

Chapter 3

Literacy, numeracy and the state in early Mesopotamia

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INTRODUCTION

The intertwined origins of numeracy, literacy and the state in fourth-millennium Mesopotamia have been widely recognised for several decades now. Yet their exact relationship remains a matter of hot dispute. At one extreme, Denise Schmandt-Besserat (1992; 1996) argues that early literacy was no more than a bureaucratic accounting tool whose sole precursor was an increasingly complex and uniform system of clay counters, attested all over the Middle East from the eighth millennium BC. At the opposite pole, Jean-Jacques Glassner (2003) sees no role for numeracy in the origins of cuneiform, evidencing private and familial uses as well as institutional ones.¹

In this article I provide an interpretation that gives equal weight to numeracy and literacy, which I hope amounts to more than a simple compromise between the two sides. I argue that from about 6000 BC Neolithic villagers used simple geometric counters in clay and stone to record exchange transactions, funded by agricultural surpluses. As societies and economies grew in size and complexity, increasing strain was placed on trust and memory, driving both an increasing numerical sophistication and the invention of written signs for the commodities, agents, and actions involved in managing them in the late fourth millennium BC. Here I take the story beyond its usual endpoint, further arguing that this numerate, literate urbanism in turn pushed both literary and mathematical development, giving rise to the world's first supra-utilitarian mathematics and literature in the territorial kingdoms of southern Iraq over 4,000 years ago. I shall also argue that literature and mathematics were very closely intertwined in the ideology of Middle Bronze Age statehood and kingship.

The evidence presented here, collected and analysed by a vast range of scholars over the last 150 years, comes not only from the documents themselves – written on clay tablets in the long-dead Sumerian and Akkadian languages with a complex wedge-shaped script now called cuneiform – but also from other objects and relationships discovered through archaeological excavation in Syria, Iran, and Iraq. Covering the

period approximately 6000–1600 BC, this is necessarily far from an exhaustive survey; rather I have tried to exemplify each major development with evidence from one or two sites.

COUNTING WITHOUT WRITING IN THE NEOLITHIC MIDDLE EAST

There have been people living in the Middle East for at least 500,000 years, when Neanderthals occupied caves in the Zagros mountains of northern Iraq (Matthews 2000: 13–6*). Anatomically modern humans have inhabited the region for about 100,000 years (Matthews 2000: 17–22). From 15,000–10,000 BC² the slow process of sedentary settlement began, with “new aspects of social structure, such as architecture, burial, ritual paraphernalia and exchange networks [...] already well established features of human communities long before any fundamental alteration in subsistence strategies had occurred” (Matthews 2000: 52). Over the next few millennia, hunting and gathering gradually and patchily gave way to agriculture and then animal husbandry, but never entirely died out. By 7000 BC three domesticated cereals – barley, emmer wheat, and einkorn – were widespread. Hunting dogs were the first animals to be domesticated, probably even before the existence of agriculture. Sheep, goats, and then pigs, none of which are direct competitors for food eaten by humans, were exploited for meat and secondary products. Cattle were the last of the major domesticates to appear in the Middle East, some time after 6500 BC (Matthews 2000: 51–4).

As farming techniques became more efficient and cultivars higher yielding, the protection and equitable distribution of harvest surpluses also became increasingly necessary. It is in these circumstances that we first find recorded number, in the form of tiny ‘tokens’ made of clay or stone and shaped into simple geometrical forms – spheres, cylinders, cones, discs, and tetrahedra. They are found in villages and settlements all over the Middle East, from western Syria to central Iran. The very earliest evidence, from five early eighth-millennium BC sites in northern Syria and western Iran, predates both farming and the use of pottery in the region.³ Thereafter, Schmandt-Besserat (1992: 36–9) documents tokens at a dozen or more sites per millennium, from southeast Anatolia and the Levant to eastern Iran, right up until about 1500 BC, “tapering off in Mesopotamia in the third millennium BC while lingering longer in Syria and Iran” (Schmandt-Besserat 1992: 39). She argues for a regional system, in which the meanings of individual tokens were fixed across vast distances and time-spans (Schmandt-Besserat 1992: 164).

Of course, in many contexts small clay objects are very difficult to interpret: we have no way of knowing why prehistoric villagers might have made or kept them. For instance, Tell Abada was an early fifth-millennium site in the foothills of eastern Iraq, 80% excavated during rescue excavations in the 1970s and 80s preparatory to the construction of the Hamrin Dam (Jasim 1985; Jasim & Oates 1986). The village comprised some 10 large tripartite houses, each arranged around a central courtyard. Around 90 tokens were recovered from two phases of Building A, the largest of the settlement and in the centre of the site. All were found in seven discrete groups of four to 16 tokens in the western half of the building, mostly in bowls or jars but also in little heaps on the floor. Around half of the tokens were spherical, including a few with up to five notches in them; another third were roughly conical, the remainder discs and rods. Each cluster was composed of a mixture of shapes, ranging in size from a few millimetres to 5cm (Jasim & Oates 1986: 352–7). Not a single sealing or other remnant of administrative apparatus was found in the building (see below). As Jasim and Oates conclude,

“Although the context of the small clay tokens at Abada proves for the first time their mutual relevance, it does not indicate their actual purpose. The unusual numbers of infant burials found under Building A could suggest some religious significance, with the implication of a ritual function for the tokens. But an accounting use as genuine ‘calculi’ is equally plausible,

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and ... perhaps the most persuasive – though the two functions are not necessarily as distinct as our terminology implies.”

(Jasim & Oates 1986: 355)

Evidence for the function of tokens comes through particular types of archaeological context. A particularly clear example comes from Tell Sabi Abyad, a late Neolithic village on the Balikh river in north-central Syria which was destroyed by fire around 6000 BC (Akkermans & Verhoeven 1995; Akkermans 1996). Five densely clustered rectangular houses, composed of many small rooms, and four round ones, known anachronistically as *tholoi*, were uncovered in Dutch excavations at the so-called Burnt Village in 1991–92. Two houses and one *tholos* yielded clay tokens, carefully fashioned into simple geometric shapes. Buildings II and V were primarily used for storing and processing cereals, as witnessed by knee-high deposits of grain in some rooms and large numbers of grinding slabs, mortars and pestles in others. In each case, the tokens were found in just one or two rooms, where they had been carefully stored along with hundreds of clay stamp-sealings from bags, baskets, jars, and doors as well as a variety of other small stone, ceramic, and bone artefacts. *Tholos* VI was used for both storage cloth manufacture. None of the three constructions seems to have been inhabited domestically.

These sealings, amongst the earliest attested anywhere in the Middle East, were designed to stop unauthorised entry into whatever they marked, thus showing that people were storing and controlling access goods of high value. Although over 60 different designs of seal impressions are known at Sabi Abyad, suggesting that a large number of individuals were involved in the process, not a single actual stamp seal has been recovered. The excavators conclude that either the seals were made of perishable material such as wood or bone – or that the objects were sealed at some other place and came to Sabi Abyad through trade or exchange (Akkermans & Verhoeven 1995: 25). We should probably understand the tokens, so carefully stored with the sealings, as records of the transactions, but exactly which quantities and commodities they represented it is impossible to say. It is likely, however, that systematisation was local at best (Friberg 1994: 484). Particular shapes and sizes must have had particular meanings to the individuals involved in trade and storage at Sabi Abyad but, although the general signification of tokens was well understood across the region, the clusters of tokens could themselves be meaningfully deciphered only by someone who remembered the transaction they invoked.

NEW MANAGEMENT MEDIA IN CHALCOLITHIC TOWNS

The dramatic social and economic developments that took place across the Middle East during the fourth millennium BC have been collectively dubbed the “Uruk phenomenon” by the region’s archaeologists, after the enormous city of that name in southern Iraq (Collins 2000; Rothman 2001; Postgate 2002; Algaze 2004). We shall consider Uruk itself in the following section, but first let us examine the management of increasing social complexity in the Chalcolithic towns of northern Mesopotamia.

Hacinebi is situated in the foothills of the Taurus mountains in Anatolia, on a key crossing of the Euphrates river. Here the riverine trade which brought copper and timber to southern Iraq intersected with the overland caravan route which linked the eastern Mediterranean with the rest of the Middle East. It was excavated for six seasons in the 1990s by a team led by Gil Stein, whose aim was to explore the impact of the Uruk expansion on Chalcolithic culture (Stein (ed.) 1999; Stein 1999; 2001; 2002). In the first four centuries of its occupation (c.4100–3700 BC), Hacinebi already exhibited many key features of indigenous social complexity:

“What we see is the regional center for a small-scale, complex polity, perhaps something we could call a simple chiefdom, with hereditary élites, *a complex administrative technology*, advanced metallurgy, socioeconomic differentiation, long-distance exchange of raw materials and/or prestige goods, and a craft economy that combined household production with small-scale

specialisation by independent producers of ceramics and copper ornaments. In general, the economy seems to have been largely geared towards local consumption, although some surplus production must have been taking place to support the limited importation of exotic raw materials for use as prestige goods legitimating the existing social hierarchy.”

(Stein 2001: 279; *my italics*)

However, that ‘complex administrative technology’ was not, according to the evidence, a numerate one. Elegantly made, élite stamp seals were in use alongside cruder domestic ones to seal a wide range of portable objects with local clays, often in purpose-built store rooms (Pittman 1999; Blackman 1999; Stein 2001), but never in conjunction with tokens as at Sabi Abyad.

During the period c.3700–3300 BC life and society continued relatively unchanged across most of Hacinebi. However, the northeast corner of the site displays a radically different material culture, typical rather of Uruk and other settlements in the south of Iraq, over 700km away. Diagnostic finds include a wide range of locally made Uruk-style pottery, architectural decorative elements typical of Urukian public buildings, and personal ornaments (Stein 2001: 285–9; 2002: 151–2). And while the rest of Hacinebi continued, for the most part, to seal its surplus goods with local stamp seals, the Urukian colonists rolled cylindrical stone seals over both local and southern clays and stored tokens in sealed clay envelopes (Pittman 1999; Blackman 1999).

At Hacinebi, southerners came north to dwell alongside the local population in an economically and socially autonomous enclave, presumably set up to exploit local copper resources (Stein 2001: 299). But they also founded new settlements on the upper reaches of the Euphrates. Habuba Kabira South, for instance, was a walled town of about 10ha on a strategic bend of the Syrian Euphrates about 150km due south of Hacinebi, excavated in 1971–76 (Strommenger 1980). There is no doubt that communal living at Habuba was organised on a completely different scale to the Neolithic village of Sabi Abyad and even to the Urukian colony at Hacinebi. Inhabited for about 120 years some time between 3400 and 3000 BC, it was centrally planned and managed, with a grid system of paved and drained streets, and very regular architecture. Rations were distributed, here as at Uruk, the Hacinebi enclave and elsewhere, by means of mass-produced, standardised bowls. Urukian administrative technologies – cylinder seals and clay sealings, tokens and clay envelopes – were also ubiquitous. The 200-odd baked clay tokens display an unprecedented variety of shapes; over half were incised or otherwise marked before firing (Schmandt-Besserat 1992: 88–91). Two broken clay envelopes containing two and six tokens respectively were found in ‘the largest and most imposing house of the northern sector of the city’, along with other administrative debris including flat pieces clay impressed with both seals and token-like marks (Strommenger 1980: 64 fig. 58; Schmandt-Besserat 1992: 116, 136).

At both Habuba and Hacinebi we thus see the merging of counting and sealing technologies, with the invention of the sealed clay envelope in which clusters of tokens could be stored. Impressions of the tokens to be put inside were first made on the outside of the envelope, and the whole thing sealed – now with cylindrical seals that could cover the whole surface. But the redundancy in this system rapidly became apparent: why go to all the trouble of storing tokens when one has made tamper-proof records of them already? Thus recording quantities of objects took another step towards abstraction, as empty envelopes were flattened into flat tablets of clay, whose surfaces bore impressions of tokens and seals.

Even before writing, then, people from the southern alluvium were recording numbers of stored commodities to protect them from theft or to document transactions. Yet we probably should not call this activity mathematics, or even arithmetic, as there is no evidence yet of consistent number bases (Englund 1998: 51). Further, it was just as dependent on memorising the correlations between individual transactions and individual tablets as the Neolithic token system of Sabi Abyad. It was still not possible to record the objects of accounting, or the agents, circumstances, or types of activity. All that had

changed was the move from ephemeral clusters of tokens to permanent impressions of them in clay. Indisputably, though, it was the precursor of a system that became incredibly sophisticated and flexible when writing was thrown into the mix, somewhere in southern Iraq at about the time that Habuba Kabira was abandoned in the very late fourth millennium BC.

ACCOUNTING AND TRAINING IN THE FIRST CITY STATES

Throughout the fourth millennium increasing surplus wealth, managed through token technology, had driven a massive population growth in the region of southern Iraq, which was then a mix of fertile river plain and abundantly verdant marshes. Permanently dry land, fit for habitation, was hard to come by, so large settlements grew in single spots, gradually rising above the extraordinarily flat landscape on the accumulated rubble and rubbish of centuries. These increasingly large cities, with populations in the tens of thousands, were far too huge and impersonal to be run along the old lines of family, trust, and memory. Uruk itself had grown to 250ha in size by 3000 BC, with at least 280 further hectares of inhabited hinterland (Algaze 2004: 141). German excavators, working regularly at Uruk since 1928, have shown that its central administration, based in the monumental temple complex of some 30 hectares at the heart of the city, was supported by a strong religious ideology, expressed through imagery on objects large and small, focussed on the chief priest and the anthropomorphic deity he worshipped (Nissen 1986). Just as in the northern colonies, at Uruk excavators found tokens, sealings, clay envelopes and ration bowls all around the central religious precinct – along with some 5,000 proto-cuneiform tablets which had been thrown away after their useful life was over. Frustratingly, though:

“Archival information which might have been derived from the excavated Uruk [tablets] was in great part lost, due both to the record method of the excavators, but also and fundamentally to the fact that the archaic texts formed – seemingly without exception – part of the general debris of pottery shards, animal remains, etc, removed from administrative units of the central [temple] district Eanna and either deposited in trash holes or used as fill in constructions of walls and floors.”

(Englund 1998: 41)

Nevertheless, on internal grounds it is possible to isolate three stages of the tablets' development. “Numero-ideographic tablets” (Englund 1998: 51-5) are almost identical to those found at Hacinebi and Habuba that bear impressions of cylinder seals and tokens. But they are also marked with one or two signs, incised with a pointed tool, which ‘represent discrete objects (sheep, jugs of beer and dairy fats, strings of dried fruits, textile products)’ (Englund 1998: 53). These notations, so far attested only in the big cities of the south, are thus the first explicit record of the material objects of accounting. Many are clearly pictographic, schematically representing containers and the like; it is thus probable that the remainder are too, even if we cannot currently identify the objects signified or the conventions used to represent them.⁴

⁴In the following stage, known conventionally as ‘Uruk IV’, is hitherto known only in Uruk itself. These tablets, mostly unbaked and unsealed, exhibit a range of some 900 incised word signs and five different numerical systems for counting different types of commodity. They may record one or more transactions of a single type, whether income, expenditure, or internal transfer. The front side of a tablet may be divided into box-like cases, each of which records a separate item of account, typically with a total or other derived figure on the reverse (Englund 1998: 61). Analysis of the individual entries on the front, combined with summations on the back, has established that the same numerical signs could take different quantitative values, depending on what was being counted (Nissen *et al.* 1993: 25–9).

But for the first time it was not only the objects and quantities of account that were recorded, but also the human and institutional agents and the type of transaction involved (Englund 1998: 215). And unlike at Neolithic Sabi Abyad, where it seems that tokens were used to account for *traded* goods, here in Uruk the accountants dealt only in the domestic economy: fields and their crops, livestock and their products, and the temple personnel themselves. And once again accounting technology had undergone a concomitantly large shift in the invention of incised symbols, mostly pictograms, to represent the commodities, land and labour under central administrative control. Numbers, however, continued to be represented by impressions of tokens – and, crucially, this is how we can infer so confidently the function of tokens in prehistoric periods.

The mature stage of literate accounting at Uruk – also attested in smaller numbers in settlements across southern Iraq and southwest Iran – is conventionally known as ‘Uruk III’ and probably dates to a century or so around 3000 BC. The forms of the incised ideograms show much greater standardisation than the preceding Uruk IV stage, and have lost much of their pictorial quality. Document formats can be much more complex too, with ‘secondary’ accounts summarising and consolidating the contents of many ‘primary’ records, often over several years (Englund 1998: 61–4).

Take, for example, the brewing of beer, an essential staple for many societies with no reliable access to clean drinking water. In southern Iraq brewers used barley which had been processed in two different ways: malt, which involves soaking, germinating, and drying the barley grains; and groats, which are hulled and crushed barley grains. On the front of a typical ‘primary’ tablet four different types of beer, counted by the jug, might be allocated to several different officials, with the total for each beer given on the back. While individual objects were counted in groups of 10 and then 60, barley was accounted for with a special set of four capacity units related to each other by the ratios 1 : 6 : 60 : 180, with the smallest unit equivalent to about 24 litres and the largest to some 4,320 litres.⁵

A typical ‘secondary’ beer-account might calculate the malt and groats necessary to brew each of the four beer types in the ‘primary account’, for the officials listed on that tablet as well as several more. Malt and groats were notated with the same number system as barley, but marked with tiny dots and diagonal dashes respectively. First the quantities of groats and malt needed for each of the four types of beer were calculated separately, then the total number of beer jars summed; finally, the overall amounts of groats and malt for all beer types were totalled (Nissen *et al.* 1993: 43–6). We cannot tell whether these were theoretical calculations, made in advance of production in order to requisition the necessary raw ingredients, or an accounting after the fact. Either way, tablets like these comprised a tiny part of the Uruk bureaucracy that traced production right from sowing the field with barley, to harvest, to the final production and consumption of the beer.

As the production of accounts entailed complex multi-base calculations, not surprisingly the accountants sometimes made errors. In the example just discussed, three small units of grain were accidentally omitted from the total on the ‘primary’ tablet, while on the ‘secondary’ tablet the malt and groats were totalled to different amounts when they should have been equal. Trainee scribes thus had to practice both writing and calculating, and they did so increasingly systematically: whereas less than 1% of Uruk IV tablets have been identified as scribal exercises some 20% of the much larger, mature Uruk III corpus is thought to be the product of bureaucratic training (Englund 2004b: 28). The exercises take two forms: on the one hand, highly standardised lists of the objects of account; and on the other, apparently *ad hoc* arithmetical problems.

For instance, a group of about eight small tablets from a single find-spot in Uruk give the lengths and widths (in conspicuously round numbers) of irregular quadrilateral shapes, with no indication of scribe, institutional authority or administrative context. Their areas, when calculated, turn out to be “a multiple of the large area unit 5 eše

[c.11ha] ... times two extra factors of the type $(1 + 1/n)$ " (Friberg 1997–98: 11–12). In other words, they appear to be carefully prepared mathematical exercises rather than genuine surveyors' records. The calculations themselves were presumably not written down but performed by the manipulation of counters, as in many other ancient societies (Powell 1995). Scribal students learned how to write numbers in context by means of 'Word list C', an elementary exercise in enumerating the basic commodities of the Uruk administration known from nearly 60 fragmentary manuscripts (Veldhuis 2005). For instance, lines 18–25 read:

10 (vessels of?) milk
 1 (unit of) cream
 10 cows
 1 bull
 10 ewes
 1 ram
 10 nanny-goats
 1 billy-goat

Trainee scribes also copied and memorised thematic lists of nouns related to the accounting practices of Uruk: commodities such as containers, textiles, metal and wooden objects; fish, birds, and animals; professional and administrative titles; names of cities and other geographical terms. The list of professions now known as Lu A, for instance, is attested in over 160 exemplars while others, such as a list of bovines, are apparently unique manuscripts that were rarely used for training. While the *thematic* range of these word lists is co-extensive with the bureaucrats' remit – there are no lists of gods, for instance, or wild animals – their *lexical* range is much wider: they record many words that were never in practice used by the administrators, so far as we know. The point was, though, that they could have been: the new writing system had to accommodate all the possible uses that the accountants of early cities might want to put it to (Veldhuis 2005).

In short, by the end of the fourth millennium BC, southern Mesopotamian city states had implemented an extensible and powerful literate technology for the quantitative control and management of their assets and labour force. In doing so, they had created in parallel a new social class – the scribe – who was neither economically productive nor politically powerful, but whose role was to manage the primary producers on the élite's behalf.

ENUMERATING THE LITERARY IN THIRD-MILLENNIUM POLITIES

For much of the third millennium BC the political infrastructure of southern Iraq remained fairly stable. Individual city states and their immediate hinterlands tended to retain strong local identities while sharing a common culture, religion, and management structure. They regularly formed economic and military alliances with their neighbours for the sake of prosperity and security, while disputes over water and land resources were settled by warfare or arbitration by a third polity.

During this period, writing gradually accrued new powers as it was adopted for a variety of institutional purposes, from recording legal contracts to issuing administrative orders and documenting political events (Cooper 2004). Paranomasia, or punning, enabled scribes to record the sounds of all words of the language, not only those that could be represented pictorially. At the same time, visual changes were made: cases became lines of writing; the script became ever more abstract and 'cuneiform' or wedge-shaped. Numerals that imitated the form of accounting tokens were gradually replaced by cuneiform notation. Yet literacy and numeracy remained overwhelmingly in the hands of institutional bureaucrats managing land, labour, and livestock.

In the southern Iraqi city of Shuruppak in around 2600 BC, for instance, over 100 named temple and palace employees were allocated land and seed grain (at about 35 litres per ha),

each precisely recorded and totalled, with which they were expected too feed themselves and their dependents. Identical quantities of seed grain are recorded as leaving the central depot - but written by a different scribe, who preferred new-style number notation where the first preferred the old-style, impressed numeration. (Nissen *et al.* 1993: 58–9). As this small example shows, while many individuals and families doubtless earned their livings through personal enterprise based on trust and memory, never coming into contact with the written record, institutional economies continued to run on centrally managed quantitative models, planned and carried out by literate and numerate professionals.

Similarly, scribal training continued to rely on much the same types of exercise as before, though with the addition of new genres. Trainee bureaucrats still copied and memorised highly standardised lists of words – often the same exercises that had been created by the Uruk accountants in the late fourth millennium, even when (as in the case of the professions list Lu A) many of the words they contained were no longer in use (Michalowski 2003). New lists of nouns were also added, such as lists of gods, but these too were all necessary knowledge for palace and temple administrators. ‘Word list C’ continued to be copied, and arithmetical exercises set whose primary goal was still the correct manipulation of lengths and areas.

Now, though, we begin to see arithmetical formats that do not simply imitate account documents. From the cities of Shuruppak and nearby Adab there are both lists and tables of lengths and the square areas that result from multiplying them together, that systematically work through the length units in ascending order (Nissen *et al.* 1993: 135–40). From Shuruppak come two different answers to a problem about rationing a warehouse full of grain between a large group of workers at 7 litres each. One student has calculated a round-number answer with a small amount of grain left over; the other has attempted an exact solution (Melville 2002). In real administrative circumstances no worker ever received 7 litres of grain, but always some multiple of 5 or ten litres, but it is noteworthy that 7 is the smallest integer that does not neatly divide any of the number bases used in grain metrology. In short, the arithmetical lists, tables, and exercises together show an increasing pedagogical interest in the properties of numbers for their own sake, beyond the immediate needs of administrative accounting but always stemming from that context.

Out of these innovations and traditions in scribal culture also came new, non-administrative functions of writing that we might now label as ‘literary’. For instance, amongst the earliest literary works are the so-called *Zà-mì* (‘praise’) hymns from 25th-century Abu Salabikh (a city in southern Iraq whose ancient name is unknown). They comprise a 300-line sequence of 70 short litanies praising a city and the deity associated with it, attested in several dozen manuscripts:

Kesh, the birthing brick,
home of the small speckled *tu* bird:
praise mother Nintud!
...
Girsu,
home of the princely dagger:
praise Ningirsu!
...
Isin, pole of heaven and earth:
praise Ninisina!

(*Zà-mì* hymns, lines 75–7, 117–19, 186–7; after Biggs 1974: 48–51)

On the face of it, the composition is little more than a list of geographical and divine names, elaborated with epithets. How should we understand it: as list or literature? In fact the boundaries between early Mesopotamian lists and literature are very difficult to draw. As Rubio (2003: 205) has noted, “the same text can be regarded as a list of field names, canals and cult places by one scholar, whereas another would interpret it as a literary

text.”⁶ There are two basic problems at the heart of the ambiguity. First is the matter of comprehensibility: scribes did not yet write all the grammatical elements of the Sumerian language, making it difficult for modern readers to determine authorial intention. Second is the matter of literary style:

“A frequent rhetorical device in Sumerian literature is what could be called ‘enumeration’. A text may consist mainly of a listing of the terms of a lexical set. Each term is encased in a fixed repeated formula and provided with a comment. The enumeration is inserted in a narrative or laudatory frame.”

(Civil 1987: 37)

As Gonzalo Rubio argues, we should view Sumerian lexical lists and literary works not as antithetical but as two complementary and mutually productive artefacts of scribal culture:

“Nothing would seem more strictly denotative than listing. However, the fact that lists are cognitively comprehensive but thematically selective is precisely what turns them into connotative devices when used as templates for literary enumerations. ... The link between both kinds of textuality, lists and literary texts, lies in a common rhetorical device: enumeration; and the compositions of some Sumerian literary works gravitates around this very device.”

(Rubio 2003: 201)

Further, enumeration by its very definition entails counting as well as listing; it was at the very heart of cuneiform literacy and numeracy. Thus out of recorded quantitative bureaucracy emerged, via the humble pedagogical list, the first explorations of the aesthetic qualities of numbers and words – namely mathematics and literature – in the middle of the third millennium BC.

MEASUREMENT, MATHEMATICS, AND POWER IN EARLY EMPIRES

In the last centuries of the third millennium city alliances began to coalesce into more formal territorial empires, ruled not by nameless priests and bureaucrats in the name of a god, but by charismatic kings who united their people through personal prowess and force. Rulers such as Sargon of Agade (2334–2279 BC), Shulgi of Ur (2094–2047 BC), and Hammurabi of Babylon (1792–1750 BC) united and held together huge territorial empires the size of modern nation states through wily political manoeuvring, skilful military strategy, and fortuitously long reigns. They each built on the core kingdoms conquered and held by their immediate predecessors, but none was able to build stability into the system. In every case, within a generation or two their successors, with neither longevity nor sheer force of personality on their side, had overseen the collapse of those states back to the size of the original core kingdoms or to total eradication.

However dominant these new-style kings, they nevertheless had to accommodate themselves to the mighty temples, which were still the economic powerhouses of the land. They did this through taking some of the attributes of priesthood, prioritising piety as highly as military might. To promote and concretise this personality-orientated kingship a new form of praise literature was created and developed to extol the ruler’s all-round prowess. Hymns to deities and to temples, such as the *Zà-mì* litanies, had been recorded since the mid-third millennium BC; hymns to kings were an entirely novel phenomenon. In the opening lines of a praise poem of king Shulgi, for instance, enumerations of his heroism are followed immediately by divine patronage:

I, the king, was a hero already in the womb.
I, Shulgi, was born to be a mighty man.
I am a fierce-looking lion, begotten by a dragon.
I am the king of the four regions.
I am the herdsman and shepherd of the black-headed people.
I am a respected one, the god of all the lands.

I am a child born of Ninsumun.
 I am the choice of holy An's heart.
 I am the man whose fate was decided by Enlil.
 I am Shulgi, the beloved of Ninlil.
 I am he who is cherished by Nintur.
 I am he who was endowed with wisdom by Enki.
 I am the powerful king of Nanna.
 I am the growling lion of Utu.
 I am Shulgi, who has been chosen by Inana for his attractiveness.

(Black *et al.* 1998–2005: no. 2.4.2.01, lines 1–15)⁷

This particular praise poem, commissioned in commemoration of the seventh year of Shulgi's reign (Halla 1970), was not only current in the royal court but also found its way into the scribal schools, where it retained a central place in the curriculum until at least the reign of Hammurabi's successor Samsu-iluna (r.1749–1712 BC) (Tinney 1999). The pedagogical role of this hymn, and others like it, was not simply to exemplify classically beautiful Sumerian literature but to also to instil the ideals of Middle Bronze Age kingship into the future accountants, bureaucrats and clerks whose vocation it would be to uphold the institutions of state.

Those palace and temple managers now had to control taxation and tribute over vast territories as well as the domestic labour and production they had been overseeing for centuries. They responded by implementing new, more efficient management techniques. The most significant change came in the 23rd to 21st centuries BC, parallel to the development of courtly praise literature: the development of a single number system which could be used to write any quantity of any commodity at all (Powell 1976; Foster & Robson 2004). We call now this the sexagesimal place value system (SPVS): *sexagesimal* because the scribes chose base 60 out of all the number bases available to them – presumably both because it was the system used to count discrete objects such as sheep and beer jugs and as it was the lowest common multiple of the vast range of metrological units then in use – and *place value* because it represented size not by the physical appearance of the signs themselves but by the order in which they were written, as in the modern decimal system.

Where once the scribes calculated by manipulating counters, now they used the SPVS for multiplication and division. But they used it *only* for those two purposes, continuing to add and subtract in the old way and to *record* numbers, weights, and measures in the old fashioned multi-base systems. Thus sexagesimal numeration is visible in the cuneiform record only where the accountants forgot to erase their scribbled calculations from their tablets (Powell 1976), or in the arithmetical and mathematical exercises written by trainee scribes. The SPVS potentially set numbers free from the objects they were counting or measuring, though in fact they were rarely liberated for long. For the scribes of four millennia ago, numbers remained indisputably properties of real-world or imagined objects, not platonic entities in their own right.

In the early second millennium BC, elementary scribal training underwent a revolution (Veldhuis 1997; 2004; Robson 2001). The old lists of nouns were radically revised, and new lists introduced that trained more abstract properties of the cuneiform writing system and the SPVS. Thousands of arithmetical and metrological tables and several hundred mathematical word problems attest to this new regime, in which emphasis was put more on the ability to manipulate imaginary lines and areas in almost algebraic ways, than it did on the ability to count cattle or calculate work rates (Høyrup 2002; Robson 2002).

A typical school problem, probably from the city of Larsa, just north of Uruk, in about 1800–1750 BC, asks for two integers whose product is 60 given that their difference is seven. The answers – five and 12 – are demonstrated by treating the product 60 as a rectangular area whose sides are the two unknown quantities. The rectangle is manipulated very

concretely using a method we now know as completing the square (though it is perhaps more familiar in symbolic algebraic guise).

“A reciprocal exceeds its reciprocal by 7. What are the reciprocal and its reciprocal? You: break in two the 7 by which the reciprocal exceeds its reciprocal so that 3;30 (will come up). Combine 3;30 and 3;30 so that 12;15 (will come up). Add 1 00, the area, to the 12;15 which came up for you so that 1 12;15 (will come up). What squares 1 12;15? 8;30. Draw 8;30 and 8;30, its counterpart, and then take away 3;30, the holding-square, from one; add to one. One is 12, the other is 5. The reciprocal is 12, its reciprocal is 5.”

(YBC 6967; after Neugebauer & Sachs 1945: text Ua)

Even if we allow that the invention of the sexagesimal place value system was a necessary condition for the creation of mathematics as an intellectual game, divorced from the mundane necessities of central administration, it alone is not sufficient to explain that extraordinary development. Nor does it explain the particular form that mathematics took, so clearly focused on the correct calculation of lines and areas. Jens Høyrup (1990) has posited an oral “surveyors’ culture” in the third millennium BC in which professional land administrators entertained and tested each other with mathematical riddles based on their professional interests. But that hypothesis does not adequately account for the turn to literate mathematics in the early second millennium; little remains of any third-millennium style practical pretext in the example just discussed.

Rather, it is necessary to take a step back and look again at the ideology of the state under which the trainee scribes were preparing to serve. Piety and militarism have already been mentioned as key components of kingship; the third strand was justice. Royal hymns and monumental imagery of the early second millennium BC give equal weight to all three. The Sumerian word for justice was *níg-si-sá*, literally ‘straightness, equality’. The royal regalia of justice were the measuring rod and line, often presented to the king by a god on royal monuments or, more usually in Sumerian literary works, a goddess:

“Nisaba, the woman radiant with joy, the true woman, the scribe, the lady who knows everything, guides your fingers on the clay: she makes them put beautiful wedges on the tablets and adorns them with a golden stylus. Nisaba generously bestowed upon you [king Lipit-Eshtar, r.1934–1924 BC] the measuring rod, the surveyor’s gleaming line, the yardstick, and the tablets which confer wisdom.”

(From *A praise poem of Lipit-Eshtar*: Black *et al.* 1998–2005: no. 2.5.5.2, lines 18–24)

Even the great goddess Inana, most especially associated with sex and war, gave up her measuring equipment last of all when forced to strip at the gates of the underworld:

“When she entered the sixth gate, the lapis lazuli measuring rod and measuring line were removed from her hand.

‘What is this?’

‘Be satisfied, Inana, a divine power of the underworld has been fulfilled. Inana, you must not open your mouth against the rites of the underworld.’”

(From *Inana’s descent to the Underworld*, c.1750 BC:

Black *et al.* 1998–2005: no. 1.4.1, lines 154–8)

The trainee scribes, once they had finished their elementary training, memorised long passages of beautiful Sumerian literature such as these (Tinney 1999), carefully designed to inculcate them with the ideals of statehood and kingship, including numerate justice in the form of equitable division of land.⁸ Other compositions, in the form of humorous dialogues between trainee scribes, addressed matters of competence and incompetence more directly:

“(Girini-isag *speaks*): ‘You wrote a tablet, but you cannot grasp its meaning. [...] Go to apportion a field, and you cannot even hold the tape and rod properly; you are unable to place the field pegs; you cannot figure out its shape, so that when wronged men have a quarrel you are not able to bring peace but you allow brother to attack brother. Among the scribes you (alone) are unfit for the clay. What are you fit for? Can anybody tell us?’

(*Enki-manshum replies*): ‘Why should I be good for nothing? When I go to divide a plot, I can divide it; when I go to apportion a field, I can apportion the pieces, so that when wronged me have a quarrel I soothe their hearts and [...]. Brother will be at peace with brother, their hearts [soothed].’”

(From *School dialogue 3*, c.1750 BC: Vanstiphout 1997: 589)

In the light of these passages and images it becomes clear that area-based mathematics was, at one level, simply royal ideology in another form, promoted through practice and through literary representation. Thus, while modern scholars have chosen to portray Old Babylonian literature and mathematics as amongst the world’s first truly creative and non-utilitarian writings – and indeed there is much to admire in their beauty – for their producers and consumers they represented above all idealised abstractions of the ordered urban state, with god, king, and scribe at its centre.

CONCLUSIONS

There are many accounts of the importance of writing in development and management of early states worldwide. But few pay more than passing lip-service to the central role of numeracy, and even fewer consider the effects of urban bureaucracy on the development of supposedly ideology-free intellectual pursuits such as literature and mathematics. For early Mesopotamia, I contend, it is inadequate to consider one without the others: to simplify greatly, numeracy drove statehood drove literacy; training in professional literacy and numeracy for the service of the state drove mathematics and literature which in turn supported the ideals of the state. Whether this complex nexus of relationships is peculiar to early Mesopotamia, or whether it holds to some degree for other early state societies, I leave for others to determine.

NOTES

- 1 Both stances have been thoroughly critiqued. The most important reviews of Schmandt-Besserat’s work include Friberg (1994), Michalowski (1993), Oates (1993), Powell (1994), and Zimansky (1993). Glassner’s book has been reviewed by Dalley (2005), George (2005), Postgate (2005), and Robson (2006) amongst others.
- 2 The siglum ‘bc’ indicates uncalibrated radiocarbon dates.
- 3 Tokens were presumably in use at this time in northern Iraq too; the lack of evidence may be a function of the restricted opportunities for excavation there over the last few decades since the significance of tokens was first recognised. See Quenet (2005) for a concise survey of the origins of writing in northern Iraq. For an excellent overview of counters and proto-literate accounting in Elam (southwest Iran) see Englund (2004a).
- 4 There is no room, on this view, for Schmandt-Besserat’s “complex” or “decorated” tokens (which, with rare exceptions, are not archaeologically attested in administrative contexts) as the precursors of proto-cuneiform word signs (see Englund 1998: 55).
- 5 If this seems complicated it is useful to remember that there are 20 fluid ounces in an Imperial pint and eight pints in a gallon; almost all pre-metric weights and measures use a bewildering variety of number bases.
- 6 Thus some scholars have argued that ‘Word list C’ is not an elementary scribal exercise but an esoteric literary work (e.g. Westenholz 1998).
- 7 Ninsumun: the divine mother of the legendary hero Gilgamesh, from whom Shulgi’s dynasty claimed descent. An: the supreme deity, very distant from human affairs. Enlil: The father of the gods, and spouse of the goddess Ninlil; particularly involved in the doings of mankind. Nintur: an important birth goddess. Enki: the god of wisdom and cunning, who was thought to reside in the Abzu, the fresh-water sea under the world. Nanna: the moon god, worshipped especially in Shulgi’s home city of Ur. Father of the sun god Utu and the goddess Inana. Inana: The most important goddess of Sumer, worshipped for her sexual relations with her lover Dumuzid and others, and for her warlike aspect.
- 8 Enumeration inspired by lexical lists remained a central feature of curricular Sumerian literature in the early second millennium BC: see Veldhuis (2004) for a comprehensive and convincing discussion.

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