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BEGINNING OF THE METAL AGE IN THE CENTRAL BALKANS ACCORDING TO THE RESULTS OF THE ARCHEOMETALLURGY

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Abstract

The gradual development of the primary copper metallurgy in Balkans starts with production of small jewelry pieces and ends with the serial production of massive tools and weapons. It is confirmed that this metallurgy depended on the contemporary mining, i.e. the available sources of the raw materials. It is also corroborated by the discovery of two Early Eneolithic copper mines: Rudna Glava in Eastern Serbia and Ai-Bunar in Bulgaria /first half and the middle of the 5th millennium BC/. These mines are also the evidence for the local exploitation of the carbonate copper minerals – malachite and azurite. The technology employed is close to the former flint mining in the Late Neolithic; massive pebbles obtained from the neighboring alluvial deposits were used as mining hammers. Identical technology was employed in the mines dating from the later periods /Rudnik, Central Serbia, Jarmovac, Priboj na Limu/. The Vinča culture of the central Balkan followed all metallurgical phases of introduction of metal and use of the carbonate ores /Gradac I – III phase/. This long process of including the metal in wider use lasted generally from the middle of the 5th millennium BC to the end of the 4th millennium BC, i.e. to the appearance of the Bronze Age.

Keywords: *Eneolithic; Primary mining; Archaeometallurgy; Malachite; Rudna Glava; Mali Šturac, Jarmovac*

1. Introduction

The archaeology was based on collecting material remains of the former /ancient/ civilizations but did not always stick to this basic prerequisite of its relatively late appearance among the historical sciences. It has been dealing with hypotheses and was engaged in speculations in solving certain complex events important for appearance /or disappearance/ of ancient cultures and their fundamental achievements.

The emergence of the first use of metal in the Eneolithic/Copper Age/ of the Balkans was explained, on the base of the low absolute chronology, as a consequence of the

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visits of the 'protectors' of the Aegean Bronze Age. They were the imagined professional metallurgists sent in these areas to look for the new sources of the raw materials for the advanced civilizations of the East Mediterranean or even the Near East [1]. However, the real evidence for such assumed expeditions, which brought to the Balkans the first knowledge about copper mining and processing of this earliest prehistoric metal, has never been provided. In its way was also standing the fact that 'protectors' of the Mediterranean Bronze Age could not have transferred the knowledge concerning first metallurgical experience because it would have been very distant past for them and thus unknown /as primeval/ as for the autochthonous cultures in the Balkans that had not experienced that past. It turned out, however, that remains of the earliest mining in the Balkans are very sporadic and as a rule destroyed by later exploitation from the prehistoric to the modern times.

Therefore, the first archeometallurgical analyses relied directly on the existing museum collections of copper artifacts according to principle – how much metal finds so much metallurgy. Their scarcity was hence taken as evidence that primary metallurgy had no significant impact on the evolution of the Early Eneolithic cultures in the region. It was also emphasized that there are no information for copper ore smelting, so more attention was paid to collecting the native copper and the contemporaneous technique of cold working. The gradual development of the copper metallurgy in the eastern and central Balkans starting with simple jewelry and small implements (the phase of cylindrical beads and wire bracelets) and reaching to the massive tools and hammer-axes has been recognized rather early on the basis of the archaeological finds. Thus has indirectly been confirmed the independence of the primary copper metallurgy, which could be followed from the simplest forms of the objects for everyday use to the implements of substantial weight cast in the one-piece moulds.

As a result we came to conclusion that the initial phase of the Early Eneolithic metallurgy could be better explained only on the basis of evidence concerning contemporary mining. The interdependence of the metallurgical tradition and available sources of raw material is in that way permanently present in production of the metal artifacts in prehistory. The knowledge of technology employed in the earliest copper mines in the Balkans as well as the discovery of the Early Eneolithic cultures as bearers of the mining activities are necessary for the understanding of the origin of the primary copper use. By the discovery of two more mines in the Central Balkans /Rudna Glava/ and in the Eastern Balkans /Ai-Bunar/ [2] in the 1960s, these two basic elements of the copper use during Early Eneolithic have finally been joined into unique production entity. These mines, which have been archaeologically investigated to a considerable extent, are dated in the Early Eneolithic, i.e. the Early Copper Age: Ai-Bunar corresponds with cultures Karanovo VI /Karanovo V in the south Thrace dating from the first half and the middle of the 5th millennium BC [3] while Rudna Glava was active during the Gradac phase of the Vinča culture and its date is similar [4]. These mines are the evidence for local exploitation of carbonate copper minerals – malachite and azurite. The massive pebbles of volcanic

origin had been obtained from the neighboring river deposits and used as heavy mining hammers. The technology employed at Rudna Glava is very similar to the former mining of flint in the Early Neolithic or in even earlier phases of this period throughout the continent.

Similar technology but this time of higher level, judging by the various types of pebbles-hammers, was used in the copper mines at Mali Šturac /Rudnik, Central Serbia/ and particularly in Jarmovac /Priboj na Limu/. The first mine had been exploited in the Bronze Age or the later periods while the other one had been exploited during the Eneolithic but its exploitation continued until the modern times [5].

By comparing the technology employed in the earliest copper mines in Thrace and Eastern Serbia as well as the similar examples in other regions the striking similarity could be encountered. The use of pebble-hammers with transversal groove is identical; the veins of copper ore were followed to the border of the oxidation zone at the exploited deposit and generally using same technology in the quest for malachite, azurite and native copper. The introduction of copper, therefore, implies identical or very similar exploitation of the carbonate or oxide ores regardless of the geographic location but there is a considerable difference in the absolute chronology [6].

Similar evidence suggests that use of the metal in the Eneolithic metallurgy depends directly on the sources of raw materials within given territory. Thus very early use of silver prevails in the Aegean, particularly in the Cyclades [7] while the copper metallurgy of large scale along with the first bronze alloys prevails besides gold, in the continental Balkans. The processing and obtaining of the metal in the early phases of its use in the Central Balkans are insufficiently documented from the technological aspect. Thus an often asked question where had been the smelteries or at least the individual smelting or casting furnaces remains generally unanswered.

An attempt to explain the first mines as sources of materials used for pigments: azurite for blue pigment, malachite for the green one is not based on the existing evidence. Even M. M. Vasić, the first investigator of the Vinča culture came to conclusion that there is no evidence for the use of ‘carbonate’ pigments in the settlement Vinča-Belo Brdo despite the presence of amorphous malachite in the later /Gradac/ phase of the settlement.

The cold working of the native copper is usually not accepted as distinct archeometallurgical phase although it is not clear what it could be in that case. The sporadic use of malachite as decorative mineral is not unexpected but it has no metallurgical significance as it was the question of mechanical treatment. The transition to the obtaining of copper from malachite is illustrated by cylindrical beads made of thin sheet metal and worn side by side on the same necklace with beads of malachite (mineral). The bracelet made of copper of high purity comes from the Vinča culture (Gradac II phase) settlement Divostin near Kragujevac where the amorphous malachite was also found in a considerable quantity. This bracelet belongs to the well-known ‘Pločnik’ type represented by one specimen in hoard 3 from the eponymous site / Gradac III phase /. The smelting of carbonate ores for production of jewelry and small tools was introduced at the Vinča culture settlement Gornja Tuzla / Gradac I-II

phase/. There has also been found the amorphous malachite [8].

It has been known for a long time that it is not simple to determine the composition of the metal used for the earliest massive tools in the Early Eneolithic – whether it is the native copper or the copper obtained by smelting carbonate ore because of the exceptional purity of metal in both instances.

The finding circumstances of the earliest metal artifacts have the important role in drawing conclusions about the primary metallurgy. There has also been introduced the term 'metallurgy of necropoles' denoting the origin of the most of early copper artifacts. They are the grave goods as the compulsory offerings in the funerary ritual observed in the Early Eneolithic communities in the Middle Danube basin and in the Carpathian basin. The valuable contribution to the classification and archeometry of the copper jewelry and tools of the Eneolithic period are various hoards containing the finished copper products or the 'founder's waste' prepared for melting down. The magnificent grave goods of copper and gold from the famous Varna necropolis radically changed the assumptions concerning the metallurgy of the Late Eneolithic in the Eastern Balkans / Gumelnița – Karanovo VI culture/ [9]. The high technological level of the Late Eneolithic in the Balkans when massive copper tools had been produced in series is evident.

The Vinča culture followed all the stages of gradual introduction of the metals in the Central Balkans. The most acceptable is the conclusion that metallurgical production became possible only simultaneously with primary copper mining – mostly concerning the carbonate and oxide ores. This fact speaks rather in favor of the 'revolution of mining' than the 'revolution of metallurgy', which concerns more the technology of alloys and the serial production of the bronze artifacts.

The south region of the Vinča culture provides different archeometallurgical evidence to a certain degree. The most interesting among the larger Vinča settlements existing along the south edge of the zone with the richest ore deposits in Eastern Serbia /Majdanpek – Rudna Glava – Bor/ is the settlement Belovode near Petrovac na Mlavi. This settlement existed during Gradac I – II phase; according to the division of the Early Eneolithic culture into Gradac I – III phases it relates generally to its south area and is based on the corresponding archeometallurgical development. The most important result of such relatively chronological division is the sharp distinction between the south and north region of the Vinča culture. While the former enters the final stages of the Early Eneolithic through the Gradac III phase, the latter is exposed to pressure and partial destruction by the cultures of the Pannonian Early and Later Eneolithic [10].

It turned out that processing of malachite during Gradac I – II phase was, regardless of the technical and production level, just the local production. According to the existing evidence we should not expect any distinct center during the first stage of metallurgy in the Vinča culture. The situation with smiths and smelters gathered in small artisan communities is more probable for the Gradac III phase because the serial production of massive tools and weapons has only been possible on the basis of the considerable increase of the available quantity of copper obtained from the carbonate copper

minerals. The early production centers have been confirmed so far only in the Baden culture /Eastern Slavonija/ at the site Saloš – Donja Vrba near Slavonski Brod and this points to the Alpine zone in the northwest abounding in the sulphides copper ores [11].

It is not difficult to imagine the countless ways of circulation of the first metal, from the commercial exchange to plundering. Therefore it is impossible to distinguish, using classic archaeological methods, how many artifacts had been produced of the copper from one or many sources of the raw materials that could also be rather distant from each other.

The investigations concerning the origin of malachite in the Vinča settlements in the Morava valley in relation to Rudna Glava /Gradac I phase/ did not yield the expected results. The analyses of the radioactive isotopes of lead in some samples were hampered by the increased radioactivity of the copper ore from Rudna Glava [12] as well as by applying the analytic method insufficiently adjusted to the distinctive conditions of the site situated on the strip mine of the modern magnetite mine [13].

Therefore, the different levels of development of metallurgy within the contemporaneous cultures of the Early Eneolithic in this region are understandable. Thus, the Tiszapolgar culture, which was closer to the sources of the Carpathian copper yielded considerable number of massive hammer-axes (mostly grave goods) while geographically close Sopot culture did not yield the data about its own production of the copper artifacts.

The metallurgy in the Balkans repeats the primary mining technology and copper processing independently of the chronological and geographical differences. This was possible to achieve because the initial knowledge about metals was in the

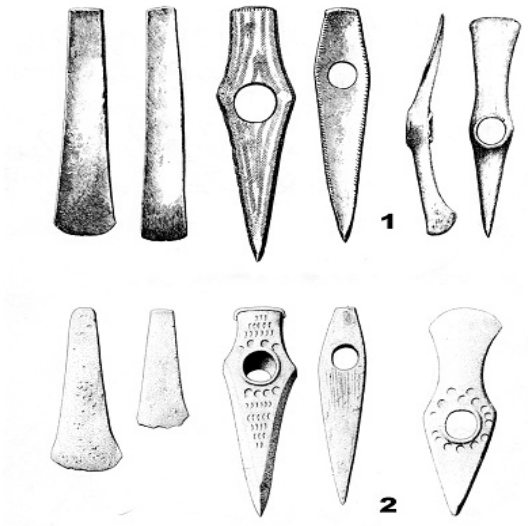

Fig. 1. Massive copper tools and weapons, Eneolithic period
1. Central Balkans; 2 Western Balkans

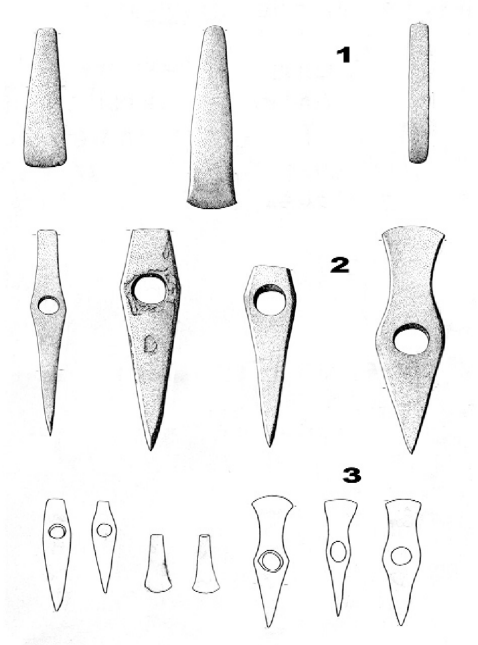

Fig. 2. Massive copper tools and weapons, Eneolithic period
1-2. Eastern Balkan; 3. Lower Danube basin

Balkan-Aegean area rather early but the prerequisites for its intensification were very different.

Bearing in mind the early occurrence of small number of copper objects within the Neolithic cultures in the Balkans and their diverse dating as well as the absence of reliable evidence concerning the very beginning of the metallurgical processing of malachite – there still remains, however, the primary mining of carbonate copper minerals, determined chronologically and geographically. Therefore, the Gradac I phase of the Vinča culture /Rudna Glava/ and Karanovo V-VI /Ai-Bunar/ denote according to our present knowledge the beginning of the metallurgical activity in the Balkans. The use of gold from the river deposits was probably of a later date as it is suggested by the necropolis in Varna /Black Sea coast/.

The long process of including the metal in regular use lasted from the middle or the end of the 5^{th} millennium BC until the end of the 4^{th} century BC. The quoted dates are also confirmation of gradual / and independent / improvement of the metallurgical knowledge in the Eneolithic period of the Balkans.

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