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ON NUMBERS, TABLES AND CALENDARS: WHEN WRITING APPEARED

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Abstract

This article examines the question of whether the recording of numbers and calendar dates, usually provided as examples of the earliest writing in Mesoamerica, should be considered writing. The objective of this article is not to deny that this constitutes writing (which in the opinion of the author it does), but to point out that the investigators who agree on this position individually accept distinct definitions of what writing is, that is, as much those who define writing in the "classic" way, as a system that is based on and reflects language, as those who are in favor of a broader definition (often employing the term "semasiography"). Whether numerical and calendrical signs are themselves linked to a specific language will therefore be analyzed. Without wishing to list all the criteria that in the author's opinion should be decisive in categorizing a system as "writing", some of the factors involved with the recording of numbers and dates are identified and explored.

Resumen

En el presente artículo se plantea la pregunta si el registro de los números y las fechas calendáricas, usualmente proporcionadas como ejemplos de la escritura más antigua de Mesoamérica, puede considerarse escritura. El objetivo del artículo no consiste en negar de que se trate de escritura (lo cual es innegable, según la autora), sino en observar que muchos investigadores que están de acuerdo con este planteamiento parten, a nivel individual, de distintas definiciones de lo que es escritura, tanto los que la definen de forma "clásica", como un sistema que se basa y refleja la lengua, como los que están a favor de una definición más amplia y que con frecuencia recurren al término de "semasiografía". Se analizará, por lo tanto, si los signos de números y los signos calendáricos están adscritos de por sí a un idioma concreto. Sin pretender indicar todos los criterios que en opinión de la autora deberían ser decisivos para categorizar un sistema como "escritura", se identificarán y analizarán algunos de los factores relacionados con el registro de números y fechas.

INTRODUCTION

When did writing appear in Mesoamerica? It is one of those questions usually answered without much hesitation: more or less in the year 600 BC, as attested on the San José Mogote relief depicting a prisoner (Figure 1), between whose lower legs appears a calendrical date, identified as *1-Xòo* or '1 Movement' (Marcus 1976: 45; 1992: 36; Marcus and Flannery 2001: 155-156; Romero Frizzi 2003: 20, and others) or '1 Eye' (Urcid 2005 I: 5-6, 2005 II: fig. 1.3), and which probably indicates the individual's name. However, is this really writing? My concern does not arise so much from denying that we are dealing with writing in this case, but instead that this characterization (as "writing") is accepted by various authors who themselves accept somewhat different definitions of writing. In this article, then, I intend to examine if the notation or recording of numbers, and by extension, calendrical

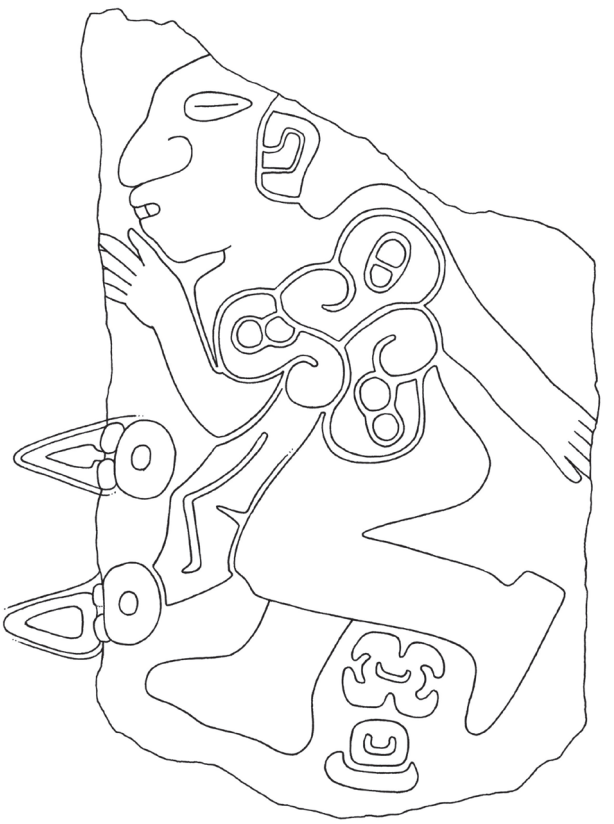

Figure 1. Monument 3 from San José Mogote with relief of a prisoner (drawing by Christophe Helmke after Flannery and Marcus 2003: Fig. 3b).

signs, comply with the generally accepted classic definition of writing, which is that the writing is based on a language, or if instead the definition of writing ought to be broadened.

ORIGINS OF WRITING IN MESOAMERICA: CALENDRICAL EXAMPLES

Without doubt, calendrical notations are the usual examples offered as the oldest instances of writing in Mesoamerica (e.g. Ayala 1993: 68; Wiesheu 1994: 335; Martínez Marín 1996: 398; Romero Frizzi 2003: 20; Pérez Suárez 2012).[1] I am going to start here with the well known 1976 compilation by Joyce Marcus (although certainly since that time new monuments with inscriptions have been discovered, which I will also mention). Thus, Marcus, in addition to the already mentioned relief of the prisoner of San José Mogote, lists other monuments with writing, all dating to the Middle (900-400

[1] This is not to claim that these authors mention only calendrical examples when speaking of earlier writing forms in Mesoamerica (cf. Houston 2008; below).

BC) and Late Formative (400 BC-AD 50) periods, the majority of which contain calendrical notations. Equally well known as the relief of the captive are Stelae 12 and 13 from Monte Alban (500-300 BC) with text arranged in columns and with signs that clearly indicate numbers (bar and dot numerals for "fives" and "ones") or day signs with either months or year bearers (Marcus 1992: 38-40). Other examples are later (Late Formative 400 BC-AD 50) and among the calendaric inscriptions are Long Count dates. These include Stela 2 from Chiapa de Corzo, with the earliest inscription in this cycle, corresponding to the 9th of December, 36 BC;[2] then Stela C (with a date of 31 BC)[3] and Monument E of Tres Zapotes; Stela 1 from El Baúl (dating to 36 or 16 BC),[4] Stela 2 of Takalik Abaj (AD 103 and AD 126; Pérez Suárez 2012: 6), Stela 10 and Altar 1 of Kaminaljuyu (Marcus 1976: 49-55), which are followed by Isthmian texts properly speaking, such as the Tuxtla Statuette (Houston 2008: 296; Pérez Suárez 2012: 6). Apart from these Isthmian or Epi-Olmec monuments, we find still earlier (200-100 BC) examples namely the conquest slabs on Structure J at Monte Alban that contain hill glyphs with toponymic glyphs above them and a text including calendrical signs (Marcus 1976: 49; Helmke and Nielsen, this volume). In this last inscription, it is noteworthy that the proportion of non-calendrical texts continues to increase.

Nevertheless, there are other examples of still earlier Mesoamerican writing that do not appear to be calendrical. One of the most important is the so-called Cascajal Block, dating to around 900 BC, discovered in 1999, but made available to the general public only in 2006 in a publication in the journal *Science* (Rodríguez *et al.* 2006: 1610-1614; Magni 2012: 2). On the block, 62 incised glyphs are found, arranged in more or less regular sequences, forming rows with some glyphs being repeated (Rodríguez *et al.* 2006: 1612-1613; Magni 2012: 3). Not all of the glyphs have been satisfactorily identified in spite of considerable advances in this line of research (cf. Magni 2012), and doubt remains concerning the overall interpretation of this text, which oscillates between proposals that it is a text arising from everyday life, perhaps including a list of tributes (Ortiz Ceballos *et al.* 2007: 18), a text of ritual and mythical character (Magni 2012: 7-8), or a commemorative tableau and a divining table (Reilly 2013),[5] and what can be regarded as a case of so called "script death" (Skidmore 2006a: 5-6). Apart from this recent find, there are well known examples of non-calendrical graphic registers listed by Marcus and later by other authors. One of these examples is the series of two to eight aligned glyphs, drawn on the chests or between the legs of the so-called "Danzantes" of Monte Alban (1976: 47; cf. Houston 2008: 276-277, 293-296).[6] Another is the sequence of the glyphs that appear on Monument 13 from La Venta, called "The Ambassador" (Figure 2), earlier dated to around 500-400 BC (Marcus 1976: 47, 1992: 41), but nowadays considered to be roughly contemporary to the San José Mogote relief, which is to say c. 600-500 BC (Houston 2008: 292; cf. Skidmore 2006), or even 200 years older (Karl Taube, personal communication 2002, cited in Houston 2008: 292, see also discussion in Lacadena 2008b: 615-614). On this latter, three glyphs appear in a column that, as Marcus indicates (1976: 48, 1992: 42), in later times will become a preferred mode of organization for series of glyphs.[7]

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[2] December 8th, 36 BC, according to more recent data of Tomás Pérez Suárez (2012: 6).

[3] September 3rd, 32 BC, according Pérez Suárez (2012: 6).

[4] March 6th, AD 36, according to Pérez Suárez (2012: 5-6).

[5] I am grateful to Jerry Offner for pointing out this proposal of Reilly.

[6] Another sign that Marcus considers as an example of writing, and additionally related to language in particular, is the sign of "flowery blood scroll" or "groin scrolls" which probably indicate blood flowing from mutilated genitals of the "Danzantes". According to this researcher, these signs form a "triple tone pun" in Zapotec, given that they would refer to the word *gui*, which in this language refers by homophony to "flower", "sexual organ" and "that which is offered in sacrifice" (Marcus 1992: 38, 1976: 45). Nevertheless, Javier Urcid, referring to the *Vocabulario en Lengua Zapoteca* by Fray Juan de Córdova refutes this idea, showing that "sexual organ " in Zapotec would be *letaa* o *lezaa*, while "offering" would be *quiie* (Urcid, email of 02.16.2013). I thank Javier Urcid for providing this information.

[7] The same mode of organization appears in another recent discovery, San Bartolo (Guatemala). On one of the stone blocks there is an inscription of 10 glyphs arranged in a vertical column. This inscription was dated by Saturno, Stuart and Beltran to ca. 300-200 BC (2006: 1282).

Figure 2. Monument 13 from La Venta (after Marcus 1992: 43, Fig. 2.13).

One of the glyphs of the series probably represents the head of a bird, while to the left of the figure there is a sign for "foot", also ubiquitous in later times (Marcus 1976: 48, 1992: 42; Houston 2008: 292). Lacadena (2008b: 615-616) goes further by proposing that the signs are arranged in two vertical columns – the second one formed by the footprint sign; that the circle and the lobed sign beneath it are a numeral and a day-sign, making it a calendrical date (2008b: 619); and that the signs of bird-head and the footprint correspond to a title and to an action.[8] I am completely in agreement with Marcus, Houston and Lacadena in considering these examples as evidence of early writing in Mesoamerica, but what draws my attention are the criteria that these authors employ for concluding that this is a system of writing. Thus, Houston (2008: 276) emphasizes that it is a sequence of aligned glyphs,[9] which is one of the three criteria that he proposes for considering something to be a writing system (2008: 292),[10] while for Marcus what is decisive is that there is a columnar arrangement (which is one

[8] Based on the sequences "number-day sign" and "name/title-action", and on the geographical distribution of languages, Lacadena (2008b: 609, 622-626) proposed the hypothesis that the signs on this monument represents a Mixe-Zoquean syntax. I am grateful to Jesper Nielsen for pointing to me this paper.

[9] Actually, Houston here uses the word "linear". However, following Harris (1999: 180-182) I prefer to distinguish between what is considered "linear" and "aligned", with the first adjective referring to the temporal sequence of the chain of speech, and the second to the spatial dimension proper to graphic expression.

[10] He states: "disposed into linear sequences that can theoretically expand into greater degree of syntactic complexity" (Houston 2008: 292).

of the possible forms of alignment), although it involves "no clear calendrical glyphs (days, months, year bearers, and so forth) or numbers (bars or dots)" (Marcus 1992: 42). For Lacadena (2008b: 615-616), the inclusion of the footprint in the inscription is based on the assessment of the text being arranged in a columnar format. Thus also for him, the columnar arrangement is crucial, as well as the presence of the calendrical sequence of a number and a day sign.

For my part, I am not trying to question the consideration of numeral or calendrical symbols or the sequences of signs on Monument 13 of La Venta or on the Cascajal Block as examples of writing. What interests me, as I stated from the onset, is that it is precisely the calendrical inscriptions (which include registers of number) that do not usually cause hesitation in being considered "writing", independently of the definition of the same accepted by each researcher. Thus, Joyce Marcus indicates that she accepts Diringer's definition, that writing is "the graphic counterpart of speech, the 'fixing' of spoken language in a permanent or semi-permanent form" (Marcus 1992: 17). Obviously, if writing represents a spoken language, it must represent a particular language. Meanwhile, the same researcher provides examples of how a calendrical sign can be verbalized without ascribing it to a particular language. For example, while discussing Stela 2 from Chiapa de Corzo, in which an initial series date appears, she identifies one of the signs as *acatl* —utilizing the Nahuatl term— or *ben* —resorting to the term used by the Yucatec Maya— (Marcus 1976: 50). In a similar manner, given "the difficulty in demonstrating that early inscriptions were produced by speakers of an ancient version of the Zapotec languages" (Urcid 2005 I: 9), it is not certain in what language the famous example of writing on Monument 3 of San José Mogote should be read, specifically, the name of the prisoner in the form of a calendar date, it is simply supplied in an Indo-European language (English, Spanish, etc.) as '1 Movement' or '1 Eye' (see above), so that in reality this example is treated as evidence of writing mostly because of the presence of the numeral 'one'. Certainly, Marcus herself emphasizes that the majority of the earliest examples of writing in Mesoamerica −of course, the researcher wrote before the discovery of the Cascajal Block− "are inextricably linked to the pre-Columbian calendar" (1976: 39), whereby the use of numeral and calendar signs appears to be a strong criterion when speaking of writing. My question is if these signs are linked to some particular language or whether they operate across various languages, which would put in doubt the idea that one may speak of writing only when it is a matter of representation of a spoken language.

Moreover, we should ask if one of the criteria listed by Houston (2008: 292), alignment (commonly called *linearity*; below),[11] also implies connection with some particular language. Regarding this dependence of a writing system on a language, Houston (2008: 275-276) differentiates between open and closed systems, the latter generally being restricted to a specific language or to a group of related languages, and the former probably understood by various cultures and speakers of different languages. This distinction also weakens the criterion that writing represents a language. Additionally, while discussing the conceptualization of early writing in Mesoamerica with regard to the development of graphic form ("to present its development in graphic form"), Houston (2008: 278) indicates that one of the possibilities for classifying these writing systems is based on their attributes, that is, whether they use the system of bars and dots to write numbers, or if they use (or do not use) the Long Count. Thus again, it turns out that the use of numeral signs and calendrical signs is one of the relatively secure criteria for speaking of writing, even when accepting the traditional definition of it, that is, a system that represents speech. However, is it really so? Are numeral signs and by extension, calendrical signs linked to a particular language?

[11] I agree with the opinion of Sebastian van Doesburg (personal communication, 2011) that in general we have a tendency—perhaps based on intuition—that when signs are organized in an aligned form, they constitute writing.

NUMERAL SIGNS: LINKED TO A LANGUAGE?

The question of number signs is a paradigmatic case, because an enormous gap may be observed among Mesoamericanists themselves in how these elements of scripts are defined. While researchers such as Elizabeth Hill Boone (2000: 30) resort precisely to the scripts for mathematics (in the Western World) to provide examples of semasiography, that is of systems that "... function independently of language, although they operate on the same logical level as spoken language and can parallel it" (Boone 2000: 30),[12] others, such as Miguel León-Portilla (1983: 54-58), Juan José Batalla Rosado (1995a: 77; 1995b: 625, 627-630) or more recently Alfonso Lacadena (2008a: 8), between others, explicitly consider number signs as part of the system of "true" (meaning "glottographic" or representing a language) writing. Among these should be also mentioned Hanns Prem, who proposed exact definitions of what should be called "logogram" and "ideogram".[13] According to this investigator (Prem 2008: 18), a logogram would be a sign characterized by "a strict relationship —one to one—between the sign (the logogram) and the morpheme denoted by it",[14] while an ideogram would be a sign that "corresponds to various words, generally more or less synonymous, that is, different phonetic expressions with an (almost) identical meaning […] that transmits meanings (or fields of meaning) and not words" (Prem 2008: 18-19).[15] Examples of ideograms, according to Prem, would be mathematical figures and symbols, given that they transmit fields of meaning and not words. Nevertheless, Prem (2008: 19) also considers that "[it] is characteristic of logograms that they can be applied and understood also in different languages, although they may be pronounced in different form",[16] and for this opinion again offers the example of algebraic figures and symbols (Prem 2008: 19, n. 9 and 10). However, precisely this conclusion blurs his differentiation, so exact, between logo- and ideograms. If we accept the definitions of Prem, numeral and, more broadly, algebraic signs, correspond perfectly to his definition of ideograms, that is, signs that exceed the boundaries of a single language. It is therefore not possible to talk about, in this case, a linkage to a particular language, given that these signs can be verbalized in any language provided that the speaker is acquainted with the conventions of this code. However, despite the lack of a relationship between number signs and a particular language, Prem, like various other researchers, characterizes them as logograms, placing them alongside "true writing systems", as the glottographic ones are considered. Given all this, my idea is that if we agree on using the category of "logogram" for signs attached to a particular language (as the name "logogram" suggests), we might also agree to use "ideogram" for "various words, generally more or less synonymous, that is, different phonetic expressions with an (almost) identical meaning", as Prem suggests (above), but still in reference to synonymous words in a particular language; but then it would be more logical to have another term for signs transparent in different languages, and which can be "semasiogram" proposed by David Wright (2009: 236).[17]

My point is that in these three cases the "operational principle" of the sign is different, and the number signs (and other algebraic signs) are not bound to any specific language. They can cross the

[12] Similarly, Sampson considers that mathematical notations are "a highly sophisticated case of semasiography" "un caso altamente sofisticado de semasiografía" (1997: 43).

[13] But it is worth stressing that the category "ideogram" has tended to be rejected as imprecise (Gelb 1963: 35; Sampson 1997: 48). In fact, Prem seems to be one of the few, if not the only one, to give a precise definition of what an ideogram could be. In the majority of older theoretical texts, the category of ideogram used to be described as a sign that represents an idea graphically, but this definition has proven to be insufficiently precise

[14] "una relación estricta –uno por uno– entre el signo (el logograma) y el morfema denotado por él" (Prem 2008: 18).

[15] "corresponde a varias palabras, generalmente más o menos sinónimas, es decir, diferentes expresiones fonéticas con un significado (casi) idéntico [...] transmite más bien significados (o campos de significado) y no palabras" (Prem 2008: 18-19).

[16] "es característico de los logogramas que se pueden aplicar y entender también en diferentes idiomas, aunque se pronuncien en forma diferente" (Prem 2008: 19).

[17] He says: "if the sign is motivated and its reading is meaningful in two or more languages (which do not have a close genetic relationship), it is a 'semasiogram'" (Wright 2009: 236).

boundaries of a single language and are able to be verbalized in various languages, maintaining their semantic value. To give an example of this, we need only look at a coin or a bill with a value of, let us say, "five", in which the number is written in the code shared by various cultures of the world, for example, the system of Arabic numbers. Written as "5", this meaning remains clear for those who may not know the language from which the name for the currency comes (Spanish, Polish, Russian, Hungarian, etc.; Figure 3a-d) or even when the system of writing in which the name of the currency is written is different (for example the Cyrillic script of Eastern Slavic languages, Figure 3c).[18] On seeing the number "5", the value of a bill or coin is obvious, as opposed to cases in which the value of a bill or coin is written with letters of a glottographic system, for example, *quarter dollar*, *cinco pesos*, *pięć złotych* or *öt forint* (Figure 3e-g), that is, when it is necessary not only to know the code (the alphabetic system), but also the language on which the glottographic system is based to understand. Similarly, we can give an example of a mathematical task written with algebraic signs (Figure 4) −anyone from a Western culture will understand it[19] and will be able to verbalize it in his language, as opposed to the information written on the side in a glottograhic system, which, although possibly able to be read aloud, will be understood only by someone who understands the language on which the text is based. One more argument that number signs —and by extension, the writing system of mathematics—does not depend on a particular language, for which reason its graphs[20] should not, in my opinion, be called logograms is that if it were thus, then the khipu system ought to be called "logographic" and we can easily imagine that such a designation would meet immediately with vigorous disagreement.

Summing up, the case of number signs and mathematical script is paradigmatic because as it is, it is not related to any particular spoken language (see also Whittaker 2009: 51). It is possible to "read", "translate" or "verbalize" mathematical script in any language, because in principle, there is no underlying linguistic system there. Anyone knows the code and the convention can verbalize them in his tongue, and the knowledge of a particular language is not required to capture the message encoded in mathematical script. Brian Rotman, mathematician and philosopher, expressed it clearly: "A written symbol long recognized as operating non-alphabetically —even by those deeply and quite unconsciously committed to alphabeticism— is that of number, the familiar and simple other half, as it were, of the alphanumeric keyboard" (1997: 18). In a similar manner, David Olson —among the most distinguished theoreticians of literacy— states that Arabic numerals and signs of mathematical operations "do not represent words in any particular language",[21] and can be expressed in any language (2010: 139). For this reason, in my opinion, it is not possible to call number signs "logograms" —and exactly of this same opinion is Olson (2010: 139)— as those investigators who characterize them as an intrinsic part of a "true" (meaning glottographic) system consider them (Nicholson 1973: 2-3, n. 5; Lacadena 2008a: 8, 15; Zender 2008: 28; Helmke and Nielsen 2011: 3-22; Batalla 1995b: 627-630).[22] It could be argued, of course, that even these signs were created within a specific cultural context linguistic context and to be reproduced in a particular language. Nevertheless, any human intellectual "product" is always created in a specific linguistic context. And certainly what is written

[18] To be precise, in fact the Cyrillic script can be equated to the Latin script, because they are both alphabetic systems. What differentiates them is the repertory of their signs (called "notation" by Haris; 1999: 143).

[19] To be precise, this also depends on the degree of complexity of the task.

[20] "Graph" is a term proposed by Sampson, to indicate a "distinctive written symbol" that does not correspond with "letter", because it can equally refer to other signs in the same writing (phonetic [alphabetic]) system such as accents or punctuation signs as well as signs of other systems commonly called "ideograms" or "characters" (as in the case of the Chinese system). According to Sampson, "graph" would be parallel to "phone" or unit of sound in spoken language (1997: 29-34; see Sampson 1985: 22-25 [English original text]). I understand that this is not a matter of establishing a one to one relationship between graph and phone, but that it concerns only naming minimal units of a system of writing.

[21] "no representan palabras de ninguna lengua concreta" (Olson 2010: 139).

[22] Notable exception here is Gordon Whittaker, who clearly differentiates between writing as a system which reproduces speech, iconography, and notation, which is "employed in recording mathematical information, tallied counts, music, pottery batches, and so on", making a clear statement that the last one "has no fixed relationship to a given language" (2009: 51).

Figure 3. Coin and paper currencies from different countries; a) Poland; b) Mexico; c) Russia; d) Hungary; e) Mexico (out of circulation); f) USA; g) Hungary (photographs by the author and images in the public domain; fig. 3g was reproduced with the permission of Sorin Trimbitas) .

Zapisz w jak najprostszej postaci

$$\frac{x-1}{x-4} - \frac{1-x}{x^2-7x+12} + \frac{4-2x}{3-x}$$

Figure 4. Algebraic task (after http://zadane.pl/).

on a Hungarian banknote will be verbalized as *öt forint* by Hungarians, but if the number is written in the form *öt*, a foreigner—for example a user of the Latin alphabet— to read this text "well" will first have to know which sound corresponds to *ö*, and second, will have to understand at least this word in Hungarian to know that its referent is "five". Meanwhile, if the graphic sign "5" is employed (Figure 3f),[23] the foreigner will already know that it concerns five units of Hungarian money (provided always that he knows the Arabic number code, certainly). In other words, it is clear that what is recorded graphically on the banknote/coin of 5 forints has been put there with the intent of being expressed in the Hungarian language, but the system of registering numbers permits a reproduction/verbalization in another language, or even simply a comprehension of the idea without the need for vocalization.

Suitable examples here would be traffic signs: there is no doubt that these also are always created in a specific linguistic context. Nevertheless, the great majority of them (see Figure 5a) are comprehensible for all who know the code, even if they are speakers of different languages and can be verbalized by them, for which reason authors such as Boone (1994: 15-22, 2000: 30-31, 2008: 317-319), Jackson (2011: 231ff., 2013: 21ff.) or Urcid (in press) characterize them as semasiographic systems. Nevertheless, to these signs may be added graphs which form part of a glottographic system (Figure 5b-c), and in that case the traffic sign will begin to function in both ways, semasiographically (clear in various languages) and glottographically (tied to a particular language). It is clear that although we may not know the language in which the additional word (in the middle of a "stop" sign) is based, and even if we may not know the writing system used to write it , we still understand the meaning of this traffic sign thanks to the continued functioning of the semasiographic principle (Figure 5c). Similar modification of a graphic sign comprehensible in various languages − such as a number − can be accomplished by adding to it *-st*, *-nd*, *-th* or *-szy*, *-go*,[24] etc., and only then can we talk about the linking of this graphic sign to a particular language, although the semasiographic principle does not stop operating (that is, someone who does not know English, will continue to know that the referent of "1st" has something to do with "1", although the significance added by the part "st" −apart from indicating part of its sound − means that it is an ordinal number).

To sum up, it is worth citing Hyman, who indicates how the restricted (classic) definition of writing as a system that more fully represents speech, can cause confusion: "... it is senseless to assert that recourse to a spoken language for the explanation and teaching of a writing system makes that system glottographic; we should then be obliged to classify virtually all technology as linguistic in nature, because humans rely on spoken communication in its creation and use" (Hyman 2006: 241). Therefore, without doubt, any code of human communication is always created within a specific linguistic context, and such a code can be put into a language (because oral language is the most

[23] Or the Roman number "V", as in Figure 3.g.
[24] Endings used earlier in the Polish script.

Figure 5. Traffic signs from different countries; a) signs without glottographic writing; b) glottographic stop signs employing alphabetic writing (as used in English and Spanish-speaking countries and Turkey); c) stop signs employing other kinds of glottographic writing (China, Korea and Morocco).

capable and intrinsic system of human communication)[25] but this does not indicate that language and the graphic communication system are semiologically equal (cf. Goody 1977: 76-77; Cardona 1999: 29; Battestini 2000: 30; among others), nor that different graphic communication systems function making use of the same operative principles. This will be better seen when we focus our attention on the origins of other systems of writing in the world, and above all in Mesopotamia.

ORIGINS OF WRITING IN THE WORLD

Our conviction that writing is a system that represents language is undoubtedly based on the role that the ancient Greeks gave to it in the first place, and in the second place, the linguists.[26] Some authors (cf. Coulmas 2003: 2; Hyman 2006: 240) have noted that the first person who contributed to a definition of writing *per se* was Aristotle, who said "Words spoken are symbols or signs of affections or

[25] In saying this, I consider language as a semiotic system created in natural form by humans to communicate among themselves, as opposed to a system of writing, which should instead be considered an exterior "technology" (cf. Ong 2009: 84-94), because it is not learned in "natural" form, and its use in general requires additional artifacts (a surface and a tool).
[26] Starting with Ferdinand de Saussure (1945: 51). See also Colas (2011: 14); Mikulska (in press: Parte II).

impressions of the soul; written words are the signs of words spoken" (Aristotle 1938: 115). However, Greek writing, as opposed to four systems of writing in the world that have arisen independently, in Mesopotamia, Egypt, China[27] and Mesoamerica (cf. Woods 2010a: 15ff.), from the very beginning seems to have had the objective of faithfully representing speech. According to the historian Herodotus, the Greeks called letters *phoinikeia*, "Phoenician things", which indicates that they themselves were conscious of having inherited their writing system from the Phoenician system (Cook 2003: 288-289), which was certainly consonantal (cf. Healey 2003: 227). Nevertheless, it remains unknown exactly where the Greeks encountered the Phoenician system, possibly in Ugarit (modern Syria), Cyprus or Sardinia (where Phoenician inscriptions are found), or perhaps arising from their encounter with Aramaic writing (Healey 2003: 256), or even owing to contact with Egyptian soldiers and people of the Near East in Wadi el-Hol (Egypt), where recently inscriptions with Egyptian hieratic signs in them used to record a Western Semitic language were discovered (Lech Trzcionkowski, personal communication 2014).[28] Not requiring direct contact with Phoenicia itself implies that the date of "door opening" to Greek writing would be before the traditionally accepted IX-VIIIth centuries BC (Healey 2003: 256). As is well known, the Greek gave vocalic values to some Phoenician letters (Healey 2003: 256), which led to the formation of the alphabet properly speaking. What is important is that one of the oldest, if not the oldest, inscriptions in the Greek system is the text written on a vessel found on the island Pithekusai in a tomb from the end of the VIIIth century BC, although probably the container was made a generation before (Węcowski 2011: 71). The inscription is the recording of a poem-epigram, in Greek, already containing vowels, and written in three verses (a form in use by this time in Mesopotamia; West 2006: 61). To date, Greek inscriptions of a utilitarian character, such as the administrative and economic records we know from ancient Mesopotamia and Egypt, are lacking. It appears therefore that the principal concern of the Greeks was to record faithfully a poem (or speech), in a system that would permit the writing of vowels, crucial for an adequate recording of this type of text (Lech Trzcionkowski, personal communication 2014).[29] Nevertheless, the Greeks modified a system that was already in use, and that itself was the result of other modifications and adaptations of a recording system that originally arose to fulfill much more "utilitarian" purposes than that of recording poems or songs, and in which case, surely in the moment of its invention, was not capable of representing continuous speech.

I refer here to the origins of writing in Egypt and in Mesopotamia. Although earlier it was thought that Egyptian writing was in some manner motivated or inspired by the previous invention of writing in Mesopotamia, because the former appears already completely developed (that is, with logograms and phonograms;[30] Davies 2003: 126-127), more recent finds indicate, first, that it is still debatable which of the two systems is older, and second, that as in the case of the Near East, the first graphic Egyptian records also have a utilitarian character. This concerns little bone and ivory tags, which

[27] It is worth recalling an old hypothesis, recently mentioned and supported by Bottéro (2008: 258-259), that Chinese writing borrowed the idea of recording speech from the West (although the form used is completely original to the Chinese). This hypothesis is based, not only on the fact that Chinese writing is more recent than Mesopotamian and Egyptian, but also because it arose in a sudden form — a conclusion derived from the fact that the oldest artefacts with writing contain inscriptions in a developed system, that record continuous discourse, as opposed to the Mesopotamian and Egyptian systems which for 500 years used systems that did not record continuous discourse, given that they were basically administrative and lexical registers (Bottéro 2008: 258-259; Bagley 2008: 225, 227, 232-233).

[28] More concerning the project in Wadi el-Hol, may be found at: http://www.usc.edu/dept/LAS/wsrp/information/wadi_el_hol/ [Accessed: 2nd of May 2014].

[29] My sincere thank you to Lech Trzcionkowski for the information on the finds in Wadi el-Hol and on other places considered possible points of contact between the Greeks and consonantic writing, as well as for the information on the vessel from Pithekusai and the recommendation of Martín L. West's book (2006).

[30] Phonograms are graphic units that represent a non-semantic unit of language such as a syllable or phoneme, that is to say, a unit of sound or group of sounds.

were tied to "bales of cloth or other high-value grave goods". These tags contain as many numeral as hieroglyphic signs (Baines 2008: 156), in which respect they seem similar to the oldest examples of the graphic recording system of Mesopotamia that appear in the famous clay tablets.

For their part, these tablets, which date from 3200 BC, were found principally in Uruk, Babylon (modern Iraq; Hyman 2006: 232), but also in nearby areas such as Niniveh (Iraq), the west of Iran and in the north of Syria (Walker 2003: 19). This recording system is called "archaic Sumerian writing" (Sampson 1997: 71, 67), but also "archaic cuneiform" or "proto-cuneiform", and the inscriptions of this period have a economic or bureaucratic character, since they communicate information concerning a certain commercial product (various foods, livestock or textiles) and their quantity, the second item recorded. The signs for the objects counted for the most part exhibit a high degree of iconicity —for example, the sign of an ox has the form of the head of an ox, the sign for barley has the form of a shoot, etc. (Walker 2003: 21)— although there are also examples of representations of entire animals, for example of a goat or of a sheep, each one accompanied by the number "10" (tablets of Tell Brak, Syria; Walker 2003: 19).

Still older than the clay tablets are the so-called *bullae*, also used in commercial transactions, and whose antiquity goes back to the middle of the IVth millennium BC. They were balls of hollow clay, in whose interior originally were found small clay objects easy to make by hand, such as cylinders, spheres, disks, etc. (Figure 6a). Those objects called *abnu*, *tokens* or "fichas" are found separately in excavations of more ancient places, that reach back to the IXth millenium BC (Schmandt-Besserat, in: Cardona 1999: 66-67; Olson 2010: 131; Michałowski 1993: 996). Denis Schmandt-Besserat (in: Cardona 1999: 7; Coulmas 2003: 41), following Pierre Amiet (Sampson 1997: 81; Michałowski 1993: 996), develops a hypothesis that the tokens represent objects from commercial transactions (sheep, rams, etc.), but that their form was not intended to reproduce the form of the designated thing, but instead was due to the ease by which they could be made by hand (Cardona 1999: 67), so that it is a matter of abstract representation or is the result of a symbolic abstraction. According to Schmandt-Besserat, *abnu* were enclosed in *bullae*, and their content in form of graphic signs was inscribed on their surface, this being the origin of the writing surface (Olson 2010: 131) and of the proto-cuneiform tablet (in: Cardona 1999: 67; cf. Sampson 1997: 81) (Figure 6b). Schmandt-Besserat also proposed that the graphic signs of the *abnu* later evolved into certain logograms of the Sumerian system, however, this part of the hypothesis has been strongly criticized (in: Sampson 1997: 85). Thus according to Lieberman, Le Brun and Vallat, "if any aspect of Sumerian writing descended from the use of tokens and the habit of making corresponding marks on the surface of *bullae*, it is likely to have been exclusively the numeral system" (Sampson 1985: 60).

Therefore, if the hypothesis of Schmandt-Besserat is incorrect, then what is observed with the *bullae* is the process of abstraction which led to the creation of signs of numbers. If, on the other hand, this hypothesis is correct, the signs drawn on tablets would be the result of a double abstraction as much for the signs that refer to "things" (and which in this region of the world later evolved into signs of a glottographic system), as for those that refer to numbers, which appear represented already in the most ancient tablets (3200 BC; Coulmas 2003: 42; Cardona 1999: 67) and which evolved in another direction from the glottographic signs, that is, in a refined semasiographic system, on principle not written in a specific language.

As for signs for numbers, the opinion of Piotr Michałowski (1993: 998) should also be mentioned, that in the proto-cuneiform system a register of abstract numbers was still not used —these would appear up to a thousand years later (Damerow 1988; Damerow and Englund 1987, in: Michałowski 1993: 998)— given that numbers were still connected with the object counted. That is to say, the sign for the number "1", in reality was "a unit of x" (for example, "sheep"), so that there was not a "one" which could be manipulated freely and connected syntactically with another type of object to count (for example, "cheeses"). In reality, in ancient Mesopotamia, there existed at least five distinct

numbering systems that were used to count different types of goods. For example, with the sexagesimal system (with units 1, 10, 60, 600, 3600) persons, animals, dried fish, tools, stones, etc. were counted while the bisexagesimal system (with units of 1, 10, 60, 120, 1200, 7200) was used for products made of grain, cheeses or fresh fish (Woods 2010b: 40). This very description, I believe, already indicates that within particular groups of objects to count, numeral signs had to possess an abstract value, since, upon using the numbers of one of these systems, the objects to be counted still had to be indicated, given that the numeral sign gave information only on the class of the product which was counted (as if we were able to make use of distinct graphic signs to record quantities of liquids, grains, animals, etc.). In fact, the very fact that there were five (or at least five) counting systems, with distinct graphic signs to record them graphically, involved with so many more objects to count, shows that within these groups or categories, it was still necessary to differentiate between them.

What remains without doubt is that in the Sumerian tablets the interdependence of both systems is seen, or better said, of the use of the glottographic principle and of the semasiographic prnciple at the same time, in a complex graphic system. Both types of annotations—one which little by little is going to depend more and more on the spoken language, the other which, to the contrary, will develop without any relationship with it—would arise at the same time, as products of the creation of the same mind (or with the annotation of numbers being even older). According to Sampson, to represent numeric value by a separate graphic sign, that is, not to repeat the counted object the times that might be necessary, while expressing its quantity by means of another sign, is a result of the process of abstraction proper to graphic systems or writing as such. At the moment of "the separation of numeral graphs from graphs indicating the objects enumerated" (1985: 50), the numeric value of the things counted is abstracted. The key point is that the process of abstraction is not only providing the evolutive line towards glottography, in which development

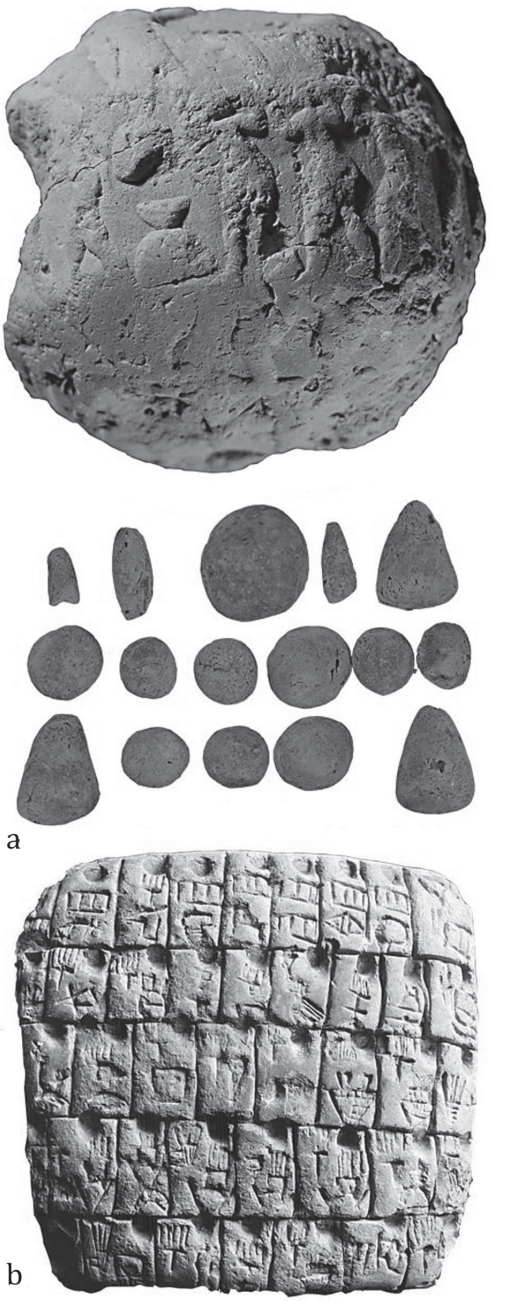

Figure 6. Sumerian artifacts with the oldest examples of writing; a) *Bulla* MS 4632 with 17 tokens called *abnu*. Syria/Sumer/Highland Iran, ca. 3700-3200 BC; b) A list of 41 titles and professions on a tablet MS 2429 (photographs after Schøyen Collection 2011).

the process of abstraction consists in assigning graphic signs to units of the language (morphemes, syllables or phonemes), but also towards what in this article I am calling a semasiographic system, which is to say, not linked to a particular language, and that without doubt is a syntactic system, although different from glottographics. As Olson explains, on passing from the system of "counting tokens" (representing three sheep by three tokens, "sheep", "sheep" and "sheep") to the system of representing the number of objects alongside these same (by means of two signs, one for the number "3", and the other for the object "sheep"), a system is created that permits the combination and recombination of various symbols, thus permitting the expression of a broad range of meanings (Olson 2010: 132-133). For Olson (2010: 139), a syntactic system includes one that represents speech as much as one that represents numerical notation because what matters is that each provides a distinct model for thinking. This last point is crucial, given that Olson himself, the expert in literacy, denied in an explicit manner the idea of writing as a pure transcription of speech,[31] stating that: "writing systems capture only certain properties of what was said (Olson 1994: 7; 2010: 42; emphasis mine). In addition, Olson (1994: 8; 2010: 43) says: "far from writing being mere transcription of speech, writing is coming to be seen as providing a model for speech itself", that is, it is thanks to (glottographic) writing that the human mind begins to make an analysis of language as a linguistic system, that is, to differentiate words, syllables, phonemes, etc.

Similarly, various researchers who work with the oldest systems of writing indicate that the first graphic registers did not represent the continuous chain of speech nor did they bother to codify spoken language as their primary or sole objective (apart from the Greeks). Thus Bagley emphasizes that the oldest Mesopotamian records, as well as the Egyptian, served for the annotation of "specific bits of information for bookkeeping purposes" with a "lexicon unequipped to transcribe" (Bagley 2008: 225; cf. Woods 2010b: 39). Moreover, the oldest tablets (or almost the oldest, since they date from the Uruk II period, that is 3100 BC) did include signs which correspond to substantives of the spoken language (for example, "[male] slave" and "[female] slave") and signs of numbers, but still lacked prepositions or verbs which made the codification of continuous discourse impossible.

It is important to note that among specialists in proto-cuneiform there is no agreement whether there is a glottographic system present in the clay tablets, in a manner similar to the case of Mesoamerica where it is debatable if economic records such as the *Matrícula de Tributos* or the *Codex Mendoza* are writing or not. According to some experts in proto-cuneiform, in this system are evidenced, at best, "[w]eak connections to [spoken] language" (Hyman 2006: 232 and n. 5), while others see such correspondences without the least doubt. In this case, according to Hyman, speaking specifically of the archaic cuneiform system, the specialists get caught by "the prison-house of language", since they first identify signs as logograms (as Caplice, in: Hyman 2006: 234), but then indicate that these logograms are not strictly related to any particular language, so it is not glottographic writing. "The confusion here is remarkable […] outside language there are no words (and, hence, no logographic writing)" (Hyman 2006: 234).

NUMBERS AND GRAPHIC SPACE

There is an additional aspect of the recording of numbers in Mesopotamia (although from a later epoch, that is after the late Sumerian Babylonian system dating from 2000 BC to AD 75) that should also be presented. As this system developed (not in a direction towards glottography as has been mentioned), it began to make use of positional value of digits, that is, the value of the numeral depends

[31] Although he is not the only one, because here Harris (1999: 113ff.), Derrida (2008: 48, 56-57), Rotman (1997) and various others should also be mentioned (cf. Mikulska, in press).

on its position in relation to another, as occurs in the Arabic system, or the Maya or in the khipu. In the case of the Babylonian system, the highest values are written to the left, and the lower to the right, but additionally, the same signs are used to write fractions, which application depends equally on the order of the digits and the context (Walker 2003: 32). It follows that what the Babylonian system does —just as Arabic, Mayan or khipu— is to assign value to a sign depending on its "spatial" position within the recorded information. In other words, use is made of graphic space (which would be "visual" in case of the khipu), which is one of the most important principles of the algebraic script. And this is a type of system that deserves special attention.

However, possibly due to the problems associated, theorists of writing systems generally devote very little space in their work to mathematical script. A notable exception is Roy Harris who investigates further and comes to the surprising, at first glance, conclusion that it is the writing that takes advantage of the "enormous potential of writing as *writing*" (1999: 189).[32] The great value of this system is that it "uses the two-dimensional surface of writing with a different purpose", that is, "their scriptorial structure is designed with a view to integrating various kinds of calculations" (Harris 1999: 187, 1995: 134).[33] Already the same basic positional notation in mathematical notation (for example, "84"), in which the "8" has the value "eight tens" by being to the left of the "4", exemplifies the central idea expressed in the previous sentence. In addition, Harris points out, talking about the Sumerian notation of numbers based on position,[34] that this was "a complete break with the notion that written signs should agree or reflect the structures of the oral language. In other words, this notation *could not have been invented at all* if integration with speech had been the main concern of the inventor" (1999: 189, emphasis added). This idea that writing does not have to rely on speech is the key to mathematical script and the key to the use of the written −"graphic" for those who cannot be convinced− sign as such (cf. Harris 1999: 189-190).

Wanting to see the algebraic script as a system that reflects language can lead to a blind spot in a similar manner to the case of proto-cuneiform writing (or of the record of tributes in the *Codex Mendoza*). As was seen before, the mathematical script is a code par excellence not related to any spoken language in particular, that is to say, it is not created with a base in any oral language, it is not dependent on it and by itself functions without any "oral realization." However, precisely "the imprisonment of language" can lead to opinions like Gelb's, who speaking of mathematical formulae said: "each simple sign has or can have an exact correspondence in speech"[35] but afterwards stated that the meaning of the global formula is "conveyed by the sum of the signs in an order and form which does not follow the conventions of normal, phonetic conventions" (Gelb 1963: 18).[36] What can be taken from this finding is that what is recorded in an algebraic writing system can be verbalized in different idioms, precisely because it does not follow the syntax of any specific language, but does possess a structure and develops its own syntax, in a similar—although not equal—manner as a glottographic system. This observation, in my opinion, also works for other systems that some authors (Boone 1994: 15-22, 2000: 30-31, 2008: 317-319; Jackson 2011: 231-233, 2013: 21-23; Colas 2011: 14-16; Urcid in press; above) call semasiographic; while the possession of structure or syntax cannot be the criterion to distinguish between glottographies and semasiographies, since both possess it (Javier Urcid, personal

[32] "[E]norme potencial de la escritura en tanto *escritura*" (Harris 1999: 189; emphasis in original).

[33] "[U]tiliza la superficie de escritura bidimensional con un fin diferente" "su estructura escrituraria está diseñada con el fin de integrar diversos tipos de cálculos".

[34] Using this word with the meaning that Elkins gives it (1999: 257).

[35] Harris criticizes it saying it is not possible to find "exact correspondences in speech" ("correspondencias exactas en el habla") for each mathematical sign but that it is rather a matter of "approximate equivalences" ("equivalencias aproximadas"; Harris 1999: 188).

[36] Perhaps this type of consideration arises from the frequent opinion that mathematical annotations may be "secondary derivatives of glottic writing" "derivados secundarios de la escritura glótica", as Harris sums it up (1999: 187).

communication 2013), the fact is that the latter contain patterns that indicate the decoding order (among other indicators, thanks to alignment), and then allow verbalization in different languages. This is what causes mathematical script to be generally accepted intuitively as a system of writing, owing to its not being linked to any particular language.

Returning to the use of the (two dimensional) writing surface, it turns out that it is used in the writing system for mathematics for syntagmatic purposes, for example, to indicate the mental calculations to be done, and not only for "reading" the text. This occurs in the vertical alignment on the page of numerals to add or multiply (cf. Harris 1999: 193) or divide. Thus, mathematical notations show in a very obvious way that the same graphic system serves for the creation of meaning and knowledge. For this reason Jackson called them an "active tool for the creation of knowledge" (2013: 28-29), along with other semasiographies she called "operational" and which also include tables, diagrams, sketches, train schedules, calendars, etc. (2013: 26-31; below). We can ask, obviously, if any system of graphic communication does not serve as such a tool,[37] because as Rotman noted, "mathematical thinking and writing are folded into each other and are inseparable not only in an obvious practical sense, but also theoretically, in relation to the cognitive possibilities that are mathematically available" (Rotman 1997: 24). Overall, we could say, following Cardona (1999: 133), that to manipulate content at the level of visual space is a huge cognitive accomplishment —if not "revolution", as the Italian anthropologist prefers to put it— and in my opinion, it is the basis that serves to organize data, and then to organize thought, which is the theme I develop in the next section.

LISTS AND TABLES

The great cognitive advancement that occurred arising from the use of graphic space actually began before assigning place value to numbers and before the creation of diagrams. As Jack Goody pointed out (1977: 68, 70, 75, 81), the first moment when cognitive processes make use of formal operations of a graphic type is making lists. Examples are the earliest records of Mesopotamia, first the aforementioned economic and administrative lists, and then the lexical (Goody 1977: 81-82; Høyrup 1994: 22), both kinds of texts possessing great antiquity and distribution (Bagley 2008: 220). In these, as in Egyptian onomastic lists, items are organized by category, but to arrange them correctly one must first carry out a process of abstraction and categorization (Goody 1977: 74-110). As Goody says, the question in oral form "what is a tomato?" is quite trivial and meaningless, but crucial for the development of classification lists (1977: 105), in which the objects listed will be organized in an aligned form. Lists are then the result of a process of abstraction that separates the components from some of their linguistic, social and communication context — in a manner similar to how a process of abstraction permitted separation of numerical value from counted objects (above). Indeed, the economic and administrative lists are composed of two types of script signs, the numerical and the logographic (cf. Goody 1977: 82; above) — which again makes it clear that you cannot consider either of these systems as the only one to determine the occurrence of writing. According to Goody, this moment is the real beginning of literacy (1977: 68, 70, 75, 81), which in the Mesoamerica field Miller (1983: 46) also stressed, saying that "the significant cultural act is not writing, but list-making".[38]

What is most relevant now is that lists are something conferred fully with graphic form, given that this creation takes advantage of the visual possibilities offered by the graphic interface, which "has more than one dimension and hence allows a variety of procedures for arranging and processing"

[37] I thank Javier Urcid for this observation.

[38] Miller continues: "... the moment in time when man began to make recorded lists marks the beginning of literacy, not when he developed a form of notation recorded in the linear form we call writing" (1983: 46).

(Harris 1999: 180).[39] In fact, for organizing lists, graphic space is used quite liberally (from top to bottom or vice versa, from left to right or vice versa, etc., Goody 1977: 81) a procedure that later will be employed as much in mathematical scripts as in any glottographic system. Tables follow lists and make even greater use of spatial organization, using two alignments at the same time (cf. Goody 1977: 81) and forming a "grid" which allows the best efficiency in the analysis of data. According to Goody, it is precisely tables that are responsible for "the shift from utterance to text [that] led to significant developments of a sort that might be loosely referred to as a change in consciousness and which in part arose from the great extension of formal operations of a graphic kind" (1977: 75), and again it must be stressed that it is the "grid" that is the basis of the table, but also of algebraic scripts and glottographic systems. In other words, even though our writing seems to us "lineal", it actually encompasses two alignments at the same time, the vertical and the horizontal, producing a third, global, that, in graphic space in some manner "underlies" a two-dimensional or "grid" format (Harris 1999: 183).

For the purposes of this article, it is indispensable to emphasize that the definition of a table—"... an arrangement of numbers, words or items of any kind, in a definite and compact form, so as to exhibit some sets of facts, or relations in a distinct and comprehensive way, for convenience of study, reference, or calculation." (in: Goody 1977: 54) does not indicate the necessity of the use of some glottographic system for its elaboration.[40] Therefore, the use of tables is proper as much to glottographic systems as to semasiographic ones (among them mathematics), since the data can be recorded by means of signs of any type (iconic, glottic/glottographic, etc.), but what matters is that the information is transmitted thanks to the visual arrangement of the data, which shows the relationships among them. That the use of glottographic signs is not determinant for the creation of a table can be observed in the examples of the charts presented in Figure 7a-b, in which the data are codified by means of signs of arrows, colors, flags (for which the names of countries written glottographically could be substituted without any problem), and numbers or letters of the alphabet. As can be seen, some of them do not operate via the glottographic principle (that is, it is not a matter of pronouncing them as "a", "b", etc.), but via what I would call the semasiographic principle, which in this case assigns the graphic signs to the measurements of chests and hips. Additionally, it must be emphasized that even when the tables with information provided using a glottographic system begin to be verbalized, producing a continuous oral text, it is exactly at that point that the information transferred by marking relationships among the data is lost. In other words, the tables are created to be seen and analyzed, and not "read", and normally their use implies extracting the data needed in a given moment.

Therefore, as mentioned, the use of tables belongs as much to glottographic systems as to mathematical script, but equally should be mentioned the calendar register form —contemporary European calendars as much as the Mesoamerican *tonalamatl*— horoscopes (Chinese and medieval European), or the magic interpretive tables of the Near East, the Chinese *I Ching* or the Ifá graphic notation (of the Yoruba of current day Nigeria). All these are cultural products that have resulted, in my opinion, from the use of graphic registers and taking advantage of graphic space, and conversely, the use of registers permits the creation of greater complexity in these systems of computation. Although it is not my objective to investigate the beginnings of calendars and systems of divination in various regions of the world in this article (cf. Goody 1977: 91-93), I want to call attention to their indubitable antiquity and to the fact of their close link with graphic registers, the use of graphic space, and in particular, with the elaboration of diagrams or graphic tables. And the *I Ching* system of divination can serve as a brief example here.

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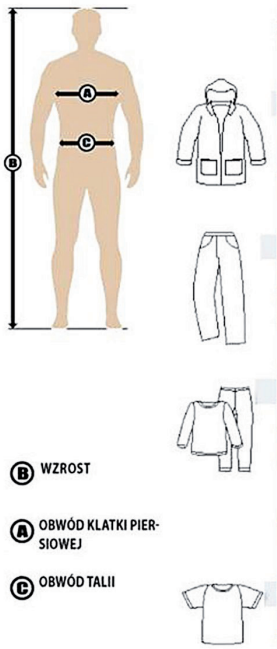
[39] In the Spanish translation: "tiene más de una dimensión y, por ende, permite una variedad de procedimientos de formación y procesamiento" (Harris 1999: 180).

[40] Even if the absence of any comment about the use of glottographic signs in tables is a result of lack of interest of the authors of the dictionary in this regard.

a



MĘŻCZYZNA

B		156/164	156/164	164/172	172/180	180/188	188/196	196/204
		XS	S	M	L	XL	XXL	XXXL
BLUZA/KURTKA/KAMIZELKA								
		44/46	46/48	48/50	50/52	52/54	54/56	56/58
		48/50	50/52	52/54	54/56	56/58	58/60	60/62
A	cm	90/94	94/98	98/102	102/106	106/110	110/114	114/118
	inch	35½/37	37/38½	38½/40	40/41½	41½/43½	43½/45	45/46½
SPODNIE								
			34/36	38/40	42/44	46/48	50/52	54/56
			38/40	42/44	46/48	50/52	54/56	58/60
C	cm		66/74	74/82	82/90	90/98	98/106	106/117
	inch		26/29	29/32	32/35½	35½/38½	38½/41½	41½/46
BIELIZNA								
			34/36	38/40	42/44	46/48	50/52	54/56
			38/40	42/44	46/48	50/52	54/56	58/60
A	cm		78/86	86/94	94/102	102/110	110/118	118/123
	inch		30½/34	34/37	37/40	40/43½	43½/ 46½	46½/48½
C	cm		66/74	74/82	82/90	90/98	98/106	106/117
	inch		26/29	29/32	32/35½	35½/38½	38½/41½	41½/46
T-SHIRT								
A	cm		80/88	89/97	98/106	107/115	116/124	125/133

b

País	Mortalidad Infantil	Gasto en salud % PIB	Desempleo Urbano	Hogares bajo línea de pobreza
Argentina	↓	=	↓	=
Bolivia	↑	↑↑↑	↑	=
Brasil	↑	↓	↓	↑
Colombia	↓	=	↓	=
Costa Rica	↑	↑	↓↓↓	↑
Chile	↑	↑	↓	↓
Ecuador	↓	↑	↓	↓
El Salvador	↑↑↑	↓↓↓	↓	=
Guatemala	↑	↓↓↓	↑↑↑	=
Honduras	↓	↑	↓	=
México	↑	↓	↓↓↓	↓
Nicaragua	↑↑↑	=	↓	=
Panamá	↓↓↓	↓↓↓	↓	↑
Paraguay	↓↓↓	↑	=	↑
Perú	↓	↑	=	↑
R. Dominicana	↑	↑	↓	↑
Uruguay	↑	↑	↑	↑↑↑
Venezuela	↑	↑	↓	↑

Figure 7. Examples of tables exhibiting very limited use of the glottographic principle; a) sizing chart; b) Infant mortality and associated factors. Note that the country names written in the alphabetic system can be replaced by miniature flags for each country, without changing the information conveyed.

This system consists in first creating a graphic inscription in the form of a trigram (a sign of three lines, continuous or discontinuous, whose shape depends on a random procedure), then making a combination of two trigrams to form a hexagram (of six lines) (Figure 8a). These constitute a closed repertoire, and given that the possible combinations of the trigrams are eight in all, the hexagrams in total are 8 x 8, which yields 64, and a divinatory interpretation is linked to each one (Chen 1972).[41] The "normal" form of presenting the hexagrams is in the form of a table (Figure 8b), thanks to which it is easy to find the combination of two trigrams which are located in cells which inaugurate the rows and columns (indeed, this is another example of a table without glottographic signs). As to the antiquity of the *I Ching* system, it origins are situated in a mythical antiquity (Wilhelm and Baynes 1997: 47), although the actual collection of 64 hexagrams comes from King Wên (progenitor of the Chou dynasty; 1150-249 BC; Wilhelm and Baynes 1997: 59; cf. Chen 1972: 237-238).[42] Nevertheless, in tracing the origin of the signs, it turns out that the eight trigrams of the repertoire appear in distinct combinations in two very early *Book of Changes*: one from the Hsia Dynasty (2205-1766 BC) and the other from the Shang Dynasty (1766-1150 BC), and one of the hexagrams (combinations of the trigrams) appears in both (Wilhelm and Baynes 1997: 58). What interests me is to point out that this system (or an earlier but similar one) has an antiquity similar to the earliest records of Chinese writing, which appear in the so-called "oracle-bones" (tortoise shells or scapulae of oxen). While here every assertion depends on the dating accepted, what can be said is that, according to recent investigations, these objects with the recording of a continuous text date to around 1200 BC (Bagley 2008: 190ff.; Bottéro 2008: 250ff.), although the interpretation of signs produced by heat in turtle shells or scapulae was practiced much earlier (Bagley 2008: 191). What is relevant is that more or less at the same time as the divinatory records in "bone-oracles", the *I Ching* appeared with its trigrams and then hexagrams. Although it cannot be affirmed if in those times they were already drawing the information in the form of a table (in the same way that it cannot be affirmed that in the times of San José Mogote the *tonalamatl* was recorded in the form of a table, as it later appears in Postclassic codices), nevertheless, this is quite possible, given the complexity of the calculations involved in arriving at a hexagram (cf. Chen 1972) as well as the creation of one sign by means of the other two.

What is crucial is that the creation of the tables, that is of graphic formulae that make use of graphic space to facilitate the perception of relationships between signs, has a similar antiquity with glottographic systems. In other words, again it is the same mind that creates these two graphic "products": tables and glottographic writing.

CONCLUSIONS

To answer the questions posed at the beginning of this article, I do not have the least doubt that the oldest calendrical inscriptions in Mesoamerica are examples of writing. In my opinion, however, it is not in this case glottographic writing, that is, based on the representation of speech. The criteria that allow for using the term writing are, in this instance, abstraction, alignment and the use of graphic space.

Abstraction permits abstracting the numeric value from things counted to create signs that represent objects or words, that is, it is a process that moves toward the road to glottography. The creation of numeral signs, and their later development into a more complex system (for example, that of mathematics) is the result of a different process that does not have as its goal the presentation of language, either in its origins, or later. These signs can be verbalized in any language (or even not

[41] In reality, the system is much more complex and still not completely understood (cf. Chen 1972: 237).

[42] Shih-chuan Chen, for his part, finds a precise date which records the use of the *I Ching* in a story that takes place in the year 685 BC concerning the Count of Ch'en arriving at the hexagram Pi (1972: 238).

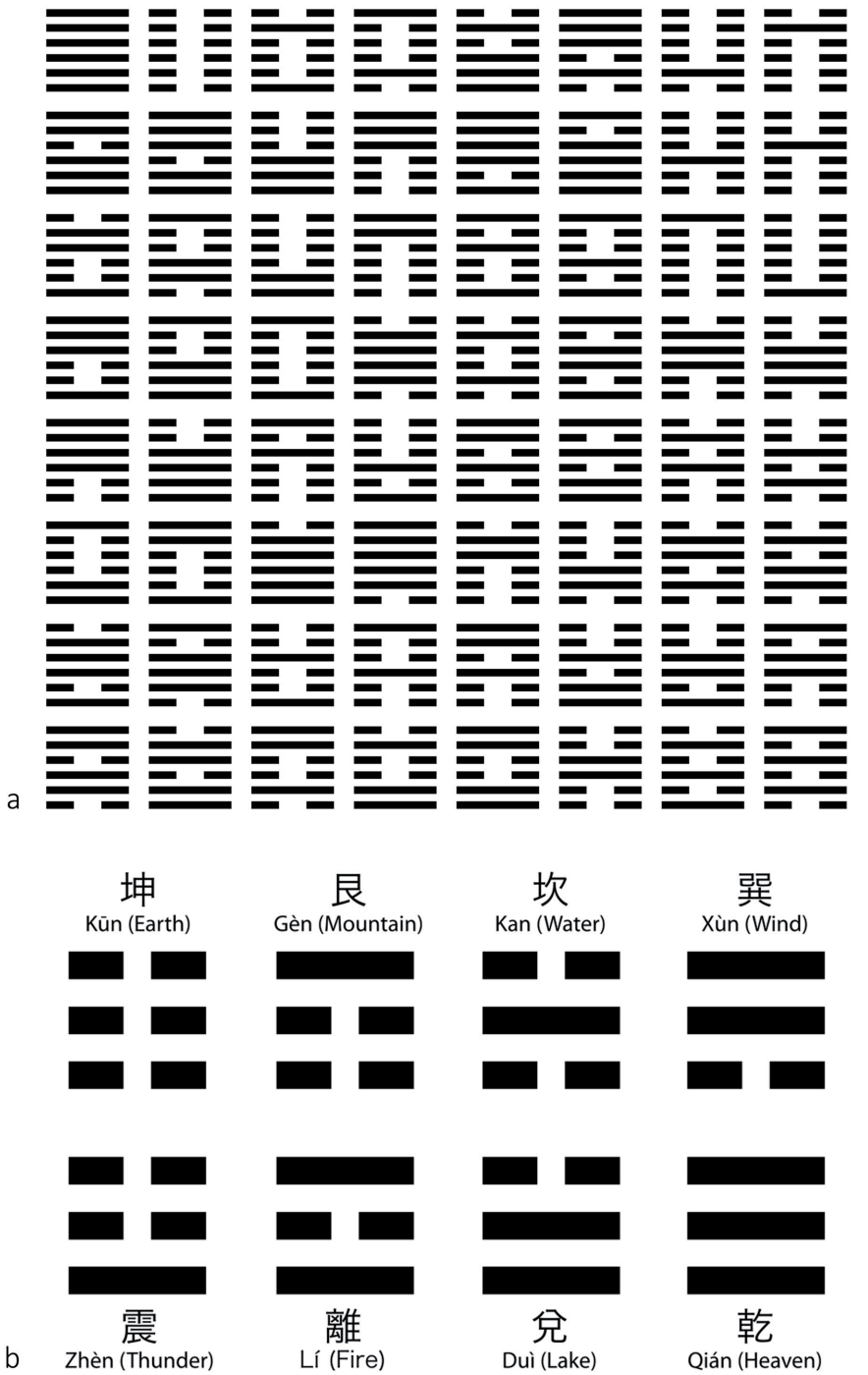


Figure 8. Trigrams and hexagrams of the *I Ching* (after Wikipedia 2013).

verbalized), always and when the code employed is known. In both cases, however, systems are created that permit combining and re-combining graphic signs, providing the possibility to express a broader range of meanings (Olson 2010: 132-133; above), and what is important is that even signs of different character (that is, that operate under different principles) can be combined, forming more complex systems. Such is also the case with calendar registers: undoubtedly one part of them is recorded by means of numbers, but the other part is comprised of signs of days, months or other periods of time. Here the question is if this second group of graphic signs is linked to a particular language. Taking into account that we can speak of 'movement' or 'eye' in the case of the relief of San José Mogote, or of *acatl* or *ben* in the case of Stela 2 of Chiapa de Corzo (above), or even *cipactli*, 'lizard' or 'caiman', or of *ollin*, 'movement' in the case of the *Codex Borgia*, I believe that there are now no arguments affirming that these signs are written in a particular language (although it is clear they were created or used in a specific linguistic context, the same as "5" with reference to *öt forint*). This, however, could be supported via the verbalization (in the language of their authors) of these signs, which implies some change or addition of meaning arising from homophony, or, in other words, that owing to the principle of homophony, these verbalized signs also refer to other meanings—which only could be provided in a particular language. That is, in such a case, the differentiation between a system of writing codified semantically from one codified phonetically would be evident, thanks to the use of homophony, which is when a system of graphic communication begins to be limited to a specific language (Urcid in press; cf. Wood 2010a: 20). A clear example of the use of a homophony principle is the glyph for 'year' in the form of a turquoise square, since in Nahuatl turquoise is called *xīhuitl*, which is homophonic with *xīhuitl* also meaning 'year' (Batalla 1995b: 630).[43]

As for the other two criteria, alignment and the use of graphic space, again they are aspects that appear as much in glottographic systems as those that have come to be called semasiographic. Alignment makes use of the bidimensionality of the graphic space, in which the signs are organized in a way that indicates the order (or different orders) of their processing,[44] but does not necessarily imply glottographic reading, given that it functions equally, for example, with a mathematical or calendrical register. These last, for their part, are those that operate par excellence thanks to taking maximum advantage of the possibilities offered by graphic space, that is, thanks to the use of grids and tables. It should be noted that in the process of development of non-glottographic registers, the use of graphic space leads to the creation of diagrams (calendrical, chemical, physical, molecular, etc.), kinship diagrams, truth tables used in logic, UML models, etc. (Hyman 2006: 245-246). Again, a glottographic system does not dispense with the use of graphic space, beginning with the underlying "grid" (that governs the processing of the text) and with the very organization of the page. Conversely, the glottographic principle can be used in tables, diagrams and schema (although it is not indispensable; above).

Based on the arguments presented here, I believe that we can affirm that the inscriptions on the relief of San José Mogote or on Stelae 12 and 13 of Monte Alban, as well as those on Monument 13 at La Venta or on the Cascajal Block, are records of writing. Perhaps in the last two it is glottographic writing, that is, they are based in a particular language, although this assertion remains at the hypothetical level, since we do not know the language involved and because we cannot be sure if they contain a record of continuous discourse. Nevertheless, in all these monuments the inscriptions comply with other criteria analyzed here: abstraction, alignment, and use of graphic space. Finally, I should point out that in no case in this brief article have I explored all the criteria that should be taken

[43] As far as I know, our earliest example of the use of the glyph for "year" in the form of a turquoise square is from *Codex Borbonicus* (pl. 34, 37, 37). A date inside a square appears also in some stone pre-Hispanic monuments, nevertheless, the color is missing, so it can neither be affirmed nor denied that such signs also operated in a homophonic manner.

[44] Processing is the term used by Harris (1999: 93ff.; 1995: 64ff.) which includes as much the process of the elaboration of the text as that of its reproduction (verbalization or reading, according to the type of the text).

into account when speaking about what writing is, nor have I had space to provide a report on the many contributions to this discussion made in recent years. I have focused only on why inscriptions of numbers (and by extension, calendar registers) constitute writing, even though they are not based on nor do they reflect any particular language.

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