Application of a Set of Avian Bones for Reproduction of Prehistoric Geometric Designs

The author discusses 'an avian bone hypothesis', one of the possible ways of creating geometric designs, common on Eurasian and Mediterranean sites throughout the Bronze and Early Iron Ages.

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Introduction

Geometric designs, especially those dated to the Upper Paleolithic, have been the subject of extensive research interest for several decades. The rows of zigzags and meanders first appeared on Upper Palaeolithic materials and became widespread at Eurasian and Mediterranean sites through the Bronze and the Early Iron Ages. One of the most captivating questions is how these designs were created. Among the innumerable suppositions concerning these geometric designs, the hypothesis that suggests utilisation of some avian bone seems most intriguing. According to this hypothesis, the first drawing instruments were made using bird bone. The weakest part of the suggestion is the absence of solid supporting data other than the observations on specifics of designs; in particular, that the angle of them fairly fits the angle of a curved bone.

However, despite a shortage of direct evidence, the hypothesis contributes to the history of ancient craft tools and has a potential practical application for reproducing archaeological geometric designs, and therefore deserves attention.

General characteristic of avian bone tool and its basic drawing performance

There are three avian bones with the inner angle of a natural curve coinciding with the geometric designs: a wishbone and a pair of bones located on the right and left sides of the low part of the sternum (**fig. 1**).

A curved wishbone does not look to be suitable to draw straight lines on a flat surface. However, it is capable of imitating rocker stamping (**fig. 2**). The rocker pattern often accompanies geometrical designs in some archaeological ceramic series (*Molodin 1985*).

Each of the paired curved flat bones looks appropriate to become a drawing tool. The relatively small sizes of the bone make it fit comfortably in hand and thus making it appropriate for applying to a flat and moderately rounded surface (**fig. 3**).

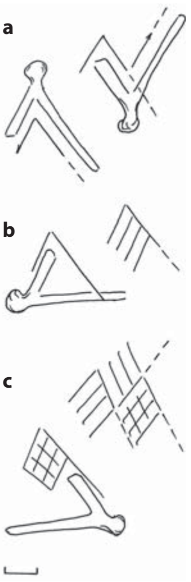
One of sides of the bone is naturally straight; while the other could have been smoothed artificially. The bone tool has two working edges (working edge 1 and working edge 2) of more or less fixed length (**fig. 4:a**) positioned with the sides of a natural angle (α). The placement of handles (H) could float (**fig. 4:b**) when the tool is moved.

Compared to the wishbone handling, an avian tool requires relatively more effort. There are at least two basic suggested ways of drawing:

1. The tool is pressed against a surface. Then the first line is performed along one of the working edges (either working edge 1 or working edge 2). It is also possible to draw first two lines along both edges. Turning the tool to the other (either front or back) side and merging working edge 1 the previous line from inside produces the next line along working edge 2. (**Fig. 5:a**)

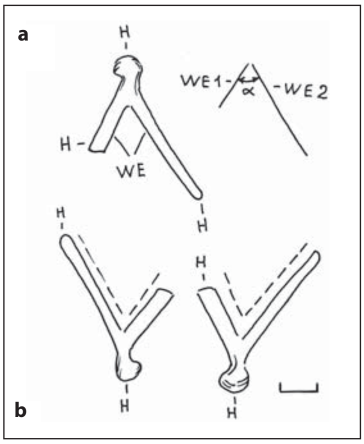
Moving the tool further in that manner, alternating sides of the tool (front/back and vice versa) to clasp every previous line with working edge 1, produces an organised zigzag.

■ Fig. 1 Proposed avian bone drawing tools

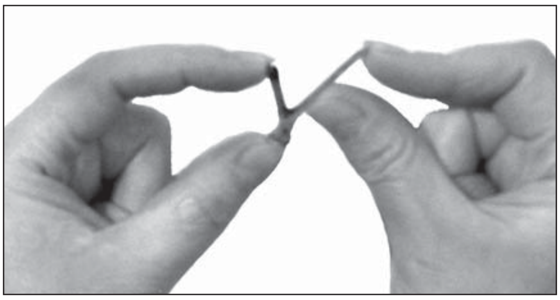


■ Fig. 5 Avian bone tool's basic drawing performance

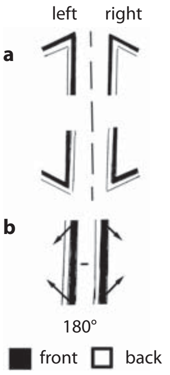
■ Fig. 2 Imprints on clay made with a wishbone



■ Fig. 4 General characteristic of the avian bone tool



■ Fig. 3 Hands holding an avian bone proposed as a tool

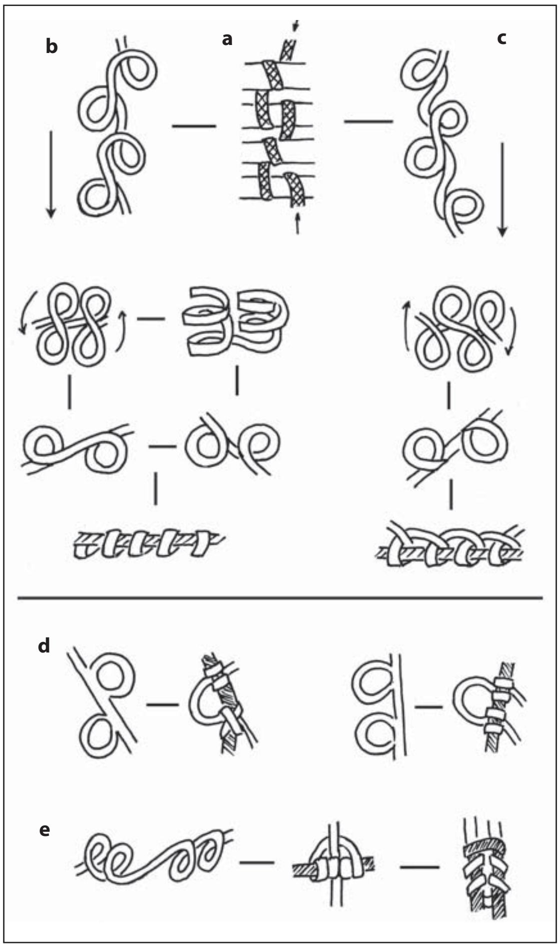


■ **Fig. 6** Graphic representation of a pair of avian bone tools

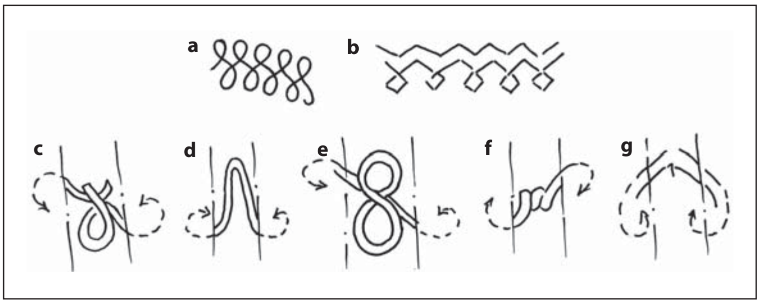
2. The avian bone tool is pressed against a surface. Two lines are produced along working edges. Shifting the tool along the lines designated as supportive and stepping on the width of working edge 1 makes a column of approximately 3 lines, or a shaded rhomb (**fig.5:b**).

In terms of visual performance, left and right avian tools are identical. When marking front and back position of each two-sided avian bone in different colors, right and left drawing tools may be shown as substitutes of each other (**fig. 6:a**). When placing against the direction of natural curve of the bones, a turn on 180 degrees transforms the right tool into the left one, the back position into the front one, and vice versa (**fig. 6:b**).

The direction of design execution depends on which one of the pair of tools is employed; start position of avian bone tool; right- or left-handed grip, et cetera. The best way is to keep turning the image around.



■ **Fig. 8** Hypothetical woven (fastening) model of the geometric designs



■ **Fig. 7** Spiral pattern in the materials of the Bronze and Early Iron Ages of Eurasia: **a, b, d, f, g** – from Bader et al. 1987: Fig. 2; 12; 51; 52; 71; **c, e** – from Grakov 1977: Fig. 23; 64

The positioning of working edges of the avian bone tool as the supportive lines makes it visually obvious that it is possible to apply both basic techniques concurrently. The tool could be moved from the "corner" in the left or right direction, up or down, and vice versa. Basically, the technique consists of moving shaded rhombs (**fig. 5:c**). The obtained supportive net is quite compatible with geometric patterns.

There are at least two difficulties accounted during evaluation of the bone tool graphic performance. First, an inevitable accumulation of distortion (because of the inaccuracy of the bone tool) may cause noticeable deformation of the supportive net, when it comes to extensively repeating patterns. Second, sometimes only the fragments might represent a relic that produces large gaps to be reconstructed.

Considering what else one may count on when applying the avian bone tool, it seems noteworthy to appeal first to traditional views on the geometric design as originated from weaving techniques.

Hypothetical woven (fastening) model of early geometric designs

The extremely viable zigzag and meander patterns dated to the Bronze - Early Iron Ages demonstrate significant variability. In addition, the meander pattern shows a strong trend to be transformed into its modern recognisable modifications (*Molodin 1992*). However, despite of all the transformations, the meander-based designs maintain a hard core, which is a spiral arrangement.

On the other hand, even casual observations on metal series of the Bronze and Early Iron Ages of Eurasia shows an increased weight of spiral pattern for numerous and various metal accessories. In this category of artefacts, the spiral pattern is quite strongly associated with a distinctive fastening mode (functioning or decorative) (*Yegoreichenko 1991; Bader et al. 1987; Grakov 1977*). The lower chronological limit for this type of artefacts is dated to the Early Bronze Age (*Yegoreichenko 1991*), a time when the old prototypes get their moulded "copies" in new available material. In addition, décors, which may be referred as spiral-like or loop-like, are also represented in ceramic series (*Bader et al. 1987*).

Some observations of spiral designs dated to the Metal Time of Eurasia (**fig. 7**) suggest a format hypothetically involved for probable prototypes. By means of this rather primitive scheme (**fig. 8:a**), it is possible to craft several variants of a two-piece twisted product from a quite loose one (**fig. 8:b**) to a tight one (**fig. 8:c**). The actual difference between "spiral" and "knot" sides would be quite comparable because the result mostly depends on how the second part would be placed. However, folding the scheme on the "knot" side would produce tight knots (**fig. 8:c, d**). To fasten a virtual twisted item in a quick and comfortable way it is functionally acceptable to use the simplified variant of knots, which in fact are the parts of the spiral from other side (**fig. 8:e**).

The suggested weaving scheme is worth noting not only for its functions. The scheme clearly demonstrates features, which make it available for visual decisions. The scheme is compact, visibly assembled and repetitive (**fig. 9:a**). It could be easily disintegrated and put together again. The front and back positions of a virtual band are presented in a certain proportion and convert into each other with every spin. Every turn envelops a minimum of 3 widths of the band. Only one of those virtual parts is linked to the next spin through its opposite side. The scheme might be transformed into a simplified 2-part spiral variant (**fig. 9:b**).

Both "spiral" and "knot" sides of the basic scheme are practically indistinguishable from a graphic execution point of view. Despite some differences they may be considered symmetrical (**fig. 9:c**) as left and right sides of each other. When applying a double band (consisting of two threads of different colors) to the scheme, its basic dual pattern becomes clear (**fig. 9:d**).

The distinctive feature of the pattern is that the opposite sides of the band share its space with each other between extremes. The graphic pattern may be displayed on the basic scheme in both disintegrated and composed variants (**fig. 9:e**).

The format also provides a possibility to craft a personal drawing tool attuned to hand sizes. Since the scheme is supposed to be made by hand, literally the fingertips, the size of the tool may be considered constant.

From a practical point of view, the hypothetical woven format allows suggesting a preliminary sketch. The supportive draft would correspond to a graphic presentation of the hypothetical weaving scheme (**fig. 9:c**). Each turn would partly overlap the next one to make a shared area, where a band converts from one side to the opposite one (**fig. 9:e**). The suggested preliminary sketch looks well matched with an avian bone basic drawing performance.

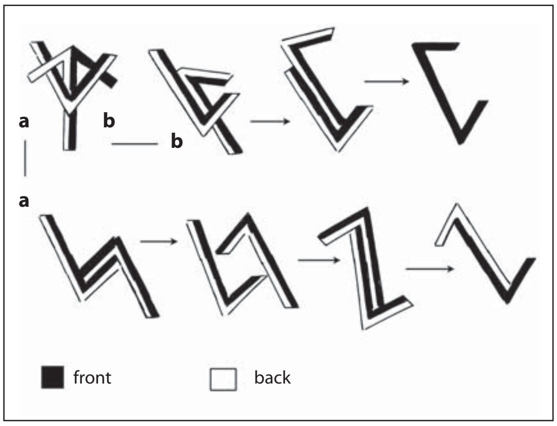
From the other side, the mechanisms and settings of the appearance of the geometric designs in materials of different archaeological cultures are not always clear. There is a possibility that weaving experience could influence an individual creatively either tangentially or not at all.

Lock scheme of paired avian bone tools

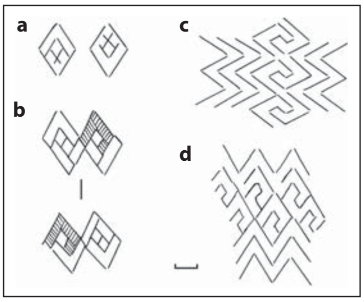
Consideration that the avian bone tools are paired makes it possible to assume that the designs could exploit the interlocking of two left and right avian bones.

In functional arrangement, the interlock is a somewhat complex 3D pattern. From a visual point of view it becomes interesting when placed on a flat surface (**fig. 10**). In the position in which both avian tools are visible, it is possible to open the lock from both left and right sides (**fig. 10:a, b**) moving one of the avian bone tools along another.

The "lock" scheme takes into consideration a certain movement in the opposite direction (Front-Front /Back-Back connection) for every move forward (Front-Back/Back-Front connection): every step put forward on one side corresponds to one put back on other side.



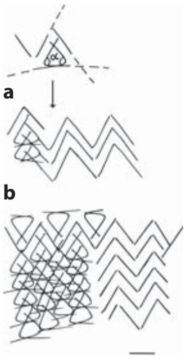
■ **Fig. 10** Graphic representation of the "lock" connection of the paired avian bone tools



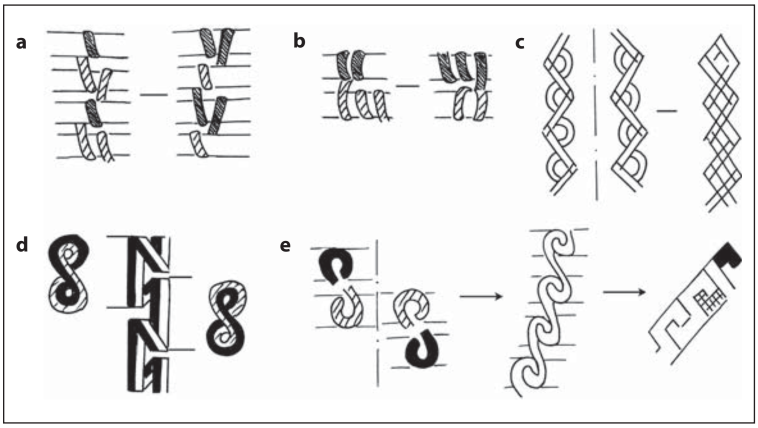
■ **Fig. 14** Graphic transformation of the "lock" scheme into a meander pattern

So it looks possible to employ the inner angle (α) of the curved bone. Practically alternating the rows with the opposite (Front-Back/Back-Front) and the rows with the matching (Front-Front /Back-Back) connections allows rearranging the lock scheme into a zigzag pattern (**fig. 11:a**). This manipulation produces a supportive net, which opposes the avian bone tool's inaccuracy and reduces significantly the possible distortion in vertical and horizontal directions (**fig. 11:b**).

Alternative techniques (without a net) to make a zigzag pattern might be based on more familiar ways of bisecting the angle α. For example, observation of ceramics suggests that a preliminary sketch of the design may have included triangles (split rhombs) shaded in different directions (**fig. 12; 13**).

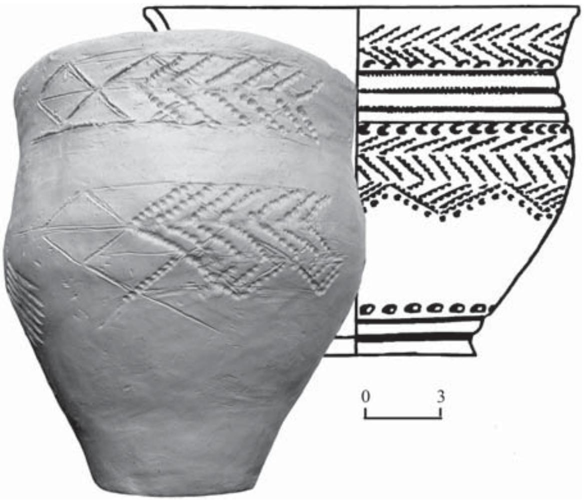


■ **Fig. 11** Graphic transformation of the "lock" scheme into a zigzag pattern

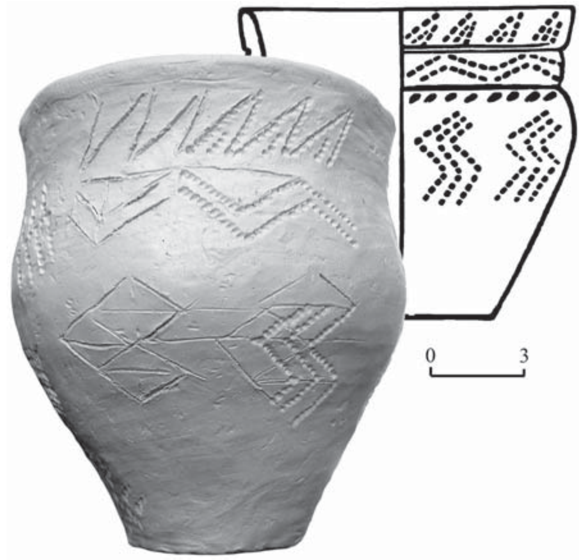


■ **Fig. 9** Hypothetical woven (fastening) scheme and its visual transformations

The "lock" scheme shows a bond of paired drawing tools as a form that could not be defined just by one term. However, this connection may be considered as a link of two parts inscribed into rhombs (**fig. 14:a**). Given that the turn on 180 degrees transforms the right avian bone tool into the left one, and vice versa, that formation may be disintegrated into pairs of rhombs inscribed into the zigzag supportive net. Summation of the lock scheme for each unit (shaded rhomb) produces a pattern, which represents both right and left bone tools in a ⅓ proportion (**fig. 14:b**). The pattern may be applied as is, and to imitate the spiral design (**fig. 14:c, d**).



■ **Fig. 12** Example 1: A sketch for a pottery design made with an avian bone tool with an original in the background (the Andronovo culture, Western Siberia, the Bronze Age, from Lamina et al. 1995: Fig. I.2)



■ **Fig. 13** Example 2: A sketch for a pottery design made with an avian bone tool with an original in the background (the Andronovo culture, Western Siberia, the Bronze Age from Lamina et al. 1995: Fig. I.4)

Conclusion

The application of avian bone tools looks reasonable for reproducing archaeological geometric designs. A supportive net allows for a changing of the scale of the figure, and gives space for creativity. A possible difficulty is that the scale of the net would not match an original. However, avian bone tools could provide an acceptable image with accuracy closely linked to skilled archaeological artefacts. The avian bone tools also look suitable for replication of some written samples. Applying this tool may provide an antique lure to replica without effort (**fig. 15**).

Despite the possible inconsistencies, the avian tool hypothesis considers an item of natural origin as a feasible tool, and provides additional insight on potential drawing instruments, craft skills, and décor techniques of prehistoric societies.

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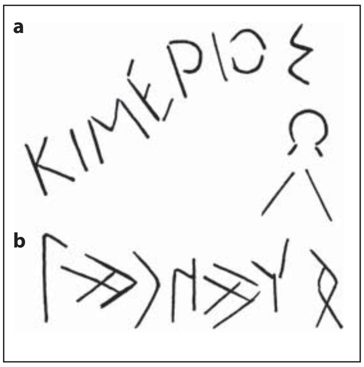
Summary

Utilisation d'un ensemble d'os aviaires pour la reproduction de motifs géométriques préhistoriques

Parmi les innombrables hypothèses concernant les motifs géométriques que l'on retrouve dans de nombreux sites de l'Age du Bronze et du début de l'Age du Fer en Eurasie et dans le monde méditerranéen, l'une suggère l'utilisation d'os aviaires, et plus précisément le bréchet et la paire d'os qui se trouve des deux côtés du sternum des oiseaux. Ces os permettent de reproduire des répliques acceptables des motifs retrouvés sur des vestiges archéologiques. La limite de cette hypothèse réside dans l'absence de données fiables, autres que la simple observation des motifs.



■ **Fig. 15** Graphic capacity of an avian bone tool in replication of ancient written samples: **a** from Grakov 1977: Fig. 71; **b** from Nomads …1989: 59

Zur Anwendung eines Satzes von Vogelknochen für die Herstellung prähistorischer geometrischer Muster

Unter einer Vielzahl von Vorschlägen zur Herstellung von geometrischen Mustern, die auf euroasiatischen und mediterranen Fundplätzen der Bronze- und frühen Eisenzeit weit verbreitet sind, ist eine Hypothese besonders faszinierend, die besagt, dass dabei bestimmte Knochen von Vögeln zur Anwendung gekommen sind. Konkret in Betracht kommen dabei das Gabelbein und das Knochenpaar, das sich auf der rechten und linken Seite des unteren Teils des Brustbeins befindet. Mit diesen Knochen können qualitativ hochwertige Muster hergestellt werden, die den archäologisch bekannten Formen sehr nahe kommen. Der Schwachpunkt dieser Hypothese ist das bisherige Fehlen von eindeutigen Nachweisen. Lediglich die Analyse der vorhandenen Muster dient hierfür derzeit als Grundlage, vor allem dass der Winkel der Muster so genau dem Winkel eines gebogenen Vogelknochens entspricht.

■ **Eva Lamina** received her PhD in History with a Specialty in Archaeology from the Russian Academy of Sciences. As a field archaeologist she has participated in excavations in South-West Siberia. Her research interests are focused on technologies and the designs of prehistoric ceramic.