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Viktor I. Klochko*

YAMNAYA CULTURE HOARD OF METAL OBJECTS, IVANIVKA, LOWER MURAFA: AUTOGENESIS OF 'DNIESTER COPPER/BRONZE METALLURGY'

ABSTRACT

In 2015 near the village of Ivonivka, Mohyliv-Podilskyi Region, Vinnytsia *Oblast*, a hoard of copper objects was found by chance by the River Murafa. The majority of objects belonging to the hoard were fashioned out of a rather pure copper with a combination of admixtures, which can be named 'the Ivonivka group'.

Key words: hoard, yamnaya culture, Middle Dniester Area

Up to only some years ago among the research results of barrow complexes along the Middle Dniester – *Kamenka/Ocniţa and Yampil barrow cemetery complexes* there was a lack of data related to metal objects from the Yamnaya culture (YC) and decline phase of Eneolithic culture [Manzura, Klochko, Savva 1992; Kośko, Potupczyk, Razumow (Eds) 2014; Kośko (Ed.) 2015; Klochko *et al.* 2015]. In this context, the discovery of a hoard of metal goods near the village of Ivonivka in the upper course of the Murafa, has significantly changed our conception of the beginnings of copper metallurgy and early phases of its development in this northern part of the Black Sea Region.

In 2015 near the village of Ivonivka, Mohyliv-Podilskyi Region, Vinnytsia *Oblast*, a hoard of copper objects was found by chance by the River Murafa [Klochko, Kozymenko 2016: 2.1.16]. The circumstances related to the discovery of the hoard, precise localisation and its connection to the settlement or encamp-

* Department of Archaeology National University of Kyiv-Mohyla Academy, Skovorody 2, 04665 Kyiv, Ukraine; vklochko@ukr.net

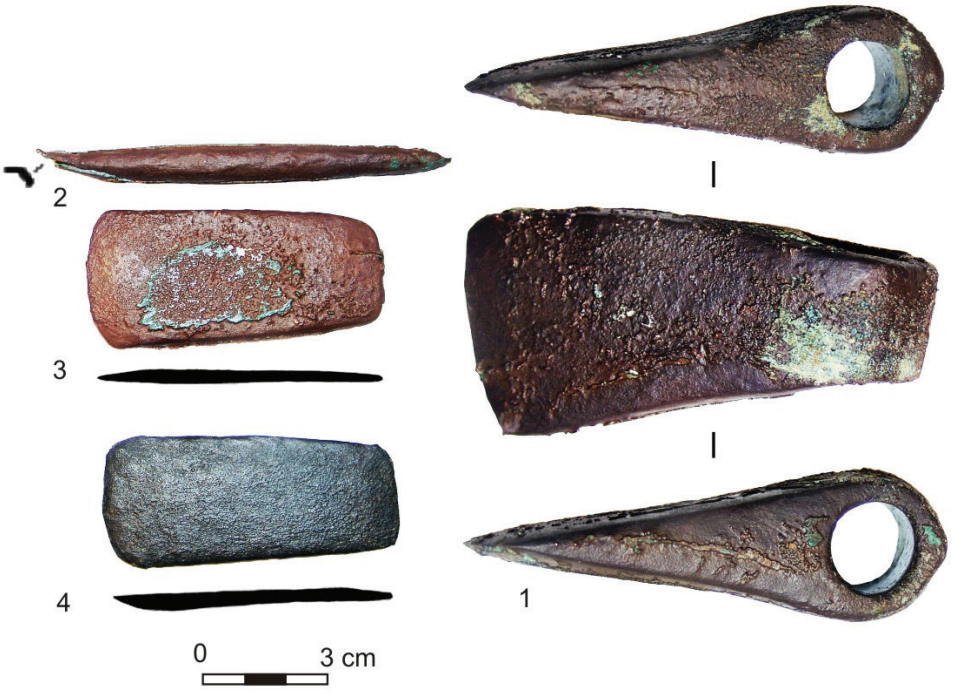

Fig. 1. Hoard from Ivonivka. Ivonivka, Mohyliv-Podilskyi Region, Vinnytsia *Oblast* [*after* Kolchko, Kozymenko 2016]. *See* Tab. 1: 1 – analysis number 1330. 2 – analysis number 1331, 3 – analysis number 1328, 4 – analysis number 1329

ment, remain unknown. The discovery though, on the western border of the *Yampil barrow cemetery complex* is in a particular way associated with it [Potupczyk, Razumow 2014: Fig. 1.2: 1].

1. DESCRIPTION OF THE IVONIVKA HOARD

The hoard contained: 1. shaft-hole axe, length 11.2 cm, blade width 5.4 cm, butt width 2.8 cm, butt diameter 2.1 and 2.2 cm; 2. bit, length 10.1 cm, diameter 1.0 cm; 3. adze, length 7.6 cm, blade width 3.6 cm, thickness 0.6 cm; 4. adze, length 7.4 cm, blade width 3.2 cm, thickness 0.4 cm (Fig. 1).

A spectral analysis of objects from the hoard was conducted by T.Yu. Goshko at the laboratory of the Institute of Archaeology, NAN Ukraine (Tab. 1).

Table 1

Spectral analysis of objects conducted by T.Yu. Goshko at the laboratory, Institute of Archaeology, NAN Ukraine

Analysis number	1328	1329	1330	1331	1359	1360	1361	1362	1363	1364	1355	1356	1357	1358	1332	1327	1042	1145
Figures	Fig. 1: 3	Fig. 1: 5	Fig. 1: 1	Fig. 1: 2	Fig. 2: 5	Fig. 2: 3	Fig. 2: 4	Fig. 2: 8	Fig. 2: 8	Fig. 2: 9	Fig. 5: 3	Fig. 5: 5	Fig. 5: 4	Fig. 5: 2	Fig. 7: 1	Fig. 7: 2	Fig. 11: 1	Fig. 11: 2
Ag	0,043	0,028	0,045	0,078	0,037	0,043	0,049	0,013	0,036	0,069	0,007	0,007	0,02	0,036	0,011	0,012	0,039	0,033
Al.																		0,117
As		1,187	0,26												1,137	1,443		2,115
Bi	0,002			vestigial		vestigial		vestigial		vestigial	vestigial					0,009		
Ca	0,006	0,006	0,003		0,029	0,032	0,056	0,294	0,463	0,399	0,015	0,205	0,281	1,414	0,016	0,011	0,408	0,048
Cl	0,024	0,053	0,014	0,043	0,749	1,396	0,66	0,799	0,101	0,244			0,031	0,12		0,036	0,359	0,285
Co	0,035																	
Cr	0,019	0,024	0,025	0,021	0,025	0,023	0,031		0,034						0,029			0,022
Cu	99,04	97,99	99,2	99,41	98,73	97,63	98,18	92,77	96,7	96,62	99,36	97,95	97,88	95,94	96,45	96,84	97,33	96,64
Fe					0,005	0,096	0,014	0,304	0,317	0,039	0,029	0,178	0,062	0,195	0,007	0,008	0,293	0,049
Na																	0,221	
Ni	0,04	0,01	0,03	0,064	0,009										0,04	vestigial		
P	0,082	0,055									0,078							0,173
Pb	0,021	0,007		0,038	0,026	0,017	0,024		0,055		0,014	0,02	0,038	0,082	0,019			
S	0,081	0,174	0,071	0,095	0,14	0,139	0,505	3,66	0,539	0,529	0,086	0,091	0,302	0,529	0,446	0,32		0,093
Sb	0,023	0,022	0,03												0,01		0,066	
Si	0,524	0,372	0,254	0,209	0,226	0,588	0,442	2,105	1,334	1,831	0,369	1,526	1,331	1,556	1,804	0,87	1,206	0,355
Sn	0,045	0,034	0,025	0,028	0,031	0,036	0,041	0,052	0,096	0,079	0,035	0,023	0,054	0,126	0,03	0,049	0,077	
Tb		0,024	0,03	0,014														
Te	0,013	0,014	0,013													0,027		
Ti									0,321	0,188								0,072

The majority of objects belonging to the hoard were fashioned out of a rather pure copper with a combination of admixtures, which can be named 'the Ivonivka group' (Tab. 1: An. nr. 1328 – 1331), whereby one of the adzes was made out of an arsenic metal alloy from the arsenic group, whose contents is greater than 1% (see below for the chronology of arsenic bronzes appearing in the region).

The shaft-hole axe from the Ivonivka Hoard was cast in a 'close' two-part mould (Fig. 1: 1), of a rather advanced technology. This ought to be related to a later chronology, to that of a 'late pit grave' phase, which in the middle drainage basin of the Dniester is dated to 2650-2500 BC [*Yampil dating* of the decline YC – Goslar *et al*. 2015: 281-282]. In respect to this axe, in my opinion, the description '**Ivonivka type**' is the best fit, belonging to the decline YC.

The objects from the Ivonivka Hoard (Fig. 1: 2) are one of a kind; it is the first discovery of such a find of a metal tool from the early Bronze Age in the northern Black Sea Region. The artefacts from the hoard (Fig. 1: 3, 4) have a similar form to that of Eneolithic 'Usatovo' and 'Maykop' flat axe-adzes in the Anatolia tradition, though differing significantly in their smaller dimensions, though among 'Maykop' samples there also occur similarly small products (Fig. 12: 4-6; 7).

It is possible to suggest that the 'Ivonivka Hoard' reflects the craftwork of a master carpenter, which ought to be dated to the late phase of the YC. It is particularly interesting to find analogies of this with the wooden cart from site 6 in Pysarivka near Yampil [Harat, Potupczyk, Razumow 2014: 142-145] in respect to its possible constructors and place of workshop.

2. THE IVONIVKA HOARD IN THE CONTEXT OF RESEARCH ON THE OLDEST METALLURGY IN THE EASTERN CARPATHIANS, PODOLIA AND VOLHYNIA.

The other signs of metallurgy in the eastern Carpathians, Podolia and Volhynia continue to find little study. The research of N.V. Ryndina on the metallurgy of this region [Ryndina 1971, 1980, 1998] despite everything have left the exploitation of local deposits by the most chronologically distant of regional metallurgists an unresolved question.

Our research, conducted together with geologists and metallurgists have somewhat broadened our concept of copper ores in the region and their exploitation in the period of the Tripolye culture [Klochko *et al*. 2000; Kloczko *et al*. 2003].

Yu.N. Maleev [1976] wrote on the local metallurgy in the decline Bronze Age – on the basis of materials from the Myshkovychi site, Gava-Holihrad culture as did Goshko [2011] – the basis of spectral and metalographic research of objects from the cemetery complex in Hordiyivka (Gordievka).

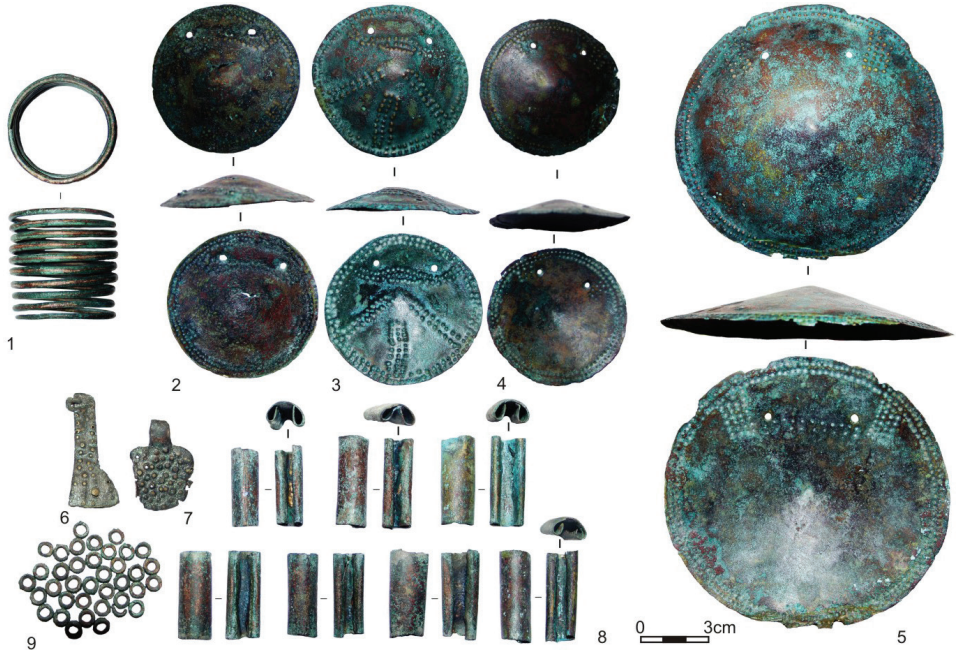

Fig. 2. The hoard from the Velyka Kisnytsia site, Yampil Region, Vinnytsia *Oblast* [*after* Klochko, Kozymenko 2016]. *See* Tab. 1: 3 – analysis number 1360, 4 – analysis number 1361, 5 – analysis number 1359 1361, 8 – analysis number 1362,1363, 9 – analysis number 1364

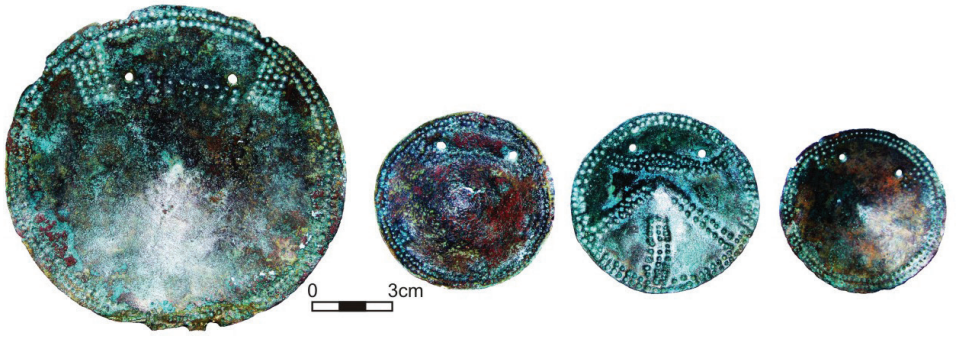

Fig. 3. Discs from the Velyka Kisnytsia hoard, Yampil Region, Vinnytsia *Oblast*

The above research field gained further perspective in the Carpathian – Volhynia "Willow Leaf" study at the Metallurgy Centre of the 'Circum-Pontic metallurgical province' [Klochko, Klochko 2013: 54-55].

The most recent attempt to use information gained at commercial Internet auctions related to new complexes of the Cucuteni-Tripolye culture, discovered through the use of metal detectors on the Dniester drainage basin and eastern Carpathians undertaken by V. Dergachev [2016], demonstrated the significant potential of this research direction in the context of a total disintegration of relic preservation in post-Soviet Eastern Europe.

The above-mentioned article brings to research practice in particular complexes and objects from a huge collection, studied, investigated and recently published by us [Klochko, Kozymenko 2016], which to a significant degree change our concept of the metallurgy of prehistoric communities in the Eastern Carpathians and Podolia.

2.1. CONTEXT OF THE OLDEST, ENEOLITHIC METALLURGY IN THE MIDDLE DNIESTER DRAINAGE BASIN AND PODOLIA.

First and foremost, four new complexes subject to research have been introduced, discovered both in the area of the (a) *Yampil barrow cemetery complex* and (b) in neighbouring regions, situated more to the west of Chernivtsi *Oblast*, Khmelnytska *Oblast* and Ternopil *Oblast*.

a. The hoard from the *Yampil barrow cemetery complex*: Velyka Kisnytsia Yampil Region, Vinnytsia *Oblast*.

In 2015 a hoard of copper objects was found near the village of Velyka Kisnytsia, at the Tripolye culture settlement, dated to period B [Klochko, Kozymenko 2016: 1.2.48]. The 'Velyka Kisnytsia Hoard' contained: 1. A multi-coil bracelet (?) from a rod with a diameter of 0.3 cm, diameter 15 cm, length 5.2 cm (a second, similar bracelet, damaged by a plough, was not included in the collection); 2. Disc, ornamented punch, diameter 7.8 cm, height of cone 1.3 cm; 3. Disc, ornamented punch, diameter 8.5 cm, height of cone 1.4 cm; 4. Disc, ornamented punch, diameter 7.8 cm, height of cone 1, 1 cm; 5. Disc, ornamented punch, diameter 14 cm, height of cone 2.6 cm; 6. Pendant, measuring in length 4.8 cm; 7. Pendant measuring in length 3.5 cm; 8. Double-twined piped beads measuring in length from 3.7 to 4.4 cm, thickness from 1.5 to 2.0 cm; 9. Round beads with a diameter of 0.6 cm. (Fig. 2).

Of particular note are the discs found in the hoard, ornamented by means of indentation in the form of anthropomorphic figures (?), Similar to Eneolithic goods from the Dunaj Region (Fig. 3).

The 'Velyka Kisnytsia Hoard' is the oldest hoard of copper objects from the Tripolye culture, among those found in Ukraine. On the basis of chronological analysis of ceramic ware from the settlement (conducted by M.Y. Videiko) it can

Fig. 4. Finds from hoards in Romania: Brad (1-3) and Hăbăşeşti (4) [*after* Mareş 2012]

be dated to the BI phase of this culture. Objects from the hoard possess analogies to those from Romania, the Hăbăşeşti settlement and Brad Cucuteni culture, phases A2-B1 [Mareş 2012] (Fig. 4).

The copper in the 'Velyka Kisnytsia Hoard', on the basis of micro-admixtures content, can be divided into two basic groups: An. 1362 – 1364 and An. 1359 – 1361. The latter is similar to the metal from the 'Ivonivka Hoard' (Tab. 1). The similarity of micro-admixtures content in copper from hoards of such diverse chronology points to the one and the same, clearly local, source of raw materials.

Fig. 5. The Kelmentsi Hoard. Kelmentsi Region, Chernivtsi *Oblast* [*after* Klochko, Kozymenko 2016]. *See* Tab. 1: 2 – analysis number 1358, 3 – analysis number 1355, 4 – analysis number 1357, 5 – analysis number 1356

Fig. 6. Letychiv Hoard. Letychiv Region, Khmelnytskyi *Oblast* [*after* Klochko, Kozymenko 2016]

Fig. 7. The hoard from the Loshniv site, Terebovlia Region, Tarnopil *Oblast* [*after* Klochko, Kozymenko 2016]. *See* Tab. 1: 1 – analysis number 1332, 2 – analysis number 1327

Clearly, these are Dniester copper-bearing sandstones, whose exploitation by Tripolye culture metallurgists has already been recorded [Klochko, *et al*. 2000; Kloczko, *et al*. 2003] on the basis of materials in the Upper Dniester drainage basin.

b. Hoards from the Dniester drainage basin, found beyond the *Yampil barrow cemetery complex*:

(ba) hoard of ornaments, Kelmentsi Region, Chernivtsi *Oblast*, represents the local crafts of several types of ornaments from the decline Tripolye culture, from local raw materials; (bb) assemblage, discovered Letychiv Region, Khmelnytskyi *Oblast* most likely related to the work of ornamentation is of miners, perhaps also

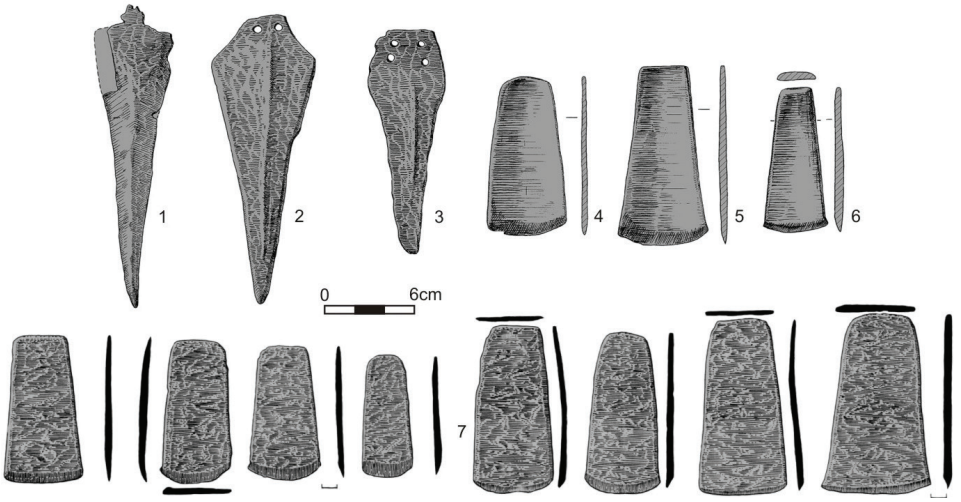

Fig. 8. Daggers and flat axe-adzes of the Usatovo culture, Odessa *Oblast* and Moldavia: 1. Usatovo 1.1.1; 2. Usatovo 1.3.1; 3. Sucleia 3; 4. Usatovo 1.9.8; 5. Usatovo 1.13; 6. Usatovo 1.12.1. [*after* Klochko 2001]. Flat axe-adzes of the Maykop culture, northern Caucasus: 7 [*after* Chernykh 1966]

miners of ore; (bc) assemblage from the village of Loshniv, Terebovlia Region, Tarnopil *Oblast*, as the first find of arms and work tools belonging to the Gordineşti group, late Tripolye culture.

ba. In 2015, Kelmentsi Region, Chernivtsi *Oblast*, a hoard was found (Fig. 5) [Klochko, Kozymenko 2016: 1.2.49] at the Tripolye culture settlement.

The 'Kelmentsi Hoard' found in a vessel from the CI stage of the Tripolye culture, contained: 1. Vessels; 2. Spiral twined beads; 3. Chisel (length 10 cm; thickness 1 cm; blade width 1.6 cm); 4. Rings; 5. Funnel beaker pendants (Fig. 5). This is the first hoard of a Tripolye master craftsman – of copper ornaments. Metal, from which the goods were made, part of this hoard, is homogenous (Tab. 1: An. 1355 – 1358) and another sample, analogous to the raw material of products from the settlement of Hlybochok [Klochko, *et al*. 2000; Kloczko, *et al*. 2003].

bb. Indirect proof of local copper extraction in the Eneolithic is the hoard, discovered in 2005 Letychiv Region, Khmelnytskyi *Oblast* [Klochko 2016: Drawing 5] (Fig. 6).

The 'Letychiv Hoard' contains four objects: a unique, massive shaft-hole axe-mattock with a long pipe sleeve, measuring in length 15 cm; a miniature axe-adze, measuring in length 11 cm (sceptre head) and two pendants in the form of axe-adze models, measuring in length 5.2 and 3.4 cm (Nicholas elements). In general, these finds as a whole remind us not a hoard, but the grave furnishings of an ore miner (axe-mattock models in the form of a sceptre and pendants can be understood as examples of the secularisation of work tools belonging to ore miners and their work).

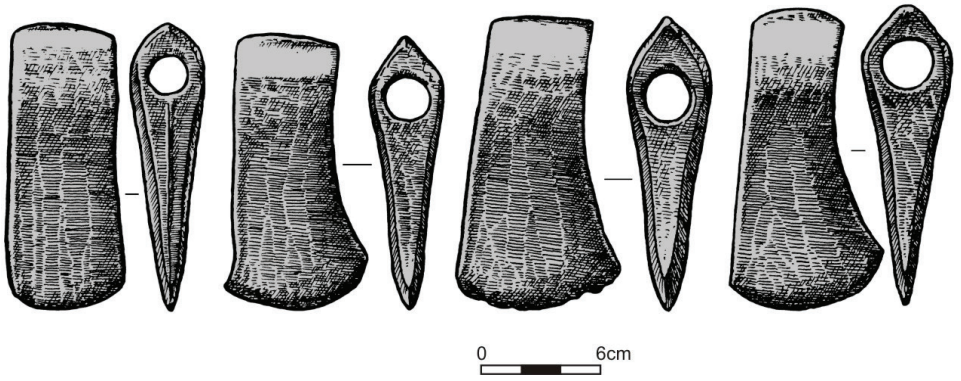

Fig. 9. Main axe types of the hoard from Vîlcele (Baniabic/Bányabükk), Cluj, Transylvania, Romania [*after* Vulpe 1970]

bc. In 2016 a hoard was discovered near the village of Loshniv, Terebovlia Region, Tarnopil *Oblast* (Fig. 7) [Klochko, Kozymenko 2016: 1.3.49].

The hoard from the Loshniv site contains: a Mediterranean dagger (Usatovo), length 20.4 cm, thickness 0.5 cm, handle width 5.2 cm (an. nr 1332) and adze (flat shaft-hole axe) Small-Asian (Usatovo, or also Maykop), length 13.6 cm, thickness 0.5 cm, blade width 5.6 cm (an. nr 1327) (Fig. 7, Tab. 1). Both objects were fashioned out of arsenic bronze. Such an assemblage of objects (dagger and shaft-hole axe) is characteristic for 'Princely' burials of the Usatovo (group), late Tripolye culture [Klochko 2001: 43-49, Fig. Tab. 1, 9; Klochko 2006: 34-37, Drawing 9, 11]. Similar, flat axe-adzes are also known in Maykop culture in the northern Caucasus [Chernykh 1966] (Fig. 8). Usatovo products fashioned out of arsenic bronze, Anatolia type, are considered to be the oldest products fashioned out of bronze in the northern Black Sea area [Ryndina, Konkova 1982]. The hoard from the Loshniv site, which in all probability belongs to the Gordineşti group, late Tripolye culture, demonstrates that arsenic bronzes of the Anatolia type are becoming widespread from the second half of the 4th mill. BC in the entire Dniester drainage basin as far as its northern course.

2.2. THE CONTEXT OF 'EARLY BRONZE' METALLURGY ON THE MIDDLE DNIESTER DRAINAGE BASIN AND PODOLIA.

The 'Ivonivka Hoard'– the first such find in Ukraine and the second after the 'Vîlcele or Baniabic/Bányabükk Hoards', discovered in Romania, Cluj, Transylva-

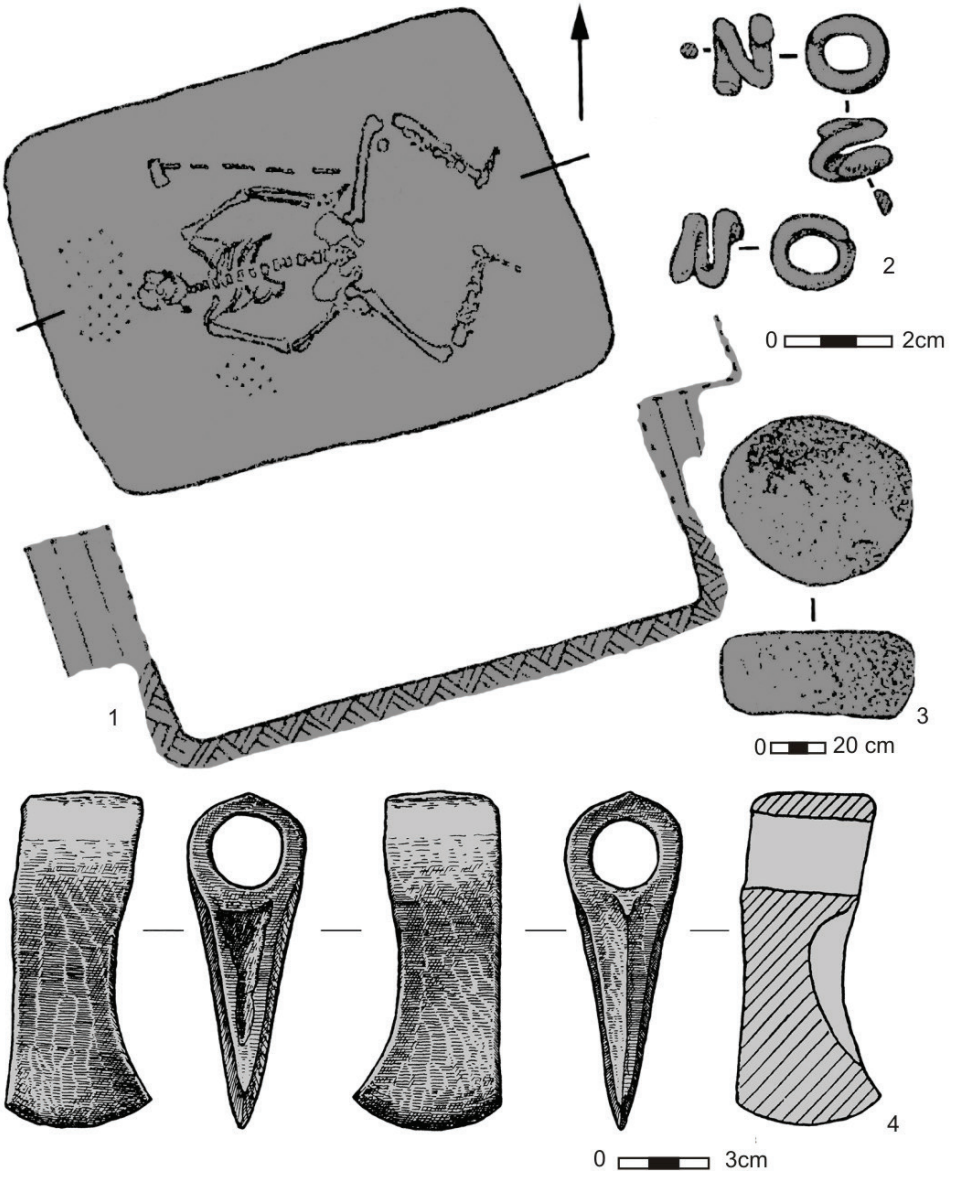

Fig. 10. The barrow near the village of Pidlissia, Brovary Region, Kiev *Oblast*, Ukraine, burial 1/2 (1); Silver Temple rings (2); shallow navy blue-pestle (3); copper shaft-hole axe (4). [*after* Bratchenko, Klochko, Soltys 2000]

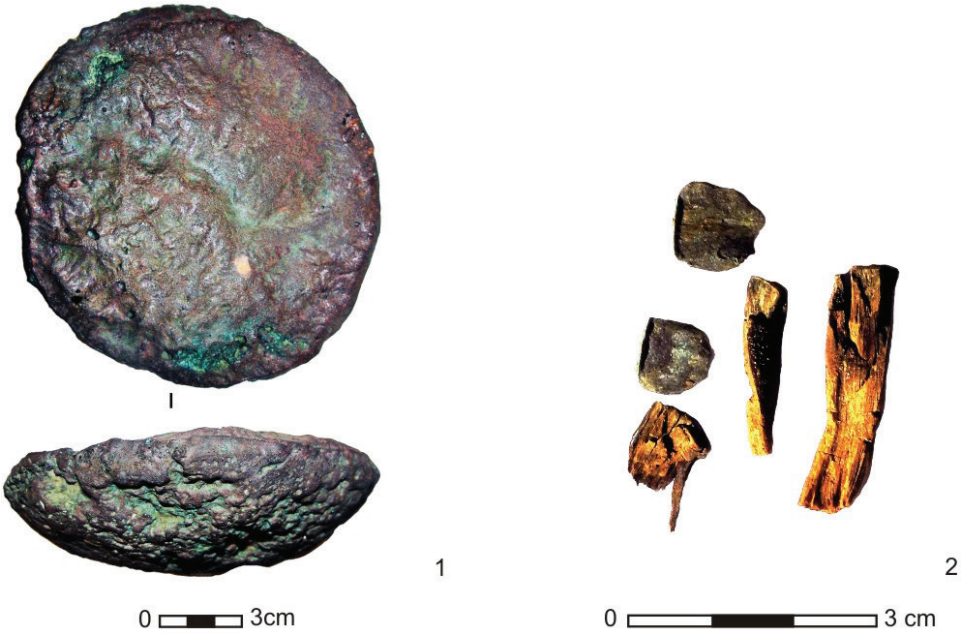

Fig. 11. Metal objects: 1 – ingot of 'raw copper' from the Humentsi site, Kamianets Region, Khmelnytskyi *Oblast* [*after* Klochko, Kozymenko 2016]; 2 – bronze tiles from the inhumation, Prydnistryanske I/4 [*after* Klochko, *et al*. 2015]. *See* Tab. 1: 1 – analysis number 1042

nia [Roska 1933; Vulpe 1970, 27, № 1–32, Taf. 1, Taf. 2, Taf. 3. 25–32] in respect YC hoards. The 'Vîlcele Hoard' contained 32 objects – only axes – whereas the 'Ivonivka Hoard' boasts an entire set of tools for fashioning wood: shaft-hole axe, two adzes and a bit, being the first such hoard of a master-carpenter of the YC.

Despite the fact that the axes from the 'Vîlcele Hoard' are rather differentiated in respect to their form and technology of production (some were cast in open-cast moulds, while others – enclosed two-part moulds, whereby in the latter the respective axe forms of rather differentiated form and technology of production were linked) (Fig. 9). All of these are traditionally recorded as the one type by Vulpe [1970], as Baniabic/Bányabükk, considered to be the oldest type of axe with an opening for a shaft hole, in the Carpathian Basin (shaft-hole axes in the Carpathian Basin) [Dani 2013].

In this context, there has been recent mention on the fact that the evolution of shaft-hole axes began in the northern Black Sea area as early as the Eneolithic from axes of the Sokolov type, which subsequently link axes of the 'Pidlissia and Baniabic/Bányabükk type' [Klochko, Klochko 2013: 54-55].

In earlier literature, based on a new find of an analogous axe, cast in an open mould form, in a YC early pit burial (deceased placed in a supine position with legs

Fig. 12. Casting mould from Zherdenivki, Haisyn Region, Vinnytsia *Oblast* (1); casting mould from Pysarivka, Starokostiantyniv Region, Khmelnytskyi *Oblast* (2) [*after* Klochko, Kozymenko 2016]

contracted at the knees), Pidlissia site, Brovary Region, Kiev *Oblast*, [Bratchenko, Klochko, Soltys 2000] (Fig. 10: 4), I propose such axes be known as the "Pidlissia variant" of the 'Baniabic/Bányabükk type' [Klochko 2001: 78-83; Klochko 2006: 65-66]. Further, bearing in mind the significant differences in the technology of production, it would be more correct to speak of the 'Pidlissia type', which belongs to the early phase of the YC – dated in the Middle Dniester drainage basin to 2800 – 2350 BC [Klochko 1999: 195].

To this early period of the Bronze Age the ingot of 'raw' copper from the Humentsi site is also dated, Kamianets-Podilskyi Region, Khmelnytskyi *Oblast*, (Fig. 11: 1). Its dimensions are: 12x13x3 cm and correspond to medium-sized so-called 'caste bowls of the early Bronze Age in Europe [Bátora 2006: p. 29; Plates 16, 7]. The metal out of which the ingot is made, is copper of a particularly characteristic (Dniester) composition of micro-admixtures (Tab. 1: an. nr 1042). This testifies to the smelting of copper from a local material in a given region.

The tradition of processing arsenic bronze during the decline Tripolye culture (Usatovo arsenic bronzes and those from the site of the 'Loshniv Hoard') is also continued in the Dniester Region during the early Bronze Age. This is testified to not only by the adze from the 'Ivonivka Hoard' (Fig. 1, 3; an. nr 1329), but also 'guards' serving as reinforcers in the wooden handle of the stone mace from the inhumation grave of the Catacomb culture, Prydnistryanske 1, I/4 near Yampil (Fig. 11: 2, Tab. 1: an nr. 1145) [Klochko, *et al*., 2015: 188-189, Fig. 7], also made out of arsenic bronze. The metal from which these 'guards' are made is entirely analogous to that of the adzes from the 'Ivonivka Hoard', which points to the one and the same source of raw material.

2.3. CONTEXT OF THE CONTINUATION OF METALLURGY TRADITIONS IN THE LATE AND DECLINE BRONZE AGE.

The subject of local metallurgy and its processing in the late Bronze Age has been discussed by Maleev [1976] and Goshko [2011]. New finds of bronze casting forms for Lusation sleeved hammer-axes, related to the early phase of the Chernoles culture [Klochko 2016a; 2016b] from the villages of Zherdenivka, Haisyn Region, Vinnytsia *Oblast* (Fig. 12: 1) and Pysarivka, Starokostiantyniv Region, Khmelnytskyi *Oblast* (Fig. 12: 2) [Klochko, Kozymenko 2016: 4.2.4.2; 4.2.4.3] are broadening the base of information on prehistoric metallurgy in the Dniester drainage basin. There is no doubt that the metallurgy of this region in the Late Bronze Age requires a separate study; nonetheless it is possible to note that also in this period the above-mentioned materials testified to a further exploitation of local copper ores.

Fig. 13. Map of new 'Dniester' finds: 1. Ivonivka; 2. Velyka Kisnytsia; 3. Kelmentsi; 4. Letychiv; 5. Loshniv; 6. Barrow, Prydnistrianske site; 7. Humentsi; 8. Zherdynivka; 9. Pysarivka

3. CONCLUSIONS

The exploitation of Dniester copper bearing sandstone was commenced by Tripolye craftsmen already by the BI phase at the latest. As a result, as in the case of exploiting Volhynia copper, the metallurgy of the middle and late Tripolye culture develops in similar fashion in eastern regions of the Funeral Beaker Culture and Lublin-Volhynia Painted Ceramic Ware culture.

The new materials presented (Fig. 13) show that the earlier presented and subjected to study, *Carpathian Volhynia Early Bronze Age centre of Metallurgy of the Corded Ware culture* [Klochko, Klochko 2013] took shape in the Dniester drainage basin on the basis of Tripolye culture metallurgy, whereas in the Early Bronze Age

its south-east part (foremost in the region of the *Yampil Barrow Cemetery Complex*) was exploited by autochthons of the Yamnaya and Catacomb cultures.

Moreover, in the Middle and Late Bronze Age, local metallurgy continued to be developed by the cultures of Babino, Komarov, Noua, Gava-Holihrad and Chernoles. Importantly, Dniester copper was also exploited during the Iron Age and the Middle Ages.

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REFERENCES

Bátora J.
2006 *Štúdie ku komunikácii medzi strednou a východnou Európou v dobe bronzovej.* Bratislava.

Bratchenko S.N., Klochko V.I., Soltys O.B.
2000 Metalevi sokyry yamnoyi kultury Serdnoyi Naddniprianschyny. *Arkheolohichnyi litopys Livoberezhnoyi Ukrayiny* 1-2: 8-14.

Chernykh E.N.
1966 *Istoriya drevneyshey metallurgii Vostochnoy Evropy.* Moskva.

Dani J.
2013 The Significance of Metallurgy at the Beginning of the Third Millennium BC in the Carpathian Basin. In: V. Heyd, G. Kulcsár, V. Szeverényi (Eds) *Transitions to the Bronze Age. Interregional Interaction and Socio-Cultural Change in the Third Millennium BC Carpathian Basin and Neighbouring Regions,* 203-232. Budapest.

Dergachev V.
2016 Novye klady metallicheskikh izdeliy kultury Kukuten-Tripolie iz Srednego Podneprovia (Ukraina). In: L. Sîrbu, N. Telnov, L. Ciobanu, G. Sîrbu, M. Kaşuba (Eds) *Culturi, Procese şi contexte în Arheologie. Volumul omagial Oleg Levitki la 60 de ani*, 36-42. Chişinău.

Goshko T.Yu.
2011 Metalevi vyroby z Hordiyivky. In: V.I. Klochko (Ed.) *Hordiyivskyi mohylnyk,* 151-236. Vinnytsia.

Goslar T., Klochko V.I., Kośko A., Włodarczak P., Żurkiewicz D.
2015 Chronometry of Late Eneolithic and "Early Bronze" cultures in the Middle Dniester area: investigations of the Yampil Barrow Complex. In: A. Kośko (Ed.) *Podolia as a cultural contact area in the 4th/3rd-2nd millennium BC. Baltic-Pontic Studies* 20: 256-191.

Harat K., Potupczyk M., Razumov S.
2014 Charakterystyka źródeł archeologicznych pozyskanych w latach 1984-1993. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 45-204. Poznań.

Klochko V.I.
1999 Radiocarbon chronology of the Early and Middle Bronze Age in the Middle Dnieper Region. The Mironivka barrows. *Baltic-Pontic Studies* 7: 163--195.
2001 *Weaponry of Societies of the Northern Pontic Culture Circle: 5000-700 BC. Baltic-Pontic Studies* 10.
2006 *Ozbroyennia ta viyskova sprava davnoho naselennia Ukrayiny.* Kyiv.
2016a Drevneyshye etapy razvitiya metallurgii na Ukraine (Tipokhronologiya drevnikh metallicheskikh izdeliy Ukrainy). In: V.I. Klochko, A.V. Kozymenko*, Drevniy metall Ukrainy,* 285-331. Kiev.
2016b Pro vtulchasti sokyry-kelty Chornoliskoyi kultury. In: *Arkheolohiya i davnia istoriya Ukrayiny* 2(19), 100-102. Kiev.

Klochko V.I., Klochko L.
2013 Complex of Metal Goods between the Vistula and Dnieper rivers at the turn of the 4th/3rd to the 3rd millennium BC. Concept of the Carpathian – Volhynia "Willow Leaf" metallurgy centre. *Baltic-Pontic Studies* 18: 39-71.

Klochko V.I., Kośko A., Potupchyk M.V., Włodarczak P., Żurkiewicz D., Ivanova S. V.
2015 Tripolye (Gordineşti group), Yamnaya and Catcomb culture cemeteries, Prydnistryanske, site 1, Yampil Region, Vinnitsa Oblast: archaeometric and chronometric description and a taxonomic and topogenetic discussion. *Baltic-Pontic Studies* 20: 177-249.

Klochko V.I., Kozymenko A.V.
2016 *Drevniy metall Ukrainy.* Kiev.

Kloczko V.I., Manichev V.I., Kompanec G.S., Kovalchuk M.S.
2003 Wychodnie rud miedzi na terenie Ukrainy zachodniej jako baza surowcowa metalurgii kolorowej w okresie funkcjonowania kultury trypolskiej. *Folia Praehistorica Posnaniensia, X/XI:* 47-78.

Klochko V.I., Manichev V.I., Kvasnitsa V.N., Kozak S.A., Demchenko L.V., Sokhatskiy M.P.
2000 Issues concerning Tripolye metallurgy and the virgin copper of Volhynia. *Baltic-Pontic Studies* 9: 168-186.

Kośko A. (Ed.)
2015 *Podolia as a cultural contact area in the 4th/3rd-2nd millennium BC. Baltic-Pontic Studies* 20.

Kośko A., Potupczyk M., Razumow S. (Eds)
2014 *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6. Poznań.

Maleev Yu. N.
1976 Liteynye formy s poseleniya Myshkovichi v Podnestrove. In: S.S. Berezanskaya, V.V. Otroschenko, D.Ya. Telegin (Eds) *Eneolit i bronzovyi vek Ukrainy,* 232-239. Kiev.

Manzura I.V., Klochko E.O., Savva E.N.
1992 *Kamenskie Kurgany.* Kishinev.

Mareş I.
2012 *Metalurgia aramei în civilizaţiile Precucuteni şi Cucuteni.* Suceava.

Potupczyk M., Razumow S.
2014 Zgrupowanie cmentarzysk kurhanowych w rejonie jampolskim. In: A. Kośko, M. Potupczyk, S. Razumow (Eds) *Naddniestrzańskie kompleksy cmentarzysk kurhanowych społeczności z III i z pierwszej połowy II tysiąclecia przed Chr. w okolicach Jampola, obwód winnicki. Z badań nad północno-zachodnią rubieżą osadnictwa społeczności kręgu kultur „wczesnobrązowych" strefy pontyjskiej. Badania z lat 1984-2014. Archaeologia Bimaris – Monografie* 6, 35-40. Poznań

Roska M.
1933 Le dépôt de haches en cuivré de Baniabic, département de Turda-Arieş. *Dacia* 3-4: 352-355.

Ryndina N.V.
1971 *Drevneyshee metalloobrabatyvayuschee proizvodstvo Vostochnoy Evropy.* Moskva.
1980 Metall v kulturakh shnurovoy keramiki Ukrainskogo Predkarpatia, Podolii i Volyni. *Sovetskaya arkheologiya* 3: 24-41.
1998 *Drevneyshee metalloobrabatyvayuschee proizvodstvo Yugo-Vostochnoy Evropy.* Moskva.

Ryndina N.V., Konkova L.V.
1982 O proiskhozhdenii bolshykh usatovskikh kinzhalov. *Sovetskaya arkheologiya* 2: 30-42.

Vulpe, A.
1970 *Äxte und Beile in Rumänien I. Prähistorische Bronzefunde IX/2*. München.