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A BRONZE FLANGE-AXE FROM THE EARLY BRONZE DUBENE-SAROVKA SETTLEMENT (PRODUCTION, FUNCTION AND SOCIAL CONTEXT)

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Introduction

In the 1990s, the excavations at Sarovka locality near the village of Dubene, Karlovo Municipality (central Southern Bulgaria, **fig. 1**) revealed a low tell of c. 2.00 m thick cultural layers. According to the evidence from the recent excavations, the site was founded during the second stage of the Karanovo VI culture, in later fifth millennium BC (Nikolova 2000c, 87). After a c. 600 years break, a community of the Yunatsite culture population reoccupied the tell during the Early Bronze (EB) Age. The vertikal stratigraphy of the EB levels and radiocarbon dates provide the foundation for the EB chronology of the site from later 4th (EBI) to the 3rd quarter of 3rd millennium BC (EBIIIA) (**fig.1**) (Nikolova 1999a; Nikolova 1999b; Nikolova 2000a; Nikolova 2000c; Nikolova/Görsdorf, in print; here and below the chronology is based on calibrated dates).

Among the most important finds discovered at EBA Dubene-Sarovka was a bronze flange-axe (**figs. 2,3**). The axe has been assigned to the general typology of Balkan flanged axes – together with a find from Romania – to the Fundeni-Dubene type (Nikolova 1999a).

Further, this communication is an attempt to approach the archaeological metallurgical investigations of the region in the context of the general problems of the ancient pyrotechnology that requires a detailed chronological, social and cultural contextual analysis (Yakar 1984, 60; Gale *et al.* 1985, 144). It will be shown that the ancient local metallurgy of western Upper Thrace reflects the interactions of cultures from different directions, which resulted in advanced cultural achievements. In other words, an interaction model rather than diffusion and independent innovation models, is proposed to explain the origins of local bronze metallurgy.

The find and its function

Recently, the Balkan flange-axes have been divided into 7 types (Nikolova 1999a, fig. 15/4). The Dubene-Sarovka axe has been assigned to the Fundeni-Dubene type. It is characterized by a slightly trapezoidal body with narrow ends and oval profile, as well as by slightly inverted prolong edges (**figs. 2,3**). The find is complete and has a green to grayish-green undisturbed surface. The length of the axe is 17 cm, the maximum width is 4 cm, and the maximum thickness is 2.6 cm. It can be assumed a lost-wax or stone mould was used to produce the axe, followed by slightly finishing sharpening of the front end after the cooling process.

According to the chemical analysis provided by a Philips electronic microscope SEM-515 and X-ray apparatus EDAX, the Dubene-Sarovka axe was made of copper alloy that yielded 2.11% (2.50%) lead and below 1% nickel (**tables 1.1-1.2**). The evidence from archaeological excavations in Western Europe verifies that such axes were attached to a wooden handle (personal observation of finds from museums in Switzerland; see also the axe found together with the so-called Ice Man (Spindler 1994). However, it is worth mentioning that the flange-axes were distributed at different scale and context in the distinct parts of Europe. This fact in turn faces the question of the function of these finds.

It appears that the flange-axes in Western Europe functioned similar to the shaft-hole axes in the Balkans. They were used for lumbering and wooden-working, and other household activities (for instance, butchering). In addition, they also had functions such as a prestige sign and an effective weapon. In my opinion, functionally, we cannot completely separate flat, shaft-hole and flange-axes. The emergence and development of the different kinds of metal axes is a special topic for further research. For now it can be mentioned that the occurrence of both categories of axes (shaft-hole and flange-axes) in the Balkans may also indicate some more peculiar function of the latter, also known as axe-chisels (Черных 1978).

Of importance is the fact that in the EBA of the Balkans, the flat and flange-axes were likewise very important social prestige signs. For instance, the EB II finds from Southwestern Bulgaria (rescued from hunt-treasures; possible cemetery at Rupite Locality; unpublished) comprise a gold jewelry, daggers, flat and flange-axes, etc. The EB III collective find from the Emenska Cave includes two flat trapezoidal axes along with a gold jewelry (Николова/ Ангелова 1961). This evidence indicates the association of the flat and flange-axes with the social elite.

At the same time, according to the evidence provided by the Dubene-Sarovka find, the innovation of the lead copper alloy used for the flange-axes indicates the producer wanted to improve the quality of the copper metal. As a result, it is likely that the flange-axes had an important role in the subsistence economy of the EB society in western Upper Thrace.

The chronology of the flange-axe from Dubene-Sarovka

The EBA settlement of Dubene-Sarovka was occupied in all three EBA stages (Nikolova 1999b; Nikolova 2000a; Nikolova 2000c). In 1994, the flange-axe was discovered on the western central excavated periphery of the site, at a depth 0.40 m under the surface, in a destroyed layer of the tell that comprised numerous pottery from EB II. Because of absence of a closed depositional complex, the axe can be dated to any of the phases of the EB I-III represented on the tell. The upper chronological border is determined by the earlier EB III pottery (the 3rd quarter of the 3rd millennium BC) discovered mostly in the eastern and northern uppermost layer of the excavated site that was a subject of long-term agricultural activity.

For the time being, two flange-axes of Fundeni-Dubene type are known from the Balkans – the finds from Fundeni and from Dubene-Sarovka. The former find provides indirect evidence for the chronology of the Dubene-Sarovka find as it was attributed to the Glina III culture that completely dated from EB II (Nikolova 1999a, 301; for Glina culture see Schuster 1997). The thick EB II cultural layer, the settlement pattern, the rich pottery documented at Dubene-

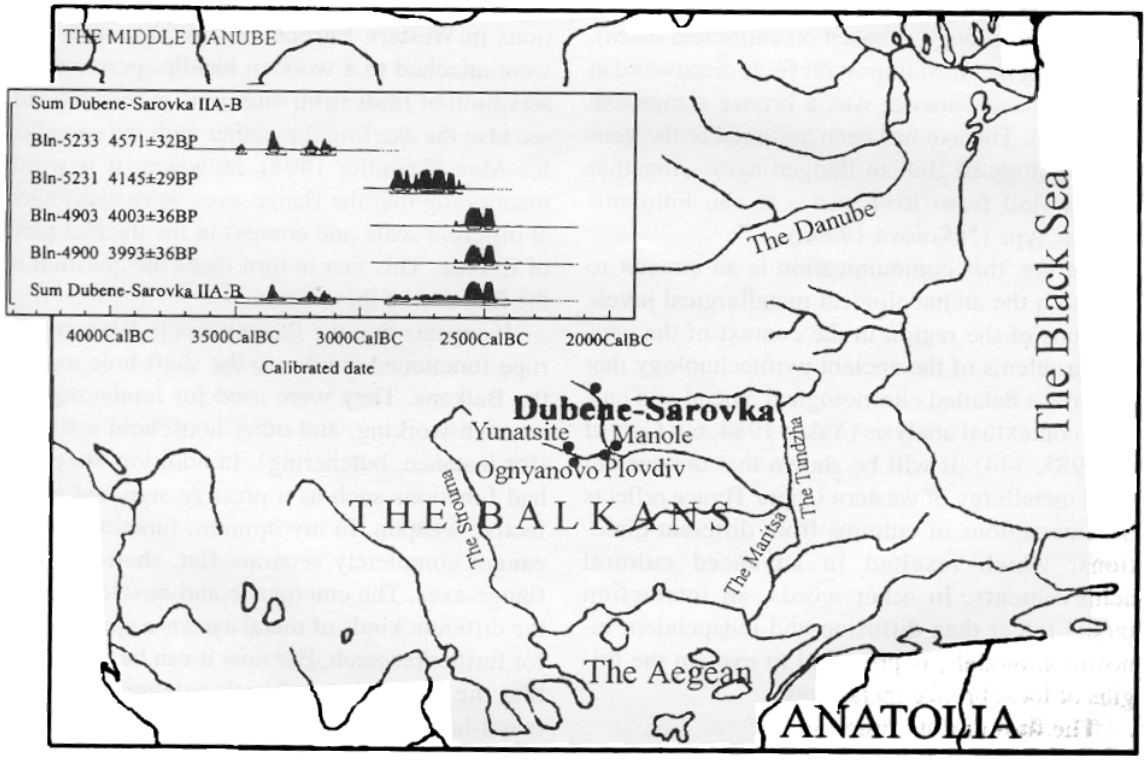

Fig. 1. Dubene-Sarovka and other central sites of Yanatsite culture.

Sarovka are the cultural context of a prosperous society, that may also confirm the Dubene-Sarovka axe was produced in EB II (the first half of the third millennium BC).

This chronology corresponds to the recent state of the investigation of the origin of the flange-axes that generally changes the view on the earliest distribution of the flange-axes in the Balkans. As previously stated (Nikolova 1999a, 299-310), not many flange-axes were discovered in the Balkans, in comparison to Western Europe, because of the popularity of the shaft-hole axes. Until the 1980s, the stratigraphic data on such flange-axes were from the latest EB II context (Ezero 4), corresponded to early EBA in Western Europe. Accordingly, Chernykh (Черных 1978, 156) believed that they documented a "north-western influence" into the Balkans. But recently, some finds dated to the late Tripolye culture, along with the revision of Glina culture chronology and the unpublished flange-axe from Ovcharitsa site (Ezero culture) discovered in late EB I – earlier EB II context, have -characterize the data base of the new hypothesis: the earliest Balkan flange-axes preceded that from Western Europe. They are comparable with Remedello axes from Italy, 3400 BC-2400 BC (Bagolini/ Pedrotti 1998), which may indicate a synchronous process of distribution of the earliest flange-axes in the Balkans and Italy. But the problem needs further investigation, as the flanged axe of the so-called Ice Man can be dated from earlier fourth millennium BC. In the light of recent evidence, it can be concluded the flange-axe from Dubene-Sarovka dates from Early Bronze II (the first half of the third millennium BC), which chronology corresponds to its settlement context, and its typological and comparative characteristics.

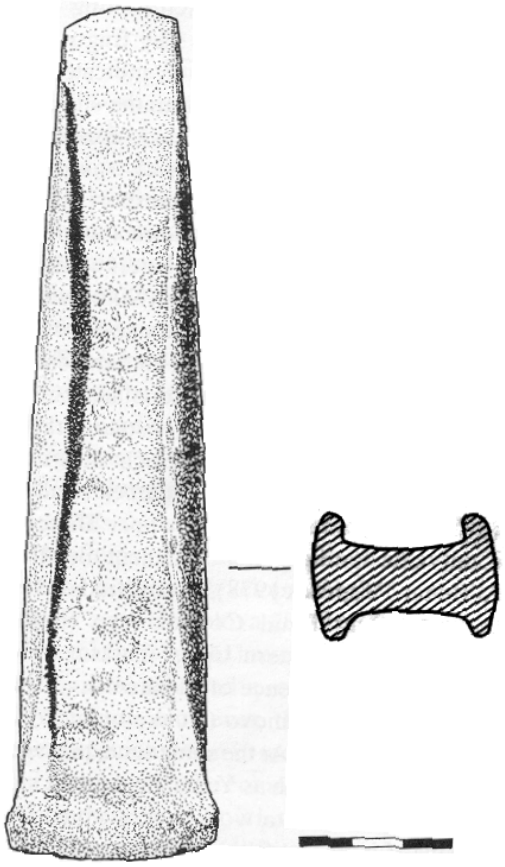

Fig. 2. The flange-axe from Dubene-Sarovka, drawing.

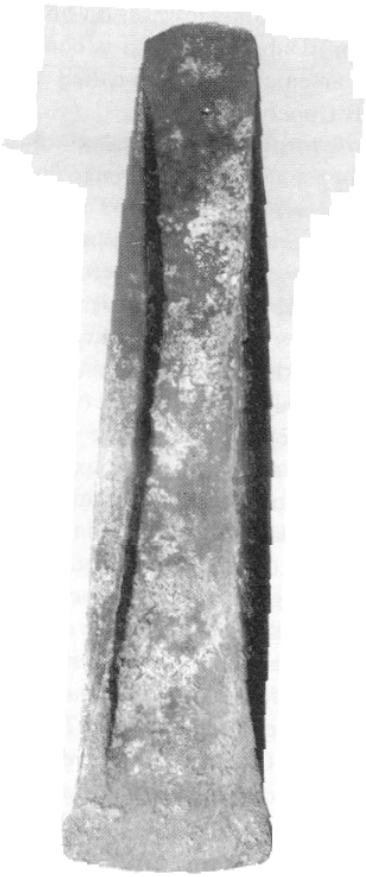

Fig. 3. The flange-axe from Dubene-Sarovka, photo.

The next problem faces the question where the axe was made. The following section is an attempt to argue that the flange-axe was a product of local metalsmith center.

Dubene-Sarovka: a newly discovered center of production of bronze finds in Upper Thrace and its social parameters

The technological characteristics of the Dubene-Sarovka axe indicate the maker had developed metallurgical technological skills towards using copper alloys to improve and quality of the metal. There is no comparative analysis of the hardness of the Final Copper axe from the same region and the Early Bronze flange-axe, but the latter looks much harder.

Some authors assume that lead, as a purposeful addition, was used to improve the bronze fluidity for casting (Charles 1980, 179). In this case, chemically, the leaded bronze possibly signifies a stage or an aspect of development of the knowledge of the copper alloy towards tin-bronze, since the find from Dubene-Sarovka is contemporary with other arsenic and the so-called arsenic-tin finds in EB Upper Thrace.

It is worth mentioning the analysis of the small object of copper alloy dross, given to the Museum of History in Karlovo Town by a Dubene villager. The find has a possible zoomorphic shape and is a copper alloy with a very high percentage of lead – 8.15% (10.13%). According to the information provided by the villager, the find was discovered in 1995 next to the Sarovka site and near the EB II house at the Dubene-Izvora site (which was excavated in 1992). Both sites are close to each other. They are divided by non-excavated area, though the topography and surface material indicate that in the past they belonged to one and the same EB village (or village compound). The copper alloy dross completely corresponds to that of the axe, as the higher percentage of lead was a result of the metalwork process during which the waster metal accumulated weightier material in comparison to the produced finds. Therefore, my conclusion is that the copper alloy dross found c. 100 m from the area where the flange-axe was unearthed, is evidence of local production of the axe. Other indirect evidences for local production of metal finds are: a clay pin mould on the floor of a house from Dubene-Sarovka IIB3 (unpublished, curated in Karlovo Museum of History); metal slag fragments in levels from later Dubene-Sarovka IIB and other fragments of moulds from disturbed levels at Dubene-Sarovka IIB. All of these data imply local metallurgical activity and production of metal finds at EB Dubene-Sarovka. For the time being, the dating of this metallurgical center is based on the chronology of the axe – EB II, as discussed in the previous section. In light of the evidence presented above, the metallurgical activity at Dubene-Sarovka can be considered as one of the reasons for the prosperity of the community in EB II. The site became *a central place* of the Upper Stryama region.

The next issue is the location and access to the ancient, probably open mines for metal ore occurs. There is no special investigation of traces of ancient mining in the Sredna Gora Mountains that surrounded Dubene-Sarovka to the south and from the east. But, the site is not far from the Panagyurishte area where rich mining deposits have been documented. The slag fragments discovered in the EB II village may indicate that raw ore sources were not so far from the site and that the extraction metallurgy was conducted at Dubene-Sarovka. Raw material was probably moved to the site by wheel transport and/or the river communication route. Indirect evidence for wheel transport used by the villagers comes in the form of a clay model of a wheel (Nikolova 2000c, fig. 15.30/ 3) from EB II-III Dubene-Sarovka IIB. The possibility of identifying the ancient metal resources is increased Pb-isotope analyses since it precisely defines the characteristics of the metal finds and mining resources. Such sites as Troy seem to rely on non-local resources (Gale *et al.* 1985 and ref. cited there). In Upper Thrace there is only one certain center of ancient metallurgy – Ai Bunar (Черных 1978), but the finds date from the preceding Final Copper Age (Nikolova 1999a). In EB western Upper Thrace, there are two sites with evidence of metalwork – Dubene-Sarovka and Ognyanovo (an axe-mould, Детев/ Мацанова 1977). At the same time, in one of the biggest villages such as Yunatsite, neither significant traces of metalwork nor a considerable amount of metal artifacts were documented. One possible explanation is that there is specialization of production between the different villages of the

Table 1.1. Microscopic elemental analysis of the Dubene-Sarovka flange-axe (I).

KV=30 TILT=0.0 TKOFF=25.0 BKG PT1=7.2 BKG PT2=11.0

Elements	WL.%	AT.%	S.E.%
NIK	0.21	0.23	13.88
CUK	97.29	98.99	0.20
PBL	2.50	0.78	6.82
Total	100		

Table 1.2. Microscopic elemental analysis of the Dubene-Sarovka flange-axe (II).

KV=30 TILT=0.0 TKOFF=25.0 BKG PT1=7.0 BKG PT2=13.0

Elements	WL.%	AT.%	S.E.%
NIK	0.17	0.23	13.88
CUK	97.10	98.99	0.20
ZNK	0.46	0.46	6.71
ASK	0.15	0.13	31.81
PBL	2.11	0.78	6.82
Total	100		

Yunatsite culture. According to this model, the evidence of metalwork at Dubene-Sarovka infers the existed local resource of metal ore. In western Upper Thrace, the development of Plovdiv-Nebet Tepe as a chieftain center of the Yunatsite culture was assumed (Nikolova 1999a, 312-314). According to that model, sites such as Yunatsite and Dubene-Sarovka were local centers in close interrelation with the main political place.Obtaining the right to exploit metal resources and practice metallurgy can be considered a factor in the increased social stratification of the EB II society at Dubene. This is the period of emergence of the initial chieftains (chiefdoms) in the Balkans as a level of the political development that preceded the archaic state (Nikolova 2000b). The production of metal finds might have belonged to a family (or families) that had a regular access to the metal recourses. However, the assumption that household specialization in metallurgy was one of the characteristics of the community life in the EB Balkans is theoretical. It is part of the perception that agriculture and the different kinds of stockbreeding activities were still of primary importance, along with intensive pottery production. To confirm this model it is worth mentioning that Dubene-Sarovka was located in one of the most favorable microregions in the Balkans for occupation by agricultural-stockbreeding communities, as:1. The Stryama valley is very favorable for intensive agriculture; 2. The Stara Planina Mountains is rich in pasture-grounds for seasonal stockbreeding; 3. The Sredna Gora is a foundation for possible access to metallurgical resources; 4. In the neighborhood of Dubene there are rich local resources for pottery production; 5. There are favorable communication routes that connected the Stryama valley population with close and distant cultures (see also below).

The palaeobotanical and osteological data confirms the intensive agricultural-and-stockbreeding subsistence economy of the EB Dubene-Sarovka community (Nikolova 1999a). But since this is only one aspect of the multifaceted household economy of the Dubene-Sarovka villagers, the metallurgy itself was an important stimulator of the development of the social stratification in the village confirmed by the settlement pattern. For instance, Apses-House #1 (Nikolova 1999, fig. 13/2) was the residence of one of the most

powerful families according to its architectural features and abundance of finds (stone axes; a big number of spindle whorls; plain and rich ornamented fine and technomic pottery). Moreover, there is functional differentiation between the Dubene-Sarovka buildings. Most of them were habitations but some had mainly a storage function. Accordingly, there were households that possessed more that one building, which were organized as house-compounds. Consequently, the occurrence of the flange-axe at the village of Dubene-Sarovka was not accidental, but a result of the complex cultural development in the Upper Stryama valley in Early Bronze II. This is a society, which was leading in the development of the metallurgical technology in the Balkans. The flange-axe and the evidence of the metallurgical activity at Dubene-Sarovka change the image of the social-technological aspects of the EB Thracian metallurgy and to supplementary questions of cultural interactions of Upper Thrace communities during the Early Bronze Age.

Evidence for regional interaction in metallurgy

The technological aspects of the bronze metallurgy (leaded bronze) practiced at Dubene-Sarovka connect that region with southern metalwork, such as the hoard of Petralona and the leaded bronze finds from Thermi and Anatolia (Branigan 1974, 147, 149-150; Yener 2000). On the other hand, typologically there is a correlation between the flange-axes from the Balkans and those from Central and Western Europe (Nikolova 1999a, 299, 301). Then, there are two directions of interaction - the distribution of the idea of the leaded bronze connects Dubene-Sarovja with the south metallurgical centers, while the kind of the axe is common shape for the Balkans and Central Europe.

The EB I settlement of Dubene-Sarovka has been investigated over a small area only, so it is not clear whether metalwork was practiced in the village during this period. But, moulds for flat axes discovered at Donja Vrba – Saloš (Lozuk 1995), along with the kiln artifacts, indicates a later EB I Baden metallurgical activity. For the time being, it does not have any analogies in the Balkans, although daggers were popular in the Baden complex, as in the Cernavoda III and earlier Ezero cultures(Vajsov 1993; Nikolova 1999a, 301 sq.). This may indicate contacts between the producers, as well as a trade between communities. Additionally, the pottery of the Yunatsite I culture, Pernik I and Sitagroi IV – Dikili Tash IIIA has close and numerous analogies in the Baden culture complex. Therefore, it cannot be excluded in future that evidence of contacts between different EB I culture in the Balkans can be extended to the realm of the metallurgical activity.In contrast to investigations of EB I metalworking in the Balkans, the EB II metal finds are well documented. The leading cultures in the metalwork have been defined such as Ezero II, Vučedol, Glina, and – as this communication argues – Yunatsite culture. In the area of the last, Dubene-Sarovka and Ognyanovo in the Upper Maritsa valley indicate the metalwork and distribution of metal finds was based on developed local metalsmith centers. As will be shown below, using the example of Dubene-Sarovka, these centers were not isolated and followed the most advanced tendencies in the development of the bronze metallurgy.

The arsenic and leaded bronze in the context of Balkan – Aegean – Anatolian cultural interactions

The investigations of the 1990s clarified many cultural problems regarding the emergence of the bronze metallurgy in the Balkans. Among the variety of metal finds in earlier fourth millennium BC, daggers gradually become the main metal find. They were used in the subsistence economy, social prestige ideology and warfare. Initially, daggers were made of unalloyed copper, but by c. 3600 BC (see Nikolova 1999a for Hotnitsa-Vodopada), the arsenic copper alloy was involved in the earliest bronze metallurgy as an optimal variant for hardness of the copper for this sort of metal artifacts. It is worth mentioning that arsenic copper is the principal metal alloy for daggers even in the second millennium BC in Western Europe.

According to the radiocarbon chronology, the innovation of the earliest bronze was a synchronous process in the Balkans (Hotnitsa-Vodopada) and in Anatolia (e.g. Ilıpınar; Yener 2000, 45). This innovation indicates a synchronous and interactive process of the emergence of the Bronze

Age in the Balkans and Anatolia, a problem to be discussed in details elsewhere. To explain the process, the diffusion of the idea of the arsenic-bronze from the southeast into the Balkans is to be assumed. One of the reasons is that arsenic was very popular in fourth millennium BC in Anatolia (Yener 2000). In contrast, the Balkan metallurgists in later fifth and earlier fourth millennia BC exclusively used non-alloyed copper.

Toward the end of the fourth millennium BC, tin copper alloy was known and used in some regions of Anatolia. By the mid-third millennium BC, tin-bronze artifacts were recorded from most areas in Anatolia (Yener 2000, 75). Along with them, lead became an important deliberate element in the copper alloy. For the purposes of our theme, of importance are the data from Thermi, where leaded bronze finds were documented (Branigan 1974, 147, 149-150). In the latter part of 1970s, studies show that the region was connected with Upper Thrace, based on the ceramic similarity of the encrusted pottery (Георгиев *et al.* 1979). Long-distance contact, trade, intermarriage, peer contacts and many other models can be proposed to explain the nature of contacts between the communities from the Balkans, Anatolia and the Aegean in the Early Bronze Age. On the subject of leaded bronze, the Dubene-Sarovka flange-axe represents a very important record that connects the Southern Balkans bronze metallurgy with the EB Aegean and Anatolian cultures where lead was known and used in the bronze metallurgy (see Yakar 1984 and 1985; Kunç 1986; Yener 2000). It is worth mentioning the conclusions reached by Branigan (1974, 76) that Aegean EB metalworkers exercised control over the quantity of the lead used in their lead-bronzes.

The closest parallel of Dubene-Sarovka lead copper alloy is the hoard from Petralona (Branigan 1974, 76, 149-150), where Pb is 1.00% to 1.45% .

Of 600 Anatolian artifacts made of copper alloys analyzed in the 1960s, 5% percent contain deliberate quantities of Pb and/or Sn and As (Esin, after Kunç 1986, 99). Further investigation of the Anatolian copper and copper alloys confirmed the importance of the lead for Early Bronze metallurgy, despite the fact that there are sites and regions in which arsenic-bronze was preferred even in the third millennium BC (e.g. İkıztepe in the Pontic region - see Kunç 1986).

Of importance for the problem of the Early Bronze lead-bronze are the Tepecık and Tülıntepe tells in Eastern Turkey (Çukur/ Kunç 1989). They were situated c. 60-70 km from the copper and lead mines of Ergani Maden and from the mines of Keban. Galena (lead/silver) ore fragments, containing 17.94% to 40.03% Pb, were found on both of them. However, in Tepecık (from the so-called Chalkolithic), 50% of the analyzed slag fragments contained 2% or more As, while no lead-bronze was documented. At Chalkolithic Tepecık, of 6 samples tested, 2 were lead-bronze (3.22% and 5.68% Pb, in combination with high percent of Fe). But in the Early Bronze levels of the same site, no lead-bronze objects were documented despite the presence of galena fragments. The variety of metal composition on this site is considerable (two samples of arsenic-bronze, one of low-tin copper alloy, one of copper with 1% Ni and even two iron objects), although "poor" copper objects predominated.

B. Jovanović (1985-1986, 53) placed stressed on the so-called "strengthening of the Aegean cultures, including also the Cyclades" in the Early Bronze Age towards the Axios basin and Pelagonia. The recent cultural picture provides evidence of mutual interaction between the southern Balkans and the Aegean. The presence of encrusted pottery on Thasos Island (Maran 1998, 129; Nikolova 1999a, 225) clearly represents northern influence. By the very least in EB II, the last micro-region was completely integrated with the Drama valley, so that an identical ceramic style of the encrusted pottery developed in both areas that, on its hand, was very close to the Yunatsite culture pottery from the Upper Maritsa and Stryama Rivers' basins. Following the direction of the diffusion of the encrusted pottery, the southeastern point is Thermi, where lead-bronze was popular. In addition, the Poliochni metal finds (for instance the axe from Poliochni IV) have an affinity to the Balkans (Parzinger 1993, 351, table 208/15). Further, the preliminary published dagger from Rupite (Southwestern Bulgaria) is similar to Early Helladic finds. The gold necklaces from the same site can be also con-

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nected with the Aegean cultural circle.

Therefore, there are systems of similar elements that connect the southern Balkans, the Aegean, and Anatolia despite the developed local metallurgical and typological variety. In addition, the discovery of EB I silver earrings in a grave from EB I Yunatsite 16-17 (possibly the earliest silver finds in the Balkans) may also indicate a southern influence. For the time being, it is not clear if there is an interrelation between these silver items from Yunatsite and the Dubene-Sarovka lead-bronze flange-axe. Both sites are located in western Upper Thrace and on the both sides of the Sushtinska Stredna Gora. The general association of lead and silver in the areas of an extractive metallurgy is a result of the link in the knowledge of silver and lead metallurgy (Wheeler/ Madden 1980, 105; de Jesus 1980, 63-64; Gale *et al.* 1985, 143, comment 2). Then, the question of possible common local utilization of lead and silver ores by the Yunatsite culture communities (for instance galena) occurs for further investigation.

According to some experiments, the smelted copper can contain more than 2% non-deliberate elements, such as arsenic and lead. This is a reason many important conclusions concerning deliberate copper alloys to be rejected (Gale *et al.* 1985, 154 sq.). As a matter of fact, on the subject of innovations, the deliberate copper alloy can be produced not only through adding the certain element, but by mixing of different kinds of ore as well (for instance as flux – see Tylecote 1980, 188). Then, the knowledge of those special ores that appeared in the context of the development of certain technology also requires future research specified as a question of discovery (primary innovation), invention (or secondary innovation) or diffusion (Naylor 1996, 41) of the new trait.

In the Upper Stryama valley, elemental analysis of the Final Copper axe (Museum of History, Karlovo Town) indicates non-alloyed copper that differs from the lead copper alloy of the Dubene-Sarovka flange-axe. This, along with the content of the lead (over 2%), implies that the emergence of lead copper alloy was not an accidental experiment. In my opinion, it indicates a special knowledge that the local metallurgists obtained by contacts with peoples to the South.

The flange-axes in the Balkans and its relation to Central European finds

Except for Dubene-Sarovka in western Upper Thrace, the other documented and published flange-axes in the Balkans originate from eastern Upper Thrace and the Lower Danube (Nikolova 1999a, 299-301). Their distribution infers that the flange-axes were distributed in distinct regions of the Balkans. The Fundeni find implies that an exchange-route existed through the Stara Planina or the Sredna Gora / Stara Planina Mountains. Although there is no chemical analysis of the Fundeni find, some imports from the Upper Stryama valley to the north could not be excluded. In eastern Upper Thrace, there was a local production center where Şincai type was popular (Ezero 4, Sliven - Черных 1978, table 27/7,11). It is not clear, to which extent the Carpathians metallurgical region had already been developed by EB II. But in the last period, the southern Balkan metallurgy, especially in Bulgarian Thrace with a variety of different micro-centers, was a leading one region of metallurgical production. Metallurgical activity can be also expected in the northern Aegean, although for the time being, the evidence is very scanty – for instance a slag fragment from Sitagroi Vb (Renfrew 1986, 188; see also Aslanis/ Tzachili 1995). From Oltenia, one of the possible exchange goods was the salt. At Govora Sat – Runcuri (Roman 1987), encrusted pottery occurred, with an affinity to the Vučedol culture and to the Central Balkan encrusted pottery. It was present in a period when that ceramic style was not popular among the Glina culture (Schuster 1997). The influence and diffusion of the encrusted pottery ceramic styles can be explained by very strong cultural contacts, economic basis of which might have been the exchange of goods of the Glina population to the west and south.

Despite the common distribution of similar types of flange-axes in the Balkans (Nikolova 1999a, 299-301), there are two general different tendencies in the Early Bronze in the Balkans and in Central Europe. In the Balkans the shaft-hole axes were more popular (Nikolova 1999a, 294-299; see Vulpe 1996-1998 for Tei II-III find from the MBA Northern Balkans). Their popularity gradually decreased in western direction. At the same time, in Central and Western Europe, the

flange-axes were widespread in the later third and second millennia BC and represented the leading metal axe type in the region (Nikolova 1999a).

The popularity of flange-axes in Central Europe and the similarity in the typology between Central European and Southeastern European finds implies that cultural contacts existed between both regions. Notwithstanding that fact, they do not indicate a western influence. The earliest EB finds from the Balkans preceded that from Western Europe, except for the single find from the Alps (Nikolova 1999a, 299). Further investigations will possibly define the relationship between the Balkan and Remedello culture flange-axes.

Unfortunately, there are no certain chronological correlations between the flange-axes and Baden culture. The axe from Dobanovci, for instance, is typologically close to the finds from the EB III Vinkovci culture, so it could to be later than Baden.

The Stryama valley, the Balkan communication routes and the cultural interactions during the Early Bronze Age

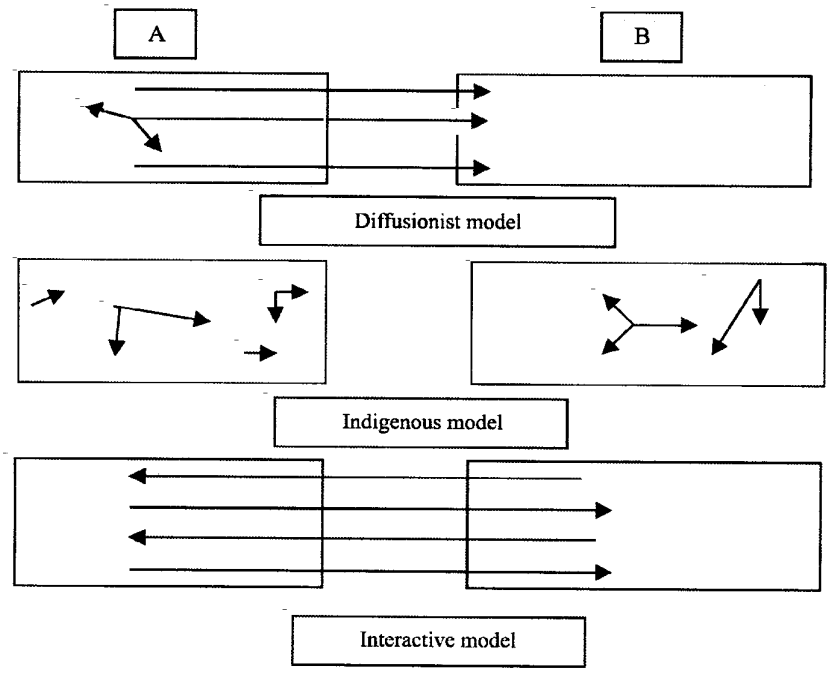
The evidence for the multifaceted nature of interactions between the EB Upper Stryama and surrounding populations requires approaching the problem of the communication routes that connected the communities from the region under discussion with neighbor and distant cultures. Located close to the communication route that connected the Western Balkans with the Southeastern Balkans and Anatolia, the Stryama River was one of the important Balkan routes for the transmission of new ideas, as well as for the exchange in the EBA (Николова, in print).

In the Early Bronze Age, ceramic parallels document a communication route that connected the Stryama valley with the Northern Aegean. The direct parallels between Dubene-Sarovka IIA pottery and Sitagroi IV, as well as plenty of analogies in the encrusted ceramics from Early Bronze II Dubene-Sarovka IIB and Sitagroi Va-Dikili Tash IIIA, indicate that there are traces of that route through the Rhodope Mountains. The last seems to be also important for the distribution of the idea of the innovation of lead-bronze. In the light of the recent evidence, the distribution of that innovation seems most likely from the southeast (Anatolia - Thermi) into the Balkans, keeping in mind the evidence for ceramic interrelations as well. The alternative model includes an independent discovery of high lead copper ores. Their exploration is very unlikely in the context of the general cultural processes in the regions under discussion.

The precise analogies between Dubene-Sarovka pottery and Pernik-Krepostta and Radomir-Vakhovo ceramics from the Upper Struma valley in Southwestern Bulgaria (Nikolova 1999, fig. 9/6) indicate the presence of another active EB route that crossed the western Sredna Gora Mountains. It is worth specifying, in compare to Dubene-Sarovka, that the EB II false corded earthenware was not popular at Yunatsite (respectively on the Topolnitsa communication route). This ornamentation was shared by Dubene-Sarovka and Plovdiv-Nebet Tepe from the Yunatsite culture in Western Upper Thrace (Nikolova 1996, fig. 22), the Pernik-Krepostta population from Pernik group, and the northwestern periphery of the Ezero culture – EB II Dolno Sakhrane (Nikolova 1999a, fig. 9.6/12).

The distribution of EB metal finds in Southwestern Bulgaria indicates that the region was not a developed metalworking center. Metal finds from this region would indicate that it depended mainly on trade. Further investigation will specify the nature of the interaction between the Dubene-Sarovka metalwork and Western Bulgaria. It is reasonable to propose that the ceramic similarity between the two is a sign of more multifaceted contacts and interactions that includes trade in metal objects, as well.

Dubene-Sarovka and Fundeni flange-axes have been found in two regions divided by the highest parts of the Stara Planina Mountains, which were a serious communicative barrier in prehistory. However, analysis of recent archaeological data infers that there were contacts between the two through the central Stara Planina Mountains during the Early Bronze Age (see in details in Николова, in print). This, in turn, makes it possible to believe that the metal finds from Dubene-Sarovka metal finds were exported to north. This model stands in contrast to the state of research in 1970s when Balkan flange-axes were known mostly from the lower Danube and



Diffusionist model - one center, from wich the discovery or inventions are distributed outside the local system

Indigenous model - one and the same inventions occur in different cultural system without mutual influence

Interactive model - the innovations are distributed in two systems as a result of multifaceted mutual interactions

Fig. 4. Different models of distribution of innovations in prehistory. For the variety of the interactive models see Nikolova 1991.

were accepted as exceptional finds in Upper Thrace (Черных 1978).

In the eastern Upper Thrace, the EB bronze metallurgy was significantly developed according to the data from Ezero and the numerous documented metal finds (Черных 1978; Nikolova 1999a). The shared common cultural standards of the Ezero and the Yunatsite culture in western Upper Thrace included the metallurgy, but lead-bronze in the Ezero culture. Nevertheless, the flange-axe from Ovcharitsa, for the time being, is the earliest documented example of axes in western Upper Thrace from east. But additional data are needed to decide the initial distribution of the flange-axes in the Balkans and of the nature of contacts between metallurgists from both micro-regions.

Whether the Dubene-Sarovka population acquired their knowledge through diffusion of the metallurgical innovation or independent innovation remains to be tested. The benefit of conducting a cultural contextual analysis of the prehistoric metalwork is the possibility to recognize whether similarities are an isolated feature of the cultural system, or only an element of a multi-aspect interacting system. Yakar's critiques of Muhly's diffusionist model for the diffusion of arsenic-bronze (Yakar 1984, 59-60) did not specify any alternative models for the distribution of the common technology. In some cases, it is based on insufficient logical arguments (Gale *et al.* 1985, 145).

Conclusions and summary

The flange-axe from Dubene-Sarovka revealed new important technological aspects of Upper Thracian bronze metallurgy. As the find was discovered in the destroyed uppermost culture layer of Dubene-Sarovka tell, it generally dates from EB II-III. But the site's context and similarity with the Glina culture find from Fundeni are arguments for inferring an EB II chronology for the find (earlier third millennium BC). The flange-axe belongs to Fundeni-Dubene type and was made of lead-bronze. It was probably used for lumbering and wooden-working, but it also functioned as social prestige-sign and weapon as well.

The increased frequency of finds of flange-

axes from Southern Bulgaria, including evidence of their local production, forces a revision of the conclusion of E. Chernykh that the so-called axe-chisels were general characteristics of the north of Bulgaria (Черных 1978, 156).

Technological and contextual analysis of the axe is a foundation to argue that it was a local product. This would indicate that Dubene-Sarovka was a center for production of EB metal finds in the Central Balkans. It is possible that the lead ore may have come from the Sredna Gora Mountains and the find was produced by household professionals. However, this hypothesis needs future investigation. It can be assumed the metal finds were exchanged through the Stryama River, as well as through Trans-Stara Planina or Sredna Gora / Trans-Stara Planina communication routes.

From a technological point of view, the employ of lead copper alloy in the bronze metallurgy of Upper Thrace is of importance. In this context, the Dubene-Sarovka axe is an exceptional EB find in Upper Thrace. It is found in a period when the arsenic-bronze and unalloyed copper finds dominated the Balkans. Leaded bronze was a significant copper alloy in Anatolia and in the Aegean. It spread in the Balkans because of its possibility to improve the qualities of the copper. This innovation was a valued aspect of the metallurgical activities toward discovering of the tin-bronze. It seems that rich in lead copper ores were used in the extracting process. But the innovation of the lead copper alloy might have been diffused into the Balkans from the south or southeast (from Troada, or from an Anatolia – the Aegean – the Balkans communication route) as an element of multifaceted mutual interactions.

Despite the fact that metallurgy in the Balkans was technologically connected with the Aegean and Anatolia, the typological analysis indicate another line of interactions – Central Europe. That line was especially strong in the Final Copper Age and continued in Early Bronze Age, as exemplified by common metalsmith products, such as daggers and flange-axes.

The Dubene-Sarovka flange-axe occurred in the context of a developed EB social hierarchy and an emergence of initial chiefdoms in the Balkans. It is itself a record of increased process of social differentiation.

In this paper, it has been shown that the identification of technological similarities between the metalwork of distant and close cultures in the Balkans, the Aegean and Anatolia is not straightforward. It concerns certain elements that were distributed in by multidirectional interactions - see also Николова 1991; Николова 1992; Nikolova 1993; Nikolova 1994. The case study presented from the Upper Stryama valley proposes an interaction model in which communities and individuals were involved, not only finds and resources. It was also suggested that Balkan prehistoric household economy was based on the interactions with cultures in different directions. This model stands in contrast to both the diffusionist and independent models for the distribution of the innovations (**fig. 4**).

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BIBLIOGRAPHY

Георгиев, Г. И./ Мерперт, Н. Я./ Катинчаров, П. В./ Димитров, Д. Г. 1978. Езеро. Раннобронзовото селище. Софоя.

Детев, П./ Мацанова, В. 1977. Присторическото селище при с. Огняново. – Известия на музеите от Южна България 3, 45-86.

Николова, Л. (in print). Праисторическото развитие и планинските комуникационни коридори в Средна Гора и Стара планина (проблеми на интерпретацията на археологическите извори). - Старопланински проучвания (in print).

Николова, Л. 1992. Поява и разпространение на надгробните могили в Карпато-Балканския регион (ранна бронзова епоха). - Археология 3, 1-10.

Николова, Л. 1991. Проблеми на културните взаимоотношения между Югоизточна и Централна Европа. Автореферат на кандидатска дисерта-

ция. София.

Николова, Я./Ангелов, Н. 1961. Разкопки на Еменската пещера. – Известия на Археологическия Институт 24, 297-316.

Черных, Е.Н. 1978. Горное дело и металлургия в древнейшей Болгарии. София.

Aslanis, I./ Tzachili, I. 1995. Chalkolithische und frühbronzezeitliche Metallfunde aus Nordgriechenland – ihre Beziehungen zur balkanischen und anatolischen Metallurgie. In: Jovanović, B. (ed.). Ancient Mining and Metallurgy of Southeastern Europe. International Symposium. Archaeological Institute and Museum of Mining and Metallurgy. Belgrade/ Bor. 89-94.

Branigan, K. 1974. Aegean Metalwork of the Early and Middle Bronze Age. Oxford.

Bagolini, B./ Pedrotti, A. L. 1998. Atlas du Néolithique Européen. Vol. 2. Liège.

Charles, J. A. 1980. The coming of copper and copper-base alloys and iron: a metallurgical sequence. In: Wertime, Th.A./ Muhly, J. D. (ed.). The Coming of the Age of Iron. 151-181.

Çukur, A./ Kunç, Ş. 1989. Analyses of Tepecik and Tülintepe Metal Artifacts. - Anatolian Studies 39, 113-120.

Gale N. H./ Stos-Gale, Z. A./ Gilmore, G. R. 1985. Alloy types and copper sources of Anatolian copper alloy artifacts. -Anatolian Studies 35, 143-173.

de Jesus, P. S. 1980. The Development of Prehistoric Mining and Metallurgy in Anatolia. BAR International Series 74. BAR. Oxford.

Jovanović, B. 1985-1986. Arheometalurgija i hronologija eneolitskih kultura centralnog i južnog Balkana. - Macedoniae Acta Archaeologica 10, 47-53.

Korfmann, M./ Kromer, B. 1993. Demircihüyük, Beşik-Tepe, Troia – eine Zwischenbilanz zur Chronologie dreier Orte in Westanatolien. - Studia Troica 3, 135-71.

Kunç, Ş. 1986. Analyses of İkiztepe metal artifacts. - Anatolian Studies 36, 98-101.

Lozuk, J. 1995. A problem of the Baden Group metallurgy at the site of Saloš-Donja Vrba near Slavonski Brod. In: Jovanović, B. (ed.). Ancient Mining and Metallurgy of Southeastern Europe. International Symposium. Archaeological Institute and Museum of Mining and Metallurgy. Belgrade/ Bor. 55-58.

Maran, J. 1998. Kulturwandel auf dem griechischen Festland und den Kykladen. Studien zur kulturellen Verhältnissen in Südosteuropa und dem zentralen sowie östlichen Mittelmeerraum in der später Kupfer- und frühen Bronzezeit. 1-2. Bonn.

Naylor, L. 1996 Culture and Change. Westport, Connecticut/ London.

Nikolova, L. 2000a. The Yunatsite culture: Periodization, chronology and synchronizations. - RPRP (1999) 2-3, 33-97.

Nikolova, L. 2000b. Social transformationa and evolution in the Balkans in the Fourth and Third Millennia BC. In: Nikolova, L. (ed.). Analyzing the Bronze Age. Contributions to the Prehistoric Cultural Pattern in the Balkans. (=RPRP 4). 1-8.

Nikolova, L. 2000c. Dubene-Sarovka-Yunatsite Culture and the Integrations in the Early Bronze Balkans. In: Nikolova, L. (ed.). Technology, Style and Society. Contributions to the Innovations between the Alps and the Black Sea. BAR International Series 854. 201-239. Oxford.

Nikolova, L. 1999a. The Balkans in Later Prehistory. Periodization, Chronology and Cultural development in the Final Copper and Early Bronze Age (Fourth and Third Millennia BC). BAR International Series 791. Oxford

Nikolova, L. 1999b. Dubene-Sarovka IIB1-3 in the Upper Stryama valley (Towards the periodization and chronology of Early Bronze II in the Balkans). - Archaeologia Bulgarica 3, 1-7.

Nikolova, L. 1993. The Problem of the Diffusion of the Cremation Rite (Baden - Kostolac – Coţofeni). In: Pavúk, J. (ed.). Actes du XIIe Congres International des Sciences Préhistoriques et Protohistoriques. Bratislava, 1-7 september 1991. Institut archéologique de l'Académie Slovaque des Sciences. Nitra/ Bratislava. 561-564.

Nikolova, L. 1994. Data about sea contacts during the Early Bronze Age in South-Eastern Europe (c. 3500/3400 – 2350/2250 B.C.). - Thracia Pontica 5, 57–81.

Nikolova, L./ Görsdorf, T., in print. New radiocarbon dates from the Balkans (Dubene-Sarovka). Approach to the Early Bronze Absolute chronology in Upper Thrace. - Radiocarbon.

Parzinger, H. 1993. Studien zur Chronologie und Kulturgeschichte der Jungstein-, Kupfer- und Frühbronzezeit zwischen Karpaten und Mittlerem Taurus. Mainz am Rhein.

Renfrew, C. 1986. The excavated area. In: Renfrew, C./ Gimbutas, M./ Elster, E. (ed.). Excavations at Sitagroi. A Prehistoric Village in Northeast Greece. Vol. 1. Los Angeles. 175-222.

Roman, P. 1987. Cercetări la Govora Sat – "Runcuri"în 1977. - SCIVA 36, 2, 279-297.

Schuster, C. F. 1997. Perioada Timpurie a Epocii Bronzului în Bazinele Argeşului şi Ialomiţei Superioare. Institutul Român de Tracologie. Bibliotheca Thracologica 20. Bucureşti.

Spindler, K. 1994. The Man in the Ice: The Discovery of a 5,000-Year-Old Body Reveals the Secrets of the Stone Age. New York.

Tylecote, R.F. 1980. Furnaces, crucibles, and slags. In: Wertime, Th.A./ Muhly, J.D. (ed.). The Coming of the Age of Iron. 183-228.

Vajsov, I. 1993. Die frühesten Metalldolche Südost- und Mitteleuropas. - PZ 68, 103-145.

Vulpe, A. 1996-1998. Toporul de bronz de la Gostini (jud. Giurgui). - Buletinul Muzeului "Teohari Antonescu" 2-4, 122-126.

Wertime, Th.A./ Muhly, J.D. (ed.) 1980. The Coming of the Age of Iron. New Haven/ London.

West, E.G. 1982. Copper and its alloys. Chichester.

Wheeler, T.S./ Madden, R. 1980 Metallurgy and Ancient Man. In: Wertime, Th.A./ Muhly, J.D. (ed.). The Coming of the Age of Iron. 99-126.

Yakar, J. 1985. Regional and local schools of metalwork in Early Bronze Age Anatolia. Part 2. - Anatolian Studies 35, 25-38.

Yakar, J. 1984. Regional and local schools of metalwork in Early Bronze Age Anatolia. Part 1. - Anatolian Studies 34, 59-86.

Yener, A. 2000. The Domestication of Metals: The Rise of Complex Metal Industries in Anatolia. Boston/ Köln.

БРОНЗОВА БРАДВА ОТ РАННОБРОНЗОВО СЕЛИЩЕ ДЪБЕНЕ-САРОВКА (ПРОИЗВОДСТВО, ФУНКЦИЯ И СОЦИАЛЕН КОНТЕКСТ)

Лолита Николова

(резюме)

През 1994 г., по време на разкопки на раннобронзово селище Дъбене-Саровка (община Карлово, **фиг. 1**), бе открита бронзова брадва (**фигури 2, 3**). Тя има трапецовидно надлъжно сечение. Надлъжни й ръбове са слабо завити към тялото на брадвата. Размерите й са: дължина – 17 см, макс. ширина – 4 см, макс. дебелина – 2,6 см. Брадвата е определена като тип Фундени-Дъбене. Металографският анализ показва висок процент на олово - 2,11% (2,50%). Според данни от Западна Европа, този вид брадви са използвани чрез прикрепена към тесния край дървена дръжка.

Плоските брадви със завити навътре надлъжни ръбове имат сходна функция с едноострите брадви с отвор (водещ тип на Балканите през ранен бронз II-III) – сечещо оръдие в дървообработване и в домакинство. Контекстуалният анализ дава възможност да се допусне, че металните брадви са също оръжие, както и престижен социален символ през ранната бронзова епоха.

Брадвата от Дъбене-Саровка е открита в найгорния разрушен пласт на селищната могила. Относителната хронология на последната е ранен бронз II-III, но може да се допусне по-тесен хронологичен обхват – ранен бронз II (първа половина на III хил. пр. Хр.).

В статията е аргументирана теза, че Дъбене-Саровка е новооткрит раннобронзов център за производство на метални предмети на Балканите. Подчертава се, че нови данни поправят изводите на Е. Черних за северозападен (централноевропейки) произход на разглеждания вид брадви и за преимущественото им разпространение в Северна България, в сравнение с Южна България.

Появата на оловен бронз в тракийското метално производство е свързвана с разпространението на тази нова идея в Анатолия и Егея. Предполагат се контакти между последните две области от една страна и Тракия от друга. Същевременно се подчертава се, че данните за олово в Тракия от раннобронзовата епоха се срещат заедно с тези за сребро (селищна могила Юнаците, Пазарджишко).

Предложеният културен модел на многоаспектни взаимодействия между балканските култури, Егея и Анатолия контрастира както на дифузионния, така и на модела на независима поява на технологични новости. Първият се основава на двустранни и многостранни взаимодействия, а не на еднопосочно влияние или на изолираност на културните общности в праисторията.

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