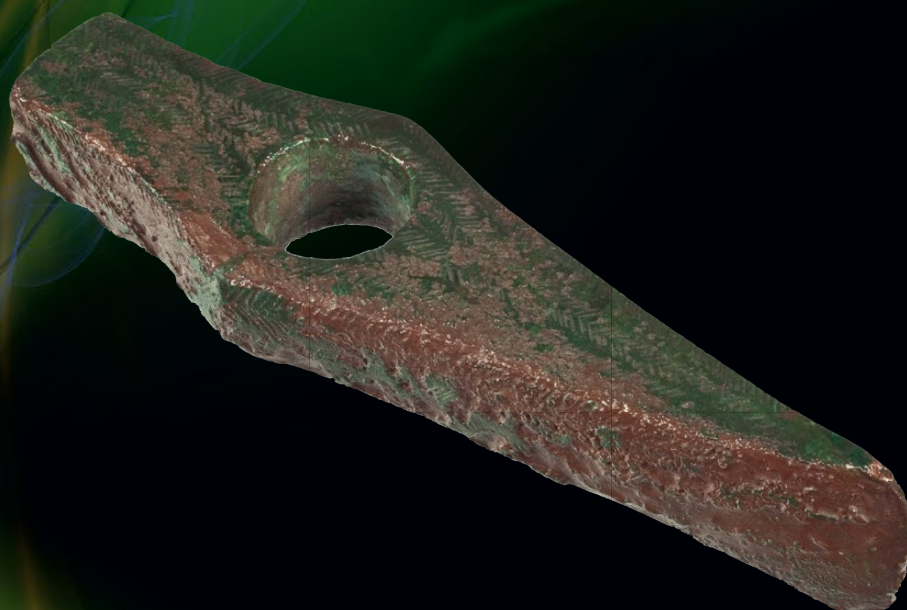




# The Rise of Metallurgy in Eurasia

Evolution, Organisation and Consumption  
of Early Metal in the Balkans



Edited by

Miljana Radivojević, Benjamin W. Roberts,  
Miroslav Marić, Julka Kuzmanović Cvetković  
and Thilo Rehren



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*To the memory of Borislav Jovanović, our colleague, friend and inspiration*

*(1930 - 2015)*



# Contents

List of Authors .....	v
Foreword by Evgeniy N. Chernykh .....	xi
Foreword by Barbara S. Ottaway.....	xiii
Foreword by Stephen J. Shennan.....	xiv
Acknowledgements .....	xvii
<b>Part 1 Introduction .....</b>	<b>1</b>
<b>Chapter 1 The birth of archaeometallurgy in Serbia: a reflection.....</b>	<b>3</b>
Julka Kuzmanović Cvetković	
<b>Chapter 2 The Rise of Metallurgy in Eurasia: Evolution, organisation and consumption of early metal in the Balkans: an introduction to the project.....</b>	<b>7</b>
Thilo Rehren, Miljana Radivojević and Benjamin W. Roberts	
<b>Chapter 3 Balkan metallurgy and society, 6200–3700 BC .....</b>	<b>11</b>
Miljana Radivojević and Benjamin W. Roberts	
<b>Chapter 4 The Vinča culture: an overview.....</b>	<b>38</b>
Benjamin W. Roberts, Miljana Radivojević and Miroslav Marić	
<b>Chapter 5 Introduction to Belovode and results of archaeometallurgical research 1993–2012.....</b>	<b>47</b>
Miljana Radivojević	
<b>Chapter 6 Introduction to Pločnik and the results of archaeometallurgical research 1996–2011.....</b>	<b>60</b>
Miljana Radivojević	
<b>Chapter 7 Excavation methodology for the sites of Belovode and Pločnik .....</b>	<b>77</b>
Miroslav Marić, Benjamin W. Roberts and Jugoslav Pendić	
<b>Part 2 Belovode.....</b>	<b>81</b>
<b>Chapter 8 Belovode: landscape and settlement perspectives .....</b>	<b>83</b>
Miroslav Marić	
<b>Chapter 9 Belovode: geomagnetic data as a proxy for the reconstruction of house numbers, population size and the internal spatial structure .....</b>	<b>94</b>
Knut Rassmann, Roman Scholz, Patrick Mertl, Kai Radloff, Jugoslav Pendić and Aleksandar Jablanović	
<b>Chapter 10 Belovode: excavation results .....</b>	<b>108</b>
Miroslav Marić, Benjamin W. Roberts and Miljana Radivojević	
<b>Chapter 11 Belovode: technology of metal production.....</b>	<b>123</b>
Miljana Radivojević and Thilo Rehren	
<b>Chapter 12 Pottery from Trench 18 at Belovode.....</b>	<b>152</b>
Neda Mirković-Marić, Marija Savić and Milica Rajičić	

<b>Chapter 13 Chronological attribution of pottery from Trench 18 at Belovode based on correspondence analysis .....</b>	<b>170</b>
Miroslav Marić and Neda Mirković-Marić	
<b>Chapter 14 Belovode: technology of pottery production .....</b>	<b>186</b>
Silvia Amicone	
<b>Chapter 15 Figurines from Belovode .....</b>	<b>199</b>
Julka Kuzmanović Cvetković	
<b>Chapter 16 Ground and abrasive stone tools from Belovode .....</b>	<b>205</b>
Vidan Dimić and Dragana Antonović	
<b>Chapter 17 Bone industry from Belovode .....</b>	<b>215</b>
Selena Vitezović	
<b>Chapter 18 Chipped stone industry at Belovode .....</b>	<b>221</b>
Elmira Ibragimova	
<b>Chapter 19 Chemical and technological analyses of obsidian from Belovode .....</b>	<b>233</b>
Marina Milić	
<b>Chapter 20 Archaeobotanical evidence of plant use at the site of Belovode.....</b>	<b>236</b>
Dragana Filipović	
<b>Chapter 21 Animal remains from Belovode .....</b>	<b>249</b>
Ivana Dimitrijević and David Orton	
<b>Chapter 22 Belovode: past, present and future.....</b>	<b>259</b>
Benjamin W. Roberts and Miljana Radivojević	
<b>Part 3 Pločnik .....</b>	<b>263</b>
<b>Chapter 23 Pločnik: landscape and settlement perspectives .....</b>	<b>265</b>
Miroslav Marić	
<b>Chapter 24 Pločnik: geomagnetic prospection data as a proxy for the reconstruction of house numbers, population size and the internal spatial structure .....</b>	<b>271</b>
Knut Rassmann, Roman Scholz, Patrick Mertl, Jugoslav Pendić and Aleksandar Jablanović	
<b>Chapter 25 Pločnik: excavation results .....</b>	<b>281</b>
Miroslav Marić, Jugoslav Pendić, Benjamin W. Roberts and Miljana Radivojević	
<b>Chapter 26 Pločnik: technology of metal production.....</b>	<b>301</b>
Miljana Radivojević and Thilo Rehren	
<b>Chapter 27 Pottery from Trench 24 at Pločnik .....</b>	<b>317</b>
Neda Mirković-Marić, Marija Savić and Milica Rajčić	
<b>Chapter 28 Chronological attribution of pottery from Trench 24 at Pločnik based on correspondence analysis .....</b>	<b>345</b>
Neda Mirković-Marić and Miroslav Marić	
<b>Chapter 29 Pločnik: technology of pottery production .....</b>	<b>362</b>
Silvia Amicone	



<b>Chapter 30 Figurines from Pločnik</b> .....	375
Julka Kuzmanović Cvetković	
<b>Chapter 31 Ground and abrasive stone tools from Pločnik</b> .....	382
Vidan Dimić and Dragana Antonović	
<b>Chapter 32 Bone industry from Pločnik</b> .....	393
Selena Vitezović	
<b>Chapter 33 Chipped stone industry at Pločnik</b> .....	397
Elmira Ibragimova	
<b>Chapter 34 Plant use at Pločnik</b> .....	408
Dragana Filipović	
<b>Chapter 35 Animal remains from Pločnik</b> .....	422
Jelena Bulatović and David Orton	
<b>Chapter 36 Pločnik: past, present and future</b> .....	433
Benjamin W. Roberts and Miljana Radivojević	
<b>Part 4 The Rise of Metallurgy in Eurasia: a view from the Balkans</b> .....	437
<b>Chapter 37 Relative and absolute chronology of Belovode and Pločnik</b> .....	439
Miroslav Marić, Miljana Radivojević, Benjamin W. Roberts and David C. Orton	
<b>Chapter 38 The social organisation of the Vinča culture settlements. New evidence from magnetic and archaeological excavation data</b> .....	455
Knut Rassmann, Martin Furholt, Nils Müller-Scheeßel and Johannes Müller	
<b>Chapter 39 Belovode and Pločnik: site visibility and remotely sensed data</b> .....	460
Jugoslav Pendić	
<b>Chapter 40 Population size and dynamics at Belovode and Pločnik</b> .....	477
Marko Porčić and Mladen Nikolić	
<b>Chapter 41 Metallurgical knowledge and networks of supply in the 5th millennium BC Balkans: Belovode and Pločnik in their regional context</b> .....	484
Miljana Radivojević, Thilo Rehren and Ernst Pernicka	
<b>Chapter 42 The pottery typology and relative chronology of Belovode and Pločnik: concluding remarks</b> ..	528
Neda Mirković-Marić and Miroslav Marić	
<b>Chapter 43 Pottery technology at the dawn of metallurgy in the Vinča culture</b> .....	538
Silvia Amicone, Miljana Radivojević, Patrick Quinn and Thilo Rehren	
<b>Chapter 44 Belovode and Pločnik figurines in their wider context</b> .....	552
Julka Kuzmanović Cvetković	
<b>Chapter 45 Ground and abrasive stone tools from Belovode and Pločnik: concluding remarks</b> .....	556
Vidan Dimić and Dragana Antonović	
<b>Chapter 46 Bone tool technology at Belovode and Pločnik</b> .....	560
Selena Vitezović	

<b>Chapter 47 Chipped stone industries in the Vinča culture</b> .....	<b>564</b>
Elmira Ibragimova	
<b>Chapter 48 Geochemical characterisation of chipped stones from Belovode and Pločnik</b> .....	<b>566</b>
Enrica Bonato, Martin Rittner and Silvia Amicone	
<b>Chapter 49 Belovode obsidian in a regional context</b> .....	<b>570</b>
Marina Milić	
<b>Chapter 50 Plant consumption at Belovode and Pločnik: a comparison</b> .....	<b>574</b>
Dragana Filipović	
<b>Chapter 51 Evidence for animal use in the central Balkan Neolithic across the early metallurgical horizon: the animal remains from Belovode and Pločnik in context</b> .....	<b>585</b>
David Orton, Jelena Bulatović and Ivana Dimitrijević	
<b>Part 5 The Rise of Metallurgy in Eurasia and Beyond</b> .....	<b>599</b>
<b>Chapter 52 Balkan metallurgy in a Eurasian context</b> .....	<b>601</b>
Miljana Radivojević and Benjamin W. Roberts	
<b>Chapter 53 Where do we take global early metallurgy studies next?</b> .....	<b>619</b>
Benjamin W. Roberts, Miljana Radivojević and Thilo Rehren	
<b>Appendices</b> .....	<b>624</b>
<b>Bibliography</b> .....	<b>627</b>

## Chapter 17

# Bone industry from Belovode

Selena Vitezović

### Introduction

The bone industry encompasses all artefacts (tools, decorative items, manufacture debris) made from osseous raw materials (bone, antler, teeth, ivory, mollusc shells) (Averbouh 2000; Poplin 2004). Along with stone and flint, bone raw materials were very important for making everyday tools and other artefacts in all prehistoric societies. Their use, however, depended upon their availability as well as the economic and cultural preferences of a given community. Osseous raw materials had an important place in the Vinča culture, and they were frequently used for both everyday tools and decorative objects, representing a significant proportion of the material culture.

The osseous industry from Belovode was analysed from a technological perspective (cf. Inizan *et al.* 1995: 13 ff.), including the raw material choices, technology of manufacture, and typological data. The assemblage of about 60 artefacts includes those recognised during excavations as well as those separated during the post-excavation faunal analysis. Numerical data are not presented since they relate to only a segment of bone artefacts recovered so far at Belovode, and therefore are not statistically meaningful.

### Techno-typological analysis

The raw material used within the Belovode settlement included large mammal ribs, metapodial bones from small ruminants, astragals from ovicaprines, wild and domestic pigs, red and roe deer antlers and occasionally teeth (only boar tusks and red deer canines). Bones were the predominant raw material, although antler artefacts also were found in small numbers.

Prehistoric craftspeople divided bones and antlers into blanks by chopping, breaking, or by direct and indirect percussion. The main technique used for final shaping of the artefacts was burnishing with various abrasive tools. The perforations on the bones were made by drilling with a flint borer.

The typological classification used here is based on the link between the supposed function and form of the active part of the objects, originally created by H. Camps-Fabrer (1966, 1979) and now used for numerous

European prehistoric assemblages, with some modifications and improvements (e.g. Voruz 1984; Pascual Benito 1998; Beldiman 2007). The artefacts were classified into several groups: I pointed tools; II cutting tools; III burnishing tools; IV punching tools; V objects of special use; VI decorative items; VII non-utilitarian items; and VIII incomplete artefacts. Within these groups, further subtypes and variants were identified based on morphology, function, manufacturing technique, and raw material used (Vitezović 2007, 2011a, 2013a; 2016a: 79–98; see also Bačkalov 1979; Beldiman 2007).

### I Pointed tools

Subtype I1. Awls or medium-sized pointed tools were the most common tool type. Two subtypes were recorded at Belovode: awls made from long bones (subtype I1A) and from flat bones, mainly ribs (subtype I1B).

For awls of subtype (I1A), ovicaprine metapodials were predominantly chosen. The bone was split longitudinally so that the artefact was shaped from a segment of the semi-circular cross-section, and then by grinding and burnishing (Figure 1). A proximal or distal epiphysis segment may be preserved at the basal part. Only one awl was made from an entire distal segment and has a complete distal epiphysis preserved at the basal part. There is a full cross-section of the epiphysis at the mesial section, and the distal end is shaped into the point by scraping and burnishing (Figure 1).

One completely preserved awl made from an ovicaprine metapodial bone should be highlighted. It was made from a longitudinally split bone and has one half of the distal epiphysis at the proximal end, a semi-circular cross-section, and a fine tip at the distal end (Figure 1). This example is of note because of its very small size and intensive traces of use (worn surfaces), indicating that it was in use for a long time, repeatedly re-sharpened, until reduced to its size at discovery.

Awls fashioned from small, ruminant metapodials were widespread across the whole of later prehistoric Europe, especially in the Neolithic and Chalcolithic periods (e.g. Schibler 1981: Table 1/1; Voruz 1984: Figure 24; Séfériadès 1992b: Plates 137/a–c and 191/c; Stratouli 1998: Tables 40/1 and 42/1–6; Pascual Benito 1998: 48,



Figure 1. Awls produced from sheep/goat metapodial bones.

Figure III.16; Deschler-Erb *et al.* 2002: Figure 507/1–4; Lang 2005, Table 187/1–25; Hüser 2005, Table 1). They are very common in the Vinča culture (cf. Срејовић and Јовановић 1959: Figure 1; Perišić 1984: Tables 2/10, 2/11, and 4/31; Russell 1990: Plate 14.1f; Vitezović 2007: 86–87, 105; Vitezović 2011b: Figure 5).

At Belovode, awls made from ribs (subtype I1B) were also relatively numerous, with the ribs coming mainly from large mammals (cattle- and red deer-sized animals). The ribs were split longitudinally, so that the blank for further shaping was a single bony plate. Ribs are very resilient in their fresh state and so not easy to work. In order to split a rib, it was necessary first to extract segments by breaking or by direct or indirect percussion. The obtained segments were then split with a flint burin (cf. Christidou 2001: 42). The final shape may have been obtained by scraping with a flint tool and/or by burnishing with an abrasive tool. On the Belovode awls, only traces of the final phase are visible, indicating burnishing and polishing on the lateral sides by a fine-grained, abrasive stone tool.

The final form of the awls is triangular, or they have straight edges in the proximal and mesial parts with the edges subsequently converging to the fine point. Only one-sided awls were present at Belovode (double awls were not recovered), some of which were particularly well made, with basal parts carefully cut and burnished (Figure 2). Traces of intensive use are visible on most of them:

polish, striations, and worn outer surfaces, and smoothed and abraded spongy tissue on the inner surfaces.

This is a tool type that is common in the majority of Neolithic and Chalcolithic sites in Europe (e.g. Schibler 1981: Table 37/5–8; Voruz 1984: Figure 20; Deschler-Erb *et al.* 2002: Figure 10/3–7; Lang 2005: Tables 189/26–29, and 190/1–4; Hüser 2005: Table 6). Rib awls are also fairly characteristic for the Vinča culture, although their relative number within one assemblage may vary due to the method of recovery (used ribs are less conspicuous than, for example, ovicaprine metapodials) They are known in large numbers at, for example, Vinča-Belo Brdo (Срејовић and Јовановић 1959: Figure 2) or Motel Slatina (Vitezović 2007: Tables XXI, XXIII, XXIV and XXV).

Subtype I2. Heavy points were not numerous; one specimen, made from a large mammal (cattle- or red deer-sized animal) rib, should be mentioned. It was made from an unsplit segment (unlike awls), but one bone plate is only partially preserved due to intensive use. Its distal end is a massive, heavily worn point. In addition, one beam segment of roe deer antler was used as a heavy point, minimally modified, with only the crown tines being removed. The tip was smoothed and blunt from use.



Figure 2 Awls produced from ribs.



Figure 3. Fine pointed tool (needle) with broken perforation at the basal part.

**Subtype I3.** Three needles or fine-pointed tools were discovered. All three belong to the subtype of eyed needles (I3A), which are 'true' sewing needles with a small perforation placed near the base. They are all fragmented, broken exactly at the perforation, perhaps during use. They were made from small diaphyses segments, which were carefully burnished and polished. Perforations were made by drilling with a fine-pointed flint borer, and their diameter does not exceed 4 mm (Figure 3). Eyed needles are rarely encountered (perhaps due to fragmentation) in the Vinča culture bone industries. A few are known from Vinča-Belo Brdo (Perišić 1984: Tables 17/130 and 17/131), one from Selevac (Russell 1990: Figure 14.2), and one from Drenovac (Vitezović 2011b: Figure 16). They are known in somewhat larger numbers at the Neolithic site of Khirokhitia in Cyprus, where they are linked with the processing soft plant fibres (Legrand 2007: 76–83).

## II Cutting tools

In this group, one particular artefact should be highlighted: an adze made from a red deer antler that had been shed, as indicated by traces of rodent



Figure 4. Large cutting tool made from red deer antler.

gnawing covering a large part of one surface; traces of manufacture are superimposed on these. A crown segment was used, i.e. the segment of a beam and segments of the two upper tines. The end of the beam was obliquely cut and had a fine cutting edge which is partially preserved. A slightly ellipsoidal perforation was placed at the basal part of the tool. It has clear traces of manufacture where the outer cortex was carved out and then the hole was created by drilling (Figure 4). The working edge is, unfortunately, only partially preserved, so the use-wear traces are poorly visible (polished distal end). This tool is most likely to have been used as an adze in woodworking.

Antler is often used to make large cutting tools, especially those used in woodworking, since it is a material resilient to shock from impact (cf. Guthrie 1983; Christensen 2004). Most often, axes and adzes are made from lower segments of beam, sometimes with the actual base being used, although similar axes and adzes are found on some Vinča sites (cf. Bačkalov 1979: Table XXXI/8).

## III Burnishing tools

**Subtype III2.** Two fragmented tools from split boar tusks were most likely used as scrapers. They were roughly triangular in shape with one of the edges worn and damaged from use. They were probably used for processing plant materials (cf. Maigrot 2003: 124–128).

### V Objects of special use

**Subtype V2: Spoons.** One fragmented spoon made from an antler segment was discovered at Belovode. Only the spoon part is preserved, while the handle is broken. It was made from a longitudinally split segment of red deer antler beam, and shaped by cutting, scraping and burnishing with flint tools and abrasive stones. The spoon is rectangular and the fragmented handle had a square cross-section (Figure 5). The spoon part is almost completely flat and worn on both the outer and inner surfaces with the spongy tissue being almost completely abraded. The exact function of this artefact is difficult to establish but it may be assumed that it was used in contact with soft, organic materials, perhaps for applying grease in the working of leather or applying organic pigments to textiles.

Spoons of this type (with separate bowl and elongated handle) are rare in the Vinča culture. This contrasts with the earlier Starčevo culture period, when spoons that were carefully made from *Bos* metapodials were common (cf. Vitezović 2011a). Furthermore, a strict choice of raw material and careful manufacture are not characteristic of this artefact type, and spoons are encountered with a great variety of shapes, sizes, levels of curation, and raw material choices. Several spoons, also made from red deer antler, were discovered at the eponymous site, Vinča-Belo Brdo (cf. Васић 1932: 39–40; Vačkalov 1979: Tables XXVII/ 1–12 and XXIX/ 1–3, 5; Игњатовић 2008: 269, Catalogue 198); one antler spoon was recovered at Vitkovo (Витезовић 2012); and one unusual specimen made from a mandible was found at Pavlovac-Kovačke Njive (Vitezović 2014).

**Subtype V4: Used astragals.** Four astragals were found at Belovode, two from ovicaprines and two from species not usually used in their manufacture – a wild pig and a domestic pig (Figure 6). The pig astragals were used in their natural shape with the entire prominent surfaces being used so intensively that they became completely flattened and worn down. The ovicaprine astragals have had their lateral sides worn down, with some loss in volume. They also have perforations, one through the central part and a second through the upper part. The perforations were made by drilling; polishing from use can be observed in their interiors.

The Late Neolithic and Chalcolithic periods in southeast Europe are characterised by the use of short bones, either unmodified or with minimal modification, i.e. the natural shape of the bone is largely preserved (e.g. Bolomey and Marinescu-Bîlcu 1988: 347, Figure 7/6; Lang 2005: Table 191/16–18; Zidarov 2005; Bacvarov and Vitezović 2014; Kogălniceanu *et al.* 2014). In the Vinča culture, only astragals were used (worked phalanges have not yet been discovered), in their original shape or with one or more perforations added. These were



Figure 5. Fragmented spoon made from red deer antler.

predominantly ovicaprine and cattle astragals and, more rarely, from red deer. Only at Belovode have pig astragals been reported (Jacanović and Šljivar 2001). Used astragals are known from Divostin (Lyneis 1988), Selevac (Russell 1990), Drenovac (Vitezović 2011b: 129–130, Figure 12), Motel Slatina (Vitezović 2007: 98–100, Tables IV and VII) and Pavlovac-Kovačke Njive (Vitezović 2014). They show great diversity in the position and degree of use of the perforations and the overall degree of wear.

The resemblance of the used astragals to gaming and/or gambling pieces from ancient Greece or Rome has provided a strong analogy for some researchers, with others seeing the presence of perforations as relating to their use as pendants (cf. Russell 1990: 538–539; Jacanović and Šljivar 2001). However, their intensive use-wear suggests otherwise, although an exact method of their use is difficult to reconstruct (cf. experiments by Meier 2013 on astragals in Bronze Age Hungary). Experimental reconstructions also showed that it was possible to use astragals as loom weights



Figure 6. Used astragals.

(Grabundžija *et al.* 2016). Specimens from Dragușeni-Ostrov were interpreted as burnishers (for an overview of some of the hypotheses see Bolomey and Marinescu-Bîlcu 1988: 347 and Figure 7/6 and Kogălniceanu *et al.* 2014: 292–294). Used astragals have a large temporal and geographical distribution, and it is very likely that they had more than one function. For the Vinča culture objects, intensive polish and shine suggests contact with soft, organic materials (cf. Maigrot 2003; Legrand 2007 for interpretation of use-wear traces), while the loss of volume on some suggests contact with very abrasive, inorganic materials. It is most likely that these astragals were used in relation to the production of textiles and leather (Vitezović 2007; see also Grabundžija *et al.* 2016), although some of the most heavily used pieces may have been used on pottery (cf. experimental results in Meier 2013).

**Subtype VI: Decorative items.** Only two decorative items were discovered. One is a small, ring-shaped object with a prong at one end; it was most likely made from a large, long bone segment. It is perforated in the centre, finely made and polished, and was probably used as some sort of bead or other decoration on clothes (Figure 7). It has a partial resemblance to the type of decorative items known from Early Neolithic sites in the Near East (cf. Russell 2001: Figure 3) but closer analogies are not currently known so, for the moment, this is a unique find from the Vinča culture.

The other decorative artefact is a residual canine of a red deer. It has a perforation, approximately 3 mm wide, through the upper part and shows intensive polish and some damage to the lower part from use (Figure 7). The perforation itself is also polished, suggesting it was in use for some time (cf. d'Errico 1993) with the degree of wear being between stages 2 and 3 using the model proposed by Bonnardin (2008: 300).

Red deer canines were often used for decorations from early prehistory (cf. Barge-Mahieu and Taborin

1991; d'Errico and Vanhaeren 2002; Choyke 2001; Taborin 2004 and references therein) and they certainly had specific meanings, in addition to their aesthetic value (e.g. protection, symbols of identity and/or prestige). They were even imitated in other materials such as other osseous raw materials, stone, etc. (Choyke 2001). Both red deer canines and their copies occur in the Starčevo culture (cf. Vitezović 2011a) but are not frequently found at Vinča culture sites. One copy comes from Selevac (Russell 1990: Figure 14.7a) and two were

identified from Vinča-Belo Brdo, one in bone and one probably in shell (Игњатовић 2008: cat. 222). The find from Belovode is therefore very important for the study of the geographical and chronological distribution of these ornaments.

## Results and discussion

The osseous artefacts recovered from Belovode during the 2012 and 2013 excavations represent a cross-section of the entire bone industry from the Vinča culture settlement. Pointed tools dominate, followed by cutting and burnishing tools, and then objects of special use. The bone tools were used for small crafts, and most likely for processing leathers, hides and plant materials (wood and plant fibres). Only a few heavier tools were recovered, and some tool types are completely absent, including hammers and other punching tools, as well as fishing and hunting equipment (e.g. harpoons, fishhooks). Very few decorative objects were found.



Figure 7. Ornaments: perforated tooth and ring-shaped ornament.

The raw materials were obtained mainly from domestic animals that were available within the settlement. Antlers were at least partly collected (i.e. shed antlers), and a few artefacts were made from skeletal elements obtained from hunted wild animals, for example, the used astragal from a wild pig and the pendant made from a red deer canine. Manufacture debris was not present, suggesting that the activity areas for processing osseous raw materials took place elsewhere in the settlement.

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### Conclusion

The techniques used and the typological repertoire produced fits well within the Vinča culture bone industry (cf. Bačkalov 1979; Russell 1990; Vitezović 2007). The overall bone industry demonstrates high technological know-how and familiarity with raw materials. The specific traits of the Belovode assemblage are the use of pig metapodials, since pig bones were mainly avoided (cf. Vitezović 2013b), and a previously unknown type of decorative item, in the shape of a small ring with prong at one side.

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# Appendices

## Appendix A – Excavation data for Belovode and Pločnik (seasons 2012 and 2013)

Available online at <https://doi.org/10.5522/04/14769990>



## Appendix B – Data relating to specific chapters

### *Appendix B\_Ch5*

Radivojević, M. 2007. Evidence for Early Copper Smelting in Belovode, a Vinča Culture Settlement in Eastern Serbia. Unpublished MSc dissertation. UCL Institute of Archaeology, London.

Available online at [https://doi.org/10.32028/9781803270425/AppendixB\\_Ch5](https://doi.org/10.32028/9781803270425/AppendixB_Ch5)



### *Appendix B\_Ch11*

Certified Reference Materials - basalt glass

EPMA

Optical Microscopy

SEM EDS

Technical documentation\_images of studied materials\_Belovode

Available online at [https://doi.org/10.32028/9781803270425/AppendixB\\_Ch11](https://doi.org/10.32028/9781803270425/AppendixB_Ch11)



### *Appendix B\_Ch14*

Belovode Catalogue

Belovode Petrography

Available online at [https://doi.org/10.32028/9781803270425/AppendixB\\_Ch14](https://doi.org/10.32028/9781803270425/AppendixB_Ch14)



**Appendix B\_Ch15**

Belovode Figurines Database

Available online at [https://doi.org/10.32028/9781803270425/AppendixB\\_Ch15](https://doi.org/10.32028/9781803270425/AppendixB_Ch15)

**Appendix B\_Ch20**

20.1. List of all taxa in the analysed samples from Belovode (prior to the taxa amalgamation and extrapolation of item counts).

20.2. Images of some of the archaeobotanical remains from Belovode: 1. einkorn grain; 2. einkorn glume base; 3., 'new type' hulled wheat glume bases; 4. 'new type' hulled wheat grains; 5. flax/linseed seeds; 6. barley rachis; 7. bitter vetch seeds; 8. *Rubus idaeus/fruticosus* seeds; 9. *Corylus avellana* nutshell fragments; 10. *Prunus* cf. *domestica* var. *insititia* fruit stone fragment; 11. *Lapsana communis* seed; 12. *Chenopodium album* type seeds; 13. *Trifolium arvense* type seed; 14. *Trifolium repens* type seed; 15. *Cerastium* seed; 16. *Fallopia convolvulus* seed; 17. *Galium aparine* seed; 18. Indeterminate plant matter (? nutmeat); 19. Indeterminate (*Scrophularia* type) seed.

Available online at [https://doi.org/10.32028/9781803270425/AppendixB\\_Ch20](https://doi.org/10.32028/9781803270425/AppendixB_Ch20)

**Appendix B\_Ch26**

EPMA

Optical Microscopy

SEM EDS

Technical documentation\_images of studied materials\_Pločnik

Available online at [https://doi.org/10.32028/9781803270425/AppendixB\\_Ch26](https://doi.org/10.32028/9781803270425/AppendixB_Ch26)

**Appendix B\_Ch29**

Pločnik Catalogue

Pločnik Petrography

Available online at [https://doi.org/10.32028/9781803270425/AppendixB\\_Ch29](https://doi.org/10.32028/9781803270425/AppendixB_Ch29)



**Appendix B\_Ch30**

Pločnik Figurines Database

Available online at [https://doi.org/10.32028/9781803270425/AppendixB\\_Ch30](https://doi.org/10.32028/9781803270425/AppendixB_Ch30)**Appendix B\_Ch34**

34.1. List of all taxa in the analysed samples from Pločnik (prior to the taxa amalgamation and extrapolation of item counts)

34.2. Images of some of the archaeobotanical remains from Pločnik: 1. emmer grain; 2. emmer spikelet fork; 3. terminal spikelet fork (cf. emmer); 4–5. 'new type' hulled wheat spikelet forks; 6–8. tetraploid free-threshing wheat rachis segments; 9. *Cornus mas* fruit; 10. *Rubus idaeus/fruticosus* seed; 11. *Corylus avellana* nutshell fragments; 12. *Fragaria vesca* seed; 13. *Solanum nigrum* seed; 14a-b. possible food remains (with embedded fragment of a cereal grain visible in 14b); 15. fragment of dung pellet; 16. *Hypericum* seed; 17. *Chenopodium album* type seed.

Available online at [https://doi.org/10.32028/9781803270425/AppendixB\\_Ch34](https://doi.org/10.32028/9781803270425/AppendixB_Ch34)**Appendix B\_Ch38**

GIS data on the Late Neolithic houses of the Vinča settlements Belovode, Drenovac, Pločnik, and Stubline. The file in WTK-format contains data of all house ground plans which were reconstructed on the basis of the magnetic prospection data. The file also contains the information (size in sqm and orientation) for each house that was taken into account in the statistical evaluation. This is the size of the ground area of the houses are in square metres. The house orientation refers to the north azimuth.

Available online at [https://doi.org/10.32028/9781803270425/AppendixB\\_Ch38](https://doi.org/10.32028/9781803270425/AppendixB_Ch38)**Appendix B\_Ch41**

Tables from Chapter 41

Available online at [https://doi.org/10.32028/9781803270425/AppendixB\\_Ch41](https://doi.org/10.32028/9781803270425/AppendixB_Ch41)

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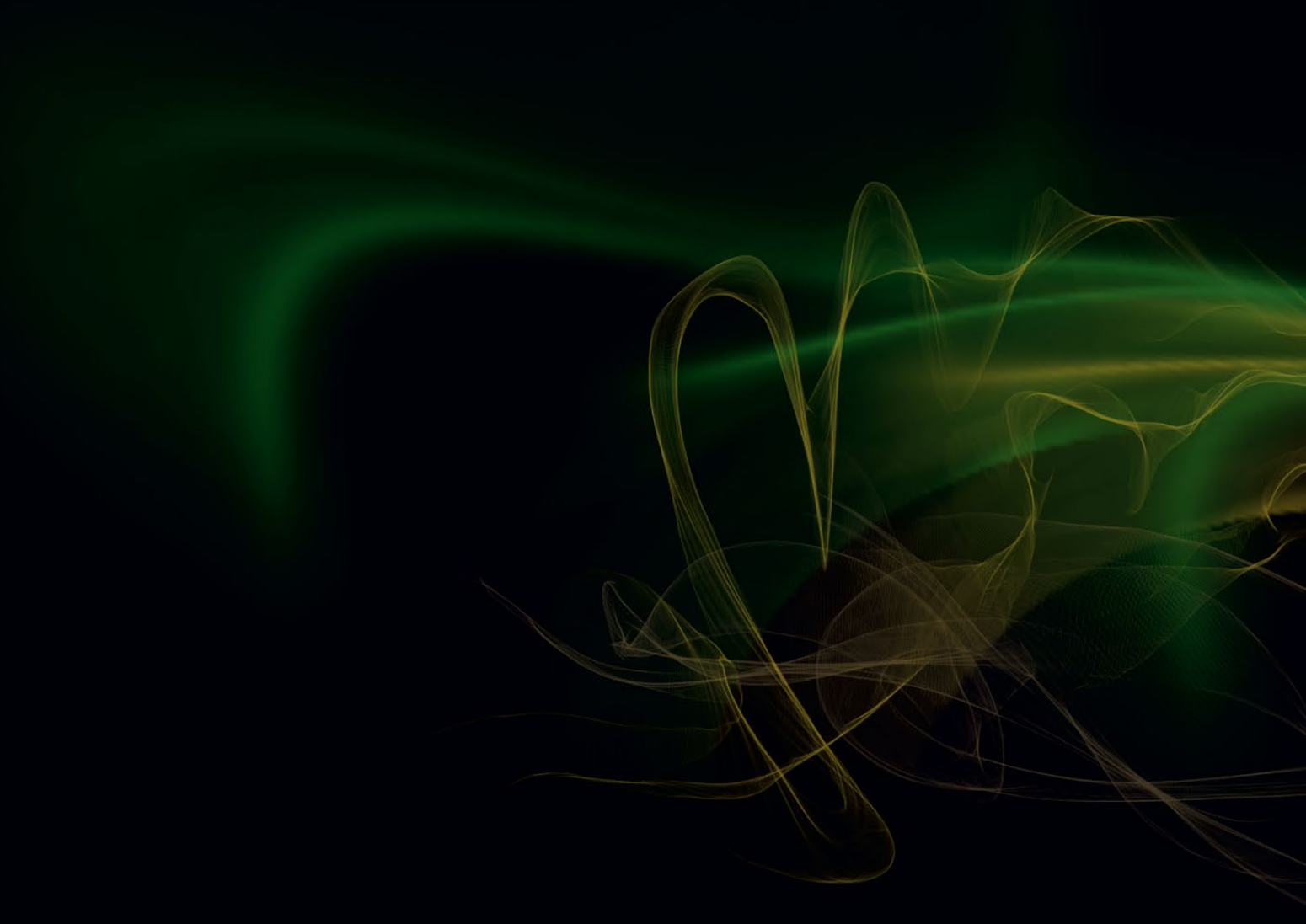
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*The Rise of Metallurgy in Eurasia* is a landmark study in the origins of metallurgy. The project aimed to trace the invention and innovation of metallurgy in the Balkans. It combined targeted excavations and surveys with extensive scientific analyses at two Neolithic-Chalcolithic copper production and consumption sites, Belovode and Pločnik, in Serbia. At Belovode, the project revealed chronologically and contextually secure evidence for copper smelting in the 49th century BC. This confirms the earlier interpretation of c. 7000-year-old metallurgy at the site, making it the earliest record of fully developed metallurgical activity in the world. However, far from being a rare and elite practice, metallurgy at both Belovode and Pločnik is demonstrated to have been a common and communal craft activity.

This monograph reviews the pre-existing scholarship on early metallurgy in the Balkans. It subsequently presents detailed results from the excavations, surveys and scientific analyses conducted at Belovode and Pločnik. These are followed by new and up-to-date regional syntheses by leading specialists on the Neolithic-Chalcolithic material culture, technologies, settlement and subsistence practices in the Central Balkans. Finally, the monograph places the project results in the context of major debates surrounding early metallurgy in Eurasia before proposing a new agenda for global early metallurgy studies.