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INTRODUCTION

Studies of worked osseous materials were neglected for a long time, but in the past two decades they are on the rise. In recent years, numerous methodological and theoretical innovations were introduced and the quantity and quality of publications increased, including numerous individual articles, PhD thesis, monographs. Particularly important were several conferences and thematic sessions held in Europe, North America and Asia, devoted to the problems of worked bone. As a result, several edited volumes appeared, with high quality and diverse papers – for example, those edited by H. Luik et al. (2005), Ch. Gates-St-Pierre and R. Walker (2007), A. Legrand-Pineau & I. Sidéra et al. (2010), J. Baron and B. Kufel-Diakowska (2011), F. Lang (2013), A. Choyke and S. O’Connor (2013), Mărgărit et al 2014, to mention just a few.

Osseous materials began to be recognized as an important part of the archaeological finds first by the French school, and the most important theoretical and methodological work was done by French researchers. The most significant was the work by H. Camps-Fabrer, who initiated a large research program on bone industry, *La Commission de Nomenclature sure l’Industrie de l’Os Prehistorique*, later continued by other researchers. Work organized by M. Patou-Mathis on the *industrie osseuse peu élabore* should also be mentioned. However, the most important role in spreading and promoting the research on bone artefacts and its importance in the past few decades has been that of the Worked bone research group (WBRG), formed almost 30 years ago, and one of the official working groups of the International Council for Archaeozoology (ICAZ) since 2000. The main role of the WBRG is to improve communication between individuals studying worked animal hard tissues (especially bone, antler, and ivory) with a special emphasis on archaeological finds. A broad diachronic and multidisciplinary approach is emphasized in order to promote the exchange of ideas concerning attitudes towards and procurement of raw materials, technology, and cognitive aspects of bone working.

Since the first meeting, held in London in 1997, eight other meetings took place and in 2014 Belgrade was the host of the jubilee 10th Meeting of the WBRG (for more information, see www.wbrg.net).

Over sixty oral and poster presentations were held during the five conference days, contributed by 100 authors. Thirty-nine papers were selected for this volume, and I. Riddler, the organiser of the very first meeting and I. Riddler, the organiser of the very first meeting, and N. Trzaska-Nartowski.

Selected papers encompass the wide chronological and geographical range – from the Mesolithic period to the 18th century AD, from South America to the Eurasia

and South Africa. Selected case studies do not simply present interesting archaeological material, but they also cover a wide range of topics – methodological issues, in particular traceological investigations, reconstructions of technological procedures, problems related to the interpretation of functions, problems of the identification of workshops, and also symbolic use of osseous raw materials in both prehistoric and historic times. Papers are organised by alphabetical order, since the topics overlap and it was not possible to create distinctive thematic groups.

Such a variety in topics, as well as an increasing number of researchers focusing on studies of osseous raw materials, clearly shows that these studies have an important potential to contribute to the more general archaeological studies. Osseous artefacts are no longer disregarded, but are slowly gaining more and more space and are slowly taking place alongside with lithic industries and other classes of raw materials. However, there is still much work to be done, and bone tool studies still have to show all the potential they have.

Last but not least, I would like to thank all the people who helped during the conference and afterwards, during the preparation of the book. Special thanks to all the colleagues from the Institute of Archaeology and to all the colleagues and staff from the National museum in Belgrade, which generously offered the room for the conference and also helped with the lovely post-conference excursion to the Lepenski Vir. I would also like to thank for the hospitality to Dragan Janković, curator of the City museum, who welcomed us at the site of Vinča-Belo Brdo, and to dr Mira Ružić, who welcomed us at the Archaeological collection of the Faculty of Philosophy.

Finally, special thanks to the reviewers, who helped to enhance the scientific value of this volume.

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Close to the bone...


Selena Vitezović
INTRODUCTION – THE ANARGHIRI IXa SETTLEMENT

The last decade the rescue excavations at the coal mining zone near to the modern town of Amindeon in northwestern Greece conducted by the Ephorate of Antiquities of Florina (ex-29th Ephorate of Prehistoric and Classical Antiquities) shed new light on the prehistory of northwestern Greece as a great number of prehistoric settlements were found near to the four lakes of the area. Some of these settlements were excavated partly or completely over the last years (Χρυσοστόμου et al. in press; Chrysostomou, pers. com. 2014, Chrysostomou et al. 2015).

One of them, the Anarghiri IXa settlement (fig. 1), is located in the coal mining zone of Amindeon that belongs to the Public Power Corporation of Greece and it was excavated during 2011 and 2012 (Χρυσοστόμου et al. in press; Chrysostomou, pers. com. 2014; Chrysostomou et al. 2015). It seems that the settlement was situated near or in the marshy area of the nearby Chimaditis lake and was established in the early 5th millennium BC at the foot of a low mound of 0.6 hectares in size (Chrysostomou et al. 2015). The excavation seasons yielded impressive findings such as thousands of wooden vertical piles used for house infrastructure, a wooden palisade that encircled the settlement during the

Fig. 1. The location of Anarghiri IXa settlement and the adjacent area.
Bronze Age, a ground plan of a burnt neolithic house, as well as thousands of portable artifacts, mainly chipped stone tools, clay figurines, clay spindle whorls, grinding stones and bone artifacts (Chrysostomou, pers. com. 2014; Chrysostomou et al. 2015). Although the study of the artifacts and therefore of the cultural phases is still in progress, preliminary results of the research shows that this settlement dates back from the Greek Late Neolithic (5400/5300-4700/4500 BC) to the last phases of Early Bronze Age (3300/3100-2300/2200 BC) (dates for the Greek Neolithic and Bronze Age are according to Androu e al. 2001) (Chrysostomou, pers. com.2014).

THE BONE INDUSTRY

During the two excavation seasons at least 154 bone artifacts have been collected by hand. In this paper there will be an attempt to present the bone artifacts by focusing mainly on their typology and technology. At the moment, since the study of the complex stratigraphy of the settlement is still in progress, it’s not possible to attribute any certain number of artifacts to certain cultural phases or to extract information about the preferences over tool categories or manufacturing techniques over certain cultural phases of the settlement. However, a preliminary analysis of the distribution in space indicated that the majority of the bone artifacts were found in the centre of the settlement and in trenches that show great density of other mobile artifacts such as chipped and ground stone tools, figurines and clay spindle whorls (Chrysostomou pers.com. 2014).

ARTIFACT CATEGORIES

The bone artifacts of the settlement can give us useful information about the intra-settlement activities and for those that probably took place outside of it. Although the assemblage is rather small, it is characterized by diversity, as the artifacts can be divided to the following distinct categories: a) tools (pointed tools, polishing tools, cutting tools, picks), b) projectile points, c) spindle whorls, d) personal ornaments and e) bones and antler tines with manufacture traces (Table 1).

<table>
<thead>
<tr>
<th>Tools</th>
<th>Projectile Points</th>
<th>Personal Ornaments</th>
<th>Spindle Whorls</th>
<th>Bone/Antler Tines with Manufacture traces</th>
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</table>

A. Tools
This category consists of 129 artifacts. This broad category can be divided into further subcategories under the following criteria: the form of the active end and raw material (Camps-Fabrer 1966; Stordeur 1988).

A. 1. Pointed tools. This category prevails all others as it consists of 117 artifacts. Most of them have been shaped on long bones mainly long bone splinters (fig. 2) and only a few on ribs or teeth. Due to the small size of the splinters it was hard to recognize on all cases the anatomical element used for the tool manufacture, but so far it was possible to testify the use of metapodials, tibiae and radii and fibulae of small and medium-size animals. These splinters were either extracted from the bone shafts through percussion or through the ‘grooving and splitting’ technique that has been also attested in other prehistoric assemblages from mainland Greece (Christidou 1999; Stratouli 1998a,1998b; Moundrea-Agrafi oti 1981; Elster 2001,2003). Many of them would have been also selected among food remains that were later shaped into tools. For their shaping the manufacturers used both the transverse and diagonal grinding which was mostly applied to the working end. Pointed tools were also shaped on long bone diaphysis or on almost whole bones (ulnae, tibiae, radii and metapodials) from medium and large size animals (fig. 3) that retain one epiphysis (either distal or proximal).

![Fig. 2. Pointed tools on bone splinters.](image)

![Fig. 3. Pointed tools shaped on whole bones.](image)
The use of more elaborate and time consuming techniques is attested in the pointed tools shaped on split metapodials fashioned by abrasion (fig. 4), also well represented in many Balkan neolithic settlements (Arabatzis 2013, Christidou 1999; Elster 2001, 2003; Stratouli 1998a, 1998b; Vitezović 2007, 2011) The raw material used was metapodials of small and medium-size animals, mainly from ovicaprines. Both split distal and proximal epiphyses were used as handling bases with a tendency to use the proximal epiphysis more as a handling base. On almost half of the tools of this subcategory, the split epiphysis is partly preserved or not at all. On almost all cases the metapodial was first cut in half by a stone tool and then the manufacturer(s) used grinding (transverse and/or diagonal) in order to shape the active point and the body of the tool. Transverse grinding was usually used in the shaping of the tool body while the diagonal grinding was used for the shaping of the active end. There was a tendency to produce tools that were rather slender. Their length varied from 3.9 cm to 7.5 cm with a tendency from 4 to 6 cm and their width from 0.3 cm to 1.7 cm. Only in four tools the tip of the active end is preserved completely and on all other cases part of it is missing. Also, in one case the active end is rounded probably due to the contact with the worked material. One very interesting pointed tool is the one in figure 5. It seems that the artisan split the diaphysis and abraded it in order to shape a rather lengthy point, but left the distal epiphysis which he/she shaped also via grinding in order to produce a flat base.

Ribs were also used for the manufacture of pointed tools. Eight tools made on split ribs of medium and large size animals were found. Traces of transverse and diagonal grinding that are visible laterally show that the rib elements were grinded laterally so that one end converges to a point. With the exception of two very long tools with length 15.5 cm and 19 cm respectively (fig. 6), the average length of these tools is 6.25 cm, while the average width of the tools is 1.77 cm. The state of preservation of the active end is rather good as in five cases the active end is preserved almost intact. One of the pointed ribs has two very sharp narrow sides and it must have also been used as a cutting tool.

It seems that the exploitation of the teeth for pointed tools was rather limited. It is noteworthy to mention a pointed tool that has been shaped on a bear tusk (fig. 7). Its manufacturer spent a lot of time in order to produce a rather lengthy tool (8.6 cm) with a possible handle and a very elongated active point.

Except from the form of their active end that give us evidence about their potential use, we get important information from the study of the use wear traces. Their study (orientation, extent, distribution) under low microscopic examination (up to 50x) and their comparison with different experimental approaches (Legrand and Sidéra 2004, Sidéra and Legrand 2006) could possibly lead us to the assumption that most of the pointed tools must have been used in fur and leather working.

A. 2. Polishing tools tools are also attested in the assemblage. The tools of this very small category were shaped mainly on long bones of medium size animals (fig. 8) on antler beam fragment (one case) or on flat bones (at least one ad hoc, expedient scraper was shaped on a non split rib). In contrast to the pointed tools where more elaborate techniques were used for the manufacture, percussion and abrasion were the most common techniques for their manufacture of the tools and these were limited to the active end. The tools shaped on long bones have

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**Fig. 4. Pointed tools shaped on split metapodials.**

**Fig. 5. Pointed tool shaped on metapodial. Photo by the author.**

**Fig. 6. Pointed tools shaped on ribs.**

**Fig. 7. Pointed tool shaped on tooth. Photo by the author.**

**Fig. 8. Polishing tool. Photo by the author.**
Close to the bone...

semi-circular active end which is highly polished and the preliminary examination of the use wear traces under low magnification (up to 25x) and their comparison with traces from experimental approaches (Campana 1989; Sidéra and Legrand 2006) indicates that these tools must have been used as hide burnishers.

A. 3. Cutting tools. The use of cutting tools is not so well attested in the studied assemblage. Only one massive antler axe with a big shaft hole has been recovered. It’s not completely preserved as part of it’s active end is missing (fig. 9). It was probably used in woodworking.

A. 4. Picks. One tool shaped on antler tine could be interpreted as a pick. It’s almost 15 cm and it has a shaf hole in the middle of the shaft. The working end (distal end of the tine) it’s rounded and polished.

B. Projectile points

While all other categories of pointed implements are related to intra-settlement household activities that are very well documented in almost all neolithic sites in Greece, this very interesting category gives us information about activities that took place outside of the settlement and are related to hunting activities and maybe warfare.

This rather rare in prehistoric Greece artifact category is being represented by five objects that were found in different parts of the settlement. One of the artifacts is a bone arrowhead and the rest of them are spear points.

The small arrowhead shaped on long bone (length: 5 cm, width: 0.9 cm, fig. 10) seems to be the only published bone arrowhead from northwestern Greece so far. Similar artifacts are also known from other neolithic settlements in the Balkan peninsula like Starcevo-Grad from Serbia (Витезовић 2012: 237:fig. 2a, b.), from Romania (Mantu et al. 1997) and from some Chalcolithic settlements of Bulgaria (Бояджиев 2014).

The spear points were shaped on long bones and on antler too. Antler was chosen due to its physical and mechanical properties. Its length and its elasticity (Currey 1970; MacGregor and Currey 1983) makes it the ideal raw material for a projectile point. All of these points are quite lengthy (from 8.9 cm to 11.5 cm) and only two of them are preserved completely. All of them must have been inserted into wooden shaft. Four types have been distinguished. In type I, the completely preserved projectile point has round cross section and a very distinct base (fig. 11a) that reveals the hafting method while the projectile point of the type II has a massive strong tip and a round cross section (fig. 11b). The Type III point had a round cross section but is not completely preserved. The Type IV has a flat cross section and seems to be unfinished.

The small quantity can’t help us a lot concerning the use of these artifacts. They could have been used in hunting, but we can’t exclude the idea that they could have also been used as warfare equipment although until now the excavated settlements of the area don’t provide us with evidence of interpersonal violence or more organized conflict between groups or communities.

C. Spindle whorls

The most common archaeological evidence for spinning and for the textile production are the spindle whorls. The bone spindle whorls comprise a rather rare artifact category compared to the clay spindle whorls found in prehistoric settlements in Greece. Perforated femur and humerus heads, that can be characterized as spindle whorls, have been reported from Neolithic and Chalcolithic settlements from Thessaly (Stratouli 1988b: 166-168) but also from Bronze Age settlements from mainland Greece, Peloponnesos, and from the island of Aegina (Banks 1967; Blegen 1928; Walter and Felten 1981; Rahmstorf 2008; Siennicka 2012). Similar items have also been reported from the Early Bronze Age site of Poliochni (periods: azzurro, verde e rosso, giallo) located in the island of Lemnos in the Aegean sea but the excavator didn’t offer any interpretation concerning their use (Bernabò-Brea 1964: Tab. XCI, CLXXXI; 1976: Tab. CCLV).
Bone spindle whorls have been also found at least four prehistoric settlements in Turkey; in the Early Chalcolithic Kuruçay (Duru 1994), in the Chalcolithic/Bronze Age settlement of Arslantepe (Choyke 2000; Frangipane et al. 2009; Laurito 2010), in Gözlükule (Goldman 1956) and the Bronze Age Troy (Balfanz 1995). Also, a few bone/ivory spindle whorls have been reported from Tell ‘Abū al-Kharāz in Central Jordan Valley (Fischer 2009) and similar objects have been reported from Alisar Höyük, Byblos, Megiddo and Tepe Gawra I (Goldman 1956; von der Osten 1937) and from the site of Godedzor in Armenia (Choyke 2011).

Similar items have also been reported from the Balkans. Twelve similar objects have been found in the Bronze Age castelliere in the Istrian peninsula although there are serious objections about their use as spindle whorls (Becker 2005). A perforated cattle femur has been reported from the Late Neolithic phase of Amzabegovo in the neighboring country of F.Y.R.O.M. (Smoor 1976, 191, fig. 123) but it has been interpreted as a bone loom weight by the excavator. Similar items have been reported from many European prehistoric settlements (see Becker 2005 for a detailed analysis for the distribution of these items in Europe).

The bone spindle whorls found in the prehistoric settlement of Anarghiri IXa comprise a rather small assemblage that is being represented by a semi-finished spindle whorl, two finished and totally preserved and one finished but half preserved spindle whorl. The study of this small quantity can give us some rather interesting information concerning the manufacture and typology of this artifact category.

These whorls were made of femur and humerus heads which were extracted from the bone by probably a stone burin. Then the basal part was abraded in a grinding stone in order to make a rather flat surface. The second stage of this manufacturing process is related with the levelling of the upper part of the spindle whorl so that two straight and parallel surfaces are made. The drilling of a hole that joins these two facets seems to be one of the final manufacturing stages although it is very possible that the drilling of the hole started before the levelling of the facets and that the hole was renewed during the manufacture stages.

As it can be seen in fig. 12, three categories have been distinguished. All of them are imitations of prehistoric clay spindle whorls. The two completely preserved spindle whorls fit into the trapezoid category (fig. 12a,b) while the half preserved seem to be discoid (fig. 12c). The semi finished spindle whorl can fit in the convex category.

Since there aren’t any experimental works concerning the use of bone spindle whorls, the research about their use was focused on bibliography and experiments concerning prehistoric clay spindle whorls. As it has been noted about the prehistoric clay spindle whorls, their function is dependent on some factors that affect the spinning speed, the rotation of the rod and the type of the produced fiber. More specifically, these interconnected factors are: a) the diametre, b) the weight, c) the height and d) the form, the position and the diametre of the perforation (Andersson 2003; Andersson et al. 2006; Barber 1991, 1994; Crewe 1998; Carrington-Smith 1975, 1992; Hochberg 1980; Øye 2011).

The diametre of the spindle whorl seems to be one of the most important factors that affect its use because it is related with the speed of the spinning rod (Andersson et al. 2006; Hochberg 1980). Recent studies of prehistoric clay spindle whorls of the Aegean have shown that usually the diametre of most spindle whorls ranges from 3 cm to 5 cm (Τζαχίλη 1997:121; Παπαδοπούλου 2010: 184). In our case, the diametre of the base seems to range from 4.2 cm to 5.2 cm.

The study of the weight of the spindle whorls can give us important information about the produced fiber (Andersson 2003; Barber 1991; Carrington-Smith 1975, 1992; Crewe 1998). The weight of the two completely preserved spindle whorls is 15gr and 22gr while the weight of the half preserved is 8gr. According to Carrington-Smith (1975: 181; 1992: 681) light clay spindle whorls (from 10 to 30/40 gr.) were used for the manufacture of short fibers of wool, linen or cotton while Andersson (2003: 25, 80) associates the spindle whorls that weight more than 15gr with the production of threads of medium thickness.

Fig. 12. Bone spindle whorls.
The height of the spindle whorl seems an important factor in the spinning process (Keith 1998; Øye 2011) as it affects the speed and duration of the spin of the spindle and adjusts the relationship between the weight and the diameter of the whorl. In our case, the height of the three complete bone spindle whorls ranges from 0.7 to 1 cm.

The perforation was drilled almost in the centre of the whorls that may have played an important role in the spinning process since off-center perforation affects the spinning speed (Andersson et al. 2006; Crewe 1998). In only one case the diametre of the perforation is exactly the same in both facets. The diametre of the perforation ranges from 0.8 cm to 1.5 cm in the upper facet and from 0.8 to 1.3 cm in the basal part of the spindle whorl. According to Liu (Liu 1978:90) and his ethnographic study on clay spindle whorls, the majority of the perforation diametre is 0.7 or 0.8 cm while the biggest diametre usually doesn’t exceed 1 cm.

In conclusion, these bone spindle whorls present the same techno-morphological characteristics as the clay ones found in prehistoric settlements. Their perforation diametre (except in one case) falls into the normal dimensions, while their weight indicates their use for the production of thin threads, without excluding the possibility that they could have also been used for the production of medium size threads.

Although the number of unfinished or complete bone spindle whorls might rise with the study of the collected faunal assemblage, it is expected that the number the bone spindle whorls will not reach the one of the clay spindle whorls. The small collected quantity is a small indication of bone experimentation of the prehistoric habitants of Anarghiri IXa and an indicator of the circulation of ideas in the Balkans. As it was mentioned before, the use of bone spindle whorls is not an unknown phenomenon in the prehistoric Balkans, so someone cannot exclude the idea of a imported idea that didn't flourish. At the same time, it is tempting to say that this small number reveals the limited desire of the manufacturers to spend time and effort in order to transform a bone into a spindle whorl. Compared to clay spindle whorls, the manufacture of bone spindle whorls is a more complicated task related with three stages: the acquisition of the raw material (bones mainly from cattle), the shaping stages (cutting bone, grinding and drilling for the shaping of the perforation) and the use and repair (reshaping a worn perforation may not be an easy task). In terms of eff ort, the prehistoric manufacturers could save energy and time by using clay in order to manufacture spindle whorls or even manufacture spindle whorls from recycled sherds of pottery vessel walls (Ornelle et al. 2012, Siennicka 2012).

D. Personal ornaments

The presence of personal ornaments made of bone and teeth show a different side of the neolithic way of life; the desire for body adornment. It seems that the prehistoric habitants of Anarghiri IXa used mostly teeth and less long bones or antler for the manufacture of personal ornaments. Twelve artifacts have been recovered and almost all of these were found in trenches located at the centre of the excavated area.

Most of the decorative objects are pendants (n=12, fig. 13, fig. 14 a, b, c) shaped on teeth (mainly canines) of mostly wild animals (mainly bears, wild boars and foxes) and also there is one ring (fig. 14 d). The manufacture of the pendants was rather simple. On most cases the perforation was made on one end of the tooth by drilling mainly both sides. Lengthwise splitting of the tooth is attested only in one case (fig. 14 a). On two cases, the pendants are unfinished since the artisan(s) didn’t complete the drilling of the perforation.

Pendants made of teeth from wild mammals may have had more than one function except the aesthetic one. These body ornaments could have communicated messages and expressed social identity and prestige within the community. The choice of the raw material (teeth from wild mammals) and its acquisition mode (hunting) may have served a symbolic function that could have given some prestige...
and could have functioned as a trophy to the person that wore this kind of artifacts or the person who killed the game and maybe manufactured the pendants. Also, it’s rather tempting to assume that, as it has been suggested, the unelaborated perforated teeth could have been used as a link between the individuals and the natural world and could have been used metonymically in order the wearer(s) of the ornament(s) to be associated with the qualities of the animal (White 1992; Michelli 2012).

**E. Bone and antler with manufacture traces**

The presence of a few long bones and antler with manufacture traces (n= 4) indicates that (at least part of) the manufacture process of the bone artifacts could have been held inside the settlement. This very small assemblage consists of one phalanx with a perforation, one wild boar tusk with grinding traces (probably was also used as a scraper), one rib with grinding traces and one antler tine with chopping marks in the middle of its length.

**DISCUSSION – CONCLUSIONS**

This preliminary analysis of the bone artifacts can give us some limited but rather useful information about the worked bone industry of the settlement. The osseous industry of the settlement is characterized by a diversity of categories and also by a prevalence of tools used in in-situ-settlement daily life activities. The assemblage is also characterised by the small presence of artifacts that were used outside of the settlement in hunting (or at least in warfare too).

Since the assemblage contains a few semi finished artifacts, we can presume that at least part of the manufacturing process of the bone artifacts was being held inside the settlement. As has been suggested for other prehistoric settlements in northern Greece (Arabatzis 2013; Χρηστίδου 1992; Christidou 1997), the scarcity of bone and antler waste could be a result of a cleaning of the inhabited areas. We can also assume that some of them were manufactured in areas outside of the settlement, where certain conditions (e.g. running water for the defleshing of the bones) must apply for the manufacture of the artifacts (Campana 1989; Newcomer 1974).

Like all other prehistoric settlements in mainland and more specifically in northern Greece but also in adjacent areas (Arabatzis 2013; Christidou 1999; Elster 2001, 2003; Moundrea-Agrafioti 1981; Russell 1990; Sidéra 1998, Smoor 1976; Στρατούλη 2002; Stratouli 1998a, 1998b; Vitezović 2007, 2011) pointed tools prevail all other tool categories. In this settlement, the proportion is rather high as almost 76 % of the collected assemblage consists of pointed tools. On the other hand, the small number of bevel ended tools may be the result of the avoidance of the prehistoric habitants of the settlement in the use of this kind of tools.

There is a clear preference on bones, mainly long bones, and less on flat bones, antler and teeth. Long bones mainly metapodials of small and medium-size animals were used for the manufacture of pointed tools. Ribs were mostly used for the manufacture of pointed tools while teeth were used mainly for the manufacture of ornaments and less for tools manufacture.

Antler was not so much exploited, as the artifacts made of this kind of raw material are rather few. However, it is noticeable that antler was used mainly for the manufacture of tools and projectile points. Antler could be obtained and imported in the settlement by collecting (shed antler) during specific months of the year and after a successful hunting (unshed). The few antler artifacts can't give us much information about the acquisition patterns of the raw material and maybe antler was imported in the settlement in both ways. The limited use of antler in the settlement could also be a reflection of a deer scarcity in the hunting region or maybe hard recognizable by us symbolic reasons may have kept their habitants away for the exploitation of this raw material.

The presence of personal ornaments made of bone and teeth shows a different side of the prehistoric way of life, the desire for ornamentation. Pendants made of teeth from wild mammals may have had more than one function except the aesthetic one. The choice of the raw material (wild mammals) and its acquisition mode (hunting) reveal a symbolic function that could have given some prestige to the person that wore this kind of artifacts or the person who hunted, killed and maybe manufactured the pendants.

The small number of bone spindle whorls in the settlement may represent the limited use of bone for the manufacture of spindle whorls. Bone spindle whorls could be used only in certain occasions as replacements of clay spindle whorls. Their scarcity maybe indicates some kind of experimentation in the production of spindle whorls that didn't flourish.

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INTRODUCTION

An archaeological team from the University of York, under the direction of Julian D Richards and Steve Roskams, has maintained a long-running research project investigating Anglo-Saxon and Anglo-Scandinavian settlement on the Yorkshire Wolds (see Richards 2001a, 2001b, 2003, 2011a, 2011b, 2012; Richards and Roskams 2012, 2013; Richards et al. 2008, 2014). Its aims have been to examine a number of early-medieval ‘productive sites’ (a diverse array of site types, commonly characterised by large numbers of metal-detected finds), and to explore contemporary estate structure, with a particular view to characterising changes in patterns of settlement between the Anglian (c.AD 700-850) and Anglo-Scandinavian (c.AD 850-1066) periods.

This project has included a high-level analysis of metal-detected activity (within the wider VASLE (Viking and Anglo-Saxon Landscape and Economy) project (Richards et al. 2009), as well as a number of discrete interventions at the sites of Burdale, Cottam, and Cowlam (see references above). It is with these sites that this paper is concerned, and, more particularly, with the small but significant corpus of worked-bone tools there excavated. The paper aims to bring this material to wider attention in the finds-research community.

THE SITES

Our sites lie on the Yorkshire Wolds, an upland area long known to preserve evidence for early and later medi-
eval settlement structures, and which has been subjected to an extensive programme of research over a period of over half a century. The region is best known for the long running excavations at the site of Wharram Percy, and the painstaking, contextualised approach that has characterised survey and excavation here has led to a broader understanding of the relationship between Wharram, its surrounding landscape, and other settlements in the region (see Wrathmell 2012 for a review). Here we are concerned with the Middle-Saxon site of Burdale, just two miles south of Wharram, and contemporary and later settlement at Cottam and Cowlam, less than 10 miles to the east.

The area now known to incorporate the remains of the Anglian settlement of Burdale (SE 875623; fig 1) has been worked by metal-detectorists for several years, with a number of Roman and early-medieval finds being reported to the Portable Antiquities Scheme over this time. With a view to systematic investigation, the University of York, under the direction of Julian D. Richards and Steve Roskams, undertook a programme of research, culminating in controlled investigation between 2005 and 2007 (Richards and Roskams 2013).

The parish of Cottam, c.10 miles north-east of Burdale, incorporates a number of archaeological sites, preserving both Anglian and Viking-Age settlement remains, including a complex of timber hall buildings dating to the 8th and 9th centuries, and a later 10th-century enclosure at a slight remove. This early-medieval activity was first identified through its distinctive cropmarks and unusually large collection of early-medieval metal-detected finds, but controlled detecting, fieldwalking and excavation have since allowed a number of important questions about the sites to be answered. Most notably, Richards has demonstrated that despite Cottam's impressive detecting signature, excavation shows there to be little about it that could be considered exceptional in an economic or social sense. Today's parish of Cottam was once part of a larger estate, which appears to have had a complicated history of landholding during the turbulent years of Scandinavian settlement. Artefactual evidence from the sites preserves evidence for a number of minor crafts taking place, but lacks indicators of extensive trade or exchange.

One of the locality's more interesting characteristics is the apparent transience of its settlements. Following occupation in the Roman period at Cottam A, a new settlement appears to have been founded just a kilometre or so to the north-west, at Cottam B. There is no evidence for continuity of occupation, and the fact that both settlements sit on a trackway is simply testament to the persistence of that routeway through the landscape. The Anglian settlement at Cottam B appears to have lasted no more than half a century, before a new settlement was set up 0.1km to the north in the later 9th century. However, this site itself seems to have been gone by the middle of the 10th century, and excavations at the nearby Deserted Medieval Village of Cowlam suggest that this was the site of another new foundation just ahead of the turn of the first millennium. Furthermore, excavations here demonstrated the existence of an earlier settlement (dating from the mid-eighth century), albeit on a fairly limited scale. There is no evidence of craft or any scale of trading activity, despite the site's 'productive' metal-detected signature, though the faunal assemblage does suggest that the settlement had some level of agricultural significance (Richards et al. 2014: 252-3). The results are best seen in the context of the work at Cottam A and B, demonstrating the widespread and dispersed - albeit socially and economically articulated - nature of rural settlement in the region, which then seems to have been reorganised in the wake of later 9th-century Scandinavian settlement and land-taking (Richards et al. 2014).

This paper aims to build on the work of Richards et al. (2014, and papers cited therein) in synthesising the evidence from these sites within their regional context, by paying particular attention to the worked bone used and, perhaps, manufactured, at them. This may provide a useful elaboration on more general site syntheses, as well as a paranda for ideas proposed from other materials (faunal remains, ironwork, or ceramics, for instance). Thus, in what follows the sites of Burdale, Cottam (A and B) and Cowlam, and their worked-bone collections, are discussed in turn.

**Burdale**

The University of York's programme of remote survey undertaken in the Burdale valley identified several phases of settlement activity, consisting of concentrations of enclosure ditches, trackways, cuts, possible buildings, and evidence for burning. Fieldwalking and metal-detector survey confirmed the existence of two main foci of activity, and two seasons of excavation were undertaken on these enclosures in 2006 and 2007. Key objectives of this project were to characterise Anglo-Saxon activity on the site, with a particular view to the relationship between artefacts and excavated features, and to collect and analyse both environmental and artefactual material. The current paper is concerned primarily with the latter.

The post-exavcation programme was completed in 2013, the archive deposited at Malton Museum, and both a summary and a full report have now been published (Richards and Roskams 2012, 2013). Nonetheless, it serves us to briefly summarise the site topography and sequence herein. In synthesising the available evidence, Richards and Roskams describe a sequence of enclosures and periodic re-modification through the 8th and 9th centuries. Structures on site include a bow-sided hall, while five SFBs attest to craft or industrial activity, and the site clearly played host to agricultural activities. In all, the site appears to have been a relatively prosperous early-medieval rural estate.

The start of Anglo-Saxon activity on the site is marked by the presence of two sceattas (Series D, dated AD 700-715; Series E, AD 710-760), and a focus of activity in the 8th and 9th centuries is supported by the presence
of reasonably diagnostic Anglo-Saxon objects such as base-metal jewellery and dress accessories, tweezers, and a significant quantity of ironwork: most particularly knife blades. There is also evidence for activity in the Viking Age, in the form of coinage (an Arabic dirham, and styca of Aethelred II, AD 841-4) and simple metalwork (pins and a bell paralleled at York). Nonetheless, there is little evidence for the settlement surviving long into the 10th century. The finds - including the worked bone and antler - are best seen in this context: an Anglo-Saxon rural estate centre of some social and economic standing.

**Worked Bone Objects**

39 bone/antler artefacts were excavated (Table 1), and are interpreted as the possessions of Burdale’s sedentary and visiting populations (Ashby 2013), given the site’s rural character, and the absence of evidence for manufacture. Notwithstanding the collection’s relatively small size, it comprises well preserved material that is well suited to comparative analysis across the region, most notably within the Yorkshire Wolds region; there are important collections from Wharram and West Heslerton, as well as Cottam and Cowlam (see below).

<table>
<thead>
<tr>
<th>Find Type</th>
<th>Frequency</th>
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</thead>
<tbody>
<tr>
<td>Comb</td>
<td>26</td>
</tr>
<tr>
<td>Pin/needle</td>
<td>8</td>
</tr>
<tr>
<td>Textile Tool</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>39</td>
</tr>
</tbody>
</table>

*Table 1. Bone Objects from Burdale.*

The Burdale collection includes 26 complete or fragmentary composite combs. Both single- and double-sided varieties are represented, as well as two examples of the unusual and highly ornamented ‘semi-double’ combs (see Fig 2).

![Fig. 2. An Ornate Semi-double Comb from Burdale (sf 107). Photograph, Richards and Roskams 2013: CC-BY-NC-SA.](image)

The eleven double-sided combs are uniformly of Type 12, while the fifteen single-sided combs include examples of Types 2a (five examples); 2b, and 8a (Table 2; see Ashby 2011 for typology and type descriptions). Of particular note is a small fragment of connecting plate, featuring the faceted, triangular cross-section that is characteristic of Type 8a. This type was in circulation in the 10th and 11th centuries, so the find postdates much of the Burdale assemblage. It may have been deposited during the final years of early-medieval activity on the site.

<table>
<thead>
<tr>
<th>Type</th>
<th>Date Range</th>
<th>Frequency</th>
</tr>
</thead>
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<tr>
<td>2a</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>2b</td>
<td></td>
<td>7 (including 2 semi-double?)</td>
</tr>
<tr>
<td>8a</td>
<td>10th-11th C</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Indeterminate (d-s)</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Indeterminate (s-s)</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

*Table 2. Type Frequencies of combs from Burdale, (after Ashby 2011).*

Otherwise, this distribution of forms fits with the site’s 8th-/ 9th-century occupation date, established with relation to various finds and numismatic data. The absence of manufacturing waste is a frequent feature of Middle-Saxon and Viking-Age rural settlements, and suggests that Burdale, like Cottam and Cowlam (see below), should be seen as a consumption site - in terms of boneework - rather than a producer. This is in broad accordance with the lack of evidence for crafts such as textile manufacture, though of course it is difficult to argue too strongly from negative evidence. The tentative suggestions from analyses of the ironwork (Blakelock 2013: 9-10) that the site may have been of some status is certainly supported in the combs (particularly in the ornate semi-double examples such as sf 107; fig 2). Arguing from the finds corpus as a whole, Richards (2012) suggests that Burdale displays a higher status than that of its more famous neighbour at Wharram, though they may have made up part of the same estate. This is as visible in the relative quantities of sceattas (silver coinage), as it is in the differences in form and hardness of the knife-blades. Thus, differences in the combs between these sites - most likely brought in from outside - may indirectly reflect patterning in site function. Perhaps the different qualities of products produced on these sites were equally mirrored in the quality of objects brought in.

Other items from the site include a socketed handle (sf243; cf MacGregor 1985: 168-70), and two perforated...
sheep tibia (cf examples from York; MacGregor et al. 1999: 1990). There are also 9 pointed objects, of which 8 may be classified as pins or needles, and one is a textile implement – a picker-cum-beater. The pins/needles are all of rudimentary design, featuring expanded but unornamented spatulate heads. These characteristics are typical of pins from Middle-Saxon England and contemporary contexts elsewhere in Britain, Ireland, Scandinavia and continental Europe (e.g. Lagore, Haithabu, Southampton; see Macgregor 1985: 120-121 for a survey).

The textile tool (sf149; fig 3) is more characteristic of the Viking Age, as it features a pointed tip, flattened butt, and sub-circular cross section. Various forms of pin beaters are known from contexts dating to throughout the Early Middle Ages, when they were used by weavers to beat weft into place. The form from Burdale, however, with its flattened butt, is generally thought to be associated with the vertical (or two-beam) loom: apparently a 10th-century urban innovation (see MacGregor et al. 1999: 1968; Walton Rogers 1997: 1760). Microscopic analysis shows that the tool is highly polished, with particularly well-developed use-wear towards the distal end, consistent with this function. Rudimentary textile tools rarely seem to have travelled far from their place of use, so this find - albeit isolated - from a Mid-Saxon rural context is significant. Visible preservation of cancellous tissue allows the tool’s raw material to be confidently identified as medium-/large-mammal longbone, which would be broadly consistent with it being manufactured as needed using locally available materials, but while ZooMS confirms this identification (see Table 6, Appendix), it offers no further precision.

To summarise, the most notable aspect of the Burdale assemblage is its corpus of high-quality combs. It provides an important contribution to the collection of early-medieval material from the region, and will be discussed in comparative terms below.

Cottam

Cottam A

Excavation in 1996 at the site now known as Cottam A, identified a Romano-British rural settlement. Evidence for activity on the site continuing into the Anglian and Anglo-Scandinavian periods was present to a very limited degree, perhaps related only to visits to an old quarry, which by now may have been in use as a watering hole for livestock. Accordingly, the finds span the Late Iron Age to Viking periods, though with concentration in the Roman and Anglo-Saxon phases. Though finds from early-medieval phases are few, there are some significant worked-bone items, as we will see (Ashby 2014a).

Find Type | Frequency
--- | ---
Comb (Type 3, date c. AD 700-900) | 2
Socketed Point | 1

Table 3: Bone Objects from Cottam A

Of particular note are two combs, both of the single-sided, handled type (Ashby Type 3). These have previously been associated with Frisian activity, but their Anglo-Saxon associations are now clear (Riddler 1990). Also of interest is a socketed point (Fig 4): an implement cut from the proximal end of a sheep metatarsus, with a deep channel gouged into it, whether for functional or decorative effect. Just below this channel, the bone is roughly sheared, bringing the end to a point. The proximal articular surface is centrally perforated, so that a central channel runs through the entire length of the object. Its appears to be a semi-manufacture which failed during the process of lathe-turning. Date and intended function are difficult to ascribe.

Cottam B

1km to the north-west of Cottam A, research including field walking, geophysical survey, and excavation revealed an 8th- to 9th-century ‘Butterwick-type’ enclosure (see Everson and Stocker 2012; Wrathmell 2012), encompassing the remains of several rectilinear hall buildings. The site was abandoned by the end of the 9th century, before, in the early tenth, a new enclosure was laid out just 100m to the north, though occupation here was even more shortlived than the first at Cottam B. This new settlement featured an elaborate status-enhancing (through effectively unfortified) gateway, and finds included diagnostically Scandina-
vian and Anglo-Scandinavian items (such as a Borre style buckle, Jellinge style brooch, and 'Norse' bell). Richards has argued convincingly that the earlier settlement constituted part of an Anglian multiple estate (Richards 1999, 2001) that was later reorganised in the Danelaw settlements, whereupon it developed into an independent manor under the lordship of a new, perhaps Scandinavian lord.

When the Department of Archaeology, University of York began investigation in 1993, Cottam B became the first productive site in the York area to be subject to excavation. The results show that though the site was certainly a prosperous agricultural settlement, over-reliance on the size of the metal detected assemblage as an indicator of site character would have resulted in an overestimation of status and significance. Moreover, it would have led to a fundamental misrepresentation of its character; excavations revealed little evidence for trade or craft production, and in the Anglian period in particular, the site seems to have been cut off from trade with the prosperous and cosmopolitan wic at York. Here we provide a further correction to the perceived archaeology of these sites, as we are concerned with non-metallic artefacts, and the worked-bone collection in particular.

Boneworking

<table>
<thead>
<tr>
<th>Find Type</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Comb (Type 3)</td>
<td>1</td>
</tr>
<tr>
<td>Comb (Type 12/Indet d-s)</td>
<td>5</td>
</tr>
<tr>
<td>Knife Handle'</td>
<td>1</td>
</tr>
</tbody>
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Table 4. Bone Objects from Cottam B.

There are antler handled combs at the site, of a form known across England and the Low Countries (e.g. (MacGregor 1985, 91; Roes 1963, 22-3), but largely unknown in Scandinavia (e.g. Roes 1963, 22-3). The Cottam B examples include an ornate example, decorated with complex, incised-line decoration (e.g. sf 16; see Ashby 2011; Riddler 1990: 9), and of 'southern' construction (ie its body being cut from a complete antler tine, rather than two fitted connecting plates, as appears more common in the north of England). Notwithstanding their moniker, such combs are well paralleled in Yorkshire, including at York itself (Waterman 1959, 89; Rogers 1993, 1389-94, fig.679) as well as elsewhere in northern England (e.g. Daniels 1988, 195, fig.37; Peers and Radford 1943, 70, Alexander 1987, 101-2).

There are also examples of double-sided combs, though these are largely fragmentary. They preserve connecting plates of both flattened and plano-convex section, and feature rudimentary decoration. Finally, the site produced a fragmentary implement (?knife) handle, in relatively poor condition. The piece would originally have been of circular section, but was subsequently truncated at the tang end. It features incised-line and crude ring-and-dot ornament.

Cowlam

The late-9th-century Anglo-Scandinavian settlement at Cottam B was shortlived, however, as within 50 years or so a new, planned settlement was founded at nearby Cowlam. This development was presumably demanded by the lord's newfound prosperity, set within the changing tenurial circumstances of the 10th century (Richards 2014: 264-5; see Fleming 2010: 269-289).

Work at Cowlam, again directed by Julian D Richards and Steve Roskams (Richards et al. 2014), demonstrated that this was indeed the site of a new 10th-century nucleated village, though previously unsuspected settlement dating to the 8th and 9th centuries was also identified. Metal detecting had located a focus of Anglo-Saxon small finds on the edge of the deserted medieval village of Cowlam, a site originally excavated in 'rescue' circumstances in the early 1970s (Brewster 1988). Recent geophysical survey (magnetometer and resistivity) identified a number of features in this area, and a programme of augering, test-pitting and small-scale excavation allowed further investigation. These demonstrated the presence of an Anglo-Saxon SFB (dated by the presence of an 8th-century sceatta) cut into the natural bedrock, as well as a series of drainage ditches and property boundaries. The story emerging from the area was thus one of greater complexity than had at first been anticipated; a large, Middle-Saxon estate incorporating a dispersed array of settlements seems to have been succeeded by a nucleated site in the 10th century: perhaps an incipient manor.

Excavations at Cowlam were small-scale, however, and objects of worked bone are scarce. Other than two roughly-worked sheep radii, the only find recorded was a single needle-like object of postcranial mammal bone (Ashby 2014b; Table 5; Fig 5).

<table>
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<th>Find Type</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Comb</td>
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<tr>
<td>Pin/Needle</td>
<td>1</td>
</tr>
<tr>
<td>Textile Tool</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
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</table>

Table 5. Bone Objects from Cowlam.

Fig. 5. A needle-like object from Cottam A (sf 464) Photograph, Steve Ashby.
DISCUSSION

Excavations at Burdale, Cottam, and Cowlam were undertaken on a range of scales, and sample sizes are not large. Faunal assemblages were variable in size, and typically fragmented, but we are able to say that they were dominated by sheep (see Richardson, in Richards et al. 2014; cf Richardson 2010). This differs from what we see at York, for instance (e.g. O’Connor 1994), but is unsurprising given the soil geology of the wolds (see Richardson 2012 for a closer analysis, and comparison between these sites and nearby Wharram). This provides a useful background to the worked-bone under study, though it seems that at least some of this material (notably the combs) was brought in from off-site.

Turning to the worked bone, a number of general observations can be made of the material from these Middle Saxon and Viking-Age sites. Overall quantities of finds are small, so a phase-by-phase analysis is not undertaken herein. Nonetheless, none of the sites shows any evidence of being anything other than a rural settlement specialising in agriculture, with small quantities of craft undertaken on site. There is no evidence for the import or use of exotic materials or artefacts, or of specialist craft or large-scale industry. In general terms, the worked bone is in accord with Richards’ general interpretation of these ‘productive’ sites.

Fig 6 makes clear the dominance of combs as a find type at all sites with worked-bone collections of any size. This pattern is true in both Middle-Saxon (Burdale, Cottam B) and Viking-Age (Cottam B) phases. There is little more to be said about the distribution; though it is tempting to relate the presence of a single picker-cum-beater at Burdale to the site having a specialist status, the absence of any other evidence for textile manufacture is concerning, as is its apparently late date. It is perhaps more informative to compare these distributions with those from the much more ‘productive’ and well-studied sites at Wharram Percy, 50% of the collection of 123 pieces of Middle and Late-Saxon (ie Viking-Age) worked-bone material from Wharram’s South Manor related to combs, while 29% were from pins (MacGregor 2000: 148). This is in close accordance with the pattern from Middle-Saxon Burdale, and overall the pattern fits entirely into what we might expect to find on a number of upland settlements between the 8th and 10th centuries.

Without doubt, the material of greatest potential here is the combs. There is no evidence for on-site manufacture, and though there is no evidence for insular imports similar to those found at Wharram (Riddler et al. 2012: 148), this is perhaps unsurprising given the small size of the collections at our sites. Nonetheless, some of the combs are of such quality that they do suggest either elite control or some significant level of purchasing power. This is particularly the case for Burdale. The same is not true for Cottam, where the combs are somewhat rudimentary in ornament and finishing, if efficiently made; one suspects that the 10th-century examples could easily have been acquired at a large market such as York. There are no combs from Cowlam, though excavation there was small-scale.

At Burdale and the Cottam sites, both single- and double-sided combs are well represented. The Middle and Late-Saxon collection from Wharram’s South Manor also appears to comprise equal parts single- and double-sided combs (MacGregor 2000), while at Fishergate, York, single-sided combs are ascendant (e.g. Rogers 1993: 1388-1402). The same is not true of many Middle Saxon sites elsewhere in England (see for example Drinkall and Foreman 1998; Riddler 2004: 146, 147). The Burdale and Cottam material does thus fit very clearly into a local tradition. Indeed, when we consider the combs in greater detail, both form and ornament are typical of collections from the Middle-Saxon and Anglo-Scandinavian north. Though they do not afford high levels of geographic resolution, manufacturing techniques, such as the use of the ‘alternating-edge’ rivet arrangement are thoroughly consistent with the broader tradition of early-medieval Britain and Ireland. Similarly, there is no evidence for the exploitation of exotic raw materials, with antler (most likely red deer in the majority of cases) dominant. Though these combs were not manufactured on site, it seems unlikely that they were brought in from great distance. Nonetheless, the Burdale combs in particular are distinctive, and do not fit easily within the corpus of examples from the region’s emporium at Fishergate, York.

The Burdale combs are remarkable for their quality of production and ornament. These combs are meticulously finished, featuring complex designs and motifs, and are particularly notable for the care and consideration taken for the sake of symmetry and balance in both form and decoration. The Burdale combs are of a markedly higher
standard in this respect than those from Cottam B, which must speak to the purchasing (or commissioning) power of the occupiers of the site.

The relatively poor standard of ornament and rudimentary finishing in Cottam B’s combs might be seen as surprising in the context of what, on the basis of metal-detected evidence, would probably be characterised as a relatively prosperous, ‘productive’ site. However, Richards’ integrated programme of survey and excavation has convincingly demonstrated the un-exceptional nature of the site, and this is mirrored in the comb material. It is tempting to consider whether the excavation of further ‘productive’ sites would result in the recovery of similarly unexceptional objects of worked bone.

Moreover, the status distinction implied in the combs from Cottam and Burdale is informative with regards to discussion about the respective functions of the two sites. Burdale was part of an Anglo-Saxon multiple estate, perhaps together with nearby Wharram. The settlements at Cottam B represent a transitional phase in the reorganisation of the Anglo-Saxon landscape: a specialised upland landholding that was one component of a Middle-Saxon multiple estate, possibly held by Northumbrian royalty, followed by a new, independent farmstead introduced in the context of Anglo-Scandinavian land-taking and landscape reorganisation. The combs reinforce this impression, and emphasise the fact that the character of activity on morphologically similar and geographically proximate sites may be differentiated in a way that is most visible in their artefact collections. Even given the small size of the assemblage, the Wolds sites provide an instructive case study in the ways in which the analysis of worked bone can provide a useful means by which to compare the changing nature of sites, settlement, and landscapes.

APPENDIX: RESULTS OF BIOMOLECULAR ANALYSES

The Burdale worked bone collection provided the opportunity to trial a recently developed biomolecular form of species identification. Though the project’s success as a pilot fostered the adoption of this technique on numerous further projects (e.g. von Holstein et al. 2013; Ashby et al. 2015), the results have not previously been reported, so are included below.

ZooMS (Zooarchaeology by Mass Spectrometry, see Buckley et al. 2009; Houmslow et al. 2013) is a rapid, high throughput technique that allows the proteomic identification of a diverse range of animal products to species. It targets the collagen within bone to create a protein ‘fingerprint’ that can be matched against a library of known spectra. The technique is ideally suited to the analysis of worked bone, as it is both minimally destructive and rapid, which means that it may be applied to both highly-worked objects, and large numbers of otherwise undiagnostic pieces of manufacturing debris. The method was therefore trialled on the Burdale corpus, and the results (together with macroscopic identifications) are presented in Table 6.

This study was the first application of the method to an artefactual collection, though subsequent analyses have recently been published (e.g. von Holstein et al. 2014; Ashby et al. 2015). For the Burdale survey, a number of samples were cross-identified using ancient DNA analysis (see von Holstein et al. 2014). This supported the accuracy of ZooMS identifications, and showed the efficacy of the technique in the study of worked-bone artefact studies. The approach has consequently since been more widely adopted (e.g. von Holstein et al. 2013; Ashby et al. 2015).

REFERENCES


Richards, J. D., Naylor J. and Holas-Clark, C. 2008 The Viking and Anglo-Saxon Landscape and Economy (VASLE) Project [data-set], York, Archaeology Data Service [distributor]. doi:10.5284/1000044


Acknowledgements: This paper synthesises data published elsewhere (notably Ashby 2013, 2014a, 2014b; Richards and Roskams 2012, 2013; Richards et al. 2014). The Cottam, Cowlam, and Burdale projects were directed by Julian D Richards and Steve Roskams, with support from project teams acknowledged in the associated publications. I would like to thank Julian Richards for permission to use illustrations and images from the project archives, and for his encouragement to synthesise the data. ZooMS work was directed by Matthew Collins, and undertaken by Stacey Sachs, with support from Isabella von Holstein.
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</tr>
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Table 6. Results of Burdale ZooMS Analyses (undertaken by Stacy Sachs).
BONE AND ANTLER ARTEFACTS FROM AN 8-5TH CENTURY BC SETTLEMENT AT GRZYBIANY, SOUTH-WESTERN POLAND

Justyna Baron  
Marcin Diakowski  
Tomasz Stolarczyk

Abstract: The paper presents the general results of studies on 75 bone, antler and horn artefacts produced by the excavations of a late Bronze Age and early Iron Age lake settlement at Grzybiany, in present-day south-west Poland. The site is unique due to its wet environment that resulted in the preservation of organic materials ranging from massive breakwater constructions and wooden trackways to small objects made of antler, bone, horn and wood. Our aim is to present the collection of worked bone and antler objects, which is one of the largest Bronze and Iron Age assemblages in Poland.

INTRODUCTION

In the vicinity of the present-day town of Legnica is the only area in Lower Silesia (an historical land covering more or less SW Poland) where natural lakelands survived. This is called Legnica Lakelands or Kunice Lakelands with origins in a melted glacier. The lakes are usually irregular and relatively shallow, with a maximal depth reaching 10 m. Due to intense drainage works starting from 18th cent. AD, Koskowice Lake is one of few surviving lakes of this type.

Prehistoric sites located both on the lake promontory and in its vicinity (Fig. 1), were known as early as from the 1930s, but regular excavations of a settlement site located on the promontory started in 1959 and continued to 1962 (Siedlak 1964; Marek and Siedlak 1972). The most intense survey including interdisciplinary research and underwater prospection was undertaken between 1970-1980, but the results, although widely known and considered an archaeological ‘sensation’ in some brief general papers (e.g. Bukowski 1982, 1985), have never been fully published. Recently, three small trenches were opened in 2010 and 2011 to verify former data on the site’s stratigraphy (Baron and Stolarczyk 2012). In the last two years, a project has been run to prepare both documentation and collections for a complete final publication (Stolarczyk and Baron 2014).

The site is unique for two reasons: one is that the wet environment resulted in the preservation of organic materials including massive constructions such as trackways and breakwater constructions. The second is a long-lasting settlement producing thick occupational layers, reaching 1 metre in some parts. This enabled observation on changing trends in farming structure and production strategies. Artefact studies, stratigraphy analysis and 14C dating – however
the last must be considered as only supporting artefact chronology as they belong to the ‘Hallstatt’ plateau of the calibration curve (Becker and Kromer 1993) – proved the existence of three settlement stages covering a period from 9/8th cent. to the end of 5th cent. BC. Placing this in the relative chronology of this part of Poland, the site was inhabited from the late Bronze to the early Iron Age (Baron 2014). It is worth noting that the oldest settlement stage (layer III) is clearly separated with sterile soil from two subsequent stages (layers II and I, Fig. 2) confirming the temporary flooding of the site area.

The total number of artefacts is unknown as some part of the documentation has been lost (mostly from the earlier excavations), but one can estimate over 130,000 pottery shards (Żur 2014), and many artefacts made of metal, stone, wood, bone, antler and glass. The picture is completed with over 11,000 animal bones, plant remains, daub lumps with construction imprints, charcoals etc. Despite the many large sites excavated recently in the course of rescue work, Grzybiany settlement remains unique even if, according to our estimations, only 14% of the site area was recorded.

The paper presents the general results of studies on 75 bone, antler and horn artefacts produced by the excavations (Fig. 3) and analysed together (without dividing them into settlement stages). Although the state of preservation varied for particular objects, for most of them it was possible to carry out material, technological and typological analysis. A full study of the collection, including archaeozoological, functional analysis and detailed production techniques is included in the site monograph (Diakowski 2014; Diakowski and Zych 2014).

Most of the finds have analogies from large well-excavated and frequently fortified settlements located mostly on lake promontories in present-day north-central Poland. Excavations of early Iron Age sites such as Biskupin (Łukasiewicz and Rajewski 1938; Drzewicz 2004), Smuszewo (Durczewski 1985), Sobiejuchy (Harding et al. 2004) and Jankowo (Ostoja-Zagórski 1978) produced hundreds of objects made of organic materials, including bone and antler. Although obtained at remote locations, they are a good point of reference in our studies since such sites in south-western Poland are rare.

METHODS

In the first stage of research to identify various types of traces (natural vs. anthropogenic ones), macroscopic observation was undertaken. Then, microscopic observation was involved with the use of a stereoscopic microscope, an Olympus SZX9 (up to 57×) and a metallographic microscope, a Nikon ECLIPSE LV100 (50–500×).
On many bone fragments natural traces were identified which, in some cases, might imitate working traces. Particular attention was paid to the degree of fragmentation and breakage patterns in bone material. Some researchers consider them as the remains of deliberate activities (e.g. Romanow 2011, pp. 154-155). Most of them, however, are of natural origin (Binford 1981; Lyman 1994; Marciniak 1996 with further references therein). Such transformations include a variety of exfoliation and cracking resulting from weathering (Behrensmeyer 1978), breakage resulting from depositional and post depositional factors and trampling (Behrensmeyer et al. 1986). Moreover, canine bite marks (e.g. dog, wolf and fox) and imprints of plant roots were observed.

CLASSIFICATION AND ARTEFACT ANALYSIS

The collection was divided into three main groups: half-products, waste, and finished objects of various types (Table 1) and using a variety of processing techniques (Table 2). They come mostly from layer II which is rich in artefacts and reflects site occupation in the 7th cent.-mid. 6th cent. BC (Fig. 2). In most publications, bone artefacts are divided into general categories (e.g. tools, weapons, elements of horse-harness and ornaments) and then into types (e.g. Drzewicz 2004). That however suggests a priori possible functions of the analysed objects and in this paper the labels are mostly used just to order the artefacts and do not have to reflect their original functions.

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<th>layer II 7-mid. 6th c. BC</th>
<th>layer I mid. 6-5th c. BC</th>
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<td>-</td>
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<td>-</td>
<td>1</td>
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<td>-</td>
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<tr>
<td>pins</td>
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<td>2</td>
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<tr>
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<td>6</td>
<td>12</td>
<td>75</td>
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</table>

Table 1. Bone and antler artefacts from the settlement at Grzybiany

Half-products

Table 2 contains 22 objects displaying various technological traces of manufacturing process. Bone objects were made of the long bones of large and medium-sized mammals (Plate 1). In one case, the bone was identified as belonging to a sheep or a goat. All the half-products were initially cleft with a stone pebble.

The shape of three artefacts suggests they might be the half-products of perforators (Plate 1:1-3), while another object seems to be a fragment of an unfinished bone point with traces of whittling made by a metal knife on its tip (Plate 1:4).

Most half-products were made from antler and represent three stages of processing:

1. Initial division of the raw material (Plate 2; Plate 3:2)
2. Advanced working process represented by blanks (Plates 3:1, 3:3, 3:4; Plate 4:1)
3. Items whose shapes allowed them to be identified as belonging to defined tool groups (Plates 4:2-5).

An initial division stage was identified on ten artefacts, of which one was made from the basal section of an antler, five were divided from the section between the base and the antler crown and contained tines. Chopping, breaking and splitting and - on one artefact - sawing traces were observed. Four tines were detached by chopping around the compact tissue while on one polishing was only noticed at the tip. Unfortunately, it remains unclear how the last one was cut off since only natural breakage was observed in the distal part.
More advanced treatment occurs on four blanks of cortical bone obtained from an antler beam (Plates 3:1, 3:3, 3:4; Plate 4:1). Their length is 10.4-11.3 cm while their width is much less at 1.1-3.2 cm and the cross-sections are rectangular. They display traces of chopping, whittling and splitting with a wedge.

The third stage of the working process is represented by four artefacts of which three are half-products of leaf-shaped arrowheads (Plates 4:2-4). Their surfaces display traces of whittling, scraping and sawing. In the case of one object, only a part of a fusiform pin survived. Advanced working observed on one object allowed for its identification as a half-product of a fusiform arrowhead (Plate 4:2). On its surface only whittling resulting in multiple overlapping facets was observed. On one artefact, a natural surface of cortical bone survived which makes it the least worked object in this small collection (Plate 4:5).

Waste

On 18 objects from the middle settlement stage (layer II), working traces were so heavy that it excluded them from further use (Diakowski 2014: Tables 5-8). Most of them (16 items) are horn cores displaying sawing traces at their bases. These sawing marks are analogous to those caused by horn removal (Binford 1981). The horn cores belonged to domestic cattle (10) and goat (4). On some artefacts, traces of cleaving and sawing were observed. The latter ones are displayed on core surfaces perpendicular to the long axis (Plate 5:1). In the case of two artefacts, sawing was observed as well as breakage on the surface (Plates 5:2, 5:3). Detailed analysis proved both were pieces of one horn (Plate 5:4). The high number of horn cores worked in this specific way reflects great interest in obtaining horn. However, it is not clear what this raw material was used for, because, due to the environmental conditions, the finished products did not survive. They might have been used as drinking horns, which are part of the Urnfield tradition, in particular in the early Iron Age period. In the Hallstatt culture, drinking horns were prestigious grave goods (e.g. Hochdorf burial – Biel 1978) and ceremonial accessories used in feasting, as is depicted on bronze situlae (e.g. from Vače – Kastelic 1956).

Moreover, two pieces of red deer antler were identified in the waste. One is a piece of a beam displaying chopping marks, the other one is part of a tine base with chopping marks caused by the detaching of the tine.

Skates

Excavations at Grzybiany produced five skates from various layers (Plate 6). They were made of radial bones belonging to red deer (Plate 6:1) domestic cattle (Plates 6:2, 6:5) and horse (Plates 6:3, 6:4). Such artefacts have

<table>
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<th>Waste</th>
<th>Skates</th>
<th>Perforators</th>
<th>Points</th>
<th>Arrowheads</th>
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Table 2. Processing techniques on bone and antler artefacts from the settlement at Grzybiany
been widely used across Europe from the Bronze Age to modern times (e.g. Küchelman and Zidarov 2005). Similar objects come from settlements dated to the late Bronze/early Iron Age from present-day Poland, e.g. from Biskupin (Drzewicz 2004: 19-20), Smuszewo (Durczewski 1985: 93-95), Jankowo (Ostoja-Zagórska 1978: fig. 10e, 12a). The high standardization of their manufacturing is a common feature of these objects. The posterior sides of the diaphysis displayed traces of detachment from the ulna while the anterior ones were partly ground to obtain a flattened facet. In the case of two skates, chopping marks resulting from the shaping of the distal epiphyses were observed as well (Plates 6:2, 6:4).

**Perforators**

Seven artefacts with pointed tips were assigned to this category, which are sometimes known as awls (Drzewicz 2004: 24). They were made of sheep or goat, pig, domestic cattle or horse bones. In addition, their shapes varied heavily depending on bone selection (Plates 7, 8:1, 8:2). In one perforator, a half of a distal part was originally a handle (Plate 7:1). A characteristic of two further items made from metapodial bones is the completely preserved distal part which was a handle as well (Plates 7:2, 7:3). The shape variability compared to other artefacts results from the application of different techniques of manufacturing. Two perforators were made from horse splint bones and two others from fragments of long bone diaphysis.

In the case of this category, the selection of raw material is interesting as bones of domestic cattle and red deer were used to produce the perforators, while examples from other sites were made mostly from goat or sheep bones (Drzewicz 2004). Such objects are common on settlements of the Urnfield culture and were recovered at Jankowo (Ostoja-Zagórska 1978: fig. 12:b-f), Smuszewo (Durczewski 1985: tablica 48-51:1-16), Sobiejuchy and Biskupin (Drzewicz 2004: 31-32) and are called picks (Durczewski 1985: 81), double-ended awls (Łukasiewicz and Rajewski 1938: 47), hooks (Malinowski 1958: 32) or arrowheads (Fogel 1979: 120-121; Drzewicz 2004: 31-32). One item is a socketed point made from the metapodial bone of a sheep-sized animal. The socket was drilled into the bone at the proximal end, reaching the marrow cavity.

**Arrowheads**

This category includes two leaf-shaped tanged arrowheads made from red deer antler (Plates 10:1-2). The first arrowhead is elongated with a lozenge-shaped body and a tang on which whittled facets are present (Plate 10:1). The barbs were shaped from the tang by sawing. The body has a flat oval cross-section, while the tang’s cross-section is oval.

The surface of the other arrowhead bears linear traces made by whittling with a metal knife. Its tip is broken as a result of impact. This artefact has no use-traces. Similar objects come mostly from fortified settlements from central-north Poland such as Biskupin (Drzewicz 2004, 113, tabl. 15), Smuszewo (Durczewski 1985, tabl. 55: 1-29) and Sobiejuchy (Harding et al. 2004, 259, plate 31:1-11).

**Object made from antler tine**

On this artefact made from red deer antler, traces of circumferential chopping with a metal axe at its base are evident (Plate 10:3). Spiral striations of various widths and depths surround the tip. A single object of this type comes from a fortified settlement at Smuszewo in Poland (Durczewski 1985: tabl. 59.3) while several others are known from Asva in Estonia (Luik 2010).

**Tine handle**

This object was made of red deer antler tine. In its base, a rectangular socket (i.e. a fixing hole) parallel to the object’s long axis was drilled (Plate 10:4).

**Fitting**

Excavations at Grzybiany also produced a decorated red deer antler fragment – probably a fitting (Plate 10:5). It has the shape of a plaque and is 4 mm thick. On its upper surface, circle and dot decoration is evident. Such decoration required the use of metal tools and rarely occurs, however, some examples dated to the Bronze Age are known (e.g. Choyke 2005: plate V.8b).

**Button**
This elongated object was made from red deer antler tine, with a perforation in its central part (Plate 10:6). Similar tools made of pig metapodial bones instead of antler (Jaworski 1990).

Rib tools

Two artefacts made of the middle sections of domestic cattle ribs belong to this category (Plates 10:7-8). They are simple tools made mostly by chopping. In both cases, the outer surfaces displayed a concentration of overlapping linear traces, perpendicular or slightly oblique to the axis of the bones. They vary in shape and depth.

One rib tool has a shaped rounded end with a worn surface at its edge (Plate 10:8). Both side edges are heavily rounded and polished as well. Many similar objects come from Biskupin (Drzewicz 2004). In the case of these artefacts, it is not possible to identify traces of use from production. However, experimental work proves such clear linear striations derive from working raw wool. Similar objects were recovered at the Urnfield site of Wojkowice in south-western Poland (Gralak 2010: ryc. 103:2, 4; ryc. 104).

Axe

This category consists of only one object made from the basal part of a red deer antler (Plate 11). The working edge was oblique and the object surface displayed traces from the removal of pearling and an eye tine. Above the removed tine, a bilateral rectangular hafting hole was drilled.

Hammers

There are two examples of hammers – a complete and a fragmented one. A completely preserved object was manufactured from the base to eye tine segment of a red deer antler (Plate 12:1). Above the eye tine, a bilateral rectangular hole was drilled. In its distal part, on the spongy bone level, a hole parallel to the tool’s long axis was drilled.

The other hammer is fragmented and survives as a piece with a rectangular hole and four other small perforations (Plate 12:2).

Such objects are typical for the late Bronze and early Iron Age with many examples coming from Biskupin (Drzewicz 2004: tabl. 8: 6-11) and Smuszewo (Harding et al. 2004: tabl. 32:28).

Picks

Two artefacts were identified as picks, both made from red deer antler (Plates 12:4, 12:5). In one object, an eye tine is its working part and a beam piece acts as the haft (Plate 12:5). The other pick is made from tine. The spongy bone in the basal part was perforated parallel to the long axis. Unfortunately, due to the poor preservation (heavy exfoliation of the proximal part) and the lack of clear technological traces, we cannot say if the perforation is natural or deliberately made.

On both picks the tine tips show abrasion on both sides. Additionally, both objects display large chips making the edges concave. Similar implements from Biskupin are called picking tools or hoe-like tools (Drzewicz 2004: 16-19). Apart from Biskupin, picks come from Sobiejuchy (Harding et al. 2004: plate 32: 18, 22), Smuszewo (Durczewski 1985: tabl. 60: 1-4, 6) and Jankowo (Ostoja-Zagórski 1978: ryc. 12: n, 15: g, h).

Lid

This carefully executed object was made from the burr of a red deer antler and displays traces of sawing and intense scraping (Plate 12:3). At the edge of the upper (convex) facet, two pairs of holes were drilled. A flange of the lid was perforated as well – a single hole was located between the two pairs described above. A similar object comes from the site of Sobiejuchy (Harding et al. 2004: 64, 257, plate 29:18).

CONCLUSION

Faunal remains are usually the second most numerous artefact group (after pottery shards) obtained in course of archaeological excavations at settlements dated from the Neolithic onwards and the site of Grzybiany is not an exception with c. 11,000 animal bones, antler and horn pieces. This suggests that the animal raw material, even including the collection of antler sheds, was extremely easy to acquire and use. The relatively abundant artefact collection provides information on both raw material selection and the production of bone artefacts and antler processing on the site. The analysis proves that the objects under discussion played a constant and important role in the life of the people living in the settlement in Grzybiany for nearly four centuries. This is reflected in both the objects’ forms and possible functions covering most everyday activities including such essential ones as farming and the processing of various materials used for making shelters and clothes (perforators, points, axes, hammers and picks). Some objects prove the usage of faunal material in widely understood areas such as mobility (skates), hunting and warfare (arrowheads), clothing decoration (pins) or storage (a lid). Moreover, their manufacturing, most likely carried out on the site, as evidenced by waste and half-products, involved various techniques and tools – made both from stone and metal which also proves the high skill level of their makers.
Close to the bone...

Plate 1. Bone half-products. After Diakowski 2014, with modifications.
Plate 2. Antler half-products representing the initial division of the raw material. After Diakowski 2014, with modifications.
Close to the bone...

Plate 5. Production waste. After Diakowski 2014, with modifications.
Close to the bone...

Plate 8. Bone perforators (1-2) and pins (3-5). After Diakowski 2014, with modifications.
Close to the bone...

Plate 10. Bone and antler artefacts. 1, 2 – arrowheads; 3 – tine tool with spiral striations; 4 – tine handle; 5 – fitting; 6 – button; 7, 8 – rib tools. After Diakowski 2014, with modifications.
Close to the bone...

REFERENCES


J. Baron, M. Diakowski, T. Stolarczyk, Bone and antler artefacts from an 8-5th century BC settlement...


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THE ARCHAEOLOGICAL SITE

The paper presents data issued from the analysis regarding a special symbolic artefact made of red deer antler discovered in the well-known archaeological site of Şoimeni – “Dâmbul Cetăţii”, Păuleni-Ciuc Commune, Harghita County, Romania. These belong to the Middle/Late Phase of the Bronze Age in Romania, Wietenberg Culture (Middle Phase, II; cca 1800 – 1600 BC). The prehistoric settlement is placed at 8 km northeast of Miercurea-Ciuc and at 1-1.5 km northeast of Şoimeni (Csíkcsomortán), Păuleni-Ciuc comm., Harghita County, in the area called “Dâmbul Cetăţii” (“Várdomb”) (For further data related to the site, history of research as well as osseous materials industry dated from Aeneolithic and Bronze Age levels see Beldiman et alii 2014; Buzea 2012).

DECORATED RED DEER ANTLER PLATE

The object presented here was recovered during the 2000 excavation campaign from a complex (Hut 7) (fig. 1). It is a relatively small fragment of a circular decorated plate. Catalogue Code PCD/IV 3. Type: IV E2 b. Owner: National Museum of the Eastern Carpathians, Sf. Gheorghe. Inv. no. 5456. Context data: Section I Square B 8 Hut 7, Depth 0.60 m. Wietenberg Culture, 2nd phase. Black uniform colour resulted probably by intentional burning (cf. Beldiman et alii 2012a: 104, 248, pl. 34; Beldiman 2012b). Red deer antler plate, probably circular, with geometric, on relief and engraved ornamentation that consists in parallel grooves and sculpted triangles, made probably with a metal blade. The triangular fragment has an irregular shape, and convex and concave edges resulted after the deliberate fracture of the object. A small sector of the upper side seems to have been recently fractured on two planes (sides A and B, at the point 1). The surfaces were affected by the corrosion (humic acids) which created small irregular ovoid holes randomly placed on the sides (fig. 1/1-6). The fragment represents about 1/7 from the entire piece (fig. 1/7; fig. 8/1-6). This has an intense black colour with metallic polish aspect on the upper side and brown on the inferior side. The colour is resulted probably by deliberate burning. The heat treatment facilitates a high risk of fracture. Consequently, the burning might succeed the manufacture. The dimensions (in mm) are: A 24.21; B 36.23; C 28.04; maximum thickness 9.17; thickness of the circumference about 5. Initial dimensions: diam about 85; maximum thickness 9.17; thickness of the circumference about 5 (fig. 2).

The piece was entirely manufactured using various procedures/techniques such as: direct percussion/splitting; indirect percussion/chopping, scraping, direct per-
cussion/chopping, engraving. The upper side presents several distinctive elements whose detailed analysis allows us to hypothetically reconstruct the ornamentation of the artefact. The surfaces are concentrically placed starting from the centre to the circumference as follows: a flat surface of scraping (S1), with fine, oblique, parallel striations; an ample circular groove (S2) which is convex asymmetric and it marks the edge of the flat surface; an oblique surface (S3) obtained by chopping and repeatedly applied percussion (piquetage), with a specific, irregular aspect (fig. 2).

The ornamentation: a small triangular part is preserved on the oblique surface, close to the distal end of one of the grooves (T2), partially preserving the channelled and guttered anatomic tissue of the antler and partially modified by abrasion. This fragment indicates the probable existence of an relief isosceles triangle which was part of an ornamental assemblage comprising probably eight identical triangles (T1 – 8) placed at equal distances on a marginal band, close to plate circumference; these elements were designed on the oblique surface at the moment of its grooving by chopping or repeated percussion (piquetage); within two distinct stages, two engraved, linear, parallel grooves were done on the oblique side (SG 1 – 8) (two of them are partially preserved, SG 1 – 2). These probably formed a central cruciform ornamentation (fig. 2). Dimensions: L crossbar A 21; L crossbar B 23; L crossbar C 18.5; L crossbar D 14; distance between the grooves of the crossbars 5.5.

The fragment is conventionally placed on the inferior sector of the entire piece circumference. The piece sides are named with A – B – C; the angles are named with the numbers 1 – 2 – 3 (fig. 2). The inferior side is irregular and it is made of the spongy tissue, superficially

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Fig. 1. Şoimeni – “Dâmbul Cetăţii”. Wietenberg Culture. Decorated red deer antler plate. 1-6 General views. 7 Hypothetical reconstitution.

Fig. 2. Şoimeni – “Dâmbul Cetăţii”. Wietenberg Culture. Decorated red deer antler plate. Elements of description (surfaces, grooves, decoration).
shaped by chopping; the thickness of spongy tissue is different on various sectors due to the chopping technique applied (2.30 – 4); the thickness of the compact tissue is 4.70. The aspect of the tissues (compact and spongy) was modified by probably deliberate burning (fig. 6/5-7). All the elements of the upper side: the flat surface (S 1), the circular groove (S 2), the triangular surface (T 2), the oblique chopped surface (S 3), the linear grooves (SG 1 – 2) preserve an intense, uniform, black colour as a result of burning. The spongy tissue is uniform dark brown and with a rounded relief as an effect of the heat factor (fig. 6/5-7). These details indicate that the physical changes done by heating were produced before fracture; thus, the heating treatment was applied with the aim of changing the material artefacts by baking/deliberate burning.

According to the microscopic observations and the acceptance of the premise that the plate was initially circular and of the premise that the initial decoration based on symmetry (as the identified analogies suggest), the ornamentation was obtained by chopping and engraving and probably combined two elements (fig. 2): 1 a central motif; engraved cross with unequal sides (A – D) formed by eight, parallel grooves, placed at a distance of 5.5 mm of each other and joined in a right angle (SG 1 – 8); 2 a marginal motif: a circular band made from eight, on relief, isosceles triangles (T 1 – 8); the triangles angles were opposed, alternatively placed at equal distances between each other as well as the edge of the on relief flat surface (S 1) and of the piece circumference; 4 of them (= T 1, 3, 5, 7) were placed along with the distal ends of the cross parts, with the angles oriented to the inner side; other 4 (= T 2, 4, 6, 8) were placed between the crossbars, with the angles oriented to the outer side.

The ornamentation of the plate could combine the central cross, the marginal, circular band and eventually, some geometrical elements (linear or circular ones) placed in the areas between the crossbars.

The elements resulted by technical modification of the upper side (shaped surfaces, with various diameters, concentrically placed) are numbered from 1 to 3 and defined in the following manner (figs 2-7): 1 on relief, circular, flat surface (S 1) resulted by chopping/scraping using a metallic blade, probably knife; there are well-preserved specific oblique striations; diameter 48; 1a around the flat surface, an oblique surface was shaped (S 1a), finished by chopping and scraping (the surfaces of triangles are preserved, T 2); inner diameter 48; outside diameter 85; width 18; 2 circular groove (S 2) made by direct and indirect chopping has a semi-circular and concave asymmetric section which marks the circumference of the flat surface S 1; it is slightly deeper than the oblique surface; there are no traces of pigmentation; there are no traces of previous marking; inner diameter 48; outer diameter 55; width 2.5 – 3; maximum depth 1.2 – 2; 3 oblique surface (S 3) representing a marginal circular band made by chopping or piquetage; it has an irregular aspect; the oblique chopping at about 45° from the circumference of the flat surface S 1 towards the piece circumference; traces of impact with overlapped marks are preserved. The surface was not finished after chopping. It was not shaped by abrasion in order to create contrast with the flat surface S 1, polished; inner diameter 55; outer diameter 85; width 15; 4 circular band comprising probably eight on relief, triangular, flat surfaces (isosceles triangles) (numbered T 1 – 8), alternatively placed with the opposite points which resulted by chopping and scraping; about 1/3 of the T 2 is preserved; the sides were named with a b c and the points with numbers 1 – 2 – 3; the T 2 preserved sector comprises point 1 and partially the sides a and b; the triangular surfaces were not marked – there are no traces in this respect. It seems that these were directly chopped; dimensions L a 18.30; L b 12; L c 12; high about 2; 5 engraved short, wide groove (SG 1_1); it was overlapped by SG 1_2; it was probably done with a metallic blade (bronze) with the active part rounded on one of the sides; the depth is small; it was engraved with the help of a metallic blade (bronze) with the active part sharped on one of the sides; the edge of the blade was irregular and generated the axial striations visible on the walls of the groove; it has parallel linear edges and convex walls; the profile is in an asymmetric U, the walls are irregular, with an inclination of 45°-50°. They are covered with parallel, overlapped, well-marked axial striations, specific for scraping procedure; there are no traces of pigmentation preserved; initial length 18; preserved length: 6.76; width proximal end 2.40; width mesial part 2.40; width distal end 1.40; maximum depth 1.00; 7 residual grooves (SR 1_1 - 5) resulted during the engraving procedure of SG 1; SR 1_1 – 4 are long grooves, placed on the flat surface (S 1), close to the edge of SG 1, oriented on oblique directions; SR 1_5 is short, placed on the S 3 oblique surface, close to ED of SG 1, being parallel to this; it has fine cutting striations which are linear and have long asymmetric V profile; they indicate that the blade used for shaping was a bronze one (knife blade); 8 engraved short, wide groove (SG 2_1) probably made with a metallic blade with the active part rounded on one of the sides; the groove has a small depth; the end is asymmetric convex and it is placed parallel to the diameter of the flat surface; the edges are linear and parallel; the profile is wide, concave and symmetric; it was made by repeated scratching starting from the centre of the piece towards its circumference; the direction is proximal end – distal end; it is more difficult to observe it because it is partially covered by SG 1_2; there are no traces of pigmentation; initial length 18; preserved length 12.70;
width proximal end 4.20; width mesial part 4.20; width distal end 1.75; maximum depth 0.5; 9 short groove less wide and deeper (groove 2_2); similar to SG 1_2; done by engraving with a metallic blade (bronze) with the active part sharped on one side, with an irregular edge which generated the axial striations which is observable on the walls of the groove; the end is convex and sharp, being longer than the diameter of the flat surface; profile in asymmetric U, with irregular walls, inclined at about 45°-50°, covered with well-marked, overlapped, parallel, axial striation specific for scraping technical procedure; there are no traces of filling with pigments; initial length 18; preserved length 12.70; width proximal end 2.25; width mesial part 2.25; width distal end 1.2; maximum depth 1.5; 10 residual grooves (SR 2_1 - 4) resulted after engraving technical procedure of SG 2; SR 2_1 – 3 are short grooves, placed on S 3 oblique surface, close to distal end of SG 2, they are parallel to these; SR 2_4 is a long groove placed on S 1 flat surface, close to the SG 2 side, being oblique oriented towards this; there are fine, linear cutting grooves, with asymmetric V elongated profiles; they indicated the blade that was used for this purpose = bronze blade of a knife.

As concerns the manufacture sequences of debitage and based on microscopic observations we can propose the followings (fig. 7/1-3): a central cylindrical segment of the antler beam was extracted (length about 100 mm and its diameter about 100 mm) at the level of the third time (the central one). The possible technical procedures engaged in these operations were: direct percussion/chopping and direct percussion/fracture or transversal cutting and direct percussion/fracture (manufacturing chain, stages 1 – 2). The central time was removed from its base by chopping or transversal cutting. Direct percussion/chopping were applied on the beam at about 50 mm above and below the level of the third time base. This beam segment was selected because it offered the widest part and an oval section more pronounced. In this respect, a rectangular or polygonal fragment with a width about 80 – 100 mm and with the sides preserving a less acute curving could have been extracted (according to the particularities of age of the animal and the parameters of beam).

As concerns the manufacture sequences of shaping and decoration and based on microscopic observations we can propose the followings (fig. 7/4-6; figs 3-6): 1 extracting by direct percussion/splitting of a fragment with
Close to the bone...

- a rectangular or polygonal shape, with a width of about 80 – 100 mm and a flat-convex section, with the upper side convex (anatomically); it is one of the wide sides of the segment obtained during the debitage stage. The inferior side is almost flat. The fragment represents about 1/4 or 2/3 from the circumference of beam (manufacturing chain, stage 3); 2 shaping the sides and the edges was done probably by direct percussion/chopping; flat-convex section (manufacturing chain, stage 3); 3 defining the general circular shape of the piece by direct percussion/chopping applied on sides and edges; flat-convex section; in this way a circular plate with a diameter of about 70-80 mm was obtained (manufacturing chain, stage 3); 4 the upper side (S 1) flat in the central part and oblique in the marginal band was obtained by scraping; a polygonal section was obtained (asymmetric octagonal) (manufacturing chain, stages 4 – 5); 5 making the circular groove (S 2) by indirect percussion/chiselling? The preserved traces allow us to define the parameters of the used tool – chisel with narrow and rounded active part (manufacturing chain, stage 6); 6 making the marginal, deep circular band with an oblique surface (S 3) and the row of on relief triangles (T 1 – 8) by indirect percussion/chiselling. The surface is lower with 2 mm than the level of the flat surface.

Fig. 4. Şoimeni – “Dâmbul Cetăţii”. Wietenberg Culture. Decorated red deer antler plate. 1-7 Microscopic details (surfaces, grooves, decoration).

Fig. 5. Şoimeni – “Dâmbul Cetăţii”. Wietenberg Culture. Decorated red deer antler plate. 1-7 Microscopic details (surfaces, grooves, decoration).

Fig. 6. Şoimeni – “Dâmbul Cetăţii”. Wietenberg Culture. Decorated red deer antler plate. 1-7 Microscopic details (surfaces, grooves, decoration).
(1), approximately at the level of the S 2 circular groove (manufacturing chain, stage 7); 7 engraving the grooves (SG 1_1, SG 2_1) of the central cross motif by scraping with a knife blade starting from the centre towards the circumference (manufacturing chain, stage 8); 8 deepening the grooves (SG 1_2, SG 2_2) by intense scraping with a knife blade (manufacturing chain, stage 8); 9 scraping the superficial, residual grooves (SR 1_1-5; SR 2_1-4) by exceeding the length of the engraved grooves or as failures in positioning the knife blade. They allow us to define the parameters of the tool used for cutting – metallic blade with a fine edge = bronze knife (manufacturing chain, stage 8). The engraving of the grooves was done starting from the proximal end towards distal end; the tool was used with the right hand; 10 deliberate burning in order to colour the piece black (manufacturing chain, stage 9).

It is possible to formulate some remarks regarding the use-wear traces and function of the decorated red deer antler plate. So, the engraved edges and the inner part of the ornamentation (SG 1 – 2 grooves) do not preserved traces of bluntness and functional polish (figs 4-6); the S 1 flat surface has no use-wear striations; traces of bluntness, polish, metallic aspect; the unshaped edges as well as the chopped, oblique surface preserves some traces of bluntness and functional polishing; the broken of the artefact was a deliberate one having the purpose of destruction by direct percussion using an instrument with the metallic active part narrow, with a rectangular section (chisel-type), antler artefacts being difficult to fracture in usual conditions; there are some specific traces well-preserved such as: grouped impact traces, some of them overlapped, placed at the left edge of SG 1, with the removal of the compact tissue at various thicknesses; other traces placed at right edge of SG 1 show the instrument which was used for percussion: a tool with a short and narrow active part, with a rectangular section, like a narrow chisel. We may conclude that the piece was deliberately fractured and abandoned after its destruction.

The irregular aspect of the inferior side, with ununiformed thickness of spongy tissue, with no intention for shaping (fig. 1/2; fig. 6/5-7) it suggest the use of the artefact as an ornamental element placed on a support such as: wall, textile object, leather, wood, metal or recessed in wood, combined with metallic elements (like the belts). No elements of a possible fixing device are preserved (perforations, notches), but the piece might have had them (cf. Beldiman, Sztancs 2014).

The absolute dating of the Wietenberg Culture level assures the indirect dating of the analysed piece. It is dated from 1830-1680 BC, being among rare pieces made of osseous material belonging to Wietenberg Culture which was associated with an radiocarbon date and among the rare such Prehistoric pieces of osseous materials from Romania (cf. Whitlow et alii 2013: 38; Whitlow 2014; Whitlow et alii 2014; Beldiman et alii 2014).

ANALOGIES

So long, no close analogies were identified for this piece; so far it seems to be a unique one. Animal with a symbolic value which has documented since the early Prehistory, the red deer generated myths and various representations over time, as the manifestations of material culture such as artefacts of common use (tools, weapons) or symbolic ones (perforated residual canines, other adornments, decorated non-utilitarian artefacts etc.). They are presented in Romania since the Upper Paleolithic (for details, see Beldiman et alii 2014). Various symbolic artefacts are made of red deer antler. These are frequently decorated with geometrical el-
Close to the bone...

Elements. Pendants, bracelets, various plates, sleeves, axes etc. are only some of the pieces made of red deer antler (cf. Beldiman 2000; Beldiman 2002; Beldiman 2007; Beldiman et alii 2010; Beldiman, Sztancs 2004; Beldiman, Sztancs 2014; Beldiman et alii 2012b: 59, 202, pl. 129; Sztancs 2011; Aldea 1973; Dumitrescu 1974; Chidioșan 1980; Rischuța 1995; Andrițoiu, Rustoiu 1997; Popa, Ștefu 2009; Popa, Simina 2004; Lascu, Gheorghiu 2009; Ciută, Ciută 2013; Popescu 2013).

Within the Bronze Age cultures, there are various depositions in pits with ritual purposes and symbolic representations of the animals such as zoomorphic protomes made of clay. In a recently published work a detailed approach of the symbolism related to animals can be found; it also takes into account the red deer within Wietenberg Culture (Beldiman et alii 2015a; Beldiman et alii 2015b; Marc, Bărbat 2014; Marc et alii 2015; Rischuța, Marc 2015; Savu, Gogăltan 2015; Moldovan 2009).

The incised, on relief or fretted motifs representing circles and isolated cruciform elements or combined with other geometric elements are frequent within the cultures of the Bronze Age, Wietenberg Culture included. It is frequent on various ceramic pots, especially on bowls – (fig. 8/7-9 (incised or excised motifs) (Moldovan 2009; Rischuța, Marc 2015: 166, pl. IV/a) and on the bronze pieces such as bracelets, belts, plaques, harness pieces, swords (on relief, engraved or fretted motifs) – coming from hoards and isolated discoveries in Transylvania and Hungary (cf. Petrescu-Dîmbovița 1977, plates 12-13, 20/8, 31-34, 74/51, 108/3, 6, 117/4, 118/1, 126/28, 132/2-3, 140/19, 147/7, 171, 172, 181/1-2, 192/7, 9, 252/2, 256/7, 257, 301, and especially plates 56/3, 74/29-31, 118/17, 125/20, 132/1, 159, 187, 256/6, 347/2; Gábor 2015; Popa 2015: 188, 190, figs 1-3).

CONCLUSIONS

The archaeological excavations carried out during 1999-2013 campaigns in the Prehistoric site from Șoimeni – "Dâmbul Cetății" offered the opportunity of recovering an assemblage of artefacts made of osseous materials belonging to Cucuteni-Ariuşd, Jigodin, Costişa-Ciomortan and Wietenberg Cultures. The studied assemblage comprises 108 artefacts. All of them are preserved in the collections of the Eastern Carpathians National Museum of Sfântu Gheorghe, Covasna County. Among these 17 pieces are dated from Wietenberg Culture. Most of the artefacts are bone awls made of long bones of large and medium-sized herbivores. There were present in optimal conditions all the aspects required by the complex study of the pieces. The approach supposed a systematic examination of all artefacts in optical microscopy.

The typological analysis of the osseous materials industry from Șoimeni – "Dâmbul Cetății" allowed us to add new types of objects for Wietenberg Culture. Among rare symbolic pieces we analyse here a circular decorated red deer antler plate. This kind of object has never been identified before within the discoveries of osseous materials artefacts from the site or from any other Wietenberg sites. The fragment of decorated plate was made from a red deer antler beam fragment (compacta tissue). The ornamentation consists in two parallel grooves, made probably with a metal blade. The possible manufacturing chain includes several stages: extraction, shaping, drawing the ornamentation (circle). This decorative symbolic piece seems to have been intentionally broken and coloured by intentional burning.

The extensive microscopic study of the surfaces of the pieces allowed us to notice the traces of manufacture and wear and to propose the sequences of shaping. All the procedures were done by well-applied chopping, abrasion and grooving. The manufacturer presented strong ability for these operations, a sense of symmetry and a routine in this domain.

The Wietenberg osseous materials artefacts assemblage from Șoimeni – "Dâmbul Cetății" offers new benchmarks from a typological, palaeo-technological, cultural and chronological point of view. These allow the complex and extensive approach of the manifestations of civilisation and culture of the communities that lived during the Bronze Age times in Transylvania.
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Close to the bone...


Abbreviation list
Comm. – commune
ED – distal end
EP – proximal end
Inv. no. – inventory number
L – length
PCD – Șoimeni/Păuleni-Ciuc

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BONE WORKING AND THE ARMY: AN EARLY EIGHTEENTH–CENTURY BUTTON WORKSHOP AT THE BELGRADE FORTRESS

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Abstract: During excavations in 2008 at the Belgrade fortress, a large quantity of portable finds dated from the early 18th century were discovered within one structure, known as the Blockhouse. The Blockhouse, situated at the Upper Town’s south-eastern wall, was a defensive structure that had been built between 1718-1721, but was never completed due to changes in plan. Shortly after its aboveground portion was partly torn down the vaulted subterranean chamber was largely filled with waste, i.e., with items used by the Austrian troops (who occupied the fortress at the time) between 1717 to 1725. Finds included ceramic and glass vessels, knives, leather shoe soles, buckles, etc., and bone manufacturing debris. The bone manufacturing debris included c. 85 pieces of large herbivore ribs from which circular pieces, c. 1.15-1.20 cm in diameter, and larger, c. 1.4-1.5 cm had been cut out. Some technological aspects will be analysed in this paper, as well as the choice of raw material, manufacturing techniques, and the entire mode of production. We will also discuss the origins of this debris, the nature of its end-products and the implications for an analysis of everyday life in the Belgrade Fortress in the early 18th century.

The most important trade and industries were based on wool, leather and hide (cf. Albarella 2003: 71), along with production in osseous raw materials (bones, horns, ivory, etc.). Publications of pre-modern and modern osseous artefacts have often limited themselves to cataloguing attractive finds, and have less often focused on typologies and distributions (e.g., Kovács 2002: Kat. Nos. 81, 227-243, Popović and Bikić 2004: 97-98, Kühtreiber 2006, Taf. 108/D5, 109, 110, 113/E5-E7, 114/E9, E10) Only a small number of publications have dealt with complex analyses and the technological aspects of bone manufacturing (e.g., MacGregor 1985, 1989, Jaworski 1999, Moreno García et al. 2010, Konczewska 2011, Pawłowska 2011, Rijkelijkuizen 2013).

THE CONTEXT OF THE FIND

During archaeological excavations at Belgrade Fortress in 2008, a defence building, called Blockhouse, was thoroughly investigated. It was situated at the south-eastern wall of the Upper Town of the Belgrade Fortress (figs. 1, 2).

The Blockhouse has a rectangular shape in its aboveground segment, with five windows – loopholes, while the subterranean section has comprised one vaulted room. These two parts were connected by an aperture in
the floor of the upper level, and the subterranean room also had one opening in the opposite side, within the trench (Bikić 2012: 210-211).

The building was constructed during the Austrian occupation, between 1718 - 1721, but was never completed, due to changing to construction plans. (Popović 2006:211-218). Soon afterwards, the Blockhouse was partially destroyed, and the subterranean room was filled with debris from surrounding areas of the Upper Town. As two large barracks were in the vicinity, it may be assumed that artefacts contained within this waste had been used by Austrian army during their occupation of 1718-1721. The assemblage is dominated by ceramic and glass vessels, clay pipes, knives, shoe soles, buckles, but also included bone manufacture debris, which is the subject of this paper (fig. 3).

THE BONE MANUFACTURE DEBRIS

The find consisted of c. 85 pieces (some had fresh breakage and could be fitted together) of bone debris of different shapes and dimensions, but predominantly rectangular pieces from which rounded segments had been removed.

Raw materials

All these pieces came from the ribs of large mammals, and judging from their size, were most likely from cattle (cf. Wolsan 1982). Almost all rib segments were present – proximal, mesial and distal (only epiphyses were not noted, i. e., all segments belong to the corpus costae) although those belonging to wider and more flat segments prevailed.
As mentioned above, an attempt was made for refitting, but without much success; only pieces with fresh breakages could be fitted together, suggesting that either ribs were not cut into pieces at the spot, or that a considerable loss of volume had occurred during cutting. However, judging from the shape of the segments themselves, it is most likely that the raw material was already fragmented elsewhere. This means that the raw material most probably represents kitchen refuse, where the ribs had been removed during the process of food preparation and/or consumption (cf. Kunst 2013), and had not been separated during the first stage of butchering of the animal body, or later from a tannery or hide-workshop (for butchery practices, cf. Olive 1987).

Bones and horns from domestic animals, especially cattle, were used in bulk in medieval times, and it is assumed that this was because they were easily available and obtainable in large quantities as the by-products of meat consumption, or from Skinner’s and tanner’s workshops (cf. Konczewska 2011: 305). Other (cheaper) raw materials were used as well – such as hooves (cf. Rijkelijkuizen 2013). Furthermore, unlike antlers, which had to be gathered if large quantities were needed (cf. Billamboz 1977), cattle skeletal elements were available all year-round and presumably at lower prices. Cattle bones may also have been preferred for their aesthetic, mechanical and physical properties: colour, shape, size and thickness (cf. Konczewska 2011: 305, with references).

Apart from horn, bone is a strong and at the same time flexible material, which has thermoplastic properties and is easily modified into a variety of shapes (cf. Rijkelijkuizen 2013). The larger bones, from cattle and horses, especially metapodials, were used for a variety of purposes. The use of cattle ribs has been reported only occasionally.

Manufacturing process

Analysis of the bone manufacturing waste from the Blockhouse has allowed the manufacturing process to be reconstructed. Differently sized rib fragments, already broken into pieces elsewhere, were brought to the working area for further processing. The main blank was of more or less rectangular shape. Most of the rib fragments just had irregular, broken edges, with fibres torn, suggesting that they were simply smashed by direct percussion, most likely with some heavy cutting or punching tool, such as an axe or cleaver (cf. Brugal and Defleur 1989, see also Klippel and Schroedl 1999).

A smaller number of pieces had traces of transversal division. Onsome of these pieces, deep grooves may be observed near to the edges where they have been broken into pieces by a heavy cutting tool, such as an axe, whereas other pieces have traces of irregular cutting, most probably by a large knife.

These more or less rectangular pieces were then trimmed along their outer longitudinal edges. In most cases, again, rough edges with fibres torn may be noted, as a result of direct percussion, and more broken off than cut off. As only a few pieces show traces of a cutting tool, such as a knife, are visible – these cut edges have a slightly wavy appearance and show the movements of a tool, stopping, hesitating, changing and showing evidence of small mistakes, etc.

Breaking into pieces and removing the side portions was necessary to ease the longitudinal splitting, as ribs are very resistant, and it impossible to split an entire rib longitudinally. Splitting was done by posing a cutting tool between two plates and then applying indirect percussion (cf. Christidou 1999, see also Klippel and Schroedl 1999: 226-227). Only three smaller pieces come from unsplit ribs, presumably too small to split and thin enough to be cut through.

From the blanks thus obtained (single bone plates of ribs) rounded segments were cut out, by drilling, from the lower and upper surfaces. Traces of drilling, in the shape of horizontal concentric lines, are visible in negative within the hole. A slightly thicker, wider centre at the cross-section represents the meeting point of the two drilling operations. On all but one of the bone pieces, where the drilling tool had not been precisely positioned at the inner/ lower side, the drillings meet perfectly. Two groups of perforations can be distinguished – smaller ones, around c. 1.10 -1.15 cm in diameter, and larger c. 1.4-1.5 cm in diameter. This indicates that at least two drilling tools of different dimensions had been used. The type of tool used was a simple three-forked drilling tool (cf. Luik and Maldre 2003, also Luik this volume, Klippel and Schroedl 1999: 226), i. e., a drill that had a central spike for making the central perforation (see below). According to MacGregor (1985: 101), “the implement used was evidently a centre-bit with a curling profile and with an extended central point which, when it had penetrated the bone from one side, allowed the drill to be aligned on the same spot from the other”. Such tools have been used since Roman times (cf. Vecsey 2012) and their use is confirmed by finds from medieval Visegrád (Gróf and Gróh 2002: 283, fig. 2).

It is interesting to note that the internal positioning of the holes on the blanks varies a great deal. Sometimes they holes almost overlap, sometimes the gap between the holes is wide, sometimes the holes are aligned in one row, sometimes in two. Furthermore, several pieces show that the surface available was maximally used, i. e., the entire space is used, while other pieces had been discarded even though a few more discs could have been cut out.

At the lower (inner) surfaces of the ribs the spongy tissue is completely exposed, it has been left unworked and is very rough. Only a few examples have traces of whittling, i. e., a knife was used to cut thin strips of material, but even on these this was not done on the entire surfaces, and it is therefore more likely the result of incomplete splitting (removal of the other bone plate) and was not originally intended for smoothing the surface.
These traces were only observed on one piece, on the upper side, and may be related to the removal of soft tissue. As it would have been much easier to smooth entire rib segments with some sort of abrasive tool prior to drilling, we may conclude that the final products retained these rough surfaces.

**Final product**

All these bones represent debris, discarded pieces from which blanks for final products have been removed. From the shape of the final product it is clear from the trace itself – that these were small circular pieces, with a diameter of c. 1.40-1.00 cm. According to Klippel and Schroedl’s work on bone button production on St Kitts, there was less than 1 mm difference between maximum disc diameters and minimum hole diameters, (1999: 227-228) Our material shows a similar pattern.

In several examples, discs were not cut out completely, but where left partially embedded in the bone. This enables us to make a relatively precise reconstruction of the bone discs. It can suggested that the buttons – were circular in shape, with their outer edges slightly truncated at the upper surface. At the centre, they had small perforations c. 1-2 mm in diameter. As mentioned above, the bone discs fall into two sizes with only small variations.

It has been estimated that the total number of end products from this debris will have amounted to at least 370 bone discs.

**DISCUSSION**

Similar finds, consisting of both debris and finished items, have been discovered at several sites in Europe, but also in colonial contexts outside Europe, dating from late medieval into modern times. Their interpretation is two-fold, as rosary beads and as buttons.

In Tallinn, Estonia, over 40 bone scrap fragments and 6 semi-finished or finished pieces were discovered in the street called Roosikrantsi, and were dated to the medieval and early modern periods (Luik and Madre 2003, also Luik, this volume). The debris itself can be dated to 15th-17th century (Luik and Madre 2003), although some may be a little more recent in date (see Luik, this volume). Most of this debris originated from large mammals, mainly *Bos* ribs, although scapulae and a few long bones were also discovered. They were interpreted as beads or buttons, and it was noted that some scrap fragments were quite thick and were therefore more likely to be the remains of bead-making.

In Visegrád, Hungary, such debris was discovered along with other bone refuse, from dice making, and also with a rare find of an iron bit used in manufacture, suggesting that this had been bone carving workshop. This material was interpreted as the remains of a rosary bead making workshop and was dated to the 14th-15th centuries (Gróf and Gróh 2002).

Remains of bone manufacturing debris from the late medieval –early modern period has been discovered at several locations in In Wroclaw, Poland, (Konczewska 2010, 2011, Pawłowska 2011). Debris from the production of disc-shaped final products, mainly from large long bones, was noted in several streets (Konczewska 2011), including those areas where written documents mention rosary manufacturing (Konczewska 2010).

In Konstanz, Germany, morphologically similar types of debris have also been discovered, although in the case...
mainly from long bones, and the end-products seemed to have been more carefully made, with smooth surfaces, perhaps even with additional polishing (cf. Röber 1996: 118-119, Spitzers 1999: abb. 2, 6). These finds were date from the 15th and 16th century (Spitzers 1999: 242).

Similar findings are known from France (Maire 1998) and Italy (Bianchi 2014 with references). The closest European comparison to our assemblage comes from Pavia (Bianchi 2014: fig. 1). The bone working debris in Pavia also dates from the 18th century and contains a similar range of rough rectangular plaques from large mammal ribs with spongy tissue exposed on the lower surface. Three of these were made from other flat bones and only one was smoothed on both surfaces (Bianchi 2014: 177).

The process of manufacture of beads can also be reconstructed after written sources and illustrative evidence. Miniatures and engravings from the 15th to the late 18th century provide representations of artisans working, so some details may be observed, especially tools used, such as diverse boring and drilling tools. Particularly important are Diderot and D'Alembert's Encyclopaedia from the 18th century, that shows several artisans at work and below the tools they used (Moreno García et al. 2010: 187, fig. 9) and a drawing of a German Paternosterer at work, from the Stadtbibliotheken in Nürnberg, dated into the first half of the 15th century (Sandor 1961: Fig. 40; Spitzers 1999: abb. 3, Das Hausbuch) (see also Gróf and Gróh 2002: fig. 4, 5).

In addition to the examples discussed above, particularly interesting bone working assemblages have been recovered in the European colonies – in North America and the Caribbean. Both manufacturing debris and the corresponding single-hole discs have been reported from numerous 18th and 19th century sites in North America (Klippel and Schroedl 1999, Klippel & Price 2007). Many of these (up to two thirds) came from American or British military sites (Klippel & Price 2007: 137-138). One of the richest finds, with over 1000 fragments, comes from Brimstone Hill, St Kitts, West Indies, and was uncovered during excavations of the British fortress, in an area that is known to have been occupied by African slaves (Klippel and Schroedl 1999).

The St Kitts debris is mainly from flat cattle bones (predominantly ribs and occasionally scapulae) and from turtle bones. The bones of coastal turtles are somewhat different to cattle ribs, since they are joined by sutures and do not have cortical bone on the edges; they seemed to have been mainly chopped and not split. Klippel and Schroedl were also able to reconstructed the shape and size of their single-hole bone discs from pieces that several pieces that had not been successfully extracted. The dimensions of these final products showed large variations, with diameters from c. 8.5 mm to c. 32 mm. In this instance the large buttons had been mainly intended for topcoats, and the smaller ones for waistcoats, trousers, etc. (Klippel and Schroedl 1999, Klippel & Price 2007).

The method of making both beads and buttons by simply drilling discs for further shaping from flat bone segments was, widespread in Europe has also been seen in the examples that have been discussed from the colonies. Distinguishing between bead and button making debris is not easy, and there is always the possibility that
that both beads and buttons were produced in the same place and by the same technique.

This was not the only method for bead making. Finds from Seville, Spain, dated from the 18th century (Moreno García et al. 2010) include several groups of from several phases of working, allowing the reconstruction of manufacturing techniques (Moreno García et al. 2010: 186-187; similar finds also came from France – Maire 1998). In these examples, both beads and buttons could have been produced by using the same technique, only the buttons would have had different dimensions, being larger in diameter and thinner.

In distinguishing the debris of buttons from those of beads the very choice of raw material is important. Long bones, particularly cattle metapodials, were preferred for beads, as more thick end-products could be made from them. Also, such bones are naturally smooth, so they do not require a great deal of polishing, while flat bones (scapulae, ribs, and occasionally other flat bones) seem to have been preferred for buttons. The choice of raw material depended largely on availability, especially in the case of buttons made for military; where the most available raw material was used (see, for example, use of turtle bones – Klippel and Schroedl 1999). Out of flat bones, ribs are the most abundant, and can be obtained from kitchen waste; although scapulae may have been easier to work, requiring less preparation for obtaining one blank, the quantity available would have been much smaller.

When considering possible uses the the context of finds must be carefully considered. Some examples have further evidence in the form of written documents, confirming that rosary manufacturing occurred in certain quarters, in the immediate vicinity of the deposited debris (e.g., Konczewska 2010, Ryc. 174/523-526; 2011: 308, see also the name of the street in Tallinn – Luik, this volume).

**Covered buttons**

MacGregor (1989: 121) suggested that bone discs from many medieval sites were probably the “skeletons” of covered buttons. According to S. Hinks (1995) and W. Klippel and his co-authors (Klippel and Schroedl 1999, Klippel & Price 2007), most of these specimens formed the cores for cloth thread covered buttons.

The analysis of the 18th century cloth covered buttons from the Colonial Williamsburg Foundation collection, done by X-rays, clearly showed that single-hole discs formed the button core (Klippel and Schroedl 1999: 230). One of the recent examples comes precisely from Belgrade fortress, where one such button in a final phase, with cloth covering, may be seen (fig. 8, 9) (Bikić 2013: fig. 3b). With the distribution of finds within this grave context (Bikić 2013: fig. 2), and also the dimensions – 12 pieces with c. 1.4 cm in diameter and two more pieces with c. 1.1 cm in diameter – taken into consideration, these were most likely shirt buttons.

M. Sandor (1961: fig. 43) offered a different reconstruction, with rather a complicated scheme of posing a thread and attaching such a button on the clothes. However, such a central perforation is not particularly convenient for such a method of usage, and K. Jaworski (2012: 178-179) has argued that these bone discs are unfinished, and offered another reconstruction, by adding four more holes around the central one. Numerous finished buttons from osseous materials (mainly more “expensive” ones, such as antlers, discovered in the Crimea, have only one, single hole at the centre (Душенко 2013). We may therefore conclude that in most cases the final shape of the majority of buttons was a single-hole disc, mainly covered by some cloth.

**Clothing the army**

These finds open interesting questions about how the needs of consumers were met. Most of the debris is related to the army, although numerous buttons were probably produced for civilians as well. In cases from British fortresses, the sheer quantity of debris demonstrates how large the needs of the army were. Most of armies in early modern times had their own supplying centres. Clothes were the next most important item after food (Tallett 1992: 119). Furthermore, shoes, coats, socks, wore out rapidly, so soldiers would borrow, even steal clothes from civilians, other soldiers, or even plunder from the dead and...
wounded. Particularly new recruits would join in their own, personal clothes. In the early eighteenth century only elite troops would have worn something resembling the full uniform, ordinary soldiers were often identified as belonging to the same side by markings or badges (an armband, a sash, piece of fern or feather in their cap, etc.).

Over time, regular government contracts for large quantities of clothing, boots, etc., and increasingly detailed specifications concerning cut, colour and pattern of soldiers’ clothes, led inevitably to increased standardization. We may in fact observe the emergence of uniforms in attempts to make the supplies of clothes regular and sufficient. For example, the Austrian War Council ordered in 1707 that all infantrymen should wear clothes of light grey, the colour which had increasingly been associated with the Imperial forces from the time of the Thirty Years War (Tallett 1992: 118-120). However, there are no archaeological examples of how and on when this decree on army clothes was put into practice and to what extent.

As for our example from Belgrade fortress, although the quantity seems modest when compared to British military sites, it is important to outline that the time span is quite short and the entire find most likely presents a single-event, i.e., one episode of preparing / repairing the clothes for soldiers. It is interesting to note that within the same context, within Blockhouse, bronze buttons with imperial initials were also discovered, thus confirming the logical assumption that high-ranking officers were present at the Fortress.

CONCLUSIONS

This, for the time being unique find from the territory of Serbia, offers some interesting information on button production and the army, but also raises some interesting questions. It is evident that the debris was produced in a short time period, most likely representing a single event, therefore, the question is, who made the buttons and why? Was this the work of a specialized craftsman or workshop? Was there a need for Austrian army to quickly renew the uniforms? Or was this regular activity? Furthermore, it is difficult to assess what the quantity of bone debris means, for example, how many uniform pieces could this quantity of button blanks furnished and for which parts exactly were these buttons used?

This Belgrade find is particularly important as it demonstrates the wide geographical distribution of this method of button production, which now includes South-Eastern Europe. Our assemblage comes not only from a securely dated context, but also one with a very narrow time frame. Good preservation also revealed some interesting technological traits, and enabled the full reconstruction of the chaîne opératoire and comparisons with analogous finds from other parts of the world.

Most of the button production debris reported from other parts of the world show the same main characteris-

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INTRODUCTION

This paper is devoted to two bone anvils which were discovered during the recent excavation of the Viminacium amphitheatre. Finds of bone anvils are very important, as they summarize our knowledge on bone working, metallurgy and agriculture. The function of similar bones in the past gave rise to different misled interpretations, from the assumption that they were tools for polishing wood and stone (Semenov 1964), to those about the unknown Getic writing system (Boroneanț 2005). However, recent ethnographic studies that were initially made by M. Esteban Nadal (2003), and later by other authors, too (Esteban-Nadal and Carbonell Roure 2004, Aguirre et al. 2004) resolved the function of those tools. They identified them as anvils that were used as a base for manufacturing saw-teeth on blades of iron sickles by hammer and chisel. 

The earliest appearance of bone anvils is related to the Hellenistic period and comes from the site of Olbia in Ukraine and from Greco-Scythian sites Neapolis and Thanagoria (Semenov 1964: 186) and also from Getic settlements (Arnăut 2007). Along with Viminacium there are only few sites from Roman period with reported bone anvils. In the city of Histria (Romania) within the 2nd–3rd century AD deposits, 40 specimens of bone anvils were discovered (Beldiman et al. 2011b), while 4 bone anvils were found during the excavations of the site Ostrov-Durostorum (Romania) (Beldiman et al. 2011a). At the site of Chitila (Romania), that is related to Getic autochthonous population, 13 anvils were discovered (Beldiman et al. 2011b, Boroneanț 2005). There is also a single find of a bone anvil from the site of Pantanello (Gál 2010: 9) in Southern Italy, which has been dated between the early 2nd century BC to the beginning of the 1st century AD (Gál and Bartosiewicz 2012). Within the western Mediterranean region (Iberian peninsula, France, North Africa) numerous finds of bone anvils have been detected, dating back from the 5th to the 20th century AD (Grau-Sologestoa 2012, Poplin 2007, Poplin 2013, Rodet-Belarbi et al. 2007 and references therein). Bone anvils were also found in early medieval deposits in Hungary (Gál et al. 2010).

The appearance of anvils and specific use wear marks did not change through all these periods. The majority of anvils were made of ungulate long bones, usually metapodials, but there are also examples of usage of other bones, such as mandibles (Grau-Sologestoa 2012) or even red deer antlers (Beldiman et al. 2011a). Metapodial shafts were usually first flattened by file before usage and then smoothed. In the course of serration, the blacksmith would move the sickle on the anvil (figs. 5, 6). Once a bone was covered with rows of dents, it could be flattened and smoothed again, in order to be reused.

ARCHAEOLOGICAL BACKGROUND OF VIMINACIUM FINDS

Viminacium is located near Kostolac in Eastern Serbia, on the right bank of the Mlava River, close to its confluence with the Danube River (fig. 1). Initially it was a legionary fortress. Along the fortress, which was built...
during the 1st century AD, a city developed. Viminacium was the capital of the province of Moesia Superior, while in the late Roman period it was the capital of the province of Moesia Prima (Mirković 1968: 56–73, Поповић 1968).

Bone anvils were discovered within the Viminacium amphitheatre, which was situated in the north-eastern corner of the ancient city area, approximately 50 m away from the north-western corner of the legionary fortress (fig. 2). Based on previous archaeological excavations, it can be assumed that the amphitheatre was built at the beginning of the 2nd century AD and that it was used until the end of the 3rd or early 4th century AD (Nikolić and Bogdanović 2012). Both anvils belong to the layer that dates back to the middle and second half of the 4th century AD. At that time, the amphitheatre was abandoned, buried and not in use anymore, while in the late 4th century AD, a necropolis was set in this area (Nikolić and Bogdanović 2012: 44, Vuković and Bogdanović 2013: 254–255).
Viminacium Bone anvils

The first anvil represents an almost complete horizontal beam of a right cattle mandible (fig. 3). It is 222 mm long and 87 mm wide. On both outer and inner flats there are ca. 40 rows of small marks in the shape of triangles with V-shaped cross section. The length of the base of triangular marks is 1.5–2 mm and the length of rows varies between 8 and 28 mm. The majority of the rows run parallel to each other, while there are some that cross and run in various directions. The basal rim of this mandible in one of its part is smoothed down.

The second anvil was made of a distal cattle metatarsus (fig. 4) and its preserved length is 114 mm, while it is 35 mm wide. The tool is not complete: on the proximal part there is an old breakage, while the lateral condylus was broken in the course of excavations. The anterior and posterior sides of the diaphysis of this metatarsal bone had been whittled down and smoothed prior to its usage. On both the anterior and posterior sides there are rows of triangle dents with V-shaped cross section: 6 on the anterior and 12 on the posterior side. The dents are 1.5–2 mm long, and the rows are ca. 20 mm in length and they follow the entire width of the bone. There are rows which are mutually parallel, but there are also the ones that cross others. Shallow differently oriented scratches that vary in size have also been noted on both wider sides of this bone. Those marks sometimes run over the incisions, while sometimes incisions also run over them.

Discussion

The two bones from Viminacium that were used as anvils have different features (figs. 3, 4). While the metatarsal bone had been flattened prior to its usage, the mandible outer and inner sides had not been previously prepared. This is probably due to the fact that the mandible has more or less flat sides in contrast to the metatarsus which has a convex shaft. The smoothed part of the mandible basal rim represents either use wear marks left by the blacksmith’s grip on the anvil while working, or traces of bone smoothing for the purpose of easier maintenance of the anvil. Both anvils had two active sides. Rows of triangular dents that run across both sides of those bones represent typical use wear marks for bone anvils formed during shaping of sickle teeth (figs. 5, 6). Scratches on metatarsal diaphysis that run across and beneath the rows of dents indicate that this anvil was smoothed down again and reused. Since intensive reusing of anvils during reshaping usually produces breaking of the shaft of the bone (Beldiman et al. 2011b: 180) we suggest that this anvil could have been broken in the course of its usage. The metatarsal anvil represents a typical tool of its kind that suggests specialization of the blacksmith.

Metapodial bones were the most frequent raw material used for making bone anvils in Roman times, as well as in other periods. The Pantanello anvil (Gál 2010: 9) was also made of cattle metapodial and majority of bone anvils from the Roman sites in Romania (Beldiman et al. 2011b: 180)
Late Roman bone anvils from Viminacium (2011b) were made of cattle metapodials, too. Mandibles were used as anvils less frequently and similar anvils made of this bone are known from medieval sites in France, Portugal and Morocco (Grau-Sologestoa 2012). Mandibles and metapodial bones usually fall within primary butchery waste (O’Connor 1993), so there is a possibility that they were intentionally segregated at this stage of butchery to be used in blacksmiths workshops as anvils.

CONCLUSION

The discovery of the bone anvils from Viminacium is a unique finding within the territory of Central Balkans. These tools are not well known among archaeologists and we argue that there are probably more anvils hidden in the faunal material of other Roman and late Roman sites across Europe. As bone anvils were used during shaping serrated teeth of iron sickles, they are an indirect proof of the existence of these agricultural tools mentioned by Columella (De re rustica II.20.3, Poplin 2013b). Sickles (falx messoria) of different types (White 1967: 72–85, 205–210) have been found on numerous localities throughout the Roman Empire, as well as within the provinces on the territory of Serbia (Поповић 1988: 82–86, Чолаков 2010: 51–56). According to ancient written sources (Varro, De re rustica I.49–50, Columella, De re rustica II.20), depictions on Roman monuments (Поповић 1988: 83, White 1967: 84–85) and ethnographic data (Esteban-Nadal 2003), it is known that sickles were mostly utilized by soldiers and civilians in the reaping of cereals (fig. 7).

Viminacium is located in the fertile plains of Stig, where Roman agricultural activities have been attested (Spasić-Đurić 2009: 44–45, Ilić 2012: 14–15, Живановић 2013: 24–25). Several late Roman villae rusticae that represent a key for landownership and agricultural production have already been archaeologically confirmed in the vicinity of this city (Jovičić 2011: 30–43, 60–67, Jovičić 2012). Tools and other finds related to agriculture have been discovered in Viminacium area, as well within other Late Roman sites in Serbia (Поповић 1988, Живановић 2013: 57–83, Ilić 2012). The finds of bone anvils certainly complement the picture of developed agriculture in this region. Their presence also suggests the existence of blacksmith workshops, which have not yet been discovered in the area of Viminacium.

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INTRODUCTION

The purpose of this paper is to explore two relatively new analytic techniques that have been applied to bone tools thought to have been used in ancient hunting weapons. The techniques rely on patterns of macro- and micro-fractures in brittle solids to identify potential causes of mechanical failure. I present the results of previous experiments undertaken to establish the reliability of these techniques on bone tools and the potential that these techniques hold for the functional analysis of archaeological artefacts. As with all use-trace analyses, these techniques are intended to form part of a multi-analytical approach.

In recent years there has been a proliferation of research into the origins of projectile technology, which, due to the poor preservation of organic materials, has tended to focus on the better represented stone tools (e.g. Lombard 2005, 2007, 2011; Lombard & Pargeter 2008; Sisk & Shea 2009; Yaroshevich et al. 2010). By 'projectile' I mean an object that is projected via an intermediary mechanism, such as an atlatl or bow. Quartz segments found in approximately 60 000 year-old deposits from KwaZulu-Natal, South Africa, have been interpreted as arrow armatures, based on morphology and use-wear studies (Wadley & Mohapi 2008; Lombard 2007, 2011; Lombard & Phillipson 2010). Together with a bone point from Sibudu (Backwell et al. 2008), these are currently thought to constitute the earliest evidence for mechanically projected flight weaponry, such as a bow and arrow. Mechanically projected weapon systems are regarded as
symbiotic technologies and signal a high degree of cognitive flexibility – a trait unique to our species (Lombard & Haidle 2012). The use of projectile technology would have significantly altered social relations among early human populations by allowing them to exploit a wider trophic niche (Shea 2011). The challenge for archaeologists is recognizing these weapon components and distinguishing between those tools that were used as thrusting or throwing spears and those that were used with the aid of an intermediary mechanism like a bow.

The study of bone tools has concentrated primarily on the identification of use-traces to identify past function, using the principle of tribology (e.g., Chomko 1975; LeMoine 1994). This principle states that when two surfaces come into contact and friction is produced, similar materials and similar modes of use will result in similar types of wear, identifiable under a microscope. The underlying premise is that types of wear equate to specific functions and/or specific contact materials (Semenov 1964; Chomko 1975; Olsen 1989; Griffiths 2001). There have been a host of such studies, focused on the identification of archaeological bone tool functions, published under the auspices of the International Council of Archaeozoologists’ Worked Bone Research Group (e.g., Choyke & Bartosiewicz 2001; St-Pierre & Walker 2007; Legrand-Pineau et al. 2010). Although use-wear can develop relatively quickly (Buc & Loponte 2007; van Gijn 2007), most tools pass through a stage of indistinct polish before sufficient use-wear traces build up to allow for accurate identification of contact material or function (LeMoine 1994; Griffiths 1997). Tools used for different lengths of time in the same activity and on the same material may appear different (Buc & Loponte 2007; Thompson et al. 2011). Many bone points for example, including awls and hunting points, may develop rounding along the tip and edges (Arndt & Newcomer 1986; Buc 2011) making identification of specific function difficult.

While most bone tool studies have relied on use-wear features such as polishes and striations, some have looked at breakage patterns (e.g., Arndt & Newcomer 1986). These studies, however, have tended to use a descriptive nomenclature different to comparable stone tool studies. For example, terms such as spiral, dull, split (e.g., Tyzzer 1936), transverse, jagged (e.g., Pokines 1998), cleavage (Langley 2015) and bevelled fractures (e.g., Arndt & Newcomer 1986) have been used, which are themselves simply morphological descriptions; they tell us very little about the mechanical forces responsible for their formation. Bone is a highly complex material that is susceptible to a number of different types of fractures depending on the type and condition of the bone (see Cowan 2001; Currey 2012). As bone dries out it behaves more like an inorganic brittle solid, making it suitable for macrofracture analysis and other types of brittle solid failure analyses (Guthrie 1983; Johnson 1985; Kasiri & Taylor 2008). It is worth looking at the nature of brittle solid fracture before exploring the two techniques used to interpret bone tool function.

BRITTLE SOLID FRACTURE

Simply put, the theory of fracture mechanics states that certain fractures will develop on brittle-solid tools used in a specific activity (e.g., Hayden 1979; Lawrence 1979; Dockall 1997). Although bone is anisotropic (Johnson 1985; Knecht 1997; Szabó & Thurner 2013), and has been shown to be more durable than stone weapon tips when used experimentally (e.g., Currey 1979), it nevertheless shares the same fundamental properties as all brittle solids and responds in predictable ways when stressed (Lawn & Marshall 1979; Guthrie 1983; Cotterell & Kamminga 1987; LeMoine 1994, 2001, 2007; Kasiri & Taylor 2008), a fact that has been borne out in subsequent experimental studies (e.g., Arndt & Newcomer 1986; Griffiths 2006; Bradfield 2011; Bradfield & Lombard 2011). This is due to the presence of calcium hydroxylapatite in cortical bone, which is responsible for rigidity and which, during fracture, behaves more like stone than other osseous materials, such as antler (Guthrie 1983).

As bone dries out it loses elasticity and the relative frequency of calcium hydroxylapatite crystals increases. Under these conditions cortical bone becomes a semi-brittle solid, subject to brittle fracture (Piekarski 1970; Bonfeld 1987). Under non-dehydrated conditions, however, cortical bone loaded by a high-velocity impact, such as from projectile hunting, will also experience brittle solid shattering (Hollinger et al. 2005). The HOHO commission identified two broad types of fractures, namely Hertzian and bending, each of which have several distinct types of fracture terminations (see Hayden 1979). The identification of these fracture termination types can be used to establish a number of variables, for example, the amount of force exerted, vertical direction of the force and the nature of the contact area (Hayden 1979). We can therefore appeal to the mechanics of brittle solid fracture to identify potential bone weapon tips.

A long bone such as a humerus or femur consists of cortical and trabecular bone. Archaeological bone points were usually made from the denser and stronger cortical bone, which in turn consists of Haversian bone and plexiform bone. Viewed in cross section, Haversian bone consists of a number of osteons, made up of Haversian canals and concentric cement lines, surrounded by lamellar bone matrix (FIG 1.). Running perpendicular to the Haversian canals are Volkmann’s canals. These canals serve to supply blood to the rest of the bone. Also present in the bone matrix are air spaces called voids or lacunae. On the other hand, plexiform bone has a brick-like structure of force exerted, vertical direction of the force and the nature of the contact area (Hayden 1979). We can therefore appeal to the mechanics of brittle solid fracture to identify potential bone weapon tips.
Haversian bone. This is because the volume fraction of voids in Haversian bone, which are, together with canals and vascular spaces, the sites around which stress concentrates, is higher than that in plexiform bone (Lakes et al. 1990; Kim et al. 2005, 2006). Therefore more energy is required for crack propagation in plexiform bone (Kim et al. 2005).

Another property of brittle solids is their tendency to deformation wear, characterised by the formation of micro-crack networks, caused by elastic deformation around impact locations (Lawn 1993; Vashishth et al. 1997; Sklar & Dietrich 2004; Thompson et al. 2011). Bone is known to develop micro-cracks as a result of fatigue and other accumulated mechanical stress factors, usually when subject to a dynamic load greater than its tensile strength (Johnson 1985; Lakes et al. 1990; Kim et al. 2006; Leng 2006; Rennick 2012). Such damage manifests as cracks and/or separations in the non-lamellar portion of plexiform bone and between cement lines in Haversian bone (Schaffler et al. 1989; Abdel-Wahab et al. 2012). Micro-cracks in Haversian bone are short and randomly orientated, whereas in plexiform bone micro-cracks are longer and parallel to the lamellar bone, albeit that they develop less frequently (Kim et al. 2005). Micro-crack deformation in cortical bone has been recorded to range from 1 μm to 3.5 μm in diameter and can easily reach 100 μm in length (Leng 2006; Kasiri & Taylor 2008; Abdel-Wahab et al. 2012). Cracks that are oriented longitudinally are, however, known to result in lower fracture toughness compared to cracks oriented transversely (Lucksanasombool et al. 2001), and are therefore likely to develop more rapidly and obtain greater dimensions than their transverse counterparts (O’Brien et al. 2003). This is due to the intrinsic nature of long bones which tend to experience failure parallel to the fibre structure (Behrensmeier 1978). Different parts of the bone and the skeletal element from which the bone derives is also important in determining fatigue strength (Reilly & Currey 1999). Techniques commonly used to examine micro-crack propagation for medical purposes are thin-sectioning (Burr & Hooser 1995), scanning electron microscopy (Schaffler et al. 1994), and confocal laser microscopy (O’Brien et al. 2000). All these methods make use of two-dimensional thin sections and are therefore destructive procedures, unsuited to the examination of archaeological tools.

The study of anthropogenic bone tool breakage is not new (e.g., Tyzzer 1936; Currey 1979; Guthrie 1983; Arndt & Newcomer 1986; Knecht 1997; Choyke & Bartosiewicz 2001; St-Pierre & Walker 2007; Legrand-Pineau et al. 2010). The study of fracture patterns is just as informative as other use-trace indicators; yet, whereas there appears to be a standardised nomenclature to refer to and describe polishes and striations, the same cannot be said of fractures (see Langley 2015). Given the similarity in breakage patterns between stone and dry bone and bone subject to high velocity longitudinal impact, it makes sense to use the same rigorous, verifiable and demonstrable approach to functional studies (sensu Johnson 1985).

**MACROFRACTURE ANALYSIS**

Macrofracture analysis is a method that is easy to use and does not require a microscope. It is based on the principles of fracture mechanics and explores the break-
age properties of brittle solids subject to use (Hayden 1979; Odell 1981). It is used primarily in the examination of stone tools thought to be part of ancient hunting weapons (e.g., Fischer et al. 1984; Odell & Cowan 1986; Lombard 2005; Lombard & Pargeter 2008; Villa et al. 2009a, b, 2010), but has been shown to be equally applicable to bone points (Bradfield 2011; Bradfield & Lombard 2011; Pargeter & Bradfield 2012).

For points used as weapon tips a fracture may occur when the point hits a hard surface perpendicular to the point’s main axis. The impact can cause chips to detach from the dorsal and ventral surfaces near the tip. Next, one or more transverse bending fissures may travel down the lateral edge of the point’s length as the force of the impact is transferred down the point (Bergman & Newcomer 1983). Various factors influence the type of fractures that will occur. Most of these factors have to do with the morphology of the point, particularly the relative length and cross section shape of the point (Bergman & Newcomer 1983). The most common type of damage to points used for hunting occurs at the tip (Frison 1989). Depending on the type of fractures, the position of the fractures and the particular grouping of various fracture types, inferences can be drawn as to the probable activity responsible (see Bergman & Newcomer 1983). Various factors influence the type of fractures that will occur. Most of these factors have to do with the morphology of the point, particularly the relative length and cross section shape of the point (Bergman & Newcomer 1983). The most common type of damage to points used for hunting occurs at the tip (Frison 1989). Depending on the type of fractures, the position of the fractures and the particular grouping of various fracture types, inferences can be drawn as to the probable activity responsible (see Bergman & Newcomer 1983; Fischer et al. 1984; Lombard 2005; Yaroshevich et al. 2010). These types of fractures are commonly referred to as macrofractures.

Fischer and colleagues (1984) conducted experiments on stone tools to isolate and define macrofractures that could be considered diagnostic of the type of impact associated with hunting. They referred to these macrofractures as diagnostic impact fractures (DIFs). These DIFs included step-terminating bending fractures, uni-facial and bifacial spin-off fractures and impact burinations (FIG 2). Later the method was refined to exclude spin-off fractures smaller than 6 mm to avoid confusion with accidental breakage patterns (Lombard 2005). The simplest DIFs recorded during stone tool studies are step-terminating bending fractures. These result from longitudinal pressure from the distal and proximal ends of the objects (Fischer et al. 1984). Probably the most easily recognisable DIFs are bending fractures from which spin-off fractures initiate (Fischer et al. 1984). Bending fractures that result from pressure perpendicular to the dorsal and ventral sides of the objects will result in small spin-off fractures on only one broad side. On artefacts used as impact tools, where the forces run parallel to the broad sides, the spin-off fractures can have considerable dimensions, and long spin-off fractures can occur on one, or even both sides. Spin-off fractures on both sides of a point, initiating from the same bending fracture, can in practice occur in hardly any other way than through use as a hafted impact implement such as a spear or arrow. This type of fracture is therefore considered diagnostic for impact use, irrespective of the dimensions of the fractures (for further fracture definitions and illustrations see Hayden 1979; Fischer et al. 1984; Villa et al. 2009a; Yaroshevich et al. 2010). Recent bone tool experimental studies have attempted to follow this nomenclature when referring to use-related breakage on bone tools (Bradfield & Lombard 2011; Pargeter & Bradfield 2012; Bradfield & Brand 2015), although a host of other studies demonstrate bone tool breakage patterns consistent with hunting implements (e.g. Tzyzzer 1936; Petillon 2006). These studies have shown that step-terminating fractures can develop on bone through trampling and accidental dropping, and are thus not a reliable indicator of longitudinal impact in bone tools (Pargeter & Bradfield 2011; Bradfield & Brand 2015). The only DIF that occurs in bone subject to longitudinal impact, and no other activity, is the spin-off fracture larger than 6 mm.

It must be remembered that macrofracture analysis identifies longitudinal impact rather than hunting impact per se. At this stage we cannot distinguish between a hand-projected spear point and a mechanically projected arrow. One of the limitations of the macrofracture method is that, in any given experimental hunting sample, macrofractures and DIFs only occur in a minority of cases, making it difficult to interpret the possible hunting function of individual pieces. As such, it would be unwise to rely on this method alone to identify a hunting assemblage (sensu Rots & Plisson 2014). What is needed is a way to identify tools that have undergone impact, but which show no visible signs of damage on the surface.

**MICROFOCUS-COMPUTED TOMOGRAPHY**

Micro-focus computed Tomography is a relatively new procedure to acquire an archaeological application (e.g., Jacobson et al. 2011, 2012; Bradfield 2013). The
machine, which is more commonly used in palaeontological research to acquire three-dimensional images of fossils embedded within rock, has recently been used to view micro-damage in cortical bone: its effects on bone strength \textit{in vivo} (Leng 2006), and its propagation from impact (Bradfield 2013). Here I review the potential application of this technique to archaeological bone tools as a method for investigating past function.

The X-Tek microfocus X-ray computed tomography (Nikon Metrology XTH 225/320 LC dual source industrial system) machine, hereafter referred to as the micro-CT scanner, works by sending x-rays from a target through a rotating specimen to a detector panel (FIG 3). The images picked up by the detector panel are sent to a computer where the images are reconstructed using advanced imaging software. The micro-CT scanner is capable of scanning objects ranging from a block of breccia to a seed-pod, achieving maximum spatial resolution in the region of 5–10 \(\mu\text{m}\), depending on object geometry and the parameters chosen for the task. This technique permits the non-destructive investigation of objects for the purposes of imaging internal structures and performing 3D analyses. Imaging analysis software such as VG Studio Max used with the micro-CT image data allows the viewer to move through the object on any plane, essentially viewing a series of hundreds or thousands of individual images (e.g., .tif or .bmp files).

To enhance the contrast between the bone in the specimen and the surrounding environment, radio-opaque substances such as lead sulphide (PbS) or barium sulphate (BaSO\(_4\)) precipitate can be used to treat the bone prior to micro-CT scanning (Leng 2006). These substances are absorbed by the bone and display on x-rays as artificially dense. Because of the absorption factor, this approach is inappropriate for archaeological specimens. Alternatively, the object can be embedded in a homogenous substance such as flour, which will permit higher scanning energies to be used, while also minimizing beam scattering caused by the sharp boundary between the object and the air (see Bradfield 2013). The flour facilitates achieving the necessary material contrast in the images and allows for easy cleaning of the object after scanning. It should be noted, however, that this method too would adversely affect archaeological residues, although it would not destroy them as would lead sulphide and barium sulphate. Once preparation of the object is complete, it is mounted on the manipulator arm of the micro-CT scanner. During my experiments (Bradfield 2013) I tried using two different targets for the various scans – a 225 kV static target and a 225 kV rotating target. Each bone point was scanned using 3000 projections. On average, a spatial resolution of 6.2 \(\mu\text{m}\) was achieved for each specimen – far higher than similar scans of \textit{in vivo} bone in the study by Leng (2006). Due to the proximity of the specimens to the target needed to achieve the high resolution, only the first 10 mm from the tip were scanned. This was deemed acceptable since it encompasses the functional end where micro-structural damage ought to occur.

The aim of my experiment was to test whether the micro-CT scanner could image bone histology to the degree necessary to identify micro-structural damage, and secondly, to test whether different dynamic and static loading conditions result in different micro-structural damage that might allow one to gauge the probably activity to which a tool was put. Five replica bone points were scanned in my experiments, each used in a different activity. These included simulated hunting, hide piercing, ‘accidental’ dropping and peri-depositional trampling. The fifth tool was not used, but allowed to undergo natural weathering for a period of two years (see Bradfield 2013). Not only were micro-cracks identifiable in the micro-CT scans, but distinguishable patterns of micro-cracks were observed in the various bone points that can aid in the interpretation of function (FIG 4). The bone awl used for hide piercing developed single micro-cracks originating from the macrofracture. The bone point that had undergone trampling by goats’ hooves developed a distinctive mesh pattern of micro-cracks, not present in any other specimen. The bone point that had been allowed to undergo natural weathering developed circumferential micro-cracks associated with bone weathering stage 2 (Behrensmeyer 1978). The bone point that had undergone simulated hunting impact developed
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the most micro-cracks of all the experimental specimens. In this case it was observed that numerous micro-cracks had grouped together along the direction of the bending force and merged to form fatigue cracks (FIG 4; Bradfield 2013). Micro-cracks, occasioned through stress and which develop along and between the cement lines in Haversian bone, will multiply and increase in size in proportion to the amount of force or stress experienced. Eventually, several micro-cracks will merge to form the larger fatigue cracks seen in the figure. Had more force or continued force been applied, I expect that these fatigue cracks would have propagated through to the other side of the bone point resulting in a macrofracture.

While micro-CT scanning has the potential to add interesting and informative lines of evidence to our interpretation of bone tool function, it does have limitations. For instance, to achieve the necessary resolution, the bone point must be placed as close to the x-ray emitter as possible. This means that only a small portion (~10 mm) of the specimen can be scanned at any one time. In order to obtain results from an entire tool multiple scans are necessary, which can then be digitally stitched together. This does, however, increase the cost and time required for analysis.

DISCUSSION AND CONCLUSION

In this paper I have presented a brief review of two new methods of use-wear analysis that can be applied to the investigation of bone tool function. My own research is focused on the identification of hunting function, and it is within this context that my discussion is largely confined. Both methods rely on the principles of brittle solid fracture under longitudinal impact loading conditions. During high speed impact, bone fracture toughness reduces greatly with increased loading rates resulting in fracture patterns similar to brittle solid fracture in inorganic solids (Arndt & Newcomer 1986; Adharpurapu et al. 2006; Griffits 2006; Bradfield & Lombard 2011). Macrofracture analysis can therefore be used to detect tools that have experienced high velocity longitudinal impact such as a hunting weapon would be expected to experience. However, even on bone points of known hunting function, spin-off fractures occur only on a minority of specimens (Bradfield & Lombard 2011; Bradfield 2012). In other words, while a spin-off fracture will indicate longitudinal impact consistent with hunting use, its absence does not necessarily rule out this activity. Further analytical criteria are needed in conjunction with macrofracture analysis to identify potential hunting weapons.

This issue of differential damage in macrofracture analysis and ambiguity in traditional use-wear analysis necessitates another avenue of functional exploration. Another property of brittle solids, and also of bone material regardless of its moisture content, is its tendency to produce micro-cracks when fatigued (Lawn 1993; Sklar & Dietrich 2004; Thompson et al. 2011). The size and dimensions of the micro-cracks are important for differentiating them from naturally occurring histological features, such as canals. Micro-CT scanning allows for micro-cracks, and other naturally occurring features, to be viewed in three-dimensions and thus obtain a more detailed understanding of micro-crack and fracture propagation than traditional histological thin-sections. This ability, as has been shown, is vitally important in distinguishing between utilitarian and natural fractures as well as histological features such as canal spaces. My own experiments with the micro-CT scanner have confirmed Shipman’s (1981) observation that different breakage conditions produce different
micro-structural responses in bone. An analysis of these responses can shed light on the conditions that caused them. In the absence of unambiguous surface indicators, micro-CT scans might provide one avenue of further functional exploration, helping to resolve the question of whether bone points functioned as weapon tips. The technique is also able to detect other forms of use-related damage, such as low-velocity impact through hide piercing and incidental damage that could result from trampling, dropping, or even natural weathering (Bradfield 2013). While a promising avenue for future studies, this technique is still in its infancy. A greater number of experimental conditions need to be tested before this technique is applied to archaeological material.

Together with macrofracture and use-wear analysis, micro-CT provides a promising avenue for investigating bone tool function, especially in relation to their potential use as part of hunting weapons. It is important to note that the mechanics of brittle solid fracture measure longitudinal impact and not hunting per se. The brittle fracture techniques therefore have not bridged the old problem of equifinality. Macrofracture and micro-CT are not mutually exclusive of other use-wear analyses. Neither is intended as a stand-alone technique. The veracity and reliability of interpretations are greatly increased by using a multi-analytical approach. Together, use-trace analysis can provide a promising avenue for research on archaeological tools.

REFERENCES


Abstract: The Quebrada del Real 1 is a rock-cave archaeological site located in the Sierras of Córdoba (Córdoba province, Argentina). The site presents a long-term human occupation from ca. 7400 years BP to the final Late Holocene (1100-360 years BP). Bone tools were recovered only in the Component 2, dated at the early Late Holocene (ca. 3000 years BP). The cultural context of the Component 2 showed that the rock-cave was used by foragers as a seasonal base-camp, where the processing and consumption of ungulates, small-game and seed were the main activities developed. However, the bone tool morphology, physical and use-wear diversity suggests that multiple activities were also carried out on animal and plant tissues that rarely preserved archaeologically. The study draw to the conclusion that the need to process the by-products of a broad-spectrum diet through the diversification of bone technology may not have been an exclusively phenomena of the Late Prehispanic Period (ca. 1100-360 years C14 BP). Thus, its origins may be found during the early Late Holocene, ca. 3000 years BP.

INTRODUCTION

The archaeological research of the Sierras of Córdoba has been increased over the last years by the development of systematic studies on human peopling during the Pleistocene-Holocene Transition and their changes across the Holocene (Cornero et al. 2014; López et al. 2015; Rivero 2009, 2012; Rivero & Medina 2013; Rivero et al. 2008-2009, 2010). However, the studies on bone technology have been relegated to a second place due to the priority of the archaeology to answer chronological questions focusing on the lithic projectile technology.

The bone tools recovered in the middle levels of Quebrada del Real 1 archaeological site are analyzed in this paper. The bone tools were mentioned in Rivero et al. (2008-2009), but never studied in detail. Thus, the aim of this paper is to provide a full morphological, physical and use-wear description of the assemblage exploring the nature of the activities performed in the site and their relation with the intensification process observed during the Sierras of Córdoba Middle and Late Holocene (Berberián et al. 2008; Rivero 2009; Rivero et al. 2010).

MATERIALS & METHODS

Quebrada del Real 1 (QR1, S 31° 40.330’, W 64° 53.538’, 1914 m.a.s.l., Figure 1) is a rock-cave located in the Pampa de Achala upper mountain grassland range (Córdoba Province, Argentina) (Rivero et al. 2008-09). The site shows a long-term human occupation from ca. 7400 years BP to the final Late Holocene (1100-360 years BP), but the bone tools considered in this paper were recovered only in the Component 2 (C2). The C2 archaeological assemblage is dated at 2950 ± 90 year C14 BP (LP-2042; charcoal) and is characterized by the presence triangular projectile points with slightly to markedly concave bases and the absence of pottery, resembling to other Middle Holocene and early Late Holocene deposits of the area (Medina et al. 2011, 2012; Rivero 2009; Rivero et al. 2008-2009). The lithic and faunal evidence of C2 suggests that the rock-shelter was used by human foragers as a short-term site for large-groups food processing and consumption task, where the main activity was the processing and consumption of guanaco (Lama guanicoe), pampas deer (Ozotoceros bezoarticus) and small rodents (Medina et al. 2011, 2012; Rivero 2015; Rivero et al. 2008-2009). However, edible seeds and plant fibers processing were also suggested by seven hand-stones recovered in stratigraphy (López et al. 2015; Pastor et al. 2012).

The C2 bone tool assemblage is formed by 10 items, including complete or near so bone tools, pre-forms and manufacture by-products. The assemblage was classified into morpho-functional groups following Campaña (1989) and Camps-Fabrè (1967): flat points, blunt
points, pin-like tools and spatulas. The anatomical and taxonomical identifications were based on the reference collections of the Área de Arqueología del Centro de Estudios Históricos “Prof. Carlos S.A. Segreti” and Museo Argentino de Ciencias Naturales “B. Rivadavia”. The physic, metric and microscopic structures were determined to identify the functionality and manufacture processes of tools. Metric structure was taken according to usual parameters: maximum length, width and thickness, and apical length, width and thickness. A binocular and an incidental microscope from 20X to 200X were used for microscopic analysis. Use-wear patterns were described, photographed and defined according to reference collections, which include our experimental database and publications (cf. Averbouh & Provenzano 1998-1999; Borella & Buc 2010; Buc 2012; David 2008; D’Errico et al. 2012; Legrand 2007; Legrand & Sidéra 2008; Nami & Scheinsohn 1997; Sidéra 1993; Stone 2011).

RESULTS

The bone tools include three pin-like tools, one spatula, one flat point and one blunt point (Figure 2a-d). Other four items were considered manufacture waste or artifacts with unknown functionality (Figure 2e-h). The metric and physic data of the assemblage is presented in the Table 1. The intense anthropic modification makes it difficult to identify the taxa and body parts selected to make the bone tool, with the exception of an Andean condor (Vultur gryphus) distal radius and two pampas deer (Ozotoceros bezoarticus) antlers. The lack of sign of burning rules out the use of heat to shape the tools. The items show no weathering or visible taphonomic alteration, which allows the functional and technical analysis.

Flat point

This is a point, flat in its cross section, and fractured in its base(Figure 2a). It shows longitudinal and oblique coarse striations suggesting surface was shaped by abrasion with a coarse-grained material. No other use wear can be seen under high magnification.

Pin-like tools

The pin-like tools are made on non-identified macro-vertebrate long bone splinters (Figure 2b). The metric data suggests that they were made in a standardized...
Close to the bone...

and uniform fashion, mostly in a crucial variable as thickness. Two items (QR1-6; QR1-8) show longitudinal coarse striations interpreted as manufacture traces made with an abrasive coarse-grained material (cf. Averbouh & Provenzano 1998-1999; David 2008; Figure 3a). The variations in the striations’ width suggests that surface was more finely abraded in QR1-6 than in QR1-8, where manufacture traces are clearly visible as a scraped surface (cf. Averbouh & Provenzano 1998-1999). The pin-like tool QR1-4 does not present manufacture traces, suggesting that the sharp point was made during blank extraction and used without modification. Thus, little energy and time were involved in the manufacture of the pin-like tools, showing features of an “expeditive technolology” (sensu Nelson 1991).

The apical area of QR1-6 and QR1-4 shows similar use-wear patterns of transversal striations and rounded surfaces that suggest drilling activities in soft materials (Figure 4a-b). According to microscopic patterns of striations and relief measured in actual database, the QR1-6 was used to work on a soft material that could be identified as skin (Figure 4a) while QR1-4 was used on a silica-rich plant (Figure 4b) (cf. Buc 2011; Stone 2011). The pin-like tool QR1-8 did not present a clear pattern of use-wear and the explicit identification of the activities performed or the material worked was not possible.

**Spatula**

The spatula was made on a non-identified ungulate rib rubbing the surface with an abrasive material, which left

<table>
<thead>
<tr>
<th>QR1</th>
<th>Morpho-functional Group</th>
<th>Bone</th>
<th>Taxa</th>
<th>Max. Lenght</th>
<th>Max. Width</th>
<th>Max. Thickness</th>
<th>Apical Thickness</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Manufacture waste</td>
<td>Antler</td>
<td>Ozotoceros bezoarticus</td>
<td>143,33</td>
<td>18,71</td>
<td>13,5</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Non determined</td>
<td>diaphysis</td>
<td>Mammalia</td>
<td>143,43</td>
<td>21</td>
<td>8,5</td>
<td>-</td>
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<tr>
<td>3</td>
<td>Spatula</td>
<td>rib</td>
<td>Mammalia</td>
<td>65,37</td>
<td>8,14</td>
<td>1,93</td>
<td>1,89</td>
</tr>
<tr>
<td>4</td>
<td>Pin-like tool</td>
<td>unknown</td>
<td>unknown</td>
<td>75,37</td>
<td>6,05</td>
<td>2,87</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Manufacture waste</td>
<td>distal radius</td>
<td>Vultur gryphus</td>
<td>43,74</td>
<td>15,36</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>Pin-like tool</td>
<td>unknown</td>
<td>unknown</td>
<td>52,83</td>
<td>4,55</td>
<td>3,44</td>
<td>1,7</td>
</tr>
<tr>
<td>7</td>
<td>Flat Point</td>
<td>unknown</td>
<td>Mammalia</td>
<td>84,85</td>
<td>17,85</td>
<td>5,4</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>Pin-like tool</td>
<td>unknown</td>
<td>unknown</td>
<td>84,45</td>
<td>3,7</td>
<td>3,8</td>
<td>1,6</td>
</tr>
<tr>
<td>9</td>
<td>Non determined</td>
<td>antler</td>
<td>Ozotoceros bezoarticus</td>
<td>115,65</td>
<td>15</td>
<td>29,17</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>Blunt Point</td>
<td>diaphysis</td>
<td>Mammalia</td>
<td>44,22</td>
<td>12,14</td>
<td>9,3</td>
<td>9,73</td>
</tr>
</tbody>
</table>

Table 1. Physical and metric structures of bone tools. All measurements are expressed in mm.
multiple wide and coarse striations along the bone axis (Figure 2c; Figure 3b). The use-wear traces are transversely oriented over longitudinal manufacture traces and restricted to the apical sector of the tool, particularly to its concave face. This use-wear suggests a transversal action like the smoothing activities. According to crossly, light, short striations and the rough micro-relief, it is possible to identify the worked material as leather or hide (Figure 4c,d; cf. Buc 2011, 2012; D’Errico et al. 2012; Soressi et al. 2013).

**Blunt point**

The blunt point is made on an elongated macro-mamal long bone splinter that was slightly regularized by rubbing with a coarse-grained material (Figure 2d). Flakes can be easily seen in the apical end of the tool, inclusively under the naked eye. Metallographic analysis could not be accomplished because the size of the tool impedes its cenital view. However, transversal and parallel striations were recorded on the apical end under binocular microscope. The striations are short, deep and wide (Figure 5a), similar to the observed in experimental bone tools used as pressure flakers in lithic debitage (see D’Errico et al. 2012; Nami & Scheinsohn 1997) and in archaeological flakers from northern Argentinean Patagonia, with which also share the metrical structure in apical width and thickness (cf. Borella & Buc 2009). Thus, the blunt point of QR1 could have been used to retouch lithic artifacts by exerting pressure on these edges.

**Undetermined items and manufacture waste**

A distal radius from an Andean condor (*Vultur gryphus*) that presents cut-and-break technique marks (Figure 2e; 5b) and an antler tine of pampas deer with roughing marks on its basal end (Figure 2h; 5c) were interpreted as manufacture waste. The idea follows similarities with the results obtained by experimental manufacture programs (cf. Buc et al. 2014; David 2008) and is reinforced by the non-used roughly aspect of the marks seen under the binocular microscope.

A long-bone splinter (QR1-2) shows oblique, deep and V-shaped in cross section marks made by a lithic edge (Figure 2f; 5d). However, the artifact has no certain morphology or a use-wear pattern to be classified in a morpho-functional group, even when it was worked on both surfaces. A possible hypothesis is that it was used as a handle considering its concave-convex cross section.

Finally, an antler tine of *Ozotoceros bezoarticus* shows no cultural marks, making it difficult to classify it as a bone tool (Figure 2g). However, the item is considered here because it could be a pre-form or a selected antler stored as raw material for future needs.

The unfinished items and manufacture waste helped to reconstruct the manufacture sequence of bone tools.
They also provide indirect evidence of the existence of bone tool manufacturing in QR1, even when the slight modification or minimal use-wear makes it difficult to identify some items as tools.

DISCUSSION & CONCLUSION

The study of the worked-bone assemblage of QR1(2) provides several insights regarding the daily use of bone tools and the activities performed by the early Late Holocene foragers in the site. Two characteristic of the assemblage reflect that the bone tools were related to short-term and low-risk activities (Nelson 1991; Torrence 1983). Firstly, tools show low-energy investment in manufacture and simple designs, without any features of curated technology. Most of the bones were obtained from animals killed near the site for food and fashioned into tools by basic manufacture techniques as cutting, fracturing, scraping and abrading. Secondly, minimal use-wear was recorded in the active areas, showing a low-intense use of the artifacts in concordance with the short-term occupation of the site. Moreover, the variability in pin-like tools use-wear, even when showing a standardized metric structure, suggests that they were versatile tools that could perform different tasks with minimal labor investment (Nelson 1991).

The diversity of bone tools also suggests that multiples and unexpected activities were carried out at QR1(C2), mainly related to hide working, net or basketry making and lithic tool production. The morphological, physical and use-wear pattern study confirms that pin-like tools were used into drilling activities in soft organic materials as silica-rich plants and skins, whereas the spatula was used to smooth animal leathers or hides. On the other hand, blunt point presents traces compatible with lithic flakers, suggesting on-site lithic artifact manufacture and maintenance.

Furthermore, the study demonstrates that evidence of perishable technologies of hides or plant fibers, which are crucial for many subsistence activities, can be recorded in archaeological sites even when original material is not preserved (Soffer 2004; Stone 2011). Thus, the analysis of bone technology allows exploring a component of the material culture that has been relegated directly or indirectly to the realm of hunting weapons, showing how important the objects made from soft tissues were that are rarely found in the archaeological record.

Finally, the tool-type composition of QR1(C2) resembles to others retrieved in the Sierras de Córdoba Late Prehispanic Period sites (ca. 1100-360 BP; Medina et al. 2014). Therefore, the need to process the resources and the by-productsof a broad-spectrum hunting and foraging diet through the diversification of technology may not have been an exclusively phenomena of the Late Prehispanic Period. Thus, the origins of this strategy might be found in the Middle-Late Holocene boundary, ca. 3000 years BP, when a dramatic decrease in the local abundance of *Lama guanicoe* reduced the forager’s prey selectivity by adding lower-ranked resources as small-vertebrates and wild fruit to subsistence activities (Medina et al. 2011; Rivero 2009).

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INTRODUCTION

Although aware of the main bias of the book’s selection of articles and the potentials of archaeozoological and archaeological-study in Avar archaeology, I will present a more ‘traditional’ archaeological and art-historical survey of their antler objects. The carved representations of – presumably – Avars and their horses on two characteristic, already published finds constitute the subject of this paper. The findings come from Nosa (Nosza) and Mandelos (Nagyolaszi) in present-day Serbian province of Vojvodina. Having been made of tine, the objects are archeologically, dated contexts, to the second half of the seventh century, as well. Such tools can also be found at Early Byzantine sites, such as the Ras fortress (Popović 1999: 121, Sl. 69/4).

THE NOSA FIND

The first find to be presented here comes from the very north of Bačka. It was found back in 1955 at the Pörös meadow, north of the village of Nosa (Sekereš 1957: 231). This find may be a trace of an Avar-time settlement, or its cemetery, located at the non-flooded position (cf. Bugarski 2008: 442); in the literature there is a vague mention of another surface find from the site, a small (?) Late Avar strap-end (Szentpéteri 2002: 156).

The tool from Nosa is 14.2 cm long (Fig. 1). It is hollowed out at the point, up to 6.5 cm from the top of the tool, almost to the middle of the tool. At the broad end it is perforated by two opposite holes, 0.2 cm in diameter, supposedly for fixing a handle (Sekereš 1957: 231, Sl. 1, 3). Perhaps without enough caution, the object was assigned to disentangling hooks (Bugarski 2009a: 124-125, n. 53). Some authors still doubt that these objects had this type of functional use, putting the name itself under quotation marks – ‘Knotenlöser’ (Daim 1987: 219; Daim 1996: 360) – but Aleksandar Ranisavljev offers a very instructive piece of information, stating that even today the shippers on the Danube use similar iron-made tools to tie knots at the end of ropes (Ranisavljev 2007: 54).

These antler tools are usually found in male graves from the Early Avar Period. At the thoroughly studied cemetery at Leobersdorf they are dated to the earliest phase, FA, which lasted until 650/670 (Daim 1987: Abb. 29). Yet, disentangling hooks come from more broadly dated contexts, to the second half of the seventh century, as well. Such tools can also be found at Early Byzantine sites, such as the Ras fortress (Popović 1999: 121, Sl. 69/4).
A detail which perhaps does not speak in favour of assigning the tool to disentangling hooks is that it was hollowed out at the sharp rather than the broad end, like bone awls which are often found in Avar-time settlements (e.g. Stanojević 1987: 126; Andjelić 2008: 127). The same was noted quite early by László Szekeres, who nevertheless stated that ‘the differences are not so significant to make us search for another type of [functional] use [of the find]’ (Sekereš 1957: 233). Similarly shaped tools come from Early Byzantine sites too, from Svetinja by Viminacium (Popović 1988: Sl. 20/4) and, especially, from Gornji Stetreoc (Ivanišević and Špehar 2006: 141, Fig. 3/14).

Leaving aside its functional determination – the issue remains open – the antler tool from Nosa is lavishly decorated with carvings (Fig. 2). Three standing human figures and two horses are depicted in profile. Two out of three carvings of humans were incised in detail. It can be seen that they had long braided hairs and wore long clothes with belts, bags hanging from them. Below one person’s bag, an object is depicted – albeit not very precisely – while ‘another object hangs in line with the edge of the clothes [of the second person].’ It could well be a belt strap-end (Sekereš 1957: 231-232, 234), but not necessarily. The third person depicted may have been female (Szentpéteri 2002: 156).

The horses stand calmly. One of the carvings has been made in more detailed and more beautiful fashion, partly overlaying a human image. The saddle is placed on the carpet, reaching below the horse’s abdomen (Sekereš 1957: 232). Although the saddle was illustrated only summarily, it has been claimed that it represents a ‘typical saddle from the first [Avar] wave’ (Mrkobrad 1980: 106). The stirrups were not illustrated (Fig. 3).

The sixth carving is barely visible. It is trapezoidal in shape, with a rectangular engraved in the upper part (Sekereš 1957: 232). In his paper based on the Nosa find,
Arnulf Kollautz (1978: 137) stated that a tent with a rectangular opening was depicted. This seems likely. Below the representation of the tent, inclining toward the point of the tool, shallow horizontal lines were incised.

'In this part, the tool surface is very worn and smoothed by usage.' It has been noticed that thin and shallow contours of some sketches are drawn with confidence, and therefore do not represent the artist's first carvings, with a more general remark that some of the scenes – especially that of a nicely drawn horse – are artistic creations in the true sense of the word.' Having completed his detailed autopsy of the find, László Szekeres showed that some representations were worn, and some were not, 'from which it would emanate that the object was used for a long time, and that the drawings were not incised at one and the same time.' It is again underlined that some figures overlap each other. The author goes even further, expressing his strong impression that the images of persons and horses were made by different artists (Sekereš 1957: 232-233). If this was so, one might question the interpretation that the object, at least originally, displayed a typical genre scene of two horsemen's encounter (Kubarev 2001: 348). Here one may also mention the representation of two counterposed unsaddled horses incised on a bronze back plate of an Early Avar strap-end from the Ciglana Polet cemetery in Vrbas (Verbász). As the other plate was said to be made out of silver (Nagy 1971: 214, T. XXVIII/13), and thus probably exposed, the drawing was by all appearances incised as a result of the artist's (or the owner's) 'inner necessity'. The drawings of unsaddled horses from Nosa and Vrbas are fairly similar.

As regards ethnic and chronological attribution of the Nosa find, Szekeres suggested that it 'belonged to a nomadic shepherd or warrior'. Leaning on Theophanes' description of Avar costume (cf. Pohl 1988: 18), he concluded that the owner must have been of that origin. As the tool was found by chance, the author restrained himself from a more narrow estimation of its age (Sekereš 1957: 234), and in an old but still important catalogue a date between the seventh and the ninth centuries was suggested (Dimitrijević et al. 1962: 54). Judging by the above-mentioned belt fitting from the same site, a date within the eighth century was agreed for both finds (Szentpéteri 2002: 156). In any case, László Szekeres was right in supposing that the tool could have come from a grave (Sekereš 1957: 233), or even from a ruined cemetery (Dimitrijević et al. 1962: 54). Bearing in mind the strap end, the necropolis at the Pörös site in Nosa may have been in use in the Late Avar period as well, but it is clear that the carved antler object was of a considerably earlier date. In what follows, I will try to narrow down its date.

The most important argument in favour of an earlier date is the representation of the tent. Among the data on Avar lifestyle in Asia, i.e. on that of the Jou-Jan, their possible antecedents, both Zacharias Rhetor and a Chinese source, Pei-shi, mention tents (cf. Kovačević 1977: 23; Kollautz 1978: 137). As the Avars in the Carpathian Basin could not have practised a nomadic way of life (Bugarski 2008), their settlements, dug in loess (rather than settlements in tents) most probably soon became permanent (Stanoev 1996: 5). A different concept of home indicates a shift in the way of life (Bugarski 2009a: 151).

Summarily represented fashion styles, being quite traditional, do not in fact constitute dependable chronological markers (Figs. 2, 4). Hair clasps – archaeological proofs of data from the written sources and pictorial evidence, just as in the case the Nosa find – are usually dated late, from ca. 670 to the end of the eighth century, and discussed in the wider context of changes in Avar material culture in the last third of the seventh century and onwards. In male graves, these late hair clasps were found in pairs (Andrási 1997: 118, 122, Abb. 21). Yet the Avars wore braids in earlier times as well. The appearance of their first delegation to Constantinople made a strong impression on the capital's population, as recorded by Theophanes, who has left a description of their hairstyle too. Metallic clasps found in male graves, although rarely, provide archaeological evidence of a braided hairstyle (cf. Pohl 1998: 56). Not long ago, such functional attribution of Early Avar clasps from four male graves at Čik was offered, the latest of them dated to the first half of the seventh century (Bugarski 2009a: 99).

Avar kaftans, as sketched on the tool from Nosa, do not differ from the common Central Asian, especially Early Turkic costume. Their representation, among other details, testifies that Avar graffiti derive from the Central Asian ones, which speaks of such origin of [a part of the] European Avars as well (Kubarev 2001: 348; cf. Mogil’nikov 1981: Ris. 21, 22).

The shape of the saddle depicted, on the other hand, can perhaps lead to a closer dating of the scene (Fig. 3). Avar saddles are not well known, and on the basis of rare well-reconstructed finds it could be concluded that the elevated seat of the two-part saddle, the lower part of which was in the form of two plates resting on horseback, 'has semicircular arched heads in the front and the back' (Kovačević 1977: 125, Sl. 67, 68), i.e. swells and cantles. The reconstruction of the saddle from a grave at Tiszafuvar.
I. Bugarski, Carved antler tools from Nosa and Mandelos reassessed...

Fig. 5. Reconstruction of the saddle from Tiszafüred, after Garam 1969, Fig. 7.

Fig. 6. Chronology of Eastern European saddles, after Komar 2008, Ris. 1.

ured, dated to the middle of the seventh century, is somewhat different (Garam 1969: Fig. 7; Fig. 5). With a laid back cantle, it resembles the one depicted on the tool from Nosa.

Using as an argument the finds of statuettes from China, these differences were explained by the sex of the riders. Saddles with vertical plates were believed to have been designed for female riders, and saddles with laid back cantles for male (cf. Komar 2008: 240). Yet a ceramic vessel in the form of a cavalryman from South Korea, dated to the sixth century, shows precisely a saddle of the first group; it bears one of the earliest representations of stirrups as well (Nicolle 1998: 202).

According to the results of a study carried out by Anatolii Konstantinovich Ambroz, saddles with vertical swells and cantles were widely used as early as the fourth century, while saddles with laid back cantles were only introduced in the seventh (Ambroz 1973: Ris. 2). Recent years saw breakthroughs in the study of the chronology of Eastern European saddles from the Early Middle Ages. Both pictorial and archaeological sources from Avar, Lombard, Byzantine, and Persian milieus testify that in the middle of the seventh century new types of sad-
The saddle depicted on the Nosa find would perhaps most resemble the Borodaevka find, from the Sivašovka horizon, i.e. from the last quarter of the seventh century (Fig. 6a). It is striking that, in most cases, in horsemen's graves with partially preserved wooden saddles from this horizon there are no stirrups, just as they are not represented on the antler tool from Nosa! Such saddles were made precisely for more comfortable, long-distance riding without stirrups, which is explained as a West Turkic tradition. Similarly shaped is the saddle depicted on bas-relief from the tomb of Emperor T'ai-tsung at Shao-lin, dated to the sixties and seventies of the seventh century (Komar 2008: 247-248, Ris. 1/13, 3/6; cf. Kollautz 1978: T. I/2-3), and, apparently, an image from Mongolia (Kubarev 2001: Ris. 1/5).

Although the Nosa find does not bear images allowing its absolute dating, a more reliable framework could be set up. Convincing parallels offered by Gleb Vladimirović Kubarev (2001) lead us to agree with his conclusion that the carvings on the Nosa find draw their origin from Central Asia. The image of the tent may best speak to that effect. The artist could have seen such a home first in distant Asian lands, and perhaps even in the south of the Carpathian Basin, which would mean that that image (the most worn-out one!) was incised soon after this group of Avars had reached their new land.

As noticed by László Szekeres, in the relative chronological sequence of the carvings on the tool, the images of the horses were the last to be made, one of them overlaying a human figure (Sekereš 1957: 232-233). Judging by the shape of the saddle, we may suppose that they were incised at some point in the course of the seventh century, most likely in its last quarter. So, even in the absence of any data on the archaeological context, we come close to concluding that the tool was made and used at some time between the second half of the sixth century and the end of the seventh. The possible date of the saddle depicted may lead us to attribute the tool to the Middle Avar wave of settlers. It has been noticed that certain grave finds from Čik (Pétrèvere) and Mokrin (Homokrév) point to a settlement process of a population which was nomadic in its origin (Bugarski 2009a: 151-152; Bugarski 2009b: 122). The Nosa find, on the other hand, best depicts the initial nomadic tradition of the (various groups of the) Avars (cf. Kollautz 1978), a way of life which must have been abandoned soon after their arrival in the Carpathian Basin.

THE MANĐELOS FIND

The second find to be analyzed here comes from a horseman's grave at the Stara Ciglana – Zabrana (Old Brick Factory) site, south of the village of Mandelos in Srem. This damaged multilayered site is located on an elevated position framed by the Mandelos Stream (Ercegović-Pavlović 1982: 50; Gačić 1988: 108; Tadin 1995: 257, Pl. 2). The grave was discovered by chance in 1968, and later on, in the course of excavations preceding the motorway construction, a Late Avar cemetery was explored on two occasions (Gačić 1988; Tadin 1995). The 1968 grave was certainly not in its immediate vicinity, as in two decades' time the border of the clay extraction zone must have moved towards the area of the cemetery. At the same site an Iron Age settlement was documented, and in its vicinity a number of other sites were recorded, ranging from Prehistory to the Middle Ages (Gačić 1988: 108), which testifies that in past epochs this place below the Fruska Gora could offer good conditions for life.

The grave was dug in loess, up to four meters in depth. The grave finds were published by Slavenka Ercegović-Pavlović (1982), and there are two articles on the preserved skull. In the first one it was 'classified as of Mongoloid type'. In accordance with the archaeological estimation of the accompanying finds, it was concluded that the horseman must have been an Avar (Grimes 1982). As a result of a similarly conceived conclusion of a more recent anthropological analysis of the skull, the age of the deceased ‘[who]
most likely died naturally’ was corrected to be 35-40 years (Miladinović-Radmilović 2009: 131). Without refuting the proposed ethnic attribution, one can still have some doubts. Such affiliation cannot be derived from cranial measures by themselves, and the Mandelos skull does not come from a professionally excavated grave.

The so-called disentangling hook is of the usual shape and 13.2 cm long (Fig. 7). It is particularly interesting for its carved decoration, i.e. for the hunting scene, which was not explained in so much detail as the one on the Nosa tool. It is noted that the riding horseman hunted with his bow and arrow for a realistically drawn bird. Unlike the bird, the man and his horse were represented in a very schematic way. The horseman is depicted in profile, with a typical Avar long hairstyle, possibly braided (Fig. 8). Important is the author’s following sentence: ‘As far as the ... horse harness is concerned, only the ‘saddle’, consisting of a piece of cloth, has been drawn.’ Two unfinished carvings were noted as well. One realistically presents a horse’s head, while the other could not be interpreted. It was concluded that they were incised at the same time with the others (Ercegović-Pavlović 1982: 50, 52, Pl. II/1, IV/1-3, Fig. 2). Perhaps because of the hunting scene, the author described the find as an implement for pulling the bow.

As regards other grave-finds, a cast silver belt fitting (Ercegović-Pavlović 1982: 52, Pl. II/2) may be ascribed to the so-called heraldic belt fittings of Early Byzantine origin (Fig. 9/3). The closest analogy comes from Kerch. In Crimea, the matching ‘two-horned’ (Δυόρουςει) fittings are dated to the second half of the seventh century (Aibabin 1990: 52, Ris. 50/47; Aibabin 2011: 235-236, Taf. 31/65).

The grave also produced a single-bladed sword with an ellipsoidal hilt ending, cast in bronze, and two-part sheath fittings (Ercegović-Pavlović 1982: 50-52, Fig. 1: Figs. 10/1, 9/4). The rings finishing the hilts of double-bladed swords are characteristic of the earliest weapons in Avar use (Mrkobrad 1980: 98), but they appear later as well, on double-bladed swords. According to Éva Garam, one of the initial specimens comes from Kunágota, while at the beginning of the seventh century there was a concentration of such finds in the middle part of the interfluvial region between the Tisza and the Danube (Garam 1992: 170–171). A total of ten swords with matching sheath fittings were mapped in that area by Csanád Bálint, with the
riding equipment have many analogies, but they cannot be narrowly dated in themselves (Fig. 10/2, 3).

On the basis of the finds listed, the horseman’s grave was dated to the end of the sixth/beginning of the seventh centuries, while the possibility was left open that the warrior from Mandelos could have been buried right at the time of the siege of Sirmium, that is around 582’ (Ercegović-Pavlović 1982: 53). Dušan Mrkobrad advocated for a wider dating, to the ‘first [Avar] wave’ (Mrkobrad 1980: 89, n. 591), as did Leposava Trbuhović, who had attributed the find to the early phase of Avar domination (Trbuhović 1982: 68). In a more recent account the Mandelos grave was dated to the last quarter of the sixth and the first quarter of the seventh centuries (Szentpéteri 2002: 233). Ljiljana Tadin doubted the conditions of the find, observing that they were of various kinds and ‘of a large chronological span’, and, consequently, not from a single grave. This was not explained in greater detail.

I would, however, accept the following remark of the author, that the objects cannot be dated to the end of the sixth and the beginning of the seventh centuries (Tadin 1995: 257-258). Separate dating of the finds, as performed here, points to the middle of the seventh century, perhaps to a date around the year 650. It seems to me that the above-processed objects, including the disentangling hook, could easily have come from one grave. Disentangling hooks are known from horsemen’s graves, e.g. from grave 28 at Čik (Bugarski 2009a: 38-39).

At first glance, the carved scene is of a pastoral rather than military character, as the horseman was depicted as hunting. As regards weaponry, only a bow and arrow were shown, and there are no representations of stirrups and saddle. One cannot observe any other characteristic details either, such as the belt. To make a comparison, such details are represented on the Nosa find. So it can be supposed that the sketch from Mandelos did not represent the deceased – a fully equipped horseman armed with a sword, a type of weapon usually attributed to members of Early Mediaeval military and social elites (Nicolle 1999: 34) – or perhaps it did, but in a different role and/or at a significantly younger age.

Despite the bird being disproportionately large in comparison with both the horseman and the horse, this is evidently a hunting scene. On the basis of a few preserved graffiti, it has been concluded that such scenes were most popular in the Avar milieu (Kubarev 2001: 347). It was suggested that, in Avar society, the hunt was a privilege of higher social strata and a kind of military training (László 1955: 153-158). To that effect, it should be noted that the depicted horseman was equipped, by all appearances, with a powerful reflex bow (cf. Ricz 1983). At any rate, it seems that hunting was not among the leading economic activities of the Avars. Game meat was very seldom put in graves (Grefen-Peters 1987: 275-282), and in settlements it was represented in very small percentages (Vörös 1991). Even the raw materials, like deer tine, could have been collected in nature, and not by hunting (Choyke 1995: 224, 233-234).

DISCUSSION AND CONCLUSIONS

The majority of Avar disentangling hooks were not decorated at all, and decorated tools – like the Early Byzantine ones – usually bear geometric designs. A rare exception is the find from Cserkút, ornamented with a carved motif of running animals (Kiss 1977: 18, Pl. I/13). Human representations are very rare on bone objects from the Avar context (cf. Kubarev 2001). Some of them are heavily schematized, so that the carving on a needle-case from Jánoshida resembles a few images incised on hand-made pots, like the one from the Čik cemetery (Kovačević 1972: 66-67, 69; Bugarski 2009a: 130-131, Sl. 115), or on particular spindle-whorls (Madaras 1994: T. VIII/61-1). Such representations on metallic objects are more numerous, either on various fittings, rattles, or belt elements (Rácz 2012), including the ones depicting the hunt (Kovačević 1977: 168-169, Sl. 130). Being highly idealized, the images on metallic vessels are quite different (Bálint 2010).

So it may be concluded that our objects, and especially the one from Nosa, bear the most truthful representations of the Avars, matching the data from the written sources. Even after surveying the abundant Avar-related literature I could not find any similar carvings, and neither did Kubarev in his short synthesis (Kubarev 2001). As I may have missed some finds, we still cannot claim that such decorated horn objects were only characteristic of the southern parts of the Khaganate; yet, it should be added that from Mokrin in this region came a bone tube decorated with a thoroughly explained religious scene with animals and the ‘tree of life’, the origin of which has been sought in the Altai region, or in the Caucasus and Ural (Kovačević 1977: 199-200, Sl. 139; Ranisavljev 2007: 55-56, T. XXXVIII; cf. Bálint 1989: 168, Abb. 78/1-3).

Judging by the clothes, hairstyles and representation of the riding horseman with bow and arrow, most similar are the scenes on bone objects from the Altai region, so one can accept that Central Asia, or the Altai, was the origin of human representations on our antler tools (Kubarev 2001: 348, Ris. 1/3, 3/4, 6). Very elaborate scenes on bone objects, to some extent similar to ours but of an earlier date, are known from Central Asia. We can mention e.g. the finds from Tilla Bulak and Orlat in Uzbekistan, dated respectively within the first centuries BC-AD and to the first and the second centuries AD (Gruber et al. 2012; Ilyasov and Rusanov 1997-1998).

When it comes to our finds, most striking are the similarities to the hunter depicted on the horn swell plate from grave 9 at the Kudyrge cemetery, populated – as stated – with people resembling the Avars of the Danube Region (Gavrilova 1965: 104, T. XV/12, XVI/1: Fig. 11), and to the horses and horsemen represented on petroglyphs...
from the Chuyskaya steppe (Kubarev 2004: 76-78, Ris. 2/1: Fig. 12), and Kara Ojuk in the Altai (Lo Muzio 2010: 433, Fig. 13), dated to the Early Turkic period.

To some extent similar is the representation of the horseman on the fragmented horn plate of a bow (?) from catacomb 17 in the Çir-Yurt area in the north of present-day Dagestan in the Caucasus. Different views on the ethnicity of the buried have been offered. Boris Viktorovich Magomedov thought that these were Khazars, while some attributed them to the Alani (Korobov 1999: 8, 21). Rašo Rašev refuted such interpretations, believing that both the funerary practices and the small finds point to a Central Asian origin, and describing the horseman’s long braided hairstyle as Turkic (Rašev 2007: 147, T. 97/17, 18: Fig. 13). Furthermore, there are some similarities between our scenes and the one on the swell plate from Shilovka on the Volga River. Although with some reservations, Alex Komar linked Eastern European finds to the West Turkic, Altaic tradition (Komar 2008: 248, Ris. 2/1).

The most impressive pictorial evidence for Early Mediaeval Turkic costume is the famous ‘Ambassadors’ fresco from Afrasiab in Uzbekistan (e.g. Arzhantseva and Inevatkina 2006). Exceptional for its details and colours, the fresco presents diplomatic missions to the king of Samarkand, most likely from the year 662. Among the delegations from Sogdiana, Chaganiana, China, Korea, etc., the images of 26 members of the Turkic mission have been perpetuated. A detailed presentation of their costume, to put aside some rather general features, is actually of less value for our study, as it cannot be compared to the carvings on small antler objects (cf. Bálint 2007: 549-551). On the other hand, the presented hairstyle with braids (Yatsenko 2004: Pl. 1: Fig. 14) has much more in common with the representations on tools from Nosa.
and Mandelos. The same is true for more than 170 Early Turkic anthropomorphic stone sculptures, which constitute the largest and most informative reference group (Kubarev 2000).

Both the circumstantial dating of the Nosa find and the date provided by other finds from the Mandelos grave may be placed in the middle and within the second half of the seventh century. After having analyzed all the details listed above, including the shape of the saddle carved on the find from Nosa, the two antler tools may perhaps be seen as indicative of an immigration from Central Asia. Bearing in mind that from the mid-sixth century the Al-tai region was the core area of Turkic power, one should not exclude the possibility that the above-processed finds were of a (West) Turkic origin. During the middle of the seventh century and in its second half, the main flow of immigration to the Carpathian Basin led from (and across?) Eastern Europe. Scholars usually explain the evident changes that took place in the Middle Avar period as due to that influx (Daim 2003: 497).

The owners of the tools may by all means be regard-ed as Avars, especially when this term is understood in cultural and chronological, and not strictly ethnic terms. Just as in the case of other Early Mediaeval populations, the ethnogenesis of the Avars was multi-layered and included groups of different origins, among them certainly the newcomers from the East (Pohl 1998: 20-21, 42; Pohl 2003: 574–579; Daim 2003: 480; Burgarski 2009a: 152–154). The carved representations from Nosa and Mandelos match the descriptions of the Avars left by the chroniclers, but on the other hand it is clear that widely accepted Central Asian fashion styles were displayed, apparently Turkic in origin and not attributable solely to the Avars (cf. Kubarev 2000: 86). This is not surprising, since as early as the middle of the sixth century the Turkish khan Diz-abulus warned Constantinople that the Avars approaching the borders of Byzantium were in fact renegades from his rule (Howorth 1873: 115, 125). As Menander Protec-tor further reports some years later, in 576, the same was heatedly claimed by his son, khan Turxanht, when he met Valentine, who was sent on a mission by Emperor Justin II (cf. Golden 2013: 62–63, n. 106).

To conclude, the above-presented arguments lead us to agree with Kubarev’s estimation of the origin of our carvings (Altai), while judgements about the ethnic background of the owners of the tools (Turkic? Avar? Turkic becoming Avar?) require more caution, even if we put aside general considerations of that issue (Brather 2004). It may be added that a Turkic origin has been suggested for the very rare Avar runic inscriptions on bone objects, and for those on the golden vessels from the famous Nagyszentmiklós treasure as well (Szalonitai and Károly 2013; Róna-Tas 2002).

Khazar political authority over vast East European territories can by no means be regarded as a solid back-ing for such ethnic affiliation of the finds from Ćir-Yurt and Shilovka. To start with, it is well known that a Khazar Khagan’s guard unit numbered ‘four hundred soldiers in a purely Turkic tradition’ (Gorelik 2002: 133, XI/4). Even if caution was necessary,1 and even if one were to agree with Csanád Bálint’s general reservations regarding the overemphasized ‘Orient-preference’ in archaeological research on the Avars (Bálint 2007), on the basis of the origin of representations and the above-proposed dating of the finds it seems likely that the antler tools from Nosa and Mandelos belonged to Western Turkic newcomers who, in the second half of the seventh century, strength-ened Avar ethnic substance and their Khaganate.

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1 That single graves from the same period could receive different inter-pretritions is testified by the burial – rather than a hoard (cf. Morrisson et al. 2006: 346) – from Stejanovci in the Srem region, near Mandelos. This burial contains silver objects of Byzantine origin and coins of Emperors Constans II and Constantine IV (Mlinic 1982), on the basis of which it was, with due caution, interpreted in light of renewed con-tacts between the Avars and Byzantium after the year 674 (Burgarski 2012: n. 34).
I. Bugarski, Carved antler tools from Nosa and Mandelos reassessed...


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INTRODUCTION

Studies of worked bone in Mexico are relatively recent, having initiated in the late 19th century, reaching a peak during the present century. Pérez-Roldán (2013) notes that objects manufactured from both animal and human bone have been recovered from a number of pre-Columbian archaeological sites throughout Mexico. The oldest such artifact—a camelid sacrum carved to resemble the head of a carnivore—was discovered in Tequixquiac in the State of Mexico and has been dated to 10,000 B.C. Bone artifacts have also been recovered from other early sites in the Basin of Mexico (2500 and 100 B.C.), including settlements at Xico, Tlatilco, Zacatenco, Ticoman, El Arbolillo, Gualupita, and Terremote, among others (Botella and Alemán 2000; Talavera et al. 2001; Pereira 2004; Lagunas 2004; Rojas et al. 2004). The abundance of worked bone artifacts recovered from Teotihuacan distinguishes the city from other Mexican archaeological sites. In this study, we examine artifacts made from human bone at Teotihuacan, with the goal of better understanding the production and use of these enigmatic items.

Located less than 50 km from modern Mexico City, Teotihuacan was one of the largest and most important cities of pre-Columbian America. With a population estimated to have surpassed 100,000 inhabitants at its height (1st-6th centuries A.D.), the Central Mexican city covered some 22 km2 (Figure 1). The Teotihuacanos were great builders, creating monumental pyramids (e.g., the Pyramids of the Sun and Moon, and the Temple of the Feathered Serpent). The streets and avenues are aligned to the cardinal directions. The residential compounds — Tetitla, La Ventilla, Atetelco, etc.— housed small temples, residential areas, patios, storage areas, and workshops. Teotihuacan society was divided into three segments: the leaders (rulers), the middle class (priests, architects, military officers, and merchants), and the working class (farmers and artisans) (Manzanilla 1995). Perhaps the most impressive aspect of Teotihuacan were the city’s skilled artisans who manufactured items from a variety of raw materials: ceramic pots, chipped stone implements, including cutting tools, projectile points, and symbolic items, ground stone tools and architectural elements; precious stone (slate, mica, and bluish-green stone) ornaments and textile inlays; and the use of bone to manufacture a variety of tools, including needles, polishers, and burins, as well as ornaments. Teotihuacan stands out among Mexican archaeological sites not only for the quantity of the worked bone instruments, but also for the variety of items produced from human and animal bone. In this study, we focus on objects of worked human bone, including finished products (e.g., tools, ornaments) and discarded items with production errors so severe they rendered the items unsuitable for their intended use (Figure 2).

STUDY SAMPLE

Worked bone artifacts from Teotihuacan have been studied by archaeologists, physical anthropologists, and archaeozoologists, all of whom have made a distinction between items made from human vs. non-human (i.e., animal) bone.

As part of the 2005-2013 seasons of the project “Técnicas de manufactura de los objetos de hueso del México prehispánico: Teotihuacán” (“Manufacture Techniques of the Bone Implements of Prehispanic Mexico: Teoti-
Fig. 1. Location of the archaeological site of Teotihuacán, Mexico. Map by Campos-Martínez, 2015.

Fig. 2. Map of Teotihuacan, indicating the apartment compounds and architectural complexes where worked bone artifacts have been recovered. Map edited by Pérez-Roldán, 2014.
huacan”), 1,112 artifacts (348 complete, 158 incompletes, and 606 fragmented) were examined. Analyses included taxonomic, taphonomic, typological, and technological studies designed to reveal information regarding the functional and productive characteristics of the items in the sample.

METHODOLOGY

Analysis of the Teotihuacan worked bone objects included. First, selection of modified material. All items were classified as either modified or unmodified. Any objects with production evidence (e.g., cuts, surface treatment) or indications of use (e.g., use-wear) were set aside for more detailed analysis.

Anatomical identification. The skeletal elements (e.g., distal epiphysis, proximal epiphysis or diaphysis), and side (left or right) of all modified items were recorded.

Taxonomic identification. The class, order, family, genus, and species (when possible) were identified. In some cases, modification made species identification impossible. For this step, we consulted the reference collections and specialized works curated at the archaeozoology laboratory of the Universidad Nacional Autónoma de México (UNAM; National Autonomous University of Mexico), the Instituto Nacional de Antropología e Historia.

<table>
<thead>
<tr>
<th>Apartment Compound/Architectural Complex</th>
<th>Worked Human Bone: Finished Items (Tools, Ornaments, Offerings)</th>
<th>Worked Human Bone: Manufacturing Byproducts</th>
<th>All Worked Animal Bone (Finished Items and Manufacturing Byproducts)</th>
<th>Total</th>
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<tr>
<td>Xalla</td>
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Table 1. Summary of human and animal bone artifacts recovered from Teotihuacan apartment compounds and architectural complexes.
Assessment of conservation. Items were considered complete when 80-100% of the bone was present, incomplete when 60-79% was present, and fragmented when <50% was present.

Manufacturing techniques. Analysis followed the protocols established by the project “Técnicas de manufactura de los objetos de concha del México prehispánico” (Manufacturing Techniques of the Shell Objects of Prehispanic Mexico) (Velázquez 2007) and the UASLP project “Técnicas de los objetos de hueso del México prehispánico” (“Manufacture Techniques of the Bone Implements of Prehispanic Mexico”). The technology categories identified by Adán Álvarez (1997) were also employed for this analysis.

Establishing the typology. For this stage of analysis, the material was divided into two groups: 1) manufacturing waste, and 2) finished objects (e.g., tools, ornaments, offerings). The parts and zones of each bone were described following Camps-Faber (1976, 1980); the finished products were identified and measured following Pérez-Roldán (2013: 108-136).

RESULTS

The sample is composed by 1112 artifacts of human bone which come from architectural complexes include: the Ciudadela (Temple of the Feathered Serpent and Compound 1D), the North Quadrangle, the Great Compound, Xalla, Zacuala, Tetitla, El Corzo, the Northwest Compound, the Casa Teotihuacana Temprana, the vicinity of Palace II, La Ventilla, Atetelco, Teopancazco, Caves I-III, the Oaxaca Barrio, Salto del Agua, and Tlatlalcac.

Through taxonomic and typological analyses, it has been able to detect particular compounds and sectors of Teotihuacan with abnormal concentrations of bone objects, including both finished pieces and manufacturing by products. The artifacts of human and animal bone recovered from Teotihuacan apartment compounds and architectural complexes are summarized in Table 1.

Human bone was modified to produce needles, burins, smoothers, brushes, percussion instruments, chisels, wedges, reamers, palette knives, modeling tools, gouges, shuttles, sewing awls, handles, rasps (omichicahuaztli), palettes, hammers, picks, drills, paint brushes, bone folders, hair pins, pot polishers, bars, rippers, scrapers, stirrers, tine flakers, hide smoothers, tubes, and rods (Graph 1 – Figure 3).
Unfinished worked bone items include rods and waste from long bone epiphyses and skull fragments.

Worked bone ornaments include pins, rings, buttons, beads, inlays, pendant earrings, and garment pins (Graph 2). Fragments of various ornaments were also recorded (Graph 3). Items identified as offerings include canes, animal figurines (depicting felines), masks made from human skulls, pendants made from human maxillae, rope-ladder rungs made from femurs, and tubes decorated using the graffito technique (Figure 4).

The human bones used by the Teotihuacanos to produce these items might derive from two potential sources: sacrificial victims (Sugiyama 2005; Torres and Cid 2011) and the ancestors of the artisans (Meza, 2008: 200-203). In the former instance, when war captives arrived, they were paraded in front of the city’s leaders before being sacrificed in public venues (Sugiyama 2005). The bones and organs were then removed from the bodies and the head priest directed the distribution of anatomical parts to different groups. For example, long bones and skulls would be disarticulated and sent to the artisans who worked bone, while axial skeleton remains would be buried in pits.

The latter proposal envisions individuals dying of natural causes and their relatives (perhaps women) removing the soft issues to clean their bodies, taking the bones to their craftsmen relatives who then manufactured a variety of instruments (Meza 2008: 181-203).

A third alternative is also possible. The premise is based on the control of death—regardless of the cause—with relatives performing traditional funeral rites. However, should they wish to bury their dead, they might be required to pay a tax to the state in order to do so. This might explain the presence of some partially complete skeletons in apartment compounds like Tlailotlacan (Archer 2012) and Teopancatzco (Schaaf et al. 2012). Those who could not pay the tax may have had another alternative: following the funeral rites, the deceased could be taken to what we call the “House of Decomposition”. There, a group of people would receive the bodies and leave them exposed to the elements in order to encourage decomposition, until all that remained was the skeleton. Subsequently, the bones would be sent to craft specialists, and unused parts would be disposed of in a mass grave. Based on material and contextual evidence, Rojas (2008) observed Level 1 weathering (sun exposure and microfractures) and
disarticulation marks on the axial skeleton, suggesting that the bodies were exposed to the elements and carrion animals. We should also add that the bone objects examined for this study showed indications of boiling (perhaps by the craftsman and not as part of the per mortem treatment), with evidence of weathering and scavenging. Where was this “House of Decomposition”? One possibility is El Corzo, where 53 axial skeletons (torsos) were recovered (Rojas 2008). However, this number does not represent a huge population; thus, another venue may have yet to be explored.

FINAL CONSIDERATIONS

At Teotihuacan, human bones were utilized to manufacture objects used in daily life and tools associated with productive activities like wood working, lapidary, hide tanning, basketry, and tailoring, all of which were performed by craft specialists. The objects varied in terms of the anatomical part selected and the perceived value of the raw material. For example, bones from war captives were considered more valuable; thus, they were transformed into decorative elements forward attire (e.g., the human maxillae pendants at the Temple of the Feathered Serpent). The bones would otherwise come from the House of Decomposition, eventually being worked into tools for use in daily activities.

Interdisciplinary studies in archeology and human osteology have provided a clearer understanding of the bone working industry in this complex, ancient Mexican city.

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INTRODUCTION

Carving in osseous materials was a well represented craft in the Roman times. Diverse materials, bone, antler, ivory, were used for everyday items, tools, toilet accessories, jewellery, etc. (cf. Bíró 1987, 1994;2012, Deeschler-Erb 1998, Hrnčiarik 2004, 2012, MacGregor 1985, Petković 1995, Schallmayer 1996, inter alii). Also, all these osseous materials were used as decorations placed onto object made from other material – wooden furniture pieces, boxes, lids, etc. (cf. e.g. MacGregor 1985, Schallmayer 1996, Goldfus and Bowes 2000, Bíró 2012, Vass 2012). They may have been purely decorative, abstract, but also floral, zoomorphic and particularly complex representations of mythological scenes were very finely made (e.g., Bíró 1987, 2012, Petković et al. 2016).

THE ARCHAEOLOGICAL CONTEXT OF THE FIND

The Roman city of Naissus was established during the 1st century AD, as a settlement of artisans and traders that followed the army. The city obtained the status of municipium probably at the same time as the other cities in the province of Moesia Superior, during the reign of the emperor Traianus (98-117) or Hadrian (117-138) (Pierpont 1976: 34-35). There is no information if Naissus received the status of colonia, although this can not be excluded, considering that it was one of the four largest cities in Roman Dardania. City territory was the place of the battle in 269 AD between the Roman army and Goths, when the emperor Claudius II achieved an important victory (Petrović 1979: 39). During the entire 4th century AD, Naissus was an important city, where emperors would stay during their journeys and where they issued edicts (Vasić 2008: 9-23). The city was heavily destroyed by Huns in 441 and 447, but was partially recovered afterwards.

During the Late Antiquity, Naissus was one of the most important cities in the central Balkan area. Diverse archaeological remains of it are often encountered as the modern city develops. Rescue excavations carried out in 20th and 21st century revealed numerous and rich find-
ings, including residential and ceremonial buildings, churches, graves and grave monuments, and diverse and extraordinary portable finds (Петровић 1993: 64-69, Jeremić 2014: 5-55).

During the rescue excavations carried out in 1987-8 in the north-western part of the Late Antique fortification, a Late Antique building was discovered. The building was *intra muros* and it had walls preserved up to 3 m. This object, later labelled „palace“, had at least three phases of building and was in use during the Late Antique and Early Byzantine period. In the Middle Ages, this area was used as a cemetery (фиг. 1).

The structure was partially researched – the northern part, approx. 30 x 11 m, obtained one room of octagonal ground-plan and two additional square rooms. They were all decorated with floor mosaics with geometric motives, fresco painted walls, architectural stone decoration (pillars, etc.), installations for floor and wall heating and developed system for water supply. The period of building of this structure is placed into early 4th century AD after the find of Maximinus Daia coins. Second phase is probably mid-4th century; it was destroyed by Goth (378-380) or perhaps Hun invasions (441 or 447 AD). During 6th century, traces of economic activities were noted (large number of iron tools for leather and wool processing) and place was abandoned in late 6th century (Jeremić 2007: 95-97).

Apart from other portable material, in the central part of the octagonal room, in the layer of ashes and charcoal, above mosaic and red burnt soil, a large quantity of antler decorative pieces were recovered, that will be presented here.

THE FIND

A total number of approximately 210 pieces were found (some of the broken pieces were fitted together, but not all of them). They were all made from red deer antler cortex, predominantly (or exclusively) from beam segments. They were all heavily burnt, differing in colour – from black, greyish nuances to completely white and reddish (from debris), probably due to the different position within the burning debris at the moment of fire (exposed to direct fire or covered by debris). The pieces included abstract, floral and zoomorphic decorations.

Manufacture

First phases of manufacture can only be hypothetically reconstructed.

From entire antlers, beam segments were selected; tines were probably chopped off or cut off and either discarded or used for other objects. The initial preparation for working must have included some softening of the raw material, since antlers are very resilient while fresh, but also must not be too dry, or they may break irregularly (cf. MacGregor 1985). There are several possible softening techniques, soaking antlers in cold water, applying acid solutions, combining soaking in cold water with short period of boiling, etc. (cf. MacGregor 1985: 63-66, Osiowicz 2007, see also Deschler-Erb 2005: 211-212). However, exact technique used can be only speculated.

After that, blanks from outer cortex were extracted, in shapes of baguettes or plaques. In order to make the most from given raw material, probably grooves were incised first to ease detaching of blanks with the help of wedges (cf. MacGregor 1985: 55-58).

Since final objects were of small dimensions, presumably blanks were smoothed prior to cutting final shapes on both, front and back surfaces. This may have been done by files or rasps for more rough parts, but final polishing was performed by use of cloth and sand, plant stems, etc. (cf. MacGregor 1985: 58, Bianchi 2007: 368-369, and references therein). Since no traces of file or rasp movements were noted, we may assume that the final polishing was carried out by use of some very fine polishing mean, such as cloth or something similar. Back surfaces were very finely polished on all pieces, although slightly damaged at some of them (cf. back surfaces on fig. 2b, 5, 8, 9).

Final shapes included diverse geometrical shapes and zoomorphic representations, namely fish and birds (manufacture of each is discussed below). Last stage was making decoration and positioning pieces into predetermined area, presumably on some wooden artefact.

Decoration consisted mainly of incisions and dotted circles, but arranged and combined in such a manner to avoid repetition and to create visual effect. Incisions may be vertical, horizontal or diagonal, following the outer lines of the given shape or be running in different directions, and may be single or double.

Circle-and-dot decoration was made by a metal bit with a tip consisting of a middle anchoring spike and two engraving spikes on either side of it, that was used in following manner: “When the middle anchoring spike was placed on the surface of the support, only two arcs were scratched to begin with around the central point. Next,
when these two arcs joined to form a circle, they became a circle-and-dot decoration. By this time, the central bit had already made a hole, namely the dot, in the middle.” (Vecsey 2012: 68, see also figs 29-32).

Curved lines were also made by the same method and with the same tool as drilling operations.

Several large groups can be outlined within this find: discs, elongated stripes (ghirlandes), lozenge-shaped and leaf-like pieces, fish and birds. There are also several individual pieces that do not belong to any of these groups and pieces too fragmented to establish their original shape.

**Discs**

Total number of 89 segments, slightly oval in shape, were found (dim. usually approx. 1.7 x 1.5 or 1.8 x 1.6 cm) (fig. 2, 3). Except for two, all of them were decorated by two parallel circular incisions (double circle-and-dot motif, for manufacture cf. Vecsey 2012 and see above), thus forming three panels, and had a perforation in the centre. At some pieces, the perforation is used, widened and of irregular shape, so perhaps some of these were fastened by nails (for example, fig. 3b). Only one disc was left undecorated and just one had four dotted circles.

Discs were all extracted from a blank by drilling out the antler from the lower surface only, thus obtaining slightly trapezoidal cross-section (i.e., lower diameter is slightly narrower than the diameter at the upper surface). Since it is easier to cut through thick antler from two sides, the choosing of this method may have been functional, perhaps such cross-section was needed to fit more easily the discs into predetermined, carved space on the object on which they were placed.

Few discs had outer surface slightly irregular, from piece being snapped off after it was almost cut through. Variations in dimensions between different discs were probably due to the level of abrasion (i.e., they were all most likely made with just one, not with diverse tools).

**Lozenge or leaf-like pieces**

Second group of the geometrical motives comprises 25 pieces (fig. 4, 5), mainly leaf-like (21) or lozenge-shaped (4), decorated (15) or without decoration (10). Their dimensions vary, with length from 2.8 to over 5 cm, suggesting several different templates were used for obtaining these pieces. They were cut out by chisels and wedges.

Decorations was in shape of incised lines, dotted circles or net of lozenges in various combinations: incised lines that run parallel to object edges, with or without

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**Fig. 2. Discs: a) front, b) back side.**

**Fig. 3a-d. Discs.**

**Fig. 4. Lozenge-shape.**
dotted circles (fig. 4), dotted circles connected by incised lines or with curved lines running around them, one piece had large double dot-and-circle at the centre, etc. (fig. 5).

Elongated stripes (ghirlandes)
Several fragments of elongated, narrow, wavy stripes were found, 0.7–0.8 cm wide (fig. 11-13). All are fragmented, i.e., it was not possible to establish the original length for any of them. It is also possible that several pieces were placed one after another in a row to create one or more long stripes. They were also made by cutting with chisels and wedges. Most of them are decorated by combination of dotted circles and incised lines – lines connecting diagonally the dots (lower edge of a dot is connected with upper edge of the next one in row), probably imitation of water waves.

They may have represented some sort of a frame for the entire scene, or perhaps were placed separately, on others sides of the object (assuming it was square-shaped).

Fish representations
Almost 30 pieces represent fish. Two were completely preserved (fig. 8, 9), other pieces included fish body, tail and head segments (fig. 6, 7). They all have the same initial shape – body is in a shape of lozenge with rounded edges, with triangular extension representing the tail. The head is marked by two deep curved incisions and had eye, in a shape of dotted circle, and mouth, in a shape of deep, slightly curved incision. Bodies were decorated with dotted circles or undecorated, tails were ornamented with incisions, running parallel to the tail edges.

Shaping and decoration are quite simple, but effective, giving very realistic impression. Small variations in design of pattern give the illusion of great diversity, although they all have the same and very simple form. Some fish were turned into right, others into left – per-
Close to the bone...

haps they represented pairs. Again, dimensions vary, with maximal length 8-8.5 cm, and width 1.4-1.8 cm, suggesting several templates were used.

**Birds**
Three bird heads could have been recognized (fig. 10). The best preserved had elongated neck and part of the body, while the remaining two were too fragmented. Other two are simply head fragments.

The birds had eyes in a shape of dotted circles, same as fish, and beaks had short incision. By their looks, it is most likely that they represent ducks or some other water fowl. Several diverse segments, some fan-shaped, with dotted circles, may have been parts of tails.

**Other**
Other pieces included pieces with oval or straight edges with incised lines and/or dotted circles, that were either unique or shape or too fragmented to be fall into any of the groups above. Also, several simple amorphic fragments without decoration were noted.

**DISCUSSION AND CONCLUSION**

The find from „Octagon structure“ most likely represents decoration of one single object, probably furniture piece such as chair or chest. One large stone block, discovered at the site, covered by ash, soot and plate pieces may point to such hypothesis. This block may have served as the base for wooden furniture, however, there are no direct evidence for that. As no traces of contact with metal were found, it can be assumed that these pieces were used as inlay, placed into prepared carvings, or glued to the surface (some circular pieces may have been fastened, but with wooden fittings, since no traces of contact with metal were preserved).

Osseous materials were commonly used for crafting inlays and decorative plates for diverse artefacts in the Roman period, such as lids for boxes, pyxis and other small artefacts (cf. Petković 1995: 37, T. XXI, 8-9; 53, T. XI, 1-3, 7, Petković et al. 2016). Some individual analogies may be found for other segments, however, the find from Naissus as unity has no known analogies.

Fish representations made from osseous materials are rare, only few tokens are known from western provinces (missilia), used in spectacles after important military vic-
T. Čerškov, G. Jeremić, S. Vitezović, Zoomorphic decorations from osseous materials from Naissus (Niš)

Fig. 11. Ghirlande segment.

Fig. 12. Ghirlande segment.

Fig. 13. Ghirlande segment.

Tories or imperial jubilees (Schenk 2012: 13-14). One plate from red deer antler with carved decoration of fish emerging from water is known from the site of Kostol-Pontes in Serbia, dated into late 3rd - first half of the 4th century AD (Petković 1995: 55, 107, kat. 692, T. XLI, 8), and probably represents an application from wooden furniture.

Some parallels may be found in other types of raw material. Throughout the Roman times, especially in the 4th century, panels made in opus sectile technique, from glass, precious stones and marble were particularly popular. Panels and vessels decorated in such technique with fish representations were discovered in Athens, Corinth, Rome, Narbonne, Cairo (Feugère 2001: 11-20; Platz-Horster 2002: 148-149, fig. 4-5).

In the region of the Black Sea, furniture with wooden applications in a shape of swan are known from the period of 6th-2nd century BC (Cокольский 1971: T. III), and from the same region originates one comb sheath from the Roman period (1st-2nd century AD) with carved swan (Cокольский 1971:141, T. XVII, 8). However, again, most analogies may be found among artefacts made from mosaic glass, particularly in one type of shallow bowls decorated by incrustations on their interior. They were made in workshops of Alexandria in 4th century AD, and were discovered in Carnuntum and Trier. Here birds, most likely ducks, were represented surrounded by floral motives (Merten 2010:377-378). One such vessel was discovered at Mediana near Naissus, with representation of a white peacock.

Bone was the dominant osseous material for long time, in particular preferred skeletal elements were long bones, especially metapodials, from cattle and horses. Compact bone of long bones was widespread, since this material possesses desired physical and mechanical qualities – especially great thickness, and that allows a representation to be carved more easily and with more precision. Luxurious objects were predominantly made from antler or elephant or hippopotamus ivory (cf. Schallmayer 1996). Antler in general was less popular as raw material in period from 1st-3rd century AD; it was rarely encountered in the southern parts of the Empire, while in northern it represents Celtic traditions. The situation changed in the 4th century, when almost no bone, but many antler workshops existed (Deschler-Erb 2005: 213). The quantity of antlers used in their manufacture was substantial, suggesting that workshop in which it was made had regular and relatively rich supply in this raw material (unlike bones, which were obtained from butchers or leather-working – cf. Choyke 2012).

The reconstruction of the entire scene was not possible. Fish and water birds imply this was most likely some swamp or lake representation. Several oval and other pieces with somewhat elaborated decoration may have represented plants around it. Discs, ghirlandes, etc., may have been placed around the main scene, but also may have taken place on other sides of the object. What object was it is also an open question – it may have been some wooden box, or chest, but also some other furniture piece, such as throne (keeping in mind the context of the find, i. e., the luxury of the room where it was find).

Decorative applications made from elephant ivory or other osseous materials, with figural motives, represented luxurious items and are only occasionally found. The find from Naissus stands out by its richness and extraordinary crafting. Its origin, i. e., where they made in some of local artisan’s workshops, or imported, remains open. Although the Alexandrian workshops were famous for production of bone and ivory items and plating for furniture, in the Late Roman period this craft was transferred to the western artisan centres, like the newly-founded capital city of Constantinople. Also, recent discoveries of workshop debris and carved pieces from both the East and the West suggest that bone carving workshops were much more numerous than previously thought (cf. Goldfus and Bowes 2000: 186, and references therein).
The workshop where our objects were manufactured may have been located in a large city centre, like Thessalonica or Constantinople, it is also possible that it was made in one of local towns, such as Scupi, Ulpiana or Naissus. Furniture, was usually produced in carpenters' workshops and often the same artisans were carving both wood and bone artefacts (Petković 1995: 13-14).

From one side, it is entirely possible that among numerous artisans' workshops in Naissus also existed bone/ivory workshop. The remains of such workshop were not (yet) discovered, but this may be due to various reasons – excavations were carried out mainly on sepulchral area, collection of bone material on excavations from early and mid-20th century was inadequate, etc. On the other hand, the very status of Naissus as a rich and important city and also trade centre implies large quantities of luxurious artefacts were circulating (Đrča 2004: 189-191, cat. 133-141). In the city was also confirmed the presence of the state workshop (officina) for production of the objects from precious metals, where were also manufactured famous silver vessels – jubilee bowls, given as presents for merits and loyalty to the emperor Licinius in 317/318 AD (Đrča 1983: 9-31, Popović 1997: 134-138, Popović 2006: 116-117; Mirković 2012: 12).

This find belongs to the period of flourishing of Naissus, and period when this building was occupied by some important person. Central place of the find suggest it may have been decoration of a luxury chair (θρόνος) or box (scirinia), used by the owner or user of the building for reception in the official part of the palatium.

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INTRODUCTION

There is a category of bone artefacts for which it is extremely hard to establish its status for past societies, whether it was really used, and in which terms, or just remained as debris once detached from the exploited carcass: the animal skull. Recorded in Stone Age sites as a complete anatomical segment or found as fragments only, crania do not really pay much attention to archaeologists when they are examined to be identified as animal species/parts only. Highly damageable while made of numerous bones, each skull stays in this way not particularly questioned in the frame of regular osteological investigations when it is recorded within the faunal remains, studied then as any of the other anatomical parts composing the animal skeleton; it is only when they come from a specific context—found placed on a stone into a cave, for instance (Clottes 1995)—that issues regarding their purpose of use or meaning are obviously discussed.

The recent discoveries at the Tivoli-4.1 open air site (Liège, Belgium) where several worked skulls of red deer have been refitted as complete artefacts enable here to propose a symbolic utilization of this animal material at ca. 5500/5000 Cal BC. Indeed, as demonstrated below, these were shaped at a specific time period of the year in a particular way, regardless it is known how the rest of the animal was exploited. Since the same records have been yielded from other and diverse contemporary Mesolithic contexts in the Northern Europe, it is established 1/ the relevancy of the technological approach to discuss Stone Age practices related to the use of animal heads and 2/ the symbolic dimension of an unilateral practice used by various Mesolithic societies towards an animal material that is obviously of a high significance to them—in growth deer ring-frontlets—when facing the local expansion.

A SYMBOLIC USE OF ANTLER IN-GROWTH, TO FACE NEOLITHIZATION

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Abstract: Skulls of large cervids still wearing their antler in growth and shaped into cranial bone rings have newly been identified at Tivoli-4.1 (Place Saint-Lambert, Belgium). The technological analysis that includes experimental test on the replication of the bone deer ring-frontlets shows here that these have eventually been used as objects or “trophies” left in situ. In the frame of this study, several similar pieces have been identified from other north-European sites, all yielded from Mesolithic contexts. Since they refer then to various human cultural groups, and that the concerned sites are eventually located on the border zone regions of the most northern territorial Neolithic primary expansion, these objects might actually refer to a materialized symbolism developed by Mesolithic hunters to face the Neolithization process.

Apstrakt: Lobanje krupnih cervida sa rogovima još u rastu, oblikovane u prstenove od kranijalnih kostiju nevano su pronađene u Tivoliju-4.1 (Plas Sen-Lamber, Belgija). Tehnološka analiza koja je uključila i eksperimentalno proučavanje replika koštanih prstenova-“frontleta” od jelena pokazuju da su mogli biti korišćeni kao objekti ili “trofeji” namerno ostavljeni in situ. U okviru ove studije, nekoliko sličnih primeraka je identifikovano na drugim severnoevropskim lokalitetima, svi iz mezolitskih konteksta. S obzirom na to da pripadaju različitim kulturnim grupama, i s obzirom na to da svi potiču sa lokaliteta smeštenih u graničnim oblastima najsevernije neolitske primarne ekspanzije, ovi predmeti se mogu odnositi na materijalizovani simbolizam koji su mezolitski lovci razvili spram procesa neolitizacije.

Tivoli (Liège) and the two other known Mesolithic sites in Belgium excavated down in valleys that have yielded no comparative bone material, compared to the newly occupied Neolithic territories (Linear Bandkeramik, Villeneuve-Saint-Germain, after Allard 2007)
of communities attached to a totally different mankind (Cauvin 2000).

ARCHAEOLOGICAL CONTEXT

At ca. 5500/5000 Cal BC, the southern parts of the Northern Europe that were traditionally inhabited by Mesolithic groups of hunters-gatherers are being colonized by communities practicing plant cultivation and animal livestock husbandry. In Belgium, the site of Tivoli-4.1 (Liège, Place Saint-Lambert, sector Tivoli, zones 19/20, layer presently named 4.1 - Cf. van der Sloot 2006) is surrounded in the region by territories held by populations turned towards food-producing economies and settled lifeways (Fig. 1). The site is located on the North shore of the Meuse River alluvial plain on outlet axis of its confluent in there with the Légia River (van der Sloot et al. 2003), thus placed on a zone deep into the valley that is also directly placed at the foot of the plateau where the Neolithic communities were principally organized.

The anthropogenic vestiges are distributed on two main areas (sectors 19 and 20) representing together a surface of ca. 24 m² that has yielded dozens of lithic artefacts and a concentration of animal bones. No ceramic was found there. The bone material is in the form of a deposit containing segments of animal carcasses, worked deer skulls and tools made from bone, antler and tooth (Fig. 2). By means of re-articulating and refitting of anatomical parts showing dismembering and/or cut marks, a recent osteological investigation suggests that various stratigraphical units of the site initially made carefully distinct by the archaeologists combine in fact into a single episode of large mammals' exploitation, to which belong the frontlets concerned (Binois 2011). If a high amount of tools of which belongs the whole set of arrowheads is undoubtedly Mesolithic, the others are equivocal and their attribution to an early stage...
Close to the bone...

of the Neolithic can not be ruled out so far. In addition, whereas the clearly Mesolithic products are with a patina, the others are conversely not. Thus, either the Mesolithic and/or the Neolithic groups was at the origin of the material accumulation. The radiocarbon (AMS) dating show that all together some of the antler tools, two waste of production of the ring-frontlets and some animal bones of the layer 4-1 can be considered quite contemporary to the bone deposit, as they all fit into a relatively thin chronological frame around 5300 Cal BC (David et al. 2012). Since the material is yielded from a recent excavation and precisely because it is found adjacent to an Early Neolithic settlement site excavated some decades ago in the same area, at Place Saint-Lambert (Otte 1984), Tivoli-4.1 eventually appears as (part of) a key site to discuss interactions between diverse population-types possibly interested by a same geographical spot and/or a same resource in the landscape, in terms of socio-cultural practices inscribed in the material domain.

CORPUS AND PATTERNS

All together, Tivoli-4.1 yielded three pieces made each from a red deer skull (Fig. 3 to 5). Supplementary investigations are still in progress for notably understanding the precise relationship between the worked osseous material and the bone deposit when it concerns the deer species (Bridault/David in prep.). By the time, one can already attribute every piece to a single individual (Cervus elaphus), insofar they all show a different size of skull. The pieces represent craniums that have been cut perpendicularly to the main anatomical axis. Each piece corresponds to a skull (without jaws) after that, on the one hand, the sinus-frontal bones and, on the other hand, the occipital bones have been entirely removed from the cranium (Fig. 6). The skull is thus sliced transversally at both the front and back sides of a mid part that is representing a bone ring where, in the preserved case, the unshed stag antlers are still standing (Fig. 3). The expected waste debris in the form of complete occipital bones is actually represented by the two other pieces (Fig. 4 and 5). The anterior extremity of the skull representing the sinus has not been found in the faunal remains, but this anatomical part is also most fragile, hence usually not found in Stone Age sites. The recorded occipital bones are more or less in a complete stage and their edges show they have been removed in the same way, transversally to the skull and down to the bottom of the cranium, slicing in all tissues to remove the head's back end in one piece. When compared to a complete red deer skull, it is noticeable that there is no much place left between the bone ring-frontlet and the removed occipital. The presence of two occipitals indicates that at least two other bone ring-frontlets have been obtained from the slicing of the deer heads, while both the frontlet and the back shall fit together if from the same cranium. In this sense, both artifact-types—the
bone ring-frontlet and the occipital part—are theoretically belonging to the same sequence of technical transformation of the red deer skull (Fig.6).

Interestingly, the bone ring-frontlet shows antlers at a first stage of growth. The outer antler tissue is neither mature nor has turned into the usual recognizable hard cortical bone. The most well preserved frontal appendix shows it is only in the form of a mineralized round-like tip spongy end on the pedicle. It indicates that the skull comes originally from a red deer that was killed at the spring time, in April, at the regrowth period (refait), when the annual physiological rhythm of the cervids initiate again the growth of new antlers on the pedicles, soon after these have been left free from their former antlers previously shed in February/March (Fig. 7). The size of the pedicle, which is actually corresponding to that of the spongy protuberance left unworked on the ring-frontlet, with 45 mm in length and 37 mm in width, is suggesting that the animal was a mature male. On the skull part, the degree of ossification of the interparietal fused line suggests that the deer was then relatively young, ca. 2-5 years (Mystkowska 1966:136). A same remark can be addressed about the segmented occipital parts, which display similar aspects in fused anatomical lines and module size (measurable as for Tiv.247 with 94 mm from the external occipital protuberance to the basal end of the foramen magnum, and for Tiv.346 with 140 mm between both mastoid processes, and with respectively 34 and 36 mm between, for each, the external occipital protuberance and the parietal-frontal fused line). However, comparative data from archaeological deer are lacking in order to establish if these two segmented occipital parts would not belong to female instead.

All the three pieces show on the edges of their osseous ring straight planes and teared out surfaces (surfaces d’arrachement). In several areas, planes are visible besides the natural fused lines of the skull, if not cutting through these, leaving various straight depressions into the bone but no extra mark on the outer plain bone of the pieces (Fig. 8). Since the original aspect of the surfaces is well preserved, the absence of cut marks on the frontal bone of the ring-frontlet for instance, may just come to signify the skin of the red deer head could have been left on the skull when the head was sliced, or that by the effect of some natural putrefaction the skin of the pedicle was naturally defleshed and cleaned, so worked. Another cranium found at the site, which represents a contra example of a discarded red deer head which remained unsliced; still wearing its antlers fully developed, it shows several cut marks at the level of the pedicles, as well as on the frontal bones (Fig. 9). While our pieces show no further shaping-mark, nor use-wear pattern, without it can be explained by taphonomical is-

Fig. 7 – Deer antler growth under the velvet skin at the springtime, here on a mature male. Unknown photographer (Source: Internet image).

Fig. 8 – Tivoli (Belgium). Original aspect of the fractured edge of a segmented occipital from red deer (arrow, straight plane with possible impact marks from the top of the skull; grey, surfaces d’arrachement on the anatomical lateral sides and at the bottom, on the basal part of the occipital bone). Photo S. Oboukhoff/CNRS.

Fig. 9 – Tivoli (Belgium). A red deer head has been exploited for the skin, as suggested by the cut marks it displays (arrows on the magnified view). Supplementary taphonomical injuries, represented by punctures relative to dog gnawing that are still visible at the edge of the frontal bones, suggest that the cranium was finally discarded as a complete skullcap (frame, in the background). Photos S. Oboukhoff/CNRS.
sues, the presence of both the bone ring-frontlet and two segmented occipitals together in the faunal assemblage of Tivoli-4.1, amongst several broken bone diaphysis of large mammals testifying themselves of marrow fracturing, suggests that some red deer heads may have been split for consumption. Would the skulls, so worked, be the results of fracturing the red deer heads for their interest in the brain, for instance?

CONTRIBUTION OF AN EXPERIMENTAL TEST

In order to conduct an experimental test, which aim was precisely to seek the anatomical and technical constraints implied in brain exploitation, various tools found at the Tivoli-4.1 and Saint-Lambert sites were replicated, and each of them used on a red deer head to slice it; an antler bevel, a flint tranchet, a polished stone axe, a sandstone tranchet and a bone bevel end. While it was not possible to obtain numerous red deer heads since they are for the actual hunters of a very high price that was unaffordable to us, the protocol of study has been reduced to a simple expression; each tool participated to get a bone ring-edge and no particular attention was drawn on the way the tool was exactly maintained during the slicing operation. The deer heads newly received from a hunt have been stored for some days in a freezer before the beginning of the experiment. In order to keep enough visibility on the bone as a clean material during the work, and while presence of the skin on the deer heads would produce a certain amount of drops of blood; the fur was pulled out from the cranium soon after the heads were de-frozen, with no incidence on the material aspect. The heads were thus close to a fresh state of preservation when worked. With respect of the locations of impact marks, as observed on the edges of the archaeological pieces, each skull was sliced from the top of the head towards its right or its left side, or vice versa, down to bottom and deep into the bone. Eventually, the presence of antlers left unshed on the worked animal skull went profitable to stabilize the head on the available stone bolder used as a high working table (David et al. 2012). For enabling the recording after the bone was cut, each skull was boiled with non-caustic soda to remove when it was dry again all the soft tissues by a care hand-cleaning made with wooden sticks.

A skull was worked by indirect percussion with the antler bevel used as a chisel. As the tool made from this raw material is reacting as an elastic matter when percuted on the bone with a wooden club, its cutting edge was unsuitable to grip the cortical (frontal) bone with efficiency. After many attempts and intermediate re-shapes of the tool’s working part, the work was stopped in order to record the minimal damages it made on the skull. Actually, it only scratched superficially some asperities of the bone surface with no incidence (Fig. 10). The flint tranchet used by direct percussion after it was hafted on a shaft, like an adze, was extremely efficient, al-

Fig. 10 – Slicing a red deer skull by indirect percussion with an antler chisel was not possible. The bevel end made from antler rebound on the bone and deformed quite rapidly (left). It only scratches the frontal bones superficially. Photos, after David et al. 2012.

Fig. 11 – Slicing a red deer skull by direct percussion with a flint adze (left) was effective, but the aspect of the bone edges (seen here from the superior view) does not match with that from the archaeological material. Photos, after David et al. 2012.

Fig. 12 - Truncated a red deer skull by direct percussion using a polished stone axe (left) was effective, but the aspect of the bone edges (seen here from the posterior-superior view) does not match that from the archaeological material. Photos, after David et al. 2012.

Fig. 13 - Slicing a red deer skull by indirect percussion using a sandstone chisel (left) was effective, and the aspect of the bone edges (seen here from the superior and anterior views) resembles to that observed on the archaeological material. Photos, after David et al. 2012.

Fig. 14 - Slicing a red deer skull by indirect percussion using a bone chisel (left) was effective, and the aspect of the bone edges (seen here from the superior and anterior views) totally match that observed on the archaeological material. Photos, after David et al. 2012.
though during the work its cutting edge became rapidly deeply retouched, leaving into the bone material several flint chips on its way through (Fig. 11). The skull was well sliced, but the edges of the bone ring appeared then extremely irregular, which is due to the non-stop retouch effect involved then in the repeated percussions that have changed the initial sharpness of the cutting edge into a blunt end. This was not the case of these obtained using the polished stone axe, albeit several deep impact marks were accidentally made aside, on the frontal bone, when the tool was not cutting in line (Fig. 12). The stone axe is a very heavy tool that was not so suitable for the technical task involved here, which was requiring instead a greater precision, as shown by the straight unretouched edges of the archaeological material. With the stone axe thus, the skull could not be properly sliced, actually it was only truncated (décalotté). Hold with hand, used here non hafted, just like a chisel or an intermediate piece percuted with a wooden club, the sandstone chisel was oriented in an oblique manner towards the bone from above, although it was also hand-hold and employed similarly, as an intermediate piece that was directly percuted with a wooden club (Fig. 14). The impact and depression marks yielded using either the sandstone or the bone chisel match those observed on the archaeological pieces (Fig. 13). It has indeed enabled to properly slice the skull, for which single planes yielded by the successive percussions have developed in line, forming a regular ring's edge. Besides, its own cutting edge remained undamaged. This was not the case of the bone chisel, which working part has deeply changed into a smooth broken end during use while it partly perforated also the basisphenoid bone from above, although it was also hand-hold and employed similarly, as an intermediate piece that was directly percuted with a wooden club (Fig. 14). The impact and depression marks yielded using either the sandstone or the bone chisel match those observed on the archaeological records with the consecutive straight-cut anatomical segment. Only the tool made from bone however was capable to slice the skull with the same incidence as for the archaeological records, i.e., more by splitting the bone than properly fracturing it on both lateral anatomical sides. The long length of the bone chisel made it was indeed easier to handle practically than the short and thick sandstone. After the bone chisel was first used to perforate the bone from the top of the cranium at the level of the parietal-frontal fused line, the bone chisel was oriented in an oblique manner towards one of the sides, in order to remove with some efficient lever effect the bone that was anatomically lateral-sidied. More than strict fracture planes occurring then on the edge from either side of the central area of the bone ring, this has left thus some lateral depressions or teared out surfaces (surfaces d’arrachement) that are finally identical to those on the archaeological records.

As a result, it was only in one case when the skull was truncated that the brain appeared, i.e., when the polished stone axe was utilized. In all other circumstances, the brain was not accessible as a substance ready to be removed as a whole. This means that the slicing of the skulls as observed from the archaeological records of the Tivoli-4.1 site, after it was successfully replicated by experiment using a bone chisel by indirect percussion, had apparently no relation with the exploitation of the brain.

DISCUSSION

A possible utilization of the skulls as stock-cubes, for which the cranium would have been discarded as a kitchen remain after been fractured and used as any other bone of the skeleton for the interest in its nutrients, may be at the origin of the presence of both the bone ring-frontlets and the segmented occipitals on the site. In this case however, the technical investment involved here that see then the slicing of the skull in three most regular parts showing straight edges, instead of roughly just breaking it in two or several random fragments, is too important to grant hypothesis this material represents eventually debris of consumption. The reduction of the red deer skulls in anatomical segments stays unclear, if not understood as the one, the occipital, representing the debris of production of the other one, the bone ring-frontlet, i.e., an object manufactured from the skull. If the comparative material gathered for the study, presented below, supports this hypothesis, the various segments constituting hence the remains of complete red deer heads might have been also used singly or together. One is reminding here the plastered skulls made from animal cranial parts, as known from other Stone Age archaeological contexts (Hodder and Pels 2010). Together with the segmented skulls, a clayish matter placed in or covering the pieces would have indeed well acted as a protection against the natural degradation of the bone edges, preventing them being damaged during (long term) exposure, hence showing no visible use wear as it is the case here. The taphonomical evidences gathered from the other bone elements of the osseous deposit of the site indicate besides that the edges of the faunal remains deliberately broken in a fresh state are in general in a good shape of preservation. This is actually suggesting that the major amount of debris from the animal carcasses left in situ was buried quickly in the loamy sediment of the site. While no evidence of temporary roof-bearing structure has been found during excavations, if our pieces are resulting from an exposed ephemeral artefact or construction, this can not by be demonstrated so far.

NEWLY IDENTIFIED SIMILAR FINDS

Amazingly, an important comparative material in the form of six similar bone ring-frontlets and two segmented occipitals has been recognized during the analysis of remains of two contemporary settlement sites, in Friesack 4-IV, Germany (Fig.16), and Dabki 9, in Poland (David 2007). From both these undoubtedly Mesolithic sites (Gramsch 1987, Czekaj-Zastawny et al. 2013, Kabaciński et al. 2014), the segmented skulls have been taken from...
Close to the bone...

Fig. 15 – Large deer bone ring-frontlets and occipital bones yielded by the Friesack 4-IV, Germany (all figures except n°5), and Dabki (Poland) sites (n°5). N°1-4 and 6 are from the Red deer. N°5, 7 and 8 are from the Elk. N°1, 2, 4-6 and 8: Bone ring-frontlets. N°3 and 7: Waste of production of the bone ring-frontlets (occipital bones). N°1 and 4 are anterior-superior view, N°2, 3, 5 and 6 show either anterior ((3) or posterior view (2, 5 and 6), N°7 and 8 show respectively lateral and inferior views. Photos É. David/CNRS.

appropriated a natural form for transforming it into a symbolic object meant for him to represent a “culturalized” natural form, as if the anatomy constructed as a whole would have been created naturally or by natural forces solely.

By looking at the cranial bone’s morphology at its junction with the pedicles, any hunter was enabled probably to recognize which animal species has been initially used for making the artefacts, the red deer or the elk. However, since the Elk antler has always been transformed, it seems the shaping enabled identifying it with more certainty. It is possible that the hardest bone parts of the sliced heads were then not visible during use and/or exposure, either while these were still covered with their original fur, or even plastered. The antlers therefore would have been shaped, so that their origin as animal material would remain identifiable. As to reinforce this idea, the non-shaping of the antlers that is left cylindrical when the ring-frontlet is made from red deer respects the initial morphology of the natural anatomy of this species of cervid that is indeed precisely tubular at a mature stage. There is in this sense a possible appropriation for a symbolic use of primeval deer heads by the Mesolithic hunters transformed into a material representation of distinct large cervids, for which parts of their craniums were briefly used and/or exposed in situ where the activities of the hunters have taken place.

The antlers were probably chosen in growth less for the minimal technical effort they offered for being transformed into objects than for their symbolic value considering they precisely refer to the spring time, which is meaning the renewal of the cycle of the wild life. With this respect, and since the vestiges presented here seem to come from Mesolithic contexts only when attributed, they could have been made, meant in opposition to the domesticated animals which process of reproduction is conversely only referring to Neolithic communities. While the hunt of large cervids was also conducted by these latter, it might have run in competition with the exploitation of the deer that, as a species, was conversely central in Mesolithic subsistence. If not employed just to be used as territorial markers—frontlets are indeed known from actualist ethnographical contexts as deer heads fixed on trees around the living area, in order to mention to the potential visitors that some people are living there (Grønn et al. 2008)—the deer skulls once so transformed might simply have been employed by Mesolithic hunters to materialize their strong relationship to the wild; not only as being part of
it, but in using a symbolic on the large antler bearing species while these are precisely the kind of animals that can always best represent the hunting (Hell 1995), as if the hunters had shown in this way that they were indeed the ones who were able to “cultivate” the growth of the wild as an emblematic resource, to the farmers.

If this symbolic use of large cervids initially was specific to Stone Age societies, one would then expect to record the same or equivalent vestiges also at the beginning of the Mesolithic. In Friesack, which is proposing also one of the longest chronological sequence attributed to the Mesolithic in Europe, the shaped deer skulls appear precisely at the very end of the stratigraphical sequence only (layer IV-2), i.e., at about the same time when did occurred the territorial Neolithic primary expansion in the North-European plains (Hartz et al. 2007). The fact that the bone ring-frontlets are found yet in various places in Europe, but always in Late Mesolithic contexts, suggests it constituted a possible unilateral answer grown in relation or in reaction to the Neolithization phenomenon from Mesolithic societies, regardless their original traditional cultural heritage. The deer ring-frontlets gathered here for comparisons are indeed from diverse and distant Mesolithic cultures (Fig.16). So forth, it would be no surprise to find similar vestiges from other sites dated to the same chronological frame in other parts of Europe, and mainly from revisiting the faunal remains as it was the case here for every site. Finally, the new comparative material suggests the worked skulls from Tivoli-4.1 might be Mesolithic too.

CONCLUSION

On the basis of the technological approach, as presented here by means of integrating results on the taphonomical, typological, technical (techniques and use-wear traces) and experimental analyses interaction and with consideration of related contextual data, an unpublished artefact-type was recorded: the bone ring-frontlet made of primeval large cervid skull. Used as an object, the segmented occipital part represents its most well preserved corresponding debris of production. With this latter, the ring-frontlets have potentially been part of a more complex practice and/or architecture made using different raw materials that was probably highly significant and/or standing visible in the functional activity area. This is suggested on the artefacts by the shaping of the antler extremities when compared to the bone parts left untouched and which edges display planes that are extraordinary fresh regardless their provenance in Europe. From the large study frame involved here, their presence on various sites of the latest phase of the Stone Age in northern Europe, i.e., associated then to diverse Mesolithic cultures, and on archaeogological sites that are always located deep into river valleys or based on shore but close to Neolithic villages, suggest their symbolic value for the last hunters of Mesolithic traditions when facing the Neolithic cultural-based system.

REFERENCES


Note

Inventory list recording the ring-worked large deer skulls with their radiocarbon AMS date

Tivoli, 4.1 unit (Place Saint-Lambert, Liège, Belgium): One Red deer ring-frontlet:

PSL/I AL Z20Secteurs-E-F Tiv.371 refit with PSL/I AL Z20Secteurs-E-F Tiv.370

Two segmented occipital parts:

PSL/I AL Z20TQ29 Tiv.346

GrA-44332 6335±40 BP

[5465-5218 Cal BC, calibration 95.4 % confidence OxCal 4.2-86 ©Bronk Ramsey 2014]

PSL/I AL 20/00P7 CIII plan16 Tiv.247

GrA-44321 6320±40 BP

[5461-5214 Cal BC calibration 95.4 % confidence OxCal 4.2-86 ©Bronk Ramsey 2014]

Friesack 4, horizon IV-2 (Germany), Late Mesolithic (Gramsch 1987):

Four Red deer ring-frontlets:
K245; K356 (layer IV-2); K280 (layer IV-2), K127 (layer IV-2);

One Elk ring-frontlet:

n°? (no individual label);

Two segmented occipital parts:

98-40 (layer IV-2); n°? (no individual label).

Dabki 9 (Poland), Late Mesolithic, Ertebolle culture (Kabaciński et al. in prep.):

One Elk ring-frontlet:


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INTRODUCTION

The multi-period site of Paks-Gyapa, unearthed under the direction of Gábor Váczi in 2008 (Váczi 2009: 254), is laying on the eastern border of village Gyapa, 10 km from the city of Paks in the northern direction (Figure 1). In addition to a small Late Copper Age (Baden culture) assemblage including 417 animal bones of which 253 were identifiable, it yielded the most abundant archaeozoological assemblage known so far from the Early Bronze Age of Hungary. A total of 7,572 identifiable remains were found in about 150-160 Makó and Somogyvár-Vinkovci culture features (Gál & Kulcsár 2012: 209.).

Domestic animals dominated in both assemblages by 93.67% and 90.61% of the remains, respectively. Sheep and goat were the most frequent species in the Late Copper Age assemblage yielding 44.66% of the remains. They were followed in frequency by cattle (31.62%) and pig (15.81%). Contrary, cattle was the most frequent species (61.74%) in the Early Bronze Age assemblage, being followed by sheep and goat (17.89%), and pig (9.54%).

The Late Copper Age assemblage contained four bone tools representing 1.56% of the total bone collection. The Early Bronze Age assemblage included 31 artefacts made from bone, antler and tusk that represent 0.41% of the total archaeozoological assemblage. Their detailed presentation and comparison to the coeval bone manufacture in the region is the subject of this paper.

Prehistoric utensils being concerned, the classifying of tools into the different type categories follows Jörg Schibler's...
RESULTS

Four artefacts form the Late Copper Age tool assemblage: a small point without articular end (Type 1/7), a small *ad hoc* chisel (Type 4/8), a round diaphysis chisel (Type 6) and a faceted bone fragment (Type 22). The first three, well identifiable utensils were made from skeletal parts of sheep or goat (Figure 2). According to the clear hand-polish on their surface, and evidence for curation in the case of the small point and chisel, these tools have been used for long time.

The fourth artefact was made from a cattle radius. The faceted diaphysis fragment suggests a runner-like tool, but since only a small part of the object has been recovered, the exact function of this implement remains unclear.

From the point of view of the manufacture continuum, the point and chisels represent second class tools. The selection of radius from a large ungulate as well as its planned working into a faceted tool ranks it among the first class artefacts (Choyke 1997).

The majority of Early Bronze Age artefacts (27 items) were manufactured from the bones of various domestic and wild species. Three tools were made from the antler of red deer and roe deer, respectively. A wild boar tusk object was also identified (Table 1).

Most of the bone tools represent points. Among these, round diaphysis point (Type 1/3) is dominating by eight specimens (Figure 3). Except for a metacarpus, they were made from sheep or goat tibiae.

Small points with articular end (Type 1/4), large, massive points with articular end (Type 1/6), small points...
without articular end (Type 1/7), middle size points without articular end (Type 1/8), large, massive points without articular end (Type 1/9) and projectile points with long haft stem and point (Type 3/5) were also represented by one or two specimens each (Figures 4-5). Various skeletal parts from a number of species such as cattle humerus and metapodium, from sheep or goat femur and tibia, pig radius, red deer metapodium served as raw materials for these artefacts.

Chisels and scrapers were found in a smaller number. They mostly represent curved scrapers (Type 4/11) made from scapulae of large ruminants and pig, and small chisels (Type 4/5 and Type 4/14). The latter were carved out from tibia and metacarpus of sheep or goat (Figure 6).

Among the six polished tools, three represent grinded astragali from cattle and aurochs. Both their dorsal and plantar surfaced were modified as illustrated on Figure 7. The other three polished tools are a rib cattle, a sheep tibia and a roe deer antler (Table 1).

A single artefact was carved out from pig tusk. Its base is broken, therefore one can not be sure whether it was drilled and hung, but its slim shape, pointed end, and smooth surface suggest that it used to be a pendant or a similar object suspended or fixed on cloth or a similar material (Figure 8).

Antler manufacture is evidenced by two utensils at Paks-Gyapa (Figure 9). The larger is a hafted rose and beam tool. Since the top of implement is broken, it is hard to decide whether it was an adze or rather an axe-like tool. The base of antler is also present on the smaller artefact. A whole was drilled into the eye-tine in this case which probably represents a socket for blade.

More than half of the above described implements may be grouped among first class tools on the base of deliberate selection of raw material, planning of tool, degree of craftsmanship. The rest of utensils represent second class and ad-hoc tools which were mostly produced from simple bone fragments in short time, and without needing special skills in bone or antler manufacture.

**DISCUSSION**

Modified bones, tusk and antler were represented in a modest number both in the Late Copper Age and Early Bronze assemblages found at Paks-Gyapa, suggesting a small interest in bone manufacture at the settlement. It is worth considering, however, that Class I tools formed half of the Early Bronze tool assemblage that contains sufficient items to be discussed. This points to the fact that even occasionally producing implements from hard tissues of animals, the raw material was often deliberately selected by craftsmen. Consequently, certain types of tools or objects must have been important for the people inhabiting this settlement.

So far Late Copper Age bone tools were described from three sites in Transdanubia. The Baden culture site of Aparhant-Felső legelő, located at about 50 km in south-western direction from Paks-Gyapa, yielded a small number of ad hoc bone tools. Similarly to the artefacts under study, they were made from skeletal parts of sheep that seemed to have been the most important species from an economic point of view as well. Interestingly, the bone tool collection found at Aparhant-Felső...
Close to the bone...

<table>
<thead>
<tr>
<th>Type of tool (Schibler’s typology)</th>
<th>Bone</th>
<th>Class</th>
<th>Top</th>
<th>GL</th>
<th>GB</th>
<th>GD</th>
<th>LMF</th>
<th>GSB</th>
<th>Feature</th>
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<tbody>
<tr>
<td>Round diaphysis point (Type 1/3)</td>
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<td>1</td>
<td>2/1</td>
<td>68.5</td>
<td>12.6</td>
<td>8.1</td>
<td>-</td>
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<td>1075</td>
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<td>71.4</td>
<td>28.1</td>
<td>21.6</td>
<td>-</td>
<td>-</td>
<td>1075</td>
<td>Used for long time, broken top</td>
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<td>84.0</td>
<td>29.0</td>
<td>23.0</td>
<td>-</td>
<td>-</td>
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<td>89.5</td>
<td>25.7</td>
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<td>-</td>
<td>-</td>
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<td></td>
<td>90.7</td>
<td>28.6</td>
<td>21.8</td>
<td>-</td>
<td>-</td>
<td>1075</td>
<td>Broken top</td>
</tr>
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<td>Tibia (Caprinae)</td>
<td>1</td>
<td>3/4</td>
<td>97.3</td>
<td>29.2</td>
<td>22.4</td>
<td>-</td>
<td>-</td>
<td>1080</td>
<td>Used for long time, curated, blunt top</td>
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<td>28.6</td>
<td>21.1</td>
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<td>-</td>
<td>858</td>
<td>Broken top</td>
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<td></td>
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<td></td>
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<tr>
<td>Small point with articular end</td>
<td>Radius (pig)</td>
<td>2</td>
<td>8/9</td>
<td>79.5</td>
<td>24.8</td>
<td>17.9</td>
<td>-</td>
<td>-</td>
<td>1078</td>
<td>Polished handle</td>
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<td>10/9</td>
<td>152.5</td>
<td>28.2</td>
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<td>-</td>
<td>-</td>
<td>1105</td>
<td>Burnt fragment, used for short time</td>
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<td>Metapodium (Caprinae)</td>
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<td>5/4</td>
<td>55.7</td>
<td>9.8</td>
<td>4.4</td>
<td>-</td>
<td>-</td>
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<td>2</td>
<td>3/8</td>
<td>59.0</td>
<td>18.6</td>
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<td></td>
<td></td>
<td>715</td>
<td></td>
</tr>
<tr>
<td>Middle size point without articular end</td>
<td>Tibia (Caprinae)</td>
<td>2</td>
<td>12/9</td>
<td>97.8</td>
<td>14.2</td>
<td>5.5</td>
<td>-</td>
<td>-</td>
<td>851</td>
<td>Possibly curated</td>
</tr>
<tr>
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<td>Metapodium (cattle)</td>
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<td></td>
<td></td>
<td></td>
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<td>1075</td>
<td></td>
</tr>
<tr>
<td>Large, massive point without articular end</td>
<td>Metapodium (large ruminant)</td>
<td>2</td>
<td>7/1</td>
<td>94.3</td>
<td>22.4</td>
<td>8.0</td>
<td>-</td>
<td>-</td>
<td>1062</td>
<td>Curated, blunt top</td>
</tr>
<tr>
<td>Projectile point with long haft stem and point</td>
<td>Long bone diaphysis (large ruminant)</td>
<td>1</td>
<td>2/2</td>
<td>83.8</td>
<td>11.0</td>
<td>3.9</td>
<td>-</td>
<td>4.1</td>
<td>520</td>
<td>Flat, polished top, well preserved top</td>
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<tr>
<td>Projectile point with long haft stem and point</td>
<td>Metapodium (red deer)</td>
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<td>2/1</td>
<td>120.4</td>
<td>8.5</td>
<td>6.5</td>
<td>-</td>
<td>3.0</td>
<td>1111</td>
<td>Round, eroded surface, well preserved top</td>
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</tbody>
</table>
### Table 1. Summary table with measurements (mm) of Late Copper Age (shaded lines) and Early Bronze Age tools from Paks-Gyapa

<table>
<thead>
<tr>
<th>Type of tool (Schibler’s typology)</th>
<th>Bone</th>
<th>Class</th>
<th>Top</th>
<th>GL</th>
<th>GB</th>
<th>GD</th>
<th>LMF</th>
<th>GSB</th>
<th>Feature</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small chisel (Type 4/5)</td>
<td>Tibia (Caprinae)</td>
<td>2</td>
<td>-</td>
<td>58.0</td>
<td>14.3</td>
<td>8.2</td>
<td></td>
<td></td>
<td>1075</td>
<td>Fragment</td>
</tr>
<tr>
<td>Small ad hoc chisel (Type 4/8)</td>
<td>Metacarpus (Caprinae)</td>
<td>ad-hoc</td>
<td>29/23</td>
<td>71.7</td>
<td>14.4</td>
<td>9.8</td>
<td></td>
<td></td>
<td>582</td>
<td>Broken end, handpolished</td>
</tr>
<tr>
<td>Curved scraper (Type 4/11)</td>
<td>Scapula (large ruminant)</td>
<td>ad-hoc</td>
<td>-</td>
<td>68.0</td>
<td>35.4</td>
<td>11.8</td>
<td>-</td>
<td>-</td>
<td>1080</td>
<td>Burnt fragment</td>
</tr>
<tr>
<td>Curved scraper (Type 4/11)</td>
<td>Scapula (aurochs)</td>
<td>ad-hoc</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>938</td>
<td>Scapula scraper</td>
</tr>
<tr>
<td>Curved scraper (Type 4/11)</td>
<td>Scapula (pig)</td>
<td>ad-hoc</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>715</td>
<td>Scapula scraper</td>
</tr>
<tr>
<td>Small chisel with articular end</td>
<td>Metacarpus (sheep)</td>
<td>2</td>
<td>-</td>
<td>63.3</td>
<td>27.5</td>
<td>19.3</td>
<td>-</td>
<td>-</td>
<td>1130</td>
<td>Broken end</td>
</tr>
<tr>
<td>Round diaphysis chisel (Type 6)</td>
<td>Tibia (Caprinae)</td>
<td>2</td>
<td>30/25</td>
<td>117.7</td>
<td>14.6</td>
<td>19.6</td>
<td>13.4</td>
<td>24.0</td>
<td>582</td>
<td>Handle from the distal epiphysis, handpolished</td>
</tr>
<tr>
<td>Polished tool (Type 19)</td>
<td>Anter (roe deer)</td>
<td>ad-hoc</td>
<td>-</td>
<td>204.0</td>
<td>30.0</td>
<td>14.9</td>
<td>-</td>
<td>-</td>
<td>758</td>
<td>Polished tine-end</td>
</tr>
<tr>
<td>Polished tool (Type 19)</td>
<td>Rib (cattle)</td>
<td>ad-hoc</td>
<td>-</td>
<td>195.0</td>
<td>24.1</td>
<td>10.1</td>
<td>-</td>
<td>-</td>
<td>715</td>
<td>Scraper-like tool</td>
</tr>
<tr>
<td>Polished tool (Type 19)</td>
<td>Tibia (Sheep)</td>
<td>ad-hoc</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>493</td>
<td></td>
</tr>
<tr>
<td>Polished tool (Type 19)</td>
<td>Astragalus (cattle)</td>
<td>1</td>
<td>-</td>
<td>67.7</td>
<td>47.4</td>
<td>38.5</td>
<td>-</td>
<td>-</td>
<td>858</td>
<td>Polished on both surfaces</td>
</tr>
<tr>
<td>Polished tool (Type 19)</td>
<td>Astragalus (aurochs)</td>
<td>1</td>
<td>-</td>
<td>74.3</td>
<td>52.2</td>
<td>39.3</td>
<td>-</td>
<td>-</td>
<td>456</td>
<td>Polished on both surfaces</td>
</tr>
<tr>
<td>Polished tool (Type 19)</td>
<td>Astragalus (aurochs)</td>
<td>1</td>
<td>-</td>
<td>74.4</td>
<td>49.4</td>
<td>41.7</td>
<td>-</td>
<td>-</td>
<td>857</td>
<td>Polished on both surfaces</td>
</tr>
<tr>
<td>Bone with manufacturing wear (Type 22)</td>
<td>Radius (cattle)</td>
<td>1</td>
<td>-</td>
<td>105.2</td>
<td>22.6</td>
<td>17.9</td>
<td>-</td>
<td>-</td>
<td>597</td>
<td>Possibly a runner-fragment</td>
</tr>
<tr>
<td>Pig tusk pendant(?) (Type 23)</td>
<td>Lower canine (pig)</td>
<td>1</td>
<td>-</td>
<td>16.2</td>
<td>11.0</td>
<td>12.5</td>
<td>-</td>
<td>-</td>
<td>724</td>
<td>The base is broken</td>
</tr>
<tr>
<td>Antler rose and beam tool with blade</td>
<td>Antler (red deer)</td>
<td>1</td>
<td>-</td>
<td>86.8</td>
<td>82.2</td>
<td>56.6</td>
<td>-</td>
<td>-</td>
<td>855</td>
<td>Blade hole drilled into the eye-tine</td>
</tr>
<tr>
<td>Hafted antler rose and beam axe-like tool</td>
<td>Antler (red deer)</td>
<td>1</td>
<td>-</td>
<td>142.0</td>
<td>86.8</td>
<td>55.6</td>
<td>-</td>
<td>-</td>
<td>1103</td>
<td>Fragment; medio-laterally drilled through by a rectangular hole of 23.1 x 20.7 mm</td>
</tr>
</tbody>
</table>
of a number of wild animals (Gál & Kulcsár 2012: 209, 140-145). Not only gathering, but hunting also was reg-

rated examples. In addition to the (mostly gathered) 

injuries site of Dombóvár-Tesco. It lays between the previous 

ence from this settlement. Small and middle size points 

sone from the lake of Lake Balaton. The total of 26 

Boleráz culture artefacts included various awls and chisels 

made from bones, as well as pig tusk tools (a pendant, 

a scraper and an unidentifiable object), and two hafted 

antler tools made from red deer antler. 

The Baden culture tool assemblage was more abun-

dant: it contained 94 items in all. Round diaphysis point 

made from sheep and goat tibia was the dominating type 

in this assemblage, but other types of points and chisels 

were also well represented. A number of tusk- and antler 

articles from both assemblages were found in graves. Most of the implements represented Class II and ad hoc 

tools (77% in the Boleráz and 68% in the Baden culture 

collection, respectively). The majority of artefacts were 

made from the skeletal parts of sheep and goat, and cattle 

(Gál 2014: 327). These species also dominated in the re-

fuse bone assemblages and in the sacrificial pits (Horváth 


The third site is Kaposújlak-Várdomb laying at about 

110 km in south-western direction from Paks-Gyapa. This settlement yielded artefacts from several periods in-

cluding the Late Copper Age (Pécel-Baden culture) and Early Bronze Age (Somogyvár-Vincovci culture). The older tool collection contained 35 artefacts, majority of them representing points. As for the origin of the raw 

material of implements, sheep and goat were the leading 

species in this case as well (Gál 2011: 140). 

The Early Bronze assemblage from this site represents 

one of the richest tool collections not only in Southern 

Transdanubia, but in the entire Bronze Age of Hunga-

ry (Choyke 1984; Choyke at al. 2004; Choyke & Barto-
siewicz 2009). Small ruminant metapodial points and 

other types of awl as well as antler tools (mostly hafted 

implements) were dominating in this assemblage includ-

ing 135 artefacts in all. The selection of species and ske-

letal parts was much more various than in the aforemen-

tioned examples. In addition to the (mostly gathered) 
antler of red deer, bones of large and small ruminants 

were manufactured in a similar proportion (Gál 2011: 

140-145). Not only gathering, but hunting also was reg-

ularly practiced at this site as evidenced by the remains 
of a number of wild animals (Gál & Kulcsár 2012: 209, 

Fig. 1). 

The other Early Bronze Age site yielding modified 
bones from the region is the Somogyvár-Vincovci cul-

ture site of Dombóvár-Tesco. It lays between the previous 

site and Paks-Gyapa, at about 80 km from the latter in 

south-western direction. A total of 28 tools were identi-

ied from this settlement. Small and middle size points 

without articular end were the most frequent type of 

implement. In addition, tusk- and antler tools, chisels 

and other bone artefacts were also identified in a small-

er number. Most of the modified bones originated from 
cattle, which also dominated the refuse bone assemblage, 
being closely followed by sheep and goat in frequency 

(Szabó & Gál 2013: 60-68). 

The above mentioned parallels evidence that the Late 

Copper Age assemblage from Paks-Gyapa shows similari-


ties with the coeval tool collections from the region 

both regarding the typology and origin of artefacts. The 

Early Bronze Age tool assemblage, however, showed a 

number of differences in comparison with the coeval as-

semblages. At Paks-Gyapa, it seems to have been a need 

for round diaphysis points made from the long bones of 

sheep and goat. Although cattle became the leading spe-

cies in the Early Bronze Age assemblage by over 60% of 

the refuse bone remains, most of the utensils were still 

carved out from the skeletal parts of Caprinae suggesting 

the continuous role of these species in bone manufac-


ture. 

The proportion of projectile points with long haft stem 

and point is also notable at Paks-Gyapa. This type of tool 

would suggest people’s interest in hunting. Although this 

activity was not frequently practiced as suggested by the 

small proportion (9.39%) of bones from wild animals, a 

number of small and big game were hunted around the 

settlement (Gál & Kulcsár 2012: 209, Fig. 1). No fish 

bones were found at this site, but since the archaeological 

remains were only hand collected, and neither wet siev-

ing nor dry screening was applied during the excavation, 

fishing can not be excluded among food provision either, 

especially taking into account the proximity of river Dan-

ube (Figure 1). 

The most interesting artefacts found at Paks-Gyapa, 

however, are the faceted astragali from big ruminants. 

They may have been used in playing and rituals as well as 
in everyday activities such as smoothing alike, but they 

are outstanding in their rarity. Faceted short bones have 

not yet been described from Early Bronze Age assem-

blages neither from Transdanubia nor from the other 

parts of the country. The closest parallel comes from the 

early Middle Bronze Age site of Jászdózsa-Kápolnahalom 
in the north of the Great Hungarian Plain (North-east-

ern Hungary). In addition to the 29 grinded bones found 
in Hatvan culture contexts, 33 stray finds also represent-

ed short bones with flattened sides. The raw material in 

this case was quite various: phalanges from a number of 

species such as cattle, sheep and goat, pig, horse and 

red deer, as well as astragali from cattle, sheep and goat 

and red deer. Flattened bones were also common types 
of tools at the Middle Bronze Age sites of Százhalombat-

ta-Földvár (Vatya culture) and Füzésabony-Öregdomb 
(Füzésabony culture) in Central and Eastern Hungary, 
respectively (Choyke & Bartosiewicz 2009: 362-363, Ta-

ble 1, Plate III).
CONCLUSIONS

Both the Late Copper Age and Early Bronze Age bone assemblages from Paks-Gyapa contained a small number of artefacts made from hard tissues of animals. The four Baden culture implements were carved out from bones. Sheep and goat served as raw material, similarly to the other coeval assemblages in the region. The typology of tools did not show any special characteristics either in the context of bone manufacture in Transdanubia during the Late Copper Age.

The Early Bronze Age assemblage outstands in the frequency of round diphysis points and projectile points with long haft stem and point as well as in the presence of faceted astragali from big ruminants. Contrary to the coeval sites in the area, sheep and goat as raw material kept on being as much important as cattle which evidently became the leading species in the economy of Early Bronze Age inhabitants in Southern Transdanubia.

REFERENCES


Acknowledgements: Archaeologists Gábor Váci is thanked for inviting me to study the Late Copper Age and Early Bronze Age assemblages from Paks-Gyapa, respectively. Anna Biller is thanked for separating the bone tools from the rest of assemblage in the Late Copper Age material. This research is being granted by the Hungarian Scientific Research Fund (OTKA Programme NF 104792).
Animal bones are not finds that might be anticipated in quantity in the archaeological investigation of former mills, whether wind or water powered. However, excavation of a medieval postmill near Hartlepool (HER 12, Figure 1), Co. Durham, England, revealed a large pit containing horse bones (Archaeological Services 2013). Dismembered body parts, rather than entire corpses, appear to have been deposited and metapodials were conspicuously absent. This pit also produced two broken artefacts made from horse metacarpals, Figures 2 and 3. This suggested that the miller had acquired these partial horse carcases as a source of raw material, though only the metapodials appear to have been required. It would appear that the horse metacarpal artefacts were necessary for the functioning of the mill and were made on site. These objects are characterised by holes piercing the shaft at the proximal and distal ends from anterior to posterior, and smooth scoops in the anterior surface of the shaft. No parallel is present in MacGregor’s (1985) study of post-Roman bone artefacts. However earlier, unprove-
nanced, finds of comparable objects were recognised as “a distinct class of implement” (Reader 1910, 51). The scoop was suggested “as a rest to hold some material while it was being manipulated” and the holes “may have been for securing the object” (Reader 1910, 58). There is a superficial resemblance to bone skates and sledge runners with comparable fixing holes (MacGregor 1985, 143), but these lack the scoops in the shaft seen in the Hartlepool finds.

Subsequently, more artefacts of this type were recovered from the demolition deposits on the site of a windmill at Ryhope (RCK14, Figure 1), formerly also in Co. Durham (Archaeological Services 2014). This mill was a medieval foundation but the site continued as a working post-medieval mill, appearing in estate records covering 1796-1804. All but one of the Ryhope artefacts are also made from horse metapodials. The exception was made from a cattle metatarsal, of the large and improved type of cattle which occur locally in the archaeological record from the later eighteenth century. Two complete examples of the horse bone artefacts were found, Plate 1. The penetrating holes are square in section and would appear to have accommodated hand-forged square section iron nails. The posterior of the proximal and distal articular ends have been trimmed so that the bones lie flat on this surface. Some artefacts have clearly been discarded because movement during use has enlarged the nail hole, Plate 1 distal metatarsal for example, so the object was no longer held in place securely. The use of a nail with a head and/or a washer is suggested by a circular crush mark round the anterior nail hole on one example. The broken bones demonstrate that the scoop in the shaft was a weak point prone to failure. Two charred and broken artefacts suggest that friction generating heat was associated with their function, and a contributory cause of breakage. One artefact shows a torsion break, indicating that the normal direction of stress could be reversed. It would appear that the bone objects represent an inexpensive and easily replaced item, designed to break in use rather than jeopardise a more difficult to replace part of the mill mechanisms.

**EARLY INTERPRETATIONS**

The Ryhope assemblage generated the first two interpretations to explain the function of these artefacts. The initial supposition was that, since the perforations through the shafts are explicitly man made, the smooth scoops on the shafts were also a deliberately manufactured part of the artefact. Hence it was suggested that these bones acted as bearings, where turning beams passed through internal partitions in the mill. In the absence of surviving physical evidence, various materials have been proposed for such bearings in early medieval windmills (Lucas 2006, 119), though bone as a cheap, robust and readily available raw material was not considered.

Further understanding of the mechanics of a windmill generated the second hypothesis, presented as a poster at the Belgrade conference (Gidney 2014). Windmills require systems of gearing to transfer the turning of the
Close to the bone...

sail into the rotation of the upper millstone. It is generally presumed that such gearing was of timber construction, though Lucas (2006, 119) points out that historians have no substantiating evidence. The transmission of gear wheels relied upon interlocking joints and needed to be capable of resisting torsion forces. Some gear wheels were of ‘clasp arm’ design, where spokes were fitted in pairs on each side of the shaft and locked together with halved dovetail joints, forming a collar round the shaft. This construction transmitted torsion forces without weakening the turning shaft (www.wimbledonwindmill.org.uk). It was suggested that these horse bone artefacts represented evidence of such ‘clasp arm’ gear attachments. The scoops in the bone shafts possibly indicated either where the bones fitted onto the turning shaft or represented crude half dovetail joints, while the holes through the ends were where the pair of bones encircling the shaft were joined and tightened.

More detailed examination of the use of clasp arm gearing in windmills showed that this was primarily associated with the large brake wheel, transmitting the turning of the windshaft to the gears driving the millstone. Biddle (2000, 117-124) discusses and illustrates medieval clasp-arm constructions, which are characterised by the arms forming a square round the shaft with no recessing to fit the curvature of the turning beam. The huge size of clasp arm wheels, the precision needed for tight fitting half dovetail joints and the lack of scooping to fit onto the shaft demonstrated that this hypothesis was untenable.

THE PROBABLE FUNCTION

The final line of enquiry was suggested by Stan Kuhlmann (pers. comm.), who considered that the scoops on the shafts of the bones might represent a wear pattern, rather than being a deliberately crafted part of these objects. Perusal of a Glossary of mill parts encountered the Rap, defined as “a block of hard wood or bone on the shoe to take the knock of the quant or damsel” (Wailes 1967, 217). The shoe leads the grain from the hopper to the millstones and has to be constantly tapped to maintain an even flow. The quant is the square sectioned spindle turning an over-drive millstone while the damsel is a spindle with flanges on an under-drive millstone. Figure 4 illustrates the position of the rap in the shoe. A further source states of the rap that “it is replaceable so the whole shoe does not need to be remade when the rap wears down” (www.angelfire.com/journal/pondlilymill/glossary.html).

This function would appear to explain all the features observed on these bone objects. The smooth scoops on the shafts of these bones may not have been deliberately cut and polished by the miller but may merely be the result of wear from the constant knocking of the quant when the millstone was turning. If the miller only trimmed the posterior and pierced the holes through either end of the whole bone, these objects would have been relatively
quick both to make and to fit. The exposure of the mar-
row cavity within the scoop, seen on some examples, was
not deliberate but the result of wear, leading to breakage
at the weakened section of the shaft. The friction charring
and torsion break may represent occasions when the mill
malfunctioned, for example the revolutions of the quant
had speeded up or the hopper had run low on grist.

FURTHER ARCHAEOLOGICAL AND HISTORICAL PARALLELS

To confirm this hypothesis, further examples of these
objects were sought from extant mills, in addition to ar-
chaeological finds. Though the rap is essential for feeding
the grain from the hopper to the millstones in both wind
and water mills, it is a small item that is rarely considered
by mill heritage groups (Mills Archive Trust pers. comm.,
North East Mills Group pers. comm.). Animal bones re-
main of little interest to archaeologists primarily interest-
ed in the structural remains of mills and with constraints
on publication, resulting merely in the mention that bone
was recovered, for example the Old Mill at Berkhamstead
(Hunn & Zeepvat 2009).

However, one possible parallel for these bone objects is
recorded from the excavation of a late medieval post mill
at Bridlington, East Yorkshire: “three ox cannon bones,
not illustrated, with chopping marks near the joint. The
bones had large pieces cut from one or both sides and
a hole has been drilled through the bone near the joint”
(Earnshaw 1973, 31). Further, illustrated, examples were
found in the excavations of two sixteenth – eighteen
century windmill sites at Pashley Down in Sussex, com-
prising one complete but unworn example and broken
fragments of two horse metacarpal artefacts, comparable
with those from Hartlepool and Ryhope, together with
three cattle metapodial artefacts (Stevens 1982, 115). Ste-
vens (1982, 120) summarises earlier discussions of com-
parable artefacts, which considered that they may have
functioned “as chocks or brakes, as the 'scoop' scar shape
seemed to reflect the wear that a moving part might in-
fect” and that “it would appear that bones having scoops
worn in their shafts would have been put to some similar
common use which at present remains an enigma”. The
earlier published examples (Reader 1910, 51-58) were
all unprovenanced, so there was no explicit link to the
function of the mill as an aid to interpretation, though the
scoped cut and flattened back were considered as con-
stant and defining characteristics.

A MODERN COMPARANDUM

The proposition that these bone artefacts are worn out
raps is a plausible solution to the enigma of their wear
and function. This hypothesis received further confirma-
tion from the examination of a discarded worn wooden
rap from Little Salkeld watermill in Cumbria. This has a
hole drilled through at either end, a scoop worn mid-shaft
and traces of friction charring, Figure 5. The wooden rap
commences as a rectangular block of wood and the scoop
is the result of wear from contact with the damsel. The
wooden raps at Little Salkeld mill last for 12-18 months
before needing to be replaced (Little Salkeld millers, pers.
comm.).

This wooden rap is much shorter than the horse bone
artefacts but the dimensions of the scoop are compara-
ble. There is considerable variation in the design of the
shoe and the size of the rap in extant mill furniture, re-
flecting the miller's choice of design relative to the size
of the stones and the driving mechanisms. One of the
cattle metapodial artefacts from Pashley Down has had
both articular ends sawn off to make a short rap with
one large scoop worn almost to the two fixing holes (Ste-
vens 1982, 115), comparable to this modern wooden rap.
Once worn, the wooden raps at Little Salkeld are simply discarded. Besides being a harder material, which may have taken longer to wear down than wood, the bone raps appear to have had the advantage of several uses, by reversing the ends and face of the bone in contact with the quant or damsel. Examples from both Hartlepool and Ryhope show more than one scoop worn on the shaft, as do two examples from Pashley Down postmill (Stevens 1982, 115). One of the Pashley Down examples has extra fixing holes and trimming of both faces of the distal articulation to accommodate this reversal of the surface in wear.

POSSIBLE RATE OF DISCARD

It would appear from the finds of only two or three of these bone raps from the mill sites at Hartlepool, Bridlington and both the Pashdon Down mill sites, that this may have been a normal rate of discard for the working life of a mill. As noted above, a wooden rap can last for eighteen months in a mill which works all week round. The more seasonal workload of a rural medieval mill and the possible slower rate of wear on bone could indicate that one rap might last for several years, particularly where more than one aspect of the bone shaft has been worn. Ryhope is outstanding with the recovery of seventeen of these objects. This may reflect either a hoard of worn out raps from the lifetime of the mill or, more probably, an increase in throughput to cope with supply for an increasing urban population on Tyneside in the late eighteenth century.

CONCLUSION

The explicit association of stratified examples of these bone objects with windmill sites throughout England suggests that this was once a standard item of mill furniture. The use of bone for crafting this small component of the working parts of a mill appears to have been largely ignored by both archaeologists and historians. These finds demonstrate that the range of handicraft skills needed by a miller included bone working in addition to carpentry and stone dressing.

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www.wimbledonwindmill.org.uk Education: Teacher's Notes Part 2, Materials, Design and Technology

Acknowledgements: The interest and assistance of the millers in facilitating a private viewing of the working mechanisms at Little Salkeld watermill in Cumbria, and donation of the worn wooden rap, is gratefully acknowledged.
Janine Wilson, Archaeological Services, Figures 1-3.
Yvonne Beadnell, Figures 4 and 5.
Paul Stokes, Plate 1.
BONE ANVILS FROM THE CITY OF SASSARI (16TH-18TH CENTURIES AD)

Elisabetta Grassi

Abstract: This paper presents a series of bone objects brought to light during archaeological excavations in the city of Sassari (Sardinia, Italy), dated to the 16th-18th centuries AD. The artefacts were manufactured from the diaphysis of long bones (metapodials, tibiae, radii) of cattle and horses, and they present on their surface parallel rows of tiny triangular-shaped indentations across the longitudinal axis of the diaphysis. By confronting the data with those of other archaeological and ethnographic research from the Franco-Iberian area, it was therefore possible the identification as bone anvils used to create teeth on the serrated blades of agricultural sickles. The presence of these findings is not uncommon in archaeological contexts of France, the Iberian Peninsula, Ukraine and the North Africa but, until now, they were unknown in Sardinia. The first data lead to hypothesize an import of this practise from the Iberian Peninsula to the island.

INTRODUCTION

Over the last decade several carved bone artefacts have been uncovered in urban archaeological excavations in the city of Sassari with the following characteristics: diaphyses of long bones (metapodials, tibiae, radii) of cattle or horses with a series of V-shaped grooves some millimetres deep. These are laid out in an almost regular fashion, in parallel straight or curved lines, some of which overlay others (Fig. 1). The typological identification of the finds from Sassari was carried out thanks to direct comparison with analogous material of a contemporary date found in 2009 in the fill of a ditch around the Castle of Alginet (Valencia); this study of the bone finds, to date unpublished, was carried out by S.S. Bua at the Fauna Laboratory of the Museum of Prehistory, Valencia (Spain). By examining the existing literature they managed to identify the artefacts from Sassari as bone anvils used to create teeth on the serrated blades of agricultural sickles.

Although reports of animal bones with similar features have been made since the 19th century, numerous differing hypotheses with regards to their function have been made over the years: counting aids (Cartailhac 1895; Durand 1974), decorative objects (Molinero-Pérez 1971; Julià et al. 1992; Zapater Baselga 1995; Arnau Basterio 1997; Castillo et al. 1999; Antoñanzas et al. 2000), amulets or idols (Serrào 1978; Sá Coixão 1996), files, smoothing tools or polishing/scraping tools (Semenov 1964; Serrào 1978; Briosi et al. 1995; Cardoso e Gomes 1996; Benco et al. 2002; Rodet-Belarbi et al. 2002), to cite just a few.

Although a connection with metalworking was hypothesised some time ago, on the basis of frequent as-
association with metal slag and the identification of iron residues in the wear marks (Benco et al. 2002), special ethnographic studies to retrace the process of craft production have been carried out only recently (Esteban-Nadal 2005; Esteban-Nadal, Carbonell Roure 2004; Aguirre et al. 2004). After choosing a bone deemed suitable, the blacksmith would eliminate the epiphyses and the natural bumps, thereafter working the diaphysis with a file and a grindstone until a smooth surface was obtained. Then, having tempered the blade, the blacksmith would place the sickle on one of the surfaces of the bone, tapping it with a wedge-shaped chisel and a hammer, eliminating the sharp edge by creating teeth to the sickle. The result of the action is the characteristic V-shaped grooves, which are almost parallel, which may overlap or not, depending on the use of the anvil. When the surface of the support was completely covered with signs of wear, the blacksmith could repeat the smoothing process in order to cancel them and then continue with the use of the support as long as the thickness of the bone would bear the mechanical pressure applied (Esteban-Nadal 2005).

The earliest reports of bone anvils date to the 5th c. BC - 5th c. AD in the area of Greek colonies in the Black Sea (Semenov 1964). Another wide area of distribution is that of the western Mediterranean (France, Spain, Portugal, North Africa) with finds dating from the 5th to the 18th centuries. The area close to the Pyrenees is one in which a particularly high concentration has been found (Briois et al. 1997; Esteban-Nadal, Carbonell Roure 2004; Moreno-Garcia et al. 2005, 2006, 2007; Poplin 2009; Rodet-Bellarbi et al. 2007 and references). Along with these areas we may add the recent discoveries in various areas of central and eastern Europe, such as in Hungary (Gál et al. 2010) and in Romania (Beldiman et al. 2011), mostly dated to the Roman and Medieval periods. For an up-to-date catalogue of published reports of bone anvils the reader may consult the recent work by I. Grau-Sologestoa (2012).

To our knowledge, only one similar example to the anvils from Sassari has been found in Italian archaeological contexts. This is a cattle metacarpus from Pantanello, in Chora del Metaponto (Matera), dated between the 2nd c. BC and the 1st c. AD (Gál 2010; Gál, Bartosiewicz 2012). The anvils found in Sassari hence constitute not only the first of such finds in Sardinia, but also the largest collection of them in Italian contexts.

**THE ARCHAEOLOGICAL Contexts**

At the current stage of investigation, the sample from Sassari is composed of 19 anvil fragments made from cattle and equine diaphyses, which can be dated between the 16th and the 18th centuries (Tab. 1). Almost all (18) come

<table>
<thead>
<tr>
<th>N.</th>
<th>Area</th>
<th>Context unit</th>
<th>Century</th>
<th>Anatomic part</th>
<th>Taxon</th>
<th>Subtype</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>SS Castello, Area 1500</td>
<td>1521</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Metacarpus</td>
<td>Cattle</td>
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</tr>
<tr>
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<td>1515</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Tibia</td>
<td>Equid</td>
<td>I</td>
</tr>
<tr>
<td>4b</td>
<td>SS Castello, Area 1500</td>
<td>1515</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Radius</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>4c</td>
<td>SS Castello, Area 1500</td>
<td>1515</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Radius</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>4d</td>
<td>SS Castello, Area 1500</td>
<td>1515</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Metapod</td>
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<td>Un.</td>
</tr>
<tr>
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<td>1513</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Tibia</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>5b</td>
<td>SS Castello, Area 1500</td>
<td>1513</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Metapod/radius</td>
<td></td>
<td>Un.</td>
</tr>
<tr>
<td>6</td>
<td>SS Castello, Area 1500</td>
<td>1504</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Tibia</td>
<td></td>
<td>Un.</td>
</tr>
<tr>
<td>7</td>
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<td>1520</td>
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<td>Radius</td>
<td></td>
<td>Un.</td>
</tr>
<tr>
<td>8b</td>
<td>SS Castello, Area 1500</td>
<td>1516</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Tibia</td>
<td></td>
<td>III</td>
</tr>
<tr>
<td>14</td>
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<td>1504</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Tibia</td>
<td></td>
<td>Un.</td>
</tr>
<tr>
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<td>615</td>
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<td>Radius</td>
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</tr>
<tr>
<td>11a</td>
<td>SS Castello, Area 9000</td>
<td>Rec. Generale</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Tibia</td>
<td></td>
<td>II</td>
</tr>
<tr>
<td>10</td>
<td>SS Castello, Area 9000</td>
<td>Rec. Generale</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Tibia</td>
<td></td>
<td>IV</td>
</tr>
<tr>
<td>11b</td>
<td>SS Castello, Area 9000</td>
<td>Rec. Generale</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Tibia</td>
<td></td>
<td>II</td>
</tr>
<tr>
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<td>1023</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Tibia</td>
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<td>I</td>
</tr>
<tr>
<td>12</td>
<td>SS Castello, Area 1000</td>
<td>1003</td>
<td>18\textsuperscript{th}\textsuperscript{-19\textsuperscript{th}}</td>
<td>Radius</td>
<td></td>
<td>II</td>
</tr>
<tr>
<td>13</td>
<td>SS Castello Area 1000</td>
<td>1023</td>
<td>16\textsuperscript{th}\textsuperscript{-17\textsuperscript{th}}</td>
<td>Tibia</td>
<td></td>
<td>II</td>
</tr>
<tr>
<td>8a</td>
<td>SS Ex-Inferm. S. Pietro</td>
<td>Ampliamento</td>
<td>16\textsuperscript{th}\textsuperscript{-18\textsuperscript{th}}</td>
<td>Metatarsus</td>
<td></td>
<td>IV</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6 9 4</td>
</tr>
</tbody>
</table>

*Table 1. Bone anvils from the city of Sassari: distribution after subtypes and year of discovery UN = Undetermined subtype (fragments).*
from the area of the Aragonese Castle. This building, which was erected around 1330 in the time of Sassari’s rebellion against the Crown of Aragon, was a stronghold directed by the governor of the city during the following Spanish domination; in 1535 it became the headquarters of the Inquisition, while during the Savoy period it was used as the barracks for the Italian Army (Regio Esercito Italiano) until its partial demolition in 1877 (Orlandi 1988). All the anvils come from different sectors of the external ditch (areas 1000, 1500, 9000 and 600), the fill of which was formed of small accumulations between the second half of the 16th c. to the 19th c. Areas 1500, 9000 and 600, which on the whole can be dated to the second half of the 16th c. to first half of the 17th c., are composed of a large quantity of domestic and workshop refuse, featuring pottery rejects and faunal remains, many of which have been worked (Sanna 2011; Grassi 2011). The area 1000, which corresponds to the part of the ditch in front of the barbican, besides material from the 16th and 17th centuries (contexts from 1004 to 1027), also contained material from the 18th and 19th centuries (contexts 1001, 1002 and 1003) (Sanna 2011; Grassi 2011).

A single anvil was found at the excavation of the Infermeria dei Padri osservanti di S. Pietro (known as ex-Infermeria S. Pietro), at a short distance from the convent of the Monache Cappuccine, on the road that leads from the nearby church of St. Apollinare (Fig. 2). The fragment, which was found in the garden area and was examined during restoration and restructuring work of the building, can be dated to approximately the 16th-18th c. (Cambule 2009).

METHODOLOGY

The study of the Sassari anvils was carried out by the author and by S.S. Bua. Part of the sample was described in a recent publication (Grassi, Bua 2011). The data described here also include three anvils which have not been described to date (n.12, n.13, n.14), as they were found later.

The study of the artefacts was carried out using a methodology which would guarantee efficient analysis and recording of the essential data. Each find was given a code composed of archaeological context (full name and abbreviation), year of discovery, area, context unit and progressive number attributed (e.g. Sassari Castello (SS CASTELLO) 2009, Area 1500, US 1521, n.2). The description of the artefacts included (wherever possible): anatomic part, side and species identification, followed by a description of the treatment of the surfaces. On the basis of the latter, we adopted a conventional typological classification which reflects the state of wear of the artefacts when abandoned (Beldiman et al. 2011).

Taking into consideration the number of anatomical faces with the signs of wear (modelled, smoothed, or bearing traces of tapping) we then distinguished between the following subtypes: simple anvils (used on one side), double anvils (used on both sides), triple anvils (used on three sides), quadruple anvils (used on four sides) and an undetermined subtype (fragments for which it was not possible to determine with certainty the state of use).
**ANALYSIS OF THE ARTEFACTS**

Most of the bone anvils found in the archaeological contexts in the old town of Sassari were made of equid bones (eight horses, and probably one donkey), while six were made from cattle diaphyses. Four of these, due to the high degree of fragmentation and wear, could not be attributed to a particular species. The presence of equid diaphyses is interesting as in the fauna contexts from which the anvils were recovered cattle were prevalent, while equid never exceeded 2% of the fragments identified (Grassi 2011). The choice of the latter may hence be related to a specific preference of the local blacksmiths (to the contrary of what we know of the Iberian peninsula, where cattle bones are more common) (Grau-Sologestoa 2012), or the fact that this type of bone was more readily available.

Regarding the anatomical parts used, ten anvils were made from tibiae, five from radii, while the remaining fragments are from metacarpi, metatarsi, non-identified metapodials and metapodials/radii. Investigation of the anvils in the Iberian peninsula report a more or less standardised and exclusive use of metapodials in the most recent periods, while in earlier eras the blacksmiths working with serrated blades used a great variety of anatomical parts, above all long bones, but also flat bones such as the mandible and coxal (Esteban-Nadal 2005). The predominance of metapodials is due to their thicker and more robust diaphysis, resulting in a longer duration of the work surface, and to their being worked with greater ease, thanks to the anatomical conformation. Hence, the preference in the Sassari area for the tibia and the radius is suggestive of a low degree of expertise in the technique or a recent cultural importation.

The diaphyses display differing degrees of wear: in some fragments the shape of the bone is still perfectly recognisable and the surface is only lightly smoothed, in others the diaphyses are heavily modelled, in some cases giving the artefact a quasi-rectangular shape. Bearing in mind the number of anatomical faces with signs of wear, the following have been identified: 6 single anvils, 5 double anvils, 1 triple anvil, 2 quadruple anvils, and 5 in the undetermined group (Tab. 1). Also in the triple and quadruple subtypes the teeth marks and characteristic V-shaped grooves are in any case limited to the main face of the bone (anterior or posterior), while the lateral and medial faces show only abrasions and chisel marks to give the artefact a more appropriate shape. The epiphyses were generally removed and, in some cases, part of the distal epiphysis remains. The degree of use varies greatly, ranging from little use (resulting in few signs of serration) to those with visible signs of abrasion aiming to eliminate the previous serrations (Fig. 3), a clear sign of prolonged re-use of the anvil (finds n.2, n.4a, n.6, n.7, n.8b, n.3, n.11a, n.1, n.8a and n.12).

In general, there appears to have been a preference for the use of the plantar/caudal and palm faces. In fact, in the single subtype (finds n.2, n.4a, n.4b, n.4c, n.5a and n.1), the signs of wear are on this side, while the dorsal/cranial side does not display signs of wear. The lines formed by the V-shaped grooves are usually straight, and almost parallel, but in some cases the curve of the serration (Fig. 4) seems to reflect the blade of a sickle (anvils n.4b, n.10 and n.12).

In two cases (finds n.4c and n.11b) the signs of the serration can be seen, of at least two types of blade, one with a smaller and closer sawtooth layout, and another in...
DISCUSSION

To our knowledge, there have been no previous reports of bone anvils in Sardinia, even though it is not to be excluded that in other archaeological contexts, artefacts of this type may have been found, but given the difficulty of interpretation and the little attention often paid to faunal remains, they may not have been recognised and identified for what they are.

It is also important to note that, even though archaeozoological research in Sardinia has made great steps forward in recent years, the record is still incomplete and discontinuous, with notable dearths in the study of fauna and worked bones both from a chronological and geographical point of view (Wilkens 2012: 81-136).

The research conducted until now does not give precise details regarding the use of cattle and equid bones as anvils in recent years in the island. However, several historical and ethnographic reports confirm the presence of the sawtooth sickle in Sardinia until at least the 19th century. For example, in his 1790 treatise on Sardinian agriculture, Andrea Manca dell’Arca refers to a sickle for harvesting corn, which is represented as being sawtoothed in the illustrated tables of his volume (Manca dell’Arca 2000: 38-39). Ethnographic studies have confirmed the use of the sawtoothed sickle in Italy, in the South and the islands; even in the 1970s in Sardinia, the smooth sickle imported from the Italian mainland was called the “foreign sickle” (fracci furistèra), to distinguish it from the sawtoothed counterpart of previous tradition, which was simply called “sickle” (fracci o farci) (Bravo 2001: 93; Angioni 2003: 133). Furthermore, the sawtoothed sickle appears with an apotropaic function in the local legend of “sa sùrbile”, a sort of vampire-woman of the Sardinian tradition, who liked to suck the blood of unbaptised babies. To ward off this unwanted guest one merely had to place a serrated sickle on the front door, as this would force the witch to spend the night counting the teeth (Turchi 1994: 33).

Almost all the bone anvils found in Sassari can be dated to the 16th-17th centuries. Only two fragments, from Area 1000 of the Castle and from ex-Infermeria S. Pietro can be dated to a later period, 18th-19th c. and 16th-18th c., respectively, while their residual nature cannot be excluded.

With the exception of the fragment from ex-Infermeria S. Pietro, all the anvils therefore come from the fill of the external ditch of the Castle, in association with craftsmen’s refuse, in particular pottery and spacers. Furthermore, above all in Areas 1500 and 9000, the presence has been noted of several finds connected with the processing of hard animal materials (worked bones, fragments of deer antlers and antler crossbow projectiles). The provenance of the anvils from Spanish period layers suggests that a cultural practice was imported from the Iberian area, a hypothesis already formulated by F. Poplin (2009) for other contexts in the western Mediterranean. It is not to be excluded that the importation of the technique could have taken place alongside the Catalan-Aragonese repopulation and consequent migratory flow of craftsmen into the city of Sassari. For that matter, amongst the professional figures who were beneficiaries of concessions of
goods between 1330 and 1333 there were six iron-related craftsmen: one ferron, three freiners and two coltellars (Conde y Delgado de Molina 2000: 114).

Furthermore, in a decree by Hugh III of Arborea (1381), the knife grinders are mentioned (sos qui arrodant ferramenta), along with a reference to the charges for the sharpening of a large sickle, a distrale and a pudaioiu (Costa 1992: 354). But, at present, we don’t know for sure that the use of bones as anvils was really imported from Iberian area.

CONCLUSIONS

The research into bone anvils in Sardinia is still at a fledgling stage and the present work is to be considered a preliminary study.

Following the example of the Catalan and Portuguese teams, an expansion of the investigation to outline the historical and ethnographic aspects is highly desirable. Such research could aim to verify whether this practice continued up to the contemporary period and whether it was present in other parts of the island.

REFERENCES


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INTRODUCTION

The Roman fort at Iža lies in the location Leányvár, a short distance from the town of Komárno. It is situated on the left Danube bank, in the foreground of Brigetio, and forms part of the defence system Ripa Pannonica.

The area between the Váh and the Danube became of huge strategic importance at the time of the Marcomannic wars. Coin finds indicate that the first earth-and-timber fort was built sometime after a truce was agreed upon in AD 175. The disastrous fall of the fort took place between December 178 and Spring 179, when it was burned and abandoned. Eleven barracks made of unfired bricks, from the time when the fort existed were unearthed in the southern area of the site. Many of them had been disturbed by the building of the stone fort and other interventions. In place of the destroyed earth-and-timber fort, and likely in short time, the Romans built a stone fort surrounded by V-shaped ditches. It contained baths in the south-eastern corner, whose existence was probably concurrent with the rest of the fort. Another structure related to the fort was building I, dating from the late fourth century. During the Constantine period, and forms part of the defence system Ripa Pannonica.

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The ruins of the Roman fort were recorded as early as the seventeenth century, but it was not until the first quarter of the twentieth century that the fort was excavated, first by the enthusiast J. Tóth-Kurucz. The most significant excavations, however, were conducted by scientists of the Archaeological Institute of the Slovak Academy of Sciences, at first B. Svoboda and later K. Kuzmová and J. Rajtár, who led systematic excavations at this site for several decades (Kuzmová/Rajtár 2010: 11-32). The studied collection comes exclusively from the excavations done by the Archaeological Institute, since finds from previous excavations have not been localised and identified. They were probably placed in the collections of the museum in Komárno (Hrnčiarik 2012), but a missing museum catalogue from this period hampers their identification. In total, 220 items of worked bone, antler and ivory were analysed. From the functional point of view they can be divided into jewellery, parts of soldiers’ equipment, items used for textile and leather working, knife handles, musical instruments, playing stones, furniture, writing items, half-finished products and other objects.

Jewellery (Fig. 1)

Since earliest times, jewellery has been used to decorate both the female and the male body and clothes. As it relatively quickly changed with fashion, it often serves as a good dating tool. The highly valued items were not only the pieces made of precious metals but also those made of ivory, mountain crystal or amber. However, jewellery was frequently produced also from cheaper materials such as bone or antler, and such items form the largest group in the studied collection. Based on their function, they can be divided into hairpins, beads and bracelets.

In Latin, pins/hairpins were most often referred to as acus or crinale (Bíró 1994: 30). They were used mostly for arranging female hairstyles, but also for holding clothes together (Bíró 1994: 23), in medicine (Ruprechtsberger 1997: 10), etc. Regardless of their function, the shapes of the pins differ only slightly. The pins or pin fragments

Abstract: The Roman fort at Iža lies in the location Leányvár, a short distance from the town of Komárno. The studied collection comes exclusively from the excavations done by the Archaeological Institute of Slovak Academy of Sciences. In total, 220 items of worked bone, antler and ivory were analysed. From the functional point of view they can be divided into jewellery, parts of soldiers’ equipment, items used for textile and leather working, knife handles, musical instruments, playing stones, furniture, writing items, half-finished products and other objects.

Apstrakt: Rimsko utvrdenje Iža nalazi se na lokaciji Leánivar, nedaleko od grada Komarno. Zbirka koja je ovde analizirana potiče sa iskopavanja koja je sporoveo Arheološki institut Slovačke Akademije nauka. Ukupno je analizirano 220 predmeta od kosti, roga i slonovače. Funkcionalno, oni obuhvataju nakit, delove vojničke opreme, predmete korišćene za obradu tekstila i kože, drške noževa, muzičke instrumente, kockice za igru, delove nameštaja, pribor za pisanje, polufabrike i druge predmete.
E. Hrnčiarik, Roman bone artifacts from Iža

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coming from the Roman fort total 94 pieces, and are categorised as decorated or undecorated. The decorated items represent a collection of 36 pieces, which can typologically be divided into nine groups based on the decoration of the head:

Type I. Pin with a ball-shaped head (8 pieces; Fig. 1:1).
Their closer dating is impossible and they occur throughout the Roman period. On the studied site they were found in destruction layers over the earth-and-timber fort as well as in layers dated to Late Antiquity (Hrnčiarik 2010a: 44).

Type II. Pin with an oval section of the head (7 pieces; Fig. 1:2).
They are very similar to the previous type and their exact dating is impossible (Hrnčiarik 2010a: 45).

Type III. Pin with an egg-shaped head (7 pieces; Fig. 1:3).
Like the two previous types, they existed throughout antiquity (Bíró 1994: 32). Four pieces from the Roman fort at Iža date to the first half of the third century, i.e. the time when Building I disappeared. Other pieces come from undated layers.

Type IV. Pin with a cylindrical head, rounded at the top (3 pieces; Fig. 1:4).
These pins date from the second to the fourth century (Hrnčiarik 2010a: 47).

Type V. Pin with a hemispherical head, which is only slightly divided from the body (3 pieces; Fig. 1:5).
These pins have an unmarked neck, which is often formed by a cut only. One example from the Roman fort, dated to the first half of the third century, has two such cuts, forming a kind of ring on the neck. Other pieces have only one cut and cannot be dated (Hrnčiarik 2010a: 51).

Type VI. Pin with a pine cone shaped head (4 pieces; Fig. 1:6).
Pins of this type are relatively common finds on Roman sites. Their heads may either be undecorated or decorated by hatching or cross-hatching. Both of them were found in the fort at Iža. One of the items was found in a layer dated to Late Antiquity, others are undatable (Hrnčiarik 2010a: 53).

Type VII. Pin with a figurative head (1 piece; Fig. 1:7).
The studied collection includes a unique find of a pin with the head formed as a comic actor. Pins crafted in this way are unknown but the actor's clothes, his crossed legs, position of hands and the overall composition have parallels in finds made from different materials and dated to the third century (Hrnčiarik 2010a: 56).

Type VIII. Pin without a head, with the body decorated with one or two cross-hatched strips at the top (2 pieces; Fig. 1:8).
The finds from the Roman fort come from undatable layers. In Pannonia, similar pins date to the late Roman Imperial period (Bíró 1994: 33).

Type IX. Pin with a square section of the head (1 piece; Fig. 1:9).
This pin was found in a layer dated to Late Antiquity, and is a rather rare find in the Roman context. Similar pins are much more often found in the barbarian context.
A separate group among the finds are undecorated pins with a transversely cut, rounded or pyramid shaped
upper part (Fig. 1:10-12), which existed in all Roman provinces throughout the Roman period. They had various functions. When used in hairdressing, their advantage was that they could be hidden. But they may have been used to fasten textiles together, for writing or similar. Totally 30 pieces were found in different locations of the Roman fort, in addition to another 28 fragments of pin bodies or tips, which, however, do not necessarily come from decorative pins but may, for instance, come from needles.

Two other jewellery groups found on the studied site are represented only sporadically. They include one undecorated, undated bead that is square in section (Fig. 1:13). Similar beads were used in necklaces, bracelets and often also amulets attached to a scabbard (Hrnčiarik 2004: 91-92). The last item is a fragment of a bone bracelet decorated by concentric rings (Fig. 1:14), which has parallels in Bratislava-Rusovce dated to Late Antiquity (Hrnčiarik 2014: 75).

Parts of the soldiers’ clothing and equipment (Fig. 2)

These parts form the second largest group of finds from the Roman fort at Iža. Bone and antler were cheap and available materials used mostly in bow and sword making. Such components do not only have decorative function, but the qualities of the material itself are used.

From the technical point of view, a recurve bow consists of several parts. The upper and lower limbs were made of bone, and on the limb tips were small grooves (string nocks) to which the string attached. The riser of the bow was made of wood, on which bone plates were glued. One longer piece of bone inlay was glued in the middle. Space between the bone inlay and the wooden riser was filled with antler plates to improve the construction properties of the bow. The parts were joined together with putty or glue. Around 27 fragments of bow inlay (two of them have string nocks) were found in the Roman fort (Fig. 2:8), most of them in the destruction layer over the earth-and-timber fort (Rajtár 1992: 167-168). Arrows, however, which are naturally connected with bows, have been preserved in the archaeological material only minimally, as they were produced mostly from organic materials. From the Roman fort have been preserved two pieces of the so-called nocks (Fig. 2:3), which were used to hold the arrow onto the string (Bíró et al. 2012: 78).

Bone or antler components of a sword were situated either on its hilt or sheath (Junkelmann 1986: 183). Hilts were usually made of wood, alternatively of bone or antler, and rarely also of ivory. The hilts consist of three or four parts: the guard (most often a semicircular section whose purpose was to protect the hand against injury or prevent it from slipping up the blade), the grip, and the pommel (attached to the end of the hilt to hold it together), to which sometimes a metal rivet was added (Deschler-Erb 1999: 23). In the Roman fort at Iža, a fragment of what was probably the grip of a sword, made on a lathe, was preserved (Fig. 2:1). Another hollow bone object is likely a fragment of a pommel, which could have been attached to the hilt by a rivet (Fig. 2:2). However, the exact function of both items is unclear, since similar objects were used as knife handles, furniture decoration or similar. Another two bone fragments found in the fort were used as scabbard inlay. Such inlays were usually placed in the scabbard’s lower section, and their function was not only decorative but also constructional: they held the various parts (wooden plates coated with leather) together. Based on H. Mikler’s typology (Mikler 1998: 57), it is a perpendicular double inlay, consisting of a front part (U-shaped in section) and a back part – a plate that was inserted into the front part. One preserved fragment comes from the front part, and has hatched decoration along the edges (Fig. 2:6). Another fragment comes from the back part (Fig. 2:7) and is decorated by drilled holes. Similar finds from Pannonia date between the second and third century (Carnap-Bornheim 1994: 357), and the analysed pieces can be dated to the same period.

Bone components of military equipment occur only marginally. The studied material contains one button made on a lathe (Fig. 2:5), and one ring (Fig. 2:4), both used to fasten a military leather belt (e.g. Petculescu 1983: fig. 6), on which a scabbard with a sword used to be hung.
Items related to textile and leather working (Fig. 3)

Direct evidence of textile production and tanning in the fort was not preserved, nor are they assumed on this site in the Roman Imperial period. However, textile working is attested by the analysed items – 12 pieces of awls (Fig. 3:1-2), pointed on one or both sides. Similar pieces can be found as early as in prehistoric times, and since they were used until the previous century, it is hard to date them (Zeman 2001: 126-127). In the Roman fort they come from undatable layers and structures, so their usage cannot with certainty be attributed to the Romans or Germans. The awls were used for piercing holes in leather or textile. The Roman soldiers often used them for repairing their shields but likely also shoes and clothes. J. P. Wild even assumes that they may have been used in weaving (Wild 1970: table 16/d).

Other finds from the Roman fort include 13 pieces of bone needles (Fig. 3:3-4), which have either a rectangular or figure-of-eight shaped eye, and come in various sizes and lengths. They may also have been used for making holes, for fastening garments together, or in hairdressing, but their primary function was joining or sewing textiles or leather. In the same category belong fragments of eleven hollow bones (Fig. 3:5), often richly decorated, from needle cases, which were containers designed for storing fragile needles or awls. Most of them come from layers that arose after the Roman soldiers abandoned the fort, and can be dated to Late Antiquity. Another item found on the site is one referred to as a bone skate (Fig. 3:7), which was used in leather working and dates to Late Antiquity.

Knife handles (Fig. 3:6)

A knife is one of the most versatile tools, which have been used since prehistory until modern times. It consists of two parts: the handle (mostly made of wood but also bone, antler or ivory) and the metal section used for cutting, slicing and so on. Among the finds from the Roman fort, two types of handles can be found. The first group is represented by one find only – a handle from a folding knife, which was made from two pieces joined by bronze rivets, and decorated with concentric circles and incised lines on the surface. The second group contains six pieces of simple handles, which were fastened to the metal section by a spike. They were made in a simple way, undecorated, and some of them may have functioned as handles for metal awls. Bone handles consisting of two parts (Šaranović-Svetek 1981: tab. III/1, 4, tab. IV/8) attached to the knife by rivets, were not preserved in the Roman fort.

Playing stones (Fig. 4:5-6)

The Romans combined the old Egyptian, Greek and Etruscan forms of board games into new, more sophisticated forms. Games were played in public places, in the army, but also in private. The most widespread were for instance the originally vernacular game "Nine Men's Morris", with rules identical with their modern counterparts (Hrnčiarik 2002: 137-141). Dice (alea) and playing stones (calculi) made of various materials, were often used in board games. Bone dice from the Roman fort at Iža were not preserved, but the six pieces of playing stones that were found prove that they were popular among the Roman soldiers. They were
usually made of horse or beef bones, and were carved from the longer, flat leg bones or from shoulder blades (Deschler-Erb 1998: 416). Some of the preserved items are worked on one side (2 pieces) or on both sides (4 pieces). Playing stones were often made on a lathe, but the studied collection does not include such pieces. The bone playing stones are unsuitable as a dating tool, as the various shapes are known from the entire Roman period, and the stones were also adopted by the Romans' un-Roman neighbours.

**Whistles (Fig. 4:3)**

The whistle is one of the oldest musical instruments, but has undergone only slight changes since it was invented. The Romans called it *tibia* (Mikler 1997: 60). Ancient reports tell us that as many as 14 types of whistles existed in the Roman period. They were normally made from hollow bones of small animals. In Augst, the whistles were made from bones of a dog, gander and crane (Deschler-Erb 1998: 154). Apart from these, as H. Mikler suggests, bones of a vulture or pelican may have been used (Mikler 1997: 60). Three pieces of whistles were found in the studied area. Two of them are bone pipes, cut on both ends, with a slot in the middle of the body, which was done by one transverse and one oblique cut. Similar pieces were found in Gorsium (Biró 1987: tab. 17/135), in Augst (Deschler-Erb 1998: tab. 28/1975-1980) and in Brigetio (Biró 1994: tab. LXXVI/632-634). The third preserved example has two slots on the body.

**Other items**

Other finds from the Roman fort at Iža include a cylindrical bone hinge, which, judging from its size (Fig. 4:4), comes from a larger object such as a wardrobe or chest (Hrnčiarík 2010b: 44). Three pieces of styluses (Fig. 4:1-2), used for writing, were also found in the fort (Hrnčiarík 2006: 423–427). On the basis of S. Deschler-Erb's typology (Deschler-Erb 1998: 143–144), they can be classified as stylus types with a profiled head (1 piece) and stylus types with a scoop-shaped head (2 pieces). A larger group consists of bone combs (around 10 pieces), which were used not only for arranging hair but also as decoration. The group contains both single-sided and double-sided combs, mostly from layers dating from Late Antiquity to the Migration period.

Another seven pieces, whose function could not be determined, are rather ordinary, but bear traces of decoration or working. The finds of 12 partially worked bones and antlers, likely half-finished products ready for further working, complete the collection of bone and antler finds from the Roman fort at Iža.

The presented typological analysis of bone, antler and ivory artifacts from the Roman fort at Iža-Leányvár has shown that products made of these materials were used in various spheres of human lives: as body decoration, tools used for personal hygiene, for food preparation, textile or leather working, as parts of soldiers’ equipment and clothing, parts of furniture, and as items used in games and entertainment. The design and luxurious character of some of the items indicate that their origins must be sought outside the area of the fort, or even outside the nearby Brigetio, where a bone working workshop was unearthed (Borhy/Számadó 2001: 28). Some of the items, however, are simple objects that could have been produced by the soldiers themselves in the fort. It is interesting that although the finds come from a purely male environment, a high number of finds, mainly pins, is associated with women. We can therefore assume that most pins decorated male clothing or fastened male garments together. It is also possible that the soldiers made many of these items for their wives in their free time. Yet the fragmentary state in which some of the pins were found suggests that they were used, and likely also worn, by women that lived in the fort. The same is true for textile working tools. The function and the luxurious nature of some of the finds complete our knowledge about the Romans’ presence in the studied area. The analysis of the finds has partially confirmed hypotheses about their social life on the middle Danube frontier. A comparison between the structure of bone, antler and ivory products from the Roman fort and other similar sites on the middle Danube shows a clear similarity in their content.

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A RARE FIND OF BONE BEADS FROM THE LATE BRONZE AGE CEMETERY IN THE SOUTHERN CARPATHIAN BASIN

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Abstract: Barice-Gređani group was first defined on a basis of cemetery finds from cemetery Barice near Gornje Orahovica and it was long known in literature as a group of Barice-Gređani type cemeteries. That was supported by a number of excavated and published cemeteries and lack of settlement research in Slavonian and Bosnian Posavina was present at that time. The first material from settlement of Barice-Gređani group was partially published in late 1980s. A numerous new settlements and cemeteries of Urnfield Culture were discovered and excavated in last 30 years due to intensive building of infrastructure, organising museum networks and monument protection system. In that light it is now possible to reinterpret older finds and make more complex contextualisation of Barice-Gređani group burial ritual. Three bone beads found in burial 16 belong to rare finds in the cemeteries of Barice-Gređani group. Only two cemeteries except Mačkovac from area that covers group Barice-Gređani have similar worked bone finds. Bone objects are exposed to funeral pyre together with deceased in all excavated contexts.

INTRODUCTION

Urnfield culture is one of the most prominent phenomena of prehistoric Europe. Its specific cultural production and social organization marked the period for 13th to 9th c. BC thus becoming the synonym for European Late Bronze Age. The demographically propulsive and economically influential Urnfield culture is a pan European phenomenon that is present in the area of Carpathian Basin. In fact, based on present knowledge, Carpathian Basin was one of the cultural and social centres from where technological innovations of Urnfield Culture spread. There are many regional variations of the culture and the Carpathian Basin stands as extremely prolific archaeological area. Current scientific knowledge about the Late Bronze Age is a result of wider research on genesis of Urnfield Culture, migrations and technology transfer.

Numerous researches showed distinct characteristics and regional variants of the Urnfield Culture in the southern Carpathian basin (cf. Vinski-Gasparini 1973; 1983; Čović 1958; Minichreiter 1983; Majnarić-Pandžić 2000; Dular et al. 2002; Karavanić 2009). The most significant researches for this paper are one that first started to define Barice-Gređani group in Sava River Basin (cf. Čović 1958; Minichreiter 1983).

Barice-Gređani group was first defined on a cemetery (Čović 1958) and it was long known in literature only as a group of Barice-Gređani type cemeteries. That was supported by a number of excavated and published cemeteries, but also with lack of settlements in Slavonian and Bosnian Posavina at that time. The first material from settlement of Barice-Gređani group was published in late 1980s (Đurđević 1988). A numerous new settlements and cemeteries of Urnfield Culture were discovered and excavated in last 30 years due to intensive building of infrastructure, organising museum networks and monument protection system. In that light it is now possible to reinterpret older finds and make more complex contextualisation of Barice-Gređani group burial ritual.
Describing the Urnfield culture of northern Bosnia Vinski-Gasparini (1983: 623) used the name „cemeteries of the type Barice“. She thought that its emergence has to be observed within the process of infiltration of Virovitica group during Br D period in 13th c. BC. She dated this type of cemeteries from 2nd half of 13th c. and 12th c. BC (Ha A1), while they are not documented in Ha A2 phase. In time when the text was written the cemetery in Gredani was not yet published, although the author was familiar with it and quoted it as close cultural analogy. Vinski-Gasparini defined relation of the Barice type cemeteries and Late Bronze Age settlements of north Bosnia as unclear. She could link no finds from known settlements to Barice type cemeteries as there was only one cave site – Hrustovača, dated to Br D. All the others, hillfort type settlements such as Zecovi, Kekića glavica and Vis are later, dated from Ha B, and the finds from Donja Dolina cannot be linked to Barice type cemeteries either. Therefore the problem of connecting cemeteries and settlements remained open until more recent works (Dular et al. 2002; Marijan 2010; Kalafatić 2011) contributed to the more precise overview of the Barice-Gredani group.

THE CONTEXT OF THE FIND

Bone beads analysed in this paper are found in burial 16 from the Bronze Age site of Mačkovac (14th - 12th century BC), situated in Sava River Basin in Eastern Croatia (Fig. 1). Both the settlement and the cemetery in Mačkovac have been well defined, and partially excavated in past years. More than 120 graves is excavated from the cemetery.

Site belongs to defined Barice-Gredani cultural group which is developed in the frames of the Late Bronze Age in the Southern Carpathian Basin (Kalafatić 2011). The basis for contextualisation of bone finds are culturally, chronologically and spatially close, recently excavated sites in wider Sava River basin, like large settlement and cemetery Bošnjaci and cemetery Gornja Orahovica (Fig. 1).

Burial 16 was found in excavation campaign 2005 (Fig.2). It belongs to predominant group of „clean graves“ with poorly visible boundaries of burial pit which is consequence of different factors. These factors will be discussed in more detail with description of burial ritual.

For urn in burial 16 is used the bowl with a very outwardly drawn rim and one ribbon-like handle. The bowl's colour is an uneven light brown and grey-brown.

Restauration of urn (Fig. 3) enabled obtaining precise measures of the grave urn from burial 16: greatest height: 12.6 cm, greatest diameter over lid: 35.5 cm and the diameter of the urn base: 10.7 cm.

During process of micro-excavation in laboratory lithic blade was found positioned at the bottom of the urn among fragmented burnt bones (Fig. 4A). The blade is 54 mm long and 16 mm wide (Fig. 4B), preserved in the mesial and proximal part, while the distal end is missing. The widest part is at the place of the breakage, the artefact becomes narrower from distal towards the proximal
end, so the base itself is the narrowest part. Its platform is smooth and the bulb prominent, which, in combination with regular cross-section of the blade, points to the use of a soft hammer. It has trapezoidal cross-section and traces of negatives from previously removed straight blades with parallel edges. It was not possible to determine the raw material since the artefact changed its structure and colour due to the exposure to high temperatures; it is now white in colour and the original colour cannot be identified.

OSTEOARCHAEOLOGICAL ANALYSIS OF BURIAL 16 FROM MAČKOVAC

Preserved skeletal and dental remains were macroscopically analysed with the use of a magnifying glass in order to establish sex and age of the studied individual but also to record changes occurring as a result of burning. Taphonomic characteristics of the preserved skeletal material were assessed according to the criteria proposed by Shipman et al. (1984).

The remains of only one individual are present in the analysed burial - most probably a younger female aged between 18 and 30 years. Only human bones and teeth were recorded (no animal remains) with no trace of pathological changes. The studied bone assemblage is characterised by medium/good bone preservation with a predominance of medium-sized bone fragments (between 10 and 20mm) with only a few larger fragments (over 20mm). The colour of the cremated bones is predominantly white with tinges of light/dark grey. The predominance of white colour suggests that the body was exposed to heat of above 600°C for a sustained amount of time as several studies confirmed that the predominance of white is characteristic of bones exposed to temperatures greater than at least 645°C (e.g. Holden et al. 1995; Shipman et al. 1984; Walker et al. 2008). A large majority of studied fragments exhibit deformations such as thumbnail fractures, spiral deformities, and loss of volume. The occurrence of these changes suggests that the body was burnt when soft tissue (flesh and fat) was still attached to the bone. A sudden dehydration of bone due to cremation may result in significant loss of bone volume resulting in occurrence of transverse and elliptical fracture lines, especially on long bones and cranial fragments (McKinley 1994). These changes are usually associated with cremations when soft tissue is still present on the bone. Furthermore, the presence of so called thumbnail fractures is exclusive for cremations of fresh bones or bones with flesh and fat still attached to it (Buikstra and Swegle 1989).

DESCRIPTION OF BONE ORNAMENTS IN BURIAL 16 FROM MAČKOVAC

Parts of personal ornaments in the form of three bone beads (Fig. 5) were discovered among the human remains. Two of them are complete while the third one is broken and only partially preserved. All three are cylindrical in shape with large central hole through longitudinal axis. Outer surface is carved with furrows along the circumference of a shaft, but each one of beads is unique so they are described individually. Beads were macroscopically studied with the use of hand lens (magnification 10x). To reveal the interior structure of bone used for beads, a computed tomography (CT) scan was carried out. In addition their surface was carefully examined with Dino-lite Edge digital microscope under non-polarizing light. Measurements were taken as follows: maximum length along specimen’s longitudinal axis, and maximum diameter at the widest point near one end.
The larger bead (Fig. 5A) is more robust and somewhat shorter than the other two. It is rounded rectangle in cross-section and has three ridges separated by two wider U-shaped furrows cut along its circumference. Ridges have flat tops, with two at the ends wider than the middle one. Non-symmetrical ends are well preserved and show clear cut off surface forming a right angle to the longitudinal surface of bead (Fig. 6A). The interior of this bead is very smooth (Fig. 6B). Greatest length: 12.5 mm, greatest diameter: 10.4 mm.

The smaller bead (Fig. 5B) has four ridges separated by three narrow U-shaped furrows. It is oval in cross-section. All ridges are gently rounded on tops with one at the end slightly broader and irregular in comparison with others. Furrows are, unlike in the larger bead, twice as narrower than ridges. Both ends are rounded and ragged on the inner edge indicating breakage. Greatest length: 14.6 mm, greatest diameter: 8.0 mm.

The third bead (Fig. 5C) is fragmented and only partially preserved (ca 25% of a complete bead). Speci-
Close to the bone...

men consists of two fragments which loosely conjoin on recent break, leaving just a portion of a longitudinal side with one end, while the rest of it is missing. Although the other end of this bead is broken off, based on comparison with other two beads from the same grave it is safe to assume that the bead was most likely of similar size. There are three ridges separated by two furrows. Ridges are equally wide and have flat top, while furrows are slightly asymmetrical. Preserved end is smooth; presumably polished. The bead is eroded on both exterior and interior. Compared with other two beads interior surface of the bead is more chalky with moderate spalling. It suggests that this bead could have been broken prior to cremation or did break during cremation. Either way, it resulted with visibly damaged surface ‘covering’ possible traces of manufacture and/or use wear, and in thinner cortex. Greatest length: ca 12.6 mm, greatest diameter: n/a.
DISCUSSION

When he published the first Barice-Gredani group cemetery Barice near Gornja Orahovica near Grača- nica, B. Čović (1958) described funerary rite in details. He also believed that the deceased was not incinerated at the burial site but that the pyre was prepared at a different location. Burnt remains were collected and cleaned, probably washed in the water (documented by bones being clean, with traces of ashes or burnt wood appearing only very rarely). Burial itself consisted of a pit where cleaned burnt bones were laid first, then grave goods and all was covered by a large vessel (Čović 1958: 92-93). Absence of charcoal, pottery sherds and process of returning of exact soil in the burial pit makes boundaries of burial pits often poorly visible during excavation process known as „clean graves” phenomena. Čović's find clearly shows that the cemetery extends longitudinally, thus refuting later claims about using burial mounds as a way of organising cemetery space in Barice-Gredani group. In this cemetery (Barice), 38 graves were discovered, with standardised burial type. Only grave 26 is an exception for having the urn (a bowl with restricted mouth) placed in a „regular” way, facing up, with bottom on the ground (Čović 1958: 84).

B. Belić (1964) observed regularities in placement of the cemeteries in the landscape as well as funerary rite on the basis of two cemeteries – Kulasi near Doboj and Mala Brusnica near Bosanski Brod. He found that the cemeteries are situated close to water, which he did not attribute to chance but as a rule stemming from philosophical and religious views of afterlife. Belić also thought that deceased were not incinerated at the cemetery. From the colour and state of pottery he concluded that urns were exposed to fire during burning of the deceased, as well as bronze items which also show traces of burning. Internal layout of graves indicates the existence of some kind of grave markings.

K. Vinski-Gasparini (1983: 633) describing funerary rites of Late Bronze Age in north Bosnia describes „uniform way of burial” on Barice type cemeteries, „graves are funnel shaped and burnt bones are laid directly on the ground and covered with a deep or shallow bowl used as urn and reversed upside down”. Pottery grave goods can be intentionally broken and often remains of charcoal and burnt wood can be found above grave pits, which must be connected with some kind of ritual before burial. These rituals are identical to ones in Virovitica group graves, only difference being that in Virovitica group cemeteries bones are laid in urn and covered with a bowl instead directly on the ground. Vinski-Gasparini (1983: 633) considered Gredani cementers to be an exception within Virovitica group and differences between them as usual between groups Zagreb, Velika Gorica and whole Baierdorf-Velatice horizon. According to Vinski-Gasparini, cemeteries of Barice type do not continue to Ha B period. This shows that at that moment, in 1983, K. Vinski-Gasparini did not consider Posavina as separate cultural complex, but defined Slavonian site Gredani as part of Virovitica group. Therefore she did not consider different funerary rite at that site as distinct characteristic of different cultural group, but explained it as a variation within Virovitica group.

New research, such as one conducted by B. Marijan (2010) looks on funerary rites of Barice-Gredani group resulting from excavation of the cemetery Popernjak near Bošnjaci. Marijan (2010) presents the following observations based on 32 graves. On the basis of this cemetery standard funerary rite of Barice-Gredani group can be determined and it coincides with rite in Gornja Orahovica-Barice near Gračanica and Gredani, meaning bones are laid directly on the ground and covered with a bowl turned upside down. This extensively excavated cemetery, although according to Marijan (2010) excavated only in small part, shows a clear situation, i.e. a homogenous structure of the cemetery without Virovi-
Close to the bone...

Mačkovac, but they were not exposed to fire.

Regarding the above mentioned finds from grave 16 in Mačkovac, cylindrical shape and large cavity inside described beads suggest that they have been manufactured from a small shaft bone(s). Given that all beads are largely remodelled and lost almost complete if not all of their original bone surface during the remodelling process, it is nearly impossible to identify skeletal element or species. Furthermore the results of CT scans were inconclusive at this resolution (Fig. 5D). Further investigations with more precise μCT will show more detailed marks which will give us more insights in prehistoric craft skills.

However, based on the size and shape of these segments the bone probably came from a small to medium sized animal. The interior side of the fragmented bead show some trabecular bone structure (Fig. 6F). Cautiously it can be assumed that these beads were most likely produced from first phalanx of a small ungulate, perhaps sheep or goat.

Preserved ends on two beads (Fig. 5A, 5C) show clear cut off surface with a series of very fine parallel striation marks visible (Fig. 6E). This suggests general orientation of polishing activity performed to shape aforementioned ends. The middle bead (Fig. 5B) have rounded ends that were either formed differently (broken instead of cut) or were not polished. Furrows were shaped by scraping. Traces of chisel-like tool used are visible in the form of clear parallel narrow striations along circumference of beads in the middle of before mentioned furrows between ridges (Fig. 6C; Fig. 6D).

All three specimens are white in colour (with limited discolouration in form of greyish mottling) and chalky in texture. They are completely calcined as a result of their exposure to very intensive burning. This suggests that these beads have been cremated with human remains, most likely as part of the decorative item worn by the deceased person.

Three preserved bone beads are all that remains from an unknown number of segmented beads that may have been worn either as a part of necklace or bracelet. Larger bone bead shows much finer production then the smaller one while the fragmented one is too damaged and eroded to say more. Very smooth surface of the interior of two beads (Fig. 6B) is probably a result of intensive use wear,
most likely caused by abrasion of some form of string and suggests prolonged use of these beads as ornaments. If that is the case then we may hypothesise about the real function of these beads as jewellery part of persons apparel that were in function prior to the disposal, rather than just a symbolic grave gift put onto the pyre with a deceased.

Reconstruction of Late Bronze Age costumes of Barice Gređani group is difficult also because of rare occurrence of bronze finds in graves. Such a small percentage of bronze finds, found mostly (if not only) in children and women burials (Marijan 2010) suggests presence some kind of „metal taboo” within Barice Gređani group.

CONCLUSION

Lack of worked bone finds in Bronze Age cremations is partially because of fragility of the bone finds, low frequency of such finds in burial ritual, and on the other hand in the state of research. Three carved bone beads from grave 16 in Mačkovac are rare and extraordinary find. They were most likely part of the deceased person's apparel and not simply placed on the funerary pyre as a grave gift. Similar finds are evidenced in other contemporary cemeteries in the area. At the time we are unable to discuss about their significance either as a fashion objects or perhaps as a symbol marking a potential common identity of their wearers. Process of micro-excavation and flotation and sieving of all soil material from burials will raise level of such finds on general scale and fulfill our knowledge of Bronze Age life and afterlife rituals.

REFERENCES


SEVERAL OBSERVATIONS ON SEMI-FINISHED BONE PRODUCTS SUPPORTING THE EXISTENCE OF A BONE WORKSHOP IN MURSA

Marina Kovač

Abstract: The holdings of the Museum of Slavonia in Osijek keep a large number of Roman bone objects which are part of the Collection of Roman Bone Objects. The Collection consists of more than 800 objects which include various types of needles, pins, cosmetic implements, dice, tokens, spoons, combs, knife handles and other types of handles, weaving equipment, different decorative rings and plaques, writing tablets, parts of furniture etc. Due to the lack of archeological context, the analysis relies on a general chronological framework of certain types. The Collection also holds a dozen of semi-finished products and raw materials (bovine and goat horns and antlers). This paper deals with chaîne opératoire during the manufacturing process of certain types of objects, such as needles, pins or parts of furniture. Although a bone workshop has not been archaeologically confirmed in Mursa (Osijek), both the great number of bone objects from the old Museum holdings and various bone objects recently found in archaeological excavations in the Mursa area put forward a hypothesis about the existence of local workshops in Mursa.

INTRODUCTION

Colonia Aelia Mursa was situated on the elevated right bank of the river Drava, in direct proximity to its estuary to the Danube (fig. 1). The advantageous position between the two rivers, swampy ground and forests were excellent prerequisites for building a settlement: fertile ground was good for agriculture and farming, while the forests provided resources and food (wood and game). Plains and rivers facilitated the establishment of a traffic network, both on land and water (Bulat 1989: 8 & Göricke-Lukić 2000: 7).

The Roman Mursa most likely grew from an earlier settlement of the Andizet tribe. There are historical records about conflicts between the Pannonian tribes and the Romans in the area, but no record remains of the role of the Andizet tribe in those conflicts. A more peaceful period began with the Tiberian conquest of Pannonia, while romanization under Trajan continued during Emperor Hadrian’s rule. Hadrian also encouraged the boom

Fig. 1. Location of the city of Osijek on the right bank of the river Drava, 25 kilometres upstream of its confluence with the Danube, ©Open-StreetMap with contribution of Marina Kovač, 2014.

Due to its position, Mursa was an important traffic intersection, and it may have also been a relevant commercial and artisan centre. The importance of Mursa is supported by Roman maps *Itinerarium Antonini*, *Itinerarium Burdigalense* and *Tabula Peutingeriana*, where it is mentioned as *Mursa Maior* (Bulat 1989: 9).

From the 17th century, travel writers, chroniclers and engineers (L. F. Marsiglia, Fr. W. v. Taube, M. P. Katančić, J. Koller and R. Franjetić) all presumed the outline of Mursa. M. P. Katančić made a map with the outline of Mursa in the 18th century, the first reconstruction of Mursa appears in his "Dissertatio de columna millitaria ad Eszekum reperta" from 1782, based on fortifications and Roman remains visible at the time. He placed Mursa in present-day Donji grad (Lower Town, which is placed in the eastern part of modern-day Osijek). In the early 20th century, engineer Radoslav Franjetić, with the help of M. P. Katančić’s reconstruction and an old Osijek city scheme from 1786, created his own reconstruction of Mursa. He concluded that Mursa was probably rectangular in shape, surrounded by double ramparts (Pinterović 1978: 158-161 & Bulat 1989: 22-23). Over the past 16 years, archaeological research in ancient Mursa has shed light on specific aforementioned hypotheses and reconstructions, and the publication of the research in question will provide a more coherent view of Mursa’s topography in the future.

**BONE WORKSHOPS IN ROMAN TIMES**

Different factors influenced the supply of bones as raw material during the Roman period. Animal bones were available due to frequent consumption of domestic animal meat in everyday diet. A smaller percentage of bone material was acquired through hunting deer, boars and birds. The material was also collected seasonally among discarded deer antlers (deer shed their horns in late winter or in spring, roebucks in the winter and reindeers from November to May, depending on gender and age) and through the purchase of luxury material, such as ivory.

The existence of workshops suggests a strong commercial tie which could have been created between artisans and butchers. The most affordable way to acquire the material for bone objects was to slaughter animals. Large, solid bones were highly valued, so even while cutting the animal and processing the meat, special attention was given to the bones so that they would not be damaged. Each wasteyard or pit was a potential source of bone material.

Bone workshops were located at the city’s fortifications, both *intra* and *extra muros*, which was common in Mursa-sized Roman settlements (Šaranović-Svetek 1988-1989: 108-115). Presumably, a similar process of bone acquisition also occurred in Mursa. Arthur MacGregor assumes that before bone material was worked with a knife, it was soaked in cold water for 48 hours and then put in boiling water for 15 minutes. Longer boiling was not necessary and could compromise the material (there was a risk of boiling all the collagen). The process softened the raw material, so it could be processed more easily (long scrapings are more easily removed with a knife) and it was also more flexible. Little is known about horn processing in Roman era, but due to the nature of the preparative method used for horns, the workshop was most likely permanent (MacGregor 1985: 51-64).

**SEMI-FINISHED PRODUCTS OF THE COLLECTION OF ROMAN BONE OBJECTS IN THE MUSEUM OF SLAVONIA**

The Museum of Slavonia’s Collection of Roman Bone Objects leads to the conclusion that raw materials, half-products and manufacture debris were probably overlooked during archaeological excavations. More often than not, they were not collected or they were collected to a small extent, depending on the archaeologist’s interest. Such a situation in the Osijek Collection of Roman Bone Objects makes it quite difficult to reconstruct the *chaîne* Mursa, their location and quantity.

In the depots of the Museum of Slavonia in Osijek, there is a large number of Roman Bone Objects. The Collection of Roman Bone Objects counts 800 objects in the museum database and another roughly 300 bone objects of undetermined typology, such as, damaged hairpin and needle shafts, which are not in the inventory, but serve as a statistical indicator of the large quantity of bone objects produced (fig. 2).

![Fig. 2: Around 300 bone objects of undetermined typology (damaged hairpin and needle shafts) from the Museum of Slavonia, Photo by Marina Kovač, 2014.](image-url)
Close to the bone...

ing equipment, different decorative furniture elements, writing tablets etc. The objects came to the Museum in late 19th and through the first half of the 20th century: they were either purchased, donated or found randomly. A smaller number was discovered during archaeological excavations in the second half of the 20th century. Nevertheless, since the excavations are of later date, they do not provide detailed information about the context of the finds. While studying bone objects from Mursa, similarities with the research results regarding material from sites in the surrounding countries emerged.

Recently, special attention has been given to the study of chaîne opératoire regarding bone objects. This analysis, introduced by André Leroi-Gourhan, follows the step-by-step process in the production of an artefact, from acquiring raw material, through production techniques to the final design, use and disposal of the object. Therefore, the emphasis is on the production method and technique, but it also includes the social context. However, the technical approach in the study of artefacts does not exclude typology. The two approaches can be combined to study artefacts and provide a more meaningful interpretation of the operational chain, as opposed to the study of individual artefacts, independently of each other context (Blaser et al. 1999-2000: 364-366 & Vitezović 2013: 2014).

Based on the objects from the Collection of Roman Bone Objects, some of the steps in the operational sequence can be reconstructed. Recorded in the Inventory books are raw materials, semi-products and manufacture debris found in Osijek, Osijek-Lower Town or Osijek-Lower Town-Vijenac narodnih heroja Slavonije, all of which will be discussed.

Apart from two horns (probably goat and cattle horn) and one deer antler, found during rescue survey at the Vijenac narodnih heroja Slavonije (present-day Vijenac Murse), these finds were discovered within the fortifications, i.e., within the borders of Katančić's and Franjetić's reconstructions (fig. 3). The two horns could be semi-products (AA-18443 and AA-18795), while the deer antler is a finished and used product (AA-20326). There are traces of cleaver visible on the object AA-18443, with the clean and careful cut at the base of the horn. That is the only trace of processing on this raw material. This step in the operational sequence could be part of preparation process, after it was acquired as raw material (breeding the animal or buying the raw material). Horn core was chopped from the skull, without any signs of further processing, so it could have been disposed of during tanning, not necessarily as workshop material (MacGregor 1985: 53).

The same conclusion may be applied to the cattle horn listed under the inventory number AA-18795 which also has visible traces of cutting at the base. Unlike the aforementioned, this semi-product is in much worse condition.

Both of these artefacts could have been used to manufacture a handle, probably for a knife. The artefact under AA-20326 provides an example of such a handle, found at the same site as the two previously mentioned objects (fig. 4). This artefact was made of a deer antler and has the remains of an iron thorn on the distal end. It is probably a knife handle or a handle of another utilitarian object with a visibly polished surface. The handle is damaged on several places, with longitudinal cracks. There is a big distal crack, where the bone has risen 15 mm up from the rest of the surface, probably due to the circumstances in the deposit and the fact that the iron part is inserted here. In the middle, there is transversal damage caused by a blow, (22 mm long and 2 mm wide). At the proximal base, there is a deep, 10 mm-long notch from a saw or knife, and a shallow incision between the deep notch and the basal edge. These are most likely attempts or mistakes made during processing.

The base of the artefact is not cut as regularly and straight as the aforementioned examples. It seems it was first cut with a blade, and then finally broken off and separated. Also, it is possible that the current, uneven section of the base was constantly used, closed and attached to the “cover” from another piece of bone.

There is a small number of horns and antlers discovered at the Vijenac narodnih heroja Slavonije, without any record of a hearth or tools for processing bone material to confirm there was a workshop on that location. In late 1st and early 2nd century, Pannonia experienced economic changes due to decreased import and the whole situation...
must have influenced Mursa as well. Supposedly, this period also marked the establishment of local workshops which supplied soldiers and civilians. Vesna Šaranović-Svetek considers bone workshops in Siscia, Sirmium and Mursa, which turned into larger workshop centres in the 2nd and 3rd century (Pinterović 1978: 117 & Šaranović-Svetek 1988-1989: 123).

Given that the research is old and the context of the finds is unknown because there is no detailed documentation, it is possible that there were more similar finds relating to raw bone material, semi-products and manufacture debris than what had been collected on the site and brought to the Museum.

The operational sequence for horn handles can be reconstructed based on these before mentioned finds. The first step was acquiring the raw material (breeding and slaughtering animals or buying the raw material), then preparation (cleaning, soaking, boiling) – which can be illustrated by the two horns with a visible straight proximal cut. Then there was the manufacture, more precisely design (cutting, sawing, drilling, decorating, polishing), after which the object was put to use. The usual wear and tear was sometimes repaired, and then finally the objects was disposed of and thrown in the waste pit.

One of the by-products was manufacture debris, for instance, probably part of a diaphysis of cattle’s long bone (AA-2460) or manufacture debris under the inventory number AA-1078. Both objects were donations to the Museum, and only Osijek is listed as the location of the finds, without any further details.

Item AA-2460 is a compact bone of uneven width, exposing the spongy bone within the medullary cavity (fig. 5). On one end of the long bone, there is a transversal cut under the epiphysis. The edge is rounded, although with some damage on the ends and it seems it was processed further, probably polished. The opposite end has an irregular edge (height 4.9 cm, width 4.6 cm.) and it seems force was used on that side with minimal use of tools, i.e., parts were broken up into pieces for further processing. Visible remains of several shallow and deeper notches made by a blade on that part of the diaphysis confirm this. The outer surface of the compact bone shows traces of processing. Apart from notches, there are sometimes densely grouped additional indents probably as a result of pressure applied while using the cutting tools for further processing. Given the lack of traces, such as long knife cuts or decoration, the irregular breakage and notches, this could be manufacture debris.

Item AA-1078 can also be categorized as manufacture debris (fig. 6). It is a smaller bone (height 1.8 cm, width 2.1 cm) cut transversally. In this case, it was probably disposed due to repeated mistakes during manufacture, indicated by multiple traces of a blade, both transversally and longitudinally. The width is approximately the same, with the spongy bone visible on the inside. The object is of uneven height and material was rotated during cutting on both ends. Blade traces are the most concentrated along the edges of this irregular ring, with the dull and rounded straight edge and the relatively sharp edge on the opposite side, which seems to have been broken after being partially cut. The two pieces of manufacture debris are part of the operational chain as a by-product, immediately after acquiring the raw material.

The Collection of Roman Bone Objects also has six bone rods, two of which are large semi-products (AA-18587 and AA-1073), and four smaller ones (AA-173737, AA-173758, AA-173759 and AA-173760). Firstly, the two larger semi-products can illustrate the operational sequence for handles, pieces of furniture, tokens and dice or weaving, sewing and knitting tools (fig. 7). These two semi-products help us reconstruct the operational chain from the acquisition of raw material onwards.
Bone stick AA-18587 is one of the first steps in production of bone objects. In this case, it is probably a cattle long bone. There are long cuts from a knife with various carved surfaces. The intention of the artisan seems to have been to form a rectangular rod, judging by the transversal notch on one end, where the rod is almost rectangular. Parts of the spongy bone are visible on that end next to compact bone.

After the working phase, which is well-illustrated by item AA-18587, there would be further processing, illustrated by the item under AA-1073 (fig. 8). This semi-product is formed into a rectangular shape, 130 mm long and 10 mm wide. The rod does not have straight endings, it slants on one end. At the straight end, there is a round bump in the middle of uneven height – the projection of the fixed point where the object was placed on the lathe. That same end also shows a notch on two surfaces, slanting on the transversal axis. The cutting was interrupted for some reason. This stick might have been used as base for tokens and dice production, hairpins and needles, parts of furniture and so on. This step was followed by fine processing such as polishing, smoothing and decorating until presenting the final product. With time, the product could have been repaired to last longer.

The Collection features four smaller semi-products (AA-173760, AA-173759, AA-173758 and AA-173737) probably used to make sewing and clothing needles, hairpins and toilettries (fig. 9). These objects also present the processing stage in the operational sequence which was preceded by acquiring the raw material. Knife traces are visible on all four items, creating numerous irregular surfaces. One side is pointy, while the opposite side shows traces of breakage. The pointy end indicates that it should have been shaped in some sort of needle point, a hairpin or a spatula, while the opposite end was supposed be shaped as the head. After that, there was polishing, use and finally, disposal.

CONCLUSION

What is problematic about the Roman bone finds from the Collection of Roman Bone Objects from the Museum of Slavonia in Osijek? The issue is that neither a significant number of raw material, nor semi-finished products or manufacture debris have not been found in Mursa. This is probably due to lack of systematic excavations until the 1970’s in Mursa area. Even then, bone material (raw material, semi-finished objects and manufacture debris) was not properly collected. As a result, the bone workshop has not been archaeologically confirmed. Also, it is still unknown what the final number of objects in this Collection is (not all objects are in the Inventory books and the material is located in different places inside the Museum depots). The PhD research by Senior curator Marina Kovač is the first systematic work on this material and it will provide the first comprehensive research of this Collection.

Future steps concerning this issue are: to collect all the bone objects inside the Museum depots related to this Collection; to finish typology of Roman bone objects (general chronological frame); to look into available recent excavations (worked bone, animal remains); attempt to find common characteristics in technology of manufacture between i.e. hairpins, needles or tokens, and also try to determine the type of animal bone used to make the objects.

Although a bone workshop in Mursa (Osijek) has not been archaeologically confirmed, given both the great number of finished bone objects from the old Museum holdings and various bone objects recently found in archaeological excavations in Mursa area put forward a hypothesis about the existence of local workshops in Mursa that remain to be proven.

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BONE CYLINDRICAL OBJECTS FROM STOBI

Zlatko Kovancaliev

Abstract: A group of 18 bone objects found at the Early Byzantine complex at Stobi deserve special attention because of their disputable use. Some scholars consider these objects as parts of looms, where they serve as heddle holders. They are cylindrical, perforated in the middle, with rectangular cutting at one end. Their surface is always decorated with incised lines, and circle and dot motif. A newly discovered object at Stobi with a rectangular supplement inserted in the cutting, fully discards their identification as knife handles. Most of the objects have use wear traces which support the possible idea as heddle holders or at least some usage with a thread. Presenting the context of the finds, this is another attempt to understand their exact function.

INTRODUCTION

Stobi is one of the most excavated and best preserved archaeological sites from the Roman and Late Antique period in the R. of Macedonia. It is located in the central part of the R. of Macedonia, some 80 km south from Skopje, along the European route E-75, at the confluence of the river Crna into the river Vardar (ancient Erigon and Axios). Its position between two rivers has provided a long history of habitation, starting from the late Bronze Age until the 6th century A.D. At the time of Augustus the city becomes an oppidum civium Romanorum, and soon after, during the 1st century A.D. gains the rank of municipium, thus minting its own coins (Папазоглу 1957: 235; Wiseman 1986: 40). In the early 4th century A.D. Stobi became an episcopal seat, and the first confirmed bishop, Budios, took part in the ecumenical council in Nicea in 325 A.D. At the end of the 4th century, with the partition of the province Macedonia, Stobi enters into the newly established province, Macedonia Salutaris. Soon after, in early 5th century, it is renamed Macedonia Secunda, in which Stobi is most probably the capital city (Wiseman & Mano-Zisi 1974: 139; Mikučić 1981: 214) most of the buildings in this area were discovered in the period between 2009 and 2010 as part of the capital project funded by the government of the Republic of Macedonia. The following years of excavation until 2013, have resulted in an uncovering of a segment of the Early Byzantine city of Stobi. The complex is composed of private houses, workshops, and shops. The houses are organized along the main street, divided with narrow alleys, and the workshops and shops are located around the Semicircular Court. The buildings have beaten earth floors, some have two stories, with walls made of stones in the lower zones, mud bricks in the upper zones, and covered with roofs made of tiles. The movable finds, clearly identify the function of some rooms as kitchens, workshops or storage facilities. During the excavations of this Early Byzantine complex, at floor levels in closed context, eighteen cylindrical objects of bone are discovered which are subject of research in this study.

Nine of them are fully preserved, eight are partly damaged, and only one object is preserved in fragments. The special analysis on the objects from Stobi has not been done yet, but many identical with them, widely discov-
Z. Kovancaliev, Bone cylindrical objects from Stobi

ered at the Balkans, are identified by researchers as objects made of red deer antler. A huge number of such objects are known from the territory of Bulgaria (Владкова 2002: 97, T. II, 53; Владкова 2006: 264, Pl. III, 4-6, 10, 11; Владкова 2009: 214-215, T. VI, 6-9; Владкова 2012: 218, Pl. IV, 29-31; Коичева 2000: 248-257, T. VIII, IX) and Serbia (Јанковић 1983: 135, kat. br. 222-226; Петковић 1995: 49, Т. XXXVI, 4-6; Шепар 2010: kat. br. 201-202, sl. 45). Only a few have been published from other sites in Macedonia (Георгиев 1989: 209, сл. 5, 5; Канзурова Стојанова 2009: сл. 4, ж, з, ј). All are closely dated, starting from the second half of the 4th century AD and continuing until the end of the 6th century AD. All eighteen objects from Stobi are found on floor levels from the last urban phase of the Early Byzantine city, dated in the second half of the 6th century AD. Three hoards (Stobi E, F, G) are discovered in this settlement, and the latest coins found in two of them are minted during the reign of Mauricius in 584 – 585 AD (Hadji - Maneva 2009: 113). Greater part of the objects are found as singular finds in a room, in two cases two objects are found in one room, and only in one case even three objects in one room.

CHARACTERISTICS

All of the objects have three mutual characteristics: cylindrical shape, rectangular cutting at one end, and longitudinal perforation in the middle. The spongy structure of the antler was ideal and a good starting point for long perforations. The longest is 6.2 cm, and the shortest is 4.8 cm, but most of the objects differentiate only in millimetres. The diameter at one end is wider and it gradually becomes narrower to the other one, probably following the natural shape of the antler. The section is mostly oval, rarely circular and only in one example (Pl. I: 5) is hexagonal. Very rare as it is (Fig. 6; Pl. I: 15), the cylindrical object is found together with a rectangular supplement which perfectly fits into the rectangular cutting. The objects’ surfaces are always decorated with incised lines. Generally the markings consist of incised cross wise lines (two, three or four parallel lines) which divide the surface of the object in two or three zones. These two or three zones can be filled with crossed lines, diagonal lines, some combined with the circle and dot motif, or rarely, left blank (Pls I-II). The motifs are similar, but there are no objects with identically covered surface, nor objects without decoration. During the process of incision on one object, the rectangular supplement was inserted so part of the cross wise lines continues to its surface (Fig. 1). Judging by the surface observation possible filling with black colour into the incised lines can be noted at three objects (Fig. 2, a-c). Chemical analysis is not made to confirm the colouring, because these traces can be a result of charcoal presence or minerals in the soil, where the objects were found.

DISCUSSION OF FUNCTIONALITY

When researchers discover these objects, they often identify them as knife handles, as their shape and decoration at first glance really look like a nicely carved bone handle. But careful analysis offers a little basic information which fully discards their eventual usage as knife handles. Firstly, the length of the Stobi objects does not reach more than 6.2 cm, therefore cut handling with a short handle makes the process of cutting more difficult and requires greater power and strength. Besides that, if the blade is broken off, the tang would retain into the cutting or into the longitudinal perforation, or traces of corrosion by the metal, which occur as a result of a contact of bone with corroding metal, would be noted at least at some of the examples. Also there is no cylindrical object with a metal blade found yet, but there are examples where a rectangular supplement is inserted into the cutting. Such cylinder object with an inserted rectangular supplement was excavated in 1974 at Stobi (Inv. no. MF-74-52, currently kept in the depot of the Archaeological museum in Skopje and unavailable for studying). It is worth mentioning that it was found at the same floor level with another similar object (Pl. I: 2). The next example (Pl. I: 3) was discovered in 2009, and the rectangular supplement was found the next year when the excavations continued in the same room. The most interesting of all is the object with Inv. no. PH-12-03 found in situ in 2012 (Pl. I: 15) with the...
rectangular supplement (2.1 x 1.8 cm) inserted into the cutting. Other similar cylindrical objects with inserted rectangular supplement are known from the site Novae near Veliko Trnovo in R. of Bulgaria (Vladkova 2012: Pl. IV, 29-31).

Only with the usage of these rectangular supplements it is reasonable to have the cutting at one end. On the question why great part of the cylindrical objects are found without these supplements, the answer probably lies in their small dimensions, so they are rarely noted by the excavators, or the possibility of being made of wood, and therefore are not preserved.

In 1983, the cylindrical objects from Gamzigrad in Serbia got a different interpretation from the one as knife handles. The archaeologist Đorđe Janković identifies them as objects used in weaving, but he does not provide additional information for the way of use or about the context of discovery as confirmation of this theory (Janković 1983: 135, kat. 222-226). Much later, in 2000, Kina Kojčeva published 13 from the 19 discovered such objects at the site Gradište near Gabrovo in Bulgaria (Kojčeva 2000: T. VIII, IX). She puts them in the group of objects with an unknown function, and her arguments against the identification as knife handles are as follows: "the large width of the cutting and the longitudinal perforation, cannot ensure stability during work with an instrument; the diameter of the perforation sometime exceed 10 mm size which is not confirmed at the tang of metal knives; there are no traces of corrosion at the surface; the use wear traces and deformation at the base of the cutting most probably are result of contact with soft materials such as leather or thread" (Kojčeva 2000: 248-250). This is also the first time some researcher to note the use wear traces at the bottom of the cutting.

Later, Pavlina Vladkova agrees with Janković’s identification as objects used for weaving, and for the cylindrical objects discovered at the Early Byzantine sites in Bulgaria, says that they are part of a horizontal loom, where they serve to hold the thread while opening the heddles (Vladkova 2002: 97, T. II, 53; Vladkova 2006: 264, Pl. III, 4-6, 10, 11; Vladkova 2009: 214-215, T. VI, 6-9; Vladkova 2012: 218, Pl. IV, 29-31). Vladkova says that Janković ascertained this identification on the basis of ethnographic parallels, but unfortunately in his paper there are no such parallels. Although she adds that finds that can be connected with spinning and weaving are discovered with them, but she is not precise about which.

Despite Janković and Vladkova identifying the cylindrical objects as objects for weaving, it remains unclear how they were functioning or how the loom in which they were implemented looks like. Judging by the description which Vladkova gives, she alludes to a horizontal treadle operated loom, where the cylindrical objects serve as pulleys of the heddles, similar to the looms of the 20th century (Fig. 3). However, the oldest illustration of this kind of loom dates from the middle of the 13th century A.D. (Wild 1987: Fig. 1). Therefore any assumption for the existence of the horizontal loom with treadles in the 6th century, based only by the cylindrical objects is too audacious and unreliable. John Peter Wild in his study...
of Roman textiles proves that horizontal looms already existed in 250 A.D. (Wild 1987). If the cylindrical objects were integral parts of a loom as Janković and Vladkova suggest, it is possible that it was horizontal but without treadles. Again, he remains uncertain regarding its way of functioning and what kind of textiles were woven using it.

Another piece of information that supports their relation with looms or household production of textiles is the context of their discovery. Depositing knives in graves is a common practice, but neither at Stobi nor other sites, there is no case where this type of object is found in a burial. This definitely suggests that their usage should be sought in some of the household activities. Despite that, all cylindrical objects from Stobi are found in settlement contexts, and very often, at the same floor levels, even a few stone spindle whorls have been found. Two of them (Pl. I: 2; and Inv. no. MF-74-52, now in Archaeological Museum in Skopje) are found together with four steatite spindle whorls (Fig. 4, 1-4). In another case there are three steatite spindle whorls, one bronze spindle whorl (Fig. 4, 5-8) a fragmented roe deer antler (Fig. 5) and a cylindrical object (Pl. I: 3). Two others (Pl. I: 4, 17) are found with one stone spindle whorl (Fig. 4, 9), and two more (Pl. II: 10-11) also together in a same room. With the excavations in 2011, in a small area in a room, three cylindrical objects were found (Pl. II, 12-14), together with two spindle whorls (Fig. 4, 10-11). Judging by these contexts, it can be concluded that the process of spinning was certainly active in most of the rooms where these objects are discovered.

Use wear traces
The possibility that their function is closely related with usage of threads is confirmed by the longitudinal perforation in the cylindrical objects and the perforation into the rectangular supplements. They are made in the same direction and perfectly fit together (Fig. 6). If they were not made for passing a thread, their manufacture is absolutely useless. As an additional argument of the usage with threads are the use wear traces in the form of semi-circular depressions at the base of the cuttings. They are most clearly visible at the edges, at the corners (Fig. 7, a-d), and sometimes several run from one corner to the other (Fig. 7, e-h), or set in a shape of a wide centrally positioned depression. Most of them are even visi-
Close to the bone...

...ble with the naked eye, although a much better view can be achieved if they are studied with microscope. These use wear traces unequivocally point out that they are a result of extensive use and friction of a tight thread into the bone.

CONCLUSIONS AND POSSIBLE USAGE OF THE OBJECTS

In this phase of research, when we are lacking illustrations or descriptive material from that period, we can only assume how the looms from the 4th and 6th century A.D. looked like. Probably the way of raising the heddles and opening the shed was very simple, but is also similar with the one implemented in the later horizontal looms with treadles. If the cylindrical objects were an integral part of the loom, judging by the use wear traces at the bottom of the cutting and their perforations, the possible way of usage is as follows (Fig. 8):

The cylindrical object is set vertically, with the cutting upwards, and thread (Fig. 8, thread No. 1) is tied in a knot at the lower end and passes through the perforation of the cylindrical object and the perforation of the rectangular supplement and holds them at one axis. This way the rectangular supplement can be easily lifted and lowered but it remains unclear what the thread is tied at the top.

Another two threads (Fig. 8, threads Nos. 2-3) are tied with a knot at the upper side of the supplement; they pass through its perforation and continue along the sides of the cylindrical object. At the lower end they eventually hold the heddle of the loom. Thus when the rectangular supplement is lifted, the possible heddle also lifts, and a shed in the warp threads is formed. When they are lowered, the weight of the heddle tightens the thread and results in forming semi-circular depressions, which are normally most visible at the edges.

The search for antique or contemporary examples of these kind of objects used in a horizontal loom have not resulted with success. The implemented methodology in this study is just an attempt to understand the possible way in which the cylindrical objects were used. The achieved results are not final; they derive from the data available until present day. The future excavations and research will add to these results and will surely bring us forward to a more accurate interpretation of the function and understanding of these objects.

Fig. 7. Semicircular depressions on the base of the cuttings, photos made using digital microscope Celestron with 10 times magnification.

Fig. 8. Possible usage of the cylindrical object and the rectangular supplement using threads (drawing Z. Kovancaliev).
Plate I.
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OBJECTS MADE OF ANTLER AND ANTLER PRODUCTION IN THE ROMAN MUNICIPIUM IUVAVUM (SALZBURG)

Felix Lang

Abstract: In Iuvavum, nowadays Salzburg, quite an amount of antler waste as well as semi products and finished items have been found by excavations. On the bases of the waste material it is possible to reconstruct the “chaîne opératoire” of the main antler product of Iuvavum: handles for knives or other implements. The waste is concentrated in certain areas, thereby referring to crafting activity nearby. Some of this spots show also metal working. A possible connection of these activities will be discussed as well as the unusually high number of pieces connected with antler working in compare to bone, which was the more common material until the Late Roman period.

Apstrakt: U Juvavumu, današnjem Salcburgu, tokom arheoloških istraživanja otkrivena je veća količina otpadaka od rogova, kao i polufabrikata i gotovih proizvoda. Na osnovu otpadaka bilo je moguće rekonstruisati operativni lanac (“chaîne opératoire”) osnovnih proizvoda od roga: drški za noževe i drugi alat. Otpaci su koncentrisani u određenim delovima, ukazujući na zanatske aktivnosti koje su se odvijale u blizini. Na nekim od ovih mesta ima i tragova metalurških aktivnosti. U ovom radu će se diskutovati o mogućim vezama između ove dvije aktivnosti, kao i o neobičajeno visokoj količini komada vezanih za preradu rogova u odnosu na kost, koja je bila znatno češća sirovina sve do poznorimskog perioda.

TOPOGRAPHY AND HISTORY OF IUVAVUM

The municipium Claudium Iuvavum belonged to the province Noricum. The town was situated in a valley on both sides of the river Salzach between the small mountains Festungsberg, Mönchsberg and Kapuzinerberg. The earliest building activity at this place can be dated in the first years after the Roman conquest 15 BC. This settlement developed quickly and became the status of a municipium under Emperor Claudius.

Generally, the history of the town can be subdivided in four phases. Phase 1 dates in the 2nd half of the 1st c. AD. Phase 2 begins around 100 AD. It is characterized by stone buildings replacing the former wooden architecture. Most or even all houses of phase 2 were destroyed in the last quarter of the 2nd c. AD and rebuilt around 200 AD with slightly different ground plan and on higher level. This phase 3 ended at the middle of the 4th c. AD. There is only little information concerning the last Late Roman phase 4. It seems that the building area had been reduced considerably (Kovacsovics 2001a: 231; Kovacsovics 2002a: 172-191; Kovacsovics 2009b: 18-20; Lang et al. 2012; Thüry 2014: 41-113).

GENERAL REMARKS ON THE STATE OF RESEARCH

The knowledge of the ancient town is based on rescue excavations. The entire area is covered by the present-day historic city centre. Therefore, wide parts are not explored (cf. Kovacsovics 2002a: 192f. fig. 31). Mostly just short excavation reports are published and the material is not investigated in detail. Especially about the bone material not much is known (cf. Forstenpointner et al. 2009; Markert et al. 2011: 35). Notably in older excavations little interest was given to skeletal remains and only a selective number was stored and/or inventoried. Objects or manufacturing waste of bone and antler are seldom mentioned in publications. Some are of unclear dating. Furthermore, during World War II the museum was badly damaged by bomb hits and parts of the finds got lost (Kovacsovics 2013: 47f.). Nevertheless, there is (as far as I know) quite an amount of bone/antler objects and an unusually high number of antler production waste (521 pieces) found in the Roman town.

Fig. 1. Plate of a handle, Makartplatz 6. BDA, photo F. Lang.
ANTLER OBJECTS

Most of Roman antler objects found in Iuvavum are handles. There are two main types (cf. MacGregor 1985: 167f.), paired plates riveted to either side of an iron strip tang (Fig. 1, 2.1-2) and cylindrical ones (Fig. 2.3-4, 8). Especially iron knives with curved blade and antler plates as handles decorated with dot and ring and/or carved motives are characteristic local products that stand in Iron Age tradition (Dolenz 1998: 255-257; Gostenčnik 2001: 385; Gostenčnik 2005: 204-207. 299; Lang 2008; Struber 2008: 316-319; Gostenčnik, Lang 2010: 201 fig. 4,113.14.16; Lang 2012: 55 cat. no. 2.10.1).

The second numerous group consists of objects made of antler tines sawn off at the proximal end and shaped at the tip on one or two sides forming a more or less sharp edge (Fig. 3) (Lang 2008: 339 fig. 4,3.4; Gostenčnik, Lang 2010: 201 fig. 5,118; Lang 2012: 55 fig. 62). Probably they have been used as wedges in the manufacture of other antler objects, plates for handles especially (see below).

Another piece of antler is a spindle whorl (cf. MacGregor 1985: 185-187; Deschler-Erb 1998: 137) decorated with dot and ring motives and a metal sleeve, most likely to strengthen the perforation (Fig. 4). The whorl has been found in the inner yard of the Alte Universität (Heger, Moosleitner 1971: fig. 94; Gostenčnik, Lang 2010: 200 fig. 3,111). Further, there is...
Close to the bone...

The base of a shed antler found in the Furtwänglerpark (excavations see Krammer 2007; Hampel 2014: 75f.) could have been used as an amulet (cf. Mikler 1997: 20f.; Gostenčnik 2005: 272-278). There seems to be a perforation, but it is not absolutely clear, because the object is damaged there. Therefore it could be also a waste piece of antler manufacturing (Fig 6.).

Fig. 7 found in Makartplatz 6 was probably used as a digging tool (Lang 2012: 55 fig. 61 cat. no. 2.10.3; cf. MacGregor 1985: 178f.), whereas two rod shaped antler objects with notches at the end (Fig. 8; Lang 2012: 55 fig. 60) are pegs or wedges, that could have various functions, for example as tent-peg (thanks to Sofija Petković for the information). In Waagplatz 3 (Thüry 2014: 215f.) a tine hollowed out at the proximal end has been found (Fig. 9). The 31.2cm long is a handle of a large tool, probably some kind of blade (thanks to Sofija Petković for the information). Fig. 10, a shaped tine with perforation at one end (a pendant?) found in the Alte Universität, is maybe not finished (Gostenčnik, Lang 2010: 212 fig. 5,119).

DISTRIBUTION OF ANTLER WASTE

Antler waste with working traces has been found in several spots of Iuvavum (Fig. 11; cf. Lang 2008: 336-339, Gostenčnik, Lang 2010: 202-204; Lang 2012; Lang et al. 2012; Thüry 2014: 38-40):
- Makartplatz 6 (Fig. 11.4; Höglinger et al. 2012; Hampel 2014: 78f.): 298 objects
- Getreidegasse 38 (Fig. 11.6; Feldinger 1989): 115 objects; some have been found in disturbed layers mixed with finds dating to the Modern Age, but these do not differ from the clearly Roman ones; therefore they can be almost certainly added
F. Lang, Objects made of antler and antler production in the Roman Municipium Iuvavum (Salzburg)

Fig. 7. Digging tool (?). BDA, photo F. Lang.

Fig. 8. Pegs or wedges (thanks to Sofija Petković for the information). BDA, photo F. Lang.

Fig. 9. Handle of a large tool (thanks to Sofija Petković for the information). BDA, photo F. Lang.

Fig. 10. Pendant (?). BDA, photo F. Lang.
Close to the bone...

- Linzergasse 17/19 (Fig. 11.2; Hell 1967; Kovacssovics 2002a: 186; Thüry 2014: 164-181): 33 objects
- Makartplatz (Fig. 11.3; Hell 1959; Kovacssovics 2002b: 18f.; Kovacssovics 2012): 22 objects
- Festung Hohensalzburg (Fig. 11.12; Kovacssovics 1998: 11; Binder 2014: 28f.): 21 objects
- Alte Universität (Fig. 11.7; Heger 1973: 42f.; Moosleitner 1982; Thüry 2014: 119-122): 9 objects
- Lederergasse 3 (Fig. 11.5; Kovacssovics 1999: 29; Kovacssovics 2002a: 186): 7 objects
- Neue Residenz (Fig. 11.11; Kovacssovics 2001b: 80-87; Kovacssovics 2001/02; Kovacssovics 2002b: 9; Kovacssovics 2005: 11-15; Kovacssovics 2008: 42-48; Kovacssovics 2009a): 6 objects
- Alte Residenz (Fig. 11.9; Kovacssovics 1989; Kovacssovics 1991: 43f.; Kovacssovics, Seebacher 1999; Kovacssovics 2001a: 242f.; Jäger-Wersonig 2005; Kovacssovics 2008: 36-39): 5 objects
- Priesterhausgarten (Fig. 11.1; Hell 1952; Kovacssovics 2002a: 185f.; Thüry 2014: 146-149): 2 objects
- Mozartplatz 4 (Fig. 11.10; Moosleitner 1986): 1 object

Looking at the distribution a concentration in certain areas can be stated, where bone crafting is rather likely:

On the left river side there are indications in Alte Universität and Getreidegasse 38. In the Alte Universität a workshop place has been excavated dating to the 1st and 2nd c. AD, where smiting and copper, maybe also glass, melting took place (cf. Kovacssovics 2002a: 181; Lang, Knauseder 2008; Knauseder 2010; Lang et al. 2012). Getreidegasse 38 is lying close to the river bank and was used to deposit garbage. Due to the short distance, it is
quite likely that the workshop waste of the Alte Universität has been brought there. Bone/antler carving activity was also determined in the Furtwänglerpark next to the Alte Universität (Narobe, Narobe 1930: 190), but the finds were destroyed in 1944 by bomb hits on the Salzburg Museum before publishing (Narobe 1967: 58).

On the right river side waste has been found at the Makartplatz, Makartplatz 6, Lederergasse 3 and Linzergasse 17/19. In Linzergasse 17/19 the excavator postulates (a) workshop(s) dating probably to the 2nd c. AD, where also metal working took place. The finds from Lederergasse 3 belong to a destruction layer dating to the end of the 2nd c. AD. The antler objects from Makartplatz on the other hand have been found in waste layers and the filling of cisterns. Martin Hell considered that the workshop in the Linzergasse used the area around the Makartplatz for deposition, which is approximately 150m away (Hell 1967: 97; cf. Lang, Knauseder 2008; Knauseder 2010; Lang et al. 2012). Anyhow, it is of course possible that this workshop or a second one was located at the area Makartplatz/Lederergasse, probably in the building of Makartplatz 6, where the biggest amount of antler waste has been found (Lang 2012).

The third area is the Festung Hohensalzburg. The antler waste has been found there in a natural rock-hollow under the floor of the medieval chapel. A precise dating of these finds is not possible, maybe Late Antiquity.

Because of the limited number of pieces found in the other places of the town antler crafting areas there are uncertain/unlikely.

**Working methods and produced objects** (cf. Lang 2008; Gostenčnik, Lang 2010: 202-204; Lang 2012; Lang et al. 2012)

Sawing and knife shaping were the most common working techniques. Axes or chisels were seldom used and just in an early stage of the manufacturing process. Due to the half-finished objects (Fig. 12) predominantly handles for knives or other implements have been produced (Fig. 1, 2). The different kinds of waste connected with the production of antler plates for handles allow reconstructing the ‘chaîne opératoire’. The tines shaped at the tip mentioned above (Fig. 3) were most likely used in this process as wedges to split the antler lengthwise (cf. Ulbricht 1978: 50). They have always been found connected with waste from antler manufacturing. The rivets of the handles have been made by drilling. After that the plates have been smoothened and usually decorated. The connection of iron and antler working that can be stated for the Alte Universität, Linzergasse 17/19 and maybe also the Alte Residenz points to a combined production of blades and handles in one workshop (Lang 2011: 298f.). On the other side there are no indications for smiting in Makartplatz 6 and the area nearby. Possibly there existed an independent antler workshop.
There are no indications for other products except pieces found in the Festung Hohensalzburg (Fig. 13). The half fabrics there are most likely unfinished spindle whorls (cf. Cribellier, Bertrand 2008: 169 fig. 4). The next step of production concerning these whorls could have been lathe turning, but by now there are no traces of this technique in the whole assemblage of antler waste.

**The amount of antler compared to bone**

There are 521 pieces of manufacturing waste that can be determined as antler. Most of them belong to red deer (*Cervus elaphus*), but single pieces are from fallow deer (*Dama dama*) and most likely elk (*Alces alces*) as well. In contrast, just five bones show clear traces of manufacture. The high amount of antler is rather uncommon in civil settlements before the Late Roman period. Bone was the predominant skeletal material of the 1st to the 3rd c. AD, whereas in military context antler has been used more often (Deschler-Erb 1998: 88-92). The high amount of antler in Iuvavum could be for several reasons:

Because of the products and excavated places – The high amount of antler can be explained by the produced objects and the excavated areas, where these products have been made or the manufacturing waste of this production has been disposed. For handles, especially those made of paired plates, antler was more suitable than bone. Further, knives with curved blade and antler handles are based on local Iron Age traditions (cf. Gostenčnik 2001). Maybe, just by luck the workshop areas have not been excavated by now, where needles and other objects made of bone were produced. Among the finished objects in Iuvavum these dominate against objects of antler (cf. Gostenčnik, Lang 2010). In fact, concerning an investigation in the Furtwänglerpark the excavators postulate the production of handles, spoons and other items (Narobe, Narobe 1930: 190). At least the spoons should have been made of bone, but the finds got lost in World War II, so this cannot be proofed (Narobe 1967: 58).

Because of the archaeologists – As stated above in older excavations just a selective number of bone and antler finds has been kept, most likely the bigger examples. Therefore a great part of the smaller bones could be lost. Moreover, worked antler should be easier to recognize by the excavators (different opinion: Deschler-Erb 1998: 195) and hence noted in the inventory or in reports.

**SUMMARY**

The main part of antler objects found in the Roman municipium Iuvavum, nowadays Salzburg, are handles, cylindrical ones as well as paired plates riveted to either side of an iron strip tang. This last type is especially characteristic for iron knives with curved blade that stand in Iron Age tradition. These plates are usually decorated with dot and ring and/or carved motives. Other objects are rare, for example a spindle whorl or a lid of a pyxis, with the exception of a group of antler tines shaped at the tip on one or two sides forming a more or less sharp edge. Quite likely they have been used as wedges in manufacturing to split antler lengthwise.
These tines are connected with pieces of antler showing working traces, mostly sawing and/or knife shaping. Quite an amount of this manufacturing waste has been excavated in several spots of Iuvavum. It is not easy to localize bone and antler crafting activity exactly, because there are no distinctive installations. Nevertheless, the concentration of waste material in certain areas indicates at least a workshop in the Alte Universität that deposited the waste in Getreidegasse 38 close to the river Salzach, one or two workshops on the right river side in the area of Makartplatz, Makartplatz 6, Lederergasse 3 and Linzer-gasse 17/19 and a last one at the Festung Hohensalzburg.

Due to the half fabrics from the Festung Hohensalzburg mainly spindle whorls have been produced, whereas in the other areas handles for knives or other implements have been made, especially plates for iron knives with wavy blade. For these products the reconstruction of the ‘chaîne opératoire’ is possible. In some of the crafting areas also indications for smiting have been found. Therefore, it is possible that handles and blades have been made in the same workshop.

The high number of pieces connected with antler manufacturing is quite uncommon for a civil Roman settlement of the 1st-3rd c. AD. Usually bone was the predominant skeletal material. There may be several reasons for an explanation: Antler is more suitable for handles, especially for those made of two plates. Some areas that have been excavated are firmly connected with the production of exactly these handles. Another explanation could be the lack of interest in skeletal remains, especially in older excavation. Just a limited number of bone and antler has been kept. Maybe bones have been stored in a more limited number than the bigger antler, where in addition traces of manufacturing have been easier recognized.

REFERENCES


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INTRODUCTION

In the article bone tools found from medieval and early modern suburbs of Tallinn are discussed. The studied find material comes from the excavations at Roosikrantsi Street 9/11 in 1996 and at Tartu Road 1 in 2011-2012. The plot at Roosikrantsi Street 9/11 was located by the road to Pärnu and western Estonia. Both bone and antler artefacts and working refuse were quite numerous there, the earliest finds belonging to the 13th-14th centuries and latest to the 17th-18th centuries. The plot at Tartu Road 1 was located in the suburb by the road to Tartu and also to northeastern Estonia. The earliest finds there date from the 14th-15th centuries and the latest from the 18th-19th centuries. Both artefacts and working debris have been found, the most abundant among the debris were waste of bead and button making. Some antler objects and antler working refuse were also found. At the present stage of investigation the greatest share of bone and antler working waste in Tallinn has been found from the excavations in the suburban areas. The bone and antler working refuse found at these suburbs may refer to itinerant bone workers who stayed and worked there.

BONE AND ANTLER ITEMS FROM ROOSIKRANTS STREET 9/11

The plot at Roosikrantsi Street 9/11 was located by the road to Pärnu and western Estonia (Fig. 1:B). Two excavations were made in 1996, with a total area of 2300 m². Both bone and antler artefacts and working refuse were quite numerous there, the earliest finds belonging to the 13th-14th centuries and latest to the 17th-18th centuries. The plot at Tartu Road 1 was located in the suburb by the road to Tartu and also to northeastern Estonia. The earliest finds there date from the 14th-15th centuries and the latest from the 18th-19th centuries. Both artefacts and working debris have been found, the most abundant among the debris were waste of bead and button making. Some antler objects and antler working refuse were also found. At the present stage of investigation the greatest share of bone and antler working waste in Tallinn has been found from the excavations in the suburban areas. The bone and antler working refuse found at these suburbs may refer to itinerant bone workers who stayed and worked there.

INTRODUCTION

In the article bone tools found from medieval and early modern suburbs of Tallinn are discussed. The studied find material comes from two sites: Roosikrantsi Street 9/11 and Tartu Road 1 (Fig. 1). The archaeological investigations at Roosikrantsi Street 9/11 took place in 1996 and at Tartu Road 1 in 2011-2012. An overview of bone and antler items from the site Roosikrantsi Street 9/11 has been published more than ten years ago (Luik, Maldre 2003), an analysis of the bone and antler artefacts found at Tartu road 1 is completed recently (Luik et al. 2015). Both plots were located near the roads to the other towns of Medieval Livonia: the plot at Roosikrantsi Street 9/11 by the road to Pärnu and Riga and western Estonia, and the plot at Tartu Road 1 in the suburb by the road to Tartu and also to Narva and northeastern Estonia. The aim of the present article is to give a short overview of bone items and bone working debris found from these two sites and to discuss the question why the greatest share of bone and antler working debris in Tallinn has been found from these suburban sites.

BONE AND ANTLER ITEMS FROM ROOSIKRANTS STREET 9/11

The plot at Roosikrantsi Street 9/11 was located by the road to Pärnu and western Estonia (Fig. 1:B). Two excavations were made in 1996, with a total area of 2300 m². Both bone and antler artefacts and working refuse were quite numerous there, the earliest finds belonging to the 13th-14th centuries and latest to the 17th-18th centuries. The plot at Tartu Road 1 was located in the suburb by the road to Tartu and also to northeastern Estonia. The earliest finds there date from the 14th-15th centuries and the latest from the 18th-19th centuries. Both artefacts and working debris have been found, the most abundant among the debris were waste of bead and button making. Some antler objects and antler working refuse were also found. At the present stage of investigation the greatest share of bone and antler working waste in Tallinn has been found from the excavations in the suburban areas. The bone and antler working refuse found at these suburbs may refer to itinerant bone workers who stayed and worked there.
plate, which was probably riveted to a wooden base, it
could belong to the early modern or modern period
(Fig. 2:13; Luik, Maldre 2003: 9-10, fig. 6). Three turned
details, found from the eastern part of the excavation,
apparently also date from a later period (Fig. 2:8, 14;
Luik, Maldre 2003: 16, fig. 13). Some decorative plates
of bone were also found (Fig. 2:3-5; Luik, Maldre 2003:
12-13, fig. 9).

Several handles of knives and forks and their frag-
ments were found, the earliest is probably the profiled one
decorated with dots and circles (Luik, Maldre 2003: fig.
10). Seven handles consist of plates riveted to the sides of
iron tang of the object. Four handle-plates were made of
bone (Luik, Maldre 2003: fig. 11), and three of ivory (Fig.
2:9-10, 12). These knives and forks are late, modern-time
cutlery. Some of them were recovered from the disturbed
eastern part of the excavation, some were found from the
western part where incidental 16th-18th-century finds
came to light among the earlier ones (Luik, Maldre 2003:
13-16).

Some tools made of antler and bone were also discov-
ered (Luik, Maldre 2003: 11-12, figs. 7-8). An awl made
from elk antler tine and a hammer of an antler beam
probably belong to the 13th-14th centuries. A tool of a
tine, with wedge shaped end, and an object of a metatarsal
bone of cattle came to light in the disturbed layer of
the eastern part of the excavation.

The majority of the finds are of bone and antler
working scrap, including four bone fragments with
working traces (Fig. 3:11, 16; Luik, Maldre 2003: 20-
21, fig. 17). The 20 antler fragments include produc-
tion refuse (mainly sawn-off tine tips and fragments
from the concave side of antler) and half-finished items
(plates of the compact part of antler prepared for fur-
ther working, and other fragments) (Fig. 3:1-10, 12-15;
Luik, Maldre 2003: 17-19, figs. 14-16). Nearly half of
the bone finds from Roosikrantsi Street are bone scrap
from the production of buttons (a total of 46 pieces).
A few bone buttons and a bone bead were also among
the finds. The greater part of the scrap from button
making is made up of rib fragments, but some are of
cattle scapula (Fig. 4; Luik, Maldre 2003: 21-23, table
1, figs. 18-20).
Close to the bone...

BONE AND ANTLER ITEMS FROM TARTU ROAD 1

The plot at Tartu Road 1 was located in the suburb by the road to Tartu and also to northeastern Estonia (Fig. 1:A). This suburb has been called Kivisilla – that means Stone Bridge – suburb, because at this place a stone bridge was located on the Härjapea River. Remains of the oldest medieval building were found at the northern part of the excavated area. Several buildings with different sizes have been located in the area in later periods (Kadakas et al. 2013).

An area of about 1100 m² was investigated at Tartu Road 1, the cultural layer at the site was 2.5-3 m thick. It was possible to distinguish three building stages of the medieval house, in the course of rebuilding works it was built larger. By the opinion of archaeologists Ulla Kadakas and Villu Kadakas who investigated the area both the location of the plot as well as the size and division of space of the house indicate rather a building for public use (e.g. a guesthouse or a tavern) than a simple dwelling. 86 bone and antler objects were found during the excavations in 2011-2012, half of them – 43 – were fragments of working refuse. Six bone items were found already during the preliminary research in 2010. The earliest finds date from the 14th-15th centuries and the latest from the 18th-19th centuries (Kadakas et al. 2013; Russow et al. 2013; Luik et al. 2015: figs. 3-11).

According to find contexts more than a half of bone objects could be connected to the medieval period, the 14th – last quarter of the 16th centuries: a bone needle, a fragmentary double composite comb, a claw bone of a bear, some dice and disc-shaped gaming pieces, a toggle, a crossbow nut, a detail of a knife handle, a cylindrical object and some decorative plates made from antler (Fig. 5). Worked elk antler pieces (Fig. 6) and bone working debris left from bead making (Fig. 7) also come mostly from medieval contexts. Two bone flutes made from sheep/goat tibia also could be dated to this period (Fig. 5:9-10). It is worth of mentioning here that from Tērvete in Latvia, the neighbouring country of Estonia, an image of a man with presumable bone flute has been found, scratched on the clay side of a stove. This image probably dates from the 13th century (Urtāns 1970: 227, fig. 3; Griciuvienė 2005: 214, fig. 1300).

Fig. 3. Antler (1-10, 12-15) and bone (11, 16) working debris from Roosikrantsi Street 9/11 (AI 6109). Photo by H. Luik.

Only a few items could be dated to the early modern period, the 16th-17th centuries, according to their
finding contexts: two cattle phalanges with engraved marks, an antler comb, a bone fork and a handle (Fig. 8:1-5). About twenty objects could be dated to the 18th-19th centuries. Most of such finds are bone buttons and button making debris (Fig. 9). Only two other items could belong to the 18th-19th centuries: a fragment of a tooth brush and two parts of a cylindrical bone tube (Fig. 8:8-9). Six bone items found during the preliminary investigations in 2010 – two handles (Fig. 8:6-7) and four buttons – come from the 16th-18th century contexts.

USED RAW MATERIAL AND UNWORKED FAUNAL REMAINS

The species whose skeletal parts were used for making artefacts in both sites were cattle (Bos taurus), elk (Alces alces), sheep/goat (Ovis aries/Capra hircus) and pig (Sus scrofa domestica). A few items of elephant ivory were found from both sites (Figs. 2:9-10, 12; 8:7), in addition one claw bone of brown bear (Ursus arctos) was found from the site Tartu Road 1 (Fig. 5:1). Mainly cattle bones and elk antler were used as raw materials. Most often used skeletal parts at both sites were long bones, ribs and antler (Fig. 10).

The material of a little more than half of the finds could be identified to species level at Roosikrantsi Street 9/11 (Luik, Maldre 2003: 28-29, table 2). Nearly a quarter of finds can be identified as cattle bones, but most of the unidentified bones also belong likely to cattle. Of elk only antlers were used; about a fifth of probably cattle bones – ribs and long bones – were used for making beads and buttons. The comb, the dice, the fork and the handle are also probably made from cattle bones. Since all these items have been carefully worked and characteristic attributes of bone have been removed it is not possible to identify the bones precisely and it could be possible that horse bones were also used occasionally. The only bone items made from sheep/goat bones are the two bone flutes made from tibiae. Three objects are made from pig bones – a needle from a fibula, a point from a rib and a presumable toggle from a radius. About a sixth of identified material were antler working debris and the working debris and artefacts were of antler. At least five objects – pins from fibulae – were of pig’s bone, one handle was of sheep metatarsus and three handles were of elephant ivory. Local production was primarily connected with button making, which explains the use of flat bones – ribs and scapulae – which constitute more than a third of identifiable material. Sawn-off horn cores, indicating the working of horn, were not found at Roosikrantsi Street 9/11 (Fig. 10; Luik, Maldre 2003, 28-29).

At the plot Tartu Road 1 definitely cattle bones are the three phalanges and the horn core, the faceted handle (Fig. 8:6) is made from cattle long bone. Most probably cattle bones – ribs and long bones – were used for making beads and buttons. The comb, the dice, the fork and the handle are also probably made from cattle bones. Since all these items have been carefully worked and characteristic attributes of bone have been removed it is not possible to identify the bones precisely and it could be possible that horse bones were also used occasionally. The only bone items made from sheep/goat bones are the two bone flutes made from tibiae. Three objects are made from pig bones – a needle from a fibula, a point from a rib and a presumable toggle from a radius. About a sixth of identified material were antler working debris and
antler items: a simple comb, gaming pieces, decorative plates etc. Only one cattle horn core with working traces has been found from the site, presumably horn was not worked there. One handle is made of elephant ivory (Fig. 10; Luik et al. 2015: 148).

Among the analysed unworked faunal remains from Roosikrantsi Street 9/11 and Tartu Road 1 also the bones of domestic animals prevail, most abundant are cattle bones (ca 53-58%), sheep/coat and pig bones were next numerous. A few horse (Equus caballus), dog (Canis familiaris) and cat (Felis catus domesticus) bones were also found. The bones of wild animals were represented only by some bones of mountain hare (Lepus timidus) at both sites; at Tartu Road 1 a few bones of wild boar (Sus scrofa fera) and seals (Phocidae) were identified also. Both butchering and kitchen waste were represented among faunal remains (Luik, Maldre 2003: 26-27, fig. 22; Russow et al. 2013: 159-162, table 2, fig. 6; Luik et al. 2015: 160). Similar composition of species is common also for the archaeological material from other medieval and early modern towns of Estonia (e.g. Maldre 2007; Haak 2007: 43-47, table, fig 1; Rannamäe 2010; Haak et al. 2012: 300, table 2, fig. 3). Antler working debris and antler items are relatively numerous both at Roosikrantsi Street 9/11 and Tartu Road 1, but other elk skeletal parts were not represented among faunal remains, thus the found antler pieces were probably raw material brought there by the antler workers (Luik, Maldre 2003: 27; Luik et al. 2015: 160).

Nevertheless, the abundance of bone and antler working refuse at these two sites is remarkable in the context of Tallinn and other towns of Estonia. Much less bone working debris than from these suburban plots has been found from the territory of the Tallinn Old town inside the town wall (e.g. Luik 2001: 324; Luik, Russow 2014: 109). Bone workers are not mentioned among craftsmen of Tallinn in medieval written sources (Kaplinski 1980), but they are mentioned only rarely elsewhere also (e.g. Christopheren 1980, 228; MacGregor 1985, 53, 372-373; Konczewska 2011, 306-308). More abundant bone working refuse is still known from some medieval castles in Estonia, for example from Otepää and Viljandi (Luik 2009: fig. 15:1-9, 20:1, 3; 27:1, 4; 2015: 96 ff. ; Haak et al. 2012: 321-325, figs. 24-31).

But does the abundance of bone and antler working refuse from the sites at Roosikrantsi Street 9/11 and Tartu road 1 suggest that a permanent bone and antler working workshop could have been located in these suburban areas?

**Fig. 6. Antler working debris from Tartu Road 1 (AI 7032). Photo by S. Nittim.**

**Fig. 7. Bone beads and bead manufacturing debris from Tartu Road 1 (AI 7032). Photo by S. Nittim.**

**BONE WORKERS IN MEDIEVAL AND EARLY MODERN SUBURBS OF TALLINN**

Similar bone and antler items – combs, handles, flutes, gaming pieces, beads, buttons etc. – have been found also from other sites in Tallinn and from other medieval and early modern towns and castles of Estonia (e.g. Lihula, Otepää, Tartu, Viljandi; Luik 2001; 2002; 2009; 2015; Heinloo et al. 2011; Haak et al. 2012). Comparable bone artefacts are known also from the neighbouring countries (e.g. Caune, Celmiņš 1988; Berga 1992; Apala 1994; Rackevičius 1999; Blaževičius 2011; Vasiliauskas 2012) and elsewhere in Europe (e.g. Ulbricht 1984; MacGregor 1985; van Vilsteren 1987; Röber 1994; Erath 1996; Spitzers 1999; Gröf, Gröh 2001; Heege 2002).
The bone finds from Roosikrantsi Street 9/11 cover a span of 600 years, from the 13th to the 18th centuries. Working debris from Roosikrantsi Street 9/11 could mostly be divided into two categories: antler working scrap which could belong to the medieval period and button making scarp which is probably somewhat later (Luik, Maldre 2003: 16-23, figs. 14-20). Even if to presume that all bone and antler fragments with working-traces except of button making refuse belong to the 13th-14th centuries, the number of such finds – 24 pieces – is quite modest and does not suggest the presence of a permanent bone and antler working workshop in the area, although bone and antler objects have indubitably been made there (Luik, Maldre 2003: 29-30).

The number of button making scrap, dated to somewhat later period, is about 50 finds which testify to the manufacture of a little more than 200 buttons. Some dozens of bone plates with holes speak of a work of only couple of hours (Spitzers 1999, 242). But even for the sites with thousands of button and bead blanks no permanent workshop has been suggested, a button maker is thought to have travelled from place to place (e.g. Gröf, Gröh 2001, 282). Probably a travelling button maker stayed in the area of Roosikrantsi Street 9/11 for a while and manufactured buttons according to the demand for his production. The other possibility still is that a workshop has been located somewhere in the neighbourhood and the scrap found is but a very small part of its refuse, the rest of which may have been destroyed by the later activities or are located in a still uninvestigated area (Luik, Maldre 2003: 30-31).

The large medieval house at the plot Tartu Road 1 may have been a guesthouse or a tavern. The location of the house near the bridge and the roads as well as find material, especially shards of ceramic vessels speak both in favour of such a hypothesis (Kadakas et al. 2013: 142; Russow et al. 2013: 150-155, 166). Such an interpretation suits also well with the bone finds. Gaming and gambling also belonged to medieval taverns (Heinloo et al. 2011: 46-47, 64-66, fig. 14), the dice and disk shaped gaming pieces found from the plot were witnesses of such pastimes. Music definitely also belonged to the taverns (Heinloo et al. 2011: 24) and so the bone flutes fit well with this interpretation.

Medieval bone and antler working debris is rather scant at Tartu Road 1 also and does not support a hypothesis about the existence of a permanent bone workshop in this area either. Presumably the scant working refuse may have been left by itinerant craftsmen. There was probably no stable market or sufficient customers for products of bone workers in small towns. This has been presumed for example about bead and button makers, whose simple tools for drilling beads/buttons enabled an itinerant way of life (Gröf, Gröh 2001: 282). It could have also been possible for an antler worker, who probably carried with him a certain amount of material and produced objects following the demand on site. A guesthouse or tavern at the crossing point of roads and the river could have been a suitable stopping place for such craftsmen.

Could the medieval bone and antler working refuse at Tartu Road 1 have been the result of the activities of one or several bone workers? It seems more probable that there have been different craftsmen who presumably specialized in specific products and handled particular materials. A craftsman making beads from the
diaphyses of long bones could have easily got the necessary raw material on spot, since a lot of cattle long bones were found among unworked faunal remains (Russow et al. 2013: fig. 6). An antler worker should have carried at least some amount of raw material with him. Elk skeletal parts are usually not represented among unworked faunal remains in the medieval towns of Livonia, although a few elk and red deer bones have been found at medieval castles (e.g. Luik, Maldre 2003: 26-27; Haak 2007, 49; Rannamäe 2010; Haak et al. 2012: 308-309, tables 1-2). The two decorative plates from Tartu Road 1 (Fig. 5:11-12) were manufactured using similar working methods and could have been made by the same craftsman. Some antler pieces have also been prepared in a manner, so that decorative plates could have been manufactured of them (Fig. 6:1, 3). A very similar decorated antler plate has been found also at the other side of the Härjapea River, at Tartu Road 10 (Fig. 11:7). It is possible that this plate could have been bought from the bone worker who stayed at Tartu Road 1 (Luik et al. 2015: 161, fig. 12:1). An antler artefact in the shape of a truncated cone and folded decorations (Fig. 5:15) has parallels in the decoration of gunpowder horns made from antler (van Vliet- steren 1987: fig. 30; Caune, Celmings 1988: fig. 58; Haak et al. 2012: 313-314, fig. 17). Perhaps in the case of this hollow antler object the plan was to carve a gunpowder horn, but the blank broke during manufacturing. The craftsman may have wanted to use the broken blank to create another object, but for some reason it was left unfinished.

A few items belonging to the early modern period (Fig. 8:1-7) represent common artefacts, which were used in domestic households – a comb, a fork and some handles. The cattle phalanges were most likely children toys. One of them has a more sophisticated decoration: small dots and a quadrangle divided into four triangles. A phalanx with a similar decoration has been found e.g. from Amsterdam (Rijkelijkhuizen 2008: fig. 1.2). Bone buttons may have belonged to garments, a few bone working refuse could presumably originate from domestic craft (Fig. 9; Egan, Pritchard 1991: 314). Some bone buttons could be the product of local domestic button making, but there is no working refuse left from manufacturing of shank buttons, which were also found from this plot.
The early modern bone items found at Tartu Road 1 are in general similar to the bone finds from the rest of the territory of the Kivisilla suburb, where also cutlery with bone handles, bone combs and brushes, buttons, turned bone items and cattle phalanges are common finds (Fig. 11:1-5). But it is noteworthy that bone working debris has not been found from other plots in Kivisilla suburb, except for only one antler piece with cutting traces from the plot at Tartu Road 18 (Fig. 11:6; Luik et al. 2015: 162, fig. 12:2).

SUBURBS – SUITABLE LOCATION FOR ITINERANT BONE WORKERS?

As already mentioned both plots discussed in the present article – Roosikrantsi Street 9/11 and Tartu Road 1 – were located near the roads to the other towns of medieval Livonia (Fig. 1). The plot at Roosikrantsi Street 9/11 was located near the road from Harju Gate toward Pärnu and Riga and western Estonia and the plot at Tartu Road 1 – by the road from the Karja and Viru Gates toward Tartu and Narva in eastern Estonia. Presumably these sites could have been a suitable location for itinerant craftsmen.

Bone working refuse has been found from similar contexts in other Livonian towns as well (Fig. 1). For example in a small town Viljandi in southern Estonia both bone items as well as bone working scarp has been found in the suburb near Riga gate. The working debris consisted mostly of flat rib and antler plates suitable for making decorative plates, a bone plate with engraved letters has also been found there. Probably a travelling bone worker or workers may have stopped at this place (Luik 2015: 105-106, fig. 3). Andres Tvauri who excavated this plot has suggested that probably a smithy and a tavern were located there, finds from these excavations have been dated mostly to the 14th-16th centuries (Tvauri 2000: 56). The tavern and forge were both located close to the road to Riga – an important centre in medieval Livonia – so this area may have been a favourable place for an itinerant craftsman to spend some time. Thus this site probably also indicates the existence of itinerant bone workers in medieval Livonia. Except of the suburb at the Riga Gate, bone working debris has been found also from the suburb near the Tartu Gate in Viljandi (Haak 2007: 50, fig. 2).

In Tartu bone working debris has been found at the southern or the so-called Riga-suburb, which was located near the Riga Gate (Haak 2007: 50). However, the possibility can not be ruled out that some artefacts or refuse found from the Riga-suburb in Tartu could have been brought there from other districts of town with waste and filling material (Haak 2014: 61, 64). Some bone and antler items at Tartu Road 1 in Tallinn also come from the filling layer of wide pit which was filled in the beginning of 17th century (Kadakas et al. 2013; Luik et al. 2015: 146). Material for filling the pit could originate from the cultural layer of the same suburban site, but it is also possible that it was brought from somewhere else.

CONCLUSIONS

At the present stage of investigation the largest amount of bone and antler working waste in Tallinn has been found from the excavations in the suburban areas. Bone finds from both the discussed sites – Roosikrantsi Street 9/11 and Tartu Road 1 – are quite similar and testify that the suburbs located by the roads to other towns and castles could have been suitable stopping places for itinerant craftsmen who also manufactured their products there. Similar was the situation also in some other towns of medieval Livonia (e.g. Viljandi, Tartu). Bone working refuse from Roosikrantsi Street 9/11 comes from two periods: antler working scarp belongs to the medieval period, button making scarp is probably later. At Tartu Road 1 majority of bone and antler working debris comes from the medieval period, only a few bone working scarp pieces – button making scarp – belongs to the later times, to the 18th century. Finished bone items found at both plots represent medieval and early modern artefacts, which are common among finds from Tallinn and other Estonian towns as well as in neighbouring areas.

REFERENCES

Close to the bone...


H. Luik, Bone working in the suburbs of Medieval and early modern Tallinn, Estonia


Abbreviations:
AI – Institute of History, Tallinn University
TLA – Tallinn City Archives

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INTRODUCTION

The Šventoji sites are the best known Neolithic sites on the west coast of Lithuania (Fig. 1). About 60 archaeological sites as well as many isolated finds and several hoards are known and dated to the period between 6000-5000 cal BC. Some of these sites were excavated in 1966-1972 and 1982-1998, during these years an area of 10300 sq. meters was investigated. The results of these investigations have been published by the researcher of the sites Rimutė Rimantienė (1996a, 1996b, 2005), many drawings and photos of the worked bone objects also appear in these publications. The latest excavations were carried out in 2013-2014 as part of the project “Neolithization of coastal Lithuania” (Piličiauskas 2016; Piličiauskas, Heron 2015).

Numerous bone artefacts and working debris were found at sites 1-4, 6, 23 and 26 at Šventoji (Fig. 1) and could be dated to the period between 3500-2500 cal BC. The greatest number of bone objects as well as zooarchaeological material comes from sites 6 and 23. The number of bone finds from the other sites is considerably smaller.

The aim of the present research is to identify the raw materials chosen to make these objects and the working methods used for making bone and antler artefacts at Šventoji. Another related goal was also to identify possible differences in the raw materials at specific sites and to determine whether these differences could be chronological in

Fig. 1. Sites of Šventoji on the coast of Lithuania, interpolated from LIDAR data.
their nature or connected some other cause. Comparison of the finds from the sites proved to be difficult since the number of finds varies greatly from site to site and in the case of only a few finds both the differences and similarities could be incidental. An overview will be given about unworked faunal remains from the Šventoji sites and the selection of skeletal parts of different species for making artefacts will be compared with the frequency of bones of these species among unworked animal bones.

**SITES OF ŠVENTOJI: LOCATION AND CHRONOLOGY**

The Šventoji archaeological complex was discovered during drainage works in 1966 by M. Balčius and R. Rimantienė (Rimantienė 2005). Archaeological sites and isolated finds were discovered on a swampy Littorina sea terrace, 16 km long and up to 2.5 km wide, stretching between the City of Palanga and the Lithuanian-Latvian state border (Fig. 1; Piličiauskas et al. 2012; Piličiauskas 2016). Today, Šventoji might be considered one of the best archaeologically investigated areas in Lithuania. In addition to extensive test-pit work over 4400 sq. meters, some sites were investigated, uncovering an area of ca 9900 sq. meters. Šventoji sites are situated on the banks, littoral areas and beds of former lagoons, estuary channels and rivers. The sites were interpreted as habitation sites, refuse layers, fishing stations and possibly pile dwelling settlements. A lot of them are wetland sites with well preserved organic materials found in waterlogged lake deposits (gyttja). Great amounts of pottery as well as wooden and bone fishing equipment were brought to light during excavations. Remains of intensive amber processing also emerged. Large scale seal hunting and fresh water fishing was inferred in contrast to a very few, questionable signs of farming economy in the Šventoji region during the Neolithic. Today, the cultural layer is badly deteriorated due to ploughing and lowering of the water table at most sites. However, bone and wooden artefacts are still well preserved in the waterlogged gyttja of former water beds. Today, the city of Palanga constantly expands into coastal meadows thus forming an additional serious threat to the Šventoji sites (Piličiauskas et al. 2012; Piličiauskas 2016).

Human occupations at different sites were 14C dated to 6000 cal BC (Šventoji 40), 4000-3700 cal BC (Šventoji 43 and 45), 3200-2500 cal BC (Šventoji 1-4, 6, 23, 41A, 42, 51, 52), and 2000-700 cal BC (Šventoji 9, 41B, 47, 48) (Piličiauskas et al. 2012; Piličiauskas, Heron 2015; Piličiauskas 2016). However, the Middle/Late Neolithic sites of Šventoji 1-4, 6, 23 and 26 were investigated to a much greater extent compared to the others.

Investigations at the Šventoji 1-4 sites took place in 1967-1969, 1971-1972, 1974-1978, 1986-1995, 1997-1998, 2002-2006 and 2014. An area of 6750 sq. meters was uncovered, not including numerous test pits (Rimantienė 2005; Piličiauskas et al. 2012; Piličiauskas 2016). These sites are represented by a continuous refuse layer (1.3 km in length) mainly representing the remains of fishing stations accumulated in the gyttja of a narrow lake lying just beside its northwest coast. The existence of large scale fishing activities was demonstrated by enormous numbers of freshwater fish bones brought to light within the lower horizon of the cultural layer. Around 2900 cal BC Narva ware was replaced by Globular amphora ware (with an evident features of corded ware in the latest stage at the Šventoji 1 site) although other aspects of the culture and subsistence strategies did not undergo any significant changes at that time. Long and thin pine laths functioned as the main constructional element of almost all fishing structures during the Middle and Late Neolithic at Šventoji (Piličiauskas 2016).

Further south of sites 1-4, another archeological site within the wider lagoon bed is known – Šventoji 6. Here, the bed of the lagoon-lake is wide and shallow and thus, suitable for constructing pile dwellings, which was probably the case with this site. It was investigated in 1982-1988 and 1997. An area of 2001 sq. m was uncovered, not including numerous test pits (Rimantienė 2005; Juodagalvis, Simpson 2000). 14C suggests site 6 was intensively used between 3000-2500 cal BC, a period that coincides with time sites 1-4 were inhabited. The archaeological material of those sites is also similar to each other. The same two pottery types are present at Šventoji 6 – Narva and Globular amphora wares. Very common fishing elements – pine bark floats, stone net sinkers and pine laths were numerous at Šventoji 6. Wooden eel clamps, hoes, digging sticks, axe handles and paddles were also recovered. Round amber buttons, oval and trapezoidal pendants, tubular beads and a single perforated disc are known. Flint waste and artefacts including rhombic and triangular arrowheads were less numerous. Several slate points and axes are also known (Rimantienė 2005; Piličiauskas 2016).

Šventoji 23 and 26 sites were situated by the same lake as sites 1-4 and 6, but on the opposite eastern bank. There are only 250 meters between sites 23 and 26 with some scattered archaeological finds in between. Therefore, both sites can be discussed together. They were investigated in 1970-1971 and 2002-2005. An area of 1948 sq. m was uncovered during archaeological excavations. Finds recovered are very close to those found at site 6. The main difference is the extraordinary richness of the amber assemblages (Rimantienė 2005; Piličiauskas 2016).

As two types of pottery were found it seems the archaeological material at Šventoji 26 is associated with at least two occupation phases. The first phase is reflected in the same pointed-based Narva ware well known at contemporary sites 1-4 and 6. The next type is similar to Combed ware that was certainly being produced during 3900-3700 cal BC in the southeast Baltic region although over a broader period. 14C dates from sites 23 and 26 lie outside the ‘Combed ware’ period, probably because of the small number of dates. Nevertheless, dates between...
3000-2500 cal BC may be considered reliable (Piličiauskas, Heron 2015; Piličiauskas 2016).

Many sites in the Šventoji area demonstrate significant chronological overlap within the range of 3000-2500 cal BC. Thus, over the long-term, sites 1-4, 6, 23 and 26 were inhabited at the same time. People may have moved from settlement to settlement every season or every few years, moving many times between the most suitable dwelling zones, e.g. between sites 6, 23 and 26. The east bank of the lagoon (sites 23 and 26) could have been used for winter camping rather than during the summer when fishermen tried to live as close as possible to the best fisheries. Yet, an alternative interpretation of the settlement system is possible. Fishing stations at sites 1-4 might have been used together with the habitation sites at Šventoji 23 or 26 and by the same community. Enormous numbers of fish bones and clear underrepresentation of vertebrae compared to bones from the head bear witness to the highly elaborated and specialized fishing activities at sites 1-4, at least during the Middle and the first part of the Late Neolithic (3200-2500 cal BC) (Piličiauskas 2016).

FAUNAL REMAINS AND SUBSISTENCE

About 2000 mammal bones, 1500 fish bones and 160 bird bones were found at the Šventoji sites. Zooarchaeological analyses of the bones were published in several publications, however, producing slightly different results (Stančikaitė et al. 2009; Daugnora 2000; Daugnora, Girkūnas 2004). The biggest numbers of animal bones were found at sites 3, 6 and 23 (Fig 2). Remains of seals (Phocidae) were most common among animal bones at all sites except for Šventoji 3. The number of seal bones varies from ca 30% (N=98) (Šventoji 3) to ca 79% (N=200) (Šventoji 2) of identified mammalian bones. Bones of four seals species – harp (Phoca groenlandica), harbour (Phoca vitulina), ringed (Phoca hispida) and grey seal (Halichoerus grypus) were found. Wild boar (Sus scrofa), elk (Alces alces), beaver (Castor fiber), aurochs/bison (Bos primigenius/Bison bonasus)1 were the most hunted animals, after the seal. Pike (Esox lucius), pike-perch (Sander lucioperca) and perch (Perca fluviatilis) were the most important fish species exploited. Mallard (Anas platyrhynchos) bones prevail among bird remains (Stančikaitė et al. 2009). The percentage of domestic animal bones differs in various publications, however, was very low and did not exceed 1% of the entire assemblage (if dog is excluded). Furthermore, 14C dating of domestic animal bones (a sheep tooth, a cattle tooth and a horse metatarsal bone with a spavin) revealed that these bones dated to modern times and were therefore intrusive (Stančikaitė et al. 2009; Piličiauskas 2016). This date suggests that the greatest share or even all domestic animal bones are modern admixtures within the Neolithic layers. Moreover, horse bones can be attributed to wild horses as well as to domestic ones. Concerning the subsistence activities at the Neolithic sites in the Šventoji area, archaeological

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1 Most bones identified to the species level belong to aurochs.
data, zooarchaeological materials, stable isotope analyses carried out on human bones and ‘foodcrusts’ as well as biomolecular investigations of ceramic contents all suggest fresh water fish were of the greatest significance in the diet of Šventoji people during the Middle and Late Neolithic (Piličiauskas, Heron 2015; Piličiauskas 2016; Stančikaitė et al. 2009).

RAW MATERIALS USED FOR MAKING ARTEFACTS

About 250 bone and antler items from the Šventoji Neolithic sites in the collections of the Lithuanian National Museum were studied by the authors. It was not possible to investigate artefacts actually exhibited in the museum exposition. Quite many bones and teeth among the find material showed no sign of deliberate manufacturing or use wear and therefore cannot be regarded as artefacts. There were 180 real artefacts among the researched finds. Animal species and skeletal elements were identified on the worked bone material although in the case of carefully finished objects it was not always possible to identify bones to the species level (Fig. 3).

The species whose bones were most often used for making tools was elk. It was possible to identify at least 40 worked elk bones, and most of the bones identified as ‘large herbivore’ presumably also came from elk. Most often, long bones were used, especially metacarpals and metatarsals. These skeletal elements are suitable for making artefacts because of their long and straight shape. It is noteworthy that elk antlers were only seldom used: only ten antler objects were present among identified material, some more are in the museum exposition; altogether 15 elk antler tools and antler pieces with working traces have been found. Elk incisors were used as pendants and 16 such incisor pendants were identified among the finds from Šventoji. Some elk teeth were broken and it is not possible to ascertain if these were also pendants.

Only a few bones from other large ungulates could be identified precisely. In five cases, bones of aurochs or bison were used, four of these objects were tooth pendants and one was a tibia. Some worked red deer (Cervus elaphus) bone – a radius and a metapodium – were also found.

Skeletal elements from wild boar were used in 14 cases, most being scrapers and pendants made from boar tusks and teeth. A few items were made from roe deer...
Close to the bone...

(Capreolus capreolus): bones (metapodials and tibiae) were used in four cases, one object was made from antler and some antler pieces with working traces on them were also among the finds. Some bird bones and teeth from mountain hare (Lepus timidus) have also been identified. Fox (Vulpes vulpes) ulnae were used as awls. A couple of brown bear (Ursus arctos) canines were found from site 23, but these were not perforated.

The choice of raw material for manufacturing bone tools was rather standardized. Elk long bones were preferred raw materials but antler was only seldom used. One particular type of bone tool – scrapers – were mostly made from seal bones. The tibiae of this seal species are big and the anatomical shape of the bone needs very little alteration to produce a scraper. Only one or both edges of the bone were sharpened for this purpose. Seal bones were most numerous among unworked faunal remains as well (Fig. 2), but almost only tibiae and canines from seal were selected to manufacture objects. The tooth-based pendants have mostly been made from the incisors and canines of certain species: elk, wild boar, aurochs/bison and seal. Incisors of mountain hare were also used, not as pendants, but apparently glued to pieces of leather, which has been preserved due to the waterlogged conditions.

The raw materials selected to manufacture the worked bone, antler and tooth finds from the Neolithic coastal sites of Loona and Naakamäe (Saaremaa Island, Estonia: Luik et al. 2011) are very similar to the osseous materials selected for making tools at the Šventoji settlements. Antler items were also rare at these sites. Among the elk bone based finds, metapodials were often preferred for making artefacts. Aurochs was only represented by some tooth pendants and a few long bones. Seal bones were also used for making artefacts at these sites, but scrapers made from tibiae have not been found there. Most of the tools made from seal bones comprised awls made from fibulae. Tooth pendants were made from different teeth of elk, seal, wild boar and aurochs although a few pendants from the canines of fox, dog and mustelidae were also found. The number of artefacts made from bird bones (mostly Anseriformes and Anatidae species) is somewhat greater at the sites in Saaremaa. Bird long bones were mostly used to produce tubular beads and pendants although sometimes awls were made from bird bones there. In a few cases, the bones of wild boar and fox were used (Luik et al. 2011). Presumably the subsistence strategies at all these coastal settlements were quite similar and this is reflected in the exploitation of animal bones for making tools as well.

TOOL TYPES AND FUNCTIONS

What kinds of activities are reflected by the bone and antler tools found from Šventoji? The absence of large heavy-duty antler tools (axes, adzes, hammers) among osseous artefacts from the Šventoji sites is noteworthy. Only stone axes and adzes are found at Šventoji (Rimantié 2005, fig. 76:1; 84; 101 etc.). Heavy-duty antler tools have not been found at the Neolithic coastal sites of Loona and Naakamäe either (Luik et al. 2011) although such tools are more common at some earlier sites on the Lithuanian coast, e.g. the Late Mesolithic site of Smelté and the Early Neolithic site of Palanga (Piličiauskas et al. 2015: figs. 7, 11). Some large antler items may still be found in
assemblages. Rimantienė, who lead the investigations at Šventoji, has interpreted some of the worked antlers as an ard point and shovels (Rimantienė 2005: 139, figs. 61; 171:10; 273), but such functions for these antler finds has not been verified so far. Although the earlier investigators of Šventoji were anxious to find proof of farming at these sites suppositions have not yet been confirmed. Some of the above-mentioned large antler objects may simply be waste from antler working; some tines were removed from the antler rack and were probably used for manufacturing a variety of tools.

The only bevel-edged antler tool was found in the site alluvium deposits in the bed of an ancient (Bronze Age) paleo-river during the archaeological excavations in 2012. The handle of the tool made from a hazel tree was dated to the Bronze Age – 1511-1446 cal BC (Poz-65433, 3220±30 BP) (Fig. 4). It seems likely that cuts on the proximal end of the tool were made with a metal tool.

An enigmatic elk antler tool was found at site 6. One edge is wavy and a groove is incised into it, probably for inserting small flint blades. A row of irregular hollows were hollowed into the opposite side of the tool, the function of these hollows is unknown (Fig. 5:1; Rimantiene 2005, fig. 275). The function of one other elk antler tool is also not known. This tool is made from an antler tine where the tip was sharpened to a point: one side is faceted and the other has been ground on stone. The spongiosa of the antler was hollowed out and an oval hole carved into the concave side of the tine (Fig. 5:2; Rimantiene 2005, fig. 170:1). A quite similar tool was found at the Aeneolithic site of Berești 'Dealul Bulgarului', Romania. It is called an 'unfinished mattock', presumably because of the hole that does not extend through the tool (Beldiman et al. 2012: 94, pl. 19). But at least in the case of the antler tool from Šventoji, there was never an intention of making a hole that penetrated the object.

Antler tools come only from those sites where the number of tools made from osseous materials is larger, something which can be expected given the small number of antler objects. The only antler artefacts from site 3 are two rods with elk heads which will be discussed in more detail below. Some antler objects are known from site 4, most of which are made from elk antler: a large antler tine, a whole antler from which one tine is removed, the above-mentioned tool made from antler tine (Fig. 5:2) and a harpoon head with two barbs (Fig. 6:1). One awl was made from roe deer antler. Four antler pieces come from site 23 comprising an antler point and some fragments with working traces, two of which are from elk antler and one fragment from roe deer antler. Antler objects are most numerous at site 6 where altogether eleven tools and fragments with working traces came to light. Nine of these objects were made from elk antler and two from roe deer antler. Artefacts include the above-mentioned tool with groove and hollows (Fig. 5:1) and an antler tine which may have been a punch used in flint working (cf. Vitezović 2013, 269, figs. 6-7) although verification of this function awaits formal functional research. A thin tool with an oval working end (Fig. 5:3) has a similar shape as burnishing tools which usually were made from ribs and were used for several kinds of tasks (Tóth 2013: 160, fig. 15.3). Two items have been called 'shovels' (Rimantiene 2005: fig. 273) but it seems more likely that these objects are rather just antler beams from which the tines have been removed. The remaining objects are antler pieces with various working traces on their surfaces.

Several tool types were made from bone. Among possible hunting tools and weapons, barred harpoon heads

Fig. 6. Antler (1) and bone (2-4) harpoon heads. 1 elk antler, 2 elk metacarpus, 3-4 large ungulate long bone.

Fig. 7. Bone tools from Šventoji: spearhead (1), scrapers (2-3), awls (4-9). 1, 6 large ungulate long bone, 2-3 harp seal tibia, 4 bird humerus, 5 red deer metapodium, 7 roe deer tibia, 8 seal metapodium, 9 elk metapodium.
likely used for seal hunting should be mentioned as well as a few spear- and arrowheads (Fig. 6:2-4; 7:1; Rimantienė 2005, figs. 30, 123 etc.). At least three left side seals scapulae with holes, probably caused by harpoons, were found in the general faunal assemblages from the Šventoji sites (Fig. 8). The character of injuries shows how animals were hunted – tools were thrown right into the heart area thus breaking the scapula in the process.

The greatest share of bone tools were connected to hide and leather working, fiber or bast processing or bark peeling. Presumably, the sharp bevelled-edged scrapers made from seal tibiae were used for cleaning the hides (Fig. 7:2-3; Rimantienė 2005: fig. 42:1; 123:4 etc.). Various awls and points were probably multi-used tools, e.g. for hide and bark working and basketry making (Fig. 7:4-9; Rimantienė 2005: figs. 42:3-9; 123:11-13 etc.). These tools are not standardized: awls and points in different sizes are known made from the bones of several species and skeletal elements. Simple, opportunistically chosen ad hoc points with sharp tips were also used as awls. Some points could have been used as weaving tools for making mats, fishing nets and baskets which are common finds at the Šventoji sites since the soil conditions there are favorable for preservation of organic materials (Rimantienė 2005: 65-67, 98-99, figs. 32, 115 etc.). Wild boar tusks may also be used as tools (Rimantienė 2005: fig. 274:10-11). Usually swine tusks were not worked with their naturally sharp edges being used as ad hoc scrapers. Sometimes longitudinally split tusks were also used. Wild boar tusks may have been used for scraping the surface of wooden items and split tusks for cutting and scraping bark for making containers (Maigrot 2005, 115, figs. 2:4-6; 3:2-3).

Comparing the distribution of these tools from different sites in the Šventoji area it turns out that harpoon heads, scrapers, awls and points have been found at most of the sites, although, of course, they are more numerous at the sites with larger numbers of bone items. However, some differences in tool distribution can be observed (Fig. 9). The largest numbers of tooth pendants (ca 44%, N=34) came from sites 23 and 26. No harpoon heads and very few seal tibia scrapers were found at these sites. Sites 1-4 are quite similar to site 6 in terms of the types of tools found there. The number of tooth pendants was lower at these sites although scrapers constitute ca 9% (N=4) of all bone tools and at site 6 even ca 24% (N=13). The biggest share of seal bones was also found at this site. Harpoon heads were most numerous at sites 1-4. Differences between the sites may be explained by their different functions. Sites 1-4 and 6 may be considered fishing stations and fish-processing refuse zones instead of dwelling ar-

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**Fig. 8.** Left scapula of harp seal from Šventoji 4 site with healed trauma and deadly injury probably caused by harpoon.

**Fig. 9.** Composition of bone tools at the sites of Šventoji.
Site 6 might have had pile dwellings as well, and sites 23 and 26 were dry ground habitation sites. Moreover, four fragments of human skulls (from four individuals) were found at site 23 and a few human bone fragments were recovered from site 26. Both the human bone fragments as well as some tooth pendants may originate from destroyed graves (Piličiauskas 2016).

Tooth pendants, probably attached to the costume or headdresses, are quite numerous at Šventoji sites (Fig. 10; Rimantienė 2005: 105-107, fig. 47). In addition to their function as ornaments, such pendants may have had additional meanings connected with social identities, protective magic or some other beliefs (Lõugas, Zagorska 2001; Larsson 2006; Jonuks 2009, 111 ff.). Although some differences are observable in the spread of pendants at specific sites it is not possible to draw any conclusions about the preference for some species since the number of finds at some sites is very modest. In general, the same species were used at all sites. Site 23 is significant because of the large number of tooth pendants found there. The presence of ornaments made from the teeth of several species is also characteristic of other Neolithic sites (e.g. Lõugas, Zagorska 2001: table 1; Larsson 2006: 274; Kriiska et al. 2007: figs. 8-10; Jonuks 2009: 116; Luik et al. 2011: fig. 12). Unusual finds comprise mountain hare teeth glued to a piece of leather (Fig. 10:5), which are not yet identified at any other sites although they have been found at the three Šventoji sites of 4, 6 and 23. A triangular piece was cut out from one elk incisor from site 23, but the root of this tooth was not perforated (Fig.10:2). Some elk and aurochs teeth with similar triangular cuts are known from the Estonian Neolithic sites of Tamula and Naakamäe (Kriiska et al. 2007: fig. 8; Luik et al. 2011: fig. 12:14). A triangular piece with two holes cut from a wild boar tusk was found at site 1 (Rimantienė 2005, fig. 123:14). Similar
triangular wild boar tusk plates have also been found at the site of Loona (Luik et al. 2011, fig. 12:10).

In addition to tooth pendants there are a very few artefacts that can be connected with cult or religion. These objects include three rods with carved elk heads: two larger rods were made from elk antler and a third, smaller rod was carved from a rib (Fig. 11; Rimantienė 2005: 100-102, figs. 44; 170:2 etc.; Iršenas 2000: figs. 3-5; 2010, 175-177, fig. 1:4-6; Kashina, Zhulnikov 2011: 20-21, fig. 3:7). Both large antler rods come from site 3 and the small rib-based rod from site 4. Such rods are also found at the Neolithic site of Kretuonas in eastern Lithuania, at Zvejnieki in Latvia, at Riigiküla and Villa in Estonia as well as at several sites in Finland, Karelia and Russia (Iršenas 2000: figs. 6-8; 2010: 175-177, fig. 1; Jonuks 2009: 107-108; Kashina, Zhulnikov 2011: figs. 1-3). The possible meaning of these rods and also the significance of the elk in Mesolithic and Neolithic culture and religion in Scandinavia, eastern Baltic region and the forest zone of Russia have recently been discussed in several publications (Bolin 2000; Iršenas 2000; Jonuks 2009; Kashina, Zhulnikov 2011). A harpoon head with circle and dot decoration (Fig. 12:1), found at site 6 was also mentioned as a kind of ritual object (Rimantienė 2005: 115-117, fig. 52), its decoration, which is unusual in the Neolithic context of the eastern Baltic region, will be discussed below.

**BONE WORKING METHODS**

Several bone working methods, most of which were used both in the Mesolithic and Neolithic periods (David 2007, 2014; Christidou 2005; Maigrot 2005; Diakowska 2011; Pratsch 2011; Vitezović 2011, 2013; Tóth 2013; Treuillot 2013) could be observed on the bone and antler tools from the Šventoji sites.

The main method for splitting bones at Šventoji was grooving: a longitudinal groove was cut into the diaphysis of long bone with a flint tool and then the bone was split (Fig. 13:5-6; Christidou 2005: 93-94, fig. 4; Treuillot 2013: fig. 3; David 2014: 41-42, 75). A groove incised into the bone is visible at the edge of longitudinally split bones, sometimes the groove was not deep enough in some places and the line of the fracture does not exactly follow the direction of the cut (Fig. 13:5; Christidou 2005: 94, 97, figs. 2, 10). Fracturing bone was also used, e.g. breaking by direct percussion, characterized by a puncture cavity near the break (Fig. 13:1-2; David 2004: 116-117). Some longitudinal blanks have been produced by breaking by direct or indirect percussion techniques on the lateral side of metapodials (Fig. 13:3; Treuillot 2013: 147-149, fig. 2). The groove and truncated breaking method was used for segmenting antler (Fig. 13:4; David 2007: fig. 6; 2014: 125). The surface of bone and antler was scraped using a flint tool (Fig. 14:1-2; David 2014: 58; Treuillot 2013: fig. 6) or ground on stone (Fig. 14:3-4; David 2014: 60). In a few cases, the chatter-marks left by a working blade skipping over the surface of the cortical bone are visible on bone artefacts (Fig. 14:5).

Holes were made in bone objects, mostly tooth pendants (Fig. 10) but also into harpoon heads. Holes usually have a double-conical shape, i.e. they have been bored from two sides with a sharp tipped flint tool (David 2014: 83, 85, 185). Three different hole versions could be observed in the tooth pendants from the Šventoji area: (1) first a concavity was cut into the root part of the tooth and then the hole was bored into the middle of this cavity; (2) the root part made thinner by scraping it smoother on two sides and then the hole was bored; (3) the root was not worked before the hole was bored. At present, it is not known if these differences might reflect some chronological differences or just represent different preferences of the persons who made these objects. The hole of the antler tine tool with the ground tip was made using the nicking technique (Fig. 5:2; David 2014: 101, 110).

Only a few bone artefacts are decorated. Decorating was more common for amber objects (Rimantienė 2005: figs. 64, 107:1, 5), since amber was mostly used for ornaments. Some diagonal lines were incised into an elk metapodium (Fig. 14:6). Decorating bone items with simple incised motifs was a common method both in the Mesolithic and Neolithic periods (Indreko 1931: figs. 31, 34, 36; Vankina 1999: pls. IV, XXIX, XLVI-XLVII; Bitner-Wróblewska 2007: figs. 240-245; Treuillot 2013: fig. 8d; David 2014: 51-54). Small transverse notches are visible on some bone objects (Fig. 14:7), but it is not clear if these were meant to be decoration or rather had some other meaning. Similar small notches are cut into some bone and antler artefacts found e.g. from Zamostye in Russia (Lozovskaya, Lozovsky 2013: 107, figs. 4:14, 13:1, 15), from Pärnu River in Estonia (Indreko 1931: figs. 33, 35) and from Lake Lubāna in Latvia (Vankina 1999: pls. XXXIII:1-2, XLVIII:10 etc.).

A harpoon head was decorated with circle and dot ornaments and an elk metatarsus was decorated with pentagonal and hexagonal motifs cut around the central dot, imitating a circle and dot decoration, both objects come from site 6 (Figs. 12, 14:8; Rimantienė 2005: figs. 52, 276:1-2). Probably the harpoon head with circle and dot decoration was not locally made and someone without the necessary tool, skills and knowledge has tried to copy such decoration on elk metatarsal bone. Is similar decoration also known at other Neolithic sites in the eastern Baltic region? The antler axe-shaped tool decorated with circles and dots was found in the Pärnu River and was discussed by Richard Indreko in an article about decoration on Estonian Stone Age bone tools (Indreko 1931: 61-66, fig. 29; Rimantienė 2005: 116). Probably Indreko dated this axe to the Stone Age because of the many Mesolithic and Neolithic bone and antler tools that were found in the Pärnu River. However, he was not quite sure about the dating of the decorated antler ‘axe’ and supposed that it might also date to some later peri-
Fig. 13. Bones dissected by direct breaking (1-2), longitudinally split bone (3), antler dissected by the groove and truncated breaking (4) and bones dissected by grooving (5-6). 1 elk radius, 2 harp seal tibia, 3 roe deer metatarsus, 4 elk antler, 5 elk metatarsus, 6 elk metacarpus.

Fig. 14. Worked and decorated bones and antler from Šventoji: pieces with scraping traces (1-2), tool tips ground on stone (3-4), chatter-marks on a spearhead (5), incised lines (6), small transverse notches (7), imitations of dots-and-circles (8). 1, 4 elk antler, 2 harp seal tibia, 3, 8 elk metatarsus, 5, 7 large ungulate long bone, 6 elk metapodium.
od, e.g. the Bronze Age or Early Iron Age (Indreko 1931: 65-66). The shape of the ‘axe’ from the Pärnu River is still quite different from Bronze Age burr and beam tools and according on the shape it belongs more likely to much later period: similar ‘axes’ are found from the medieval contexts (Paulsen 1956: 52-59, figs. 19-22). A dagger decorated with oblique lines and circles and dots found in Lake Lubāna in Latvia is also considered to be Neolithic (Vankina 1999: 117, pl. XLVII:11; Rimantienė 2005: 116), but as it is a stray find from the lake the dating remains uncertain. Artefacts with analogies to both the Mesolithic, Neolithic and Bronze Age types have been found in Lake Lubāna (Vankina 1999: 23). The motifs comprised of concentric circles were known in the Neolithic Period on other kinds of finds such as decoration used e.g. on the Grooved Ware ceramic vessels and in the art of the passage tombs in the British Neolithic (Thomas 1996: 156, fig. 6.7). However, the circle and dot motif has not been found on bone-based Neolithic tools elsewhere in Europe. Several red deer antler axes found from Denmark, Germany and Hungary were decorated with circles and dots, but these axes belong to the Bronze Age (Lange 1926; Indreko 1931: 62-66; Schrickel 2012). This ornament was used also on other types of artefacts in the Bronze Age, e.g. on antler discs, horse bridles and whip handles in Central Europe (e.g. Kimmig 1992: pl. 21-22; Kristiansen, Larsson 2005: figs. 78-79; Choyke 2005, pl. V:8; 2010, fig. 18.11.9; Sofær et al. 2013: 484, fig. 26.5) and on bone pins in eastern Latvia and Byelorussia (Bitner-Wróblewska 2007: fig. 345; Egreitienko 2008: fig. 2). A compass-like metal tool or center-bit was used for making circle and dot decoration (MacGregor 1985: 60-61). It is possible that the harpoon head from Šventoji comes from a region where metal tools were already known. However, making of circles and dots ornament with stone tools in the Neolithic period cannot be excluded, which is demonstrated by the experiments made with Paleolithic stone tools (Tomenchuk, Stork 1997). Nevertheless, such ornamentation was probably not known in the Šventoji area as hinted at by the piece of bone that was found on which someone tried to imitate circles and dots decoration on its surface.

One of the rods with an elk head carving is also decorated (Fig. 11; Iršenas 2000: figs. 4-5; Rimantienė 2005: fig. 220). This item is carved very skillfully and is ornamented with lines and oval notches incised under the chin of the elk head. The eyes and nostrils of the elk are carved in relief, its teeth are marked with small notches and a grid of thin lines is engraved on the animal’s ears and snout. This elk head is carved very naturalistically, the other two examples are more schematic (Rimantienė 2005: figs. 170.2, 218). The other elk head from elk antler was not manufactured so skillfully and perhaps it is not even finished. The third example, made from elk rib is much smaller and planar. It may also be possible that the skillfully carved elk head was brought from outside the area and the other heads represent imitations made on spot.

SUMMARY

In this paper we have presented the results of research into raw material identification, bone working methods and functions of artefacts at the Neolithic sites in the region of Šventoji in Lithuania. Some degree of standardization in the choice of raw materials is characteristic of the Neolithic bone tools from the Šventoji area. The long bones of elk were used most often but elk antler artefacts are few. Mostly, one type of tool – tibia scrapers – was made from seal bones. Seals were generally the animals that were most often hunted at the Šventoji sites. The absence of heavy-duty antler tools is also remarkable and this phenomenon distinguishes the sites of Šventoji from other, earlier sites on the Lithuanian coast: the Late Mesolithic site of Smeltė and the Early Neolithic site of Palanga. The greatest share of the bone tools that came to light seem to be connected with hide and leather working, basketry making, fibre processing and textile working (awls and scrapers) and with marine mammal hunting (harpoon heads). Artefacts connected with cult and religion or expressing social identities are also represented among the bone objects from Šventoji. Most of these objects comprise pendants made from animal teeth as well as three rods with elk heads should also be mentioned. Several bone working techniques were used, e.g. grooving, splitting, controlled fracturing, scraping, grinding, boring, and incising. Only a few decorated artefacts have been found at Šventoji. Bone tools from the sites of Šventoji are characteristic of the coastal Neolithic sites on the eastern shore of the Baltic Sea where marine mammal hunting was an important occupation although fresh-water fishing and land mammal hunting were practiced as well. Differences in the frequencies of tool types found at various sites of Šventoji may be explained by the different ways these settlements were used.

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A CONTRIBUTION TO THE STUDY OF MEDIEVAL BONE INDUSTRY: BONE AND ANTLER OBJECTS FROM THE SITE OF PONTES – TRAJAN’S BRIDGE (9TH–11TH CENTURY)

Vesna Manojlović-Nikolić

Abstract: Archaeological excavations of the Roman site of Pontes – Trajan’s Bridge, in the village of Kostol (near Kladovo), were carried out from 1979 to 1991. A part of a Slav settlement was discovered inside the walls of the Roman fortress, including semi recessed houses, furnaces and pits. According to the stratigraphical data, its architecture and archaeological finds are dated to the period between the 9th and the 11th century. Among numerous archaeological finds special attention was paid to bone and antler objects. More than 200 objects were found: various tools, decorative and gaming objects, combs and semi finished items. The objects’ types suggest that they were not produced in a crafts centre but in the settlement itself. The most interesting items are numerous astragals. The majority of bone and antler objects were used for everyday jobs. All of these activities were practiced within homesteads. According to osteological analyses, sheep and goat bones were used (pig bones only exceptionally), as well as deer antlers. This suggests that besides agriculture, which was the main occupation of the population, husbandry and hunting had an important role in the economy of the settlement.

INTRODUCTION

The archaeological site of Pontes – Trajan’s Bridge is located on the right bank of the Danube in the village of Kostol, some 5 km downstream from Kladovo. Archaeological excavations were carried out here from 1979 to 1991 as part of a project that included rescue research of the cultural heritage jeopardized by the construction of the hydroelectric power plant Djerdap II. The Roman fortress of Pontes had been built approximately in the same period as the fortress of Drobeta (today: Turn Severin in Romania) with the goal of protecting the famous Roman bridge that had been constructed between the First and the Second Dacian War (101/102−105/106) by the famous Roman architect Apollodorus of Damascus. Archaeological excavations uncovered several phases in the construction and reconstruction of the fortress as well as some parts of the Late Roman fortification (Гарашић и др. 1980: 23; Ibid 1984: 44-47). After abandoning the older settlement, population made use of the fortress and built their homes inside it. A great number of orbicular or pear shaped furnaces were found outside the fortress, which were built at the same period. All of them had calottes made of earth or stone. Those furnaces are dated into the 11th century and it is considered that they were used by the population that lived in the settlement inside the fortress (Гарашић и др. 1984: 46). Some parts of the northern slope of the Danube were used for burials in the period from the 9th to the 12th century (Ibid: 46-47).

The main subject of this paper is the research conducted inside the fortification. The medieval settlement discovered there was dated into the end of the 8th – beginning of the 9th century on the basis of stratigraphy, architectural characteristics and archaeological material. According to the data obtained from literature and the analyses of excavations reports and archaeological material as well, we can single out three habitation levels: a) from the end of the 8th to the mid 9th century; b) from the
Bone and antler objects abound in the archaeological material from medieval levels of this site. Bone and antler as raw materials are in use since the oldest periods of prehistoric times. Gorgeous items made of bone or antler are present even in the Paleolithic art. Working on bone and antler reached its peak during the Roman period, while this industry later became reduced to producing objects for everyday use only, especially during the period from the 9th to the 11th century (Марјановић-Вујовић 1985: 192; 1986: 160; 1987: 117-119).

Objects analyzed in this article are mostly made of long bones, sheep or goat, as well as dear antler, and rarely of roebuck antler and ox or pig bones. Bone material that was fit to be worked upon was obtained from animals that were hunted down/killed or those that died of natural causes. Bones that did not require complicated processing were usually selected. We are often able to notice such traces that are consequences of body dismemberment or detachment of particular bones. Technology of bone and antler working is very similar to wood processing: same tools are used and processing includes cutting, slicing, scraping, polishing, carving, boring etc.

BONE AND ANTLER OBJECT TYPES

The analysis of medieval layers formed upon the Roman settlement gives us significant data about the beginning and the lifespan of the settlement, as well as the construction of houses and organization of the settlement. Among the abundant archaeological material, special attention is paid to bone and antler objects that were found in all strata − in houses, pits or outside them, in total 202 items (Манојловић 1996). Bone and antler objects are usually classified into two main groups. The first one encompasses tools, while the second group consists of objects used for various activities in everyday life, some of them decorated with very simple ornaments (Hrubý 1958: 118−218; Торев 1963: 83−93; Slivka 1984: 377-416; Becker 1989: 104−142). The largest number of objects analyzed are various types of tools and astragals, while the remaining part consists of handles, functionally associated with tools and combs.

Tools

Durability and unchangeable function of some tool types made them the most common in our material. The most frequent are different types of awls, mostly made of sheep or goat tibia, and conical pointed tools − punches made of deer antler, 78 items in total. The making of such tools was simple − only one bone end was cut sideways and additionally polished. The opposite end usually retained its anatomical shape and was used as a handle. Sometimes it was cut flat so that it would be convenient to fix a wooden shaft on it (Fig. 1: 1−5). Antler peaks have more or less sharply pointed top while the opposite end is flattened (Fig. 1: 6, 7).

Both awls and punches belong to the oldest tool types and their shape, working and function remained the same from prehistoric times up to the medieval period. Their simple manufacturing and wide use in everyday life, e.g. for skin processing (extending and fastening to the pad), making and fixing drift nets and pottery decorating, made them the most numerous among the bone and antler objects found.

The natural shape of the larger end of antlers makes them convenient for tools since they require minimal intervention or none whatsoever (Fig. 2). Their tops are polished with use. Based on the way the opposite end was worked upon, we can differentiate two variables: a) items with filled cross-section that could be used as plant tools, and b) items that have a hole for fixing another tool implant into it. Some examples have holes on both sides (Fig. 2: 4), which indicates that they were hung by waistbelts; however, some authors suggest that they had a symbolic meaning (Атанасов 1987: 109−110).

Handles, 19 of them in total, although not tools themselves, are functionally connected with tools. They usually made part of knives of different lengths. Bone and antler handles are equally represented. Bone items are cylindrical in shape and either carefully or just partly polished on the outside (Fig. 3: 1, 2), while handles made of tubular
Bones are different in shape (Fig. 3: 3, 4). The handles – sheeting, mostly fragmented except in one case, are very rare (Fig. 3: 5). Richly decorated handles, such as the one from the site of Veliki Gradac, are exceptionally rare finds on medieval sites dating from the 9th to the 11th century (Janković 1981: 36). They are, however, common in archaeological material from Bulgaria and Romania dating from the same period (Тотев 1963: 88−89, Обр. 3−6; Barnea 1967: 86−94, Fig. 44−48).

Only two bone whorls (one discoid and one cup-shaped) as well as one needle (Fig. 4) suggest that whorls were made of clay and needles of wood. A greater number of bone needles found at the site of Popovica – Buljino Gnezdo speaks in favour of the assumption that some kind of a tailors’ workshop existed there (Жеравица 1979: 201−211).

Combs
Combs belong to personal objects and are represented with only six fragmented items made of antler (Fig. 5). This type of combs i.e. the composite comb is known since the Late Roman period (Petković 1995: 21−22, 109−110) and the same construction scheme remained in the medieval period as well (Манојловић-Николић 2007: 150). Items from Pontes – Trajan’s Bridge do not have the usual decoration – simple carved short and slanting lines – that were common in that period, for example on the comb from Belgrade Fortress, dated into the 10–11th century (Марјановић-Вујовић 1975: 287−289). This type of composite comb with or without decoration was widespread during the period from the 9th to the 11th century in Germany, Poland, Bohemia, Slovakia, Russia (Манојловић-Николић 2012a: 34−35). According to the typology of medieval combs from Great Britain and Northern Europe, our combs correspond to the type 12, dated into the 6–9th century (Ashby 2010: 7).

Astragals
Almost one hundred (99 in total) astragals were found at the site of Pontes – Trajan’s Bridge in medieval layers and houses and pits as well. Most of them are made of deer bones, 90 items in total, while 8 are made of sheep, goat or ox bones and only one of pig bones (Манојловић 1996: 87−100, cat. no. 226−324).

Astragals of smaller animals’ bones were used for a widespread game, named jacks, which was played mostly
by children. This is confirmed by the fact that they were found in necropoles and usually as grave offering in children graves (Marjanović-Vujović 1972: 149–160). According to archaeological data, we can trace such objects back to the La Tène period. During the Greek and Roman periods there were various games that required common jackstones, pebbles, tokens, bone, antler or wooden dice and astragals. Literary sources are almost nonexistent in the period leading to the Middle Ages, and even archaeological information is insufficient. However, ethnographic researches testify that some of these games have endured until today, especially among the cattle-raising population in Romania, Macedonia and Albania, but in a slightly changed form (Lovretić 1907: 75; Capidan 1934: 214).

Special attention should be given to the great number of deer astragals. Certainly, they could not have been used as jacks in games because of their size. Astragals carved with various combinations of lines represent a sort of a puzzle for the researchers. If we pay attention only to the ornaments, which are always carved in and almost rectilinear, we can notice that the most common combination is that of horizontal and vertical lines. On the basis of this fact we can single out several variations: astragals decorated with intersect lines, not always perpendicularly, reminding us of a chessboard; (Fig. 6: 1–3); similar to those are astragals with slanting lines that cross each other, thus forming rhomb fields (Fig. 6: 4–6); astragals with carved horizontal lines that are intersect with one or two vertical lines (Fig. 6: 7–12); astragals with horizontal lines only (Fig. 7: 1, 2); astragals with cross-shaped lines (Fig. 7: 3); astragals with ornaments in two zones, which thus cover the entire convex side of an object (Fig. 7: 4–6); astragals with short, divergently carved lines (Fig. 7: 7–9).

It is possible that carved lines represent a marking system for astragals used in gaming, similarly to dice with four static sides that were used during the Greek and Roman periods. In that game each side had a certain value and this fact can be linked to astragals which also have four static sides (Manojlović-Nikolić 2003: 274). For
the time being, there are no objects found in Serbia that can be identified — without a trace of doubt — as being used in hazard games. The lack of gaming dice and tokens from our medieval sites might be explained by the nature of material they were made of — which was probably wood. A literary source provides some very important data, mentioning that the church had forbidden gaming. This was written down by Bulgarian Presbyter Cosmas in the 10th century (Тотев 1972: 35-36). That prohibition mostly concerned the clergy, but all the faithful as well. Likewise, St. Peter’s and St. Paul’s regulations given in St. Sava’s Nomocanon explicitly condemn all hazard games (Петровић 1991: 59а−61а).

All previous observations about the systems and different variations of marking were not helpful in solving the problem concerning the purpose of deer astragals. Having in mind their size, it is obvious that they were not used as jacks. This leads us to take into consideration other possible aspects of their usage — namely, their usage for divination and augury. This idea was suggested by M. M. Vasić in his article about divination in Neolithic Vinča. He describes slanting and transverse lines carved onto pieces of rock crystals, as well as their combinations that form rhomboid fields. Those carved lines are always on one side, same as on our astragals, while the opposite side has no ornaments (Васић 1956: 30−31, сл. 1−4). In search of a solution to the mystery of those rock crystals, M. M. Vasić suggested that sounds coming from pebbles falling into the dish in divination rituals at the Delphi oracle were the same as in Neolithic auguries (Ibid: 29). Although this note concerns prehistoric times, we may assume that our astragals have the same function, especially if we have in mind that divination and augury remained almost unchanged up to today, as a conservative way of spiritual expression. During the last few years we have increasing interest for astragals belonging to all periods of human history (Dandoy 2006: 131–137). However, they remain a riddle for scientists except in such cases when we can be certain that they were used as jacks.⁴

The archaeological context in which our deer astragals were found did not allow us to form any conclusions about their usage. They are dated to the period from the 9th to the 11th century, same as the rest of the archaeological material found, and therefore this fact does not help us solve the problem of astragals’ function. However, the fact that they were found in pits, houses and layers together with the rest of archaeological finds suggests that they had not been put away to any special places. This might be expected for objects that were used, as presumed, for games or for divination and augury. Although this is a far cry from final conclusions, we hope that even hypotheses can contribute to the further resolution of this problem. In favor of this theory, we will cite contemporary data:

Fig. 7. Deer bone astragals with line-incisions.

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⁴ J. Dandoy cites in one of his latest articles concerning the use of astragals during various periods that they were used in different games, depending on the period, with special interest shown in the usage for divination and augury (Dandoy 2006: 131–137).
children in Brazil use astragals and other animal bones in their games even today and that is an indubitable evidence on the continuity of astragal usage (Salgado 1990: Fig. 123).

**DISCUSSION AND CONCLUSION**

The presented analysis of bone and antler objects shows just one segment of medieval economy at Pontes – Trajan's Bridge during the period from the 9th to the 11th century. The modest repertoire of tools, in which awls prevail, suggests that they were in use for series of everyday jobs such as skin working, pottery decoration, making of fishing nets etc. All mentioned jobs were performed as household activities. Thus, the most necessary objects were produced within the settlement and the choice of raw materials, uncomplicated making of the tools and their functionality are a reflection of such economy. The bone and antler finds suggest that apart from agriculture, which was the main occupation of the inhabitants, husbandry and hunting had an important role in the economy of the medieval settlement at Pontes – Trajan's Bridge as well. In this context, the large number of deer astragals found among the archaeological material is somewhat puzzling. The possibility that they were used for games and especially the idea that they were used for divination and augury made them very interesting and the mystery of their function remains unsolved.

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INTRODUCTION

The use of the valves for a usage purpose seems to be connected by two human types, previous to Homo sapiens, namely Homo erectus in Sangiran (Choi and Driwan-toro 2007) and the Neanderthal man, as shown by a series of discoveries on Italy (Douka 2011) or Greece territory (Darlas and de Lumley 1999). The adornments obtained from bivalves are attested later, in Aurignacian environment, being obviously associated to modern man (Van- haeren and d'Errico 2006, Alvarez Fernandez and Žor- is 2008).

The valve of Unio seems to have been used for the first time with the intention to be processed, at the level of the cultures Precris and Starčevo-Criş, in settlements identified on Romania’s territory (Beldiman and Sztan- ccs 2009, 2013). Its usage doesn’t seem to be extend- ed, though, in the entire areal Starčevo-Criş (Vitezović 2012). The species begins to be better represented, in its processed form, at the Eneolithic level, namely at the communities from the areal Gumelniţa, but also at the neighboring one, belonging to Ariuşd-Cucuteni culture - in the sites from Izvoare, Frumuşica, Scânteia, Ruginoasa and Fulgeriş (Țurcanu 2013), and also at Ariuşd (Sztanccs and Beldiman 2014). In these cases we are referring at the production of circular beads. A pendant confectioned from valve of Unio was identified in an environment Stoicani-Aldeni, at Suceveni – Stoborăni (Galaţi County) (Beldiman et al. 2012). In more remote spaces, the Unio valves adornments were identified in the fa- mous sites from Çatalhöyük (Bar-Yosef Mayer 2013), Sitagroi (Nikolaïdou 2003), Dispilio (Ifantidis 2004, 2005) or Mureybet (Maréchal and Alarashi 2008), but we were not able to identify the presence of these types of adornments in the West European area. The place of the Unio valve seems to have been taken by the valves from the Cardiidae family, also transformed in circular beads (Ricou and Esnard 2000, Bonnardin 2009).

Processed valves of Unio with an utilitarian purpose are also mentioned at Poduri Dealu-Ghindaru – Cucu- teni A phase (Bâlăşescu and Radu 2004), but also in more remote regions, for instance in Greece (5700-5300 BC), at Platia Magoula Zarkou (Becker 1999), at Çatalhöyük (Bar-Yosef Mayer 2013) or, for another species, at Su Coddu (Sardinia) (3500-2900 BC) (Manca 2014). More- over, Unio valves, with a seratted aspect appear in a se- ries of Mesolithic and Neolithic sites on France’s territory (Courtin and Vige 1987), in opposition with the adorn- ments made from the same valve, which are not present in this space.
The Eneolithic communities of the Kodjadermen- Gelmelnita-Karanovo VI cultural complex have witnessed considerable geographic expansion over south-eastern Europe (from the Carpathian Mountains to the Aegean Sea), during a period of time between 4600/4500 and 3500 cal BC (Bréhard and Bălăşescu 2012). They are characterised more particularly by the presence of tell settlements, sometimes surrounded by defensive structures such as ditches and embankments, others by palisades, with dwellings disposed in parallel rows (Petrescu Dimboviţa 2001, Popovici 2010, Ştefan 2010). For the Gumelniţa culture, houses with simple clay floors are the most common dwelling structure, while those with floors made of logs covered by a layer of plastered clay are rare (Popovici 2010).

We must consider the fact that as food resource, the gathering of bivalves had an important weight in the economy of the Gumelniţa communities located close to the Danube River. Thus, in the Hârşova-tell settlement (Constanţa County), the percentages of the distribution of the faunal remains indicate 4.79% for Bivalvia (Bălăşescu et al. 2005: table no. 44), while in the Borduşani-Popină settlement, they indicate 20.30% for Bivalvia (Bălăşescu et al. 2005: table no. 39). Moreover, in the Hârşova-tell settlement a very large amount of remains testifying to the gathering of bivalves (500 kg) was highlighted, especially destined for the celebrating of distinct rituals (Bălăşescu et al. 2005: 239).

From the levels of Gumelniţa culture, come also valves of the *Unio* sp. processed to be made into personal adornments but also into utilitarian tools. The processing of the valves of *Unio* sp is attested in numerous settlements from the southern Romania: Hârşova-tell (Mărgărit and Popovici 2012), Borduşani-Popină, Sultana – Malu Roşu, Măriuţa-tell (Mărgărit et al. 2014), Vităneşti, Luncaviţa (Bălăşescu et al. 2005) or Pietrele (Berciu 1956, Hansen et al. 2008).

**RAW MATERIAL**

*Unio* is a freshwater bivalve whose body is totally protected by two calcareous valves, with an elongated-elliptic morphology, similar as shape and dimensions. Dorsally, each shell has a slightly raised part, called the umbo. The adult can reach up to 6-14 cm (Grossu 1962) (Fig. 1/a). In this case was chosen a local blank, obtained as a sub-product of the gathering process. For instance, among the food wastes from the settlement Hârşova-tell, the valves of the species *Unio* are well represented quantitatively, their nutritional contribution being quite substantial (Radu 2011: 91). The shells gathering, from the type *Unio* sp., although it seems a daily, summer activity, does not present the same importance along the warm season. Because the bivalves have certain specific ecological requirements (substrata, turbidity, water speed), they are not encountered in all the aquatic basins. The connection with a main branch or river, and the water...
level, influence their density. Increased densities, accessible to the gatherer, are encountered only at low levels of the water. For the sites along the Danube (Hârşova-tell, Borduşani-Popină), these conditions are encountered only towards the end of summer (Mărgărit and Radu 2014).

PERSONAL ADORNMENTS

Archaeological discoveries

In the personal adornments case, we identified pieces in different transformation stadium, from entire valves, simply perforated, and irregular splints, to finished beads, used as personal adornments, a fact that allowed us the entire reconstruction of the operational scheme (Table 1). For the first stage of the transformation process, we identified entire valves (N=3), deriving from the Hârşova-tell settlement, perforated by rotation in the same place, right under umbo (Fig. 1/b). From the tell settlement of Vitanești comes a valve perforated by indirect percussion.

The next stage consisted in bending the piece around the perforation, conferring to these pieces a subrectangular shape (N=7). At one sample it is obvious a beginning of perforation, by circular rotation, only from the internal face, which was not finished, but which allows us to evidence clearly the perforation technique (Fig. 1/c).

We also identified the samples in an intermediary processing stage (4 pieces from Hârşova-tell; 2 – Vitanești, 1 - Bordușani-Popină), meaning that the fracture edges begun to be regularized by abrasion, but the pieces never reached the finished processing stage (Fig. 1/c, pieces no.3-5). For the final stage, the procedure consisted in shaping the circumference of the piece, by abrasion, in order to confer circular morphology to edges and reduced dimensions to pieces (7 pieces from Hârşova-tell, 2 – Bordușani-Popină). At a part of the samples, the abrasion was also applied on the superior side, in order to make the piece thinner (Fig. 1/d).

In relation to the wear stigmata, they are obvious especially on the level of the perforation, being characterized by the blurring of the marks resulted following the action of rotation and the regularization and rounding of the perforation’s walls, depending on the duration of usage. So, the first stage is represented by the perforations present on the unfinished items (Fig. 2/a), with marked perforations signs and a raw edge of the perforation, which has not acquired a perfectly circular aspect, yet. A second stage may be identified on some of the finite items (Fig. 2/b), consisting in the blurring of the manufacturing marks on variable areas and in the rounding of the perforations, which corresponds to their being used as adornments. Finally, a third stage consists in the remove of the rotation marks and the appearance of a polished area around the perforation, probably following the prolonged rubbing against the suspended thread (Fig. 2/c-d).

Another type of adornment, which, alas, is present in only one sample, deriving from Vitanești (Fig. 3/a), consists in a subrectangular blank endowed with a perforation for suspension. One of the long sides corresponding to the valve exterior edge, was regularized by abrasion. The other side illustrate a cutting by sawing, superposed by abrasion (Fig. 3/c). We may assume the application of an extraction method. Towards one of the extremities, was made a rotation perforation from the inferior

<table>
<thead>
<tr>
<th>Settlement</th>
<th>Typological category</th>
<th>Processing stage</th>
<th>No. pieces</th>
<th>Wear traces</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hârşova-tell</td>
<td>Perforated valve</td>
<td>Preform</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Rectangular blanks</td>
<td>Preform</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Irregular pearl</td>
<td>Preform</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Circular pearl</td>
<td>Finished piece</td>
<td>7</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Seratted valve</td>
<td>Finished piece</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Bordușani-Popină</td>
<td>Circular pearl</td>
<td>Finished piece</td>
<td>2</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Irregular pearl</td>
<td>Preform</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Seratted valve</td>
<td>Finished piece</td>
<td>2</td>
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<tr>
<td></td>
<td>Abrased valve</td>
<td>?</td>
<td>3</td>
<td>+</td>
</tr>
<tr>
<td>Vitanești</td>
<td>Pendant</td>
<td>Finished piece</td>
<td>1</td>
<td>+</td>
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<tr>
<td></td>
<td>Irregular pearl</td>
<td>Preform</td>
<td>2</td>
<td>-</td>
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<tr>
<td></td>
<td>Perforated valve</td>
<td>Preform</td>
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<tr>
<td></td>
<td>Abrased valve</td>
<td>?</td>
<td>3</td>
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</tr>
</tbody>
</table>

Table 1. Archaeological data, technological and functional, connected to the Unio valves, discovered in the analyzed settlements from the Romanian Chalcolithic.
The piece was strongly used because the perforation marks disappeared and the perforation wall is rounded (Fig. 3/b).

**Experimental program**

In order to identify the costs invested in the manufacturing of this type of items, both in point of time and in point of effort, we have developed an experimental program, allowing us to record all the variables (means of obtaining the raw material, technological stages, time recorded for each operation, tools used, wear evolution). Furthermore, observations made on archaeological specimens were compared to experimental replicas made on modern specimens from valve of *Unio* sp. Moreover, we set ourselves the task of wearing these beads manufactured experimentally, as composite adornments, and to periodically evaluate the perforation and the surface of the items under the microscope. This experimental col-

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*Fig. 2. Evolution of the wear traces at the level of the perforations (archaeological items).*

*Fig. 3- Pendant made from valve of *Unio* (Vitânești).*
lection had the aim of helping us better understand the 
way in which the wear evolves during the usage of the 
item and, implicitly, the patterns observed on the archae-
ological specimens.

The gathering of raw materials was made by collecting 
valves from the banks of one Danube branch. We identi-
fied areas of tanatocenosis, so in only 10 minutes, may be 
gathered approx. 40 bivalves. Acquisition was much sim-
pler for the archaeological specimens, because the valves 
were colected from the food remains.

For the operation of debitage, we used two possible 
methods: fracture and extraction. In the first case (Fig. 
4/a), using a hammer, the valve was knapped, the result 
being a few irregular splints, which can be turned into 
ornaments. However, the method is not very produc-
tive, as the fractures are not controllable (the number 
of the blanks resulted may not be evaluated) and the 
blanks obtained are irregular. In exchange, the method 
is fast, as the above-mentioned blanks are obtained in 
3-4 seconds.

The second method, put into practice by means of a 
unifacial sawing procedure, takes more time to obtain 
each blank (10 minutes), yet this blank is regular, close 
to the desired dimensions and one may very well evaluate 
the number of blanks that can be obtained from one valve 
(Fig. 4/b).

Then the achievement of the perforation followed, by 
means of a unifacial rotation procedure, operation real-
ized in less than 5 minutes (Fig 4/c). The finite item was 
obtained by means of a rigorous abrasion against a peri-
odically watered stone. The abrasion was applied on the 
fracture plane and the upper side, following the two final 
stages, taking about 10 minutes (Fig. 4/d). Concluding, 
to produce a circular bead, one needs up to 25 minutes.

Later on, the items were put together in a bracelet, 
tracking the evolution of the surface wear and of the 
perforation. The first microscopic analysis was carried 
out about four months after the bracelet was put togeth-
er (Fig. 5/a) and, as one can see from the pictures, the 
perforation had lost its raw aspect, the rotation marks 
being visible, and on them it started to appear the wear 
that follows the rubbing against a thread. Six months after 
use (Fig. 5/b), the rotation marks are almost completely 
removed, and a significant wear area appears, the perfo-
ration being deformed in the point of constant rubbing 
against the thread to which the item was attached. The 
scratches of abrasion disappeared.

After an year (Fig. 5/c-e), the wear is very advanced, 
in the sense that the items acquire a strong macroscopic 
polish, accompanied by the disappearance of the techno-
logical stigmata. Moreover, the perforations have a cir-
cular morphology, lacking the specific rotation grooves. 
Yet, it is clear that the pieces are still perfectly functional, 
demonstrating a particular resilience, despite the appar-
ent fragility of the raw material.
UTILITARIAN TOOLS

Another manner of processing valve of *Unio* sp. consist in obtaining pieces with serattted (Bordușani-Popină – 2 items, Hărșova-tell – 1 item) or abraded (Bordușani-Popină – 1 item, Vitănești – 3 items) aspect (Table no.1). In the case of a sample deriving from Hărșova-tell (Fig. 6/a), the process consists in applying convergent incisions, which led to the removal of small splints with a triangular morphology and the achievement of a denticulate aspect, quite irregular. The deepening of the denticulates is of 4 mm, and the distance between them of 7 mm. Instead, for a piece from Bordușani-Popină (Fig. 6/b), the technological intervention consist in making small oblique cuts, by sawing at a small distance one of another. Their profile is in asymmetrical V, in accor-
dance with the morphology of the tool active part with which was made the incision. They have a length of approximately 1 mm and are disposed at a distance of 0.8 mm. They were achieved from the inferior side, by a tool repeated passage, as shown by the starting point of the incision.

In this case, we cannot longer speak about adornments, being actually more likely about utilitarian objects. Those could have been used for pottery decoration, but Bar-Yosef Mayer (2013) described another hypothesis: they could serve as ‘fish scalers’. We must underline the fact that at none of these pieces we cannot speak about usage marks, the teeth are nor blunt or fractured, but they have a very fresh aspect. We suspect that these pieces have not yet been used, so we cannot advance the hypothesis regarding their using manner.

For the valves characterized by the abrasion of the edges, we have not identified other technological marks, besides the abrasion scratches disposed transversally to the axis. (Fig. 6/c). We do not know if we are dealing with using marks (in literature it is well known the utilization of valves as tools) or we are dealing with a piece during its processing.

DISCUSSION

These examples illustrate the fact that, in Europe, the history of valves utilization, especially for the adornments production, was written in the same time as that of the modern man. They continued to be used along Prehistory, each community using local or imported species, in accordance with the opportunities or with their cultural
options. Traditional populations have shown us that ornaments may convey numerous messages, depending on the context of their use. Thus, the ornaments may have been linked to social classes, to age or gender, or may have been worn only during certain rituals or throughout the wearer’s life etc.

The study of the Unio sp. valves utilization manner allows us to understand certain aspects regarding the economy of the Eneolithic communities, the aesthetical and technological practices and the interaction with the aquatic environment, in this particular case the local environment. We must not ignore and the social dimension, numerous specialists considering as preeminent element in the selection of raw material, the cultural value conferred by the community. The two determinatives (access to resources and cultural option) seem to complete one another meaning that, the knowledge concerning which parts of the animal skeleton may be used materialized in the community’s myths (Choyke and Daróczi-Szabó 2010). The species analyzed in this study was used in an opportunistic manner, which does not exclude and the cultural dimension: in a first stage as important nourishing source, and in a second stage as a source for beads and usage pieces production, by recovering valves from the domestic wastes. Starting from the specialists’ observations, the period for gathering certain species can offer indications regarding the moment in which these pieces were manufactured and, maybe, their utilization manner. We must draw that the raw material furnished by the aquatic resources is, generally, hydrated. This characteristic is important, especially in the case of processing bivalve shells. The valves of Unio sp. cannot be kept, one year to another, in order to be processed because they exfoliate during the technological process. So obviously their processing took place shortly after gathering, and, starting from the above mentioned specialty data, we may advance the hypothesis of a processing in autumn.

The specialists agree in asserting that technology depends (like in the raw materials case), first of all, upon the cultural tradition, which implies a collective material experience, gathered in time (Choyke 2009, 2010, Dobres 2010, Lemonnier 1993, Luik 2011, Luik and Maldre 2007). People accept and use the same gestures in order to establish links with the past of the group to which they belong, a fact that helps maintaining the collective memory and the social stability (Radley 1997). This is proven by the presence in the Eneolithic studied settlements of the personal adornments, in various stages of processing, following the same technological scheme of transformation. Experimental studies have illustrated the special resilience of these personal adornment, as a year after they have been manufactured and worn they are still perfectly usable. This leads to the conclusion that the composite adornments were manufactured at large intervals of time, probably, when necessary, only the fractured items being replaced.

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ANTLER WORKSHOP IN CARIČIN GRAD (JUSTINIANA PRIMA):
RECONSTRUCTION OF THE TECHNOLOGICAL PROCESS

Nemanja Marković
Sonja Stamenković

Abstract: The ruins of Caričin Grad are believed to be the site of the once important regional centre of Justiniana Prima, the city built by Emperor Justinian I (527-565) to honor his birthplace. The city lasted a very short time, as it was abandoned in the early 7th century AD. Archaeological excavations brought to light many traces of antler-working which were clearly accumulated within a short span of time: between c. AD 535 and 615. During the excavations in the area of the city's south-eastern corner tower, significant evidence for craft production was recorded. A total of 81 pieces of craft material, unfinished, semi-finished, and finished products (combs) made from antler have been found. Associated coin finds indicates that the workshop was active, during the reign of Emperor Justinian I, and the waste material represents the entire production sequence, from the preliminary processing of material through to the final stages of manufacture, as testified by numerous diverse elements of unfinished and semi-finished combs. This kind of activity is also confirmed in the southwestern quarter of the Lower Town, with an additional 37 pieces of antler waste and semi-finished combs excavated there. Specialized craft tools have also been found, and these allow us to reconstruct aspects of antler production such as procurement of raw materials and manufacturing technology.


INTRODUCTION

The remains of Caričin Grad, situated in southern Serbia, 30 km southwest of Leskovac and 8 km northwest of Lebane, are identified with the important regional early Byzantine center of Justiniana Prima, founded in the 530s by the emperor Justinian I (AD 527-565), in order to perpetuate his birthplace. Situated in a rural area in the western part of the province of Dacia Mediterranea, the city presents a unique example of late urbanization in the northern provinces of Illyricum (Figure 1). Since it lasted a very short time and the area has remained uninhabited until today, it has yielded well-preserved monuments and material remains. The city was abandoned in the early 7th century AD as the result of incursions by Slavic populations and the cessation of Byzantine control over almost the entire territory of Illyricum (Kondić, Popović 1977: 367-374; Bavant, Ivanišević 2003: 39-50; Ivanišević, Stamenković 2010: 41).

Archaeological excavations at Caričin Grad have been conducted for more than a century. In the last two decades, the focus of research was on two important units of the city: (1) the intramural housing and fortification of the Lower Town, and (2) the northern part of the Upper town, that is, the area between the northern wall of the Acropolis and northern rampart of the Upper town (Figure 2).

In this paper, an important part of the Lower Town, the complex of the south-eastern corner tower, will be considered. Excavations in this area began in 2002 and lasted until 2008. They were focused on parts of the eastern and southern defensive walls, the intramural space between them, the corner tower, the area outside the defensive walls, and the ditch that protected the approach to the tower from its eastern side. The thorough excavations clearly brought to light two chronological phases: one period connected to the reign of Emperor Justinian I (AD 527-565), and the other dated to the second half of the 6th century (Bavant, Ivanišević 2006: 387-394; Ivanišević, Stamenković 2010: 39-41). The plentiful evidence of antler production (mostly recorded outside the eastern defensive wall, and in the ditch mentioned above) have focused our interest on this part of Caričin Grad.
The excavations outside the walls, along the eastern rampart, extended over a surface measuring 8m x 9.70-14m. There was a very clear stratigraphy in the section between the northern profile on the North, running perpendicular to the tower’s eastern wall along a length of 14 m, the southern profile on the South which extended perpendicular to the eastern rampart along a length of about 9.70 m, the fortification itself on the West, and almost up to the modern local road on the East.

A significant number of craft materials including unfinished, semi-finished, and finished products made from antler were distributed between from the main occupation level, right down to natural. The highest concentration of the aforementioned finds was recorded along the southern profile of the trench, mostly about 2.20 to 3.80 metres from the eastern facade of the tower. Along the eastern rampart and parallel with it, the remains of a small narrow wall were discovered, stretching from the northeastern tower’s corner to the northern profile of the trench (Figure 3). It was not excavated along its full length. The wall may be later than the occupation layer, but we cannot exclude the possibility that both the antler debris and the wall originated from the same period, and were scattered together during leveling work at this place. Based on coin finds, these stratigraphic units are dated to the period of Justinian I. No argument can be made as to whether the wall is connected in some way to the antler manufacturing activities.

As a result of poor quality foundations (or perhaps an earthquake), the southeastern tower soon began to sink, even before the end of the reign of Justinian I. Consequently, its base was especially reinforced on its external face by a 1m thick layer of yellow and brown clay, poured along the eastern, northern and probably southern sides of the tower, some time during the reign of Justin II. This is corroborated by the find of a half-follis struck during the early years of his reign (Ivanišević 2010: 12). These layers of embankment also covered the area described above.
Close to the bone...

Fig. 2. General plan of Carićin Grad.
A similar situation was observed in the defensive ditch found by the eastern side of the fortification. Based on the quantity of antler refuse and unfinished products, this may have been a midden area during Justinian I’s reign. The ditch was filled in during the reinforcement work on the tower at the beginning of Justin II’s reign. No traces of unfinished or half-finished antler finds were found in layers from this more recent phase (dated to the second half of the sixth century AD). Concerning the whole of the excavated area outside the eastern defensive wall and southeastern corner tower, a number of stray finds were recorded in the remaining southwestern intramural housing areas of the Lower Town. Sporadic finds of bone working activity were also documented in the Upper Town, but these are not considered herein.

This paper deals with questions of whether the antler artifacts were produced in the aforementioned excavated locations, and whether sufficient arguments exists to demonstrate antler workshop activity. In particular it aim to identify the technological production process, and reconstruct the tools used in this work.

MATERIAL AND METHODS

Analysis of fauna remains in understanding manufacturing technology provides information of potential raw materials, way in which the environment could be exploited: the relative distances of resources from settlements reflecting relatively complex strategies for procurement. Of the total of animal remains collected (2940), identification up to the level of genus was completed for 1290 fragments. The remains of 22 species were identified in the faunal assemblage from the southeastern corner tower. The domestic species include sheep (*Ovis aries*), goat (*Capra hircus*), cattle (*Bos taurus*), pig (*Sus domesticus*), horse (*Equus caballus*), donkey (*Equus asinus*), mule (*Equus caballus x Equus asinus*), camel (*Camelus sp.*), dog (*Canis familiaris*), cat (*Felis chatus*), hen (*Gallus domesticus*), duck (*Anas domesticus*) and goose (*Anser domesticus*) while the wild species comprised red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), wild pig (*Sus scrofa*), hare (*Lepus europaeus*), fox (*Vulpes vulpes*), beaver (*Castor fiber*), falcon (*Falco sp.*), carp (*Cyprinus carpio*) and catfish (*Silurus glanis*). Domestic animals outnumber game (comprising over 90% of NISP), and produced the most important and reliable meat supply. Based on the number of identified specimens (NISP), caprines (sheep and goat) are the most common taxa (35% NISP), followed by domestic pig (23% NISP) cattle (12.3% NISP), hen (12% NISP) and red deer (4% NISP). Other taxa were identified in small numbers and altogether comprise less than 13% of NISP. Red deer is the best represented game species. Wild pig, roe deer and rabbit were also hunted (Marković 2013). However, only red deer antler was worked. The minimum number of individuals (MNI), based on the number of sawn-off burrs, shows that antlers from four individuals are present in the assemblage from the southeastern corner tower, while one individual is represented in the area of the Lower Town’s southwestern intramural housing.

Out of 118 objects, 81 came to light by the southeastern corner tower, while the rest were found in the southwestern intramural housing in the Lower Town. Material was analyzed based on a tripartite classification in which waste may relate to the primary, secondary, or tertiary phases of the manufacturing process. This classification was developed from the *chaîne opératoire* analysis of lithics created by A. Leroi-Gourhan (1971, 1973), and applied by Niall Sharples in his analysis of antler waste from Bornais, South Uist (Ashby 2005; Pawłowska 2011: 316).

The *primary* stage is represented in the archaeological record by large pieces of bone or antler in which gross morphology is still clear, but which bear visible marks of chopping, cutting, or sawing. This waste represents the preliminary processing of unworked material into
smaller, workable pieces (possibly also for storage for later use). The secondary stage may be recognized by the presence of half-worked or discarded blanks. Antler or long bone might be split longitudinally into four or more segments, which may then be shaped, divested of all porous core material, and worked into blanks. At this stage, reworked pieces begin their transformation into finished artefacts or components (e.g. the connecting plates or billets of composite combs). The tertiary stage of manufacture includes the final phases of production, such as the cutting of comb teeth, decoration, and riveting together of components. The items are finished by trimming and smoothing.

MANUFACTURING TECHNOLOGY

In its initial stages, bone/antler technology is very similar to woodworking, and involves identical tools and processes (e.g. cutting, grinding, carving, engraving and drilling). Bone and antler workshops would have operated in conjunction with specialists in other raw materials, and may have produced objects that combined metal, cloth, or leather. Bone workshops might have been situated close to butchers, making animal bone an easily available source of raw material (Choyke 2012: 335, 345).

Material from the south-eastern corner tower is represented by the three sawn off burrs, segments of the main antler beams, and cut-off antler tines and crown portions. One burr is still attached to the pedicle, while two others are from shed antlers. Portions of the main antler beam may be categorized according to how they were to be manufactured, and form three groups.

The first group consists of seven items produced from the segments of the main beam and tine bifurcations. The second group comprises triangular and square pieces produced from medullary tissue from the main beam (n = 15). They represent waste from the process of vertically splitting the antler to produce long, rectangular plates of compact material. The third group consists of fragments (n = 12) of smaller size and varied shape, and which represent shavings from cutting and splitting the main beam and lower parts of tines. There are also 19 tines of varying lengths (from 41mm to 110 mm), as well as 14 fragments from the antler crown (Figure 4).

In this assemblage, a fragment of an unknown object (possibly a handle) was also found. It has a cylindrical shape, is 56 mm long, with a slit in the middle, and is decorated with parallel oblique lines and the circle-and-dot motif (Figure 5a). Another object, 50 mm in length, with a central slot and a perforation on the opposite side, is decorated with parallel transverse, longitudinal and oblique lines. It was found inside the city walls in the complex of the southeastern corner tower (Figure 5b). Similar items dated to the early Byzantine period are documented in Karataš (Diana) and site Gradina on Jelici Mountain (Špehar 2010: 76-77, No. 200-205; Milinković 2001:120, Abb. 35/13, 14).
Material from the ditch in front of the southeastern corner tower also comes from antler workshop activities. This assemblage is represented by one sawn-off burr from a shed antler and one eye tine, two pieces of medullary tissue from the main beam with irregularly triangular cross-sections, three fragments of the crown of different shapes and three antler tines about 100mm in length. From the area of the southwestern intramural housing in the Lower Town comes one sawn-off burr from shed antler, one rectangular plate with a crack through the middle that was discarded in an unfinished state, two pieces of medullary tissue from the main antler beam with irregularly triangular cross-sections, eight fragments from the crown in various shapes and 25 antler tines with lengths between 36 mm and 135 mm. The bulk of the material comes from the layers dated to the second half of the sixth century AD.

Tools for crafting and decorating antler objects were found in several locations in Caričin Grad. An iron saw could well have been used in the primary stage for dividing antler racks into large segments. Two such saws were found. One came to light in a small house, pressed into the wall near one of the towers of the eastern gate of the Upper Town (Deroko, Radojičić 1950, 138, fig. 40; Popović 1988, fig. 111; Popović 1990, fig. 283). The other was found in the southwestern intramural housing area (Ivanšević 2010: 24, fig.19/4) (Figure 6). Numerous and various types of knives representing multipurpose tools were found at several locations in the Upper Town (Bavant 1990) and Lower Town. These tools could have been used to split antlers longitudinally as well as for whittling blanks.

Of most interest, however, are two iron tools which were used to produce the ring-and-dot decorative motif (Bíró et al. 2012: 55-58). These were found in the narthex of the double basilica, and in the southwestern intramural housing of the Lower Town (Figure 7). These items have been dated (on the basis of associated coin finds) to the second half of the sixth century AD. A tool of the same form was found at Gradina site on the Jelica Mountain, and published as an unknown object (Милинковић, Шпехар 2014: 147, No. 163).

Finds from worked antler production, including one unfinished comb from the East Portic on the South Street in the Upper Town (dated to the second half of the sixth century) allows us to reconstruct the tripartite analysis of the detailed chaîne opératoire for the production of combs from the workshop in the southeastern corner tower. The process of manufacturing antler combs has already been studied before, and is well reconstructed (Galloway and Newcomer 1981; Ambrosiani 1981; Ashby 2014).

The first step was probably soaking antler for a couple of weeks to soften it for easier working. The second step was the removal of all parts of the antler rack that could not be used in the production of combs, such as the burr, parts of the crown and the tips of the tines. The split beam was then sawn into smaller parts which were then split vertically through the compact antler to produce rectangular plaque-shapes. These pre-prepared shapes were then roughly filed and organized based on their shape into toothplates. These toothplates were then riveted between a pair of long side plates to connect them together. The whole comb was then trimmed, the teeth cut in the toothplates, and finally the refined form was finished with filing, polishing and incised decoration was undertaken (Figure 8).

Two basic types of combs were found at Caričin Grad. The first is a single-sided comb (Ivanšević 2012: 59) while the other is double-sided (Bavant, Ivanšević 2003: 59). However, so far, only worked antler activity for manufacturing the latter has been discovered.

During the Early Middle Ages of Northern Europe, combs were manufactured in a more standardized way with some regional differences in the method of manu-
Close to the bone...

facture (Ashby 2013: 196). Standardization in the production of combs is also visible in the workshop material from the southeastern corner tower at Caričin Grad. Similar antler workshops revealed in Fedesti, Birlad-Valea Seaca and Suceag in the Eastern Carpathian Regions in the time of Sântana de Mureş-Černjachov culture dated to the 4th-5th century (Sergiu, Popa 2010), and Ordacsehi (Hungary) dated to the 5th-6th century (personal communication with Alice Choyke from Central European University, Budapest). Worked antler activity was also testified on late Roman archaeological sites in Maladers, Schaan, Hörbranz, Iringenhausen, Pfyn, Rheinau, Rheinfelden, Müschhag, Twann-Petersinsel, Yverdon-les-Bains (Switzerland) which are dated to the 3rd and 4th centuries (Deschler-Erb 2005: 212). It seems that antler handicraft is much more widespread in the northern provinces of Empire, especially in the frontier forts. This type of craft is typical for the Germanic population, especially the production of antler combs, and appears to have no roots in Roman manufacturing tradition (Biró 2002: 67-69).

CONCLUSIONS

The workshop from the south-eastern corner tower seems to have operated for a short time during the reign of Emperor Justinian I. The profile of the workshop indicates that the main raw materials to be worked were red deer antlers. Raw material was mainly obtained by collecting shed antlers although a small percentage of the antlers were also obtained from hunted animals. The analyzed material represents a quantity waste material, unfinished products, and damaged products. Almost all manufacturing techniques, from sawing, rough filing, and cutting, through to fine filing, polishing and incising for decoration are represented in the assemblage. The focused strategy in procurement of the raw materials used in this workshop suggests highly specialized production, predominantly for the manufacture of combs. The workshop from the south-eastern corner tower was a small operation that operated only for a short time when, perhaps, it was moved elsewhere in the city while the tower was undergoing reconstruction.

Given that isolated finds of manufacturing waste and half-finished antler products have been found, the existence of another workshop located in the southwestern intramural housing of the Lower Town might be hypothesized. This idea finds support in the presence of iron tools that could have been used to produce ring-and-dot incised decoration, suggesting that antler manufacturing survived at Caričin Grad during the second half of sixth century. However, based on the present results it is difficult to say to what extent this was the case, and what precise form it may have taken. It is hoped that future research will permit both the recognition of new workshops and the identification of their assemblages, in order to improve scholarly understanding of the role the manufacture of these objects played in daily life in this early Byzantine city.

REFERENCES


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INTRODUCTION

The aim of this paper is to provide a synthesis of the archaeological dossier of the carved bone and antler pieces discovered in northern Dobruja (SE Romania). The finds were discovered in early Roman, late Roman and early Byzantine sites in this area that belonged to NE Moesia Inferior (1st-3rd centuries AD) and Scythia (4th-6th centuries AD). Although the assemblage is rather reduced in number, there is a remarkable variety. Some of the finds are typical to Lower Danube limes.

STATE OF RESEARCH IN THE AREA

Only a limited number of monographs on worked bone and antler are available on the territory of Moesia Inferior and later province Scythia. Often, the objects of bone and antler were consigned to short appendices at the end of articles or monographs. Such examples is the two monographs dedicated to the late Roman necropoleis from Callatis/Mangalia and Beroe/Ostrov where only a limited space was dedicated to the carved bone and antler assemblages (Preda 1980; Petre 1987). This explains why carefully attention should be paid to seemingly humble bone and antler objects. Vladkova’s attempts to present the assemblages of carved bone and antler discovered in Bulgarian part of Moesia Inferior and later province Moesia Secunda is noteworthy (Vladkova 2006: 58-74). Other assemblages from Odessos/Varna, Histria/Istria and Noviodunum/Isaccea were published recently (Haralambieva 2007: 39-63; Beldiman et al. 2011: 63-91; Beldiman et al. 2014: 233-268), but the largest recorded collection of bone and antler objects has been unearthed at Ostrov – Ferma 4, an early Roman rural settlement located nearby Durostorum/Silistra (ELEFTERESCU 2008: 219-297). In contrast, the bone assemblage from one of the legionary bases of the province – Troesmis/Turcoaia – is reduced in number and variety. This is due, however, to intermittent archaeological excavations. Early Roman rural settlements from Niculițel and Telita delivered a fairly large number of carved bone and antler, partially results of local workshops (BAUMANN 2003: 155-232). A recent excavation at Niculițel, Tei Com site, provided a large number of bone artefacts, together with some hints of a local production of hairpins and sewing needles (Nuțu, Stanc 2014: 59-70). Finally, a survey of the artefacts of carved bone and antler discovered in northern Dobruja has been recently published (Nuțu, Stanc, Stan 2014).

ARCHEOLOGICAL CONTEXTS OF THE FINDS

Geographical distribution of carved bone and antler finds in northern Dobruja (PL. 1) show the prevalence of settlements located on the Danube limes – Beroe/Ostrov, Troesmis/Turcoaia, Dinogetia/Garvăn, Noviodunum/Isaccea, Aegyssus/Tulcea, and Halmyris/Murighiol. The intensive archaeological excavations carried out in these strategic outposts of the Roman army might explain this situation. However, only a limited number of the finds are pieces of military equipment. The vast majority may be associated with every-day life activities and personal adornments. Coastal settlements as Argamum/Cape Dolojman-Jurilovca and the fortified horreum from Tomprachi delivered modest assemblages of worked bone. The finds’ spectrum from inland rural settlements from Telita and Niculițel does not differ too much from the above-mentioned urban settlements. However, from this milieu we have the only evidences of a local production.

THE WORKSHOPS

Unfinished bone and antler objects have been found in urban and rural settlements in northern Dobruja (for this topic see latest approach in Nuțu, Stanc, Stan 2014). Several debris were brought to light at Telita, in a 4th officina located in the area of Noviodunum/Isaccea, an important Roman and early Byzantine city and also a legionary base. Latest fieldworks in Argamum/Cape Dolojman-Jurilovca
delivered a series of antler offcuts and blanks. Among the rich osseous materials from Halmyris/Murighiol, there are also several antler blanks. Unfortunately, the physical appearance of workshops in this region is unknown in the absence of any clear evidence of this kind. On the other hand, a specialized workshop of worked bone existed within a 2nd-mid 3rd centuries Roman villa excavated at Niculițel. A large number of bone hairpins and needles were discovered on this spot and is a reliable indicator for the existence of a local production centre.

THE ASSEMBLAGE OF CARVED BONE AND ANTLER

Over 200 objects of bone and antler were indexed so far in this region.

Hair accessories occupies first place among discoveries, due to large amount of hairpins and combs of various types. About 100 finds have been discovered in the Roman settlements form this area, most of them in the villa rustica from Niculițel and in the thermae of the civilian settlement from Troesmis/Turcoaia during fieldworks in the ’70.

Six varieties of hairpins (acus/spina crinalia/comata ria) were identified, frequently encountered in the Roman provinces (pinecone decorated, head decorated with gold foil, bead-and-reel, cut-flat head, globular/spherical or biconical-shaped head and conical-shaped head) (Pl. 2/1-4). Among the varieties, a flamboyant type is the one decorated with gold foil on the head (Pl. 2/5). A single find was discovered so far in the region, in the Roman villa from Niculițel and may be dated from the mid-2nd century AD up to the mid-3rd century AD (Nuțu, Stanc, Paraschiv 2014: 126, no. 332, pl. 37; Nuțu, Stanc, Stan 2014: 44-45, pl. 1/3). Over 90 examples of this type were indexed recently by Bartus spread across the Roman provinces, especially in the middle Danube region (Bartus 2010: 35-43). As for chronology, the author noticed that no less than 36 finds discovered in secured archaeological contexts were dated in the 3rd and 4th centuries AD, without excluding the possibility that this type has its origins even earlier, in the first half of the 2nd century AD.

The combs are well represented inside the assemblage of osseous materials discovered in the necropolis of Beroe/Ostrov. The 46 finds discovered here occupies the main position within the north Dobruja repertoire of 54 finds. Together with double-sided composite combs, typically Roman, three unilateral combs with semicircular handle were brought to light and were generally regarded as a ‘barbarian’ fashion in Roman milieu. The Roman series has clear similarities within the Lower and Middle
Danube late Roman horizons, as for example in Pannonia where is a remarkable frequency of this type in 4th century graves (Biró 1994: 36-37, pls. 37-41, 42-43), while in Upper Moesia these finds occur in great number in 5th-6th centuries settlements (Petković 1995: 21-23). Two main varieties have been identified among the composite combs: straight-ended and volutes-ended, and the ratio between them is fairly close (20:16 in favour of straight ended variety) (PL. 2/6-7). A fine unilateral comb was discovered in the fortified horreum from Topraichioi and has typical features for this type: a semicircular handle and bell-shaped plates with saddle-like endings (PL. 2/8).

It was discovered in an occupation level from the end of the 4th century AD. This fact support Petković hypothesis regarding their diffusion south of the Danube after the battle of Adrianople, when large groups of Goths settled in this region (Petković 2006: 361).

The jewellery is represented by several types of pendants (so-called Hercules’ crook) and bracelets made of single-piece or bone beads (PL. 3/9-11). A small fish/dolphin-shaped pendant (PL. 3/12) is a unique discovery in the Lower Danube region (Nuţu, Stanc, Stan 2014: 71, no. 1, pl. 14). However, aquatic motifs decorate a variety of everyday utensils from Britannia to Gallia and Middle Danube (as for example a fish-shaped pendant from Donauländischen Museums in Komárno, see Hrnčiarik 2012: 61-62, pl. 8/177) in early and late Roman period.

A variety of dress accessories were discovered in north Dobruja, but the overall number is modest. Dress accessories consist in buckles, cloak fasteners, purse dumb-bell fasteners (Taschenbeschläge), and decorative belt-plates. Three buckles were found in north Dobruja, each of a different variety. Two finds from Halmýris/Murighiol and Beroe/Ostrov are of late Roman and early Byzantine period, while the one from Noviodunum/Isaccea it was discovered in a 2nd century AD grave. These Roman settlements are located on the Danube limes and act as strategic points, reinforced with heavily military units during the entire Roman period. Across the Roman provinces, bone buckles have been found mostly in military areas. Especially the find from Noviodunum/Isaccea (PL. 3/13) having a D-shaped frame is frequently encountered in Raetia, Noricum, Pannonia, Moesia Superior and Inferior in 1st – early 3rd centuries AD (Nuţu, Stanc, Stan 2014: 76-77). Of a later period (early Byzantine) is the bone buckle from Beroe/Ostrov, probably an imitation of the copper alloy examples (PL. 3/14). These imitations of well-spread types of a period occur rarely, and only two other examples may be noted; firstly, a find from Pontes/Kostol discovered in a late 4th century – the beginning of 5th century AD level (Petković 1995: 39, pl. 25/8); a second example is a belt buckle from Caesarea Maritima, with close parallels in 6th centuries AD metal examples (Ayalon 2005: 31-32, no. 98, fig. 8).

A typical early Byzantine find are the flat dumbbell shaped purse fasteners (Taschenbeschläge) (PL. 3/15-17).

These finds represent a regional peculiarity, because they are spread mainly in the Lower Danube area. Scythia, Moesia Secunda, Dacia Ripensis and Moesia I are the significant regions where these finds are frequently encountered, and there is no contradiction to consider that they are a typical local artefact. Noteworthy to mention a concentration of these finds in north Bulgaria and SE Romania (early Byzantine Scythia, present day Dobruja). Although are some differences in sizes, the type is homogeneous, with two holes at each end, probably for leather stripes, and a characteristic decorative pattern made of concentric incised circles-and-dots. Their chronology is from 4th century AD up to early 7th century AD, with a peak of their usage in 6th century AD (Uenze 1992: 194-195; Nuţu, Stanc, Stan 2014: 80-81).

The objects of daily-use are typical for Roman and early Byzantine settlements in this area: spoons, sewing needles, handles used for knives and knot loosener. The number of spoons in Moesian assemblages rarely exceeds a few examples, and the four finds discovered in this region fit in the general picture (PL. 3/18-19). Nevertheless, one notable exception is the weaving implements, the sewing needles, spindles, distaffs and whorls with 34 finds (PL. 4/20-24). These seemingly humble objects are evidence of the local textile industry, insufficiently investigated in this area. The eight handles discovered in north Dobruja are associated with a variety of tools, hard to define exactly. At least one remarkable example found in a sarcophagus at Niculiţel – Bădila (PL. 4/25) may be connected with a peculiar type of utensil, maybe a penknife, bistoury, distaff or a mirror (Nuţu, Stanc, Stan 2014: 99-101, no. 39, pls. 20-21/39a-b). The lion head-shaped handle is chronologically secured in 2nd century AD and the closest parallel comes from the Antioch on the Orontes (Russell 2000: 81, fig. 2/upper side). Another closer geographical analogy is known in Komárno Museum, but was dated later, in 3rd century AD (Hrnčiarik 2012: 73, pl. 15/231). The functionality of so-called ‘knot loosener’ is still under debates (PL. 4/26). While Biró suggested that were used to lope the rope when loading pack animals (Biró 1994: 47-48, pls. 57-58/488-493; also Mikler 1997: 55-56), Ciugudean hypothetically linked a find from Apulum/Alba Iulia with the Roman insignia of the cornicularii (Ciugudean 1997: 38-39, pl. 30/1).

The military equipment and parts of weapons are few in number. Just one bow lathe, bone chaps and a sword pommel, were discovered in sites placed along the Danube, mainly in military milieux. The sword pommel from Aegyssus/Tulcea (briefly mentioned in Glad & Nuţu 2010; revisited in Nuţu, Stanc, Stan 2014: 105, no. 1, pl. 23) falls into Kishfıne – Köln type group (PL. 5/27). Examples from Nida/Hedernheim decorated with ribs on the surface were dated in early Roman period (Omann 1997: 52-53, pl. 1/3-8). Based on analogies, we may date the sword pommel from the mid.-2nd century AD to the beginning of the 3rd century AD. Two trapezoidal-shaped
Pl. 2. Hairpins (1-5), composite combs (6-7) and unilateral comb (8).
Close to the bone...

Pl. 3. Pendants of Hercules’ crook (9-11), fish/dolphin-shaped (12), buckles (13-14), flat dumb-bell purse fasteners (15-17), spoons (18-19).
Pl. 4. Weaving implements: distaff (20), needles (21-24), lion-shaped handle (25), knot loosener (26).
Close to the bone...

Pl. 5. Military equipment: sword pommel (27), bone chaps (28-29), bow lath (30), harness mount (31), box veneer (32).
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Pl. 6. Counters (33-39), dice (40-41), bone skates (42-43).
bone chaps from Telîța – Valea Morilor (Pl. 5/28-29) have clear parallels in Britannia and in Continental sites from 2nd-4th centuries AD (Nuțu, Stanc, Stan 2014: 106-107). The bow lath from Beroe/Ostrov (Pl. 5/30) is the only kind in north Dobruja; another example from Dinogetia/Garvân is probably of middle Byzantine period. A unique example of harness gear comes from Halmyris nogetia/Garvăn is probably of middle Byzantine period. The assemblage from 2nd-4th centuries AD (Nuțu, Stanc, Stan 2014: 112, no. 1, pl. 24) (Pl. 5/32). Counters and dices were used in daily-life and are amply attested in the region, in urban and rural settlements as well (Pl. 6/33-41). Two skates made of horse metacarpals were also discovered on this site locate on the Danube and associated with children’ leisure during harsh winters on the local ponds (Zahariade 2009: 183-187) (Pl. 6/42-43).

A miscellaneous category consists in furniture decorations for wooden-boxes, gaming pieces (counters and dices), medical/cosmetical instruments, writing implements, but also two bone skates. Bone strip with various decoration were used to embellish different Roman furniture and daily-use objects. An analysis of the various groups show a large variety of wooden-boxes mounts used to decorate and at the same time to strengthened personal toilette chests. A fine example was brought to light at Troesmis/ Turcoaia (Nuțu, Stanc, Stan 2014: 112, no. 1, pl. 24) (Pl. 5/32). Counters and dices were used in daily-life and are amply attested in the region, in urban and rural settlements as well (Pl. 6/33-41). Two skates made of horse metacarpals were also discovered on this site locate on the Danube and associated with children’ leisure during harsh winters on the local ponds (Zahariade 2009: 183-187) (Pl. 6/42-43).

FINAL REMARKS

Albeit spatially limited, this analysis of the carved bone and antler from north Dobruja enhanced the knowledge on this topic in the land placed between the Danube and Pontic coast. Moreover, this synthesis showed a series of regional characteristics inside the assemblage, but also and open new questions regarding the spreading area of certain types. It can be also noted that carved bone and antler objects underwent moderate changes between the early Roman and early Byzantine periods, because were usually employed in everyday activities.

REFERENCES


G. Nuţu, S. Stanc, Carved bone and antler in northern Dobruja


INTRODUCTION

Recent archaeological discoveries show that the oldest traces indicating the use of stone tools in the context of scraping come from the Lower Paleolithic site Dikika in Ethiopia (at the site were discovered, among others, the ribs bearing on their upper surfaces traces associated with scraping the meat remnants) and are more than 3.39 million years old (McPherron et al. 2010). In turn, the oldest bone tools, which surfaces have been intentionally finished with scraping techniques have been discovered in the Middle Paleolithic site Broken Hills (Kabwe), Zambia (Barham et al. 2002). Scraping the surface of the bone is therefore one of the oldest known technologies of which bone material was treated.

Action itself as well as the general nature of the traces that it induces have been well described in the literature (Christidou 2008; d’Errico et al., 1984; Fischer 1995; Newcomer 1974; Olsen 1984: 134-135; Olsen & Shipman 1988; Semenov 1964: 16-20).

Scraping is described as a movement of a tool across its working edge, usually toward or away to the operator (fig.1). Working edge is held usually at very high angle to worked surface and the leading aspect of the edge is pulled rather than pushed. Very similar to described action is whittling which is described as shawing off material with the working edge of the tool. The tool is held mostly at a low angle to the worked surface and motion is generally away from the operator (Keeley 1980: 17; Odell 1981a).

Reading Osseous Artefacts – An Application of Micro-Wear Analysis to Experimentally Worked Bone Materials

Justyna Orłowska

Abstract: According to the methodology of use-wear analysis, it is assumed that processing each type of raw material with stone tools involves leaving on it characteristic traces, analysis of which may allow to determine for instance the type of work or even the type of tool being used. Presented research is focused on the application of experimental works and microscopic observation to make identification and description of the two different bone processing activities – scraping and whittling, carried out by different kind of flint tools.

Apstrakt: Prema metodologiji analiza tragova upotrebe, pretpostavlja se da obrada bilo kog tipa sirovine kamenim alatkom ostavlja karakteristične tragove, čija analiza može da omogući utvrđivanje vrste rada, pa čak i tipa alatke koja je korišćena. U ovom radu predstavljena su istraživanja fokusirana na primenu eksperimentalnih radova i mikroskopskih opservacija u identifikovanju i opisivanju dve različite akcije obrade kostiju – struganje i ljuštenje, koje se obavlja različitim kremenim alatkama.

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Fig. 1. On the left examples of tools used during experimental works: a) blade, b) end-scraper, c) burin, d) groover. On the left method of use.
Traces left by the stone tools on the worked surface during the mentioned activities are in general similar to each other and occur on the surface of the bone in the form of a set of a multiple, parallel or nearly parallel, closely spaced striations arranged in bundles. However, in many cases we are able to distinguish this two activities, due to the presence of characteristic damages observed on the worked bone surface.

Use wear analysis of the stone tools from many archaeological sites show that artefacts identified as scrapers and whittling tools (connected with processing of bone materials) were mostly represented by unretouched and retouched blades and flakes. Besides them were used end-scrapers, groovers and burins (among others Dumont 1983; Jensen, Petersen 1985; Odell 1981a).

According to George H. Odell (Odell 1981b), on the working edges of any kind of stone tool we can see damage occurred in the form of removal from margins of the tool as like breakages resulting from forces to which the edges were submitted. This lead us to the point in which we have to analyze the variations which affects of the bone surface during technological activities. From the one hand we have stone tools and their morphology: shape of the edge, outline of the edge, presence/absence of the retouch, its distribution, form and scar-sizes (Van Gijn 1989: 3-4; Vaughan 1985: 19-24). From the other hand, bone material and it’s properties: size, shape, elasticity, hardness. Of course we cannot forget about another element which is connected with technological activity and its own variations, like type of movement or duration of the work. These variables are partly illustrated by figure

![Figure 2](image-url)
Close to the bone...

2, which shows an example of the contact zone between different kinds of flint tools and surface of the bone. In most cases, applying a working tools’ edge to the bone surface counts only a few millimetres. Most of the aforementioned variables plays an important role in shaping the individual traces and their invasiveness.

Presented research focused on the application of experimentation and microscopic observation to the identification and detailed description of the traces left by scraping and whittling of the bone surface. Data obtained during experimental works suggest the presence of characteristic micro-wear patterns associated with many variables which will be discussed in presented paper.

METHODS AND EXPERIMENTS

As M. Newcomer (1974) suggests, a major problem with conducting experimental research on the technology of bone tools is that many different manufacturing techniques and tools can be used to achieve the same or very similar tool. This is why, during experiments directly subordinated to the project various kinds of flint tools (made nowadays, for the needs of the experiments) were used. During the selection of tools, information such as the chronological and cultural affiliation of individual forms as well as conclusions derived from observations made by the researchers as a result of use-wear analyses of Late Glacial and early Holocene flint materials from the area of the Polish Lowland was taken into account (i.a.: Kufel-Diakowska 2011; Osipowicz 2010: 203-231; Pyżewicz 2013: 240-249; Winiarska-Kabacińska 2002).

This approach allowed to focus the conducted experiments in the direction of work and use of the tools with the most likely profile, based on research carried out so far. Secondly, it allowed (to some extent) the verification of observations made during previous microscopic analyzes of those tools through an attempt to identify technological traces made by them on processed materials. For scraping unretouched blades, burins, end-scrapers and groovers were chosen; For whittling unretouched blades, burins and groovers. Stone tools were made of Baltic erratic flint.

To fully take into account variables resulting from the nature of the worked material, fragments of deer (Cervus elaphus) long bones (metapodials) were processed in various states of preservation: fresh and dry/softened in water (soaked in plain water for up to seven days). Before processing they were divided into blanks (average 1.5 cm width and 12 cm long). Scraping and whittling were applied on the external surface of bone. Variations in the kind of used flint tool and it’s working edge, working angle (low (<45) vs. high (ca.90), state of bone and the duration of the work were examined as possible factors affecting the variability in processing traces. After processing, the analyzed bone materials were cleansed with water mixed with detergent. All experimental samples are presented in table 1.

The applied terminology in this study was taken from a conceptual systems existing in the literature (among others Christidou 2008; d’Errico et al. 1984; Jensen 1994: 20-27; Keeley 1980: 17-25; Olsen 1984: 55-184); the system was adapted to the needs and requirements of analysis carried out during the project. Experimental samples were analyzed under various levels of magnification: low magnifications (<100 ×) received by use optical microscopy, and higher magnifications (typically 100 ×–200 ×) which were taken by using scanning electron microscopy. The advantages and disadvantages of using this two methods were widely described in the literature, so there is no need to present them once more (among others LeMoine 1997: 15-16; Olsen 1988). The micro-wear research was conducted with a microscope-computer set Zeiss® SteREO Discovery V8, that allows obtaining magnifications of up to 8,0x (actual magnification up to about 80x; microscope is equipped with a two-point fiber-optic illuminator with white xenon light) and scanning electron microscope / focused ion beam – Quanta 3D FEG.

CHARACTERIZATION OF THE TRACES OBSERVED ON THE EXPERIMENTALLY WORKED SURFACES

Scraping

The observed traces associated with scraping, left by all the tools, are in general terms consistent with previous observations made by researchers in this field (Christidou 2008; d’Errico et al., 1984; Olsen 1984: 134-135). Due to the fact that each of the tool used in experimental works

Fig. 3. Surfaces scraped with flint blade using high angles and a motion away from the operator. Micrographs of experimental traces visible with small magnifications (>100x). A – fresh bone scraped for 20 minutes; B - dry/soaked bone scraped for 20 minutes; C - fresh bone scraped for 60 minutes.
Blades
In the case of blades and flakes, observed traces form sets of long and straight striation (fig. 3, 4). They are parallel or intersecting to each other and often arranged on bands. Bands consist of a series of shallow, parallel scratches, of similar depth and (more or less) V or U-shaped section. In the initial phase of use of the tool, when its working edge is still without scars or other breakages, traces observed on the surface of worked bone are relatively little diverse. Between each of sets of linear marks, gentle streaks or groove-like marks are visible. Surface roughness decreases and more diversity in striations are produced by the continuous formation of micro-retouches due to use on the working edge (fig. 3C).

Burins
Very similar to described above are traces left by burin facet (fig. 5, 6). The traces are arranged in broad parallel or intersecting bands. Striations are long and straight. The surface on which the linear marks develop has a flat aspect (fig. 5A; even much more than a blade). Well visible for this kind of tool turned out to be micro-cuts (fig. 5B), which were directly corresponding with the launching point of the separate stroke. Often, due to use, micro-breakages appears on the working edge of the tool, which decreases surface roughness. This in turn makes the marks left on the surface of the bone become more like those left by retouch tools (fig. 5C).

End-scrapers
The traces observed on the surfaces worked by end-scraper or a groover are much more diversified in morphology, because their edges are intentionally retouched. Uneven surface causes that contact zone can

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Table 1. Experimental database.
Close to the bone...

Fig. 4. Surface of fresh bone scraped for 20 minutes with flint blade using high angle and a motion away from the operator. Micrographs taken using a scanning electron microscope (SEM).

Fig. 5. Surfaces scraped with flint burin using high angles and a motion away from the operator. Micrographs of experimental traces visible with small magnifications (>100x). A – fresh bone scraped for 20 minutes; B - dry/soaked bone scraped for 20 minutes. The arrow indicates the starting point of the scraping strokes; C - fresh bone scraped for 60 minutes.

Fig. 6. Surfaces of fresh bone scraped with flint burin for 20 minutes using high angle and a motion away from the operator. Micrographs taken using a scanning electron microscope (SEM).
sometimes be limited only to single retouched areas of the tool, hence the traces of these are by far the most diverse in terms of size and depth.

In the case of end-scraper, traces form sets of long, very prominent, parallel or intersecting striation (fig. 7, 8). Striae are arranged in wide, clearly distinguishable bundles, usually curved and partly overlapping. There are very well visible separated, wavy formation of the marks left by the tools denticles. Diversity bands consist of a series of parallel scratches, of diversity depth and (more or less) V- or U-shaped section. Depth and width of striation is very often greater than marks left by the blade, they are also less regular. Between sets of linear marks, rough streaks or groove-like marks are visible which are modifying their direction.

**Groovers**
Traces made by flint groovers are very similar to those left by the end-scraper. Striae are arranged in wide, deep, clearly distinguishable bundles, usually curved and partly overlapping (fig. 9, 10). Bands consist of a series of parallel scratches, of similar or diversity depth and (more or less) V- or U-shaped section. There are prominent and mostly separated by the wavy formation of the marks left by the narrow working edge. Very often is noticeable the launching point of the scraping strokes. Rough streaks or groove-like marks between sets of linear marks modifying their direction is also readable.

**Whittling**
Whittling due to the slightly different motion differs from scraping mainly with the length, shape and invasiveness of observed traces. What important, in the case of whittling it is possible to identify the variables that are not observed on scraped surfaces, which is an important indication in the identification of performed activity. Internal construction of each of the traces is similar to those described above, and therefore detailed description will not be repeated here.

**Blades**
Whittling with unretouched blade is characterize by sets of short, wavy or curved striation, parallel or inter-
secting, often arranged on bands (fig. 11A-C). Rough streaks or groove-like marks between sets of linear marks modifying their direction is well visible. Decrease of surface roughness depends mostly on the continuous formation of micro-retouches due to use on the working edge of the blade. In many cases, well visible are irregularly distributed sets of transversal superficial notches, so-called “chatter-marks” (fig. 11A) - ridges oriented perpendicular to the long axis of the scraping striations (Luik 2011; Newcomer 1974; Schipman 1988). Their dimensions very likely corresponded to the width of the contact areas between the blade and the bone surface during the course of the work. These traces are formed as a result of a tool being pressed with a considerable force or held at a wide angle to the worked raw material (usually not much softened), which makes it subjective to vibrations that often cause the tool to ‘tremble’, resulting in marks of this kind. The launching point of the separate stroke is in most cases clear visible in a kind of micro-cutting (fig. 11B). If the pressure was notably huge or material was good softened the launching points are present in a kind of dovetails (fig. 11A) diversified in depth. What worth noticing, for whittling traces characteristic are facets, evidently separate from each other and perpendicular ripples which gave the bone surface specific waviness (fig. 11C).

**Groovers**

Traces left by using the groover (fig. 11D-F) leave mostly sets of short, parallel or intersecting striation. Striae are arranged in wide, deep, clearly distinguishable bundles, usually curved and partly overlapping. Bands consist of a series of parallel scratches, of similar depth and (more or less) V- or U- shaped section. Well visible are separated, wavy formation of the marks left by the narrow working edge of the tool. Rough streaks or groove-like marks between sets of linear marks are modifying their direction. Depth and width of striation is very often greater than marks left by the blade.

**Burins**

For whittling with burin (fig. 11G-I) characteristic are sets of short, mostly wavy striation, arranged in broad parallel or intersecting bands. Worth noticing is the flat aspect of the surface on which the linear marks develop.
Fig. 11. Surfaces whittled with different kind of flint tools with a low angle and motion away from the operator. Micrographs of traces visible with small magnifications (>100x). A – dry/soaked bone whittled using a blade for 20 minutes; B - fresh bone whittled using a blade for 60 minutes; C – dry/soaked bone whittled using a blade for 60 minutes; D - dry/soaked bone whittled using a groover for 20 minutes; E - fresh bone whittled using a groover for 60 minutes (high angle); F - dry/soaked bone whittled using a groover for 20 minutes (high angle); G - fresh bone whittled using a burin for 20 minutes; H - dry/soaked bone whittled using a burin for 60 minutes; I - dry/soaked bone whittled using a burin for 20 minutes.

Fig. 12. Example of scraping and whittling traces observed on archaeological tools. A – scraping, B – scraping, well visible micro-cuts; C – whittling with a retouched tool, working edge narrow; D – scraping, well visible facet of the worked surface and micro-cuts; E – whittling, well visible dovetails; F – whittling, clear legible “chatter marks”.

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### Activity Tool Main characteristics

| Unretouched blade | Scrapping
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<td>- sets of long and straight striation, which are parallel or intersecting to each other and often arranged on bands,</td>
<td>- traces arranged in broad parallel or intersecting bands,</td>
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<td>- bands consist of a series of shallow, parallel scratches, of similar depth and (more or less) V or U-shaped section,</td>
<td>- striations are long and straight,</td>
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<td>- when working edge of a tool is still without scars or other breakages, traces observed on the surface of worked bone are relatively little diverse,</td>
<td>- the surface has a flat aspect,</td>
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<td>- between each of sets of linear marks, gentle streaks or groove-like marks are visible,</td>
<td>- well visible are micro-cuts, which are directly corresponding with the launching point of the separate stroke,</td>
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<td>- surface roughness decreases and more diversity in striations are produced by the continuous formation of micro-retouches due to use on the working edge,</td>
<td>- due to use, micro-breakages appears on the working edge of the flint tool, which decreases surface roughness,</td>
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<td>- if the pressure was large enough, so-called “chatter-marks” are also legible (only when worked bone was dry).</td>
<td>- if the pressure was large enough, “chatter-marks” appeared (only when worked bone was dry).</td>
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| Burin | Groover
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*Table 2. Characterization of the technological traces observed on the experimentally worked bones.*
Bands consist of a series of shallow, parallel scratches, of similar depth and width. In most cases of experimentally worked surfaces, well visible are irregularly distributed sets of transversal superficial notches, whose dimensions very likely corresponded to the width of the contact areas between the burin and the bone surface during the course of the work (fig. 11G,H). Similarly as in case of blade, on the worked surface often occur so-called “chatter-marks” and very characteristic are facets, evidently separate from each other (fig. 11I). The launching point of the separate stroke is clear visible, mostly in a kind of dovetails diversified in depth.

Described differences and similarities in the characteristics of whittling and scraping traces, observed on the experimentally worked surfaces seems to be quite important and allowed the registration of a number of various variables created on bone surfaces as a result of work with different tools and activities performed. Observations that have been made can be useful for description and classification of the individual technological traces. Detailed information on this subject is synthesized in table 2.

DISCUSSION AND CONCLUSION

The presented results of experimental studies showed how many factors affect the nature of traces that we observe. Starting from the state of preservation of the processed material, the type of tool used, how it was held and what kind of work was done and by the degree of damage occurred on the working edge. The study aimed to try to capture the potential variables that could enable, among others, the identification of tools and techniques used on archaeological material.

The most of described traces allows their identification or exclusion on the prehistoric material (fig. 12). Most obvious are of course traces in a form of sets of long and straight striations (fig.12A) which are the result of scraping of the bone surface. However, their morphology, among others organisation of striae, their depth, width is very diverse and complex. Traces created by intentional retouched working edges (e.g. end-scrapers) and those tools on which micro-retouches are formatting during the long use (for example blades) are very similar to each other, and in the light of the conducted experiments practically indistinguishable.

Micro-cuts (fig. 12B, D) observed on both scraped and whittled surfaces inform us about the launching point of the separate stroke. What important, it can give us also information if the working edge of a flint tool was retouched or not and in many cases also the clue about its size (fig. 12C). May also help in an attempt to identify the specific flint tool, eg. if the activity was performed with a tool of a relatively narrow working edge or with more width one.

The another observed variable is in turn very characteristic for whittling and occur as dovetails and specific waviness of the worked bone surface (fig. 12E). The depth, acuity and invasiveness of these traces is a good evidence of softening of the raw material – traces are more legible and invasive if bone is good softened. Performed experiments show, that when bone was dried, whittling was very difficult to perform, non effective and in most cases ultimately lost its original character which became more like scraping.

Other important factor is mostly visible in a form of so-called “chatter-marks” (fig. 12F), which are mostly the result of working with a tool which were tightly pressed against (or held at a wide angle to) the worked surface. It can give us also the clues about the raw material hardness, because in the light of conducted experimental works, traces of these occurred mainly when bone was hard and non-softened.

Although to fully understand the variety of tools and kinematic which could be used to shaping the raw material we still need to conduct a number of experimental works with much more variables included, eg. different hafting systems and state of softening of bone material. Of course we cannot forget about use-wear and post depositional factors that also have an influence on the bone surface and in many cases can in a significant way change technological traces that we are study nowadays.

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Archaeological research on early Holocene sites provides many categories of sources. In most cases, these are artefacts made of stone materials, which had the greatest chance to preserve until today. Analyses of such objects undoubtedly provide lots of valuable information concerning life in this period. However, even the most accurate analyses of stone artefacts cannot give reliable data on the aspects of prehistoric economy that can be discussed basing on the sources of organic material. Nevertheless, artefacts of this sort are extremely rare and, hence, should receive due attention.

Until recently, the Polish studies on the Mesolithic artefacts made of osseous materials have focused primarily on building typological and chronological schemes (Galiński 1986; Kozłowski 1969). The first paper to take up the issues related to the production of such artefacts appeared in the early 1990s (Bagniewski 1992). Currently, this type of analysis is carried out mainly on finds from sites of archaeological excavations, such as Krzyż Wielkopolski 7 (Kabaciński et al. 2008), Pobiel 10 (Diakowski 2011) and Dudka 1 (Pratsch 2006). The analyses of stray finds are still rare. Only several studies have been dedicated to this matter (i.a., Diakowski and Płonka 2010; Goslar et al. 2006: 8-9; Kufel and Diakowski 2008; Orłowska and Osipowicz 2015; Sulgostowska 2012; Sulgostowska and Hoffmann 1993). This is not a good situation, since in the absence of more properly dated collections from sites of clear stratigraphic context, these sources could be an important element in interpreting numerous economic issues (among others), which reflect the activities of the population in the Middle Stone Age on Polish lands.

The purpose of this article is to present the results of microscopic analysis of two bone harpoon heads from site 33 in Wiele, located in Mrocza commune (central Poland). The observations made here might contribute to a broader research on the production technology concerning this type of blades, which will be possible in the future.
The archaeological site Wiele 33 is situated in central Poland, in the southern part of Krajenski Lakeland, within the old littoral zone and the present floodplain of Lake Wieleckie. At present, the edge of the reservoir is situated about 800 m to the south-west and about 300 m to the west the River Rokitka is located (Fig. 1). The site covers a small part of the slope and the bottom of a small valley, exposed to the south-west. The lake basin soils are of organic origin (rotting wood, peat and gyttja). In the peripheral zone of the lake Mesolithic artefacts were found in the context of loose sands with their primary source probably being rusty soil (documented solely by drilling).

The site has been discovered in July 1992 by a farmer who dug two bone harpoons while performing a grassland remediation (Mroczyński and Olszewski 1995). In June 2004 the first excavations took place under the leadership of Michał Kobusiewicz of the Polish Academy of Sciences in Poznań. The author of this article visited Wiele 33 in the autumn of 2013, and in the summer of 2014, under the auspices of the Institute of Archaeology, Nicolaus Copernicus University in Torun, conducted verification excavations on the site.

RESULTS OF THE ARCHAEOLOGICAL RESEARCH

Two seasons of excavations led to the uncovering of 56.5 sq. m site area, of which 32.5 sq. m were examined in the season of 2014 (Fig. 2). As a result of this work, settlement remains were discovered, vast part of which can be associated with the activities of the Mesolithic population. Apart from the two bone harpoon heads described...
in the further part of the article, 861 flint artefacts were acquired during the excavations of 2014, which can be associated with the said period. This comprises mainly humic material, in most cases waste, but also several cores (Fig. 3: 1-6) and tools were found, including microliths (Fig. 3: 7-14), wastes from their production – microburins (Fig. 3: 15) and end-scrapers (Fig. 3: 16). Significantly, this collection comes from a relatively small area of about 300 sq. m (a narrow strip along the shore of an ancient lake, approx. 10 m wide and 30 m long - Fig. 2).
General characteristics of the artefacts allow us to associate them with the population of Komornica culture and date them to the end of the Boreal period. The excavations gave no evidence of other bone artefacts from the Mesolithic period.

METHODOLOGY

The main goal of this article is to present a use-wear study of the two Mesolithic bone harpoon heads from the Wiele site. Early part of the analysis was conducted with use of a Nikon SMZ-2T microscopic-computer kit. This device enables a limiting magnitude of up to 12.6x (with real magnitude of 120x), computer digitization and processing of optical images. During further polish analysis a Zeiss-Axiotech microscopic-computer kit was applied, enabling a limiting magnitude of up to 50x (with real magnitude of 500x). All the photos were made with a Carl Zeiss™ SteREO Discovery V8 microscope (with magnification range of up to 80x) with an Canon A620 camera attached.

A comparative basis for the conducted interpretations was formed by a collection of over 100 experimental flint tools, used in bone and antler processing, as well as several tens of artefacts made of osseous materials, employed in the course of experiments in various household activities. This collection is deposited at the Institute of Archaeology, Nicolaus Copernicus University in Toruń.


BONE HARPOON HEADS: THE RESULTS OF MORPHOLOGICAL AND TYPOLOGICAL ANALYSIS

Both harpoon heads can be classified as Gnieźniewo type – type 5 according to Clark (Clark 1936: 117, fig. 41; Galiński 2013: 139; Mrózynski and Olszewski 1995: 53). Apart from Wiele, Gnieźniewo type harpoons are known in Polish archaeological collections from eight sites: Góra Orle, Gniezno (two points), Ostrowo, Bolków (two points), Osowa Góra, Lake Wiecianowskie, Ujście and Nowe (Galiński 2013; Kozłowski 1969). Generally, harpoon heads of this type are characteristic for the Northern Mesolithic cultures. They are most common in Denmark, Mecklenburg, Brandenburg and Pomerania. Single specimens are also known from the area of Kaliningrad, Estonia and Latvia (Kozłowski 1969: 138-139). The spread of this type of harpoon heads is associated with two large early Mesolithic cultural complexes: the wider Maglemosian culture and the complexes of cultures gathered around the coast of the Baltic Sea (David 2007: 42-44).

The Wiele harpoon heads are quite similar to each other. Specimen 1 has a delicate, well-formed single barb and a flat cross-section (Fig. 4). It is 21.0 cm long, 2.2 cm wide (at most) and 1.2 cm thick (at most). At the base a single natural perforation of 0.3 cm in diameter is located. Similarly, specimen 2 has one well-formed barb, a flat cross-section and at the base a single natural perforation of 0.4 cm in diameter is located (Fig. 6). It is 19.5 cm long, 2.6 cm wide (at most) and 1.2 cm thick (at most).

According to the findings of an archaeozoological analysis conducted by Daniel Makowiecki (Institute of Archaeology, Nicolaus Copernicus University, Toruń, Poland) both harpoons were made of red deer (Cervus elaphus) long bones - in anatomical terminology, the left and the right metacarpal bones (III et IV, dexter et sinister) of mature animals over 3 years old. Both artefacts are made of the plantar surfaces of the bone (Mrózyński and Olszewski 1995: 50).

MANUFACTURING TRACES

The performed microscopic analyses led to the identification of structural damages resulting from different operations carried out during the production of the harpoons. The study of the damages enabled an interpretation of this process and a determination of similarities and differences between the two specimens in this matter. No use-wear traces were observed on the artefacts.

Specimen 1 (Fig. 4)

The earliest stage of the harpoon production shows traces of knapping and preliminary breaking out the bone fragments, noticed on its base (Fig. 5A). The bone was probably split with wedges, which left small barbs (Fig. 5B) and breakings with hinge terminations (Fig. 5C) on its side. The characteristics of the observed traces suggest that the wedges used were semi-circular in outline and about 8 mm large. The processed bone was probably well softened at this stage. The next phase of harpoon production was the preliminary whittling of the more considerable roughness of the surface that remained after the use of the wedges (Fig. 5D). Then, the entire surface of the artefact was probably scraped intensively along its axis with a flint tool (Fig. 5E). Today, traces of this activity are visible only in the base part of the harpoon head, approximately at half of its length. The base of the implement was cleaned with utmost care. The scraping was performed probably with use of a retouched toothed tool,
which left on the bone traces in form of plastic streaks. At this stage of processing the bone must have been only slightly softened, which can be concluded basing on the sharpness and the inner linearity of the traces left by flint tools (Fig. 5F). During the scraping also a kind of blunt groover was probably used, leaving on the bone traces in form of narrow plastic streaks oriented diagonally to the axis of the implement, visible at its base. On the head of the bone traces of sawing forming V-shaped cuts can also be observed (Fig. 5G). Their origin is not clear. They can be intentional or they might have been formed during the bone cleaning process. The surface of the harpoon head was ground only in its upper part. Traces of this activity are almost illegible (Fig. 5H) due to highly precise polishing of this part of the tool (Fig. 5I). Both operations were carried out longitudinally and perpendicularly to the orientation of the specimen. Both sides of the point barb were made in a slightly different way. It was sawn from two directions on the inside part of the bone, creating a V-shaped groove (Fig. 5J). Additionally, the shape of the barb was emphasised with a cut parallel to the axis (Fig. 5K). On the outside, the barbs were probably formed by whittling.

**Specimen 2 (Fig. 6)**

The early stages of this tool production were probably quite similar to the example described above. The bone was split with wedges (Fig. 7A) and the created surface was smoothed with a narrow-edge chisel-type tool or simply by knapping. Traces formed during these activities are almost identical to those observed on the first harpoon head, though better preserved. At the contact surface of the split and the outer part of bone one can notice a narrow plane with perpendicular striations, suggesting, that after the use of wedges, the uneven parts of the surface were sown (Fig. 7B). This type of activity applied instead of ‘classical’ whittling combined with the features of traces suggest, that the bone was already slightly softened or not softened at all. On the surface of the harpoon head no scraping traces of better readability were observed.
Only at the top some striations can be noticed, probably resulting from use, yet the morphology of these striations (narrow plastic streaks) indicates they were created with a narrow-edge burin/groover (Fig. 7C). Traces of the use of these tools are visible also on the underside of the harpoon head between the ground part and the polished part. Most probably, directly after splitting the bone, the semi-product of the harpoon head was ground intensively on its upper part (Fig. 7D). The grinding covers the entire surface of this part of the tool except for the inside of the bone, though also here, in certain places, e.g., close to the natural perforation (Fig. 7E), in the middle part of the tool (Fig. 7F) and on the fragments of the splinted surface, traces of grinding were observed. The described activity was performed with use of a classical plate and, probably, a narrow-edged tool, which can be concluded basing on the multidimensionality (at small width) of the traces visible on the inside (concave) of bone (Fig. 7G). Starting from the mid-length, the grinding on the upper part of the harpoon head was followed by a very precise polishing, less invasive than in the specimen described above (Fig. 7H). The harpoon barb was shaped on the outside by whittling (Fig. 7I) and on the inside it was additionally improved by sawing (Fig. 7J).

MANUFACTURING CHAÎNE OPÉRATOIRE OR STAGES OF PRODUCTION

Microscopic analysis of manufacturing traces on the original point allows reconstruction and drawing of some preliminary conclusions about activities that take place in the course of the tool production process. However, such traces are always incomplete, lacking the full spectrum of possible actions. So far, more comprehensive analyses for reconstructing the technological process of manufacturing the Gniewino type harpoons have not been conducted. It is therefore difficult to make here far-reaching assumptions pertaining to the location of the analysed specimens, with this regard, among other known artefacts of this sort. However, in the future, observations made as a result of the conducted research (currently applicable
only to the described harpoons) may constitute an important element of a generalising technological analysis. Unfortunately, at this moment, performing such analyses is impossible. In summary, having taken into account the information obtained from the studies on both harpoons, the following conclusions considering the sequence of operations carried out during the production process can be drawn:

a) The earliest stage of the harpoon production is connected with traces of knapping and preliminary breaking out fragments of the bone.

b) The subsequent stage of the process was splitting the bone with wedges, which left small barbs and breakings with hinge terminations on the inside of both harpoons.

c) Next, the surface of the artefacts (in both cases probably to a different extent) was scraped along its axis with a flint, probably a retouched tool, and later ground on fine-crystalline plate and polished.

d) The last noticeable stage of production was creating the barbs, which were made with use of a very specific technique. Both sides of each barb were made in a slightly different way. On the inside of the bone it was sawn from two directions, creating a V-shaped groove. On the outside, the barbs were probably formed by whittling.

In the course of the analyses some differences between the two artefacts were also observed. The raw material of which they are made was probably in both cases softened to a different extent. It seems, that different techniques and tools were applied with aim to compensate for burrs and irregularities formed in the course of the bone splitting process. In case of one artefact the said tool was a saw, whereas in case of the other – a whittling knife and a scraper. The above-mentioned differences in the intensity of the use of scrapers in cleaning the surface of the specimens and in the degree to which the points were polished are also interesting. It seems unlikely that they result from technological causes, i.e., due to both tools being at different stages of the production chain. Probably, this problem could be solved after more Gniešwino type blades are examined.

IMPLEMENTS’ FUNCTION

The conducted microscopic analysis led to a number of well-readable technological damages being recorded, whose characteristics may serve as a basis for future comparative analysis and interpretations of the manufacturing process of this type of points. Undoubtedly, both analysed harpoons were made with utmost precision, probably with use of many specialist tools. One ought to notice, that the production of the described harpoon heads was strictly connected with the knowledge of the natural shape of raw materials, which may be proven by the use of bone plantar surfaces as a half-product (which, unlike dorsal surfaces, are definitely flatter) and the natural perforation in making the harpoon base.

Most of the applied techniques are more or less analogous to the ones used in other artefacts of this type dated to Early and Middle Stone Age. In the Polish collection (in general terms) similar sequence of operations was performed, for example, in the production of the Late Glacial bone point found near Wiele village on site in Lisi Ogon (Orłowska and Osipovich 2015). The traces of the wedge-splinter technique identified on the harpoons are characteristic for the North-eastern Mesolithic and represent the manufacturing ‘tradition’ – the so-called Zamostje method (David 1999: 355-358). However, analogies with regard to the use of this technique were provided by a significantly greater collection of Early Mesolithic implements, covering almost the entire Europe, including Estonia: Pulli and Kunda Lammasmägi (David 1999: 382, fig. 241; 2005); Russia: Ivanovskoje 7 (Skakun et al. 2011), Ozerki 5 (Zhilin 1998), Zamostje 2 (David 2006; Lozovskaya and Lozovski 2013), Latvia: Zvejnieki 2 (David 2003), as well as areas of Sweden: Ageröd 1 (David 1999: 570, PL.96), Germany: Hohen Viecheln (David 1999) and Great Britain: Star Carr (David 1999: 554-555, PL. 80-81). Despite highlighting this technique mainly in the Mesolithic, its roots should be traced to early Allerød (Terberger 1996: 19, fig.5).

In order to summarize the conducted analysis, one should also reflect on the nature of the deposit of Wiele points. The fact, that they were found in the profundal zone of the lake at the shore may be related to the intentional use of these tools. Such harpoon heads with a single perforation at the base (by means of which a rope can be fastened to the tool) were probably affixed to the top of a javelin. Thanks to the rope - fastened to a shaft or held by the hunter – at the moment of hitting a prey with the harpoon, the shaft was released and it was able to control the animal with the rope. Another option was to attach various objects at the end of the rope in order to slow the prey down. They were used in hunting and fishing (Verhart 2000: 114). Both harpoon heads could have been lost, e.g., during pike fishing in littoral shallows in the Spring. Yet, there is also another possibility. Both harpoon heads were made in almost identical way and wear no use-wear traces. Taking this into consideration together with the location in which they were found and the relatively small size of the site, it can be suggested, that the two harpoons might be a deliberate deposit (a ritual offering?) of some sort made next to the camp, in the profundal zone of the lake. Such suggestions may substantiate a found in a short distance away, in the same area and probably at the same stratigraphic level an aurochs skull (Fig. 2). Of course, at this stage of research suggestions of this kind are only speculation that requires verification.

CONCLUSION

The example of harpoon heads from Wiele shows, that archival stray finds are very important in the study
of osseous technologies and interpreting the function of archaeological sites. Technological analyses give us a new view on the archival artefacts, which so far have existed in the literature very often in the context of typology, exclusively. The seemingly limited cognitive value aside, they are a very significant source of information. In many cases these objects may wear distinctive traces that facilitate assigning them to particular technological traditions or historical periods, complete and enhance our existing knowledge of the issues related to the processing of raw bone material. Similarly, the use-wear traces, whether observed on tools or not, very often help to interpret functions of selected artefacts or even entire sites.

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BONE FIBULAE AS GRAVE GIFTS IN UPPER MOESIA

Sofija Petković

Abstract: This paper deals with the bone specimens of Roman fibulae in Moesia Superior. Although, some parts of some types of Roman brooches were made of bone or ivory, it is quite unusual that whole fibula, or its major part is manufactured of osseous material. Generally, bone fibula would not be functional – it could easily break or bend, especially considering the composite construction of Roman brooches. The reason for the use of bone material for the production of fibulae may be their ritual character. Namely, in Upper Moesia Roman bone brooches were discovered only in burial context, as grave gifts.


Roman fibulae (also known in the literature as brooches) were made in great variety of forms and types, evolving over nearly one millennium. Different materials, mainly metals and metal alloys were used in their manufacture. More rarely, osseous materials were used in the production of fibulae. Although, some parts of some types of Roman brooches were made of bone or ivory (Riha 1979, 26, 184-185, Typ 7.7, Typ 7.9, Abb.59, 1562-1568, 1577; Bíro 1987, 35-36, Fig. 85. 145/765-3), it is quite unusual that the whole fibula, or a major part of it, would be manufactured from some kind of osseous material. Generally, if we take into account its functional aspect, a bone fibula would not be too useful – it could easily break or bend, especially considering the composite construction of Roman brooches. Nevertheless, some other Roman items, usually made of metal, have also been made of bone, antler or ivory such as like belt buckles and strap-ends or chest plating (Bíro 1994: 22, Pl. VIII, 48-40; Petković 1995: 39, T. XXV, 6-9; Deschler-Erb 1998: Katalogband, 324, 330, 333). These items were substitutes for luxurious, expensive objects and ornaments made of precious metals, gold, silver, gilded bronze or bronze, artistically cast and engraved. However, this must not have been the only reason for manufacturing bone brooches, as such fibulae were mostly simply cast objects made of bronze or brass. There must have been another reason for the use of osseous materials in their production. Leaving aside functional and economic reasons for the manufacture of bone brooches in Roman period, such brooches may also have had a special symbolic value. Since their origin, fibulae had a symbolic significance as social, cult or religious designations, a kind of ancient badge (RGA, Fibel und Fibeltracht, II, § 2-5, 11). In this context, the case of bone fibulae found in the territory of Upper Moesia (Moesia Superior) may shed light on one aspect of this problem. Namely, such brooches were found only in burial context as grave goods.

Among the Roman brooches from Moesia Superior we noted two specimens made of bone. The first one is a knee-fibula completely executed from bone, discovered in a rich tumulus – the grave of a Thracian woman in Ulpiana, dated to the first half of the 3rd century AD (Čepošić 1986: 179 et sequ. T. I, 2-3) (Fig. 1). The second fibula, in the shape of a dove, comes from a cremation burial in Viminacium and dates to the second half of the 2nd – the first half of 3rd century AD. This bone fibula has probably once had a bronze spring and pin. (Fig. 2) Both burials belonged to the type of cremation grave reflecting a strong indigenous tradition, in the first case in Ulpiana, Thracian (Čepošić 1986: 186-187), and in the second case a Dardanian or Triballian background in Viminacium (Golubović 1998: 251-253). These fibulae may reflect autochthonous beliefs about afterlife. In the case of these brooches the reason for using osseous materials in their manufacturing may well be their ritual character.

Bone brooches from Moesia Superior belong to two ordinary types of Roman fibulae, very often found at our sites. The brooch from tumulus in Cerkesko polje – Ulpiana belongs to the hinge knee-fibula type, known as type Petković 19 C (Čepošić 1986, Petković 2010: 144-146, 421, 433, T. XXVI, 5-8, T. XXVII, 1-2, Tabele 5, Map 7) and the specimen from G1-27 from a grave in the necropolis Višeg grobalja – Viminacium is a zoomorphic fibula in the shape of dove, type Petković 25 C (Golubović 2004: 83, Pl. I, 5; Redžić 2007: 53, kat. 275, T. XXIV, 275; Petković 2010: 202, T. XXXVII, 1-8). Since these objects were found in rich burials with luxurious grave goods, the economic reason for use of bone to manufacture a fibulae (bone as a cheaper raw material) is not feasible.

1 M. Bíro identifies a fragment of a bone bird fibula found in the area of nymphaeum in Gorsium as a representation of a magpie although this brooch has rather had form of an eagle or a dove, both familiar decorative themes in Roman minor art.

2 Deschler-Erb 1998, Text und Tafelband, 5-87. – The author discusses the symbolic meaning of different kinds of osseous raw material.
A cremated woman of a high social rank was buried in the Ulpiana tumulus. The grave comprised a rectangular two-level pit, similar to the simple cremation burials in Moesia Superior of the same period known as burial type Mala Kopašnica II (Garašanin 1968, 6-16; Zorobuih 1968, 25-27; Јовановић 1984, 103-105). The burial pit measured 3.10 x 2.10 x 0.80 m while the lower level – the inner pit, that is, the grave itself in the narrow sense (1.40 x 0.40 x 0.50 m), had sides built of tegulae and a cover comprising two stone slabs. Nevertheless, a large mound (R=30 m, h=5 m) was erected over the grave and various luxurious utensils were placed inside the burial (Срејовић 1986: 185). Grave-gifts were placed inside the built grave after the cremated remains of deceased were placed, gathered in a luxurious purple cloth with golden thread. In addition to ceramic and glass vessels, silver and gold jewelry was discovered in this grave, a pair of gilded sandals and two silver boxes, as well as a gilded silver spindle and also fragments of a bone spindle (Срејовић 1986: 180-185, T. I-IV). The grave goods indicated that the deceased was female although unfortunately anthropological analysis has not been carried out. If we assume that these Late Roman grave goods were the property of the deceased woman (or at least objects appropriate for her age, gender and social status), it is interesting that she used two spindles with whorls, the silver one and another made of bone. However, there is another explanation for the deceased receiving two spindles in her burial – one of

3 D. Srejović considered this burial to be a bustum, but the evidence shows it is more likely an ustrinum. As in Mala Kopašnica II graves, the sides of the burial pit were burned, but the amount of carbonized wood and ashes found in the pit was too small to have come from a bustum type burial. Also, the jewelry of deceased as well as other grave-gifts were untouched by fire. The objects were placed in the grave together with the cremated bones and ashes brought from the pyre.

4 Originally, finds from this grave were held in Museum of Kosovo and Metohija in Priština. Some of the grave-goods were brought to Belgrade in 1998 to be presented at an exhibition of Serbian Academy of Science and Art Arheološko blago Kosova i Metohije od neolita do ranog srednjeg veka (Archaeological Treasure of Kosovo and Metohija from the Neolithic to Early Middle Age) and were never returned back. These finds are now held in the National Museum in Belgrade. Unfortunately, the bone items from the burial remained in Museum of Kosovo and Metohija and were lost during the civil war in 1998-1999.

5 The cremated remains of deceased were lost during the civil war 1998-1999.
them (the silver one) could have been used by the dead woman during her lifetime, but the other, made of bone, was put in the grave as a grave-gift, designed to be used by deceased in her afterlife (ad usus mortuum). Silver as material symbolize Moon, water, fertility and female principal, and, in a way, is connected to the underworld. Bones were, from prehistory, the symbols of the underworld and death, but also they symbolize rebirth. In the case of Ulpana grave luxurious silver spindle as well as bone spindle could be used in her lifetime, but the bone fibula was definitely manufactured for the “underworld use”. In this case osseous material symbolizes imperishability, permanence and eternity. The same meaning, but perhaps even more accentuated could have been given the bone fibula from the same burial as it is a completely unusable item. The bone fibula might have been used to fasten clothing if it had had a metal pin and spring mechanism, but the bone pin and bone hinge-mechanism it was equipped with would have made its practical use impossible. (Fig. 1) In some way it represents a model of a fibula made of bone. 

Grave G1-27 from the necropolis of Viminacium at the site of Pećine also belongs to the Mala Kopašnica II type of cremation grave. According to S. Golubović, this type of grave in Viminacium (type Viminacium III b) should be considered to be a provincial Late Roman form combined with an autochthonous (Dardano-Mysian or Triballo-Mysian) tradition (Golubović 1998: 251-253). The anthropological analysis was carried out in this case but the age and gender of the deceased could not be estimated (Golubović 2004: 82). In addition, the grave finds have not yet been published, except for a general statement that the bone fibula was found together with “several ceramic vessels dated to 2nd century” (Redžić 2007: 53, kat. 275, T. XXIV, 275). There are drawings in the documentation materials of the archaeological excavation from 1978 at the necropolis of Pećine. The documentation includes descriptions (C – charts) of two jugs and two ceramic lamps. Three more pottery items were noted (one more jug, a pot and a plate). Based on the types of these jugs and lamps, the ceramic finds from grave G1-27 could be dated to the second half of the 2nd – first half of the 3rd century AD (Brukner 1981: 114, 116, T. 137, 50-51, T. 142, 103; Račišić 2011: 131, T. XVI, 13-14; Kruijff 2011: 64-70 , type VIII 2 a; 91-98, type X).

Comparing these two sets of burial data connected to the archaeological contexts of bone fibulae finds from Moesia Superior, beyond the form of the two-level grave-pit and the dating in the 2nd-3rd century AD, we are confronted to two quite different concepts – a tumulus-grave of a wealthy woman at Čerkesko polje – Ulpiana and the simple Mala Kopašnica II type grave at Pećine – Viminacium. Nevertheless, these burials originate from the Dardanian Mala Kopašnica I type grave which developed from the indigenous cremation graves during the 1st century AD (Jovanović 1984: 105-106). New excavations at the Mala Kopašnica – Sase type of necropolis in Mala Kopašnica near Leskovac and in Davidovac near Vranje confirmed this hypothesis (Petković 2012: 88; Stamenković 2013: 59-63; Ivanšević, Stamenković 2014: 71-73; Petković 2016: 324-334, Plans4-5, Figs. 1, 18-19, 21). At the site of Davidovac – Gradište 39 cremation graves, among them burials from the earliest phase of Mala Kopašnica I type burials with elements of autochthonous burial practices (burning on the sides of grave, remains of a funeral feast within the grave or among a group of graves, placing weapons in grave, etc.) (Petković 2016: 328). On the other hand, two-level burial pits placed underneath a tumulus should not be considered originally a Thracian form, although they are numerous in the Eastern Balkans (Thracia, Moesia Inferior, Dacia Ripensis), because both elements, tumuli (Garašanin 1968: 18-23; Gélov 1970: 7-8; Jovanović 1984: 112 et seq.) and two-level grave-pits (Garašanin 1968: 18-23; Jovanović 1984: 112 et seq.) were appropriated from other cultures. Such graves only appear after the Roman conquest of the Balkan Peninsula in the 1st century AD. It is important to emphasize that during the protohistoric period, there was an intense exchange of economic, political and religious traditions between the Balkan tribes (Papazoglu 2007: 334-394). This process resulted in the synthesis of their cultures in the Late La Tène period (Iron Age), which comprises the Early Imperial period, in the 1st – mid-3rd centuries AD (Petković 2012 b: 75-77).

An interesting attempt to define ethnic and territori-al borders among the Iron Age tribes of Central Balkans based on burial customs was carried out by Dragoslav Srejović (Cpejović 1979: 79-87). The evidence from the distributions of different burial forms indicated the presence of three zones, among them a middle territory that supposedly were inhabited by the Dardani and Triballi tribes. This territory, generally comprising the Morava Basin, was indeed confirmed in Greek and Roman sources as the region inhabited by these tribes (Papazoglu 2007. 47-54, 143-161). In the Roman period this was the territory of the province of Moesia Superior, later divided into Moesia I, Dacia Ripensis, Dacia Mediterranea and Dardania. The names of Late Roman provinces reflect these former ethnic communities, keeping in mind that the Moesia were very similar peoples to the Dacians and the Triballi to the Dardanians. Nevertheless, the grave at Čerkesko polje- Ulpiana could be considered a burial proper to ones from Dardanian territory and the grave at Pećine – Viminacium was found inside a large necropolis in the capital of province. In first burial, the ritual character of bone fibula is more obvious because the item has no functional value of the item and given the luxurious gold and silver grave goods from the same grave. In grave G1-27 at Pećine, except for the ceramics, only the bone dove-fibula was found and this item could be used as a brooch if it had had a bronze or silver spring and pin.

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6 At this point, I must express my gratitude to my colleague Saša Redžić, Ph.D. for the verbal information.
On the other hand, doves were familiar symbols on Roman tombstones in the Central Balkans, where the dead women were represented holding them in their hands. The dove symbolizes the soul of the deceased, especially a pure soul. Also, it was an animal devoted to an autochthon goddess, together with dogs, snakes and goats based on evidence from sets of female silver jewelry (Петковић 2012b: 72-77, Fig. 2, Figs. 4-6, T. V, 2). These sets always comprise a pair of brooches, anchor-fibulæ (Петковић type 15 C) or knee-fibulæ (Петковић Type 19 C), connected by silver chains with pendants in the form of ivy-leaves. They are often found in sacred hoards of silver items and coins, discovered in the territory of Upper Moesia and Dacia, marking the migration of the indigenious mining population in the first three centuries AD, probably the Dardanians or some other Illyrian tribe (Петковић 2012b: 65-72). Thus, it seems likely that the cremated person buried in grave G1-27 containing the bone dove-fibula as a grave-gift was a woman or a girl.

It may be concluded that both burials with bone brooches belonged to deceased women, cremated at us trium and buried in two-level grave-pits. This may mark these graves as created for funerals taking place in an indigenous tradition, including the items manufactured from bone (brooches, spindle whorls, etc.) meant as grave-gifts designed for the afterlife.

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ROMAN BUCKLES MADE FROM BONE AND IVORY DISCOVERED AT THE SITE OF VIMINACIUM

Saša Redžić

Abstract: In this paper will be presented three buckles, two made from bone, and the third made from elephant ivory. All three were discovered within graves of Viminacium necropolises. Bone examples were fastened with the belt buckle tang, also made from bone, which was fastened with buckle ring by a metal shaft. Third belt set consists of ring-shaped buckle and a calotte-shaped button made from elephant ivory. Also, two fittings made from copper alloy belong to this belt set. Based on the representations on the funeral monuments, the reconstruction was made of belt sets of this type – first pierced ends of leather belt pass through the buckle, and then they are attached to the buttons. After relatively large number of buckles that have just one button, as the case with here presented belt set, it may be assumed that one end of the leather belt was permanently attached to the buckle. For the above mentioned ring-shaped buckle from elephant ivory, only analogies exist at the site of Dura Europos in Syria.

All three represented finds are considered to be equipment used by military. However, such an interpretation is now questioned, since the two bone buckles were discovered in children graves. Apart from these buckle, in children graves are also encountered bone belt frames, and a common offering were also crepudia necklaces, which consist of mollusc shells, marine snail shells, perforated canines of predator animals, and pendants in a shape of falus or made from bone or copper alloys. The fact that these artefacts were made from organic materials and have magic-apotropaic role, suggest that perhaps here the interpretation should be sought.

The Roman city of Viminacium was situated in the vicinity of present-day village of Stari Kostolac, at the confluence of the river Mlava into the Danube. Viminacium was one of the most important military and civil centres in the Moesia Superior. The camp of the Legio VII Claudiae was erected at the right bank of the river Mlava, and was settled almost continuously from 1st to 4th century AD. A civil settlement devolped in the vicinity of the military one. The archaeological site is endangered by the building of the power plants and constant exploitation of coal, therefore, extensive rescue excavations, started in mid-20th century, are still on-going. Excavations unearthed rich and diverse remains from the settlements, military camp and in particular from necropolises - at southern necropolises nearly 13 000 graves were excavated with over 30 000 artefacts (cf. Golubović 1999, 2004, Korać and Golubović 2009, and references ththerein).

Hereby we shall present three buckles, two made from bone, and the third one made from the elephant ivory. The oldest here presented specimen was made from bone

Figure 1. Buckle no. 1
and is in the shape of pelta (Figure 1). The buckles of this kind were fitted by a hinge with belt fitting. The base of the hinge is metal and bone tang is missing on our specimen. Cross-beam of this buckle, 4,5 cm wide, was cut in the middle, and from the interior it had a volute decoration.

Similar bone buckles are known from Vindonissa (Unc, Deschler-Erb 1997: Tafel 44, 1194-1209) and one specimen is kept in the National museum in Wales, dated into period before the dynasty of Flavii, according to the context of its discovery (Chapman 2005: 117-118, Sg24). Also should be mentioned one similar specimen from Spain, from the site Herrera de Pesuerga (Fernandez Ibanez, Cavada Nieto 2005: 213-214). Buckles of this type were much more common in metal and as such were used mainly by soldiers throughout the Roman Empire during the Early imperial period. This chronology is confirmed here by published specimen discovered in the child's grave, along with the coins of the emperor Traianus.

The variant of buckles in a shape of letter D, into which our second here presented specimen belongs, probably represents most widespread type, not just during the Roman times, but also in times that followed its collapse. Their use during the Roman period was very diverse, so the identification of their belonging to a certain belt sets is not always an easy task. Here I shall mention some of the possible use of buckles in the shape of letter D. Apart from fastening the belt sets, they may also be used for fixing parts of military equipment. They can be also used for attaching the sword to the belt, for fastening the armour of lorica segmentata type, and may also be present of the neck protective pieces in some types of Roman helmets. Utilitarian value of these buckles may be also seen on shoes, as well as on the horse equipment (Redžić 2013: 76).

The ends of bone ring of our buckle is modelled in the shape of letter D, and are perforated so the spindle, made from copper alloy and used for attaching the bone tang, can pass. (Figure 2). Analogies for these bone finds are unknown, although the copper alloy specimens were widespread throughout the Roman empire.

S. Hoss believes that the buckles of this type, made from metal, enter into use during the reign of Augustus, and during the reign of the dynasty of Flavii their use was in decline. She also states that that during the first half of 1st century were worn by members of cavalry units (Hoss 2009: 320). One specimen of this type was found in Emona, in the burial context along with the coins of Domitianus (Petru 1972: T.XXIX, G-450, 22), and similar pieces of various sizes are often encountered in Pompeii.

Three specimens from Viminacium, made from metal, were discovered in closed contexts and were dated by coins. Out of mentioned buckles, two were discovered in shaft graves along with Vespasian coins, while the third one was discovered along with one coin dated into the reign of Nero, and the other approximately into 1st-2nd century AD (Redžić 2013, catalogue numbers 110, 111, 117). Here presented bone buckle was found in a child grave along with two coins, the later one belonging to Hadrianus reign.

Third buckle here presented has ring shape, and, unlike previous two, it was made from ivory. It belongs to...
the belt set which also contained one button with calotte-shaped head, also made from ivory, and two fittings made from copper alloy (Figure 3). This type of buckles is most often found with two buttons with calotte-shaped heads, which are used for fixing the entire belt set.

Based on presentations from grave monuments, it was possible to reconstruct the mode of wearing of this belt set type – the ends of belt strap were cut and pulled through the buckle, and then attached for the buttons (Figure 4). For the buckles discovered with only one button, as is the case here, we may assume that one of the ends may have been permanently attached to the buckle.

The only analogies for the ivory buckle, to my knowledge, are those discovered on the site of Dura Europos in Syria (James 2004: 76-77, Fig. 37, 47). As the previous two buckles, this one was also considered to be a part of military equipment, whose examples made from copper alloys or silver may be encountered throughout the Empire. Since they were much more common in the eastern provinces, this leads some of the authors to make a hypothesis that these objects were of Persian origin (cf. James 2004: 249-250). Also it should be noted that in western provinces the variants with the square shaped, also fixed by buttons, is much more common (Hoss 2014: 60-64).

D. Ciugudean dated these examples made from metal into early 3rd century until the end of its third quarter (Ciugudean 2010: 454) Concerning the dating of these belt sets in the graves of Viminacium necropolises, seven buckles of this type were discovered along with coins. Particularly should be noted one example found with the coins issued in the time of co-reign of Marcus Aurelius and Lucius Verres, and one buckle with bone button discovered in the grave with the fitting with inscription VTERE FELIX with the coins dated approximately into 2nd century. Also, one set was found with one coin from the reign of Calligula and one coin from the reign of Commodus as Caesar (172-180 AD). The remaining four graves were dated by coins from the 3rd century, with the latest one being the coins of Gallienus (Redžić 2013: 97). After all this data, I consider that the beginning of use of this belt set type should be moved to the last third of the 2nd century AD.

Very conspicuous is the fact that the findings of these buckles are distributed along the limes of the Roman empire, thus suggesting that the main consumers were soldiers. Direct evidence for this claim are representations on burial monuments, presented on Figure 5. To these burial monuments should be added two sculptures of soldiers from Apulum on which are clearly presented ring-shaped buckles fixed by buttons (Ciugudean, Ciugudean 2000: 214-215, fig. 4-5). However, every rule has exceptions, as visible on Viminacium necropolises, where one belt set was discovered in double grave of deceased of children age, and the other in a grave of a woman (Redžić 2013: 97). As mentioned above, buckles no. 1 and 2, which are considered to be the part of military equipment were also found in children graves. After these examples, we may
conclude that although the main consumers for these belt sets were soldiers, they were also sporadically used by other categories of Roman population which were clearly not soldiers by vocation.

The suggestion that the reason for wearing the bone belt sets by children is considerably lighter weight is refuted by the finds of metal belt sets. Apart from these buckle, in children graves a common offering were also mollusc shells, marine snail shells, perforated canines of predator animals, and pendants in a shape of falus or club made from bone or copper alloys. The mentioned finds from organic materials were often arranged into crepudia necklaces, and the fact that these artefacts have magic-apotropaic role (see Spasić-Durić 2008: 168-169), suggests that perhaps here the interpretation of the bone segments of belt sets should be sought.

CATALOGUE

1. Bone buckle with missing tang. Cross-beam is cut in the middle where interior volutes are created. A few more volutes are placed on the ring of the buckle. Finding place: Viminacium, the location Više grobalja, year 2009, C-12336. Dimensions: width 4.5 cm. Dating: 1st half of the 2nd century.

2. Buckle made from bone with copper alloy hinge on which a bone tang was placed. Finding place: Viminacium, the location Više grobalja, year 1984, C-2440. Dimensions: buckle length 2 cm, width 2.5 cm. Dating: mid-2nd century.

3. Belt set consisting of fragmented buckle and a calotte-shaped button and plaque-shaped foot made from ivory, as well as two hinges made from copper alloy; one discoid with a ring and the other rectangular-shaped. Finding place: Viminacium, the location Pirivoj, year 1997, C-32-33. Dimensions: buckle diameter: 9 cm; button diameter: 2.2 cm; diameter of a discoid hinge: 4 cm, ring diameter: 2.4 cm; rectangular: length 3.8 cm, width 3.2 cm. Dating: third segment of 2nd – second third of the 3rd century.

REFERENCES


PRODUCTION IN HAMWIC: SIX DIALS STRUCTURE 15

Ian Riddler
Nicola Trzaska-Nartowski

Abstract: Commodity production has been identified as a major characteristic of Middle Saxon England (c AD 670–870) but little evidence has been provided, as yet, of how it was undertaken within the four major pre-Viking wic sites. The waste materials associated with Structure 15 at Six Dials in northern Hamwic illustrate how antler, bone and horn were worked in conjunction across the period c 720–820. All three materials were worked together, with bone forming 70% of the raw material. Quantities of waste were dispersed across sixty layers within twelve pits. These pits were originally dug for a variety of purposes, and were subsequently adapted as rubbish pits. The worked bone waste is largely restricted to cattle metapodia, with small quantities of horse and caprine bone used on occasion, alongside red, roe and fallow deer antler, and whale bone. The lower fills have small quantities of waste and the largest deposits lie in the uppermost layers, suggesting that production may have intensified in the early ninth century. Shortly afterwards, the structure was abandoned, and production was centred on a smaller number of properties, each working at a more intense level.

A significant change of emphasis in discussions of the role of the English pre-Viking wic sites in the 7th to 9th centuries AD has seen a movement away from a focus on the exchange of prestige goods, towards an analysis of the circulation of bulk commodities (Hodges 1989: 84-5; Hamerow 2007; Moreland 2010). Concomitant with this important re-evaluation of the nature of material culture within these sites has come a consideration of production across them, their immediate hinterlands and beyond them into the depths of the countryside. Where rural settlements were once seen as serving the wic settlements and being slavishly dependent upon them, the wic settlements are now viewed (by some at least) as dependent on these rural settlements. For Moreland, for example, the wic sites owe their very origins to the intensification of production seen in the countryside from the late 7th century onwards (Moreland 2010: 227-8), whilst Hodges (2012: 61) has suggested that for northern Europe as a whole at this time ‘the majority of utilitarian commodities were manufactured in rural settings by craft collectives’.

Nonetheless, the wic sites, and Hamwic in particular, have usually been portrayed as settlements specialising in craft production. This production was either intensive (Hodges 1989: 84) or small-scale but intensifying either from c AD 720/730 onwards (Moreland 2010: 213 and 237-8), or in the early 9th century, driven by monastic aggrandisement (Hodges 2012: 133). Production has rightly been seen as an important component of the wic sites, but as yet, little supporting evidence has been provided for it. The Ipswich ware survey, for example, covers the distribution of the ware across eastern England and discusses production and consumption, but says little about ceramic production within Ipswich itself (Blinkhorn 2012: 90-9). Commodity production has been ably described for Lundenwic, but it is currently the only English wic site to have been comprehensively analysed and discussed in this way (Cowie and Blackmore 2012: 156-69; Riddler and Trzaska-Nartowski 2012; Fowler and Taylor 2013: 56).

There is little published evidence outlining the nature of commodity production within Hamwic, beyond the brief but important summaries provided by Morton (1992: 55-9) and Andrews (1997: 205-41). What commodities were being produced at Hamwic and how and where was this production undertaken? What was the scale of production, and for what purpose? For this settlement, the focus of study and publication to date has lain with ceramics, non-ferrous metals, glass and faunal remains (Hodges 1981; Timby 1988; Bourdillon and Coy 1980; Bourdillon 1994; Hinton 1996; Hunter and Heyworth 1998; Hamerow 2007). Recent published excavations have been located largely in the southern part of the settlement, with the exception of work at St Mary’s Stadium (Garner 2001;
Antler and bone working forms one of the most conspicuous elements of production across the 7th to 9th centuries in Hamwic and other English wic sites. In part, this is because waste materials of antler and bone are abundant within most of the wic sites, whilst being almost entirely absent from contemporary rural settlements (Riddler 2001; Riddler and Trzaska-Nartowski 2011: 124-5; 2012). This is a notable and significant reversal of the concept of rural craft production sustaining an urban population: in this case, the urban craftsman is the prominent figure, who may even have sustained the needs of the immediate hinterlands of the wic sites. Around 20,000 fragments of antler and bone waste have come from excavations in Hamwic, with over 70% of that material retrieved from the Six Dials area, in the northern part of the settlement. In looking for evidence of worked antler and bone production, therefore, northern Hamwic forms a major focus. Within the Six Dials area of the settlement worked antler and bone waste has been found on all of the excavated sites but particularly in the central area, within a site excavated as SOU31 (Andrews 1997: fig 4). Structure 15, one of the structures from that excavation, can usefully serve to illustrate the nature of antler and bone working in one specific part of the settlement, across a limited time period of c AD 720-820. It provides a small but significant illustration of the character and rhythm of commodity production in one part of 8th-century Hamwic (Figure 02). The method of analysis adopted here is the same as that utilised for a contemporary assemblage at Bedford Street in Lundenwic (Riddler and Trzaska-Nartowski 2012) but in this case waste assemblages can be directly related to a specific property.

Structure 15 lay well away from the two east-west streets at Six Dials and may have been approached from the west by an alleyway, part of which was excavated, although it is argued below that the main entrance lay on the other side of the building. Virtually all of the structure survived, unimpeded by subsequent pit digging, and it was slightly bow-sided in shape (Andrews 1997: 86). A small rectangular feature lay within the building and may have functioned as a storage pit. Andrews argued that the lack of further pits cut into the building suggest-
ed that it was built in the first half of the 8th century and lasted until well into the 9th century, if not later. Equally, however, there was no evidence for more than one phase of building and the antler and bone waste appears to belong to a single period of activity, extending merely into the early part of the 9th century. The structure may have continued in use beyond c AD 820 but from that point onwards it was not a workshop for antler and bone working; and it is conceivable that occupation ceased here when craft production came to an end in the early 9th century.

Structure 15 was surrounded by pits and worked antler and bone waste came from a number of these features, particularly those located on its western and south-western side, alongside smaller quantities of pits to the north, south and east (Figure 02). The proximity of the pits to the structure, as well as their shared alignment, suggests that they were closely associated with it. To the south, pits lay beyond the vestiges of a gravel area, and to the east a space 3m wide was devoid of any features, with just one pit close to the south-eastern corner of the building. The eastern doorway, extending out into this empty space, may have been the main entrance to the structure, with the majority of the antler and bone waste deposited close to the western doorway, within an area that functioned as a space for the deposition of disposable material culture.

Precise relationships between each feature are difficult to determine but the earliest pits appear to be 4603, 4605, 4614 and 4700. These pits were cut by features 4942, 4607, 4612 and 5232 (Figure 02). A short distance separates this group from two pits (4947 and 7520) lying to the west and north, both of which produced antler and bone waste of this phase. At the east a pit (4685) was partially excavated; its eastern half lay beyond the limits of excavation. It also contained a small quantity of waste attributable to this phase. A further pit (4807), close to the south-eastern corner of the structure, also produced antler and bone waste. Pits lying further to the south are associated with Structures 9 to 13, an area that produced the largest quantity of antler and bone waste from all of Hamwic.

Andrews (1997: 86) noted ‘the presence of large quantities of bone- and antler-working debris in the upper fills of several pits’ associated with Structure 15 but the situation is slightly more complicated. The earliest pits in the area (7502 and 5434) contained a few worked antler and bone offcuts and are associated with Structure 33, an earlier building built nearby on a different alignment. They belong to Phase 1, in terms of antler and bone working at Hamwic, of c 670-720. Pits to the west of Structure 15 cut into Structure 33, which had been abandoned by the time that Structure 15 was built, at some point in the first half of the 8th century. Twelve of the pits surrounding Struc-
Figure 03. Percentage Distributions of Ceramic Fabric Groups across selected features associated with Structure 15:
A. Feature 4603

Figure 03. Percentage Distributions of Ceramic Fabric Groups across selected features associated with Structure 15:
B. Feature 4605
I. Riddler, N. Trzaska-Nartowski, Production in Hamwic: six dials structure 15

Figure 03. Percentage Distributions of Ceramic Fabric Groups across selected features associated with Structure 15:
C. Feature 4614

Figure 03. Percentage Distributions of Ceramic Fabric Groups across selected features associated with Structure 15:
D. Feature 4700

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ture 15 contained antler and bone waste and the quantities from each feature are summarised in Table 01. The excavation strategy involved the excavation of just 50% of each pit and, as a result, the totals of waste provided in Table 01 reflect the quantities excavated, rather than the amounts originally deposited. Although an expedient method of excavation for its time, it creates considerable problems in attempting to quantify the scale of production, as noted below.

Waste was recovered from numerous separate layers within the features associated with Structure 15 and most of the layers contained quantities of ceramics, and occasionally also coins, allowing them to be phased with some accuracy. In previous texts, emphasis has been placed on the waste contents of individual features (Riddler 2001) but it is the subtleties of deposition within each layer, viewed across a number of features, that is more significant in dealing with this material. The phasing of the features is based in the first instance on two important monographs dealing with Hamwic ceramics, the results of which can be correlated with recent (and often revised) dating evidence for the fabrics present, obtained from other sites (Hodges 1981; Timby 1988; Blackmore 2003; 2012; Blackmore and Vince 2012; Blinkhorn 2012; Madsen 2004). The nine fabric groups established for Hamwic (Timby 1988: 74) can be expressed as percentage distributions by weight for the layers within each of the features that produced antler and bone waste (Figure 03). The pattern is similar (although not identical) across the diagrams for each of the features surrounding Structure 15. The lowest layers that provided waste materials are dominated by Fabric Groups 3 and 9, consisting of sandy wares and imported, largely Merovingian sherds. Above these, the layers show an increasing dominance of Fabric Group 2 (chalk-tempered wares) and a notable decrease in imported wares. The uppermost layers reflect the increasing presence of Fabric Group 4 (mixed grit-tempered wares), occurring alongside Fabric Group 2 and gradually supplanting it. This sequence of ceramics reflects change across the period c 720–820. The dominance of Fabric Group 4 in ceramic assemblages has been understood previously as an indication of ‘late’ contexts (Timby 1988: 114) and Andrews (1997: 86) suggested that some of the pits around Structure 15 may have been used up to the early 10th century, but the fabric dating has been revised here to indicate contexts of c AD 800–870, following the dating evidence for these wares subsequently provided for Lundenwic (Blackmore 2003: 236). A strong sense of continuity over time can be seen from the spatial distribution of these features and it is echoed by the nature of the antler and bone waste itself. Indeed, it is argued below that the character of that waste indicates its relative dating, as well as providing a sense of the scale of production.

A total of 1,349 fragments of antler and bone waste came from 60 layers within the 12 pits (Table 02). Most of the layers produced small quantities of waste, with only 15 providing more than 20 fragments and just 6 extending beyond 50 fragments (Figure 04). The quantity of worked bone waste exceeds the quantity of antler for

![Figure 04. Quantity of Waste from Layers within Features associated with Structure 15](image-url)
I. Riddler, N. Trzaska-Nartowski, Production in Hamwic: six dials structure 15

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Table 01. Quantity of worked antler and bone offcuts, by feature. CMW=Comb Manufacturing Waste

Figure 05. Quantities of antler waste, worked bone waste, worked whale bone, comb manufacturing waste and sawn horn cores from layers with ten or more offcuts associated with Structure 15

almost all of the 24 assemblages with 10 or more offcuts (Figure 05). Both bone and antler waste are present in all of these assemblages. For the 9 layers with 40 or more offcuts, the percentage of antler varies from 18.2% to 33.1% and the overall percentage of antler present is 29.8%. The initial impression provided by Table 02, therefore, is of numerous production episodes, mostly resulting in small quantities of discarded waste, which were deposited in
Close to the bone...

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**I. Riddler, N. Trzaska-Nartowski, Production in Hamwic: six dials structure 15**

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|            | 331 | 423 | 313 | 13 | 13 | 4 | 31 | 221 | 1,349 |

*Table 02. Quantity of worked antler and bone offcuts, by layer*
Close to the bone...

...pits located close to Structure 15. Just over 70% of the waste consists of worked animal bone.

A closer examination of the waste material reveals a little more about commodity production. The red deer antler waste includes 22 burrs and 20 crown off cuts, providing a minimum number of 22 antlers. The antler has an average weight of 5.1g. This figure is slightly lower than that for Hamwic as a whole, which is 6.0g (n=2,431), but the key point is that red deer antler was heavily worked and reduced to small, light fragments (Figure 06). Almost all of the antler waste can be identified as coming from red deer (*Cervus elephus* Linnaeus 1758), with the exception of a roe deer (*Capreolus capreolus* Linnaeus 1758) antler from feature 4614 and a fragment of fallow deer (*Dama dama* Linnaeus 1758) antler, securely stratified within feature 4700 (Figure 07). This is a remarkable find from an 8th-century Anglo-Saxon context, reflecting the very limited but gradually increasing evidence for the survival of fallow deer in post-Roman England (Riddler 2014: 3 and fig 5; Sykes and Carden 2011: 146). Its enormous rarity in England at this time may have made fallow deer antler a prestigious raw material, obtained (much like whale bone) under opportunistic circumstances; but rarity does not automatically equal value, and fallow deer antler was not necessarily prized as a material resource.

The most prominent component of the assemblages surrounding Structure 15 is the presence of the proximal and distal ends of worked cattle (*Bos taurus* Linnaeus 1758) metapodia. Worked metapodia were found in 33 of the 60 layers and form just over 30% of the total quantity of waste (Table 03 and Figure 08). It might be expected that the total of proximal off cuts for each bone type (the metacarpus and the metatarsus) would equate with the total of distal off cuts in each layer, but this was seldom the case and there are some large differences in numbers within certain layers. However, given that 50% or more of each layer was left unexcavated, it would be unwise to place too much emphasis on these disparities.

At first sight, the figures suggest that only small numbers of metapodial off cuts were discarded into individual layers and that production was mainly on a small scale. However, if the figures of Table 03 are doubled, on the...
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|        |        | 111 | 79 | 95 | 43 | 27 | 355 |

*Table 03. Cattle Metapodial Offcuts from Features Associated with Structure 15*
basis that 50% or less of each feature was excavated, then most of the layers have minimum numbers of two or more metapodia, up to an estimated total of 96 metapodia from feature 4614 layer 4615 and 120 metapodia from feature 4603 layer 4604. These represent more appreciable totals, indicating production on a larger scale, as noted also at the contemporary site in Bedford Street at Lundenwic (Riddler and Trzaska-Nartowski 2012: 87-8). Even without expeditiously doubling the figures, it is noticeable that 10 layers produced 15 or more metapodial offcuts. Within six of these layers, the minimum number of metacarpals is either the same as that for the metatarsals, or somewhat larger. The key point, however, is that worked cattle metacarpals and metatarsals are found together in almost all of these layers and were clearly worked in association.

Waste of species other than cattle is poorly represented and consists of small quantities of offcuts from horse (Equus caballus Linnaeus 1758) and from caprines, the latter probably sheep (Ovis aries Linnaeus 1758). Thirteen worked horse bone offcuts came from nine layers within five features. Nine of these are metapodial offcuts and the remaining four are from the radius or tibia. The thirteen caprine offcuts came from seven layers within four features and consist mostly of long bone offcuts, with the tibia more common than the metapodia in this case. The relative percentages of worked horse bone and worked caprine bone, both extending to 1.7% of the identifiable material, accord with the situation seen generally across northern Hamwic and Lundenwic (ibid: 78-9). Worked horse bone is more common within one area of south-eastern Hamwic (ibid, 77-8) but its occurrence otherwise equates well with the relative representation of horse within faunal assemblages from the settlement. Worked whale bone, a notable feature of Hamwic (Riddler 2014a and b), is restricted to four fragments recovered from separate layers within one feature. At Hamwic, whale bone would have been available on an opportunist basis as a direct consequence of strandings in the local area, and it may not have been provided to all antler and bone workers. It is well attested elsewhere in the Six Dials area and, although not as abundant as in the preceding phase of activity (c 670-720), was still widely used at this time, if not at Structure 15 (Riddler 2014b: 4-5 and fig 9).

Sawn horn cores form another component of the worked material associated with Structure 15. Nine of the thirty-one cores consist merely of small fragments, not readily identifiable to species. Of the remainder, eight of the cores are from goat (Capra hircus Linnaeus 1758), thirteen are from cattle and just one is from sheep. They were distributed in small numbers across nineteen layers within nine features.

Waste from cattle metapodia dominates the worked bone assemblage. Beyond the metapodia, the worked cattle bone extends to the occasional use of the radius and tibia, with most examples of these offcuts spread across ten layers within three features (Table 04). The tibia was a little more popular than the radius and its accompanying ulna. A sawn calcaneum is a rare offcut type both for Hamwic and for Anglo-Saxon England as a whole (Figure 09). The restricted range of worked cattle bone is echoed in the choice of metapodia, radius and tibia for the worked horse and caprine bone. Just over 40 fragments of cattle-sized rib bone were also identified, most of which had been trimmed to shape and would have formed mounts for caskets, although some could have been used on composite combs.

The possibility of the deliberate selection of large adult cattle bone by the antler and bone worker was examined for Bedford Street at Lundenwic by considering the quantities of fused and unfused cattle metapodia (ibid: 82). For both the distal metacarpus and the distal metatarsus, the quantity of fused bone from Structure 15 as a whole extends to around 88%, higher than the figures of 73.4% and 81.6% obtained for the assemblage from Bedford Street, and appreciably higher than comparable figures for unworked cattle bone. Widths of the fused distal metacarpus offcuts provide a binomial distribution, which can also be compared with Bedford Street (Figure 10). For that assemblage it was estimated that 45% of the metapodia were female and 55% were male. For Structure 15 at Hamwic the corresponding figures are 57% for females and 43% for males. Thus, a clear preference for adult cattle bone is indicated but there is less concern about the size of the bone than could be seen at Lundenwic. Knight's conclusion that the ‘diversity of sizes suggests that while larger bones may have been preferred for working, they were certainly not used to the exclusion of all others’ (Knight...
I. Riddler, N. Trzaska-Nartowski, Production in Hamwic: six dials structure 15

2006: 102) remains a pertinent summary of the situation across the 8th and 9th centuries within the English wics.

In summary, the waste assemblages from pits associated with Structure 15 provide a consistent image across the period c. 720 – 820. 70% of the waste material consists of worked cattle bone, most of which stems from metapodia. The remaining waste is formed of red deer antler, with the occasional and probably opportunist use of other species, including roe deer antler, fallow deer antler and whale bone. The waste also includes a small quantity of

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Figure 10. Widths at the condyles of worked cattle distal metacarpals from Hamwic Structure 15 and Lundenwic Bedford Street

Table 04. Worked Cattle Bone associated with Structure 15
Close to the bone...

horn cores, with cattle horn preferred to goat, and sheep horn used only on rare occasions. The dominance of bone over antler is a notable characteristic of features of this period in Hamwic. Antler is more common in assemblages of Phase 1 (c 670-720) and also in Phase 3 deposits of c 800-850. Where antler forms 30% or less of an assemblage in Hamwic, that assemblage is likely to date to the mid to late 8th century. The range of worked cattle bone is more confined than the near-contemporary assemblage from Bedford Street at Lundenwic or the material recovered from Chapel Road East in southern Hamwic (Riddler and Trzaska-Nartowski 2012, 77; Driver 1984; Riddler 1992). Within northern Hamwic, bone selection was largely confined to cattle metapodia. ‘Specific bones were chosen for particular purposes’ (Riddler and Trzaska-Nartowski 2012: 81) and the emphasis on cattle metapodia is a direct reflection of the manufacture of composite combs in this area of Hamwic.

In terms of commodity production, combs are the most common object type of antler and bone to be recovered from the settlement as a whole (Figure 11) and, unsurprisingly, they form the majority of the antler and bone objects recovered from the features associated with Structure 15 (Table 05). Unfinished fragments of combs (consisting of tooth segments cut to shape but not assembled), alongside waste from their manufacture (described here as comb manufacturing waste), were found in twenty-eight layers within eleven of the twelve features (Table 06 and Figure 12). The relative representation of antler within the overall total of waste associated with Structure 15 is 29.8%, yet it rises to 50% across this material, and the majority of finished comb fragments associated with Structure 15 are made of antler, and not bone (Table 05). Thus, waste material from the initial stages of working shows a dominance of bone over antler, whilst offcuts associated specifically with comb tooth manufacture, discarded at a later stage in the working process, indicate an even division between antler and bone. This may reflect the fact that antler was largely used in comb manufacture, whilst worked bone had other uses as well, particularly in the manufacture of pin-beaters, implements utilised in textile manufacture. In addition, it is quite possible that...
combs manufactured with bone connecting plates were equipped with tooth segments made of antler. Studies have shown that antler was the preferred material for comb tooth manufacture and the surprise, perhaps, is that so many tooth segments from Hamwic were actually made of bone and – on occasion – of whale bone as well (Riddler 2014b: 6-7).

The specific types of comb produced at Structure 15 can be extrapolated from the unfinished and finished items recovered from nearby features, as well as some elements of the waste material. They include double-sided composite combs, some equipped with relatively coarse teeth, a comb type produced in some numbers at Hamwic and found also at Quentovic. There is one example from Lundenwic, which was almost certainly made at Hamwic (Cowie and Blackmore 2012: fig 168 <S384>; Jean Soulhat, pers comm) (Figure 13). Alongside this type, there is plentiful evidence also for the manufacture of handled combs, produced in both antler and bone (Figure 14). A specific antler offcut type consists of a thin sliver of rectangular section sawn through the centre of a tine (Figure 15). These represent the channels cut through antler handled combs to accommodate the tooth segments. Each of these offcuts is, in effect, evidence for a handled comb, and twenty-nine were identified amidst the antler waste associated with Structure 15. An equivalent offcut in bone consists of a long, narrow sliver, once again sawn on either side; thirty-one examples have been recorded from Structure 15 feature layers (Figure 16). Bone handled comb manufacture can be identified also from the presence of modified condyles from the metapodia, alongside shaped offcuts that stem from the modelling of the comb
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Table 06. Unfinished Tooth Segments and Comb Manufacturing Waste from features associated with Structure 15
handle. These are less numerous but equally distinctive offcut forms.

A rough estimate of the quantity of bone handled combs manufactured within an assemblage of this period can be obtained by simply counting the minimum number of cattle metatarsals present, since this was the preferred bone type for this purpose (Riddler and Trzaska-Nartowski 2012: 88). It is a crude estimate, because metatarsals could also be used to produce comb tooth segments, rather than handles. A significant point about Table 03 is that worked cattle metacarpals and metatarsals tend to be found together in the same layer. This situation is seen within most layers and the few exceptions occur where there are just a few offcuts of either bone. Table 03 indicates that the two bones were generally used together and it can be argued that the handle of a handled comb was formed from the metatarsus, whilst the tooth segments were cut from the metacarpus. A pair of these bones would have formed sufficient raw material to create one handled comb. For Structure 15 as a whole, the minimum number of cattle metatarsals is 95 although this figure, of course, represents waste from only 50% of each feature. The figure is well beyond that of thirty-one obtained from one specific bone offcut type noted above, and probably provides a better indication of the level of production. There would be comparatively little waste from each handled comb, beyond the ends of the metapodia (Figure 08) and a range of fragments sawn from the bone midshafts (Figure 17). Thus, for worked antler and bone small quantities of waste do not automatically equate with small-scale production.

The antler and bone waste associated with Structure 15 forms an important assemblage because it comes from secure, relatively undisturbed, well-dated contexts and it shows how waste was dispersed from the workshop of a bone, antler and horn worker over a period of around a century. In analysing the contents of these pits the focus here has lain with individual layers, rather than entire features. Most – but not all – of the features immediately surrounding Structure 15 were used for the disposal of antler and bone waste, although they were initially dug for other purposes. Some of them would have been used for cess disposal, whilst others were dug to extract brickearth or acted as storage pits, and they were subsequently utilised as rubbish pits. Most of them would have remained open at any one time across the 8th century. On numerous occasions small quantities of waste, amounting to just a few fragments, were discarded, particularly in the lower levels of the features. Antler and bone waste may well have been discarded across several pits at the same time. A few pits (4612, 4685, 4942, 5232 and 7520) only received small quantities of waste, distributed across one to three layers. Beyond these lay four pits (4605, 4700, 4807 and 4947) with around forty to eighty offcuts coming from three to six separate layers, whilst the three largest assemblages come from features with five layers of waste (4607), eleven layers of waste (4603) and thirteen layers of waste (4614).

Not every layer in every one of these features contained antler, bone or horn waste and the largest quantities of waste tend to be concentrated in the upper layers (Table 02). This may indicate that production was intensifying across the late 8th to early 9th century, but equally these are the last assemblages associated with the structure and they could represent termination deposits, where the contents of the workshop (including curated material) were discarded. The first possibility is more likely in this case, because termination deposits normally include heavier, larger pieces of antler, as well as largely unmodified bone, and neither of these things are evident in these late layers. The assemblages closely resemble the remainder of the worked bone and antler waste from Structure 15, but occur in greater quantities. As such, they reflect 8th-century working practices in this area. The relative quantity of antler in these deposits is still around 30% of the total. Immediately to the south, extensive assemblages of 9th-century material show higher percentages of antler, extending up to 50% in some cases.
By looking in some detail at waste stemming from the manufacture of antler, bone and horn implements in one small area of 8th-century Hamwic, it is possible to tentatively refine the broad arguments presented by Moreland and Hodges. The recording of assemblages from a number of other workshops in Hamwic, currently in progress, will add a great deal of additional data to the current understanding and may well change the broad outline presented here. In terms of worked skeletal materials, there is a distinct change at Hamwic around c AD 720, with a transition from antler working to an emphasis on bone working. At precisely the same time, the range of combs produced in Hamwic changes. Earlier experiments in producing single-sided composite combs made from bone are abandoned in favour of the introduction of the handled comb, manufactured in antler but, significantly, also in bone. This period has been called ‘the Middle Saxon Bone Interlude’ (Riddler and Trzaska-Nartowski 2012) and the core of this interlude is the period c AD 720-820, with Hamwic and Lundenwic both providing important assemblages that usefully define its characteristics. The handled comb forms an important component of this interlude. The origins of this comb type almost certainly lie on the Continent in the late 7th to early 8th century but it develops rapidly from c AD 720 onwards to become one of the quintessential comb forms of Anglo-Saxon England. At Hamwic, commodity production in antler, bone and horn can be said to increase from c AD 720 onwards, largely because the number of workshops increases dramatically. Commodity production within each workshop does not increase at this time and stays at a fairly low level throughout the remainder of the 8th century. A number of workshops appear to come to an end in the early years of the 9th century and the latest assemblages of waste from them are usually the largest. The craft continues in other areas and may have been rationalised at this time, reducing to a smaller number of workshops, each manufacturing on a larger scale than seen previously in Hamwic. Thus, an increase in commodity production is accompanied by a rationalisation of production centres.

There is much still to be learnt about Structure 15, in terms of the other activities that occurred there, beyond antler, bone and horn working. It provides a small window into production circumstances within an 8th-century wic site and whilst it follows the broad and general outlines of commodity production, it also enhances them.

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A STRANGE BONE OBJECT FROM LATE ROMAN NECROPOLIS GLADNO POLJE IN BELA PALANKA (REMESIANA)

Mira Ružić

Abstract: Late Roman necropolis Gladno Polje was explored in 2011. It is situated on the plateau right above the river of Nišava. During the campaign more than 50 graves were excavated. According to archaeological material and stratigraphical and osteological analyzes data the residents of Remesiana were buried in the explored part of the cemetery during the mid-4th century. The unique and strange bone object was discovered in grave no. 1: arched in shape, square in cross section and with thinner ends each with two holes. We point out that the described item is the sole bone object from the grave units. A bone spindle whorl was found nearby but we assume that it might be a part of inventory of a female grave. Only a few antler objects were discovered in the economy building nearby dating from 4th–5th century.

Archaeological site Gladno Polje in Bela Palanka (Roman Remesiana) was explored during 2011 within the project of highway E 85 construction (fig. 1). Two unities from Late Roman period were excavated on the flat plateau up above the north bank of the river Nišava: necropolis situated right above the river and the economy building
north from it. According to archaeological material and stratigraphical and osteological analyzes data the building was in function during 4th and 5th century and its residents were buried in the explored part of the cemetery during the mid-4th century. A complex with tombs built of stone and brick on site Latinsko Grobište (that made a entirety with Gladno Polje) was explored in the same time.

Tomb complex is archaeologically known since the end of 19th century (Јеленић 1884: 80-81). Until 2011 two tombs were discovered. The first one was discovered in 1884 but unfortunately there are no traces of it today (Пејић 1982: 82). In the other, discovered in 1923, the rich grave items were found, but without bone or antler objects (Сариа 1925: 71; Поповић 2001: 85; Поповић 2009). Both constructions are from the mid-4th century. During 2011 campaign a new one was found (fig. 2). Two individuals were buried there: men and women, both 45 to 50 years old. No bone item was among numerous grave finds. This tomb was dated in the second half of 4th century and it is the youngest one in the complex (Ружић 2012, 353-354). Stairs carved out in limestone lead to the foothill of Ravanica where the remains of economy buildings were explored (fig. 3). According to stratigraphy and archaeological material analyze they were in function during 4th and 5th century and its inhabitants were buried on explored part of necropolis during mid 4th century (Ружић 2012: 357).

More than 50 graves were explored within the necropolis of Gladno Polje. The deceased were deposited in the simple rectangular graves in two ways: with head on the east or with head on the west. Grave finds and the position of the spikes inside the grave suggest that there were the wooden coffins. Beside adult individuals a great number of children were buried here, with pathological changes on the bones that confirm performing hard labor among the children. The inventory of the explored graves is usual for the period. Beside the personal jewelry (earrings, diadems, necklaces, bracelets, rings), clothing components (fibulae, sections of belt sets) and rare iron or bronze tools, the pottery vessel was always placed next to the foots and bronze coin put in the mouth or in the hand of deceased (Ружић 2012: 356-357).
The unique and strange bone object was discovered in grave no. 1 (fig. 4). It is a grave of a child. According to grave finds (two bronze bracelets, diadem) a girl 3 to 4 year old was buried there (fig. 5). She was placed in the coffin on her back and buried with her head to the east. The bone object we are speaking about laid next to her left foot. The item is arched in shape, square in cross section and with thinner ends each with two holes (fig. 6). At the first sight it seemed like a handle of a small bucket. According to the age of the girl buried there we could considered some other use of the object i.e. it might be some kind of rattle since we know that they were in use during antique time although different in material and shape (Layne 2009: 24-25). The grave insets had been put in the grave very carefully and we found them in situ: the bracelets on her hands, a diadem on the head. Likewise if this object is rattle we expect it in her hand. We do not find any similar object in the available literature. A well preserved bronze coin of Crisp, a son of Constantine the Great, not for long time in use was found next to mandible. According to it the deceased girl was buried towards the mid 4th century.

We point out that some raw materials, such as glass and bone or antler that were bountifully used during the 4th century are very rare in cemetery Gladno Polje. An antler spindle whorl was found out of grave context but we assume that it might be a part of inventory of a female grave (fig. 7). It is biconical in shape and decorated with concentrically incised lines on the both sides. According to literature this type of whorl was usual during the Late Roman period (Petković 1995: 43). The strange bone item mentioned above is the sole bone object found in the grave while the glass vessels also usual during that period are not present at all as a grave inset.
We can notice the same phenomenon in the archaeological material from the excavations of the economy building situated nearby. Among more than 750 objects mainly coins, parts of door locks, iron tools and rare glass specimens (mainly the flat glass from the windows) only three antler objects were discovered: the comb, the bracelet and the iron tool handle. Although damaged the comb can be reconstructed: it is the tripartite comb made of antler with profiled shorter sides and with two rows of teeth and the rectangular formwork ornamented with engraved concentric circles that was linked to the body with two iron rivet (fig. 8). This type of combs is frequent in archaeological material from Moesia Superior and surrounding provinces of Roman Empire (Popović 1987: 128-136; Petković 1995: 23). They were produced from the last third of the 4th until the mid-5th century (Popović 1987: 123). To the same period belongs a fragment of the antler bracelet (fig. 9). It is semicircular in cross-section and decorated with “buds” on the surface. The third antler object found in economy complex in Gladno Polje was a handle of an iron tool that is probably an bradawl according to the shape of the hole for the tool (fig. 10). Such small bradawls are numerous among the archaeological material from the site and so confirm its purpose. The handle is simple in shape and undecorated. This type of a handle is common in material during the various periods and Roman items are usually dated into the 4th or 5th century (Petković 1995: 48). All antler objects from economy building in Gladno Polje were found in the level dated to the end of the 4th or the beginning of the 5th century by the bronze coins of Valens and Valentinianus I.

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EARLY MEDIEVAL BONE TOOLS FROM NORTHERN CROATIA

Tajana Sekelj Ivančan

Abstract: This paper deals with bone tools found during archaeological excavations of six sites in northern Croatia. All these items present a pointed tip, but differ from each other: the main feature of the first group is a hollowed bone, while the second group is represented by a flat object. They were found in domestic archaeological contexts that can be dated between the 7th and the 9th centuries, and in a grave dated to the late 10th or the early 11th century. Both types of objects appear at the site of Torčec – Prečno Pole, almost at the same time, which, together with the differences in shape, suggests that each type was intended for a particular primary function. This implies that they should also be distinguished by terminology and therefore the term “bone thatching needle” is proposed for the first group of objects and “bone awl” for the second one.

In recent years, several systematic archaeological excavations of early medieval villages located in northern Croatian were conducted. The area in question encompasses the southernmost part of the Pannonian basin, surrounded by two rivers, Drava on the North and Sava on the South, both flowing into the Danube. During prehistoric and historic times, numerous cultures and communities have inhabited this area, and after the collapse of the Roman empire, diverse populations migrated through this region during the early Medieval times, and the predominance slowly gained diverse Slav communities. Since the beginning of the 7th century AD until the appearance

Map 1 - Map showing the sites where thatching needles were found - red: 1 Torčec - Prečno Pole; 2 Buzin; 3 Varaždin - Brezje IV; 4 Stari Jankovci - Gatina; 5 Stružani - Vršov; north; 6 Vukovar - Lijeva Bara; black: settlements dated to the 7th and the 8th centuries; yellow: settlements dated to the late 8th, 9th and the early 10th centuries; gray: early medieval settlement, not accurately dated
of new, western, Frankish empire at the end of the 8th and in the early 9th century, small, but permanent settlements begin to emerge, which are noted by recent archaeological researches.

In some features, bone tools were found, mostly made of hollowed sheep or goat tibiae bones, pointed at one side (Figures 1 and 2, Table 1, Graph 1). In scientific literature these objects are mostly referred to as bone awls or, less frequently, as bone thatching needles (Bartošková 2003: 230-233, Obr. 1-2). At the site of Torčec – Prečno Pole I, in Podravina (Map 1:1), various spiked bone objects were found in three features dated to the period between the first half of the 7th c. and the mid-8th c. Three of these objects were found in one feature (Figure 1: 1-3) and two similar in the second feature (Figure 1: 4-5) while the sixth object was recovered from the third contemporaneous feature (Figure 1: 6). This type of objects is usually made of hollow bones pointed at one end and sometimes perforated at the other, wider end in order to allow thatching fibres (Figure 1: 1). It is not possible to ascertain if the primary function of this thread was, for example, to attach this object to the belt, to thatch or for something completely different. These findings from Torčec were already examined and interpreted as tools for thatching wicker, straw or other plant fibres (Sekelj Ivančan 2010a).

Thanks to extensive field survey along the highway routes, as well as systematic research of some sites in northern Croatia, nowadays we have access to several examples of similar bone tools. Moreover, what motivated this article was the fact that, besides this group of objects, usually interpreted as tools for thatching plant fibres, at the same site a somewhat similar but distinctive object was found: a flat object with a sharp tip on one side (Figure 2: 15). The sides of the tip were polished. This artefact was found in a context dated to the very end of the 8th or the 9th ct. (Sekelj Ivančan 2010b: 249, T. 29, kat. br. 185).

Therefore, our aims were, on the one hand, to determine the primary function of both types of items that appear at the same site almost the same time, and, on the other hand to investigate the date of the similar hollowed bone objects that have been recently found at other sites, in order to determine more accurately the time frame in which this type of bone tools appears in continental Croatia more frequently.

Apart from Torčec, similar hollowed bone objects have also been found on several other locations in the area of northern Croatia. All sites are located along the watercourses of the Drava and Sava rivers (Map 1). The first artefact is located in central Croatia in Buzin, near Zagreb (Map 1: 2), where an early medieval settlement was excavated (Radman Livaja et al. 2011; Sečkar 2011; Grgurić 2011). In one of the features three similar hollowed objects made of a sheep or goat tibiae were found (Figure 2: 7-9). They are also hollowed bones with a pointed tip, which suggests that they can be interpreted as thatching needles. This example from Buzin, similar to the Torčec one, with three thatching needles found inside the same structure, may suggest that a particular activity was carried out in this part of the settlement during the period between the 8th and the mid 9th century, which is the date established by radiocarbon dating of charcoal from the feature in Buzin (Table 1: 2; CalAD 660-870). Several identical items found in the same archaeological unit are oft en argued to prove that a particular area can be interpreted as a working space in which a particular function was carried out, which may vary depending on the type of object. The structures where the thatching needles were found both at Buzin and Torčec, have been interpreted as dwelling spaces, where the specific activities that were carried out implied the use of this particular type of objects.

It is also worth mentioning that at the early medieval settlement of Varaždin – Brezje IV (Map 1: 3), a small
## Thatching needles:

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<td>SU 004/037</td>
<td>C14 - CalAD 615+18</td>
<td>Tibia sheep/goat</td>
<td>Sekelj Ivančan 2010a, 343, kat. br. 2</td>
</tr>
<tr>
<td>3</td>
<td>Torčec-Prečno Pole</td>
<td>SU 004/037</td>
<td>C14 - CalAD 615+18</td>
<td>Tibia sheep/goat</td>
<td>Sekelj Ivančan 2010a, 343, kat. br. 3</td>
</tr>
<tr>
<td>4</td>
<td>Torčec-Prečno Pole</td>
<td>SU 022</td>
<td>/mid-7th- early 8th ct.</td>
<td>?</td>
<td>Sekelj Ivančan 2010a, 343, kat. br. 4</td>
</tr>
<tr>
<td>5</td>
<td>Torčec-Prečno Pole</td>
<td>SU 022</td>
<td>/mid-7th- early 8th ct.</td>
<td>Tibia, ?</td>
<td>Sekelj Ivančan 2010a, 343, kat. br. 5</td>
</tr>
<tr>
<td>6</td>
<td>Torčec-Prečno Pole</td>
<td>SU 042</td>
<td>/mid-7th- early 8th ct.</td>
<td>Tibia sheep/goat</td>
<td>Sekelj Ivančan 2010a, 343, kat. br. 6</td>
</tr>
<tr>
<td>7</td>
<td>Buzin</td>
<td>SU 003</td>
<td>C14 - CalAD 660-870</td>
<td>Tibia sheep/goat</td>
<td>Grgurić 2011, 334, Sl. 3</td>
</tr>
<tr>
<td>8</td>
<td>Buzin</td>
<td>SU 003</td>
<td>C14 - CalAD 660-870</td>
<td>Tibia sheep/goat</td>
<td>Grgurić 2011, 334, Sl. 3</td>
</tr>
<tr>
<td>9</td>
<td>Buzin</td>
<td>SU 003</td>
<td>C14 - CalAD 660-870</td>
<td>Tibia sheep/goat</td>
<td>Grgurić 2011, 334, Sl. 3</td>
</tr>
<tr>
<td>11</td>
<td>Stari Jankovci-Gatina</td>
<td>-</td>
<td>- late 7th- 8th ct.</td>
<td>?</td>
<td>Filipec 2015, 18</td>
</tr>
<tr>
<td>12</td>
<td>Stružani-Vrtlovi, north</td>
<td>-</td>
<td>/8th-9th ct.</td>
<td>left radius sheep bone</td>
<td>Miklik Lozuk 2012, 55, 128, kat. br. 131</td>
</tr>
<tr>
<td>13</td>
<td>Stružani-Vrtlovi, north</td>
<td>-</td>
<td>/8th-9th ct.</td>
<td>right radius dog bone</td>
<td>Miklik Lozuk 2012, 128, kat. br. 132</td>
</tr>
</tbody>
</table>

## Awl:

<table>
<thead>
<tr>
<th>No.</th>
<th>Site</th>
<th>Feature</th>
<th>Dating</th>
<th>Animal species</th>
<th>Bibliography</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Torčec-Prečno Pole</td>
<td>SU 087</td>
<td>- /late 8th. i 9th ct.</td>
<td>?</td>
<td>Sekelj Ivančan 2010b, 249, T. 29, kat. br. 185</td>
</tr>
</tbody>
</table>

Table 1 - List of bone tools with data about the site, archaeological unit of origin, dating, animal species and the anatomical part of which the object is made and the bibliographical reference.
Close to the bone...

fragment of bone with pointed tip was found. Although fragmented, it is probably a similar bone object to those discussed here – a thatching needle (Figure 2: 10) (Bekić 2011: T. 15, Z).

The thatching needles recovered in 1988 at the site of Stari Jankovi-Gatina (Map 1: 4), near Vinkovci can be attributed to this group as well. At that site, a dwelling space located near a cemetery, dated between the late 7th and the second half of the 8th c. was excavated, but unfortunately it remains unpublished to date (Šmalcelj 1992: 48-49). Future work will bring more detailed information about this find, but for now, the mere finding of this type of bone tool in the feature and/or at a site from the Avar times, is significant itself (Filipč 2015: 18).

At site of Stružani, in Slavonia (VRTLOVI, KUČIŠTE, Veliki Trstenik, north -Map 1: 5), an attempt was made to identify the possible functions carried out at the features where thatching needles were found. Two thatching needles were found in two early medieval features, situated 15 m away from each other (Figure 2: 12-13). In both features, a thatching needle and a clay whorl were found, which lead to the author to suggest that the activities that took place within the dwelling space involved hand spinning of threads and clothing treatment, although she also acknowledged the possibility of these workrooms being used for making clothes (Miklik-Lozuk 2012: 54-55).

From the findings aforementioned, only in one (SJ 022) of the three features in Torčec, a thatching needle was found together with a fragment of ceramic whorl, while in the other two no whorl was recovered, as is the case with the findings from Buzin. Although there is only a small number of investigated examples, one can see that there is no clear pattern in which both types of objects (thatching needles and ceramic whorls), both related to the process of treatment of thread and/or clothes, appear together in the same context. However, we can see that the ceramic whorls, as items used in the process of production of threads of plant or animal origin for clothes making, occur very frequently in early medieval features of the excavated settlements in northern Croatia (Sekelj Ivančan 2010c).

In recent years, various worked bones were recovered thanks to the research carried out in northern Croatia. The first group of objects is made of hollowed sheep/goat tibiae or a dog and a rabbit bones and they were probably used commonly as a thatching needles, as it is suggested because of their hollowed tip. They were probably used for thatching fibres of animal or plant origin in order to make baskets, ropes and similar products. It is important to stress that the hollow tip of these bone tools had an important role: after the basic thicker thread already attached to future product is lifted using a pointed tip, the thread which is thatched to the other side of the product could have been easily and smoothly passed through the convexly formed inner part of the bone. However, due to the pointed tip these thatching needles could have been used as an awl, as well.

Object 15 (in Figure 2) is, unlike the hollowed thatching needles, a flat object with clear traces of use on its tip. Since there is no hollow tip which would make thatching of threads easier, this item was most likely a genuine stapler tool, an awl for piercing the fabric, leather or any other material.

Besides the common use of these objects in everyday life, early medieval people placed a similar bone object in a grave near the deceased, which possibly indicates a religious aspect of this object. At the site of Vukovar – Lijeva Bara (Map 1: 6), a similar but smaller perforated thatching needle (Figure 2: 14) was found near the skull of an infant, together with head and neck decorations and an iron rasp. This thatching needle was made from a distal part of the rabbit’s humerus (Demo 2007: 126, T. 1:1.1; 2008: 126, 140 1.1) and was possibly stored in a container suspended from the neck. It is possible to interpret it as a find in non-functional position that might have served as an amulet. The grave in which it was found, is dated between the late 10th and the early 11th c., according to other finds and its position within the entire graveyard (Demo 2009: 417-418).

Some of the above described bone tools come from features which can be closely dated to the 7th and the 8th centuries, while some of them, except for objects found in the grave, date to the late 8th and the 9th centuries. The data was gathered in available published literature or during verbal communication with the colleagues. It is necessary to point out that in recent years plenty of archaeological research of medieval settlements and rescue excavations on highway routes were carried out in northern Croatia. The vast majority of these have not yet been analysed and published in detail due to the large amount of collected material and the complexity of the sites, so more findings of this type can be expected in the near future. However, some data can be found in the Croatian Archaeological Yearbook, publication of the Ministry of Culture, in which preliminary data on the excavated sites are published, and according to which a map with earmarked findings of concurrent settlements is composed. The map shows explored early medieval settlements from the 7th and the 8th centuries (Map 1: black), the villages from the turn of the 8th and 9th centuries (Map 1: yellow) and early medieval but not clearly specified settlements (Map 1: gray), because, as is shown by findings of bone tools presented here, their emergence and intensive use can be expected exactly during that period. Objects of this type could also be found at other sites in the area between the rivers Sava, Drava and Danube where features from the early Middle Ages have been recorded.

Although relatively rarely represented among early medieval finds in northern Croatia, the bone tools that have been found can be clearly divided into two groups considering the external features and the probable prima-
Figure 1.
Close to the bone...

Figure 2.
ry usage in everyday life in the period between the begin-
ning of the 7th to the beginning of the 10th centuries (till
to the beginning of the 11th ct. in a grave). In one instance,
both groups appear at the same site, almost at the same
time, which implies that each of them was intended for
a specific primary function, differing from each other.
Consequently, in order to distinguish them terminolog-
ically, the term “bone thatching needle” is proposed for
the first group of objects (Figures 1 and 2, Table 1: 1-14),
and “bone awl” for the second (Figure 2: 15, Table 1: 15).

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BONE FIGURINES OF THE EARLY ISLAMIC PERIOD:
THE SO CALLED “COPTIC DOLLS” FROM PALESTINE AND EGYPT

Ariel Shatil

Abstract: In the Early Islamic period (7th–11th century CE) a new type of figurine appears in the archaeological record: small, crudely crafted human figures made of bone. Some researchers see them as toys meant to prepare girls for motherhood; others see them as fertility figurines. Although there is no archaeological evidence that they existed in pre-Islamic Egypt and Palestine, nor any evidence connecting them solely to any Christian population in the Islamic period, they are mostly referred to as early Christian or “Coptic dolls”. In Egypt and Palestine they seem to appear suddenly at the end of the 7th century, coinciding with the Arab conquests, but they might have existed earlier in Iran and Mesopotamia. With the new Muslim empire bridging former Byzantine and Sassanian lands, these dolls found their way to Egypt and Palestine where they were reproduced in huge numbers becoming popular in all levels of society of the 8th and 9th century. By the end of the 11th century they disappeared as quickly as they appeared, probably because of restrictions placed on their production by Islamic laws.

Apstrakt: Tokom ranog Islamskog perioda (7–11. vek) u arheološkim nalazima pojavio se novi tip figurine: mala, grubo oblikovana ljudska figura od kosti. Pojedini istraživači smatrali su da su ovo lutke namenjene devojčicama koje su ih pripremala za majčinstvo; drugi su ih smatrali figurinama za plodnost. Mada nema arheoloških podataka o tome da li su postojele u pre-islamskom Egiptu i Palestini, niti postoje dokazi koji bi ih povezali isključivo sa hrišćanskim populacijom tokom Islamskog perioda, one se često označavaju kao ranohrišćanske ili “koptske lutke”. U Egiptu i Palestini se izgleda pojavljuju naglo krajem 7. veka, što se podudara sa arabljanskim osvajanjem, ali su mogle postojeći i ranije u Iranu i Mesopotamiji. Kako je novo muslimansko carstvo povezivalo nekadašnje vizantijske i sasanidske oblasti, ove lutke su našle svoj put do Egipta i Palestine gde su proizvedene u velikim količinama i bile veoma popularne u svim slojevima društva tokom 8. i 9. veka. Krajem 11. veka, one nestaju jednako naglo kao što su se i pojavile, verovatno usled ograničenja u njihovoj proizvodnji prema islamskim zakonima.

INTRODUCTION

This article discusses bone figurines, generally dated to the Early Islamic period (circa 640-1100AD) and often referred to as “Coptic dolls”. The function and use of these figurines is controversial: some scholars see them as apotropaic, fertility or magical figures (e.g. Török, 2005; Vachala, 2012), others see them merely as toys (e.g. Rahman, 1981). Until the 1960s they were known mostly from museums and antiquities markets and attempts to establish clear chronological or stylistic sequences were hampered by the lack of data on artifacts from excavations and the varied characteristics and shapes of these objects. In the following pages I aim to present a clearer picture of the origin, chronology, style and development of these so called “Coptic dolls” in Egypt and Palestine.

HISTORY OF RESEARCH

These bone figurines were first recognized as a homogenous artifact group by Joseph Strzygowski in 1904, although earlier mentions exist (e.g. Gayet, 1902:46). In his volume "Koptische Kunst", he described 13 “puppen” from the Cairo Museum and was the first to suggest they were toys rather than cult figurines (Strzygowski, 1904:201-204, Taf.XVIII). Not all researchers agree (e.g. Török, 2005:248; Vachala, 2012). Strzygowski concluded a pre-Islamic origin and dated the dolls between the 4th and 12th centuries. A fragment with a religious Christian inscription, supporting his pre-Islamic origin thesis, was in a group of figurines which he had purchased in Cairo in 1900-1901 for the Kaiser Friederich Museum. Some of these were published later by Sir Leonard Woolley (1907) and Oskar Wulff (1909). Although Strzygowski never actually used the term “Coptic dolls”, it was already attached to them by Woolley, and continues to be used even today. This is probably because Strzygowski, and Gayet before him, published them in volumes titled “Coptic Art”.

Expanding on the idea that the figurines were early Christian apotropaic figurines, Woolley suggested a stylistic development from a naturalistic human shape to a schematic cross shape (Woolley, 1907:219-220). According to him the series begins with naturally carved figures stylistically influenced by earlier classical figurines (e.g. PL.1:1; see also Strzygowski, 1904:Taf.XVIII:8880; Wulff, 1909:Taf.XXXII:528). As the series progresses the figurines become squarer, schematic and superficial. Finally they reach a fully schematized cross shape (e.g. Alaoui, 2000:No.268; Woolley, 1907:Fig.10). In 1930 Kate Elderkin published “Jointed Dolls in Antiquity”, an article surveying the use of articulated dolls (figurines with movable legs and/or arms) from Egypt's Middle Kingdom to the Early Islamic period. Her chronological sequence of style development resembles Woolley’s (Elderkin, 1930:477-479), but she does not mention Christian ideas influenc-
Plate 1 - Dolls from excavations in Ramla: (1) Miniature articulated doll; (2) Cloth doll head; (3) Flat articulated doll; (4) Flat articulated schematic doll; (5) Unarticulated schematic doll; (1-5) scale 1:1; (1) Color image courtesy of the Museum of Ramla. ©Israel Antiquities Authority
ing the progression. In her opinion it simply reflected a degradation of classical art during the period that post-dates it, and as she admits, “the sequence is somewhat puzzling” (Elderkin, 1930:478).

Woolley’s and Elderkin’s theories were based on museum specimens of unknown provenance and date, as most of today’s known figurines were still buried. Since the 1960s more such bone statuettes were excavated in Egypt, mainly by the American expedition to Fustat (Kubiak & Scanlon, 1973, 1979; Scanlon, 1968, 1974) and the Polish and French excavations in Alexandria (Rodziewicz, 1978, 2007). It was from Palestine, however, that they surprisingly emerged in growing numbers but most were never published. In 1981, L.Y. Rahmani described a few examples from excavations in Palestine and from the L. A. Meyer Memorial Museum of Islamic Art in Jerusalem. He offered a process of reduction from naturalistically carved Roman dolls with articulated legs and arms, to stylized “Coptic dolls” with only arms articulation or no articulation at all. Those were “finally reduced to heads only” (Rahmani, 1981:77). Rahmani was the first to seriously challenge the figurines’ attribution to Coptic culture and their apotropaic or magical nature (Rahmani, 1981:79).

Other important additions to our knowledge were Török’s publications of the large collection of specimens from the Museum of Fine Arts in Budapest (Török, 1993, 2005). Contradicting Rahmani, Török sees the figurines as magical idols, remnants of Byzantine votive terracotta figurines. Also in 2005 Ayalon published the figurines from Caesarea Maritima where circ. 30 examples were found from well stratified contexts (Ayalon, 2005:81-85).
Recently Rodziewicz published a large assemblage excavated by the French expedition to Fustat with many new and original insights into chronology, style, form, use and origin, most of which find confirmation in the present article (Rodziewicz, 2012:9-20).

GEOGRAPHICAL DISTRIBUTION

Bone figurines of the Early Islamic period have been found across the Middle East, from Egypt in the southwest, to Turkey in the north and Iran in the east (Map 1). However, large gaps appear in this geographical distribution: the areas of modern Lebanon, Syria and Iraq are nearly devoid of examples, and their number in Iran is limited. A small group from the port city of Siraf, on the east coast of the Persian Gulf, may represent the eastern limit of their spread (British Museum Inv. nos. 2007.6001.10720, 10714, 10706, 10698, 10258). A single doll from Tarsus on the south-eastern coast of Turkey marks the northern limits (Goldman, 1935:548 Fig.45), and in Egypt they dwindle in numbers beyond the limits of Lower Egypt.

Although a few dolls were recovered in other sites, in Egypt large numbers of dolls seem to be concentrated at the two major Early Islamic urban centers – Fustat and Alexandria (Rodziewicz, 2012:16). In Palestine, the picture is slightly more revealing (Map 2). Many dolls were indeed found in the large urban centers such as Ramla (PL.1; see also Ayalon & Sorek, 1999:63, Fig.91), Jerusalem (PL.2; Shatil, forthcoming), Tiberias (PL.3), Caesarea (Ayalon, 2005:81-85 Figs.31-34) and Ashkelon (Wapnish, 1997:338 Fig.6), but in smaller and different sites as well. Towns such as Jaffa (PL.5:7; Re’em 2010), Yokneam (Agadi, 1996:237-238 Fig.XIX.1:7-9) and Banias (Israeli, 2001:59, Nos.64-65) also produced some dolls, and desert pilgrimage sites of the Byzantine period, such as Nessana and Shivta, by the Early Islamic period slowly dwindling in size and importance, produced a few examples (PL.4:1-3). Dolls were also recovered in village size sites and farms (PL.4:4; PL.5:2; Ben Michael et al. 2004). In the Umayyad palaces at Kh. el-Minia and Kh. el-Mafjar, royal construction projects not associated with actual settlements, dolls were also found (PL.5:1, PL.5:12), and a doll was recovered from the isolated “Cave of the Treasure” (PL.5:5) in the Judean Desert.

Plate 2 - Dolls from excavations in Jerusalem: (1) Flat articulated doll; (2) Flat unarticulated schematic doll; (3) Flat painted cloth doll head; (4) Painted cloth doll head; (5) Unarticulated doll of an Egyptian type; (1-4) scale 1:2, (5) scale 1:1. ©Israel Antiquities Authority.
Plate 3 - Dolls from excavations in Tiberias: (1) Flat unarticulated stylized doll; (2) Flat unarticulated schematic doll; (3) Flat unarticulated schematic doll; (4) Articulated doll; (5) Cloth doll head; (1-5) Scale 1:1. ©Israel Antiquities Authority.
Thus the evidence from Egypt points to the dolls being a phenomenon of the large urban centers, while the evidence from Palestine points to a wider cultural distribution. The difference could reflect the concentration of Egyptian archaeology on the larger sites rather than actual cultural differences. The dolls were objects favored and liked by city dwellers, villagers, farmers and Bedouins, and their large number in urban centers may only reflect the larger size of populations there. Moreover, that some dolls are carved from ivory, others exquisitely painted and decorated, while many are simple and crude, shows that they were produced for all echelons of society.

CONTEXT AND FUNCTION

Woolley saw these figurines as early Christian or Coptic apotropaic objects related to fertility and childbirth (Woolley, 1907:219-220). Török and Vachala agree, and write that these “idols” are the remincient of a pagan idea or belief, practice and iconography continued by Christian-Copts into the 7th-9th centuries (Török, 1993:60; Vachala, 2012:26).

Plate 4 - Dolls from excavations in sites in the Negev desert: (1) Doll covered by layers of cloth from Nessana; (2) Doll fragment (head) from Shivta; (3) Bone shaft with incised eyes from Shivta; (4) Bone shaft with incised eyes from Upper Nahal Besor; (1) Scale 1:2; (2-4) Scale 1:1. (1,3&4) ©Israel Antiquities Authority. (2) ©Metropolitan Museum of Art (Acc. no. 37.75.19) gift of H. D. Colt. (www.metmuseum.org).

Indeed, some of these figurines were found in supposedly Coptic or Christian context: a small number is known from Mareotis, a pilgrimage site for St. Menas south of Alexandria (Kaminski-Menssen, 1996:Taf.96-97), and from Nessana and Shivta (PL.4:1-3), Byzantine monastic and pilgrimage stations in the Negev. However, all such Christian sites experienced an influx of Muslim settlers as evidenced by many Early Islamic objects as well as mosques built alongside the monasteries and churches in the 7th-10th centuries (Negev, 1993; Negev, 1993a; Rodziewicz, 2012:14).

Archaeological evidence from Egypt and Palestine further shows that these dolls were found largely in cities of Early Islamic foundation, Fustat and Ramla (PL.1), where possibly a Muslim majority coexisted with Christian and Jewish populations. In other cities where these dolls were found, such as Jerusalem (PL.2), Tiberias (PL.3) and Caesarea (PL.5:10-11) – which reasonably held a non-Muslim majority at least at the beginning of the Early Islamic period – no archaeological evidence whatsoever suggests that the “Coptic dolls” lay in pre-Islamic levels or were limited to a culturally Christian context. For the same
Close to the bone...

Plate 5 – Dolls from various excavations in Palestine: (1) Cloth doll head from Kh. el-Mafar; (2) Cloth doll head from Tel Zomera; (3) Cloth doll head from Beit-Shéan; (4) Cloth doll head from Wadi-Dair; (5) Cloth doll head from the "Cave of the Treasure"; (6) Articulated doll from Kh. el-Burj; (7) Flat unarticulated schematic doll from Jaffa; (8) Flat unarticulated doll from Wadi-Dair; (9) Flat unarticulated doll from an unknown site; (10) Flat unarticulated schematic doll from Caesarea Maritima; (11) Flat unarticulated schematic doll from Caesarea Maritima; (12) Flat unarticulated stylized doll from Kh. el-Minia; (1-11) Scale 1:1; (12) Not to scale. ©Israel Antiquities Authority.
reasons Rodziewicz writes that "the definition of dolls recorded exclusively in an Islamic context as 'Coptic dolls' seems to be unjustified" (Rodziewicz, 2012:16-17). Thus there clearly is no archaeological evidence that these dolls made their appearance prior to the beginning of the Arab conquests of Palestine and Egypt, nor is there evidence that connects them solely to the Christian population of the Islamic period.

Two opposing opinions regarding function and cultural use of these figurines were already expressed at the start of the 20th century, and both are still held by different researchers today. In one prevalent opinion first expressed by Woolley and later by Wulff, the bone figurines are apotropaic or magical Christian objects and the insistence on sex organs shows a fertility or childbirth connotation (Woolley, 1907:219-220; Wulff, 1909:131). Török agrees and writes that the figurines were "possessed as amulets by women who wanted to receive divine help in matters of love, marriage, fertility and childbirth" (Török, 2005:249). On the opposing side stands the opinion that the figurines are toys. This was first suggested by Strzygowski (Strzygowski, 1904:201); later Rahmani (1981:80) and Rodziewicz (2012:10) elaborated on the subject, writing that the dolls, besides being for child's play, had an educational purpose in preparing girls to be wives and to take care of their own body, household and children.

Authors bring several justifications to support their opinion that the figurines are apotropaic figures rather than toys: (a) some of them are made of ivory and such expensive and breakable objects would not have been given to children; (b) their explicit female features do not accord with their use as toys, but rather express their function as fertility figurines (Török, 1993:60); (c) several were found in burials (Török, 2005:248; Vachala, 2012:28); (d) one from Berlin Museum bears a Greek inscription reading ΕΙΣ ΘΕΟΣ, which translates as "the One God" (Török, 1993:60; Török, 2005:248); and finally, (e) the figurines reflect a continuation of pre-Islamic traditions in iconography, practice and belief which can be traced in earlier Byzantine and pagan votive figurines (Török, 1993:60; 2005:249; Vachala, 2012:26).

I suggest that none of these justifications is valid. Dolls and toys of expensive materials are known in many cultures, both historic and modern, and on this Rahmani writes: "the survival of many breakable toys in museums all over the world attests to the care children may lavish on their toys, and girls especially on their dolls" (1981:79). That the dolls are naked and have female features cannot be used as an argument against them being toys. Ignoring for a moment that not all bone dolls are portrayed naked (PL.1:5, PL.2:2, PL.3:1-3, PL.5:7-12), even the naked ones could be dressed and undressed by their owner, as shown by a doll in the Benaki Museum in Athens (inv. no. 10737; Pitarakis, 2009:243-246 Figs.28-29). Both Rahmani and Rodziewicz conclude on this matter that the female features carved on the figurines were shown there for educational reasons, preparing girls for motherhood (Rahmani, 1981:80; Rodziewicz, 2012:10).

The statement made by Török and Vachala that some of these dolls were found in tombs is incorrect. The confusion may stem from the fact that in both Egypt and Palestine, the Roman custom of burying bone figurines with deceased girls or women was not uncommon in earlier periods. Indeed many bone figurines from the 2nd-5th centuries were found in tombs in Jerusalem and other sites in Palestine. However this practice had ceased before the time the Arabs entered the region. Of the 190 dolls from excavations I studied, only two fragments were found associated with a burial: one in Fustat, the other in Ramla (Golan, 2002; Rodziewicz, 2012:12). In both instances the eroded fragments should be considered as part of the fill rather than a burial gift. Thus, until archaeological evidence proves otherwise, no bone figure from the Early Islamic Period can be associated or considered as a funerary item.

Most of the dolls with a well-defined provenance from Egypt and Palestine were actually found in domestic contexts. In Alexandria (Rahmani, 1978:337-345; 2007:81-86) and in Fustat (Rodziewicz, 2012:12) all the figurines were recovered near Early Islamic dwellings and in the city dumps. The same holds for excavations in Caesarea (Ayalon, 2005:81-85) and Jerusalem, where dolls were found in domestic contexts and in trash pits of a local Early Islamic market where there may also be evidence for their production (Shatil, forthcoming).

In regard to the so-called "magic Berlin figure" (Wulff, 1909:Taf.XXII:526), bearing the Greek inscription, I see no similarity in the shape of this bone item with any of the 300 or so known Early Islamic dolls. About the inscription itself Rahmani writes: "the reading of this figurine's inscription seems unsure and in fact looks upside-down" (1981:79 footnote 30).

Török's and others' opinion that the nude Early Islamic bone figurines are stylistic descendants of early Christian terracotta votives and that they reflect practices related to fertility and childbirth of early Christian and pagan Egypt (Török, 1993:60; 2005:249; Vachala, 2012:26; Woolley, 1907) is not widely accepted. In the Late-Roman and Byzantine periods in Egypt and Palestine nudity was very limited; unlike the bone dolls, most terracotta female figurines were dressed (Elgavish, 1969; Rodziewicz, 2012:10; Singer, 1993:Figs.23-28; Zemer, 2009:Figs.138-139,142,148-149). Moreover, with the growing influence of Christianity the production of terracotta figurines in Palestine for cult and religious use dwindled until it ceased in the 6th century (Singer, 1993:5; Zemer, 2009:150). In Byzantine Egypt production of women figurines, sometimes nude, but mostly dressed, reclining, sitting or standing, with babies in their arms, pregnant, or in Orants postures continued into the 8th century. They were found in domestic, mortuary and religious context, and their regional diversity suggests they were produced
by individual families or village workshops as much as by known large potteries in Abu Mina and Elephantine (Frankfurter 2015). The Byzantine terracottas in Egypt were thus completely different than the Early Islamic dolls in style and context and therefore in function as well.

I may conclude that the archaeological evidence and iconographic analysis of the Early Islamic bone dolls points to them being toys rather than magical or apotropaic idols. The elaboration on this function, that they were also used for educational purposes, is reasonable, but speculative. It should be noted that an object may hold several functions at the same time, or at different times (see Sidéra and de Maret, this volume). A doll may function as a toy for a child, an educational tool for the adolescent girl and a symbolic object, reminiscent of her childhood, when she marries. Some dolls painted with intricate designs reminding of Henna tattoos still practiced today in engagement ceremonies in traditional families and societies in Egypt and Palestine may support this.

CHRONOLOGY DEVELOPMENT AND CHANGE

In his article “Ancillary dating materials from Fustat” Scanlon writes: “These dolls do not seem to experience any chronological development nor can variants in form or execution be firmly established… …they persisted well into the Fatimid period, and we cannot entirely disallow an Ayyubid or even Mamluk dating for those found in the upper reaches of the original mounds” (Scanlon, 1968:16). Scanlon’s observation reflects the varied styles and shapes of the Early Islamic dolls. Indeed no two of them are exactly alike. The individuality exhibited by almost each and every doll makes any typological attempt difficult.

The different sequences of change and development in the shape and style of the dolls mentioned earlier all pose certain problems. Woolley’s suggestion that the dolls were early Christian apotropaic figurines, developing from naturally carved figures to cross shaped figures is problematic for two reasons. First, the dolls cannot be attributed to Christian populations or Christian cultural context (see discussion above). Second, the cross shaped figures at the end of his sequence are barely known from excavations and their dating is problematic. Elderkin’s suggestion that the dolls reflect a degradation of classical art and carving, and become more schematized through the 7th-12th centuries, is problematic because in several sites naturalistic or semi-naturalistic dolls were found together with schematic ones at the same levels, and sometimes at the same locus. For example, two dolls from level 3 in Fustat were uncovered at the same location, but one is rather natural and the other is schematic (Rodziewicz, 2012:175-177 Nos.280 and 282). In Caesarea Maritima, an articulated doll was found at the same location of two extremely schematic dolls (Ayalon, 2005:83,85 Nos.319, 326, 327). In Tiberias two unarticulated dolls, one linear and schematic (PL.3:3) and one of a stylized type sometimes dated erroneously to the Mamluk period (PL.3:1), were found together in the same room. For similar reasons, Rahmani’s suggestion of a reduction sequence from full-bodied articulated dolls to schematic unarticulated ones, and finally to stand-alone heads cannot be verified. In Jerusalem full-bodied articulated dolls were found together with unarticulated dolls and stand-alone heads in trash pits of a local market-place dating to the 8th century (PL.2:1-4; Shatil, forthcoming). Thus archaeological evidence points to the existence of the entire corpus of Early Islamic dolls, with all or most of its shapes and variants, approximately at the same time.

Stratigraphic and numismatic evidence gathered at Fustat, Caesarea and Jerusalem, points to end of the 7th century as their earliest appearance in both Egypt and Palestine, with their proliferation throughout the 8th-10th centuries (Ayalon, 2005:81-85; Rodziewicz, 2012:172-199; Shatil, forthcoming). Following the arrival of the Fatimids into Egypt and Palestine from the west around 970, the dolls’ numbers appear to dwindle. In Fustat only one doll could be connected with Fatimid architecture (Rodziewicz, 2012:189 No.303). Accordingly, only a few dolls from Palestine can be dated to 11th century context. It seems that the latest examples are two dolls from Yokne’am which were found under the foundations of a Crusader floor, and since both are in relatively good condition, they could theoretically be ascribed a date of mid to late 11th century (Agadi, 1996:237-238). It appears however, that the production of some doll types – especially those carved in the round from complete bone diplhyses and of a more naturalistic style – does not continue past the first half of the 8th century (e.g. PL.1:1). At the same time, the popularity of schematically made cruder dolls rises during the 8th-10th centuries. These particular trends may be related to economic reasons (the simpler dolls were easier to carve and cheaper to buy) or to the slow and gradual move of Islamic art away from depicting the human body.

How indeed can one reconcile the mass production of human-shaped figurines or dolls with the Islamic objection to portraying living forms? The view that Islamic art is iconoclastic is a commonly held misconception (Rosen-Ayalon 2001:289). Islamic art shows human and animal figures in sculpture and painting throughout its entire history, and although religious buildings are devoid of figural representations, in secular art there are impressive numbers of them (Allen 1988:17; Rosen-Ayalon 2001:289). In some periods and regions the opposition to these representations by orthodox groups was stronger and fiercer to the point where they are avoided, prohibited or destroyed, while other regions and periods were more lenient. Probably because of their great popularity, dolls seem to have been an item of controversy between the two opposing attitudes of Islam to figural representations. The disappearance of the more naturalistically carved dolls after the middle of the 8th century may be
the result of restrictions placed on doll's production by religious authorities and market inspectors (Rahmani 1981:80). We know that already by the early 10th century the manufacturing of dolls was prohibited in some places (Hamdani, 2008:95), while nearly at the same time oral traditions concerning the use of dolls were put to writing and elaborated (Rahmani 1981:79-80).

ICONOGRAPHY, STYLE AND DESCRIPTION

Shape and execution

The Early Islamic figurines in Palestine and Egypt are most often carved on large and medium mammals' long bone diaphyses (sheep, goat, cattle, horse, donkey or camel metapodials), either complete or longitudinally sectioned. The general shape and carving shows the characteristics of skillful craftsmen, but with minimal time sectioned. The lack of small details. Nearly all of them exhibit simplicity, sectioned. The general shape and carving shows the characteristics of skillful craftsmen, but with minimal time and effort invested into the finishing and execution of small details. Nearly all of them exhibit simplicity, schematization, and seem not to be well finished. The lack of investment may have served to make them less expensive on the market (Rodziewicz, 2012:11).

Most dolls of Egyptian origin, and some of southern Palestinian origin, possess a typical face featuring incised almond- or V-shaped eyes and arched eyebrows meeting above a narrow elongated carved nose and a small relief carved mouth that appears to be smiling. Some effort may be given to shape a protruding small chin (PL.1:1, PL.2:5, PL.4:1-2, PL.5:1-2, PL.5:6, PL.6:1-6; see also Caubet & Gaborit-Chopin, 2004:98, No.108; Kubiak & Scanlon, 1979:PL.XVII:2; Rodziewicz, 1978:Figs.12-14, 16-17; 2007:Nos.27-28; 2012:Nos. 288-293, 300, 304, 313; Scanlon, 1968:Figs. 4a-4d; 1974:PL.XVII:7). As one looks to more northern and eastern sites in Palestine and Jordan, such as Ramla, Caesarea, Beit-She'an, Heshban and Ayla, these incised features become carelessly executed and appear only on stand-alone cloth dolls heads (PL.1:2, PL.5:3-4; and see also Ayalon, 2005:No.312-313; Ina, 2000:188; Vollenweider & Platt, 2009:Fig.14.4:1; Wulff, 1909:Taff. XXII:542). A large group of Egyptian dolls, articulated and carved in the round in a semi-naturalistic appearance, have large rounded heads with no incised facial features. The eyes and other decorations of the face (tattoos?) were painted on the bone surface, while the typical nose and small mouth were executed in relief, and the ears carved. (PL.6:1; see also Petrie, 1927:PL.LV:597; Rodziewicz, 2012: Nos.279-281, 283; Scanlon, 1968:14, Fig.3d, 4a; Wulff, 1909:Taff.XXII:529). Interestingly, a few fragments found at Ashkelon on the southern coast of Palestine suggest that there, a doll carver made dolls that probably imitated this Egyptian group (Wapnish, 1997:338, Fig. 6 the doll on the left is published upside down and the head is mistakenly referred to as the torso; Further examples at: www.digashkelon.com).

Many Palestinian dolls have no delineated face features; instead the head is convex at the front giving them a three-dimensional appearance. The relief carved nose was sometimes preserved but the rest of the face was painted (PL.1:3-5, PL.2:2, PL.3:2, PL.3:5-7, 8,11). This tradition appears on none of the Egyptian dolls. Among these Palestinian dolls local traditions may also be discerned: some painted cloth-dolls heads from Jerusalem and Amman seem to stem from the same tradition (Compare PL.2:3 with Olavarri-Goicoechea, 1985:Fig.24:11). A small group of flat dolls from Ramla and Ashkelon has no parallels in any other site (Compare PL.1:4 with Wapnish, 1997:Fig.6, right).

Finally, a group of flat, schematic and highly stylized and decorated dolls appears mainly in northern sites in Palestine (PL.3:1, PL.5:12 and see also Ayalon, 2005:No.315; Israeli, 2001:59, No.64; Petrie, 1932:Fig. XXIV:11; Török, 2005:No.185). These dolls probably represent a northern Syrian tradition as suggested by some parallels from Hama (Oldenburg, 1969:Fig.49:8-13).

Dress and accessories

All or most of the dolls would have been clothed and had elaborate wigs of wool or human hair attached with bitumen or clay (Pitarakis, 2009:Figs.28-29; Rodziewicz, 2012:PL.106.2; Vorderstrasse, 2015:Fig.7.2; Wulff, 1909:Taff. XXII:532, 539). Some had earrings in their pierced ears; others may have had bracelets and necklaces. Some had movable arms attached to sockets at the shoulders with dowels or strings, while others had the general shape of the arm incised on the sides of their body.

A doll at the Benaki Museum (Inv. no. 10737) is dressed with 14 layers of colorful tunics made of linen, cotton, wool, hemp and silk. On its left foot a shoe is preserved (Pitarakis, 2009:246, Fig.28). Although this is the most extraordinarily rich example of doll's clothing, it is not the only one. Still in the Benaki Museum, a rag doll with a bone head (Inv. no.10390) has a linen cloth tunic with blue checked pattern on an indigo background (Alaoui, 2000:No.269; Pitarakis, 2009:246). A doll found at Nessana in the Negev (PL.4:1), and dated to the late 7th-early 8th century is often brought as another example of a rag doll with a bone head, but I suggest that it is actually another complete bone doll with several cloth tunic layers covering its female body.

Not all bone dolls were dressed in textile clothes. In Palestine, flat, schematic, unarticulated dolls appear on which the outline of clothes is incised on the surface. This is in fact the most common doll type in Palestine and it appears neither in Egypt nor in the Negev desert. The incised clothes represent a long robe with long sleeves and it is sometimes decorated with horizontal or diagonal lines, zig-zags and crosses (PL.1:5, PL.2:2, PL.3:2, PL.5:7-11; see also Agadi, 1996:237-238, Fig.XIX.1:7-8; Ayalon, 2005:85, Fig.33:326-327, Fig.34:328-329; Israeli, 2001:59, no.65; Kletter, 2005:88-89, Fig.24:1; Roll & Ayalon, 1989:188, Fig.117:1; Shatil & Behar, 2012:320-321, Fig.17.1:12). The incised circle-and-dot designs on
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dolls of the type appearing on PL.3:1 and 6:4 may also
represent decoration on the clothes it is wearing.

Painted decorations
Dark brown, black or red paint was used to highlight
incised features as seen on some museum examples with
paint preserved. In some examples, paint or other sub-
stance filled into dolls’ incised eyes and eyebrows “help
give a lifelike appearance” (Elderkin, 1930:479, Figs.29-
31). In other cases, mostly on dolls carved in the round
from Egypt and cloth doll heads from Palestine (PL.2:3-
4), the facial features such as mouth, eyes and eyebrows
are painted on the bone surface rather than fill incised
elements. Other painted features may be hair-locks on the
forehead, ‘lovelocks’ on the cheeks, and a kind of scarf or
necklace (Alaoui, 2000:Nos.266, 269; Olavarri-Goicoe-
A. Shatil, Bone figurines of the Early Islamic period...

The surface of some of the more naturally rendered Egyptian dolls is adorned with elaborate paintings on the face, torso, legs and arms. These tattoo-painted dolls exist in many museums (Alaoui, 2000:No.266; Hasson, 1999:31; Moraitou, 2012:No. 135A-C) and Rodziewicz considers the designs to allude to wedding tattoos, as still practiced in traditional societies in the Middle East (Rodziewicz, 2012:15). Dolls of exactly the same semi-realistic shape, but with no paint (PL.6:1; either never applied or not preserved) were excavated in Fustat in significant numbers and dated from the end of the 7th to 9th century (Rodziewicz, 2012:Nos.279-281, 283; Scanlon, 1968:14, Fig.3d, 4a).

In most cases the richly painted dolls are dated by museums to the Fatimid period (mid-10th-12th century), supported by analogous drawings from that period on lusterware, paper and wall paintings. A drawing in the Israel Museum in Jerusalem, said to be from Fustat, shows a nude female figure. Given the figure's details, accessories, ornaments and jewels the drawing was identified as Fatimid (Hoffman, 2000:40-44; Rice, 1958). Long lovelocks frame her face and fall on the cheeks. The eyes are almond-shaped and large. Some parts of the figure are covered by tattooed designs: a circle of dots on the right cheek and a flame shape design on the left appear on some of the painted dolls as well. A stylized palmate tattoo on the left breast of the drawing reoccurs above and below the breasts on dolls as well as on their female genitalia and on the back of their hands. The large eyes and eyebrows, long lovelocks, necklaces and tattooed or decorated palms and feet add to the similarities between the painted dolls and the Fatimid drawing in Jerusalem. Comparing them, Rice wrote: “The whole series of tattoo marks (on the drawing)... can be seen in stylized... bone statuettes which I do not hesitate to ascribe to Egypt... and to the Fatimid period” (Rice, 1958:35).

Indeed the motifs seen on the Fatimid nude drawing and on the painted dolls are recurring motifs in Fatimid art. They are repeated on wall paintings, lusterware and ivory panels and as Hoffman puts it, they “mark the work as distinctly Fatimid” (Hoffman, 2000:42, Fig.3-4). However, Jenkins has followed the origin of the palmate motif on pottery to 9th century Susa where it appears on polychrome lusterware (Jenkins, 1968), and in Fustat a doll hand painted with exactly the same palmate designs seen on the dolls do not undermine their attribution to the time of the Umayyad and Abbasid dynasties. Rather they represent the early appearance of these motifs in popular art pre-dating the Fatimid era. The origin of these motifs should be sought out in Mesopotamia and Iran to which it probably arrived from Central Asia during the Sassanian period.

ORIGIN

A further step in understanding the development of the dolls in Egypt and Palestine would be to find their origin and forerunners as those remain obscure. The early Islamic art and minor crafts were susceptible to artistic influences from the regions that the Arabs conquered or came in contact with. Western classical traditions of late antiquity were encountered in Syria, Palestine and Egypt. Eastern influences made their way into Early Islamic art from the East, especially from and through Sassanian Iran. Another possible influence may have been that of the pre-Islamic Arabian Peninsula, although this remains problematic because of our lack of data and knowledge.

Local forerunners

During the Hellenistic period a tradition of carving flat, slim and tall female figurines emerges in Palestine and Egypt (PL.7:1). Though they are sometimes presented side-by side with Early Islamic dolls, especially in old publications, these figurines are completely different in style and meaning from the Early Islamic ones (Petrie, 1927:PL.V:592; Rodziewicz, 2007:PL.2:2; Wulff, 1985:Fig.24:11). The curls and lovelock motif can also be seen on the mid-9th century famous dancers wall painting of the harem in Samarra (Costa, 1996:Fig.5), contemporary or even later to the dolls from Jerusalem and Amman. Costa sees these and other motifs of Early Islamic art as elements of earlier Central Asian artistic ideas spreading on the Silk Road route (Costa, 1996:25). Among many other examples, a woman with lovelocks appears on the 6th century painted vase from Merv, now in the National Museum of History of Turkmenistan at Ashgabat (Compareti, 2011:Fig.1). In the Buddhist monastery at Mirān, in central Asia, frescos from the mid-3rd to the 5th century show figures, male and female, with long lovelocks and curls arranged on the forehead (Costa, 1996:Figs.6-7) in a very similar fashion to that of the early Islamic painted dolls.

Thus I agree with Rodziewicz that the attribution of the painted bone figurines (e.g. Alaoui, 2000:No.266; Hasson, 1999:31; Moraitou, 2012:No. 135A-C) to the Fatimid period should be reconsidered. Archaeological evidence in Fustat, Amman and Jerusalem shows that dolls with similar painted motifs were being made in Egypt and the Levant in the late 7th and early 8th century. Some popular Fatimid motifs and features, namely the painted lovelocks, curled hair and the stylized palmate designs seen on the dolls do not undermine their attribution to the time of the Umayyad and Abbasid dynasties. Rather they represent the early appearance of these motifs in popular art pre-dating the Fatimid era. The origin of these motifs should be sought out in Mesopotamia and Iran to which it probably arrived from Central Asia during the Sassanian period.

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1909: Taff. XXII: 525). In Egypt they are interpreted as toys or as funerary concubines, and many were found in the Isis temple at Ras el-Soda (Rodziewicz, 2007: 15-16, 61). Contrary to Rodziewicz’ claim that they are found only on Egyptian soil, examples are known from Samaria, Dor, and Be’er Sheva in Palestine (Erlich, 2010: 155). They are usually presented wearing a short wig with a typical coif- fure and standing on a short square base, their long arms falling down, close to the body. They represent a very simple type of local bone figurines that follows an artistic cannon of the period, and unlike the Early Islamic dolls, have no variants. These figurines disappeared long before the rise of Islam, around the 4th century in Egypt according to Rodziewicz (Rodziewicz, 2012: 13), but probably much earlier in Palestine.

In the Late Roman period, a new type of bone figurines, interpreted as dolls on account of their movable limbs, appeared in the archaeological record of Palestine (PL: 7:2; Crowfoot & Fitzgerald, 1929: PL XXI: 34; Hamilton & Hussein, 1935: PL LXXII: 3; Porath, Dar & Applebaum, 1985: 143-144, Fig. 37: 1, 2; Rahmani, 1960; Singer, 2004; Fig. 11).

These dolls belong to a series of articulated figurines that like the Early Islamic dolls have their limbs attached to the body with pins, hinges or wire. Like most Early Islamic dolls from Palestine, Late Roman ones were carved from sections of long bones, mostly metapodials, and their backs were sometimes left unworked. The Late Roman dolls portrayed females dressed with long flaring robes, rarely are they portrayed naked like their Early Islamic counterparts. The Roman dolls have stylized, even extravagant, well-executed hairdos and headdresses emphasized in low relief, while the Early Islamic dolls have no hair at all or were fitted with a wig.

While none of the Early Islamic dolls from Palestine and Egypt were found in burials, many of the Late Roman ones were found in tombs. Their mortuary context and their iconography clearly show that the Late Roman dolls were of a different tradition and had no apparent artistic or iconographic influence on the 7th century Islamic dolls. The Late Roman dolls continued to be produced in Palestine at least until the end of the 4th century, but they were
no longer in use at the time of the rise of Islam. That said, the Hellenistic figurines and Late Roman dolls prove that a tradition of fashioning from bone of female figurines and dolls was well rooted in the classical cultures of Palestine and Egypt. Although we do not yet have any local examples of Byzantine dolls of the 5th to mid-7th centuries, we can speculate that production may have continued on a smaller scale and certain carvers or workshops may have preserved the technological knowledge and some elements of the artistic tradition.

**Eastern forerunners**

Bone figurines with a greater similarity to the Early Islamic dolls were excavated in Mesopotamia and Iran in Parthian context. These Parthian dolls show some general characteristics reminiscent of the Early Islamic dolls which appeared centuries later. These are, for example, an emphasis on delineating fat folds on the belly and neck, a simplistic execution of the female genitalia with a triangle or two diagonal incisions, an emphasized steatopygia, movable arms and static legs, and on the most schematic of them, breasts marked by an incised X, a common motif on the Early Islamic dolls. Some of these schematic Parthian figurines are in fact so close in appearance to the Early Islamic ones, that they are sometimes inter-confused (Hasson, 1999:31, the doll on the left is Parthian).

Many Parthian figurines were found in Seleucia on the Tigris, where they are dated to the first two centuries AD. According to Van Ingen the naturally rendered female Parthian bone figures represent the ‘Mother Goddess’ because of the way some of them hold their breasts in their hands and because of the emphasized steatopygia and female triangle (Van Ingen, 1939:41, PL.LXXXIII:609-614). Van Ingen notes a gradual transition from naturally carved figurines holding their breasts to schematically rendered figures where the composition is marked by atrophied, nearly indistinguishable arms and an X incision separating the breasts. This schematized composition may be repeating on the later Early Islamic dolls, but on these only the X marking the breasts and the odd shape of the shoulders hints to what were once folded arms holding breasts (e.g. PL.1:4, PL.2:1, PL.3:3-4, PL.5:6, PL.6:2-3).

It should be noted here that the motif of the female deity holding her breasts is deeply rooted in female representations in the art of the entire ancient Near-East from very early periods (see many examples in Collon 1995), however in the Hellenistic and Roman periods in Palestine the local traditions discontinue and this motif, and in fact frontal nudity in general, nearly disappears. The female representations in terracotta figurines in Palestine turns towards the western classical traditions, where nudity is exclusive to Aphrodite and is very different from the eastern nudity preserved on the Parthian bone and terracotta figurines. In Egypt the motive of the women holding her breasts, although rare, continues at least into the 6th century on crude terracotta figurines (e.g. Frankfurter 2015:F11).

Other Parthian figurines were found at Susa. While in Seleucia the majority of Parthian figurines were found in domestic contexts (Van Ingen, 1939:43), in Susa most of them originate in graves (Boucharlat & Haerinck, 1994:195). A few of the Susa figurines, now in the Louvre, were published by Caubet and Gaborit-Chopin (Caubet & Gaborit-Chopin, 2004:83-87, Nos.89-94). Among the six published examples of the ’epoc parthe’, two seem to be identical to Early Islamic dolls from Palestine and Egypt. According to Caubet and Gaborit-Chopin these Parthian dolls were excavated by Jacques de Morgan (1897-1912), but at least one of them, a flat articulated doll similar to some early Islamic dolls found in Alexandria, Caesarea, Tiberias and Jerusalem (e.g. PL.2:4; Ayalon, 2005:83-84, Nos.319-320, Fig.32:319-320; Rodziewicz, 2007:83, No.29, PL.15:29; Shatil, forthcoming;Nos.50-52) was published by Boucharlat and Haerinck (1994:192, No.8) as a figurine from Ghirshman’s excavations. Roman Ghirshman was the first archaeologist to seriously explore the Islamic period in Susa in 1946-1967. In ‘Ville d’Artisans’ he uncovered a mosque from the 7th-8th century and graves of earlier periods (Gasche, 2009) from which all the figurines appear to have originated. Thus the bone figurines presented by Caubet and Gaborit-Chopin may contain material of Sassanian and Early Islamic provenance from Ghirshman’s excavations. A bone figurine in the Metropolitan Museum (PL.7:3), said to have originated from Nisapur and to possibly be of pre-Islamic origin, is another parallel to the Parthian-Sassanian doll from Susa and the articulated Early Islamic dolls from Palestine and Egypt. The Metropolitan figurine may represent a continuum from the Parthian period to the Pre-Islamic era in Iran, but its exact context and chronology is uncertain.

Parthian dolls also appear on other sites in Mesopotamia such as Nuzi (Starr, 1937:422, PL.102:A, PL.141:K), Nippur (Knudstad, 1968:104, PL.7) and Uruk (Van Ess & Pedde, 1992:194-204, Taf.117-120). Their continuation into the Sassanian period is however problematic. De Mcquenem found them in Sassanian infants tombs in Susa (1934:219-220, Fig.65) but Boucharlat and Haerinck doubt this dating (1994:197). Van-Ingen thought that they must have continued after the Parthian period and into the Sassanian era, and must have formed a link with “certain Coptic bone figurines, sometimes called dolls” (Van Ingen, 1939:46).

Three figurines of unclear date and provenance, found in the upper layers of the western parts of the Esagila Temple in Babylon (Koldewey, 1911:49, Abb.85) may be another evidence for the link between Parthian-Sassanian figurines and the early Islamic dolls. One is a large Parthian bone figurine of a naturalistic type similar to those found in Seleucia, but the two others are a doll head and a complete semi-naturalistic doll of a type most common in Early Islamic Fustat (e.g. PL.6:1; see also Petrie,
Close to the bone...

1927:PL.LV:597; Rodziewicz, 2012:Nos.279-281, 283; Scanlon, 1968:14, Fig.3d, 4a; Wulff, 1909:Taf.XXII:529).

Besides the many Parthian and few possibly Sasanian bone figurines excavated in Iran and Mesopotamia, there are also other bone figurines in museums which are said to have been found in Iran. The chronology assigned to them by museum authorities varies, but their shapes and style undoubtedly makes them contemporary to, or slightly earlier than, the Early Islamic dolls. One is a naturally carved ivory figurine in the British Museum (Inv. no.135580), supposedly from the vicinity of Ur, and dated by Davies to the early 1st millennium BC (Davies, 1975:239, Suppl.71, PL.CL). A fragment of a similar ivory figurine from Egypt was published by Strzygowski and dated by him to the 4th-5th centuries (Strzygowski, 1904:204, Taf.XVIII:8880). Yet another similar ivory figurine, this one complete, was dated by Wulff to the 7th century (Wulff, 1909:Taf.XXII:528). These naturally carved figurines stand at the beginning of both Woolley's and Elderkin's sequences of development for the Early Islamic dolls corpus, and represent the earliest type. One such doll, though much smaller in dimensions, was retrieved from Umayyad context in excavations at Ramla (PL.1:1; Segal, 1998) confirming these dolls were in use at the early 8th century. Thus a date of mid-7th-8th century would be best accurate for this type's appearance in Palestine and Egypt, but it may have been known earlier in Mesopotamia as the figurine from Ur suggests.

Another figurine at the British Museum (Inv. no. 134876), said to possibly originate from Iran, and dated by Davies to the 4th-5th centuries AD (Davies, 1975:239, Suppl.73, PL.CL), may also represent a link between eastern pre-Islamic figurines and the Early Islamic dolls of Egypt and Palestine. This figurine has an extenuated steatopygia and a narrow belly marked by thick rings or fat folds, a large chest with pillow-like breasts and unarticulated arms pointing downwards. The head was carved separately and fitted to a drilled socket on the figurine's body. The facial features incised on the head are identical to those of the Early Islamic dolls. A few other similar examples of this type are known from other museums and auction houses catalogues, and it is dated between 300BC to 1000AD. This Iranian figurine type is however very similar to dolls excavated in Egypt. One example from Antinopolis (Sheikh 'Ibada), was mistakenly dated to the Roman Period (Caubet & Gaborit-Chopin, 2004:98, No.108), another is at the British Museum (Inv. no. OA.912) and is said to have originated from Antaeopolis (Qaw el-Kebir). Close in style to these figurines are two specimens, one found in Fustat in early 8th century context, the other, of unknown origin, is in the Budapest Museum of Fine Arts (Rodziewicz, 2012:No.278, PL.36, PL.98.6; Török, 1993:56, PL.LXXXIV). The figurine in Budapest is made of slate, but it is identical to the bone figurine from Fustat. According to Rodziewicz the Fustat figurine was used for a long period of time before it was intentionally damaged from the waist down and discarded at the beginning of the 8th century (Rodziewicz, 2012:173). These figurines therefore may have appeared in Egypt in the second half of the 7th century. Rodziewicz sees similarities between these dolls and African art and suggests it might have been brought to Egypt by Arab tribes from Yemen whose art was inspired by relations with the Horn of Africa (Rodziewicz, 2012:16). However interesting her suggestion is, an eastern origin of this type seems more likely in view of the Iranian dolls of similar shape and style.

Finally, there is another group of figurines with examples at the Metropolitan Museum (PL.7:4) and the Freer Gallery of Asian Art at the Smithsonian's Museum, Washington D.C. (Inv. No. S1987.104). Like the type discussed above, these figurines have their heads attached to the body by a tenon inserted into a socket drilled from the top. The shoulders are squared and on the chest two conic protrusions represent the breasts. The Metropolitan figurine is dated by the Museum to the Early Islamic period, and said to have originated from Iran. The one at the Freer Gallery is said to originate from the South-West Caspian region of Iran, and dated by the museum to the 1st millennium BC. Recently however, two examples were excavated at Fustat. Both were found in contexts of the late 7th to 9th century (Rodziewicz, 2012:Nos.285,286). Once again, the archaeological evidence points to the appearance of the type in Egypt in the 7th century, while the museums specimens from Iran might point to an earlier origin in the east.

Thus we may conclude that in Mesopotamia and Iran, a tradition of carving bone figurines was practiced at least since the Parthian period (3ed cent. BC -3ed cent. AD). These figurines were used in both domestic and funerary context and seemed to have continued into the Sasanian period (3ed – 7th century). Unfortunately, all known examples of possible pre-Islamic Sasanian origin lack proper context and their dating uncertain. Studying the shape and style of the Parthian-Sassanian bone figurines, we see the development of characteristics of the Early Islamic dolls, such as the schematization of the 'hands holding breasts' motif, which is finally only hinted by the 'X' separating the breasts and the odd shape of the shoulders. Moreover we see that some Iranian and Mesopotamian figurines may serve as proto-types for at least a few of the Early Islamic doll variants of Egypt and Palestine.

Arabian Forerunners

A number of small pre-Islamic stone sculpture heads from Yemen and Southern Arabia, some in the British Museum (Inv. no.122.009, 122.007, 130.893), the Freer Gallery of Asian Arts (LTS1992.6.55, LTS1992.6.146) and others excavated in Qaryat al-Fau, Saudi Arabia (al-Ansary, 1982:120), bear a striking resemblance to the heads of many of the Early Islamic dolls. While these heads are of uncertain date (estimations are between 300BC to
100AD), and my knowledge of pre-Islamic Arabian art is very limited, they cannot be ignored as a possible origin of the style reflected at least in some of the Early Islamic bone dolls. In recent years it is becoming clear that the exposure of pre-Islamic Arabia to Christian Egypt on the one hand, and the Sassanian world on the other, created a material culture that inspired and influenced the art of early Islam (Keall, 1995; Rosen-Ayalon, 1973; Talgam, 2004:110-117). It is therefore quite possible that popular and minor Early Islamic crafts were influenced by the Sassanian and western Classical arts both directly and via an intermediary tradition of Southern Arabia which was itself exposed to eastern and western traditions prior to the rise of Islam.

CONCLUSION

With the new Muslim empire bridging areas of former Byzantine and Sassanian dominion, intense migrations of various groups into Palestine and Egypt began in the middle of the 7th century. Artists from different corners of the empire were brought to build and decorate the palaces, mosques and newly founded cities of the first Islamic rulers, and the meeting of cultures encouraged the transmission of ideas and artistic traditions bringing about the foundation of early Islamic art.

At present there appears to exist no undisputed proof that Iranian and Mesopotamian figurines from the Parthian and Sassanian periods indeed influenced the Early Islamic dolls, but the archaeological evidence and the continuation of artistic motifs which I presented here strongly point in this direction. Several types of the Early Islamic dolls find parallels in the east where they might have developed slowly in several regions (Rodziewicz 2012:15). With the influx of peoples and artists from the east into Palestine and Egypt these figurines found their way into the region. The local populations quickly adopted them because the tradition of crafting female figurines and dolls from bone and other materials, as well as some aspects of their iconography was not entirely strange to them. Some forms may have been abandoned, but others were copied and reproduced with new meanings and forms. It should not come as a surprise that Persia had a major role in the formation of this Early Islamic component of popular art, as Persia served a gateway of eastern influences into both royal and minor Early Islamic arts and architecture (Rosen-Ayalon 1973; Talgam 2004).

Although the tradition of carving figurines out of bone was not new to Egypt or Palestine, the popularity of the Early Islamic dolls and their multitudes of shapes and styles reflect the introduction of new local and regional traditions developing as a result of the exchange of artistic ideas and the new freedom experienced by craftsmen after the Arab conquest. The significant number of dolls found in Early Islamic sites makes it difficult to accept Scanlon’s opinion that they were “whittled by otherwise busy men at rest” (Scanlon, 1968:17). On the contrary, in large urban centers such as Fustat, Alexandria, Ashkelon, Ramla, Jerusalem, Caesarea and Tiberias dolls seem to have been produced on a large scale by skilled craftsmen, fashioning them for the rich and the poor, for local and regional markets.

After the middle of the 7th century, the Early Islamic dolls spread quickly from their production centers in the large urban settlements to smaller and less prominent sites. Even Bedouin children may have enjoyed them as testified by the doll found at the “Cave of the Treasure” in the Judean desert (PL.4:5). Another interesting doll was found in the Western Wall Plaza excavations in Jerusalem (Weksler-Bdolah, On, Ouahnouna & Kisilevits, 2009; Ouahnouna, forthcoming) while dismantling a wall built during the 8th or 9th centuries (PL.2:5). This doll has features not seen on other Palestinian dolls, such as the small squares representing the breasts and the diagonal sawn arms, but dolls of similar style were found in Egypt, especially in Fustat (compare PL.6:4; Rodziewicz, 2012:PL.47:300-302, PL.48:304; Scanlon, 1974:PL.XVII:7 right; Török, 2005:No.176; Wulff, 1909:Taf.XXI:532-533). This unique doll indicates that although dolls were produced locally in Jerusalem, they were also brought from Egypt to Palestine, probably by merchants traveling between the regions and bringing Egyptian dolls as gifts to their children. This is not the only possible evidence of exportation of Early Islamic dolls from their original crafting site. The Tarsus doll, the only one found in Asia Minor (Goldman, 1935:548 Fig.45), was probably brought there from Fustat, Alexandria or somewhere in Palestine where similar dolls were found (PL.5:1-2, PL.6:5-6; Kubiak & Scanlon, 1973:Fig.19e; Rodziewicz, 1978:Fig.15; Rodziewicz, 2012:PL.50, No.313; Scanlon, 1968:Fig.4c; Strzygowski, 1904:No.8877; Török, 2005:No.172; Wulff, 1909:PL.XXII:539-540). Also very suggestive are the dolls in the British Museum found in the 8th-9th century levels at Siraf on the eastern coast of the Persian Gulf. Some of them have parallels in Ayla, the important Early Islamic port city in the Gulf of Aqaba (Ina, 2000:188), reflecting trade between these two important parts of the Caliphate.

By the 10th century dolls became such a prominent and important component of the early Islamic culture that they likely posed a problem for Islamic religious thought which encouraged refraining from the depiction of humans or animals in art [as dolls pose a problem in Islam even today (Buchanan, 2014)]. A tradition (hadith) was written down, probably around the 9th-10th century, telling how the prophet Muhammed came to condone the use of dolls when his nine year-old bride ‘Aisha brought them with her into her new home. When asked by the Prophet who the dolls were she answered that they were her banāt, daughters, thus explaining the use of dolls as educational toys preparing the girl for motherhood (Rahmani, 1981:79-80).
During the Fatimid period the Early Islamic dolls seem to lose their cultural importance and popularity. Based on stylistic and iconographic considerations many dolls were dated by researchers to the 12th century and even later, but I believe that by the end of the 11th century their production was already brought to an end. They disappear from Egypt, Palestine and other regions of the Islamic Caliphate as quickly as they appeared at the end of the 7th century. The reason for their disappearance is just as obscure as their origin. Possibly, the turmoil and civil wars that afflicted the Muslim world and especially Palestine, at the end of the 10th and the 11th centuries, and finally the Crusade, contributed to their disappearance. Another possibility, in my opinion more valid, is the strengthening of religious institutions and thought that did not see the dolls, especially the naked female ones, as complying with religious institutions and thought that did not see the dolls, especially the naked female ones, as complying with Islamic law. Very suggestive in this regard is a Persian early dolls, especially the naked female ones, as complying with religious institutions and thought that did not see the dolls, especially the naked female ones, as complying with Islamic law. Very suggestive in this regard is a Persian early doll from Caesarea Maritima, Israel. 1st-13th Centuries. Al-Ansary, A.R. 1982. Qaryat al-Fau: A Portrait of Pre-Islamic Civilization in Saudi Arabia. Riyadh.

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A. Shatil, Bone figurines of the Early Islamic period...


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These past five decades have seen a development in the study of prehistoric bone industries based on an increasingly skilful and in-depth analysis of the objects. This improved knowledge of the tools has provided a better understanding of the way they have been transformed, which helped form an image of the industries as processes fashioning objects – sometimes quite intensely – in accordance with narrow cultural norms (Camps-Fabrer, 1964; Choyke, 1984; Goutas, 2003; Legrand, 2007; Sidéra, 1993 & 2012). In order to complete the picture of the bone tool kit, we drew attention, in the 5th conference of the WBRG, to the existence of previously unrecognised elementary pieces consisting of simple traversal segments of broken bones. These are scarcely distinguishable from butcher's scraps or left-overs after consumption, but in reality are tools without apparent shaping. Only the wear traces - smoothing, striations, macro- or micro-flaking and deformations of volume in the active parts - identifiable with microscopic equipment – indicate they were real cutting tools probably used as adzes. We therefore previously termed them “crude adzes” (Sidéra, 2010).

Here again we should like to draw attention to unknown objects, but of another type. They are made from ruminant metapodia, more or less fashioned, to which the expressive metaphoric properties of the human body had been assigned: they were in fact dolls. Like the “crude adzes” they exploited the bones’ natural forms. These objects, well documented in Africa by ethnography, are worth studying to be able to identify them within archaeological assemblages. Attested in diverse places and periods of prehistory and history these anthropomorphic bone figurines are often highly worked. They are known in the Upper Palaeolithic (de Saint Périer, 1924: 82; Hahn, 1971: 234) (fig. 1, no. 1), in the Balkan Neolithic and Chalcolithic (Todorova 1978; Ivanov 1988; Lichardus 1988; Sidéra 1998; Biehl 2003) (fig. 1, no. 2), in Antiquity (Bianci, 2012) (fig. 1, no. 3), in the Byzantine period (fig. 1, no. 4), as well as at the beginning of the Islamic period in the Middle East and Africa (Early Islamic period) (Shatil, 2013 & this volume) (fig. 1, no. 5). Here we will examine the characteristics of the pieces made from ruminant metapodia and the attributes that make them artefacts, as well as the contexts in which they are found and in which they were used.

**DOLLS: DATA FROM AFRICAN ETHNOGRAPHY**

Ethnography provides multiple examples of dolls in varied forms and made from various materials – including bone. These dolls are associated with divers uses, some of them for play, but also ritual or magic. The three aspects are often mixed at the same time or successively in the same doll (Lusardy, 2006) – as we shall see below through concrete examples. For the sub-contemporary periods western and southern Africa are known for important series of metapodial dolls. They illustrate the variety of treatments bones used for these purposes can undergo and provide clues with which to identify such objects within archaeological collections. We shall describe them while emphasizing how the material is treated and the wear traces that may be found on them.

Certain African dolls consist of a metapodium left as it is without any technical intervention or addition. Sometimes, the proximal extremity is just planed down slightly. Lutten (1933: pl.1) reproduces a photo of three young girls from Metteboulou in Senegal, one of whom is holding a simple metapodium without any artifice – in reality a doll.
Along the coast of West Africa (fig. 2) whole goat metapodia above all, but also from cows and sometimes pigs, are used. Once the bone has been dried and cleaned, rings made of leather, metal, or fine glass beads are added - representing necklaces or belts, or again ear-rings (fig. 3, no. 1, 2 & 3). In this case the father of the girl pierces, from one side to the other, the epiphysis, which is to form the doll’s “head” (fig. 3, no. 2). These piercings are the only direct technical interventions on the bone. Unlike the previous example in this case there is an explicit reference to the human body. The personal ornamentations, evoking a woman’s attire, give all its dimensions to the object - thereby becoming a metonym for the feminine body. With the Balantes of Guinea Bissau, Landumas of Guinea Conakry and Himba of Namibia one can even tie a string to your bone doll to carry it over the shoulder (fig. 4). All these dolls are called “di kori”, which means “bone son/daughter”. They are used to favour young women’s fertility. According to Allainmat (1942) a women treats this “bone son” like a real child and when she bears her own child she will give it to him as a toy. An important element is apparent here concerning the ambiguous and multiple statuses of these di Kori dolls. They have a role that is both profane and magical; for they are endowed with propitiatory virtues. Rossie, whose study concerns the dolls of the Moroccan Atlas (2005: 200), also under-
lines this ambiguity “... the distinction between ritual doll and child's toy doll can become blurred as is the case for dolls used to simulate burials or for the wooden spoon dolls used to make rain”. Other authors have also underlined the connection between the African dolls and women's fecundity (Dagan, 1990; Cameron, 1996; Leibhammer & Dell, 1998) which is connected to the fertility of the soil and are characteristic of agricultural cultures according to Lusardy (2006). Thus among the Bissagos of Guinea Bissau the “bone children” are cow metapodia that hang down girls' backs until they are married; both toy and symbol of fecundity, the object represents the child to come (Duquette 1983: 132-133; Cameron 1996: 62). Moreover, in Senegal paired dolls exist made from two ruminant metapodia of different sizes – large and small – joined together with a coloured cord. This again suggests the clothing in the representation of the mother carrying her child on her back (fig. 5, no. 1 & 2). To designate these objects, on which all kinds of daily care are lavished, Gell, in his anthropological theory of art and agency, speaks of a “quasi-person” (1998, 133-134). These terms are perfectly adapted to these figurines.

What makes the object a “doll” are not the modifications made to the bone, which is most often left untouched, but all the external attributes that are added to it – numbers of which are of perishable materials. In many cases they will leave no trace once they have disappeared. They also prevent marking by wear traces, since they protect the bone by covering it (fig. 5). In the Moroccan Atlas the metapodial dolls have the following appearance: “A leg bone from a sheep slaughtered for the aid el-kebir, that is the tenth day of the month of dhu-el-hijjah (the last month in the Muslim calendar and the month of pilgrimage), is used by girls in the region of Khouribga - near Settat and not far from Casablanca – to make a doll called ashûra. A stick is tied across this bone to represent the arms and the resulting frame is then dressed as a woman. The girls put henna on the doll's head. The face is not indicated” (Rossie, 2005: 200). Clearly, if such objects were brought to light once their perishable adjuncts had decayed and with no information as to their purpose or context of use, there would be nothing to indicate their actual function and the archaeologist would be helpless. In certain examples bee's wax can be placed on the bone to model the breasts or the features of the face (fig. 6, no. 1 and 2). The bone is also hidden under

Fig. 3: Balante dolls "Di Kori", Guinée-Bissau. 1: Bare Metapodium with a belt made of small glass beads. 2. Bare Metapodium with belt, necklace and earings made of glass beads and leather. 3. Bare metapodium with a belt made of small glass beads, a shell glued to the bone, and a skirt of vegetal fibres.

Fig. 4: Himba doll, Namibia. Covered Metapodium. String with bead ornaments, covered in red Mineral powder, which frames a decorated diaphysis. The doll includes a shoulder strap for carrying.
Close to the bone...

the covering material. Cameron (1996: 63) reproduces a
doll from the Horstmann collection modelled on a can-
non bone entirely covered with bee's wax. This wax and
bone doll represents a woman with her baby on her back.
It has two small white beads for eyes and is ascribed to
the Bamans of Mali. In the centre of Togo the wax can be
applied at certain points on the bone, for the purpose of
modelling the face with eyes made of two grains, a pair of
breasts and a conic base (Bachmann & Hansmann 1973:
19, fig. 9). The two examples illustrated, attributed to the
Hausa – but this needs to be confirmed – are addition-
ally decorated with small necklaces, belts, and ear-rings
made with small glass beads, which also underlines the
feminine character of the dolls (fig. 6, no. 2). Much fur-
south, in Namibia amongst the Himbas, dolls are
also found made out of goat or antelope metapodia. They
are covered at both ends with fine cords - the whole cov-
ered with the mixture of grease and red mineral powder.
Women anoint themselves with this from head to toe
(fig. 4). In its collections, the Belgian Royal Museum for
Central Africa in Brussels possesses several examples, for
which the reference to the feminine world is suggested by
the red paste ointment.

If we review these examples from the archaeologist's
perspective, we may thus group these examples into two
basic types:

1. The metapodium is entirely untreated without any
technical transformation. Several models are then possible.
The bone's anatomic features are intrin-
sically deemed to evoke the form of the human
body. It is in a way naturally anthropomorphic.
The metapodium's distal end constitutes the
head, the diaphysis – the body. It can also be
viewed that its very rectilinear form evokes a
phallus, in a masculine/feminine fusion having
a propitiatory magic effect. In any event, the
symbolic values attributed to the bone's natural
anatomic features are the basis for the meaning
given to the object.

A second model, less elementary, is deco-
rated. Items in perishable materials have been
added to the simple bone such as wooden arms,
modelled wax, string, rags, leather, hair, and
grains, but also items made of hard material,
such as unguents made of a mixture of grease
and mineral material, and personal ornaments
such as necklaces, belts, bead, earings, or rings.
The references to the human body are here ex-
plcit and external. They always – or nearly al-
ways - belong – to the world of women.

2. The metapodium receives a technical
treatment that modifies the natural bone.

It is perforated to have items added to it
– particularly earings. The bone can also be
smoothed in places. These modifications are discreet and not always representative of the “doll” as an object.

An object consisting of a bare and unworked metapodium will display, depending on its state of preservation, traces of smoothing due to manipulation that are identifiable on a microscopic scale. It may also show alterations in its initial volume, such as fractures, crushing, splintering, and smoothing, owing to falls and friction or through being banged together. When they are intact all archaeological metapodia are worth examining meticulously so as to reveal any form of wear trace which might identify an object of this type – especially if it is in a funerary context.

An object consisting of a metapodium that is bare but covered with various materials will be more difficult to identify as an artefact. None of the additions made to the bone to represent a face in wax or textiles or clothes with textile or cord will leave any trace in the long term, or else very basic and probably difficult for an archaeologist to interpret. The colour red may impregnate the bone or, through staining the fabric or cords, leave a coloured trace. These modifications in appearance are clues, as are, likewise, the drillings in the articulations. These modifications must in no case escape the archaeologist’s attention. In such cases the bone needs to be examined for modifications to its volume due to wear, such as smoothed areas and cracks. The “hard” items associated with the bone in imperishable material, such as personal ornaments, rings, or beads, would enable a symbolic meaning to be detected with more certainty, but do not allow any inference as to its intention. Here the importance should be stressed that archaeologists assign to these objects seeing in them “amulets” (Chauvet, 1938) or “idols” (Maier 1961; Todorova, 1978; Lichardus, 1988; Shade-Lindig, 2004). Biehl seems to have been one of the few to talk of dolls for certain figurines of the Chalcolithic in Eastern Europe (2003). It should be added these objects are never studied from a technological and functional point of view but typologically.

ARCHAEOLOGICAL DOLLS?

So the issue of archaeological dolls *stricto sensu* is worth raising. The Greek or Roman iconography, in which refined dolls are carved from bone or ivory for little and young girls (fig. 1, no. 4), is quite explicit. Funerary monuments for young girls include dolls, stressing the importance of such objects for Roman and Greek children (fig. 7, no. 1). But what about cultures without writing and a realistic iconography? How can it be demonstrated that we are dealing with dolls?

Let us go back to Africa and the upper Congo in the Democratic Republic of Congo. In the Upemba Depression archaeology has brought to light a series of entirely unworked metapodia which it has been successfully shown were probably used as dolls (de Maret, 1985: 166-168). In the numerous cemeteries scattered over this vast flood plain, for a period in which, between the 9th and 13th centuries, a refined culture referred to as “Classic Kisalien” flourished, the excavations have yielded abundant funerary goods – including metapodia from goats and various antelopes. These metapodia come from the burials of children, but also from a few graves of adults. Intact, occasionally with a slight patina, they were not found with any other bone from the same animal. They do not correspond therefore to quarters of meat left as a viaticum. The metapodia are positioned in view, sometimes several at a time, alongside or on the deceased child’s thorax. One of them is decorated with a copper ring. Their function remains mysterious (Hiernaux et al. 1971: 43) until it is realised that in other parts of the continent these bones could be used as dolls. This would explain why they are found in children’s graves. But how is it possible to find support for such a hypothesis as suggested by ethnography, without any parallel in recent periods in central Africa? As it happens that in the Kisalian period the orientation of the body is very systematic, the hypothesis seems plausible that if these bones were dolls their “heads” ought to point in the same direction as the
Close to the bone...

head of the corpse. In fact, wherever excavation data is sufficiently precise this is invariably the case. In one or two cases the cannon bone is placed horizontally, as if cradled by the child (de Maret, 1985: 166-168).

If the metapodia from Kisalian period children’s graves do indeed represent the remains of dolls, this begs the question of their presence in adult burials, since of the 36 metapodia found in Kisalian graves, 8 are associated with adults. As dolls are - in Africa (Dagan 1990; Mattas 1999) as elsewhere – girls’ toys, they are clearly associated with the female sex. After verification it appeared that where in the Kisalian the metapodia were found associated with adults, the graves always belonged to women – judging by the nature of their funerary goods (de Maret 1985: 181-184). Thus these metapodia never come from masculine graves. All this strongly suggests their use as dolls within the feminine world.

Multiple elements connect the Kisalian culture with the present inhabitants of the region, the Lubas, an ethnic group famous for the beauty of its art and the prestige of its ancient kingdom. With the Lubas of the last century the cylindrical dolls were made from clay, poker-worked banana tree trunk or wood. In the last case they are in general about ten centimetres tall and the cylindrical body terminates in a more or less rounded head – giving the whole a very schematic human form and a very explicit phallic look (fi. 6, no. 3). In Africa there are many ethnographic (Roumeguère & Roumeguère-Eberhardt 1960), and archaeological (Matenga 1997: fig.17) examples of wooden or clay dolls that also have a phallic form. The choice of the metapodium, owing to its very rectilinear natural form, might refer precisely to the fusion of masculine and feminine organs in liaison with the propitiatory magic practices to do with women’s fertility (Cameron 1996; Leibhammer & Dell 1998; Dagan 1990). This would provide a good explanation of these dolls’ presence in the graves of adult Kisalian women.

Beyond Africa, at the end of the Linear Pottery Culture circa 5100 BC – the first continental European Neolithic – in the western part of Europe, Caprine metapodia materialising human faces constitute the funerary attributes of two children’s graves. In one, north-east of Paris at Berry-au-Bac “le Vieux Tordoir” (burial no. 607), the bone is a metatarsus from a young Caprine, of which the distal part is decorated with fine mother-of-pearl discs glued on the bone as eyes and mouth. The nose is made more prominent with a halved-Dentalium shell. If the bone is transformed – which is not completely clear given its surface's substantial taphonomic deterioration - then this technical modification is discreet and confined to the diaphysis. The sides and front face may have been thinned down (Sidéra 2000: fig. 29, n°14 & 2009) (fig. 8, no. 2). In the other burial, in the east of France in Haute-Alsace at Ensisheim “les Octrois” (burial no. 13), it is a Caprine's unworked right metacarpus. The proximal part forms the head. It is perforated by two holes for the eyes set with disks made from shells. The central void is filled with birch tar (Gallay & Mathieu 1988; Mathieu 1992) (fig. 8, no. 1). In both cases the realism of the representation should be emphasised. One of the figurines mimics all

Fig. 8. Possible dolls of the Linear Pottery Culture. 1. Ensisheim “les Octrois” (burial no. 13): Caprine’s Metacarpus with perforated holes for the eyes set with disks made from shells and central void filled with birch tar. From Gallay & Mathieu 1988. 2. Berry-au-Bac “le Vieux Tordoir” (burial no. 607): Caprine’s Metacarpus with discs of mother-of-pearl for the eyes and a half Dentalium shell for the nose. 3. Caprine’s phalanx with discs of mother-of-pearl for eyes and with abrasion on the posterior face. From Sidéra, 2000: fig. 29.
the features of the human face: eyes, nose, and mouth, right down to materialising the prominence of the nose. In the other case the whites of the eyes and the pupils are suggested by a ring of white nacre around a black central circle of birch tar.

The epiphysis of the Berry-au-Bac metapodium is missing, as if eroded. This may be a wear trace owing to manual manipulation – the only one on this piece. No surface abrasion is visible, but it should be remembered that coming from a young animal the bone was fragile and has been much deteriorated by roots: the roots have scored its original surface in every direction. The Ensisheim piece is better preserved. It is “much polished on its posterior part” (Mathieu, 1992: 28). However, never having been observed under the microscope it is difficult to come to a conclusion about this trace.

Both metapodium figurines – of very similar workmanship – are isolated, and the study of the traces is inconclusive. Both are associated with children’s graves – likely female – and we can thus reasonably associate them with the western Linear Pottery Culture on account of both the incorporation of standards doll types, and repetitive cultural-behavioural pattern.

We should add that the metapodial figurine from the Berry-au-Bac burial is associated with another figurine – also anthropomorphic – with mother-of-pearl discs for eyes. It is smaller in size as it is made from a whole Caprinne's phalanx. The bone presents a clear direct transformation: an abrasion of the two epiphyses – distal and proximal – of the phalanx's posterior face, which flattens by the profile. This classic case of a technical action has made it possible to identify another object of the same type, but from a contemporaneous village in a detritus context – the lateral ditch of a house. It is a bare phalanx abraded in exactly the same way. Nothing was added to it, or else it was intentionally or accidentally stripped clean before being thrown away (Sidéra, 2009). These objects, of which at least two examples exist, suggest the existence of another model of doll, if this function is admitted: large made from metapodia and small from phalanx. In this way, the Berry-au-Bac tomb be a striking illustration of a mother/baby pair - like the African double figurines (fig. 5)? Would the metapodium’s very flat profile and the phalanx figurine's flat back have been deliberately shaped to make it easier to fit the pieces together? It is possible. The way the items were arranged in the tomb does not support this hypothesis: the two figurines are parallel to one another and face down (Allard et al., 1997). In any case, they are exceptionally realistic and striking witnesses to life.

With their morphology – very different from the family of very schematic flat anthropomorphic figurines of the Linear Pottery Culture of central Europe and the later ones from the early south-east European Chalcolithic – the metapodium and phalanx figurines of the Late Linear Pottery Culture take full advantage of the bones' natural forms. They also aim at a greater realism, materialised by the volume of the bone and the detailed representation of the face. Attached to a limited geographic area – the Paris Basin and Haute Alsace at the very end of the Linear Pottery Culture – these figurines in volume manifest a rupture between the Classic Linear of central Europe and that of the Paris Basin and Haute Alsace, just as they illustrate the historico-cultural liaison between these last two regions (Constantin and Ilett, 1993; Jeunesse, 1995; Sidéra, 2000a; Sidéra, 2012). It should be noted these objects in volume and with an apparent face have equivalents in the peri-contemporary Mediterranean contexts, or later in Italy (Maier, 1961), and Syria (Kenyon, 1961). They may be associated with the appearance of artefacts of Mediterranean traditions – techniques and materials (Sidéra, 2009 & 2010). The doll hypothesis obviously rests more on the systematic association of the items with child burials rather than on concrete wear traces, which we have seen are fragile and not always representative of the African ethnographic examples. It should not be forgotten these objects are never – or rarely – analysed from a technological and functional angle but always typologically. At any rate, the existence of different models of dolls in vogue in the Linear Pottery Culture associating two figures – the mother and the child or baby – is solid. Here ethnography provides a useful framework for comprehending more fully these archaeological models and of how they fit into social practices and beliefs. Accordingly, one could take the view that these dolls or quasi-persons – to adopt Gell’s terms – are not only toys, but also principles of fertility. This would also go with the fertility of the land evoked by Lusardy, corresponding to cultures of farmers.

However this may be, these examples illustrate the strong implicit meanings of which the bone – “ruminant metapodium” - is the bearer in many sub-present or past cultures. Nothing to eat around the metapodium. It is the bone “good to think” par excellence, to paraphrase Claude Lévi-Strauss (1962). Its straight form making it stand upright, the central lines on the bone’s anterior and posterior faces acting as a demarcation between two parts, and the foramen of the anterior face, which opens towards the bone’s interior, placed under the very round and symmetrical articulation are so many features that probably lead this bone to be a powerful metonymy for the human body. It naturally becomes anthropomorphic. This provides a further example of the selection of specific skeletal parts according to cultural values and the deeper symbolic meaning with which these objects are imbued.

For instance, whilst in Neolithic continental Europe the metapodium plays a very important role in the development of the industry, in the Mediterranean the tibia has also a prominent position. Thus – and as we have sought to show here – these differentiated choices, which may be termed cultural, are the signs of an interiorised aesthetic approach to bone matrices. Here it is argued
that they also incorporate metaphorical value beyond functional and aesthetic factors. Shedding light on such apparently simple objects provides a valuable contribution that makes more tangible the underlying complexity of ancient beliefs and symbolic practices.

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INTRODUCTION

A variety of post-medieval bone artefacts are variously described as apple corers, cheese scoops or eating scoops. MacGregor (1985, 180) provides a definition of the standard form made from metapodial bones of sheep: "the distal end normally forms the handle, with the articular condyles left intact. The proximal end is cut off and about half the length of the shaft exposed by removing either the anterior or posterior wall. Shaping the exposed end into a rounded cutting edge renders the scoop ready for use. Decoration in the form of criss-crossed lines and other motifs usually covers much of the handle". Within this generic description may be included one typologically distinct group of objects, which form the subject of this discussion and for which a different function is proposed.

The assemblage of artefacts under consideration was originally collected by a "mud lark", or foreshore collector, on the river Thames in London. The artefacts were offered for sale, inaccurately described as examples of apple corers, and purchased by internet auction. Though realising the importance of this typologically distinct artefact, due to limited funds, the author was only able to purchase 92. This was the majority of a larger collection amassed by the "mud lark" over a very long period of time. The finder of these artefacts was not an archaeologist, the bones were not stratified and there must have been some selectivity in what was retained or disposed of elsewhere. However, the present collection is sufficiently large for meaningful analysis.

The bone tools are well preserved, having been recovered from the mud and silt on the River Thames foreshore near to Tower Bridge. The tools have been fashioned from nineteen cattle, forty-six sheep and five deer metapodials, together with twenty-two sheep tibiae. Individual records were made of species, skeletal element, decoration and any other distinguishing traits. Measurements follow von den Driesch (1976).

TYPOLOGY

The tools can be divided into four distinct types. Types 1 to 4 are depicted from the left to right on Plate 1. The basic form of the tools follows Mac Gregor's (1985, 180) description above. Only additional distinct characteristics are described for each type.

Type 1
Cut straight at the proximal end of the shaft to form the working surface, sometimes with the corners rounded off - possibly with use. Number of examples: Sheep tibia 7; metacarpal 8; metatarsal 11; Cattle 8; Roe deer 4.
One example of a radius has been recorded on the Portable Antiquities Scheme, LON-8DE7F3. It is complete and well used, and unusual in that it was found in the River Wandle, some distance away from the River Thames foreshore.
Type 2
Comparable to Type 1 but with a tick like feature on the medial and lateral sides, where the transverse cut has been made in the distal shaft. This has to be a deliberate feature because it can only be made with, for example, a triangular file, rather than the knife proposed by MacGregor (1985, 180). Number of examples: Sheep tibia 1; metacarpal 3; metatarsal 8; Cattle 2.

Type 3
Cut square or shaped at the proximal end to form the working edge. The transverse cut on the distal shaft has a shallow cut, about 1.5cm from the distal epiphysis, which has been filed down to leave the rest of the bone proud. The example in Plate 1 has a triangular shape but other examples are rectangular or trapezoidal. In all examples, this surface is polished, though it is unclear whether this was before or during use, or both. Number of examples: Sheep tibia 8; metacarpal 1; metatarsal 8; Cattle 6; Roe deer 1.

Type 4
Similar to Type 3 with a triangular shape made at the transverse cut on the distal shaft, which is then worn unevenly by use. Number of examples: Sheep tibia 3; metatarsal 5.

Sub-type A
The handle is formed from the proximal, rather than distal, articular end of the bone, see Plate 2. There is one
example in this collection, made from a sheep metatarsal.

A recent find on the Portable Antiquities Scheme looks superficially similar though the handle is formed from the distal end and a side view is needed to confirm the shaping of the shaft.

Sub-type B

The scoop is cut from the medial or lateral side of the bone, rather than the anterior or posterior face. One example of cattle metacarpal; two sheep tibia with scoop cut on medial side; two sheep tibiae with scoop cut on lateral side. One of these appears to be cut for a left handed person; it only feels comfortable for use when held in the left hand.

Sub-type C

Only seen on three cattle metatarsals and one sheep metatarsal with fused distal epiphyses. These have the peripheral parts of the trochlear condyles removed. For the cattle bones, on one example saw marks are clearly visible, on the other two the modification appears to have been performed with a sharp blade. The remaining medial and lateral surfaces are smooth to touch, but do have other wear patterns on them. On these larger bones, cutting off the peripheral parts of the condyles may have made handling the tool easier. The sheep bone artefact was presumably for finer work.

THE BONES

Zooarchaeological Analysis

Before detailed analysis of the function and wear of these tools was undertaken, the group was first treated as a standard archaeological bone assemblage for analysis. This approach was taken to see if it was possible to establish a broad chronological context for these finds. Subsequently, if their use could be established, it might also be possible to narrow down the date range and location of manufacture. MacGregor (1985, 180) proposed a post-medieval origin for the broader class of artefact of similar manufacture. The presence of large sheep tibiae, associated with later post-medieval improved livestock types, also suggested a post-medieval date range.

Published faunal remains reports are available from two excavations in the vicinity of the Thames foreshore, where these artefacts were recovered. The first report consulted for evidence to suggest where and when these tools could have been manufactured was the site of the former Royal Mint, East Smithfield (MIN86), less than 400 metres away from the Thames (Grainger & Phillips 2010). The site was a Cistercian Monastery until the dissolution in 1539 and was subsequently a Royal Navy victualling yard from 1560-1785. This Navy yard was described in Stow’s Survey of London in 1598: “of late time in place thereof is built a large storehouse for victuals; and convenient ovens are built there, for baking of biscuits to serve her majesty’s ships. The grounds adjoining, belonging to the said abbey, are employed in building of small tenements” (Rhys 1923, 114).

A number of rubbish pits in part of the excavation of the Naval Victualling Yard, Open Area 29, known as Swedeland Court, though sometimes referred to as Skinner’s Alley in the late sixteenth and early seventeenth centuries, contained waste from small-scale industrial concerns, situated to the North East of the site. Also recorded at that time on the peripheries of the victualling yard were a shoemaker, knife maker, carpenter, stationer, tanner, stiller, starch maker and a brimstone-maker, (Grainger 2010, 60). It is possible that more trades were carried out in and around the Yard and not listed because they practised a trade that was not one of the recognised Guilds.

One pit in Open Area 29, [7114] contained 88 cattle distal metatarsals all sown. West (1995, 33) commented that the bone workers were being rather wasteful in cutting the metatarsals off as much as 2-3in above the anterior distal foramen. However, this would not have been the case if these were potential blanks for some other use. A prime possibility is the cattle bone tools, described below, though other alternatives include pinners’ bones (MacGregor 1985, 171: Fig 89) and the short raps for shoes of mill furniture (Gidney, this volume).

There is also zooarchaeological evidence for the location of industries processing animal carcasses in post-medieval period in the Eastern Parishes of London, just north of the Victualling Yard, (Yeomans 2007, 103 Figure 8).

The second report is of an excavation in Aldgate (Thomson et al 1984), approximately 1km away from the Thames. This produced structural remains of the late sixteenth - early seventeenth century and refuse pits containing a large seventeenth - eighteenth century assemblage of animal bone. One of the cattle metatarsals was sown in a similar way to those found at the Royal Mint site (Armitage et al 1984, Fig 67:4:141). There was a small broken worked bone thought to be from accumulated refuse of early - mid eighteenth century, labelled “possible apple corer”. When it was examined, the wear and shape was almost identical to some of the Thames Tools. This bone was seen just prior to the presentation of this paper and will need to be analysed for micro wear to confirm that it was used for the same function.

Cattle

There are sixteen metatarsals and three metacarpals. Only five metatarsals had the distal epiphysis fused. All the cattle bones appear to derive from small, unimproved stock. One fused metatarsal could be measured for Bd: 46.2mm. This is slightly below the Bd range of 46.8-53.3mm for a sample of eleven modern Dexter cows with withers height range of 0.91-1.11m (Gidney pers. comm.).
West (1995, 25 Table 4) gives a withers height range of 1.25-1.27m for the cattle at the Victualling Yard, calculated from five metapodials. West further states that these cattle bones were of a comparable size to those from Saxon deposits in London, representing small, unimproved Chillingham-size cattle. From the horn cores West suggests that most of the cattle slaughtered at the Victualling Yard in the middle period (1635-1726), were oxen, (castrates), with a small number of bulls and cows amongst them. Earlier, in the sixteenth century, the Navy victualers had sourced surplus male beasts and culled cows from the Fenland graziers, with a record of the purchase of 739 head of cattle in 1513-14 (Trow-Smith 1957, 201).

Of the remaining fourteen unfused metapodials, only three are metacarpals. There are three metatarsals from very young animals, no more than 3 months old as the surface of the diaphysial plate is poorly formed and the bones are very porous (Serjeantson et al 1986). There is evidence from the Victualling Yard assemblage that there were dairy cows present in the vicinity, (West 1995, 37). The remaining unfused metatarsals all have more ossified diaphysial plates, though in varying states of wear from use. These bones represent animals older than 5 months but younger than 18 months, when the epiphysis fuses.

It is possible that all of these metapodial bones were waste from a trade dealing in calfskins, for example a velum maker or a tawyer; tanners normal only took hides of mature cattle (Serjeantson et al 1986, 232). The continuing association of calf feet with calf skins was demonstrated in 1993, when Simpson’s abattoir, Cockfield, Co. Durham allowed the author to have the skin from a home-reared six month old Jersey calf (Stokes 2000).

Sheep
Visually, there is a large variation in the sizes of the sheep bones, from small examples comparable to the modern North Ronaldsay in size, to the larger metatarsals and metacarpals which may represent both larger regional types and mature wethers. Such a range in size is not surprising for post-medieval London. In addition to sheep coming into London from long distances, on the hoof, there would have also been skins arriving by boat from the eastern seaboard of Britain, as well as the Baltic. Raw skins were the trade of Fellmongers, who purveyed them to Skinners and Whittawers. Hides and woolfells were principal exports from Scotland from the fourteenth century. By the sixteenth century, hides (12%) and woolfells (9%) contributed 21% of the receipts for exports recorded by Scottish Customs (Whyte 1995 76). Such trade may have been interrupted during the seventeenth century during the three Dutch Wars, and no ships went into the port of London in the plague year of 1665.

Metapodials
To determine whether any goat bones were present in this collection of artefacts, all the metapodials were measured using the criteria of Boessneck (1969). However, all fell within the sheep range.

The apparent size range observed in the collection of artefacts was quantified by measuring Bd of twelve artefacts made from metacarpals, plotted in Figure 1, and thirty-three metatarsals, plotted in Figure 2. For the larger sample of metatarsals in Figure 2, a normal, unimodal distribution is apparent. This contrasts with the comparable data from the Aldgate excavation (Armitage 1974 unpubl.), which appear to show a bimodal distribution. The artefacts from the Thames show a clear overlap with the lower end of the Aldgate distribution, which may imply size criteria in the selection of bones for the manufacture of these tools. Post-medieval examples from Lincoln (Dobney et al 1996, 154-5) are also plotted in Figure 2, where it can be seen that there is broad overlap with the Thames artefact size range and the lower end of the Aldgate range.

Tibiae
Twenty-two of the artefacts have been made from tibiae. Unlike the metapodials, which may have been left in the wool fells, the tibiae represent consumption of leg joints. For example, the detail from Hogarth’s print of “An Election Entertainment” in 1755, shows a bone-in leg joint on the table, Plate 3.

Only three tibiae were unfused, suggesting that mutton from mature sheep was being consumed. Possible sources of mutton shank bones might include an officer’s mess, either in the victualling yard or on board a ship in port, or docksider taverns.

Fresh meat was consumed 4 days a week when a vessel was in dock. However, by 1745 the Victualling Board requested the Admiralty to reduce it to two days (Baugh 1977, 448). Mutton was certainly mentioned in a letter to the Admiralty Secretary from the Victualling Board commenting on the price of fresh meat: “in that the contractor cannot undertake to furnish fresh beef under 9d. a pound or mutton one shilling a pound” (Baugh, 1977, 433). Sheep are not included in any surviving records for the Victualling Yard. This suggests that any mutton was procured as dressed carcasses rather than purchased on the hoof for slaughter on site.

It is therefore probable that the tibia used for crafting the Thames tools may derive from different sheep to those of the metapodials. The plot of Bd x Dd in Figure 4 shows a clear bimodal distribution in the dimensions of the distal tibiae used for making these artefacts, with the majority appearing to represent one population, referred to here as Thames 1, and three much smaller examples, designated Thames 2. The Aldgate sample is not included as only the measurement Bd was taken. To gain an insight into the possible type of the sheep sourced for mutton, comparison is made in Figure 4 with modern, unimproved Northern Short Tail breeds (Soay, Manx Loaghtan, Hebridean), a modern Lincoln Longwool wether.
Close to the bone...

**Sheep Metacarpals**

![Sheep Metacarpals Graph](image1)

Fig. 1. Sheep metacarpal, distal breadth (Bd).

**Sheep Metatarsals**

![Sheep Metatarsals Graph](image2)

Fig. 2. Sheep metatarsal, distal breadth (Bd).

**Sheep Tibia**

![Sheep Tibia Graph](image3)

Fig. 3. Sheep tibia, distal breadth (Bd).
Fig. 4. Sheep tibia, distal breadth (Bd)/ distal depth (Db).

Plate 3. Detail from Hogarth print An Election Entertainment, 1755.
and an improved late eighteenth-early nineteenth century archaeological find from Co. Durham (Stokes 1994). It can be seen from Figure 4 that the group designated Thames 1 forms a discrete population, smaller than the modern longwool wether and larger than the other comparatives. The small Thames 2 group falls within the range of the modern primitive sheep.

Comparison of the Bd measurements of the Thames tools with the Aldgate assemblage in Figure 3 is instructive. The Thames 1 group overlaps and extends the top of the size range seen for the Aldgate finds, while the Thames 2 group falls below the Aldgate range. The presence of sheep of a variety of phenotypes is indicated.

**Radius**

No artefacts made from sheep radius are present in the Thames foreshore collection. The sole example is recorded on the Portable Antiquities Scheme, LON-8DE7F3.

**Deer**

Five artefacts were made from roe deer metatarsals. One example had an unfused distal epiphysis. Roe deer had been exterminated throughout southern Britain by the early post-medieval period, with the last recorded roe deer having died out in Epping Forest by the sixteenth century (Armitage & Butler 2005, 325). These metatarsals probably represent skins imported in to London, either from northern parts of Britain or possibly the Baltic, along with the trade in hemp and Stockholm tar.

**SCIENTIFIC ANALYSIS**

Fortunately, the bones were badly washed leaving some mud and sediment in the medullary cavity of several examples. In particular, one sheep tibia did not have any mud staining on the working surfaces and appeared to have some white residue in place of the mud in the medullary cavity. This artefact and four other bones, three tibiae and one metacarpal, had not picked up any colouration from the mud on the working surfaces. With the exception of the metacarpal, all have a black staining on the posterior aspect. One interpretation may be that these artefacts were possibly originally found within a leather sheath, with animal fat protecting the working surfaces. Tallow, for example, was readily available in the victualling yard where there was a Tallow House (Grainger & Phillpotts 2010, 11). This suggestion cannot be confirmed because contact has been lost with the finder. The Thames Discovery Group has been made aware of this possibility for any future finds.

Dr Chris Caple kindly subjected the white residue in the tibia to Fourier Transform Infra-Red Adsorption Spectroscopy (FTIR), analysis.
P. Stokes, *A new interpretation of post-medieval bone scoops...*

Spectroscopy analysis (FTIR). The results, see Plate 4, show peaks between 2800 and 3000 cm\(^{-1}\) which suggest the presence of hydrocarbons probably materials such as fats, oils or waxes.

The simplest explanation, that the white substance is merely adipocere from the degradation of marrow that was not cleaned out of the bone shaft, does not account for the other features associated with these finds. It is, however, supporting evidence that these tools were not used as apple corers.

**THE DECORATION OR MARKINGS**

The decoration on the bones is interpreted as owners’ marks, much like the customised trowel handles of field archaeologists. The motifs are simple, made up of lines and dots. Including those on the Portable Antiquities Scheme and two that recently appeared for sale on internet auction, there are 17 undecorated tools, 62 different patterns with single examples, eight patterns with two examples and two patterns with three examples, making 72 individual marks in total.

**REPLICAS AND WITHERS HEIGHTS ESTIMATES**

Experimental replication proves that it is impossible to work the bone with just a knife, contrary to MacGregor’s (1985, 180) suggestion that scoops were “commonly executed with no more than a knife”. In fact, for crafting replicas of the Thames artefacts, a saw, files and sandstones or sandpaper of varying coarseness were required. The little tic like feature in Type 2 was best reproduced with a triangular file. The shaped piece at the top of the worked surfaces on Type 3 needed to be cut first then a light saw mark made to determine the size of the shape, then filed or sanded down a little. Subsequently, when in use this area would wear smooth. Type 4 is similar to Type 3, though without the saw mark and filing down the shape, allowing each tool to have an individual wear mark on it from use.

In replicating a Type 4 tool made from an unfused metatarsal, an unfused metatarsal from a Manx Loughton ewe, approximately 12 months old, was used, see Plate 5.

To get an idea of the withers height of sheep in the Thames 2 group, when replicating a Type 4 tibia, a tibia from a mature Manx Loughton Ram was obtained so that, when cut, the position of the proximal posterior nutrient foramen would be in the correct place. This tibia was also chosen because it was a close match in the distal measurements (Manx Bd 27.9mm, Type 4 Bd 27.8mm Plate 10). A withers height of about 63cm was calculated from the GL of the Manx Loaghtan bone using the factor given in von den Driesch & Boessneck (1974, 339). This height estimate is at the top end of that for the sheep from the Victualling Yard (West 2010, 124) and post-medieval Exeter (Maltby 1979), but smaller than some of those from

![Plate 5. Unfused sheep metatarsal Type 4 and metatarsal from a Manx Loughton ewe, approximately 12 months old.](image-url)
Aldgate, where (Armitage et al 1984 138) states there were “sheep with estimated withers heights of between 71 and 83cm” Figure 3 shows that the Thames tools overlap and exceed the range of the Aldgate sheep tibia for Bb, suggesting that bones from sheep of comparable, or larger, size were used to make these tools.

IDENTIFYING THE FUNCTIONS OF THE VARIOUS TYPES OF SCOOP

The Thames tools are intrinsically unlikely to have been used as apple corers. Firstly, the concentration of these tools is in an unlikely place. It is improbable that more than the odd one or two apple corers would have been accidentally or deliberately deposited in the Thames in one location. Secondly, some are far too large, particularly the cattle bone artefacts. The alternative function would appear to be connected to the river, though the reason for such an accumulation was not immediately apparent.

Previous descriptions of similar tools have referred to them as scoops, as summarised by MacGregor (1985, 180): “…scoops were used as an aid to eating apples by those who had lost all their teeth. An alternative suggestion, that they were used for coring apples, ……they were used in taking samples from cheeses to test their ripeness.” A further suggestion as to their function may be as a tool in making traditional straw bee skeps (Bove 2013) and allied crafts.

The morphology, wear and shape of the Thames tools are distinctive. Therefore comparison with other types of bone corers and scoops for macro use wear, micro wear, manufacturing techniques and modern known tool use was seen as a methodology for determining other functions of tools within the broad category of “scoop”. The first objective was to quantify the differences between the Thames bone tools and those known to be apple corers. This approach was possible by comparison of the author’s collection of fifty-three bone apple corers with the collection of Thames tools. It was anticipated that it might be possible to identify two functional classifications within the many types of scoops. One distinctive characteristic of the Thames tools is the transverse hole through the condyles of the all fused sheep metapodials and three cattle metatarsals for the insertion of a lanyard. This hole is absent from all examples of apple corers recorded by the author and forms a clear typological division between the two classes of scoop.

Apple Corers

Apple corers, when used, have a very distinct brown staining, as seen under a digital microscope in Plate 6. To replicate this staining, a sheep metacarpal was made into an apple corer and the waste piece of the shaft was placed in chopped apple for a month. This prolonged exposure to the acidic juices of the apple turned the bone fragment brown. The juice from apples contains ascorbic acid, with a pH of 3.0 - 4.5, which etches the surface of the bone. The juice also contains phenolic compounds which oxidize with an enzyme, polyphenol oxidase, forming the brown pigment.

The replica, the piece placed in chopped apple for a month and a late nineteenth century apple corer were subjected to Fourier Transform Infra-Red Adsorption Spectroscopy analysis (FTIR). This showed conclusively that traces of hydrocarbons, previously observed on one of the Thames tools, were absent on tools used solely for apple coring use. The brown staining and acid etching seen microscopically for the apple corer is absent in a comparable view of a Thames tool, Plate 7. Instead, striations and polish are visible that are not apparent on the apple corer. A different use history for the two types of artefact is thereby implied.

From the research carried out so far on apple corers, it appears that historical bone examples were only made from sheep/goat and deer metapodials. Wood, silver and
Ivory were also used for the manufacture of apple corers. An accurate date of the earliest solid silver example can be obtained from the assay marks, dated 1682 (Clayton 1971, 14). Dates carved on bone or wood are suggestive but not necessarily contemporary with manufacture.

_Fids and Marlin Spikes_

While the Thames tools are not apple corers, this type of scoop may have provided the inspiration for making a comparable tool to serve a different function. So far, it appears that this type of tool is unique to London, particularly two places on the Thames foreshore, marked X and Y on Figure 5. The largest concentration of these tools to date was found on the foreshore, just downstream from Tower Bridge, point X. Recent finds have nearly all come from the site of the new Millennium Bridge opposite St Paul’s cathedral, point Y. This may reflect disturbance of sediments during construction of the bridge. The abundance of these tools in these areas may be due to good preservation in the Thames silt and mud and paucity of excavations at shipyards or naval dockyards elsewhere.

It is clear that there was a great deal of activity requiring these tools near to the Naval Victualling Yard, because the largest number of this type of tool were found in the river silt and mud opposite this site. This is one possible location for the makers production work place, another being Aldgate. All manner of different craftsmen would have been needed around such a dockyard because the ships would have needed a wide range of equipment, besides comestibles, when being victualled, especially if they were newly built and being fitted out for sea for the first time. At the time the Victualling Yard was in use, 1560-1785, the Navy was expanding due to Wars with the Dutch, French and Spanish. The Fleet numbered some 168 by Lady Day 1687 (Knighton 2003, 152), by 1745 the fleet numbered some 211 ships. (Baugh, 1977, 227). Four years later the fleet numbered 291 ships (Baugh 1977, 235). All first and second rate ships were built in the Naval shipyards, while smaller ships of third rate and below were built in merchant yards all along the Thames (Baugh 1977, 191-235). The first half of the eighteenth century was the heyday of shipbuilding establishments in Britain (Phillips 1951, 199). All these wooden sailing ships utilised a large amount of rope, which needed to be constantly maintained and repaired.

The impact on the Thames is described by Phillips (1951, 199): “The Seven Years War, which began so disastrously for us, and ended so well, was fated to start in 1755. Thus it happened in 1750 that the Thames shipyards were busy with the sound of saw, adze and hammer, while the rope yards hummed with hemp spinning machinery, and all was abustle with frantic activity, turning out men-of-war.”

John Rocque’s 1746 map of London (www.locatinglondon.org) clearly shows a number of rope walks in the area of St Paul’s and the Tower of London.

Further consideration of the sheep metapodials inspired the idea that the tools might have been used on rope. Eight of the sheep metacarpals appear to have had a great deal of wear on one or other side of the working end, giving the suggestion of a twisting movement to open, for example rope. Such rope working tools are
known as fids and marlin spikes. The editor of The Mariner's Mirror, kindly provided an article on “Fid/Marlin Spike: Etymologies” (Sayers 2013) to aid determination of the correct term to use for these tools. It is clear from this that fids are made of wood or bone, whereas marlin spikes are made of metal (Sayers 2013, 335). If the tools are fids, they would have been used with a clockwise action: “Notice that it (the fid) goes under the strand with the lay and then rotated clockwise a quarter turn to open the rope” (Smith 1990, 42).

The reason for not using the tip of the metatarsals is that they do not open the lay of the rope as far (see comment by Toss below), this is the possible reason for more metatarsals than metacarpals being present in all species.

To seek confirmation that the Thames tools could be fids, the Museum of Knots and Sailor’s Ropework at Ipswich was visited. Des Pawson, the museum owner and curator, was very helpful and explained that if the Thames tools had been used for working rope, the correct term would be fid. Mr Pawson exhibited a range of wooden fids, together with some modern metal fids. Two of the modern metal fids had been obtained from America and were called “Hudson Phids”, designed by Brion Toss, a professional rigger. Plate 8 demonstrates the similarity in size and design to examples of the Thames Tools.

Contact was made with Brion Toss, enquiring the origin of the Hudson Phid design, resulting in this comprehensive response: “The Phid is based on a tool called a Fid-O, which was a two-piece tool invented by an old Navy bosun’s mate, Jim McGrew. Because it was round, it made a smaller hole in the rope than (triangular) Swedish fids. Because the nose was removable, the splicer could tuck the strand and get it seated before removing the tool from the rope. All good, but that extra piece was always falling to the floor. So I came up with a one-piece version with the same virtues, inadvertently reinventing a very, very old wheel.

Considering how much more efficient the ancient version appears to be, it seems amazing that anyone would want to use a “standard” conical fid. I suspect that increasing rope size might have played a part. Perhaps rope toughness as well. And the conical fids don’t require a stockpile of suitable bones.

My tools, I will say, have the advantage of thinner walls, so easier rope insertion. Some refinement in shape for efficiency, too.” (Brion Toss pers. comm.)

Toss definitely thought that the Thames tools and Hudson Phid were similar in form and function, and kindly donated one of the small phids to enable further comparison and photography, Plate 9.

After this promising confirmation of a putative use for the Thames tools, further parallels were sought. Contact was made with marine archaeologists at universities and units around Britain but no-one had seen anything comparable to the Thames tools. A visit was made to the Mary Rose at Portsmouth, where Chris Dobbs, the Head of Interpretation and Simon Ware, the Collections Officer kindly arranged a viewing of the fids recovered from the wreck. However these fids were all wooden, and nothing comparable to the Thames tools had previously been seen by the museum staff.

The traditional working ropewalk at Hawes in Wensleydale, North Yorkshire, was also visited to seek a further opinion. A Swedish fid was being used in the work shop. On being shown a small selection of the Thames tools,
the rope workers considered that the bone tools could be used as fids.

Since there is a similarity in design to the Swedish fid and the coincidental name of Swedeland Court for the possible production site, Swedish Museums were also contacted. No parallels were known from post-medieval docksides or ship wrecks.

The Thames tools were also shown to Steve Waters, a professional rope worker and owner of Rope Services UK at Houghton le Wear, Co. Durham. The feedback was that there were no long and wide examples needed to work thick ropes such as anchor cables. It was also suggested that the small examples of Thames tools, such as the sheep and deer metapodials and the sheep tibia, would only have been suitable for using on small ropes such as that used for ratlines or ratlings, defined as: “small ropes which cross the shrouds horizontally, at equal distances, from the deck upwards, forming ladders to go up or down from the mast head” (Biddlecombe 2012, 23).

Replica fids and Tarred Rope
Replica tools were made and used to see if they functioned correctly, first on some sisal rope then on some hemp rope, which had been soaked in modern Stockholm Tar. The latter is not an exact parallel as the modern product is thin at room temperature, whereas in the past it needed to be heated to make it liquid. The tools were also used on some modern tarred rope kindly donated by Steve Waters of Rope Services UK. Overall, the replica tools functioned as well as the Swedish fid and the Hudson phid on all types of rope. There are difficulties in reproducing the wear patterns exhibited on the Thames tools, plate 7. The modern Stockholm tar did not dry out but remained sticky so when the replica tool was used the tar left striations on the bone see plate 10. No wear could be detected on any of the replica tools from the limited use on any other rope. This suggests that only very prolonged use with suitably tarred rope would result in the type of wear displayed on the Thames tools.

Looking at photographs of some modern hard wood conical fids, it is possible to see similar deep grooved parallel lines in the wood like the wear patterns on the sides, backs and distal ends of some of the Thames tools.

Until comparisons and measurements between them can be made, there remains speculation in the interpretation of the use of these tools. Further experimental and comparative work is needed.

Why Make Fids of Bone?
There was a necessity to supply a large number of tools during the great expansion naval shipping due to wars and replacement of losses from decay, storms. Concurrently, a large number of mercantile ships were being built for an ever increasing overseas trade, which in turn lead to more naval vessels being needed for escort duties. It is possible that there was insufficient hard wood for small
fids. Something else hard, durable and plentiful was required, so the riggers turned to what was to hand. Masses of bone waste being produced by the slaughters, butchers, and skinners, all working in the same or nearby places.

The favoured wood for nineteenth century fids was Lignum Vitae from the Caribbean and north coasts of South America. This wood was known in Europe from the beginning of the sixteenth century, but would have been too expensive and scarce for ordinary seaman and shipyard riggers.

The interpretation of this class of bone scoop implement found on the Thames foreshore is therefore that they were fids for splicing small ropes, probably dropped by accident over the side of ships whilst being rigged from new, or under repair at the time of being victualled, somewhere between 1560 and the 1750s.

Further research is required to ascertain whether this class of scoop is known outside London. Water-logged bone is very durable so preservation on riverine and maritime sites ought to be good. More nearby post-medieval excavation records and bone reports need to be examined to find more possible production sites. More analysis with FTIR of residues within the marrow cavity of these tools is needed. It is unclear whether either or both naval and civilian workers would have used these bone tools. An answer may be forthcoming from consultation of the very detailed Admiralty records of this time period.

REFERENCES

P. Stokes, A new interpretation of post-medieval bone scoops...


Acknowledgements: Thanks must be given to the following: Des Pawson for showing me his extensive collection of rope working tools and without whom I could not have progressed. Louisa Gidney for the help, loan of extensive collection and library and encouragement without whom I would not started this project. Chris Caple for carrying out the FTIR analysis work. Brion Toss Profession Rigger and inventor of the Hudson Phid for his advice and providing one of his small phids, Steve Waters Owner of Rope services UK at Houghton le Wear, Co. Durham for advise and for providing some tarred rope. All the staff at the Museum of London & LAARC for their help.
THE CONTEXT

The village Uroi is placed in Hunedoara County, on the right bank of the Mureş River, near Simeria, the town to which it belongs from an administrative point of view. The well-known and emblematic Uroi Hillock is at the border of Uroi village and partially on Rapoltu Mare village (fig. 1). The area is well-documented from archaeological point of view due to the discoveries dated from Paleolithic, Neolithic, Aeneolithic/Copper Age, Bronze and Iron Age, Roman period.

The archaeological site from Uroi—“Sigheti” was discovered in 2011 when the motorway Deva-Orăştie has been built. It was first mentioned within the diagnosis made by the specialists of National Museum of Romanian History from Bucharest. Then it was excavated by a team of archaeologists from the Museum of Dacian and Roman Civilisation of Deva. Research team: Cristina Bodó – scientific responsible, Marius Gheorghe Barbu, Mihaela Maria Ion (Barbu), Ioana Lucia Barbu, Ionuţ–Cosmin Codrea, Antoniu Marc, Costin Daniel Țuțuianu.

The site is located at 20+280 - 20+512 km on Deva-Orăştie Motorway, in the Mureş Floodplain, 100 meters far of the river. The Bronze Age settlement is placed between km 20+290-20+450 and it continues to South on the area of Deva-Orăştie Motorway.

The archaeological excavations carried out at Uroi—“Sigheti” led to the discovery of 230 complexes from different epochs and having various destinations were excavated by a research team from the Museum of Dacian and Roman Civilisation, Deva.

The Complex 13 (Cx_13) is an oval pit (2.70 x 2.30 m) with depositions whose purpose was probably a ritual one. It is dated from the Bronze Age (Wietenberg culture, phases II-III). The inventory comprises: clay artefacts, chipped flint tools, shells, a pendant made of a dog canine. The complex comprises 82 freshwater shells (Unio sp.). From these, 38 present each a technical/intentional perforation placed on the area of maximum convexity. The perforations (diameter: around 5 - 10 mm) are irregular/oval and were shaped by percussion or pressure applied on both sides.

An important issue in the analysis of the complex is related to the signification of the perforated shells in the ritual deposition from the pit. The analysis including microscopic examination and an experimental approach bring arguments to support or to reject several hypotheses. The shells were probably used as adornments or as decorative elements. The usage of pieces might have been a regular one or a special one within offering ceremonies related to the presence of aquatic environment (the river) with final deposition of the remains in the pit.

Abstract: The archaeological site of Uroi—“Sigheti”, Hunedoara County is placed on the Mureş Valley. In 2011, 230 de complexes from different epochs and having various destinations were excavated by a research team from the Museum of Dacian and Roman Civilisation, Deva.

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Objekat Kompleks 13 (Cx_13) predstavlja ovalna jama (2.70 x 2.30 m) sa verovatno ritualnim depozitom. Datovana je u bronzano doba (Vitenberg kultura, faze II-III). Inventar obuhvata: keramičke predmete, okrešene kamene alatke, školjke i privesak od kanina psa. Pronađene su ukupno 82 slatkovodne školjke (Unio sp.). Od njih, 38 ima tehnički/namernu perforaciju smeštenu tamo gde je najkoveneksnija. Perforacije (prečnika oko 5 - 10 mm) su bile nepravilne ili ovalne i dobijene su perkusijom ili pritiskanjem koje je primenjeno sa dve strane. Značajno pitanje u analizi ovog komplesa je u vezi sa značenjem perforiranih školjki u ritualnom depozitu jame. Analiza je obuhvatila mikroskopsko proučavanje i eksperimentalni pristup putem kojih su određene hipoteze proverene ili odbacene. Školjke su verovatno korišćene kao nakit ili dekoracija. Njihova je upotreba mogla biti obična ili posebna, u okviru ceremonije davanja, u vezi sa vodenim okruženjem (rekom) sa finalnim deponovanjem ostataka u jami.
THE COMPLEX 13 (CX_13)

It is a pit with depositions whose destination was probably a ritual one. Its shape is oval in plan and conical in profile, with a diameter of 2.70 x 2.30 m and depth of 1.10 m. A part of its diameter still lays in the Northern profile of the surface which was affected by the construction of the motorway. Beneath a light-coloured layer of earth of 30 cm thick and poorer in inventory, a thick layer of ash, pigments and fragments of coal appeared (fig. 2/6).

The inventory of the pit comprises: numerous fragments of clay pots – entire bowl, a miniature vessel, cups, a decorated piece of clay, a fragment of an undetermined clay object, a fragment of a miniature wheel, 82 freshwater shells, two chipped pieces of flint (one of them being retouched), and a pendant made of a perforated dog canine (fig. 2/1-5).

The inventory is miscellaneous. It was impossible to make a clear distinction of the areas in which certain categories of artefacts could have been placed, thus it is not a special deposit where the pieces were put in a certain order. It seems to be a mixture of artefacts and ash in the area of ritual practice, outside the archaeological complex, collected and thrown in the pit. The pots were ritually broken.

The shells do not preserve traces of burning. The entire ashy filling of the pit comprises shells mixed with the rest of inventory. Despite of the large quantity of ash, it seems that it was put in the complex when it was already cold. Consequently, the ceramic inventory does not preserve traces of secondary burning.

THE PERFORATED SHELLS

From the 82 Unio sp. shells, 44 are unperforated (33 entire and 11 fragmentary, 15 right valve and 23 left valve). Their dimensions are between 42 and 84 mm. The 38 perforated shells present each a technical/intentional perforation placed preferentially on the area of maximum convexity (umbo). The perforations are irregular/oval or two/three-cusped and were shaped by percussion. The diameter is variable – see table 1 and figs 4-8.

The perforated shells were selected by Marius Gheorghe Barbu according to the criterion of bilateralism and...
THE PERFORATIONS

Status of conservation of perforations is: 33 entire, 5 fragmentary. Most of the perforations have similar diameters, and often the same place at the level of the maximum convexity (umbo) at quite similar distance from the edge; there are also some significant exceptions.

The perforations have similar parameters, so they were probably made in a single sequence, by a single person with the same tools, using the same procedures – multiple indirect percussion or pressure applied alternatively in several places which after they were joined, formed the perforation, the procedure was applied on both sides on a medium-hard (ground?) background in order not to break the piece. The edges of perforations present micro-flakes on both sides. The tool was probably a lithic one. We should underline the care with which the perforations were done.

The experiment that has been recently done (2012) by Marius Gheorghe Barbu on Unio sp. shells collected from the Mureș River revealed that the unilateral perforation produces flakes when the awl gets on the other side of the shell. Another conclusion is that the perforation is easily done when a support such as the ground (which is less hard) is used.

The perforations have a slightly oval shape, sometimes with a cusped outline, with their edges in steps. This aspect was produced by indirect percussion applied bilaterally and repeatedly in order to obtain a certain diameter and not a regular shape.

The dimensions of perforations are: maximum diameter: 20.60 mm (USG 35); minimum diameter: 6.01 mm (USG 26); medium diameter: 12/7 mm.

The distance between edge and perforation is: maximum: 24.39 (USG 26); minimum: 4.43 mm (USG 14); medium: 12 mm (tables 1-2).

As concerns the orientation of the perforations in comparison with the long axis of each piece we can observe the existence of several groups: right valve: oblique 12, horizontal 7, vertical 0; left valve: oblique 15, vertical 1, horizontal 3 – see table 3.

We should underline the predilection for oblique orientation of the perforations in comparison with the long axis of the shell. It is a simple way of making the perforation – it seems that this aspect did not have a functional signification.

In realizing the perforations, there were distinguished certain repeatable or comparable dimensional and placing parameters which indicate the technical intentionality; the technique finality and probably the perforation of the shells by a single person in a single sequence.

The microscopic analysis

It highlights the micro-fractures produced at perforating (on both sides), micro-fractures after perforation process, overlapped planes which are flat, unaffected by the bluntness; rarely, the edges of fracture are superficially blunted, polish, due probably to taphonomic causes – figs 9-13.

Utilisation

As presumable sequences we could take into account: shells consumption, cleaning, perforation, hanged on a string? They do not preserve use-wear traces. There are some traces of mutual impact between shells, maybe when hanging on a string.

The usage of pieces might have been a regular one or a special one within offering ceremonies related to the presence of aquatic environment (the river) with final deposition of the remains in the pit. The ritual might imply the fundamental elements: fire, water, earth, consumption of liquids and foods, various offerings with symbolic valences: ceramic objects (small cart wheel, ritually broken; object decorated by incision), perforated shells (previous consumption; shell used as a symbol?). Within the Bronze Age cultures, there are various depositions in pits with ritual purposes (Beldiman et al. 2015b; Marc, Bărbat 2012; Marc 2012b; Bărbat 2013; Sztancs et al. 2013).

Their status of preservation is the following: 12 entire pieces and 26 fragmentary (table 1); some pieces are in a very good status of conservation; others are broken in Prehistory or recently, exfoliated, or preserving traces of corrosion etc. (figs 4-8).

Morphological and dimensional parameters collected and processed for technological expressivity: length, maximum width (at the level of umbo), diameters of perforations, distance between the edge of the perforation and the edge of the shell, orientation of the perforation in comparison with the long axis of the shell (oblique, vertical, horizontal) – see tables 1-3, charts 1-3 and fig. 3.

The shells have a maximum length of 70.30 mm (USG 28, USG 30), minimum of 31.44 mm (USG 38), maximum width 39.95 mm (USG 25), minimum 28.15 (USG 36).

Close to the bone...
CONCLUSION

Cx_13 complex – in its inventory there were discovered 19 pairs of shells perforated at the level of umbo with an unclear purpose probably in order to create an ad-hoc hanging device for a ritual related to aquatic context of the river. The symbolic or decorative role is indicated by the chosen of 19 shells of the same type but not compulsory pairs (right/left).

They are not adornments like necklaces or pendants sewn on clothes because they do not preserve traces of bluntness and polish at the perforations levels and have not identical perforations.

These were done by a single person, in a single manufacture sequence, applying the same technical procedures: multiple indirect percussion/pressure done at the umbo’s level, applied alternatively from the inner and outer side of the shell.

An important issue in the analysis of the complex is related to the significance of the perforated shells in the ritual deposition from the pit. The analysis brings arguments to support or to reject some functional hypotheses. Some other further arguments and opinions can enrich this discussion and highlight new frameworks for a better understanding of the situation, in comparison with some similar ones.

REFERENCES


Acknowledgements: On this occasion, we express our gratitude to Cristina Bodó, PhD researcher at Museum of Dacian and Roman Civilisation of Deva for offering her kind support in making accessible for study the perforated shells discovered at Uroi-“Sigheti”. Photographs without specification related to the author have been taken by Corneliu Beldiman. English version by Diana-Maria Sztancs.
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Close to the bone...

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Close to the bone...


Fig. 2. Uroi – “Sighetii”. Cx_13. Wietenberg culture. Artefacts from the inventory: 1, 2-5 Ceramic pots; 2 Perforated dog canine; 6 General view of the ritual pit. Photos taken by Marius Gheorghe Barbu.
Fig. 3. Uroi – “Sighetii”. Cx.13. Wietenberg culture. Perforated shells. Conventions of description: 1 Dimensions; 2 Orientation of perforations.
Close to the bone...

Fig. 4. Uroi – "Sigheti". Cx_13. Wietenberg culture. Perforated shells (USG 1-8).
Fig. 5. Uroi – “Sigheti”. Cx.13. Wietenberg culture. Perforated shells (USG 9-16).
Close to the bone...

Fig. 6. Uroi – "Sighetu", Cx_13. Wietenberg culture. Perforated shells (USG 17-24).
Fig. 7. Uroi – “Sigheti”. Cx_13. Wietenberg culture. Perforated shells (USG 25-32).
Fig. 8. Uroi – “Sighet”. Cx_13. Wietenberg culture. Perforated shells (USG 33-38).
Fig. 9. Uroi – “Sigheti”. Cx.13. Wietenberg culture. Perforated shells – details (USG 9).

Fig. 10. Uroi – “Sigheti”. Cx.13. Wietenberg culture. Perforated shells – details (USG 21).

Fig. 11. Uroi – “Sigheti”. Cx.13. Wietenberg culture. Perforated shells – microphotographs: 1-4 USG 36.
LIFE IN A MEDIAEVAL CASTLE: 
BONE ARTEFACTS AS INDICATORS OF HANDICRAFT AND LEISURE

Tatjana Tkalčec

Abstract: The paper presents artefacts made of animal bones found in the archaeological excavations at Vrbovec castle in Croatia. The osteological sample consists of around 6850 fragments of bones, teeth, horns and antlers (mostly mammalian, with some bird and fish bones). Bone artefacts are rare finds at the castle, and mostly come from the backfill of the mediaeval cistern and from the modern-period horizon. In other words, they date from the 15th and the first half of the 16th century. We can divide the finds into utilitarian objects used as tools (awl) and implements for sewing and knitting, and perhaps also for working lace, and objects related with leisure (pipe/flute, spinning tops-astragaloi). They inform us about certain segments of life and activities taking place at the castle during the Late Middle Ages and the Early Modern Period.

Apstrakt: U radu su predstavljeni predmeti izrađeni od životinjskih kostiju otkriveni tokom arheoloških istraživanja Burga Vrbovec u Hrvatskoj. Uzorak se sastoji od ukupno oko 6850 fragmentata kostiju, zubi i rogova (uglavnom sisavaca, nešto ptica i ribljih kostiju). Predmeti izrađeni iz kostiju rijetki su nalazi na burgu, a uglavnom potječu iz sloja zatrpavanja srednjovjekovne cisterne te iz novovjekovnog horizonta, odnosno datiraju se u 15. i prvu polovinu 16. stoljeća. Možemo ih podijeliti na uporabne predmete korištenje kao alatke (šila) pribor za šivanje i pletenje, možda i izradu čipke, te na predmete za razbibrigu i dokolicu (svirala, zvrkovi-astragalii). Govore nam o nekim segmentima života i aktivnostima koje su se odvijale na samome burgu tijekom kasnog srednjeg i ranog novog vijeka.

The castle of Vrbovec lies on a steep slope offering a splendid view of the Sutla river valley, in the village of Kle- novec Humski in the very northwestern part of Croatia.

The Institute of Archaeology (Zagreb) began the trial investigations of the castle in 1987 and 1994, and from 2001 the archaeological investigations and conservation work on the architecture have been continuously carried out till present day. The results of the first ten seasons of archaeological research have been presented at museum exhibitions and in numerous articles and academic papers, as well as in a monographic edition (Tkalčec 2010a), with a list of complete older references; Tkalčec 2014a).

The last five seasons of excavations have brought a new understanding of life in the mediaeval castle (Tkalčec 2012, 2013, 2014b, 2015).

Vrbovec Castle or castrum Vrbouch is directly or indirectly mentioned in historical sources in the period between 1267 and 1497 (Karbić 2010). Although we can track historical data referring to the castle of Vrbovec from the second half of the 13th until the late 15th century, archaeological excavations point to an even earlier time of its construction, i.e. to the very end of the 12th century, and to an even longer continuity of its use until the mid-16th century. The polygonal layout of the Romanesque castle has been preserved only at foundation level and in the lower portions of walls of ground-floor rooms. Nevertheless, the well-discerned layers with rich finds provided a wealth of new information about the ways everyday life in the castle functioned, especially in its later phases, from the way kitchenware was used in the preparation of food, to more luxurious eating and drinking vessels used by the feudal lord, to the interior design of the castle, lavishly decorated with tile stoves, as well as stone profilations of windows, doors etc., characteristic for the beginning of the 15th century (Horvat, Tkalčec 2009, Tkalčec 2010b, 2010c, Zglav-Martinac 2010).

Archaeological investigations brought to the light of day abundant faunal remains from all periods of life at the castle. The sample consists of a total of around 6850 fragments of bones, teeth and horns/antlers, of which 20.92% were determined as mammals (Mammalia), 3.17% as birds (Aves) and 0.23% as remains of fish (Pisces). Indeterminate fragments amounted to 75.68%. For the period between the 12th and 14th centuries a predominance of remains of pigs (around 60%) is noticed (NISP analysis), while remains of cattle and small ruminants vary between 10% and 20% depending on the period. During the second half of the 15th century the proportion of pigs drops significantly but grows again towards the end of the 15th, while in the 16th century its proportion is again very low. A decline in the proportion of pigs in the latter half of the 15th century coincides with a substantial rise of small ruminants. At the turn of the 16th century and during that century the number of bone remains of cattle rises. A calculation of the minimum number of individuals (MNI) shows a fairly balanced proportion for all animal species through all the periods, with the exception of pigs and cattle at the turn of the 16th century, where the MNI for these species rises significantly. The share of wild animals (wild boar, red deer, roe deer and rabbit) was relatively constant at all times and does not exceed 5% (Trbojević Vukićević et al. 2010). There is only a single bone attributable to the horse. Although there are only few remains of dog bones, the presence of carnivore tooth marks on bones of domestic and wild animals allow the assumption that dogs were common at the site.
Traces of butchery marks were documented on a large number of animal bones, including both primary and secondary (dismemberment into smaller pieces) as well as tertiary marks (shallow incisions on bones, characteristic for defleshing of bones) (Trbojević Vukičević et al. 2010: 242).

Although a number of faunal remains were found at the Vrbovec Castle, the finds of worked bone artefacts are exceptionally rare. Most come from the backfill of the mediaeval cistern. The assemblage consists of artefacts used as sewing and knitting implements, objects used during time of leisure, as well as certain objects and semi-products of indeterminate function. Except for the needle and the flute, the function of the remaining bone artefacts (including the so-called astragaloi) remains at least partly open. This is due to the fact that, on the one hand, such artefacts may have been used in various ways and in a number of different activities and, on the other, we were unable to find direct typological analogies in artefacts with a clearly identified function, that is, various possibilities of their application and use have been put forward in the literature.

As explained previously, a few of the bone artefacts show different marks of primary treatment in the process of making a bone artefact. That indicates these activities at the very castle of Vrbovec. Initial processing attempts are identified on a deer antler (*Cervus elaphus* L.) from the cistern backfill dated to the second half of the 15th c. - second half of the 16th c. (*Cat. No. 1*). This half-finished product exhibits traces of short, sharp cuts. One end is sawn off in a regular fashion, while the other is irregular. A fragment, or more precisely, fragments of another red deer antler (*Cervus elaphus* L.), which was scorched by fire that also damaged a wooden tower from the first half of the 16th century, likewise exhibits short incisions, probably from processing (*Cat. No. 2*).

A sewing needle with a damaged upper part where a thread hole (the eye) is visible represents the oldest artefact made of bone, and originates from a layer dated to the 14th or the first half of the 15th century (*Cat. No. 4*). The needle, due to its dimensions, was probably used for sewing coarse materials or hide. Most of the other bone objects originate from the layer of backfill of the castle cistern, dating back to the late 15th and the first half of the 16th century.

A long bone artefact, made of compact bone substance (*substantiae compacte*), probably a long bone of cattle, is coarsely made or unfinished, although finely smoothed on the outside and somewhat less well on the inside. Both ends are pointed near the top. Due to this, the object might have been an awl or possibly a tool for knitting fishing nets (*Cat. No. 3*). The next object, also finely made of compact bone substance of a large animal (e.g. cattle), may have equally been used as an awl or a tool for knitting fishing nets (*Cat. No. 5*). One end is crudely pointed while the other is regular and ends with a slightly bulging circle. A similar, but smaller object of the same type, whose function escapes us, is an awl (?), likewise made of compact bone matter of a large animal (*Cat. No. 6*).

An interesting artefact, also made of finely processed compact bone matter from a diaphysis of a long bone whose lower end is broken off while the upper one finishes with a narrowing neck topped by a pronounced round bulge, allows several possible interpretations of its function (*Fig. 1, Cat. No. 7*). On the one hand, the artefact is reminiscent of a lace-knitting tool—a lace bobbin—of the kind used in the manufacture of the so-called Lepoglava lace. In this part of Croatia, the lace making craft affirmed itself in particular towards the end of the 19th and the beginning of the 20th century, and today the Lepoglava lace is inscribed on the List of Intangible Cultural Heritage of the UNESCO. Even though it is believed that the Pauline Order introduced this lace-making method in Lepoglava, a town lying around 30 km from the Vrbovec castle, we nevertheless, due to the lack of concrete information or analogous finds, cannot ascertain that this artefact served this precise function. In the literature, bobbin lace is dated to the 16th century, although the place of its origin is still uncertain. Some authors are...
more inclined to the theory positing Italy as the cradle of bobbin lace, same as in the case of needle lace, which is mentioned in the sources as far back as the 15th century (Jackson 1900: 15-16), while others favour Flanders as the place of origin of bobbin lace (HE: 314). Moreover, as regards the identification of the function of this artefact from Vrbovec, there is mention in the literature of similar bone artefacts that sometimes feature a thin metal prong on the very top, which, alternatively, may be merely pointed. Such artefacts have been interpreted as writing instruments, that is, the so-called styli, used for writing on wax tablets or parchments (Soltan-Kościelcka 2007). Since such round-tipped writing implements are extremely rare, we assume that our artefact should rather be interpreted as a sewing tool or an implement for weaving or knitting.1 It also merits mention that similar bone artefacts were found in Hungary, in the 16th century Styrian fort of Bajcs, where they were interpreted as stiffeners (Gürtelverstreifer) (Vândor 2002: 126, Cat. no. 57-58), as well as in the Royal Palace of Buda, where they were also interpreted as clothing accessories, namely as elements of belts (Kovács 2005: 313, Fig. 3: 6-7). Such finds are found at the Royal Palace of Visegrád (Kováts 2005: 301, Fig. 15), as well as at the Lower Castle from Visegrád. Although there are several similar finds known from Hungary from the late medieval and early modern period, and they were usually defined as “belt stiffeners”, no explanation of their use is available in the literature. Our specimen, in spite of one broken end, is highly reminiscent of the mentioned objects. On the other hand, in case its now missing part had originally had a thickened, drop-shaped form, this might really have been a lace bobbin. If, however, its broken top extended into a point, it is not excluded that this may have been a knitting needle, which would give us a hint as to how a noblewoman spent her day in the castle. In case this object was really a lace bobbin, this would expand our understanding of the production of this type of lacework to include the late mediaeval period in Croatia. However, the problem surrounding the identification of this object remains unresolved.

A few bone artefacts tell us also a story about how the nobleman and noble child spent their leisure time - playing flute and playing with astragaloi. A unique find of a pipe or flute (Fig. 2, Cat. No. 8) made of a bird femur (os femoris) was found in the cistern backfill. It exhibits a clearly visible opening with flat upper and round lower edge. The upper top of the flute is cut straight, while the lower one is cut at a slant; it is also partly damaged, although it is not entirely clear whether this might be the beginning of another hole, since the end is broken off. Based on this, the object might have been a pipe, that is, a flute, but it might equally have been a whistle used for military purposes or during hunting. In Croatia, the only specimens so far published in the literature are the bone pipes from the forts at Čanjevo (Višnjić 2008: 117, T. 2/8) and Barilović (Janeš 2014: 75, Fig. 76). In the foreign literature dedicated to the Middle Ages and the Modern Period, the finds of pipes made of long bird bones are more common, appearing from the Early Middle Ages until the Modern Period (Kláště 2002: 381, Tab. 175/6), that is, they are known also from the earlier periods of Antiquity up until the Late Middle Ages and the Modern Period, in which we underline the pipes found in Visegrád (Gál 2005: 328-329, Fig. 6-7).

Objects made of phalanges or metatarsal animal bones, the so-called astragaloi, perforated with one hole (passing through both sides of the bone) or several, like in the case of the three finds from Vrbovec, in archaeological contexts are found from prehistoric times to the Modern Age. They were by and large made of knucklebones of sheep or goats, as well as pigs. They are usually interpreted as bone pendants of votive and divining character, but are also recognised as objects intended for augury, gambling, and play. Two astragaloi made of pig bones Cat. No. 9 (Phalanx proximalis) and Cat. No. 10 (Ossa metatarsalia III) were found in the cistern backfill and dated to the 15th century, while an astragal Cat. No.

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1 Metal styli are more common, while as regards styli made of organic materials (bone or wood), more common are those with a metal pin on top, which allowed for a nearer and clearer recording of signs. Tips of all these styli feature various forms and are mostly flat, so it was believed that they doubled as correcting tools for mistakes in writing. Styli with solid round tips are not suitable for this purpose, so they are extremely rare (Soltan-Kościelcka 2007: 228).
made of a large ruminant bone, most probably cattle (Phalanx proximalis) originates from the layer dated to the first half of the 16th century.

Astragal Cat. No. 9 has three holes for threads on three sides on its wider end, while the opposite, narrower end has two opposing holes. The second specimen was made of the left metatarsal bone of pig, perforated at the middle with two holes through either side of the diaphysis (Cat. No. 10). The latter specimen has analogies in Schlossberg, in a specimen made of a metacarpus of a young pig, perforated with a single hole and dated to the 15th century (Bitschnau et al. 2007: 227, Taf. 1/D9). The authors attributed the artefact to the assemblage of gaming and leisure items, noting that such a bone on a cord may have produced sounds when pulled and may have also been used as a spinning top or rattle. In addition to the more common specimens with one hole, there are also sporadic finds with two parallel holes (likewise perforated through either side of the bone), such as our specimen (Bitschnau et al. 2007: 219-220). The third astragal from Vrbovec, Cat. No. 11, has two perforated channels with regular circular openings (below the proximal edge in the lateral-medial direction and immediately above the distal epiphysis in the cranial-palmar/plantar direction). Below the proximal edge on the palmar/plantar side there is another circular opening entering into the existing proximal channel.

Although the function of some of the artefacts presented here has not been fully ascertained, there are clear indicators that some kind of minor bone processing activity took place at the Vrbovec castle. Bone artefacts might have formed part of dressing accessories or as tools for knitting fishing nets; as sewing, weaving or lace making implements (?), as well as music instruments and toys in the everyday life of the inhabitants of the mediaeval castle.

CATALOGUE

1. Bone artefact, bone, red deer antler (Cervus elaphus L.?), object of unknown use, traces of longitudinal processing visible on all sides of the bone; traces of transverse processing visible on one end; length 8 cm, diameter 2.9 cm, weight 44.6 g; Fieldwork marks: PGV’04, □ B4, PN 401; Context: SJ 76; Stored at: Veliki Tabor Castle, Inv. no. DVT 1588.

2. Bone artefact, bone, red deer antler (Cervus elaphus L.? – two fragments exposed to fire, with visible sharp cuts – attempts at processing; length 9.5 cm, width 6.1 cm, weight 39.4 g; Fieldwork marks: PGV’08, U 272, PN 453; Context: SJ 171; Stored at: Veliki Tabor Castle.

3. Awl (?), compact bone matter (substantiae compacte), probably from a long bone of cattle, crudely processed or unfinished tool, rectangular cross-section, both ends pointed; length 19.3 cm, width 1.1 cm, thickness 0.8 cm, weight 25.5 g; Fieldwork marks: PGV’04, □ B4a, PN 318; Context: SJ 76; Stored at: Veliki Tabor Castle, Inv. no. DVT 1590.

4. Needle, bone, damaged upper part with a hole for thread, flattened and smoothed body, pointed top, round cross-section; length 8.6 cm, width 0.9 cm, weight 2.7 g; Fieldwork marks: PGV’06, □ A6, PN 367; Context: SJ 90; Stored at: Veliki Tabor Castle, Inv. no. DVT 1582.

5. Awl (?), (tool for knitting fishing nets?), bone, compact bone matter (substantiae compacte), probably from a long bone of cattle, round cross-section, one side damaged, pointed top; length 9 cm, width 1.1 cm, weight 7.1 g; Fieldwork marks: PGV’04, □ B4, PN 319; Context: SJ 76; Stored at: Veliki Tabor Castle, Inv. no. DVT 1589.

6. Awl (?), (tool for knitting fishing nets?), bone, compact bone matter (substantiae compacte), probably from a long bone of cattle, round cross-section, pointed top; length 4 cm, diameter 9 mm, weight 2.8 g; Fieldwork marks: PGV’04, □ B4, PN 337; Context: SJ 76; Stored at: Veliki Tabor Castle, Inv. no. DVT 1587.

7. Needle/lace bobbin (?), bone, compact bone matter from a diaphysis of a long bone, round top, narrowed neck serving as a spool (?); preserved length 5 cm, neck diameter 6 mm, top diameter 8 mm, body diameter 7 mm, weight 2.7 g; Fieldwork marks: PGV’04, □ A/B4, PN 311; Context: SJ 76; Stored at: Veliki Tabor Castle, Inv. no. DVT 1584.

8. Pipe, thigh bone of a bird (os femoris); one preserved hole, damaged top, length 53 cm, diameter 8 mm, weight 1.6 g; Fieldwork marks: PGV’04, □ B4, PN 400; Context: SJ 76; Stored at: Veliki Tabor Castle, Inv. no. DVT 1585.

9. Astragal, bone, phalanx (Phalanx proximalis), upper phalanx of a pig; on the wider end of the phalanx there are three holes for passing thread on three sides, while on the opposite narrower end there are two opposing holes; length 3.6 cm, width 1.8 cm, weight 4 g; Fieldwork marks: PGV’04, □ B4, PN 399; Context: SJ 76; Stored at: Veliki Tabor Castle, Inv. no. DVT 1583.

10. Astragal, bone, left metatarsal bone of a pig; two pairs of holes perforated on the distal end through both sides of the diaphysis; length 7.3 cm, width 2.1 cm, diameter of the middle part of the bone 1.2 cm, weight 8.5 g; Fieldwork marks: PGV’04, □ B4, PN 309; Context: SJ 76; Stored at: Veliki Tabor Castle, Inv. no. DVT 1586.

11. Astragal, bone, phalanx (Phalanx proximalis), upper phalanx of a large ruminant (most likely cattle) perforated with two channels with openings of regular circular form (below the proximal edge in the lateral-medial direction and immediately above the distal epiphysis in the cranial-palmar/plantar direction) and another circular opening on the palmar/plantar side below the proximal edge, length 4.9 cm, width 2.5 cm, weight 12.8 g; Fieldwork marks: PGV’04, □ C4, PN 454; Context: SJ 72; Stored at: Veliki Tabor Castle.
Close to the bone...
Close to the bone...
REFERENCES


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Artefacts are stored at the Veliki Tábor Castle, Museums of Hrvatsko Zagorje.
POSSIBLE SMOOTHERENING AND POLISHING TECHNIQUES
PRACTICED OVER BONE AND ANTLER ARROWHEADS
AT IRON AGE SITES OF ATRANJIKHERA AND JAKHERA

Vinayak

Abstract: The analysis of bone and antler arrowheads from two Iron Age sites, Atranjikhera and Jakhera in Upper Ganga Plains, India reveals that surface of significant number of arrowheads was intentionally smoothen and polished during production process, while others were left unsmoothened and unpolished. In the light of this fact, certain questions naturally emerges in our mind, such as why these arrowheads were smoothen and polished, even if such artifacts could be used efficaciously without these features? Though their manufacturers were well aware of the fact that arrowheads could be lost or damaged in their very first use, than why they invested so much of their resources, energy and time to achieve a smoothen and polished surface. One may explain it in terms of the physical and mechanical requirements of the artifacts as well as such artifacts being used as the marker of their social identity. The present paper try to analyze the materials, tools and technologies used to carve out these smoothen and polished arrowheads. Additionally, the paper also seeks to answer the question why these arrowheads were smoothen and polished.

INTRODUCTION

Projectile-tips are critical to the functioning of any projectile. They are the first to physically come in contact with the target and bear the force of impact. They are usually made on or attached to projectile to achieve smooth aerodynamic movement during flight, deep penetration, strong impact and so on. Due to the nature of these functions, they are normally prepared from strong and tough materials. Bones and antlers have the desired mechanical and physical proprieties to produce such kind of artifacts. Realization of these properties has resulted in the continuous use of bones and antlers in the production of a variety of projectile tips since prehistoric time. They were used for the production of arrow tips (hereafter arrowhead) on substantial scale during Iron Age in Upper Ganga Plain (Gaur 1983; Dikshit 1971: 51-55; Tripathi 1976, 2001). Arrowhead production techniques of this period and region could be an important source of information about contemporary societies but lack of interest in worked bone studies by archaeologists in India has rendered this field almost unexplored.

The analysis of bone and antler arrowheads from two Iron Age sites, Atranjikhera and Jakhera in Upper Ganga Plains, India (Fig. 1) reveals that surface of significant number of arrowheads was intentionally smoothen and polished during production process, while many others were left unsmoothened and unpolished. In the light of this fact, certain questions naturally emerges in our mind, such as why these arrowheads were smoothen and polished, even if such artifacts could be used efficaciously without these features? Though their manufacturers were well aware of the fact that arrowheads could be lost or damaged in their very first use, than why they invested so much of their resources, energy and time to achieve a smoothen and polished surface. One may explain it in terms of the physical and mechanical requirements of the artifacts as well as such artifacts being used as the marker of their social identity. The present paper try to analyze the materials, tools and technologies used to carve out these smoothen and polished arrowheads. Additionally, the paper also seeks to answer the question why these arrowheads were smoothen and polished.
these objects because of their peculiar use, handling and transportation, repair, burial, excavation and post-exca-
vation can be mistaken with those generated at the time of their production (Stone 2011a). For example impression results of the handling can be misunderstood with leather or hides polish. Likewise smoothening and polishing as part of production process can get severely affected due to weathering agents and post-excavation activities, such as aggressive cleaning with abrasive brushes, and makes them unsuitable for the analysis (Griffitts 2001:185-195; d’Errico and Backwell 2003: 1559-1576; Guarino 2006: 513).

Most of the arrowheads found from Atranjikhera and Jakhera are not much affected by weathering agents and their surface patterns are considerably well preserved. It helps in their macro- and microscopic observation under low and high magnification (5X-220X). A hand held Di-no-Lite Digital (AM-413T Pro) microscope (Fig. 2) with the magnification of 230x was used to examine the micro-wears of each arrow-head. During the observations, special care was taken for assessing if the patterns were the result of manufacturing or created by functional and accidental activities. While doing so, every arrowhead’s manufacturing patterns and use wear patterns were recorded separately (d’Errico and Backwell 2003: 1559-1576; Blumenschine et al. 1996: 493-507; Domínguez-Rodrigo and Yravedra 2009: 884-894; Bello and Soligo 2008: 1542-1552; Greenfield 1999: 797-808; Lyman 2005: 1722-1732).

SITE AND MATERIAL

Atranjikhera (27° 42’ N and 78°44’ E) and Jakhera (27° 50 N and 78° 41 E) are situated on the right and left bank of river Kali Nadi, one of the main tributary of river Ganga in
Upper Ganga Plains, in present day Uttar Pradesh, India, (Fig. 1). Jakhera is about 16 km north of Atranjikhera as the crow flies. Excavation at these sites conducted by Archaeological Section, Aligarh Muslim University, India which lasted several seasons (7 seasons at Atranjikhera 1961-62, 1963-63, 1963-64, 1964-65, 1965-66, 1967-68, 1969-70; 6 Seasons at Jakhera 1974-75, 1975-76, 1985-86, 1986-87, 1988-89, 1992-93) (Gaur 1983; Gupta and Haider 2000) has attested the presence of Iron Age. Their collections currently are housed in the museum of same university.

The earliest dates assigned to the use of iron in this part of country dates back to circa 1100 B.C.E. (Gaur 1983). Use of iron in this region was generally accompanied by P.G.W. (Painted Grey Ware) and N.B.P.W. (Northern Black Polished Ware) pottery cultures. (Gaur 1983; Tripathi 1976, 2001). Numerous bone and antler arrowheads have been attested at Atranjikhera and Jakhera in association with other usual archaeological finds of Iron Age culture of Upper Ganga Plains (Tripathi 1976, 2001; Dikshit 1971: 51-55; Gaur 1983). Author had the opportunity to study the collection of bone and antler arrowheads from these sites (Source: Atranjikhera and Jakhera Archive). Earlier, minor account of bone, ivory and antler artifacts from Atranjikhera was published in its excavation report (Gaur 1983). Similar findings from Jakhera have been discussed in a brief note in a news letter (Salahuddin and Alam 2000).

Author faced certain difficulties in the study of bone and antler arrowheads collection from these sites whose excavation is spread over several seasons. The collection is poorly classified and documented. Only some Atranjikhera arrowheads tags were marked with the period associated to them, leading to the uncertainty in their chronological classification. The excavation report does not provide much clue about their dating. Jakhera arrowheads were even in more poor condition. They were not properly labeled according to their trench, layer and depth; many important arrowheads do not have any antiquity number on them. Damaged paper and plastic bags, which contain on average 3-5 arrowheads without mentioning any period, has worsened the situation. Under these circumstances it is difficult to do chronological analysis of arrowheads from these sites. As a result, in this paper they have been taken as arrowheads belonging to Iron Age as a whole.

Together about 525 arrowheads, mostly made from bones and antlers have been found from both sites. Out of 318 bone, ivory and antler artifacts from Atranjikhera, around 170 are arrowheads, including fragment, blanks and unfinished objects (Source: Atranjikhera Archive). Similarly out of 769 bone, ivory and antler artifacts found from Jakhera, around 355 are identified as arrowheads and their fragments (Source: Jakhera Archive). These numbers clearly indicate the predominating presence of arrowheads among osseous artifacts in the Iron Age. Typologically arrowheads found from Atranjikhera have been grouped in eleven different categories by its excavator (Gaur 1983), but no such attempt has been made for Jakhera arrowheads by its excavator. Although, Atranjikhera arrowheads were classified according to their physical features, no measure has been undertaken for the development of standardized classification and combining them with local or regional sets. In the absence of any standardized classification for Upper Ganga Plain arrowheads, author has used his own classification for these sites.

Broadly four categories are identified at these sites on the basis of arrowhead shape: Tang Arrowhead, Socket Arrowhead, Barb Tang Arrowhead and Barb Socket Arrowhead. They are further divided into several sub-categories. Tang types are the most numerous followed by Sockets, Barb Tangs and Barb Sockets. The cross-section of smoothen and polished arrowhead blades is mostly circular, oval or lozenge. Length of these arrowheads varies from 3 to 12.5 cm (intact ones) but none of them have the shape and size that could fit as spearhead.

**ARROWHEAD MANUFACTURING PROCESS**

It was noticed during documentation that production process of bone and antler arrowheads at both sites...
is more or less identical. Close proximity and river connectivity might have helped in this development. The application of Choyke’s (et al. 2004: 177-189; 2005: 129-156) categorization (ad-hoc and planned) on these arrowheads lead us to the conclusion that majority of them were made from carefully selected raw material and skillfully manufactured.

Planned production of artifacts has been divided into three broad manufacturing stages (Skochina 2010: 25-36; Horwitz, et. al. 2006: 169-173; Ashby 2005; MacGregor 1985; Christidou 2001: 41-48). The primary stage involves the initial processing or preparation of raw material and chopping or sawing up of complete bones and antler into smaller, workable pieces. The secondary stage involves the conversion of these pieces into blanks and roughouts for the production of the final objects. The tertiary stage involves manufacturing operations such as shaping barbs and tips, or making incision design, trimming, smoothening, and giving it final finish. The first two stages are inter-connected and played important roles in selection and articulation of tertiary techniques. Hence, it is not possible to discuss tertiary stage in isolation without having idea of first two stages.

No experimental work was conducted by the author for the possible identification of manufacturing tools and technology used in their production of Atranjikhera and Jakhera arrowheads. Majority of arguments presented here are based on observation of these arrowheads. The identification of the raw material used for the production of arrowheads present several difficulties. According to Russell (2001b: 271-280) too much of physical transformation of natural bones and antlers at manufacturing stage leads to the problems in the identification of animal species. Majority of Atranjikhera and Jakhera arrowheads were fashioned in similar way. Debris generated during production of arrowheads was not preserved well in the course of time and mostly ignored by the excavators. Initial processing is not traceable due to same reason. Physical features of bone arrowheads suggest that many of them were most probably produced from front and rear leg bones of large ungulates (cattle, deer and horse). Though, physical features of antler arrowheads are not much helpful in the determination of species.

The literature on bone and antler processing techniques recognizes the application of softening methods on raw material by the prehistoric and historic communities. (Diakowaski 2011: 93-116; Horwitz, et al. 2006: 169-173; Skochina 2010: 25-36; Schibler 2001: 49-60; Olsen 1979: 341-373; Davis et al. 1983: 98-103; Stone 2011a: 284; Narain 1974: 4; Moorey 1994: 111; Dikshit 1971: 51-55). But the detection of softening method at Atranjikhera and Jakhera is difficult because old soaked and boiled bones and antlers are difficult to detect from their physical and isotopic analysis (Davis, et al. 1983: 98-103; Koon et al. 2003: 1393-1399, 2010: 62-69; Lebon et al. 2010: 2265-2276). But facet of shaping marks indicates that this method might have been applied to facilitate the production. These marks also show that mostly metal tools were used to make blanks and roughtouts for final stage (Fig. 3). The identification of kind of metal tools (copper, bronze, or iron) used in the production is matter of further investigation. Blank and roughouts were produced through longitudinal splitting of bone and antler pieces into smaller segments, then additional shaping of these roughout pieces was done by shaving off processes and ridges (Emery 2008: 204-221; Olsen 1979: 341-373). Small transverse lines generated through scraping on arrowheads should not be misunderstood as file or rasp smoothening. They are essentially chattering marks. These marks could have been generated when hard material was used with study force for cutting or scraping bone. This result in vibrations or cause a ripple effect of blade, leaving small lines at regular intervals, perpendicular to the direction of movement (Olsen 1979: 341-373; Newcomer 1974: 138-153; Luik 2006: 132-149). Modifications of arrowheads till this stage were uniform. Later they were modified according to the desired typologies such as tangs, socket, barbs, decoration etc. Smoothen-
SMOOTHENING AND POLISHING

As mentioned earlier, significant number of arrowheads were further smoothen and polished after scraping and shaving during tertiary production stage. Here, smoothening most of the time led to the manufacturing polishing. It is difficult to make out a difference between smoothening and polishing techniques over bone and antler surfaces. At Atranjikhera and Jakhera, both smoothen and polished arrowheads appear more or less the same.

Macro and microscopic examination of Atranjikhera and Jakhera arrowheads has resulted in the identification of several smoothening and polishing techniques. Grinding is the simplest technique use for smoothening bone and antler but it can be a shaping technique as well (d’Errico and Backwell 2003: 1559-1576). The question is if arrowheads at these sites were shaped or smoothen by grinding. Compared to scraping, grinding might considered as slow and energy consuming shaping technique (Pasveer and Bellwood 2004), specially while working on hard materials such as bone and antler. It is the preferred shaping technique in pre-historic times especially in areas where metals use was limited or not used at all.

After the advent of metal and standardization of bone and antler industry in Upper Ganga Plain, grinding was replaced by fast and energy efficient shaping techniques like scraping. Scraping on majority of finished and unfinished arrowheads from Atranjikhera and Jakhera can be easily recognized through scraping steaks visible on them (Fig. 3). In all certainty grinding was not a favored shaping technique at these sites.

Arrowheads at Atranjikhera and Jakhera were smoothen through grinding method in a variety of ways. Parallel and closely spaced as well as unidirectional zigzag or straighten striations are visible on number of smoothen arrowheads (Fig. 4). The striation patterns suggest that they were caused due to friction between abrader and arrowhead in back and forth, side by side, circular motion. These patterns are appear in longitudinal as well as transversal direction; indicating that arrowheads were constantly repositioned during smoothening. These smoothening movements could have been performed manually or on lathe, in a combination of clockwise or anticlockwise direction. Grooves on arrowheads caused by grains of abraders have different dimensions suggesting the use of different sizes of grain material. Stones of different grain sizes have been reported from excavation, mostly in sand stone (Gaur 1983; Gupta and Haider 2000). It is possible that some of these stones were used as abrader for arrowhead smoothening. Only few arrowheads from Jakhera were smoothen through this method and it is hardly visible on Atranjikhera arrowheads.

Parallel, deep and variably spaced longitudinal unidirectional striations on pointed side are indicative of file smoothening (Fig. 5). Variation in striation size hints towards the use of a variety of grain materials. In most cases they were the result of the use of metal files as suggested by striations pattern. Sometime the use of blade can also result in similar patterns and be misunderstood with file smoothening, especially when their edges are not very sharp or they have saw type edges and scraping is performed in longitudinal direction with light pressure.

Fig. 4. Probable traces of grinding on arrowheads (JKR Antiquity No.: 318-74; 317-93)
Vinayak, Possible smoothening and polishing techniques practiced over bone and antler arrowheads...

(Fig. 6). Similar to grinding, the file smoothening can also be used for shaping as well as smoothening; however it is a slow and energy insufficient method compared to scraping. At Atranjikhera and Jakhera it was a popular smoothening technique but its use as shaping technique was much limited.

Another popular smoothening technique practiced at these sites was lathe smoothening. This technique can easily be recognized from chattering lines created in the course of smoothening (Fig. 7). These chattering lines were the results of blade vibration on arrowhead during lathe turning. The chattering lines always have the longitudinal orientation to the axis of arrowheads due to parallel stances of arrowhead and blade at the time of rotation. In certain cases these chattering marks are long enough to suggest that sometime considerably wide blades or chisels were employed for smoothening. On few occasions some sort of comb or file was used at the time of rotation. This action will result in completely transversal 'U' shaped deep striations or grooves (Fig. 8). Like above mentioned two smoothening techniques, this technique can be used for shaping as well as smoothening but at Atranjikhera and Jakhera it was largely utilized for smoothening.

Glossy look on bones and antlers is normally the result of polishing generally performed after the smoothening. But at Atranjikhera and Jakhera, sometime polishing was done even before smoothening. Shaping (scraping) traces are easily visible underneath the shiny surface of few arrowheads indicating that they were directly polished after shaping rather than passing through smoothening leg. But smoothening performed with fine particle for longer duration in a focused area can also result in shiny surfaces.
For this region various polishing materials and techniques have been suggested to make bone and antler objects shiny (Narain 1974; Dikshit 1971: 51-55). But the recognition of exact polishing material at Atranjikhera and Jakhera is not an easy task without the help of experimental archaeology. Yet, several polishing techniques have been identified on Atranjikhera and Jakhera arrowheads. If fine grained particles were to be held against the bone and antler surface at the time of lathe rotation, it can create a shiny look. This action has been identified on number of arrowheads on the basis of very fine transversal and parallel striations (Fig. 9). Striation orientation suggest that fine particles held in or attached to leather, cotton, etc. were rubbed against arrowhead surface to achieve the gloss. Striations dimensions also indicate that different size particles were used for polish.

Another possible method was to rub them with soft material alone, like wet leather, wet cotton, clay, fish skin, wax, etc. In this method arrowheads were polished manually in various motion (back and forth, side by side, circular). Sometime the polishing materials were smeared over the arrowheads at the time of lathe rotation. The striations caused by polishing are hard to detect by optical microscope and can be mistaken as use wear, cura-
tion, handling or any other gloss caused by some other factors (Fig. 10). Additionally glossy surfaces can also be achieved through rubbing abrader and soft materials alternatively (Olsen 1979: 341-373, 1980: 39-67). Polishing of arrowheads can be differentiated from the gloss caused on them because of the contest use. For this one need to have a careful examination of tips (more rounded) and other use wear features.

**DISCUSSION**

After having examined the possible smoothening and polishing technique practiced over bone and antler objects shiny (Narain 1974; Dikshit 1971: 51-55). But the recognition of exact polishing material at Atranjikhera and Jakhera is not an easy task without the help of experimental archaeology. Yet, several polishing techniques have been identified on Atranjikhera and Jakhera arrowheads. If fine grained particles were to be held against the bone and antler surface at the time of lathe rotation, it can create a shiny look. This action has been identified on number of arrowheads on the basis of very fine transversal and parallel striations (Fig. 9). Striation orientation suggest that fine particles held in or attached to leather, cotton, etc. were rubbed against arrowhead surface to achieve the gloss. Striations dimensions also indicate that different size particles were used for polish.

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Another reason for the smoothening and polishing was the primary concern to make them last long. Bone and antler arrowheads can get broken or lost in their very first use. Atranjikhera and Jakhera arrowheads are no ex-
ous conflicts were took placed. They paved the way for considering as precious commodity. For its control number of urban centers (Chakravarti 2010). Land was begun to surplus agriculture system and its leads to establishment of Pastoral subsistence structure was replaced by stagnant generations.

These circumstances led to the development of various regional variations and how this was imparted to the future provides a fair idea about cultural traditions, the area (Russell 2001b: 271-280). Smoothen and polished objects can give a nuanced understanding of these mechanical and physical changes but closely embedded in the social life of individuals within a group to conform to its norms or express dissent. For example at Atranjikhera and Jakhera arrowheads as well.

It is difficult to ascertain to what extent smoothen and polished objects from Atranjikhera and Jakhera were the mark of once social identity. Smoothening and polishing can be encouraged under various social circumstances. Every stage of manufacturing of these objects resulted in the some value addition (Choyke 2001: 251-266). These value additions were not taking shape in a vacuum. A nuanced understanding of these provides the glimpse of their social setting. They were not simple mechanical and physical changes but closely embedded in the social life of the area (Russell 2001b: 271-280). Smoothen and polished objects can give a fair idea about cultural traditions, technological advancement along with its individual and regional variations and how this was imparted to the future generations.

Iron Age in Upper Ganga Plain brought many changes. Pastoral subsistence structure was replaced by stagnant surplus agriculture system and its leads to establishment of urban centers (Chakravarti 2010). Land was begun to consider as precious commodity. For its control numerous conflicts were took placed. They paved the way for the establishment of territorial states. Technological advancement, and growth in urban population also noticed. These circumstances led to the development of various crafts. Technological advancement can also be seen in bone and antler arrowheads production. A standardized chain operation (including smoothening and polishing) was followed in their manufacturing. It shows their manufacturers were skilled personnel. And manufacturers working way closely influenced by their social life. Thus, if changes were took placed in their social life, than these might be reflected in their manufacturing techniques used for arrowheads production.

Preference for bone or antlers of specific species or group of species carried distinct meanings. Populations across the world associate a range of values with animals around them - from being quite unsentimental towards them to accepting them as pets and companions. The symbolism imposed over animals likewise is multifaceted. Some are treated as symbols of vigor and virility and accepted as the markers of royalty. Some are considered symbols of wealth and prosperity. Some are selected for sacrifices and community feasts, others not (Russell 2012: 7). Game animal, too, were considered persons and must be respected even when they are dead. It involved taking care of carcass and not allowing anything to be thoughtlessly discarded, even the bones (Russell 2012: 55). Poorly finished (unsmeothen and unpolution) arrowheads might be considered disrespectful to the killed animals. Historically animals in complex human societies were not only the source of food but often part of the ritualistic paradigm (Lev-Tov and D. deFrance 2010: 1-). The products made from these animals were considered to possess the same powers for their users as associated with a living animal (Choyke 2010:199-209). A poorly finished artifact implied the lack of such powers in that object as represented by the living animal. This might applies to Atranjikhera and Jakhera arrowheads as well.

Smoothen and polished arrowheads could have been the mark of individual or group identity. Choyke and O’Connor (2013) has opined that all manufacturing choices cannot be solely explained in terms of efficiency. Such choices can also be explained in term of desire on the part of individuals within a group to conform to its norms or express dissent. For example at Atranjikhera and Jakhera smoothening and polishing on lathe might have been practiced by certain individuals or group to stand apart. Multiple value additions through different methods led to an object being considered a wealth object, even though it still retained its utility value. Such objects might have also been used as gift items or exchange commodity between individuals or groups through which they maintained personal and inter-group relationship (Miotti and Marchionni 2013: 116-126; Vitezovic 2013: 59-73). Since certain groups considered them mark of identity or status symbol, it is quite possible that they employed strict control over the skills and techniques. They must have made every effort to preserve it to them and not let it pass to others.
Intricately fashioned (smoothen and polished) arrowheads may have also acted as symbols of power, prestige and social differentiations (Vitezovic 2012). The amount of time and energy invested in their production is indicative of the fact that they were to be utilized by persons of privilege. Such persons - elders in family, veteran hunters, big man of community and so on - cut across age, gender and community boundaries. It is quite possible that some of these arrowheads were designed to perform certain peculiar tasks. They could have been used in specially organized community tournaments where hunting expeditions were more in the nature of pleasure activities. Least to mention they could have also used in warfare (Luik 2006: 132-149).

CONCLUSION

The aforementioned macro and microscopic observations about bone and antler arrowheads of Atranjikhera and Jakhera demonstrate that a variety of smoothening and polishing techniques were in vogue at these two sites during Iron Age. Their characteristic features are reminder to the technological sophistication of Iron Age culture of Upper Ganga Plains. This sophistication in arrowhead techniques was prompted not only by mechanical and physical requirements but also as an effort to display social identity through them. No doubt, a variety of mechanical and physical concerns led to the development of this technology such as stability during flight; longer and multipurpose use; protection against weathering agents, etc. These techniques could have also been in response to the symbolism which came to be attached to the animal world. The finest products of this technology were used in maintaining interpersonal and community relationships. They were the symbols of wealth, power and prestige for their owners. These facts justify the investment of the resources, energy and time in the smoothening and polishing of arrowheads.

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MORE THAN MEETS THE EYE: MICROSCOPIC AND TECHNOLOGICAL STUDIES ON EARLY BRONZE AGE BONE AND ANTLER BEADS FROM KICHARY NOWE, SOUTH-EASTERN POLAND

Kinga Winnicka

Abstract: The aim of this paper is to highlight the most interesting developments in the studies of worked bone and antler beads originating from the multicultural site Kichary Nowe in south-eastern Poland. The beads are associated with Early Bronze Age, Mierzanowice culture burials. This material required an interdisciplinary approach, thus, zooarchaeological, microscopic, technological, taphonomic and contextual analyses have been employed. The core of the studies aimed at identifying micro-traces on the beads using optical microscopy and additionally SEM/EDS analysis. Different scraping and cutting marks have been observed, some of them strongly resembling experimentally generated micro-traces made by bronze implements. It is very interesting in terms of metal consumption in the Mierzanowice culture which manifests mainly as personal adornments made of copper alloys and deposited as grave goods. Unexpectedly, cellulose fibres in undisturbed context have also been observed on some of the artefacts. This residue may have originated from a prehistoric textile. The application of microscopic and technological approach shed some light on production methods and the use-life of bone and antler beads, as well as on ‘hidden’ aspects of the Mierzanowice culture, such as the suspected use of metal implements and plant textiles.

Apstrakt: Cilj ovog rada je da osvetli najinteresantniji doprinos proučavanju perli od kosti i roga sa višeslojnog lokaliteta Kihari Nove u jugoistočnoj Poljskoj. Perle se vezuju za rano bronzano doba i za kulturu Mježanovice. Ovaj materijal je zahtevalo interdisciplinarni pristup, pa su, prema tome, primenjene zooarheološke, mikroskopske, tehnološke, tafonomske i kontekstualne analize. Osnovni cilj bio je identifikacija mikro-tragova na perlama korišćenjem optičke mikroskopije i dodatnih SEM/EDS analiza. Različiti tragovi struganja i sećenja su uočeni, od kojih neki veoma podsećaju na eksperimentalno stvorene mikro-tragove koje ostavljaju alatke od bronze. Metal je u Mježanovice kulturi korišćen za lične ukrase pravljene od legura bakra, koji su ostavljani kao grobni prilozi. Neočekivano, uočena su celulozna vlakna u neporemećenim kontekstima na pojedinim artefaktima. Ovi ostaci mogli bi poticati od praistorijskog tekstila. Primena mikroskopskog i tehnološkog pristupa pružila je uvid u metode proizvodnje i korišćenje koštanih i roga, kao i na ‘skrivene’ aspekte Mježanovice kulture, kao što je pretpostavljena upotreba metalnog alata i biljnog teksta.

INTRODUCTION

Beads are one of the most commonly occurring artefacts in the archaeological record. They are closely associated with the evolution of the human need to adorn oneself and to manifest one’s identity (social status, age cohort, gender identity, etc.). The oldest examples (in the form of pierced shells) date back to ca. 100 000 years ago Africa and Middle East and were made by early anatomically modern humans (Vanhaeren et al. 2006; Bouzouggar et al. 2007; D’Errico et al. 2009). The first known beads sensu stricto (basket-shaped) appear on the European continent in the Upper Paleolithic and bear witness to the complexity of Aurignacian symbolic culture (White 1989; 2007). There are many points of interest regarding production and use of beads, i.e.: social identity, regional trends, symbolic meaning of raw material, craft specialisation and complexity of social relationships during times of transformation (i.e. Bar-Yosef Mayer & Porat 2008; Wright et al. 2008; Thomas 2011). Arguably, archaeological methods – especially microscopic analysis – are the most suitable for studying such small and abundantly occurring artefacts. Combining it with broad contextual and material studies, this interdisciplinary approach allows a better understanding of the production and use of beads which leads to interesting interpretations connected to craftsmanship and social meaning (see: Moulherat et al. 2002; Taniguchi et al. 2002). This approach has been applied with success to bone and antler beads from an Early Bronze Age site in Poland. Some of the most interesting results are presented in this paper.

MATERIAL AND METHODS

The site and cultural context

The site of Kichary Nowe is located on a loess patch on the Sandomierz Upland, ca. 10 km from the town of Sandomierz in the Świętokrzyskie Voivodeship (fig. 1; 2). Excavations there took place over several archaeological seasons (1987–2013) and were led by H. Kowalewska-Marszałek of the Institute of Archaeology and Ethnology, Polish Academy of Sciences in Warsaw and her team. The chronology of this multicultural site spans for more than two millennia with graves of the Funnel Beaker, Corded Ware, Mierzanowice and Złota cultures (Kowalewska-Marszałek 2000; 2007).

The analysed material is associated with the last phase of the Kichary Nowe sepulchral site: the Mierzanowice
culture cemetery dating back to the Early Bronze Age (2400–1500 BC in south-eastern Poland; Kadrow 2001: 17–23). This culture, along with the Strzyżów culture, Nitra group and Füzesabony culture, is a part of the so-called epi-Corded Ware cultural cycle in East-Central Europe (Kadrow 2001: 45). The Mierzanowice culture graves from Kichary Nowe – their context and artefact inventories have been linked to the late phase of this culture, relatively dated to 1950/1880–1650/1600 BC (Kadrow & Machnik 1997: 100–102). Recently (May–June 2014), nine human and animal bone samples have been dated at the Radiocarbon Accelerator Unit, University of Oxford. The obtained dates are slightly earlier than expected, ranging 2026–1746 cal BC. A publication addressing the results is in preparation to be published (Kowalewska-Marszalek & Winnicka, in prep.).

The beads: archaeological context, typology and raw material

The material has been analysed in 2013–2014 and it consists of 64 bone and antler beads of different shapes and sizes. They were found in nine graves – out of a total of 30 Mierzanowice culture graves. There are 11 more beads from this site which were not included in the study and are currently being analysed by the author. Other deposited personal adornments included faience and shell beads, as well as shell, bone and wild boar tusk pendants and copper willow leaf-shaped earrings (Kowalewska-Marszalek, in prep.). Bone and antler beads have often been found in context with other beads: faience (in all graves) and shell (in five out of nine graves) and with bone bead separators (in graves 30 and 33). The sample is relatively small and it is difficult to conduct statistical analysis but it is fair to make a general assumption that in this case bone and antler beads are associated mainly with adolescent and adult females (Table 1). However, two skeletons have been identified as male, both adult and in one instance it was impossible to determine sex and age. It needs to be noted that only in graves 32 and 37 the skeletons and grave goods were found in mostly undisturbed context and only in grave 32 the beads (made of bone, faience and shell) formed a concentration near the head of the deceased woman (Kowalewska-Marszalek, in prep.). Full contextual information will be published in a monograph of the site Kichary Nowe which is being prepared at the Institute of Archaeology and Ethnology, Polish Academy of Sciences.

The material was divided into three types: barrel-, cylinder- and tube-shaped beads (Dubin 2009: 362; after Beck 1928). The most numerous is the first type with a total of 38 beads; there are also 19 cylinder-shaped beads, and only seven tube-shaped beads.

The beads have also been analysed from a zooarchaeological perspective. The results indicate that the various shapes and sizes of the artefacts are connected to the differences in the raw material. Barrel-shaped beads appear to be made from sections of the long bone diaphyses of sheep/goat or roe deer sized animals (A. Laso-
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ta-Moskalewska, personal communication), most likely metatarsi which can also be substantiated by the bony structures observable during microscopic analysis (Fig. 3). Cylinder-shaped beads were in all probability made from antler tines, maybe from red deer as suggested by E. David (electronic personal correspondence). During microscopic observations (Fig. 4) it was also possible to distinguish a cell distribution characteristic of antler (Paral et al. 2007). The last type – tube-shaped beads could have been made of long bone diaphyses of mammals such as hares or dogs. It is worth noting that one of the beads was made from a bird long bone diaphysis (T. Tomek, personal communication).

Additionally, DNA testing has been conducted at the Institute of Genetics and Biotechnology, Department of Biology, University of Warsaw. Two samples were acquired from one barrel-shaped and one cylinder-shaped bead but the results were inconclusive. The antler bead sample was contaminated by some human DNA, although the bone bead sample suggests that a rabbit (Oryctolagus cuniculus) bone might have been used which is also improbable for this period (Doan 2014, unpublished genetics report). The testing will be repeated on analogous material in the near future.

**The method: microscopic analysis**

The methodological background for microscopic studies of osseous materials, as well as earlier literature can be found in recent *Manuals in Archaeological Method, Theory and Technique* (Almeida Évora 2015). It is worth noting that this method has not been extensively applied in Polish archaeology, with use-wear studies concentrating mainly on prehistoric bone and antler tools (e.g. Diałkowski 2011).

Microscopic observations have been conducted by the author at the Laboratory of Archaeometry and Conservation of Archaeological Artefacts, Institute of Archaeology, University of Wroclaw. I have used two light (or optical)
microscopes: stereoscopic (OLYMPUS SZX9) and metallographic (NIKON Eclipse LV 100). The method allows observations to be made on the surface of an artefact in a range of magnifications (up to 1 000×) and choosing the most suitable for a particular task such as studying polish, scraping and cutting marks or residues, etc. Live observations and subsequently pictures were taken using Lucia and NIS Elements software, and the graphics were designed by the author using Adobe Photoshop CS5.1. Selected samples have also been analysed using SEM/EDS at the Laboratory of Electron Microscopy, Faculty of Chemistry, University of Wrocław (with W. Gil). For this
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purpose one of the samples was sputter coated in conductive metal (gold) which did not affect the visibility of micro-traces under light microscopes.

Methodological problems

There are two problems that need to be addressed when conducting microscopic research on archaeological artefacts. The first one is the preservation of the natural surface of the artefact which affects the visibility of micro-traces. The analysed bone and antler material from Kichary Nowe was generally well preserved but in several instances the structure of the bone has been heavily eroded due to taphonomic factors. Moreover, most of the artefacts were coated in patches of calcite crust, sometimes blocking the suspension hole with an infill of sediment. In some cases humic acid staining was also visible, obscuring the investigation of possible anthropogenic micro-traces. There were also post-excavational factors associated with handling and processing of the archaeological material, such as ink marks and modern scratches (for all cases see Fig. 5). It has also been observed that the cylinder-shaped antler beads tend to be better preserved than the rest of the material, probably because antler contains a higher percentage of collagen and the items were more highly polished than the rest of the collection (O’Connor 1984: 7).

The other problem concerns use-wear traces manifesting as polish. This can be observed on many of the analysed artefacts. It appears that loess particles present in the sediment are likely to cause abrasive polishing on all bone samples from the site, including human bones as shown in a comparative analysis (Fig. 6). Another factor is the ease with which even a heavily eroded bone acquires polish, even during handling and storage (Fig. 7). It appears though that recent polish is very bright, even luminous in contrast with a smooth but matted surface of a heavily worn artefact. It also seems that in some cases recently acquired polish only accentuates prehistoric use-wear traces, especially on prominent parts of the artefact’s surface topography. However, it is advisable to proceed with caution when studying and trying to interpret this kind of micro-trace on bone and antler artefacts as use-wear.

RESULTS

Cylinder-shaped antler beads

In total, 19 cylinder-shaped beads from Kichary Nowe have been analysed. The best results were acquired using lower magnifications: up to 100×. The beads appear to have well pronounced outer surface and inner sur-
face ridges (associated with manufacturing and/or use-wear) (Fig. 7), especially the latter which is connected to the process of drilling a hole in the antler raw material. There were also scraping marks observable on the surface of two beads. On the first bead they were in the form of clearly pronounced minute parallel scratches, probably generated during the manufacturing process, e.g. cutting the antler in order to prepare segments (Fig. 11). On the second bead the traces are very ambiguous, so it is difficult to ascertain their genesis.

Also strong polish was observed over the whole outer surface of the beads (Fig. 8) but it is more pronounced near the ridges and again – especially near the inner one (Fig. 9). The polishing seems to be connected with the way the beads were joined to produce a compound ornament: a necklace or a bracelet, or a decorated belt. The polish traces observed on the inner ridge might have been generated by the drilling of the hole and/or related to the manner the bead was suspended on a string, strap, etc. In one instance it was possible to examine the inner ridge the bead. It appears that the upper part of the drill hole was rounded and smoothed out by the way the bead was suspended (Fig. 10).

The morphometrics indicate that the beads are surprisingly uniform with regard to their dimensions in diameter although their length varies (Fig. 12). It is also worth mentioning that the drill holes are different in size and appear to have been drilled from two sides of the bead (Fig. 13). Combining this with the microscopic analysis results suggests the following chaîne opératoire: the antler (probably the beam part where the compacta is thick enough) was formed into a rod (oval in cross-section), which was then segmented and each segment was subsequently perforated. It can be thus assumed that this process would require skill and reflects a desire for a uniform and well crafted product.
Fig. 10. Fragment of a cylinder-shaped antler bead from grave 33: smooth and polished upper part of the drill hole (arrows; drawing by B. Staniszewska; illustration by K. Winnicka)

Fig. 11. Cylinder-shaped antler bead from grave 46: minute unidirectional grooves associated with the production of the artefact (drawing by B. Staniszewska; illustration by K. Winnicka)
Barrel-shaped bone beads

There are 38 barrel-shaped beads in this collection. The best preserved and most consistent is the group found in grave 32 at Kichary Nowe (Fig. 14). The beads have been examined using a range of lower magnifications. Macro- and microscopic observations confirm that the artefacts were made of long bone diaphysis. This procedure required cutting off the epiphyses, segmenting the shaft and forming the product into a desired shape by thinning the walls towards the cleaned out medullary cavity (Fig. 15). One of the beads appears to be cruder than the others in the assemblage, with faceted walls that have not been formed entirely into the shape of a barrel (Fig. 16). The beads have very smooth outer surfaces so it can be assumed with a degree of caution that they have been worn for some time although it is impossible to state for how long and what kind of material has caused the polishing of the surface (probably textile and/or human hair and skin). It is also possible that they were deliberately smoothed and polished with some kind of fine abrasive such as leather and fine silt and then worn but the use wear obscures the final manufacturing polish. It can be assumed from the archaeological context that these beads together with faience and shell beads found in the grave might have formed a sort of ornamental headdress and/or a complex necklace, although comprehensive spatial analysis of the finds as they emerged from the earth of the grave would be required to confirm it.

Different micro-traces have also been observed on other beads from this collection. One specimen is unique – the author has only recently excavated it (August 2013) and it has not been cleaned or otherwise processed. Microscopic analysis began soon after the end of excavations. There are traces on its outer surface which can be identified as cut marks associated with the pre-production (post-consumption traces) or production of the artefact, e.g. removing of the soft tissues (or peristium) (Fig. 17). There are also minute multidirectional scratch-
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Fig. 14. Barrel-shaped bone beads from grave 32: from longest to shortest; scale: 10 mm (illustration by K. Winnicka)

Fig. 15. Barrel-shaped bone bead from grave 32: typical specimen; fragment of a faience bead embedded inside the medullary cavity (illustration by K. Winnicka)
Fig. 16. Barrel-shaped bone bead from grave 32: faceted walls cut by a sharp implement (illustration by K. Winnicka)

Fig. 17. Barrel-shaped bone bead from grave 60: possible cut marks (illustration by K. Winnicka)
es visible which may be a result of wearing the ornament on a coarse textile (Fig. 18). Unfortunately, the surface of this bead is quite eroded so these results should be treated with caution. There is also an atypical bead – a double barrel bead – in this assemblage (Fig. 19). It appears to be heavily used. Unfortunately, the post-excavational handling of the artefact (extensively cleaned, glued and suspended on a thread for a museum exhibition) decreases the validity of any microscopic examination.

The morphometric analysis shows that the dimensions of the barrel-shaped beads divide roughly into two groups (Fig. 20). Size differences can be explained by the fact that the beads were apparently produced from two sets of skeletal elements with slightly different sizes (metacarpal/metatarsal bone or possibly distal radius), but it is more secure to say that the raw material was obtained from long bone diaphyses from small ruminants. The production sequence for these beads seems to be less technologically advanced than in the case of antler beads, although some skill would have been required to shape segmented shafts into barrels.

Tube-shaped bone beads

The last category of analysed beads is the least uniform and the most problematic in the collection. The finest specimen is a bird bone bead in perfect state of preservation. It appears to be heavily worn with a lot of microscopically observable polish scratches (Fig. 21). Similar use-wear can be observed on another bead but this time the traces are associated with smoothing and rounding of the topographically pronounced parts of the artefact around the medullary cavity (Fig. 22). There are also ambiguous scraping marks visible on yet another tube-shaped bead but its outer surface is too eroded to be certain (Fig. 23).

The production sequence for this type of bead was the least technologically advanced. It only required the epiphyses to be cut off and cleaning out the medullary cavity. It was a task which could have been performed by a non-craftsman, even a child.

The function of these artefacts is unclear. They are the least numerous and fairly crude, it is thus less probable that they were part of some adornment. My proposition is that the tube-shaped beads might have been functional elements of clothing, i.e. strap endings, or they might have been suspended on draw cords (or parts of bag closures with loops, as suggested by A. Choyke). They were likely to be lost during every day activities but also easily replaced. This hypothesis accounts for their simple construction and low representation in the graves.

One of the artefacts is unique because it clearly bears visible scraping marks on its well preserved natural surface (Fig. 24). The micro-traces are in the form of unidirectional striations of different width. They seem consistent with traces generated experimentally with a metal implement. This is a surprising find in the light of metal consumption in the Mierzanowice culture which has been scarce, with very little bronze and mainly decorative copper artefacts (Kadrow 2001: 225). The epi-Corded Ware cultural complex is perceived as being ‘not quite’ Bronze Age in contrast to the contemporaneous Unětic culture with abundance of bronze finds in different contexts (Kadrow 1995: 82–86; Kadrow 2000: 135).
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Fig. 19. Barrel-shaped bone bead from grave 12: atypical ‘double barrow’ (photo by K. Winnicka)

Fig. 20. Correlation between length and diameter of barrel-shaped and tube-shaped bone beads from Kichary Nowe
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Fig. 21. Tube-shaped bone bead from grave 37: highly polished surface with minute multidirectional scratches (drawing by B. Staniszewska; illustration by K. Winnicka)

Fig. 22. Tube-shaped bone bead from grave 17: smooth and polished ridge area and minute multidirectional scratches on the surface (drawing by B. Staniszewska; illustration by K. Winnicka)
Fig. 23. Tube-shaped bone bead from grave 33: unidirectional grooves on a highly polished but eroded and ink stained surface (drawing by B. Staniszewska; illustration by K. Winnicka)

Fig. 24. Tube-shaped bone bead from grave 17: grooves suggest that the surface was worked with a metal implement; on the right: experimentally generated scrape marks on bone (after: Christidou 2008, Figs. 4 and 9; drawing by B. Staniszewska; illustration by K. Winnicka)
In order to confirm the finding additional SEM/EDS observations have been carried out (Fig. 25). Surprisingly, some traces of copper and zinc have been found on the surface of the bead, specifically in the grooves (Fig. 26). This could be associated with the metal implement by which the bone has been worked. Although there are two other possible explanations: the bead may have been part of a copper or bronze object which did not survive taphonomic processes, alternatively the traces can be connected to the microtaphonomy of the sediment itself. Undoubtedly, this is an important result and further analysis is required to confirm it.

Other finds – cellulose fibres?
During microscopic observations fibre-like structures were identified on the surface of some of the cylinder-shaped antler beads. They are most clearly visible under higher magnifications – up to 1000×. They appear as criss-crossing iridescent ‘ribbons’ and seem to be embedded in the upper calcified layer of the bone (Fig. 27). Their smoothness suggests that they are not of animal origin (Bergfjord & Holst 2010: 1192). Their diameter ranges from 3 to 5 μm indicating that they might be nettle or flax fibers (op. cit.: 1194) although they seem fairly thin which might be attributed to the erosion of the sample. Additional SEM/EDS observations have been conducted (Fig. 28) confirming that the residue is organic and that it bears resemblance to other fiber sample SEM images (e.g. Chen & Jakes 2001). Unfortunately, it was impossible to discern any other diagnostic features so the results remain inconclusive.

Researchers have suggested that nettle may well have been use as early as in the Upper Paleolithic (Kvavadze et al. 2009). Moreover, textile imprints have been found on shell adornments from the site of Kichary Nowe that have been identified as ‘poor quality, thick and stiff linen’ (Kurzawska & Kowalewska-Marszalek 2010: 163). It is thus not entirely unfeasible that residues of plant (or animal) textiles might have been preserved, embedded within the surface of bone and antler artefacts with which they were in contact in the grave.

Unfortunately, it is also possible that these are not fibres but organic residues of microorganisms which would in this case be associated with taphonomic processes. Such organic residues have been found on the surface of one of the beads (Fig. 29). It was possible to identify them as chytrid fungae which live in the ground (Chen & Chien 1998).

CONCLUSIONS
The research presented above revealed material, technological and functional differences between three types of bone and antler beads found in nine graves of the Early Bronze Age, Mierzanowice culture from the site of Kichary Nowe located in south-eastern Poland. Microscopic analysis allowed identification of micro-traces associated with the production and use of the artefacts. It also helped to confirm the zooarchaeological assessment of the raw material by identifying diagnostic microstructures.

Cylinder-shaped beads appear to be the most difficult to produce as they required the antler to be worked in several production steps in order to make one bead. It also must have taken a considerable amount of effort to manufacture enough beads to assemble them into an adornment. Also, barrel-shaped bone beads seemed to
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Fig. 26. SEM/EDS readings of mineral residues on the surface of a tube-shaped bone bead from grave 17; Cu/Zn content indicated by arrows (illustration by K. Winnicka)

Fig. 27. Organic residue (plant fibres?) on the surface of a cylinder-shaped antler bead from grave 46 (drawing by B. Staniszewska; illustration by K. Winnicka)
Fig. 28. Organic residue (plant fibres?) on the surface of a cylinder-shaped antler bead from grave 46: SEM micrographs, different magnifications; top right corner: surface of a historic fibre (after: Chen & Jakes 2001, Fig. 5a; illustration by K. Winnicka)

Fig. 29. Organic residue on the surface of a cylinder-shaped antler bead from grave 33; on the right: SEM micrograph of Rhizophlyctis hyalina (after: Chen & Chien 1998, Figure 2; drawing by B. Staniszewska; illustration by K. Winnicka)
have been manufactured in a chaîne opératoire requiring some skill in forming the bone into the desired shape. Cylinder-shaped beads are very uniform in shape (cylindrical or sometimes more disc-like), barrel-shaped beads less so, but both types are well crafted indicating that they were made as ornaments to be worn on the hair and dress and then deposited in the grave. On the other hand, tube-shaped beads seem to be an ad hoc element of clothing. Rather functional than ornamental, easily lost or discarded and simple to make. It can be assumed that cylinder- and barrel-shaped beads were made by more skilled or at least a more experienced person or persons, while tube-shaped beads could have been made ad hoc by anyone, whenever needed.

One of the most important finds – made possible by the use of microscopic methods – was the identification of striations consistent with micro-traces experimentally generated by a bronze implement. It is very interesting in terms of metal consumption in the Early Bronze Age epi-Corded Ware cycle and requires further comparative studies.

Another unexpected find is the fibre-like organic residue embedded within the upper layer of the cortical bone on one of the beads. There are some indications that these fibres may have originated from ancient plant-derived textiles but this hypothesis also requires further testing.

In conclusion, microscopic analysis of bone and antler beads can shed some light on their production and use-life. In this case, it also brought interesting insights into the use of metal tools in a culture known for a limited use of such implements. The use of higher magnifications might also lead to discoveries of mineral and organic residues, some of which of prehistoric origins.

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