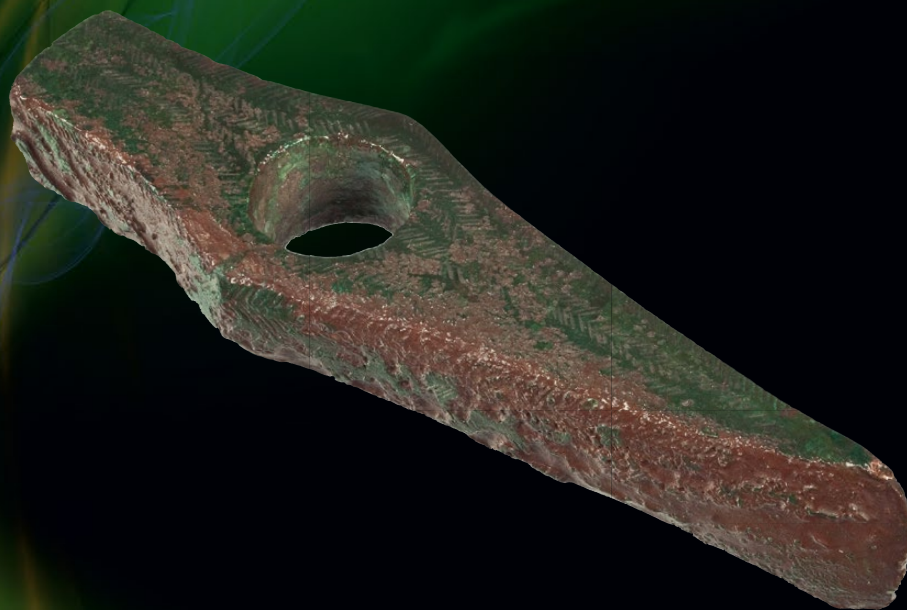




The Rise of Metallurgy in Eurasia

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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(from Pločnik, Serbia) - Julka Kuzmanović Cvetković.

Inner back cover: Reconstruction of the world's earliest copper smelting. Green flames come from the extraction of metal from malachite. Experiments at Pločnik, Serbia (2013) - Marko Djurica

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

(1930 - 2015)

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Chapter 36

Pločnik: past, present and future

Benjamin W. Roberts and Miljana Radivojević

Introduction

The 2012 and 2013 excavations and subsequent post-excavation analyses by *The Rise of Metallurgy in Eurasia* project team at the site of Pločnik built upon nearly a century of discoveries and excavations led initially by the National Museum of Belgrade (Grbić 1929; Stalio 1960, 1962, 1964, 1973) and co-led latterly by the National Museum Belgrade and Museum of Toplica, Prokuplje (Kuzmanović Cvetković 1998; Šljivar 1996, 1999, 2006; Šljivar and Kuzmanović Cvetković 1997a, 1998a, 1998b; Šljivar *et al.* 2006). This later phase of work across 23 trenches (see Chapter 6) has, as at Belovode, yet to be fully published with the only detailed analysis being done on the metallurgical remains (Radivojević 2012; 2015; Chapter 6) together with a small programme of radiocarbon dating (Radivojević and Kuzmanović Cvetković 2014: 17–18). The evidence for copper metal production at Pločnik comprises only two droplets of smelting or melting activity (Radivojević and Rehren 2016: 220; see Chapter 6) and rectangular firing structures with copper minerals, metal artefacts and casting debris in association, as excavated in Trenches 20 and 21 (see Chapter 6, Figure 8) (Radivojević *et al.* 2013: 1033, Figure 2; Šljivar and Kuzmanović Cvetković 2009a: 61). However, the importance of selecting the site of Pločnik for *The Rise of Metallurgy in Eurasia* project lay primarily in the extensive evidence for metal artefacts from the moment of its discovery and the potential to explore questions around Vinča metal consumption practices. The metal artefacts known from the site ranged from copper beads to the famous discovery of massive copper metal implements which have been found from 1928 onwards (Grbić 1929; Šljivar 1996, 1999; Šljivar *et al.* 2006; Šljivar and Kuzmanović Cvetković 1996–2009; Stalio 1964; see Chapter 6). Most recently, archaeometallurgical analyses revealed a tin-bronze foil from an undisturbed context at Pločnik dated to an occupation horizon of c. 4650 BC, making it the earliest known tin-bronze artefact anywhere in the world (Radivojević *et al.* 2013). As at Belovode, the absence of a detailed publication meant that further questions relating to evidence for early metal primary or secondary production and metal consumption could not be explored. The same methodological approach used at Belovode to investigate in detail the archaeological context of early metallurgy and

metal at Pločnik, encompassing geophysical and aerial survey (see Chapters 24 and 39), systematic excavation and sampling, followed by extensive post-excavation analyses, was employed. As at Belovode, the entire excavation archive is made available online for current and future scholars (see Appendix A).

On metallurgy

As detailed in Chapter 25, Trench 24, was placed between two previous Trenches (20 and 21) which had produced rectangular firing structures and metallurgical finds including the earliest known tin bronze metal (Radivojević *et al.* 2013; Radivojević and Kuzmanović 2014). The evidence for copper metallurgy excavated in Trench 24 encompasses several stages in the *chaîne opératoire* of metal production including ore selection and melting and/or refining. The archaeological context of the metallurgical evidence is far more precisely documented, radiocarbon dated and contextualised than in earlier excavations at the site and serves to build upon the results and interpretations of earlier archaeometallurgical research.

The recovery of mainly green coloured malachite minerals and ores from throughout the stratigraphic sequence of Trench 24—albeit at a lower frequency than at Belovode—highlights the ubiquity of copper bearing minerals and ores throughout both of these Vinča culture settlement sites. The presence of green-and-black and green-yellow minerals in Horizon 1 and occasional occurrence of blue azurite provides further evidence for the careful selection of minerals and ores by their colours for specific uses at different times in the occupation of the site. Whilst neither copper smelting slag nor slagged sherds were excavated at Pločnik by *The Rise of Metallurgy in Eurasia* project, a copper metal bead was found in association with a kiln (F15) in Horizon 3 that provides the earliest secure radiocarbon dated evidence for metal at the site, contemporary with the start of the Gradac ceramic phase (see Chapter 26). In addition, a copper metal ring was found in association with a stone rectangular-shaped burnt structure (F3) in Horizon 1, thought to be a kiln or furnace, but this could only be partially excavated due to its location in the corner of the trench. Furthermore, the extensive concentration of ground stone tools found at Pločnik,

which has been interpreted as a workshop/production area (F9) in Horizon 1, also encompassed two tools thought to have been used in the hammering and thinning of metal objects (see Chapters 31 and 45). The new evidence at Pločnik not only confirms the presence of secondary metal production activities at the site such as melting and/or refining and possibly also hammering/thinning but also provides secure radiocarbon dates for a copper metal object and subsequently a potential firing structure, confirming the contemporary appearance of the Gradac Phase and metallurgy at the site.

On communities

Understanding of the scale and duration of the community who lived at Pločnik has been significantly advanced by *The Rise of Metallurgy in Eurasia* project. However, as one area of the site is occupied by a village and the site has also been partially destroyed by the construction of a railway line and the erosion processes of the river Toplica, even the extensive geophysical and aerial surveys undertaken could only cover c. 60% (16 ha) of the site. Hence, whilst the geophysical survey revealed c. 300 anomalies identified as burnt houses in at least three major groups, this was only in the northern area of the settlement. The overall reconstruction of the Vinča settlement area is thought to be c. 26 ha and spans at least four to five major house groupings (see Chapter 24). There are potentially larger houses which demonstrate more variation in size than at Belovode. As at Belovode, earlier and much larger estimations of the Vinča settlement at Pločnik must be revised downwards (*contra* Šljivar and Kuzmanović Cvetković 1998a). The estimation of the population of the community living at Pločnik, based on house groupings (see Chapter 24) and mathematical modelling (see Chapter 38 and 40), suggests c. 600–1250 people during the later Vinča phases.

The excavation and radiocarbon dating of the entire stratigraphic sequence at Trench 24 identified 39 features across activity Horizons 1–5, which were radiocarbon dated and subsequently modelled (see Chapter 37), as well as detailed sub-divisions according to stratified ceramic typo-chronologies based on c. 14500 diagnostic ceramic fragments (Chapter 42). This provides a far more precise relative and absolute chronology for the occupation of the site spanning c. 5200–4400 BC than had previously been achieved. It not only spans the Vinča culture but enables a temporal and typological refinement of the tripartite Gradac ceramic phase (see Chapters 37 and 42) and reveals the late dating of the final phases of activity at Pločnik, overlapping with the Bubanj-Salčuta-Krivodol (BSK) communities of the Middle Chalcolithic in the Central and Eastern Balkans, potentially confirming

continuities rather than collapses in the southern Vinča culture communities (cf. Radivojević and Grujić 2018).

The recovery and analysis of the charred plant assemblage provides the first archaeobotanical evidence of plant use and crop husbandry at the site (see Chapter 34). The excavations revealed the by-products of food preparation and plants following their burning, discard and probable spreading and re-distribution. The overall assemblage demonstrated that the community at Pločnik consistently cultivated primarily einkorn, emmer and ‘new type’ hulled wheat. Whilst lentils and peas may also have been grown, the continued presence of wild fruits highlights the importance of food sources beyond the domesticated crops. In certain excavated contexts, it was possible to identify the residues of specific activities such as the fine-sieving of hulled and free-threshing wheat and disposal of by-products (F39). The recovery and analysis of the animal bone assemblage represents the first archaeozoological evidence from the site of Pločnik (see Chapter 35). As with the archaeobotanical assemblage, it is comparable to evidence found at other—admittedly more distant—Vinča culture settlement sites. The excavations revealed an increasing shift towards cattle, a decreasing emphasis on the hunting of wild fauna, and no clear evidence for an age-at-death pattern that would indicate intensive milk production. The subsistence evidence revealed at Pločnik compares well with that at other Vinča culture sites and provides the foundations for further research in this formerly neglected area (see Chapters 50 and 51).

A large rectangular wattle and daub house structure (F1, 2, 4, 5, 6 and 10) in Horizon 1 provided a major focus for the excavations at Pločnik. Beyond radiocarbon dates that place it at the very end of the Vinča culture sequence (see Chapter 37), the structure revealed evidence of a construction technique of pedestals for load-bearing beams that is currently specific only to the site of Pločnik. In contrast, the preservation in the daub outline of a sub-structure of parallel rows of split timbers demonstrated that the floor construction is evidenced elsewhere (see Chapter 25). The assemblage from inside the house structure was relatively limited, comprising a small number of ceramic vessels, a polished stone axe and metal fragments/droplet, however evidence of a concentration of stone and ceramic debris found to the northwest of the structure, suggests that the latter objects were removed before and/or after the destruction and burning of the house (see Chapter 25).

The presence of the partially excavated stone rectangular-shaped burnt structure (F3), thought to be a kiln or furnace, and the concentration of large ground

stone tools (F9), thought to be a workshop (Chapter 31), also in Horizon 1 in close proximity to the wattle and daub house structure can provide potential insights into the organisation of craft production. Whilst the metallurgical interpretation of the former (F3) is discussed above and in Chapters 26 and 41, the quantity and varied typology of the ground stone tools and the group of elongated and carefully polished stone axes in the latter (F9) is strongly suggestive of a workshop or production area. The connections spanning ground stone and metal production and use have previously been highlighted with white stone axes also only appearing during the Gradac Phase (see Chapter 45) and being the only non-metal artefacts found with the massive copper implements at Pločnik (Šljivar 1999; Šljivar *et al.* 2006: 261–265). However, the excavations undertaken by *The Rise of Metallurgy in Eurasia* project revealed not only a ground stone workshop or production area in close proximity to a potential metalworking area but also stone tools thought to be used for hammering and/or thinning metal objects, as highlighted above. This close spatial association of stone and metal production activities occurred in the open and outside of the house structure.

The production of ceramics is extensively evidenced at Pločnik with the repeated repairing and re-use of kilns (F11, F14, F15 and F32) in Horizons 2, 3 and 4 and potentially in Horizon 1 (F3), in certain cases potentially over a long period. The analysis of the pottery production techniques demonstrated that the craftspeople were not always able to control the firing atmospheres and whilst they were able to achieve c. 750°C, they rarely exceeded c. 850°C (see Chapters 29 and 43). The association of a copper bead with a kiln (F15) in Horizon 3 (see Chapter 26) highlights that whilst the pyrotechnological conditions of the Vinča ceramics might not have been easily transferable for copper smelting, they were certainly sufficient for copper melting, refining or manipulating, and that this may well have been performed by the same craftspeople in the same place. The production of chipped stone tools occurred across three different *chaîne opératoires*, in cream tabular flint, pebble flint and local river gravel sources. The thick blades were retouched to produce end-scrapers or drills, the fine blades and bladelets were used in composite tools and the flakes were made into scrapers or tranchets (see Chapters 33 and 47). The evidence for bone tool production is limited as the excavated area may well have been a place where bone objects, mainly pointed and burnishing tools for leathers, hides or plants, were used and subsequently broken and abandoned (see Chapters 32 and 46). The networks revealed by the different raw materials being exploited and artefacts being made at Pločnik are evidenced by the copper ore and copper metal objects (see Chapter 41), ground stone tools (see Chapter 45)

and ceramics (see Chapters 42 and 43). However, the presence of a rare, large and elongated *Spondylus* bead not only contextualises the earlier stray find of over 300 *Spondylus* shell beads from the vicinity of the site but highlights the very distant connections involved, spanning the spatial extent of the Vinča culture and beyond (see Chapter 32 and 46).

Further work

The excavations at Pločnik in 2012 and 2013 by *The Rise of Metallurgy in Eurasia* project comprised only a single trench, initially measuring 5 x 5 m and subsequently extended to encompass the large rectangular wattle and daub burnt structure (F1, F2, F4, F5, F6 and F10) in Horizon 1. The project aimed to excavate and analyse a complete material, structural and environmental sequence at Pločnik that would include further metal artefacts and metallurgical remains in order to understand metal production and consumption in context. The 39 features spanned wattle and daub rectangular structures, kilns, finds concentrations, pits, and dwelling dugouts. These results enabled the project to largely achieve the original aims but also created new avenues of investigation for further work.

1. Whilst the project has made significant contribution to establishing the spatial scale of settlement at Pločnik, it is now clear that there are at least four major groupings of burnt houses whose chronologies have yet to be determined. Further targeted excavations and sampling would enable a far clearer sense of where and when increases and decreases and settlement activity and demographics occur. The western and southern borders of the settlement could be more precisely defined with further geophysical survey and excavation.

2. The complete sequence of activity at Pločnik, including pre- and post- Vinča culture activity requires further definition. Only the western area of Trench 24 could be excavated to the natural soil to expose the complete sequence of occupation at the site, revealing in the process a complex pit structure (F38), potentially comparable to late Starčevo and early Vinča period pits in the central Balkans (see Chapter 25). Given the broader debates around the Starčevo-Vinča transition and the subsequent Vinča- Bubarj-Salçuta-Krivodol (BSK) transition, the evidence for activities and their dating at Pločnik would make the site a priority for further investigation.

3. The organisation of subsistence activities is not well understood with the archaeobotanical and archaeozoological sampling and analyses representing a major development at the site as well as a significant development in the region. Further targeted excavations for additional samples and, in particular

taking advantage of the extensive stratigraphy exposed for over 300 m along the river Toplica, would enable a far more detailed picture of subsistence practices throughout the site.

4. The organisation of craft production at Pločnik—and in particular the interconnections of stone, ceramic and metal production spatially and temporally across the site—require far more detailed excavation and post-excavation analyses. Whilst metallurgical remains and metal artefact fragments are indeed associated with the partially excavated

burnt rectangular stone structure (F3), a feature type also found in earlier largely unpublished excavations, the activities relating to the feature (type) remain incompletely defined.

5. There has been relatively little survey and fieldwork in the landscape surrounding the site of Pločnik, whether to explore the potential sources of different materials used at the site (stone, copper minerals and ores, graphite etc.), the management of the land for arable or pastoral agriculture or the presence of smaller and potentially contemporary Vinča sites.

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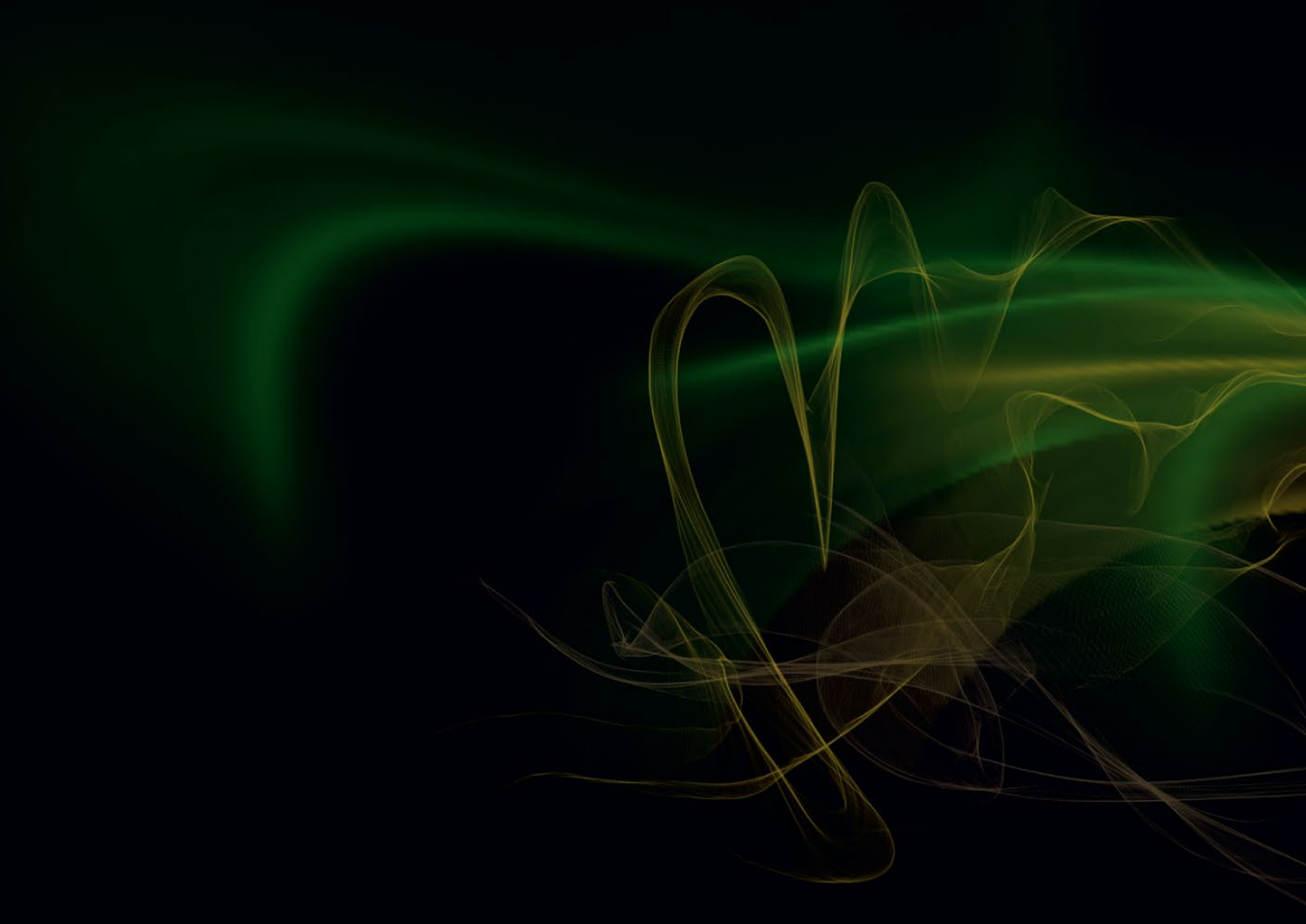
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The Rise of Metallurgy in Eurasia is a landmark study in the origins of metallurgy. The project aimed to trace the invention and innovation of metallurgy in the Balkans. It combined targeted excavations and surveys with extensive scientific analyses 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.