middle Chronology; – = date undetermined

Comments on individual tablets follow each table.

*The early years of Rim-Sin*

Just two years after this cluster YBC 4721 (Example 5; *YOS* 5 103) already exhibits a much more sophisticated structure. First, the tablet is shaped to fit the data, so that it has a ‘landscape’ orientation with the width longer than the height, rather than the more usual ‘portrait’ format. Many of the tables in this group have the same orientation (as does *PBS* 8/1: 24, the last tablet in the very early group, Table 3, which predates YBC 4721 by just two years).

Second, column headings are used consistently for the first time. The final, qualitative column is labelled MU.BI.IM, literally ‘its name’. This will remain the standard heading for the final column throughout the Old Babylonian period.<sup>6</sup> Headings are necessary because the horizontal axis of calculation comes into use: the final column of quantitative data is derived from preceding columns, and (in this case) is used to double-check the values in the first column. Vertical and horizontal additions can be totalled for double-checking for the first time.

Third, explanatory *interpolations* can note information outside the categories of the tabular columns. We could almost say that YBC 4721, dating to 1822 BC, is the world’s earliest attested spreadsheet.

*Example 7: YBC 4721*

obv.

1	ŠE.SAG.NÍG.GA	<i>a-na</i> URIM <sup>ki</sup>	<i>a-na</i> X-[... <sup>ki</sup> ]	<i>a-na</i> <sup>1</sup> LARSA <sup>2</sup> <sup>ki</sup> <i>-ma</i>	ŠU.NIGÍN	MU.BI.IM
	5 01.0.0	5 01.0.0			5 01.0.0	<i>li-pí-it</i> - <sup>d</sup> SUEN
	5 01.0.0		3 3 <sup>1</sup> / <sub>4</sub> .3.4, 5	1 26.1.1, 5 <sup>1</sup>	5 01.0.0	<i>nu-úr</i> - <sup>d</sup> <i>da-gan</i>
	4 56.2.0	3 00.0.0	[1 00.0.0]	56.2.0	4 <sup>1</sup> 56 <sup>1</sup> .2.0	<i>ì-lí</i> -URU <sup>ki</sup>
5	4 37.3.2		[ ]	4 37.3.2	4 37.3.2 <sup>1</sup>	<sup>d</sup> UTU- <i>ki-ma</i> - <sup>1</sup> <i>ap</i> -[ <i>u</i> ]

*iš-tu* 2<sup>1</sup>3.1.4 <sup>1</sup>ERÉN <sup>d</sup>UTU-*ki-ma-ap-lu*<sup>1</sup>

rev.

1	19 36.0.2	8 01.0.0	4 <sup>1</sup> 34.3.4, 5	7 00.1.3, 5	19 36.0.2	
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*iš-tu* ŠE.GUR LÚ.NE.X

ù 2<sup>1</sup>3.1.4 GUR<sup>1</sup> ERÉN <sup>d</sup>UTU-<sup>1</sup>*ki-ma-ap-lu*<sup>1</sup>

ITI BÁRA.ZAG.GAR UD.7.KAM

5 MU <sup>d</sup>*ri-im*-<sup>d</sup>SUEN LUGAL

<sup>6</sup> MU.BI.IM is also the final column heading of the OB mathematical table Plimpton 322 (Robson 2001).

*Translation*

oby.

1	Grain available	For Ur	For ...	For <i>Larsa</i>	Total	Its name
	5 01	5 01			5 01	Lipit-Suen
	5 01		3 34;45	1 26;15	5 01	Nur-Dagan
	4 56;24	3 00	[1 00]	_ 56;24	4 56;24	Ili-alim
5	4 37;40		[ ]	4 37;40	4 37;40	Šamaš-kima-aplu

from which 23;20 gur (are for) Šamaš-kima-aplu's labourers.

rev.

1	19 36;04	8 01	4 34;45	7 00;19	19 36;04	
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From which grain for Lu-.....

and 23;20 gur for Šamaš-kima-aplu's labourers.

Month I, day 7

Year of Rim-Sin the king (Rim-Sin year 1)

All other known tabular accounts from the early years of Rim-Sin's reign are headed too, have at least one, more often two axes or levels of calculation, and often include linear notes (Table 4). The fully functional table has arrived—not only in the kingdom of Larsa but in Isin and Uruk too.

*Table 4: Dated tabular accounts from early in the reign of Rim-Sin*

<i>Publication</i>	<i>Museum no.</i>	<i>Provenance</i>	<i>Cols</i>	<i>Hdgs</i>	<i>Or</i>	<i>Axes</i>	<i>Notes</i>	<i>Year</i>	<i>Date</i>
<i>YOS</i> 5 103	YBC 4721	Ur or Larsa	6	M	L	H1 V1	L	RS 1	1822
<i>OECT</i> 15 10	Ash 1922.281	Larsa?	3	M	P	V2	L	RS 1	1822
SaMü 1991: 156 W20472,88		Uruk	3	O	P	V2	L	Anam a	1821-17
SaMü 1992: 167 W20472,87		Uruk	3	O	P	H1 V1		Anam a	1821-17
<i>PBS</i> 8/1 34	CBS 15167	Nippur	6+	Y	L	H?		RS 5	1818
SaMü 1992: 168 W20472,121		Uruk	6	O	L	H1 V1+	L	Irda-nened	1816-10
<i>YOS</i> 5 196	YBC 6209	Ur or Larsa	7	O	L	H1 V1	L	RS 10	1813
<i>UET</i> 5 647	U 17216	Ur	3	M	–	V2?	L	RS 16	1807
<i>PBS</i> 8/1 13	CBS 15173	Nippur	8	Y	P	V1	LC	Di 13	1804
<i>UET</i> 5 857	U 7802G	Ur	5	O	–	H1 V <sup>1</sup>	L	RS 23	1800
<i>PBS</i> 8/1 36	CBS 15171	Nippur	5	–	P	V <sup>1</sup>	L	RS 24	1799
<i>PBS</i> 8/1 33	CBS 15174	Nippur	4	I	P	V2	L	RS 26	1797
<i>OECT</i> 13 87	Ash1924.1036a	Larsa area?	3	O	P	V1		RS 27	1796

SaMü = Sanati-Müller (1991-93).

*OECT* 15 10 account of workers and grain, grouped by ethnicity (?): vertical addition with subtotals and totals.

SaMü 1991:156 account of oil delivered by merchants (final column heading *dam-gàr-me-eš*), with column for silver value unused. Vertical subtotals according to oil type (*ì-giš*, *ì-šaḥ*), when silver equivalent is calculated: 8 sila per shekel of vegetable oil, 12 sila per shekel of animal fat. Total silver equivalent at end of document.

SaMü 1992:167 account of rams and their silver equivalents (calculated); delivered by merchants (column heading blank). Totals of each given.

*PBS* 8/1 34 account of deliveries. Commodities unspecified, but units change from *ma-na* to *sila* near bottom of obverse. No vertical totalling; horizontal structure not clear.

SaMü 1992:168 account of four different types of ovid totalled for plucking (final column heading, *zú-si-ga-ku<sub>4</sub>-ra*). Totalled horizontally by shepherd, for whom the total hair/wool is also totalled, and yield per ovid calculated, within linear comments. Columnar totals, if there were any, are now missing from the damaged reverse of the tablet.

*YOS* 5 196 account 6 types of ovids, *ŠU.NIGÍN* 'total' as last column heading. Interlinear notes give names of shepherds. Column totals at bottom, grand total on reverse in prosaic summary. Wool/hair total given too but not tabulated.

*UET* 5 647 no horizontal calculations. Appears to be subtotal in line 9 before interlinear note *UGULA* [+ PN?]. First headings to the two numerical columns apparently identical: unclear.

*PBS* 8/1 13 tabular offering account, like *sattukkum* archive. Commodities in tiny illegible signs over numerical columns at top of table. Interlinear summary comments assigning lines above to individual temples. Totals for each commodity given in non-tabular form on reverse.

*UET* 5 857 account of canal repairs. Columns all numerical, with interlinear notes assigning entries to particular locations (including *Nirda* and *Kurhianum* (see *OECT* 15 7, Table 6). Calculates volume of canal horizontally from dimensions, with notes in last column as to whether finished or not. Total length given in non-tabular summary on reverse.

*PBS* 8/1 36 fragmentary account of *sattukkum* offerings. Totals given prosaically on the edge, with interlinear notes assigning lines above to individual temples.

*PBS* 8/1 33 account of *sattukkum* offerings. Totals of three types of sheep and grand total given at bottom of table. Interlinear comments ascribe days of the month to the entries above.

*OECT* 13 87 account of *sattukkum* offerings. Totals given outside tabular formatting on reverse.



*The later years of Rim-Sin's reign*

Towards the end of Rim-Sin's reign we start to find clusters of tablets showing how the minutiae of tabular formatting could vary over a matter of days or months within single archive (Table 5). At the same time, there is striking cross-archive consistency in formatting: the final heading of all these accounts is MU.BI.IM and there is a heavy preponderance of landscape orientations.

*Table 5: Dated tabular accounts from the last years of Rim-Sin*

<i>Publication</i>	<i>Museum no.</i>	<i>Provenance</i>	<i>Cols</i>	<i>Hdgs</i>	<i>Or</i>	<i>Axes</i>	<i>Notes</i>	<i>Ruler</i>	<i>Date</i>
Ro fc. 1	Col P 292	Larsa	8	M	L			RS 31	1792
Ro fc. 2	Col P 286	Larsa	8	M	L			RS 31	1792
Ro fc. 3	Col P 314	Larsa	5	M	L			RS 31	(1792)
Ro fc. 4	Col P 291	Larsa	5	M	L			RS 31	1792
Ro fc. 5	Col P 324	Larsa	4	M	L	H1 V1		RS 31	(1792)
Ro fc. 6	Col P 287	Larsa	7	M	L	H1 V1	L	RS 31	1792
Ro fc. 7	Col P 288	Larsa	8	M	L		L	RS 31	1792
Ro fc. 8	Col P 289	Larsa	5	M	L		L	RS 31	1792
Ro fc. 9	Col P 293	Larsa	5	M	L		L	RS 31	1792
Ro fc. 10	Col P 290	Larsa	8	M	L		L	RS 31	1792
Ro fc. 11	Col P 294	Larsa	5	M	L		L	RS 31	1792
Ro fc. 13	BM 85260	Larsa area	4	M	P	H1 V2	L	RS 31	1792
Ro fc. 14	BM 85269	Larsa area	4	M	P	H1 V2	L	RS 31	1792
Ro fc. 15	BM 16391	Larsa area	7	M	L	H2 V1		RS 32	1791
Ro fc. 16	BM 85232	Larsa area	7	M	L	H2 V1		RS 32	1791
TLB 1:55	LB 1075	Larsa area	3	M	L	H2	L	RS 39	1784

Ro fc. = Robson (forthcoming).

TLB 1:55 account of beer bread and salt, listed by city. Two groups of entries are subtotalled and the second amount taken away from the first: the earliest subtraction attested in tabular accounts.

The Columbia tablets are all daily allocations of cattle feed to a small group of cowherds over the space of a few months (discussed in detail by Robson forthcoming). The same four men are accounted for in each of the first group, another three in second. The accounts of the first group vary as to whether columns for deficits in three commodities (grain, bran, straw) are given—sometimes they are marked in even when

empty. They record no calculations at all, except in the undated tablet Col P 324 associated with them, which totals the number of oxen (GUD) and cows and calves (ÁB.AMAR) allocated to each man. The second group, which covers the same time period, uses linear interpolations to assign each cowherd to a deity: Enlil, Šamaš or Suen. Otherwise the content and formatting is identical to the first group, with columns for deficits sometimes included and left blank, sometimes omitted. The undated tabular account *UET* 5 46 (Table 8; Robson forthcoming) is very similar in content and format, but with different personal and divine names. One tablet, Col P 287, subdivides the cattle into oxen (GUD) and cows and calves (ÁB.AMAR) with totals and a grand total.

The BM tablets, almost exactly contemporaneous with the Columbia group, calculate work allocations (*šerʾānum*) for a dozen or so named workers. The two four-column tables compare the work days owed with the work days done, calculating the totals and differences for each individual, each group assigned to a particular property (NÍG.ŠU PN) or to the royal share (ĤA.LA LUGAL), and a grand total. The two seven-column tablets take identical data but also calculate the volume of earth worked by each worker using the theoretical constant  $1\frac{1}{2}$  shekels, rather smaller than those found in Old Babylonian mathematical problems on labouring for earthworks (cf. Robson 1999: 98-109; 157-61). On these tablets the workers are not grouped or subtotalled, but a total for each column is given at the bottom of the table.

A further group of three undated tabular accounts from the Larsa area is probably contemporary with these tablets (*TLB* 1 52-54; Table 8). All account for disbursals of grain, but whereas two are organised by day across the columns (UD.1, UD.2, UD.3, ŠU.NIGÍN, MU.BI.IM) with personal names in the final columns and totals in the final row, the third has days in the row labels and ration types (cultic meal, palace subsistence, ..., donkey fodder) in the column headings—the earliest attested tabular account to be structured chronologically like this (Example 8: LB 1095 = *TLB* 1 54).

*Example 8: LB 1095*

<i>na-ap-ta-nu-um</i>	ŠUKU É	A [...]	ŠÀ.GAL ANŠE	ŠU.NIGÍN	MU.BI.IM
2 ŠILA	0.0.2, 1 ŠILA	0.0.2	0.0.1	0.0.5, 3 ŠILA	UD.3.KAM
2 ŠILA	0.0.2, 1 ŠILA	0.0.1,9 ŠILA	0.0.1	0.0.5, 2 ŠILA	UD.4.KAM
8 ŠILA	0.0.2, 1 ŠILA	0.0.1,6 ŠILA	0.0.1,5 ŠILA	0.1.0 ŠE	UD.5.KAM
0.0.1	'0.0.2, 1 ŠILA'	9 ŠILA	0.0.1,5 ŠILA	0.0.5, 5 ŠILA	UD.6.KAM

*The mid-Old Babylonian period*

Over the following thirty years further formatting innovations took place, so that tabular accounts post-dating Hammurabi's conquest of Larsa typically resemble Ash 1922.290 (Example 2), with two or three levels of calculation and plenty of interlinear comments (Table 6). Theoretical constants continue to be used. Of particular interest is a group of accounts from Hammurabi's reign estimating the yield of fields (NÍG.GAR, *šukunnûm*) in small settlements in the Larsa area which uses yield rates of between 10 and 40 GUR per BÛR. The undatable accounts *OECT* 15 15. 16. 122. 134 (Table 8) have an identical format and must originate in the same archive (Robson *fc.*) The accounts in this group almost all use long introductory preambles to describe the contents of the table (Example 9; *OECT* 15 121), as does a slightly later account of fish, also from the Larsa area. One tabular account from Larsa also doubles as a legal document, with witnesses and seals (Robson forthcoming: 27).

*Example 9: Introductory preamble to Ash 1923.340*

obv. 1 *šu-ku-un-na* A.GÀR *a-a-ni-a-tim* ù A.GÀR DAM *la-ga-nu*  
 A.ŠÀ É <sup>d</sup>NANNA ù AGA.ÚS.MEŠ *ša* AB.SÍN *iš-ta-ad-du*  
 URU *šu-un-na-mu-un-dím*<sup>ki</sup>  
 GÚ ÍD *al-bi-an-na* BAL.RI A.A.BI

obv. 1 Estimated yield of the Ayaniatim meadow and DAM laganu<sup>2</sup> meadow.  
 Fields belonging to Nanna's temple and to soliders, in which cultivation has been abandoned  
 Sunnamundim town  
 On the banks of Albianna river on the opposite bank to the marshes.

*Table 6: Dated tabular accounts from the reigns of Hammurabi and Samsu-iluna*

<i>Publication</i>	<i>Museum no.</i>	<i>Provenance</i>	<i>Cols</i>	<i>Hdgs</i>	<i>Or</i>	<i>Axes</i>	<i>Notes</i>	<i>Year</i>	<i>Date</i>
<i>OECT</i> 15 7	Ash 1922.277	Larsa	4	I M	P	V3	L	Ha 35	1758
<i>OECT</i> 15 12	Ash 1922.283	Larsa	5	I M	–	H1+	L	Ha 35	1758
<i>OECT</i> 15 121	Ash 1923.340	Larsa	9	I M	L	H2 V1		Ha 35	1758
<i>TCL</i> 10 151	AO 8385	Larsa	4	I O	P	H1 V1	L	Ha 35	1758
Ro <i>fc.</i> 26	BM 85205	Larsa	6	I M	L	H1 V1	L	Ha 35	1758

Ro fc. 27	BM 22738	Larsa	10	O	L	H2		Ha 35	1758
<i>TCL</i> 10 166	AO 6408	Larsa	4	M	P			Ha 38	1754
<i>TCL</i> 10 159	AO 8423	Larsa	6	M	L	H1		Ha 38	1754
<i>TCL</i> 10 171	AO 8425	Larsa	5	M	P	H2 V1	L	Ha 39	1753
<i>PBS</i> 8/2 126	CBS 7185	Nippur	4	M	P	H1		Ha 41	1752
<i>YOS</i> 12 56	YBC 7252	–	7	M	P	H V1	L	Si 2	1748
<i>VAS</i> 18 103	VAT 8400	–	3	M	P	–	L	Si 2	1748
<i>CT</i> 45 32	BM 80169	Sippar	12	M	S	V1	C	Si 2	1748
<i>YOS</i> 12 101	YBC 7075	–	4	M	P	H1 V1	L	Si 3	1747
Scheil 1918	HE 113	Larsa	4	I M	P	H1 V1		Si 6	1744
Ro fc. 28	BM 85211	–	7	O	P	H2 V2	L	Si 7	1743
Ro fc. 29	BM 85238	–	7	O	P	H2 V2	L	(Si 7)	(1743)
Ro fc. 30	BM 13934	–	4	M	L	H1 V2		Si 11	1739

Ro fc. = Robson (forthcoming).

*OECT* 15 7 inspection of estimated yields (*šukunnu*) of fields in Nirda and Kurḫianu (Robson forthcoming: 17). Running totals of cultivated land (A.ŠA AB.SÍN), its grain (ŠE.BI) and unsown land (AB.SÍN ŠE NU) belonging to the palace and temple, with grain subtracted (in interlinear comments) for the ENSÍ.

*OECT* 15 12 fragmentary account of estimated yields of fields in Iazilum and Iakinku (Robson forthcoming: 18). For each cultivated field (A.ŠA AB.SÍN) a theoretical yield rate (NÍG.GAR) is used to estimate the yield (ŠE.BI). Uncultivated land is also noted (AB.SÍN NU).

*OECT* 15 121 account of estimated yields of fields in Šunnamundim (Robson forthcoming: 19). The account is divided horizontally between palace property (NÍG É.GAL) and the property of Nanna's temple (NÍG É.<sup>d</sup>NANNA). For each cultivated field (A.ŠA AB.SÍN) a theoretical yield rate (NÍG.GAR) is used to estimate the yield (ŠE.BI). In each case the column for unsown land (ŠE NU) is blank. Some of the totals at the bottom of the account are erroneous.

*TCL* 10 151 account of estimated yields of fields in Ukua (Robson forthcoming: 20). For each field (A.ŠA) a theoretical yield rate (NÍG.GAR) is used to estimate the yield (ŠE.[BI]). Uncultivated land is not noted. The heading of the final column listing personnel reads [...] A.GAR 'meadow'. Final totals are in the summary, outside the tabular format.

Ro fc. 26 account of fields assigned to various people (in column headings) and to towns (row labels and interlinear notes). Areas totalled horizontally and vertically.

Ro fc. 27 account of harvest shortfalls in date harvests at Ili-ištikal over two years (Ha 33 and 34, in fifth and final column heading). For each year the yield of the orchards are calculated at 12 GUR per IKU. (Small) payments and (large) deficits are recorded for each owner and cultivator. The account is witnessed and sealed by the town elders, who promise to pay back the crown the dates it is owed.

- TCL* 10 166 tabular list of garment allocations to named individuals.
- TCL* 10 159 account of date orchards in Ea-Šulgi with only one line of data in the table.
- TCL* 10 171 account of estimated yields of fields in Ea-Šulgi (Robson *fc.*:21). For each cultivated field ([A.ŠÀ AB].SÍN) a theoretical yield rate (NÍG.GAR) is used to estimate the yield (ŠE.BI), which is then halved (ŠU.RI.A.BI). Column totals are given at the bottom of the table.
- PBS* 8/2 126 account of grain assigned to individuals. If the balance (Ì.SÁ) is below 4 GUR the deficit (LÁ.Ì) is recorded; otherwise a surplus (DIRIG) may be shown.
- YOS* 12 56 Grain account over three years (Ha 42, Si 1, Si 2).
- VAS* 18 103 fragmentary account of deliveries (MU.TÚM) and deficits (LÁ.Ì) from Ha 38 to Si 1.
- CT* 45 32 Account of baked bricks over days 6 to 15 (UD.6-UD.15) in column headings, all entries for days 12 onwards blank. On some days the workers are recorded as NA.GADA 'shepherds'. Grand totals for obverse and reverse are recorded separately in non-tabular format, where the daily work rate is explicitly stated to be ÉŠ.GÀR LÚ.1.E 20 SIG<sub>4</sub> AL.ÛR.RA.
- YOS* 12 101 Account of grain deliveries and deficits.
- Scheil 1918 Account of sea fish (KU<sub>6</sub>.HIA A.AB.BA), their price (KÛ.BI) and market rate per shekel of silver (GANBA *a-na* 1 GÍN). The different types of fish are listed in the final column. Some are counted, others sold by capacity measure. The total amount of silver is given in the non-tabular summary at the end.
- Ro *fc.* 28 and 29 two versions of the same account, with the same data in slightly different formats. Lengths, upper widths, widths, depths, and two types of volume (UŠ, SAG AN, SAG, GAM, SAḤAR, SAḤAR.HI.A) assigned to various people. The first volume is calculated from data in the first four columns; the derivation of the second is unclear. Subtotals and totals of lengths and the second volumes are given in linear format.
- Ro *fc.* 30 account of grain lost between the threshing floor (SAG.NÍG.GA *ra-bi-su*) and delivery at the warehouse (MU.TÚM É.KIŠIB.BA): deficits (LÁ.Ì) are recorded for various days of the month. Subtotalled by temple and totalled at the end of the account.

### *The late Old Babylonian period*

By the reigns of Ammi-ditana and Ammi-šaduqa tabular accounts had become much less complex (Table 7). Extant examples tend to have fewer columns and are no longer used for horizontal calculations. Vertical totals are typically given in the final, non-tabular summary but tabular lists, with no calculations at all, now account for a quarter of the known corpus. Introductory titles remain common, and often replace

column headings. MU.BI.IM remains the most frequent final column heading, even when its contents are not necessarily personal names. The use of interlinear comments, however, declines. The latest attested OB tabular account is from about three decades before the last known documents of the period.

*Table 7: Dated tabular accounts from the reigns of Ammi-ditana and Ammi-šaduqa*

<i>Publication</i>	<i>Museum no.</i>	<i>Provenance</i>	<i>Cols</i>	<i>Hdgs</i>	<i>Or</i>	<i>Axes</i>	<i>Notes</i>	<i>Year</i>	<i>Date</i>
Ri 2002:3.13	BM 78306	Sippar	3	M	P	V1	–	Ad 5	1679
<i>CT</i> 45 48	BM 78182	Sippar	4	Y D	P	V2	L	Ad 8	1676
Ri 2002:3.01	BM 13168	Sippar	3		P	V	–	Ad 13	1671
Ri 2002:3.02	BM 86439	Sippar	3	M	P			Ad 36	1648
Ri 2002:3.02	BM 79967	Sippar	6	M	L		–	Aš 3	1644
Ri 2002:3.02	BM 78720	Sippar	3	O	L	V2	C	Aš 4	1643
<i>BBVO</i> 1 106	–	Larsa	3	O	P	V1		Aš 10	1637
Ri 2002:3.12	BM 79959	Sippar	3	I	L	–		Aš 10	1637
Ri 2002:3.02	BM 16543	Sippar	4	I M	P			Aš 13	1634
Ri 2002:3.02	BM 79075	Sippar	3	I	R			Aš 13/17	1634
Ri 2002:3.12	BM 79930	Sippar	3	I	L	V2	L	Aš 14	1633
Ri 2002:3.12	BM 79951	Sippar	3	I	L	V		Aš 14	1633
Ri 2002:5.11	BM 79981	Sippar	3	I	P	V1		Aš 14	1633
Ri 2002:3.01	BM 86452	Sippar	4	M	P	–		Aš 15	1632
Ri 2002:3.07	BM 79788	Sippar	7	I M	L	V1		Aš 16	1631
Ri 2002:3.07	BM 79956	Sippar	7	I M	L	V1		Aš 16	1631
Ri 2002:3.01	BM 79010	Sippar	4	I M	P	V1	L	Aš 17	1630
Ri 2002:3.12	BM 79485	Sippar	4	I M	P	V2	L	Aš 17	1630
<i>YOS</i> 13 182	MLC 721	–	3	M	P			Aš 18	1629
<i>CT</i> 45 61	BM 80627	Sippar	3	M D	L	V2	L	Aš 21	1626

Ri 2002 = Richardson (2002).

BM 78306 fragmentary account of beer, with column totals in tabular format at the bottom.

BM 78182 fragmentary account of three commodities, subtotaled and totalled. Tabular formatting breaks up two-thirds of the way down the obverse.

BM 13168 fragmentary account of two types of grain.

BM 86439 tabular list of wool and silver; no calculations.

BM 79967 fragmentary tabular list, perhaps of days worked. Most of the column headings are missing; no calculations survive.

BM 78720 account of land, in which the columnar formatting, with headings UŠ, SAG, A.ŠĀ A.GÀR MAR.TU, is adapted to accommodate upper and lower

widths (UŠ AN.TA, UŠ KI.TA, SAG AN.TA, SAG KI.TA, written as notes within the table). The average length and width are entered in each column and the area of the field recorded in non-tabular format.

BBVO 1 106 account of silver and men. Silver totalled at the end in non-columnar format.

BM 79959 account of rations, with PNs in final two columns. No calculations survive.

BM 16543 fragmentary tabular list of days worked; no calculations survive.

BM 79075 tabular list of days worked.

BM 79930 account of two types of grain rations, subtotalled by column and totalled at the end of the table.

BM 79951 account of grain, with PNs in two columns. Totals in non-tabular format at the end of the account, somewhat damaged.

BM 79981 account of wages and rations; totals in non-tabular format at the end of the account.

BM 86452 account of grain, silver, and beer. No horizontal calculations; presumably columnar totals at the end of the account, now missing.

BM 79788 tabular list of fabrics produced, with days (UD.4.KAM etc.) in the column headings and PNs in the row labels.

BM 79956 tabular list of work days, with days (UD.4.KAM etc.) in the column headings and PNs in the row labels.

BM 79010 account of silver, oil, and animal fat assigned to individuals, with occasional damaged interlinear comments. Commodity totals at the end of the account in non-tabular format.

BM 79485 account of rations, listed by month (in the column headings) assigned to female PNs. Columnar subtotals and perhaps a total in the damaged non-tabular summary at end of the account.

BM 79485 account of two types of animal, for UD.10.KAM and UD.20.KAM, subtotalled by UGULA.MAR.TU and totalled at the end of the account, in non-tabular format. Dead specimens are noted interlinearly after the subtotals and subtracted from the account; a separate total is given for them in the final summary.

#### *After the Old Babylonian period*

The heyday of the cuneiform tabular account was not in fact the 18<sup>th</sup> century BC, despite the evidence presented so far. That accolade goes to Nippur in the 14<sup>th</sup> and 13<sup>th</sup> centuries, where a full third of the six hundred-odd surviving administrative records are in tabular format (*BE* 14-15; *PBS* 2/2; *TMHNF* 5). Showing a remarkable structural similarity with tables from the time of Hammurabi and Samsu-iluna, many of them have introductory preambles, column headings of which the last

is MU.BI.IM over the row labels. Calculations, of which there may be several levels, are organised horizontally from left to right and vertically from top to bottom. They are deserving of an in-depth structural study.

For the first millennium the evidence is much scarcer. The few Neo-Assyrian tables tend rather to be tabular lists, with no horizontal axis of calculation and rare columnar or summary totals.<sup>7</sup> A large, headed tabular account from Sultantepe (*STT* 1 47) with fourteen columns and at least three levels of horizontal calculation and two vertical shows that Neo-Assyrian scribes could and did use tabulation very effectively; but it is likely that they mostly used waxed writing boards to do so.

The evidence from Babylonia comes primarily from the Eana temple in Uruk. A dozen tabular lists with two to six columns record animals sacrificed during the reigns of Nebuchadnezzar and Nabonidus in the first half of the 6<sup>th</sup> century BC (Beaulieu 2003). A headed table from 559 BC records the growth of Eana's flocks over the past decade (van Driel and Nemet-Nejat 1994). There are two levels of horizontal calculation over its 11 columns and a very complex vertical layering of running additions and subtractions, with perhaps three or four levels of calculation. Not surprisingly, there are cumulative numerical errors. Forty-odd four-column tabular lists of *sattukku*-offerings span the reigns of Nabonidus to Cambyses, 551-525 BC (Robbins 1996). All have introductory preambles, in six variants, but only four are headed or partially headed. No doubt there are more tabular accounts from the first millennium, both published and unpublished, which would fill out the picture of tabulation in the cuneiform record. For instance, there are copies of over sixty tabular accounts in CT 55-57 among the tablets from the E-babbar temple in Neo-Babylonian Sippar.

### *Conclusions*

The use of tabular formatting in the cuneiform record was fitful and patchy. After two false starts in the Early Dynastic and Ur III periods, tabulation became recognised as an efficient way of recording, storing, and sorting data only in the mid-19<sup>th</sup> century BC:

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<sup>7</sup> *E.g.*, CTN 2 125. 139; CTN 3 98. 107. 110. 111; SAA 7 116. 132. 137-139. 157; SAA 11 80-82. 126. 223.



- It enabled the horizontal separation of different categories of quantitative information associated with named individuals, from around 1850 at the latest (Table 3).
- This led to easy addition of quantitative data, along a vertical axis, by at least 1837 (Table 4).
- At the same time, data could be sorted by criteria such as destination, or date of transaction.
- Headings, attested first in the E-šumeša archive and then regularly after about 1822, obviated the necessity to repeat descriptive information.

When columns of derived data were introduced, again from at least 1822, they enabled calculations to be performed along both horizontal and vertical axes for the purposes of double-checking. At the same time, the columnar format could be ignored where necessary to provide note-like explanatory interpolations. It was at this point, arguably, that tables became truly powerful information processing tools, cognitively distinct from well-organised lists. Their evolution, it appears, took no more than thirty years.

Thereafter further refinements were made and uses found:

- From the 1790s standard calculation constants (for work rates, harvest yields, market rates) were used in tables to *make predictions* as well as to record events that had already happened.
- From the 1750s tabular accounts could function as legal records, with witnesses and seals.
- At the same time, introductory preambles added transparency to complex tables, especially when multiple levels of calculations were made.

These further developments, including horizontally organised calculations, appear on present evidence to have been exclusive to the south. Late OB tabular accounts from the Sippar area show much less complexity and are predominantly vertical in calculational structure. Tantalisingly, the format and structure of Kassite tabular accounts from Nippur suggest a direct line of descent from the mid-OB period.

What drove the development of tabular documents?

My initial hypothesis, before I started to collect the data, was that tables would somehow be linked to, or come out of, the development of the sexagesimal place value system in the 21<sup>st</sup> century BC. The meagre evidence of the Ur III period points suggestively in that direction, but much more is needed before this untested proposition can be confirmed or refuted.

I also wondered whether tables were related somehow to language change, but I can see no obvious correlation so far. Partly this is because the tables have a high density of numerical notations, logograms, and personal names. The prosaic explanatory interpolations, attested from 1822 onwards, are all in Akkadian; maybe this is relevant.

The use of tables does not seem to be imposed from political centres, as the pattern of use in the E-šumeša archive shows (Table 2). The only other possible motivation I can suggest is individual, or at least bureaucratically internal, innovation driven by a desire for efficiency and accuracy. This of course is a highly speculative proposal, but it is nevertheless clear that tables were *not* the accounting method of choice for most scribes of the Old Babylonian period. Excluding the E-šumeša archive, less than 1 percent of the published tablet copies I searched through showed tabular formatting. Even allowing for under-representation in the dataset, as outlined in the introduction, tabular accounts can never have accounted for more than about 5 percent of OB institutional archives—and had no place at all in family records. Prosaic document formatting continued to be the norm, even for complex multi-commodity, multi-personnel annual accounts.<sup>8</sup>

Much remains to be done on the topic of tabulation—in lexical and scholarly works as well as the administrative record. I hope that this brief sketch will provide a preliminary framework for further and deeper exploration of this fascinating thread in the history of literacy, numeracy, and cognition.

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<sup>8</sup> *E.g.*, YBC 7478 (*YOS* 5 208), an annual account of two shepherds' flocks from Larsa, RS 11 (1812 BC), or CBS 7197 (*PBS* 8/2 134), from Nippur, an account of fields to be harrowed and sown, Si 21 (1729 BC).

*Appendix**Table 8: Undatable tabular accounts from the Old Babylonian period*

<i>Publication</i>	<i>Museum no.</i>	<i>Provenance</i>	<i>Cols</i>	<i>Hdgs</i>	<i>Or</i>	<i>Axes</i>	<i>Notes</i>	<i>Date</i>
BBVO 1 94	–	Larsa	4		P	H1 V	L	
<i>BiMes</i> 7: Ki 46	Ist Ki 46	Kish	3+	O	–	–		
CT 45 81	BM 78212	–	4	I D	P	V?		
CT 45 85	BM 78211	–	7	M	L	V1	C	
CT 45 97	BM 80432	–	5	Y	L	H1		
CT 45 100	BM 78303	–	3		P			
CT 45 107	BM 78349	–	3	I M	L	V		–
CT 45 108	BM 78331	–	4		P			
CT 45 116	BM 80211	–	3		P			
OECT 13 28	Ash 1924.534	–	4+	–	–	–	L	–
OECT 13 91	Ash 1924.1046	–	3	O	P			
OECT 13 205	Ash 1931.139	–	4	–	P			
OECT 15 1	Ash 1922.166	–	11+	–	P	H V	L	–
OECT 15 2	Ash 1922.172		4	–	–	H V	L	
OECT 15 3	Ash 1922.173		5	–	P	H V	L	–
OECT 15 5	Ash 1922.180	–	18	–	–	H V	L	–
OECT 15 7	Ash 1922.278	Bad-Tibira	34	V	L	H1 V1	C	
OECT 15 15	Ash 1922.286	Larsa	4	–	P	H1 V	L	–
OECT 15 16	Ash 1922.287	Larsa	5	–	P	H1 V	L	–
OECT 15 18	Ash 1922.290	Larsa	8	Y	P	H V	L	
OECT 15 71	Ash 1922.346	Larsa	3	O	R	–	–	–
OECT 15 122	Ash 1923.341	Larsa	5	–	P	H V	L	–
OECT 15 132	Ash 1923.365	Larsa	3	Y	P	V		M
OECT 15 134	Ash 1923.375	Larsa	5	–	P	H V	L	–
OECT 15 230	Ash 1932.266		3	O	P			
OECT 15 240	Ash 1932.279		10	M	L	H		
OECT 15 262	Ash 1932.389		3	–	P	–		–
PBS 8/1 75	CBS 11313	Nippur	3		S	V1		M
Ri 2002:3.01	BM 96955	Sippar	4	–	P	–		–
Ri 2002:3.05	BM 81021	Sippar	4	M	L	H	C	
Ri 2002:3.07	BM 79965	Sippar	5	I M	P	V1		
Ri 2002:3.12	BM 79765	Sippar	5	–	P	–		–
Ri 2002:7.151	BM 96969	Sippar	4	–	P	–		
Ro fc. 12	Col P 323	Larsa	4	M	L	H1 V1		
SaMü 1993:199		Uruk	4	–	P	H1		
TCL 11 236		Larsa	5	O	L	V2		
TCL 11 244		Larsa	4	M	P			
TCL 11 247		Larsa	3	Y	S	V1		

<i>TCL</i> 11 249		Larsa	4	M	P		M D
<i>TLB</i> 1 52	LB 2055	Larsa	5	M	P	H1 V1	M
<i>TLB</i> 1 53	LB 1024	Larsa	4	–	P	H1 V1	M
<i>TLB</i> 1 54	LB 1095	Larsa	6	M	L	H1	
<i>UET</i> 5 468	–	Ur	4	M	P	H1 V	
<i>UET</i> 5 515	U 8806d	Ur	4	–	S	V1	M D
<i>UET</i> 5 573	U 11519	Ur	7+	Y	–	H V	–
<i>UET</i> 5 846	U 16061n	Ur	5	M	L	H1 V1 L	
<i>UET</i> 5 875	U 7735	Ur	11	M	L		C
<i>VAS</i> 18 83	VAT 7874	–	3	–	P	V1	
<i>VAS</i> 18 102	VAT 5801	–	4	M	P		L
<i>YOS</i> 5 102	YBC 4740	Ur or Larsa	4	–	P	H1 V? L	–

M = month; D = day, Ri 2002 = Richardson (2002); Ro fc. = Robson (forthcoming); SaMü 1993 = Sanati-Müller (1993).

*BBVO* 1 94 very long grain account, in which the first column is the sum of the second and third. Interlinear comments with subtotals; final column damaged.

*CT* 45 116 the tablet was ruled into four columns but the entries for the first column consistently spill over into the second.

*OECT* 15 5 substantial fragment of large summary account of grain yields of different meadows.

*OECT* 15 7 small tablet with tiny columns; headings almost illegible. Final column gives meadow names.

*OECT* 15 15. 16. 122. 134 the same format as the estimated yield accounts from Ha 35 and 38 (Table 6), Robson (forthcoming: 22-25).

*OECT* 15 18 see Example 2.

*TLB* 1 52-54 see comments on the later years of Rim-Sin, above.

*UET* 5 515 tabular formatting starts after a line or two in prosaic format.

*UET* 5 648 tabular formatting stops a third of the way down the reverse of the tablet.

*UET* 5 846 account of cattle, very similar to the Columbia Plimpton tablets (Table 5).

*UET* 5 875 month names in column headings, PNs in row labels. Entries consist of day names plus NĪG.ŠU PN; most cells of the table are blank, including all of those for the last 5 months.

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