

# Numerical Signs

## —The Sumerian and Chinese Cases

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Sumerian and Chinese writing systems are two of the oldest writing systems of the world. So far as the earliest readable documentations are concerned, the Sumerian writing system starting from Uruk IVa (ca. 3300 B.C.) is approximately 2000 years earlier than the ancient Chinese writing system known from the late Shang Dynasty (ca. 1300 B.C.). Nevertheless, they share a great number of common features in various aspects. However, the present paper does not intend to give an overall view of all the common features the two writing systems share, but concentrates solely on the numerical signs. Both Sumerian and Chinese writing systems began with the notation of numbers by means of visible marks which took different forms, from which two questions arise: 1) Why do the numerical signs precede the pictographic signs? 2) What lies behind the numerical signs, from which they took their initial forms? Based on archaeological and textual data, the present paper demonstrates that the need for numbers in a growing economy necessitated a recording system by means of substantials which developed in due course into a recording system by means of two dimensional marks. The way the numerical signs came into existence is a ready answer to the second question: The basic numerical signs are the two-dimensionalization of the material counters used before writing. Therefore, numerical signs are pictographic in nature. They are not, as some scholars have claimed, abstract signs drawn at random.

**Keywords:** Origin of numerical signs, Sumerian numerals, Chinese numerals, Proto-cuneiform, Bone inscriptions, Comparative perspective

## 1. Terminology

In both of the Sumerian and the Chinese writing systems there are two sets of signs, *shu* and *wen*.<sup>1</sup> They are the signs of these writing systems representing different parts of speech, *shu* standing for numerals and *wen* for all the other language elements except numerals. Functionally, there is no difference between them, for they all represent parts of speech. But formally and originally (from the point of view of their origin in timely aspect and the aspect of what they originate from), differences do exist. When tracing the course of the emergence of the Chinese writing, the Chinese scholars, ancient or recent, used the terms of *shu* and *wen* to differentiate the two categories of the written signs, and in the first place, to describe the consecutive stages of their development.

## 2. The sequence of *shu* and *wen* suggested by scholars

In the Sumerian and the pre-Qin (before 221 B.C.) Chinese documents, there are accounts of invention of writing embedded in literature, stating how writing came about, who the inventor was and for what purpose writing was invented etc.,<sup>2</sup> but nothing was said about the relationship between *shu* and *wen* in the Sumerian literature and nothing in the Chinese literature until the end of the South Song Dynasty (1127-1279 A.D.), when

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<sup>1</sup> The present paper involves two terms, numerical signs (or numerical notations) and signs standing for language elements other than numerals. In Chinese there are two ready terms for these two kinds of signs, “*shu*” (數) for the numerical signs, and “*wen*” (文) for the rest of the signs standing for language elements other than the numerals. For convenience’s sake, these two concise Chinese terms are used in the present paper (as collective plural). Sometimes the term “pictographic sign(s)” is used to stand for *wen*.

<sup>2</sup> See 拱玉書等 2009 (Gong et al. 2009); also see Gong et al. 2009a.

Dai Tong (戴侗) wrote that “writing began with carving, which is used to record *shu*. So, *shu* were the first (signs to be created).”<sup>3</sup> Several hundred years later, a Qing Dynasty scholar called Xu Hao (徐灝) made a similar statement, saying “at the time when writing was created, *shu* came into being before *wen*.”<sup>4</sup> A leading scholar for ancient Chinese writing of the last century expressed a similar opinion with the ancient scholars as follows: “Of the early writing, the numerical signs made the beginning. The numerical signs can be said to be the proto-signs of the earliest writing.”<sup>5</sup>

There is no clear indication of any kind to show how the Chinese scholars, particularly Dai Tong from the South Song Dynasty, came to the conclusion that *shu* were the first group of signs to be created and used in the Chinese writing system. But archaeological evidence which was brought to light in the last century clearly indicates that in the ancient Near East, and in ancient China as well, there was a pre-writing stage, during which material objects were used as counters. These material counters were transformed into two dimensional signs at the time when the material counter-keepers (= record-keepers) were inspired and even compelled by the growing economic need to abandon their traditional way of record-keeping by substituting it with two dimensional signs, whose function remained effectively the same, but whose operation became more manageable. Such a transformation ushered in a new stage of the record-keeping history, during which numbers or amount, conceivably together with the counted material goods, were kept in memory by written signs.

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<sup>3</sup> “書始於契，契以紀數，故首數” (戴侗: 《六书通释》).

<sup>4</sup> “造字之初，先有數而後有文” (徐灝: 《说文解字注笺》).

<sup>5</sup> “初有文字，當以數字為發軔，紀數字可謂初文中之原始字” (於省吾: “釋一至十之紀數字”, in 《殷契駢枝》 三編, 1944).

### 3. Material counters and counting devices used before writing

From the point of view of the present-day archaeology, the statement that man created *shu* first and *wen* the next is not made out of merely scholarly imagination. The *shu-wen* order is not an accidental phenomenon either, but a historical inevitability, as can be seen from the ancient Near East and ancient China, where material objects were widely used as counters before writing. In the ancient Near East, tokens were extensively used as counters before writing, as Prof. Schmandt-Besserat has shown in her publications of the last few decades.<sup>6</sup> In ancient China, the material objects used as counters vary greatly, ranging from tying knots (*quipu*) to wood-carvings, from chip-counters to token-like counters. These material counters were transformed in due course into two dimensional numerical signs, which, inevitably, bear similarity in form with these material counters.

Material counters, such as the chips, tokens and the wood-carvings, can only indicate the amount or number of the counted objects, or, of the recorded events, unable to disclose any information about the objects or events themselves. Therefore, they are counters (in the case of the chips and token-like counters) or counting devices (in the case of the wood-carvings) in the strict sense of the word, solely disclosing information of the amount or number, but nothing else.

The device of tying knots is different from the counting devices mentioned above, for it could be used to record not only numbers, but also the scale of events, as was said by Zheng Xuan (鄭玄) (127-200 A.D.) from the East Han Dynasty: “Man tied a big knot for a big event, a small knot for a small event”,<sup>7</sup> and by others: “How many knots are tied depends on

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<sup>6</sup> See Schmandt-Besserat 1974; 1977; 1979; 1988; 1992 and 1996, only to name a few examples.

<sup>7</sup> “事大，大結其繩；事小，小結其繩”（《易·繫辭》正義引鄭玄之說）。Quotation from Zheng Xuan in the *The Correct Meanings of the Great Treatise of I-Ching (Book of Changes)*.

the number of the things.”<sup>8</sup> Having the advantage of changing the size of the knots according to the size of the things or the scale (importance) of the events, tying knots remains a limited counting device, unable to store or transmit information about what is being counted or recorded. Therefore, tying knots is an effective device for recording amount or number, able to tell “how many”, but insufficient for recording events or things, unable to tell “what” and “how”. Xu Shen (58-147 A.D.) from the East Han Dynasty wrote in the preface to his *Explanations of Chinese Characters* that “by the time of his reign, Shen Nong tied knots to govern his things”.<sup>9</sup> It is not said what “his things” refers to. It is probable that the function of tying knots is more varied than we can imagine, particularly when the involved parties agreed upon certain rules beforehand. A certain color, for instance, might be employed to represent certain meaning. Unfortunately, archaeological evidence is completely absent for the practice of tying knots. So anything said about its function remains a conjecture.

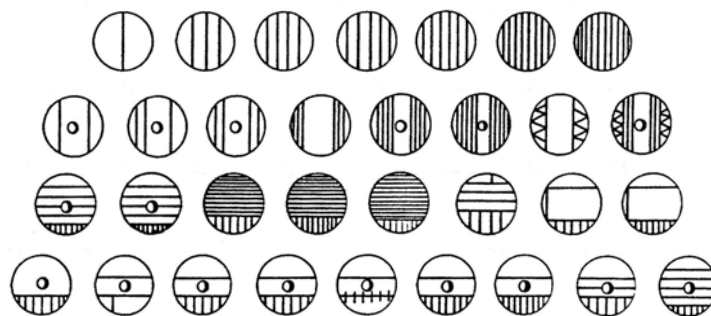
Compared with the counting devices described above, tokens from the Ancient Near East are better devices for counting and accounting. Small and plastic as they are, tokens can be modelled into different objects or animate beings. They can also be drilled through or engraved with straight lines, circular lines, notches, punches or complicated designs on the surface to represent different things they stand for. The plasticity of tokens inevitably gave rise to a great variety of forms. According to Schmandt-Besserat, “there are about five hundred token subtypes.”<sup>10</sup> Taking disks for example, more than thirty forms can be differentiated from each other. (see Fig. 1: Disks)

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<sup>8</sup> “結之多少，隨物眾寡”（《周易集解》引《九家易》）。Quotation of *Jiu Jia Yi* in the *Commentaries of Zhou Yi*.

<sup>9</sup> “及神農氏結繩為治而統其事”（《说文解字·叙》）。

<sup>10</sup> Schmandt-Besserat 1992, 17.



**Fig. 1: Disks<sup>11</sup>**

Logically, different tokens, that is, tokens of different types, the same types of different size, or the same size of the same types with different markings, stand for different objects or animate beings. It is also possible that a certain token stood for a certain thing, with the marking(s) indicating its number or amount. In this sense, some of the tokens at least are multi-functional. The roughly “five hundred token subtypes”, as was counted by Schmandt-Besserat, is the result achieved by putting together all the tokens found in different sites dating to different periods. There were never as many as five hundred token subtypes found in a single site. The number of the tokens used in one and the same site of certain time span may not as great as it first seems to be. Even so, the variety of token types of some of the sites is impressively great, indicating the important role the tokens played in the economic life. Unfortunately, there are no textual evidence describing the tokens or telling us how they work. But some judgments can be made from archaeological contexts, from common sense, and more significantly, from the formal comparativeness of the tokens with the early proto-cuneiform signs. (see Fig. 2)

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<sup>11</sup> Rearranged after Schmandt-Besserat 1992, 26.

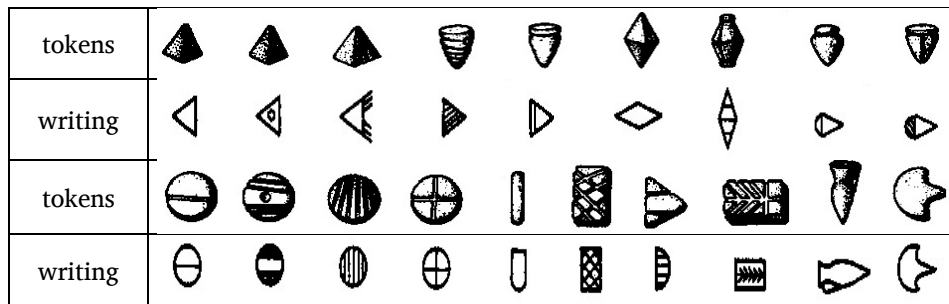


































Fig.2: Tokens and Proto-cuneiform writing<sup>12</sup>

#### 4. Transformation of material counters into numerical signs

The vast geographical area where tokens have been found, the time span of thousands of years when tokens were in use, and the great variety of forms, into which tokens were modeled, demonstrate that tokens had played an important role in the economic life of the Ancient Near East before writing came into use in the middle of the fourth millennium B.C. Ideologically and technically, tokens paved the way for writing. By the time when writing was invented and used in economic and administrative management, some of the tokens, mainly plain tokens, were transformed into signs for numerals, and others, mainly complex tokens, were transformed into signs standing for anything but numerals. As a result, signs of such an origin bear similarity with tokens. (see Fig.3) This explains why many signs of the proto-cuneiform writing from Uruk bear similarity with tokens, and why, pertaining in particular to the concern of the present paper, the numerical signs of the proto-cuneiform writing are circular or semi-circular in their physical appearance, in contrast to the numerical signs of the Chinese writing which are linear in form.

<sup>12</sup> Staatliche Museen zu Berlin 1992, Abb.20.

tokens	numerical signs	sources <sup>13</sup>	tokens	numerical signs	sources
		p.140 1.a			p.141 2.e
		p.140 1.b			p.141 2.f
		p.140 1.c			p.141 3.a
		p.140 1.d			p.141 3.b
		p.140 2.a			p.141 4
		p.140 2.b			p.141 5.a
		p.140 2.c			p.141 6.a
		p.140 2.d			p.141 6.b

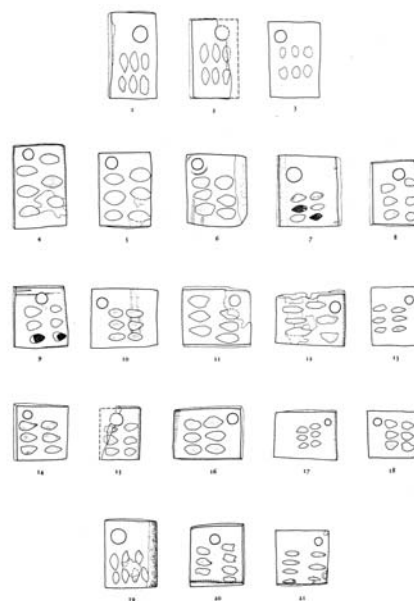
**Fig.3: Comparison between tokens and numerical signs**

The earliest Egyptian numerical signs from Abydos are circular and oval (Fig.4). They seem to come from material counters, too, which remain unknown to us. Archaeological evidence shows that tokens similar to those found in Mesopotamia and Iran were present in many archaeological sites in Egypt, including Abydos and the Khartoum of the middle reaches of the Nile.<sup>14</sup> It is likely that the earliest signs for numerals found in the Egyptian soil are connected with these tokens. In any case, the signs for the numerals “one” to “nine” from Abydos were formed in the same way as the signs for these numerals of the Sumerians by adding or multiplying the sign for “one”.

<sup>13</sup> Page numbers refer to Schmandt-Besserat 1992; For the same table, see also 拱玉書等 2009 (Gong et al. 2009), 158.

<sup>14</sup> Schmandt-Besserat 1977, 19.













**Fig.4: Numerical tags from Abydos<sup>15</sup>**

As is said before, tying knots (*quipu*), wood-carvings, chips and token-like counters were used for counting and accounting in ancient China. Some of these material counters were transformed into two dimensional numerical signs in the writing when writing was to substitute the material counters. Consequently, the chip-counters became the basis of the basic numerical signs, *one* to *eight*, of the early Chinese writing, (see Fig.5) and the device of tying knots became the basis of the numerical signs for *ten*, *twenty*, *thirty* and *forty*, in Chinese “十”、“廿”、“卅”、“卌” (卌) respectively. (see Fig.6)

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one	two	three	four	five	six	seven	eight

**Fig.5: “One” to “eight” in early Chinese**

<sup>15</sup> Dreyer 1998, 115; For the same Fig. see 拱玉書等 2009 (Gong et al. 2009), 168.

			
			
十	廿	卅	卌/𠄎
ten	twenty	thirty	forty

**Fig.6: “Ten” to “forty”**

From this we can see that the basic numerical signs of the three ancient writing systems, Sumerian, Egyptian and Chinese, are all based on material counters. They are the transformation or two-dimensionalization of the corresponding material counters, and therefore, the final stage of the development of these material counters. In terms of the “six principles for creating written signs” (六書) proposed by ancient Chinese philologists before the Common Era, numerical signs of such an origin belong to the category of *Xiangxing* (象形, resembling images), not the category of *Zhishi* (指事, indicating the concrete part), as was traditionally thought.<sup>16</sup> Nor do they belong to the signs created at random.<sup>17</sup>

## 5. Material counting systems and counting systems attested in proto-cuneiform

Tokens are divided into two categories by Schmandt-Besserat, plain tokens (roughly 8000-4400 B.C.) and complex tokens from 4400 onwards.<sup>18</sup> The

<sup>16</sup> See 嚴文明 1993, 12.

<sup>17</sup> See 裘錫圭 1978, 162 and 163. Qiu (裘), a very influential scholar in the field of the study of the early Chinese writing system, divided the pottery marks found in China into two categories: the simple marks (drawn at random) and the pictographic marks whose meaning is related with the objects they depict. He suggested that the numerical signs *one* to *eight* and the sign for *ten* of the bone inscriptions of the Shang Dynasty came from these simple marks. Qiu expressed the same view in 1993, see 裘錫圭 1993, 28.

<sup>18</sup> Schmandt-Besserat 1992, 17 and 24.

plain tokens are presumably used mainly for storing information about the number of the commodities, with different sizes of different forms standing for different numbers or amounts. It is possible that such a combination led eventually to the combination of numerical signs of different forms and sizes standing for different values in the proto-cuneiform writing systems (proto-Sumerian and proto-Elamite). The complex tokens, which considerably outgrew the plain tokens in number and form, are presumably used primarily for storing information about the commodities themselves, enabling the user to identify what they were dealing with. As a bridge connecting the human memory and what was to be remembered, the complex tokens were effective enough, but as a counting device recording numbers, they were defective in the way that one such a token could only stand for the numeral “one”, resulting in an one-to-one correspondence. Such an operation can be demonstrated by the tokens stored in an envelope found in Uruk. (see Fig.7)



**Fig.7: Envelope with six incised ovoids from Uruk<sup>19</sup>**

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<sup>19</sup> Schmandt-Besserat 1992, 122: 67. As noticed by Schmandt-Besserat, the full content of the envelope was seven incised ovoids.

There six complex tokens of the same form and size were stored in an envelope. The formal similarity between this token form and the proto-cuneiform sign for “oil” (i)<sup>20</sup> has led scholars to interpret this token as standing for “jar of oil”, with six such tokens standing for six jars of oil.<sup>21</sup> It is obvious that the identical form and size of these complex tokens stood for the same commodity of the same quantity (how big), while the number of these complex tokens, in this case “seven”, stood for the number of the commodity (how many). From this we see further that the complex tokens were not used as independent counters, but they did count when used as identification for certain commodities. Their function as counters is dependent on the function as commodity identifiers. Therefore, they never stood for “one”, but “one thing”, never stood for “two”, but “two of the same thing”, etc.

In a large circular hearth in Uruk, a group of 75 tokens was found *in situ*,<sup>22</sup> including 7 large spheres, 3 tetrahedrons, 2 cones, and 2 cylinders. These tokens, which do not bring about any association with any agricultural products, nor with any artifacts,<sup>23</sup> could have been a complex system for recording numbers or amount. Different in form and volume, they were most probably counters standing for different numerical values employed in different counting systems, such as the counting system for grain or the counting system for domestic animals etc. In other words,

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<sup>20</sup> see Green / Nissen 1987, ZATU 373.

<sup>21</sup> “Literally, the set of tokens meant ‘jar of oil, jar of oil, jar of oil, jar of oil, jar of oil’” (Schmandt-Besserat 1992, 190). In the case of the Uruk example (see Fig. 7), seven tokens for “jar of oil” were stored in the envelope (Schmandt-Besserat 1992, 122: 67).

<sup>22</sup> See Schmandt-Besserat 1992, 64, Fig.33, and description on pages 63-64.

<sup>23</sup> Schmandt-Besserat held different opinions about the the function of the tokens and proposed that “the plain tokens represented products of the farm and the country, whereas complex tokens stood for goods manufactured in the city” (Schmandt-Besserat 1992, 150).

different counting systems attested in the proto-cuneiform texts from Uruk<sup>24</sup> probably mirror different counting systems operated by tokens.

Judging from the numerals “*ten*”, “*twenty*”, “*thirty*” and “*forty*” of the bone inscriptions of the Shang Dynasty, and of the bronze inscriptions of the Zhou Dynasty, tying knots was used to stand for concrete numerical values. But it is not clear whether the ancient people of China employed different material counters (tying knots, wood-carvings, chip-counters and token-like counters etc.) to count the number or amount of different things to be counted.

## 6. Precedence of numerical notations

Now we turn to the archaeological fact or phenomenon that in Sumer, Egypt and China numerical tablets or writing materials covered only with numerical signs were found. The earliest numerical tablets dating to ca. 3500 B.C. from various sites of the Near East, including Uruk (see Fig.8) “preceded pictography by an interval of about two hundred years or ten generations”.<sup>25</sup> Since the numerical signs of the numerical tablets had the same form and were used in the same way (of combination) as the numerical signs of later times when numerical signs and pictographic signs were put together in a tablet or in the cases of a tablet, it is safe to say that they are of economic or administrative nature.

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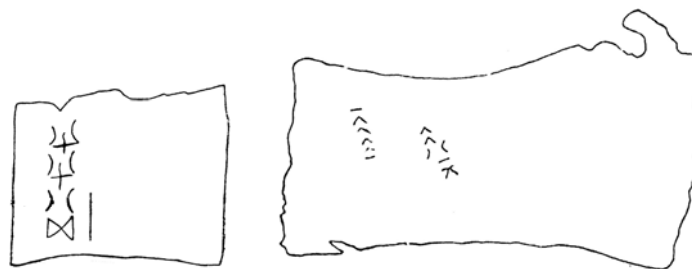
<sup>24</sup> Damerow / Englund 1987, 117-157.

<sup>25</sup> Schmandt-Besserat 1992, 133.



**Fig.8: Numerical Tablets from Uruk<sup>26</sup>**

Same as the numerical signs of the numerical tablets from the ancient Near East, the numerical tags from Egypt (see Fig.4) are also of economic or administrative nature. But the numerical signs of the numerical bones (see Fig.9) found in China were apparently used for the practise of divination, recording the images of the Eight Trigrams.<sup>27</sup> So far as we can say at the present, neither the Egyptian numerical tags, nor the Chinese numerical bones precede the pictographic signs attested in the same archaeological, historical and geographical context. Therefore, they will not be taken into consideration here, although they are inspiring and revealing for the present context.



**Fig.9: Numerical bones from China<sup>28</sup>**

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<sup>26</sup> Schmandt-Besserat 1992, 130: 77 and 78.

<sup>27</sup> See 拱玉書等 2009 (Gong et al. 2009), 176ff., with footnote 1 on page 176.

<sup>28</sup> See 拱玉書等 2009 (Gong et al. 2009), 177, Fig.77.

Now we have the following archaeological evidence from the ancient Near East and arguments based on archaeological evidence in hand: 1) The plain tokens were used considerably earlier than the complex tokens, that is, the former precedes the latter in time; 2) The plain tokens were fabricated into different complex systems, which were used to store information about the number or amount of the agricultural products; 3) The plain tokens, when used in a complex counting system, were more effective than the complex tokens in storing numerical information; 4) The numerical signs of the proto-cuneiform writing systems of Sumer and Elam are the direct derivatives from the plain tokens; 5) The numerical tablets precede the pictographic tablets. From these we may further argue that it was under the pressure of the need to store and transmit information about the number or amount of the agricultural products that man began to use the plain tokens, and that it was in order to store and transmit information about the number or amount of the agricultural products and artifacts more effectively, more sufficiently and more conveniently that man transformed the plain tokens into numerical signs and invented numerical tablets. Behind all this was the ever-growing economy and the closely related need for storing and transmitting information about numbers and amount.

In the ancient Chinese documents we find sporadically persons who tried to clarify when and how numbers came into existence. The first person to be mentioned in this context is Han Jian (韓簡) of the 7<sup>th</sup> century B.C., who said that “after things came into existence, there were images; after images came into existence, there was multiplicity; after multiplicity came into existence, there was number”.<sup>29</sup> About one thousand years later, Sima Biao (司馬彪) of the West Jin Dynasty (256-317) said that “When humans and things were already there, the device of counting came into

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<sup>29</sup> “物生而後有象，象而後有滋，滋而後有數”（《左傳·僖公十五年》）。

existence.”<sup>30</sup> Several hundred years after him, Yan Shi Gu (顏師古) of the Tang Dynasty (618-907) modified the statement made by Sima Biao as follows: “Images came into existence because things came to exist. The multiplicity came into existence because the images came to exist. Numbers came into existence because multiplicity came to exist.”<sup>31</sup> From these statements we see that the Chinese have a long tradition of viewing numbers and the related counting device as something bound to emerge in a stage of the development of the human civilization when population was booming and the economy became too complicated to manage without any aid. It is logically conceivable, therefore, that it was just during such a stage that the ancient Chinese began to employ different objects as counters or invented different devices to store and transmit information about numbers or amount. The objects or devices they employed for this purpose are known to us as tying knots (*quipu*), wood-carvings, chips (bamboo or wooden) or tokens etc. In this function, the tied knots, the carved woods and the performed chips etc. were three-dimensional numerals, standing for concrete numbers or amount, associated by agreement or convention with things/matters counted. Later, when the need for writing became an urgent necessity, at the dawn of writing, some of these three-dimensional numerals were two-dimensionalized and transformed into numerical signs of the writing system. The statement made by Sima Biao (司馬彪) of the West Jin Dynasty “Images are based on things, numerical signs on chips”<sup>32</sup> is the earliest description ever of the historical transformation from material counters to the numerical signs of the Chinese writing system. (See Fig.5)

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<sup>30</sup> “人物既著，則算數之事生” (《後漢書·律曆志》).

<sup>31</sup> “物生則有象，有象則滋益，滋益乃數起” (《漢書·律曆志》).

<sup>32</sup> “象因物生，數本杪習” (《後漢書·律曆志》篇末讚語); For a detailed discussion by Prof. Ge Yinghui, see 拱玉書等 2009 (Gong et al. 2009), 172-173.



## 7. Some general features of numerical signs

The numerical signs used in a writing system are limited in number. They can be outnumbered ten to more than hundred times by the pictographic signs used in the same writing system. Of the three well-known ancient writing systems, Sumerian, Egyptian and Chinese, the Sumerian proto-cuneiform employed far more numerical signs than the other two writing systems put together.<sup>33</sup> As is shown above, the basic forms of the numerical signs of the proto-cuneiform writing system are based on the plain tokens. The numerical signs on the tags from the Egyptian soil are probably also based on token-like counters. The origin of the numerical signs of the Chinese writing system is more complicated. The basic numerals from “one” to “eight” are based on chips, “ten” to “forty” on tied knots, “hundred” (百), “thousand” (千) and “ten thousand” (萬) on the rebus principle. The origin of the numerical sign for “nine” remains unknown until now. The numerical signs, whose origin can be traced back to the material counters, usually take a simple form which cannot be further simplified. Thus there are usually no developmental changes of the sign-forms happening to the numerical signs, which means that they remain the same during thousands of years’ use in the form they took from their birth. The formal simplicity and stability of the numerical signs form a sharp contrast to the pictographic signs whose forms vary from simple to very complicated and were doomed to undergo simplifications of various degrees in the course of their employment, especially so when the sign-forms were complicated from the outset. Such a formal simplicity and stability of the numerical signs misled some scholars to the conclusion that

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<sup>33</sup> For a list of all the numerical signs used in the proto-cuneiform, see Green / Nissen 1987, 166.

the basic numerical signs of the Chinese writing system are abstract signs drawn at random.

The numerical signs of the proto-cuneiform writing system look so different from the pictographic signs that a formal differentiation from each other is immediately conspicuous when man takes a look at the tablets. (See Fig.10). This is due to the circularness of the appearance of the numerical signs and the economic nature of the texts. Similarly, the numerical signs found in Abydos distinguish themselves from the rest of the contemporary pictographic signs in form. What is more revealing here is the fact that the numerical signs and the pictographic signs were not used together, but separately, as if they were different and independent systems not yet joined together. In contrast, the numerical signs of the Chinese bone inscriptions demonstrate no visual differentiation from the rest of the pictographic signs. The reason is apparently that all the signs, numerical or pictographic, of the Chinese bone inscriptions are linear. In addition to this, the divinatory nature of these inscriptions is obviously a contributory factor.

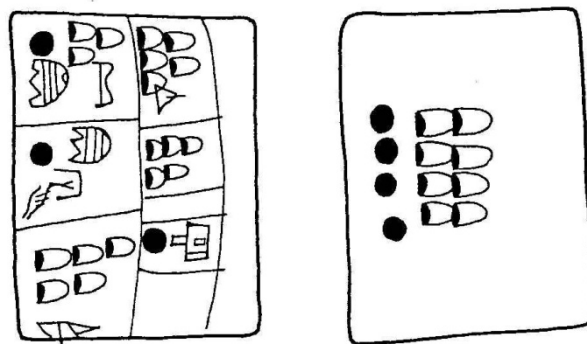
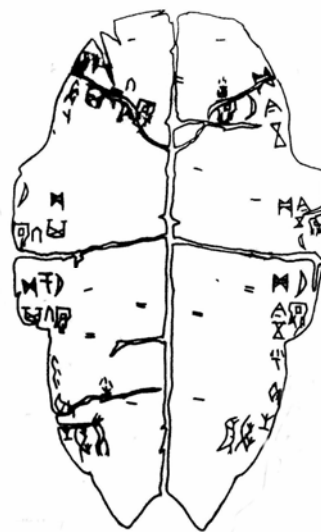


Fig.10: Proto-cuneiform text W 6710, a<sup>34</sup>

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<sup>34</sup> Englund 1994, Pl.13.



**Fig.11: A Chinese Bone Inscription<sup>35</sup>**

The established order *shu-wen*, that is, numerical signs and pictographic signs, does not mean that the latter originates from the former, nor the former develops naturally into the latter. None of the ancient writing systems, Sumerian, Egyptian and Chinese, is an exception to this rule. In the case of the tags from Abydos, the separate use of the numerical signs and the pictographic signs demonstrates that *shu* and *wen* were parallel devices for storing and transmitting information, initially used independently, but joined together later. In the case of the Sumerian writing system, *shu* and *wen* had different material basis, *shu* based on plain tokens, and *wen* on complex tokens and other objects and images. In the middle of the fourth millennium B.C. the need for storing and transmitting information more effectively, economically and manageably about the number and amount led to the epoch-breaking innovation by which the three-dimensional tokens were two-dimensionalized, giving birth to the numerical

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<sup>35</sup> 王宇信等 2004, Text 7 (Wang et al. 2004, Text 7).

Proceedings of the SCRIPTA 2010, Seoul, Oct. 8~11, 2010

signs on the tablets. This may in turn be an incentive to the birth of the pictographic signs.

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## Discussion: 'Numerical Signs – The Sumerian and Chinese Cases'

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[1] What do you mean by the term 'two-dimensionalization of the material counters'?

In the Abstract the author said that "The basic numerical signs are the two-dimensionalization of the material counters used before writing. Therefore, numerical signs are pictographic in nature. They are not ... abstract signs drawn at random.", which I didn't quite follow. And I don't understand that "the three-dimensional tokens were two-dimensionlized" which was mentioned on page 11. If the numerical signs are transformed from material counters, they could be still in the drawing stage not in the sign writing stage. How do the numerical signs go into writing system through the two-dimensinalization?

[2] Is there no differences between the Sumerian numerical signs and Chinese ones?

The author said "Nevertheless, they share a great number of common features in various aspects" in the Abstract. So according to the author I

understand “numerical signs are pictographic in nature” including Sumerian ones as well as Chinese ones.

However on page 11, the author said “The established order *shu-wen*, that is, numerical signs and pictographic signs, does not mean that the latter originates from the former, nor the former develops naturally into the latter. None of the ancient writing systems, Sumerian, Egyptian and Chinese, is an exception to this rule. In the case of the tags from Abydos, the separate use of the numerical signs and the pictographic signs demonstrates that *shu* and *wen* were parallel devices for storing and transmitting information, initially used independently, but joined together later. In the case of the Sumerian writing system, *shu* and *wen* had different material basis, *shu* based on plain tokens, and *wen* on complex tokens and other objects and images. In the middle of the fourth millennium B.C. the need for storing and transmitting information more effectively, economically and managably about the number and amount led to the epoch-breaking innovation by which the three-dimensional tokens were two-dimensionalized, giving birth to the numerical signs on the tablets. This may in turn be an incentive to the birth of the pictographic signs.” (p.11)

In this paragraph the author described the case of Sumerian writing system which had a different material basis from *shu* and *wen*, on the other hand this doesn't explain the case of Chinese. Do they have same process of transformation as Sumerian ones? Is there any possibility that Chinese ones have their own ways of writing numerical signs which is very different from Sumerian ways?

[3] Why do you think that numerical signs and signs standing for the language elements correspond to the terms *shu* and *wen* respectively?

The author said, “The present paper involves two terms, numerical signs (or numerical notations) and signs standing for language elements other than numerals. In Chinese there are two ready terms for these two kinds of signs, “*shu*” (數) for the numerical signs, and “*wen*” (文) for the



rest of the signs standing for language elements other than the numerals. For convenience's sake, these two concise Chinese terms are used in the present paper (as collective plural). Sometimes the term “pictographic sign(s)” is used to stand for *wen*.”

“In both of the Sumerian and the Chinese writing systems there are two sets of signs, *shu* and *wen*. They are the signs of these writing systems representing different parts of speech, *shu* standing for numerals and *wen* for all the other language elements except numerals. Functionally, there is no difference between them, for they all represent parts of speech. But formally and originally (from the point of view of their origin in timely aspect and the aspect of what they originate from), differences do exist. When tracing the course of the emergence of the Chinese writing, the Chinese scholars, ancient or recent, used the terms of *shu* and *wen* to differentiate the two categories of the written signs, and in the first place, to describe the consecutive stages of their development.”

But I wonder whether we can use the terms of *shu* and *wen* to differentiate the two categories as the author divided them. Because in *Shuowenjiezi* 說文解字, Xushen 許慎 said, “when Cangjie created the writing system for the first time, he took after the shape of things according to the categories. Therefore we call it Wen (倉頡之初作書, 蓋依類象形, 故謂之文)”. In this sense, Chinese *wen* represents all categories of written signs including numerical signs. Even though from Song dynasty there were special expression focusing on *shu* (as like footnote 3), that does not provide the evidence of difference between *shu* and *wen*. In my opinion they were just the proofs of interpretation about the history of writing in traditional ways.

[4] What do you think the relation of *xiang* 象 and *shu* on page 9?

If pictorial images and numerical signs were really connected in ancient China, why do you think the images of Eight Trigrams are pictorial?

I wonder whether they should be considered abstract signs from their first appearance in the documents.

[5] From what did Chinese numerical signs originate? The author compared between tokens and numerical signs in explaining Sumerian ones on page 4 and 5. But I'm not quite sure that Chinese ones also could be compared with material tokens whereas Sumerian ones could be. Because Sumerian examples come from general archeological evidences, on the other hand Chinese ones are from already fixed documents or historical writings.