OSSEOUS TECHNOLOGY IN THE EARLY AND MIDDLE NEOLITHIC IN THE CENTRAL BALKANS

Tecnología ósea en el Neolítico inicial y medio de los Balcanes centrales

SELENA VITEZOVIĆ *

ABSTRACT Osseous raw materials were important raw material in the Early and Middle Neolithic Starčevo culture of the South-East Europe; they were widely used for production of everyday tools (awls, needles, scrapers, burnishers, chisels, hammers, etc.), other utilitarian objects (such as handles), weapons (projectile points) and ornaments (pendants, beads, buckles). In this paper will be presented the analysis of technological choices (raw material selection and manufacturing techniques). Raw material selection shows the predominance of bones at most of the sites, but with some exceptions, such as high ratio of antlers in the Iron Gates region. Mollusc shells are not numerous, yet present at several sites. Raw material selection was relatively strict, while the manufacturing techniques show high level of technological knowledge and familiarity with raw material. They also display some chronological-cultural specific traits, such as use of abrasion only for the production of metapodial awls, making or large perforations, etc.

Key words: Early and Middle Neolithic, Starčevo-Körös-Criş Cultural Complex, Osseous Technology, Osseous Raw Materials, Technological Choices.

RESUMEN Las materias primas óseas fueron un materia prima de importancia durante el Neolítico Antiguo y Medio de la Cultura Starčevo, en el Sureste de Europa; éstas fueron ampliamente utilizadas para la producción de herramientas cotidianas (punzones, agujas, raspadores, pulidores, cinceles, martillos, etc.), para otros objetos utilitarios (como los mangos), para armas (puntas de proyectil) y para ornamentos (colgantes, cuentas y broches). En el presente artículo se presenta el análisis de las decisiones tecnológicas (la selección de la materia prima y las técnicas de manufactura). La selección de materia prima muestra una predominancia del hueso en la mayor parte de los yacimientos, pero con algunas excepciones, tales como una gran presencia de asta en la region de Iron Gates. Las conchas de moluscos no son numerosas, aunque presents en varios yacimientos. La elección de una u otra materia prima era relativamente estricta, mientras las técnias de manufactura muestran un gran nivel de conocimiento

* Institute of Archaeology, Belgrade, Serbia. *s.vitezovic@ai.ac.rs*
Fecha de recepción: 02/04/2018. Fecha de aceptación:24/04/2019.
http://dx.doi.org/10.30827/CPAG.v29i0.9778

tecnológico y familiarización con la materia prima. Además, se observan algunos rasgos crono-culturales específicos, tales como el uso de abrasion únicamente para la producción de punzones sobre metapodio, perforaciones amplias, etc.

Palabras clave: Neolítico Antiguo y Medio, Complejo Cultural Starčevo-Körös-Criş, Tecnología ósea, Materias primas óseas, Elecciones tecnológicas.

INTRODUCTION

The Early and Middle Neolithic Starčevo culture, part of the Starčevo-Körös-Criş cultural complex, was widespread in central Balkans and south Carpathian basin, in present-day countries of Serbia, eastern Croatia and Bosnia and Herzegovina and northern parts of Montenegro (cf. Garašanin, 1979). The absolute dates obtained by AMS method place it in the period 6200-5500 BC (Whittle *et al.,* 2002). The material culture is characterised by rich and diverse objects made from clay (vessels for cooking, storage and consumption, figurines, altars, weights, etc. (Aranđelović-Garašanin, 1954), as well as rich and diverse objects from chipped, ground and abrasive stones (retouched and unretouched blades, axes, adzes, chisels, hammers, weights, querns, whetstones, grinding stones, etc.- cf. Antonović, 2003; Šarić, 2014).

Starčevo culture communities practised agriculture and animal herding, and to a lesser extent hunting and gathering (Filipović and Obradović, 2013; Clason, 1982; Greenfield, 2008). Domestic species represented were sheep, goats, cattle and pigs, the wild species included red deer, aurochs, wild pigs and roe deer (cf. Bökönyi, 1974, 1988; Clason, 1982; Blažić, 2005; Greenfield, 2008). There are some differences between different sites, for example, at Starčevo-Grad, *Bos taurus* was the predominant species, while at Donja Branjevina caprinae prevailed (cf. Clason, 1982; Blažić, 2005).

The osseous raw materials were also important for production of diverse craft goods. The typological repertoire includes tools (awls, needles, heavy points, axes, chisels, wedges, scrapers, burnishers, small percussion tools, hammers, retouching tools, etc.), other utilitarian objects (such as handles or sleeves), weapons (projectile points) and decorative items (pendants, buckles, beads, bracelets). In this paper will be presented the analysis of technological choices (raw material selection and manufacturing techniques), based on the results obtained from the assemblages from the following sites: Ludaš-Budžak, Donja Branjevina, Golokut-Vizić, Obrež-Baštine, Starčevo-Grad, Divostin, Grivac, Drenovac, Međureč, Ušće Kameničkog Potoka, Knjepište, Velesnica, Pavlovac-Kovačke Njive, Bubanj-Novo Selo (Vitezović, 2011a, 2011b, 2012, 2013a, 2013b, 2017; Vuković *et al*., 2016) (fig. 1). These assemblages differ in quality and quantity; some sites were excavated on a small area, preservation is not very high in some assemblages and even during some research campaigns the faunal material was not carefully collected. For example, the sites of Starčevo-Grad and Donja Branjevina have the richest assemblages, with 250 and over 340 artefacts respectively, including also certain amount of manufacture debris,

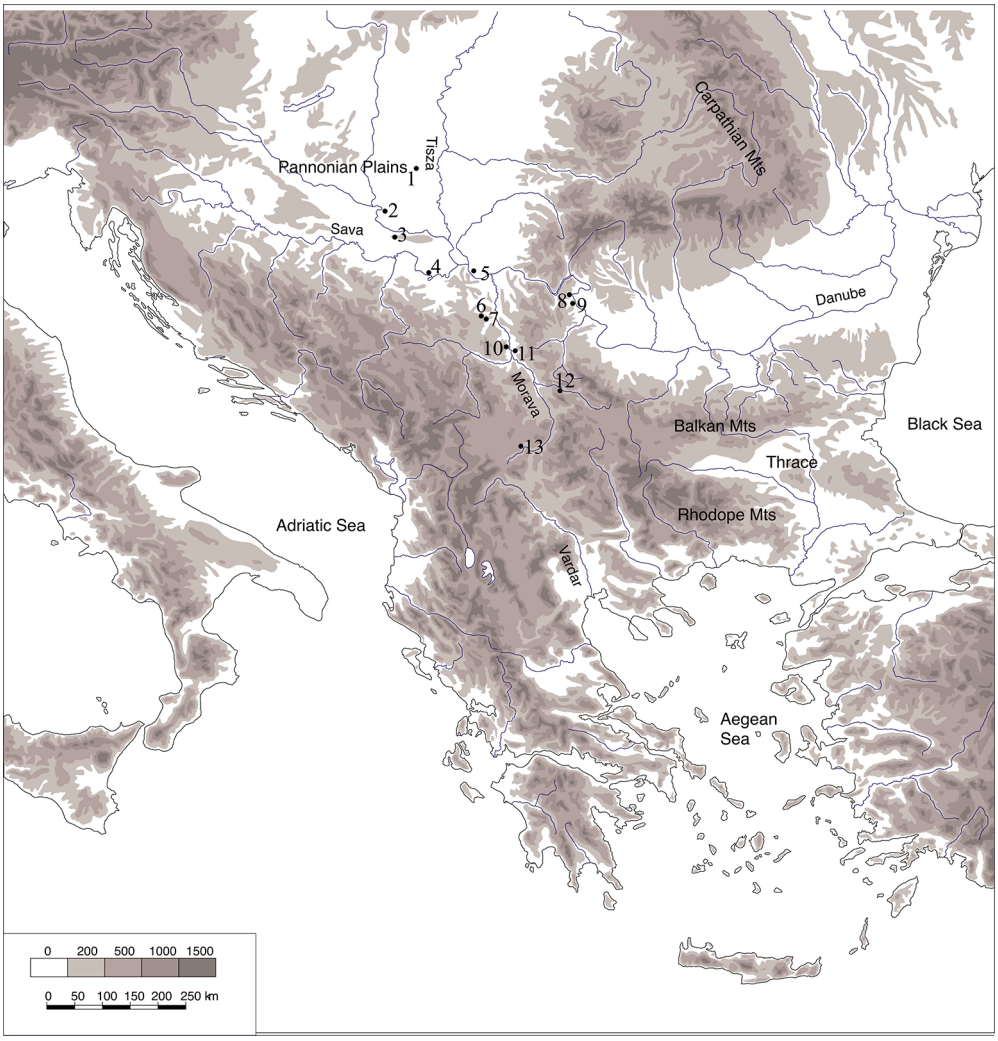

Fig. 1.—Sites mentioned in the text: 1, Ludaš-Budžak; 2, Donja Branjevina; 3, Golokut-Vizić; 4, Obrež-Baštine; 5, Starčevo-Grad; 6, Grivac; 7, Divostin; 8, Velesnica; 9, Ušće Kameničkog Potoka and Knjepište; 10, Međureč; 11, Drenovac; 12, Bubanj; 13, Pavlovac.

but it seems that smaller fragments were not collected. On the other hand, some sites were excavated recently and according to modern standards in archaeology, but some at small area, such as Međureč, or the preservation was rather low, as in case of the site of Pavlovac-Kovačke Njive (cf. Vitezović, 2011a, 2013a; Vuković *et al*., 2016 for more details). However, these assemblages provided data on the main characteristics of the raw material managing, technological procedures and typological repertoire.

RAW MATERIAL SELECTION

Main osseous raw material were ungulate bones, followed by red deer antlers; rarely, roe deer antlers, teeth from different species and mollusc shells were used. There are some differences between the different sites in ratios; they may be related to the availability of raw materials (antlers are more common in the Iron Gates region, where deer were abundant in the hinterland – cf. Vitezović, 2017:fig. 2), but also differences in daily activities and local preferences (see Vitezović, 2011a for details on raw materials) (fig. 2).

The preferred choice were ungulate metapodials and ribs, followed by tibiae and ulnae, and also were used different long bone diaphysis splinters. Other bones (e.g., scapulae, mandibles, short bones) occur rarely or were completely absent. Among species whose bones were chosen for making tools a strict selection may be observed. Caprinae bones were the best represented, followed by domestic cattle, and rarely red deer, roe deer and aurochs. Especially caprinae metapodials were the preferred choice for the most frequent techno-type, awls (fig. 3), while the cattle metapodials were exclusive or preferred choice for techno-types such as spatula-spoons and projectile points. Caprinae tibiae were usually used for specific techno-type, spatula-chisels (fig. 4). Ulnae are rarely encountered and usually these are single examples; only at Donja Branjevina several caprinae and two cattle ulnae were discovered. Also, ribs were commonly used, probably all from large mammals; usually relatively small elongated segments of split ribs were used for pointed and burnishing tools, but also there are examples or rather large, almost complete cattle ribs used as scrapers.

As mentioned above, identified bones are predominantly ungulate bones (caprinae, cattle, red deer, undetermined ungulates) and it is interesting to note the absence of bones from pigs (wild and domestic). Although some of the objects made from undetermined diaphysis fragments and ribs may have been made from pig bones, it is noteworthy the absence of those skeletal elements which can be determined with certainty, such as long bone segments with epiphysis preserved. Boar tusks were occasionally used for tools and ornaments, and also teeth from other species (both wild and domestic), were used as decorative items (e.g., red deer canines – cf. Vitezović, 2012).

Antlers were usually those from red deer. All segments were used – basal parts, beam segments (fig. 5), tines, cortex segments; there is even an example of the bracelet made from the pearly part of the base (discovered at Drenovac: Vitezović, 2012:fig. 3). Shed basal parts were discovered at several sites, including Divostin, Starčevo and Ušće Kameničkog Potoka (cf. Vitezović, 2014), suggesting that the antlers were mainly obtained by collecting. The use of red deer *bois du massacre* for artefact production cannot be confirmed with certainty. Some finds of antler segments without traces of manufacture may represent raw material cache – they were discovered, for example, at Starčevo (Clason, 1982), Divostin (Bökönyi, 1988), and Drenovac (personal observation). Roe deer antlers are quite rare, although one

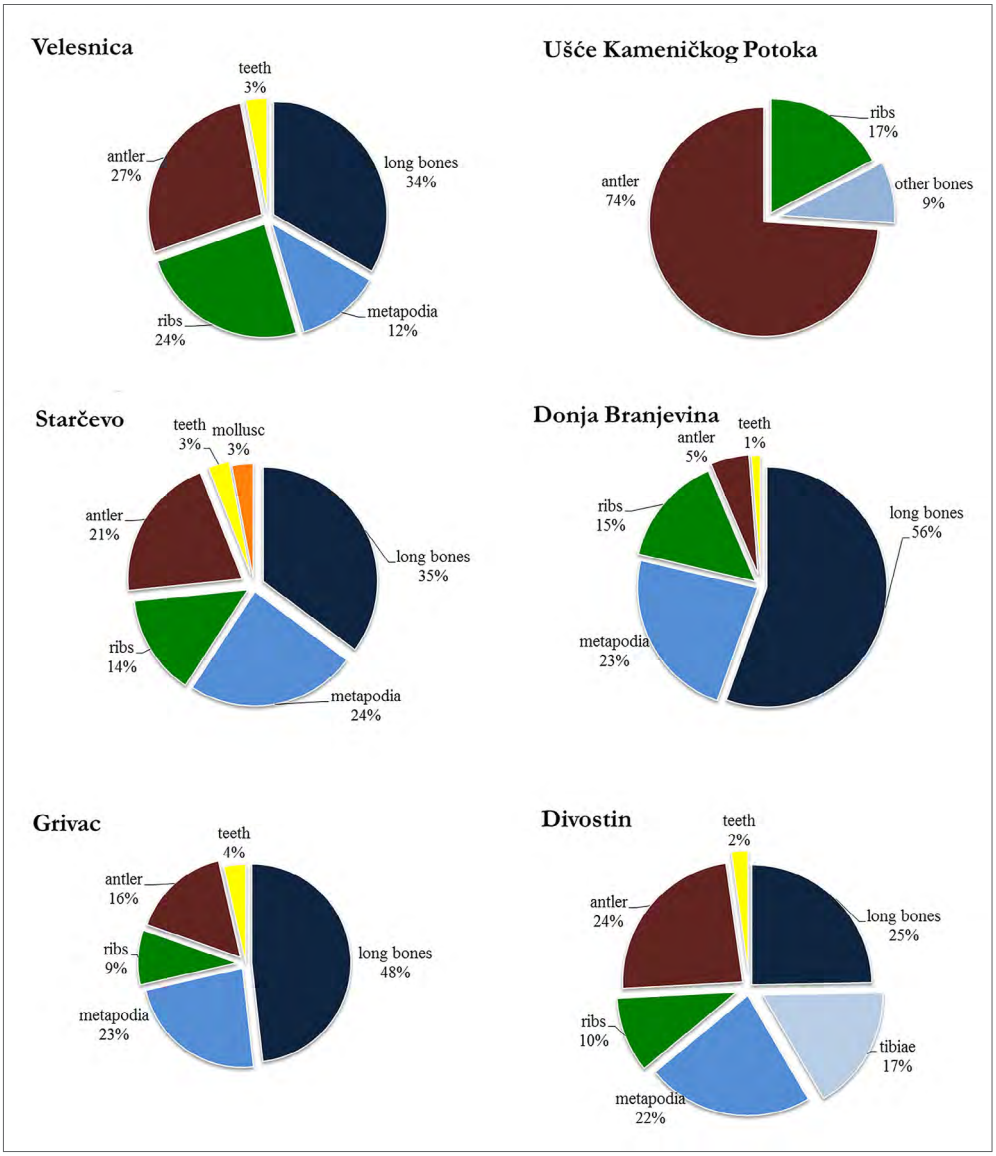

Fig. 2.—Ratios of some skeletal elements for some of the sites mentioned in the text.

relatively large segment of beam and crown, used as retouching tool from Starčevo can be mentioned (Vitezović, 2014:166).

Mollusc shells used were *Dentalium*, *Spondylus* and *Glycymeris,* and were found on selected sites only and in small quantities. *Dentalium* beads (total=3) are known so far only from the site of at Starčevo-Grad (Vitezović, 2012:fig. 2),

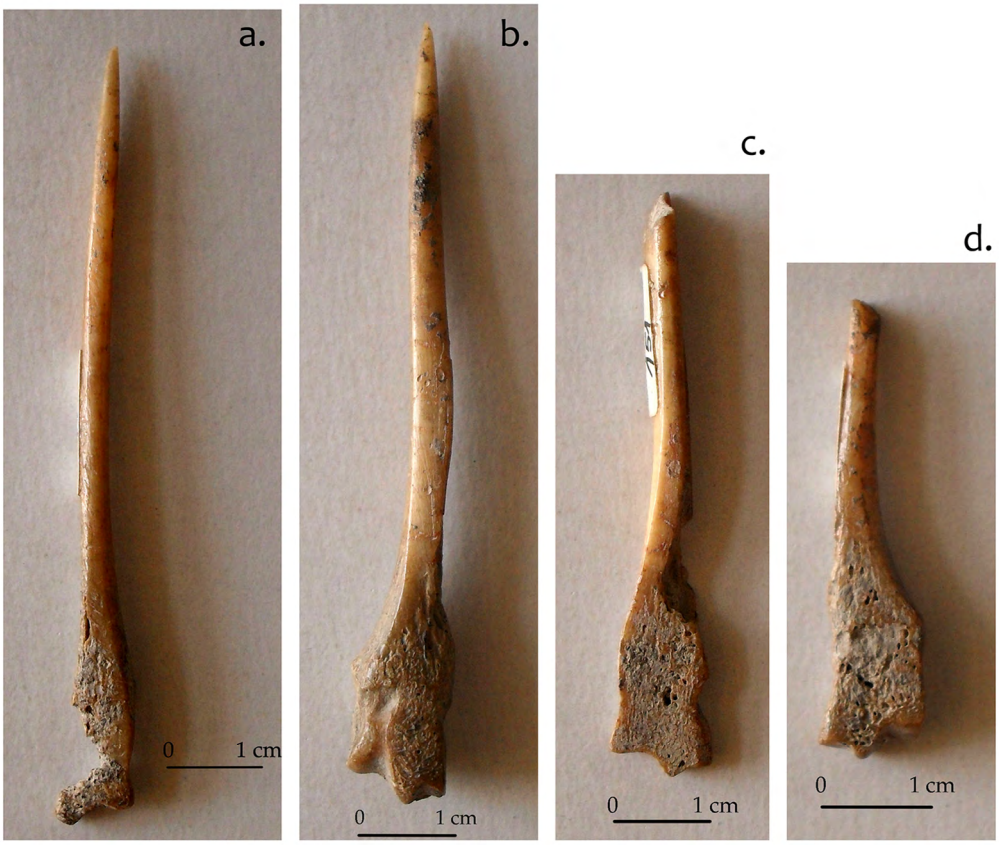

Fig. 3.—Awls made from caprinae metapodial bones by abrasion (Donja Branjevina).

where also *Spondylus* ornaments were discovered (total=4). At the site Međureč just one small bead from undetermined shell was found and at Divostin two ornaments from unidentified shells, probably *Spondylus*. The sites of Drenovac yielded five fragmented bracelets made from *Spondylus* and *Glycymeris* shells (Vitezović, 2011a, 2012).

TECHNOLOGY OF MANUFACTURE

First steps in making artefacts was preparing of the raw material, cleaning, softening by soaking in water, etc. (cf. Osipowicz, 2007, and references therein). Manufacturing processes usually included several stages, preparing of the blanks by direct or indirect percussion, sawing and cutting, and then finalizing usually

Fig. 4.—Spatula-chisel from caprinae tibia; c, details of working edge and traces of abrasion; d, polished basal part (Divostin).

by scraping with a chipped stone tool and/or burnishing by some abrasive stone or by use of sand. These actions usually leave distinctive traces on osseous materials; however, later stages of shaping may remove the traces from earlier phases and also intensive use may affect their preservation. The manufacturing techniques were reconstructed by analyses of all available objects (finished objects and manufacture debris, when available), and compared with different experimental results obtained by other authors (in particular, Newcomer, 1974; Semenov, 1976; Christidou, 1999; Schibler, 2001; Maigrot, 2003; Legrand, 2007).

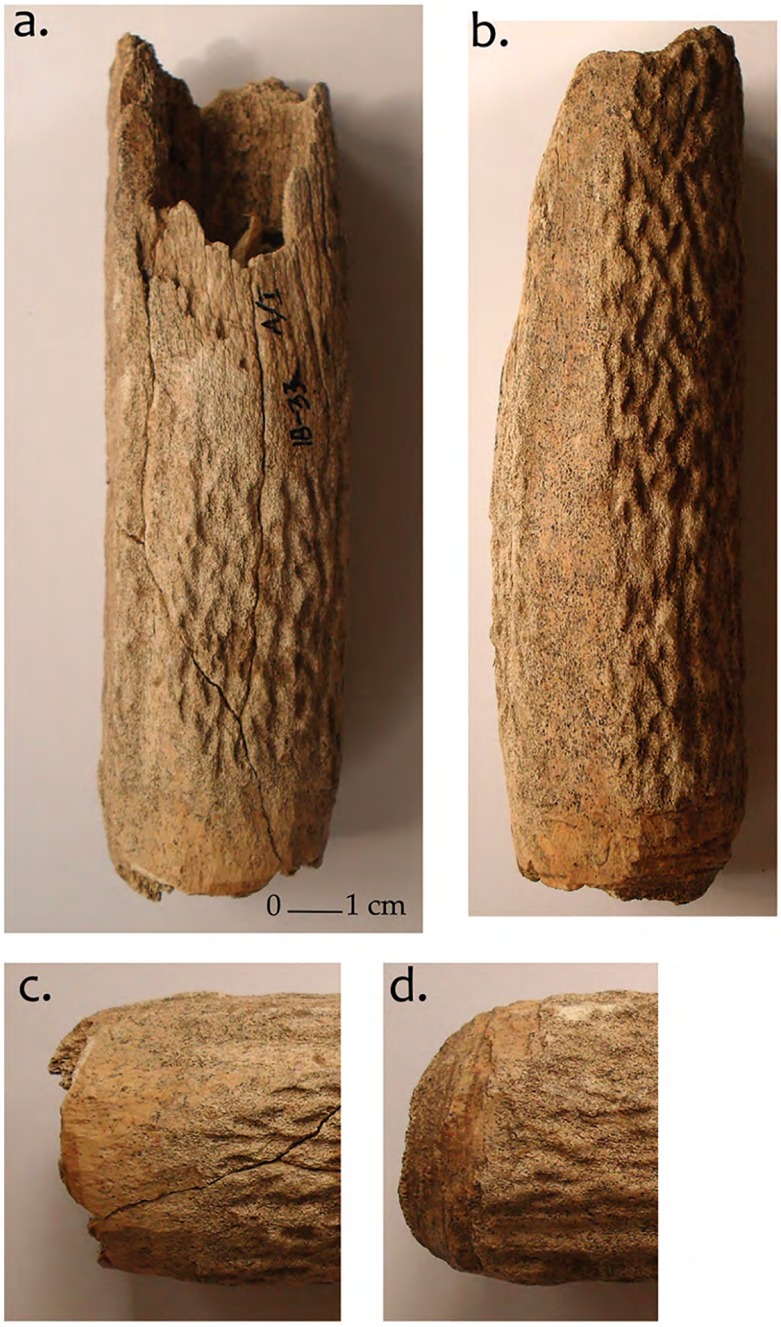

Fig. 5.—Handle made from red deer antler; c-d, details of traces of manufacture (Knjepište).

Bones

Long bones were divided into segments by longitudinal splitting or by transversal cutting, depending on desired preform. Long bones were usually split along their shaft in order to obtain an elongated piece, and especially ungulate metapodial bones were easily split longitudinally along their natural sulcus (cf. Schibler, 2001). Usually a groove is made by a chipped stone tool, to ease splitting and make it more regular. Sometimes, irregular bone splinters are used, obtained by direct percussion (usually product of breaking bones to extract the marrow).

Transversal dividing into segments was made by making a groove along the circumference of bone and then the final millimetre or so of the bone was just snapped off. Groove could have been executed with a chipped stone tool, or by abrasive fibre, or the combination of the two (fig. 6). Transversal cutting of bones, especially large and thick long bones from large mammals was quite difficult, especially in fresh bones, since the long bones are more resilient along their axis (cf. Scheinsohn, 2010 and references therein), but this method enabled obtaining blanks of regular shape.

Particularly interesting method of shaping concerns awls from small ruminant metapodials. Three distinctive manufacturing methods were in use in the Neolithic period: 1) manufacture using abrasion only; 2) manufacture by first sawing the metapodia in half and then abrading it; 3) manufacture by first abrading and then by sawing (cf. Sidéra, 2005 for details). The first method allowed more precise shaping, but restricted the number of artefacts which could have been fashioned from a single piece of raw material. Also, the result of this method are thinner

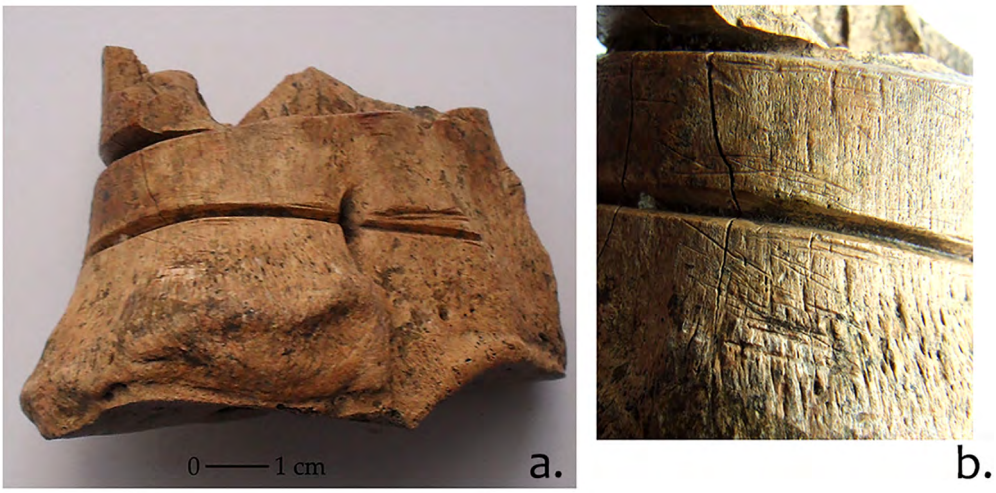

Fig. 6.—Transversal division of long bones; b, details of manufacturing traces (Drenovac).

and finer awls. Specific preform for this are full-length metapodials with one or both surfaces (ventral and dorsal) abraded, such as the one found at Starčevo-Grad (Vitezović, 2013a:fig. 12). Grindstones from sandstone or other abrasive stones were most likely used for these purposes and it is interesting to note that they are frequently found on most Starčevo culture sites (cf. Antonović, 2003; Antonović and Vitezović, 2014).

Ribs were usually divided into segments by direct or indirect percussion (cf. Christidou, 1999), and further modified into artefacts by abrasion. Most of the bone artefacts were in later stages shaped by cutting and scraping with flint tools and by polishing with different abrasive stones (more coarse- or more fine-grained), especially if the blank was obtained by direct percussion and had irregular edges. Abrasion was also used for re-sharpening the points. Sometimes, basal parts of the tools are additionally burnished and polished, to ease the grip and/or for aesthetic purposes. For example, spatula-chisels made from caprinae tibiae sometimes have completely smoothed and rounded the epiphysis which is preserved at the basal – such as examples from Divostin (fig. 4, see detail 4d).

Projectile points, for example, were produced from elongated segments extracted from large long bones (predominantly cattle metapodials), probably by use of grooving. They were further modified by scraping with chipped stone tools and additional burnishing of distal ends or even entire surfaces. One of the techno-types for which particularly complex manufacturing procedure was practiced are the spatula-spoons, produced exclusively from cattle metapodials. The metapodial bone was split longitudinally (probably by grooving and sawing) into two halves and the entire length of the bone was used. One find from Donja Branjevina of semi-finished spatula clearly shows this procedure and also demonstrates that these artefacts were produced locally (Vitezović, 2011b:fig. 17/2). This example is one longitudinal half of the metapodial bone, partially modified into a spoon, and the surface of the inner side of the bone (surface that was cut from the other half of the bone) was covered with traces of abrasion. Through several stages of cutting and scraping with chipped stone tools and burnishing and polishing with abrasive means were obtained an elongated handle and oval or triangular bowl (cf. Nandris, 1971; Sidéra, 2011; Vitezović, 2016a). According to experimental results, approximately 25 hours of work was needed (cf. Sidéra, 2011 for the details of the experimental procedure).

Rarely, perforations were made on bone artefacts, either by drilling with a flint borer (with sand added) to obtain smaller holes (5-8 mm in diameter), or with a hollow rod with sand added, to make a larger hole (1-1,5 cm in diameter). These large perforations leave distinctive debris, in a shape of small circles, and may be considered as specific for the Early Neolithic in the South-East Europe (cf. Makkay, 1990; Beldiman, 2007; Vitezović, 2013c). Perforation made by cutting was noted on a single find, on a needle from Pavlovac-Kovačke Njive (Vuković *et al.,* 2016:t. VI/2).

Bone artefacts were generally not decorated; rarely, dents may be added on the artefact (they could have been functional or purely decorative). The only exception

is one projectile-shaped object from Donja Branjevina with the zoomorphic basal part (Vitezović, 2011b:fig. 18/4).

Antlers

Dividing antlers into blanks usually started with separating the tines from the beam, and the beam may have been cut into several pieces. Antlers are much more resilient than bones, therefore, direct percussion, chopping or adzing may be successful only when applied on smaller antler beams or tines.

Antlers were usually divided into segments by a combination of diverse techniques. The main techniques were the so-called cut-and-break technique or débitage by segmentation (débitage par tronçonnage) (cf. Averbouh, 2000:186; Averbouh and Pétillon, 2011:41). It was used for transversal division and included combination of grooving, cutting and chopping. The cortex was first thinned by grooving and cutting, or, more commonly, by using an abrasive fibre. When the cancellous tissue was reached, the remaining portion of the antler was chopped off, cut off with an axe, or snapped by flexion (fig. 5). The same procedure, sawing with a wet abrasive twine, followed by fracturing, was in use in the Iron Gates Mesolithic (cf. Beldiman, 2005:38).

Another technique used was so-called groove-and-splinter technique or débitage by extraction (*débitage par extraction*) (cf. Averbouh, 2000:186; Averbouh and Pétillon, 2011:41). It was used for longitudinal division and for extracting blanks from the outer part of the antler. Usually two parallel grooves were incised longitudinally and then a blank was extracted with a wedge (cf. Averbouh, 2000:186; Averbouh and Pétillon, 2011:41; Rigaud, 2004:80). In this way were obtained elongated, more-less flat pieces, used for chisels, decorative items (such as pendant found at Starčevo – Vitezović, 2012:fig. 1), etc.

Tines were sometimes used unmodified or with minimal modifications on their natural tips. Beams were modified into cutting-edged tools, such as chisels or axes, by oblique cutting at (technological) distal ends – first one larger or several smaller pieces were cut off and then the edge was shaped by grinding and scraping (cf. Beldiman 2005:38-39).

Antler tools usually did not require additional burnishing to obtain final, usable shape (needed, for example, to obtain very thin and sharp points on bone needles). However, sometimes their outer surfaces were partially or completely smoothed by scraping with a chipped stone tool and/or with some abrasive means. Perforations on antlers were made by cutting and scraping the compact tissue, then carving out the spongy tissue (from both sides), and the final circular shape of the hole is obtained by drilling with a lithic tool. Perforations obtained this way are more or less circular and traces of a flint tool are sometimes visible on the edges (cf. Beldiman, 2005:40, figs. 8-9). Outer diameter is often slightly wider than the inner. The use makes the interior smooth and regular; one irregularly made perforation (probably unused) with clear traces of the tool which made it was found at one artefact from Ušće

Kameničkog Potoka. One small retouching tool from Donja Branjevina (Vitezović, 2014:fig. 10) had perforations on the base, used probably to attach the tool on the belt (one perforation was broken and a new one was made), made by drilling with a chipped stone perforator, same as perforations on bone artefacts.

Decorations on antler tools were not noted.

Teeth

Very little can be said on the manufacturing procedure for teeth. Boar tusks used for tools are often fragmented; they were most likely split and then modified into scrapers or knives by abrasion. Teeth used for decorative purposes are not very frequent (for example, two ornaments from boar tusks and one canid canine were found at Drenovac, one red deer canine was found at Divostin–Vitezović, 2012:figs.1 and 6) and the perforations on them were made by drilling, usually from both sides.

Mollusc shells

Also, for mollusc shells data on manufacture are scarce. Only few objects were found; *Dentalium* beads were used unmodified or only the ends were slightly curated, while ornaments from marine molluscs, such as *Spondylus,* were probably imported as finished products. Not only there is no manufacture debris from shells, but also these items are too scarce to be produced locally (assuming that the artisan needed to have at least some experience in production of these objects); furthermore, shell ornaments are typologically the same as in other European regions (cf. Séfériadès, 2010 and references therein).

DISCUSSION AND CONCLUSION

Bones and teeth were obtained locally, from butchered domestic or hunted wild animals. However, they were not simple kitchen debris, but were carefully selected and separated during the butchering process. Metapodial bones, the preferred choice for numerous techno-types, are the first to be removed during butchering (cf. Olive, 1987). We may assume that they were also stored for later use, as suggested by consistent choice of specific skeletal elements. Antlers were mainly or perhaps even exclusively obtained by collecting (there is no conclusive evidence on use of red deer *bois du massacre* for artefact production), while the mollusc shells were obtained through exchange, probably as finished items.

The differences in raw material choice between different regions may be the result of environmental, economic, but also cultural reasons. Antlers are rare in the Early Neolithic in Greece (cf. Perlès, 2004) or at Körös culture sites (Tóth,

2013), but are much more common in Serbia and Romania, especially in the Iron gates region (Beldiman, 2005, 2007; Vitezović, 2014). On the other hand, mollusc shells occur in Greece in large numbers (cf. e. g. Miller, 1996), but they decrease in the northern areas. Caprinae bones are preferred choice in the entire Balkan area, and methods for their shaping are also very uniform (cf. Stratouli, 1998; Makkay, 1990; Choyke, 2007; Beldiman, 2007; Beldiman and Sztancs, 2011; Tóth, 2013). However, metapodial bones prevail in Starčevo bone industries, while tibiae are less common than in other Early Neolithic bone industries in the Balkans (e.g., in Greece and Stratouli, 1998).

Ad hoc, expedient tools were rare, and if we arrange artefacts along imaginary axis of *manufacturing continuum* (*sensu* Choyke and Schibler, 2007), most of the bone and antler objects it them would fall into the category of carefully made objects, used over long time – they were made by using uniform method of manufacture, with relatively high labour investment and show high skill level of the craftspersons. Such high level of uniformity is suggesting that there was certain degree of standardization. This also shows cultural attitude towards this class of material culture, and perhaps the craftsman's skill was highly valued (cf. Sinclair, 1995, 1998).

The osseous industry of the Starčevo culture in the Early and Middle Neolithic in central Balkans fits well into the general picture of the contemporary bone industries in the south-eastern Europe. However, Starčevo bone industry also has certain combination of traditions of Mesolithic origin (such as the use of antlers in general, manufacturing techniques for antlers, the presence of some techno-types, such as projectile points) and innovations, some of them of Near-Eastern origin (such as spatulae-spoons, some types and subtypes of ornaments, etc.) (cf. Vitezović 2016b for more details). It was based mainly on locally available raw materials, with limited number of imported pieces, and this specific combination of traditions and innovations resulted in a culture-specific bone industry.

Acknowledgments

This paper is the result of the projects financed by the Ministry of Education and Science of the Republic of Serbia, nos. III 47001 and OI 177020.

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