Ancient Geometry: Writing Systems, Art, Mathematics

Azhideh Moqaddam (Tehran University)

Proto-Sumerian and Proto-Elamite[1] are the most ancient writing systems of the Near/Middle East. Both systems consist in geometric signs that along with numericals and pictographs appear in a curious collection. The number and variety of geometric signs rise in the Linear Elamite (LE) in a way that it is categorized as a geometric writing system.

The structure of geometric patterns and their difference with figurative motifs reject any rootless and sudden appearance in the ancient writing systems and would not be justified without postulating a long past of geometric knowledge for them. Reviewing reports on the discoveries of ancient petroglyphs, especially in the Near/Middle East and Europe, provides us with a collection of geometric patterns dating from the Neolithic era back to the Upper and Middle Paleolithic. Continuity of similar patterns on the prehistoric potteries of the Near/Middle East places their phase somewhere in between the petroglyphs and the oldest writing systems of the region.

About mid-fourth millennium BCE Sumerians counted their agricultural and manufactured goods by clay tokens. By the substitution of pictographs of goods on clay vessels containing tokens, they entered a new phase. Using numerical signs in association with pictographs prevented the latter from being repeated for every single token and consequently, about 3300 BCE a writing system based on *a mixture of geometric signs, pictographs* and determinatives made on clay tablets came into existence. At this stage signs were made in stroke-like marks and had not the appearance of what is known as "cuneiform". Around late fourth millennium BCE, the original functions of pictographs were modified and each would communicate several concepts. As a consequence, the sign inventory went under considerable reduction. Mid-third millennium BCE witnessed other changes: with the 90 degrees leftward rotation of the clay tablet, the direction of writing changed from up-down to left-right, and with the new cut of the stylus leaving cone-like marks on clay, pictographs gradually took distance from their original pictures and there appeared what we call "cuneiform script".

About 1600 written documents in PrE have been found in the plain of Susiana and the Iranian plateau from ca.3100 to 2900 BCE, whereas the limited number of 22 inscriptions in the apparently younger script of LE has been a dilemma in the history of the Iranian writing systems.[2] Recent excavations at the South Konar Sandal mound of Jiroft have yielded four new

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***Note:** In September 2008 an article on the structure of the Proto-Elamite and Linear Elamite titled "Ancient Geometry and **Proto-Iranian* Scripts; South Konar Sandal Mound Inscriptions" was sent to Germany to appear in Professor Philip Kreyenbroek's Festschrift. It was published in autumn of 2009 (*From Daenā to Dīn, Religion, Kultur and Sprache in der iranischen Welt*, Festschrift für Philip Kreyenbroek zum 60. Geburstag, Herausgegeben von Christine Allison, Anke Joisten-Pruschke And Antje Wendtland, Harrassowitz Verlag, Wiesbaden, 2009, 53-103). Unfortunately, in that edition few of the grids, figures and footnotes were unintentionally overlooked. In this edition those parts are restored, few of the previous parts omitted and the results of new researches done by the author added. The title has accordingly changed. (Azhideh Moqaddam, Spring of 2010)
Other new parts were also added to the article on Spring of 2012.

[1] Hereafter in this article PrE. Other abbreviations are added beside the related words.

[2] PrE tablets are: 1500 from Susa (Khuzestan) (de Mecquenem, 1949. Scheil 1911), 32 from Tell Malyan (Pars) (Stolper, 1985, 1-12), 27 from Tepe Yahya (Kerman) (Damerow-Englund, 2003), 1 from Shahr-e Sukhteh (Sistan) (Seyyed Sajjadi, 1374, 229, 347), 23 from Tepe Sialk (Kashan) (Glassner, 1998, 113), and 1 from Tell Uzbaki (near Tehran) (Madjidzadeh, 1377-78, 61). Tablets reported from Tell Qazir and Choqa Mish (Khuzestan) are of

inscriptions in a script which other than some previously unknown forms, seem to be a combination of signs of the two above mentioned scripts. So, the question of the origin of the so called “Elamite” scripts is now more magnified.

The language of the inscriptions as well as the identity of both PrE and LE scripts had been the obstacles in their decipherment. The word “Elamite” can show the prevailing trend in both regards, though in case of PrE it is more conjectural. The most important sources for the study of the language of the younger LE inscriptions are: 1) the inscriptions in the cuneiform Elamite from 1400 to 1200 BCE belonging to the two powerful Middle Elamite kings, Untaš Napiriša, who built the famous ziggurat of Chogha Zanbil, and Huteletuš Inšušinak, the last king of the dynasty, and 2) the Elamite versions of the royal Achaemenid inscriptions from the mid. first millennium BCE. If we go further back in time, the only reliable evidence for this language is the treaty between Nārām Sin, king of Akkad, and a king of the Awan dynasty. There are also two other inscriptions from the late third millennium BCE to be included in the list (Lambert, 1974, 3-14).

With a total number of 1200 signs,[3] PrE has generally been classified as an Ideo-/logographic writing system with few signs for numbers and probably a limited number of syllabograms. It is believed that Elamites adopted most of their numerals and numerical system from their western neighbors, the Sumerians. Others have postulated links between PrE and the ancient Sumerian writing system dated to Uruk IVa (ca. 3200-3100 BCE) (Langdon, 1928, viii. de Mecquenem, 1949, 147. Meriggi, 1969. Damerow and Englund, 2003). According to Dahl perhaps it is wiser to consider the probability of the two writing systems having been originated from a common ancestor than one from the other (Dahl, 2005, 85). The high number of hapax signs is another common feature of these Prot-scripts (Damerow, 2006, 6-7). However, the graphical values of PrE signs have not yet been determined with certainty and LE has not been of important assistance either.

The origin of LE has long been a matter of dispute among the archaeologists. It suddenly appeared in the time of Puzur Inšušinak, the last king of the Avan dynasty (late third millennium BCE), and sank into oblivion soon after his death. Scholars have proposed varied estimates for the number of the LE signs. Hinz had prepared a list of 56 signs and 5 variants with assigned graphical values which were least accepted by other scholars (Hinz, 1969, 44). In Merrigi’s list there are 62 main signs, 20 variants, 41 hapax signs, 1 divider, 5 logograms and 1 fully phonetic sign.[4] According to him, LE should be classified among syllabic scripts. He has identified 19 PrE signs in the LE and believes that 16 others can also be traced back to it (Meriggi, 1971, 184-220). As with the PrE and despite all attempts, there has been no decisive progress in the decipherment of the LE.

South Konar Sandal (SKS) mound of Jiroft in the Kerman Province of Iran has brought to light some very interesting evidence that may be of some assistance in approaching the problem.

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numerical type, and those from Tepe Hissar (Damghan) have not clearly been identified. According to Dahl (2005, 81-82) most of the tablets from Tepe Sialk are specifically not PrE.

The discovered LE inscriptions are: 19 from Susa (Khuzestan), 1 from Shahdad (Kerman) and 1 from Marvdasht (Pars). The place of discovery of the last inscription is not known. These have conventionally been labeled from A to V. Inscription Q is in the National Museum of Iran (Tehran) and all of the inscriptions from Susa are preserved in the Louvre, Paris. Inscriptions W, X, Y and Z on silver vases are probably fakes. For the photos of inscriptions see CDLI: Cuneiform Digital Library Initiative.

[3] http://cdli.ucla.edu/wiki/doku.php/proto-elamite.

[4] These signs are shown in graphical reproductions in this article. Reader can also refer to the original list in Meriggi, 1971, 203-205. For Beatrice André Salvini and Mirjo Salvini’s list, see Salvini, 1989, 331.

In three of the four inscriptions discovered, some previously known LE signs are accompanied by signs that look more archaic. As the four inscriptions introduce new signs with simpler structures in comparison to the former ones, it has been suggested that they should date further back in time and that eastern Iran could have been the cradle of the script labeled "Linear Elamite." According to the head of the excavation team, Prof. Yusof Madjidzadeh, Puzur Inšušinak adopted the script in its fully developed form from his eastern neighbors and as it was not native to his mother land Elam, was soon forgotten after his death. According to him, SKS mound inscriptions are older than all of the other twenty two known LE inscriptions.[5] He has proposed the name "*Proto-Iranian*" for this script whereas formerly Harvard Assyriologist, Piotr Steinkeller had proposed it be called "*Eastern Script*" because according to him the culture of its users, the inhabitants of the Halil Rud basin, had been drastically different from that of the Elamites who were deeply under the influence of Sumer (CHN, 29 May 2006). New archaeological findings from eastern parts of Iran are providing clear evidence to this cultural independence. Other than the fact that hundreds of inscriptions have been found in the Elamite lands, there is practically no good reason why the script should be called "Elamite." We still do not even know what the Elamites called their script or language.

South Konar Sandal mound inscriptions have yielded a total number of about 48(?) different signs, amongst which 31 are attested for the first time. These are numbers 10-(14?-)15, 17-21(?), 23-35, 37-39 and 42-48 (see table 1).

This article deals with the external structure of the LE signs and focuses on the mechanisms behind their invention. Probably, if the external structure is clarified, along with other archaeological evidence, some deductions can be made as to the geographical extent throughout which it had been used and someday perhaps, to its original cradle. For the Pr/LE signs, I have based my work on Meriggi's lists and therefore no direct reference will be made to the inscriptions.

At first glance, most of the LE signs may look like the internationally known geometric shapes such as squares, rectangles, triangles, circles etc. but they can be viewed differently. One ought to look behind their shapes or in other words, inside them. To achieve this, I split LE signs into their smallest components and whenever possible, classified similar shapes under the same groups. Doing so, I finally came to two quite fundamental forms: **line** and **dot**, basic notions of geometry. The question then, was how lines and dots had joined together to make the signs appear as they do. So, the next step was to figure out the combination patterns and this could not be accomplished without working on every single sign.

LE signs have the following geometrical shapes in common: 1) straight lines in: a) horizontal, b) vertical, and c) oblique positions, 2) curved lines with different degrees of curvature from: a) parabola and b) half circle to c) complete circle, and 3) non-straight lines from a) chevrons to b) zigzags.

[5] Reports on the Konar Sandal archaeological excavations basically include Madjidzadeh 2003 and 2004. In early 2009 another article by him titled "Jiroft Inscriptions and Origin of the Elamite Writing System" was published in the Iranian Journal of Anthropology, Anthropological Society of Iran (Spring & Summer 2009, No. 10, 97-126). Other than the above mentioned publications, some preliminary information can be obtained on Internet sites as CHN: the Iranian Cultural Heritage Organization News Agency.

Table 1: Signs of South Konar Sandal Mound inscriptions 1, 2, 3 and 4 discovered from Jiroft in two positions (indicators △ and ▽ show the two positions of signs). Grey boxes contain signs not previously attested.

No.	△	▽	SKS tablet	No.	△	▽	SKS tablet	No.	△	▽	SKS tablet	No.	△	▽	SKS tablet
1			2,3,4	**13**			2,4	**25**	some lines inside (?)		2	**37**			3
2			4	(14)	?	?	2	**26**			2	**38**			4
3			2	**15**			4	**27**			2	(39)			2
4			2	**16**			3	**28**			3	**40**			2,3,4
5			3	**17**			2	**29**			4	**41**			2,4
6			4	**18**			3	**30**	two lines inside(?)		2	**42**			4
7			3	**19**			3	**31**			1	**43**			3,4
8			2,4	**20**			3	**32**			3	**44**			2
9			2	**21**	?	?	1	**33**			2,3,4	**45**			4
10			2,3,4	**22**			2,4	**34**			2,4	**46**			4
11			2,4	**23**			1	**35**			4	**47**			1
12			2,3,4	**24**			1	**36**			4	**48**	?	?	1

I do not believe that any script could have been invented freely or out of chaos and without predetermined pattern/s or former stages of evolutionary process, even if the number of signs exceeded thousands, as is the case with Proto-scripts. Having this principle in mind, and since all of the LE signs, in one way or another, have some features in common, I assumed that there should have been what I call here a “Master Pattern” out of which they had been shaped. To find out what this original or Master Pattern had been, it was necessary to reach a form or pattern that was comprehensive enough to cover all of the signs regardless of their diverse features. This was not possible unless, after defining the basic shapes, one proceeded the other way, that is to find out how lines and dots had basically been joined to form a Master Pattern.

To reach the original form, one has to reconstruct the procedures through analyzing each single sign. There are five basic stages to follow:

Stage 1:

Basically, there are some straight lines in the signs which are arranged in different numbers and positions. Regarding the signs in Meriggi’s list, I observe a symmetry in lines like: ***a*** **b c b** ***a*** , that is the outer lines (***a*** and ***a***), middle lines (**b** and **b**) and center line (**c**).[6] This is a pattern that will govern this entire work. So, in my opinion the original pattern included 1, 2 and 3 lines in different positions (fig. 1). These are:

A	B	C	D
1	**4** (or 1)	**7** (or 1)	**10** (or 1)
2	**5** (or 2)	**8** (or 2)	**11** (or 2)
3	**6** (or 3)	**9** (or 3)	**12** (or 3)
A1+A2= A3	B4+B5= B6 (or B3)	C7+C8= C9 (or C3)	D10+D11= D12 (or D3)

Figure 1: Base patterns of stage 1

First position(A), horizontal; Second position(B), vertical; Third position(C), oblique(5-11 hours); Fourth position(D), oblique (1-7 hours). The third box in each column is actually a combination of the two former ones, that is: A1+A2=**A3**, B1+B2=**B3**, C1+C2=**C3**, and D1+D2=**D3**. Unlike the other two groups, oblique lines are not equal in size. This is explained in Note 3.

Stage 2:

2-1) In order to reach new forms one cannot continue adding to the number of lines based on the same patterns, so the simplest way for proceeding from a preliminary stage, as stage 1, to a second and more developed one, would be a change in the shapes by joining the lines together in different ways. Therefore, considering the symmetry mentioned before, that is **b** c **b**, we choose the middle position as the central point for intersections[7] and join together the patterns of fig. 1 but only in two groups: “A&B”, and “C&D”, that means “horizontal+vertical”, and "oblique+oblique".

The two oblique groups are actually mirrored forms of each other and although they can be separately put into the system, here are treated as one.[8] The resulted combinations are shown in fig. 2.

[6] There are signs in the list of Hinz with more than 3 lines. So, based on the number of lines documented in the LE sign collection, this number can be changed. Since I have worked with Merggi’s list, I came to “3”.

[7] For the explanation see next paragraph.

[8] See Note 3.

Six forms have the best symmetry with 2, 4 and 6 crosses. These are (bold letters in fig. 2):
- In group A & B: E (1 and 1 lines), I (2 and 2 lines), M (3 and 3 lines)
- In group C & D: N (1 and 1 lines), R (2 and 2 lines), V (3 and 3 lines).

A+B > E-M or 13-21		
A1+B1>E/13	A2+B1>H/16	A3+B1>K/19
A1+B2>F/14	**A2+B2>I/17**	A3+B2>L/20
A1+B3>G/15	A2+B3>J/18	**A3+B3>M/21**
E+F=G	*H+I=J*	*K+L=M*

C+D > N-V or 22-30		
C1+D1>N/22	C2+D1>Q/25	C3+D1>T/28
C1+D2>O/23	**C2+D2>R/26**	C3+D2>U/29
C1+D3>P/24	C2+D3>S/27	**C3+D3>V/30**
N+O=P	*Q+R=S*	*T+U=V*

Figure 2: Base patterns of stage 2

Note 1: If, in every case, we work on lines with equal lengths as well as different points of intersections as left, right, middle, top and bottom, we come to shapes that although absolutely probable but are not qualified for our present scheme to be continued to other stages, bearing in mind that all of these shapes can be reached through other paths too. Some examples of such shapes are given here (fig. 3).

	Left-top	Right-top	Left-bottom	Right-bottom	**Figure 3:** Examples of other ways for joining the base lines. The number of lines can be changed in each case
1 2					
	Middle-top	Middle-right	Middle-left	Middle-bottom	
3					

Note 2: Combining each single form in fig. 1 with all other forms at one stage as well as different ones, requires a large table which is avoided here. Other than the high number of possible forms, the process can go on and on with every new form, though finally a stop point will be reached. So, one can imagine the hypothetical shapes in the more complete forms. To see what a specific shape could be, it is enough to ignore some lines in the complete forms of each group. Here six forms that can appear at stages 1, 2 and 1+2 are presented:

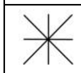
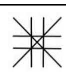
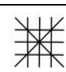
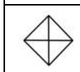
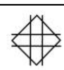
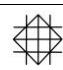
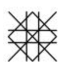
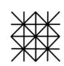
Stage 1:	A(1)+D(1)	A(2)+C(2)	A(3)+C(3)	**Figure 4:** Combinations of base patterns of one stage as well as of different stages. *Components of LE ligatures or composite signs can be observed here.*
Stage 2:	G+N	F+U	I+Q	
Stage 1 + Stage 2:	A(1)+R	B(3)+S	C(3) + E	

Stage 3:

At this stage, E, I, M and N, R, V, the only symmetrical forms of the previous stage are joined together to create new forms (fig. 5). Other asymmetrical forms can be made on them.

If we place ɛ/39 in *a closed* square or frame or in other words, if we add 4 lines to it -which will be our **a … a** lines- we will have a square with 5 horizontal, 5 vertical but 6 diagonal lines (fig. 6). ***This is what I suppose had been the Master Pattern and the original source for making***

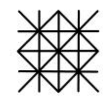
Linear Elamite signs. In fig. 6 the joint of lines are magnified to show the situation of dots in the grid.

E+N/R/V	I+N/R/V	M+N/R/V
		
13.E+22.N > W/ 31	**17.I+22.N > Z/ 34**	**21.M+22.N > γ/ 37**
		
13.E+26.R > X/ 32	**17.I+26.R > α/ 35**	**21.M+26.R > δ/ 38**
		
13.E+30.V > Y/ 33	**17.I+30.V > β/ 36**	**21.M+30.V > ε/ 39**

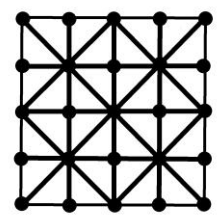
← **Figure 5:**
Base patterns of stage 3

ε/39 is the final form with 3 horizontal, 3 vertical and 6 diagonal crosses in two directions. These are the **b** c **b** lines .

ε/39 →



To increase the number of diagonal lines, we can connect the free dots. So 8 new diagonals will appear, 4 on each side, and their total number will be 14, that is 7+7 (fig. 7). Again, some new dots appear on cross lines which by drawing lines between them, new horizontal and vertical lines will be added.



a b c b a

Figure 6: Master Grid

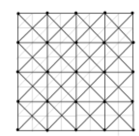
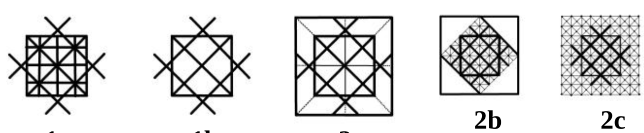


Figure 7: Master Grid with additional lines

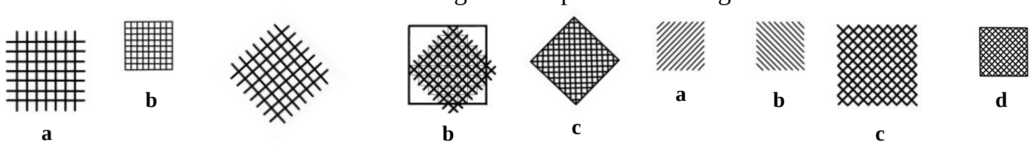
Note 3: Now we shortly return to the problem of unequal oblique lines. As previously mentioned, the length of the two oblique lines **b** and **b** had been shortened from the very first stage. Now that lines have been put into a frame, it can be seen why they were shortened. If we intend to reconstruct the "Master Pattern" inside a well-defined and regular space, we have to work with equal oblique lines inside one and two larger frames because lines **b** and **b** do not fit in the square made by joined horizontal and vertical lines. So, their lengths have to be decreased to be placed inside the same frame as the other two lines (fig. 8).



1a **1b** **2a** **2b** **2c**

Figure 8: In figures 1a and 1b, oblique lines are in equal length as horizontal and vertical lines. Oblique lines can be seen inside their own frame which encompasses the frame of horizontal and vertical lines (2a, b, c).

Numbers of lines have been increased in fig. 9 to help clear the image.



1) Horizontal and vertical cross lines (a) inside a frame(b)

2) Diagonal crosses(a) inside the frame of horizontal and vertical cross lines(b) and its own(c)

3) Shortened diagonals(a, b)and shortened diagonal crosses(c) inside a frame [lattice](d)

Figure 9: Horizontal, vertical and oblique lines in frames

Up to here, we have worked with 1, 2 and 3 lines which mean that our base number had been 3. By adding to the number of base lines, we can obtain bigger grids with more squares. Regarding the general symmetry observed in the LE signs, I chose number 9 which is a multiple of 3, consisting of: line no. **1** (= a, the frame square) + **2, 3, 4** (= b, the main lines) + **0** (= c, the central line) (fig. 10).

Note 4: Regarding how many lines are used inside the frame, the intervals between them directly affects the final shapes. In fig. 11, different intervals are shown based on number 9. These are:
- Diagonals: 1&1. 2&2. 3&3. 4&4. 5&5. 6&6. 7&7.
- Horizontals: 2&8. 3&7. 4&6.
- Verticals: 2&8. 3&7. 4&6.

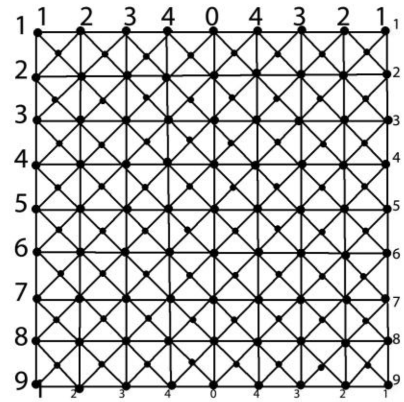
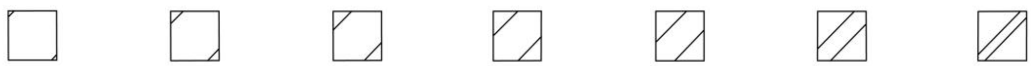


Figure 10:
Master Grid with 9 base lines

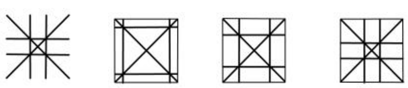


1&1 2&2 3&3 4&4 5&5 6&6 7&7

2 &8 3&7 4&6 2&8 3&7 4&6

Figure 11: Lines at different intervals inside the frame

To see how different intervals can affect the final shapes, Z (of stage 3, fig. 5) is chosen and its horizontal and vertical lines placed at 3 different points.



Z **4&6** **3&7** **2&8**

Figure 12: A grid pattern with base lines at three different intervals

Linear Elamite signs:

Classification of LE signs according to fixed criteria is not simple as they display various features. Some signs can easily be grouped together but there are signs that are too different to go under the same category. I tried to classify signs with similar shapes in one group, so Meriggi’s 103 signs went into eleven groups. New signs of the SKS mound inscriptions are included as well.

What is essential in the analysis of the structure of signs is whether or not every single sign can be placed inside the Master Grid while its lines are superimposed on the lines of the latter. Every deviation may hint to a different treating of the Master Grid. This will be clarified with each case or group of such cases.

As a sign should follow the lines of the Master Grid, based on the number of lines chosen, its size will practically be predetermined by the limits of the Master Grid lines. This means that if the base of a sign lies on the lowest line of the frame, depending on its shape, its top may come one row below the uppermost line of the Grid. Placing the top on the upper line of the frame brings up the base line. But some signs can move inside the frame without losing the symmetry of lines. The only change will be their overall sizes. So, some signs may be different from others in the dimensions of their Master Grid (see also fig. 60). *In analyzing signs, no reference will be made to the stage to which each sign belongs.*

Group 1: Lines (straights, zigzags) and dots

The first group, numbers 1 to 29 (fig. 14[9]), are generally titled as "lines and dots." These are straight and cross lines as well as zigzags. Zigzags are actually two or more diagonals in different directions (fig. 13). Dots can appear in different numbers and locations. They can be empty inside or bold.[10] Signs of this group display full symmetry and can easily be put into the Master Grid. There are some points to be mentioned:

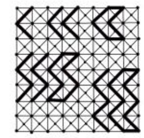


Figure 13: Chevrons and zigzags

Numbers 1, 18-19 and 10-15 seem to be very basic forms. Sign no. 10 shows that the inventor has divided the Grid into two parts, that is two horizontal rectangles which is an important point in how the Grid had been viewed. *There can be seen a trend to thicken the lines*: signs no. 19 and 20 are actually similar in their general patterns, their difference being only in dots which are lacking in 20 with thickened lines. The same point falls true with sign 27 which is actually a horizontal zigzag with an additional oblique line that is 4 instead of 3. Chevron sign no. 28 can be considered as the simplest of this type with only two but thickened lines.[11] There is a common pattern behind signs 9 and 16. Here dots and pseudo-lozenges[12] are two very close choices out of the Gird.[13]

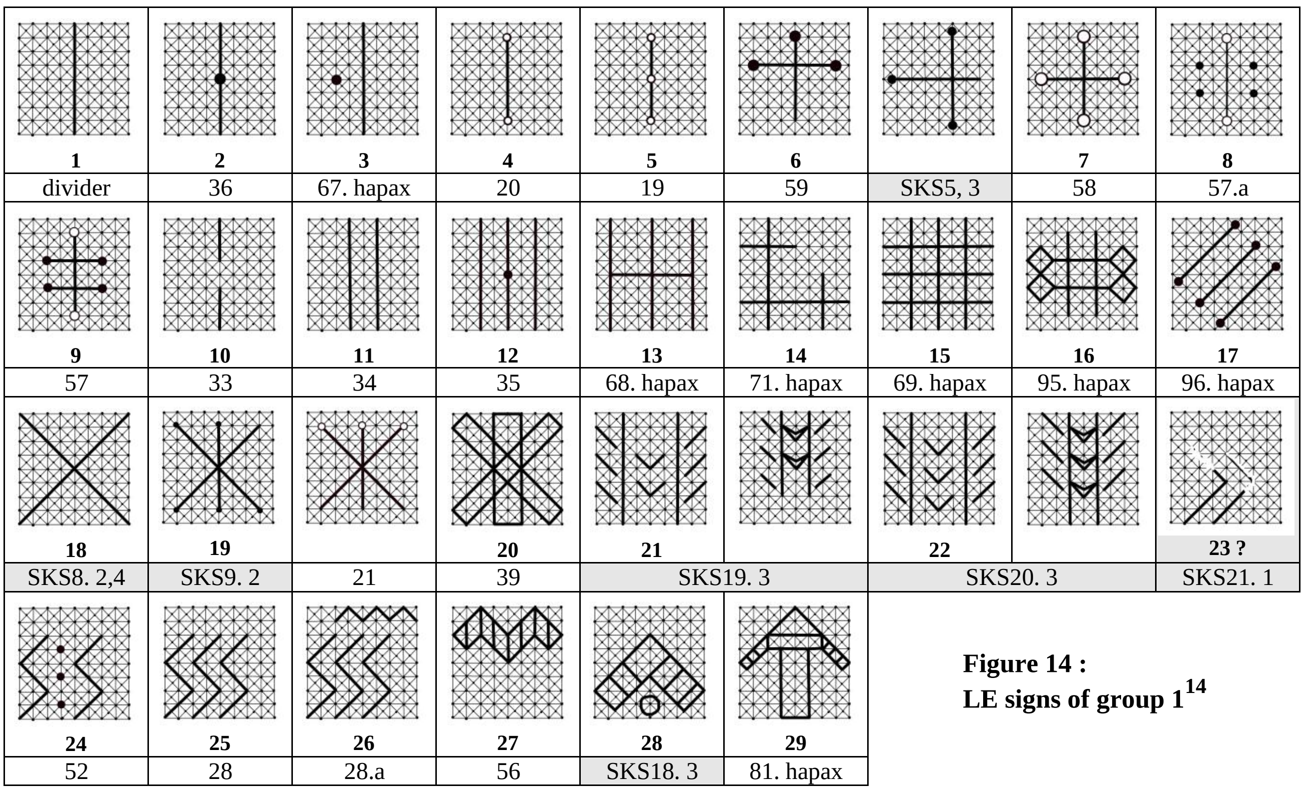


Figure 14 : LE signs of group 1[14]

Group 2: Squares and rectangles

[9] In reconstructions bold numbers immediately under the signs are serials given to them in this article. Numbers in boxes under the signs are those in Meriggi's list. Numbers after the abbreviation "SKS" refer to the serial grid numbers given to the signs in table 1. Here SKS signs are reconstructed based on the △ position.

[10] See figures 31 and 32.

[11] See group 11.

[12] Here, pseudo-lozenge is a conventional definition for rotated square. See figure 23.

[13] See figure 31c1-3.

[14] Sign no. 23 (SKS 21.1) may be the same as SKS1.27. For sign no. 45 see table 1.

The second group -signs 30 to 49 (fig. 15)- consists of complete and incomplete squares and rectangles, so to define. Square can be considered as the original outline of the diagram. Going inside from its two sides creates a rectangle. Lines can be omitted on each side of squares (37, 38) and rectangles (30) or moved up and down (31, 36, 37, 38); as sign no. 31 is the same as 33 with the horizontal line moved upwards, and by moving both horizontal and vertical lines of sign 38 up- and left-wards, sign no. 39 appears.

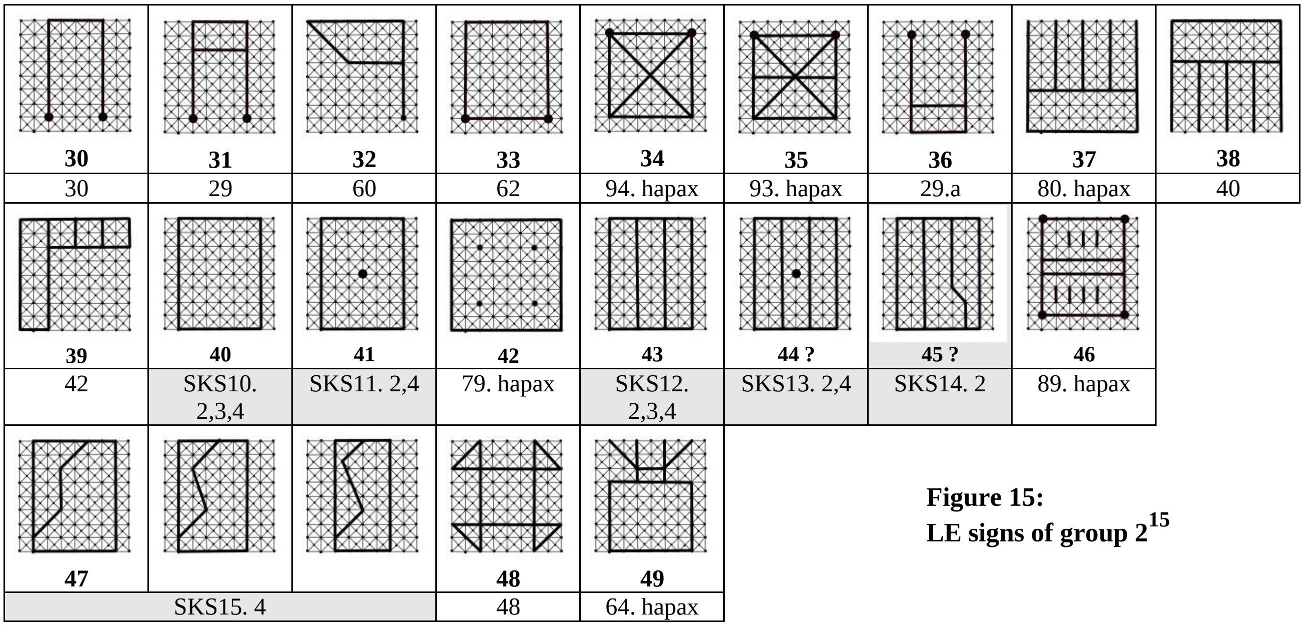


Figure 15: LE signs of group 2[15]

A quite composite pattern can be seen in sign no. 46. Numbers 32 and 47 have different appearances. They are a mixture of straight and oblique lines. 48 and 49 are square-centered. However, it seems to me that no. 48 somehow resembles 34 with the triangles pulled out and placed at corners (fig. 16). No. 49 is more freely shaped.

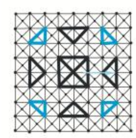


Figure 16

Group 3: Pseudo-lozenges

The third group consists of what I have called pseudo-lozenges (fig. 17). These are actually rotated squares with equal diameters and angles. All of the lines lie well on the Master Grid lines. The only point is their different sizes: 1) some signs completely cover the interior space of the Grid in squares, and 2) some, being formed in rectangles, are smaller and leave free spaces for extensions. Group 3 signs can be classified as tailless pseudo-lozenges (50-57), with upper extensions (58-76), with lower extensions (77-78), and with both upper-and-lower extensions (79). Extensions are single/double/triple [with two cases (64 and 78) having 5-part extensions] and open/closed.

[15] In SKS 2 there are vertical rectangles which their two parallel vertical lines seem to be broken or zigzagged in varying shapes. It is not clear in the photo whether the differences in the shapes of interior vertical lines are because the tablet had been wet when signs were written on it or indeed they were independent signs. It does not seem that other signs have gone under the same condition. For sign no. 45 see also table 1.

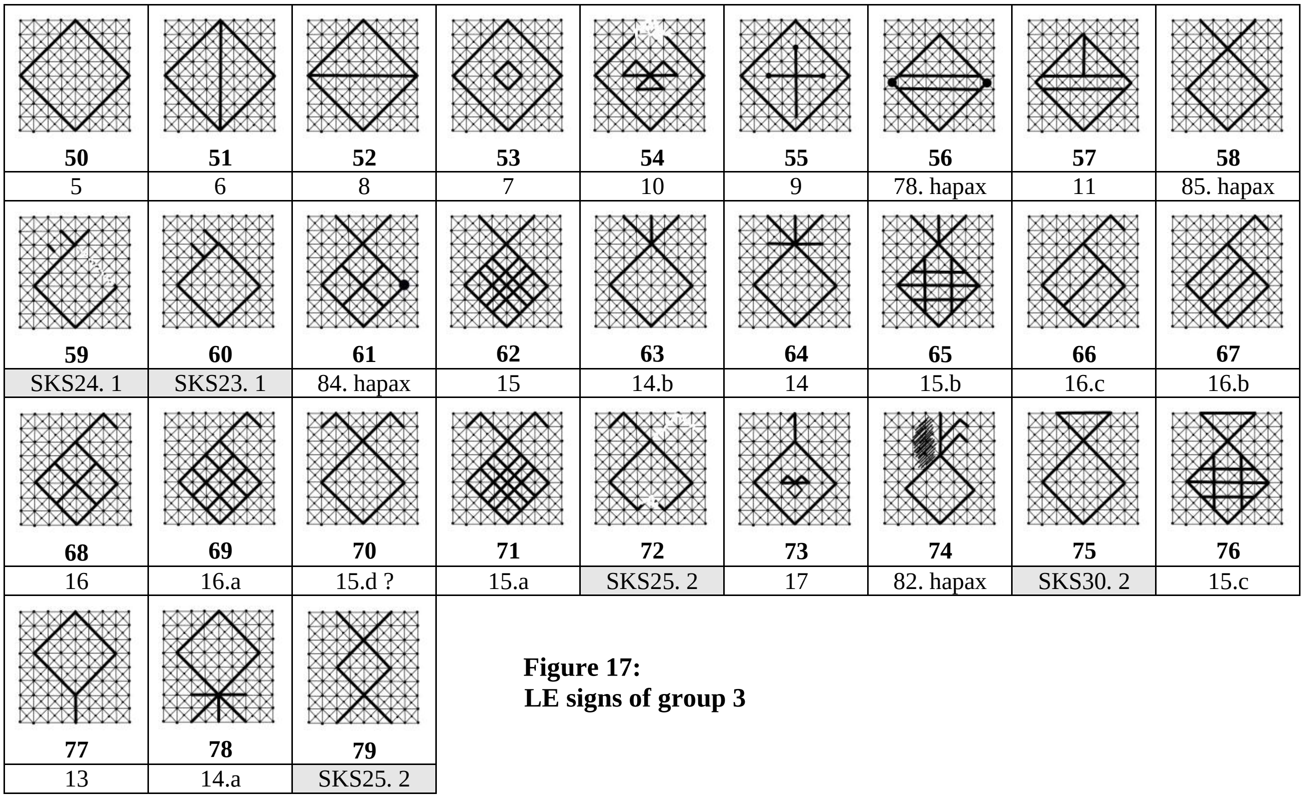


Figure 17:
LE signs of group 3

Group 4: Diagonals and triangles

The fourth group including numbers 80 to 89 -singling out numbers 90 and 91- are hatchings and butterfly shapes. These are made on one (80-83, 86-89), two (84), and three (85) diagonal crosses (fig. 18). Numbers 80 to 85 display full symmetry and are made inside defined squares. Numbers 87-89 have asymmetrical crosses as their base and therefore, are one (86) and two rows (87-89) smaller respectively. Numbers 86 and 87 have the same pattern with the second being larger and closed by side lines. The next two signs too, are somehow similar in pattern but with inward triangles and open and closed extensions.

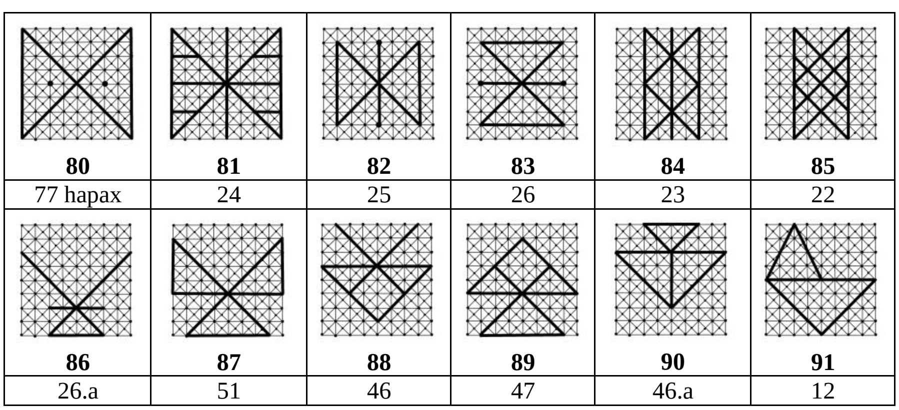


Figure 18:
LE signs of group 4

The difference of sign no. 90 with the former ones is in its deleting of crosses or changing them to a vertical line, pushing the form more towards two equilaterals. Sign no. 91 is formed on two triangles made inside two different frames (see stage 4).

Group 5: Signs 92 to 101 are included in this group (fig. 19). Chevrons and zigzags are important features of these signs, though crosses similar to those in group 4 (95) or irregular lines (100) can also be seen. Numbers 96 to 99 may be described as “single and double house-like” signs, of which no. 97 is inverted, but numbers 92 and 95 cannot be ascribed to any certain form. Putting aside “mountains”, I cannot guess what the idea behind these shapes could be. One may call them “denticles (?)”. It only seems to me that they almost follow the same pattern as the former ones with the difference in shapes ◣ ◢ and △ △. I have also included signs 100 and 101 here. Sign 100 looks like a headless fish (?), but its original identity is difficult to determine. No. 101 looks like a vessel with a handle (?).

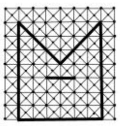
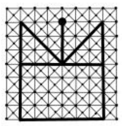
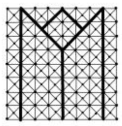
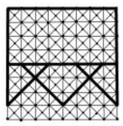
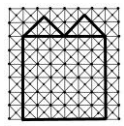
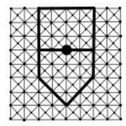
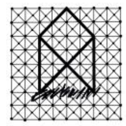
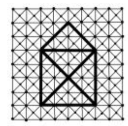
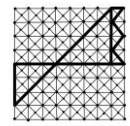
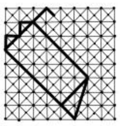
								
92	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**
97. hapax ?	55	KS16. 2	41	99. hapax	90. hapax	75. hapax	74. hapax	43
								
101								
31								

Figure 19:
LE signs of group 5

Group 6: Honeycomb signs

Numbers 102 to 109 (fig. 20) are grouped as honeycomb forms. SKS48.1 is incomplete, but it seems to me that it is a honeycomb sign. Two of these signs, numbers 106 and 109, have outward lines and extensions.

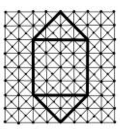
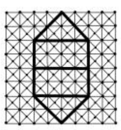
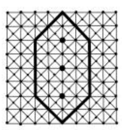
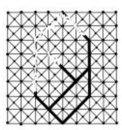
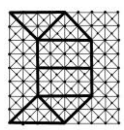
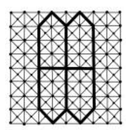
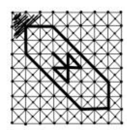
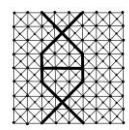
							
102	**103**	**104**	**105 ?**	**106**	**107**	**108**	**109**
1.b	1	2	SKS48. 1	1.a	4	72. hapax?	3

Figure 20: LE signs of group 6

Group 7: Triangles

Other than signs 110 and 119 which are open angles lacking bases, the rest of the signs can be grouped together as complete “isosceles” (fig. 21). These signs cannot be reconstructed inside the Master Grid square because it is not qualified to produce such triangles. Following diagonals can only end in equilaterals, so we have to proceed to another stage.

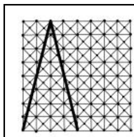
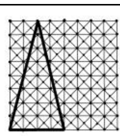
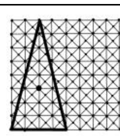
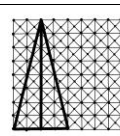
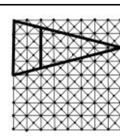
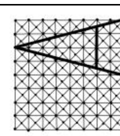
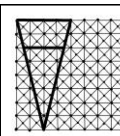
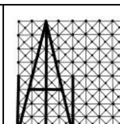
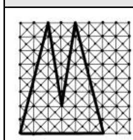
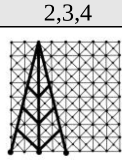
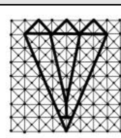
							
110	**111**	**112**	**113**	**114**	**115**	**116**	**117**
SKS32. 3	SKS33. 2,3,4	SKS34. 2,4	87. hapax	45	45.a	53.a	61
							
118	**119**	**120**					
KS34. 4	54	53					

Figure 21:
LE signs of group 7

Stage 4:

To reach an isosceles one needs to work in a more limited space inside the main frame and this can be achieved by dividing it into two parts. Here, to make the image clearer, the two resulted horizontal and vertical rectangles are shown separately (fig. 22a). Each rectangle should be considered as a main frame and cross lines made inside it (b). As seen in the figure, the four big triangles inside the main square have their bases on its four sides (c2). This could be repeated in the smaller rectangles (c1).

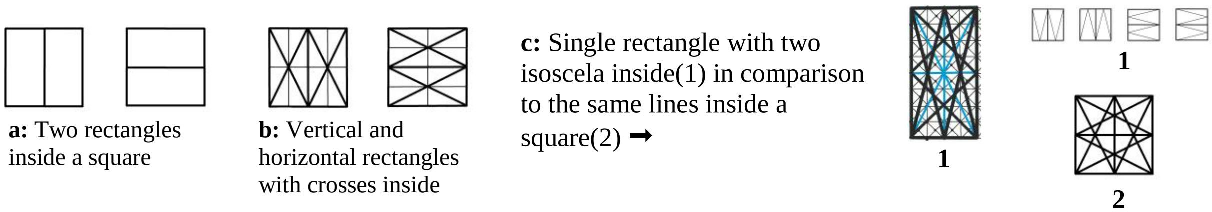


Figure 22: The process of making an isosceles inside a rectangular frame

True lozenges are other products of this procedure (fig. 23a). The process of making smaller rectangles can continue using the same method (b-c).

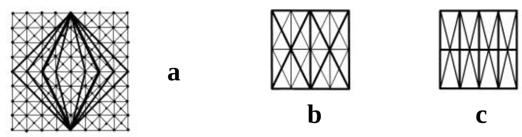


Figure 23:
Pseudo- and true lozenges inside the Grid (a). True lozenges inside and between rectangles (c, d)

Thus, sign no. 110 (fig. 21) can be viewed as the simplest and most basic shape that introduced new connection points on which an isosceles was made.

By creating new connection points, lines could be drawn between asymmetrical points too, not only in rectangles (fig. 24a), but also squares (b). This means that signs with new, regular and irregular proportions could appear. An example with full symmetry would be sign 118 (fig. 21) which can be traced in fig. 24b. Showing some single connections of this type may help one imagine the resulted different types of triangles (c):

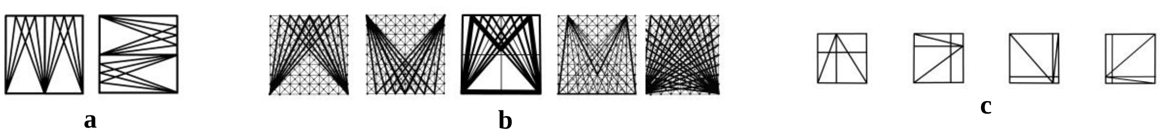


Figure 24: Asymmetrical connections inside the square and rectangular frames

An important point to be mentioned about the new diagonal lines is that making new connections did not necessarily mean making new grids with their own lines (fig. 25). A rectangle lacks the required symmetry and its lines could not be treated like a square, so lines of the Master Grid remained as original and new patterns were added to it to make additional shapes.

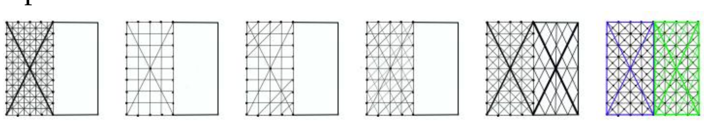
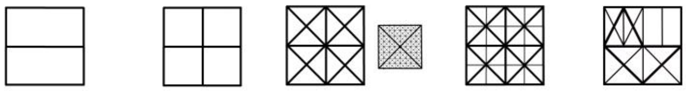


Figure 25:
Rectangles with their own crosses in comparison to the square Master Grid lines

An example for this principle can be sign no. 91 (fig. 18): the two rectangles (fig. 26a) were not treated the same way, since the shape made in the upper part is an isosceles and the one in the lower, an equilateral. This means that different parts of the Master Grid had been treated differently or, to put it another way, the inventor was free to work with different grids or frames side by side. Here we combine the two (fig. 26): if we divide the main square (a) into four smaller ones (b), each of these can be viewed as a main square (c1, c2). The inventor was free to work inside each of them or a combination of two or more, as the structure of the upper part of sign 91 belongs to stage 4 and the lower part to the previous stages (d).[16]

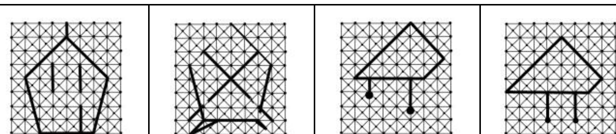


a **b** **c1** **c2** **d**

Figure 26:
Using two types of triangles inside the Master Grid

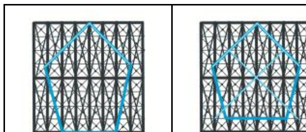
Group 8:

Signs 121 and 122 resemble group 5 but with oblique sides (fig. 27). 122 has been documented on the SKS brick inscription and though incomplete, its overall shape can almost be distinguished. The main body is similar to sign 121. The oblique sides can well be placed on the lines of smaller grids (fig. 28).[17] The upper lines follow the main Grid lines. This is also the case with the cross inside sign no. 122. In the lower left corner of sign 122, there is a short oblique extension with its left part parallel to the oblique line of the Master Grid but the right part connected to the main body along a line which cannot be superimposed neither on the Master Grid lines nor the other one; this is a new connection. Sign no. 123 has similarities to 121 but with different dimensions. The latter lacks the left oblique line and the interior lines of the former seem to have been pulled out and placed under the base.



121	**122**	**123**	
65. hapax	SKS31. 1	98. hapax	

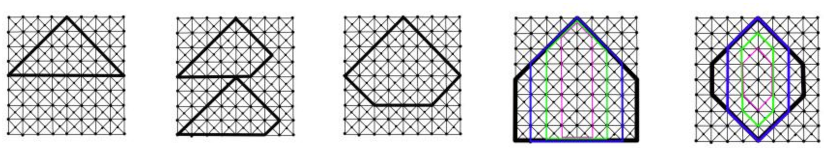
← **Figure 27:**
LE signs of group 8



a **b**

Figure 28: Pentagons

One may assume the following stages for the change of a triangle to a honeycomb sign:



a **b1,2** **c** **d1,2,3** **e1,2,3**

Figure 29:
Probable changes from a triangle to honeycomb. b, d and e are depicted in different sizes

Sign 124, which is Meriggi's hapax 86, looks like a distorted lozenge with its axis turned along an oblique line. To find out how it was made, we have to try different ways: In the first case (fig. 30a), the midline of the Grid passes from the two ends of vertical lines, as the sign indicates too, and all the lines lie well on the Master Grid. In b1-2 made inside three squares, the two vertical lines have one end on the midline. In this case too, all lines follow Master Grid's. If we change the proportions (c), the base grid has to be changed. With this method line E does not follow the

[16] Compare the lower half of 26d to figure 23a.

[17] Imagining new squares or rectangles is what I have called "free connections", since for every such connection, one is free to consider a new background shape.

lines of the two horizontal rectangles, but lies on the Master Grid line. Again, this is a free connection.

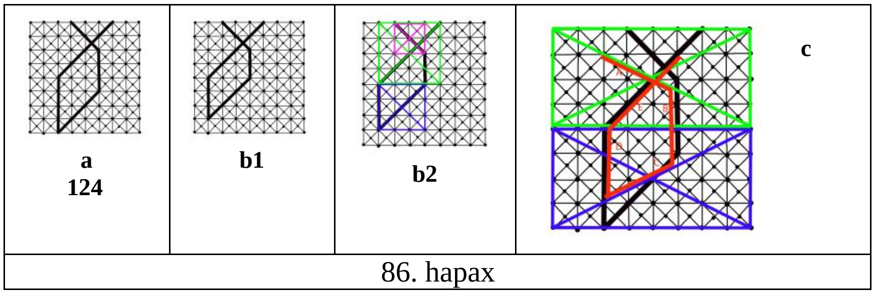


Figure 30: Three ways for reconstructing sign number 86

Group 9: Circles

Group 9 consists of circles. Drawing circles should have been an important development which increased inventor’s abilities in creating new shapes.[18]

Some LE signs have dots on or beside their lines. As previously mentioned, based on their positions, one can deduce that dots appeared on line intersections (fig. 31a). An enlarged dot makes a circle which in its smallest size is encompassed by the closest lines making pseudo-lozenge, itself encompassed by the closest lines making a square (b). So, size of a circle depends on the surrounding lines from inside the smallest pseudo-lozenge (c1) and square (d1) to the largest ones (c3/4, d3/4). The center of a circle can be matched with an isosceles too (e1-2).

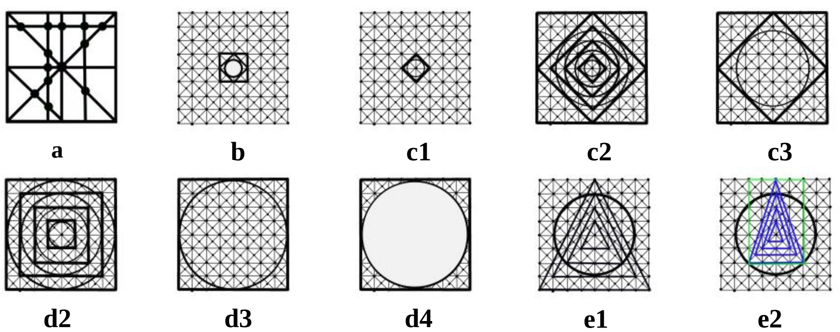


Figure 31: Dots on line intersections (a). Circles inside the smallest and largest pseudo-lozenges, squares (b-d) and triangles (e)

As there are several squares and pseudo-lozenges in the Master Grid, circles can be drawn in all of them. Circles can be overlapping (fig. 32a) as well as tangent (b-d) and in different sizes.

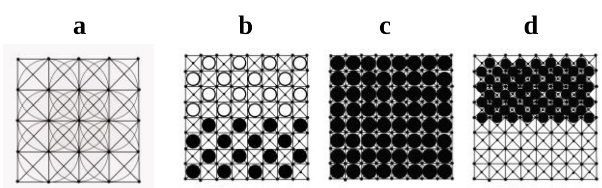


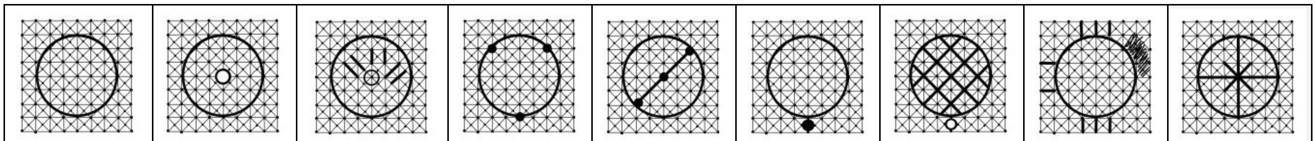
Figure 32: Overlapping circles inside squares (a). Tangent circles inside squares (b-c) and pseudo-lozenges (d). Basically circles appear in two types in the Grid: 1) bolds which are enlarged dots on line intersections, 2) non-bolds or circles freely drawn inside other shapes.

Some LE circle signs have a free space below for another smaller circle. Taking into account the symmetry that governs the Master Grid and considering that the frame square diameter passes right through the central dot, the smaller circle too should be drawn inside a pseudo-

[18] See also figure 6o.

lozenge not a square. For these two circles be tangent, the bigger one should be on 2&2 or 3&3 lines to leave a wider space between the two circles.

LE signs 125 to 132 are circles. Hinz has another circle sign in his list which is included in fig. 33, but not numbered.

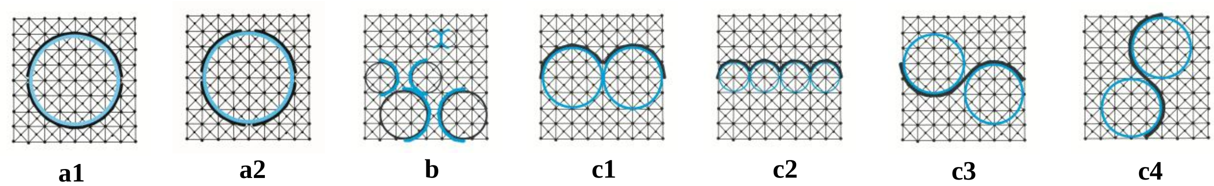


125	126	127	128	129	130	131	132	List of Hinz
102. hapax	101. hapax	83. hapax	37	37.a	SKS42. 4	38	100. hapax	

Figure 33: LE signs of group 9

Group 10: Circle surroundings

Here are included signs that have circles as their bases but with different treatments implying that it is not the circle itself that becomes the sign but parts of it or the space inside or around it maintaining its circumference. These signs are classified in two groups:



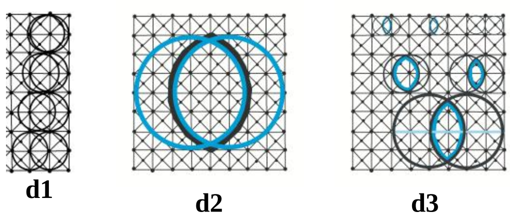


Figure 34:
Single, double, tangent and overlapping circles used for making signs

A) Single circles: In this case, every part of the circumference of a circle could be used to be worked on: half, quarter, or smaller parts (fig. 34a1-2).

B) Two or more circles: Three methods seem to have been at work with more than one circle: 1) They were juxtaposed at various intervals dictated by the Grid (examples are shown in fig. 34b). The inventor could work within the space between the circles keeping their circumferences as the two sides of the sign. 2) Tangent circles placed side by side in various positions were the second type. Their circumferences could be followed in curved (c1-2) or wavy lines (c3-4). 3) Overlapping circles, again at different intervals, were other alternatives. Closed spaces inside the these circles were used to make signs (d1-3). There is no need to emphasize that the resulted shapes are numerous.

Lines in the interior space of the overlapping circles could be drawn in two ways: 1) with two movements, putting the pen on the tablet drawing the left side up to down and then removing the pen and starting the right side from the first point up and in the same direction; 2) Drawing the whole shape with one movement, up-down-up or vice-versa without removing the pen. Depending on the speed of writer, the latter would gradually change the original shape to an independent geometric form: an ellipse which being cut at different intervals in one half, makes a parabola.[19] One can draw ellipses and parabolas in different sizes as long as the frame is

[19] Parabola has a more precise definition in geometry. Here the word is used in a very general sense.

rectangular. When it is large enough not to fit inside the limits of a rectangle, it is not an ellipse any more but a circle. In figure 35, ellipses (*parabolas) are shown in different scales both in height and width. Their horizontal diameters are shown by numbers of lines involved in the Master Grid.

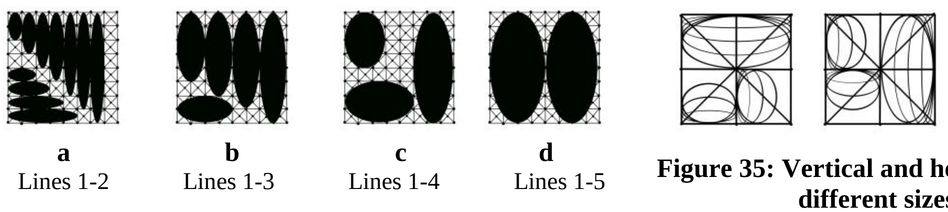


Figure 35: Vertical and horizontal ellipses in different sizes and positions

10-A) Single circles:[20]

10-A-1) There is a sign in the LE sign collection that seems to have been made on semi-circle (fig. 36). Sign no. 133, if made on a half circle, will appear as fig. 36a-b, and if on straight lines, as 36c.[21]

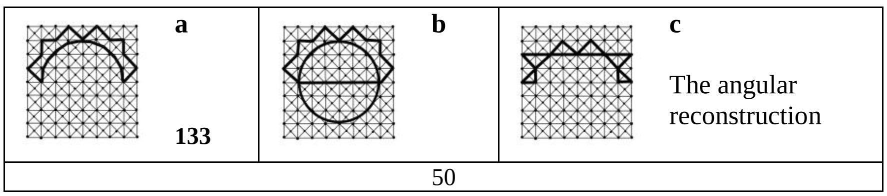


Figure 36:
LE sign of group 10-A-1

10-A-2) Signs 134 and 135 of the SKS mound inscriptions 3 and 4 are made around single circles and apparently in different sizes. In inscription 3, the circle seems to be in full size and on 1-1 lines covering the entire space of the Master Grid (figs. 37a1, 38a). Lines 2-2 (figs. 37a2-3, 38b) yield almost the same shape. However, in inscription 4 the inventor has not worked inside a square but a rectangle because the circle is small.

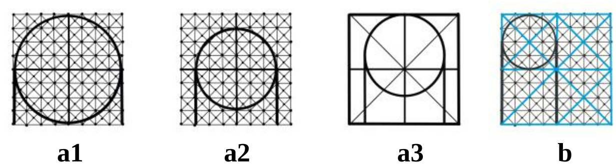


Figure 37: Using circle as the base for making a new shape: curved form

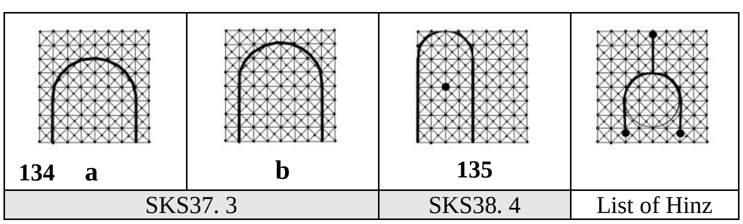


Figure 38:
LE signs of group 10-A-2

10-A-3) Another sign made on a circle is Meriggi's 27 (fig. 39a). There is a sign on the reverse side of SKS 4 which has the same structure but obviously wider. To reach such shape one needs to draw it on an ovoid/parabolic not circular base. Anyhow, here I have done it on an ellipse (fig. 39, 137a-b). The same has been done for the former sign as well. It is in two sizes to be compared with 137.

[20] See also signs 156, group 10 and SKS29, 4, group 11.
[21] This resembles sign no. 23 in Hinz's list (1969, p. 44. spaces) which is a match to Meriggi's 43.

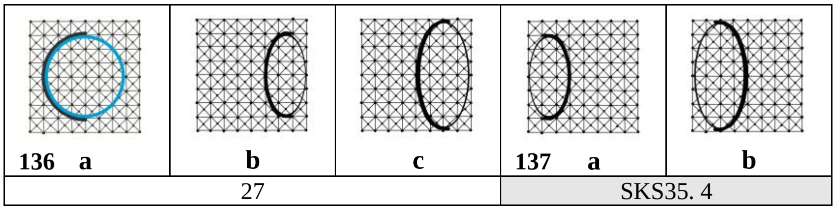


Figure 39:
LE signs of group 10-A-3

10-B) Overlapping circles:

10-B-1) In Meriggi's list, hapax sign 103 is made on the lower half of two overlapping circles (fig. 40a-b) as shown in fig. 34d2 too. Another sign that has appeared on SKS2 is no. 139. At first glance, it may seem as two curved lines getting close to each other like ( )→ ( )→ ⋂ (139 b), but it is actually made on the upper half of two overlapping circles with the side lines continued to the base of the Grid (139a). Hapax 66 has the same structure. I have reconstructed it on a parabola as well.

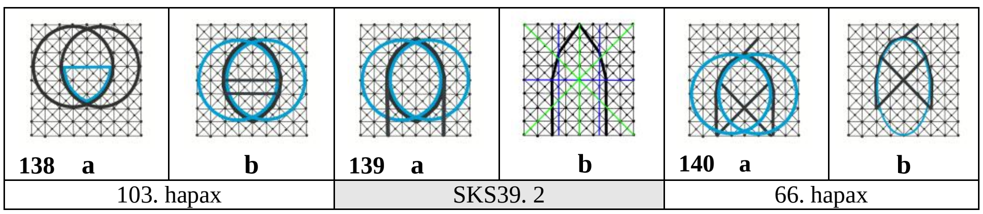


Figure 40:
LE signs of group 10-B-1

The two sidelines following their background lines, are closer in sign 141(a-b)(fig. 41). Hapax 73 in Meriggi's list is another example of overlapping circles but in this case not 2 but probably 4 (142a). To examine another possibility, this sign is made on two parabolas as well (142b). The angular version makes the picture clearer (142c).

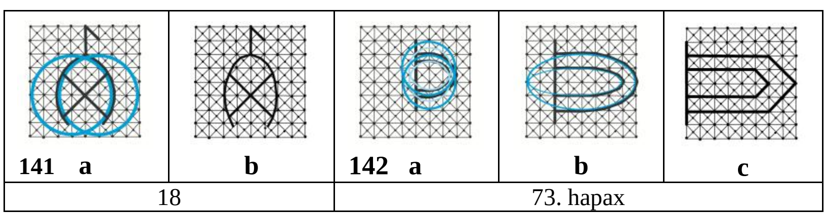


Figure 41:
LE signs of group 10-B-1

10-B-2) Four almost similar signs not existing in Meriggi's list have appeared in the SKS inscriptions. Although basically curved-sided, these have in some cases irregular sides getting even close to straight lines. Sometimes part of one side is clearly angular, so that one doubts whether it is a lozenge. This group too is the product of overlapping circles but probably indicates an archaic view towards the shape. When following the interior lines of two the overlapping circles, if one loses the right sight to the circles' circumferences and follows the straight lines of the Grid as well, the result becomes an irregular shape which can have various appearances as is clearly evidenced in the SKS inscriptions. To avoid several overlapping circles, I have reconstructed these signs inside ellipses (fig. 42). One can observe the irregularity of the interior lines in each separate case. In two cases, I have added an empty ellipse to give a clearer picture of the lines behind the signs.

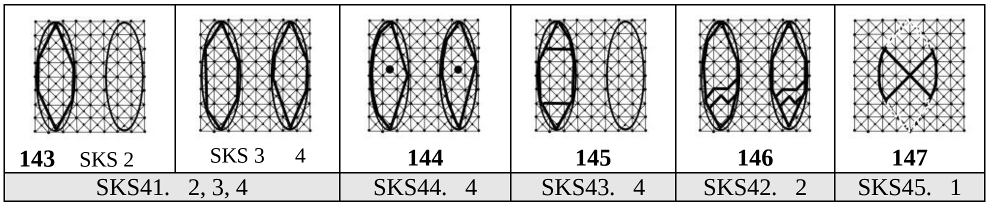


Figure 42:
LE signs of group 10-B-2

In a number of inscriptions, some circles are not fully round as they should be. Wet clay and the deformation of signs may not always be the reason. They might have undergone the same procedure of following lines of the Grid.

10-C) Juxtaposed circles (/ellipses):
10-C-1: The simplest signs of this group with circular or ovoid/parabolic bases are numbers 148 and 149. In fig. 43, these signs are shown on both circles and ellipses as their bases and in two sizes. In the first case, the circular base makes a closer shape to the original. In sign 149a, the lower case is closer to the original and thus is smaller than a semi-circle. This may be called a hyperbola.

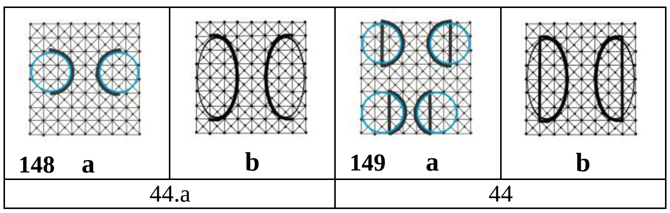


Figure 43:
LE signs of group 10-C-1

10-C-2: Other signs with similar structures but using the space in between circles or ellipses/parabolas are numbers 49, 63, 70 and 92 in Meriggi's list. In fig. 44, they are reconstructed using both circles and ellipses/parabolas. In order not to neglect any possibility, the angular shapes are also added.
The circular base of sign 150(a) resembles more to the original but for sign 151 the parabolic base (b) seems to be qualified. As for signs 152 and 153 only the ovoid/parabolic base is in accordance with the original form.

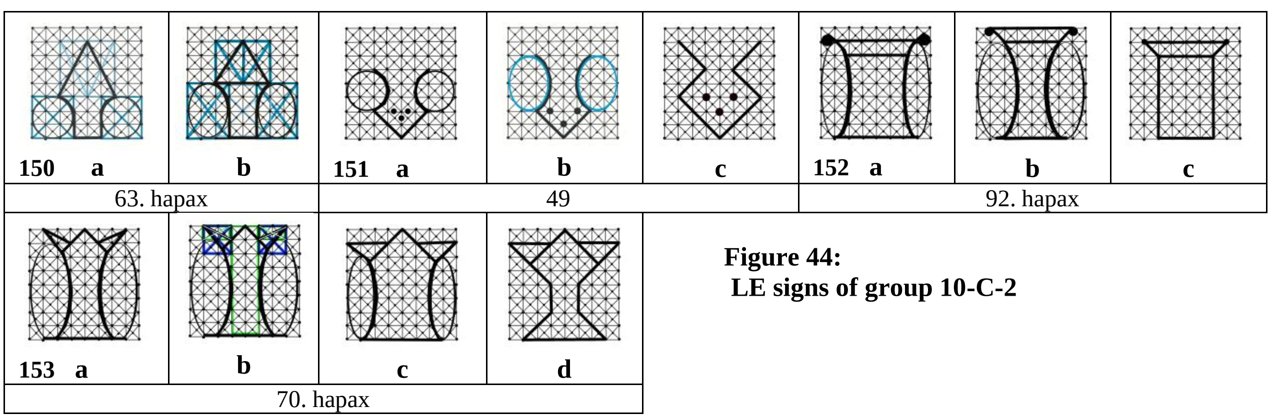


Figure 44:
LE signs of group 10-C-2

10-D) Three LE hapax signs, numbers 76, 88 and 91 in Meriggi’s list, are different from the entire collection. They look more like paintings than geometric patterns. No. 154 rejected any reconstructions on circles, so here (fig. 45) I have done it on ellipses/parabolas and in different sizes of both parts of it: head and tail. C1 with free connections on the head part fits best.

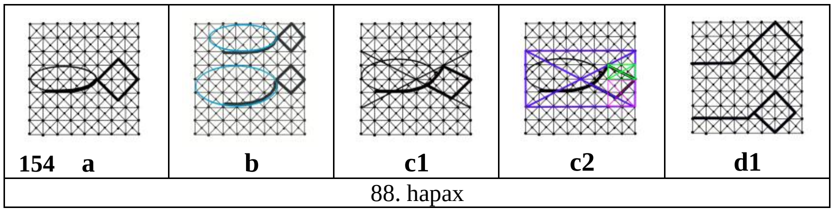


Figure 45:
LE sign of group 10-D

Sign 155 is much better matched with three circles (fig. 46, 155a) than ellipses/parabolas (155b-c).[22] The second sign, in my opinion, appears better with an ellipse/parabola than circle.

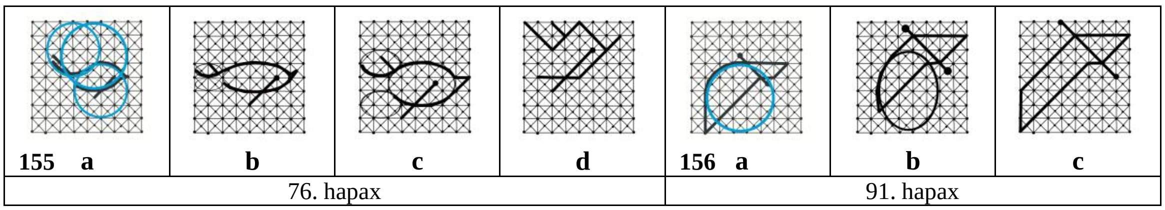


Figure 46: LE signs of group 10-D

Group 11:

Four signs, three of them appearing with SKS tablets, *again depict the inventor's inclination towards thickening the lines by doubling them* (fig. 47).[23] Apparently, the inventor has tried to make some shapes hollowed inside. No. 157 seems to be a true lozenge made in a rectangle emptied from the left side (fig. 47a1-2). I have reconstructed it in two ways (a, b), but in both cases its lines partly lie on the rectangle lines and partly on the Master Grid's because of the new connections in the new lozenge frame (fig. 48). This is also the case with sign 158. The second reconstruction, b, in a square cannot be correct. Sign no. 159, first seen in SKS4, resembles SKS 31 and hapax 65 in its outline. The difference is in the right side which has turned into a curved line probably because of the insertion of a circle (a2) inside the main shape (b). The last sign, no. 160 is interesting since it introduces a new geometric shape. In fig. 47 I have reconstructed it in two forms within squares (a1-2) but their lines do not lie on the Master Grid's. If we change the frame into a horizontal rectangle, our sign takes a clear shape. By mirroring the sign in the upper section of the Grid, there appears a prism (b).

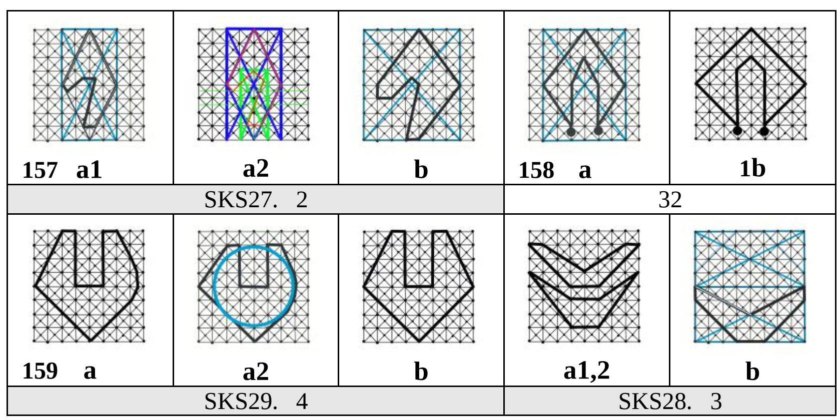


Figure 47: LE signs of group 11

[22] See also figure 34c3.
[23] See figure 14.

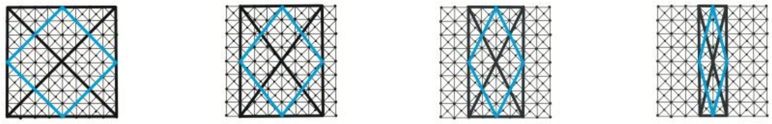


Figure 48:
Pseudo- and true lozenges in square and rectangles respectively

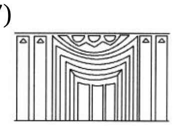
To prove the cradle of a script, evidence from other fields than mere corpus of texts can be of enormous assistance.

The two cemeteries of Mahtūt Ãbād and Rīg Anbār were plundered during the years 2000/2001. In 2002/2003 archaeological excavations started at the South and North Konar Sandal mounds as well as the above mentioned cemeteries. Local villagers, disturbing the graves of a people who had created one of the most sophisticated cultures of the ancient world, dug out thousands of invaluable objects which subsequently were sent to other countries to appear in museums and private collections. Later, some objects were returned to Iran and studied by the head of the archaeological team and his colleagues. The result of their first studies was published as a catalogue of the Jiroft objects (Madjidzadeh, 2003). Researchers were astonished by the beauty of art and the high level of technology used in their manufacture.

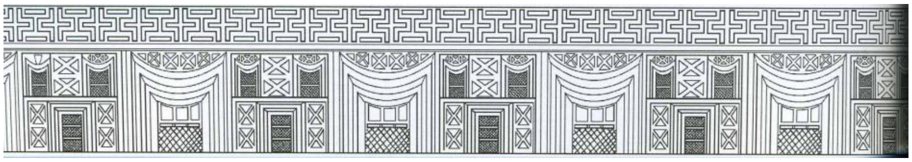
One of the most beautiful objects published in Madjidzadeh's book is a cylindrical vase made of chlorite and with an architectural representation (pic. 1). As there appeared similar examples of this vase with more or less the same representation, it was suggested by the excavator that this should have been a building of central importance to the site, probably a religious and a governmental center as well.

Picture 1: Chlorite vase, Jiroft (Madjidzadeh, 2003, 67)

Obviously, the importance of this building lies in its geometric patterns. A closer observation guides us to the point. The building has a round plan skillfully reflected in the overall design of the vase (pic.2). The exterior wall has four gates, each having a tripartite entrance and side walls moving inwards in three successive intervals which makes the entrance somehow hidden from the outsiders' view. The upper part of the entrance is similarly made but in upwards curvature. This plan can still be seen in the Iranian architecture. The façade above these is decorated with semi-circular patterns. The recessed wall between the four gates is decorated with triangular elements at the top. The inner parts are more elaborately designed (pic.3). The interior gates resemble the exterior ones in their general plan with the difference in the doors which here are not plain but decorated with hatchings and rectangular patterns above them. The uppermost decorations are also vertical rectangles and triangles. The same elements can be seen on the sides of smaller doors(?) or (pseudo-?)windows(?). These have another floor above them with similar architectural elements and decorations. There is a decorative band above these all.



Picture 2: The exterior entrance of the Jiroft vase building (idem.)



Picture 3: The interior parts of the Jiroft vase building (idem.)

All the patterns on this building can be reconstructed in our Master Grid. The only difference would logically be an increase in the number of lines necessitated by the larger surface inside which to work. So we increase the number of lines from 9 to 25 or 1-12 0 12-1.

Drawings represented in Madjidzadeh's book are in negative; if changed to positive, we can more clearly distinguish the geometric shapes. The simplest pattern, that is a square or rectangle with a diagonal cross inside, can be seen in the decoration above the interior gate and between and on the two sides of doors(?) and windows(?). Here both square and rectangular patterns are presented in negative and positive (fig. 49).

Figure 49: Cruciforms as decorative elements

Other decorative elements are hatchings (see also fig. 9) on the interior entrance (fig. 50a). Unlike other parts that most probably had been unbaked brick-works, these could well have been woven fibers. The decorative band at the topmost part of the building is reproduced here in both negative and positive (b, c). This seems to be a more elaborate design in comparison to others. It is repeated all around the topmost part of the building and the reason could have been its higher place giving the structure uniformity to look bigger in size from the outside.

Figure 50: Hatchings (a) and the decorative patterns on top of the Jiroft vase building (b, c)

The plan of the entrance is conceived by drawing two ellipses, one almost circular pattern for the upper part (see also fig. 35e) and six vertical lines for the gate sides (fig. 51a). b depicts how several such decorations are made in successive sizes. The angular reproductions of the exterior and interior entrances as well as side parts are shown in fig. 52.

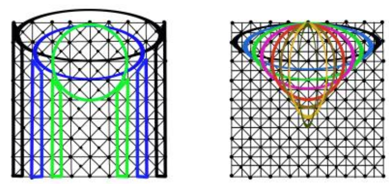


Figure 51: **Plan of the two entrances**

Archaeological excavations at the SKS mound brought to light remnants of a circular, thick wall, recessed in unearthed parts which considering its location and size, soon became the main candidate for the outer wall of the building in question. The giant, painted clay statue of a deity discovered during the excavation season of 2006-2007 in a room at the topmost part of the mound inside the wall, proved that this building had also been of religious importance, otherwise it could hardly be realized why it appeared on precious objects buried with the dead.

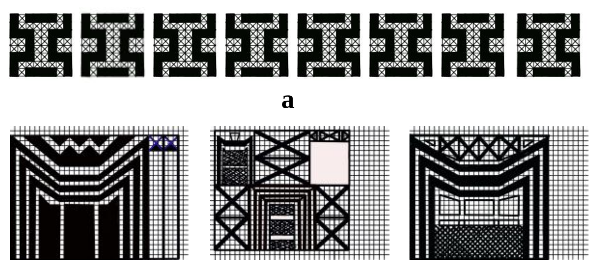
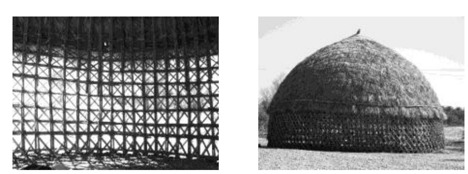


Figure 52: Geometrical reproductions of the Jiroft vase building. Decorative band(a). Buildings b and c are drawn wider to show the details

Even today one can repose in a *Kantuk* on the South Konar Sandal mound slope and watch the ancient mound from behind the same geometrical patterns that have survived the millennia. Reeds woven in crosses make a round wall over which stands a dome-like cover stabilized by ropes tied in diagonal crosses (pic. 4).



Picture 4: Jiroft Kantuk

Jiroft art is evidence to the existence of an ancient geometrical school in the Halil Rud basin, not only as a source for the invention of writing systems, but mathematical calculations, architectural designings and other intellectual achievements. Master Grid had been of numerous functions and a source for inventions in different fields. Here some cases are mentioned:

1] Scribal functions:

As previously discussed, Master Grid was a source for inventing signs to communicate concepts of everyday life.[24] Dictated by economic purposes, the system should have been under the monopoly of temple men or the governing class -both the same for millennia to come- from its early days till much later. The instrument for using the Grid was a creative mind and strong imagination to design patterns inside a simple but extremely productive grid. The method was to determine which line/s and dot/s should be chosen and in what combinations. *This could be done with or without external inspirations*. But the important question is: Was it under certain rule/s or was it freely performed? I started my work by *systematically joining together lines which finally formed a grid to be used as a source for making further signs*. This means that I directed my work from one, two and three lines towards a grid, and once the grid appeared, there came to existence a source for creating innumerable shapes for different purposes. Probably before that, the number of shapes had somehow been limited. Signs to be placed in the very primitive stages may hint to the stages that passed (fig. 53).

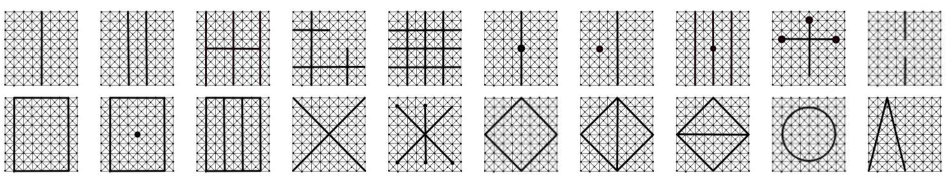


**Figure 53:
Some very simple LE signs**

Can we possibly suppose that such a Grid had existed in its totality from the very beginning when the inventor attempted to invent signs? Was it that somebody somehow found this mysterious Grid somewhere and started to make signs in it? This is against the evolutionary process of human mind. *We should look deep into the past to find the most primitive forms when man first attempted to materialize his concrete thoughts*. This had not been the same with his incredibly developed cave paintings based on his appreciable patience in watching his natural models in thousands of years. This one was his own creation. As previously mentioned, geometric shapes can be traced back in ancient petroglyphs[25] and also later in pottery designs.

If this had been the real procedure, then there should have been an order in the invention of signs. This implies that we must be able to put the signs in a chronological order according to their structures. That does not mean that every single, simple sign should have a time interval with the next and a little more complicated one, but that probably with a change in the geometrical attitude of the inventor, there had been a cease and then proceeding to the next stage. To reject this, we find us obliged to suppose that very simple signs, as those shown in fig. 53, could have been invented along or even after the more complex ones. As far as geometrical rules are concerned, this is not logical. It is not possible to jump to a "trapezoid" without knowing anything about "line and angle." One can work strictly within a defined framework or combine

[24] Considering the productivity of the Master Grid in creating shapes, it was most probably regarded as sacred and thus a means of communication with gods via symbols. Sacredness of "image" and "script" has continued up to the present in different cultures.

[25] For information on a collection of very interesting Iranian petroglyphs, see Naseri Fard, 2009.

two or more of them at the same level and simultaneously, but doing it with no knowledge of the rules governing each separately, is nothing but chaos. This is definitely not the case with the LE system.

Considering that our Grid had been a source for creating innumerable shapes, one important factor in distinguishing different groups of signs -from the simplest to the most complicated- would be the high number of specimens at hand to work on. 103 LE signs are not enough for our purpose, though Jiroft findings have yielded some very simple forms that have filled in few of the empty boxes of our puzzle. So, we have to turn to another known Elamite script with deeper roots in time: Proto-Elamite. Discussing PrE in detail, though basic for the study of LE, is not the purpose of this article, since it calls for another work analyzing all of the signs based on the same method, but here I give some hints.

According to Meriggi, LE has some signs in common with PrE. In the second volume of his book, he has compared about 57 LE signs with PrE (Meriggi, 1974, 8-24). Some of these are exactly the same, like his numbers /LE 1b=PrE 298/, /4=308a/, /5=218/, /6=219/, /7=229/, /8=220/ etc. Some signs have relative resemblance, like /LE 13 and PrE 252g/, /15 and 263/, /77 and 256/, /95 and 206/ etc. In page 5 he has classified the signs in two main groups: 1) open signs (1-105), 2) closed signs (106-340), itself with subdivisions (106-138) (140-213) (218-259) (260-283) (284-340) and (341-391). There are 393 signs and their sub-forms in his list.

In my opinion, there is nothing in the LE sign collection that may separate it from PrE other than the function of signs which caused a decrease in their number as a consequence. I believe that these two writing systems belong to the same geometric system discussed above. So, the high number of PrE signs can be of enormous assistance in finding the basic forms or, in other word, to help complete our puzzle. In some cases, however, where PrE lacks an intermediate from, it is LE that comes to assist.

Here I make some very general remarks on PrE:

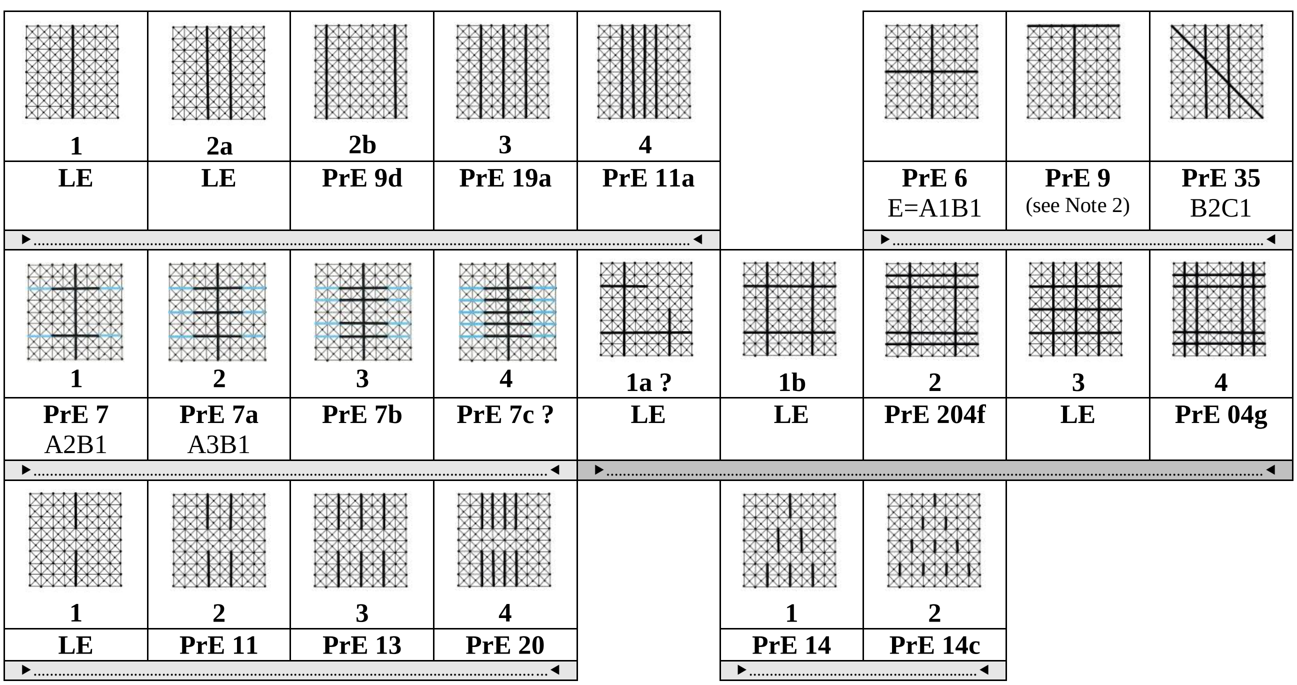


Figure 54: Some Pr-/LE. signs in a progressive sequence of invention. (For PrE signs see Meriggi, 1974, pp. 8-24). Serial numbers in boxes show the sequence.

1) Signs were all made in the same Master Grid, so the basic features are: lines -straight and diagonal- and dots/circles and whatever shape which is in connection with these, as discussed before.
2) Signs were made in progressive procedures from the simplest to the more complicated. It is here that both Pr.- and LE may cooperate to complete the picture. Some examples are presented in fig. 54. Here signs are put in order based on their structures as having 1 to 6 or more vertical and horizontal lines.[26]
All the specimens needed are not necessarily among the present sign collection. Some empty spaces may remain in our picture. This can be due to two factors: either we have to wait for new discoveries and new signs to appear or we can postulate that some signs sometime in their very early stage of usage had been substituted by other forms. Despite this, there are many signs in the PrE collection that can be put into our scheme.
3) The inventor made use of every possibility within the Master Grid. This means that each line or dot can be viewed separately and worked on independently (fig. 55). When the grid materializes, it is this view that makes every part a movable and removable unit.[27]
4) Signs were made in different sizes regarding their width or height, depending on the dimensions of chosen limits. Some very general possibilities are shown in fig. 56.

As previously mentioned, the intervals between lines directly affect the appearance of a sign. PrE signs 29, 29a, 29b and 29b' are good examples (Meriggi, 1974, 9). *Therefore, it should not be surprising to see several signs with the same shape but different dimensions*. Whether they had the same graphical value or not is another matter.

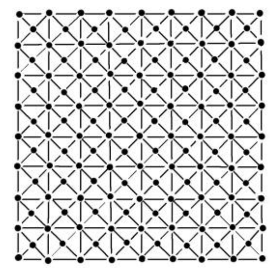


Figure 55: Viewing the Grid with all of the lines and dots as separate components to be worked on.

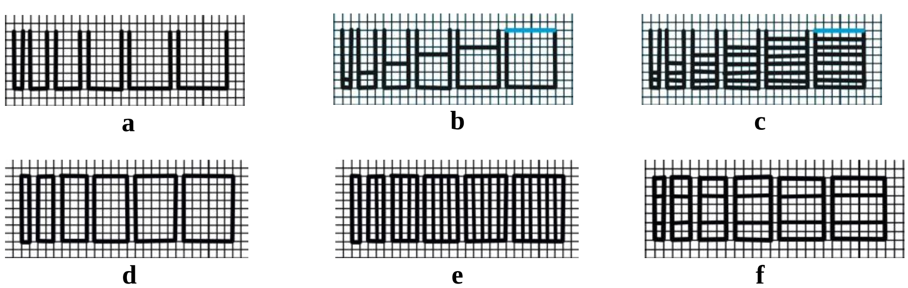


Figure 56: Open and closed rectangles in different sizes and patterns

5) Once a rule was fixed, that is when the inventor pictured a geometrical shape in the Grid -as square, rectangle, circle, lozenge, triangle etc. - he felt free in connecting every dot to every other dot within the new limits. That is the reason why in a single sign lines may seem to belong to two or more geometrical shapes, if not based on completely free connections. Of course, this does not mean going towards chaos, but only considering the grid as a multipurpose device with defined and undefined alternatives. For instance, sign no. 102e is a beautiful star which we still draw in the same way as our ancestors dictated. We can draw it 1) in the Master frame (fig. 57a, b, d, e, f), 2) considering the symmetry of the lines of two rectangles (c), or 3) inside a pseudo-lozenge (and not merely a vertical rectangle as seen in fig. 57-102e). All these are stars, but the last one has the appropriate proportions we would evaluate as best. There had been a judging

[26] Sign 2b in the first row is interesting as it best confirms figure 11 2&8 (see also figure 1B2).
[27] See the section on Recreational functions.

mind behind the figures. In the same frame we can reach sign 102d’ as well whereas 102, 102a’ and 102c can be made both inside the Master Grid and the pseudo-lozenge. A similar harmony as in sign 102e is seen in the beautiful sign of 138b made in four overlapping circles inside four squares.

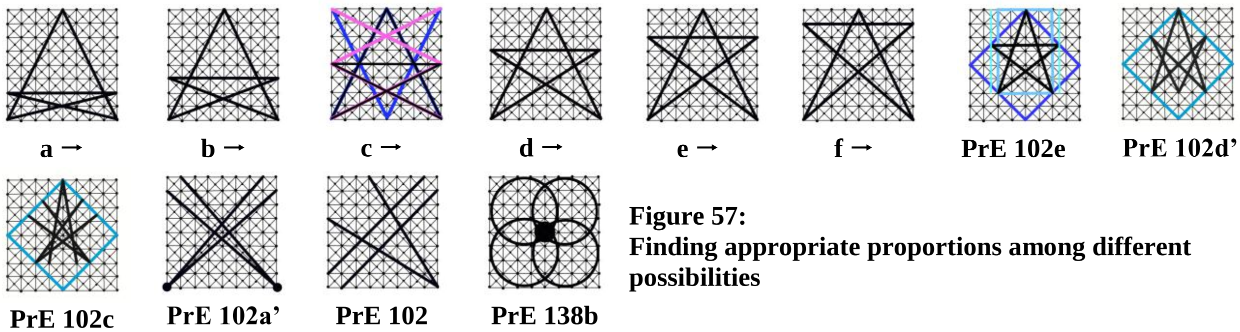


Figure 57:
Finding appropriate proportions among different possibilities

6) An interesting feature of the PrE is the use made of dots by the inventor. Dots appearing on the intersections of lines, despite their small sizes, were used as numerals (fig. 58).[28] Here, I have presented them in their smallest size at the center of the Grid as well as the corresponding largest size to make the image clearer.

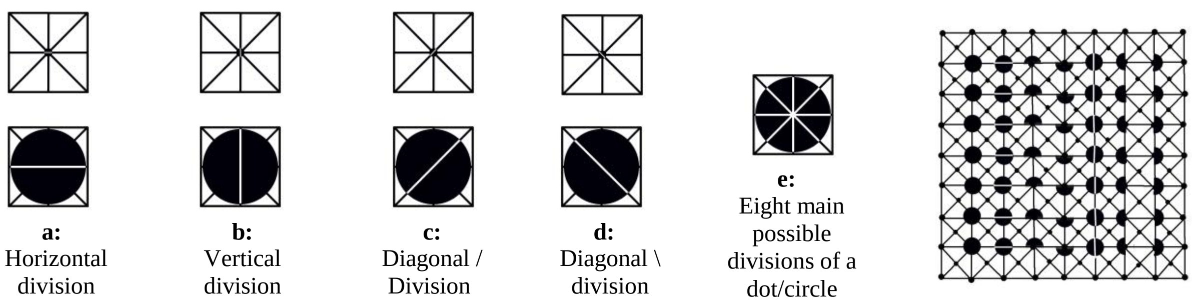


Figure 58: Possible dot divisions in the PrE

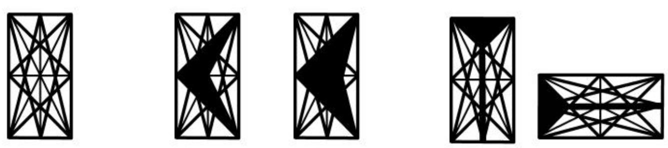
f: Complete and horizontal/vertical semi-dots in the Master Grid

7) PrE signs 316, 336 and 342 are as if an amateur hand has made the Grid a shadow in the background and drawn paintings. Though still inside the limits of the Grid, these signs are not comparable with a sign like 349  which is indeed a piece of art. The same pattern can be seen on an object from Jiroft (Madjidzadeh, 2003, 109).

8) We might be able to trace back in the PrE what is known as cuneiform script. Many of us may have asked ourselves: Where did cuneiform script come from? Why and how should a sign look like what we know as a cone? Was cuneiform the ultimate stage of a pictographic system, and if so, how did the original pictures with their whole collection of different lines break into their components and then presented by cone-like strokes? Had cuneiform script already existed as an independent system and came to be used because of a necessity? If this had been the case, then two questions need to be answered: What was the origin of this script and wherefrom and how did the idea of it being used for this purpose come? In my opinion, ancient geometry can present the answer.

[28] See Mathematical calculations.

After finishing the reconstruction of LE signs based on the methods presented, I started searching for some information on the very subject of “Ancient Geometry” and was acquainted with a very interesting book which I received two weeks later: "The Secrets of Ancient Geometry- And Its Use" by Tons Brunés first published in 1967 and reprinted in 2006.[29] In this book, in addition to many interesting points about its main subject, the role of geometry in the ancient and medieval architecture, reader can find some general information on the importance and extent of use of geometry in the ancient world too. Chapters 17 and 18 of the second volume were of special interest to me. In chapter 17, starting with the development of numerical systems among different cultures of the ancient world, the author has suggested a geometric diagram -exactly like our Master Grid- as the source for the invention of the signs known as “cuneiform”, that is the simple vertical cone-like sign and another sign known as winkelhaken. Though Brunés' deduction is based on the mere appearance of the cuneiform signs, yet it is very interesting.[30] This is exactly what I came to while working with the Master Grid. If we go back to stage 4, fig. 22, we can easily distinguish the shape in question (also fig. 59). The difference, in the simplest aspect, is in the reasoning for the shape of winkelhaken. In my opinion winkelhaken -though its original shape may not exactly have been what is shown here in fig. 59 (see fig. 67 and the related discussion)- calls for working in a rectangle not, as Brunés has discussed, a square. Another very important difference is that the writer, based on the main subject of his book, that is architecture, has given no hint of the historical background of the cuneiform signs and has only reconstructed them inside the diagram.



a: Base Grid for cuneiforms

b: Winkelhaken

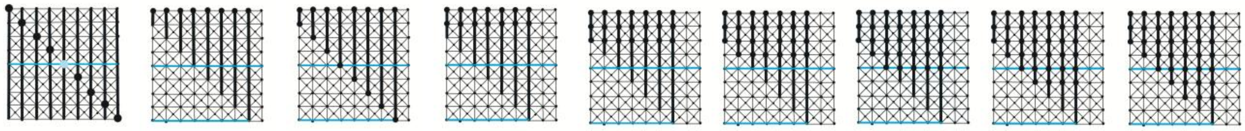
c: Vertical and horizontal cuneiform signs

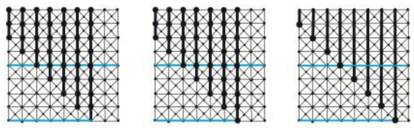
Figure 59: Cuneiform signs in a rectangular framework. Winkelhakens are shown in two sizes. See also fig. 67b.

Returning to the PrE, there is an important feature hidden in signs 1, 2, 9, 10, 11 or 12, not to mention others. These are actually tiny lines with very small dots in the middle or at the two ends. In some cases, these dots are so small as if lines have just a little thickened. These may be nothing but the small dots on the intersections of lines of the Grid. These clearly show inventor's attempt in making signs from the simplest and most primitive shapes at hand: a line and the dot on it. In fig. 60, I have shown some of the possibilities in making such signs. Horizontal or diagonal forms can also be imagined.

[29] Unfortunately I did not receive the new edition but 1967’s.

[30] In the same chapter (pp. 190-194) Brunés has put the Indo-Iranian numerals 0, 1, 2, 3, 4, 5, to 9 in the same diagram. I did the same with New Persian numerals too. This way it becomes clear why we have no problem with different styles of writing numerals, as round, angular etc. As long as numerals are made into the diagram with which we are familiar, there will be no problem in decoding them. Brunés has used the same diagram for Phoenician letters (pp.195-228) and it is strange why there should not be any reference to his interesting work in the sources allocated to the history of writing.





a b c d e f g h i

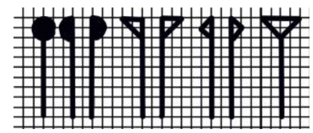
j k l

a: Lines in the same size; *one dot*
b: Lines in different sizes; *one dot*
c: Lines in different sizes; two end dots
d: Lines in different sizes; two dots
e: Lines in different sizes; three dots
f: Lines in different sizes; four dots
g: Lines in different sizes; five dots
h: Lines in different sizes; six dots
i: Lines in different sizes; seven dots
j: Lines in different sizes; eight dots
k: Lines in different sizes; nine dots
l: Lines in different sizes; *one dot*

Figure 60: Dots on lines. Note the change in the number of lines with different dots

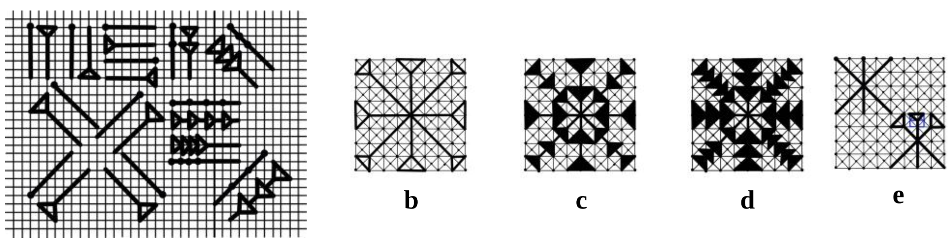
Signs 19, 20 and 36 in Meriggi's list are easily found in the grids of fig. 60: e, c, and a, respectively. Numbers 67 and 57a have free dots and 57, 58 and 59 have horizontal lines with dots. No. 21 is an example of diagonal lines with dots.

These signs are good examples of how the two basic elements became models for cuneiform signs. We can view the problem from another angle too: dots could be replaced by triangles immediately attached to the vertical lines. If we divide into two parts a dot or a circle at the top of a vertical line [●+ |], these forms appear: ◖+ | and | +◗ (fig. 61a). Pseudo-lozenge [◇] can be divided into smaller parts too: ▼+ | {and ▲+ | } (fig. 61d). This latter in its turn can make new divisions [◇]: ◥+ | , | +◤[▼=◥◤] {and also▲=◢◣} (61b), and still smaller ones: ◀ + | , | + ▶[◀ ▶=◆] (61c). The two components appear in rectangles. Of course, not all of the forms in fig. 60 have evidence in the cuneiform writing systems of the entire ancient Near/Middle East but many of them have real examples. A dot at the end of a line means an inversed cuneiform which is not as common as others (fig. 62).



a b c d

Figure 61: Three ways for making new signs. b and d are more qualified to be called *cuneiforms*.



a b c d e

Figure 62: Cuneiform signs in different numbers and positions outside and inside the Master Grid (a-d). Comparison of the LE sign no. 21 (fig. 14) with its cuneiform counterpart (e).

Now, we can pose the old question: When was the *cuneiform* invented? Was it after the inventor had created hundreds of signs -some of them very complicated indeed- that he returned to the simplest elements when the time came to invent *a new writing system*? My answer is: *this invention could have been happened at a very early stage and both systems of geometric and cuneiform could have moved side by side*. Do we know what the original function of *cuneiforms* had been? The oldest specimens show signs that some of them can be followed back to their original pictographs. If pictures, formerly painted, scratched or carved on materials as wood, bone, stone etc, were to be represented on a different material as clay, then there should have appeared the necessity of a change in the method of representation. **This means that using clay**

for writing had already existed. Of course pictures could easily be drawn by a pointed instrument on dried clay. Scratching on dried clay causes no problem as long as the forms are not too complicated and hand movements do not have to be continuously interrupted. Each interruption, other than deforming the picture, can make minute cracks which may finally cause breakages. Scratching, of course, does not leave a good shadow of pictures unless grooves are filed in with some soft material which is time consuming and cannot be practical for daily uses. A strong scratch to make lines deeper or wider had the risk of breakage. The other option could be wet clay. Working with wet clay needs a good skill of controlling the moisture. A wrong dragging of pen may causes the clay to accumulate on one end while there is always risk of grooves being filled again by the clay. So, what could be the solution to these problems? Let us review them:

- *First*, there were pictures to be represented on a **material** different from the formerly used ones;
- *second*, pictures had to be represented by a **method** other than painting, carving or scratching;
- *third*, pictures had to be made by **implements** other than those formerly used to depict them.

And, may be these had been the solutions to the above mentioned points:

1) Wet clay was used in a way already known for it. PrE tablets were all made of the same material.

2) The method applied was different from those used for materials suitable for painting or scratching. It was even different from drawing the pen on wet clay required for making geometric signs. The new method was pressing the pen on wet clay. Definitely, the method had not been of the type of stamping a negative picture on clay as it was for seals. Hundreds of images could not be depicted by pressing hundreds of stamps carrying different pictures. As with the PrE, there had to be used one or less probably more than one implement for showing all pictures. Before discussing the implement, one has to find out how different pictures could be depicted by pressing an implement on clay.

To show pictures, first they needed to be imagined in their outlines and then their interior parts broken into lines and this could not have happened, if the concept of viewing and recreating the objects based on their components had not existed. This conceptual process was not a simple one. If PrE signs had been made inside the Master Grid, then pictures too could somehow be put into it.[31] This was an amazingly intelligent achievement.

Master Grid was a strong source for breaking surfaces into parts, as it still is. If a picture is laid or imagined on a Grid background, its outline as well as its components can be defined by the components of the Grid in whatever shape they are, the most basic of which are lines and dots. So, we too, begin with "Dots": depicting an image by continuous dots seems to be practical. The closer dots are, the more precise the picture would come out (fig. 63a). This implies that Master Grid should include more lines with more dots on intersections to give more accurate images. Other than an implement with a small and probably flat, round tip to make clear print, a pointed implement can also be used to make closer holes. The result would be what is known today as "**needle-writing**." "Dots" can well depict in good detail not only straight but also curved lines but they call for several rapid hand movements

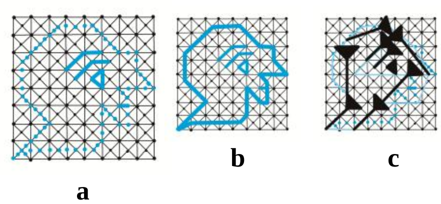
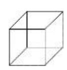
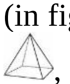
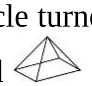


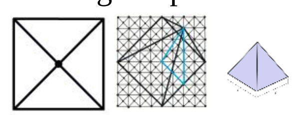
Figure 63: A picture executed in dots (a) and lines (b) and its hypothetic cuneiform counterpart (c)

[31] See Scribal functions, number 7.

which can be energy and time consuming for long inscriptions. This method is best suited for short inscriptions as well as making images on hard materials as metal. It was in use till later periods in Iranian art. If such a background is not to be accepted for the needle method, then there should be searched an origin for it.

By using the other basic shape that is “Line”, the space needed for several dots (/circles/holes) can be covered by a single pressure of stylus on clay. So, a picture turns to a set of straight lines which is more economic but loses some details and quite rapidly gets far from its original identity and this was exactly what happened with the first pictographs written in cuneiforms (fig. 63b-c).

3) What was the implement to be used for such writing and how was it shaped? I suppose that the pen or the so called “stylus” to make pictures on clay came out of the Grid itself. Obviously, dots or small holes could be made by any sharp object with round tip but the procedure of making a pen for such writing might have been more precise and systematic. Based on the Master Grid, there could be at least four basic alternatives for the cross section of a stylus: 1) circle, 2) square, 3) rectangle, and 4) triangle including: a) big isosceles which is half a square, and b) small isosceles which is one forth a square.[32] For making a stylus these shapes had to become solids. Moving the bases vertically generates cylinder  from circle, square prism -and if cut short, a cube-  from square, rectangular prism  from rectangle and triangular prism  from triangle. Cylinders, rectangular and triangular prisms could well be used as stylus, and apparently the first two had actually been used in the ancient PrE and Sumerian tablets. The two ends of these solids are flat. For keeping the form but controling the size of the cross section without making any changes into the body of the shaft, a very intelligent procedure was applied: by vertically pulling out the central dot of the section and placing it right above the center, some other forms appeared (in fig. 64 the process is shown for a square). Circle turned to cone , square to square pyramid , rectangle to asymmetric rectangular pyramid  and triangle to triangular pyramid . Obviously, the diameter of the base and the distance at which the central dot is placed affects the ultimate form.



a b c

Figure 64: Change of a square to a pyramid

By the two above mentioned procedures joining together, each solid could have its original section but a different protruding tip (fig. 65). Cone and pyramid tips could be cut at different intervals and yield flat surfaces with varying circumferences.

Each cross section is actually the same geometric shape as the base but in smaller dimension.[33] Diminishing the size of a circle inside the Grid from its largest scale to the smallest, truely ends in a dot but other shapes end in the smallest corresponding shape possible in the Grid which is obviously not a dot. The section could also be made obliquely which calls for a different view towards the Grid and the geometric shapes coming out of it. Free connections may justify these. So, each of

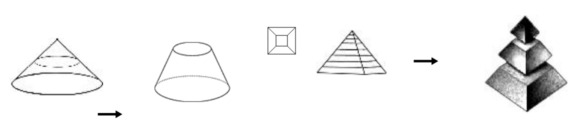


Figure 65: Different sections for circular and square base pyramids

[32] Other forms were possible too, as parabolas or hexagonals etc.

[33] Moving each section down to the base creates several solids one inside the other as the ground plan of the Ziggurat of Chogha Zanbil depicts.

these solids could be used as stylus to make impressions on wet clay depending on their sections and also the way they were held in hand (fig. 66).[34] It seems that rectangular, triangular and circular sections were among the first to be used. *Up to the present, the exact shape of the cuneiform stylus has been partially conjectured.*

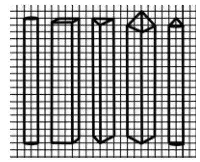
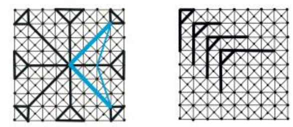


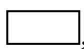
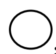
Figure 66: Some possible sections for stylus

Other than the simple wedge which could be pressed in vertical as well as horizontal and oblique positions, another print known as winkelhaken is also attested. The truth that this sign could have been made with the same stylus as for the simple wedge and by merely turning it upwards-right, and also its later appearance in the written records, does not put in shadow the importance of the reason and process of its invention. What indeed did inspire the inventor to make a winkelhaken? Probably the shape that appeared between two oblique cuneiforms (fig. 67a) could have been the source.[35] Another more probable option might be a shape like fig 67b which allows both simple cuneiform and winkelhaken be made with one and the same stylus. The latter appears with slightly upward-right movement of the stylus. This would imply that the cuneiform sign b in fig. 61 could have been the original form.



a **b**

Figure 67

4) Other than signs, formats of flat tablets were also dictated by the Master Grid, as square , rectangular , circular , parabolic , elliptic  etc. Some of these could be made as solids too, like conical cylindrical, hexagonal etc. up to the cylinder of Cyrus the Great which actually is an elliptic solid cut at the two ends. 

2] Recreational functions:

Brunés' book has another subject in common in chapter 20: "Origin of Chess." With the very first look at the Master Grid (see also fig. 32), anybody would recall a chess board. Chess must be much older than what is stated about it in the Pahlavi literature: a game brought to the Sassanian Iran as a sign of the Indian supremacy of mind challenging Iranians' as well as seeking remedy of paying tribute. After the Iranian great sage, Wuzurg Mihr, King **Xusrō Anōšag Ruwān**'s Prime Minister, had given three days of time to other Iranian noblemen to reveal its secrets and they were unsuccessful, himself did it conveniently. Then, Indians or people of the Sind valley received in return from Wuzurg Mehr another game to decode named backgammon which they failed to after forty days of fruitless effort and therefore, found themselves obliged to pay multiple tribute. The point inherent in this story might be that Iranians had been those who had mastership over both games. The two cultures being neighbors with common traditions is a point not to be ignored. Chess then up until recently in contemporary societies has been a game of intelligentsia and in the hands of those who knew its secrets. These two lead us to another function of our Grid.

The mysteriously productive Grid pouring out shapes mostly lacking in nature, not only bestowed on man a more systematized and stabilized vision of the world around, provided him with instruments for a better dominance over nature's harsh rules -improved architecture being only one- and gave him signs that being encoded by its inventor, prevented any stranger from

[34] Even today we can trace back our cored pencils with varying sections (⊙, ⊡, ⟐) to this very structure.
[35] See also SKS28 (?).

entering his ever-growing world of information, but had other gifts too. It gave the inventor/s the opportunity out of serious calculations into a more recreational world. Master Grid generated different games, mostly based on boards and beads. In addition to strengthen mental abilities, these games created a friendly atmosphere for comrades to sit, think, play, boast and have fun. But whatever came out of this mysterious board had one thing permanent with it: challenge of mind.

Playing with such Grid means that rules should be set for "lines and dots" in the first place and probably other shapes hidden in it, in the second. The Grid could be viewed in two ways: either the images of its components be imitated on whatever material by drawing, or be made in material. So, if one decides to draw them, what is needed is a plain board of appropriate material, a writing implement, and rules for how and where to draw what. The most rudimentary of this is a game still popular in Iran called "Khatt o Noqteh" or **"Line and Dot**." Due to its simplicity, it is known as children's game but even adults may be willing to play it as it is amusing and a pleasant reminder of their childhood. It is an elementary game and here is exactly where its importance lies. It is the simplest game two persons can play with a piece of paper and two pens, if not one. With no paper and pen, it can easily be played with a piece of hard object on soil. The famous X/O is another very simple Grid game based on filling square cells with cruciforms (✕) and circles (O) along horizontal, vertical and diagonal lines (fig. 68). Crossword puzzle in which the whole Grid cells are filled with graphical signs to make words, is a more improved game which combines the two scribal and recreational functions together, and probably this is the secret of its universality; it combined doing exercise on graphical signs, conjecture on lexicon, making a collection of related words and fun all together.

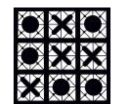


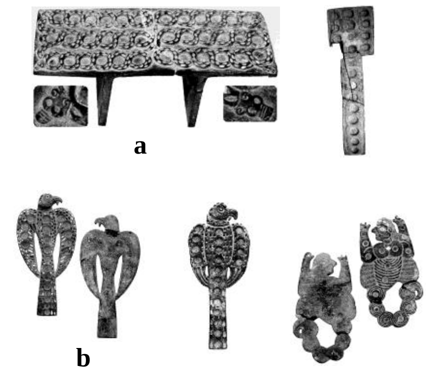
Figure 68: X/O game

As already mentioned, Master Grid had been viewed another way too. Lines and dots had to be either fixed or moving. A rapid look at dots as the simplest repeating components of the Grid and following them in different directions gives the viewer *a sense of motion*. Needle writing is itself a result of such view. Of course drawing a line from one point to another would not be possible without moving either. If, in a shape like ┤ , a point is imagined at the meeting spot of the two lines, then moving from that point further ahead to the right can mean moving the dot to another spot in the right side making the shape like this: ┼.[36] Probably, another very simple game had been moving dots along the lines in vertical, horizontal, diagonal or any other direction which lines and rules dictated. One cannot move the dots in mind, so the whole Grid had to be materialized to be touched in hand and reflect the movements. Other than perishable materials, a tablet of wet clay for drawing lines could be the first step. Baking made it more durable for several games. Now, what about dots? Drawing them on clay only made some round shapes or holes, so one had to make real pieces to play the role of dots. They had to be placed either on line intersections, inside squares, pseudo-lozenges, triangles or big circles (see fig. 32). Based on the present evidence, we may accept that placing simple square, triangular or circular objects in corresponding holes may have been amongst the most archaic choices. In time, better materials than clay were used both for boards and markers, such as precious stones, hard woods, ivory etc. Such games have appeared in archaeological findings in a vast area from India, Iran, and Mesopotamia to Egypt (pics. 5, 6). Jiroft too has yielded few specimens. Here, boards are made of chlorite and their shapes range from flat rectangular objects to more artistic works as eagles,

[36] See figure 14, 6-7.

scorpions or mythical creatures. The numbers of holes on boards are different like 36 (pic. 5a), 21(b, c), 20(d) and 16(e).[37]

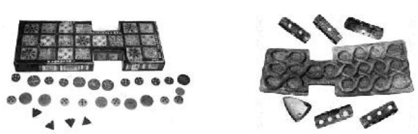
The most elaborate board game may have been Chess. The number of markers, 16 for every player, is the same as the number of squares in a line of our Grid. Brunés has shown that the three directions for movements on the chess board are all along the main lines of the diagram, that is straight (vertical and horizontal), diagonal linked with squares, and a mixture of verticals and horizontals along the diagonal line which is actually one side of the big central isosceles. It is definitely not accidental that chess and today's backgammon[38]are usually made together on two sides of a wooden box. Chess goes side by side with backgammon, a board game played in various versions and in many countries. Its ancient versions had different appearances with different rules.



c d e

Picture 5: Jiroft board games (a-e) (Madjidzadeh, 2003, 108, 120, 130, 135)

In 1926-27 the most ancient 20-squares board game with its markers were discovered in grave 789/pg of the Royal Cemetery of Ur and dated to between 2550 to 2400 BCE. (pic. 6a). Following that, four other boards were also found there. In 1977 the first board game measuring 33/4cm×12/7×cm×6mm along with 60 objects were discovered in grave IUP731 of Shahr-e Sukhteh, a Bronze Age site near Zabol in the Sistan province of Iran. The report of the discovery was first published in 1982 in an article by Piperno-Salvatori (1982, 79-85) (pic. 6b).[39] It has been dated to about 2500 to 2300 BCE, the third phase of settlement at Shahr-e Sukhteh which is almost contemporary with the Ur board. Shahr-e Sukhteh's board is decorated with engraved intertwined serpent having its tail in mouth and closely resembles a small table-like board from Jiroft (pic. 5a). Konar Sandal mounds and Shahr-e Sukhteh had been in close cultural relationships and their discoveries are evidence to the existence of an ancient board game tradition in eastern Iran.



a b

Picture 6:
a) Board game from the Royal Cemetery of Ur (British Museum)**, b) board game and dies from Shahr-e Sukhteh** (National Museum of Iran)

There are several other traditional games especially played by the villagers of Iran that are based on movements following geometric patterns. Discussing games is not the subject of this article. Here, I only give the plan of a popular game called "Dis/Duz Bazi"/"Markers game" as an example (fig. 69a). It is in two versions, one with 9 dots and the other 17. It is played by two

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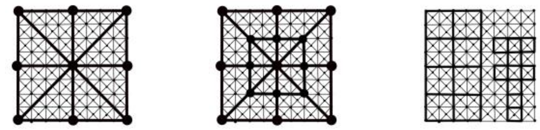
[37] d with 20 holes can be compared with the "Royal Game of Ur" and the Aseb board of Egypt. Aseb was sometimes put on the other side of Senet or "Game of Thirty squares" boards.

[38] The most famous board game in Iran is "Nard". The word "Nard" is the developed New Persian form of Sassanian Nēw-(Ardaxšahr>)Arda(x)šīr "Ardašīr the Brave", thus called to celebrate the braveries of Ardašīr I, the great King of Kings of Iran. Western backgammon covers a wider range of board games.

[39] The last report of this discovery can be found in Piperno-Salvatori, 2007, 287-295 (board in pages 294-295). Dr. Seyyed Sajjadi has presented the report of this board in an independent article (2009a, 162-177, photos in page 323). The photo can be found in his 2009b, 733 too. Bowl number 42 with the animation scene had been found in this very grave (see Artistic Functions).

persons each having eight “Dis” or markers to place on dots in a straight line while preventing the other from doing the same. The one who has finally only two markers in hand or no room to move is the loser. Sometimes, it is this game which is made on the other side of a chess board in Iran. Children’s hopping grids without a stone or preferably with a flat round stone for being moved in cells can be traced back to our Grid too.



a1: 9 dots **a2: 17 dots** **b**

Figure 69:
The geometric plan of Dis Bazi (a1, a2) and grid hopping (b)

As mentioned earlier, a characteristic of these Grid games was that they were brought from the abstract to the real. If the first stage had been drawing lines and dots on clay or on the ground and then came the next by making them real in material, so what could be the other stage? The answer would be moving it still closer to the real world by throwing life onto the board. Humans could either appear on a big board-like pattern drawn on the ground and move along defined lines or make a ball or balls of dot/s and move it/them, or both.[40] Many games, old and modern, come into mind. Master Grid had definitely other functions too.

3] Artistic functions:

The most ancient animation discovered from Shahr-e Sukhteh could not have appeared without any understanding of “motion” and previous experiences for depicting it (pic. 7) (Piperno-Salvatori, 2007, 287-295 bowl: 289-290, also Seyyed Sajjadi, 2009a, 169, photo in p. 7).[41]

Picture 7: Animation scene painted on a bowl from Shahr-e Sukhteh, Sistan, Iran (National Museum of Iran)

The perception of “something which is here in this spot can be and is there in that spot too” -what every component of the Grid reflects- may first be understood by that thing being existent at every intermediate space in between the two spots which is the same as the thing being repeated in every intermediate situation. Each such situation can be viewed as a static picture with no difference with the one before and after it no matter where its location throughout the space between the two spots is. From among all the repeating situations, the first and the last are most important because these are the two limits of what may be called the motion of *frozen pictures* (fig. 70a-b). When time comes that other moments than the start and the end should also draw attention, then immediately leaves the concept of “having no difference with the previous and the next”. So, “the thing”, that is “the same thing” should somehow appear differently in every sequential situation to have its own momentary identity. And thus appears animation, the materialized narration with its emphasis not being restricted to the first and the last moment but

[40] The concept of movement exists in the Persian word “**bāzī kardan**” “to (do) play”. The first part of this verb, “bāzī”, derives from the Pahlavi word “wāzīg” (play, game) based on a root with two forms: ^{2}u̲āz- “to play, contend, (passive?) to lose (in games)” and u̲az-“to move, carry, drive (a chariot): to fly” (Cheung, 2007, 429-433). The forms wazīdan/waz- “move, blow (of wind)”, ^{1}wāzīdan/wāz- “move, carry away, fly” and ^{2}wāzīdan/wāz- “play” are also attested in the book Pahlavi (MacKenzie, 1971, 89). In the Sassanian book of Xusrō Kawādān ud Rēdag, the word for “dance” is **pāy wāzīg** “foot play” or “foot movement”, which has survived in some of the Iranian dialects. In Persian “**bāzī kardan**” is also used for dramatic arts as is the case with the word “play” in English.

[41] A petroglyph very much similar to the Shahr-e Sukhteh animation scene has been discovered in the Teimareh Mountains of Khomein in the Central Province of Iran (see Naseri Fard, 2009, Ibex images: folio 2, image 2). Systematic temporal and spatial study of these petroglyphs has not yet been conducted in Iran. (A.Moqaddam, Spring of 2012)

extended to the entire sequence: the beginning, duration and completion of an action. The important point is that each image should represent the immediate starting moment after the very last moment of the previous image (fig. 70c). This is what Shahr-e Sukhteh images depict and is different from other known cases of the ancient world.

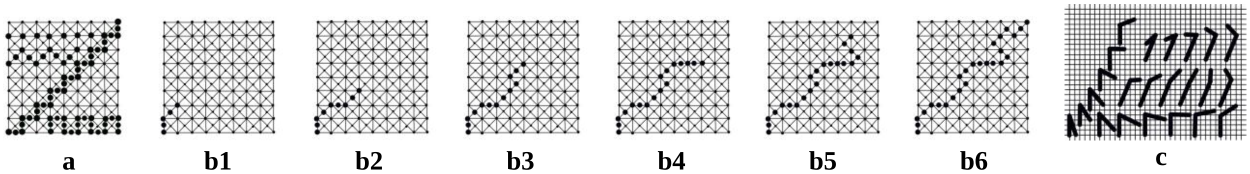


Figure 70: Dots conveying movement *of repeating pictures* (a-b). Lines in pictures conveying animation (c)

Obviously, animation needs an apparatus to show the images in motion and Shahr-e Sukhteh images on a single vessel may not be qualified to be called one, but the fact is that such a scene on a vessel that can be turned round in front of fixed eyes, somehow do convey a rudimentary sense of motion. Probably, the choice of a bowl for such scene had not been coincidental and its turning on the pottery wheel had been the past for this vision.

How could Master Grid be irrelevant to pictures, if cuneiforms for depicting “one moment pictures” had been invented inside it?

Movements in different directions inside the Grid and their varying measures could have various reflections. What tickles mind is music. Have the regular structure, harmonious shapes and their up and down replacements had such an impact on the human mind to trigger such great achievement as systematic musical composition along with the designing of instruments or redesigning of older instruments to play it? If so, stringed instruments would have been among the first choices. Vertical, horizontal and oblique lines having turned to strings of appropriate material and framed in different formats determining their lengths, produced different sounds in vibrations. In a simple square or rectangular frame (fig. 71a), strings were of the same length, so the only factor to minutely differentiate the sounds was the spot of plucking -though the main sound was made in the midline of wires- whereas a curve (previously bow instruments?) or triangle conveniently cut the strings at different lengths and so, caused different sounds to be produced (fig. 71b-g, j-k, m-n). These were harps. Harps, mentioned by the Sumerians as the most ancient instruments, had been among the objects discovered from the Royal Cemetery of Ur (2450 BCE).[42] Images of harps and other similar instruments are seen on rock reliefs and seal impressions in Elam as well as Mesopotamia.[43] They continued to be played in Iran for centuries and -along with *win* and *winkannār*- appeared as the first in a list of the musical instruments played in the Sassanian court mentioned by the Page in the story of "Xusrō Kawādān ud Rēdag".

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[42] "*One the most striking elements of Sumerian culture is the sudden appearance about 2600 B.C. of instruments (harps and lyres) so elaborate that they presuppose a long previous development of which no trace is left.*" (Duchesne-Guillemin, 1981, 287)

[43] 1] "*Harps were depicted in Iran from at least 3100 BCE to 1600 BCE, a longer period than elsewhere. Arched harps were shown on seals, being played vertically at Chogha Mish (3300-3100) and Susa (2750-2600), but horizontally in Shahri Sokhta (3000-2300 BCE) and in south-eastern Iran. In the 2nd millennium BCE the focus shifted to the Elamite region in western Iran. As in Mesopotamia, Elamite harps were angular, but the latter were smaller. ... Judging from the presence of large harp ensembles (larger than those of Mesopotamia), Elam had a major harp culture.*" {de Vale et al., "Harp" in Grove Music Online}. 2] "*In Mesopotamia the earliest known evidence for such instrument is slightly later (c3000 BCE), but given the uncertainties of dating and the scarcity of the material, it is impossible to determine in which region this harp appeared first.*" {Lawergren et al., "Iran: i) Arched harps" in Grove Music Online}.

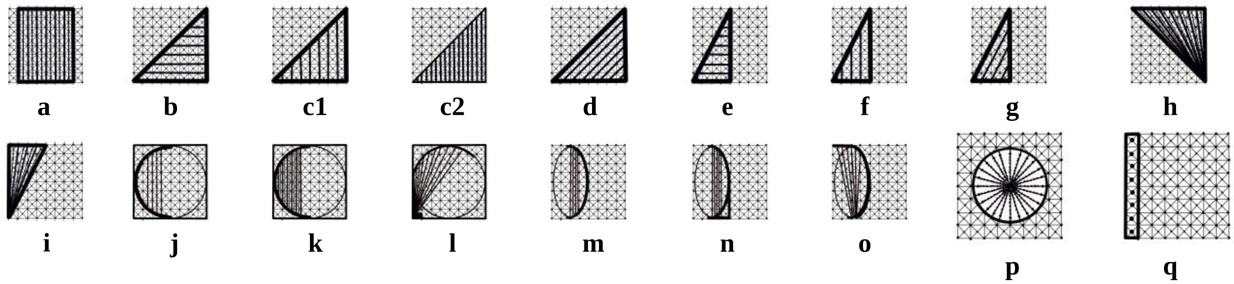

Figure 71: Harps in different shapes and with different numbers of strings (a-o) (see also fig. 24). Base patterns of a percussion (p) and a wind instrument (q)

The number of strings, their intervals and later probably, the diameter of strings could be changed according to the musical rules. Another step would have been changes in the points of connections which created new string lengths (fig. 71h, i, l, o). An important improvement happened when the Grid itself became the back support to strings to which they had been tied, so the length of each string could be controlled and changed by pressing the finger on it at different intervals. These spots were actually dots on line intersections. The quality improved with part of the back support changing to a hollowed box to resonate sounds. *Probably the older wind and percussion instruments would also evolve to more systematically manufactured objects by being remodeled inside the Grid*. In a Grid every movement is defined according to its location. A round surface is understood by several concentric circles, and its divisions -like a clock- by the sectors, as a flute is defined by the intervals of its open and closed holes (p-q).

No wonder if all these had been achieved in temples and by the (king-)priests who sought for more influence on their followers. A strange, charming sound coming out of an instrument not working in the hands of ordinary people meant possessing a sacred talent and mysterious power bestowed from Heaven.

How could a piece of music not be captured and written down with such a precise and well-defined instrument at hand? A composer could perpetuate his composition by putting it on a tablet.[44] It was possible by using conventional signs specifically invented for this purpose or the signs by which the language was written, as the acrophonic signs later used by the Sumerians. It is not unlikely that in the earliest stages signs from inside the Grid, as squares, circles, triangles etc had conventionally been used for this purpose. The most elementary notation for lire (fig. 71c1) would be names for strings (= lines), as /A-B-C-D-E-F-G-H-I/, and numbers for dots, as /1-2-3-4-5-6-7-8-9/ (fig. 72).[45]

										∅
									1•	
								1•	2•	
							1•	2•	3•	
						1•	2•	3•	4•	
					1•	2•	3•	4•	5•	
				1•	2•	3•	4•	5•	6•	
			1•	2•	3•	4•	5•	6•	7•	
		1•	2•	3•	4•	5•	6•	7•	8•	
	1•	2•	3•	4•	5•	6•	7•	8•	9•	
∅	El	Dl	Cl	Bl	A	Br	Cr	Dr	Er	∅
∅	**A..**	**B.**	**C.**	**D..**	**E.**	**F..**	**G.**	**H.**	**I...**	∅

Figure 72: Hypothetical divisions of wires in a primitive wire instrument. Names for strings in symmetric (A: A-E, B-left, B-right …) and sequential arrangements (A to I). 1-9: names for dots on strings for intervals.

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[44] "*The earliest clay tablets with writing use a round harp as a pictogram*" (Kilmer, "Mesopotamia: 2. Pre- and Proto-literate periods" in Grove Music Online).

[45] There can be seen some degree of resemblance between the modern system of musical notation and components of the Master Grid, as movements of vertical/oblique lines or dots/circles on horizontal parallel lines. The resemblance of LE sign 30 (Meriggi's 30), 31 (Meriggi's 29) and 36 (Meriggi's 29a) to some of the signs in the modern system is sobering.

Based on the present evidence, it is supposed that -even in Mesopotamia and despite the discovery of huge archives of cuneiform tablets from the Akkad and new kingdoms periods, among which there are lexical texts with specifically technical musical lexicon, as terms for stringing, tuning and playing string instruments- musical knowledge had been transmitted orally up to the Babylonian time.[46] But this may be altered by the future discoveries. The situation is more difficult in Iran because here the number of written documents is very limited. SKS3 tablet contains repeating collections of signs (fig. 73).[47] Is this likely to be a piece of music or song/hymn? It had been written on a clay tablet and then fired in kiln to be deposited in archive. Why should such a short document be written in relatively large signs and on a tablet with a size not appropriate for daily use, and then fired? The reason could be that the words or signs(?) had taken fixed forms worthy of being preserved somewhere in order to be used on different occasions.

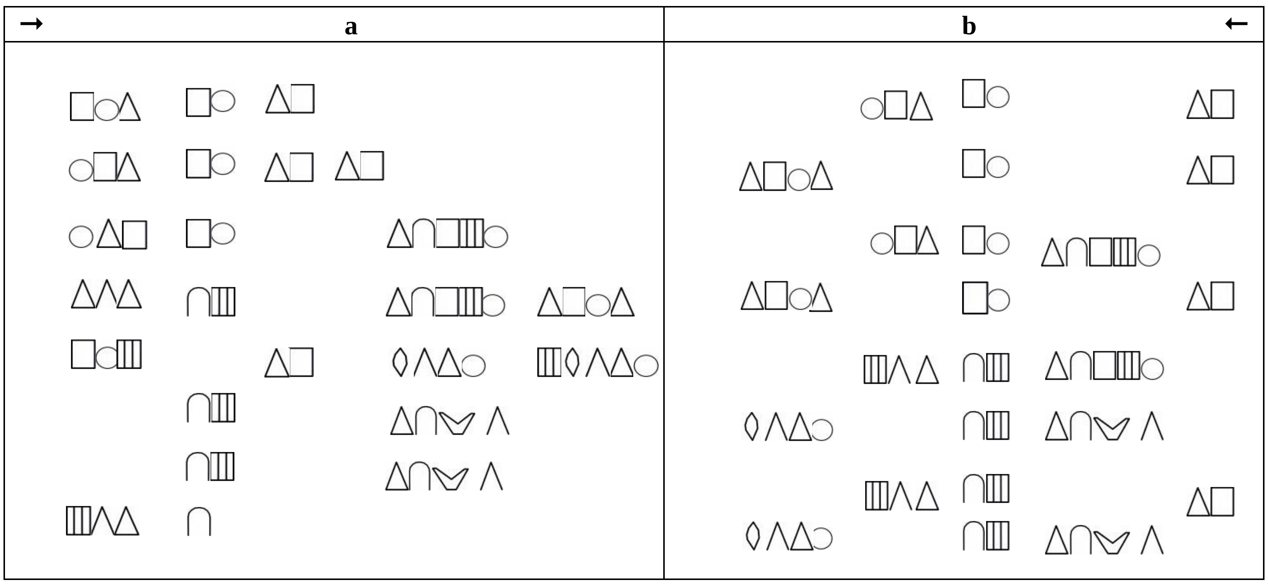


Figure 73: Rearrangement of the SKS 3 units in the △ position from boustrophedon to left-to-right (a) and right-to-left (b)

4] Mathematical calculations:

A measuring instrument as ruler is the simplest to be imagined inside the Master Grid (fig. 74a). Lines were undoubtedly counted and their intervals determined for drawing Grids of specific functions. Making a precise straight line measuring tool called for a Grid with closer line intervals. Shahr-e Sukhteh has provided us with an example (pic. 8). This is a 10cm ruler with half millimeter divisions made of ebony (CHN, 25 January 2005. Picture in Seyyed Sajjadi, 2009b, 733).

One of the most primitive but still widely used devices for doing mathematical calculations is “abacus” or “counting board/frame”. The ancient specimens could have been tablets with painted vertical lines or carved grooves between which beads made of different materials moved. So,

[46] Kilmer, "Mesopotamia: 5. Old Babylonian periods, 8. Theory and practice" in Grove Music Online. The Nippur tablet (ca. 2000 BCE), the Sippar tablet (ca. 1600 BCE) and the famous Assyrian KARI-4 (ca. 800 BCE) all contain cuneiform signs which seem to be musical directories.

[47] A study of the four SKS Mound inscriptions by the writer will appear in a separate book.

after lines had been deepened to grooves and before changing to framed rods or wires, it was a "counting board".

Again, the structure directly recalls Master Grid. The basic components have always been lines and dots (fig. 74b, also see figs. 32c, 58f) and specific rules for their roles. Obviously, rules were different for different functions and it was the extraordinary potentiality of the Master Grid which enabled it to base such diverse manipulations. As the vertical and horizontal lines inside the Master Grid were used for measuring straight lines in the form of ruler, dots on line intersections were logically used for counting numbers. PrE inscriptions are excellent evidences of this function.[48] Through time, dots were given conventional values to increase their efficiency. This was a remarkable improvement. In its early days, counting board was used to do simple calculations as subtraction, addition, division and multiplication but in time developed to do more complicated calculations as extracting square and cubic roots etc.

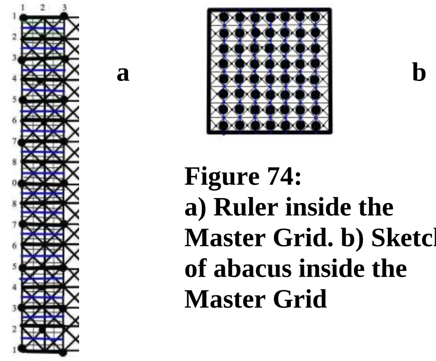
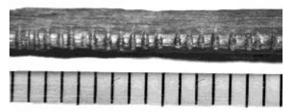


Figure 74:
a) Ruler inside the Master Grid. b) Sketch of abacus inside the Master Grid



Picture 8: Wooden ruler from Shahr-e Sukhteh

Master Grid had definitely more important mathematical functions than mere arithmetic. Precise geometric circumference and area calculations were fundamental to a developed architecture magnificently visible on Jiroft vase buildings. North Konar Sandal mound of Jiroft is actually a huge three-storey mud-brick structure with the base platform measuring 400×400m, claimed by the excavator to be not only the largest but the oldest of the type in the ancient Near/Middle East (Madjizadeh, 2003-2004, 9). On the other hand, another smaller but still massive structure (base platform: 56×35m) at Tepe Sialk of Kashan has also been nominated as probably the most ancient of the region (Malek Shahmirzadi, 2002, 27-54). These two have seriously challenged the old hypothesis of such constructions, renowned by the Sumerian word "Ziggurat", as having been originated in Southern Mesopotamia. *Obviously, the question of the Sumerians' original home land is a very serious one.*

Game boards should not be viewed as simple entertaining devices as they definitely had not been so. Movements of markers on the board were determined by mathematical calculations at different levels. PrE and LE signs are invaluable treasures that can guide us to a professional society active in innovations. Few points are mentioned here:

Dice is a very interesting invention and subject of discussions since long time ago. It might have come out of the Master Grid. This is again a matter of coming to the real from the abstract, so we have to find traces of it in the Grid and try to materialize them. Dice is a guide or actually a choice implement based on numbers. In ancient specimens, as Shahr-e Sukhteh's dies depict, these numbers are from 1 to 4, whereas in later ones -as today dies- they are from 1 to 6. But these numbers might not have been the only options as we do not know what games existed and called for what choices.

We start from number 1 and proceed up to 6. We need to find patterns in accordance with these numbers in our standard Master Grid. The simplest concept would be 1 dot on a line and

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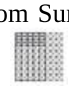
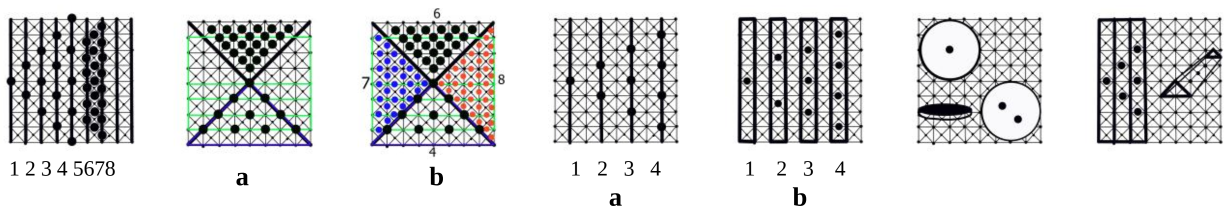
48 The most ancient counting board dated to about 2700 to 2300 BCE was discovered from Sumer. One may see some similarities to abacus in some of the Sumerian signs {Cf. probably signs 313, 324  (Labat, 1963, 36; 142,3 and 148,1)}.

then 2, 3, 4, 5 and 6 dots. The invention of devices for showing choices among these numbers calls for the observance of the fundamental principle of “equality of incidence” implying that when throwing a dice, each number should have the same chance to show as the other/s. So:
1) For the choice between 1 and 2, the device should be flat but can have various shapes like square, rectangle, triangle, round etc. Each number is shown on each surface. Whatever the shape would be, it has to roll well in the air in order to land well. Obviously, a round object rolls best (fig. 75D). It is this round, bi-faced object which we call “coin” and still toss to choose one or the other face. **2)** For the choice among 1, 2 and 3, the device should be a triangular prism with numbers made on its 3 surfaces not 5, that is on the shaft not the two ends (fig. 75E). A triangular pyramid can be used too which has the profit of having no shaft but no chance of a good roll either. **3)** For the choice among 1, 2, 3 and 4, the device should be a square prism with numbers made on its 4 surfaces not 6 (fig. 75F). **4)** For the choice among 1, 2, 3, 4 and 5, the device should be a pentagonal prism with numbers made on its 5 surfaces not 7 (fig. 75G). **5)** For the choice among 1, 2, 3, 4, 5 and 6, the device should be a hexagonal prism with numbers made on its 6 surfaces not 8 (fig. 75Ha-b).



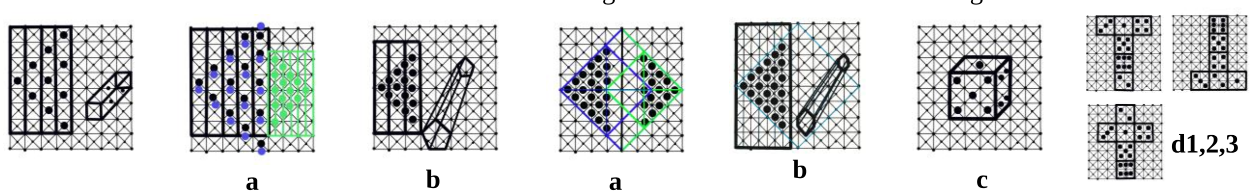
A] dots at different intervals

B] a: 1-4 dots (down). 1-6 dots (up). b: 1-4, 1-6, 1-7, 1-8 dots

C] a:1 -4 dots on line intersections. **b:** Dots in rectangles

D] 1-2 dots. Circles could be tangent

E] 1-2-3 dots



F] 1-4 dots

G] a: dots at different intervals and inside different frames. **b:** 1-5 dots

H] a: Comparison of 1-6 dots (left) with 1-5 dots (right). **b:** 1-6 dots. **c:** cubic dice (1-6 dots). **d:** unfolded cubic dies

Figure 75: Dice models inside the Master Grid

It may seem that making real objects of these models calls for each part being made separately and then stuck together. This is not what happened because solids did not evolve easily. Giving volume to a flat surface if not a line is a complicated process. Proto- and Linear Elamite signs as well as SKS signs assist us to understand this.[49] Before taking the shape of a complete cube, dies had been of other shapes. Their construction had most probably passed these procedures: **1)** Sketching the shape on whatever flexible material at hand like a thin layer of wet clay. **2)** Changing the lines (fig. 75Ca) [*see LE sign no. 2 as well as 126 = Meriggi’s hapax 101*] into areas by continuously doubling them (75Cb) [*this technique can clearly be seen in some LE signs, as no. 20 = Meriggi’s 39, 27 = Meriggi’s 56, 29 = Meriggi’s hapax 81 etc. See also PrE signs 9d, 19a, 11a*]. So, a line with a dot on it, as 75Ca1, would change to a flat rectangular area, as 75Cb1. What is drawn is the plan of the entire shape altogether. By folding the whole shape along its lines, a solid is born. A 3-columned rectangle easily changes to a triangular prism with

[49] Reader should refer to the serial numbers of signs in the reconstructions in this article.

1-2-3 dots (75E) [*see signs 43 and 44 (and SKS 12, 13). These two clearly show sketches for such solids*]. A 4-columned rectangle turns to a square prism with 1-2-3-4 dots (75F). A 5-columned rectangle changes to a pentagonal prism with 1-2-3-4-5 dots (75G). And finally, a 6-columned rectangle turns to a hexagonal prism with 1-2-3-4-5-6 dots (75H).[50] These could have been among the original dies as some of them -like Shahr-e Sukhteh's 4-numbered dies- have been discovered in ancient relics. But still another great invention happened: instead of the hexagonal prism, the rectangular prism was cut short to equal sides and the resulted cubic device was used with its entire 6 sides for the six numbers and the best roll (75Hc). Its sketch in the Grid is intelligent (75Hc). It can be a T (cf. PrE sign no. 9) or a cross which is freely numbered from 1 to 6 (fig. 75Hd).

Patterns of dies with 1-2-3 and 1-2-3-4 dots (fig. 75E-F) resemble PrE signs 14 and 14c and the arrangements of lines in both are strange reminders of the Khayyām Triangle (fig. 76).

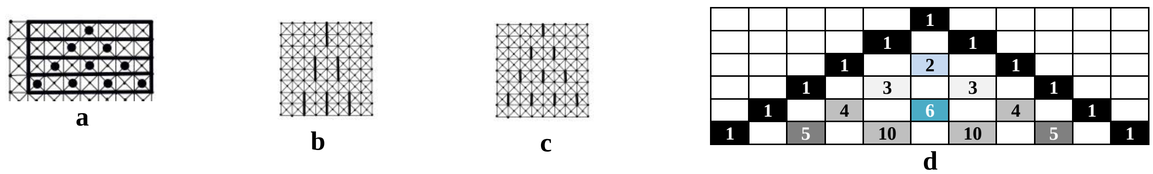
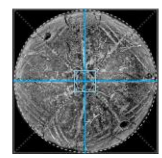


Figure 76: 4-numbered dice(a), PrE signs 14(b) and 14c(c), Khayyām Triangle(d)



Picture 9: Artificial eye ball from Shahr-e Sukhteh

Certainly, geometry and mathematics had numerous other functions. What is known today as Medical Engineering could be one of the most sophisticated. In 2006 there was found in grave no. 6705 of Shahr-e Sukhteh a female skeleton, 28 to 32 years of age, in the left eye socket of whom was laid a half-spherical artificial eye ball measuring 2.96×1.5 cm in diameter and radius respectively, dated to about 3000-2900 BCE. It was fixed against the head by a thread passing through the holes drilled to either side of the object. Eight deliberately hollowed golden (or silver?) wires inlaid in superficial grooves running between the small circle at the center and the outer part probably functioned as capillaries to maintain the moisture (Seyyed Sajjadi-Costantini, 2008). This masterpiece of medical engineering is an object with a geometric plan exactly similar to fig. 58e. Such an artifact could not have been invented, if a high level of medical, geometric and mathematical knowledge had not existed.

For the present and till more excavations are conducted in the eastern regions of Iran, one should be careful with identifying Susa or the western and southwestern Elamite realms, as the cradle of the so called Proto-/Linear Elamite writing system. The discovery of hundreds of PrE inscriptions in Susa may not be an indisputable evidence for assuming it its place of invention. Though Elamite culture has been traced in vast regions of the Iranian plateau, but with every new discovery in the eastern parts more light is shed on the lost but highly flourished cultures of these regions; cultures whose important roles in the evolution of the high civilizations of southern Khuzistan and Mesopotamia may be buried under the heavy dust of time.

[50] A closer look at the LE signs reveals that some may indeed have been flattened solids. Sign no. 34 (= Meriggi's hapax 94) turns to a square pyramid and no. 106 (= Meriggi's 10a) becomes an incomplete triangular prism when folded.

SKS mound inscriptions have yielded more signs closer to the Proto- than Linear Elamite (table 2). Since, in my opinion, the two discussed scripts are actually the same with a shift in type and number of signs, and considering the fact that more ancient layers of Konar Sandal mounds are waiting to be revealed -not mentioning other known and unknown sites of Great Iran- we better reflect more on Professor Madjidzadeh's suggestion in calling these "**Proto-Iranian*" scripts, especially if the ancestor of cuneiform scripts too, is to be sought in this system.

SKS inscriptions	SKS Sign number	PrE sign number
2, 4	8	6b
1	21 ?	57
1	23 ?	237a
1	24	227
2	25	261
3	28 ?	73g
2	30	265
2, 3, 4	33	129

Table 2: Similar signs of the SKS mound inscriptions and PrE script

SKS signs 43 to 47, totally lacking in LE, have counterparts in PrE in their general patterns.

A number of the geometric signs in the Pr-/LE have counterparts in the Proto-Sumerian as this writing system is a mixture of pictographic and geometric signs as well. A simple comparison between this system and that of the eastern neighbors', the Indus people, gives it more independence. Sumerians' cultural and scribal achievements are far from being ignored by anyone, but what are important about the SKS mound inscriptions are the simple forms of the new signs and their assembling in single tablets. It is an undeniable fact that the number of inscriptions discovered in Iran is very limited but regarding the richness of the archaeological sites of this part of the Middle East -especially its eastern regions which are archaeologically young- it is necessary to do more research before any deduction is made on the role of the Iranian lands in the cultural developments of the region.

That the structure of the main part of the writing systems discussed is geometric, makes it necessary that their origin, process of development and the reason of them being accompanied with pictographic and cone-like signs be studied. The inventory of geometric signs of these systems includes a spectrum of simple to complicated patterns which could not have been without former evolutionary stages or the result of accidental, simple or aimless activities. As mentioned, geometric patterns can be traced in the ancient petroglyphs in many parts of the world.[51] Though Iran may be among the countries with the highest number of petroglyphs, systematic studies have not yet been started there.[52] Till more discoveries bring forth further

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[51] Petroglyphs of the Paleolithic caves of Europe, especially France, have been studied more than those of the other parts of the world. A recent study on 146 cave signs by Genevieve von Petzinger is available on http://www.bradshawfoundation.com/geometric_signs/index.php. Representing relative chronological and statistical information, she has classified the geometric signs in the following groups: 1. Aviform (from 12 out of 146 sites; less than 10%). 2. Circle (20%). 3. Claviform (15%). 4. Cordiform, (3 sites). 5. Crosshatch (17%). 6. Cruciform (13%). 7. Cupule (15%). 8. Dot (42%). 9. Finger fluting (15%). 10. Flabelliform (18%). 11. Half circle (18%). 12. Line (70%). 13. Negative hand (15%). 14. Open angle (42%). 15. Oval (30%). 16. Pectiform (5%). 17. Penniform (25%). 18. Positive hand (7%). 19. Quadrangle (20%). 20. Reniform (Rare). 21. Scalariform (3 sites). 22. Serpentiform (7%). 23. Spiral (2 sites). 24. Tectiform (10%). 25. Triangle (20%). 26. Zig-zag (7 sites).

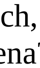
[52] Unfortunately, many of the Iranian petroglyphs have been destroyed by nature and also human activities, but still their number is considerable. Most of the petroglyphs have been discovered and introduced by Mohammad Naseri Fard in the Teimareh Mountains of Khomein in the Central Province of Iran, his birth place and home. Though not an expert of the field, he has bestowed many years of his life to them. The general themes of the petroglyphs introduced by him are as follows: 1) Geometric patterns: Dots or cup marks: dispersed; in sequences; connected with lines. Circles: simple; concentric; spiral; composite with underlines; with dots at the center. Lines: simple; parallel. Grids. Triangles. Lozenges. Star-like figures. 2) Human figures; body members like palm. 3) Animal figures. 4) Plants. 5) Objects including musical instruments as harps. 6) Ziggurat-like patterns. 7) Mythological creatures. Some

information, one would not be able to judge whether the geometric patterns of the ancient caves and rock arts should be classified as (scribal) symbols or not; but the continuity of these patterns in millennia and in different locations is certainly a sign of their importance as cultural elements. When, at the end of the fourth and during the third millennium BCE some of these ancient geometric patterns appear in accompany with a considerable number of other new and more complicated figures, one can hardly categorize them as non-writing patterns or even void of linguistic rules. Even centuries before, some of these patterns had appeared as decorative designs on manmade earthenware. Undoubtedly, a certain pattern on a vessel had a cultural background and was the manifestation of a specific thought. Someday, they may start to unfold and display their creators’ minds.

The more recent tradition of writing on stone could not have been separate from making prints on rocks in the remote past. In whatever method and with whatever meaning and purpose these were on the way of the materialization of human mind and ultimately, invention of writing. After thousands of years, the ancient tradition of making figures and patterns on stones and rocks was never abandoned and, despite the invention of different writing materials, it continued to be performed for reasons of which the long history could be the strongest. Interestingly, there can be found in Iran in the same regions where petroglyphs are found, isolated short Sassanian inscriptions and also Qor’anic verses.

To understand geometric writing systems some questions need to be answered, the most fundamental of all might be: how did they evolve and what did they communicate in their earliest days? Definitely, finding answers to these questions is most difficult, if not impossible. For the present, one may hint to some points and pose a few additional questions.

If patterns of natural phenomena around Man had been his inspirations in imitating and re-creating them, then how did human mind pass the borders of mere imitations -reflected in cave paintings- and enter the world of linear patterns or probably symbols? Chronological dating of paintings and geometric patterns of the European caves proves their very old age, if not synchrony. When did these two ways of viewing the surrounding world diverge and how much distant these two worlds of the real and conventional had been? Based on the present evidence, one may come to the conclusion that cave paintings and geometric patterns went side by side with the latter not having been developed from the first. If the realistic images had developed to linear re-creations, this was exactly the same procedure that happened in the third millennium BCE during which pictographs changed to cuneiforms, but another mechanism had been at work because apparently, cave paintings and geometric patterns had different origins and were made independently.

How could Man view the natural phenomena around him as integrated entities composed of different parts and the potentiality of changing to shapes which, in spite of being relatively different from the original, could represent those very phenomena? In other words, how could Man distinguish the structural lines of the visible phenomena and separate them, and *why should he basically do such thing*? If he made the image of his own hand , how did he come to the

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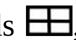
figures are accompanied by others from different groups, as geometric patterns beside animal figures (Naseri Fard, 2003). When figures are made not only beside but inside each other, they are more likely to be ligatures. Such patterns could hardly be void of symbolism.

Iranian petroglyphs should be studied according to their themes, styles, temporal and spatial distributions. Some figures have parallels in other countries and some are practically universal. Few also seem to resemble some of the PrE and LE signs (Ibid, inscriptions). Even one specimen seems to resemble SKS 17, but one has to study them in detail before coming to any conclusions.

Figure 77

understanding that this pattern  too could be equal to that very hand? Did he understand and divide the phenomena as we do today? For instance, if a vertical tree was to be understood by him as a line, did he understand the limits of the trunk and branches in the same as we do and cut them apart in a way that a straight line for him was not *b* but *a* (fig. 77) as is for us? Anyhow, if nature had been his source of inspiration in re-creating shapes, the process was not simple. It cannot be supposed that humans viewed and understood the natural phenomena the same way as we view and understand today. Therefore, one may postulate variants for representations of specific phenomena and their linear refinements through time. Another problem is that from among numerous phenomena around Man, why only some specific cases were chosen to be re-made? Looking into the eyes of another human could probably inspire a circle  (though its drawing was definitely a very difficult process), but what about shapes like hachurs  or grids , both present in petroglyphs? It truly seems that some shapes are more concrete than easily be found models for in nature. Did Man's longtime experience in making linear forms led him to a stage at which -by creating patterns non-existant in nature- he started introducing to the real world images out of his own mental world? I do not suppose that psychoactive substances had been the cause of geometric motifs be brought to the real world from a hallucinatory realm (Abraham, 2011).[53] When these motifs found especial positions in the culture of human communities, then by exerting deep influence on humans' minds, they could appear as subjects of different mental activities, because especially if they were not to be found in nature and had the capacity of manifesting properties to humans which bestowed more capabilities on them than what was needed for the ordinary daily lives, or could equipe them with higher standards, then they gradually assumed sacred aspects and served those who were able to manipulate them, or in other words knew their properties. May be in time, Man put single patterns together, whatever their source of inspiration had been, and found opened in front of him new windows (fig. 78) and consequently, those very new motifs provided him with grounds for creating more complicated patterns; and finaly, a comprehensive magical pattern evolved to be a source out of which to extract inumerable shapes with varying properties.

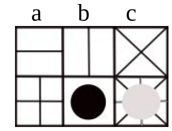


Figure 78: Simple patterns joining together

Should what we call Paleolithic geometric patterns be actually classified as "geometrical categories", or are they merely linear re-creations of some phenomena and must be identified as geometrical when produced within a systematic framework? Geometry is not just a collection of shapes but an understanding of relations among shapes and related calculations as well. Did Man discover the relations and became capable of changing shapes to each other? Nature was not able to give him such ability on itself. This ability was what created geometry. Clearly, geometry was not discovered somewhere on the earth but evolved in time, and its knowledge, like all other aspects of human culture, went from one society to another. How long did it take from the days when the so-called geometric patterns appeared up to the time when what is known as "Geometry" was born? What happened during the period between the time of the most ancient geometric patterns of the Paleolithic era and the third millennium BCE, during which the geometric writing systems of the ancient Near/Middle East evolved? What is certain is that the

[53] "… we are led to the hypothesis that *the shamanism of ancient cultures was involved with psychoactive (shamanic trance inducing) substances.* In other words: Paleolithic peoples discovered natural psychedelics, and this may have been a factor in their invention of religion, art, and mathematics."

highly developed architecture of the latter period in the ancient lands of the Near/Middle East and North Africa alone can be a sign of a high level of geometrical and mathematical knowledge, and such knowledge could not have emerged in a few centuries or millennia. This very aspect would imply that geometric knowledge and patterns had deep roots in time and in the daily lives of humans.

An understanding of the procedures during which geometric patterns evolve, the mechanisms of their evolution and the position they occupied in humans' minds may help decode their meanings in later periods.

Tool-making was not possible without pre-planning. Therefore, we may start our research at least from the days when Man started flaking his choppers to bring them close to the patterns which had been shaped in his mind.

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