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MANUFACTURE AND MEASUREMENT

Counting, Measuring and Recording Craft Items in Early Aegean Societies

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CONTENTS

EVIDENCE FOR COUNTING AND RECORDING IN THE NEOLITHIC? ARTEFACTS AS SIGNS AND SIGNS ON ARTEFACTS

Christina Marangou

Both arithmetic and recording rely on semiotic systems, necessary for storing information. Search for indications of such human operations in prehistoric periods, before the existence of deciphered texts, can only be based on material culture and on the study of human cognition and behaviour. The archaeological record in the Near East and Europe comprises three-dimensional artefacts of unknown function, as well as two-dimensional marks on various artefacts, which have both been interpreted as the materialisation of signs belonging to past reckoning and recording systems in a concrete form. This hypothesis is considered here for the evidence of the Greek Neolithic, in the light of previous studies on data from other areas.

I. THEORETICAL BACKGROUND

I.1. Signs and signs

The word 'sign' is used here with two different meanings. The first one consists of a 'mark, symbol, or device used to represent something or distinguish the object on which it is put' (sign). The second one refers to a 'basic element of communication, ...consisting of two indivisible elements, the relation between which is arbitrary (*signifiant* and *signifié*), and which derives its meaning only from its relationship to other signs within the same sign-system' (sign).[1]

According to Molino,[2] the most accurate definition of the sign, is something which stands for something else (*stat aliquid pro aliquo* according to the Scholastics).[3] Peirce[4] considers that a sign is something that means something to somebody, that it creates in this person's mind an equivalent or a more developed sign, the 'interpretant' of the first sign. An object can be represented or referred to through 'interpretants' of the original sign, in infinite cross-reference.[5]

Molino[6] distinguishes a semiology of communication (the sign is an instrument of human communication) and a semiology of representation (the sign is a substitute whose function is primarily cognitive). He agrees with Leroi-Gourhan that man builds concrete tools and symbols, both relying on the same fundamental equipment of the mind. Language and tool are both expressions of the same property of humankind.[7] Both human memory and tool are exteriorised

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[1] Brown 1993, 2858, 'sign' 2a, 2e.
[2] Molino 1992, 16.
[3] Something which stands for or represents something else is called a symbol (see further) by Renfrew (1994, 5).
[4] Peirce 1955, 99.
[5] Molino 1992, 16.
[6] Molino 1992, 16.
[7] Leroi-Gourhan 1964, 162-163; Molino 1992, 16.

and contained in the (ethnic) collectivity.[8] The sign, then, exists materially and can be analysed as an object.[9]

According to Peirce,[10] signs are classified into icons, indices and symbols. Iconic signs are those linked by resemblance to the things they are signs of. Indexical (indicative) signs are constrained in their form by what they indicate. Symbolic signs stand in an arbitrary relation to what they represent; they need neither resemble nor be constrained in their form by those things.[11] This shows the difficulty of assigning a material object or a mark to one of these categories. It would mean accepting that they were representing more or less accurately other things (they would be icons) or that they may refer to them by being affected by these objects (by having some common quality) (they would be indices) or without any perceivable relation to the latter (they would be symbols).

A symbol is 'a thing conventionally regarded as representing, typifying or recalling something else by possessing analogous qualities or by association in fact or thought; especially a material object representing an abstract concept or quality'.[12] Or a symbol is defined as 'that which, by custom or convention, represents something else'.[13] Because the relationship of representing is only referential, one (symbolic) sign can, in principle, be 'substituted for another with no loss of functional utility, provided that all relevant sign users are aware of the substitution'.[14]

The sign has symbolic function in particular types of behaviour, such as language, script, calculation, etc., which allow representation through signs or images.[15] The relationship between these forms of expression and what they refer to, as well as the nature of code-making are arbitrary.[16] The existence of an object of reference shows the conceptual level of the substitution during code-making; anyone who understands the reference understands the concept.[17]

As the tool represents distance from the object, the symbol represents distance from reality. Since there is mediation and distance, there is the possibility of a projection toward the past (memory) and toward the future (daydreaming, imagination, technical, artistic, and scientific creation).[18]

Renfrew[19] has recently summed up the different uses of sign systems by humans, referring to them rather as symbol systems. His approach considers, more generally, 'cognitive' archaeology as the 'study of past ways of thought as inferred from material remains'. It studies the specially human ability to construct and use symbols, as well as the ways in which symbols have been used in several categories of human behaviour. These include design (purposive behaviour), planning, measurement, social relations, the supernatural, and the representation of reality.[20]

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[8] Leroi-Gourhan 1965, 64.
[9] Molino 1992, 17.
[10] See, for example, Greenlee 1973, 70ff.
[11] Definitions in Noble & Davidson 1996, 112; cf. Peirce 1955, 102; Lieberman 1980, 341.
[12] Brown 1993, 3183, 'symbol'.
[13] Noble & Davidson 1996, 61.
[14] Noble & Davidson 1996, 63.
[15] Molino 1992, 17 with references.
[16] Noble & Davidson 1996, 58, 60.
[17] Noble & Davidson 1996, 61.
[18] Molino 1992, 19.
[19] Renfrew 1994.
[20] Renfrew 1994, 3, 5, 6.

I.2. Memory and cognitive devices

Oral societies use their own mnemotechnic devices,[21] but they may also have specific graphic (not written) complements.[22] D'Errico[23] has stressed the importance of the emergence, during a major stage of the evolution of human cognition, of symbolic forms of behaviour, resulting in the ability to preserve and use information stored away from the human body.

Sign systems, for instance art, counting, measurement, story-telling and writing, constitute reinforcing mechanisms which increase the length of time that information may be kept in short-term memory (which has a very small capacity) and accessed and brought from long-term into short-term memory.[24]

Sign systems and corresponding cognitive devices for recording and processing large quantities of information, impossible to retain by memory, can be used on several occasions, such as the above-cited examples. Another extreme case is navigation out of sight of land. Besides an understanding of the principles of boat building and sailing, knowledge of the waters, sky and wind were necessary to prehistoric mariners. The latter lacked precision instruments to guide them in directional orientation, although they had to conceptualise and calculate time, in the case of tides,[25] and measure distances and speed. Instruction of traditional seafaring in Pacific islands still uses mnemonic devices for the memorisation of sea routes, directions, stars positions, currents and winds and we can presume that some sort of cognitive devices would have been necessary also in the prehistoric Mediterranean.

Measurement requires actions in which devices for measuring and units of measure are often involved, including weights, measuring rods, etc.[26] Thus, some artefacts not only reflect cognition but also intentionally represent mental content; they have meaning; they are intended to be read.[27] Material representations, physical traces of cognitive devices, such as dials for time, direction and distance, are not, though, merely mental aids; they may include public display.[28] This social aspect seems to be often, if not always, interwoven with the expression of the mental ability and erudition of some individuals,[29] and, more generally, with knowledge and lore, including their teaching and transmission, of which the most obvious example would be initiation.

I.3. Elementary forms of counting and recording

The simplest method of reckoning is concrete counting, based on a one-to-one correspondence by comparing two sets of beings or objects, by bijection.[30] Different means may be used: shells, bones, grains, sticks, pebbles. They were possibly used very early in prehistory and are still used today: for example, some Iraqi shepherds keep track of their flocks with

[21] Hagège 1985, 84-86.
[22] Glück 1987.
[23] D'Errico 1998, 19 with references.
[24] Zubrow 1994, 189.
[25] Frake 1994, 123, 124, 128.
[26] Renfrew 1994, 6, 7.
[27] Frake 1994, 119.
[28] Frake 1994, 119, 130.
[29] Frake 1994, 119, 130.
[30] Ifrah 1994, 43.

pebbles.[31] These piles of stones and other objects manipulated for arithmetic operations led much later to the appearance of calculating instruments.[32]

This method cannot indicate what item was counted and cannot count more than one category at a time.[33] Nevertheless, it permits the attainment of several numbers, without naming or knowing the quantities.[34] Use of symbols which stand for concrete objects and convey information about their number, and which cannot dissociate numbers from the items counted, does not assume the concept of number and abstract counting. These proto-arithmetical techniques rather indicate the ability to establish correspondences between symbols and counted objects, that is, concrete counting.[35]

Yet, handling large numbers is difficult for ordinary minds.[36] Direct visual perception of numbers has its limits.[37] In oral societies, multiplication being in effect non-existent, addition is based on counting a set of objects or by visual direct representation. Counting one by one may be replaced by a cognitive process called subitizing, that is, apprehending without counting sets of six or fewer elements, a limit fixed by the structural characteristics of the human brain.[38] This can result in the 'base' principle of a system of numbering,[39] when a certain number of units is replaced by a higher unit (cf. for example the sexagesimal system of the ancient Near East).[40] Grouping objects in order to count them[41] is an important progress, the process being done by ordering them in series, and shows that the number sequence is unlimited.[42]

II. Evidence About Prehistoric Counting/Recording Sign Systems?

II.1. Palaeolithic and Mesolithic

One can easily imagine that similar simple mnemotechnic devices were invented independently and used in different times and places.[43] It is not surprising, then, that some series of prehistoric artefacts bearing sets of elements have been interpreted as counting or recording devices, such as the universal bone or wood tally sticks, used till recently,[44] which are carved, scratched or cut.[45] The simplest ones bear rows of similar notches. A single kind of mark –notch–

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[31] Schmandt-Besserat 1996, 11.
[32] Ifrah 1994, 298-299.
[33] Schmandt-Besserat 1996, 92.
[34] Ifrah 1994, 41-43.
[35] Nissen *et al.* 1993, 125. Different items are counted with different processes (Goody 1979, 52).
[36] Frake 1994, 124.
[37] Four according to Ifrah (1994, 33) and Schärlig (2001, 107).
[38] Goody 1994, 283 with references.
[39] Ifrah 1994, 234-235. Schärlig (2001, 107) refers to a very ancient base 'five' (four + one), as deriving from counting on one's fingers –a natural process (2001, 116).
[40] Nissen *et al.* 1993, 25, 131.
[41] The symbolic representation of these progressive groupings led to the earliest number symbols. Systems of 'early' or row numerals were formed according to this rule, like the Egyptian and Roman numerals (Menninger 1969, 42, 240).
[42] Menninger 1969, 39, 42.
[43] Nissen 1998, 31.
[44] Ifrah 1994, 157-160.
[45] Menninger 1969, 223.

shows that tallies could handle only one type of data at a time;[46] only quantities of objects or beings are indicated, not their nature.[47] These notches could not be abstract numerals, since the numbers they are supposed to have represented would be tied to the objects numbered.[48] Knots used as numerals in Peru attest a comparable method, but there they were used for state records (*quippus*).[49] The rows of notches on tallies may also be organised in separate groups, requiring variation[50] in marks.[51]

Groupings also mean rhythm, a concept that is inherent in man.[52] Regular rhythms in the natural world can be observed about stars, seasons and days, walking and heartbeat.[53] It has accordingly been argued that the first item to be counted was time. Measuring time in fact involves many repeated, sequential actions, which, when recorded, often display periodicities related to those of the sun and moon: the number of days, the lunar month and solar year.[54]

Thus the next step was attributing rhythmic sequences of marks incised on tallies to calendar notation. This was the main interpretation by Marshack[55] of marks on a series of Palaeolithic bone and ivory objects[56] attested since the end of the Mousterian. Counting time would then, according to Schmandt-Besserat,[57] permit dispersed communities to gather at intervals on special occasions. Others have interpreted the same marks as recording hunted animals.[58] Leroi-Gourhan[59] considered it more probable that they would be aids for rhythmic incantations and recitations and correspond to the rhythm of speech ('*dispositif rythmique de caractère incantatoire ou déclamatoire*'): a function similar to that of the Australian *churinga*, small plaques engraved with abstract patterns related to a mythical content.

According to Couraud,[60] the Mesolithic Azilian (11000-9000 BP) painted and/or engraved pebbles ('*galets aziliens*') show a continuity of patterns since the Palaeolithic period, and exhibit a predilection for certain clusters of numbers. The lunar calendar argument would be debatable for the larger numbers, but seems impossible for the frequent small ones; the latter may have had various functions. Yet, groups of pebbles bearing small numbers may also have been considered

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[46] Noble & Davidson 1996, 223.
[47] Ifrah 1994, 160.
[48] Menninger 1969, 247. See note 35.
[49] Menninger 1969, 253; Ifrah 1994, 169ff.
[50] Menninger 1969, 240.
[51] It has been argued that bar-and-dot numerals, among the earliest recognisable Mesoamerican written signs were probably much older than writing, because they are structured as simple tallies (Justeson 1986, 440, fig. 2a), representing bars and dots.
[52] Leroi-Gourhan 1964, 265; 1965, 82.
[53] Leroi-Gourhan 1965, 142-144.
[54] Renfrew 1994, 7.
[55] For example Marshack 1970, 1991; cf. discussion and bibliography in D'Errico 1995, 55-56, 302; 1998, 20, 49.
[56] Objections as to the identification of these marks as intentional have been expressed by Noble & Davidson (1996, 223), who argue that marks in bone occur thousands of years before the appearance of modern human morphology and before the signs or symbols. Besides, they might be an unintended by-product of the action of cutting with sharp-edged stone flakes on flesh-bearing bone. They show 'increasing control of motor sequences, but would not prove that those leaving the marks noticed them'.
[57] Schmandt-Besserat 1996, 101.
[58] References in D'Errico 1998, 20.
[59] Leroi-Gourhan 1964, 263.
[60] Couraud 1985, 98-110.

as sets.[61] The same author admits the notation of some unknown 'cycles' at the end of the Palaeolithic and the last glaciation.[62]

Microscopic examination of the engraved stone and bone Mesolithic artefacts and experimentation persuaded D'Errico[63] that the engravings had been made without any slow accumulation. This led him to the conclusion that the Azilian engravings could not be calendars or marks of hunting, but that they were rather made in a quick succession of gestures with the same tool and at the same time.[64] They would not be the bearers of a specific information (word, phoneme etc.), since they are not distinguished individually. Some of them could nevertheless be schematised human or animal figures.[65] The engravings do not reflect a consequence of climatic changes, but rather resulted from a tendency towards schematisation.[66]

D'Errico further admits the existence, since the Palaeolithic, of 'artificial memory systems' (AMSs) ('*systèmes artificiels à mémoire*').[67] Evidence about their existence in the Lower and Middle Palaeolithic is limited and controversial, but it is certain in the Upper Palaeolithic of Europe.[68] He accepts[69] that several factors are important for the elaboration of a code for such systems: morphology, spatial distribution, number and temporal accumulation of the elements. He argues[70] that, at the end of Upper Palaeolithic, marks and sets become more numerous, while marking techniques producing many marks on a restricted surface are used, and visual perception is more systematically practised for retrieving information. The codes become more complex, with hierarchical organisation of information and the use of formally differentiated marks.

II.2. Neolithic

Simple mnemotechnic means were sufficient for a very long period, but accumulation of information resulted at a certain point in the inability of the human memory to manage it and external storage became necessary.[71] In a discussion about cognitive phases in human evolution, Renfrew[72] proposes a distinct phase of 'external symbolic storage employing symbolic material culture, characteristic of early agrarian societies with permanent settlements, monuments and valuables'. This phase would follow the transition to food production (the 'Neolithic revolution') and precede the transition to the development of writing (somehow related to the 'urban revolution').

It is in this general context that some series of Neolithic finds from Greece and its neighbouring areas, notably Near East and south-eastern Europe are considered. They consist of:

- small objects of unknown function, and
- artefacts, including examples of recognisable categories, such as tools, vases or miniature objects, which bear incised signs (marks), in addition to or independently of decoration.

In the absence of any proof of function, the study of the material objects of the first category may deal with interpretative hypotheses and consider them as signs, belonging to one or more

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[61] Couraud 1985, 139-143.
[62] Couraud 1985, 148-149.
[63] D'Errico 1995.
[64] D'Errico 1995, 219, 286, 309.
[65] D'Errico 1995, 309-310.
[66] D'Errico 1995, 289.
[67] D'Errico 1995, 222-227.
[68] D'Errico 1998, 25, 43.
[69] D'Errico 1995, 222-227; 1998, 21.
[70] D'Errico 1998, 47.
[71] Nissen 1998, 31.
[72] Renfrew 1998, 4.

alternative sign systems. On a different level, since they are two-dimensional, the marks on objects of the second category, which may be utilitarian,[73] also seem to convey a message following some code, and, in this respect, they should also be considered as signs in one or more sign systems.

Both categories have been studied till now by several authors and opinions on their interpretation diverge. Yet, it has often been argued that the sign systems of notation to which they belonged were related to counting, recording or to script in one of its most elementary and archaic forms.

II.2.a. Artefacts as signs

1) Evidence from the Near East

This is how 'tokens' (Fig. 1, right), small clay, and, more rarely, stone objects of the Neolithic Near East have been interpreted as traces of concrete counting. Schmandt-Besserat developed earlier theses by Oppenheim and Amiet.[74] Based on the study of 8,162 tokens,[75] she considered them not only as counting and recording devices, but also as the immediate precursor of cuneiform writing, by mutation of the three-dimensional tokens into two-dimensional graphic symbols (cf. Fig. 1).[76]

The examples date from the 8th to the 4th millennium, have been found in a large geographical area, including Iraq, Iran, Syria, Turkey and Israel,[77] and have various geometric shapes (cones, spheres, disks, cylinders etc.) and an average size of 1-3 cm. x 3-5 cm.[78] According to Schmandt-Besserat,[79] these tokens would have evolved to meet the needs of the economy, at first keeping track of the products of farming, then extending to goods manufactured in urban workshops. Such a system would permit easy manipulation and flexible storing of unlimited quantities of information, while being open, since new signs could always be added, but their volume was difficult to use and they could not dissociate numbers from the items counted. Tallies would be more efficient for permanent records, but their data could not be disassembled.[80]

Several objections have been expressed[81] *vis-à-vis* Schmandt-Besserat's theory, mostly because she included 'plain' (geometric) and 'complex' (animals, vessels, tools) forms as part of the same reckoning system, which, moreover, would have been used during a very long period in different areas for the same function. Her six-stage model has not been proved stratigraphically.[82] Moreover, 'complex' tokens may also be interpreted alternatively as amulets, pendants, game pieces,[83] miniature vases or models.[84] Though at least some of them are clearly indices and icons, they have not been proved to fit into a single semiotic system, nor is it clear to which particular system(s) they belonged, since various other semiotic systems must have existed, among others,

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[73] The fact that an object possibly has a practical function does not preclude its having a symbolic value (cf. D'Errico 1995, 288).
[74] Lately Schmandt-Besserat 1996, 11; see also bibliography in Zimansky 1993, 517.
[75] Schmandt-Besserat 1992.
[76] Schmandt-Besserat 1996, 54. Objections in Glassner 2000, 101.
[77] Schmandt-Besserat 1996, 8.
[78] Schmandt-Besserat 1996, 15.
[79] Schmandt-Besserat 1996, 1.
[80] Schmandt-Besserat 1996, 92-95.
[81] Zimansky 1993; Glassner 2000, 87-112.
[82] Matthews 1998, 15.
[83] Ifrah 1994, 240.
[84] Zimansky 1993, 515.

play and jewellery.[85] The varied modes of representation used in these 'small clay objects' would show diversity of functions. Three-dimensional examples might be imitations of objects, but two-dimensional (flat) ones would rather be representations of representations; relative disparity in size and the presence of perforations in some cases only would also indicate functional variety.[86]

Furthermore, Schmandt-Besserat's theory has been criticised because the tokens she identified as livestock or textiles are comparatively very few, while keeping track of livestock would be expected for the Neolithic period, and textiles are common in later cuneiform documents.[87] Besides, plain tokens would not represent specific commodities constantly over the millennia over the entire Near East; similarities over this time span may be due to the fact that the basic geometric forms, which can be used in early numerical systems, are few.[88]

In spite of the critics, in the absence of any other alternate explanation, several scholars agree now that a part, at least, of the later tokens were counters.[89] The 4th millennium ones represented quantities, which would play an important role mostly in economic processes, according to Nissen.[90] If each token represented a counted unit, a small heap of tokens would represent the sum of the counted units. At a very early date, a particular number of units of the same value could be replaced by a specific symbol. By combining various symbols, relatively high numerical values could be obtained. Even though the true meaning of their shapes is not clear, the large quantities of clay tokens found in various geometric shapes may have been the representations of different numerical values.[91] With the differentiation of shapes and sizes, a second quality was added to their meaning. They were changed from indices to icons and/or symbols.[92] By the mnemonic means of differentiated shapes, specific information was transmitted concerning the nature of the represented objects, such as the product type, the units they were measured or counted in, etc.[93] If markings on tallies had unlimited possible interpretations, each clay token was now a distinct sign with a single significance; thus tokens also contained qualitative information.[94]

According to Schmandt-Besserat, from the 6th millennium tokens were often located in storage facilities and warehouses,[95] partly inside and partly outside domestic and public (since the 5th millennium) buildings,[96] most often associated with early summer deposits (4th millennium). They would have been discarded after the harvest, as soon as their (recording?) function had been fulfilled. They were therefore used primarily for record keeping rather than for reckoning and they were not related to trade and, in particular, obsidian trade.[97] In Uruk, they were discovered occasionally in fireplaces, either intentionally in order to be baked, or discarded.[98] They may be found on the floor, sometimes clustered together, as if they were kept

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[85] Lieberman 1980, 341 and note 10.
[86] Lieberman 1980, 354-356.
[87] Zimansky 1993, 516.
[88] Zimansky 1993, 516-517.
[89] Nissen *et al.* 1993, 125; cf. Glassner 2000, 103-104, 110.
[90] Nissen 1998, 26.
[91] Nissen *et al.* 1993, 11.
[92] Lieberman 1980, 343.
[93] Nissen *et al.* 1993, 127.
[94] Schmandt-Besserat 1996, 95.
[95] Schmandt-Besserat 1996, 33, 40.
[96] Schmandt-Besserat 1996, 29.
[97] Schmandt-Besserat 1996, 37.
[98] Schmandt-Besserat 1996, 31. They occur in non-domestic architecture in later periods and were sometimes found, with other status symbols, in burials of prestigious individuals, suggesting that they were used by members of the elite (Schmandt-Besserat 1996, 37).

in vessels.[99] Small groups were actually found in vases, often of small size, besides being discovered in heaps presumably contained in perishable vessels, in Tell Abada for example.[100]

The method of accumulating pebbles or clay tokens in heaps or containers, as a temporary record of numbers, has to be seen in the context of economic control, according to Nissen.[101] The frequency of small assemblages[102] led to the assumption that the accounts dealt generally with small quantities of different kinds of commodities.[103] Small quantities are also attested in proto-Elamite notation and would reveal[104] legal rather than purely economic preoccupations.

With increasing bureaucracy, from the 4th millennium, tokens were stored in the archives in sealed clay envelopes (*bullae*), with the shapes of tokens occasionally imprinted on the surface.[105] These imprints would be pictures of the tokens used as counters rather than pictures of the items they represented.[106] Yet there are occasional discrepancies between enclosed tokens and impressions.[107] Since *bullae* are often unopened, it has been suggested that they would have been used for storing and recording, not for carrying information.[108] Solid clay impressed tablets (Fig. 2) replaced *bullae* about 3500-3000 BC.[109]

Representation of tokens as impressions (their indices) shows them to have been signs within a system. The existence of indices of the tokens shows that the latter had a relationship to something else; they were signs in a single system, as they were included within a single *bulla*.[110] Besides, enclosing the tokens into envelopes with the final sum attests the understanding of the notion of cardinality.[111]

According to Lieberman,[112] such a system of numerals and impressions on *bullae* can be based on size-value (iconic). This seems to be a basis for the development of place-value (symbolic) notation: what was represented by the (relative) size of a sign was later represented by its (relative) place. Grouping values are given by the counters' positions, instead of their sizes. This led only later to the discovery of counting boards or abaci.[113] In fact, the shapes of the objects used as counters with the *bullae* suggest that they were not suited for placing on a flat surface (in connection with a counting board), since they are not particularly stable, but were rather to be held in a container.[114] This is corroborated by contextual evidence (see above).

Bullae and counters system may have operated as an alternative form of recording, perhaps in areas without a local scribal tradition,[115] since, after the invention of writing, the counters

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[99] Schmandt-Besserat 1996, 31.
[100] Jasim & Oates 1986, 355.
[101] Nissen 1986, 324.
[102] Schmandt-Besserat 1996, 20.
[103] Schmandt-Besserat 1996, 40.
[104] Vallat 1986, 338.
[105] Schmandt-Besserat 1996, 54; Nissen 1986, 324, 325, fig. 4.
[106] Schmandt-Besserat 1996, 54. See objections in Glassner 2000, 91-92.
[107] Glassner 2000, 108-110.
[108] Jasim & Oates 1986, 350.
[109] Schmandt-Besserat 1996, 55, 57. But see Glassner 2000, 152-156 about parallel use of inscribed *bullae* and tablets.
[110] Lieberman 1980, 341.
[111] Schmandt-Besserat 1996, 115.
[112] Lieberman 1980, 342-343.
[113] The abaci cluster the numbers down into groups so that they can be handled more easily; they are movable so that they can be combined without constant erasing and rewriting (Menninger 1969, 297).
[114] Lieberman 1980, 344.
[115] Jasim & Oates 1986, 349.

continued[116] to be used.[117] While the functioning of the tokens as numerals is distinct from script, they might be 'connected with the origins of writing, in some loose sense' (cf. Fig. 1).[118]

2) Evidence from Greece and other examples

It is easier to consider 'small objects' as possible material evidence about arithmetic or recording systems when they are found in groups. Yet, a number of Greek artefacts have been found in isolation or in very small sets, partly, at least, because they have not been systematically collected and identified till now. Information about their context is also exceptional.

Some examples from Greek sites, representative of the main categories of artefacts possibly belonging to such sign system(s), are presented below.[119] These examples date from the Early Neolithic of Thessaly, Western Macedonia and Central Greece, the Middle and Late Neolithic of Thessaly, the Middle and Late Neolithic of Eastern Macedonia and Thrace and the Late Neolithic of the Aegean islands (end of the 7th millennium - 5th and possibly Final Neolithic - 4th millenium BC).[120] These consist of:

i) Rounded objects, including spheres and flattened cylinders, sometimes bearing simple marks, as well as other geometric shapes, such as disks,[121] rings, ovals, cones, sticks, rods and bottle- or vase-shaped (solid) objects; and

ii) Rectangular plaques ('tablets'), loaf-shaped objects or parallelepipeds, larger than category (i), which may also bear series of repeated identical notches, points or other simple patterns. They look like tallies but might also be tokens, although, in some cases, they may also be closer to the 'signs on artefacts' category (see further, II.3).

More precisely:

i) Some larger or smaller groups, and also isolated examples, of clay artefacts, of various geometric shapes are known, from the Early to the Late or even Final Neolithic:

Several hundred clay 'roundels' of unknown function were discovered at Nea Nikomedeia, in an Early Neolithic building,[122] the so-called 'shrine'. Five figurines were also found there, three of them grouped together, as well as two outsized stone axes, two caches of over 400 unworked flint blades, and two gourd-shaped vases. The roundels were found all together in the 'shrine', and belong to two predominant shapes (rounded and ovoid). *Pintaderas*, 'ear-studs' and sling balls were also found in the settlement.[123] Unfortunately, precise information about the context and morphology of this unpublished material is still lacking.

A ceramic ball, slightly oval in section, with one flattened side,[124] and two knob-shaped, rather geometric 'doubtful twin figurines' with a convex and hollowed out, or a flattened

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[116] Lieberman 1980, 345.

[117] The distinction between curviform numerals and words written with straight lines might represent an opposition between iconic representation of clay counters, and (symbolic) use of cuneiform (Lieberman 1980, 343).

[118] Lieberman 1980, 358 and note 122.

[119] Cf. Marangou 1992, *passim* ('unidentified objects') and Marangou in press. This is not an exhaustive list of the Greek material.

[120] For the chronology of the Greek Neolithic see Andreou *et al.* 1996, 538 and Demoule & Perlès 1993, 366, fig. 2.

[121] The abundant sherd disks, perforated or not, have not been exhaustively included at this stage in the present paper. Several perforated ones should rather be weights or spindle whorls.

[122] Cf. Pyke 1996, 23, fig. 2.10.

[123] Rodden 1964, 604-605, fig. 12.

[124] Height 2.4 cm., thickness 1.8-2.3 cm., diameter of base 2.3-2.4 cm. Wijnen 1981, 47, fig. 14, no. 14.

bottom,[125] come from Early Neolithic Sesklo (EN I). From the second 'figurine' two pieces have been cut creating two flat sides at an angle of 90°. A number of 'ear-studs', also from Sesklo EN I, have a rounded (mushroom-shaped) or flat (disk-shaped) upper segment and a bulbous lower part, or may even be nail-shaped.[126] This sort of artefact is very common on various other Early Neolithic sites, as in Nea Nikomedeia,[127] Achilleion and Argissa[128] but its precise function still remains obscure.

Ten rounded 'seats'/'drums' or tokens[129] belong to a so-called 'cult scene', allegedly 'from Northern Greece', possibly Thessaly (Middle Neolithic?), acquired by the Munich Prehistoric Collection.[130] They have notches around the edges and occasionally a point in the middle of the upper surface (Fig. 3). Five out of six rectangular four-legged 'tables'[131] from the same 'cult scene', often with short parallel notches on the edges, although possibly representing pieces of furniture, may also bear either four or five points on their upper surface (Fig. 4). Finally, three bobbin- or 'drum'- or earplug-shaped implements[132] (Fig. 5) also bear slight notches and, in one case, deep dots around the middle.[133] The decoration on the thinnest part of this artefact shows that it could not be an ear-stud, since precisely this part would be hidden if worn through the ears (or the nose). A series of miniature figurines and other implements are also included in the same 'scene' (see also (ii) for parallelepipeds).

Three rectangular solids of unknown use, up to 4 cm. tall, one decorated with a pitted design, from Early and Middle Neolithic Achilleion (Fig. 6)[134] were found in post houses IIb (end of the Early Neolithic), IIIb and in a 'cult activity' area of IIIb.

Sherd-disks were found in Achilleion, usually in groups of five to fourteen, in houses of phases Ia-IVa on the bench or in the corner of the house.[135] Several disks of unknown function come from Nea Makri.[136]

'Gaming counters' from Sitagroi II (Late Neolithic I) (Fig. 7) include several small clay discs, flat on the lower surface and in the form of a low cone on the upper surface, decorated with dot-like incisions,[137] as well as several small clay balls.[138]

Ten fragments of fired long, thin, rather irregular tapering cylinders, one complete (7.2 cm. long), another one preserved up to a length of 10.5 cm. were found in Late Neolithic Saliagos.[139] Three of them were found in the same square, and three more in the same deposit.[140] Five

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[125] Height 1.82 cm. and 1.79 cm., width 1.54-2.34 and 1.42-1.61 cm., thickness 1.09-1.68 and 1.39-1.66 cm. respectively. Wijnen 1981, 45-46, fig. 14, no. 13, 18.

[126] Height 1.2-2.9 cm., width 1-2 cm. Wijnen 1981, 46-47.

[127] Rodden 1964, 607, fig. 17.

[128] See Gimbutas *et al.* 1989, 251-252 with references.

[129] Diameter 1.79-0.75 cm.

[130] There is no precise information about the original context of the objects. The 'scene' consists of sets of similar artefacts and a common origin might be presumed, at least for each set. See Marangou 1992, 219.

[131] 2.5-1.06 cm. maximum dimension.

[132] 1.58-1.4 cm. maximum dimension.

[133] *Idole*, 65-66, no. 27 and 78-79, pl. 18-19.

[134] Gimbutas *et al.* 1989, 256-257, fig. 8-14.

[135] Gimbutas *et al.* 1989, 254, fig. 8.8-8.11.

[136] Παντελίδου 1991, 4, fig. 4, 10-12, note 14, with references.

[137] Diameter 2-2.8 cm.

[138] Renfrew 1987, 366, fig. 9.

[139] Evans & Renfrew 1968, 70, fig. 84, 12-21, pl. L.

[140] Some sherd 'burnishers' (Evans & Renfrew 1968, 69-70, fig. 83, pl. L) and 11 disks of clay, 3 of stone (Evans & Renfrew 1968, fig. 85, pl. LIV), 6 from sherds, could also be considered as tokens. Disks are quite common on Neolithic sites and the largest ones at least could be covers. See also above, note 121.

slightly concave, small clay 'dishes' also come from this site, as well as six rounded sherds and three stone disks.[141]

Two decorated 'sling bullets' (?) from Dikili Tash II (Late Neolithic II)[142] bear either imprints of small cavities which cover them completely, or incised concentric lines.[143] The usual interpretation of these objects is certainly not confirmed by the decoration of these examples.[144] At Dikili Tash, the context of sling bullets sometimes includes figurines and miniature objects.[145] At Middle Neolithic Achilleion a 'sling bullet'[146] was found associated with the foundation of an early IVa building.[147]

Three irregular rings[148] from Dikili Tash II (Fig. 8)[149] may lie one on top of the other in a pile (Fig. 9). Parallels come from Goljamo Delčevo[150] and Ezero[151] and a pile of unfired disks was found in a pit at Vučedol.[152] Two of the Dikili Tash examples were found in proximity to (the third one a little further from) some animal figurines fragments and a unique rounded disk,[153] with notches on the edge and an incised pattern on each side.[154] A parallel for the latter from Šuplevec is known.[155] Other disk-shaped incised objects come from Ploskata Mogila (around 4000 BC),[156] or Medvednjak,[157] and two earlier, smaller flattened pellets from Dikili Tash I;[158] one of the latter could also be a bread model.[159]

Two Late Neolithic examples from Dikili Tash[160] look like piriform vases, but they are solid and they do not have any aperture. One of them contains an object and might also be a rattle. Parallels come from Vîhvatinți (Moldavia) and the Cucuteni culture,[161] and include an incised object from Baniata,[162] as well as the solid, bottle-shaped figurines or 'pobbles' from Sitagroi II and III).[163] Detev[164] has interpreted some Bulgarian parallels from Plovdiv,[165] Bikovo, Ruse or Kapitan Dimitrievo as 'models of decoration'.[166]

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[141] Evans & Renfrew 1968, fig. 85, pl. LIV; cf. Marangou 1992, 52-54.
[142] Treuil 1992, 121, pl. 201a.
[143] Treuil 1992, 121, pl. 200h.
[144] Treuil 1992, 123, note 112.
[145] Marangou 1992, 18-19, and in press.
[146] Diameter 2.5 x 4 cm.
[147] Gimbutas *et al.* 1989, 257, fig. 8.15.
[148] Height 1-1.9 and diameter 3-3.7 cm.
[149] Marangou 1992, 17-18, and in press.
[150] Todorova *et al.* 1975, pl. 87.
[151] Georgiev *et al.* 1979, 406, 541, fig. 203.
[152] Schmidt 1945, 198, pl. 23, no. 9.
[153] Diameter 4.5 cm., thickness 0.6 cm.
[154] Marangou 1992, 17-18, 19, fig. 80.
[155] Garasanin & Simoska 1976, 29, pl. IX, no. 31, level 5, period I.
[156] Gimbutas 1984, 208, fig. 164.
[157] Winn 1981, 355, nos. 48, 49.
[158] Marangou in press.
[159] Cf. for example a table model with 'bread-loafs' on it from Sitagroi (Θεοχάρης 1973, fig. 123).
[160] Marangou 1992, and in press.
[161] Gimbutas 1984, fig. 154.
[162] Detev 1950, fig. 32.
[163] Height 3-4 cm.; Gimbutas 1982, fig. 202; Renfrew *et al.* 1986, fig. 9.58, no. 15 (phase II), fig. 9.60 and 9.98, pl. LV, 3, nos. 156 and 155 (phase III); Renfrew 1987, 368, pl. F.2, 4, G.
[164] Detev 1965; cf. Dumitrescu 1985, pl. LIII, 1-3.
[165] Detev 1959.
[166] But see Marangou 1992, 180.

Some clay rods come from the Early Bronze Age strata at Emporio.[167] A number of unperforated sherd disks also come from these strata, but two of them were found in period IX levels (Late Neolithic).[168]

Several unpublished clay objects from Sitagroi II and III of unknown function, many of which bear an elaborated incised decoration, have been linked to ideograms, symbolic design, ritual, decoration and play.[169]

ii) Several bread-shaped or parallelepiped clay plaques are known from Thessaly, in particular from Middle Neolithic Sesklo.[170] They bear 'linear symbols or ideograms' incised before drying. Others come from Prodromos[171] and the Farsala area, the Sesklo one being part of a larger set (Fig. 10).[172] One plaque is divided into four parts by a cross, with a different number of points in each quarter; a 'bread-loaf' bears lines incised perpendicularly to its long axis. Another plaque bears several parallel series of points, perpendicular to its long axis, with empty spaces of different width between the series. A unique rectangular piece with five series of points comes from Otzaki II.[173] Hourmouziadis[174] mentions some clay objects, of various sizes and shapes, including rectangular ones, bearing points, three from Prodromos, one from Otzaki (probably the same as above) and two chance finds. He thinks that they would possibly belong to the same system of 'primitive script' (*πρωτογραφή*) as the figurines (see further, III). According to Theocharis, some at least of the Sesklo tablets would have been fired by chance. This would explain why more examples have not been preserved.

Fourteen clay parallelepipeds and bread-shaped objects of the 'cult scene', in the Munich Prehistoric Collection[175] (Fig. 11, 12) bear similar features. They have parallel notches on the edges, occasional points or crosses on the sides, and they often bear parallel incisions and dots, except on the under side, but they may also be undecorated. Five or six of them have longitudinal cracks, that apparently occurred during firing, in the centre of the upper surface. On one example, there is a series of points on both sides of the crack and incised vertical lines on both ends (Fig. 11, right).

Some clay plaques with incised decoration on the upper surface and on all four edges come from Eastern Macedonia, in particular from Dimitra (Fig. 13) and Doxaton.[176] An unpublished[177] Late Neolithic example of a long parallelepiped with graphite decoration comes from Dikili Tash. It bears parallel notches on its four long edges and a deep hole on one of its large sides. Some doubtful fragments from Dimini are also incised on one large side.[178]

Other clay plaques come from Balkan sites, such as Baniata,[179] Bikovo, Ruse, Tangiru,[180] Cascioarele (18 'prisms': incised parallelepipeds),[181] Glavanesti Vechi (four-sided tablet)[182] and

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[167] Hood 1982, 628 with references for parallels.
[168] Hood 1982, 634-635 with references for parallels, pl. 132, 30-31.
[169] Renfrew 1987, 361.
[170] Length 4.4 and 3.6 cm. Θεοχάρης 1965, 9, pl. 2A. Two fragmentary stone plaques from Sesklo bear incised linear motifs (length, 8 and 10 cm., width *ca.* 5 cm.; Τσούντας 1908, 338, fig. 268-269), but may also be figurines.
[171] Length 3 cm.
[172] Θεοχάρης 1973, fig. 181, pl. XIX, 3-4.
[173] Milojčić 1971, 32, pl. XVI, 26.1, 2, 5.
[174] Χουρμουζιάδης 1973, 81; 1994, 105, note 28.
[175] Complete ones, length 6.12-1.9 cm.; *Idole*, 65-66, no. 27, and 78-79, pl. 18-19.
[176] Respectively 5.6 x 2.8 x 2 cm.; 8.8 x diam. 3.5 cm.; length 10.9 cm. Renfrew 1987, 359-361, 369, fig. 6, 7, 10.
[177] Marangou in press.
[178] Μαλακασιώτη 1982, fig. 1.7 and 2.7; cf. fig. 2.6.
[179] Detev 1950, fig. 32b-c.
[180] Winn 1981, 194, fig. 30A; Masson 1984, 111-112, pl. II; Nikolov 1986.
[181] Stefan 1925, 189-190, fig. 42i and 43, 14-16.
[182] Comça 1978, 29, 31, fig. 26.1 and 27.6.

Popiza,[183] as well as from Dikili Tash (unpublished).[184] They bear linear patterns, zigzags and sometimes spirals. The Tangiru tablet (Fig. 14) bears horizontal incised lines ('paging'), separating vertical strokes. An incised 'tally'-like object comes from 5th millennium Tell Abada, a 'kind of proto-tablet marked with a combination of fingernail and short straight incisions'.[185]

Most Late Neolithic examples are baked. Whatever the interpretation of these artefacts, it is certain that the baked examples had been incised before firing, and, we may assume, at the same time.

Under the base of an oven model from Ovčarovo,[186] a chequer-board pattern, with some of its squares filled with parallel incisions or ochre has been interpreted as a primitive calendar. If the pattern was not located under the oven model, one could suggest an interpretation as a game board or abacus. A plaque fragment from Dikili Tash[187] with graphite decoration of crossed lines on the upper surface and a series of parallel Vs on the preserved small side, while it is rather rough underneath, would be a more credible candidate. Some other fragmentary, decorated examples from the same site may again have belonged rather to oven models.[188]

The artefacts presumably belonging to such sign systems include different categories of shapes and sizes. 'Tokens' are found from the Early Neolithic on, while tally-like objects, plaques and parallelepipeds seem to appear first in the Middle Neolithic, when they are also more numerous. There seems to be more variation in types in the Late Neolithic.

The artefacts have been found either in isolation or in small groups, with notable exceptions in the 'Shrine' of Nea Nikomedeia and in southern Jordan (see further, III). If the 'Shrine' were in fact a storage space for precious products (stone tools) and symbolic objects (figurines),[189] the occurrence of a large inventory of tokens, either counting or ritual devices (or both) would be explicable.

The occurrence of clay cylinders of unknown function at Sitagroi II, alongside various clay tokens, may show, according to Renfrew,[190] a similar situation (or stage) to that of the cylinder seals of the Near East. The latter are connected with the sealed *bullae* bearing imprints of numerals (see above), and the earliest texts.

II.2.b. Signs on artefacts and early scripts (?)

1) Evidence from the Near East and the Balkans

The representation of two horses on an Upper Palaeolithic antler also bearing marks of an 'artificial memory system' shows, according to D'Errico,[191] that these images played some role

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[183] Region of Vraza; Nikolov 1986.

[184] Some objects may look either like flat seals, or round lumps of clay, and often bear meanders. An Early Vinča, oval clay plaque with incised meander, surrounded by chevrons and semicircles comes from Banjica (Gimbutas 1982, 131, fig. 89). In addition, some objects are pierced and apparently were used as amulets or pendants. Some more tablet-like objects bearing signs are considered below (II.2.b. Signs on artefacts).

[185] Jasim & Oates 1986, 353, fig. 3, pl. 1a.

[186] Cokhadjev 1984.

[187] Marangou in press.

[188] Marangou 1992, 17.

[189] Marangou 1996a, 149.

[190] Renfrew 1987.

[191] D'Errico 1998, 43.

in the code of the system. He argues that in this period, as in modern times, sign systems may integrate at the same time iconic and symbolic elements.

The first pictographic messages in the Near East appear, in a period (Pre-Pottery Neolithic A) corresponding to the invention of agriculture, on stone plaques, associating schematic animals and abstract signs (Jerf el-Ahmar).[192] This graphic transcription of thought shows, according to Cauvin,[193] a spectacular mental advance, but not yet urgent commercial administration. One of the plaques bears engraved signs in order; some of them are repeated, several are presented in simple or combined form. One side bears 34 horn-shaped signs, the other two simple rounded signs, one of which is combined with an arrow. Traces of use on the edges show that the plaques may have been manipulated for a long time.[194]

A combination of pictograms and repeated abstract signs may represent associated qualitative and quantitative (numerical) notations.[195] This is also attested in one of the first text categories (Uruk IV, end of the 4th millennium). The latter consists of tablets bearing a numerical notation and a small number of ideographic signs, probably a quantity of a product, the product itself and a personal name, without partitioning into columns and cases.[196]

In fact, according to Nissen *et al.*,[197] in the archaic Uruk texts, different numerical signs belonging to several different numerical systems are used. Each one is applied either in broad contexts or for recording specific categories of products or measures, thus containing qualitative information about the counted product; correspondingly, some ideograms also carried quantitative information. Some signs change their numerical value according to the field in which they are used, while others are specific and may have only one numerical value for one precise counted product.

A large category of Uruk IV tablets has a surface divided into columns and cases, each case containing a unit of information; sometimes the sum of these numerical notations is incised on the reverse.[198] The disposition of signs on tablets in horizontal parallel lines may reflect the order and parallel rows in which tokens were organised by prehistoric accountants according to Schmandt-Besserat.[199] Besides, in logographic script systems where each sign corresponds to a concept and grammatical types are not represented, the distinction of groups of written units in space is necessary to avoid confusion,[200] and this may be obtained by horizontal and/or vertical lines.

It seems probable[201] that script was discovered suddenly by an individual who realised that the substitution of a word or concept by a sign, which had long been practised for numbers, could be transposed to non-numerals.[202] Fixing and using the signs would need conventions similar to those used in previous mnemotechnic methods.[203]

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[192] *Syrie* 1998, 10, fig. 2, 187, notes 1-2; Aurenche & Kozlowski 1999, 45, pl. 2-7 and 2-12; Glassner 2000, 119-121.

[193] Cauvin 1998, 10-11.

[194] Stordeur 1998, 187.

[195] Combination or accumulation of simple elements or numerical signs and pictograms is, besides, attested in several early scripts.

[196] Nissen *et al.* 1993, 20, fig. 21.

[197] Nissen *et al.* 1993, 27, 131.

[198] Nissen *et al.* 1993, 20, fig. 22.

[199] Schmandt-Besserat 1996, 85.

[200] Justeson 1986.

[201] Nissen 1998, 29, 31; Matthews 1998, 19.

[202] Nevertheless, the elaboration to later real script systems must have been the result of a long previous procedure; these systems appear completely formed and contain many different signs (Nissen 1998, 29, 31; Matthews 1998, 19).

[203] Nissen 1998, 31.

Early graphic representations would have been used initially[204] as simple signs recalling units of a conceptual whole that the reader/narrator knew by heart. Everything expected to be known by the reader was omitted, although improvisation and variation were possible.[205] The meaning of the signs was understood only by the individuals who were immediately involved. Script was not, then, fundamentally different from its precursors: the reader had stored most of the data in internal memory and external storage was simply complementary.[206]

Therefore, in the beginning, the written message did not correspond exactly to the forms of speech and could be 'read' in several different ways, even in several languages[207] (cf. Fig. 2). This may mean that script was invented in multilingual contexts, as a recording and communication system across linguistic frontiers of multiethnic groups,[208] such as in Southern Mesopotamia at the end of the 4th millennium (Late Uruk).[209] This is when, according to several scholars, in spite of objections, uncertainties and open questions,[210] recording mechanisms of clay envelopes and tokens resulted in the written code-making of script (clay tablets with signs on one or several sides), in particular proto-cuneiform, at least in its operational forms.[211]

If marks on clay artefacts were to be transformed into some form of writing, they would be symbolic as well as indexical s i g n s.[212] Abstract shapes already existed in earlier tokens from the beginning; if the number of signs on the earliest script tablets is larger than that of the tokens, this may be due to the use of wooden tokens, while other shapes may have originated from painting or tattoos.[213]

In the beginning writing records only very characteristic elements, calendars and distances (as in Egypt, China, Mesopotamia, or America); concepts which were known earlier, but which acquired a new meaning with the change of the economic system.[214] According to Matthews,[215] evidence for numerical recording and marking of propriety (potters' marks) before the invention of script, as well as in very early scripts (proto-cuneiform, protoelamitic, Egyptian, Chinese or Mesoamerican) would demonstrate that economic and administrative intensification led to writing. Notwithstanding this, he thinks that primitive script is linked to mediation of political power through ritual means.

Although an earliest Pre-Uruk writing must have existed, it would be impossible to find it, since this presumed script probably disappeared shortly after it was invented.[216] This situation would probably be similar to that of the so-called 'old European script' (Vinča signs).

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[204] Février 1948, 17.
[205] Nissen *et al.* 1993, 20.
[206] Nissen 1998, 29.
[207] Gelb 1969, 14.
[208] Mathematical language is international because it is independent from phonetic systems; it is a system of notation very far from speech (Goody 1979, 213).
[209] Matthews 1998, 19; cf. Glassner 2000, 257.
[210] See Glassner 2000 for a recent overview of opinions on the beginnings of the script in Sumer.
[211] This does not mean that there is necessarily a functional connection between plain tokens and the ultimate development of script (Matthews 1998, 16).
[212] Noble & Davidson 1996, 113.
[213] Nissen 1998, 29.
[214] Leroi-Gourhan 1965, 66-68. It is impossible, according to Leroi-Gourhan, for script to have been created for things which had been preserved before by means of oral memory, evolution concerns first what is new, what cannot be fixed in memory.
[215] Matthews 1998, 17, 19.
[216] Lieberman 1980, 358.

According to Makkay,[217] more than 300 signs were incised on vases, figurines and weights from Tordos, belonging to the Vinča A-B culture (corresponding more or less to the Greek Late Neolithic I). Winn[218] has studied a corpus of 210 Vinča (Late Neolithic I-II) signs[219] according to the object on which they occur (spindlewhorls and loomweights, figurines, pottery and unusual objects) and, in the case of pottery, the position of occurrence.[220] Longer groups of complex signs generally occur on spindlewhorls[221] and many examples of divisions into registers with sign-like incisions are found on miniature vessels.[222]

The Vinča signs are mostly rectilinear and mostly incised before firing, sometimes in isolation (on pottery, figurines, and spindlewhorls and occasionally on other objects) and sometimes in groups. A group consists of two or more signs in reasonable proximity to one another.[223] The Vinča signs are constructed from five core signs: a straight line, two lines which intersect at the centre, two lines which intersect at one end, a dot or stipple, and a curved line, and form 18 fundamental categories.[224] The Winn signs 31 to 38 and 123 to 127 seem to be numerical signs; they consist of parallel vertical or horizontal lines, or of juxtaposed stipples, including two sets of three lines, or two or three rows of stipples,[225] with, characteristically, a maximum group of six vertical lines or five stipples (cf. above, I.3. Elementary forms of counting and recording).

Depending on their location, the Vinča signs which could be numerical are divided, according to Winn, into the following categories:

i) In general, the simplest signs are found in all positions on pottery. Signs situated only on the base or on the side near the base are generally associated with what may be considered numbers.[226] It is true that they are too varied to identify the contents of the pot or quantity or destination and could hardly be identification marks of the maker or owner.[227] They could alternatively have a magical function.[228]

ii) If many sign groups on pottery, where there is plenty of space, are composed of only two signs, a larger number of signs (up to twelve according to Winn)[229] is nearly always placed on one face of a whorl,[230] where the space is very limited;[231] one Tordos spindlewhorl bears signs on both sides.[232] On the contrary, some of the whorls seem to bear numerical,[233] 'notational, numerical or magical' marks, consisting of lines or comb-like patterns.[234]

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[217] Makkay 1969.
[218] Winn 1981.
[219] Winn 1981, 19-40, table I.
[220] Winn 1981, 11.
[221] Winn 1981, 12-14.
[222] Winn 1981, 48, fig. 7C.
[223] Winn 1981, 138.
[224] Winn 1981, 59-65.
[225] Cf. Makkay 1969, 48, no. 38.
[226] Winn 1981, 72, 80.
[227] Cf. Potts 1981; Dollfus & Encreve 1982.
[228] Winn 1981, 241, 242.
[229] Winn 1981, 197.
[230] Neither the order nor the direction of the inscription has been considered of importance.
[231] Winn 1981, 145.
[232] Roska 1941 and Vlassa 1970.
[233] Winn 1981, 148, 151, 164.
[234] Winn 1981, 158.

These artefacts, as well as loomweights, which also bear occasionally simple marks,[235] obviously had a practical use.[236] It is possible, according to Winn, that the whorls were used secondarily, perhaps during the actual spinning activities, to keep record of the quantity of a material used, or of the number of times a mechanical operation was performed, etc., or that the signs were apotropaic for the activity of spinning.[237] They could also be symbols of weight or propriety, or of some other *signifié*.[238]

In contrast to the unique corpus of signs of figurines,[239] whorls seem, therefore, sometimes to fulfil ordinary needs, serving perhaps as mnemonic devices. Yet, they may contain highly specialised signs, possibly for a quite different purpose.[240] The duality of whorls is reflected in their roles in both domestic and ritual affairs, therefore indicating purposeful distinctions in sign usage and an intention to communicate something meaningful.[241] Whorls are sometimes found with figurines and/or miniature vases in the Late Neolithic[242] (see further).

iii) Several miniature vessels bear signs; when not an isolated sign, it is a long group, and it seems closer to figurine signs and consequently ritual usage.[243] Miniature vases were found in connection with figurines at Late Neolithic Dikili Tash.[244]

iv) Tablet-like objects seem to be a more credible script/accounting medium. The Gradešnica plaque[245] (Fig. 15)[246] dates from Karanovo V (late Vinča-Tordos or early Vinča C,[247] Greek Late Neolithic II), and was discovered with a figurine and two vases. One of the vases bore on the bottom a human figure and the other one some signs. The face of the plaque is divided by four horizontal lines into four registers with three or more signs in each. Two at least of the horizontal registers seem to be divided into 'cases' by means of vertical lines. Some of the more isolated ones may represent divisions between ideas, while some of the vertical lines are possibly number notations.[248]

Other tablet- or plaque-like objects with simple marks have already been presented above (II.2.a.2. Artefacts as s i g n s).[249]

That more tablets have not been found might be due to the poor preservation of unfired clay (see above) or organic materials.[250] This is suggested by a wooden tablet bearing signs, which

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[235] Winn 1981, 223, fig. 30C from Coka.

[236] Cf. Μαλακασιώτη 1982, 181.

[237] Winn 1981, 151, 195.

[238] Μαλακασιώτη 1982, 181.

[239] Figurines with incised signs from south-eastern Europe, as well as possible parallels from northern Greece, have not been considered here. If their signs probably belonged to some semiotic system, the latter is not proven to be related to counting or recording. One exceptional piece from Vinča bears a series of signs (Winn 1981, 330; Masson 1984, 95, fig. 3, 96-98, no. 7), some of which could also be numerical.

[240] Winn 1981, 107, 163, 164.

[241] Winn 1981, 235.

[242] Marangou 1992, 223; 1996a.

[243] Winn 1981, 147, 166.

[244] Marangou 1992, 18-20.

[245] 12.5 x 10.5 x 2 cm.

[246] Winn 1981, 210-214, fig. 28; Nikolov 1970, 1ff.; Georgiev 1970, 8.

[247] Nikolov 1970, 1, 2.

[248] Georgiev 1970, 8.

[249] The Karanovo handled stamp seal (diameter 6 cm., thickness 2 cm.; Georgiev 1969; Mikov 1969, 4ff.; Winn 1981, 216-219, fig. 29; Masson 1984; Makkay 1971 and 1984, 93) was found in a Karanovo VI house destroyed by fire. Its patterns look rather scrambled and it is divided into four parts by a cross incision. No relationship to numerical notations is discernible.

[250] Winn 1981, 241. It would have been possible to draw temporary signs even on the soil; besides, pebbles could have been used on the soil or the floor in a form of primitive abacus, according to Schärlig (2001, 118). Such a practice of drawing on sand is still attested in the 20th century, although

was discovered at Professor George Hourmouziadis' excavations at Dispilio (lake of Kastoria)[251] (see further).

The Vinča semiotic system is composed of elements of differing complexity. There is no clear evidence for an important economic role of signs, and the marks on spindlewhorls would not make an efficient or likely accounting system,[252] although ordering on tablets and special objects seems significant.[253] The fact that the distance between horizontal lines as well as the signs themselves become smaller towards the lower part of the Gradešnica tablet, and the 'paging', would corroborate the interpretation of this document as a script.[254] On the other hand, long sign groups on miniature vessels and figurines would suggest ceremonial contexts, according to Winn. The dichotomy between signs on pottery and those on 'ritual' objects argues for different levels of usage[255] (see further, III).

Winn[256] argues that the development of metallurgy in the Tordos area, where the actual use of signs seems to have suddenly emerged, increased the potential for trading networks. If the raw materials for metallurgy came from Transylvania and the Carpathians, Tordos may have been a considerable commercial centre. Several signs at Tordos can be interpreted as numerals, and many of the unique Tordos signs could be attributed to identifications, which might be required at an important site.[257] According to Todorova,[258] the development of metallurgy, trade, and movement of products, the increase of personal property and thus the necessity to count the growing quantity of information, resulted into the use of 'pictograms'. In the area of the most ancient signs flourished the Chalcolithic metallurgical centre of Rudna Glava. However, Winn considers that the techno-economic development of the Vinča-Tordos area was accompanied by an elaboration of ritual involving the use of signs, while economic developments in the Near East resulted in recording that eventually led to script.[259] It was natural, according to Todorova,[260] to borrow signs known from cult and magic in order to use them for counting when socio-economic reasons created such needs.

The Vinča system is not 'true' writing. There is insufficient sign group repetition, and there are very few long groups. Mostly abstract linear signs occur alongside early pictographic signs.[261] The preference for straight lines and avoidance of elaboration would be due to the small number of available signs to be incised on clay.[262] No evolution of the signs or sign usage can be proved, except for the possible greater use of pictograms at an earlier date (cf. above, Pre-Pottery Neolithic A pictograms and early numerical notation in the Near East). The only obvious schematisation of a pictogram is the animal representation, already present in the earliest phase at Tordos. There are a few decorative motifs.[263] Hooker wondered[264] if there is equivalence

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rather for ritual purposes, as a game or in order to transmit collective memory in general, for example by the Quiocos of Angola (Fontinha 1983).

[251] Χουρμουζιάδης 1996, 46, 47 and note 16.

[252] Winn 1981, 242.

[253] Winn 1981, 241.

[254] Masson 1984.

[255] Winn 1981, 245.

[256] Winn 1981, 252.

[257] Winn 1981, 255.

[258] Todorova 1979.

[259] Winn 1981, 252.

[260] Todorova 1979.

[261] Winn 1981, 236.

[262] Hooker 1992, 110-111.

[263] Winn 1981, 236. A few signs can be derived from Starčevo decorative design on pottery, others from decorative designs of the Vinča culture. The origin of a few pictograms is self-evident (Winn 1981, 252).

[264] Hooker 1992, 104.

between one sign and one concept, or one sign and one sound unit, or any intention to represent units of sound at all. A phonemic identification is precluded according to Winn:[265] the system may well be partially logographic, and some of the signs may represent words or concepts; therefore they could be combined in an unordered fashion and still be meaningful.

According to present evidence, the Vinča system of graphic representation may never have developed into a complete script system. If it never reached the stage of real writing, this is probably because it had no need to do so.[266] Maybe the economic or other need for this evolution did not appear in the Late Neolithic south-eastern Europe,[267] so that the linguistic information enters the process of code-making and decoding of the conceptual information.[268] As has been argued, when a tendency towards the creation of script appears, this tendency must either become a complete system, or disappear.[269]

In sum, in the areas under consideration, before script, signs are mainly abstract, but some pictograms occur in association with them at very early dates and might represent a combination of qualitative and quantitative information. The same combination has been noticed concerning tokens (see above). What could possibly be numerical signs are found in isolation, often on pottery, and, less frequently, in groups with other signs. They occur then more often on artefacts of unknown function, such as tablets, but also on tools related to spinning activities. This stage could be Renfrew's[270] transition period to the last cognitive phase of human evolution. The latter consists of 'theoretic culture using sophisticated information retrieval systems for external symbolic storage, usually in the form of writing, frequently in urban societies'.

2) Evidence from Greece and other examples

Some rare examples of incised signs, possibly including numerals, are known from Greece.[271] They occur on utilitarian artefacts, but also on artefacts of unknown use. More precisely:

i) Signs on pottery, in isolation or in groups, are incised on bases of vases (for example, from Tsangli)[272] or on their walls (for example, from Paradimi).[273] Series of signs including possibly numerical notation are attested on sherds from Obrenovak and Rudnik.[274]

ii) A unique Late Neolithic clay spindlewhorl from Dikili Tash, which belongs to one of the commonest, flat shapes ('plano-concave'; diameter 5 cm.)[275] (Fig. 16, 17), bears distinct signs, similar to the Vinča ones. Most Dikili Tash whorls, among those belonging to three characteristic types of the Late Neolithic, bear incised decoration: notches on the edge, as well as geometric incisions, mostly rectilinear, and sometimes points; the disposition of the motifs is radiating or in registers.[276] A flat whorl, relatively light, might be put on top of the spindle; then its decoration would be oriented upwards. A light type would be adapted for wool, while flax

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[265] Winn 1981, 236, 238.
[266] Winn 1981, 253.
[267] Masson 1984, 123.
[268] Justeson 1986.
[269] Boltz 1986.
[270] Renfrew 1998, 4 with references.
[271] For a previous presentation see Marangou 1987.
[272] Wace & Thompson 1912, 91, fig. 43.
[273] Πάντος 1987-88, 96, fig. 4, drawing 2. A number of examples are cited *passim* in archaeological reports. A systematic study of such Greek Neolithic marks is lacking.
[274] Masson 1984, 101, fig. 5, 3-4.
[275] Deshayes 1972, 204; Treuil 1992, 125, 129, 130, pl. 155D, 203A, M295; Winn 1981, fig. 30B.
[276] Treuil 1992, 127.

requires heavier whorls situated on the lower part of the spindle; this seems probable for an undecorated, heavy Dikili Tash type (*biconvexe* or *biconique*).[277] Besides, a large diameter results in slower torsion and lesser tension for the yarn.[278]

Other spindlewhorls incised with signs come from Valea Nandrului[279] and Fafos.[280] Some rather flat or disk-shaped whorls from Dimini also bear linear decoration on one side, which does not seem to be 'organically linked to the surface'. The signs might for example be symbols for weight or measurement, or proprietary signs.[281] The Dikili Tash whorl exhibits either dividing vertical lines or numerals[282] and can be compared to 'paging' of tablets from this point of view.

iii) A four-legged miniature vase[283] with incised signs on the lower part also comes from Dikili Tash (Late Neolithic), but it is difficult to distinguish the signs, let alone to identify possible numerals[284] (Fig. 18). Yet, three at least of the signs disposed in a series around a small vase from Ovcarovo consist of three oblique or vertical parallel lines or of two parallel vertical lines intersected by an oblique one.[285] These might be considered as possible numerical signs. Other signs in rows on miniature vases from Vinča[286] are less clear (on the photographs).

iv) A combination of pictograms and numerals may be incised on a flattened clay cylinder[287] from Paradimi in Thrace (Fig. 19a-c). The latter should be dated, according to Pantos, to the Early Bronze Age at the latest, and more probably, because of the clay used and the colour, to earlier periods.[288] Two animal (?) figures seem to be related to small groups of repeated abstract signs, often in sets of four or two, lozenges, rectangles and Xs. All these could belong to a counting/recording system. It is not impossible[289] that the base of such a system would then be tetradic. This combination of abstract signs and iconographic representations is also found on two of the Tărtăria tablets, the third one being only iconographic.[290] One of the Tărtăria tablets,[291] a plaque from Thessaly (see above, II.2.a.2) and the Karanovo seal,[292] among other examples, are also divided into cases or quadrants.

v) A wooden tablet discovered at Dispilio (lake of Kastoria) and dated by ^{14}C to 5260 BC, bears incised 'signs of an early script',[293] for some of which a use as numerical marks is not excluded.

Some examples bearing repeated identical, simple marks have been included in the category of artefacts as signs (see above): parallelepipeds with repeated notches, as well as tablet-like (or tally-like) objects.

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[277] Treuil 1992, 130.
[278] Τζαχίλη 1997, 121.
[279] Vlassa 1970, fig. 16.
[280] Gimbutas 1982, fig. 22A.
[281] Μαλακασιώτη 1982, fig. 1, 2 and 6.
[282] Cf. Masson 1984, 104.
[283] Maximum width 4.5 cm.
[284] Marangou 1992, 16, fig. 21K, and in press.
[285] Bonev 1983.
[286] For example, Letica 1967, pl. I.9 and V.1; cf. Gimbutas 1984, 86, fig. 40.
[287] Length 4.8 cm.
[288] Πάντος 1987-88, 96, fig. 1-3, drawing 1.
[289] Πάντος 1987-88, 98, note 35.
[290] Vlassa 1963; Hood 1968; Renfrew 1979; Masson 1984, 112-122 with relevant bibliography.
[291] Masson 1984, 119, fig. 11, 3.
[292] See above, note 249.
[293] Χουρμουζιάδης 1996, 46, 47, fig. on p. 5. The tablet is under study by Professor Hourmouziadis. Its contribution will certainly be very precious for the understanding of Neolithic sign systems.

An association of qualitative and numerical marks on the one hand (Paradimi), and a mixture of numerical marks (?) (double, triple etc. vertical parallel lines), and more complex signs on the other (Dikili Tash whorl), could constitute positive elements towards an interpretation of these sign groups as belonging to a recording system.[294] If written language comes from linking numerals with elements from representational art, and if script evolves through the common use of more than one system of graphic representation in common settings (as was said about Mesoamerican systems), then only arithmetic could permit this evolution.[295] Robson[296] argues that writing was invented for the express purpose of recording numerical information. In any case, numbers were the first to be noted in Sumer: just two signs (the notch and the circle) sufficed in the beginning, while more than sixty were used later.[297]

III. Possible Counting/Recording Sign Systems In The Neolithic And Their Potential Uses And Users

A number of Neolithic artefacts, (a) some token-like objects of unknown use, and (b) artefacts bearing incised signs, have been considered as possibly related to sign systems. These two categories are probably not mutually exclusive, at least in the Late Neolithic, since they may appear on the same site during the same major phase, as at Dikili Tash (whorl with signs, tokens and parallelepipeds).

Their morphological features enabled them to be distinguished as artefacts-signs: tokens of various shapes (EN-LN or FN) and plaques (tallies or 'tablets') (MN-LN), and as artefacts bearing marks/signs: clay tools, miniature and normal vases, and objects of unknown function (mostly tablets) (LN).

Clay (exceptionally stone) tokens appear from the Early Neolithic, and possible clay tally-like objects at least from the Middle Neolithic. Yet, other cognitive vehicles, not distinguishable in the archaeological record, such as shells or pebbles, or made of perishable material, such as wooden artefacts or ropes, may also have been used, even in earlier periods.

If tokens have no obvious practical function, the artefacts on which early two-dimensional recording may have occurred may also be utilitarian. They are related to specific occupations, namely, spinning (whorls) and storage (vases) activities. The problem of the function(s) of miniature vases remains, as it is not impossible that they had some utilitarian function (for example, storing small quantities of 'precious' materials). As seems to happen with Upper Palaeolithic 'artificial memory systems',[298] Neolithic sign systems may fit transportable objects, including tools.

The usual difficulty for the interpretation of objects of 'unknown function' is whether they belong to a single sign system or not, and if so, if this is a counting and/or recording system. Furthermore, multifunctionality is always conceivable. Other sign systems of communication must have existed in the Neolithic economic and social environment, including that of figurines/models.[299] The latter were presumably used, according to Hourmouziadis, as

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[294] Marangou 1987.
[295] Justeson 1986.
[296] Robson 1999, V.
[297] Glassner 2000, 168-169, 170.
[298] D'Errico 1998, 47.
[299] Marangou 1996a, 150.

'*σήματα*/ideograms' of a Neolithic 'proto-script' (*πρωτογραφή*), constituting an early and primitive form of script (see above, II.2.a.2).[300]

The relationship of certain Neolithic sign systems of south-eastern Europe to counting or recording, among other alternatives, seems to be a likely explanation. Nevertheless, were this accepted, the field in which this counting or recording would have functioned is unclear. Candidates include exploitation, storage and exchange of raw materials, commodities and processed or finished products, agriculture, animal herding, and spinning (and/or weaving). There is no evidence for the precise categories of quantities measured, for example, number of individual beings, length, distance, space or weight. There could be a qualitative differentiation, as the variety of examples from a same site, and indeed, the two types of the Nea Nikomedeia as well as of the Jordan tokens (see further) and the variety of form of the Munich 'cult scene' objects, suggest, unless this diversity of shape rather reflected variety of quantities (but see further).

In fact, hundreds of unworked flint flakes have been associated with a great collection of clay tokens, belonging to two different types, at least once, in Early Neolithic Nea Nikomedeia. The presence, at the same time, of some symbolic objects, figurines, could serve a different purpose, apotropaic or cultic for example.[301] If the building ('Shrine') was a public one, this could mean a common interest or care for important items stored in abundance, of which tokens would be part. Tokens, if counting/recording devices, and therefore control mechanisms, may well have been kept with important objects, yet not necessarily with the items counted. In other words, it may have not been desirable to keep counters in the same storage space as counted commodities.

Recently, 473 'standardised' tokens ('geometrics') belonging again to two different types, animal and presumed human figurines were discovered in the same space in southern Jordan (Es-Sifiya, Late Pre-Pottery Neolithic B). It has been argued that they were manufactured together for a specific purpose, possibly to be used in some transaction, an isolated event that required some kind of symbolic recording.[302] Joint manufacture of very small anthropomorphic figurines, tokens and tallies is not impossible concerning the 'cult scene' in Munich;[303] unfortunately its original context is unknown. This is all the more unfortunate, as it seems particularly significant that each type of artefacts in the Munich ensemble, including the anthropomorphic figurines, can be further subdivided into two or three sets according to size (scale). This could indicate addition of quantitative or qualitative information to each category of objects, meaningful precisely if they were counting/recording devices. Would then also the figurines themselves (of two different types) have constituted such devices, used in order to count/record humans (of both genders), for example, according to age or function?[304]

The possibility exists that the Nea Nikomedeia 'roundels' belonged to some other semiotic system, such as sympathetic magic, play or cult, for example. One could even assume that they might be some sort of tool, but there is no information about them revealing any use wear. It is of course impossible, without a detailed description of the material, or a global view of the context, as long as the Nea Nikomedeia material is unpublished, to make any valid suggestions. It is certain though that these possible counting devices could change their location and grouping, since they are movable objects. They may have been kept together after manufacture and before use. They could be at some point at the disposal of individuals or specific households.

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[300] Χουρμουζιάδης 1994, 228. Glassner (2000, 79) is against the concepts of pre- or proto-script, as well as against a pictographic origin of the script (2000, 69-86).

[301] On this subject see Marangou 1992, 1996a, 2001.

[302] Mahasneh & Gebel 1999.

[303] Marangou 1992, 1999.

[304] Marangou 1999.

This would explain the fact that these objects are usually found in small groups or in isolation during the whole of the Neolithic period. It must also be noted that sometimes the coexistence of whorls, figurines and tokens (LN Dikili Tash) might indicate the parallel occupation of adults (women?) and children in the same domestic space, in which case play could be retained as an alternative for the interpretation of some tokens.[305]

Mobility is not feasible with signs incised on Late Neolithic clay artefacts, which should represent a fixed (unchangeable) state of affairs. Whorls, possibly for wool, do bear signs occasionally in the Late Neolithic, and some rare objects bear pictographic animal figures associated with abstract signs. Counting and/or recording may then be related to some crafts, such as spinning and consequently wool, yarn, textiles, or herding and animal products, but the data presumably recorded cannot be changed. This means of course a permanent situation, possibly ownership.

On the other hand, the combination of counting devices and food storage is not proved for the moment (but see above). It is again plausible that counting devices were kept in a different space, not together with the counted items, all the more so, if they are testifying some transaction. Food storage may sometimes be connected with other symbolic items instead. For example figurines, occasionally bearing incised marks on the top of the head, were found in grain bins or in vases, and anthropomorphic figures have been applied in relief to large storage vessels.[306] All these cannot be connected convincingly with numbers, but rather with sympathetic magic or apotropaic ends. If counting was applicable to stored quantities of raw/perishable materials, then the attested simple signs incised on Late Neolithic pottery could constitute relevant evidence, again if they do not have an apotropaic or proprietary function. In addition, some other method was conceivably used for counting stored commodities, for example, the number of actual vases of constant dimensions and containing a fixed volume of foodstuff.

The relationship of counting to finished products and status or symbolic artefacts (jewellery) is not attested for the moment either. The miniature vase bearing signs from Dikili Tash was found in association with several *spondylus* bracelets,[307] but its signs cannot be proved to include numerals. Articles of jewellery seem, in fact, occasionally to be connected with some categories of miniature vases or figurines in the Late Neolithic.[308] These may at the same time be connected with whorls (see above). From this point of view the situation recalls the connection of storage (a domestic activity) and sign systems (figurines or/and miniature vases), though ones other than counting/recording systems. If not fortuitous, this relation may in fact reflect a sign system with a distinct purpose, in this case, the protection of valuables, for example.

Coexistence of sign systems is possible: The context of possible counting/recording tokens may include other symbolic objects, such as figurines (Achilleion, Es-Sifiya), indeed at the same time as stored articles (Nea Nikomedeia), including zoomorphic figurines (Dikili Tash, Es-Sifiya). The utilitarian may be interwoven with the ritual in the Neolithic, and the evidence for domestic ritual during everyday activities[309] corroborates this assumption.

Middle and Late Neolithic clay 'tallies', if tallies they were, had all their patterns incised at the same time, not successively, and their arrangement was as definitive as that of Late Neolithic artefacts bearing signs (see above). Repetition of identical marks, as sets of identical tokens, could show counting/recording of similar objects or beings. Occasional differentiation of marks

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[305] Marangou 1996a, 149.
[306] Marangou 1992, 222-223; 1996a, 149.
[307] Marangou 1992, 18.
[308] Marangou 1996a, 149; 2001.
[309] Marangou 1996a, 148-149; 2001.

might indicate the parallel use of qualitative information, two or more categories of units being counted, or the representation of different quantities by means of distinct signs (as of larger and smaller tokens).

Counting space and quantities cannot be separated from time regularity; calendar cycles of farmers are marked by star cycles, but also by concrete, operational time,[310] for practical use in agriculture. It is not impossible that the tally- and 'abacus'-like plaques with paging (rather than the decorated reverse side of ovens) are calendars, although the hypothesis cannot be tested. If these artefacts were not counting/recording devices, they could be connected with play. Idleness is not inconceivable in Neolithic times. Moreover, some games develop counting capacities with cognitive aids, such as the *warri* social game of the Ashantis by subitizing.[311] It needs a lot of subtlety to distinguish between a gaming counter and an accounting reckoner.[312]

Besides, use of numbers may result not only from play, but also from ritual; the supernatural is sometimes difficult to distinguish from children's or adults' play.[313] Furthermore, story-telling, rhythmic recitation, dancing, singing or music (cf. the Neolithic bone flutes from Dispilio[314] and Sesklo[315]) should constitute part of the life of the community including its ritual life.[316] Internal memorisation of collective cognitive heritage might need some external storage, even if this was only a complement, the transmission being made mainly orally. Rhythm and notation are common features of all these systems, but it is impossible today to distinguish between the functions of Neolithic signs and maybe no such distinction was made then, but the same objects at the same time served various functional ends.

The ambiguity of archaeological traces has often been stressed.[317] It is difficult to distinguish drawings from signs, decoration from early script.[318] This ambiguity of the archaeological record probably originates from the particular polysemic approach of humans when conveying meaning through material representations.[319] 'If decoration and notation are not mutually exclusive possibilities in the engraver's mind, how can we separate them when we analyse archaeological objects?'.[320] Here, as in the Palaeolithic, analytical and theoretical tools are not able and probably never will be able to provide clear-cut answers in all cases.[321]

The unequal distribution of tokens, but also the fact that only a few utilitarian artefacts bear signs, shows that a limited number of individuals or/and households used them, suggesting therefore some social or functional differentiation of the users. Few individuals needed or had the right to control the counting/recording operations. In the Early Neolithic of Nea Nikomedeia there is only one[322] space containing tokens in abundance, and finds in all Neolithic phases and sites normally consist of rare, small groups.

If fabrication of tokens is easy, some standards of shape and dimensions are observed at local level, such as two standardised types repeated even hundreds of times. More obviously, incision

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[310] Leroi-Gourhan 1965, 145.
[311] Goody 1994, 283.
[312] Jasim & Oates 1986, 352.
[313] Renfrew 1994, 8.
[314] Χουρμουζιάδης 1996, 52, fig. 17.
[315] Θεοχάρης 1973, colour plate 210.
[316] Cf. Marangou 1996b.
[317] Cf. Molino 1992, 24; Marangou 2001.
[318] Treuil 1983, 506-507; Treuil *et al.* 1997, 156.
[319] D'Errico 1998, 46.
[320] D'Errico 1998, 46.
[321] Cf. D'Errico 1998, 43.
[322] However, one should keep in mind that the site has not been entirely excavated.

of Late Neolithic signs on clay follows some patterns, thus necessitating knowledge of some code. We do not know if the same individuals made and used these artefacts, but some persons were aware of the codes and had control of the standards and the systems. This necessitates transmission of competence to other individuals in the social group, at least at intervals, so that 'collective' or 'joint' memory[323] persists from one generation to the next. This means, therefore, teaching and apprenticeship or initiation. Consequently, and as public display of knowledge and teaching may be involved in material vehicles of thought or cognitive devices,[324] an additional valorisation of such objects, for example by decoration, may result.

Competence in storing information may have constituted only one aspect of the role of these individuals within prehistoric societies.[325] This situation could be similar to that of connoisseurs or guardians of other Neolithic sign systems, such as those of figurines and models.[326] Individuals specialised in storing memory among preliterate human groups could be older members of the community,[327] or individuals with some special status. These would have the knowledge and the right to create and handle the cognitive devices, as well as their control and the ability to employ, understand and transmit the codes.

CONCLUSIONS

If the evidence tends to imply that counting and/or recording exist from at least the beginning of Upper Palaeolithic, relatively few artefacts have been identified as possibly belonging to such sign systems in the Greek Neolithic. They often lack secure dating or precise contextual information, and debate about their possible function(s) continues.

However, an evolution is discernible from the Early to the Late/Final Neolithic: tokens – plaques/parallelepipeds– tablets and utilitarian artefacts with signs, although tokens probably persist through all periods. The absence of evidence for continuity into the Early Bronze Age (with exceptions), if not due to excavation hazards, may show the replacement of those sign systems by some other memory scheme. This contrasts with the situation in the Near East, where script and large-scale accounting emerge at the end of the 4th millennium. Changes in the use of other sign systems are attested at the same time in the Aegean region, such as a mutation in the forms, places, and possibly actors of ritual, and a modification in the use of figurines and models.[328]

The discovery of large quantities of possible tokens is very uncommon. Both tokens and parallelepipeds are usually few in number on a site and have been found together only in restricted groups. Utilitarian artefacts with signs are also rare in a series of similar articles, and tablets are exceptional. These special objects could then be bestowed on or possessed by select households or individuals.

Lack of extensive and systematic study, as well as of contextual information does not permit the evaluation of all parameters of morphological, spatial and temporal variations of this material. The possible users, products or units measured or recorded, and purposes aimed at, may to some extent be conjectured, but much more data are indispensable in order to perceive the patterns in all their complexity.

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[323] D'Errico 1998, 47.
[324] Frake 1994, 130.
[325] Cf. D'Errico 1998, 47.
[326] Marangou 1992, 221; 1996a, 148-149.
[327] Cf. D'Errico 1998, 47.
[328] Marangou 2001.

Nevertheless, it has already become apparent in this brief overview that several types of cognitive aids may have been used in the Neolithic period, some of them possibly in relation to counting and recording. Evidence shows the existence in the Neolithic of the necessity and the capacity to create and use such sign systems. Some of the latter attained a spectacular evolution in later periods, and are still progressing today.[329]

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[329] My interest for tokens and signs started in 1981, after my first contact with the Neolithic figurines and models, including objects of 'unknown use', from Dikili Tash, Eastern Macedonia (excavations Jean Deshayes).

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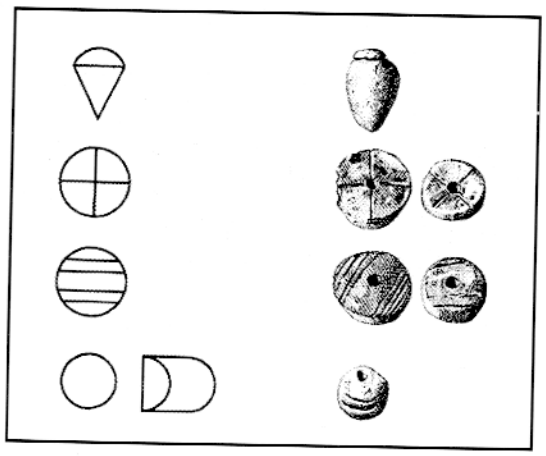


Fig. 1. Comparison of written signs from Uruk (left) and clay tokens from Habuba-Kebira-south. After *Syrie*, 16, fig. 1. By kind permission of the Société Générale de Belgique.

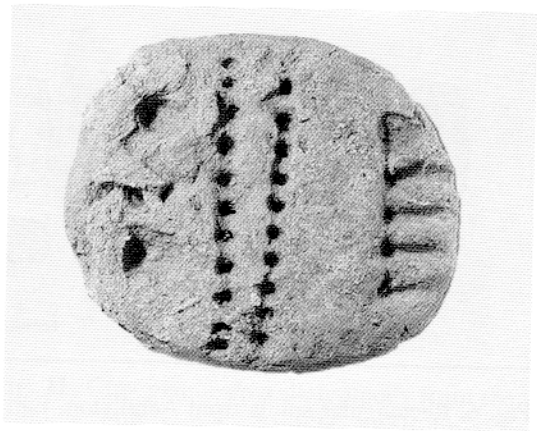


Fig. 2. Numerical tablet bearing imprints of rounded or oblong shape, probably indicating counted products. Djebel Aruda, end of the Uruk period. After *Syrie*, 194, 18. By kind permission of the Société Générale de Belgique.

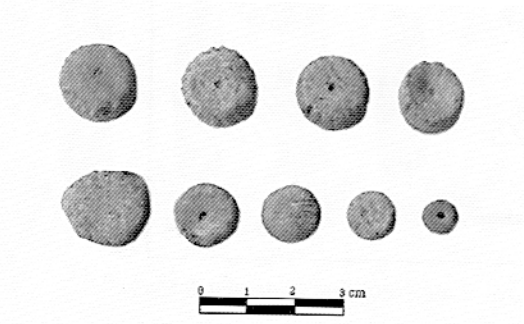


Fig. 3. Clay rounded miniature 'drums' or 'seats'. Northern Greece, Middle Neolithic (?). Photograph by the author.

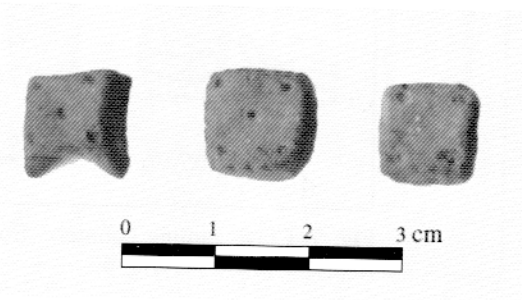


Fig. 4. Clay rectangular 'tables' or 'seats' from the Munich 'cult scene'. Northern Greece, Middle Neolithic (?). Photograph by the author.

Fig. 5. Clay miniature 'ear-studs', bobbins, or 'drums' from the Munich 'cult scene'. Northern Greece, Middle Neolithic (?). Photograph by the author.

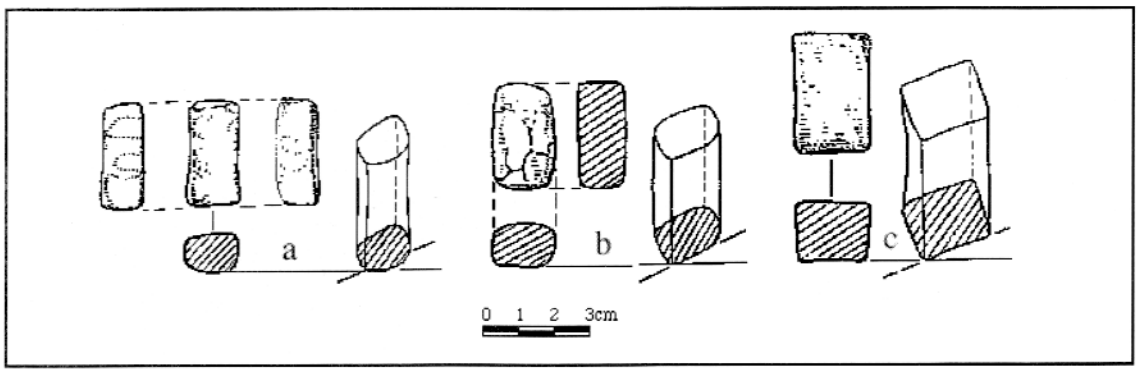


Fig. 6. Rectangular solids from Achilleion, Early and Middle Neolithic. Adapted from Gimbutas *et al.* 1989, 257, fig. 8.14.

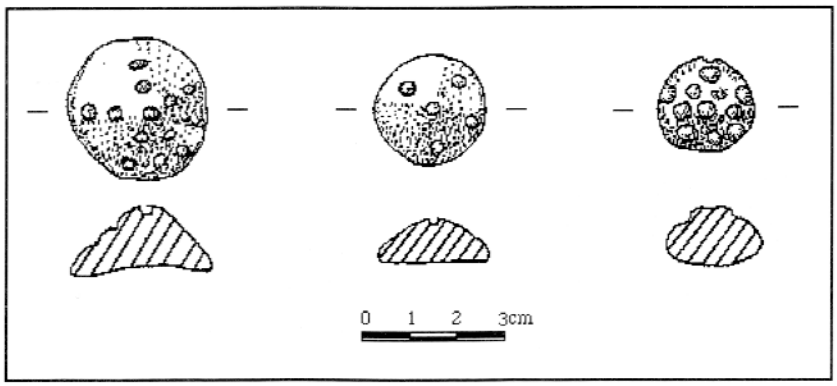


Fig. 7. Clay 'gaming counters' from Sitagroi, Late Neolithic. Adapted from Renfrew 1987, 367, fig. 9.

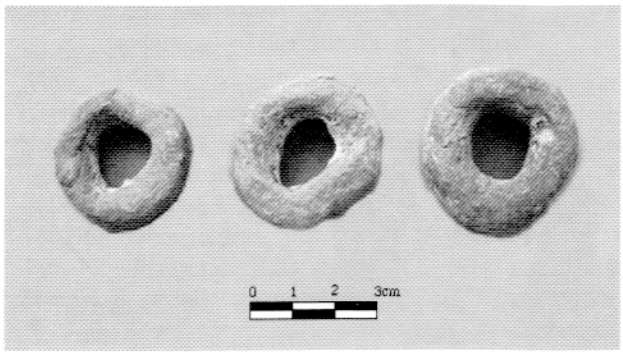


Fig. 8. Clay 'rings' from Dikili Tash, Late Neolithic. Photograph by the author.

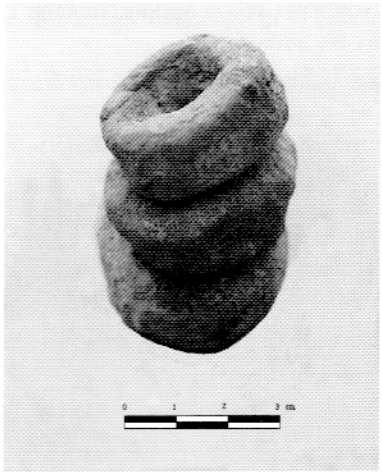


Fig. 9. Clay 'rings' from Dikili Tash, Late Neolithic. Photograph by the author.

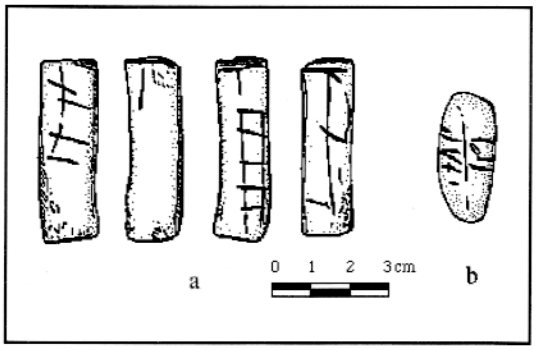


Fig. 10. Clay plaques/parallelepipeds from Thessaly, Middle Neolithic. After Θεοχάρης 1973, fig. 181.

Fig. 11. Clay plaques/parallelepipeds from the Munich 'cult scene', Middle Neolithic (?). Photograph by the author.

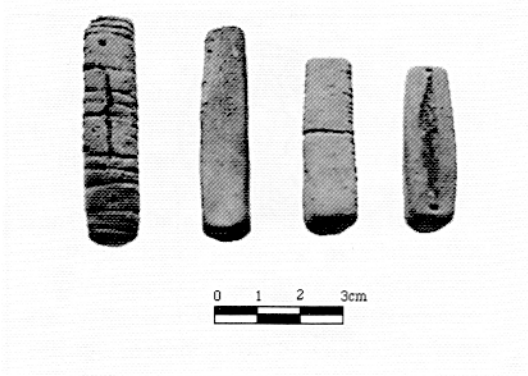


Fig. 12. Clay plaques/parallelepipeds from the Munich 'cult scene', Middle Neolithic (?). Photograph by the author.

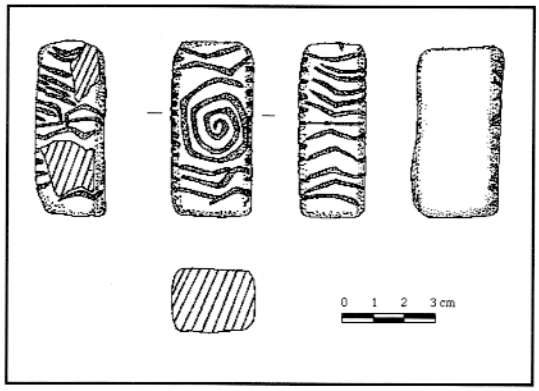


Fig. 13. Clay incised plaque from Dimitra, Middle (or Late?) Neolithic. Adapted from Renfrew 1987, 362, fig. 7.

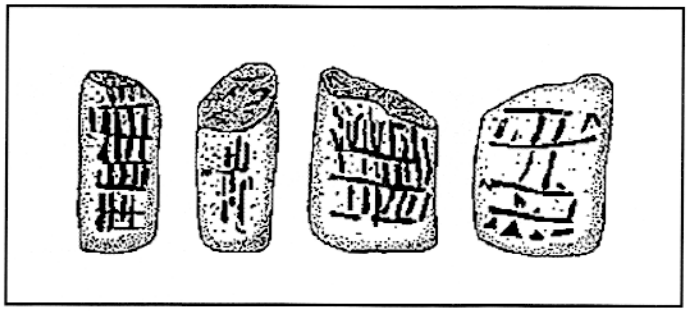


Fig. 14. Clay 'paginated' tablet from Tangiru, Gumelnitsa IIc period (*ca.* 4000 BC). Adapted from Winn 1981, 222, fig. 30a. No scale.

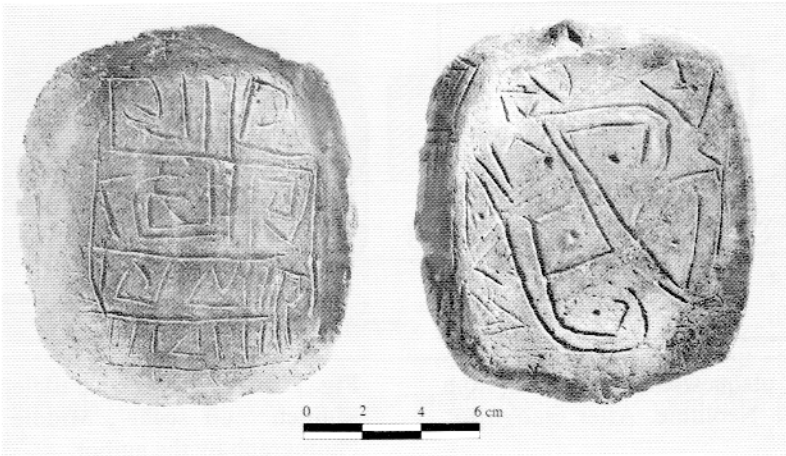


Fig. 15. The plaque of Gradešnica, Late Neolithic (Early Chalcolithic). Adapted from Nikolov 1986, 183, fig. 15a-b.

Fig. 16. Clay spindlewhorl with incised signs from Dikili Tash, Late Neolithic. After Treuil 1992, pl. 203A. By kind permission of the École Française d'Athènes.

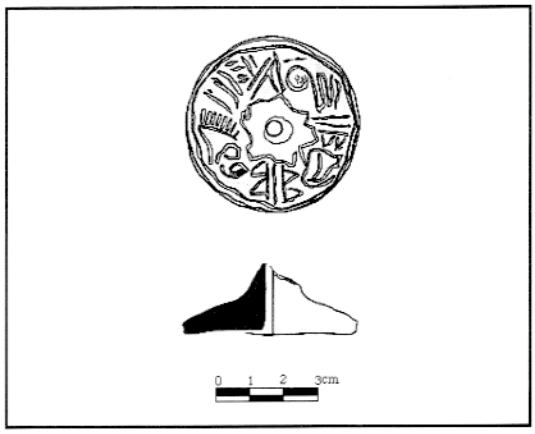


Fig. 17. Clay spindlewhorl with incised signs from Dikili Tash, Late Neolithic. After Treuil 1992, pl. 155D. By kind permission of the École Française d'Athènes.

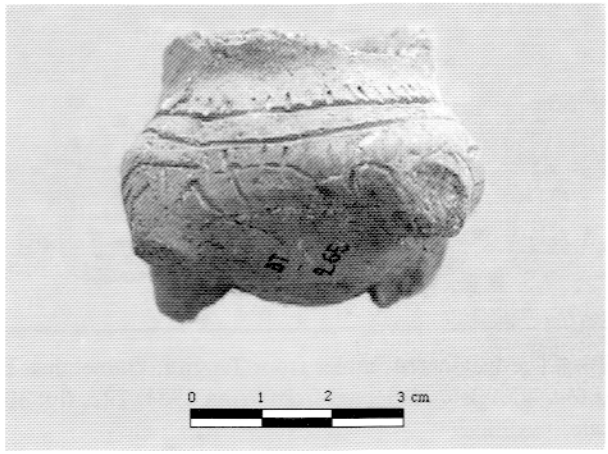
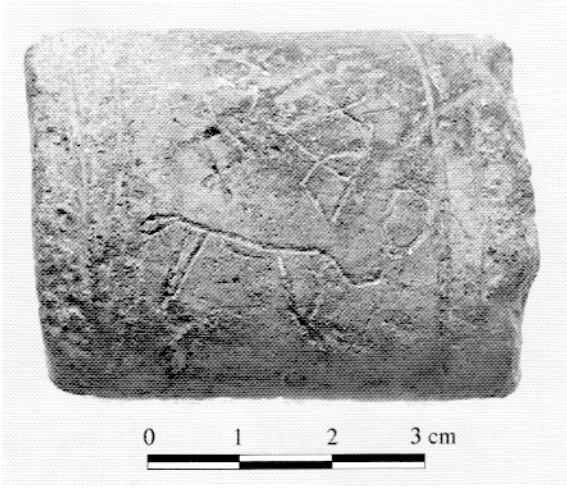


Fig. 18. Miniature vase from Dikili Tash with incised signs (?), Late Neolithic. Photograph by the author.



a

Fig. 19a-c. The clay flattened cylinder from Paradimi. Its roughly elliptical bases bear deep, oblique, parallel incisions, and its flattened side is almost completely undecorated (not shown on the photographs), as the incisions end under its edges. The revolution (curved) surface, delimited by double parallel incisions along the ends near the bases, bears various incised patterns.

On the two lateral sides of the curved surface (a, c), two quadrupeds (male and female?) are incised, parallel to the cylinder axis, one on each side. Over each animal, two abstract signs, consisting of a series of triple or quadruple Xs or lozenges, parallel to the cylinder bases, are formed by deeply incised crossed lines and points. There are three more rectangular shapes, two of which, inscribed with crossed lines, over the 'male'.

b

c

On the upper part of the curved surface of the cylinder (b), between the two ensembles of animals and abstract signs, a series of four parallel lozenges have been incised very lightly, parallel to the bases. The frequent repetition of the same pattern up to four times, the combination and the order of the marks and animal representations seem significant (photographs by the author).